Cisco vManage How-Tos for Cisco vEdge Routers

First Published: 2020-06-12

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

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

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

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

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

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

Any Internet Protocol (IP) addresses and phone numbers used in this document are not intended to be actual addresses and phone numbers. Any examples, command display output, network topology diagrams, and other figures included in the document are shown for illustrative purposes only. Any use of actual IP addresses or phone numbers in illustrative content is unintentional and coincidental.

All printed copies and duplicate soft copies of this document are considered uncontrolled. See the current online version for the latest version.

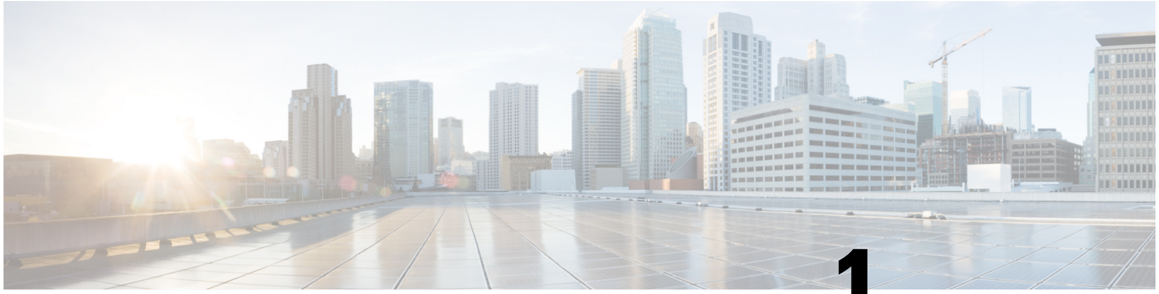
Cisco has more than 200 offices worldwide. Addresses and phone numbers are listed on the Cisco website at www.cisco.com/go/offices.

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

Cisco and the Cisco logo are trademarks or registered trademarks of Cisco and/or its affiliates in the U.S. and other countries. To view a list of Cisco trademarks, go to this URL: https://www.cisco.com/c/en/us/about/legal/trademarks.html. Third-party trademarks mentioned are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (1721R)

© 2020 –2021 Cisco Systems, Inc. All rights reserved.

CONTENTS



CHAPTER 1

Read Me First

Related References

- Release Notes
- Cisco SD-WAN Controller Compatibility Matrix and Server Recommendations

User Documentation

- Cisco SD-WAN (Cisco vEdge Devices)
- User Documentation for Cisco vEdge Devices

Communications, Services, and Additional Information

- Sign up for Cisco email newsletters and other communications at: Cisco Profile Manager.
- For information on the latest technical, advanced, and remote services to increase the operational reliability of your network visit Cisco Services.
- To browse and discover secure, validated enterprise-class apps, products, solutions, and services, visit Cisco Devnet.
- To obtain general networking, training, and certification titles from Cisco Press Publishers, visit Cisco Press.
- To find warranty information for a specific product or product family, visit Cisco Warranty Finder.
- To view open and resolved bugs for a release, access the Cisco Bug Search Tool.
- To submit a service request, visit Cisco Support.

Documentation Feedback

To provide feedback about Cisco technical documentation use the feedback form available in the right pane of every online document.

CHAPTER 2

What's New in Cisco vManage

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

Table 1: Cisco vManage Release 20.9.1

Feature	Description
Cisco vManage How-Tos for Cisco vEdge Routers	
Flexible Tenant Placement on Multitenant Cisco vSmart Controllers	With this feature, while onboarding a tenant to a multitenant deployment, you can choose the pair of multitenant Cisco vSmart Controllers that serve the tenant. After onboarding a tenant, you can migrate the tenant to a different pair of multitenant Cisco vSmart Controllers, if necessary.
Global SIG Credentials Template	With this feature, create a single global SIG Credentials template for each SIG provider (Cisco Umbrella or Zscaler). When you attach a SIG template to a device template, Cisco vManage automatically attaches the applicable global SIG Credentials template to the device template.
Match Traffic by Destination Region	When creating an application route policy or data policy, you can match traffic according to its destination region. The destination may be a device in the same primary region, the same secondary region, or neither of these.
Specify Path Type Preference	When configuring a centralized policy, you can create a preferred color group list, which specifies three levels of route preference, called primary, secondary and tertiary. The route preferences are based on TLOC color and, optionally, on the path type—direct tunnel, multi-hop path, or all paths. Path type is relevant to networks using Multi-Region Fabric.
Network Hierarchy and Resource Management	You can create a network hierarchy in Cisco vManage to represent the geographical locations of your network. You can create a region, an area, and a site in a network hierarchy. In addition, you can assign a site ID and a region ID to a device.

Feature	Description
Support for License Management Using a Proxy Server	If you configure Cisco vManage to use a proxy server for internet access, Cisco vManage uses the proxy server to connect to Cisco SSM or an on-prem SSM.
Support for Managing Licenses Using Cisco Smart Software Manager On-Prem	Cisco vManage can synchronize device licenses using a Cisco SSM on-prem license server. This is useful for organizations that use Cisco SSM on-prem to accommodate a strict security policy that does not permit devices to communicate with Cisco SSM over a direct internet connection.
Co-Management: Improved Granular Configuration Task Permissions	To enable a user to self-manage specific configuration tasks, you can assign the user permissions to perform specific configuration tasks while excluding other tasks. This feature introduces numerous new permission options, enabling fine granularity in determining which configuration task permissions to provide to a user. .
Route Leaking between Inter-Service VPN	You can configure to leak routes between the service VPNs at the same site using the **Route Leak** option in the Cisco vManage.
Schedule the Software Upgrade Workflow	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	Added support for Cisco Enterprise NFV Infrastructure Software (NFVIS) and Cisco Catalyst Cellular Gateways.
Compare Template Configuration Changes Using Audit Logs	This feature introduces a **Config Diff** option for audit logs of device templates and feature templates to view the configuration changes when a template is not attached to a device.
Customizable Monitor Overview Dashboard in Cisco vManage	You can customize the **Monitor Overview** dashboard. You can specify which dashlets to view and sort them based on your personal preferences.
Access TAC Cases from Cisco vManage	This feature allows you to access Support Case Manager (SCM) wizard using Cisco vManage. You can create, view, or edit the support cases directly from Cisco vManage without having to go to a different Case Manager portal.
Additional Real Time Monitoring Support for AppQoE and Other Configuration Options	This feature adds support for real-time monitoring of AppQoE and other device configuration details in Cisco vManage.

Table 2: Cisco vManage Release 20.8.1

Feature	Description
Cisco vManage How-Tos for Cisco vEdge Routers	
User-Defined SaaS Application Lists	In Cisco vManage, you can define lists of one or more SaaS applications, together with the relevant application server. Cloud onRamp for SaaS handles these lists in the same way that it handles the predefined set of SaaS applications that it can monitor. When you enable a user-defined list, Cloud onRamp for SaaS probes for the best path to the application server and routes the application traffic for applications in the list to use the best path.
Layer 7 Health Check for Manual Tunnels	You can create and attach trackers to manually created GRE or IPSec tunnels to a SIG endpoint. Trackers help failover traffic when a SIG tunnel is down. You can configure the trackers using the SIG feature template.
Hierarchical SD-WAN: Secondary Regions	Secondary regions provide another facet to the Hierarchical SD-WAN architecture and enable direct tunnel connections between edge routers in different primary access regions. When you assign an edge router a secondary region, the router effectively operates in two regions simultaneously, and has different paths available through its primary and secondary regions.
Hierarchical SD-WAN: Transport Gateways	An edge router or border router that has connections to two networks that lack direct connectivity can function as a transport gateway. This is helpful for enabling connectivity between routers that are configured to be within the same access region, but which do not have direct connectivity.
Hierarchical SD-WAN: Router Affinity	Often a router has multiple options to choose for the next hop when routing a flow to its destination. When multiple devices can serve as the next hop for a flow, you can specify the order of preference among the devices by configuring router affinity groups. The result is that a router attempts to use a route to the next-hop device of highest preference first, and if that device is not available, it attempts to use a route to the next-hop device of the next lower preference. Affinity groups enable this functionality without requiring complex control policies.
Match Traffic by Destination: Access Region, Core Region, or Service VPN	You can apply a policy to traffic whose destination is any one of the following—access region, core region, service VPN. Use this match condition for data policy or application route policy on a border router.
Match Routes According to Path Type	When configuring a control policy for a Hierarchical SD-WAN architecture, you can match routes according to whether the route uses a hierarchical path, a direct path, or a transport gateway path.
Match Routes by Region and Role in a Control Policy	In a control policy, you can match routes according to the region of the device originating the route, or the role (edge router or border router) of the device originating the route.
Support for SVL Port Configuration on 100G Interfaces	With this feature, you can configure SVL ports on 100G Ethernet interfaces of Cisco Catalyst 9500-48Y4C switches, thus ensuring a high level of performance and throughput.

Feature	Description
Single Sign-On Using Azure AD	Single Sign-On (SSO) with security assertion mark-up language (SAML) gives faster, easier, and trusted access to cloud applications without storing passwords or requiring you to log in to each application individually.
Support for Postpaid MSLA License Billing Models	For postpaid Managed Services License Agreement (MSLA) program licenses, Cisco SD-WAN supports two distinct billing models for licenses—committed (MSLA-C) and uncommitted (MSLA-U). The procedure for assigning a postpaid license enables you to choose one of these two MSLA license types.
Software Upgrade Workflow	You can now upgrade software images on edge devices using the **Workflows** menu in Cisco vManage.
Bidirectional Support for Packet Tracing	You can configure packet tracing on edge devices.

Table 3: Cisco vManage Release 20.7.1

Feature	Description
Cisco vManage How-Tos for Cisco vEdge Routers	
Certificate Revocation	You can revoke enterprise certificates from devices based on a certificate revocation list that Cisco vManage obtains from a root certificate authority.
Configure Default AAR and QoS Policies	You can configure Default AAR and QoS policies.
Cisco Unified Border Element Configuration	You can configure Cisco Unified Border Element functionality by using Cisco IOS XE SD-WAN device CLI templates or CLI add-on feature templates.
Disaster Recovery User Password Change	You can change the disaster recovery user password for disaster recovery components from the Cisco vManage **Disaster Recovery** window.
Hierarchical SD-WAN	You can use Cisco vManage to enable and configure Hierarchical SD-WAN, which provides the ability to divide the architecture of the Cisco SD-WAN overlay network into multiple regional networks that operate distinctly from one another.
TCP/UDP Endpoint Tracker and Dual Endpoint Static Route Tracker for Cisco vEdge devices	You can now configure static route tracker with TCP/UDP endpoint using Cisco system template, and configure a static route using the Cisco VPN template. You can then add the configured dual trackers in a tracker group using **New Endpoint Tracker Groups** option.
Co-Management: Granular Role-Based Access Control for Feature Templates	This feature introduces greater granularity in assigning role-based access control (RBAC) permissions for template use. This enables you to give a tenant self-management of network configuration tasks. Network administrators and managed service providers can use this feature to assign permissions to their end customers.

Feature	Description
VRRP Interface Tracking for Cisco vEdge Devices	This feature enables VRRP to set the edge as active or standby based on the WAN Interface or SIG tracker events and increase the TLOC preference value on a new VRRP active to ensure traffic symmetry, for Cisco vEdge Devices .
Additional Diagnostics Information Added to Admin-Tech File	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	You can upload an admin-tech file to a TAC case from Cisco vManage.
Support for Cisco VM Image Upload in qcow2 Format	You can now upload a virtual machine image to Cisco vManage in qcow2 format. Earlier, you could upload only a prepackaged image file in tar.gz format.
Software Upgrade Using a Remote Server	This feature enables you to register a remote server with Cisco vManage, and add locations of software images on the remote server to the Cisco vManage software repository. When you upgrade device or controller software, the device or controller can download the new software image from the remote server.
Packet Capture for Cloud onRamp Colocation Clusters	You can now capture packets at either the physical network interface card (PNIC) level or the virtual network interface card (VNIC) level on a Cloud Services Platform (CSP) device of a colocation cluster. To do this, you need to choose a PNIC or VNIC on the Cisco vManage interface and set the required traffic filters.

Table 4: Cisco vManage Release 20.6.1

Feature	Description
Cisco vManage How-Tos for Cisco vEdge Routers	
Cisco vManage Persona-based Cluster Configuration	You can add Cisco vManage servers to a cluster by identifying servers based on personas. A persona defines what services run on a server.
Dual Endpoint support for interface status tracking on Cisco vEdge devices	This feature allows you to configure tracker groups with dual endpoints using the Cisco vManage System template and associate each template group to an interface. The dual endpoints provide redundancy for tracking the status of transport interfaces to avoid false negatives.
Tenant Device Forecasting	While adding a new tenant to the multitenant Cisco SD-WAN deployment, a service provider can forecast the number of WAN edge devices that the tenant may deploy in their overlay network. Cisco vManage enforces this forecast limit. If the tenant tries to add devices beyond this limit, Cisco vManage responds with an appropriate error message and the device addition fails.
Cloud onRamp for SaaS Over SIG Tunnels	This feature lets you to connect to Cloud onRamp for SaaS by means of a SIG tunnel.

Feature	Description
Route Manipulation for Leaked Routes with OMP Administrative Distance	You can configure route redistribution between the transport VPN and service VPNs using the **Global Route Leak** option under the VPN feature template.
Support for License Management Offline Mode and Compliance Alarms	You can manage Cisco SD-WAN licenses through a Cisco vManage instance that is not connected to the internet. To synchronize license and compliance information between Cisco vManage and Cisco SSM, you must periodically download synchronization files from Cisco vManage and upload the files to Cisco SSM.
RBAC for Policies	Configure RBAC for policies in Cisco vManage.
Cisco vManage Persona-based Cluster Configuration	You can add Cisco vManage servers to a cluster by identifying servers based on personas. A persona defines what services run on a server.
Generate System Status Information for a Cisco vManage Cluster Using Admin Tech	You can collect system status information for a Cisco vManage cluster. Prior to this feature, Cisco SD-WAN was only able to generate an admin-tech file for a single device.
Support for Reverse Proxy with Cisco IOS XE SD-WAN Devices and Cisco SD-WAN Multitenancy	With this feature, you can deploy a reverse proxy device in your overlay network between Cisco IOS XE SD-WAN devices and Cisco vManage and Cisco vSmart Controllers. Also, this feature enables you to deploy a reverse proxy device in both single-tenant and multitenant overlays that include Cisco vEdge or Cisco IOS XE SD-WAN edge devices.
Manage Data Collection for Cisco SD-WAN Telemetry	This feature allows you to disable data collection for Cisco SD-WAN telemetry using Cisco vManage. Data collection for telemetry is enabled by default.
Geofencing	If the location of the device goes beyond its geographical boundary, you can restrict network access to the device using Cisco vManage operational commands. For more information, see the Cisco SD-WAN Monitor and Maintain Configuration Guide.
View Generated Admin-Tech Files at Any Time	You can view a list of generated admin-tech files and determine which files to copy from your device to Cisco vManage. You can then download the selected admin-tech files to your local device, or delete the downloaded admin-tech files from Cisco vManage, the device, or both.
On-Demand Troubleshooting	You can view detailed information about the flow of traffic from a device. and use this information to assist with troubleshooting.

Feature	Description
Additional Real Time Monitoring Support for Routing, License, Policy, and Other Configuration Options	This feature adds support for real time monitoring of numerous device configuration details including routing, View License Information, policy, View Cisco vBond Orchestrator Information, TCP optimization, View SFP Information, tunnel connection, View Logging Information, and View Cisco Umbrella Information. Real time monitoring in Cisco vManage is similar to using **show** commands in the CLI of a device. There are many device configuration details for Cisco vManage. Only a subset of the device configuration details is added in Cisco SD-WAN Release 20.6.1 and Cisco vManage Release 20.6.1.

Table 5: Cisco vManage Release 20.5.1

Feature	Description
Cisco vManage How-Tos for Cisco vEdge Routers	
Next Hop Action Enhancement in Data Policies	This feature enhances match action conditions in a centralized data policy for parity with the features configured on Cisco vEdge devices. When you are setting up next-hop-loose action, this feature helps to redirect application traffic to an available route when next-hop address is not available.
Clone Service Groups in Cisco vManage	You can easily create copies of service groups, download, and upload service group configuration properties using Cisco vManage.
Authorization and Accounting	You can configure authorization, which authorizes commands that a user enter on a device before the commands can be executed, and accounting, which generates a record of commands that a user executes on a device.
Day 0 WAN Interface Automatic Bandwidth Detection	You can enable a device to automatically determine the bandwidth for WAN interfaces in VPN0 during day 0 onboarding by performing a speed test using an iPerf3 server.
RMA Support for Cisco CSP Devices	You can configure the **Backup** information to enter storage server settings and backup intervals.
Service Area Mapping	To specify the service area that your Microsoft 365 application belongs to, choose an option from the **Service Area** drop-down list.
Enable Layer 7 Health Check (Automatic Tunnels)	You can configure Automatic Tunnels using Cisco vManage.
Support for Zscaler Automatic Provisioning	This feature automates the provisioning of tunnels from Cisco SD-WAN routers to Zscaler. Using your Zscaler partner API credentials, you can automatically provisions tunnels to Zscaler Internet Access (ZIA) Public Service Edges. You can choose **Zscaler** in the Cisco Security Internet Gateway (SIG) and SIG credentials feature templates to automate tunnel provisioning. You can configure provisioning of tunnels from Cisco SD-WAN routers.

Feature	Description
HTTP/HTTPS Proxy Server for Cisco vManage Communication with External Servers	Cisco vManage uses HTTP/HTTPS to access some web services and for some REST API calls. With this feature, you can channel the HTTP/HTTPS communication through an HTTP/HTTPS proxy server.
Best of the Worst Tunnel Selection	You can configure Best Tunnel Path to pick the best path while configuring SLA class.
License Management for Smart Licensing Using Policy, Using Cisco vManage	Cisco vManage shows available DNA licenses, assigns licenses to devices, and reports license consumption to Cisco Smart Software Manager (Cisco SSM).
Role-Based Access Control By Resource Group	You can configure role-based access control (RBAC) based on sites or resource groups in Cisco vManage.
Enhanced Security Monitoring on Cisco SD-WAN Devices	You can view traffic, CPU, memory usage, health and reachability of UTD.
View Loss Percentage, Latency, Jitter, and Octet Information for Tunnels	You can view the loss percentage, latency, jitter, and octet information for tunnels in a single chart option in Cisco vManage.
Optimization of Alarms	This feature optimizes the alarms on Cisco vManage by automatically suppressing redundant alarms. This allows you to easily identify the component that is causing issues. You can view these alarms in **Monitor** > **Alarms**.

Table 6: Cisco vManage Release 20.4.1

Feature	Description
Cisco vManage How-Tos for Cisco vEdge Routers	
Traffic Redirection to SIG Using Data Policy	You can create a data policy where you can selectively define an application list along with other existing match criteria in the data-policy to redirect the application traffic to a Secure Internet Gateway (SIG).
Cisco SD-WAN Multitenancy	For a multitenant Cisco SD-WAN deployment, you can configure Cisco vManage to operate in multitenant mode. Through the multitenant Cisco vManage, you can add new Cisco vSmart Controllers, manage tenants, and view tenants being served by a Cisco vSmart Controller and the OMP statistics for a tenant.
Per-class Application-Aware Routing	This release supports Per-class application-aware routing to Cisco SD-WAN. You can configure Application Probe Class using Cisco vManage.

Feature	Description
Cellular Gateway Configuration	You can configure a supported cellular gateway as an IP pass-through device from the Templates tab.
IPSEC/GRE Tunnel Routing and Load-Balancing Using ECMP	You can now use the SIG template to steer application traffic to Cisco Umbrella or a Third party SIG Provider. You can also configure weights for multiple GRE/IPSEC tunnels for distribution of traffic among multiple tunnels based on the configured weights.
Configure a Cisco vEdge Device as an NTP Parent and Optionally to Support NTP in Symmetric Active Mode.	Use the Cisco vManage device CLI template to configure a Cisco vEdge device as an NTP parent and configure the device to support NTP in symmetric active mode.
Support for Password Policies using Cisco AAA	You can now configure password policies to ensure that your users use strong passwords and can be customized based on your requirements. To configure password policies, push the `password-policy` commands to your device using Cisco vManage device CLI templates.
Policy Matching with ICMP Message	You can now define a new match condition that can be used to specify a list of ICMP messages for centralized data policies, localized data policies, and Application-Aware Routing policies.
Static Route Tracker for Service VPNs for Cisco vEdge Devices	To configure Static Route Tracking on Cisco vManage, configure an endpoint tracker using Cisco System template, and Configure a static route using the Cisco VPN template.
VRRP Interface Tracking for Cisco vEdge Devices	Use the Cisco vManage device CLI template to add an interface or a SIG container to a track list and configure tracking and priority decrement for that interface and container.

Table 7: Cisco vManage Release 20.3.1

Feature	Description
Cisco vManage How-Tos for Cisco vEdge Routers	
Self Zone Policy for Zone-Based Firewalls	This feature allows you to define firewall policies for incoming and outgoing traffic between a self zone of an edge router and another zone. When a self zone is configured with another zone, the traffic in this zone pair is filtered as per the applied firewall policy.
Extended DNS (EDNS) and Local Domain Bypass Support with Cisco Umbrella Integration	You can now configure Cisco Umbrella registration, define domain lists, and configure Umbrella DNS policy from the **Configuration** > **Security** screen in Cisco vManage.

Feature	Description
New Configuration Workflow for Cloud onRamp for SaaS for Cisco vEdge devices	Using Cloud onRamp for SaaS, you can select specific SaaS applications and interfaces, and let Cisco SD-WAN determine the best performing path for each SaaS applications.
Dynamic On-Demand Tunnels	You can configure on-demand tunnels between any two Cisco SD-WAN spoke devices. These tunnels are triggered to be set up only when there is traffic between the two devices.
Flexible Topologies	You can configure the Stackwise Virtual Switch Link (SVL) and uplink ports of switches, and Cisco CSP data ports using the **Port Connectivity** configuration settings of Cloud OnRamp for Colocation cluster .
Route Leaking Between Transport VPN and Service VPNs	You can configure route leaking between transport VPN and service VPNs using the **Global Route Leak** option under the VPN feature template.
Service insertion tracker support	You can configure service chaining for a device, from the **Service** tab.
Configure Sessions in Cisco vManage	This feature lets you see all the HTTP sessions that are open within Cisco vManage. It gives you details about the username, source IP address, domain of the user, and other information. A user with User Management Write access, or a netadmin user can trigger a log out of any suspicious user's session.
TACACS Authentication	You can configure the TACACS authentication for users using the **TACACS** configuration settings of Cloud OnRamp for Colocation cluster.
Network Assurance –VNFs: Stop/Start/Restart	You can now stop, start, or restart VNFs on Cisco CSP devices from the **Colocation Clusters** tab.
Cisco vManage Cluster Upgrade	This feature outlines the upgrade procedure for Cisco vManage servers in a cluster to Cisco vManage Release 20.3.1. To upgrade Cisco vManage instances in a Cluster, use the **Tools** > **SSH Terminal** screen.
Embedded Packet Capture	This feature is an onboard packet capture facility that allows network administrators to capture packets flowing to, through, and from the device. The administrator can Manage to analyze these packets locally or save and export them for offline analysis through Cisco vManage. This feature gathers information about the packet format and therefore helps in application analysis, security, and troubleshooting.

CHAPTER 3

Configuration

Action Parameters - Data Policy

Table 8: Feature History

Feature Name	Release Information	Description
Traffic Redirection to SIG Using Data Policy	Cisco SD-WAN Release 20.4.1 Cisco vManage Release 20.4.1	You can create a data policy where you can selectively define an application list along with other existing match criteria in the data-policy to redirect the application traffic to a Secure Internet Gateway (SIG).
Next Hop Action Enhancement in Data Policies	Cisco SD-WAN Release 20.5.1 Cisco vManage Release 20.5.1	This feature enhances match action conditions in a centralized data policy for parity with the features configured on Cisco vEdge devices. When you are setting up next-hop-loose action, this feature helps to redirect application traffic to an available route when next-hop address is not available.

When data traffic matches the conditions in the match portion of a centralized data policy, the packet can be accepted or dropped. Then, you can associate parameters with accepted packets.

In the CLI, you configure the action parameters with the **policy data-policy vpn-list sequence action** command.

Each sequence in a centralized data policy can contain one action condition.

In the action, you first specify whether to accept or drop a matching data packet, and whether to count it:

Action Condition	Description
Click **Accept**	Accepts the packet. An accepted packet is eligible to be modified by the additional parameters configured in the action portion of the policy configuration.
Cflowd	Enables cflowd traffic monitoring.
Counter	Counts the accepted or dropped packets. Specifies the name of a counter. Use the **show policy access-lists counters** command on the Cisco vEdge device.
Click **Drop**	Discards the packet. This is the default action.
Log	Logs the packet. Packets are placed into the messages and syslog system logging (syslog) files. To view the packet logs, use the **show app log flows** and **show log** commands.

Action Condition	Description
Redirect DNS	Redirects DNS requests to a particular DNS server. Redirecting requests is optional, but if you do so, you must specify both actions. For an inbound policy, **redirect-dns host** allows the DNS response to be correctly forwarded back to the requesting service VPN. For an outbound policy, specify the IP address of the DNS server. **Note** When you upgrade to releases later than Cisco IOS XE Release 17.7.1a, you must configure redirect DNS through **nat use-vpn 0** to redirect DNS to Direct Internet Interface (DIA). **Note** You can set only local TLOC preferences with redirect-dns as actions on the same sequence, but not remote TLOC.
TCP Optimization	Fine-tune TCP to decrease round-trip latency and improve throughout for matching TCP traffic.
Secure Internet Gateway	Redirect application traffic to a SIG **Note** Before you apply a data policy for redirecting application traffic to a SIG, you must have configured the SIG tunnels. For more information on configuring Automatic SIG tunnels, see Automatic Tunnels. For more information on configuring Manual SIG tunnels, see Manual Tunnels.

Then, for a packet that is accepted, the following parameters can be configured:

Action Condition	Description
Cflowd	Enables cflowd traffic monitoring.
NAT Pool or **NAT VPN**	Enables NAT functionality, so that traffic can be redirected directly to the internet or other external destination.
DSCP	DSCP value. The range is 0 through 63.
Forwarding Class	Name of the forwarding class.
Local TLOC	Enables sending packets to one of the TLOCs that matches the color and encapsulation. The available colors are: 3g, biz-internet, blue, bronze, custom1,custom2, custom3, default, gold, green, lte, metro-ethernet, mpls, private1 through private6, public-internet, red and silver. The encapsulation options are: **ipsec** and **gre**. By default, if the TLOC is not available, traffic is forwarded using an alternate TLOC. To drop traffic if a TLOC is unavailable, include the **restrict** option. By default, encapsulation is **ipsec**.

Action Condition	Description
Next Hop	Sets the next hop IP address to which the packet should be forwarded. **Note** Starting from Cisco SD-WAN Release 20.5.1 and Cisco vManage Release 20.5.1, the **Use Default Route when Next Hop is not available** field is available next to the **Next Hop** action parameter. This option is available only when the sequence type is **Traffic Engineering** or **Custom**, and the protocol is either **IPv4** or **IPv6**, but not both.
Policer	Applies a policer. Specifies the name of policer configured with the **policy policer** command.
Service	Specifies a service to redirect traffic to before delivering the traffic to its destination. The TLOC address or list of TLOCs identifies the remote TLOCs to which the traffic should be redirected to reach the service. In the case of multiple TLOCs, the traffic is load-balanced among them. The VPN identifier is where the service is located. Standard services: **FW**, **IDS**, **IDP** Custom services: **netsvc1**, **netsvc2**,**netsvc3**, **netsvc4** TLOC list is configured with a **policy lists tloc-list** list. Configure the services themselves on the Cisco vEdge devices that are collocated with the service devices, using the **vpn service** command.
TLOC	Direct traffic to a remote TLOC that matches the IP address, color, and encapsulation of one of the TLOCs in the list. If a preference value is configured for the matching TLOC, that value is assigned to the traffic.
Click **Accept**, then action **VPN**.	Set the VPN that the packet is part of. The range is 0 through 65530.

Note Data policies are applicable on locally generated packets, including routing protocol packets, when the match conditions are generic.

Example configuration:

```
sequence 21
   match
    source-ip 10.0.0.0/8
   action accept
```

In such situations, it may be necessary to add a sequence in the data policy to escape the routing protocol packets. For example to skip OSPF, use the following configuration:

```
sequence 20
   match
    source-ip 10.0.0.0/8
    protocol  89
   action accept
sequence 21
   match
    source-ip 10.0.0.0/8
   action accept
```

The following table describes the IPv4 and IPv6 actions.

Table 9:

IPv4 Actions	IPv6 Actions
drop, dscp, next-hop (from-service only)/vpn, count, forwarding class, policer (only in interface ACL), App-route SLA (only)	N/A
App-route preferred color, app-route sla strict, cflowd, nat, redirect-dns	N/A
N/A	drop, dscp, next-hop/vpn, count, forwarding class, policer (only in interface ACL) App-route SLA (only), App-route preferred color, app-route sla strict
policer (DataPolicy), tcp-optimization, fec-always,	policer (DataPolicy)
tloc, tloc-list (set tloc, set tloc-list)	tloc, tloc-list (set tloc, set tloc-list)
App-Route backup-preferred color, local-tloc, local-tloc-list	App-Route backup-preferred color, local-tloc, local-tloc-list

Access the Software Upgrade Workflow

Table 10: Feature History

Feature Name	Release Information	Description
Software Upgrade Workflow	Cisco IOS XE 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 vManage.
Schedule the Software Upgrade Workflow	Cisco IOS XE 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.

Before You Begin

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

From the Cisco vManage toolbar, click the **Task-list** icon. Cisco vManage 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 vManage 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 vManage, 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 vManage toolbar, click the **Task-list** icon.

   Cisco vManage 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 vManage opens a pane displaying the status of the task and details of the device on which the task was performed.

Add a Cisco vManage Server to a Cluster

Table 11: Feature History

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

The following sections provide information about adding a Cisco vManage server to a cluster in various Cisco vManage releases.

Add a Cisco vManage Server to a Cluster for Releases Before Cisco vManage Release 20.6.1

To add a new Cisco vManage server to a cluster for releases before Cisco vManage Release 20.6.1, perform the following steps on the primary Cisco vManage server.

Before you begin, ensure that the default IP address of the Cisco vManage server has been changed to an out-of-band IP address as described in Configure the Cluster IP Address of a Cisco vManage Server, on page 37.

1. From the Cisco vManage menu, choose **Administration** > **Cluster Management** and click **Service Configuration**.

2. Click **Add vManage**.

   The **Edit vManage** window opens.

3. In the **vManage IP Address** field, select an IP address to assign to the Cisco vManage server.

4. Enter the username and password for logging in to the Cisco vManage server.

5. Enter the IP address of the Cisco vManage server that you are adding to the cluster.

6. Specify the username and password for the new Cisco vManage server.

7. Select the services to be run on the Cisco vManage server. You can select from the services listed below. Note that the **Application Server** field is not editable. The Cisco vManage Application Server is the local Cisco vManage HTTP web server.

   - Statistics Database: Stores statistics from all the Cisco SD-WAN devices in the network.

   - Configuration Database: Stores all the device and feature templates and configurations for all the Cisco SD-WAN devices in the network.

   - Messaging Server: Distributes messages and shares state among all the Cisco vManage cluster members.

8. Click **Add**.

   The Cisco vManage server that you just added reboots before joining the cluster.

Note

- In a cluster, we recommend that you run at least three instances of each service.

- When you add the first two compute or compute+data nodes to the cluster, the host node's application-server is unavailable. The following message is displayed on the host node's GUI, before the application-server shuts down in the host node: `\Node added to the cluster. The operation may take up to 30 minutes and may cause application-server to restart in between. Once the application server is back online, the post cluster operation progress can be viewed under tasks pop-up\.`

Add a Cisco vManage Server to a Cluster for Cisco vManage Release 20.6.1 and Later Releases

From Cisco vManage Release 20.6.1, a cluster supports any of the following deployments of nodes:

- Three Compute+Data nodes

- Three Compute+Data nodes and three Data nodes

  Note DATA nodes should be added only after 3 node cluster with CONFIG+DATA is added.

- Three Compute nodes and three Data nodes (supported only in an upgrade from an existing deployment)

If you require a different combination of nodes, contact your Cisco representative.

To add a Cisco vManage server to a cluster from Cisco vManage Release 20.6.1, perform the following steps.

Perform this procedure on a Compute+Data node or a Compute node. Performing this procedure on a Data node is not supported because a Data node does not run all the services that are required for the addition.

Do not add a server that was a member of the cluster and then removed from the cluster. If you need to add that server to the cluster, bring up a new VM on that server to be used as the node to add.

Before you begin, ensure that the default IP address of the Cisco vManage server has been changed to an out-of-band IP address, as described in Configure the Cluster IP Address of a Cisco vManage Server, on page 37.

1. From the Cisco vManage menu, choose **Administration** > **Cluster Management**.

   The **Cluster Management page** window appears. The table on this window shows the Cisco vManage servers that are in the cluster.

2. Click **Add vManage**.

   The **Add vManage** dialog box opens.

   Note If the **Edit vManage** dialog box opens, configure an out-of-band IP address for the server, as described in Configure the Cluster IP Address of a Cisco vManage Server, on page 37, and then repeat this procedure for adding a server.

3. In the **Add vManage** dialog box, perform the following actions:

   a. Click the **Node Persona** option (**Compute+Data**, **Compute**, or **Data**) that corresponds to the persona that has been configured for the server.

      You can determine the persona of a server by logging in to the server and looking at the persona display on the **Administration** > **Cluster Management** window. If you choose an incorrect persona, a message displays the persona that you should choose.

   b. From the **vManage IP Address** drop-down list, choose the IP address of the server to be added to the cluster.

   c. In the **Username** field, enter the user name for logging in to the server.

   d. In the **Password** field, enter the password for logging in to the server.

   e. (Optional) Click **Enable SD-AVC** if you want Cisco Software-Defined Application Visibility and Control (SD-AVC) to run on the server.

      Cisco SD-AVC is a component of Cisco Application Visibility and Control (AVC). It can be enabled on one Cisco vManage server. The server on which it is enabled must have the Compute+Data or the Compute persona. Cisco SD-AVC cannot be enabled on a server that has the Data persona.

      If you enabled Cisco SD-AVC for this server when you changed its IP address, the **Enable SD-AVC** check box is checked by default.

   f. Click **Add**.

   g. To confirm, click **OK**.

      The dialog box indicates that the services will restart, and that the existing metadata and other information that is not required when the server joins the cluster will be deleted from the server.

      When you click **OK**, the system starts the server add operation. The **Cluster Management** window displays the tasks that the system performs as it adds the server.

      As part of this operation, the system checks the compatibility of the server that you are adding. This check ensures that the server has sufficient disk space, and that the persona that you specified matches the persona of the node.

After the server is added, the system performs a cluster sync operation, which rebalances the services in the cluster. Then the Cisco vManage servers in the cluster restart.

Add Cisco vBond Orchestrator to the Overlay Network

After you create a minimal configuration for Cisco vBond Orchestrator, you must add it to overlay network by making Cisco vManage aware of Cisco vBond Orchestrator. When you add Cisco vBond Orchestrator, a signed certificate is generated and is used to validate and authenticate the orchestrator.

Add Cisco vBond Orchestrator and Generate Certificate

To add Cisco vBond Orchestrator to the network, automatically generate the CSR, and install the signed certificate:

1. From the Cisco vManage menu, choose **Configuration** > **Devices**.
2. Click **Controllers**, from **Add Controller** drop-down, select **vBond**.
3. In the **Add vBond** window:
    a. Enter the vBond management IP address.
    b. Enter the username and password to access Cisco vBond Orchestrator.
    c. Choose the **Generate CSR** check box to allow the certificate-generation process to occur automatically.
    d. Click **Add**.

Cisco vManage generates the CSR, retrieves the generated certificate, and automatically installs it on Cisco vBond Orchestrator. The new controller device is listed in the Controller table with the controller type, hostname of the controller, IP address, site ID, and other details.

Verify Certificate Installation

To verify that the certificate is installed on Cisco vBond Orchestrator:

1. From the Cisco vManage menu, choose **Configuration** > **Devices**.
2. Choose the new device listed, and check in the Certificate Status column to ensure that the certificate has been installed.

Add Cisco vSmart Controller to the Overlay Network

After you create a minimal configuration for Cisco vSmart Controller, you must add it to an overlay network by making Cisco vManage aware of the controller. When you add Cisco vSmart Controller, a signed certificate is generated and is used to validate and authenticate the controller.

Cisco vManage can support up to 20 Cisco vSmart Controllers in the network.

Add a Cisco vSmart Controller and Generate Certificate

To add a Cisco vSmart Controller to the network, automatically generate the CSR, and install the signed certificate:

1. From the Cisco vManage menu, choose **Configuration** > **Devices**.
2. Click **Controllers**, and from the **Add Controller** drop-down menu, choose **vSmart**.
3. In the **Add vSmart** window:
    a. Enter the system IP address of Cisco vSmart Controller.
    b. Enter the username and password to access Cisco vSmart Controller.
    c. Choose the protocol to use for control-plane connections. The default is DTLS.
    d. If you select TLS, enter the port number to use for TLS connections. The default is 23456.
    e. Check the **Generate CSR** check box to allow the certificate-generation process to occur automatically.
    f. Click **Add**.

Cisco vManage automatically generates the CSR, retrieves the generated certificate, and installs it on Cisco vSmart Controller. The new controller is listed in the Controller table with the controller type, hostname of the controller, IP address, site ID, and other details.

Verify Certificate Installation

To verify that the certificate is installed on a Cisco vSmart Controller:

1. From the Cisco vManage menu, choose **Configuration** > **Devices**.
2. Choose the new controller listed and check in the Certificate Status column to ensure that the certificate has been installed.

Note If Cisco vSmart Controller and Cisco vBond Orchestrator have the same system IP addresses, they do not appear in Cisco vManage as devices or controllers. The certificate status of Cisco vSmart Controller and Cisco vBond Orchestrator is also not displayed. However, the control connections still successfully comes up.

What's Next

See *Deploy the vEdge Routers*.

Apply Policy to a Zone Pair

Table 12: Feature History

Feature Name	Release Information	Description
Self Zone Policy for Zone-Based Firewalls	Cisco SD-WAN Release 20.3.1 Cisco vManage Release 20.3.1	This feature allows you to define firewall policies for incoming and outgoing traffic between a self zone of an edge router and another zone. When a self zone is configured with another zone, the traffic in this zone pair is filtered as per the applied firewall policy.

Note For IPSEC overlay tunnels in Cisco SD-WAN, if a self zone is chosen as a zone pair, firewall sessions are created for SD-WAN overlay BFD packets if inspect action is configured for UDP.

However, for GRE overlay tunnels, if you chose a self zone as a zone pair with the inspect action of protocol 47, firewall sessions are created only for TCP, UDP, ICMP packets; but not BFD packets.

Warning Control connections may be impacted when you configure drop action from self-zone to VPN0 and vice versa. This applies for DTLS/TLS, BFD packets, and IPsec overlay tunnel.

Note On a Cisco vEdge device, packets to and from the management interface under VPN 512 do not go through the firewall module.

To apply policy to a zone pair:

1. Create security policy using Cisco vManage. For information see, Start the Security Policy Configuration Wizard.
2. Click **Apply Zone-Pairs**.
3. In the **Source Zone** field, choose the zone that is the source of the data packets.
4. In the **Destination Zone** field, choose the zone that is the destination of the data packets.

   Note You can choose self zone for either a source zone or a destination zone, not both.

5. Click the plus (+) icon to create a zone pair.
6. Click **Save**.
7. At the bottom of the page, click **Save Firewall Policy** to save the policy.

8. To edit or delete a firewall policy, click the **...**, and choose the desired option.
9. Click **Next** to configure the next security block in the wizard. If you do want to configure other security features in this policy, click **Next** until the Policy Summary page is displayed.

Note When you upgrade to Cisco SD-WAN Release 20.3.3 and later releases from any previous release, traffic to and from a service VPN IPSEC interface is considered to be in the service VPN ZBFW zone and not a VPN0 zone. This could result in the traffic getting blackholed, if you allow traffic flow only between service VPN and VPN0 and not the intra service VPN.

You have to make changes to your ZBFW rules to accommodate this new behavior, so that the traffic flow in your system is not impacted. To do this, you have to modify your intra area zone pair to allow the required traffic. For instance, if you have a policy which has the same source and destination zones, you have to ensure the zone-policy allows the required traffic.

Attach and Detach a Device Template

To configure a device on the network, you attach a device template to the device. You can attach only one device template to a device, so the template—whether you created it by consolidating individual feature templates or by entering a CLI text-style configuration—must contain the complete configuration for the device. You cannot mix and match feature templates and CLI-style configurations.

On Cisco Cisco vEdge devices in the overlay network, you can perform the same operations, in parallel, from one or more vManage servers. You can perform the following template operations in parallel:

- Attach a device template to devices
- Detach a device template from a device
- Change the variable values for a device template that has devices attached to it

For template operations, the following rules apply:

- When a device template is already attached to a device, you can modify one of its feature templates. Then when you click **Update** > **Configure Devices**, all other template operations—including attach devices, detach devices, and edit device values—are locked on all vManage servers until the update operation completes. This means that a user on another vManage server cannot perform any template operations until the update completes.
- You can perform the attach and detach device template operations on different devices, from one or more vManage servers, at the same time. However, if any one of these operations is in progress on one vManage server, you cannot edit any feature templates on any of the servers until the attach or detach operation completes.

Note You need to recreate the feature templates as the templates created prior to Cisco vManage Release 20.5 fails when attached to the device.

If the device being configured is present and operational on the network, the configuration is sent to the device immediately and takes effect immediately. If the device has not yet joined the network, the pushing of the configuration to the device is scheduled. When the device joins the network, Cisco vManage pushes the configuration immediately after it learns that the device is present in the network.

Attach a Device Template to Devices

You can attach the same templates to multiple devices, and you can do so simultaneously, in a single operation.

To attach a device template to one or more devices:

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Device Templates** and select the desired template.

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

3. Click **…**, and click **Attach Devices**. The **Attach Devices** dialog box opens with the **Select Devices** tab selected
4. In the **Available Devices** column on the left, select a group and search for one or more devices, select a device from the list, or click **Select All**.
5. Click the arrow pointing right to move the device to the **Selected Devices** column on the right.
6. Click **Attach**.
7. If the template contains variables, enter the missing variable values for each device you selected in one of the following ways:
   - Enter the values manually for each device either in the table column or by clicking **...** and **Edit Device Template**. When you are using optional rows, if you do not want to include the parameter for the specific device, do not specify a value.
   - Click **Import File** to upload a CSV file that lists all the variables and defines each variable's value for each device.
8. Click **Update**
9. Click **Next**.

   If any devices have the same system IP address, a dialog box appears or an error message is displayed when you click **Next**. Modify the system IP addresses so that there are no duplicates, and click **Save**. Then click **Next** again.
10. In the left pane, select the device, to preview the configuration that is ready to be pushed to the device. The right pane displays the device's configuration and the **Config Preview** tab is selected. Click the **Config Diff** tab to view the differences between this configuration and the configuration currently running on the device, if applicable. Click the **Back** button to edit the variable values entered in the previous screen.
11. If you are attaching a Cisco vEdge device, click **Configure Device Rollback Timer** to configure the time interval at which the device rolls back to its previous configuration if the router loses its control connection to the overlay network. **The Configure Device Rollback Time** dialog box is displayed.

a. From the **Devices** drop-down list, select a device.

b. 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.

c. To disable the rollback timer, click the **Enable Rollback** slider. When you disable the timer, the Password field dialog box opens. Enter the password that you used to log in to the vManage NMS.

d. 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.

e. To exclude a device from the rollback timer setting, click **Add Exception** and select the devices to exclude.

f. The table at the bottom 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 from the device name.

g. Click **Save**.

12. Click **Configure Devices** to push the configuration to the devices. The **Status** column displays whether the configuration was successfully pushed. Click the right angle bracket to display details of the push operation.

Export a Variables Spreadsheet in CSV Format for a Template

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Device Templates** and select the desired template.

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

3. Click **…**, and click **Export CSV**.

Configure Basic System Parameters

Use the System template for all Cisco SD-WAN devices.

To configure system-wide parameters using Cisco vManage templates:

1. Create a **System** feature template to configure system parameters.
2. Create an **NTP** feature template to configure NTP servers and authentication.
3. Configure the organization name and Cisco vBond Orchestrator IP address on the Cisco vManage. These settings are appended to the device templates when the templates are pushed to devices.

Create System Template

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

2. Click **Device Templates**, and click **Create Template**.

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

3. From the **Create Template** drop-down list, select **From Feature Template**.
4. From the **Device Model** drop-down list, select the type of device for which you are creating the template.
5. To create a custom template for System, select the **Factory_Default_System_Template** and click **Create Template**.

   The System template form is displayed. This form contains fields for naming the template, and fields for defining the System parameters.
6. In **Template Name**, enter a name for the template. The name can be up to 128 characters and can contain only alphanumeric characters.
7. In **Template Description**, enter a description of the template. The description can be up to 2048 characters and can contain only alphanumeric characters.

When you first open a feature template, for each parameter that has a default value, the scope is set to Default (indicated by a check mark), and the default setting or value is shown. To change the default or to enter a value, click the scope drop-down to the left of the parameter field and select one of the following:

Table 13:

Parameter Scope	Scope Description
Device Specific (indicated by a host icon)	Use a device-specific value for the parameter. For device-specific parameters, you cannot enter a value in the feature template. You enter the value when you attach a Cisco SD-WAN device to a device template. When you click **Device Specific**, the Enter Key box opens. This box displays a key, which is a unique string that identifies the parameter in a CSV file that you create. This file is an Excel spreadsheet that contains one column for each key. The header row contains the key names (one key per column), and each row after that corresponds to a device and defines the values of the keys for that device. You upload the CSV file when you attach a Cisco SD-WAN device to a device template. To change the default key, type a new string and move the cursor out of the Enter Key box. Examples of device-specific parameters are system IP address, host name, GPS location, and site ID.
Global (indicated by a globe icon)	Enter a value for the parameter, and apply that value to all devices. Examples of parameters that you might apply globally to a group of devices are DNS server, syslog server, and interface MTUs.

Basic System-Wide Configuration

To set up system-wide functionality on a Cisco SD-WAN device, select the **Basic Configuration** tab and then configure the following parameters. Parameters marked with an asterisk are required.

Table 14:

Parameter Field	Description
Site ID* (on routers, vManage instances, and vSmart controllers)	Enter the identifier of the site in the Cisco SD-WAN overlay network domain in which the device resides, such as a branch, campus, or data center. The site ID must be the same for all Cisco SD-WAN devices that reside in the same site.*Range:* 1 through 4294967295 (2^{32} – 1)
System IP*	Enter the system IP address for the Cisco SD-WAN device, in decimal four-part dotted notation. The system IP address provides a fixed location of the device in the overlay network and is a component of the device's TLOC address. It is used as the device's loopback address in the transport VPN (VPN 0). You cannot use this same address for another interface in VPN 0.
Timezone*	Select the timezone to use on the device.
Hostname	Enter a name for the Cisco SD-WAN device. It can be up to 32 characters.
Location	Enter a description of the location of the device. It can be up to 128 characters.
Device Groups	Enter the names of one or more groups to which the device belongs, separated by commas.
Controller Groups	List the Cisco vSmart Controller groups to which the router belongs.
Description	Enter any additional descriptive information about the device.
Console Baud Rate	Select the baud rate of the console connection on the router. *Values:* 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 baud or bits per second (bps). *Default:* 115200 bps
Maximum OMP Sessions	Set the maximum number of OMP sessions that a router can establish to a Cisco vSmart Controller. *Range*: 0 through 100. *Default:* 2
Dedicated Core for TCP Optimization (optional, on vEdge 1000 and 2000 routers only)	Click **On** to carve out a separate CPU core to use for performing TCP optimization.

To save the feature template, click **Save**.

CLI equivalent:

```
 system
clock timezone timezone
 console-baud-rate rate
controller-group-list numbers
description text
device-groups group-name
host-name string
location string
max-omp-sessions  number
site-id site-id
```

```
system-ip ip-address
tcp-optimization-enabled
```

To configure the DNS name or IP address of the Cisco vBond Orchestrator in your overlay network, go to **Administration** > **Settings** screen and click **vBond**.

Configure the GPS Location

To configure a device location, select the **GPS** tab and configure the following parameters. This location is used to place the device on the Cisco vManage network map. Setting the location also allows Cisco vManage to send a notification if the device is moved to another location.

Table 15:

Parameter Field	Description
Latitude	Enter the latitude of the device, in the format *decimal-degrees*.
Longitude	Enter the longitude of the device, in the format *decimal-degrees*.

To save the feature template, click **Save**.

CLI equivalent:

```
 system  gps-location  (latitude decimal-degrees | longitude decimal-degrees)
```

Configure Interface Trackers for NAT Direct Internet Access

Table 16: Feature History

Feature Name	Release Information	Description
Support for Interface Status Tracking on Cisco vEdge Devices	Cisco vManage Release 17.2.2	This feature supports interface tracking on Cisco vEdge devices.
Dual Endpoint Support for Interface Status Tracking on Cisco vEdge Devices	Cisco SD-WAN Release 20.6.1 Cisco vManage Release 20.6.1	This feature allows you to configure tracker groups with dual endpoints using the **Cisco System** template and associate each template group to an interface. The dual endpoints provide redundancy for tracking the status of transport interfaces to avoid false negatives.

The DIA tracker helps determine if the internet or external network becomes unavailable. This feature is useful when NAT is enabled on a transport interface in VPN 0 to allow data traffic from the router to exit directly to the internet.

If the internet or external network becomes unavailable, the router continues to forward traffic based on the NAT route in the service VPN. Traffic that is forwarded to the internet gets dropped. To prevent the internet-bound traffic from being dropped, configure the DIA tracker on the edge router to track the status of the transport interface. The tracker periodically probes the interface IP address of the end point of the tunnel interface to determine the status of the transport interface. The tracker determines the status of the internet and returns the data to the attach points that are associated with the tracker.

When the tracker is configured on the transport interface, the interface IP address is used as a source IP address for probe packets.

IP SLA monitors the status of probes and measures the round trip time of these probe packets and compares the values with the configured latency in the probe. When the latency exceeds the configured threshold value, the tracker considers the network as unavailable.

If the tracker determines that the local internet is unavailable, the router withdraws the NAT route and reroutes the traffic based on the local routing configuration to overlay.

The local router continues to periodically check the status of the path to the interface. When it detects that the path is functioning again, the router reinstalls the NAT route to the internet.

Starting Cisco SD-WAN Release 20.6.1 you can configure a tracker group with dual endpoints on Cisco vEdge devices (using two trackers) and associate this tracker group to an interface. Dual endpoints help in avoiding false negatives that might be introduced regarding unavailability of the internal or external network.

Restrictions for Configuring Tracker Groups for Dual Endpoints

A tracker group with dual endpoints can only be configured on the following types of interfaces:

- Ethernet Interfaces
- Subinterfaces
- PPPoE Interfaces

Configure NAT DIA Tracker

To track the status of transport interfaces that connect to the internet (Network Address Translation Direct Internet Access (NAT DIA)), click **Tracker** > **Add New Tracker** and configure the following parameters:

Table 17:

Parameter Field	Description
Name	Name of the tracker. The name can be up to 128 alphanumeric characters. You can configure up to eight trackers.
Tracker Type	Choose an interface, static route, or a tracker group. Starting Cisco SD-WAN Release 20.6.1 you can configure a tracker group with dual endpoints on Cisco vEdge devices and associate this tracker group to an interface. Choose **Tracker** type as **Interface** for NAT DIA and dual endpoint tracker configuration.
Tracker Type: Tracker Elements	This field is displayed only if you chose **Tracker Type** as a tracker-group. Add the existing interface tracker names (separated by a space). When you add this tracker to the template, the tracker group is associated with these individual trackers and you can then associate the tracker group to an interface.

Parameter Field	Description
Tracker Type: Tracker Boolean	This field is displayed only if you chose **Tracker Type** as a tracker-group. Select **AND** or **OR** explicitly. An **OR** operation ensures that the transport interface status is reported as active if either one of the associated trackers of the tracker group report that the interface is active. If you select the **AND** operation, the transport interface status is reported as active if both the associated trackers of the tracker group report that the interface is active.
Threshold	How long to wait for the probe to return a response before declaring that the transport interface is down. *Range:* 100 through 1000 milliseconds. *Default:* 300 milliseconds.
Interval	How often probes are sent to determine the status of the transport interface. *Range:* 10 through 600 seconds. *Default:* 60 seconds (1 minute)
Multiplier	Number of times to resend probes before declaring that the transport interface is down. *Range:* 1 through 10. *Default:* 3
End Point Type: IP Address	IP address of the end point of the tunnel interface. This is the destination in the internet to which the router sends probes to determine the status of the transport interface. **Note** In Cisco SD-WAN Release 20.5.1 and later releases, if the tracker receives an HTTP response status code, which is less than 400, the endpoint is reachable. Prior to Cisco SD-WAN Release 20.5.1, the endpoint is reachable if the tracker receives an HTTP response status code of 200.
End Point Type: DNS Name	DNS name of the end point of the tunnel interface. This is the destination in the internet to which the router sends probes to determine the status of the transport interface.

To save a tracker, click **Add**.

To save the feature template, click **Save**.

Configure NAT DIA Tracker Using the CLI

Configure NAT DIA tracker

```
system
   tracker tracker-name
   endpoint-dns-name dns-name
   endpoint-ip ip-address
   interval seconds
   multiplier number
   threshold milliseconds
```

Configure tracker group and assign it to an interface

Note You can configure only one endpoint per tracker.

```
system
 tracker nat-tracker1
  endpoint-ip 10.1.1.1
 !
 tracker nat-tracker2
  endpoint-ip 10.2.2.2
 !
 tracker nat-tracker3
  tracker-type tracker-group
  boolean or
  tracker-elements nat-tracker1 nat-tracker2
  !
 !
vpn 0
 interface ge0/1
  nat
  tracker nat-tracker3
  !
 !
```

Verify dual endpoints configuration

```
vEdge1# show running-config system | begin tracker

 tracker nat-tracker1
  endpoint-ip 10.1.1.1
 !
 tracker nat-tracker2
  endpoint-ip 10.2.2.2
 !
 tracker nat-tracker3
  boolean          or
  tracker-type     tracker-group
  tracker-elements nat-tracker1 nat-tracker2
 !

vEdge1# show tracker tracker-group

                                                            TRACKER  TRACKER
                                               TRACKER      ELEMENT  ELEMENT
VPN  INTERFACE  TRACKER NAME  BOOLEAN  STATUS  ELEMENT NAME  STATUS   RTT
--------------------------------------------------------------------------------
0    ge0_1      nat-tracker3  or       DOWN    nat-tracker1  DOWN     Timeout
                                               nat-tracker2  DOWN     Timeout
```

Apply Tracker to an Interface

To apply a tracker to an interface, configure it in the **VPN Interface Cellular**, **VPN Interface Ethernet**, **VPN Interface NAT Pool**, or **VPN Interface PPP** configuration templates. You can apply only one tracker to an interface.

A tracker group with dual endpoints can only be configured on the following types of interfaces:

- Ethernet Interfaces
- Subinterfaces

- PPPoE Interfaces

Monitor NAT DIA Endpoint Tracker Configuration

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage menu, choose **Monitor** > **Network**.
2. Choose a device from the list of devices.
3. Click **Real Time**.
4. From the **Device Options** drop-down list, choose **Dual Endpoint Tracker Info**.

Configure Advanced Options

To configure additional system parameters, click **Advanced**:

Table 18:

Parameter Name	Description
Control Session Policer Rate	Specify a maximum rate of DTLS control session traffic, to police the flow of control traffic. *Range:* 1 through 65535 pps. *Default:* 300 pps
MTU of DTLS Tunnel	Specify the MTU size to use on the DTLS tunnels that send control traffic between Cisco SD-WAN devices. *Range:* 500 through 2000 bytes. *Default:* 1024 bytes
Port Hopping	Click **On** to enable port hopping, or click **Off** to disable it. When a Cisco SD-WAN device is behind a NAT, port hopping rotates through a pool of preselected OMP port numbers (called base ports) to establish DTLS connections with other Cisco SD-WAN devices when a connection attempt is unsuccessful. The default base ports are 12346, 12366, 12386, 12406, and 12426. To modify the base ports, set a port offset value. To disable port hopping on an individual TLOC (tunnel interface), use the VPN Interface Ethernet configuration template. *Default:* Enabled (on routers); disabled (on Cisco vManage devices and Cisco vSmart Controllers).
Port Offset	Enter a number by which to offset the base port number. Configure this option when multiple Cisco SD-WAN devices are behind a single NAT device, to ensure that each device uses a unique base port for DTLS connections. *Values:* 0 through 19
DNS Cache Timeout	Specify when to time out the Cisco vBond Orchestrator addresses that have been cached by the device. *Range:* 1 through 30 minutes. *Default:* 30 minutes
Track Transport	Click **On** to regularly check whether the DTLS connection between the device and a Cisco vBond Orchestrator is up. Click **Off** to disable checking. By default, transport checking is enabled.
Local vBond (only on routers acting as vBond orchestrators)	Click **On** to configure the router to act as a Cisco vBond Orchestrator. Then specify the DNS name for the Cisco vBond Orchestrator or its IP address, in decimal four-part dotted notation.

Parameter Name	Description
Track Interface	Set the tag string to include in routes associated with a network that is connected to a non-operational interface. *Range:* 1 through 4294967295
Multicast Buffer	Specify the percentage of interface bandwidth that multicast traffic can use. *Range:* 5% through 100% *Default:* 20%
USB Controller (on vEdge 1000 and 2000 series routers only)	Click **On** to enable or click **Off** to disable the USB controller, which drives the external USB ports. If you enable the USB controller, the vEdge router reboots when you attach the device template to the device. *Default:* Disabled
Gateway Tracking	Click **On** to enable or click **Off** to Disable tracking of default gateway. Gateway tracking determines, for static routes, whether the next hop is reachable before adding that route to the device's route table. *Default:* Enabled
Host Policer Rate (on vEdge routers only)	Specify the maximum rate at which a policer delivers packets to the control plane. *Range:* 1000 through 20000 pps. *Default:* 5000 pps
ICMP Error Rate (on vEdge routers only)	Specify how many ICMP error messages a policer can generate or receive. *Range:* 1 through 200 pps *Default:* 100 pps
Allow Same-Site Tunnel (on vEdge routers only)	Click **On** to allow tunnels to be formed between vEdge routers in the same site. Note that no BFD sessions are established between the two collocated vEdge routers. *Default:* Off
Route Consistency Check (on vEdge routers only)	Click **On** to check whether the IPv4 routes in the device's route and forwarding table are consistent.
Collect Admin Tech on Reboot	Click **On** to collect admin-tech information when the device reboots.
Idle Timeout	Set how long the CLI is inactive on a device before the user is logged out. If a user is connected to the device via an SSH connection, the SSH connection is closed after this time expires. *Range:* 0 through 300 seconds. *Default:* CLI session does not time out.
Eco-Friendly Mode (on vEdge Cloud routers only)	Click **On** to configure a Cloud router not to use its CPU minimally or not at all when the router is not processing any packets.

To save the feature template, click **Save**.

CLI equivalent:

```
system
   admin-tech-on-failure  allow-same-site-tunnels
   control-session-pps rate eco-friendly-mode
   host-policer-pps rate

   icmp-error-pps rate

   idle-timeout seconds multicast-buffer-percent percentage

   port-hop  port-offset number route-consistency-check
   system-tunnel-mtu bytes timer
    dns-cache-timeout minutes track-default-gateway
    track-interface-tag number

   track-transport  upgrade-confirm minutes [no] usb-controller (on Cisco vEdge 1000 and
Cisco vEdge2000 routers only)
   vbond  (dns-name | ip-address) local (on Cisco vEdge routers acting as Cisco vBond
controllers)
```

Release Information

Introduced in Cisco vManage in Release 15.2. In Releases 15.3.8 and 15.4.3, add Track Interface field. In Release 17.1.0, add Route Consistency Check and Collect Admin Tech on Reboot fields. In Release 17.2.0, add support for CLI idle timeout and eco-friendly mode. In Release 17.2.2, add support for interface status tracking.

Configure the Cluster IP Address of a Cisco vManage Server

When you start Cisco vManage for the first time, the default IP address of the Cisco vManage server is shown as localhost. Before you can add a new Cisco vManage server to a cluster, you must change the localhost address of the primary Cisco vManage server to an out-of-band IP address. (From Cisco vManage Release 20.6.1, the primary Cisco vManage server has the Compute+Data persona.) Servers in the cluster use this out-of-band IP address to communicate with each other.

If you need to change the out-of-band IP address in the future, contact your Cisco support representative.

Cluster interconnection between Cisco vManage servers requires that each of the servers be assigned a static IP address. We recommend that you do not use DHCP to assign IP addresses to Cisco vManage servers that are to be a part of a cluster. Configure the IP address on a nontunnel interface in VPN 0.

Before you configure the cluster IP address of a Cisco vManage server, ensure that out-of-band IP addresses have been configured on VPN0 for its server interfaces. This configuration typically is done when the server is provisioned. The port type for an out-of-band IP address must be **service** for the IP address to be available for assigning to a Cisco vManage server.

Configure the IP Address for Releases Before Cisco vManage Release 20.6.1

Configure the IP address of a Cisco vManage server before you add the server to the cluster. To do so for releases before Cisco vManage Release 20.6.1, follow these steps:

1. From the Cisco vManage menu, choose **Administration** > **Cluster Management** and click **Service Configuration**.
2. Click **Add vManage**.

   The **Edit vManage** dialog box opens.
3. From the **vManage IP Address** drop-down list, choose an IP address to assign to the Cisco vManage server.
4. Enter the user name and password for logging in to the Cisco vManage server.
5. Click **Update**.

The Cisco vManage server reboots and displays the **Cluster Management** window.

Configure the IP Address for Cisco vManage Release 20.6.1 and Later Releases

Configure the IP address of a Cisco vManage server before you add the server to the cluster. To do so from Cisco vManage Release 20.6.1, perform the following steps.

Perform this procedure on the primary Cisco vManage server (which has the Compute+Data persona).

1. From the Cisco vManage menu, choose **Administration** > **Cluster Management**.

   The **Cluster Management** window is displayed. The table on this window lists the Cisco vManage servers that are in the cluster.

2. Click **...** adjacent to the Cisco vManage server to configure and click **Edit**.

   The **Edit vManage** dialog box is displayed.

3. In the **Edit vManage** dialog box, perform the following actions.

   Note You cannot change the persona of a server. So the Node Persona options are disabled.

   a. From the **vManage IP Address** drop-down list, choose an out-of-band static IP address to assign to the server.

   b. In the **Username** field, enter the user name for logging in to the server.

   c. In the **Password** field, enter the password for logging in to the server.

   d. (Optional) Click **Enable SD-AVC** if you want Cisco Software-Defined Application Visibility and Control (SD-AVC) to run on the server.

      Cisco SD-AVC is a component of Cisco Application Visibility and Control (AVC). It can be enabled on only one Cisco vManage server. The server on which it is enabled must have the Compute+Data or the Compute persona. Cisco SD-AVC cannot be enabled on a server that has the Data persona.

   Note If Cisco vManage is set up as a cluster and the cluster crashes as a result of a reboot or upgrade, the connection to the edge device is reset and the custom app ceases to function.

   To resolve this and to resume operation, redefine the custom application name with a new, unique name. For more information to define custom applications, see the Define Custom Applications Using Cisco vManage chapter of the *Cisco SD-WAN Policies Configuration Guide*.

   e. Click **Update**.

      The server reboots and displays the **Cluster Management** window.

Change Configuration Modes

A device can be in either of these configuration modes:

- vManage mode–A template is attached to the device and you cannot change the configuration on the device by using the CLI.

- CLI mode – No template is attached to the device and the device can be configured locally by using the CLI.

When you attach a template to a device from vManage, it puts the device in vManage mode. You can change the device back to CLI mode if needed to make local changes to its configuration.

To toggle a router from vManage mode to CLI mode:

1. From the Cisco vManage menu, choose **Configuration** > **Devices**.
2. Click **WAN Edge List**, and select a device.
3. Click the **Change Mode** drop-down list and select **CLI mode**.

An SSH window opens. To log in to the device, enter a username and password. You can then issue CLI commands to configure or monitor the device.

To toggle a controller device from vManage mode to CLI mode:

1. From the Cisco vManage menu, choose **Configuration** > **Devices**.
2. Click **Controllers**, and select a device.
3. Click the **Change Mode** drop-down list.
4. Select **CLI mode** and then select the device type. The **Change Mode - CLI** window opens.
5. From the **vManage mode** pane, select the device and click the right arrow to move the device to the **CLI mode** pane.
6. Click **Update to CLI Mode**.

An SSH window opens. To log in to the device, enter a username and password. You can then issue CLI commands to configure or monitor the device.

Clone Service Groups

Table 19: Feature History

Feature Name	Release Information	Description
Clone Service Groups in Cisco vManage	Cisco SD-WAN Release 20.5.1 Cisco vManage Release 20.5.1	You can easily create copies of service groups, download, and upload service group configuration properties using Cisco vManage.

When you clone or create copies of service chains, remember the following:

- Cisco vManage copies all configuration information of a service group to a cloned service group regardless of whether the cloned service group is attached to a cluster.
- Verify the CSV file and ensure that configuration information has a matching service group name during CSV file upload. Otherwise, an unmatched service group name can result in an error message during CSV file upload.

- To get an updated list of service group configuration values, always download service group configuration properties from the service group design view.

Step 1 From the Cisco vManage menu, choose **Configuration** > **Cloud OnRamp for Colocation**

Step 2 Click **Service Group**.

The service group configuration page appears and all the service groups are displayed.

Step 3 For the desired service group, click **...** and choose **Clone Service Group**.

A clone of the original service group appears in the service group design view. Note the following points:

- By default, the cloned service group name and VM names are suffixed with a unique string.
- To view any VM configuration, click a VM in service chains.
- Cisco vManage marks the service chains that require configuration as **Unconfigured**, next to the edit button of the service chain.

Step 4 Modify the service group name, if required. Provide a description for the service group.

Step 5 To configure a service chain, use one of the following methods:

- Click the edit button for a service chain, enter the values, and then click **Save**.
- Download the configuration values from a CSV file, modify the values, upload the file, and then click **Save**. See Steps 6, 7, 8 on how to download, modify, and upload a CSV file.

The cloned service group appears on the service group configuration page. You can now download the updated service group configuration values.

Step 6 To download the cloned service group configuration values, do one of the following:

Note The download and upload of a CSV file is supported for creating, editing, and cloning of the service groups that aren't attached to a cluster.

- On the service group configuration page, click a cloned service group, click **More Actions** to the right of the service group, and choose **Download Properties (CSV)**.
- In the service group design view, click **Download CSV** in the upper right corner of the screen.

Cisco vManage downloads all configuration values of the service group to an Excel file in CSV format. The CSV file can consist of multiple service groups and each row represents configuration values for one service group. To add more rows to the CSV file, copy service group configuration values from existing CSV files and paste them in this file.

For example, ServiceGroup1_Clone1 that has two service chains with one VM in each of the service chains is represented in a single row.

Note In the Excel file, the headers and their representation in the service chain design view is as follows:

- sc1/name represents the name of the first service chain.
- sc1/vm1/name represents the name of the first VNF in the first service chain.
- sc2/name represents the name of the second service chain.
- sc2/vm2/name represents the name of the second VNF in the second service chain.

Step 7 To modify service group configuration values, do one of the following:

- To modify the service group configuration in the design view, click a cloned service group from the service group configuration page.

  Click any VM in service chains to modify the configuration values, and then click **Save**.

- To modify the service group configuration using the downloaded Excel file, enter the configuration values in the Excel file manually. Save the Excel file in CSV format.

Step 8 To upload a CSV file that includes all the configuration values of a service group, click a service group in the service group configuration page, and then click **Upload CSV** from the right corner of the screen.

Click **Browse** to choose a CSV file, and then click **Upload**.

You can view the updated values displayed for the service group configuration.

Note You can use the same CSV file to add configuration values for multiple service groups. But, you can update configuration values for a specific service group only, when uploading a CSV file using Cisco vManage.

Step 9 To know the representation of service group configuration properties in the CSV file and Cisco vManage design view, click a service group from the service group configuration page.

Click **Show Mapping Names**.

A text appears next to all the VMs in the service chains. Cisco vManage displays this text after mapping it with the configuration properties in the CSV file.

Cisco SD-WAN Multitenancy

Enable Multitenancy on Cisco vManage

Prerequisites

Do not migrate an existing single-tenant Cisco vManage into multitenant mode, even if you invalidate or delete all devices from the existing Cisco vManage. Instead, download and install a new software image of Cisco vManage Release 20.6.1 or a later release.

Note After you enable multitenancy on Cisco vManage, you cannot migrate it back to single tenant mode.

1. Launch Cisco vManage using the URL `https://vmanage-ip-address:port`. Log in as the provider **admin** user.
2. From the Cisco vManage menu, choose **Administration** > **Settings**.
3. In the **Tenancy Mode** bar, click the **Edit**.
4. In the **Tenancy** field, click **Multitenant**.
5. In the **Domain** field, enter the domain name of the service provider (for example, managed-sp.com).
6. Enter a **Cluster Id** (for example, cluster-1 or 123456).

7. Click **Save**.

8. Click **Proceed** to confirm that you want to change the tenancy mode.

   Cisco vManage reboots in multitenant mode and when a provider user logs in to Cisco vManage, the provider dashboard appears.

Note The **Domain** and **Cluster Id** values created in steps 5 and 6 serve as the Provider FQDN. Ensure these values conform to current DNS naming conventions. You can not modify these values after the configuration is saved. To change these values, a new Cisco vManage cluster need to be deployed. For more details on Provider and Tenant DNS requirements, see step 3.d in Add a New Tenant.

Add Cisco vSmart Controller to Cisco SD-WAN Multitenant Deployment

1. Log in to Cisco vManage as the provider **admin** user.

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

3. Click **Controllers**.

4. Click **Add Controller** and click **vSmart**.

5. In the **Add vSmart** dialog box, do the following:

   a. In the **vSmart Management IP Address** field, enter the system IP address of the Cisco vSmart Controller.

   b. Enter the **Username** and **Password** required to access the Cisco vSmart Controller.

   c. Select the protocol to use for control-plane connections. The default is **DTLS**.

      If you select **TLS**, enter the port number to use for TLS connections. The default is 23456.

   d. Check the **Generate CSR** check box for Cisco vManage to create a Certificate Signing Request.

   e. Click **Add**.

6. From the Cisco vManage menu, choose **Configuration** > **Certificates**.

   For the newly added Cisco vSmart Controller, the **Operation Status** reads **CSR Generated**.

   a. For the newly added Cisco vSmart Controller, click **More Options** icon and click **View CSR**.

   b. Submit the CSR to the Certificate Authority (CA) and obtain a signed certificate.

7. From the Cisco vManage menu, choose **Configuration** > **Certificates**.

8. Click **Install Certificate**.

9. In the **Install Certificate** dialog box, paste the **Certificate Text** or click **Select a file** upload the certificate file. Click **Install**.

   Cisco vManage installs the certificate on the Cisco vSmart Controller. Cisco vManage also sends the serial number of the certificate to other controllers.

On the **Configuration** > **Certificates** page, the **Operation Status** for the newly added Cisco vSmart Controller reads as **vBond Updated**.

On the **Configuration** > **Devices** page, the new controller is listed in the Controller table with the controller type, hostname of the controller, IP address, site ID, and other details. The **Mode** is set to **CLI**.

10. Change the mode of the newly added Cisco vSmart Controller to **vManage** by attaching a template to the device.

    a. From the Cisco vManage menu, choose **Configuration** > **Templates**.

    b. Click **Device Templates**.

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

    c. Find the template to be attached to the Cisco vSmart Controller.

    d. Click **...**, and click **Attach Devices**.

    e. In the **Attach Devices** dialog box, move the new controller to the **Selected Device** list and click **Attach**.

    f. Verify the **Config Preview** and click **Configure Devices**.

Cisco vManage pushes the configuration from the template to the new controller.

In the **Configuration** > **Devices** page, the **Mode** for the Cisco vSmart Controller shows **vManage**. The new Cisco vSmart Controller is ready to be used in your mutitenant deployment.

Add a New Tenant

Table 20: Feature History

Feature Name	Release Information	Description
Tenant Device Forecasting	Cisco SD-WAN Release 20.6.1 Cisco vManage Release 20.6.1	While adding a new tenant to the multitenant Cisco SD-WAN deployment, a service provider can forecast the number of WAN edge devices that the tenant may deploy in their overlay network. Cisco vManage enforces this forecast limit. If the tenant tries to add devices beyond this limit, Cisco vManage responds with an appropriate error message and the device addition fails.

Prerequisites

- At least two Cisco vSmart Controllers must be operational and in the `vManage` mode before you can add new tenants.

  A Cisco vSmart Controller enters the `vManage` mode when you push a template onto the controller from Cisco vManage. A Cisco vSmart Controller in the `CLI` mode cannot serve multiple tenants.

- Each pair of Cisco vSmart Controllers can serve a maximum of 24 tenants and a maximum of 1000 tenant devices. Ensure that there at least two Cisco vSmart Controllers that can serve a new tenant. If no pair of Cisco vSmart Controllers in the deployment can serve a new tenant, add two Cisco vSmart Controllers and change their mode to `vManage`.

- If you add a second tenant immediately after adding a tenant, Cisco vManage adds them sequentially, and not in parallel.

- Each tenant must have a unique Virtual Account (VA) on **Plug and Play Connect** on Cisco Software Central. The tenant VA should belong to the same Smart Account (SA) as the provider VA.

- For an on-premises deployment, create a Cisco vBond Orchestrator controller profile for the tenant on **Plug and Play Connect**. The fields in the following table are mandatory.

  Table 21: Controller Profile Fields

Field	Description/Value
Profile Name	Enter a name for the controller profile.
Multi-Tenancy	From the drop-down list, select **Yes**.
SP Organization Name	Enter the provider organization name.
Organization Name	Enter the tenant organization name in the format `<SP Org Name>-<Tenant Org Name>`. **Note** The organization name can be up to 64 characters.
Primary Controller	Enter the host details for the primary Cisco vBond Orchestrator.

  For a cloud deployment, the Cisco vBond Orchestrator controller profile is created automatically as part of the tenant creation process.

1. Log in to Cisco vManage as the provider **admin** user.

2. From the Cisco vManage menu, choose **Administration** > **Tenant Management**.

3. Click **Add Tenant**. In the **Add Tenant** dialog box:

   a. Enter a name for the tenant.

      For a cloud deployment, the tenant name should be same as the tenant VA name on **Plug and Play Connect**.

   b. Enter a description of the tenant.

      The description can be up to 256 characters and can contain only alphanumeric characters.

c. Enter the name of the organization.

The organization name is case-sensitive. Each tenant or customer must have a unique organization name.

Enter the organization name in the following format:

```
<SP Org Name>-<Tenant Org Name>
```

For example, if the provider organization name is 'multitenancy' and the tenant organization name is 'Customer1', while adding the tenant, enter the organization name as **`multitenancy-Customer1`**.

Note The organization name can be up to 64 characters.

d. In the **URL Subdomain Name** field, enter the fully qualified sub-domain name of the tenant.

- The sub-domain name must include the domain name of the service provider. For example, for the `managed-sp.com` service provider, a valid domain name can be `customer1.managed-sp.com`.

Note The service provider name is shared amongst all tenants. Hence, ensure that the URL naming convention follows the same domain name convention that was provided while enabling multitenancy from **Administration** > **Settings** > **Tenancy Mode**.

- For an on-premises deployment, add the fully qualified sub-domain name of the tenant to the DNS. Map the fully qualified sub-domain name to the IP addresses of the three Cisco vManage instances in the Cisco vManage cluster.
  - **Provider Level**: Create DNS A record and map it to the IP addresses of the Cisco vManage instances running in the Cisco vManage cluster. The A record is derived from the domain and Cluster ID that was created in steps 5 and 6 in Enable Multitenancy on Cisco vManage. For example, if domain is **sdwan.cisco.com** and Cluster ID is **vmanage123**, then A record will need to be configured as **vmanage123.sdwan.cisco.com**.

Note If you fail to update DNS entries, it will result in authentication errors when logging in to Cisco vManage. Validate DNS is configured correctly by executing **nslookup vmanage123.sdwan.cisco.com**.

  - **Tenant Level**: Create DNS CNAME records for each tenant created and map them to the FQDN created at the Provider Level. For example, if domain is **sdwan.cisco.com** and tenant name is **customer1** the CNAME record will need to be configured as **customer1.sdwan.cisco.com**.

Note Cluster ID is not required for CNAME record. Validate DNS is configured correctly by executing **nslookup customer1.sdwan.cisco.com**.

For a cloud deployment, the fully qualified sub-domain name of the tenant is automatically added to the DNS as part of the tenant creation process. After you add a tenant, it could take up to an hour before the fully qualified sub-domain name of the tenant can be resolved by the DNS.

e. In the **Number of Devices** field, enter the number of WAN edge devices that the tenant can deploy.

   If the tenant tries to add WAN edge devices beyond this number, Cisco vManage reports an error and the device addition fails.

f. Click **Save**.

   The **Create Tenant** screen appears, and the **Status** of the tenant creation reads **In progress**. To view status messages related to the creation of a tenant, click the > button to the left of the status.

   Cisco vManage does the following:

   - creates the tenant
   - assigns two Cisco vSmart Controllers to serve the tenant and pushes a CLI template to these controllers to configure tenant information
   - sends the tenant and Cisco vSmart Controller information to Cisco vBond Orchestrators.

What to do next:

After the **Status** column changes to **Success**, you can view the tenant information on the **Administration** > **Tenant Management** page.

Modify Tenant Information

1. Log in to Cisco vManage as the provider **admin** user.
2. From the Cisco vManage menu, choose **Administration** > **Tenant Management**.
3. In the left pane, click the name of the tenant.

   The tenant information is displayed in a pane on the right.
4. To modify tenant data, do as follows:

   a. In the right pane, click the pencil icon.

   b. In the **Edit Tenant** dialog box, you can modify the following:

      - **Description**: The description can be up to 256 characters and can contain only alphanumeric characters.
      - **Forecasted Device**: The number of WAN edge devices that the tenant can deploy.

        A tenant can add a maximum of 1000 devices.

Note This option is available from Cisco SD-WAN Release 20.6.2, Cisco vManage Release 20.6.2.

If you increase the number of devices that a tenant can deploy, you must add the required number of device licenses to the tenant virtual account on **Plug and Play Connect** on Cisco Software Central.

Before you increase the number of devices that a tenant can deploy, ensure that the Cisco vSmart Controller pair assigned to the tenant can support this increased number. A pair of Cisco vSmart Controllers can support a maximum of 24 tenants and 1000 devices across all these tenants.

- **URL Subdomain Name**: Modify the fully qualified sub-domain name of the tenant.

c. Click **Save**

Delete a Tenant

Before you delete a tenant, delete all tenant WAN edge devices. See Delete a WAN Edge Device from a Tenant Network.

1. Log in to Cisco vManage as the provider **admin** user.
2. From the Cisco vManage menu, choose **Administration** > **Tenant Management**.
3. In the left pane, click the name of the tenant.

   The tenant information is displayed in a pane on the right.
4. To delete the tenant, do as follows:

   a. In the right pane, click the trash icon.

   b. In the **Delete Tenant** dialog box, enter the provider **admin** password and click **Save**.

View OMP Statistics per Tenant on a Cisco vSmart Controller

1. Log in to Cisco vManage as the provider **admin** user.
2. From the Cisco vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage menu, choose **Monitor** > **Network**.
3. In the table of devices, click on the hostname of a Cisco vSmart Controller.
4. In the left pane, click **Real Time**.
5. In the **Device Options** field, enter `OMP` and select the OMP statistics you wish to view.
6. In the **Select Filters** dialog box, click **Show Filters**.
7. Enter the **Tenant Name** and click **Search**.

Cisco vManage displays the selected OMP statistics for the particular tenant.

View Tenants Associated with a Cisco vSmart Controller

1. Log in to Cisco vManage as the provider **admin** user.
2. Click a **vSmart** connection number to display a table with detailed information about each connection.

   Cisco vManage displays a table that provides a summary of the Cisco vSmart Controllers and their connections.
3. For a Cisco vSmart Controller, click **...** and click **Tenant List**.

   Cisco vManage displays a summary of tenants associated with the Cisco vSmart Controller.

Manage Tenant WAN Edge Devices

Add a WAN Edge Device to a Tenant Network

Note If you are adding a WAN edge device that you had previously invalidated and deleted from an overlay network, you must reset the device software after adding the device. To reset the software on a Cisco vEdge device, use the command **request platform software reset**.

1. Log in to Cisco vManage.

   If you're a provider user, log in as the **admin**. In the provider dashboard, choose a tenant from the drop-down list to enter the provider-as-tenant view.

   If you're a tenant user, log in as the **tenantadmin**.
2. Upload the device serial number file to Cisco vManage.
3. Validate the device and send details to controllers.
4. Create a configuration template for the device and attach the device to the template.

   While configuring the device, configure the service provider organization name and the tenant organization name as in the following example:

   ```
   sp-organization-name multitenancy
   organization-name multitenancy-Customer1
   ```

   Note Enter the `organization-name` in the format `<SP Org Name>-<Tenant Org Name>`.
5. Bootstrap the device using bootstrap configuration generated through Cisco vManage or manually create the initial configuration on the device.
6. If you are using Enterprise Certificates to authenticate the device, download the CSR from Cisco vManage and get the CSR signed by the Enterprise CA. Install the certificate on Cisco vManage.

Delete a WAN Edge Device from a Tenant Network

1. Log in to Cisco vManage.

   If you're a provider user, log in as the **admin**. In the provider dashboard, choose a tenant from the drop-down list to enter the provider-as-tenant view.

   If you're a tenant user, log in as the **tenantadmin**.

2. Detach the device from any configuration templates.

3. Delete a WAN Edge Router.

Flexible Tenant Placement on Multitenant Cisco vSmart Controllers

Table 22: Feature History

Feature Name	Release Information	Description
Flexible Tenant Placement on Multitenant Cisco vSmart Controllers	Cisco vManage Release 20.9.1	With this feature, while onboarding a tenant to a multitenant deployment, you can choose the pair of multitenant Cisco vSmart Controllers that serve the tenant. After onboarding a tenant, you can migrate the tenant to a different pair of multitenant Cisco vSmart Controllers, if necessary.

Assign Cisco vSmart Controllers to Tenants During Onboarding

Prerequisites

- At least two Cisco vSmart Controllers must be operational and in the vManage mode before you can add new tenants.

  A Cisco vSmart Controller enters the **vManage** mode when you push a template to the controller from Cisco vManage. A Cisco vSmart Controller in the **CLI** mode cannot serve multiple tenants.

- Each pair of Cisco vSmart Controllers can serve a maximum of 24 tenants and a maximum of 1000 tenant devices. Ensure that there are at least two Cisco vSmart Controllers that can serve a new tenant. If no pair of Cisco vSmart Controllers in the deployment can serve a new tenant, add two Cisco vSmart Controllers and change their mode to **vManage**.

- Add up to 16 tenants in a single operation. If you add more than one tenant, during the **Add Tenant** task, Cisco vManage adds the tenants one after another and not in parallel.

  While an **Add Tenant** task is in progress, do not perform a second tenant addition operation. If you do so, the second Add Tenant task fails.

- Each tenant must have a unique Virtual Account (VA) on Plug and Play Connect on Cisco Software Central. The tenant VA should belong to the same Smart Account (SA) as the provider VA.

- For an on-premises deployment, create a Cisco vBond Orchestrator controller profile for the tenant on Plug and Play Connect. The fields in the following table are mandatory.

Field	Description
Profile Name	Enter a name for the controller profile.
Multi-Tenancy	From the drop-down list, select **Yes**.
SP Organization Name	Enter the provider organization name.
Organization Name	Enter the tenant organization name in the format <SP Org Name>-<Tenant Org Name>. The organization name can be up to 64 characters.
Primary Controller	Enter the host details for the primary Cisco vBond Orchestrator.

  For a cloud deployment, the Cisco vBond Orchestrator controller profile is created automatically as part of the tenant creation process.

1. Log in to Cisco vManage as the provider **admin** user.
2. From the Cisco vManage menu, choose **Administration** > **Tenant Management**.
3. Click **Add Tenant**.
4. In the **Add Tenant** slide-in pane, click **New Tenant**.
5. Configure the following tenant details:

Field	Description
Name	Enter a name for the tenant. For a cloud deployment, the tenant name should be same as the tenant VA name on Plug and Play Connect.
Description	Enter a description for the tenant. The description can have up to 256 characters and can contain only alphanumeric characters.
Organization Name	Enter the name of the tenant organization. The organization name can have up to 64 characters. The organization name is case-sensitive. Each tenant or customer must have a unique organization name. Enter the organization name in the following format: `<SP Org Name>-<Tenant Org Name>` For example, if the provider organization name is ‘managed-sp’ and the tenant organization name is 'customer1', while adding the tenant, enter the organization name as ‘managed-sp-customer1’.

Field	Description
URL Subdomain	

Field	Description
	Enter the fully qualified subdomain name of the tenant. • The subdomain name must include the domain name of the service provider. For example, for the managed-sp.com service provider, a valid domain name for customer1 is customer1.managed-sp.com. **Note** The service provider name is shared amongst all tenants. Ensure that the URL naming convention follows the same domain name convention that was followed while enabling multitenancy using **Administration** > **Settings** > **Tenancy Mode**. • For an on-premises deployment, add the fully qualified subdomain name of the tenant to the DNS. Map the fully qualified subdomain name to the IP addresses of the three Cisco vManage instances in the Cisco vManage cluster. • Provider DNS: Create a DNS A record and map it to the IP addresses of the Cisco vManage instances running in the Cisco vManage cluster. The A record is derived from the provider's domain name and the cluster ID that was created while enabling multitenancy on Cisco vManage. For example, if the provider's domain name is `sdwan.cisco.com` and the cluster ID is `vmanage123`, configure the A record as `vmanage123.sdwan.cisco.com`. **Note** If you fail to add the DNS A record, you will experience authentication errors when logging in to Cisco vManage. Validate that the DNS is configured correctly by using the **nslookup** command. Example: `nslookup vmanage123.sdwan.cisco.com .` • Tenant DNS: Create DNS CNAME records for each tenant that you created and map them to the provider FQDN. For example, if the provider's domain name is `sdwan.cisco.com` and tenant name is `customer1`, configure the CNAME record as `customer1.sdwan.cisco.com`. Cluster ID is not required in the CNAME record. Validate that the DNS is configured correctly by using the **nslookup** command. Example: `nslookup customer1.sdwan.cisco.com`. • For a cloud deployment, the fully qualified subdomain name of the tenant is automatically added to the DNS as part of the tenant creation process. After you add a tenant, it could take up to an hour before the fully qualified subdomain name of

Field	Description
	the tenant can be resolved by the DNS.
Forecasted Devices	Enter the number of WAN edge devices that the tenant can add to the overlay. If the tenant tries to add WAN edge devices beyond this number, Cisco vManage reports an error and the device addition fails.

Field	Description
Select two vSmarts	

<table>
<tr><th>Field</th><th>Description</th></tr>
<tr><td></td><td>

- Automatic tenant placement: Ensure that the **Select two vSmarts** field has the value **Autoplacement**. This is the default configuration.
- Flexible tenant placement:

a. Click the **Select two vSmarts** drop-down list.

Cisco vManage lists the hostnames of the available Cisco vSmart Controllers. For each Cisco vSmart Controller, Cisco vManage shows whether the controller is reachable and reports the following utilization details:

<table>
<tr><td>Tenant hosting capacity</td><td>Each Cisco vSmart Controller can serve a maximum of 24 tenants. Tenant hosting capacity represents the number of tenants to which the Cisco vSmart Controller is assigned in the form of a percentage. This value indicates whether you can assign another tenant to this controller.</td></tr>
<tr><td>Used device capacity</td><td>Each Cisco vSmart Controller can support a maximum of 1000 tenant WAN edge devices. Used device capacity represents the number of tenant WAN edge devices connected to the Cisco vSmart Controller in the form of a percentage of the maximum capacity (1000 WAN edge devices). This value indicates whether the Cisco vSmart Controller can support the number of devices forecast for the tenant that you are onboarding.</td></tr>
<tr><td>Memory utilized</td><td>This value represents memory consumption as a percentage.</td></tr>
<tr><td>CPU utilized</td><td>This value represents CPU usage as a percentage.</td></tr>
</table>

b. Select two Cisco vSmart Controllers to assign to the

</td></tr>
</table>

Field	Description
	tenant based on the utilization details. To select a Cisco vSmart Controller, check the check box adjacent to its hostname.

6. To save the tenant configuration, click **Save**.
7. To add another tenant, repeat Step 4 to Step 6.
8. To onboard tenants to the deployment, click **Add**.

Cisco vManage initiates the Create Tenant Bulk task to onboard the tenants.

As part of this task, Cisco vManage performs the following activities:

- creates the tenant
- assigns two Cisco vSmart Controllers to serve the tenant and pushes a CLI template to these controllers to configure tenant information
- sends the tenant and Cisco vSmart Controller information to Cisco vBond Orchestrators

When the task is successfully completed, you can view the tenant information, including the Cisco vSmart Controllers assigned to the tenant, on the **Administration** > **Tenant Management** page.

Update Cisco vSmart Controllers Placement For a Tenant

You can migrate a tenant to a different pair of Cisco vSmart Controllers from the controllers that are currently assigned to the tenant. For instance, if you need to increase the tenant WAN edge device forecast and the controllers assigned to the tenant cannot connect to these revised number of tenant WAN edge devices, you can migrate the tenant to a pair of controllers that can accommodate the revised forecast.

If you wish to migrate a tenant to different pair of Cisco vSmart Controllers, you must change the Cisco vSmart Controllers that are assigned to the tenant one at a time. Doing so ensures that one of the Cisco vSmart Controllers is available to the tenant WAN edge devices during the migration and prevents disruptions in traffic.

1. Log in to Cisco vManage as the provider **admin** user.
2. From the Cisco vManage menu, choose **Administration** > **Tenant Management**.
3. For the tenant you wish to migrate to a different controller, click **…** adjacent to the tenant organization name.
4. Click **Update vSmart Placement**.
5. In the **Update vSmart Placement** slide-in pane, configure the following:

<table>
<tr><th>Field</th><th>Description</th></tr>
<tr><td><b>Source vSmart (currently applied)</b></td><td>a. Click the <b>Source vSmart (currently applied)</b> drop-down list.
Cisco vManage lists the hostnames of the Cisco vSmart Controllers assigned to the tenant. For each Cisco vSmart Controller, Cisco vManage shows whether the controller is reachable and reports the following utilization details:
<table>
<tr><td>Tenant hosting capacity</td><td>Each Cisco vSmart Controller can serve a maximum of 24 tenants. Tenant hosting capacity represents the number of tenants to which the Cisco vSmart Controller is assigned in the form of a percentage. This value indicates whether you can assign another tenant to this controller.</td></tr>
<tr><td>Used device capacity</td><td>Each Cisco vSmart Controller can support a maximum of 1000 tenant WAN edge devices. Used device capacity represents the number of tenant WAN edge devices connected to the Cisco vSmart Controller in the form of a percentage of the maximum capacity (1000 devices). This value indicates whether the Cisco vSmart Controller can support the number of devices forecast for the tenant that you are onboarding.</td></tr>
<tr><td>Memory utilized</td><td>This value represents memory consumption as a percentage.</td></tr>
<tr><td>CPU utilized</td><td>This value represents CPU usage as a percentage.</td></tr>
</table>
b. Check the check box adjacent to the hostname of one of the Cisco vSmart Controllers assigned to the tenant.</td></tr>
</table>

<table>
<tr><th>Field</th><th>Description</th></tr>
<tr><td><b>Destination vSmart</b></td><td>
<p><b>a.</b> Click the <b>Destination vSmart</b> drop-down list.</p>
<p>Cisco vManage lists the hostnames of the available Cisco vSmart Controllers that are not assigned to the tenant. For each Cisco vSmart Controller, Cisco vManage shows whether the controller is reachable and reports the following utilization details:</p>
<table>
<tr><td>Tenant hosting capacity</td><td>Each Cisco vSmart Controller can serve a maximum of 24 tenants. Tenant hosting capacity represents the number of tenants to which the Cisco vSmart Controller is assigned in the form of a percentage. This value indicates whether you can assign another tenant to this controller.</td></tr>
<tr><td>Used device capacity</td><td>Each Cisco vSmart Controller can support a maximum of 1000 tenant WAN edge devices. Used device capacity represents the number of tenant WAN edge devices connected to the Cisco vSmart Controller in the form of a percentage of the maximum capacity (1000 devices). This value indicates whether the Cisco vSmart Controller can support the number of devices forecast for the tenant that you are onboarding.</td></tr>
<tr><td>Memory utilized</td><td>This value represents memory consumption as a percentage.</td></tr>
<tr><td>CPU utilized</td><td>This value represents CPU usage as a percentage.</td></tr>
</table>
<p><b>b.</b> Check the check box adjacent to the hostname of the Cisco vSmart Controller you want to assign to the tenant.</p>
<p>If you select a Cisco vSmart Controller that does not have the required capacity to serve the tenant devices, the update operation fails.</p>
</td></tr>
</table>

6. Click **Update**.

7. To change the other Cisco vSmart Controller that is assigned to the tenant, repeat Step 3 to Step 6.

Cisco vManage initiates the Tenant vSmart Update task to assign the selected Cisco vSmart Controller to the tenant, migrating the tenant details from the Cisco vSmart Controller that was previously assigned. When the task is successfully completed, you can view the tenant information, including the Cisco vSmart Controllers assigned to the tenant, on the **Administration** > **Tenant Management** page.

Configure Application Probe Class through vManage

Table 23: Feature History

Feature Name	Release Information	Description
Per-Class Application-Aware Routing	Cisco SD-WAN Release 20.4.1 Cisco vManage Release 20.4.1	This release supports Per-class application-aware routing to Cisco SD-WAN. You can configure Application Probe Class using Cisco vManage.

1. From the Cisco vManage menu, choose **Configuration** > **Policies**.
2. In **Centralized Policy**, click **Add Policy**. The **Create Groups of Interest** page appears.
3. Choose the list type **App Probe Class** from the left navigation panel to create your groups of interest.
4. Click **New App Probe Class**.
5. Enter the probe class name in the **Probe Class Name** field.
6. Choose the required forwarding class from the **Forwarding Class** drop-down list.

   If there are no forwarding classes, then create a class from the **Class Map** list page under the **Localized Policy Lists** in the **Custom Options** menu.

   To create a forwarding class:

   a. In the **Custom Options** drop-down, choose **Lists** from the Localized Policy options.
   b. In the Define Lists window, choose the list type **Class Map** from the left navigation panel.
   c. Click **New Class List** to create a new list.
   d. Enter **Class** and choose the **Queue** from the drop-down list.
   e. Click **Save**.

7. In the **Entries** pane, choose the appropriate color from the **Color** drop-down list and enter the **DSCP** value.

   Click **+** sign, to add more entries as required.

8. Click **Save**.

Configure Authorization and Accounting

Table 24: Feature History

Feature Name	Release Information	Description
Authorization and Accounting	Cisco SD-WAN Release 20.5.1 Cisco vManage Release 20.5.1	You can configure authorization, which authorizes commands that a user enter on a device before the commands can be executed, and accounting, which generates a record of commands that a user executes on a device.

Navigating to the Template Screen and Naming the Template

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Device Templates**, and click **Create Template**.

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

3. From the **Create Template** drop-down list, select **From Feature Template**.
4. From the **Device Model** drop-down list, select the type of device for which you are creating the template.
5. Select **Basic Information**.
6. To create a custom template for AAA, select Factory_Default_AAA_Template and click **Create Template**. The AAA template form is displayed. The top of the form contains fields for naming the template, and the bottom contains fields for defining AAA parameters.
7. In the **Template Name** field, enter a name for the template. The name can be up to 128 characters and can contain only alphanumeric characters.
8. In the **Template Description** field, enter a description of the template. The description can be up to 2048 characters and can contain only alphanumeric characters.

When you first open a feature template, for each parameter that has a default value, the scope is set to Default (indicated by a check mark), and the default setting or value is shown. To change the default or to enter a value, click the **Scope** drop-down list to the left of the parameter field and select one of the following:

Table 25:

Parameter Scope	Scope Description
Device Specific (indicated by a host icon)	Use a device-specific value for the parameter. For device-specific parameters, you cannot enter a value in the feature template. You enter the value when you attach a Cisco vEdge device to a device template . When you click Device Specific, the Enter Key box opens. This box displays a key, which is a unique string that identifies the parameter in a CSV file that you create. This file is an Excel spreadsheet that contains one column for each key. The header row contains the key names (one key per column), and each row after that corresponds to a device and defines the values of the keys for that device. You upload the CSV file when you attach a Cisco vEdge device to a device template. For more information, see Create a Template Variables Spreadsheet . To change the default key, type a new string and move the cursor out of the Enter Key box. Examples of device-specific parameters are system IP address, hostname, GPS location, and site ID.
Global (indicated by a globe icon)	Enter a value for the parameter, and apply that value to all devices. Examples of parameters that you might apply globally to a group of devices are DNS server, syslog server, and interface MTUs.

Configuring Authorization

You can configure authorization, which causes the device to authorize commands that users enter on a device before the commands can be executed.

Configuring authorization involves creating one or more tasks. A task consists of a set of operational commands and a set of configuration commands. Operational commands are show commands and exec commands. Configuration commands are the XPath of configuration commands.

You define the default user authorization action for each command type. The default action can be accept or deny. You also can define user authorization accept or deny actions for individual commands or for XPath strings within a command type. In this way, you can override the default action for specific commands as needed.

A task is mapped to a user group, so all users in the user group are granted the authorizations that the command sets in the task define.

To configure authorization, choose the **Authorization** tab, click **+ New Task**, and configure the following parameters:

Table 26:

Parameter Name	Description
Name	Enter a unique name for the task

Parameter Name	Description
+ Add Oper	Click to add a set of operational commands. In the Add Oper window that pops up: 1. From the **Default action** drop-down list, choose the default authorization action for operational commands. Choose **accept** to grant user authorization by default, or choose **deny** to prevent user authorization by default. 2. To designate specific operational commands for which user authorization is granted or denied authorization, click **+ Add Oper** to expand the Add Oper area. In the **Oper** field that displays, click **accept** to grant user authorization for a command, or click **deny** to prevent user authorization for a command, and enter the command in the **CLI** field. Then click **Add** in the Add Oper area. Do not include quotes or a command prompt when entering a command. For example, **config terminal** is a valid entry, but **"config terminal"** is not valid. Repeat this Step 2 as needed to designate other commands. The actions that you specify here override the default action. In this way, you can designate specific commands that are not authorized when the default action is accept, and designate specific commands that are authorized when the default action is deny. To remove a specific command, click the trash icon on the right side of its line in the table at the bottom of the Add Oper window. 3. Click **Add** at the bottom right of the Add Oper window.
+ Add Config	Click to add a set of XPath strings for configuration commands. In the Add Config window that pops up: 1. From the **Default action** drop-down list, choose the default authorization action for configuration commands. Choose **accept** to grant user authorization by default, or choose **deny** to prevent user authorization by default. 2. To designate specific configuration command XPath strings for which user is granted or denied authorization **Click + Add Config** to expand the Add Config area. In the **Config** field that displays, click **accept** to grant user authorization for an XPath, or click **deny** to prevent user authorization for an XPath, and enter the XPath string in the **CLI** field. Then click **Add** in the Add Config area. To display the XPath for a device, enter the **`show running-config | display xpath`** command on the device. Do not include quotes or a command prompt when entering an XPath string. Repeat this Step 2 as needed to designate other XPath strings. The actions that you specify here override the default action. In this way, you can designate specific XPath strings that are not authorized when the default action is accept, and designate specific XPath strings that are authorized when the default action is deny. To remove a specific command, click the trash icon on the right side of its line in the table at the bottom of the Add Config window. 3. Click **Add** at the bottom right of the Add Config window.

To remove a task, click the trash icon on the right side of the task line.

After you create a tasks, perform these actions:

- Create or update a user group. Use the Custom feature type to associate one or more tasks with the user group by assigning read, write, or both privileges to each task. See Configure Local Access for Users and User Groups.

Note A user group can be associated with either a predefined task or with user-defined tasks. Associating a user group with a combination of both predefined and user-defined tasks is not supported.

- Add users to the user group. These users then receive the authorization for operational and configuration commands that the tasks that are associated with the user group define. See Configure Local Access for Users and User Groups.

  If a user is attached to multiple user groups, the user receives the authorization access that is configured for the last user group that was created.

CLI equivalent:

```
system aaa
   accounting
   task name
     config
       default-action {accept | deny}
       accept "xpath"
       deny "xpath"
     oper-exec
       default-action {accept | deny}
       accept "command"
       deny ""command-id
   usergroup group-name
     task authorization-task {read | write}
```

Configuring Accounting

You can configure accounting, which causes a TACACS+ server to generate a record of commands that a user executes on a device.

Note Accounting does not generate a record of CLI commands for Cisco vManage template configuration.

Prerequisites

- The TACACS+ server must be configured with a secret key on the **TACACS** tab
- The TACACS+ server must be configured as first in the authentication order on the **Authentication** tab

To configure accounting, choose the **Accounting** tab and configure the following parameter:

Table 27:

Parameter Name	Description
Enable/disable user accounting	Click **On** to enable the accounting feature. Click **Off** to disable this feature.

CLI equivalent:

```
system  aaa
   accounting
```

Configure Automatic Bandwidth Detection

Table 28: Feature History

Feature Name	Release Information	Description
Day 0 WAN Interface Automatic Bandwidth Detection	Cisco IOS XE Release 17.5.1a Cisco vManage Release 20.5.1	You can enable a device to automatically determine the bandwidth for WAN interfaces in VPN0 during day 0 onboarding by performing a speed test using an iPerf3 server.

You can configure the Cisco VPN Interface Ethernet template to cause a device to automatically detect the bandwidth for WAN interfaces in VPN0 during its day 0 onboarding. If you configure a template in this way, a Cisco IOS XE SD-WAN device attempts to determine the bandwidth for WAN interfaces in VPN0 after completing the PnP process.

Automated bandwidth detection can provide more accurate day 0 bandwidth configuration than manual configuration because there is limited user traffic that can affect results.

A device determines the bandwidth by performing a speed test using an iPerf3 server. iPerf3 is a third-party tool that provides active measurements of bandwidth on IP networks. For more information, see the Iperf.fr website.

If a device has a connection to the internet, the device uses a public iPerf3 server for automatic bandwidth detection, unless you specify a private iPerf3 server. If a device has a connection to a private circuit and no internet connection, you must specify a private iPerf3 server for automatic bandwidth detection.

We recommend that you specify a private iPerf3 server. If a private iPerf3 server is not specified, the device pings a system defined set of public iPerf3 servers and selects for the speed test the public server with the minimum hops value or, if all servers have the same minimum hops value, the server with the minimum latency value. If the speed test fails, the device selects another public server from the list. The device continues to select other public iPerf3 servers until the speed test is successful or until it has tried all servers. Therefore, a speed test on a public iPerf3 server can use a server that is far away, resulting in a larger latency than the minimum.

The set of system defined public iPerf3 servers includes the following:

- iperf.scottlinux.com
- iperf.he.net

- bouygues.iperf.fr
- ping.online.net
- iperf.biznetnetworks.com

The following settings on the Cisco vManage VPN Interface Ethernet template control bandwidth detection. These settings are supported for WAN interfaces in VPN0 only.

- **Auto Detect Bandwidth**—When enabled, the device detects the bandwidth.
- **Iperf Server**—To use a private iPerf3 server for automatic bandwidth detection, enter the IPv4 address of the private server. To use a public iPerf3 server for automatic bandwidth detection, leave this field blank.

  The private iPerf3 server should run on port 5201, which is the default iPerf3 port.

In addition, automatic bandwidth detection requires that the allow-service all command be configured for the tunnel interface. See "VPN, Interface, and Tunnel Configuration for WAN and LAN interfaces."

The device writes the results of a speed test to the auto_speedtest.json file in its bootflash directory. It also displays the results in the **Auto Upstream Bandwidth (bps)** and **Auto Downstream Bandwidth (Mbps)** areas on the **Monitor** > **Devices** > **Interface** page of Cisco vManage.

If a device does not receive a response from an iPerf3 server, an error is recorded in the auto_speedtest.json file and displays on the **Monitor** > **Devices** > **Interface** page of Cisco vManage.

Note In Cisco vManage Release 20.6.x and earlier releases, the speed test results are displayed on the **Monitor** > **Network** > **Interface** page.

CLI Equivalent

`auto-bandwidth-detect`

`iperf-server` *ipv4-address*

There also is a no auto-bandwidth-detect form of this command.

Example

```
Device# show sdwan running-config sdwan
sdwan
 interface GigabitEthernet0/0/0
  tunnel-interface
   encapsulation gre
   allow-service all
   no allow-service bgp
   allow-service dhcp
   allow-service dns
   allow-service icmp
   allow-service sshd
   allow-service netconf
   no allow-service ntp
   no allow-service ospf
   no allow-service stun
   allow-service https
   no allow-service snmp
   no allow-service bfd
  exit
  auto-bandwidth-detect
  iperf-server 192.0.2.255
 exit
 appqoe
  no tcpopt enable
  no dreopt enable
```

Configure Backup Server Settings

Table 29: Feature History

Feature Name	Release Information	Description
RMA Support for Cisco CSP Devices	Cisco SD-WAN Release 20.5.1 Cisco vManage Release 20.5.1	You can configure the **Backup** information to enter storage server settings and backup intervals.

Points to Consider

- If you don't use an NFS server, Cisco vManage can’t successfully create backup copies of a CSP device for future RMA requirements.
- The NFS server mount location and configurations are same for all the CSP devices in a cluster.
- Don't consider an existing device in a cluster as the replacement CSP device.

Note If a replacement CSP device isn’t available, wait until the device appears in Cisco vManage.

- Don't attach further service chains to a cluster after you identify that a CSP device in the cluster is faulty.
- The backup operation on a CSP device creates backup files containing NFVIS configuration and VMs (if VMs are provisioned on the CSP device). You can use the following information for reference.
    - An automated backup file is generated and is in the format:

      serial_number + "_" + time_stamp + ".bkup"

      For example,

      `WZP22180EW2_2020_06_24T18_07_00.bkup`
    - An internal state model is maintained that specifies the status of the overall backup operation and internal states of each backup component:
        - NFVIS: A configuration backup of the CSP device as an xml file, config.xml.
        - VM_Images: All VNF tar.gz packages in `data/intdatastore/uploads` which are listed individually.
        - VM_Images_Flavors: The VM images such as, img_flvr.img.bkup.

    - Individual tar backups of the VNFs: The files such as, vmbkp.

  - The backup.manifest file contains information of files in the backup package and their checksum for verification during restore operation.

To create backup copies of all CSP devices in a cluster, perform the following steps:

1. On the **Cluster Topology** window, click **Add** next to **Backup**.

   To edit backup server settings, on the **Cluster Topology** window, click **Edit** next to **Backup**

   In the **Backup** configuration window, enter information about the following fields:

   - Mount Name—Enter the name of the NFS mount after mounting an NFS location.
   - Storage Space—Enter the disk space in GB.
   - Server IP: Enter the IP address of the NFS server.
   - Server Path: Enter the folder path of the NFS server such as, `/data/colobackup`
   - Backup: Click **Backup** to enable it.
   - Time: Set a time for scheduling the backup operation.
   - Interval: Choose from the options to schedule a periodic backup process.
     - Daily: The first backup is created a day after the backup configuration is saved on the device, and everyday thereafter.
     - Weekly: The first backup is created seven days after the backup configuration is saved on the device, and every week thereafter.
     - Once: The backup copy is created on a chosen day and it's valid for the entire lifetime of a cluster. You can choose a future calendar date.

2. Click **Save**.

3. To view the status of the previous five backup operations, use the **show hostaction backup status** command. To know about the backup status configuration command, see Backup and Restore NFVIS and VM Configurations. To use this command:

   a. In Cisco vManage, click the **Tools** > **SSH Terminal** screen to start an SSH session with Cisco vManage.

   b. Choose the CSP device.

   c. Enter the username and password for the CSP device and click **Enter** to log in to the CSP device and run the **show hostaction backup status** command.

Restore CSP Device

You can perform the restore operation only by using the CLI on the CSP device that you're restoring.

1. Use the **mount nfs-mount storage** command to mount NFS:

   For more information, see Network File System Support.

Note To access the backup file, the configuration for mounting an NFS file system should match the faulty device. You can view this information from other healthy CSP devices as the NFS mount location and configurations are same for all the CSP devices. To view and capture the information, you can do one of the following:

- In the **Cluster Topology** window, click **Add** next to **Backup**.
- Use the **show running-config** command to view the active configuration that is running on a CSP device.

mount nfs-mount storage { *mount-name* | **server_ip** *server_ip* | **server_path** *server_path* | **storage_space_total_gb** *storage_space_total_gb* | **storage_type** *storage_type* }

For example, `mount nfs-mount storage nfsfs/ server_ip 172.19.199.199 server_path /data/colobackup/ storage_space_total_gb 100.0 storagetype nfs`

2. Restore the backup information on a replacement CSP device using the **hostaction restore** command:

   For example,

   ```
   hostaction restore except-connectivity file-path
   nfs:nfsfs/WZP22180EW2_2020_06_24T18_07_00.bkup
   ```

   Note Specify the except-connectivity parameter to retain the connectivity with the NFS server mounted in Step 2.

3. Use the **show hostaction backup status** command to view the status of the previous five backup images and their operational status.

   Also, you can view the backup images from the notifications available on the Cisco vManage **Monitor** > **Logs** > **Events** page.

   Note In Cisco vManage Release 20.6.x and earlier releases, you can view the backup images from the notifications available on the Cisco vManage **Monitor** > **Events** page.

4. Use the **show hostaction restore-status** command on the CSP device to view the status of the overall restore process and each component such as system, image and flavors, VM and so on.

5. To fix any failure after viewing the status, perform a factory default reset of the device.

   Note The factory default reset sets the device to default configuration. Therefore, before performing the restore operation from Steps 1-4 on the replacement device, verify that all the restore operation prerequisites are met.

To know more about how to configure the restore operation on CSP devices, see Backup and Restore NFVIS and VM Configurations.

Configure or Cancel vManage Server Maintenance Window

You can set or cancel the start and end times and the duration of the maintenance window for the vManage server.

1. From the Cisco vManage menu, choose **Administration** > **Settings**.
2. From **Maintenance Window**, click **Edit**.

   To cancel the maintenance window, click **Cancel**.
3. Click the **Start date and time** drop-down list, and select the date and time when the **Maintenance Window** will start.
4. Click the **End date and time** drop-down list, and select the date and time when the **Maintenance Window** will end.
5. Click **Save**. The start and end times and the duration of the maintenance window are displayed in the **Maintenance Window** bar.

Two days before the start of the window, the Cisco vManage Dashboard displays a maintenance window alert notification.

Configure a Cellular Gateway

Table 30: Feature History

Feature Name	Release Information	Feature Description
Cellular Gateway Configuration	Cisco vManage Release 20.4.1	You can configure a supported cellular gateway as an IP pass-through device from the Templates tab.

You can configure a supported cellular gateway as an IP pass-through device. By positioning the configured device in an area in your facility that has a strong LTE signal, the signal can be extended over an Ethernet connection to a routing infrastructure in a location with a weaker LTE signal.

To configure a cellular gateway in Cisco vManage:

1. Create a device template for the **Cisco Cellular Gateway CG418-E** device.

   See "Create a Device Template from Feature Templates" in *Systems and Interfaces Configuration Guide*.

   After you enter a description for the feature template:

   a. From the Cisco vManage menu, choose **Configuration** > **Templates**.

   b. Click **Device Templates**.

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

c. From the **Create Template** drop-down list choose **From Feature Template**.

d. From the **Device Model** drop-down list select the type of device for which you are creating the template.

e. Choose **Cellular Gateway** > **Cellular Gateway Platform** > **Create Template**. Then configure the Cellular Gateway Platform feature template as shown in the following table.

Table 31: Cellular Gateway Platform Template Parameters

Parameter Name	Description
Basic Configuration Tab	
Time Zone	Choose the time zone to use for the device. The device uses this time zone for clock synchronization when NTP is configured.
Management Interface	Enter the IPv4 address of the management interface for accessing the device.
Admin-Password	Enter the admin user password for logging in to the device by using an SSH client or a console port.
NTP-Servers	Configure one or more NTP servers to which the device synchronizes its clock.
Cellular Configuration Tab	
IP-Src-Violation	Choose **v4 only**, **v6 only**, or **v4 and v6** to enable the IP source violation feature for the corresponding IP address types. Choose **None** if you do not want to enable this feature.
Auto-SIM	Choose **On** to enable the auto-SIM feature. When this feature is enabled, the device automatically detects the service provider to which SIMs in the device belong and automatically loads the appropriate firmware for that provider.
Primary SIM Slot	Choose the slot that contains the primary SIM card for the device. If the device loses service to this slot, it fails over to the secondary slot.
Failover-Timer (minutes)	Enter the number of minutes that the device waits before trying to communicate with the primary SIM slot after the device detects loss of service to this slot.

Parameter Name	Description
Max-Retry	Enter the number of consecutive unsuccessful attempts by the device to communicate with the primary SIM before failing over to the secondary slot

f. Choose **Cellular Gateway** > **Cellular Gateway Profile** and choose **Create Template** from the Cellular Gateway Profile drop-down list. Then configure the Cellular Gateway Profile feature template as shown in the following table.

Table 32: Cellular Gateway Profile Template Parameters

Parameter Name	Description
Basic Configuration Tab	
SIM	Choose a SIM slot and configure the following options to create a profile for the SIM in that slot. This profile indicates to the service provider which of its cellular networks the SIM should attach to. • Profile ID: Enter a unique ID for the profile • Access Point Name: Enter the name of the access point for this profile • Packet Data Network Type: Choose the type of network for data services for this profile (**IPv4**, **IPv6**, or **IPv4v6**) • Authentication: Choose the authentication method that this profile uses for data, and enter the user name and password for this method in the Profile Username and Profile Password fields that display You can configure one profile for each SIM slot in the device.
Add Profile	Click to add an access point name (APN) profile that the cellular device uses to attach to a cellular network. You can add up to 16 profiles.
Profile ID	Enter a unique identifier for the profile. Valid values: Integers 1 through 16.
Access Point Name	Enter a name to identify the cellular access point.
Packet Data Network Type	Choose the packet data network (PDN) type of the cellular network (**IPv4**, **IPv6**, or **IPv46**).

Parameter Name	Description
Authentication	Choose the authentication method that is used to attach to the cellular access point (**none**, **pap**, **chap**, **pap_chap**).
Profile Username	If you choose an authentication method other than **none**, enter the user name to use for authentication when attaching to the cellular access point.
Password	If you choose an authentication method other than **none**, enter the password to use for authentication when attaching to the cellular access point.
Add	Click to add the profile your are configuring.
Advanced Configuration Tab	
Attach Profile	Choose the profile that the device uses to connect to the cellular network.
Cellular 1/1 Profile	Choose the profile that the device uses for data connectivity over the cellular network.

2. Attach the device template to the device.

   See "Attach and Detach a Device Template" in *Systems and Interfaces Configuration Guide*.

Configure Cellular Profile

Use the Cellular Profile feature template to configure the profiles used by cellular modems on devices.

To configure a cellular profile using Cisco vManage templates:

1. Create a Cellular Profile template to configure the profiles used by the cellular modem, as described in this section.
2. Create a VPN-Interface-Cellular feature template to configure cellular module parameters.
3. Create a VPN feature template to configure VPN parameters. .

Create a Cellular Profile Feature Template

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Under **Device Templates**, click **Create Template** and choose **From Feature Template**.

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

3. From the **Device Model** drop-down list, choose the device for which you are creating the template.

4. Click **Cellular**.
5. In the **Cellular** area, click **Cellular Profile**.
6. In the **Cellular Profile** field, choose **Create Template** from the drop-down list.

   The Cellular-Profile template form is displayed. The top of the form contains fields for naming the template, and the bottom contains fields for defining Cellular-Profile parameters.

Minimum Cellular Profile Configuration

The following table describes the parameters that are required to specify the cellular profile on the cellular modem of a device. Click **Save** after you enter the values for the template.

Parameter Name	Description
Template Name	Enter the template name. It can contain only alphanumeric characters.
Description (Template)	Enter a description for the template. It can contain only alphanumeric characters.
Interface name	Enter the name of the cellular interface, which must be cellular0.
Profile ID	Enter the identification number of the profile to be used on the device. You use this profile identification number when you configure for the cellular interface in the VPN-Interface-Cellular template. Range: 1 through 15.

CLI Equivalent

```
cellular cellular0
  profile number
```

Modify Cellular Profile Parameters

You can modify paramters of a profile if your service provider requires you to do so. For example, if you procure a data plan with static IP addresses, you might need to modify the APN field in the profile.

Parameter Name	Description
Access Point Name	Enter the name of the gateway between the service provider network and the public Internet. The name can contain up to 32 characters.
Authentication	Choose the authentication method used for the connection to the cellular network. It can be CHAP, None, PAP, or PAP/CHAP.
IP Address	Enter the static IP address assigned to the cellular interface. This field is used when the service provider requires that a static IP address be preconfigured before attaching to the network.

Parameter Name	Description
Profile Name	Enter a name to identify the cellular profile. The name can contain up to 14 characters.
Packet Data Network Type	Choose the packet data network (PDN) type of the cellular network. It can be IPv4, IPv6, or IPv46.
Profile Username	Enter the username to use when making cellular connections for web services. It can be 1 to 32 characters. It can contain any alphanumeric characters, including spaces.
Profile Password	Enter the user password to use when making cellular connections for web services. The password is case-sensitive and can be clear text, or an AES encrypted key.
Primary DNS Address	Enter the IP addresses of the primary DNS servers in the service provider network, in decimal four-part dotted notation.
Secondary DNS Address	Enter the IP addresses of the secondary DNS servers in the service provider network, in decimal four-part dotted notation.

Configure Certificate Revocation

Table 33: Feature History

Feature Name	Release Information	Feature Description
Certificate Revocation	Cisco SD-WAN Release 20.7.1 Cisco vManage Release 20.7.1	You can revoke enterprise certificates from devices based on a certificate revocation list that Cisco vManage obtains from a root certificate authority.

Before You Begin

Make a note of the URL of the root CA CRL.

Procedure

1. From the Cisco vManage menu, choose **Administration** > **Settings**.
2. In the **Administration Settings** window, click **Edit** next to **Certificate Revocation List**.

   The certificate revocation options appear.
3. Click **Enabled**.

4. In the **CRL Server URL** field, enter the URL of the CRL that you created on your secure server.
5. In the **Retrieval Interval** field, enter the interval, in hours, at which Cisco vManage retrieves the CRL from your secure server and revokes the certificates that the CRL designates.

   Enter a value from 1 to 24. The default retrieval interval is 1 hour.
6. Click **Save**.

   Cisco vManage immediately retrieves the CRL and revokes the certificates that the CRL designates. From then on, Cisco vManage retrieves the CRL according to the retrieval interval period that you specified.

Configure Certificate Settings

New controller devices in the overlay network—Cisco vManage instances, Cisco vBond Orchestrators, and Cisco vSmart Controllers—are authenticated using signed certificates. From Cisco vManage, you can automatically generate the certificate signing requests (CSRs), retrieve the generated certificates, and install them on all controller devices when they are added to the network.

Note All controller devices must have a certificate installed on them to be able to join the overlay network.

To automate the certificate generation and installation process, configure the name of your organization and certificate authorization settings before adding the controller devices to the network.

For more information on configuring certificate settings, see Certificates.

Configure Cisco SD-WAN Multi-Region Fabric

Table 34: Feature History

Feature Name	Release Information	Description
Multi-Region Fabric (also Hierarchical SD-WAN)	Cisco SD-WAN Release 20.7.1 Cisco vManage Release 20.7.1	You can use Cisco vManage to enable and configure Multi-Region Fabric, which provides the ability to divide the architecture of the Cisco SD-WAN overlay network into multiple regional networks that operate distinctly from one another.
Re-Origination Dampening	Cisco IOS XE Release 17.9.1a	In networks experiencing instability, TLOCs and bidirectional forwarding detection (BFD) tunnels may alternate repeatedly between being available and unavailable. This causes the overlay management protocol (OMP) to repeatedly withdraw and re-originate routes. This churn adversely affects Cisco vSmart controller performance. Adding a delay before re-originating routes that have gone down repeatedly prevents excessive churn, and prevents this type of network instability from diminishing Cisco vSmart controller performance.

Enable Multi-Region Fabric

1. From the Cisco vManage menu, choose **Administration** > **Settings**.
2. In the **Multi-Region Fabric** area, enable Multi-Region Fabric.

Note In Cisco vManage Releases 20.7.x and 20.8.x, this area was labeled **Hierarchical SDWAN**.

Assign a Role and Region to a Device Using Cisco vManage

Before You Begin

- Plan the Multi-Region Fabric architecture, and decide on the roles (edge router or border router) and regions for each device in the network.
- This procedure uses a feature template to assign a role. For full information about configuring devices using templates, see Configure Devices.
- For information about the number of interfaces that are supported for each device, see the scale limitations in Restrictions for Multi-Region Fabric.
- From Cisco vManage Release 20.9.1, use Network Hierarchy and Resource Management to create the region that you will use in the following procedure. Creating the region includes assigning a region ID to the region. For information about creating a region, see the Network Hierarchy and Resource Management chapter in the *Cisco SD-WAN Systems and Interfaces Configuration Guide, Cisco IOS XE Release 17.x*.

Assign a Role and Region to a Device

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Feature Templates**.

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

3. Click **Add Template**.
4. Select the device type to display the templates available for the device.
5. Click the **System** template.
6. In the **Template Name** field, enter a name for the template.
7. In the **Basic Configuration** section, configure the following fields:

Field	Description
Region ID	Choose a value between 1 and 63 for a region. **Note** From Cisco vManage Release 20.9.1, enter the number of the region that you created for the device using Network Hierarchy and Resource Management, as described in Before You Begin. **Note** By default, all interfaces on the device use the region configured here. For a border router, configure one or more TLOC interfaces to connect to the core region. Other TLOC interfaces on the border router use the region configured here. See Assign Border Router TLOCs to the Core Region Using Cisco vManage.
Role	Choose **Edge Router** or **Border Router**. **Note** Only Cisco IOS XE SD-WAN devices can have the **Border Router** role.

8. For a border router, enable the device to function in the core region.

   a. From the Cisco vManage menu, choose **Configuration** > **Templates**.

   b. Click **Feature Templates**.

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

   c. Click **Add Template**.

   d. Select the device type to display the templates available for the device.

   e. Click the **Cisco VPN Interface Ethernet** template.

   f. In the **Tunnel** section, in the **Tunnel Interface** field, click **On** to enable tunnels.

   g. In the **Enable Core Region** field, click **On** to enable connections to the core region.

Assign Border Router TLOCs to the Core Region Using Cisco vManage

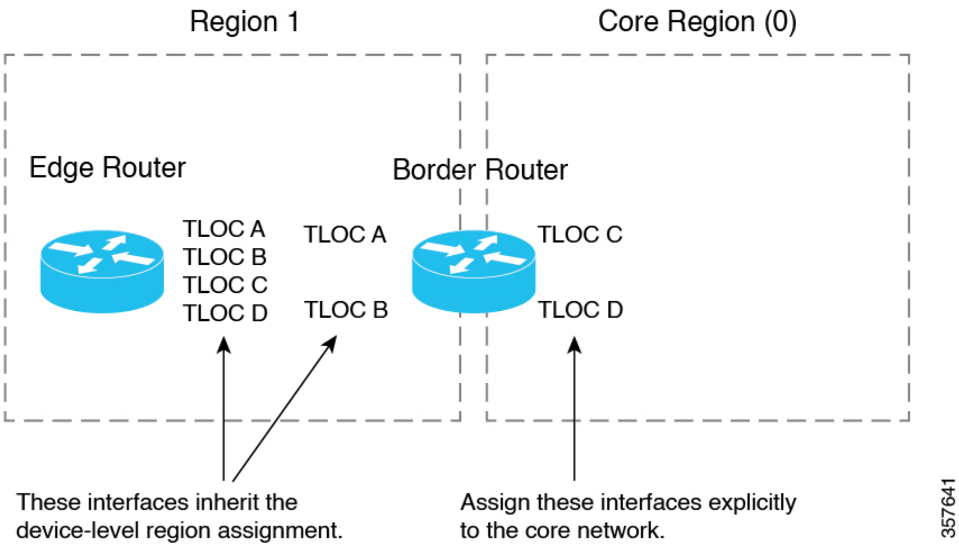
Before You Begin

- Assign the role of border router to the device and assign the device to a region. By default, all interfaces on a device use the region configured for the device. See Assign a Region and Role to a Device Using Cisco vManage.

  For a border router, configure one or more TLOC interfaces to connect to the core region. Other TLOC interfaces on the border router use the region configured for the device.

- This procedure creates a template that assigns interfaces of a specified color to the core region. Before creating the template, configure a color for the interfaces that you want to assign to the core region, or verify that they have a color configured already.

Figure 1: TLOC Interface Region Assignments


Region 1
Core Region (0)
Edge Router
Border Router
TLOC A
TLOC B
TLOC C
TLOC D
TLOC A
TLOC B
TLOC C
TLOC D
These interfaces inherit the device-level region assignment.
Assign these interfaces explicitly to the core network.
357641

Assign Border Router TLOCs to the Core Region

1. Create a Cisco VPN Interface Ethernet template for the TLOC interfaces that you want to connect to the core region.

   a. From the Cisco vManage menu, choose **Configuration** > **Templates**.

   b. Click **Feature Templates**.

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

   c. Click **Add Template**.

   d. In the **Template Name** field, provide a template name.

   e. In the **Tunnel** section, in the **Tunnel Interface** field, click **On**.

   f. In the **Color** field, specify a color that identifies the interfaces that you want to assign to the core region.

   g. Click **Advanced Options**.

   h. In the **Settings** section, in the **Enable Core Region** field, click **On**.

   i. In the **Basic Configuration** section, in the **Interface Name** field, enter an interface name.

   j. Click **Save**.

2. Add the Cisco VPN Interface Ethernet template that you created in the previous step to a device template.

a. From the Cisco vManage 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. Click **Create Template** and choose **From Feature Template**.

d. In the **Transport & Management VPN** section, locate the **Additional Cisco VPN 0 Templates** list and click **Cisco VPN Interface Ethernet**.

   This adds a new line to the **Transport & Management VPN** section, labelled **Cisco VPN Interface Ethernet**, with a menu for selecting an interface.

e. In the new **Cisco VPN Interface Ethernet** line, click the menu and select the Cisco VPN Interface Ethernet template that you created in an earlier step.

f. Click **Update**.

3. Apply the device template to the border router device.

Assign Regions to a Cisco vSmart Controller Using Cisco vManage

Before You Begin

- Plan the Multi-Region Fabric architecture, and decide on the roles (edge router or border router) and regions for each device in the network. Plan which Cisco vSmart controllers should serve each region.
- This procedure uses a feature template to assign a role. For full information about configuring devices using templates, see Configure Devices.
- For restrictions that apply to Cisco vSmart controllers, see Restrictions for Multi-Region Fabric.

Assign Regions to a Cisco vSmart Controller

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Feature Templates**.

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

3. Click **Add Template**.
4. For the device type, select **vSmart**.
5. Click the **System** template.
6. In the **Template Name** field, enter a name for the template.
7. In the **Basic Configuration** section, in the **Region ID List** field, enter a region or region list.

8. Apply the template to the Cisco vSmart controller.

View OMP Peers Using Cisco vManage

1. From the Cisco vManage menu, choose **Monitor** > **Devices**.
2. In the table of devices, click **…** at the right of the desired border router and choose **Real Time**.
3. In the left pane, click **Real Time**.
4. In the **Device Options** field, enter **OMP Peers**.

   A table shows peer information, similarly to the **show sdwan omp peers** CLI command. In the output, check the **REGION ID** column, which shows one of the following for each peer.

   - **None**: A Cisco vSmart controller that has not been configured to operate with Multi-Region Fabric. This includes the default region Cisco vSmart controllers configured before migration to Multi-Region Fabric.
   - **0**: Core region Cisco vSmart controllers.
   - *access-region-id*: Access region Cisco vSmart controllers.

Verify Connectivity Between Devices Using Cisco vManage

Use this procedure to trace the route between two devices, such as two edge devices in different regions to verify connectivity between the devices.

1. From the Cisco vManage menu, choose **Monitor** > **Devices**.
2. In the table of devices, click **…** adjacent to the desired border router and choose **Real Time**.
3. In the left pane, click **Troubleshooting**.
4. Click **Trace Route**.
5. In the **Destination IP** field, enter an IP address for the endpoint of the route tracing.
6. Click the **VPN** drop-down list and choose the VPN for the route tracing.

Verify That a Border Router is Re-Originating Routes Using Cisco vManage

1. From the Cisco vManage menu, choose **Monitor** > **Devices**.
2. In the table of devices, click **…** adjacent to the desired border router and choose **Real Time**.
3. In the left pane, click **Real Time**.
4. In the **Device Options** field, enter **OMP Received Routes**.

Locate the rows of the table that show 0.0.0.0 in the **Peer** column. These rows correspond to routes from the border router itself. If the border router is re-originating routes, then in those rows, the **Region Path** column shows two numbers for the route, including a 0 for the core region, and the **Status** column shows **BR-R** (border router re-originated).

Use Regions With a Centralized Policy

Create a Region List Using Cisco vManage

Region lists are useful when creating a region match condition for a centralized policy.

Create a Region List

1. In the Cisco vManage menu, choose **Configuration** > **Policies**.
2. Click **Centralized Policy**.
3. Click **Add Policy**.
4. In the list area, click **Region**.
5. Click **New Region List**.
6. Enter the following:
   - **Region List Name**: Name for the new list.
   - **Add Region**: One or more region numbers in the range of 1 to 63, using to the instructions in the field.
7. Click **Add**.

Add a Region Match Condition to a Centralized Policy

After you configure regions for Multi-Region Fabric, you can specify a region or region list as a match condition when configuring centralized route policy.

For complete information about working with centralized policy, see the Centralized Policy section of the Policies Configuration Guide for vEdge Routers.

Add a Region Match Condition to a Centralized Policy

1. From the Cisco vManage menu, choose **Configuration** > **Policies**.
2. Click **Custom Options** and in the **Centralized Policy** section, choose **Topology**.
3. Click **Add Topology** and choose **Custom Control**.
4. Click **Sequence Type** and choose **Route**.
5. Click **Sequence Rule**.
6. Click **Match**.
7. Click **Region**.
8. In the **Match Conditions** area, enter a region or region list.

   See Create a Region List Using Cisco vManage.

Attach a Centralized Policy to a Region

After you configure regions for Multi-Region Fabric, specify a region or region list when attaching a centralized policy.

For complete information about working with centralized policy, see the Centralized Policy section of the Policies Configuration Guide for vEdge Routers.

Attach a Centralized Policy to a Region

1. From the Cisco vManage menu, choose **Configuration** > **Policies**.
2. Click **Centralized Policy**.
3. In the table, locate the policy to attach. In the row of the policy, click **...** and choose **Edit**.

   For the **Topology**, **Application-Aware Routing**, and **Traffic Data** options, you can choose to add a new site or new region.
4. Click **New Site/Region List**.
5. Click **Region**.
6. Enter a region ID or region list.
7. Proceed with attaching the policy.

Secondary Regions

Table 35: Feature History

Feature Name	Release Information	Description
Multi-Region Fabric: Secondary Regions	Cisco IOS XE Release 17.8.1a Cisco SD-WAN Release 20.8.1 Cisco vManage Release 20.8.1	Secondary regions provide another facet to the Multi-Region Fabric architecture and enable direct tunnel connections between edge routers in different primary access regions. When you assign an edge router a secondary region, the router effectively operates in two regions simultaneously, and has different paths available through its primary and secondary regions.

Configure a Secondary Region ID for an Edge Router Using Cisco vManage

Minimum supported releases: Cisco IOS XE Release 17.8.1a, Cisco vManage Release 20.8.1

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Feature Templates**.
3. Do one of the following:
   - Create a system template for the device.
   - In the table, locate the existing system template for the device. In the row for the template, click **...** and choose **Edit**.

4. In the **Basic Configuration** section, in the **Secondary Region ID** field, enable Global mode and enter the number of the secondary region, in the range 1 to 63.
5. If you are editing an existing template, click **Update** and then **Configure Device** to push the update to the devices using the template.

Configure the Secondary Region Mode for a TLOC Using Cisco vManage

Minimum supported releases: Cisco IOS XE Release 17.8.1a, Cisco vManage Release 20.8.1

Before You Begin

This procedure describes how to configure the secondary region mode for a TLOC using a Cisco VPN Interface Ethernet template. For information about how to use the template in general, including how to specify the interface to which it is applied, see Configure VPN Ethernet Interface in the Cisco SD-WAN Systems and Interfaces Configuration Guide.

Configure the Secondary Region Mode for a TLOC

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Feature Templates**.
3. Do one of the following:
   - Create a Cisco VPN Interface Ethernet template for the device.
   - In the table, locate the existing Cisco VPN Interface Ethernet template for the device. In the row for the template, click **…** and choose **Edit**.
4. Navigate to the **Tunnel** section, and within that section the **Advanced Options** section.
5. In the **Enable Secondary Region** field, enable Global mode and choose one of the following options:

Option	Description
Only in Secondary Region	Configure the interface to handle only traffic in the secondary region.
Shared Between Primary and Secondary Regions	Configure the interface to handle traffic in the primary and secondary regions.

Note The interface inherits the secondary region assignment configured for the device at the system level.

6. If you are editing an existing template, click **Update** and then **Configure Device** to push the update to the devices using the template.

Configure a Device to Use Both the Primary-Region Path and Secondary-Region Path Using Cisco vManage

Minimum supported releases: Cisco IOS XE Release 17.8.1a, Cisco vManage Release 20.8.1

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

2. Click **Feature Templates**.
3. Do one of the following:
    - Create a Cisco OMP template for the device.
    - In the table, locate the existing OMP template for the device. In the row for the template, click **...** and choose **Edit**.
4. Navigate to the **Best Path** section, and in the **Ignore Region-Path Length During Best-Path Algorithm** field, choose **On**.

    When you select **On**, the template automatically selects **Direct-Tunnel Path** and **Hierarchical Path**.

    Note The default value is Off, and by default, OMP gives preference to a direct tunnel path over a hierarchical path because the direct path has fewer hops.

5. If you are editing an existing template, click **Update** and then **Configure Device** to push the update to the devices using the template.

Transport Gateways

Table 36: Feature History

Feature Name	Release Information	Description
Multi-Region Fabric: Transport Gateways	Cisco IOS XE Release 17.8.1a Cisco vManage Release 20.8.1	An edge router or border router that has connections to two networks that lack direct connectivity can function as a transport gateway. This is helpful for enabling connectivity between routers that are configured to be within the same access region, but which do not have direct connectivity.

Enable Transport Gateway Functionality on a Router Using Cisco vManage

Minimum supported releases: Cisco IOS XE Release 17.8.1a, Cisco vManage Release 20.8.1

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Feature Templates**.
3. Do one of the following:
    - Create a system template for the device.
    - In the table, locate the existing system template for the device. In the row for the template, click **...** and choose **Edit**.
4. In the **Basic Configuration** section, in the **Transport Gateway** field, choose **On**.
5. If you are editing an existing template, click **Update** and then **Configure Device** to push the update to the devices using the template.

Configure the Transport Gateway Path Preference Using Cisco vManage

Minimum supported releases: Cisco IOS XE Release 17.8.1a, Cisco vManage Release 20.8.1

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Feature Templates**.
3. Do one of the following:
    - Create an OMP template for the device.
    - In the table, locate the existing OMP template for the device. In the row for the template, click **…** and choose **Edit**.
4. In the **Best Path** section, in the **Transport Gateway Path Behavior** field, choose Global mode and choose one of the following options:

Option	Description
Do ECMP Between Direct and Transport Gateway Paths	For devices that can connect through a transport gateway and through direct paths, apply equal-cost multi-path (ECMP) to all available paths.
Prefer Transport Gateway Path	For devices that can connect through a transport gateway, use only the transport gateway paths, even if other paths are available.

5. If you are editing an existing template, click **Update** and then **Configure Device** to push the update to the devices using the template.

Router Affinity

Table 37: Feature History

Feature Name	Release Information	Description
Multi-Region Fabric: Router Affinity	Cisco IOS XE Release 17.8.1a Cisco SD-WAN Release 20.8.1 Cisco vManage Release 20.8.1	Often a router has multiple options to choose for the next hop when routing a flow to its destination. When multiple devices can serve as the next hop for a flow, you can specify the order of preference among the devices by configuring router affinity groups. The result is that a router attempts to use a route to the next-hop device of highest preference first, and if that device is not available, it attempts to use a route to the next-hop device of the next lower preference. Affinity groups enable this functionality without requiring complex control policies.

Feature Name	Release Information	Description
Improved Prioritization of Routes to Peer Devices in the Affinity Group Preference List	Cisco SD-WAN Controllers Release 20.9.x	This feature introduces a change to the order in which Cisco vSmart controllers advertise routes to devices. From this release, when Cisco vSmart controllers advertise routes to a device, they (a) give higher priority to routes to peer devices in the affinity group preference list, and (b) lower priority to routes that may have a higher best path score, but are not routes to a device associated with a preferred affinity group. The effect is to prioritize routes to peer devices in preferred affinity groups.

Configure Router Affinity Groups Using Cisco vManage

Configure an Affinity Group or Affinity Group Preference on a Device, Using Cisco vManage

Minimum supported releases: Cisco IOS XE Release 17.8.1a, Cisco SD-WAN Release 20.8.1, Cisco vManage Release 20.8.1

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

2. Click **Feature Templates**.

3. Do one of the following:

   - Create a system template for the device.
   - In the table, locate the existing system template for the device. In the row for the template, click **…** and choose **Edit**.

4. To assign an affinity group to a border router, in the **Advanced** section, in the **Affinity Group** field, change the mode to **Global** and enter an affinity group number, in the range 1 to 63.

   If an affinity group has been configured previously on the device, the new value replaces the previous.

5. To configure an affinity group preference order for a border router or an edge router, in the **Advanced** section, in the **Affinity Group Preference** field, change the mode to **Global** and enter a comma-separated list of affinity group numbers. This determines the order of preference for connecting to border routers. The affinity groups are in the range 1 to 63.

   Example: 10, 11, 1, 5

Note If you configure a Cisco vSmart controller to filter out routes that are not in the affinity group preference list, then the device can only connect to routers in the affinity group. See Configure a Cisco vSmart Controller to Provide Only Paths in the Affinity Preference List, Using Cisco vManage, on page 87.

6. If you are editing an existing template, click **Update** and then **Configure Device** to push the update to the devices using the template.

Configure a Cisco vSmart Controller to Provide Only Paths in the Affinity Preference List, Using Cisco vManage

Minimum supported releases: Cisco IOS XE Release 17.8.1a, Cisco SD-WAN Release 20.8.1, Cisco vManage Release 20.8.1

Before You Begin

The last step of this procedure requires logging in to the Cisco vSmart controllers that serve the regions where you are configuring this, to execute a command using the CLI.

Configure a Cisco vSmart Controller to Provide Only Paths in the Affinity Preference List

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Feature Templates**.
3. Do one of the following:
    - Create an OMP template for a Cisco vSmart controller.
    - In the table, locate the existing OMP template for the Cisco vSmart controller. In the row for the template, click **…** and choose **Edit**.
4. In the **Best Path** section, in the **Enable Filtering Route Updates Based on Affinity** field, choose **Global** mode and choose **On**.
5. If you are editing an existing template, click **Update** and then **Configure Device** to push the update to the Cisco vSmart controllers using the template.
6. Connect to each Cisco vSmart controller and clear OMP routes to ensure that only the paths in the affinity group preference list are used.

```
vSmart#config terminal
vSmart(config)#omp
vSmart(config-omp)#filter-route outbound affinity-group-preference
vSmart(config-filter-route)#exit
vSmart(config-omp)#exit
vSmart(config)#exit
vSmart#clear omp all
```

Multi-Region Fabric Policy

Table 38: Feature History

Feature Name	Release Information	Description
Match Traffic by Destination: Access Region, Core Region, or Service VPN	Cisco IOS XE Release 17.8.1a Cisco vManage Release 20.8.1	You can apply a policy to traffic whose destination is any one of the following—access region, core region, service VPN. Use this match condition for data policy or application route policy on a border router.

Feature Name	Release Information	Description
Match Routes According to Path Type	Cisco IOS XE Release 17.8.1a Cisco vManage Release 20.8.1	When configuring a control policy for a Multi-Region Fabric architecture, you can match routes according to whether the route uses a hierarchical path, a direct path, or a transport gateway path.
Match Routes by Region and Role in a Control Policy	Cisco IOS XE Release 17.8.1a Cisco SD-WAN Controllers Release 20.8.1	In a control policy, you can match routes according to the region of the device originating the route, or the role (edge router or border router) of the device originating the route.
Match Traffic by Destination Region	Cisco IOS XE Release 17.9.1a Cisco vManage Release 20.9.1	When creating an application route policy or data policy, you can match traffic according to its destination region. The destination may be a device in the same primary region, the same secondary region, or neither of these.
Specify Path Type Preference	Cisco IOS XE Release 17.9.1a Cisco SD-WAN Controllers Release 20.9.1	When configuring a centralized policy, you can create a preferred color group list, which specifies three levels of route preference, called primary, secondary and tertiary. The route preferences are based on TLOC color and, optionally, on the path type—direct tunnel, multi-hop path, or all paths. Path type is relevant to networks using Multi-Region Fabric.

Configure Multi-Region Fabric Policy Using Cisco vManage

Configure a Data Policy or Application Route Policy to Match Traffic-To Using Cisco vManage

Before You Begin

Configure a VPN list to use when applying the policy.

Configure a Data Policy or Application Route Policy to Match Traffic-To

1. From the Cisco vManage menu, choose **Configuration** > **Policies**.
2. Click **Centralized Policies**.
3. Do one of the following:
   - To create a new policy, click **Add Policy**.
   - To edit an existing policy, click **…** in the row of the policy and click **Edit Policy**.
4. Click **Next**.
5. Click **Next**.
6. Click one of the following to create a traffic policy:

- **Application Aware Routing**
- **Traffic Data**

7. Click **Add Policy** and choose **Create New**.

Note To reuse an existing policy, you can choose **Import Existing**.

8. Enter a name and description for the new policy.

9. Click **Sequence Type** and choose **Custom**.

10. Click **Sequence Rule**.

11. Click **Match** (selected by default) and click **Traffic To**.

12. In the **Match Conditions** area, in the **Traffic To** field, choose one of the following:

    - **Access**
    - **Core**
    - **Service**

13. Choose an action for the sequence and complete the configuration of the policy.

    For information about creating traffic policies in general, see Centralized Policy in the Cisco SD-WAN Policies Configuration Guide, Cisco IOS XE Release 17.x.

14. To save the policy, click **Save Application Aware Routing Policy** or **Save Data Policy**, depending on the type of policy that you are creating. A table shows the new policy.

15. Click **Next**.

16. At the **Apply Policies to Sites and VPNs** step, enter the name of the policy to apply.

17. Click one of the following, depending on the type of policy that you are creating and applying:

    - **Application-Aware Routing**
    - **Traffic Data**

18. Click **New Site/Region List and VPN List**.

19. If you are configuring a traffic data policy, choose one of the following options:

    - **From Service**
    - **From Tunnel**
    - **All**

20. Choose one of the following options to configure the sites or Multi-Region Fabric regions to which to apply the policy:

    - **Site List**: Enter a site list.

- **Region**: Enter a Multi-Region Fabric region ID or select a region list.

21. If you are configuring a data policy, do the following:

    a. In the **Select VPN List** field, choose a VPN list.

    b. Click **Add**.

22. Click **Role Mapping for Regions**.

23. For each region ID or region list, in the **Role** column, choose a role of **Edge** or **Border**. If you do not choose a role, Cisco vManage applies the policy to all routers in the region.

Note For policies that match by Traffic-To, choose **Border**. This match condition has no effect on edge routers.

24. Click **Save Policy**. A table shows the new policy. Optionally, to view the details of the policy, in the row of the policy, click **…** and choose **Preview**.

Configure a Control Policy to Match Region and Role Using Cisco vManage

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

2. Click **Centralized Policies**.

3. Do one of the following:

    - To create a new policy, click **Add Policy**.

    - To edit an existing policy, click **…** in the row of the policy and click **Edit Policy**.

4. Click **Next**.

5. In the **Configure Topology and VPN Membership** step, click **Add Topology** and choose **Custom Control (Route & TLOC)**.

6. Enter a name and description for the new policy.

7. Click **Sequence Rule**.

8. Click **Match** (selected by default) and click **Region**.

9. In the **Match Conditions** area, do one of the following:

    - In the **Region List** field, enter a preconfigured region list name.

    Note You can click the field and choose **New Region List** to define a list.

    - In the **Region ID** field, enter a single region ID.

10. (Optional) To specify a router type within the configured regions, click **Role** and choose **Border** or **Edge**.

11. Choose an action for the sequence and complete the configuration of the policy.

    For information about creating traffic policies in general, see Centralized Policy in the *Cisco SD-WAN Policies Configuration Guide, Cisco IOS XE Release 17.x*.

12. To save the policy, click **Save Control Policy**. A table shows the new policy.
13. Click **Next**.
14. At the **Apply Policies to Sites and VPNs** step, enter the name of the policy to apply
15. Click **Topology**.
16. Click **New Site/Region List**.
17. Choose one of the following options to configure the sites or Multi-Region Fabric regions to which to apply the policy:
    - **Site List**: Enter a site list.
    - **Region**: Enter a Multi-Region Fabric region ID or select a region list.
18. Click **Role Mapping for Regions**.
19. For each region ID or region list, in the **Role** column, choose a role of **Edge** or **Border**. If you do not choose a role, Cisco vManage applies the policy to all routers in the region.

Note For policies that match by Traffic-To, choose **Border**. This match condition has no effect on edge routers.

20. Click **Save Policy**. A table shows the new policy. Optionally, to view the details of the policy, in the row of the policy, click **…** and choose **Preview**.

Match Traffic According to the Destination Region Using Cisco vManage

Minimum releases: Cisco IOS XE Release 17.9.1a, Cisco vManage Release 20.9.1

For complete information about configuring an application-aware routing (AAR) policy or traffic data policy, see Configure Centralized Policies Using Cisco vManage in the *Cisco SD-WAN Policies Configuration Guide, Cisco IOS XE Release 17.x*. The information here only addresses how to use the **Destination Region** match condition.

Use the following procedure for an application-aware policy or a traffic data policy.

1. From the Cisco vManage menu, choose **Configuration** > **Policies**.
2. Choose **Centralized Policy**, which is selected by default.
3. Click **Add Policy**.
4. Optionally, you can click a list type and define a list.
5. Click **Next**.
6. Optionally, add a topology.
7. Click **Next**.

8. Do one of the following:
   - For an AAR policy, click **Application Aware Routing**, which is selected by default.
   - For a traffic data policy, click **Traffic Data**.
9. Click **Add Policy** and select **Create New**.
10. Do one of the following:
    - For an AAR policy, click **Sequence Type** to create a sequence that matches traffic by destination.
    - For a traffic data policy, click **Sequence Type** and choose **Custom** to create a sequence that matches traffic by destination.
11. Click **Sequence Rule** to create a new rule for the sequence.
12. With the **Match** option selected, click **Destination Region** to add this option to the match conditions area of the sequence rule.
13. In the **Match Conditions** area, click the **Destination Region** field and choose one of the following:
    - **Primary**: Match traffic if the destination device is in the same primary region (also called access region) as the source. This traffic reaches the destination using the access-region bidirectional forwarding detection (BFD).
    - **Secondary**: Match traffic if the destination device is not in the same primary region as the source but is within the same secondary region as the source. This traffic can reach the destination using a direct tunnel, as described for secondary regions.
    - **Other**: Match traffic if the destination device is not in the same primary region or secondary region as the source. This traffic requires a multi-hop path from the source to the destination.
14. Continue to configure the policy as described in Configure Centralized Policies Using Cisco vManage, cited earlier in this section.

Configure the Path Preference for a Preferred Color Group List Using Cisco vManage

Minimum releases: Cisco IOS XE Release 17.9.1a, Cisco vManage Release 20.9.1

For complete information about configuring an application-aware routing (AAR) policy, see Configure Centralized Policies Using Cisco vManage in the *Cisco SD-WAN Policies Configuration Guide, Cisco IOS XE Release 17.x*. The information here only addresses how to configure a path preference as part of a preferred color group.

1. From the Cisco vManage menu, choose **Configuration** > **Policies**, and choose **Centralized Policy**.
2. Click **Add Policy**.
3. Click **Application List**, which is selected by default.
4. Click **Preferred Color Group**.
5. Click **New Preferred Color Group**.
6. Configure the following fields:

Field	Description
Preferred Color Group Name	Enter a name for the color group.
Primary Colors: **Color Preference**	Click the field and select one or more colors for the primary preference.
Primary Colors: **Path Preference**	Click the drop-down list and choose one of the following for the primary preference: • **Direct Path**: Use only a direct path between the source and the destination devices. **Note** Do not use this option in a non-Multi-Region Fabric network. • **Multi Hop Path**: In a Multi-Region Fabric network, use a multi-hop path, which includes the core region, between the source and destination devices, even if a direct path is available. • **All Paths**: Use any path between the source and destination devices. **Note** This option is equivalent to not configuring path preference at all. If you are applying the policy to a non-Multi-Region Fabric network, use this option.
Secondary Colors: **Color Preference** **Path Preference**	Configure the secondary preference using the same method as for the **Primary Colors** options.
Tertiary Colors: **Color Preference** **Path Preference**	Configure the tertiary preference using the same method as for the **Primary Colors** options.

Use a Preferred Color Group in a Policy

Minimum releases: Cisco IOS XE Release 17.9.1a, Cisco vManage Release 20.9.1

For complete information about configuring policies, see Configure Centralized Policies Using Cisco vManage in the *Cisco SD-WAN Policies Configuration Guide, Cisco IOS XE Release 17.x*. The information here only addresses how to use the **Preferred Color Group** action, which incorporates path preference.

Use the following procedure for an application-aware policy or a traffic data policy.

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

2. Click **Add Policy**.
3. Choose **Centralized Policy**, which is selected by default.
4. Click **Add Policy**.
5. Optionally, you can click a list type and define a list.
6. Click **Next**.
7. Optionally, add a topology.
8. Click **Next**.
9. Do one of the following:
   - For an AAR policy, click **Application Aware Routing**, which is selected by default.
   - For a traffic data policy, click **Traffic Data**.
10. Click **Add Policy** and select **Create New**.
11. Do one of the following:
    - For an AAR policy, click **Sequence Type** to create a sequence that matches traffic by destination.
    - For a traffic data policy, click **Sequence Type** and choose **Custom** to create a sequence that matches traffic by destination.
12. Click **Sequence Rule** to create a new rule for the sequence.
13. Click **Actions**.
14. For an AAR policy, do the following:
    a. Click **SLA Class List**.
    b. Click the **Preferred Color Group** field and choose a preferred color group.
15. For an traffic control policy, do the following:
    a. Click **Accept**.
    b. Click **Preferred Color Group**.
    c. Click the **Preferred Color Group** field and choose a preferred color group.

Configure Cisco Umbrella Integration

Table 39: Feature History

Feature Name	Release Information	Description
Extended DNS (EDNS) and Local Domain Bypass Support with Cisco Umbrella Integration	Cisco SD-WAN Release 20.3.1 Cisco vManage Release 20.3.1	You can now configure Cisco Umbrella registration, define domain lists, and configure Umbrella DNS policy from the **Configuration** > **Security** screen in Cisco vManage.

Configure Cisco Umbrella Registration

Use this procedure to configure Cisco Umbrella registration globally for all devices. The procedure retrieves the Umbrella registration parameters automatically.

When configuring individual policies, it is also possible to configure Umbrella registration, but it can be managed more flexibly using the following procedure:

1. From the Cisco vManage menu, choose **Configuration** > **Security**.
2. Click **Custom Options** and choose **Umbrella Registration**.
3. In the **Manage Umbrella Registration** dialog box, use one of the following methods to register devices to Umbrella. The registration details are used globally.
   - Cisco Umbrella Registration Key and Secret
     a. Click the **Get Keys** to retrieve Umbrella registration parameters automatically: Organization ID, Registration Key, and Secret.

Note To automatically retrieve registration parameters, Cisco vManage uses the Smart Account credentials to connect to the Umbrella portal. The Smart Account credentials are configured in Cisco vManage under **Administration** > **Settings** > **Smart Account Credentials**.

     b. (Optional) If the Umbrella keys have been rotated and the details that are automatically retrieved are incorrect, enter the details manually.

     c. Click **Save Changes**.

Define Domain Lists

1. From the Cisco vManage menu, choose **Configuration** > **Security**.
2. Click **Custom Options**, and choose **Lists** from the drop-down menu.

3. Choose **Domain** in the left pane.
4. Click **New Domain List** to create a new domain list or click the domain name, and click the pencil icon on the right side for an existing list.
5. Enter the **Domain List Name**, **Add Domain**, and click **Add** to create the list.

Configure Umbrella DNS Policy Using Cisco vManage

1. From the Cisco vManage menu, choose **Configuration** > **Security**.
2. Click **Add Security Policy**.
3. In the **Add Security Policy** wizard, click **Direct Internet Access**.
4. Click **Proceed**.
5. Click **Next** until you reach the **DNS Security** page.
6. From the **Add DNS Security Policy** drop-down list, choose one of the following:
   - **Create New**: A **DNS Security - Policy Rule Configuration** wizard is displated. Continue to Step 7.
   - **Copy from Existing**: Choose a policy from the **Policy** field, enter a policy name, and click **Copy**.
7. If you are creating a new policy using the **Create New** option, the **DNS Security - Policy Rule Configuration** wizard is displayed.
8. Enter a policy name in the **Policy Name** field.
9. The **Umbrella Registration Status** displays the status of the API Token configuration.
10. Click **Manage Umbrella Registration** to add a token, if you have not added one already.
11. Click **Match All VPN** to keep the same configuration for all the available VPNs and continue with Step 13.

    Or click **Custom VPN Configuration** if you need to add target service VPNs to your policy. A Target VPNs window appears, and continue with Step 12.
12. To add target service VPNs, click **Target VPNs** at the top of the window.
13. Click **Save Changes** to add the VPN.
14. From the **Local Domain Bypass List** drop-down list, choose the domain bypass.
15. Click **Advanced** to enable or disable the DNSCrypt. By default, the DNSCrypt is enabled.
16. Click **Save DNS Security Policy**.

    The **Configuration > Security** window is displayed, and the DNS policy list table includes the newly created DNS Security Policy.

Configure Umbrella DNS Policy Using Cisco vManage

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

2. Click **Add Security Policy**.
3. In the **Add Security Policy** wizard, click **Direct Internet Access**.
4. Click **Proceed**.
5. Click **Next** until you reach the **DNS Security** page.
6. From the **Add DNS Security Policy** drop-down list, choose one of the following:
   - **Create New**: A **DNS Security - Policy Rule Configuration** wizard is displated. Continue to Step 7.
   - **Copy from Existing**: Choose a policy from the **Policy** field, enter a policy name, and click **Copy**.
7. If you are creating a new policy using the **Create New** option, the **DNS Security - Policy Rule Configuration** wizard is displayed.
8. Enter a policy name in the **Policy Name** field.
9. The **Umbrella Registration Status** displays the status of the API Token configuration.
10. Click **Manage Umbrella Registration** to add a token, if you have not added one already.
11. Click **Match All VPN** to keep the same configuration for all the available VPNs and continue with Step 13.

    Or click **Custom VPN Configuration** if you need to add target service VPNs to your policy. A Target VPNs window appears, and continue with Step 12.
12. To add target service VPNs, click **Target VPNs** at the top of the window.
13. Click **Save Changes** to add the VPN.
14. From the **Local Domain Bypass List** drop-down list, choose the domain bypass.
15. Click **Advanced** to enable or disable the DNSCrypt. By default, the DNSCrypt is enabled.
16. Click **Save DNS Security Policy**.

    The **Configuration > Security** window is displayed, and the DNS policy list table includes the newly created DNS Security Policy.

Attach DNS Umbrella Policy to Device Template

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Device Templates**, and choose **From Feature Template** from the Create Template drop-down menu.

Note In Cisco vManage Release 20.7.1 and earlier releases, **Device Templates** is called **Device**.

3. From the Device Model drop-down menu, choose a device.
4. Click **Additional Templates**. The screen scrolls to the **Additional Templates** section.

5. From the Security Policy drop-down menu, choose the name of the Umbrella DNS Security Policy you configured in the above procedure.

6. Click **Create** to apply the Umbrella policy to a device template.

Configure Default AAR and QoS Policies Using Cisco vManage

Table 40: Feature History

Feature Name	Release Information	Description
Configure Default AAR and QoS Policies	Cisco SD-WAN Release 20.7.1 Cisco vManage Release 20.7.1	You can configure Default AAR and QoS policies.

Follow these steps to configure default AAR, data, and QoS policies using Cisco vManage:

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

2. Click **Add Default AAR & QoS**.

   The **Process Overview** page is displayed.

3. Click **Next**.

   The **Recommended Settings based on your selection** page is displayed.

4. Based on the requirements of your network, move the applications between the **Business Relevant**, **Default**, and **Business Irrelevant** groups.

   Note When customizing the categorization of applications as Business-relevant, Business-irrelevant, or Default, you can only move individual applications from one category to another. You cannot move an entire group from one category to another.

5. Click **Next**.

   On the **Path Preferences (optional)** page, choose the **Preferred** and **Preferred Backup** transports for each traffic class.

6. Click **Next**.

   The **App Route Policy Service Level Agreement (SLA) Class** page is displayed.

   This page shows the default settings for **Loss**, **Latency**, and **Jitter** values for each traffic class. If necessary, customize **Loss**, **Latency**, and **Jitter** values for each traffic class.

7. Click **Next**.

   The **Enterprise to Service Provider Class Mapping** page is displayed.

   a. Select a service provider class option, based on how you want to customize bandwidth for different queues. For further detials on QoS queues, refer to the section **Mapping of Application Lists to Queues**

b. If necessary, customize the bandwidth percentage values for each queues.

8. Click **Next**.

   The **Define prefixes for the default policies and applications lists** page is displayed.

   For each policy, enter a prefix name and description.

9. Click **Next**.

   The **Summary** page is displayed. On this page, you can view the details for each configuration.

   You can click **Edit** to edit the options that appeared earlier in the workflow. Clicking edit returns you to the relevant page.

10. Click **Configure**.

    Cisco vManage creates the AAR, data, and QoS policies and indicates when the process is complete.

    The following table describes the workflow steps or actions and their respective effects:

    Table 41: Workflow Steps and Effects

Workflow Step	Affects the Following
Recommended Settings based on your selection	AAR and data policies
Path Preferences (optional)	AAR policies
App Route Policy Service Level Agreement (SLA) Class: • Loss • Latency • Jitter	AAR policies
Enterprise to Service Provider Class Mapping	Data and QoS policies
Define prefixes for the default policies and applications	AAR, data, QoS policies, forwarding classes, application lists, SLA class lists

11. To view the policy, click **View Your Created Policy**.

Note To apply the default AAR and QoS policies to the devices in the network, create a centralized policy that attaches the AAR and data policies to the required site lists. To apply the QoS policy to the Cisco SD-WAN devices, attach it to a localized policy through device templates.

Mapping of Application Lists to Queues

The following lists show each service provider class option, the queues in each option, and the application lists included in each queue. The application lists are named here as they appear on the Path Preferences page in this workflow.

4 QoS class

- Voice
    - Internetwork control
    - VoIP telephony
- Mission critical
    - Broadcast video
    - Multimedia conferencing
    - Real-Time interactive
    - Multimedia streaming
- Business data
    - Signaling
    - Transactional data
    - Network management
    - Bulk data
- Default
    - Best effort
    - Scavenger

5 QoS class

- Voice
    - Internetwork control
    - VoIP telephony
- Mission critical
    - Broadcast video
    - Multimedia conferencing
    - Real-Time interactive
    - Multimedia streaming
- Business data
    - Signaling
    - Transactional data
    - Network management
    - Bulk data

- General data
    - Scavenger
- Default
    - Best effort

6 QoS class

- Voice
    - Internetwork control
    - VoIP telephony
- Video
    - Broadcast video
    - Multimedia conferencing
    - Real-Time interactive
- Mission Critical
    - Multimedia streaming
- Business data
    - Signaling
    - Transactional data
    - Network management
    - Bulk data
- General data
    - Scavenger
- Default
    - Best effort

8 QoS class

- Voice
    - VoIP telephony
- Net-ctrl-mgmt
    - Internetwork control
- Interactive video

  - Multimedia conferencing
  - Real-Time interactive

- Streaming video
  - Broadcast video
  - Multimedia streaming

- Call signaling
  - Signaling

- Critical data
  - Transactional data
  - Network management
  - Bulk data

- Scavengers
  - Scavenger

- Default
  - Best effort

Configure Cisco SD-WAN Cloud OnRamp for IaaS on AWS

Points to Consider

- Transit VPCs provide the connection between the Cisco overlay network and the cloud-based applications running on host VPCs. You can provision up to four pairs of redundant Cisco SD-WAN cloud devices within each VPC dedicated to function as a transit point for traffic from the branch to host VPCs. The individual Cisco SD-WAN devices of each redundant pair are deployed within a different availability zone in the AWS region of the transit VPC. Multiple Cisco SD-WAN devices provide redundancy for the connection between the overlay network and cloud-based applications. On each of these two Cisco SD-WAN cloud devices, the transport VPN (VPN 0) connects to a branch router, and the service-side VPNs (any VPN except for VPN 0 and VPN 512) connect to applications and application providers in the public cloud.

- The Cisco SD-WAN Cloud OnRamp for IaaS workflow uses a public IP address of the second WAN interface to set up the Customer Gateway for mapping (ipsec tunnels) the host VPCs to a transit VPC. To add the public IP address of the WAN interface, configure the VPN interface ethernet template with ge0/0 interface for the devices used in Cisco SD-WAN Cloud OnRamp for IaaS. In vEdge Cloud routers, the tunnel interface is on the ge0/0 interface. .

- Cisco SD-WAN Cloud OnRamp for IaaS supports autoscale for AWS. To use the AWS autoscale feature, ensure that you associate one to four pairs of Cisco SD-WAN cloud devices with a transit VPC.

- Host VPCs are virtual private clouds in which your cloud-based applications reside. When a transit VPC connects to an application or application provider, it's simply connecting to a host VPC.
- All host VPCs can belong to the same AWS account, or each host VPC can belong to a different account. You can map a host that belongs to one AWS account to a transit VPC that belongs to a different account. You configure cloud instances or cloud accounts by using the Cloud OnRamp configuration wizard.

Step 1 From the Cisco vManage menu, choose **Configuration** > **Cloud onRamp for IaaS**.

If you're configuring Cisco SD-WAN Cloud OnRamp for IaaS the first time, no cloud instances appear in the screen. A cloud instance corresponds to an AWS account with one or more transit VPCs created within an AWS region.

Step 2 Click **Add New Cloud Instance**.

Step 3 Click the **Amazon Web Services (AWS)** radio button.

Step 4 In the next pop-up window, perform the following:

a) To log in to the cloud server, click **IAM Role** or **Key**. We recommend that you use IAM Role.

b) If you click **IAM Role**, then create an IAM role with Cisco vManage provided **External ID**. Note the displayed external Id from the window and provide the **Role ARN** value that is available when creating an IAM role.

Starting from Cisco SD-WAN Release 20.4.1, to create an IAM role, you must enter the Cisco vManage provided External Id into a policy by using the AWS Management Console. Do the following:

1. Attach an IAM Role to an existing Cisco vManage EC2 instance.

   a. See the Creating an IAM role (console) topic of AWS documentation to create a policy. In the AWS **Create policy** wizard, click **JSON** and enter the following JSON policy document.

```
{

"Version": "2012-10-17",

  "Statement": [{

    "Sid": "VisualEditor0",

"Effect": "Allow",

    "Action": "sts:AssumeRole",

"Resource": "*"

    }
]

}
```

   b. See the Easily Replace or Attach an IAM Role to an Existing EC2 Instance by Using the EC2 Console blog of AWS Security Blog for information about creating an IAM role and attaching it to the Cisco vManage EC2 instance based on the policy created in Step 1.

   Note On the **Attach permissions policy** window, choose the AWS-managed policy that you created in Step 1.

2. Create an IAM role on an AWS account that you want to use for Cisco SD-WAN Cloud OnRamp for IaaS.

a. See the Creating an IAM role (console) topic of AWS Documentation and create an IAM role by checking **Require external ID** and pasting the external Id that you noted in Step 4(b).

b. See the Modifying a role trust policy (console) topic of AWS Documentation to change who can assume a role.

   In the **IAM Roles** window, scroll down and click the role you created in the previous step.

   In the **Summary** window, note the **Role ARN**.

   Note You can enter this role ARN value when you choose the IAM role in Step 4(b).

c. After modifying the trust relationship, click **JSON** and enter the following JSON document. Save the changes.

   Note The account Id in the following JSON document is the Cisco vManage EC2 instance.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "AWS": "arn:aws:iam::[Account ID from Part 1]:root"
      },
      "Action": "sts:AssumeRole",
      "Condition": {
        "StringEquals": {
          "sts:ExternalId": "[vManage provided External ID]"
       }
      }
    }
  ]
}
```

c) If you click the **Key** radio button:

1. In the **API Key** field, enter your Amazon API key.
2. In the **Secret Key** field, enter the password associated with the API key.
3. From the **Environment** drop-down list, choose **commercial** or **govcloud**.

   By default, commercial environment is selected. You can choose the geographical regions based on the environment specifications.

   Note AWS Government Cloud isn't supported for vEdge Cloud routers. Therefore, ensure that you don't choose **govcloud**.

Step 5 Click **Login** to log in to the cloud server.

The cloud instance configuration wizard appears. This wizard consists of three screens that you use to select a region, add a transit VPC, discover host VPCs, and map host VPCs to transit the VPC. A graphic on each wizard screen illustrates the steps in the cloud instance configuration process. The steps that aren't yet completed are shown in light gray. The current step is highlighted within a blue box. Completed steps are indicated with a green checkmark and are shown in light orange.

Step 6 Select a region:

From the **Choose Region** drop-down list, choose a region where you want to create the transit VPC.

Step 7 Add a transit VPC:

a) In the **Transit VPC Name** field, enter the transit VPC name.

The name can contain 128 alphanumeric characters, hyphens (–), and underscores (_). It can't contain spaces or any other characters.

b) Under **Device Information**, enter information about the transit VPC:

1. In the **WAN Edge Version** drop-down list, choose the software version of the Cisco SD-WAN cloud device to run on the transit VPC.

2. In the **Size of Transit WAN Edge** drop-down list, choose an option to determine the memory and CPUs you can use for each of the Cisco SD-WAN cloud devices that run on the transit VPC. See the Supported Instance Types topic of Cisco Cloud vEdge Routers in the *Cisco SD-WAN Getting Started Guide*.

   Note We recommend that you choose the following size:

   For Cisco Cloud vEdge Routers, choose c4 instance type with four vCPUs, such as c4.xlarge (4 vCPU).

3. In the **Max. Host VPCs per Device Pair** field, select the maximum number of host VPCs that can be mapped to each device pair for the transit VPC. Valid values are 1–32.

4. To set up the transit VPC devices for Direct Internet Access (DIA), click one of the following:

   - **Disabled**: No Internet access.
   - **Enabled via Transport**: Configure or enable NAT for the WAN interface on a device.
   - **Enabled via Umbrella SIG**: Configure Cisco Umbrella to enable secure DIA on a device.

5. In the **Device Pair 1#** field, choose the serial numbers of each device in the pair. To remove a device serial number, click **X** that appears in the field.

   The serial numbers of the devices that appear are associated with a configuration template and supports the Cisco SD-WAN WAN edge version that you selected in Step 1.

6. To add more device pairs, click ⊕.

   To remove a device pair, click ⊖.

   A transit VPC can be associated with one to four device pairs. To enable the autoscale feature on AWS, associate at least two device pairs with the transit VPC.

7. Click **Advanced**, if you wish to enter more specific configuration options:

   a. In the **Transit VPC CIDR** field, enter a custom CIDR that has a network mask in the range of 16–25. If you choose to leave this field empty, the Transit VPC is created with a default CIDR of 10.0.0.0/16. There must be sufficient address space to create six subnets within the CIDR block.

   b. (Optional) In the **SSH PEM Key** drop-down list, choose a PEM key pair to log into an instance. The key pairs are region-specific. See the AWS Documentation for instructions about creating key pairs.

8. To complete the transit VPC configuration, click **Save and Finish**, or optionally to continue with the wizard, click **Proceed to Discovery and Mapping**.

With this cloud instance, a single transit VPC with two Cisco SD-WAN cloud devices has been created. You can configure multiple transit VPCs within a single cloud instance (AWS account within a region). When multiple transit VPCs exist within a cloud instance, you can map host VPCs to any one of the transit VPCs.

9. Discover host VPCs:

  a. In the **Select an account to discover** field, choose the AWS account from which you wish to discover host VPCs.

  Alternatively, to add a new AWS account from which you wish to discover host VPCs, click **New Account**.

  b. Click **Discover Host VPCs**.

  A table appears that display the VPCs, which are available to be mapped to a transit VPC. Only the host VPCs in the selected AWS account and within the same AWS region as the transit VPC appears.

  c. In the table that appears, check one or more hosts to map to the transit VPC.

  To filter the search results, use the Filter option in the search bar and display only host VPCs that match specific search criteria.

  Click the **Refresh** icon to update the table with current information.

  Click the **Show Table Columns** icon to specify which columns to be displayed in the table.

10. Map the host VPCs to a transit VPC:

  a. In the table with all host VPCs, choose the desired host VPCs.

  b. Click **Map VPCs**. The Map Host VPCs pop-up opens.

  c. In the **Transit VPC** drop-down list, choose the transit VPC to map to the host VPCs.

  d. In the **VPN** drop-down list, choose a service VPN in the overlay network in which to place the mapping.

  e. Enable the **Route Propagation** option if Cisco vManage automatically propagates route to the host VPC routes table.

  By default, **Route Propagation** is disabled.

  f. Click **Map VPCs**.

After a few minutes, the **Task View** screen appears, confirming that the host VPC has been mapped to the transit VPC.

Note When configuring the VPN feature template for VPN 0 for the two Cisco SD-WAN cloud devices that form the transit VPC, ensure that the color you assign to the tunnel interface is a public color, and not a private color. The following are the public colors:

- **3g**
- **biz-internet**
- **blue**
- **bronze**
- **custom1**
- **custom2**
- **custom3**
- **default**
- **gold**
- **green**
- **lte**
- **metro-ethernet**
- **mpls**
- **public-internet**
- **red**
- **silver**

Configure Cisco SD-WAN Cloud OnRamp for IaaS on Microsoft Azure

In the configuration process, map one or more host VNets to a single transit VNet. When mapping, you're configuring the cloud-based applications that branch users can access.

The mapping process establishes IPsec and BGP connections between the transit VNet and each host VNet. The IPsec tunnel that connects the transit and host VNet runs IKE to provide security for the connection. For Azure, the IPsec tunnel uses IKE version 2. The BGP connection that is established over the secure IPsec tunnel allows the transit and host VNet to exchange routes. The BGP connections or the BGP routes are then re-distributed into OMP within the Cisco SD-WAN cloud devices, which then advertises the OMP routes to the vSmart controllers in the domain. The transit VNet can then direct traffic from the branch to the proper host VNet and to the proper cloud-based application.

During the mapping process, the IPsec tunnels and BGP peering sessions are configured and established automatically. After establishing the mappings, you can view the IPsec and BGP configurations in the VPN Interface IPsec and BGP feature configuration templates, and modify them as necessary.

Points to Consider:

To configure Cisco SD-WAN Cloud OnRamp for IaaS on Azure, create Azure transit VNets, each of which consist of a pair of routers. Then, map the host VNets to transit VNets that exist in the Azure cloud. All VNets reside in the same resource group.

- Transit VNets provide the connection between the overlay network and the cloud-based applications running on the host VNet. Each transit VNet consists of two cloud devices that reside in their own VNet. Two cloud devices provide redundancy for the connection between the overlay network and cloud-based applications. On each of these two cloud devices, the transport VPN (VPN 0) connects to the simulated branch device, and the service-side VPNs (any VPN except for VPN 0 and VPN 512) connect to applications and application providers in the public cloud.
- The Cisco SD-WAN Cloud OnRamp for IaaS workflow uses a public IP address of the second WAN interface to set up the Customer Gateway for mapping (ipsec tunnels) the host VNets to a transit VNet. To add the public IP address of the WAN interface, configure the VPN Interface Ethernet template with ge0/0 interface for the devices used in Cisco SD-WAN Cloud OnRamp for IaaS. In vEdge Cloud routers, the tunnel interface is on the ge0/0 interface.
- Host VNets are virtual private clouds in which your cloud-based applications reside. When a transit VNet connects to an application or application provider, it's simply connecting to a host VNet.

Step 1 From the Cisco vManage menu, choose **Configuration** > **Cloud onRamp for IaaS**.

Step 2 Click **Add New Cloud Instance**

Step 3 Click the **Microsoft Azure** radio button.

Step 4 In the next pop-up screen, perform the following:

a) In the **Subscription ID** field, enter the ID of the Microsoft Azure subscription you want to use as part of the Cisco SD-WAN Cloud OnRamp for IaaS workflow.

b) In the **Client ID** field, enter the ID of an existing application or create a new application. To create an application, go to your **Azure Active Directory** > **App Registrations** > **New registration**. See Microsoft Azure documentation for more information on creating an application.

c) In the **Tenant ID** field, enter the ID of your account. To find the tenant ID, go to your Microsoft Azure Active Directory and click **Properties**.

d) In the **Secret Key** key field, enter the password associated with the client ID.

e) In the **Environment** field, choose **commercial** or **GovCloud**.

By default, commercial environment is selected. You can choose the geographical locations based on the environment specifications.

Note Azure Government Cloud isn’t supported for vEdge Cloud routers. Therefore, ensure that you don’t choose the **govcloud** option.

f) Click **Login**.

The cloud instance configuration wizard opens.

The wizard consists of three screens that you use to select a location, add a transit VNet, discover host VNets, and map host VNets to the transit VNet. A graphic on the right side of each wizard screen illustrates the steps in the cloud instance configuration process. The steps not yet completed are shown in light gray. The current step is highlighted within a blue box. All completed steps are indicated with a green checkmark and are shown in light orange.

Step 5 From the **Choose Location** drop-down list, choose a location where you want to create the transit VNet.

The locations available are based on the commercial cloud or GovCloud selection.

Step 6 Add a transit VNet:

a) In the **Transit VNet Name** field, type a name for the transit VNet.

The name can contain 32 alphanumeric characters, hyphens (–), and underscore (_). It can't contain spaces or any other characters.

b) Under **Device Information**, enter information about the transit VNet:

1. In the **WAN Edge Version** drop-down list, choose the software version to run on the transit VNet. The drop-down list includes the published versions of the device software in the Microsoft Azure marketplace.
2. In the **Size of Transit WAN Edge** drop-down list, choose an option to determine the memory and CPUs you can use for each of the Cisco SD-WAN cloud devices that run on the transit VNet. See Supported Instance Types for Cisco Cloud vEdge Routers in the *Cisco SD-WAN Getting Started Guide*.

   Note We recommend that you choose the following size:

3. To set up the transit VNet devices for Direct Internet Access (DIA), click one of the following:
   - **Disabled**: No Internet access.
   - **Enabled via Transport**: Configure or enable NAT for the WAN interface on a device.
   - **Enabled via Umbrella SIG**: Configure Cisco Umbrella to enable secure DIA on a device.
4. In the **Device 1** drop-down list, choose the serial number of the first device.
5. In the **Device 2** drop-down list, choose the serial number of the second device in the device pair.
6. Click **Advanced** if you wish to enter more specific configuration options.
7. In the **Transit VNet CIDR** field, enter a custom CIDR that has a network mask in the range of 16–25. If you leave this field empty, the Transit VNet is created with a default CIDR of 10.0.0.0/16.

c) To complete the transit VNet configuration. click **Save and Finish**, or optionally to continue with the wizard, click **Proceed to Discovery and Mapping**.

Step 7 Map host VNets to transit VNets:

a) In the **Select an account to discover** drop-down list, choose your Azure subscription ID.

Alternatively, to add a new Azure account from which you wish to discover host VNets, click **New Account**.

b) Click **Discover Host VNets**.

c) In the **Select a VNet** drop-down list, choose a desired host VNet.

d) Click **Next**.

e) From the table of host VNets, choose a desired host VNet.

f) Click **Map VNets**. The Map Host VNets pop-up appears.

g) In the **Transit VNet** drop-down list, choose the transit VNet to map to the host VNets.

h) In the **VPN** drop-down list, choose a VPN in the overlay network in which to place the mapping.

i) In the IPSec Tunnel CIDR section, to configure IPSec tunnels to reach the Azure virtual network transit, enter two pairs of interface IP addresses and a pair of loopback IP addresses for each of the Cisco Cloud vEdge Routers. Ensure that the IP addresses are network addresses in the /30 subnet, unique across the overlay network, and they aren't part of the host VNet CIDR. If they are part of the host VNet CIDR, Microsoft Azure returns an error when attempting to create VPN connections to the transit VNet.

Note The IP addresses aren't part of the host VNet and Transit VPC CIDR.

Microsoft Azure supports single Virtual Private Gateway (VGW) configuration over IPSec tunnels with redundancy provided over a single tunnel. Therefore, Cisco SD-WAN Cloud OnRamp for IaaS supports two VGWs for redundancy. During a planned maintenance or an unplanned event of a VGW, the IPSec tunnel from the VGW to the cloud devices get disconnected. This loss of connectivity causes the cloud devices lose BGP peering with Cisco vManage over IPSec tunnel. To enable BGP peering with the cloud routers rather than the IP address of the IPSec tunnel, provide the loopback addresses for each cloud device.

Note The loopback option for BGP peering supports single and multiple Virtual Gateways, or Customer Gateway configuration or both on Azure cloud. The loopback option applies only to the new host VNets mapped to transit VNets and not on the existing VNets.

j) In the Azure Information section:

1. In the **BGP ASN** field, enter the ASN that you configure on the Azure Virtual Network Gateway, which is brought up within the host VNet. Use an ASN that isn't part of an existing configuration on Azure. For acceptable ASN values, refer to Microsoft Azure documentation.
2. In the **Host VNet Gateway Subnet** field, enter a host VNet subnet in which the Virtual Network Gateway can reside. We recommend you use a /28 subnet or higher. Ensure not to provide a subnet that is already created in the VNet.

   Note Ensure that there's an unused CIDR inside the host VNet CIDR.

k) Click **Map VNets**.

l) Click **Save and Complete**.

Note When configuring the VPN feature template for VPN 0 for the two Cisco SD-WAN cloud devices that form the transit VNet, ensure that the color you assign to the tunnel interface is a public color, and not a private color. Public colors are:

- **3g**
- **biz-internet**
- **blue**
- **bronze**
- **custom1**
- **custom2**
- **custom3**
- **default**
- **gold**
- **green**
- **lte**
- **metro-ethernet**
- **mpls**
- **public-internet**
- **red**
- **silver**

The **Task View** screen appears, confirming that the host VNet has been mapped to the transit VNet successfully.

The creation of VNet Gateway can take up to 45 minutes.

Configure Cloud onRamp for SaaS

Table 42: Feature History

Feature Name	Release Information	Description
New Configuration Workflow for Cloud onRamp for SaaS for Cisco vEdge devices	Cisco SD-WAN Release 20.3.1 Cisco vManage Release 20.3.1	Using Cloud onRamp for SaaS, you can select specific SaaS applications and interfaces, and let Cisco SD-WAN determine the best performing path for each SaaS applications.

Enable Cloud OnRamp for SaaS

1. From the Cisco vManage menu, choose **Administration** > **Settings**.
2. Click **Edit**, next to **Cloud onRamp for SaaS**.
3. In the **Cloud onRamp for SaaS** field, click **Enabled**.
4. Click **Save**.

Configure Applications for Cloud onRamp for SaaS Using Cisco vManage

Table 43: Feature History

Feature Name	Release Information	Description
Service Area Mapping	Cisco IOS XE Release 17.5.1a Cisco vManage Release 20.5.1	To specify the service area that your Microsoft 365 application belongs to, choose an option from the **Service Area** drop-down list.

1. Open Cloud onRamp for Saas.
    - From the Cisco vManage menu, choose **Configuration** > **Cloud onRamp for SaaS**.

      or

    - In Cisco vManage, click the cloud icon near the top right and choose **Cloud onRamp for SaaS**.

2. In the **Manage Cloud OnRamp for SaaS** drop-down list, choose **Applications and Policy**.

   The **Applications and Policy** window displays all SaaS applications.

3. Optionally, you can filter the list of applications by clicking an option in the **App Type** field.
    - **Standard**: Applications included by default for Cloud onRamp for SaaS.
    - **Custom**: User-defined SaaS application lists (see Information About SaaS Application Lists).

4. Enable applications and configure.

Column	Description
Applications	Applications that can be used with Cloud onRamp for SaaS.
Monitoring	**Enabled**: Enables Cloud OnRamp for SaaS to initiate the Quality of Experience probing to find the best path. **Disabled**: Cloud onRamp for SaaS stops the Quality of Experience probing for this application.
VPN	(Cisco vEdge devices) Specify one or more VPNs.

Column	Description
Policy/Cloud SLA	(Cisco IOS XE SD-WAN devices) Select **Enable** to enable Cloud onRamp for SaaS to use the best path for this application. **Note** You can select **Enable** only if there is a centralized policy that includes an application-aware policy has been activated.
	(Cisco IOS XE SD-WAN devices) For Microsoft 365 (M365), select one of the following to specify which types of M365 traffic to include for best path determination: • **Optimize**: Include only M365 traffic categorized by Microsoft as "optimize" – the traffic most sensitive to network performance, latency, and availability. • **Optimize and Allow**: Include only M365 traffic categorized by Microsoft as "Optimize" or "Allow". The "Allow" category of traffic is less sensitive to network performance and latency than the "Optimize" category. • **All**: Include all M365 traffic.
	Starting from Cisco IOS XE Release 17.5.1a, you can choose the service area that your M365 application belongs to. This allows you to apply the policy to only those applications in the specified service area. Microsoft allows the following service area options: • **Common**: M365 Pro Plus, Office in a browser, Azure AD, and other common network endpoints. • **Exchange**: Exchange Online and Exchange Online Protection. • **SharePoint**: SharePoint Online and OneDrive for Business. • **Skype**: Skype for Business and Microsoft Teams. See the Microsoft documentation for information about updates to the service areas.

5. Click **Save Applications and Next**.

   The **Application Aware Routing Policy** window appears, showing the application-aware policy for the current active centralized policy.

   - You can select the application-aware policy and click **Review and Edit** to view the policy details. The match conditions of the policy show the SaaS applications for which monitoring has been enabled.
   - For an existing policy, you cannot edit the site list or VPN list.
   - You can create a new policy for sites that are not included in existing centralized policies. If you create a new policy, you must add a VPN list for the policy.
   - You can delete one or more new sequences that have been added for the SaaS applications, or change the order of the sequences.

6. Click **Save Policy and Next**. This saves the policy to the Cisco vSmart Controller.

Configure Client Sites

To configure Cloud OnRamp for SaaS on client sites that access the internet through gateways, configure Cloud OnRamp for SaaS both on the client sites and on the gateway sites.

Note You cannot configure Cloud OnRamp for SaaS with Point-to-Point Protocol (PPP) interface on the gateway sites.

Client sites in the Cloud onRamp service choose the best gateway site for each application to use for accessing the internet.

1. From the Cisco vManage menu, choose **Configuration** > **Cloud onRamp for SaaS**. The **Cloud OnRamp for SaaS** Dashboard appears.
2. Click **Manage Cloud OnRamp for SaaS** and choose **Client Sites**. The page displays the following elements:
   - Attach Sites: Add client sites to Cloud onRamp for SaaS service.
   - Detach Sites: Remove client sites from Cloud onRamp for SaaS service.
   - Client sites table: Display client sites configured for Cloud onRamp for SaaS service.
3. On the **Cloud onRamp for SaaS** > **Manage Sites** window, click **Attach Sites**. The **Attach Sites** dialog box displays all sites in the overlay network with available sites highlighted. For a site to be available, all devices at that site must be running in vManage mode.
4. Choose one or more client sites from **Available Sites** and move them to **Selected Sites**.
5. Click **Attach**. The Cisco vManage NMS saves the feature template configuration to the devices. The Task View window displays a Validation Success message.
6. From the Cisco vManage menu, choose **Configuration** > **Cloud onRamp for SaaS** to return to the Cloud OnRamp for SaaS Dashboard screen.
7. Click **Manage Cloud OnRamp for SaaS** and choose **Gateways**. The page displays the following elements:
   - Attach Gateways: Attach gateway sites.
   - Detach Gateways: Remove gateway sites from the Cloud onRamp service.
   - Edit Gateways: Edit interfaces on gateway sites.
   - Gateways table: Display gateway sites configured for Cloud onRamp service.
8. In the **Manage Gateways** window, click **Attach Gateways**. The **Attach Gateways** dialog box displays all sites in your overlay network with available sites highlighted. For a site to be available, all devices at that site must be running in vManage mode.
9. In the **Device Class** field, choose one of the following operating systems:

- **Cisco OS**: Cisco IOS XE SD-WAN devices
- **Viptela OS (vEdge)**: Cisco vEdge devices

10. Choose one or more gateway sites from **Available Sites** and move them to **Selected Sites**.

11. (Cisco vEdge devices for releases before Cisco IOS XE Release 17.7.1a) To specify GRE interfaces for Cloud OnRamp for SaaS to use, perform the actions in Steps 11a through 11d.

    (Cisco vEdge devices for releases from Cisco IOS XE Release 17.7.1a) To specify the VPN 0 interfaces or service VPN interfaces in gateway sites for Cloud OnRamp for SaaS to use, perform the actions in Steps 11a through 11d.

Note If you do not specify interfaces for Cloud OnRamp for SaaS to use, the system selects a NAT-enabled physical interface from VPN 0.

   a. Click **Add interfaces** to selected sites (optional), located in the bottom-right corner of the **Attach Gateways** window.

   b. Click **Select Interfaces**.

   c. From the available interfaces, choose the GRE interfaces to add (for releases before Cisco IOS XE Release 17.7.1a), or the VPN 0 interfaces or service VPN interfaces to add (for releases from Cisco IOS XE Release 17.7.1a).

   d. Click **Save Changes**.

12. (Cisco IOS XE SD-WAN devices) To configure the routers at a gateway site, perform the following steps.

Note If you don’t specify interfaces for Cloud OnRamp for SaaS, an error message indicates that the interfaces aren’t VPN 0.

   a. Click **Add interfaces to selected sites**.

   b. The **Attach Gateways** window shows each WAN edge router at the gateway site.

      Beginning with Cisco IOS XE Release 17.6.1a, you can choose Service VPN or VPN 0 if the gateway uses Cisco IOS XE SD-WAN devices.

      - If the routers at the gateway site connect to the internet using service VPN connections (VPN 1, VPN 2, …), choose **Service VPN**.
      - If the routers at the gateway site connect to the internet using VPN 0, choose **VPN 0**.

Note

- Correctly choosing **Service VPN** or **VPN 0** requires information about how the gateway site connects to the internet.
- All WAN edge routers at the gateway site must use either service VPN or VPN 0 connections for internet access. Cloud OnRamp for SaaS does not support a mix of both.

c. Do one of the following:

   - If you chose **Service VPN**, then for each WAN edge router, choose the interfaces to use for internet connectivity.
   - If you chose **VPN 0**, then either choose **All DIA TLOC**, or choose **TLOC list** and specify the colors to include in the TLOC list.

d. Click **Save Changes**.

13. Click **Attach**. Cisco vManage saves the feature template configuration to the devices. The Task View window displays a Validation Success message.
14. To return to the Cloud OnRamp for SaaS Dashboard, from the Cisco vManage menu, choose **Configuration** > **Cloud onRamp for SaaS**.

Configure Direct Internet Access (DIA) Sites

Note Cloud onRamp for SaaS requires an SD-WAN tunnel to each physical interface to enable SaaS probing through the interface. For a physical interface configured for DIA only, without any SD-WAN tunnels going to the SD-WAN fabric, configure a tunnel interface with a default or any dummy color in order to enable use of Cloud onRamp for SaaS. Without a tunnel interface and color configured, no SaaS probing can occur on a DIA-only physical interface.

1. From the Cisco vManage menu, choose **Configuration** > **Cloud onRamp for SaaS**.
2. From the **Manage Cloud OnRamp for SaaS** drop-down list, located to the right of the title bar, choose **Direct Internet Access (DIA) Sites**.

   The **Manage DIA**window provides options to attach, detach, or edit DIA sites, and shows a table of sites configured for the Cloud onRamp service.
3. Click **Attach DIA Sites**. The **Attach DIA Sites** dialog box displays all sites in your overlay network with available sites highlighted. For a site to be available, all devices at that site must be running in vManage mode.
4. In the **Device Class** field, select one of the following:
   - **Cisco OS**: Cisco IOS XE SD-WAN devices
   - **Viptela OS (vEdge)**: Cisco vEdge devices
5. Choose one or more DIA sites from **Available Sites** and move them to **Selected Sites**.
6. (For Cisco vEdge devices) By default, if you don’t specify interfaces for Cloud OnRamp for SaaS to use, the system selects all NAT-enabled physical interfaces from VPN 0. Use the following steps to specify particular interfaces for Cloud OnRamp for SaaS.

   Note You can’t select a loopback interface.

a. Click the link, **Add interfaces to selected sites** (optional), located in the bottom-right corner of the window.

b. In the **Select Interfaces** drop-down list, choose interfaces to add.

c. Click **Save Changes**.

7. (For Cisco IOS XE SD-WAN devices, optional) Specify TLOCs for a site.

Note Configuring Cloud onRamp for SaaS when using a loopback as a TLOC interface is not supported.

Note If you do not specify TLOCs, the **All DIA TLOC** option is used by default.

a. Click the **Add TLOC to selected sites** link at the bottom-right corner of the **Attach DIA Sites** dialog box.

b. In the **Edit Interfaces of Selected Sites** dialog box, choose **All DIA TLOC**, or **TLOC List** and specify a TLOC list.

c. Click **Save Changes**.

8. Click **Attach**. The Cisco vManage NMS saves the feature template configuration to the devices. The **Task View** window displays a Validation Success message.

9. To return to the Cloud OnRamp for SaaS Dashboard, from the Cisco vManage menu, choose **Configuration** > **Cloud onRamp for SaaS**.

Configure Cloud onRamp for SaaS Over SIG Tunnels

Table 44: Feature History

Feature Name	Release Information	Description
Cloud onRamp for SaaS Over SIG Tunnels	Cisco SD-WAN Release 20.6.1 Cisco vManage Release 20.6.1	This feature lets you to connect to Cloud onRamp for SaaS by means of a SIG tunnel.

Configure Cloud onRamp for SaaS over SIG Tunnels Using DIA

1. From the Cisco vManage menu, choose **Configuration** > **Cloud onRamp for SaaS**.

2. From **Manage Cloud OnRamp for SaaS**drop-down lsit, choose **Direct Internet Access (DIA) Sites**.

3. Click **Attach DIA Sites**.

   The **Attach DIA Sites** dialog box displays all the sites in your overlay network, with the available sites highlighted.

4. In **Device Class**, select:

Viptela OS (vEdge)

5. In the **Available Sites** pane, select a site that you want to attach, and click the right arrow. To remove a site, in the **Selected Sites** pane, click a site, and then click the left arrow.
6. Click **Add interfaces to selected sites**.
7.
8. Choose SIG tunnels from a list of interfaces or check the **All Auto SIG Interfaces** check box.
9. Click **Save Changes**.
10. Click **Attach**.

    Cisco vManage pushes the feature template configuration to the devices, and the **Task View** window displays a `Validation Success` message.

Configure Cloud onRamp for SaaS over SIG Tunnels Using a Gateway

To configure Cloud onRamp for SaaS over SIG tunnels a Gateway, perform the following steps:

1. From the Cisco vManage menu, choose **Configuration** > **Cloud onRamp for SaaS**.
2. From **Manage Cloud OnRamp for SaaS** drop-down list, choose **Gateways**.
3. Click **Attach Gateways**.

   The **Attach Gateways** pop-up window displays all the sites in your overlay network, with available sites highlighted.
4. In **Device Class**, select:

   Viptela OS (vEdge)
5. In the **Available Sites** pane, select a site that you want to attach, and click the right arrow. To remove a site, in the **Selected Sites** pane, click a site, and then click the left arrow
6. Click **Add interfaces to selected sites**.
7. Choose SIG tunnels from a list of interfaces or check the **All Auto SIG Interfaces** check box.
8. Click **Save Changes**.
9. Click **Attach**. Cisco vManage pushes the feature template configuration to the devices, and the **Task View** window displays a `Validation Success` message.

View Details of Monitored Applications

1. Open Cloud onRamp for SaaS.
   - From the Cisco vManage menu, choose **Configuration** > **Cloud onRamp for SaaS**.

     or
   - In Cisco vManage, click the cloud icon at the top right and click **Cloud onRamp for SaaS**.

   The page includes a tile for each monitored application, with the following information:
   - How many sites are operating with Cloud onRamp for SaaS.

- A color-coded rating of the Quality of Experience (vQoE) score for the application (green=good score, yellow=moderate score, red=poor score) on the devices operating at each site.

2. Optionally, you can click a tile to show details of Cloud onRamp for SaaS activity for the application, including the following:

Field	Description
vQoE Status	A green checkmark indicates that the vQoE score for the best path meets the criteria of an acceptable connection. The vQoE is calculated based on average loss and average latency. For Office 365 traffic, other connection metrics are also factored in to the vQoE score.
vQoE Score	For each site, this is the vQoE score of the best available path for the cloud application traffic. The vQoE score is determined by the Cloud onRamp for SaaS probe. Depending on the type of routers at the site, you can view details of the **vQoE Score** as follows: • Cisco IOS XE SD-WAN devices: To show a chart of the vQoE score history for each available interface, click the chart icon. In the chart, each interface vQoE score history is presented as a colored line. A solid line indicates that Cloud onRamp for SaaS has designated the interface as the best path for the cloud application at the given time on the chart. You can place the cursor over a line, at a particular time on the chart, to view details of the vQoE score of an interface at that time. From Cisco vManage Release 20.8.1, for the Office 365 application, the chart includes an option to show the vQoE score history for a specific service area, such as Exchange, Sharepoint, or Skype. For each service area, a solid line in the chart indicates the interface chosen as the best path at a given time. If you have enabled Cloud onRamp for SaaS to use Microsoft traffic metrics for Office 365 traffic, the choice of best path takes into account the Microsoft traffic metrics. • Cisco vEdge devices: To show a chart of the vQoE score history, click the chart icon. The chart shows the vQoE score for the best path chosen by Cloud onRamp for SaaS.
DIA Status	The type of connection to the internet, such as local (from the site), or through a gateway site.
Selected Interface	The interface providing the best path for the cloud application. **Note** If the DIA status is Gateway, this field displays **N/A**.
Activated Gateway	For a site that connects to the internet through a gateway site, this indicates the IP address of the gateway site. **Note** If the DIA status is Local, this field displays **N/A**.

Field	Description
Local Color	For a site that connects to the internet through a gateway site, this is the local color identifier of the tunnel used to connect to the gateway site. **Note** If the DIA status is Local, this field displays **N/A**.
Remote Color	For a site that connects to the internet through a gateway site, this is the remote (gateway site) color identifier of the tunnel used to connect to the gateway site. **Note** If the DIA status is Local, this field displays **N/A**.
SDWAN Computed Score	This field is applicable only if the site uses Cisco IOS XE SD-WAN devices. It does not apply for Cisco vEdge devices. From Cisco vManage Release 20.8.1, for the Microsoft Office 365 application, an **SDWAN Computed Score** column provides links to view charts of the path scores (OK, NOT-OK, or INIT) provided by Microsoft telemetry for each Microsoft service area, including Exchange, Sharepoint, and Skype. The chart shows the scores over time for each available interface. The scores are defined as follows: • **OK**: Acceptable path • **NOT-OK**: Unacceptable path • **INIT**: Insufficient data These charts provide visibility into how Cloud onRamp for SaaS chooses a best path for each type of Microsoft Office 365 traffic. A use case for viewing the path score history is for determining whether Microsoft consistently rates a particular interface as NOT-OK for some types of traffic, such as Skype traffic.

Enable Application Feedback Metrics for Office 365 Traffic

Beginning with Cisco IOS XE Release 17.4.1a, you can enable the following types of application feedback from additional sources. Cloud onRamp for SaaS can use these metrics to help determine the best path for Office 365 traffic.

- Enable telemetry with Microsoft Exchange cloud servers, which can provide best path metrics for Office 365 traffic on specifically configured interfaces. This involves use of a Microsoft service called Microsoft 365 informed network routing. To understand this feature better, see the information available in the Microsoft 365 informed network routing document.
- Enable application response time (ART) metrics, which configures network devices to report ART metrics.

Before You Begin

- Enable monitoring for Office 365 traffic.

- Configure a policy for Office 365, for Cisco IOS XE SD-WAN devices.
- To enable NetFlow metrics, enable Cloud Services.

  (From the Cisco vManage menu, choose **Administration** > **Settings** > **Cloud Services**)
- To enable NetFlow metrics for devices in the network, enable the **NetFlow** and **Application** options in the localized policy for each device.

  (From the Cisco vManage menu, choose **Configuration** > **Policies** > **Localized Policy** > **Policy template**, **Policy Settings** section)
- Enable Cisco vAnalytics. See Cisco vAnalytics Insights.

Enable Application Feedback Metrics for Office 365 Traffic

1. From the Cisco vManage menu, choose **Configuration** > **Cloud onRamp for SaaS**.
2. In the **Manage Cloud onRamp for SaaS** drop-down list, choose **Applications and Policy**.
3. In the **Office 365** row, click the **Enable Application Feedback for Path Selection** link.

   The **Application Feedback** dialog box opens.
4. In the **Application Feedback** dialog box, enable traffic metrics:
   - **Telemetry**: Enable Telemetry with Microsoft Exchange cloud servers to receive traffic metrics for Office 365 traffic over specific configured interfaces.

     If the option is disabled and the dialog box shows a message requesting sign-in to a Microsoft account, copy the code provided in the message and click the link to sign in. Provide the code on the Microsoft page that is displayed and log in with your Microsoft tenant account credentials when prompted. After signing in, the **Telemetry** option in the dialog box is enabled.
   - **Traffic Steering**: From Cisco vManage Release 20.9.1, check this check box to allow Cloud OnRamp for SaaS to factor in the Microsoft telemetry data in the best path decision. If you disable this, you can still view the Microsoft telemetry data in the Cisco vAnalytics dashboard, but the telemetry does not affect the best path decision.
   - (Optional) **Application Response Time (ART)**: Enable ART metrics.

Note Enabling ART automatically configures devices to report ART metrics.

5. Click **Save**.

View Office 365 Application Logs

You can view a log of the metrics that factor into the best-path determination for Office 365 traffic. The metrics appear in a Cisco vAnalytics page specifically designed to display this information. The logs provide detailed information regarding status, but are not necessary for using Cloud onRamp for SaaS.

Beginning with Cisco vManage Release 20.8.1, you can view the path score history in a chart form. See View Details of Monitored Applications, on page 118.

Prerequisites

- Enable Microsoft traffic metrics.
- Enable monitoring for Office 365 traffic.

Procedure

1. In Cisco vManage, open **Configuration** > **Cloud onRamp for SaaS**.
2. Click the **Office 365** box.

Note The box appears only if monitoring is enabled for Office 365 traffic.

3. In the **Office 365** window, click the **View Application Logs** link.
4. Log in using Cisco vAnalytics credentials. See Cisco vAnalytics Insights.

   A **Cisco SD-WAN vAnalytics** page opens. This is a Cisco vAnalytics view designed specifically for Cloud onRamp for SaaS, and only provides access to the Cloud onRamp for SaaS metrics for Office 365 traffic. It does not provide other Cisco vAnalytics functionality

5. Select an option from the cloud icon in the left pane to display various logs. Use the filter and interval options above the table to determine what log data to include.

Log Type	Description
Path Scores (**Cloud icon** > **Path Score**)	(This is the default display.) Shows a table with a log of path scores, according to interface. Each line shows the scores and related information for a specific interface at a given time. **Note** The Microsoft Teams service may appear in the table as Skype. The **Score** area includes the following columns: • **MSFT**: Path score determined by Microsoft. • **SDWAN**: Path score determined by all metrics (ART, Cloud OnRamp for SaaS path probing metrics, and Microsoft telemetry metrics). This is the score that primarily determines whether a path is acceptable for traffic. In the **MSFT** and **SDWAN** columns, the table shows the status as one of the following: • **OK**: Acceptable path • **NOT-OK**: Not acceptable path • **INIT**: Insufficient data

View Server Information Using the SD-AVC Cloud Connector

Before You Begin

- Enable SD-AVC (**Administration** > **Cluster Management**, click **...** and choose **Edit**, and choose **Enable SD-AVC**).
- Enable the SD-AVC Cloud Connector. See Enable Cisco SD-AVC Cloud Connector in the *Cisco SD-WAN Getting Started Guide*.

View Server Information

1. From the Cisco vManage menu, choose **Monitor** > **SD-AVC Cloud Connector**.
2. - For the Office 365 application, the **SD-AVC Cloud Connector** page shows the following information collected from Microsoft Cloud about the Microsoft application servers that handle Office 365 traffic:

Field	Description
Domain tab	
Application Name	Name of the application producing the traffic. Network-Based Application Recognition (NBAR), a component of Cisco IOS XE, provides the application name.
Domain	Destination domain of the traffic. This is the application server handling the cloud application traffic.
Service Area	The service area categorization, as determined by Microsoft, including **exchange**, **sharepoint**, **skype**, and **common**.
Category	Traffic categorization by Microsoft as **optimize**, **allow**, or **default**. A dash in this field indicates traffic that does not have a defined category.
IP Address tab	
IP	Destination IP of the traffic. This is the IP address of the application server handling the cloud application traffic.
Port	Destination port of the traffic.
L4 Protocol	Transport protocol of the traffic, such as TCP or UDP.
Application	Name of the application producing the traffic. NBAR, a component of Cisco IOS XE, provides the application name.
Category	Traffic categorization by Microsoft as **optimize**, **allow**, or **default**. A dash in this field indicates that traffic does not have a defined category.
Service Area	The service area categorization, as determined by Microsoft, including **exchange**, **sharepoint**, **skype**, and **common**.

3. Optionally, you can use the search field to filter the information in the table. For example, you can filter by an application name or by a domain name.

Application Lists

Table 45: Feature History

Feature Name	Release Information	Description
User-Defined SaaS Application Lists	Cisco SD-WAN Release 20.8.1 Cisco vManage Release 20.8.1	In Cisco vManage, you can define lists of one or more SaaS applications, together with the relevant application server. Cloud onRamp for SaaS handles these lists in the same way that it handles the predefined set of SaaS applications that it can monitor. When you enable a user-defined list, Cloud onRamp for SaaS probes for the best path to the application server and routes the application traffic for applications in the list to use the best path.

Create a User-Defined SaaS Application List Using Cisco vManage

Minimum supported releases: Cisco IOS XE Release 17.8.1a, Cisco vManage Release 20.8.1

1. Open the Cloud onRamp for SaaS page, using one of the following methods:

   - From the Cisco vManage main menu, choose **Configuration** > **Cloud onRamp for SaaS**.

     or

   - From the Cisco vManage menu, click the cloud icon near the top right and select **Cloud onRamp for SaaS**.

2. In the **Manage Cloud onRamp for SaaS** drop-down list, choose **SaaS Application Lists**.

3. Click **New Custom Application List**.

4. Enter a name for the list.

5. To add applications to the list, click the **Search** field and choose applications. The list includes standard applications and any custom applications that you have defined.

   Optionally, you can enter text in the **Search** field to filter for specific applications.

   The applications that you choose are added to the **Application** field, which shows each application in the list.

6. Optionally, to create a new custom application within this workflow, click the **Search** field and then click **New Custom Application**. Creating a custom application on this page is equivalent to defining a custom application in the centralized policy workflow, as described in Define Custom Applications. See Define Custom Applications Using Cisco vManage for information about the what information is required for defining a custom application, the use of wildcard characters, the logic applied when matching traffic to the attributes that you enter, and so on.

7. In the **SaaS Probe Endpoint Type** area, define the probe endpoint, which is the server that Cloud onRamp for SaaS probes to determine a best path for the traffic in the SaaS application list.

- Choose an endpoint type from the following options:
  - **IP Address**: Enter an IP address. Cloud onRamp for SaaS probes the server using port 80.
  - **FQDN**: Enter a fully qualified domain name.
  - **URL**: Enter a URL using HTTP or HTTPS. Cloud onRamp for SaaS probes the server using port 80 or port 443, depending on the URL provided.
- Enter an endpoint value, based on the endpoint type that you choose.

  Examples: 192.168.0.1, https://www.example.com

8. Click **Add**. The new SaaS application list appears in the table of application lists.

View SaaS Application Lists

Minimum supported releases: Cisco IOS XE Release 17.8.1a, Cisco vManage Release 20.8.1

1. Open the Cloud onRamp for SaaS page, using one of the following methods:
   - From the Cisco vManage main menu, choose **Configuration** > **Cloud onRamp for SaaS**.

     or
   - From the Cisco vManage menu, click the cloud icon near the top right and select **Cloud onRamp for SaaS**.
2. In the **Manage Cloud onRamp for SaaS** drop-down list, choose **SaaS Application Lists**.

   A table shows the details of each SaaS application list. Optionally, you can click an icon in the **Action** column to edit or delete a list.

Configure Controller Certificate Authorization Settings

Signed certificates are used to authenticate devices in the overlay network. Once authenticated, devices can establish secure sessions between each other. It is from the Cisco vManage that you generate these certificates and install them on the controller devices—Cisco vBond orchestrators,Cisco vManage, and Cisco vSmart controllers. You can use certificates signed by Symantec, or you can use enterprise root certificates.

The controller certification authorization settings establish how the certification generation for all controller devices will be done. They do not generate the certificates.

You need to select the certificate-generation method only once. The method you select is automatically used each time you add a device to the overlay network.

To have the Symantec signing server automatically generate, sign, and install certificates on each controller device:

1. From **Controller Certificate Authorization**, click **Edit**.
2. Click **Symantec Automated** (Recommended). This is the recommended method for handling controller signed certificates.

3. In the **Confirm Certificate Authorization Change** dialog box, click **Proceed** to confirm that you wish to have the Symantec signing server automatically generate, sign, and install certificates on each controller device.
4. Enter the first and last name of the requester of the certificate.
5. Enter the email address of the requester of the certificate. This address is required because the signed certificate and a confirmation email are sent to the requester via email; they are also made available though the customer portal.
6. Specify the validity period for the certificate. It can be 1, 2, or 3 years.
7. Enter a challenge phrase. The challenge phrase is your certificate password and is required when you renew or revoke a certificate.
8. Confirm your challenge phrase.
9. In **Certificate Retrieve Interval**, specify how often the Cisco vManage server checks if the Symantec signing server has sent the certificate.
10. Click **Save**.

To manually install certificates that the Symantec signing server has generated and signed:

1. From **Controller Certificate Authorization**, click **Edit**.
2. Click **Symantec Manual**.
3. In the **Confirm Certificate Authorization Change** dialog box, click **Proceed** to manually install certificates that the Symantec signing server has generated and signed.
4. Click **Save**.

To use enterprise root certificates:

1. From **Controller Certificate Authorization**, click **Edit**.
2. Click **Enterprise Root Certificate**.
3. In the **Confirm Certificate Authorization Change** dialog box, click **Proceed** to confirm that you wish to use enterprise root certificates.
4. In the **Certificate** box, either paste the certificate, or click **Select a file** and upload a file that contains the enterprise root certificate.
5. By default, the enterprise root certificate has the following properties: To view this information, issue the **show certificate signing-request decoded** command on a controller device, and check the output in the Subject line. For example:
   - Country: United States
   - State: California
   - City: San Jose
   - Organizational unit: ENB
   - Organization: CISCO
   - Domain Name: cisco.com

- Email: cisco-cloudops-sdwan@cisco.com

```
vSmart# show certificate signing-request decoded
    ...
    Subject: C=US, ST=California, L=San Jose, OU=ENB, O=CISCO, CN=vsmart-uuid
.cisco.com/emailAddress=cisco-cloudops-sdwan@cisco.com
    ...
```

To change one or more of the default CSR properties:

a. Click **Set CSR Properties**.

b. Enter the domain name to include in the CSR. This domain name is appended to the certificate number (CN).

c. Enter the organizational unit (OU) to include in the CSR.

d. Enter the organization (O) to include in the CSR.

e. Enter the city (L), state (ST), and two-letter country code (C) to include in the CSR.

f. Enter the email address (emailAddress) of the certificate requester.

g. Specify the validity period for the certificate. It can be 1, 2, or 3 years.

6. Click **Import & Save**.

Configure CUBE

Table 46: Feature History

Feature Name	Release Information	Description
Cisco Unified Border Element Configuration	Cisco IOS XE Release 17.7.1a Cisco vManage Release 20.7.1	You can configure Cisco Unified Border Element functionality by using Cisco IOS XE SD-WAN device CLI templates or CLI add-on feature templates.

To configure a device to use the CUBE functionality, create a Cisco IOS XE SD-WAN device CLI template or a CLI add-on feature template for the device.

For information about device CLI templates, see CLI Templates for Cisco IOS XE SD-WAN Device Routers.

For information about CLI add-on feature templates, see CLI Add-On Feature Templates.

For information about CUBE configuration and usage, see *Cisco Unified Border Element Configuration Guide*.

For information about the CUBE commands that Cisco SD-WAN supports for use in a CLI template, see CUBE Commands .

The following example shows a basic CUBE configuration using a CLI add-on template:

```
voice service voip
 ip address trusted list
```

```
  ipv4 10.0.0.0.255.0.0.0
  ipv6 2001:DB8:0:ABCD::1/48
  !
 allow-connections sip to sip
 sip
  no call service stop
  !
dial-peer voice 100 voip
  description Inbound LAN side dial-peer
  session protocol sipv2
  incoming called number .T
  voice-class codec 1
  dtmf-relay rtp-nte
  !
 dial-peer voice 101 voip
  description Outbound LAN side dial-peer
  destination pattern [2-9].........
  session protocol sipv2
  session target ipv4:10.10.10.1
  voice-class codec 1
  dtmf-relay rtp-nte
  !
 dial-peer voice 200 voip
  description Inbound WAN side dial-peer
  session protocol sipv2
  incoming called-number .T
  voice-class codec 1
  dtmf-relay rtp-nte
  !
 dial-peer voice 201 voip
  description Outbound WAN side dial-peer
  destination pattern [2-9].........
  session protocol sipv2
  session target ipv4:20.20.20.1
  voice-class codec 1
  dtmf-relay rtp-nte
```

Configure Custom Applications Using Cisco vManage

Prerequisites

Install Cisco SD-AVC as a component of Cisco SD-WAN. For information on how to enable SD-AVC on Cisco vManage, see Information on how to enable SD-AVC for Cisco SD-WAN devices.

Perform the following steps to configure custom applications:

1. In Cisco vManage, select **Configuration** > **Policies**.
2. Select **Centralized Policy**.
3. Click **Custom Options** and select **Centralized Policy** > **Lists**.
4. Click **Custom Applications**, and then click **New Custom Application**.
5. To define the application, provide an application name and enter match criteria. The match criteria can include one or more of the attributes provided: server names, IP addresses, and so on. You do not need to enter match criteria for all fields.

   The match logic follows these rules:

- Between all L3/L4 attributes, there is a logical AND. Traffic must match all conditions.
- Between L3/L4 and Server Names, there is a logical OR. Traffic must match either the server name or the L3/L4 attributes.

Field	Description
Application Name	(mandatory) Enter a name for the custom application. Maximum length: 32 characters
Server Names	One or more server names, separated by commas. You can include an asterisk wildcard match character (*) only at the beginning of the server name. Examples: *cisco.com, *.cisco.com (match www.cisco.com, developer.cisco.com, …)
L3/L4 Attributes	
IP Address	Enter one or more IPv4 addresses, separated by commas. Example: 10.0.1.1, 10.0.1.2 **Note** The subnet prefix range is 24 to 32.
Ports	Enter one or more ports or port ranges, separated by commas. Example: 30, 45-47
L4 Protocol	Select one of the following: TCP, UDP, TCP-UDP

6. Click **Add**. The new custom application appears in the table of custom applications.

Note To check the progress of creating the new custom application, click **Tasks** (clipboard icon). A panel opens, showing active and completed processes.

Example Custom Application Criteria

Criteria	How to configure fields
Domain name	**Server Names**: cisco.com

Criteria	How to configure fields
Set of IP addresses, set of ports, and L4 protocol	**IP Address**: 10.0.1.1, 10.0.1.2 **Ports**: 20, 25-37 **L4 Protocol**: TCP-UDP
Set of ports and L4 protocol	**Ports**: 30, 45-47 **L4 Protocol**: TCP

Configure Tunnels

Table 47: Feature History

Feature	Release Information	Description
IPSEC/GRE Tunnel Routing and Load-Balancing Using ECMP	Cisco SD-WAN Release 20.4.1 Cisco vManage Release 20.4.1	You can use the SIG template to steer application traffic to Cisco Umbrella or a Third party SIG Provider. You can also configure weights for multiple GRE/IPSEC tunnels for distribution of traffic among multiple tunnels based on the configured weights.
Enable Layer 7 Health Check (Automatic Tunnels)	Cisco SD-WAN Release 20.5.1 Cisco vManage Release 20.5.1	You can configure Automatic Tunnels using Cisco vManage.
Support for Zscaler Automatic IPSec Tunnel Provisioning	Cisco SD-WAN Release 20.5.1 Cisco vManage Release 20.5.1	This feature automates the provisioning of tunnels from Cisco SD-WAN routers to Zscaler. Using your Zscaler partner API credentials, you can automatically provisions tunnels to Zscaler Internet Access (ZIA) Public Service Edges. You can choose **Zscaler** in the Cisco Security Internet Gateway (SIG) and SIG credentials feature templates to automate tunnel provisioning. You can configure provisioning of tunnels from Cisco SD-WAN routers.

Feature	Release Information	Description
Layer 7 Health Check for Manual Tunnels	Cisco SD-WAN Release 20.8.1 Cisco vManage Release 20.8.1	You can create and attach trackers to manually created GRE or IPSec tunnels to a SIG endpoint. Trackers help failover traffic when a SIG tunnel is down. You can configure the trackers using the SIG feature template.
Global SIG Credentials Template	Cisco SD-WAN Release 20.9.1 Cisco vManage Release 20.9.1	With this feature, create a single global SIG Credentials template for each SIG provider (Cisco Umbrella or Zscaler). When you attach a SIG template to a device template, Cisco vManage automatically attaches the applicable global SIG Credentials template to the device template.

Configure Automatic Tunnels Using Cisco vManage

Prerequisites

To configure automatic tunneling to a SIG, complete the following requisites:

- Cisco Umbrella: To configure automatic tunnels to Cisco Umbrella, you can do one of the following
    - For Cisco vManage to fetch the API keys, specify Smart Account credentials here: **Administration** > **Settings** > **Smart Account Credentials**. Your Cisco Smart Account is the account that you use to log in to the Cisco Smart Software Manager (CSSM) portal.
    - To manually specify the API keys, generate Umbrella Management API keys. See *Management and Provisioning* > *Getting Started* > *Overview* in the *Cloud Security API* documentation on the Cisco DevNet portal.

      Specify the generated keys in the SIG Credentials template.
- Zscaler Internet Access (ZIA): To configure automatic tunnels to Zscaler, do the following:
    1. Create partner API keys on the ZIA Partner Integrations page.
    2. Add the Partner Administrator role to the partner API keys.
    3. Create a Partner Administrator.
    4. Activate the changes.

  For more information, see *Managing SD-WAN Partner Keys* on the Zscaler Help Center.

  Specify the generated keys in the SIG Credentials template.

Create Cisco Umbrella SIG Credentials Template

Minimum supported release: Cisco vManage Release 20.9.1

When you Create Automatic Tunnels Using a SIG Feature Template, on page 135, on selecting Umbrella as the SIG provider, Cisco vManage prompts you to create the global SIG credentials template, if you haven't yet created the template. Click **Click here to create - SIG Credentials template** to create the Cisco Umbrella SIG credentials template.

Template Name and **Description** fields are prefilled:

Table 48: SIG Credentials Template Name and Description

Field	Description
Template Name	(Read only) Umbrella Global Credentials
Description	(Read only) Global credentials for Umbrella

1. In the **Basic Details** section, do one of the following:

   - Enable Cisco vManage to fetch credentials from the Cisco Umbrella portal:

     a. Ensure that you have added your Cisco Smart Account credentials here: **Administration** > **Settings** > **Smart Account Credentials**.

        Cisco vManage uses the Cisco Smart Account credentials to connect to the Cisco Umbrella portal.

     b. Click **Get Keys**.

        Cisco vManage obtains the following details:

        - Organization ID
        - Registration Key
        - Secret

   - Enter Cisco Umbrella credentials:

     Table 49: Cisco Umbrella Credentials

Field	Description
SIG Provider	(Read only) Umbrella
Organization ID	Enter the Cisco Umbrella organization ID (Org ID) for your organization. For more information, see *Find Your Organization ID* in the *Cisco Umbrella SIG User Guide*.
Registration Key	Enter the Umbrella Management API Key. For more information, see *Management and Provisioning* > *Getting Started* > *Overview* in the *Cloud Security API* documentation on the Cisco DevNet portal.

Field	Description
Secret	Enter the Umbrella Management API Secret. For more information, see *Management and Provisioning* > *Getting Started* > *Overview* in the *Cloud Security API* documentation on the Cisco DevNet portal.

2. To save the template, click **Save**.

Create Zscaler SIG Credentials Template

Minimum release: Cisco vManage Release 20.9.1

When you Create Automatic Tunnels Using a SIG Feature Template, on page 135, on selecting Zscaler as the SIG provider, Cisco vManage prompts you to create the global SIG credentials template, if you haven't yet created the template. Click **Click here to create - SIG Credentials template** to create the Zscaler SIG credentials template.

Template Name and **Description** fields are prefilled:

Table 50: SIG Credentials Template Name and Description

Field	Description
Template Name	(Read only) Zscaler-Global-Credentials
Description	(Read only) Global credentials for Zscaler

1. In the **Basic Details** section, enter the Zscaler credentials:

Table 51: Zscaler Credentials

Field	Description
SIG Provider	(Read only) Zscaler
Organization	Name of the organization in Zscaler cloud. For more information, see *ZIA Help* > *Getting Started* > *Admin Portal* > *About the Company Profile*.
Partner base URI	This is the base URI that Cisco vManage uses in REST API calls. To find this information on the Zscaler portal, see *ZIA Help* > *ZIA API* > *API Developer & Reference Guide* > *Getting Started*.
Username	Username of the SD-WAN partner account.
Password	Password of the SD-WAN partner account.
Partner API key	Partner API key. To find the key in Zscaler, see *ZIA Help* > *Partner Integrations* > *Managing SD-WAN Partner Keys*.

2. To save the template, click **Save**.

Create SIG Credentials Template

Applicable releases: Cisco vManage Release 20.8.x and earlier releases.

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Feature Templates**.

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

3. Click **Add Template**.
4. Choose the device for which you are creating the template.
5. Under **Other Templates**, click **SIG Credentials**.
6. In the **Template Name** field, enter a name for the feature template.

   This field is mandatory and can contain only uppercase and lowercase letters, the digits 0 through 9, hyphens (-), and underscores (_). It cannot contain spaces or any other characters.
7. In the **Description** field, enter a description for the feature template.
8. In **Basic Details** section, do the following:

   a. **SIG Provider**: Click **Umbrella** or **Zscaler**.

   b. For Cisco Umbrella, enter the following registration parameters or click **Get Keys** to have Cisco vManage fetch these parameters from the Cisco Umbrella portal.

      - **Organization ID**
      - **Registration Key**
      - **Secret**

      To fetch the parameters, Cisco vManage uses your Smart Account credentials to connect to the Cisco Umbrella portal. To manually enter the parameters, generate the values in your Umbrella account as described here.

   c. For Zscaler, enter the following details:

Field	Description
Organization	The name of the organization in Zscaler cloud. To find this information in Zscaler, see **Administration** > **Company Profile**.
Partner base URI	This is the Zscaler Cloud API that Cisco SD-WAN uses to connect to Zscaler. To find this information in Zscaler, see **Administration** > **API Key Management**.
Username	Username of the SD-WAN partner account.
Password	Password of the SD-WAN partner account.

Field	Description
Partner API key	The partner API key. To find the key in Zscaler, see **Zscaler Cloud Administration** > **Partner Integrations** > **SD-WAN**.

9. Click **Save**.

Create Automatic Tunnels Using a SIG Feature Template

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Feature Templates**.

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

3. Click **Add Template**.
4. Choose the device for which you are creating the template.
5. Under **VPN**, click **Secure Internet Gateway (SIG)**.
6. In the **Template Name** field, enter a name for the feature template.

   This field is mandatory and can contain only uppercase and lowercase letters, the digits 0 to 9, hyphens (-), and underscores (_). It cannot contain spaces or any other characters.
7. In the **Description** field, enter a description for the feature template.
8. (From Cisco vManage Release 20.9.1) **SIG Provider**: Click **Umbrella** or **Zscaler**.

   From Cisco vManage Release 20.9.1, on selecting **Umbrella** or **Zscaler** as the SIG provider, Cisco vManage prompts you to create the corresponding global SIG credentials template if you haven't yet created the template. Click **Click here to create - SIG Credentials template** to create the Cisco Umbrella or Zscaler SIG credentials template.
9. To create one or more trackers to monitor tunnel health, do the following in the **Tracker** section:

Note From Cisco SD-WAN Release 20.5.1 and Cisco vManage Release 20.5.1 , you can create customized trackers to monitor the health of automatic tunnels. If you do not customize the SLA parameters, Cisco vManage creates a default tracker for the tunnel.

   a. Click **New Tracker**.
   b. Configure the following:

Table 52: Tracker Parameters

Field	Description
Name	Enter a name for the tracker. The name can be up to 128 alphanumeric characters.

Field	Description
Threshold	Enter the wait time for the probe to return a response before declaring that the configured endpoint is down. **Range**: 100 to 1000 milliseconds **Default**: 300 milliseconds.
Interval	Enter the time interval between probes to determine the status of the configured endpoint. **Range**: 20 to 600 seconds **Default**: 60 seconds
Multiplier	Enter the number of times to resend probes before determining that a tunnel is down. **Range**: 1 to 10 **Default**: 3
API url of endpoint	Specify the API URL for the SIG endpoint of the tunnel.

Note Prior to Cisco vManage Release 20.8.1, SIG tracker monitor statistics were reset at every Domain Name System (DNS) cache timeout interval.

Beginning with Cisco vManage Release 20.8.1, SIG tracker monitor statistics are no longer reset at every DNS cache timeout interval. SIG tracker monitor statistics are reset every two hours. A SIG tracker allows you to track the health of your SIG tunnels.

c. Click **Add**.

d. To add more trackers, repeat sub-step **b** to sub-step **d**.

10. To create tunnels, do the following in the **Configuration** section:

a. (Cisco 20.8.x and earlier releases) **SIG Provider**: Click **Umbrella** or **Zscaler**.

b. Click **Add Tunnel**.

c. Under **Basic Settings**, configure the following:

Table 53: Basic Settings

Field	Description
Interface Name (0..255)	Enter the interface name. **Note** If you have attached the Cisco VPN Interface IPSec feature template to the same device, ensure that the interface number you enter is different from what you have entered in the IPSec template.
Description	Enter a description for the interface.

Field	Description
Tracker	By default, a tracker is attached to monitor the health of automatic tunnels to Cisco Umbrella or Zscaler. If you configured a customized tracker in step **8**, choose the tracker. **Note** From Cisco SD-WAN Release 20.5.1 and Cisco vManage Release 20.5.1, you can create customized trackers to monitor the health of automatic tunnels.
Tunnel Source Interface	Enter the name of the source interface of the tunnel. This interface should be the egress interface and is typically the internet-facing interface.
Data-Center	For a primary data center, click **Primary**, or for a secondary data center, click **Secondary**. Tunnels to the primary data center serve as active tunnels, and tunnels to the secondary data center serve as back-up tunnels.

d. (Optional) Under **Advanced Options**, configure the following:

Table 54: General

Field	Description
Shutdown	Click **No** to enable the interface; click **Yes** to disable. **Default**: **No**.
Track this interface for SIG	Enable or disable tracker for the tunnel. By default, Cisco vManage enables a tracker for automatic tunnels. **Default**: **On**.
IP MTU	Specify the maximum MTU size of packets on the interface. **Range**: 576 to 2000 bytes **Default**: 1400 bytes
TCP MSS	Specify the maximum segment size (MSS) of TPC SYN packets. By default, the MSS is dynamically adjusted based on the interface or tunnel MTU such that TCP SYN packets are never fragmented. **Range**: 500 to 1460 bytes **Default**: None
DPD Interval	Specify the interval for IKE to send Hello packets on the connection. **Range**: 10 to 3600 seconds **Default**: 10

Field	Description
DPD Retries	Specify the number of seconds between DPD retry messages if the DPD retry message is missed by the peer. Once 1 DPD message is missed by the peer, the router moves to a more aggressive state and sends the DPD retry message at the faster retry interval, which is the number of seconds between DPD retries if the DPD message is missed by the peer. The default DPD retry message is sent every 2 seconds. Five aggressive DPD retry messages can be missed before the tunnel is marked as down. **Range**: 2 to 60 seconds **Default**: 3

Table 55: IKE

Field Name	Description
IKE Rekey Interval	Specify the interval for refreshing IKE keys. **Range:** 300 to 1209600 seconds (1 hour to 14 days) **Default**: 14400 seconds
IKE Cipher Suite	Specify the type of authentication and encryption to use during IKE key exchange. Choose one of the following: • AES 256 CBC SHA1 • AES 256 CBC SHA2 • AES 128 CBC SHA1 • AES 128 CBC SHA2 **Default**: AES 256 CBC SHA1
IKE Diffie-Hellman Group	Specify the Diffie-Hellman group to use in IKE key exchange, whether IKEv1 or IKEv2. • 2 1024-bit modulus • 14 2048-bit modulus • 15 3072-bit modulus • 16 4096-bit modulus **Default**: 14 2048-bit modulus

Table 56: IPSEC

Field	Description
IPsec Rekey Interval	Specify the interval for refreshing IPSec keys. **Range**: 300 to 1209600 seconds (1 hour to 14 days) **Default**: 3600 seconds
IPsec Replay Window	Specify the replay window size for the IPsec tunnel. **Options**: 64, 128, 256, 512, 1024, 2048, 4096. **Default**: 512
IPsec Cipher Suite	Specify the authentication and encryption to use on the IPsec tunnel. Options: • AES 256 CBC SHA1 • AES 256 CBC SHA 384 • AES 256 CBC SHA 256 • AES 256 CBC SHA 512 • AES 256 GCM • NULL SHA1 • NULL SHA 384 • NULL SHA 256 • NULL SHA 512 **Default**: AES 256 GCM
Perfect Forward Secrecy	• Specify the PFS settings to use on the IPsec tunnel. • Choose one of the following Diffie-Hellman prime modulus groups: • Group-2 1024-bit modulus • Group-14 2048-bit modulus • Group-15 3072-bit modulus • Group-16 4096-bit modulus • None: disable PFS. **Default**: None

e. Click **Add**.

f. To create more tunnels, repeat sub-step **b** to sub-step **e**.

11. To designate active and back-up tunnels and distribute traffic among tunnels, configure the following in the **High Availability** section:

Table 57: High Availability

Field	Description
Active	Choose a tunnel that connects to the primary data center.
Active Weight	Enter a weight (weight range 1 to 255) for load balancing. Load balancing helps in distributing traffic over multiple tunnels and this helps increase the network bandwidth. If you enter the same weights, you can achieve ECMP load balancing across the tunnels. However, if you enter a higher weight for a tunnel, that tunnel has higher priority for traffic flow. For example, if you set up two active tunnels, where the first tunnel is configured with a weight of 10, and the second tunnel with weight configured as 20, then the traffic is load-balanced between the tunnels in a 10:20 ratio.
Backup	To designate a back-up tunnel, choose a tunnel that connects to the secondary data center. To omit designating a back-up tunnel, choose **None**.
Backup Weight	Enter a weight (weight range 1 to 255) for load balancing. Load balancing helps in distributing traffic over multiple tunnels and this helps increase the network bandwidth. If you enter the same weights, you can achieve ECMP load balancing across the tunnels. However, if you enter a higher weight for a tunnel, that tunnel has higher priority for traffic flow. For example, if you set up two back-up tunnels, where the first tunnel is configured with a weight of 10, and the second tunnel with weight configured as 20, then the traffic is load-balanced between the tunnels in a 10:20 ratio.

12. (Optional) Modify the default configuration in the **Advanced Settings** section:

Table 58: Umbrella

Field	Description
Umbrella Primary Data-Center	Cisco vManage automatically selects the primary data center closest to the WAN edge device. If you wish to route traffic to a specific Cisco Umbrella data center, choose the data center from the drop-down list.
Umbrella Secondary Data-Center	Cisco vManage automatically selects the secondary data center closest to the WAN edge device. If you wish to route traffic to a specific Cisco Umbrella data center, choose the data center from the drop-down list.

Table 59: Zscaler

Field	Description
Primary Data-Center	Cisco vManage automatically selects the primary data center closest to the WAN edge device. If you wish to route traffic to a specific Zscaler data center, choose the data center from the drop-down list.
Secondary Data-Center	Cisco vManage automatically selects the secondary data center closest to the WAN edge device. If you wish to route traffic to a specific Zscaler data center, choose the data center from the drop-down list.
Authentication Required	See *ZIA Help > Traffic Forwarding > Location Management > Configuring Locations*. **Default**: Off
XFF Forwarding	See *ZIA Help > Traffic Forwarding > Location Management > Configuring Locations*. **Default**: Off
Enable Firewall	See *ZIA Help > Traffic Forwarding > Location Management > Configuring Locations*. **Default**: Off
Enable IPS Control	See *ZIA Help > Traffic Forwarding > Location Management > Configuring Locations*. **Default**: Off
Enable Caution	See *ZIA Help > Traffic Forwarding > Location Management > Configuring Locations*. **Default**: Off
Enable Surrogate IP	See *ZIA Help > Traffic Forwarding > Location Management > Configuring Locations*. **Default**: Off
Display Time Unit	See *ZIA Help > Traffic Forwarding > Location Management > Configuring Locations*. **Default**: Minute
Idle Time to Disassociation	See *ZIA Help > Traffic Forwarding > Location Management > Configuring Locations*. **Default**: 0
Enforce Surrogate IP for known browsers	See *ZIA Help > Traffic Forwarding > Location Management > Configuring Locations*. **Default**: Off

Field	Description
Refresh Time Unit	See *ZIA Help > Traffic Forwarding > Location Management > Configuring Locations*. **Default**: Minute
Refresh Time	See *ZIA Help > Traffic Forwarding > Location Management > Configuring Locations*. **Default**: 0
Enable AUP	See *ZIA Help > Traffic Forwarding > Location Management > Configuring Locations*. **Default**: Off
First Time AUP Block Internet Access	See *ZIA Help > Traffic Forwarding > Location Management > Configuring Locations*. **Default**: Off
Force SSL Inspection	See *ZIA Help > Traffic Forwarding > Location Management > Configuring Locations*. **Default**: Off
AUP Frequency	See *ZIA Help > Traffic Forwarding > Location Management > Configuring Locations*. **Default**: 0

13. Click **Save**.

Create Manual Tunnels Using SIG Feature Template

From Cisco SD-WAN Release 20.4.1 and Cisco vManage Release 20.4.1, all SIG related workflows for automatic and manual tunnels have been consolidated into the SIG template. If you are using Cisco SD-WAN Release 20.4.1 and Cisco vManage Release 20.4.1, or later, use the SIG template to configure GRE or IPSec tunnels to a third-party SIG, or GRE tunnels to a Zscaler SIG.

For a software release earlier than Cisco SD-WAN Release 20.4.1, Cisco vManage Release 20.4.1, see *Configuring a GRE Tunnel or IPsec Tunnel from Cisco vManage.*

Layer 7 Health Check: The option to create trackers and monitor the health of manually created tunnels is available from Cisco SD-WAN Release 20.8.1, Cisco vManage Relase 20.8.1. In earlier releases, the Layer 7 Health Check feature is only available if you use VPN Interface GRE/IPSEC templates, and not with SIG templates.

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Feature Templates**.

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

3. Click **Add Template**.

4. Choose the device for which you are creating the template.

5. Under **VPN**, click **Secure Internet Gateway (SIG)**.

6. In the **Template Name** field, enter a name for the feature template.

   This field is mandatory and can contain only uppercase and lowercase letters, the digits 0 to 9, hyphens (-), and underscores (_). It cannot contain spaces or any other characters.

7. In the **Description** field, enter a description for the feature template.

8. (Optional) To create one or more trackers to monitor tunnel health, do the following in the Tracker section:

Note The option to create trackers and monitor tunnel health is available from Cisco SD-WAN Release 20.8.1, Cisco vManage Relase 20.8.1.

   a. Click **New Tracker**.

   b. Configure the following:

Field	Description
Name	Enter a name for the tracker. The name can be up to 128 alphanumeric characters.
Threshold	Enter the wait time for the probe to return a response before declaring that the configured endpoint is down. **Range**: 100 to 1000 milliseconds **Default**: 300 milliseconds
Interval	Enter the time interval between probes to determine the status of the configured endpoint. **Range**: 20 to 600 seconds **Default**: 60 seconds
Multiplier	Enter the number of times to resend probes before determining that a tunnel is down. **Range**: 1 to 10 **Default**: 3
API url of endpoint	Specify the API URL for the SIG endpoint of the tunnel. **Note** Both HTTP and HTTPS API URLs are supported.

   c. Click **Add**.

   d. To add more trackers, repeat sub-step **b** to sub-step **d**.

9. To create tunnels, do the following in the **Configuration** section:

   a. **SIG** Provider: Click **Generic**.

      Cisco vManage Release 20.4.x and earlier: Click **Third Party**.

   b. Click **Add Tunnel**.

   c. Under **Basic Settings**, configure the following:

Field	Description
Tunnel Type	Based on the type of tunnel you wish to create, click **ipsec** or **gre**.
Interface Name (0..255)	Enter the interface name. **Note** If you have attached the Cisco VPN Interface IPSec feature template or the Cisco VPN Interface GRE feature template to the same device, ensure that the interface number you enter is different from what you have entered in the IPSec or GRE templates.
Description	(Optional) Enter a description for the interface.
Source Type	Click **INTERFACE** or **IP**.
Tracker	(Optional) Choose a tracker to monitor tunnel health. **Note** From Cisco SD-WAN Release 20.8.1 and Cisco vManage Relase 20.8.1, you can create trackers to monitor tunnel health.
Track this interface for SIG	Enable or disable tracker for the tunnel. By default, Cisco vManage enables a tracker for automatic tunnels. **Default**: **On**.
Tunnel Source Interface	This field is displayed only if you chose the **Source Type** as **INTERFACE.** Enter the name of the source interface of the tunnel. This interface should be an egress interface and is typically the internet-facing interface.
Tunnel Source IP Address	This field is displayed only if you chose the **Source Type** as **IP.** Enter the IP address of the tunnel source.
IPv4 address	This field is displayed only if you chose the **Source Type** as **IP.** (Optional) Enter the tunnel interface's IP address.
Tunnel Destination IP Address/FQDN	Enter the IP address of the SIG provider endpoint.
Preshared Key	This field is displayed only if you choose **ipsec** as the **Tunnel Type**. Enter the password to use with the preshared key.

d. (Optional) Under **Advanced Options**, configure the following:

Table 60: (Tunnel Type: gre) General

Field	Description
Shutdown	Click **No** to enable the interface; click **Yes** to disable. **Default**: No.
IP MTU	Specify the maximum MTU size of packets on the interface. **Range**: 576 to 2000 bytes **Default**: 1400 bytes
TCP MSS	Specify the maximum segment size (MSS) of TPC SYN packets. By default, the MSS is dynamically adjusted based on the interface or tunnel MTU such that TCP SYN packets are never fragmented. **Range**: 500 to 1460 bytes **Default**: None

Table 61: (Tunnel Type: gre) Keep Alive

Field	Description
Interval	Time duration between successive GRE keepalive messages. **Range**: 0 to 65535 seconds **Default**: 0
Retries	Number of times the keepalive messages are sent to the remote device when no response is received from the remote device. If no response is received after these many tries, the remote device is declared down. **Range**: 0 to 255 **Default**: 3

Table 62: (Tunnel Type: ipsec) General

Field	Description
Shutdown	Click **No** to enable the interface; click **Yes** to disable. **Default**: No.
IP MTU	Specify the maximum MTU size of packets on the interface. **Range**: 576 to 2000 bytes **Default**: 1400 bytes

Field	Description
TCP MSS	Specify the maximum segment size (MSS) of TPC SYN packets. By default, the MSS is dynamically adjusted based on the interface or tunnel MTU such that TCP SYN packets are never fragmented. **Range**: 500 to 1460 bytes **Default**: None
DPD Interval	Specify the interval for IKE to send Hello packets on the connection. **Range**: 0 to 65535 seconds **Default**: 10
DPD Retries	Specify how many unacknowledged packets to send before declaring an IKE peer to be dead and then removing the tunnel to the peer. **Range**: 0 to 255 **Default**:3

Table 63: (Tunnel Type: ipsec) IKE

Field	Description
IKE Rekey Interval	Specify the interval for refreshing IKE keys **Range:** 300 to 1209600 seconds (1 hour to 14 days) **Default**: 14400 seconds
IKE Cipher Suite	Specify the type of authentication and encryption to use during IKE key exchange. Choose one of the following: • AES 256 CBC SHA1 • AES 256 CBC SHA2 • AES 128 CBC SHA1 • AES 128 CBC SHA2 **Default**: AES 256 CBC SHA1

Field	Description
IKE Diffie-Hellman Group	Specify the Diffie-Hellman group to use in IKE key exchange, whether IKEv1 or IKEv2. Choose one of the following: • 2 1024-bit modulus • 14 2048-bit modulus • 15 3072-bit modulus • 16 4096-bit modulus **Default**: 16 4096-bit modulus
IKE ID for Local Endpoint	If the remote IKE peer requires a local end point identifier, specify the same. **Range**: 1 to 64 characters **Default**: Tunnel's source IP address
IKE ID for Remote Endpoint	If the remote IKE peer requires a remote end point identifier, specify the same. **Range**: 1 to 64 characters **Default**: Tunnel's destination IP address

Table 64: (Tunnel Type: ipsec) IPSEC

Field	Description
IPsec Rekey Interval	Specify the interval for refreshing IPSec keys. **Range**: 300 to 1209600 seconds (1 hour to 14 days) **Default**: 3600 seconds
IPsec Replay Window	Specify the replay window size for the IPsec tunnel. **Options**: 64, 128, 256, 512, 1024, 2048, 4096. **Default**: 512

Field	Description
IPsec Cipher Suite	Specify the authentication and encryption to use on the IPsec tunnel. Choose one of the following: • AES 256 CBC SHA1 • AES 256 CBC SHA 384 • AES 256 CBC SHA 256 • AES 256 CBC SHA 512 • AES 256 GCM • NULL SHA1 • NULL SHA 384 • NULL SHA 256 • NULL SHA 512 **Default**: NULL SHA 512
Perfect Forward Secrecy	Specify the PFS settings to use on the IPsec tunnel. Choose one of the following Diffie-Hellman prime modulus groups: • Group-2 1024-bit modulus • Group-14 2048-bit modulus • Group-15 3072-bit modulus • Group-16 4096-bit modulus • None: disable PFS. **Default**: Group-16 4096-bit modulus

e. Click **Add**.

f. To create more tunnels, repeat sub-step **b** to sub-step **e**.

10. To designate active and back-up tunnels and distribute traffic among tunnels, configure the following in the **High Availability** section:

Table 65: High Availability

Field	Description
Active	Choose a tunnel that connects to the primary data center.

Field	Description
Active Weight	Enter a weight (weight range 1 to 255) for load balancing. Load balancing helps in distributing traffic over multiple tunnels and this helps increase the network bandwidth. If you enter the same weights, you can achieve ECMP load balancing across the tunnels. However, if you enter a higher weight for a tunnel, that tunnel has higher priority for traffic flow. For example, if you set up two active tunnels, where the first tunnel is configured with a weight of 10, and the second tunnel with weight configured as 20, then the traffic is load-balanced between the tunnels in a 10:20 ratio.
Backup	To designate a back-up tunnel, choose a tunnel that connects to the secondary data center. To omit designating a back-up tunnel, choose **None**.
Backup Weight	Enter a weight (weight range 1 to 255) for load balancing. Load balancing helps in distributing traffic over multiple tunnels and this helps increase the network bandwidth. If you enter the same weights, you can achieve ECMP load balancing across the tunnels. However, if you enter a higher weight for a tunnel, that tunnel has higher priority for traffic flow. For example, if you set up two back-up tunnels, where the first tunnel is configured with a weight of 10, and the second tunnel with weight configured as 20, then the traffic is load-balanced between the tunnels in a 10:20 ratio.

11. Click **Save**.

Redirect Traffic to a SIG

You can redirect traffic to a SIG in two ways:

- Using Data Policy. For more information, see Action Parameters in the Policies Configuration Guide.
- Using the Service route to SIG. For more information, see Modify Service VPN Template, on page 149

Modify Service VPN Template

To ensure that the device connects to the SIG, you must modify the VPN template to include a service route to the SIG.

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Feature Templates**.

Note In Cisco vManage Release 20.7.1 and earlier releases, **Feature Templates** is called **Feature**.

3. For the VPN template of the device, click **Edit**.
4. Click **IPv4 Route**.
5. Click the delete icon on any existing IPv4 route to the internet.
6. Click **Service Route**.
7. Click **New Service Route**.
8. Enter a Prefix (for example, 10.0.0.0/8).
9. For the service route, ensure that **SIG** is chosen.
10. Click **Add**.
11. Click **Update**.

Create Device Template

1. From the Cisco vManage menu, choose **Configuration > Templates**.
2. Click **Device Templates**.

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

3. Click **Create Template** and click **From Feature Template**.
4. From the **Device Model** drop-down list, choose the device model for which you are creating the template.

   Cisco vManage displays all the feature templates for that device type. The required feature templates are indicated with an asterisk (*), and the remaining templates are optional. The factory-default template for each feature is chosen by default.
5. From the **Device Role** drop-down list, choose **SDWAN Edge**.
6. In the **Template Name** field, enter a name for the device template.

   This field is mandatory and can contain only uppercase and lowercase letters, the digits 0 through 9, hyphens (-), and underscores (_). It cannot contain spaces or any other characters.
7. In the **Description** field, enter a description for the device template.

   This field is mandatory, and it can contain any characters and spaces.
8. Click **Transport & Management VPN**.
9. In the **Transport & Management VPN** section, under **Additional Cisco VPN 0 Templates**, click **Secure Internet Gateway**.

10. From the **Secure Internet Gateway** drop-down list, choose the SIG feature template that you created earlier.

11. Click **Additional Templates**.

12. In the **Additional Templates** section,

    a. Automatic tunneling:

       (Cisco vManage Release 20.8.x and earlier) From the **SIG Credentials** drop-down list, choose the relevant SIG Credentials feature template.

       (From Cisco vManage Release 20.9.1) Cisco vManage automatically chooses the applicable global SIG Credentials feature template based on the SIG feature template configuration.

Note If there are any changes to the SIG credentials, for these changes to take effect, you must first remove the SIG feature template from the device template and push the device template. Thereafter, re-attach the SIG feature template and then push the template to the device. For information on pushing the device template, see Attach the SIG Template to Devices.

    b. Manual tunneling: No need to attach a **SIG Credentials** template.

13. Click **Create**.

    The new configuration template is displayed in the **Device Template** table. The **Feature Templates** column shows the number of feature templates that are included in the device template, and the **Type** column shows **Feature** to indicate that the device template was created from a collection of feature templates.

Attach Template to Devices

To attach one or more devices to the device template:

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

2. Click **Device Templates**, and choose the template that you created.

Note In Cisco vManage Release 20.7.1 and earlier releases, **Device Templates** is called **Device**.

3. For the desired template, click **...** and click **Attach Devices**.

   The Attach Devices dialog box displays.

4. In the **Available Devices** column, choose a group and search for one or more devices, choose a device from the list, or click **Select All**.

5. Click the arrow pointing right to move the device to the **Selected Devices** column.

6. Click **Attach**.

7. If the template contains variables, enter the missing variable values for each device in one of the following ways:

- Enter the values manually for each device either in the table column or by clicking **...** in the row and clicking **Edit Device Template**. When you are using optional rows, if you do not want to include the parameter for the specific device, do not specify a value.
- Click **Import File** to upload a CSV file that lists all the variables and defines each variable value for each device.

8. Click **Update**.

Configuring a GRE Tunnel or IPsec Tunnel from Cisco vManage

Table 66: Feature History

Feature Name	Release Information	Description
Manual Configuration for GRE Tunnels and IPsec Tunnels	Cisco SD-WAN Release 20.1.1	This feature lets you manually configure a GRE tunnel by using the VPN Interface GRE template or an IPSec tunnel by using the VPN Interface IPSec template. For example, use this feature to manually configure a tunnel to a SIG.

Note From Cisco SD-WAN Release 20.4.1, Cisco vManage Release 20.4.1, all SIG related workflows for Automatic and Manual Tunnels have been consolidated into the SIG template. If you are using Cisco SD-WAN Release 20.4.1, Cisco vManage Release 20.4.1, or later, configure GRE or IPSec tunnels to a generic SIG, or GRE tunnels to a Zscaler SIG, using the SIG template.

Configure Devices

You can create and store configurations for all devices—the Cisco vManage systems themselves, Cisco vSmart Controllers, Cisco vBond Orchestrators, and routers— by using Cisco vManage. When the devices start up, they contact Cisco vManage, which then downloads the device configuration to the device. (A device that is starting up first contacts the Cisco vBond Orchestrator, which validates the device and then sends it the IP address of Cisco vManage.)

The general procedure for creating configuration for all devices is the same. This section provides a high-level description of the configuration procedure. It also describes the prerequisite steps that must be performed before you can create configurations and configure devices in the overlay network.

Feature Templates

Feature templates are the building blocks of complete configuration for a device. For each feature that you can enable on a device, Cisco vManage provides a template form that you fill out. The form allows you to set the values for all configurable parameters for that feature.

Because device configurations vary for different device types and the different types of routers, feature templates are specific to the type of device.

Some features are mandatory for device operation, so creating templates for these features is required. Also for the same feature, you can create multiple templates for the same device type.

Note In releases prior to Cisco SD-WAN Release 20.7.1, if you enter < or > special characters in a Cisco vManage feature template definition or description, Cisco vManage generates a 500 exception error while attempting to preview a Cisco vManage feature template.

Starting from Cisco SD-WAN Release 20.7.1, if you enter < or > special characters in a Cisco vManage feature template definition or description, the special characters are converted to their HTML equivalents, **&lt;** and **&gt;**. This applies to all feature templates. You no longer receive a 500 exception error when previewing a Cisco vManage feature template.

Device Configuration Workflow

Devices in the overlay network that are managed by Cisco vManage must be configured from Cisco vManage. The basic configuration procedure is straightforward:

1. Create feature templates.
   a. From the Cisco vManage menu, choose **Configuration** > **Templates**.
   b. Click **Feature Templates**, and click **Add Templates**.

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

2. Create device templates.
   a. From the Cisco vManage menu, choose **Configuration** > **Templates**.
   b. Click **Device Templates**, and click **Create Templates**.

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

3. Attach device templates to individual devices.
   a. From the Cisco vManage menu, choose **Configuration** > **Templates**.
   b. Click **Device Templates**, and choose a template.

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

   c. Click **…**, and select **Attach Devices**.

Template Variables

Within a feature template, some configuration commands and command options are identical across all device types. Others—such as a device system IP address, its geographic latitude and longitude, the timezone, and the overlay network site identifier—are variable, changing from device to device. When you attach the device template to a device, you are prompted to enter actual values for these command variables. You can do this either manually, by typing the values for each variable and for each device, or you can upload an Excel file in CSV format that contains the values for each device.

Configuration Prerequisites

Security Prerequisistes

Before you can configure any device in the network, that device must be validated and authenticated so that Cisco vManage systems, Cisco vSmart Controllers, and Cisco vBond Orchestrators recognize it as being allowed in the overlay network.

To validate and authenticate the controllers in the overlay network—Cisco vManage systems, vSmart controllers, and Cisco vSmart Controllers, and Cisco vBond Orchestrators—a signed certificate must be installed on these devices.

To validate and authenticate the routers, you receive an authorized serial number file from Cisco, which lists the serial and chassis numbers for all the routers allowed in your network. Then, you upload the serial number file to Cisco vManage.

Variables Spreadsheet

The feature templates that you create most likely contain variables. To have Cisco vManage populate the variables with actual values when you attach a device template to a device, create an Excel file that lists the variable values for each device and save the file in CSV format.

In the spreadsheet, the header row contains the variable name and each row after that corresponds to a device, defining the values of the variables. The first three columns in the spreadsheet must be the following, in this order:

- csv-deviceId—Serial number of the device (used to uniquely identify the device). For routers, you receive the serial numbers in the authorized serial number file sent to you from Cisco. For other devices, the serial number is included in the signed certificate you receive from Symantec or from your root CA.

  csv-deviceIP—System IP address of the device (used to populate the **system ip address** command).

- csv-host-name—Hostname of the device (used to populate the **system hostname** command).

You can create a single spreadsheet for all devices in the overlay network—Cisco vSmart Controllers, Cisco vBond Orchestrators, and routers. You do not need to specify values for all variables for all devices.

Create a Device Template from Feature Templates

Device templates define a device's complete operational configuration. A device template consists of a number of feature templates. Each feature template defines the configuration for a particular Cisco SD-WAN software feature. Some feature templates are mandatory, indicated with an asterisk (*), and some are optional. Each mandatory feature template, and some of the optional ones, have a factory-default template. For software features that have a factory-default template, you can use either the factory-default template (named Factory_Default_*feature-name*_Template) or you can create a custom feature template.

Create a Device Template from Feature Templates

To create a device template:

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Device Templates**.

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

3. Click the **Create Template** drop-down list, and select **From Feature Template**.
4. From the **Device Model** drop-down list, select the type of device for which you wish to create the template.

   vManage NMS displays all the feature templates for that device type. The required feature templates are indicated with an asterisk (*), and the remaining templates are optional. The factory-default template for each feature is selected by default.

5. In the **Template Name** field, enter a name for the device template.

   This field is mandatory and can contain only uppercase and lowercase letters, the digits 0 through 9, hyphens (-), and underscores (_). It cannot contain spaces or any other characters.

6. In the **Description** field, enter a description for the device template.

   This field is mandatory, and it can contain any characters and spaces.

7. To view the factory-default configuration for a feature template, select the desired feature template and click **View Template**.
8. Click **Cancel** to return to the **Configuration Template** screen.
9. To create a custom template for a feature, select the desired factory-default feature template and click **Create Template**. The template form is displayed.

   This form contains fields for naming the template and defining the feature parameters.

10. In the **Template Name** field, enter a name for the feature template.

    This field is mandatory and can contain only uppercase and lowercase letters, the digits 0 through 9, hyphens (-), and underscores (_). It cannot contain spaces or any other characters.

11. In the **Description** field, enter a description for the feature template.

    This field is mandatory, and it can contain any characters and spaces.

12. For each field, enter the desired value. You may need to click a tab or the plus sign (+) to display additional fields.
13. When you first open a feature template, for each parameter that has a default value, the scope is set to Default (indicated by a check mark), and the default setting or value is shown. To change the default or to enter a value, click the scope drop-down list of the parameter field and select one of the following:

Table 67:

Parameter Scope	Scope Description
Device Specific (indicated by a host icon)	Use a device-specific value for the parameter. For device-specific parameters, you cannot enter a value in the feature template. You enter the value when you attach a device to a device template. When you click **Device Specific**, the **Enter Key** box opens. This box displays a key, which is a unique string that identifies the parameter in a CSV file that you create. This file is an Excel spreadsheet that contains one column for each key. The header row contains the key names (one key per column), and each row after that corresponds to a device and defines the values of the keys for that device. You upload the CSV file when you attach a device to a device template. For more information, see Use Variable Values in Configuration Templates. To change the default key, type a new string and move the cursor out of the **Enter Key** box. Examples of device-specific parameters are system IP address, hostname, GPS location, and site ID.
Global (indicated by a globe icon)	Enter a value for the parameter, and apply that value to all devices. Examples of parameters that you might apply globally to a group of devices are DNS server, syslog server, and interface MTUs.

14. For some groups of parameters, you can mark the entire group as device-specific. To do this, check the **Mark as Optional Row** check box.

    These parameters are then grayed out so that you cannot enter a value for them in the feature template. You enter the value or values when you attach a device to a device template.

15. Click **Save**.

16. Repeat Steps 6 through 13 to create a custom template for each additional software feature. For details on creating specific feature templates, see the templates listed in **Available Feature Templates**.

17. Click **Create**. The new configuration template is displayed in the Device Template table.

    The Feature Templates column shows the number of feature templates that are included in the device template, and the Type column shows "Feature" to indicate that the device template was created from a collection of feature templates.

Another way to create device templates from feature templates is to first create one or more custom feature templates and then create device templates. You can create multiple feature templates for the same feature. For a list of feature templates, see **Available Feature Templates**.

1. Click **Feature**.

2. Click **Add Template**.

3. From **Select Devices**, select the type of device for which you wish to create a template.

   You can create a single feature template for features that are available on multiple device types. You must, however, create separate feature templates for software features that are available only on the device type you are configuring.

4. Select the feature template. The template form is displayed.

   This form contains fields for naming the template and fields for defining the required parameters. If the feature has optional parameters, then the template form shows a plus sign (+) after the required parameters.

5. In the **Template Name** field, enter a name for the feature template.

   This field is mandatory and can contain only uppercase and lowercase letters, the digits 0 through 9, hyphens (-), and underscores (_). It cannot contain spaces or any other characters.

6. In the **Description** field, enter a description for the feature template.

   This field is mandatory, and it can contain any characters and spaces.

7. For each required parameter, choose the desired value, and if applicable, select the scope of the parameter. Select the scope from the drop-down list of each parameter's value box.

8. Click the plus sign (+) from the required parameters to set the values of optional parameters.

9. Click **Save**.

10. Repeat Steps 2 to 9 for each additional feature template you wish to create.

11. Click **Device**.

12. Click the **Create Template** drop-down list and select **From Feature Template**.

13. From the **Device Model** drop-down list, select the type of device for which you wish to create the device template.

    vManage NMS displays the feature templates for the device type you selected. The required feature templates are indicated with an asterisk (*). The remaining templates are optional.

14. In the **Template Name** field, enter a name for the device template.

    This field is mandatory and can contain only uppercase and lowercase letters, the digits 0 through 9, hyphens (-), and underscores (_). It cannot contain spaces or any other characters.

15. In the **Description** field, enter a description for the device template.

    This field is mandatory, and it can contain any characters and spaces.

16. To view the factory-default configuration for a feature template, select the desired feature template and click **View Template**.

17. Click **Cancel** to return to the **Configuration Template** screen.

18. To use the factory-default configuration, click **Create** to create the device template. The new device template is displayed in the **Device Template** table. The Feature Templates column shows the number of feature templates that are included in the device template, and the Type column shows "Feature" to indicate that the device template was created from a collection of feature templates.

19. To modify the factory-default configuration, select the feature template for which you do not wish to use the factory-default template. From the drop-down list of available feature templates, select a feature template that you created.

20. Repeat Step 19 for each factory-default feature template you wish to modify.

21. Click **Create**. The new configuration template is displayed in the **Device Template** table.

The Feature Templates column shows the number of feature templates that are included in the device template, and the Type column shows "Feature" to indicate that the device template was created from a collection of feature templates.

Create a Device CLI Template

To create a device template by entering a CLI text-style configuration directly on the Cisco vManage:

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Device Templates**.

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

3. Click the **Create Template** drop-down list and select **CLI Template**.
4. From the **Device** Type drop-down list, select the type of device for which you wish to create the template.
5. In the **Template Name** field, enter a name for the device template.

   This field is mandatory and can contain only uppercase and lowercase letters, the digits 0 through 9, hyphens (–), and underscores (_). It cannot contain spaces or any other characters.
6. In the **Description** field, enter a description for the device template.

   This field is mandatory, and it can contain any characters and spaces.
7. In the CLI Configuration box, enter the configuration either by typing it, cutting and pasting it, or uploading a file.
8. To convert an actual configuration value to a variable, select the value and click **Create Variable**. Enter the variable name, and click **Create Variable**. You can also type the variable name directly, in the format {{*variable-name*}}; for example, {{hostname}}.
9. Click **Add**. The new device template is displayed in the Device Template table.

   The **Feature Templates** column shows the number of feature templates that are included in the device template, and the Type column shows "CLI" to indicate that the device template was created from CLI text.

Configure Disaster Recovery

Table 68: Feature History

Release Name	Release Information	Feature Description
Disaster Recovery for Cisco vManage	Cisco SD-WAN Release 19.2.1 Cisco vManage Release 19.2.1	This feature helps you configure Cisco vManage in an active or standby mode to counteract hardware or software failures that may occur due to unforeseen circumstances.
Disaster Recovery for a 6 Node Cisco vManage Cluster.	Cisco SD-WAN Release 20.4.1 Cisco vManage Release 20.4.1	This feature provides support for disaster recovery for a 6 node Cisco vManage cluster.
Disaster Recovery for a Single Node Cisco vManage Cluster	Cisco SD-WAN Release 20.5.1 Cisco vManage Release 20.5.1	This feature provides support for disaster recovery for a Cisco vManage deployment with a single primary node.
Disaster Recovery User Password Change	Cisco SD-WAN Release 20.7.1 Cisco vManage Release 20.7.1	You can change the disaster recovery user password for disaster recovery components from the Cisco vManage **Disaster Recovery** window.

Out of the three controllers that make up the Cisco SD-WAN solution (Cisco vManage, Cisco vSmart Controller, and Cisco vBond Orchestrator), Cisco vManage is the only one that is stateful and cannot be deployed in an active/active mode. The goal of the disaster recovery solution is to deploy Cisco vManageCisco vManage across two data centers in primary/secondary mode.

The disaster recovery option provides automatic failover of the primary cluster to the secondary cluster. Data is replicated from the primary cluster to the secondary cluster.

There are two disaster recovery options. The option that you use depends on the function that you want the arbitrator to perform. An arbitrator is a Cisco vManage cluster that is hosted in a third data center and that monitors the connectivity and reachability of the Cisco vManage clusters that are hosted in data center 1 and data center 2. The arbitrator can detect a failure of the primary Cisco vManage cluster and issue a switchover command to the secondary Cisco vManage cluster so that the secondary cluster assumes the role of the primary cluster.

The disaster recovery options are:

- Manual—If you want to make the clusters active, you can do it manually rather than having the arbitrator do the switchover. You can specify the switchover threshold.
- Automated —Arbitrator does the monitoring of the cluster and performs the necessary action.

  A highly available Cisco SD-WAN network contains three or more Cisco vManage systems in each domain. This scenario is referred to as a Cisco vManage cluster, andCisco vManage system in a cluster is referred to as a Cisco vManage instance.

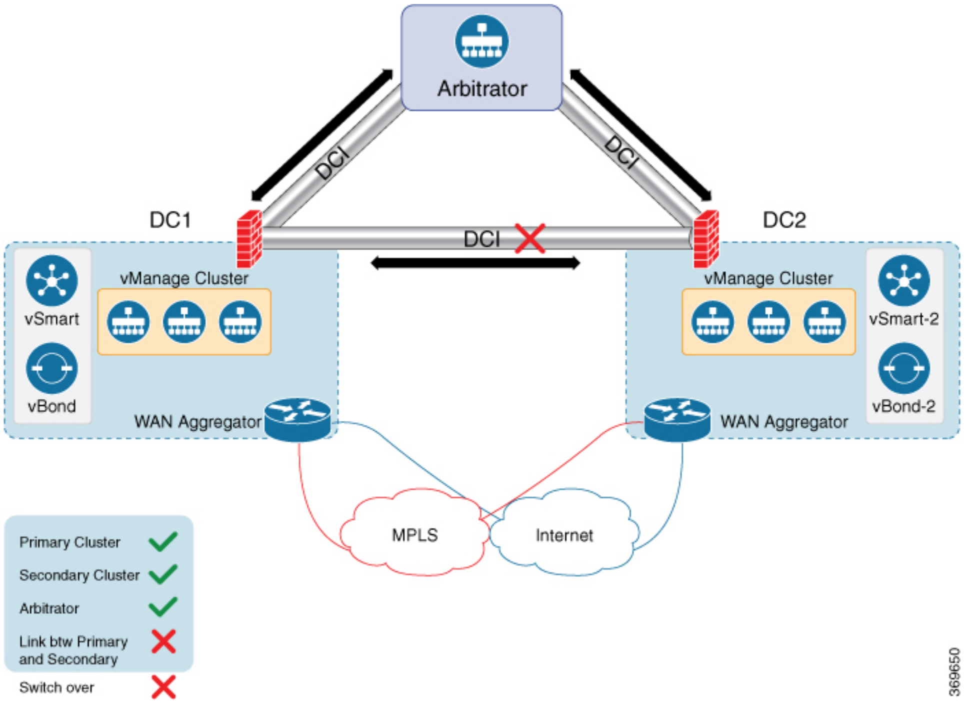
Disaster recovery is validated as follows:

- For releases earlier than Cisco IOS XE Release 17.4.1a and Cisco SD-WAN Release 20.4.1, disaster recovery is validated for a three-node cluster.
- In Cisco IOS XE Release 17.4.1a and Cisco SD-WAN Release 20.4.1, disaster recovery is validated for a six-node cluster.
- In Cisco IOS XE Release 17.5.1a and Cisco SD-WAN Release 20.5.1, disaster recovery is validated for a deployment with a single primary node.

Architecture Overview

The following diagram describes the high-level architecture of the disaster recovery solution.

The arbitrator is an additional Cisco vManage cluster that runs in arbitrator mode. The arbitrator monitors the health of the primary and the secondary clusters and performs the necessary actions.



Prerequisites

Before configuring disaster recovery, ensure that you have met the following requirements:

- For manual disaster recover configuration, ensure that you have two Cisco vManage clusters that contain the specific number of nodes as validated for your release. (The validated number of nodes for each release is described earlier in this section.)
- To configure the automated recovery option, ensure that you include an additional Cisco vManage node.
- Ensure that the primary and the secondary cluster are reachable by HTTPS on a transport VPN (VPN 0).

- Ensure that Cisco vSmart Controllers and Cisco vBond Orchestrators on the secondary cluster are connected to the primary cluster.
- Ensure that the nodes in the Cisco vManage primary cluster, the secondary cluster, and the arbitrator node are using the same Cisco vManage version.

Best Practices and Recommendations

- Ensure that you use a netadmin user privilege for Disaster Recovery registration. We recommend that you modify the factory-default password, admin before you start the registration process.
- To change user credentials, we recommend that you use the Cisco vManage GUI, and not use the CLI of a Cisco SD-WAN device.
- If Cisco vManage is configured using feature templates, ensure that you create separate feature templates for both the primary cluster and the secondary cluster. Create these templates in the primary cluster. After templates replicate to the secondary cluster, you can attach devices to templates in the secondary cluster.
- For an on-premises deployment, ensure that you regularly take backup of the Configuration database from the active Cisco vManage instance.

Changing the Cisco vManage or Cisco vBond Orchestrator Administrator Password

For releases earlier than Cisco SD-WAN Release 20.7.1, if you use Cisco vManage to change a user password that you entered during disaster recovery registration, first deregister disaster recovery from the Cisco vManage cluster, change the password, and then reregister disaster recovery on the cluster.

Changing the Disaster Recovery User Password for Disaster Recovery Components

During disaster recovery registration, you provide the user name and password of a Cisco vManage or a Cisco vBond Orchestrator user for the following disaster recovery components. You can provide the name and password of the same user for each of these components, or you can provide the names and passwords of different users for various components. The user names and passwords that you provide for a component identify the *disaster recovery user* who can access disaster recovery operations on the component.

- Cisco vManage servers in the active (primary) cluster. This component uses the password of a Cisco vManage user.
- Cisco vManage servers in the standby (secondary) cluster. This component uses the password of a Cisco vManage user.
- Arbitrator (applies only to automated disaster recovery). This component uses the password of a Cisco vManage user.
- Each Cisco vBond Orchestrator. This component uses the password of a Cisco vBond Orchestrator user.

If you change the Cisco vManage or Cisco vBond Orchestrator password of a disaster recovery user, you must change the disaster recovery component password for this user to the new password.

To change a password for the disaster recovery user, follow these steps:

1. From the Cisco vManage menu, choose **Administration** > **Disaster Recovery**.
2. Click **Pause Disaster Recovery**, and then click **OK** in the **Pause Disaster Recovery** dialog box that is displayed.

Data replication between the primary and secondary data centers stops and this option changes to **Resume Disaster Recovery**.

3. Click **Manage Password**.
4. In the **Manage Password** window, perform these actions:
    a. Click **Active Cluster**, and in the **Password** field that appears, enter the new active cluster password for the disaster recovery user.

    b. Click **Standby Cluster**, and in the **Password** field that appears, enter the new standby cluster password for the disaster recovery user.

    c. (For automatic disaster recovery only.) Click **Arbitrator**, and in the **Password** field that appears, enter the new active arbitrator password for the disaster recovery user.

    d. Click **vBond**, and in each **Password** field that appears, enter the new Cisco vBond Orchestrator password for the disaster recovery user. There is one **Password** field for each Cisco vBond Orchestrator.

    e. Click **Update**.

    The passwords are updated and the **Manage Password** window closes.

5. Click **Resume Disaster Recovery**, and then click **OK** in the **Resume Disaster Recovery** dialog box that is displayed.

    Data replication between the primary and secondary data centers restarts.

Enable Disaster Recovery on Day-0:

You need to bring up two separate clusters with no devices being shared, which means do not share any Cisco vSmart Controller, Cisco vBond Orchestrator, or Cisco vManage device.

On both clusters, configure the following:

Item	Action
Secondary cluster	Bring up the secondary Cisco vManage cluster with three Cisco vManage clusters.
Arbitrator	To assign an IP address for the OOB network, navigate to **Administration > Cluster Management**.
	Ensure reachability between the primary, secondary clusters, and arbitrator on VPN (0) using HTTPS.
	Ensure reachability between the primary cluster, secondary cluster, and Cisco vBond Orchestrators.

Verify after Registering for Disaster Recovery on Day-1

- Replication from the primary cluster to the secondary cluster happens at the configured intervals.
- Status check: **Administration > Disaster Recovery**.
- Arbitrator:

  - First health check after 15 minutes. This check provides enough time for all the nodes to be up and running with the configured disaster recovery processes.
  - Health check of the primary cluster, secondary cluster, and the arbitrator every five minutes.
  - Check the */var/log/nms/vmanage-server.log* for the status information on the arbitrator cluster.

Configure Disaster Recovery

1. From the Cisco vManage menu, choose **Administration** > **Disaster Recovery**.
2. Click **Manage Disaster Recovery**.
3. To configure primary and secondary cluster, on the Cisco vManage Disaster Recovery screen, select an IP address for any Cisco vManage node within the respective cluster.

   If a cluster is behind a load balancer, specify the IP address of the load balancer.
4. Specify the following: **Start Time**, **Replication Interval**, and **Delay Threshold** for replicating data from the primary to the secondary cluster.

   The default value for **Delay Threshold** is 30 minutes.

   The default value for **Replication Interval** is 15 minutes.
5. From the Cisco vManage menu, choose **Administration** > **Disaster Recovery**, and for Cluster 2 (Secondary), click **Make Primary**.

   It can take 10 to 15 minutes to push all changes from all the devices.
6. You can also decide to pause disaster recovery, pause replication, or delete your disaster recovery configuration.

   After disaster recovery is configured and you have replicated data, you can view the following:

   - when your data was last replicated, how long it took to replicate, and the size of the data that was replicated.
   - when the primary cluster was switched over to the secondary cluster and the reason for the switchover.
   - the replication schedule and the delay threshold.

Disaster Recovery Striking the Primary Data Center

- Switchover happens only when all the nodes in the primary data center are lost.
- The arbitrator detects the loss of all the primary data center members and initiates switchover to the secondary data center.
- Secondary data center updates the Cisco vBond Orchestrator:
  - Invalidates old Cisco vManage systems.
  - New Cisco vManage systems from the secondary data center are updated, as valid.
  - Routers reach the Cisco vBond Orchestrator after losing control connections.
  - Routers start forming control connections with the new valid Cisco vManage systems.

Troubleshooting Tips

If disaster recovery registration fails, verify the following:

- Reachability to the Cisco vBond Orchestrator from all cluster members on the secondary cluster.
- Reachability between the secondary cluster, primary cluster, and the arbitrator on the transport interface (VPN 0).
- Check that you have the correct username and password.

If disaster recovery registration fails due to arbitrator reachability, check the following:

- You must configure the arbitrator in cluster mode. From the Cisco vManage menu, choose **Administration** > **Cluster Management**, and add a Cisco vManage system as the arbitrator.
- If the IP address is not assigned to the correct arbitrator, log on to the arbitrator cluster and do the following:
  - From the Cisco vManage menu, choose **Administration** > **Cluster Management**.
  - Edit the Cisco vManage system.
  - Choose the correct IP address from the drop-down list and save the configuration.

  The disaster recovery consul process uses this IP address for disaster recovery communication. This is set once you configure the Cisco vManage system in cluster mode.

Configure GPS Using Cisco vManage

Use the GPS template for all Cisco cellular routers running Cisco SD-WAN software.

For Cisco devices running Cisco SD-WAN software, you can configure the GPS and National Marine Electronics Association (NMEA) streaming. You enable both these features to allow 4G LTE routers to obtain GPS coordinates.

Note You can configure GPS using Cisco vManage starting from the Cisco vManage Release 20.6.1 and onwards.

You can configure GPS using a Cisco vManage feature template. For geofencing to work, you need to configure GPS. To configure a GPS feature template, navigate to **Configuration** > **Templates** > **Feature Templates** > **GPS**.

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

For more information on geofencing, see Configure Geofencing.

Navigate to the Template Screen and Name the Template

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Device Templates**.

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

3. Click **Create Template**.
4. From the **Create Template** drop-down list, choose **From Feature Template**.
5. From the **Device Model** drop-down list, choose the type of device for which you wish to create the template.
6. Click **Cellular**.
7. In **Additional Cellular Controller Templates**, click **GPS**.
8. To create a custom template for GPS, click the **GPS** drop-down list and then click **Create Template**. The GPS template form is displayed. This form contains fields for naming the template, and fields for defining the GPS parameters.
9. In the **Template Name** field, enter a name for the template. The name can be up to 128 characters and can contain only alphanumeric characters.
10. In the **Template Description** field, enter a description of the template. The description can be up to 2048 characters and can contain only alphanumeric characters.

When you first open a feature template, for each parameter that has a default value, the scope is set to **Default** (indicated by a check mark), and the default setting or value is shown. To change the default or to enter a value, click the scope drop-down list to the left of the parameter field and select either **Device Specific** or **Global**.

Configure GPS

To configure GPS parameters for the cellular router, configure the following parameters. Parameters marked with an asterisk are required to configure the GPS feature.

Table 69:

Parameter Name	Description
GPS	Click **On** to enable the GPS feature on the router.
GPS Mode	Select the GPS mode: • **MS-based**—Use mobile station–based assistance, also called assisted GPS mode, when determining position. In this mode, a network data session is used to obtain the GPS satellite locations, resulting in a faster fix of location coordinates. • **Standalone**—Use satellite information when determining position. **Note** Standalone mode is currently not supported for geofencing.
NMEA	Click **On** to enable the use of NMEA streams to help in determining position. NMEA streams data from the router's 4G LTE Pluggable Interface Module (PIM) to any device, such as a Windows-based PC, that is running a commercially available GPS-based application.

Parameter Name	Description
Source Address	(Optional) Enter the IP address of the interface that connects to the router's PIM. **Note** This option is not used for configuring geofencing.
Destination Address	(Optional) Enter the IP address of the NMEA server. The NMEA server can be local or remote. **Note** This option is not used for configuring geofencing.
Destination Port	(Optional) Enter the number of the port to use to send NMEA data to the server. **Note** This option is not used for configuring geofencing.

To save the feature template, click **Save**.

Configure Groups of Interest for Centralized Policy

In **Create Groups of Interest**, create new groups of list types as described in the following sections to use in a centralized policy:

Configure Application

1. In the groups of interest list, click **Application** list type.
2. Click **New Application List**.
3. Enter a name for the list.
4. Choose either **Application** or **Application Family**.

   Application can be the names of one or more applications, such as **Third Party Control**, **ABC News**, **Mircosoft Teams**, and so on. The Cisco vEdge devices support about 2300 different applications. To list the supported applications, use the **?** in the CLI.

   Application Family can be one or more of the following: **antivirus**, **application-service**, **audio_video**, **authentication**, **behavioral**, **compression**, **database**, **encrypted**, **erp**, **file-server**, **file-transfer**, **forum**, **game**, **instant-messaging**, **mail**, **microsoft-office**, **middleware**, **network-management**, **network-service**, **peer-to-peer**, **printer**, **routing**, **security-service**, **standard**, **telephony**, **terminal**, **thin-client**, **tunneling**, **wap**, **web**, and **webmail**.
5. In the **Select** drop-down, in the 'Search' filter, select the required applications or application families.
6. Click **Add**.

A few application lists are preconfigured. You cannot edit or delete these lists.

Microsoft_Apps—Includes Microsoft applications, such as Excel, Skype, and Xbox. To display a full list of Microsoft applications, click the list in the Entries column.

Google_Apps—Includes Google applications, such as gmail, Google maps, and YouTube. To display a full list of Google applications, click the list in the Entries column.

Configure Color

1. In the groups of interest list, click **Color**.
2. Click **New Color List**.
3. Enter a name for the list.
4. In the **Select Color** drop-down, in the 'Search' filter select the required colors.

   Colors can be: 3g, biz-internet, blue, bronze, custom1 through custom3, default, gold, green, lte, metro-ethernet, mpls, private1 through private6, public-internet, red, and silver.
5. Click **Add**.

To configure multiple colors in a single list, you can select multiple colors from the drop-down.

Configure Community

Table 70: Feature History

Feature Name	Release Information	Description
Ability to Match and Set Communities	Cisco SD-WAN Release 20.5.1 Cisco IOS XE Release 17.5.1a Cisco vManage Release 20.5.1	You can create groups of communities to use in a match clause of a route map in Cisco vManage.

A community list is used to create groups of communities to use in a match clause of a route map. A community list can be used to control which routes are accepted, preferred, distributed, or advertised. You can also use a community list to set, append, or modify the communities of a route.

1. In the group of interest list, click **Community**.
2. Click **New Community List**.
3. Enter a name for the community list.
4. Choose either **Standard** or **Expanded**.
   - Standard community lists are used to specify communities and community numbers.
   - Expanded community lists are used to filter communities using a regular expression. Regular expressions are used to specify patterns to match community attributes.
5. In the **Add Community** field, enter one or more data prefixes separated by commas in any of the following formats:
   - *aa*:*nn*: Autonomous System (AS) number and network number. Each number is a 2-byte value with a range from 1 to 65535.
   - **internet**: Routes in this community are advertised to the internet community. This community comprises all BGP-speaking networking devices.
   - **local-as**: Routes in this community are not advertised outside the local AS number.

- **no-advertise**: Attaches the NO_ADVERTISE community to routes. Routes in this community are not advertised to other BGP peers.
- **no-export**: Attaches the NO_EXPORT community to routes. Routes in this community are not advertised outside the local AS or outside a BGP confederation boundary. To configure multiple BGP communities in a single list, include multiple **community** options, specifying one community in each option.

6. Click **Add**.

Configure Data Prefix

1. In the **Groups of Interest** list, click **Data Prefix**.
2. Click **New Data Prefix List**.
3. Enter a name for the list.
4. Choose either **IPv4** or **IPv6**.
5. In the **Add Data Prefix** field, enter one or more data prefixes separated by commas.
6. Click **Add**.

Configure Policer

1. In the groups of interest list, click **Policer**.
2. Click **New Policer List**.
3. Enter a name for the list.
4. Define the policing parameters:
    a. In the **Burst** field, enter the maximum traffic burst size, a value from 15,000 to 10,000,000 bytes.
    b. In the **Exceed** field, select the action to take when the burst size or traffic rate is exceeded. It can be **drop**, which sets the packet loss priority (PLP) to **low**.

       You can use the **remark** action to set the packet loss priority (PLP) to **high**.
    c. In the **Rate** field, enter the maximum traffic rate, a value from 0 through $2^{64} – 1$ bits per second (bps).
5. Click **Add**.

Configure Prefix

1. In the groups of interest list, click **Prefix**.
2. Click **New Prefix List**.
3. Enter a name for the list.
4. In the **Add Prefix** field, enter one or more data prefixes separated by commas.
5. Click **Add**.

Configure Site

1. In the groups of interest list, click **Site**.
2. Click **New Site List**.
3. Enter a name for the list.
4. In the **Add Site** field, enter one or more site IDs separated by commas.

   For example, 100 or 200 separated by commas or in the range, 1- 4294967295.
5. Click **Add**.

Configure App Probe Class

1. In the groups of interest list, click **App Probe Class**.
2. Click **New App Probe Class**.
3. Enter the probe class name in the **Probe Class Name** field.
4. Select the required forwarding class from the **Forwarding Class** drop-down list.
5. In the **Entries** pane, select the appropriate color from the **Color** drop-down list and enter the **DSCP** value.

   You can add more entries if needed by clicking on the + symbol.
6. Click **Save**.

Configure SLA Class

1. In the groups of interest list, click **SLA Class**.
2. Click **New SLA Class List**.
3. Enter a name for the list.
4. Define the SLA class parameters:
   a. In the **Loss** field, enter the maximum packet loss on the connection, a value from 0 through 100 percent.
   b. In the **Latency** field, enter the maximum packet latency on the connection, a value from 0 through 1,000 milliseconds.
   c. In the **Jitter** field, enter the maximum jitter on the connection, a value from 1 through 1,000 milliseconds.
   d. Select the required app probe class from the **App Probe Class** drop-down list.
5. (Optional) Select the **Fallback Best Tunnel** checkbox to enable the best tunnel criteria.

   This optional filed is available from Cisco SD-WAN Release 20.5.1 to pick the best path or color from the available colors when SLA is not met. When this option is selected, you can choose the required criteria from the drop-down. The criteria are a combination of one or more of loss, latency, and, jitter values.
6. Select the **Criteria** from the drop-down list. The available criteria are:

- Latency
- Loss
- Jitter
- Latency, Loss
- Latency, Jitter
- Loss, Latency
- Loss, Jitter
- Jitter, Latency
- Jitter, Loss
- Latency, Loss, Jitter
- Latency, Jitter, Loss
- Loss, Latency, Jitter
- Loss, Jitter, Latency
- Jitter, Latency, Loss
- Jitter, Loss, Latency

7. Enter the **Loss Variance (%)**, **Latency Variance (ms)**, and the **Jitter Variance (ms)** for the selected criteria.
8. Click **Add**.

Configure TLOC

1. In the groups of interest list, click **TLOC**.
2. Click **New TLOC List**. The **TLOC List** popup displays.
3. Enter a name for the list.
4. In the **TLOC IP** field, enter the system IP address for the TLOC.
5. In the **Color** field, select the TLOC's color.
6. In the **Encap** field, select the encapsulation type.
7. In the **Preference** field, optionally select a preference to associate with the TLOC.

   The range is 0 to 4294967295.
8. Click **Add TLOC** to add another TLOC to the list.
9. Click **Save**.

Note To use the `set tloc` and `set tloc-list` commands, you must use the set-vpn command.

For each TLOC, specify its address, color, and encapsulation. Optionally, set a preference value (from 0 to 232 – 1) to associate with the TLOC address. When you apply a TLOC list in an action accept condition, when multiple TLOCs are available and satisfy the match conditions, the TLOC with the highest preference value is used. If two or more of TLOCs have the highest preference value, traffic is sent among them in an ECMP fashion.

Configure VPN

1. In the groups of interest list, click **VPN**.
2. Click **New VPN List**.
3. Enter a name for the list.
4. In the **Add VPN** field, enter one or more VPN IDs separated by commas.

   For example, 100 or 200 separated by commas or in the range, 1- 65530.
5. Click **Add**.

Configure Region

Minimum release: Cisco vManage Release 20.7.1

To configure a list of regions for Multi-Region Fabric (formerly Hierarchical SD-WAN), ensure that Multi-Region Fabric is enabled in **Administration** > **Settings**.

1. In the groups of interest list, click **Region**.
2. Click **New Region List**.
3. In the **Region List Name** field, enter a name for the region list.
4. In the **Add Region** field, enter one or more regions, separated by commas, or enter a range.

   For example, specify regions 1, 3 with commas, or a range 1-4.
5. Click **Add**.

Click **Next** to move to **Configure Topology and VPN Membership** in the wizard.

Configure Groups of Interest for Localized Policy

In **Create Groups of Interest**, create lists of groups to use in a localized policy:

In Create Groups of Interest, create new groups of list types as described in the following sections to use in a localized policy:

Configure As Path

1. In the group of interest list, click **AS Path**.

2. Click **New AS Path List**.
3. Enter a name for the list.
4. Enter the AS path, separating AS numbers with a comma.
5. Click **Add**.

   AS Path list specifies one or more BGP AS paths. You can write each AS as a single number or as a regular expression. To specify more than one AS in a single path, include the list separated by commas. To configure multiple AS paths in a single list, include multiple **as-path** options, specifying one AS path in each option.

Configure Community

A community list is used to create groups of communities to use in a match clause of a route map. A community list can be used to control which routes are accepted, preferred, distributed, or advertised. You can also use a community list to set, append, or modify the communities of a route.

1. In the group of interest list, click **Community**.
2. Click **New Community List**.
3. Enter a name for the community list.
4. In the **Add Community** field, enter one or more data prefixes separated by commas in any of the following formats:
   - *aa*:*nn*: Autonomous System (AS) number and network number. Each number is a 2-byte value with a range from 1 to 65535.
   - **internet**: Routes in this community are advertised to the Internet community. This community comprises all BGP-speaking networking devices.
   - **local-as**: Routes in this community are not advertised outside the local AS number.
   - **no-advertise**: Attaches the NO_ADVERTISE community to routes. Routes in this community are not advertised to other BGP peers.
   - **no-export**: Attaches the NO_EXPORT community to routes. Routes in this community are not advertised outside the local AS or outside a BGP confederation boundary. To configure multiple BGP communities in a single list, include multiple **community** options, specifying one community in each option.
5. Click **Add**.

Configure Data Prefix

1. In the **Group of Interest** list, click **Data Prefix**.
2. Click **New Data Prefix List**.
3. Enter a name for the list.
4. Enter one or more IP prefixes.
5. Click **Add**.

A data prefix list specifies one or more IP prefixes. You can specify both unicast and multicast addresses. To configure multiple prefixes in a single list, include multiple **ip-prefix** options, specifying one prefix in each option.

Configure Extended Community

1. In the group of interest list, click **Extended Community**.
2. Click **New Extended Community List**.
3. Enter a name for the list.
4. Enter the BGP extended community in the following formats:
   - **rt** (*aa*:*nn* | *ip-address*): Route target community, which is one or more routers that can receive a set of routes carried by BGP. Specify this as the AS number and network number, where each number is a 2-byte value with a range from 1 to 65535, or as an IP address.
   - **soo** (*aa*:*nn* | *ip-address*): Route origin community, which is one or more routers that can inject a set of routes into BGP. Specify this as the AS number and network number, where each number is a 2-byte value with a range from 1 to 65535, or as an IP address. To configure multiple extended BGP communities in a single list, include multiple **community** options, specifying one community in each option.
5. Click **Add**.

Configure Class Map

1. In the group of interest list, click **Class Map**.
2. Click **New Class List**.
3. Enter a name for the class.
4. Select a required queue from the **Queue** drop-down list.
5. Click **Save**.

Configure Mirror

1. In the group of interest list, click **Mirror**.
2. Click **New Mirror List**. The Mirror List popup displays.
3. Enter a name for the list.
4. In the **Remote Destination IP** field, enter the IP address of the destination for which to mirror the packets.
5. In the **Source IP** field, enter the IP address of the source of the packets to mirror.
6. Click **Add**.

   To configure mirroring parameters, define the remote destination to which to mirror the packets, and define the source of the packets. Mirroring applies to unicast traffic only. It does not apply to multicast traffic.

Configure Policer

1. In the group of interest list, click **Policer**.
2. Click **New Policer List**.
3. Enter a name for the list.
4. In the **Burst (bps)** field, enter maximum traffic burst size. It can be a value from 15000 to 10000000 bytes.
5. In the **Exceed** field, select the action to take when the burst size or traffic rate is exceeded. Select **Drop** (the default) to set the packet loss priority (PLP) to low. Select **Remark** to set the PLP to high.
6. In the **Rate (bps)** field, enter the maximum traffic rate. It can be value from 8 through 2^{64} bps (8 through 100000000000).
7. Click **Add**.

Configure Prefix

1. In the group of interest list, click **Prefix**.
2. Click **New Prefix List**.
3. Enter a name for the list.
4. In the **Internet Protocol** field, click either **IPv4** or **IPv6**.
5. Under **Add Prefix**, enter the prefix for the list. (An example is displayed.) Optionally, click the green **Import** link on the right-hand side to import a prefix list.
6. Click **Add**.

Click **Next** to move to **Configure Forwarding Classes/QoS** in the wizard.

Configure Lawful Intercept 2.0 Workflow

Table 71: Feature History

Feature Name	Release Information	Description
Lawful Intercept 2.0	Cisco vManage Release 20.9.1	This feature lets you configure a Lawful Intercept in Cisco vManage. Cisco vManage and Cisco vSmart Controller provides LEA with key information so that they can decrypt the Cisco SD-WAN IPsec traffic captured by the MSP.

Note The Lawful Intercept feature can be configured only through Cisco vManage, and not through the CLI.

To configure Lawful Intercept in Cisco vManage, perform the following steps:

1. Create Lawful Intercept Administrator
2. Create Lawful Intercept API User
3. Create an Intercept

Configure an NTP Parent

Table 72: Feature History

Feature Name	Release Information	Feature Description
Configure a Cisco vEdge Device as an NTP Parent and Optionally to Support NTP in Symmetric Active Mode.	Cisco SD-WAN Release 20.4.1 Cisco vManage Release 20.4.1	Use the Cisco vManage device CLI template to configure a Cisco vEdge device as an NTP parent and configure the device to support NTP in symmetric active mode.

Starting with Cisco SD-WAN Release 20.4.1, you can configure a supported Cisco vEdge device as an NTP parent device by using the device CLI template. A device that is configured in this way acts as the NTP server to which other nodes in the deployment synchronize their clocks. You can configure multiple devices as NTP parents. The NTP server functionality is supported for IPv4, but not for IPv6.

You also can configure a device that is configured as an NTP parent device to support NTP in symmetric active mode. See "Configure Support for NTP in Symmetric Active Mode."

Use the following commands to configure device as an NTP parent device using a Cisco vEdge device device CLI template. For more information about configuring device CLI template, see "Create a Device CLI Template" in *Systems and Interfaces Configuration Guide*.

```
Device# config terminal
Device(config)# system
Device(config-system) ntp
Device(config-ntp)# parent
Device(config-parent)# enable
Device(config-parent)# source-interface loopback511
Device(config-parent)# stratum 6
Device(config-parent)# vpn 511
Device(config-parent)# exit
```

Restrictions and Limitations

- You can configure a device as an NTP parent only through a Cisco vManage CLI template. Cisco vManage feature templates do not support this configuration.
- The source interface must be in the same VPN that the vpn keyword defines.

Verify Configuration

Use the following show command to verify NTP parent configuration. The sample output shows that the server also is configured to support NTP in symmetric active mode.

```
Device# show running-config system ntp

system
 ntp
```

```
  keys
  authentication 101 md5 $8$vV6PtHeLdiEcLqDNLqV/mCWN5X92yT8PUPOwDCQgS4c=
  authentication 108 md5 $8$NTzFC6sRZiFUYeHw/pOY2dEoiO6dxphecDs7YnRKeuY=
  trusted 101 108
!
parent
 enable
 stratum 6
 source-interface loopback511
 vpn 511
exit
server 10.20.25.1
 source-interface ge0/1
 vpn 511
 version 4
exit
peer 172.16.10.100
 key 101
 vpn 511
 version 4
 source-interface ge0/1
exit
```

Configure On-Demand Tunnels Using Cisco vManage

Table 73: Feature History

Feature Name	Release Information	Description
Dynamic On-Demand Tunnels	Cisco SD-WAN Release 20.3.1 Cisco vManage Release 20.3.1	You can configure on-demand tunnels between any two Cisco SD-WAN spoke devices. These tunnels are triggered to be set up only when there is traffic between the two devices.

Note

- See the Prerequisites for On-Demand Tunnels.
- Do not enable on-demand on the hub device.

On the spoke devices, enable on-demand at the system level on all VPN-0 transport interfaces. In the case of multi-homed sites, enable on-demand on all systems in the site.

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Feature Templates**.

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

3. Click **Add Template**.

4. Select a device.

5. From **Basic Information**, select **Cisco System**.

6. Click **Advanced**.

7. Enable **On-demand Tunnel**.

8. (optional) Configure the **On-demand Tunnel Idle Timeout** time. The default idle timeout value is 10 minutes. Range: 1 to 65535 minutes

9. Attach the System feature template to the device template for the spoke device.

Configure Password Policies Using Cisco vManage

Table 74: Feature History

Feature Name	Release Information	Description
Support for Password Policies using Cisco AAA	Cisco SD-WAN Release 20.4.1 Cisco vManage Release 20.4.1	You can now configure password policies to ensure that your users use strong passwords and can be customized based on your requirements. To configure password policies, push the `password-policy` commands to your device using Cisco vManage device CLI templates. For more information on the `password-policy` commands, see the `aaa` command reference page.

Configure password policies for Cisco AAA by doing the following:

1. Navigate to **Configuration** > **Templates**.

2. Click **Device Templates**.

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

3. Click **Create Template**.

4. Click **CLI Template**.

5. From the **Device Model** drop-down list, choose your Cisco vEdge device.

6. Enter a **Template Name**.

7. Enter a **Description**.

8. (Optional) From the **Load Running config from reachable device:** drop-down list, choose a device from which to load the running configuration.

9. Enter or append the password policy configuration.

   For more information on the `password-policy` commands, see the `aaa` command reference page.

10. Click **Add**.

    The device templates page appears.

11. Attach the templates to your devices as described in Attach a Device Template to Devices.

Configure Port Forwarding with NAT DIA

Table 75: Feature History

Feature Name	Release Information	Description
Support for Port Forwarding with NAT DIA	Cisco vManage Release 20.9.1	With this feature, you can define one or more port-forwarding rules to send packets received on a particular port from an external network to reach devices on an internal network.

Minimum supported releases: Cisco IOS XE Release 17.9.1a, Cisco vManage Release 20.9.1

Create port-forwarding rules to allow access to a private network from the public domain.

Before You Begin

1. Configure and apply a data policy.
2. Configure a **Cisco VPN Interface Ethernet** template or edit an existing **Cisco VPN Interface Ethernet** template.
3. Configure interface overload mode. Interface overload mode is enabled by default.
4. Configure a NAT pool.

Configure Port Forwarding with NAT DIA

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Feature Templates**.

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

3. To edit a **Cisco VPN Interface Ethernet** template, click **...** adjacent to the template name and choose **Edit**.
4. Click **NAT**.
5. Under **NAT Pool**, click **New NAT Pool**.

6. Enter the required NAT pool parameters.

   For more information on the NAT pool parameters, see Configure a NAT Pool and a Loopback Interface.

7. Click **Add**.

8. To create a port-forwarding rule, click **Port Forward** > **New Port Forwarding Rule** and configure the parameters as described in the table.

Table 76: Port-Forwarding Parameters for NAT DIA

Parameter Name	Description
Protocol	Choose the **TCP** or **UDP** protocol to which to apply the port-forwarding rule. To match the same ports for both TCP and UDP traffic, configure two rules.
Source IP Address	Enter the source IP address to be translated.
Source Port	Enter a port number to define the source port to be translated. Range is 0 to 65535.
Translated Source IP Address	Specify the NAT IP address that will be advertised into OMP. Port forwarding is applied to traffic that is destined to this IP address from the overlay with the translated port match.
Translate Port	Enter the port number to apply port forwarding to. Range is 0 to 65535. Beginning with Cisco IOS XE Release 17.5.1a, static translated source IP addresses must be within the configured dynamic NAT pool IP address range.
Static NAT Direction	Select the direction in which to perform network address translation.
Source VPN ID	Specify the service-side VPN from which the traffic is being sent.

9. Click **Update**.

Configure HTTP/HTTPS Proxy Server

Table 77: Feature History

Feature Name	Release Information	Description
HTTP/HTTPS Proxy Server for Cisco vManage Communication with External Servers	Cisco SD-WAN Release 20.5.1 Cisco vManage Release 20.5.1	Cisco vManage uses HTTP/HTTPS to access some web services and for some REST API calls. With this feature, you can channel the HTTP/HTTPS communication through an HTTP/HTTPS proxy server.

1. From the Cisco vManage menu, choose **Administration** > **Settings**.
2. For the **HTTP/HTTPS Proxy** setting, click **Edit**.
3. For the **Enable HTTP/HTTPS Proxy** setting, click **Enabled**.
4. Enter the **HTTP/HTTPS Proxy IP Address** and **Port** number.
5. Click **Save**.

Note Cisco vManage uses TCP port 7 echo request to validate reachability of the proxy server. Ensure that you configure your firewall and proxy server to allow the echo requests to make the destination host ports accessible.

Cisco vManage verifies that the HTTP/HTTPS proxy server is reachable and saves the server details in the configuration database. HTTP/HTTPS connections and REST API calls to external servers are directed through the proxy server.

If the HTTP/HTTPS proxy server is not reachable, Cisco vManage displays an error message on the GUI indicating the reason for failure.

Configure Port Connectivity for Cloud OnRamp Colocation Cluster

Table 78: Feature History

Feature Name	Release Information	Description
Flexible Topologies	Cisco SD-WAN Release 20.3.1 Cisco vManage Release 20.3.1 Cisco NFVIS Release 4.2.1	You can configure the Stackwise Virtual Switch Link (SVL) and uplink ports of switches, and Cisco CSP data ports using the **Port Connectivity** configuration settings of Cloud OnRamp for Colocation cluster .
Support for SVL Port Configuration on 100G Interfaces	Cisco SD-WAN Release 20.8.1 Cisco vManage Release 20.8.1 Cisco NFVIS Release 4.8.1	With this feature, you can configure SVL ports on 100-G Ethernet interfaces of Cisco Catalyst 9500-48Y4C switches, thus ensuring a high level of performance and throughput.

Prerequisites for Configuring SVL and Uplink Ports

- When configuring the SVL and uplink ports, ensure that the port numbers you configure on Cisco vManage match the physically cabled ports.
- Ensure that you assign serial numbers to both the switches. See Create and Activate Clusters.

Configure SVL and Uplink Ports

Note Before configuring the SVL and uplink ports using the **Cluster Topology** window, ensure that you create a Cloud OnRamp for Colocation cluster. See Create and Activate Clusters.

- On the **Cluster Topology** window, click **Add** next to **Port Connectivity**.

  In the **Port Connectivity** configuration window, both the configured switches appear. Hover over a switch port to view the port number and the port type.

Note For more information about SVL and uplink ports, see Wiring Requirements in the Cisco SD-WAN Cloud OnRamp for Colocation Solution Guide.

Change Default SVL and Uplink Ports

Before you change the default port number and port type, note the following information about Cisco Catalyst 9500-40X and Cisco Catalyst 9500-48Y4C switches:

- From Cisco vManage Release 20.8.1, you can configure two SVL ports and one Dual-Active Detection (DAD) port when creating a colocation cluster with two Cisco Catalyst 9500-40X switches or two Cisco Catalyst 9500-48Y4C switches.
- To ensure that SVL and DAD ports are configured correctly for Cisco Catalyst 9500-48Y4C switches, note the following information:
  - Configure the SVL ports on same-speed interfaces, that is, either 25-G interfaces or 100-G interfaces. Ensure that both switches have the same configuration.
  - Configure the DAD port only on 25-G interfaces on both switches.
  - In case of an existing cluster, you can change the SVL ports only if it is inactive.
  - A cluster created in releases earlier than Cisco vManage Release 20.8.1 automatically displays two SVL ports and one DAD port after the upgrade to Cisco vManage Release 20.8.1.
- In case of Cisco Catalyst 9500-40X switches, you must configure the SVL and DAD ports on 10-G interfaces on both switches.
- The following are the default SVL, DAD, and uplink ports of Cisco Catalyst 9500 switches:

  Cisco Catalyst 9500-40X

  - SVL ports: Te1/0/38-Te1/0/39, and Te2/0/38-Te2/0/39

In Cisco vManage Release 20.7.x and earlier releases, the default SVL ports are Te1/0/38-Te1/0/40 and Te2/0/38-Te2/0/40.

- DAD ports: Te1/0/40 and Te2/0/40
- Uplink ports: Te1/0/36, Te2/0/36 (input VLAN handoff), Te1/0/37, and Te2/0/37 (output VLAN handoff)

Cisco Catalyst 9500-48Y4C

- SVL ports: Hu1/0/49-Hu1/0/50 and Hu2/0/49-Hu2/0/50

  In Cisco vManage Release 20.7.x and earlier releases, the default SVL ports are Twe1/0/46-Twe1/0/48 and Twe2/0/46-Twe2/0/48.
- DAD ports: Twe1/0/48 and Twe2/0/48
- Uplink ports: Twe1/0/44, Twe2/0/44 (input VLAN handoff), Twe1/0/45, and Twe2/0/45 (output VLAN handoff) for 25-G throughput.

- I, E, and S represent the ingress, egress, and SVL ports, respectively.
- Ensure that the physical cabling is the same as the default configuration, and click **Save**.

To change the default ports when the connectivity is different for SVL and uplink ports, perform the following:

1. If both the switches are using the same ports:

   a. Click a port on a switch that corresponds to a physically connected port.

   b. To add the port configuration to the other switch, check the **Apply change** check box.

   If both the switches aren’t using the same ports:

   a. Click a port on **Switch1**.

   b. Choose a port type from the **Port Type** drop-down list.

   c. Click a port on **Switch2** and then choose the port type.

2. To add another port, repeat step 1.
3. Click **Save**.
4. To edit port connectivity information, in the **Cluster Topology** window, click **Edit** next to **Port Connectivity**.

Note You can modify the SVL and uplink ports of a cluster when the cluster hasn’t been activated.

5. To reset the ports to default settings, click **Reset**.

The remaining ports (SR-IOV and OVS) on the Cisco CSP devices and the connections with switches are automatically discovered using Link Layer Discovery Protocol (LLDP) when you activate a cluster. You don't need to configure those ports.

Cisco Colo Manager (CCM) discovers switch neighbor ports and identifies whether all Niantic and Fortville ports are connected. If any port isn't connected, CCM sends notifications to Cisco vManage that you can view in the task view window.

Configure SLA Class

Table 79: Feature History

Feature Name	Release Information	Description
Best of the Worst (BOW) Tunnel Selection	Cisco vManage Release 20.5.1 Cisco SD-WAN Release 20.5.1	You can configure best tunnel path to pick the best path while configuring SLA class.

1. From the Cisco vManage menu, select **Configuration** > **Policies**. Centralized Policy is selected and displayed by default.
2. Click **Add Policy**.
3. In the create groups of interest page, from the left pane, click **SLA Class**, and then click **New SLA Class List**.
4. In the **SLA Class List Name** field, enter a name for SLA class list.
5. Define the SLA class parameters:
    a. In the **Loss** field, enter the maximum packet loss on the connection, a value from 0 through 100 percent.
    b. In the **Latency** field, enter the maximum packet latency on the connection, a value from 1 through 1,000 milliseconds.
    c. In the **Jitter** field, enter the maximum jitter on the connection, a value from 1 through 1,000 milliseconds.
    d. Choose the required app probe class from the **App Probe Class** drop-down list.
6. (Optional) Check the **Fallback Best Tunnel** check box to enable the best tunnel criteria.

    This optional field is available from Cisco SD-WAN Release 20.5.1 to pick the best path or color from the available colors when a SLA is not met. When this option is selected, you can choose the required criteria from the drop-down. The criteria are a combination of one or more of loss, latency, and jitter values.
7. Select the **Criteria** from the drop-down. The available criteria are:
    - None
    - Latency
    - Loss
    - Jitter

- Latency, Loss
- Latency, Jitter
- Loss, Latency
- Loss, Jitter
- Jitter, Latency
- Jitter, Loss
- Latency, Loss, Jitter
- Latency, Jitter, Loss
- Loss, Latency, Jitter
- Loss, Jitter, Latency
- Jitter, Latency, Loss
- Jitter, Loss, Latency

8. (Optional) Enter the **Loss Variance (%)**, **Latency Variance (ms)**, and the **Jitter Variance (ms)** for the selected criteria.

   For more information, see Configure Variance for Best Tunnel Path.

9. Click **Add**.

Configure SNMPv3 on Cisco vEdge Devices Using Cisco vManage

Table 80: Feature History

Feature Name	Release Information	Description
Support for SNMPv3 AES-256 bit Authentication Protocol	Cisco vManage Release 20.5.1 Cisco SD-WAN Release 20.5.1	You can now configure SNMPv3 users with SHA-256 protocol and AES-256 bit encryption on Cisco vEdge devices.

To configure SNMPv3, in SNMP Version, navigate to template page and configure groups and trap information:

- From the Cisco vManage menu, choose **Configuration** > **Templates**.
- Click **Device Templates**.

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

- From the **Create Template** drop-down, select **From Feature Template**.
- From the **Device Model** drop-down, select the type of device for which you are creating the template.
- Click **Additional Templates**, which scrolls the page to **Additional Templates** section.
- From the **SNMP** drop-down under Additional Templates, click **Create Template**.

  The SNMP template form is displayed. The top of the form contains fields for naming the template, and the bottom contains fields for defining SNMP parameters.
- In the **Template Name** field, enter a name for the template. The name can be up to 128 characters and can contain only alphanumeric characters.
- In the **Template Description** field, enter a description of the template. The description can be up to 2048 characters and can contain only alphanumeric characters.
- In **SNMP Version** section, click **V3**. For SNMPv3, you can configure groups, users, and trap information.
- In the Trap section, select **Trap Group** to configure trap. Then click **Add New Trap Group**, and configure the parameters as listed below:

Table 81: Trap Group Parameters for Cisco vEdge Devices

Parameter Name	Description
Group Name	Enter a name for the trap group. It can be from 1–32 characters long.
Trap Type Modules	Click **Add Trap Type Modules**, and configure the following parameters: In **Severity Levels**, select one or more severity levels for the trap. Supported security levels for the trap are critical, major, and minor. In **Module Name**, choose the type of traps to include in the trap group: • all: All trap types. • app-route: Traps generated by application-aware routing. • bfd: Traps generated by BFD and BFD sessions. • control: Traps generated by DTLS and TLS sessions. • dhcp: Traps generated by DHCP. • hardware: Traps generated by Viptela hardware. • omp: Traps generated by OMP. • routing: Traps generated by BGP, OSPF, and PIM. • security: Trap generated by certificates, vSmart and vEdge serial number files, and IPsec. • system: Traps generated by system-wide functions. • vpn: Traps generated by VPN-specific functions, including interfaces and VRRP.

To save the trap type module, click **Save**.

To configure SNMP views, in the **View & Groups** section, select **View**. Then click **New View**, and configure the following parameters:

Table 82: View and Groups Parameters

Parameter Name	Description
Name	Enter a name for the view. A view specifies the MIB objects that the SNMP manager can access. The view name can be a maximum of 255 characters. You must add a view name for all views before adding a group.
Object Identifiers (OID)	Click **Add Object Identifiers** and configure the following parameters: • Object Identifier: Enter the OID of the object. For example, to view the Internet portion of the SNMP MIB, enter the OID 1.3.6.1. To view the private portion of the Cisco SD-WAN MIB, enter the OID 1.3.6.1.4.1.41916. Use the asterisk wildcard (*) in any position of the OID subtree to match any value at that position rather than matching a specific type or name. **Note** Starting from Cisco vManage Release 20.6.1, SNMPv3 configuration of user with auth "sha-256" and priv "aes-256-cfb-128" does not support oid with (*) wildcard. • Exclude OID: Click **Off** to include the OID in the view or click **On** to exclude the OID from the view. To remove an OID from the list, click the **Delete** icon for the entry. To add the OIDs to the view list, click **Add**.

To configure the SNMP group, click **New Group**, and configure the following parameters:

Note It's mandatory to create an SNMP view before you proceed with SNMP group configuration.

Table 83: SNMP Group Parameters for Cisco vEdge Devices

Parameter Name	Description
Name	Enter the name for the group. The name can be from 1 through 32 characters and can include angle brackets (< and >).

Parameter Name	Description
Security Level	Choose the **Security Level** from the drop-down for the SNMPv3 security model: SNMPv3 is a security model in which an authentication strategy for a user and the group in which the user resides are set up. A security level is the permitted level of security within a security model. • noAuthNoPriv: Uses a username match for authentication. • authNoPriv: Provides authentication based on the Message Digest 5 (MD5) or Secure Hash Algorithm (SHA) algorithms. • authPriv: Provides authentication based on the HMAC-MD5 or HMAC-SHA algorithms. Provides DES 56-bit encryption in addition to authentication based on the CBC-DES (DES-56) standard.
View	Choose the view from the drop-down to apply to the group. The view specifies the portion of the MIB tree the group can access.

To add the SNMP group, click **Add**.

In the User section, click **Add New User** and enter the following parameters to configure SNMPv3 users:

Table 84: SNMPv3 User Parameters

Parameter Name	Description
User	Enter a name of the SNMP user. It can be 1–32 alphanumeric characters.
Authentication Protocol	Choose the authentication mechanism for the user: • MD5 digest. • SHA-1 message digest. • SHA-256 message digest. **Note** Starting from Cisco SD-WAN Release 20.5.1, SHA-256 authentication protocol was introduced. When you choose SHA-256 as the authentication protocol, you must set the security level as `authPriv`. **Note** MD5 authentication protocol is deprecated for Cisco SD-WAN Release 20.3.2 and later releases.
Authentication Password	If you have the localized MD5 or SHA digest, you can specify the respective string as password. The digest is in the format aa:bb:cc:dd where aa, bb, cc, and dd are hexadecimal values. Also, the digest should be exactly 16 octets in length.

Parameter Name	Description
Privacy Protocol	Choose the privacy type for the user: • For SHA-1 authentication protocol choose AES-CFB-128—Advanced Encryption Standard cipher algorithm is used in cipher feedback mode, with a 128-bit key. • Starting from Cisco SD-WAN Release 20.5.1, for SHA-256 authentication protocol choose AES-256-CFB-128—Advanced Encryption Standard cipher algorithm is used in cipher feedback mode, with a 256-bit key. **Note** An authentication protocol SHA-1 is no longer supported and when a trap target is configured with SHA-1 for an SNMPv3 user, no SNMP trap is generated. You need to configure an SNMPv3 user with the SHA-256 authentication protocol.
Privacy Password	Enter the authentication password either in cleartext or as an AES-encrypted key.
Group	Choose the group name from the drop-down. All the configured SNMPv3 group names are listed in the drop-down.

To configure trap target servers, in the Trap section, select **Trap Target Server**. Then click **Add New Trap Group**, and configure the parameters as listed below:

Note It's mandatory to create User before creating Trap Target Server.

Table 85: Trap Target Server Parameters

Parameter Name	Description
VPN ID	Enter the number of the VPN to use to reach the trap server. *Range:* 0–65530.
IP Address	Enter the IP address of the SNMP server.
UDP Port	Enter the UDP port number for connecting to the SNMP server. *Range:* 1 though 65535.
User Name	Choose the name of the user from the drop-down.
Source Interface	Enter the interface used to send traps to the remote SNMP server.

To add the Trap Target Server, click **Add**.

To save the feature template, click **Save**.

Note The SNMP walk application is blocked if you switch the SNMPv3 configuration to SNMPv2 configuration in the device template and apply this change through a template push. This is because the **snmp mib community-map** command for SNMPv3 isn't removed during the configuration change. Hence, you cannot switch from SNMPv3 to SNMPv2 directly, when the SNMPv3 configuration template is active. To switch to SNMPv2, you must first remove the SNMPv3 configuration from the device and then push the SNMPv2 template through a separate commit.

Configure Traffic Rules

Table 86: Feature History

Feature Name	Release Information	Description
Policy Matching with ICMP Message	Cisco SD-WAN Release 20.4.1 Cisco vManage Release 20.4.1	You can now define a new match condition that can be used to specify a list of ICMP messages for centralized data policies, localized data policies, and Application-Aware Routing policies.

When you first open the **Configure Traffic Rules** window, **Application-Aware Routing** is selected by default.

You can also view already created AAR routing policies listed in the page. It provides various information related to the policies such as the Name of the policy, Type, Mode, Description, Update By, and Last Updated details.

Note You can refer to the Mode column for the security status details of the policy. The status helps to differentiate whether the policy is used in unified security or not. The mode status is applicable only for security policies and not relevant to any centralized or localized policies.

For more information on configuring traffic rules for the SD-WAN Application Intelligence Engine (SAIE) flow, see SD-WAN Application Intelligence Engine Flow.

Note In Cisco vManage Release 20.7.x and earlier releases, the SAIE flow is called the deep packet inspection (DPI) flow.

To configure traffic rules for a centralized data policy:

1. Click **Traffic Data**.
2. Click the **Add Policy** drop-down.
3. Click **Create New**. The **Add Data Policy** window displays.
4. Enter a name and a description for the data policy.

5. In the right pane, click **Sequence Type**. The **Add Data Policy** popup opens.

6. Select the type of data policy you want to create, **Application Firewall**, **QoS**, **Service Chaining**, **Traffic Engineering**, or **Custom**.

Note If you want to configure multiple types of data policies for the same match condition, you need to configure a custom policy.

7. A policy sequence containing the text string **Application**, **Firewall**, **QoS**, **Service Chaining**, **Traffic Engineering**, or **Custom** is added in the left pane.

8. Double-click the text string, and enter a name for the policy sequence. The name you type is displayed both in the Sequence Type list in the left pane and in the right pane.

9. In the right pane, click **Sequence Rule**. The **Match/Action** box opens, and **Match** is selected by default. The available policy match conditions are listed below the box.

Match Condition	Procedure
None (match all packets)	Do not specify any match conditions.
Applications /Application Family List	**a.** In the **Match** conditions, click **Applications/Application Family List**. **b.** In the drop-down, select the application family. **c.** To create an application list: **1.** Click **New Application List**. **2.** Enter a name for the list. **3.** Click **Application** to create a list of individual applications. Click **Application Family** to create a list of related applications. **4.** In the **Select Application** drop-down, select the desired applications or application families. **5.** Click **Save**.
Destination Data Prefix	**a.** In the **Match** conditions, click **Destination Data Prefix**. **b.** To match a list of destination prefixes, select the list from the drop-down. **c.** To match an individual destination prefix, enter the prefix in the **Destination: IP Prefix** field.
Destination Port	**a.** In the **Match** conditions, click **Destination Port**. **b.** In the **Destination Port** field, enter the port number. Specify a single port number, a list of port numbers (with numbers separated by a space), or a range of port numbers (with the two numbers separated with a hyphen [-]).

Match Condition	Procedure
DNS Application List	Add an application list to enable split DNS. **a.** In the **Match** conditions, click **DNS Application List**. **b.** In the drop-down, select the application family.
DNS	Add an application list to process split DNS. **a.** In the **Match** conditions, click **DNS**. **b.** In the drop-down, select **Request** to process DNS requests for the DNS applications, and select **Response** to process DNS responses for the applications.
DSCP	**a.** In the **Match** conditions, click **DSCP**. **b.** In the **DSCP** field, type the DSCP value, a number from 0 through 63.
Packet Length	**a.** In the **Match** conditions, click **Packet Length**. **b.** In the **Packet Length** field, type the length, a value from 0 through 65535.
PLP	**a.** In the **Match** conditions, click **PLP** to set the **Packet Loss Priority**. **b.** In the **PLP** drop-down, select **Low** or **High**. To set the PLP to **High**, apply a policer that includes the **exceed remark** option.
Protocol	**a.** In the **Match** conditions, click **Protocol**. **b.** In the **Protocol** field, type the Internet Protocol number, a number from 0 through 255.
ICMP Message	To match ICMP messages, in the Protocol field, set the Internet Protocol Number to 1, or 58, or both. **Note** This field is available from , Cisco SD-WAN Release 20.4.1 Cisco vManage Release 20.4.1.
Source Data Prefix	**a.** In the **Match** conditions, click **Source Data Prefix**. **b.** To match a list of source prefixes, select the list from the drop-down. **c.** To match an individual source prefix, enter the prefix in the **Source** field.
Source Port	**a.** In the **Match** conditions, click **Source Port**. **b.** In the **Source** field, enter the port number. Specify a single port number, a list of port numbers (with numbers separated by a space), or a range of port numbers (with the two numbers separated with a hyphen [-]).
TCP	**a.** In the **Match** conditions, click **TCP**. **b.** In the **TCP** field, **syn** is the only option available.

10. For QoS and Traffic Engineering data policies: From the **Protocol** drop-down list, select **IPv4** to apply the policy only to IPv4 address families, **IPv6** to apply the policy only to IPv6 address families, or **Both** to apply the policy to IPv4 and IPv6 address families.
11. To select one or more **Match** conditions, click its box and set the values as described.

Note Not all match conditions are available for all policy sequence types.

12. To select actions to take on matching data traffic, click the **Actions** box.
13. To drop matching traffic, click **Drop**. The available policy actions are listed in the right side.
14. To accept matching traffic, click **Accept**. The available policy actions are listed in the right side.
15. Set the policy action as described.

Note Not all actions are available for all match conditions.

Action Condition	Description	Procedure
Counter	Count matching data packets.	a. In the **Action** conditions, click **Counter**. b. In the **Counter Name** field, enter the name of the file in which to store packet counters.
DSCP	Assign a DSCP value to matching data packets.	a. In the **Action** conditions, click **DSCP**. b. In the **DSCP** field, type the DSCP value, a number from 0 through 63.
Forwarding Class	Assign a forwarding class to matching data packets.	a. In the **Match** conditions, click **Forwarding Class**. b. In the **Forwarding Class** field, type the class value, which can be up to 32 characters long.
Log	Place a sampled set of packets that match the SLA class rule into system logging (syslog) files. In addition to logging the packet headers, a syslog message is generated the first time a packet header is logged and then every 5 minutes thereafter, as long as the flow is active.	a. In the **Action** conditions, click **Log** to enable logging.
Policer	Apply a policer to matching data packets.	a. In the **Match** conditions, click **Policer**. b. In the **Policer** drop-down field, select the name of a policer.

Action Condition	Description	Procedure
Loss Correction	Apply loss correction to matching data packets. Forward Error Correction (FEC) recovers lost packets on a link by sending redundant data, enabling the receiver to correct errors without the need to request retransmission of data. FEC is supported only for IPSEC tunnels, it is not supported for GRE tunnels. • **FEC Adaptive** – Corresponding packets are subjected to FEC only if the tunnels that they go through have been deemed unreliable based on measured loss. Adaptive FEC starts to work at 2% packet loss; this value is hard-coded and is not configurable. • **FEC Always** – Corresponding packets are always subjected to FEC. • **Packet Duplication** – Sends duplicate packets over a single tunnel. If more than one tunnel is available, duplicated packets will be sent over the tunnel with the best parameters.	**a.** In the **Match** conditions, click **Loss Correction**. **b.** In the **Loss Correction** field, select **FEC Adaptive**, **FEC Always**, or **Packet Duplication**.
Click **Save Match and Actions**.		

16. Create additional sequence rules as desired. Drag and drop to re-arrange them.
17. Click **Save Data Policy**.
18. Click **Next** to move to **Apply Policies to Sites and VPNs** in the wizard.

Match Parameters - Data Policy

A centralized data policy can match IP prefixes and fields in the IP headers, as well as applications. You can also enable split DNS.

Each sequence in a policy can contain one match condition.

Table 87:

Match Condition	Description
Omit	Match all packets.
Applications/Application Family List	Applications or application families.
Destination Data Prefix	Group of destination prefixes, IP prefix and prefix length. The range is 0 through 65535; specify a single port number, a list of port numbers (with numbers separated by a space), or a range of port numbers (with the two numbers separated with a hyphen [-]).

Match Condition	Description
Destination Region	Choose one of the following: • **Primary**: Match traffic if the destination device is in the same primary region (also called access region) as the source. This traffic reaches the destination using a multi-hop path, through the core region. • **Secondary**: Match traffic if the destination device is not in the same primary region as the source but is within the same secondary region as the source. This traffic can reach the destination using a direct tunnel, as described for secondary regions. • **Other**: Match traffic if the destination device is not in the same primary region or secondary region as the source. This traffic requires a multi-hop path from the source to the destination. **Note** Minimum releases: Cisco vManage Release 20.9.1, Cisco IOS XE Release 17.9.1a
DNS Application List	Enables split DNS, to resolve and process DNS requests and responses on an application-by-application basis. Name of an **app-list** list . This list specifies the applications whose DNS requests are processed.
DNS	Specify the direction in which to process DNS packets. To process DNS requests sent by the applications (for outbound DNS queries), specify **dns request**. To process DNS responses returned from DNS servers to the applications, specify **dns response**.
DSCP	Specifies the DSCP value.
Packet length	Specifies the packet length. The range is 0 through 65535; specify a single length, a list of lengths (with numbers separated by a space), or a range of lengths (with the two numbers separated with a hyphen [-]).
Packet Loss Priority (PLP)	Specifies the packet loss priority. By default, packets have a PLP value of **low**. To set the PLP value to **high**, apply a policer that includes the **exceed remark** option.
Protocol	Specifies Internet protocol number. The range is 0 through 255.
ICMP Message	For Protocol IPv4 when you enter a Protocol value as 1, the **ICMP Message** field displays where you can select an ICMP message to apply to the data policy. Likewise, the **ICMP Message** field displays for Protocol IPv6 when you enter a Protocol value as 58. When you select Protocol as Both, the **ICMP Message or ICMPv6 Message** field displays. **Note** This field is available from , Cisco SD-WAN Release 20.4.1 Cisco vManage Release 20.4.1.
Source Data Prefix	Specifies the group of source prefixes or an individual source prefix.
Source Port	Specifies the source port number. The range is 0 through 65535; specify a single port number, a list of port numbers (with numbers separated by a space), or a range of port numbers (with the two numbers separated with a hyphen [-]).
TCP Flag	Specifies the TCP flag, syn.
Traffic To	In a Multi-Region Fabric architecture, match border router traffic flowing to the access region that the border router is serving, the core region, or a service VPN. **Note** Minimum release: Cisco vManage Release 20.8.1

Table 88: ICMP Message Types/Codes and Corresponding Enumeration Values

Type	Code	Enumeration
0	0	echo-reply
3		unreachable
	0	net-unreachable
	1	host-unreachable
	2	protocol-unreachable
	3	port-unreachable
	4	packet-too-big
	5	source-route-failed
	6	network-unknown
	7	host-unknown
	8	host-isolated
	9	dod-net-prohibited
	10	dod-host-prohibited
	11	net-tos-unreachable
	12	host-tos-unreachable
	13	administratively-prohibited
	14	host-precedence-unreachable
	15	precedence-unreachable
5		redirect
	0	net-redirect
	1	host-redirect
	2	net-tos-redirect
	3	host-tos-redirect
8	0	echo
9	0	router-advertisement
10	0	router-solicitation
11		time-exceeded
	0	ttl-exceeded
	1	reassembly-timeout

12		parameter-problem
	0	general-parameter-problem
	1	option-missing
	2	no-room-for-option
13	0	timestamp-request
14	0	timestamp-reply
40	0	photuris
42	0	extended-echo
43		extended-echo-reply
	0	echo-reply-no-error
	1	malformed-query
	2	interface-error
	3	table-entry-error
	4	multiple-interface-match

Table 89: ICMPv6 Message Types/Codes and Corresponding Enumeration Values

Type	Code	Enumeration
1		unreachable
	0	no-route
	1	no-admin
	2	beyond-scope
	3	destination-unreachable
	4	port-unreachable
	5	source-policy
	6	reject-route
	7	source-route-header
2	0	packet-too-big
3		time-exceeded
	0	hop-limit
	1	reassembly-timeout

4		parameter-problem
	0	Header
	1	next-header
	2	parameter-option
128	0	echo-request
129	0	echo-reply
130	0	mld-query
131	0	mld-report
132	0	mld-reduction
133	0	router-solicitation
134	0	router-advertisement
135	0	nd-ns
136	0	nd-na
137	0	redirect
138		router-renumbering
	0	renum-command
	1	renum-result
	255	renum-seq-number
139		ni-query
	0	ni-query-v6-address
	1	ni-query-name
	2	ni-query-v4-address
140		ni-response
	0	ni-response-success
	1	ni-response-refuse
	2	ni-response-qtype-unknown
141	0	ind-solicitation
142	0	ind-advertisement
143		mldv2-report
144	0	dhaad-request
145	0	dhaad-reply
146	0	mpd-solicitation
147	0	mpd-advertisement

148	0	cp-solicitation
149	0	cp-advertisement
151	0	mr-advertisement
152	0	mr-solicitation
153	0	mr-termination
155	0	rpl-control

Match Parameters

Access List Parameters

Access lists can match IP prefixes and fields in the IP headers.

In the CLI, you configure the match parameters with the **policy access-list sequence match** command.

Each sequence in an access-list must contain one match condition.

For access lists, you can match these parameters:

Match Condition	Description
Class	Name of a class defined with a **policy class-map** command.
Destination Data Prefix	Name of a data-prefix-list list.
Destination Port	Specifies a single port number, a list of port numbers (with numbers separated by a space), or a range of port numbers (with the two numbers separated with a hyphen [-]). The range is 0 through 65535.
DSCP	Specifies the DSCP value. The range is 0 through 63.
Protocol	Specifies the internet protocol number. The range is 0 through 255.
ICMP Message	When you select a Protocol value as 1 the **ICMP Message** field displays where you can select an ICMP message to apply to the data policy. When you select a Next Header value as 58 the **ICMP Message** field displays where you can select an ICMP message to apply to the data policy. **Note** This field is available from , Cisco SD-WAN Release 20.4.1 Cisco vManage Release 20.4.1.
Packet Length	Specifies the length of the packet. The range can be from 0 through 65535. Specify a single length, a list of lengths (with numbers separated by a space), or a range of lengths (with the two numbers separated with a hyphen [-]).
Source Data Prefix	Specifies the name of a **data-prefix-list** list.
PLP	Specifies the Packet Loss Priority (PLP) (**high** | **low**). By default, packets have a PLP value of **low**. To set the PLP value to **high**, apply a policer that includes the **exceed remark** option.

Match Condition	Description
Source Port	Specifies a single port number, a list of port numbers (with numbers separated by a space), or a range of port numbers (with the two numbers separated with a hyphen [-]). The range is 0 through 65535.
TCP	**syn**

Route Policy Parameters

For route policies, you can match these parameters:

Match Condition	Description
Address	Specifies the name of a **Prefix-List** list.
AS Path List	Specifies one or more BGP AS path lists. You can write each AS as a single number or as a regular expression. To specify more than one AS number in a single path, include the list in quotation marks (" "). To configure multiple AS numbers in a single list, include multiple **AS Path** options, specifying one AS path in each option.
Community List	List of one of more BGP communities. In **Community List**, you can specify: • *aa*:*nn*: AS number and network number. Each number is a 2-byte value with a range from 1 to 65535. • **internet**: Routes in this community are advertised to the Internet community. This community comprises all BGP-speaking networking devices. • **local-as**: Routes in this community are not advertised outside the local AS. • **no-advertise**: Attach the NO_ADVERTISE community to routes. Routes in this community are not advertised to other BGP peers. • **no-export**: Attach the NO_EXPORT community to routes. Routes in this community are not advertised outside the local AS or outside a BGP confederation boundary. To configure multiple BGP communities in a single list, include multiple **community** options, specifying one community in each option.
Extended Community List	Specifies the list of one or more BGP extended communities. In **community**, you can specify: • **rt** (*aa*:*nn* | *ip-address*): Route target community, which is one or more routers that can receive a set of routes carried by BGP. Specify this as the AS number and network number, where each number is a 2-byte value with a range from 1 to 65535, or as an IP address. • **soo** (*aa*:*nn* | *ip-address*): Route origin community, which is one or more routers that can inject a set of routes into BGP. Specify this as the AS number and network number, where each number is a 2-byte value with a range from 1 to 65535, or as an IP address. To configure multiple extended BGP communities in a single list, include multiple **community** options, specifying one community in each option.
BGP Local Preference	Specifies the BGP local preference number. The range is 0 through 4294967295.
Metric	Specifies the route metric value. The range is 0 through 4294967295.

Match Condition	Description
Next Hop	Specifies the name of an IP prefix list.
OMP Tag	Specifies the OMP tag number. The range is 0 through 4294967295.
Origin	Specifies the BGP origin code. The optionss are: EGP (default), IGP, Incomplete.
OSPF Tag	Specifies the OSPF tag number. The range is 0 through 4294967295.
Peer	Specifies the peer IP address.

Structural Components of Policy Configuration for Application-Aware Routing

Here are the structural components required to configure application-aware routing policy. Each one is explained in more detail in the sections below.

```
policy
  lists
    app-list list-name
      (app application-name | app-family application-family)
    prefix-list list-name
      ip-prefix prefix
    site-list list-name
      site-id site-id
    vpn-list list-name
      vpn-id vpn-id
 log-frequency number
 sla-class sla-class-name
   jitter milliseconds
   latency milliseconds
   loss percentage
 app-route-policy policy-name
   vpn-list list-name
     sequence number
       match
         match-parameters
       action
         backup-sla-preferred-color colors
         count counter-name
         log
         sla-class sla-class-name [strict] [preferred-color colors]
     default-action
       sla-class sla-class-name
apply-policy site-list list-name
  app-route-policy policy-name
```

Lists

Application-aware routing policy uses the following types of lists to group related items. You configure these lists under the **policy lists** command hierarchy on Cisco vSmart Controllers.

Table 90:

List Type	Description	Command
Applications and application families	List of one or more applications or application families running on the subnets connected to the Cisco SD-WANdevice. Each **app-list** can contain either applications or application families, but you cannot mix the two. To configure multiple applications or application families in a single list, include multiple **app** or **app-family** options, specifying one application or application family in each **app** or **app-family** option. • *application-name* is the name of an application. The Cisco SD-WAN device supports about 2300 different applications. • *application-family* is the name of an application family. It can one of the following: **antivirus**, **application-service**, **audio_video**, **authentication**, **behavioral**, **compression**, **database**, **encrypted**, **erp**, **file-server**, **file-transfer**, **forum**, **game**, **instant-messaging**, **mail**, **microsoft-office**, **middleware**, **network-management**, **network-service**, **peer-to-peer**, **printer**, **routing**, **security-service**, **standard**, **telephony**, **terminal**, **thin-client**, **tunneling**, **wap**, **web**, and **webmail**.	`app-list` *list-name* (`app` *application-name* | `app-family` *application-family*)
Data prefixes	List of one or more IP prefixes. To configure multiple prefixes in a single list, include multiple **ip-prefix** options, specifying one prefix in each option.	`data-prefix-list` *list-name* `ip-prefix` *prefix/length*

List Type	Description	Command
Sites	List of one or more site identifiers in the overlay network. To configure multiple sites in a single list, include multiple **site-id** options, specifying one site number in each option. You can specify a single site identifier (such as **site-id 1**) or a range of site identifiers (such as **site-id 1-10**).	**site-list** *list-name* **site-id** *site-id*
VPNs	List of one or more VPNs in the overlay network. To configure multiple VPNs in a single list, include multiple **vpn** options, specifying one VPN number in each option. You can specify a single VPN identifier (such as **vpn-id 1**) or a range of VPN identifiers (such as **vpn-id 1-10**).	**vpn-list** *list-name* **vpn** *vpn-id*

In the Cisco vSmart Controller configuration, you can create multiple iterations of each type of list. For example, it is common to create multiple site lists and multiple VPN lists so that you can apply data policy to different sites and different customer VPNs across the network.

When you create multiple iterations of a type of list (for example, when you create multiple VPN lists), you can include the same values or overlapping values in more than one of these list. You can do this either on purpose, to meet the design needs of your network, or you can do this accidentally, which might occur when you use ranges to specify values. (You can use ranges to specify data prefixes, site identifiers, and VPNs.) Here are two examples of lists that are configured with ranges and that contain overlapping values:

- **vpn-list list-1 vpn 1-10**

  vpn-list list-2 vpn 6-8

- **site-list list-1 site 1-10**

  site-list list-2 site 5-15

When you configure data policies that contain lists with overlapping values, or when you apply data policies, you must ensure that the lists included in the policies, or included when applying the policies, do not contain overlapping values. To do this, you must manually audit your configurations. The Cisco SD-WAN configuration software performs no validation on the contents of lists, on the data policies themselves, or on how the policies are applied to ensure that there are no overlapping values.

If you configure or apply data policies that contain lists with overlapping values to the same site, one policy is applied and the others are ignored. Which policy is applied is a function of the internal behavior of Cisco SD-WAN device when it processes the configuration. This decision is not under user control, so the outcome is not predictable.

Logging Frequency

If you configure a logging action, by default, the Cisco SD-WAN device logs all data packet headers to a syslog file. To log only a sample of the data packet headers:

```
vEdge(config)# policy log-frequency number
```

number specifies how often to to log packet headers. For example, if you configure **log-frequency 20**, every sixteenth packet is logged. While you can configure any integer value for the frequency, the software rounds the value down to the nearest power of 2.

SLA Classes

An SLA (service-level agreement) determines the action taken in application-aware routing. An SLA class defines the maximum jitter, maximum latency, maximum packet loss, or a combination of these values for the Cisco SD-WAN device's data plane tunnels. (Each tunnel is defined by a local TLOC–remote TLOC pair.) You configure SLA classes under the **policy sla-class** command hierarchy onCisco vSmart Controllers. In Cisco SD-WAN Release 20.1.x and onwards, you can configure a maximum of eight SLA classes. However, only 4 unique SLA classes can be defined in an application aware route policy. In older releases, you can configure a maximum of four SLA classes.

Note In Cisco SD-WAN Release 20.3.1, you cannot configure more than four different SLA classes on Cisco SD-WAN devices. The application-aware routing policy is rejected, if you configure more than four different SLA classes.

You can configure the following parameters in an SLA class:

Table 91:

Description	Command	Value or Range
Maximum acceptable packet jitter on the data plane tunnel	**jitter** *milliseconds*	1 through 1000 milliseconds
Maximum acceptable packet latency on the data plane tunnel.	**latency** *milliseconds*	1 through 1000 milliseconds
Maximum acceptable packet loss on the data plane tunnel.	**loss** *percentage*	0 through 100 percent

VPN Lists

Each application-aware policy instance is associated with a VPN list. You configure VPN lists with the **policy app-route-policy vpn-list** command. The VPN list you specify must be one that you created with a **policy lists vpn-list** command.

Sequences

Within each VPN list, an application-aware policy contains sequences of match–action pairs. The sequences are numbered to set the order in which data traffic is analyzed by the match–action pairs in the policy. You configure sequences with the **policy app-aware-policy vpn-list sequence** command.

Each sequence in an application-aware policy can contain one **match** command and one **action** command.

Match Parameters

Application-aware routing policy can match IP prefixes and fields in the IP headers. You configure the match parameters with the **match** command under the **policy app-route-policy vpn-list sequence** command hierarchy on Cisco vSmart Controllers.

You can match these parameters:

Table 92:

Description	Command	Value or Range
Match all packets	Omit **match** command	—
Applications or application families	**app-list** *list-name*	Name of an **app-list** list
Group of destination prefixes	**destination-data-prefix-list** *list-name*	Name of a **data-prefix-list** list
Individual destination prefix	**destination-ip** *prefix/length*	IP prefix and prefix length
Destination port number	**destination-port** *number*	0 through 65535. Specify a single port number, a list of port numbers (with numbers separated by a space), or a range of port numbers (with the two numbers separated with a hyphen [-]).
DSCP value	**dscp** *number*	0 through 63
Internet Protocol number	**protocol** *number*	0 through 255
For Protocol IPv4 when you enter a Protocol value as 1, the **ICMP Message** field displays where you can select an ICMP message to apply to the data policy. Likewise, the **ICMP Message** field displays for Protocol IPv6 when you you enter a Protocol value as 58. When you select Protocol as Both, the **ICMP Message or ICMPv6 Message** field displays. **Note** This field is available from , Cisco SD-WAN Release 20.4.1 Cisco vManage Release 20.4.1.	**icmp-msg** *value* **icmp6-msg** *value*	For **`icmp-msg`** and **`icmp6-msg`** message types, refer to the ICMP Message Types/Codes and Corresponding Enumeration Values table.

Description	Command	Value or Range
Packet loss priority (PLP)	**plp**	(**high** | **low**) By default, packets have a PLP value of **low**. To set the PLP value to **high**, apply a policer that includes the **exceed remark** option.
Group of source prefixes	**source-data-prefix-list** *list-name*	Name of a **data-prefix-list** list
Individual source prefix	**source-ip** *prefix*/*length*	IP prefix and prefix length
Source port number	**source-port** *number*	0 through 65535; enter a single port number, a list of port numbers (with numbers separated by a space), or a range of port numbers (with the two numbers separated with a hyphen [-])
Split DNS, to resolve and process DNS requests on an application-by-application basis	**dns-app-list** *list-name* **dns** (**request** | **response**)	Name of an **app-list** list. This list specifies the applications whose DNS requests are processed. To process DNS requests sent by the applications (for outbound DNS queries), specify **dns request**. To process DNS responses returned from DNS servers to the applications, specify **dns response**.

Action Parameters

When data traffic matches the match parameters, the specified action is applied to it. For application-aware routing policy, the action is to apply an SLA class. The SLA class defines the maximum packet latency or maximum packet loss, or both, that the application allows on the data plane tunnel used to transmit its data. TheCisco SD-WAN software examines the recently measured performance characteristics of the data plane tunnels and directs the data traffic to the WAN connection that meets the specified SLA.

The following actions can be configured:

Table 93:

Description	Command	Value or Range
When no tunnel matches the SLA, direct the data traffic to a specific tunnel. Data traffic is sent out the configured tunnel if that tunnel interface is available. If that tunnel is unavailable, traffic is sent out another available tunnel. You can specify one or more colors. The backup SLA preferred color is a loose matching, not a strict matching.	**backup-sla-preferred-color** *colors*	**3g**, **biz-internet**, **blue**, **bronze**, **custom1**, **custom2**, **custom3**, **default**, **gold**, **green lte**, **metro-ethernet**, **mpls**, **private1** through **private6**, **public-internet**, **red**, **silver**
Count matching data packets.	**action count** *counter-n ame*	Name of a counter.

Description	Command	Value or Range
Place a sampled set of packets that match the SLA class rule into the messages and vsyslog system logging (syslog) files. In addition to logging the packet headers, a syslog message is generated the first time a packet header is logged and then every 5 minutes thereafter, as long as the flow is active.	**action log**	To display logging information, use the **show app log flow-all**, **show app log flows**, and **show log** commands on the Cisco vEdge device.
SLA class to match. All matching data traffic is directed to a tunnel whose performance matches the SLA parameters defined in the class. The software first tries to send the traffic through a tunnel that matches the SLA. If a single tunnel matches the SLA, data traffic is sent through that tunnel. If two or more tunnels match, traffic is distributed among them. If no tunnel matches the SLA, data traffic is sent through one of the available tunnels.	**action sla-class** *sla-class-name*	SLA class name defined in **policy sla-class** command
Group of data plane tunnel colors to prefer when an SLA class match occurs. Traffic is load-balanced across all tunnels. If no tunnels match the SLA, data traffic is sent through any available tunnel. That is, color preference is a loose matching, not a strict matching.	**action sla-class** *sla-class-name* **preferred-color** *colors*	SLA class name defined in **policy sla-class** command and one of the supported tunnel colors.
Strict matching of the SLA class. If no data plane tunnel is available that satisfies the SLA criteria, traffic is dropped. Note that for policy configured with this option, data traffic that matches the match conditions is dropped until the application-aware routing path is established.	**action sla-class** *sla-class-name* **strict** **action sla-class** *sla-class-name* **preferred-color** *color* **strict** **action sla-class** *sla-class-name* **preferred-color** *colors* **strict**	SLA class name defined in **policy sla-class** command

If more than one data plane tunnel satisfies an SLA class criteria, the Cisco SD-WAN device selects one of them by performing load-balancing across the equal paths.

Default Action

A policy's default action defines how to handle packets that match none of the match conditions. For application-aware routing policy, if you do not configure a default action, all data packets are accepted and transmitted based on normal routing decisions, with no consideration of SLA.

To modify this behavior, include the **default-action sla-class** *sla-class-name* command in the policy, specifying the name of an SLA class you defined in the **policy sla-class** command.

When you apply an SLA class in a policy's default action, you cannot specify the **strict** option.

If no data plane tunnel satisfies the SLA class in the default action, the Cisco SD-WAN device selects one of the available tunnels by performing load-balancing across equal paths.

Expected behavior when data flow matches both AAR and data policies:

1. When data policy local TLOC action is configured, the **App-route preferred-color** and **backup-preferred-color** actions are ignored.
2. The **sla-class** and **sla-strict** actions are retained from the application routing configuration.
3. The data policy TLOC takes precedence.

When there is a **local-tloc-list** action that has multiple options, choose the local-TLOC that meets SLA.

- If no **local-tloc** meets SLA, then choose equal-cost multi-path routing (ECMP) for the traffic over the **local-tloc-list**.
- If none of the **local-tloc** is up, then choose a TLOC that is up.
- If none of the **local-tloc** is up and the DP is configured in restrict mode, then drop the traffic.

Configure Service Chaining

Table 94: Feature History

Feature Name	Release Information	Description
Service insertion tracker support	Cisco SD-WAN Release 20.3.1 Cisco vManage Release 20.3.1	You can configure service chaining for a device from the **Service** tab.

Here is the workflow for configuring service chaining for a device managed by Cisco SD-WAN:

1. Service devices are accessed through a specific VRF. In the VPN template that corresponds to the VRF for a service device, configure service chaining, specifying the service type and device addresses. By default, the tracking feature adds each service device status update to the service log. You can disable this in the VPN template.
2. Attach the VPN template to the device template for the device managed by Cisco SD-WAN.
3. Apply the device template to the device.

Configure Service Chaining Using Cisco vManage

To configure service chaining for a device.

1. In Cisco vManage, create a VPN template.
2. ClickService.
3. In the **Service** section, click **New Service** and configure the following:
   - **Service Type**: Select the type of service that the service device is providing.
   - **IP Address**: IP Address is the only working option.
   - **IPv4 Address**: Enter between one and four addresses for the device.
   - **Tracking**: Determines whether the periodic health updates of the service device are recorded in the system log. Default: On

Note Maximum number of services: 8

4. Click **Add**. The service appears in the table of configured services.

Configure Sessions in Cisco vManage

Table 95: Feature History

Feature History	Release Information	Description
Configure Sessions in Cisco vManage	Cisco SD-WAN Release 20.3.1 Cisco vManage Release 20.3.1	This feature lets you see all the HTTP sessions that are open within Cisco vManage. It gives you details about the username, source IP address, domain of the user, and other information. A user with User Management Write access, or a netadmin user can trigger a log out of any suspicious user's session.

Set a Client Session Timeout in Cisco vManage

You can set a client session timeout in Cisco vManage. When a timeout is set, such as no keyboard or keystroke activity, the client is automatically logged out of the system.

Note You can edit Client Session Timeout in a multitenant environment only if you have a Provider access.

1. From the Cisco vManage menu, choose **Administration** > **Settings**.
2. Click **Client Session Timeout**.
3. Click **Edit**.

4. Click **Enabled**.
5. Specify the timeout value, in minutes.
6. Click **Save**.

Set a Session Lifetime in Cisco vManage

You can specify how long to keep your session active by setting the session lifetime, in minutes. A session lifetime indicates the amount of time for which a session can be active. If you keep a session active without letting the session expire, you will be logged out of the session in 24 hours, which is the default session timeout value.

The default session lifetime is 1440 minutes or 24 hours.

Note You can edit Session Lifetime in a multitenant environment only if you have a Provider access.

1. From the Cisco vManage menu, choose **Administration** > **Settings**.
2. Click **Session Life Time**.
3. Click **Edit**.
4. In the **SessionLifeTime** field, specify the session timeout value, in minutes, from the drop-down list.
5. Click **Save**.

Set the Server Session Timeout in Cisco vManage

You can configure the server session timeout in Cisco vManage. The server session timeout indicates how long the server should keep a session running before it expires due to inactivity. The default server session timeout is 30 minutes.

Note Server Session Timeout is not available in a multitenant environment even if you have a Provider access or a Tenant access.

1. From the Cisco vManage menu, choose **Administration** > **Settings**.
2. Click **Server Session Timeout**.
3. Click **Edit**.
4. In the **Timeout(minutes)** field, specify the timeout value, in minutes.
5. Click **Save**.

Enable Maximum Sessions Per User

You can enable the maximum number of concurrent HTTP sessions allowed per username. If you enter 2 as the value, you can only open two concurrent HTTP sessions. If you try to open a third HTTP session with the same username, the third session is granted access, and the oldest session is logged out.

Note Maximum Session Per User is not available in a multitenant environment even if you have a Provider access or a Tenant access.

1. From the Cisco vManage menu, choose **Administration** > **Settings**.
2. Click **Max Sessions Per User**.
3. Click **Edit**.
4. Click **Enabled**.

   By default, **Max Sessions Per User**, is set to **Disabled**.
5. In the **Max Sessions Per User** field, specify a value for the maximum number of user sessions.
6. Click **Save**.

Single Sign-On Using Azure Active Directory (AD)

Table 96: Feature History

Feature Name	Release Information	Description
Single Sign-On Using Azure AD	Cisco vManage Release 20.8.1	Single Sign-On (SSO) with security assertion mark-up language (SAML) gives faster, easier, and trusted access to cloud applications without storing passwords or requiring you to log in to each application individually.

Configure TACACS Authentication for Cloud OnRamp Colocation Cluster

Table 97: Feature History

Feature Name	Release Information	Description
TACACS Authentication	Cisco SD-WAN Release 20.3.1 Cisco vManage Release 20.3.1	You can configure the TACACS authentication for users using the **TACACS** configuration settings of Cloud OnRamp for Colocation cluster.

The TACACS authentication determines the valid users who can access the Cisco CSP and Cisco Catalyst 9500 devices after a cluster is active.

Points to consider

- By default, the admin users with Role-based access control (RBAC) are authorized to access the Cisco CSP and Cisco Catalyst 9500 devices.
- Do not configure the same user with different passwords when configuring using TACACS and RBAC. If same user with a different password is configured on TACACS and RBAC, the RBAC user and password authentication is used.

To authenticate users:

Note Before configuring the TACACS authentication for users using the **Cluster Topology** window, ensure that you create a Cloud OnRamp for Colocation cluster. See Create and Activate Clusters.

1. To add TACACS server configuration, on the **Cluster Topology** window, click **Other Settings** > **Add** next to **TACACS**.

   To edit TACACS server configuration, in the **Cluster Topology** window, click **Other Settings** > **Edit** next to **TACACS**.

   In the **TACACS** configuration window, enter information about the following:

   - Template Name—The TACACS template name can contain 128 alphanumeric characters.
   - (Optional) Description—The description can contain 2048 alphanumeric characters.

2. To add a new TACACS server, click **+ New TACACS SERVER**.

   - In **Server IP Address**, enter the IPv4 address.

     Use IPv4 addresses for hostnames of TACACS server.

   - In **Secret** enter the password and confirm the password in **Confirm Secret**.

3. Click **Add**

   The new TACACS server details are listed in the **TACACS** configuration window.

   Note You can add a maximum of four TACACS servers.

4. To add another TACACS server, repeat step 2 to step 3.

   When authenticating users, if the first TACACS server is not reachable, the next server is verified until all the four servers are verified.

5. Click **Save**.

6. To delete a TACACS server configuration, choose a row from the TACACS server details list and click **Delete** under **Action**.

Note To modify an existing TACACS server information, ensure to delete a TACACS server and then add a new server.

7. To view the TACACS server configuration, in Cisco vManage, click **Configuration** > **Devices**.

   For the desired Cisco CSP device or Cisco Catalyst 9500 switch, click **...** and choose **Running Configuration**.

Configure Cisco vBond Orchestrator

Once you have set up and started the virtual machine (VM) for Cisco vBond Orchestrator in your overlay network, Cisco vBond Orchestrator comes up with a factory-default configuration. You then need to manually configure few basic features and functions so that the devices can be authenticated and verified and can join the overlay network. Among these features, you configure the device as Cisco vBond Orchestrator providing the system IP address, and you configure a WAN interface that connects to the Internet. This interface must have a public IP address so that all Cisco vEdge devices in the overlay network can connect to Cisco vBond Orchestrator.

You create the initial configuration by using SSH to open a CLI session to Cisco vBond Orchestrator.

After you have created the initial configuration, you create the full configuration by creating configuration templates on Cisco vManage and then attach the templates to Cisco vBond Orchestrator. When you attach the configuration templates to Cisco vBond Orchestrator, the configuration parameters in the templates overwrite the initial configuration.

Create Initial Configuration for Cisco vBond Orchestrator

To create the initial configuration on Cisco vBond Orchestrator using a CLI session:

1. Open a CLI session to Cisco vEdge device via SSH.
2. Log in as the user **admin**, using the default password, **admin**. The CLI prompt is displayed.
3. Enter configuration mode:

```
vBond#config
vBond(config)#
```

4. Configure the hostname:

```
vBond(config)#system host-name hostname
```

   Configuring the hostname is optional, but is recommended because this name in included as part of the prompt in the CLI and it is used on various Cisco vManage screens to refer to the device.

5. Configure the system IP address:

```
vBond(config-system)#system-ip ip-address
```

   Cisco vManage uses the system IP address to identify the device so that the NMS can download the full configuration to the device.

6. Configure the IP address of Cisco vBond Orchestrator. Cisco vBond Orchestrator's IP address must be a public IP address, to allow all Cisco vEdge devices in the overlay network to reach Cisco vBond Orchestrator:

   ```
   vBond(config-system)#vbond ip-address local
   ```

   In Releases 16.3 and later, the address can be an IPv4 or an IPv6 address. In earlier releases, it must be an IPv4 address. A vBond orchestrator is effectively a vEdge router that performs only the orchestrator functions. The **local** option designates the device to be Cisco vBond Orchestrator, not a vEdge router. Cisco vBond Orchestrator must run on a standalone virtual machine (VM) or hardware router; it cannot coexist in the same device as a software or hardware vEdge router.

7. Configure a time limit for confirming that a software upgrade is successful:

   ```
   vBond(config-system)#upgrade-confirm minutes
   ```

   The time can be from 1 through 60 minutes. If you configure this time limit, when you upgrade the software on the device, Cisco vManage (when it comes up) or you must confirm that a software upgrade is successful within the configured number of minutes. If the device does not received the confirmation within the configured time, it reverts to the previous software image.

8. Change the password for the user "admin":

   ```
   vBond(config-system)#user admin password password
   ```

   The default password is "admin".

9. Configure an interface in VPN 0, to connect to the Internet or other WAN transport network. In Releases 16.3 and later, the IP address can be an IPv4 or an IPv6 address. In earlier releases, it must be an IPv4 address. Ensure that the prefix you configure for the interface contains the IP address that you configure in the **vbond local** command.

   ```
   vBond(config)#vpn 0 interface interface-name
   vBond(config-interface)#ip address ipv4-prefix/length
   vBond(config-interface)#ipv6 address ipv6-prefix/length
   vBond(config-interface)#no shutdown
   ```

   Note The IP address must be a public address so that all devices in the overlay network can reach Cisco vBond Orchestrator.

10. Commit the configuration:

    ```
    vBond(config)#commit and-quit
    vBond#
    ```

11. Verify that the configuration is correct and complete:

    ```
    vBond#show running-config
    ```

After the overlay network is up and operational, create a vBond configuration template on the Cisco vManage that contains the initial configuration parameters. Use the following vManage feature templates:

- System feature template to configure the hostname, system IP address, and vBond functionality.
- AAA feature template to configure a password for the "admin" user.
- VPN Interface Ethernet feature template to configure the interface in VPN 0.

In addition, it is recommended that you configure the following general system parameters:

- From the Cisco vManage menu, choose **Administration** > **Settings** and configure Organization name.
- From the Cisco vManage menu, choose **Configuration** > **Templates**. From System configuration template drop-down, select **create template** and configure Timezone, NTP servers, and device physical location.
- Click **Additional Templates** and from banner feature template drop-down, select **Create Template**. Configure Login banner.
- From System feature configuration template drop-down, select **Create Template** and configure disk and server parameters.
- From AAA feature configuration template drop-down, select **Create Template** and configure AAA, RADIUS and TACACS servers.
- Click **Additional Templates** and from SNMP feature template drop-down, select **Create Template** and configure SNMP.

Note The IP address must be a public address so that all devices in the overlay network can reach Cisco vBond Orchestrator.

Sample Initial CLI Configuration

Below is an example of a simple configuration on Cisco vBond Orchestrator. Note that this configuration includes a number of settings from the factory-default configuration and shows a number of default configuration values.

```
vBond#show running-config
system
 host-name         vBond
 gps-location latitude 40.7127837
 gps-location longitude -74.00594130000002
 system-ip         172.16.240.161
 organization-name "Cisco"
 clock timezone America/Los_Angeles
 vbond 11.1.1.14 local
 aaa
  auth-order local radius tacacs
  usergroup basic
   task system read write
   task interface read write
  !
  usergroup netadmin
  !
  usergroup operator
   task system read
   task interface read
   task policy read
   task routing read
   task security read
  !
  user admin
   password encrypted-password
  !
 !
 logging
  disk
```

```
   enable
  !
!
vpn 0
 interface ge0/0
  ip address 11.1.1.14/24
  no shutdown
 !
 ip route 0.0.0.0/0 11.1.1.1
!
vpn 512
 interface eth0
  ip dhcp-client
  no shutdown
 !
!
```

What's Next

See *Add Cisco vBond Orchestrator to the Overlay Network*.

Create Configuration Templates for Cisco vBond Orchestrator

This article describes how to configure Cisco vBond Orchestrators that are being managed by Cisco vManage. These devices must be configured from Cisco vManage. If you configure them directly from the CLI on the router, Cisco vManage overwrites the configuration with the one stored on the NMS system.

Create Configuration Templates for Cisco vManage

You should create configuration templates for Cisco vManage.

Configuration Prerequisites

Security Prerequisites

Before you can configure Cisco vManage in the Cisco SD-WAN overlay network, you must have generated a certificate for it, and the certificate must already be installed on the device. See Generate a Certificate.

Variables Spreadsheet

The feature templates that you create will contain variables. For Cisco vManage to populate the variables with actual values when you attach a device template to a device, either enter the values manually or click **Import File** in the upper right corner to load an Excel file in CSV format that contains the variables values.

In the spreadsheet, the header row contains the variable name and each row after that corresponds to a device, defining the values of the variables. The first three columns in the spreadsheet must be (in order):

- csv-deviceId—Serial number of the device (used to uniquely identify the device).
- csv-deviceIP—System IP address of the device (used to populate the **system ip address** command).
- csv-host-name—Hostname of the device (used to populate the **system hostname** command).

You can create a single spreadsheet for all devices in the overlay network—Cisco vManages, routers, Cisco vSmart Controllers, and Cisco vBond Orchestrators. You do not need to specify values for all variables for all devices.

Feature Templates for Cisco vManages

The following features are mandatory for Cisco vManage operation, so you must create a feature template for each of them:

Table 98:

Feature	Template Name
Authentication, Authorization, and Accounting (AAA)	AAA
Security	Security
System-wide parameters	System
Transport VPN (VPN 0)	VPN, with the VPN ID set to 0.
Management VPN (for out-of-band management traffic)	VPN, with the VPN ID set to 512.

Create Feature Templates

Feature templates are the building blocks of a Cisco vManage's complete configuration. For each feature that you can enable on Cisco vManage, a template form is provided that you fill out with the desired parameters for that feature.

You must create feature templates for the mandatory Cisco vManage features.

You can create multiple templates for the same feature.

To create vManage feature templates:

1. From the Cisco vManage menu, select **Configuration** > **Templates**.
2. Click **Feature Templates**.

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

3. Click **Add Template**.
4. In the left pane, from **Select Devices**, select **vManage**. You can create a single feature template for features that are available on both the Cisco vManage and other devices. You must, however, create separate feature templates for software features that are available only on Cisco vManage.
5. In the right pane, select the template. The template form is displayed. The top of the form contains fields for naming the template, and the bottom contains fields for defining parameters applicable to that template. Optional parameters are generally grayed out. A plus (+) sign is displayed to the right when you can add multiple entries for the same parameter.
6. Enter a template name and description. These fields are mandatory. You cannot use any special characters in template names.

7. For each required parameter, choose the desired value, and if applicable, select the scope of the parameter. Select the scope from the drop-down menu available to the left of each parameter field.
8. Click the plus sign (+) below the required parameters to set values for additional parameters, if applicable.
9. Click **Create**.
10. Create feature templates for each of the required features listed in the previous section.
    a. For the transport VPN, use the template called VPN-vManage and in the VPN Template section, set the VPN to 0, with a scope of Global.
    b. For the management VPN, use the template called VPN-vManage and in the VPN Template section, set the VPN to 512, with a scope of Global.
11. Create any additional feature templates for each optional feature that you want to enable on Cisco vManage.

Release Information

Introduced in Cisco vManage in Release 15.3.

Create Configuration Templates for Cisco vSmart Controller

For Cisco vSmart Controllers that are being managed by a Cisco vManage, you must configure them from Cisco vManage. If you configure them directly from the CLI on Cisco vSmart Controller, Cisco vManage overwrites the configuration with the one stored on Cisco vManage.

Determine Why a Device Rejects a Template

When you attach a template to a device using the screen, the device might reject the template. One reason that this may occur is because the device template contains incorrect variable values. When a device rejects a template, it reverts to the previous configuration.

To determine why the device rejected the template:

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Device Templates**.

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

3. Locate the device. The **Template Status** column indicates why the device rejected the template.

Export Device Data in CSV Format

In an overlay network, you might have multiple devices of the same type that have identical or effectively identical configurations. For example, in a network with redundant Cisco vSmart Controllers, each controller must be configured with identical policies. Another example is a network with Cisco vEdge devices at multiple sites, where each Cisco vEdge device is providing identical services at each site.

Because the configurations for these devices are essentially identical, you can create one set of feature templates, which you then consolidate into one device template that you use to configure all the devices. You can create an Excel file in CSV format that lists the variables and defines each device specific variable value for each device. Then you can load the file when you attach a device template to a device.

To export data for all devices to a file in CSV format, click the Export icon. This icon, which is a downward-pointing arrow, is located to the right of the filter criteria both in the WAN Edge List and in the Controllers tab.

vManage NMS downloads all data from the device table to an Excel file in CSV format.

Configure Cisco vSmart Controllers

Add a vSmart Controller

After the Cisco vBond Orchestrator authenticates Cisco vEdge devices, the Cisco vBond Orchestrator provides Cisco vEdge devices information that they need to connect to the Cisco vSmart Controller. A Cisco vSmart Controller controls the flow of data traffic throughout the network via data and app-route policies. To configure Cisco vSmart Controllers:

1. From the Cisco vManage menu, choose **Configuration** > **Devices**.
2. Click **Controllers**.
3. Click the **Add Controller** drop-down list and select **vSmart**.
4. In the **Add vSmart** window:
    a. Enter the system IP address of the Cisco vSmart Controller.

    b. Enter the username and password to access the Cisco vSmart Controller.

    c. Select the protocol to use for control-plane connections. The default is DTLS. The DTLS (Datagram Transport Layer Security) protocol is designed to provide security for UDP communications.

    d. If you select TLS, enter the port number to use for TLS connections. The default is 23456.

    The TLS (Transport Socket Layer) protocol that provides communications security over a network.

    e. Check the **Generate CSR** check box to allow the certificate-generation process to occur automatically.

    f. Click **Add**.
5. Repeat Steps 2, 3 and 4 to add additional Cisco vSmart Controllers. The vManage NMS can support up to 20 Cisco vSmart Controllers in the network.

The new Cisco vSmart Controller is added to the list of controllers in the Controllers screen.

Edit Controller Details

Editing controller details lets you update the IP address and login credentials of a controller device. To edit controller details:

1. From the Cisco vManage menu, choose **Configuration** > **Devices**.
2. Click **Controllers**, and select the controller.
3. Click **…**, and click **Edit**.
4. In the **Edit** window, edit the IP address and the login credentials.
5. Click **Save**.

Delete a Controller

Deleting a controller removes it from the overlay. Delete a controller it if you are replacing it or if you no longer need it in your network.

To delete a controller:

1. From the Cisco vManage menu, choose **Configuration** > **Devices**.
2. Click **Controllers**, and select the controller.
3. Click **…**, and click **Invalidate**.
4. To confirm the removal of the device and all its control connections, click **OK**.

Configure Reverse Proxy on Controllers

To configure reverse proxy on an individual vManage NMS and Cisco vSmart Controller:

1. From the Cisco vManage menu, choose **Configuration** > **Devices**.
2. Click **Controllers**, and select the controller.
3. Click **…**, and click **Add Reverse Proxy**.

   The **Add Reverse Proxy** dialog box is displayed.
4. Click **Add Reverse Proxy**.
5. Configure the private IP address and port number for the device. The private IP address is the IP address of the transport interface in VPN 0. The default port number is 12346. This is the port used to establish the connections that handle control and traffic in the overlay network.
6. Configure the proxy IP address and port number for the device, to create the mapping between the private and public IP addresses and port numbers.
7. If the Cisco vManage NMS or Cisco vSmart Controller has multiple cores, repeat Steps 5 and 6 for each core.
8. Click **Add**.

To enable reverse proxy in the overlay network, from the Cisco vManage menu, choose **Administration** > **Settings**. Then from the Reverse Proxy bar, click **Edit**. Click **Enabled**, and click **Save**.

Enable Data Stream Collection from a WAN Edge Router

By default, collecting streams of data from a network device is not enabled.

To collect data streams from a WAN Edge router in the overlay network, perform the following steps.

Collecting data streams also requires that VPN 512 be configured in your Cisco SD-WAN network.

1. From the Cisco vManage menu, select **Administration** > **Settings**.
2. For **Data Stream**, click **Edit**.
3. Click **Enabled**.
4. From Cisco vManage Release 20.4.1, choose one of the following **IP Address Type** options:
   - **Transport**: Click this option send the data stream to the transport IP address of the Cisco vManage node to which the device is connected.
   - **Management**: Click this option send the data stream to the management IP address of the Cisco vManage node to which the device is connected.
   - **System**: Click this option to send the data stream to the internally configured system IP address of theCisco vManage node to which the device is connected.

     In a Cisco vManage cluster deployment, we recommend that you choose **System** so that the data stream is collected from edge devices that are managed by all Cisco vManage instances in the cluster.
5. From Cisco vManage Release 20.4.1, perform one of these actions:
   - If you choose **Transport** as the IP address type, in the **Hostname** field, enter the public transports IP address that is used to connect to the router.

     You can determine this IP address by using an SSH client to access the router and entering the **`show interface`** CLI command.
   - If you choose **Management** as the IP address type, in the **Hostname** field, enter the IP address or name of the host to collect the data.

     We recommend that this host is one that is used for out-of-band management and that it is located in the management VPN.

   This **Hostname** option is dimmed when **IP Address Type** is **System**.
6. In the **VPN** field, enter the number of the VPN in which the host is located.

   We recommend that this VPN be the management VPN, which is typically VPN 512.

   This **VPN** option is dimmed when **IP Address Type** is **System**.
7. Click **Save**.

Enable Timeout Value for a Cisco vManage Client Session

By default, a user's session to a Cisco vManage client remains established indefinitely and never times out.

To set how long a Cisco vManage client session is inactive before a user is logged out:

1. From the Cisco vManage menu, select **Administration** > **Settings**.
2. For Client Session Timeout option, click **Edit**.
3. Click **Enabled**, and enter the timeout value, in minutes. This value can be from 10 to 180 minutes.
4. Click **Save**.

The client session timeout value applies to all Cisco vManage servers in a Cisco vManage cluster.

Enable vAnalytics

1. Open a support case with Cisco, https://mycase.cloudapps.cisco.com/case, and provide the following information:

   - Customer name
   - Organization Name (as configured in vManage)
   - Cisco Sales/SE contact
   - Approved by (customer contact)
   - Customer email
   - Approved by customer on (specify date)

   Customer approval is needed as vAnalytics collects network and application-related data, and this data is stored in the US-West cloud region in Amazon Web Services.

   After receiving this information, Cisco takes approximately 24 to 48 hours to ready the backend set up and provide the appropriate log-on credentials for vAnalytics.

   Once you receive log-on credentials for vAnalytics:

   a. Navigate to the Cisco vManage Dashboard **Administration** > **Settings** tab.

   b. Click the **Edit** button to the right of the vAnalytics bar.

   c. In the Enable vAnalytics field, click **Enabled**.

   d. Enter **SSO Username** and **SSO Password**.

   e. Check the **I agree** check box.

   f. Click **Save**.

Enforce Software Version on Devices

If you are using the Cisco SD-WAN hosted service, you can enforce a version of the Cisco SD-WAN software to run on a router when it first joins the overlay network.

To ensure that templates are in sync after an upgrade that enforces a software version, make sure of the following before you perform the upgrade:

- The bootflash and flash on the router must have enough free space to support the upgrade
- The version of the SD-WAN image that is on the device before the upgrade must be a lower version than the enforced SD-WAN version you specify in the following procedure

To enforce a version of the Cisco SD-WAN software to run on a router when it first joins the overlay network, follow these steps:

1. Ensure that the software image for the desired device software version is present in the Cisco vManage software image repository:
   a. From the Cisco vManage menu, choose **Maintenance** > **Software Repository**.

      The Software Repository screen opens and displays a table of software images. If the desired software image is present in the repository, continue with Step 2.

   b. If you need to add a software image, click **Add New Software**.
   c. Select the location from which to download the software images, either Cisco vManage, Remote Server, or Remote Server - vManage.
   d. Select an x86-based or a MIPS-based software image.
   e. To place the image in the repository, click **Add**.
2. From the Cisco vManage menu, choose **Administration** > **Settings**.
3. From **Enforce Software Version (ZTP)**, click **Edit**.
4. In **Enforce Software Version**, click **Enabled**.
5. From the **Version** drop-down list, select the version of the software to enforce on the device when they join the network.
6. Click **Save**.

Enforce Strong Passwords

We recommend the use of strong passwords. You must enable password policy rules in Cisco vManage to enforce use of strong passwords.

After you enable a password policy rule, the passwords that are created for new users must meet the requirements that the rule defines. In addition, for releases from Cisco vManage Release 20.9.1, you are prompted to change your password the next time you log in if your existing password does not meet the requirements that the rule defines.

1. From the Cisco vManage menu, choose **Administration** > **Settings**.
2. In **Password Policy**, choose **Edit**.
3. Perform one of these actions, based on your Cisco vManage release:
   - For releases before Cisco vManage Release 20.9.1, click **Enabled**.

- For releases from Cisco vManage Release 20.9.1 click **Medium Security** or **High Security** to choose the password criteria.

By default, **Password Policy** is set to **Disabled**.

4. In the **Password Expiration Time (Days)** field, you can specify the number of days for when the password expires.

   By default, password expiration is 90 days.

   Before your password expires, a banner prompts you to change your password. If the password expiration time is 60 days or more, this banner first appears at 30 days before your password expires. If the password expiration time is less than 60 days, this banner first appears at half the number of days that are configured for the expiration time. If you do not change your password before it expires, you are blocked from logging in. In such a scenario, an admin user can change your password and restore your access.

Note The password expiration policy does not apply to the admin user.

5. Click **Save**.

Install Signed Certificates on vEdge Cloud Routers

When a vEdge Cloud router virtual machine (VM) instance starts, it has a factory-default configuration, which allows the router to boot. However, the router is unable to join the overlay network. For the router to be able to join the overlay network, you must install a signed certificate on the router. The signed certificates are generated based on the router's serial number, and they are used to authorize the router to participate in the overlay network.

Starting from Releases 17.1, the Cisco vManage can act as a Certificate Authority (CA), and in this role it can automatically generate and install signed certificates on vEdge Cloud routers. You can also use another CA and then install the signed certificate manually. For Releases 16.3 and earlier, you manually install signed Symantec certificates on vEdge Cloud routers.

To install signed certificates:

1. Retrieve the vEdge authorized serial number file. This file contains the serial numbers of all the vEdge routers that are allowed to join the overlay network.
2. Upload the vEdge authorized serial number file to Cisco vManage.
3. Install a signed certificate on each vEdge Cloud router.

Retrieve vEdge Authorized Serial Number File

1. Go to http://viptela.com/support/ and log in.
2. Click **Downloads**.
3. Click **My Serial Number Files**. The screen displays the serial number files. Starting from Releases 17.1, the filename extension is .viptela. For Releases 16.3 and earlier, the filename extension is .txt.
4. Click the most recent serial number file to download it.

Upload vEdge Authorized Serial Number File

1. From the Cisco vManage menu, select **Configuration** > **Devices**.
2. Click **vEdge List**, and select **Upload vEdge List**.
3. In the Upload vEdge window:
   a. Click **Choose File**, and select the vEdge authorized serial number file you downloaded from Cisco.
   b. To automatically validate the vEdge routers and send their serial numbers to the controllers, click and select the checkbox **Validate the Uploaded vEdge List** and **Send to Controllers**. If you do not select this option, you must individually validate each router in the **Configuration** > **Certificates** > **vEdge List** page.
4. Click **Upload**.

During the process of uploading the vEdge authorized serial number file, the Cisco vManage generates a token for each vEdge Cloud router listed in the file. This token is used as a one-time password for the router. The Cisco vManage sends the token to the vBond orchestrator and the vSmart controller.

After the vEdge authorized serial number file has been uploaded, a list of vEdge routers in the network is displayed in the vEdge Routers Table in the **Configuration** > **Devices** page, with details about each router, including the router's chassis number and its token.

Install Signed Certificates in Releases 17.1 and Later

Starting from Releases 17.1, to install a signed certificates on a vEdge Cloud router, you first generate and download a bootstrap configuration file for the router. This file contains all the information necessary to allow the Cisco vManage to generate a signed certificate for the vEdge Cloud router. You then copy the contents of this file into the configuration for the router's VM instance. For this method to work, the router and the Cisco vManage must both be running Release 17.1 or later. Finally, you download the signed certificate to the router. You can configure the Cisco vManage to do this automatically or manually.

The bootstrap configuration file contains the following information:

- UUID, which is used as the router's chassis number.
- Token, which is a randomly generated one-time password that the router uses to authenticate itself with the vBond orchestrator and the Cisco vManage.
- IP address or DNS name of the vBond orchestrator.
- Organization name.
- If you have already created a device configuration template and attached it to the vEdge Cloud router, the bootstrap configuration file contains this configuration. For information about creating and attaching a configuration template, see Create Configuration Templates for a vEdge Router .

You can generate a bootstrap configuration file that contains information for an individual router or for multiple routers.

Starting from Releases 17.1, you can also have Symantec generate signed certificates that you install manually on each router, as described later in this article, but this method is not recommended.

Configure the Cisco vBond Orchestrator and Organization Name

Before you can generate a bootstrap configuration file, you must configure the vBond orchestrator DNS name or address and your organization name:

1. From the Cisco vManage menu, select **Administration** > **Settings**.
2. For vBond, click **Edit**.
3. In the vBond DNS/IP Address: Port field, enter the DNS name or IP address of the vBond orchestrator.
4. Click **Save**.
5. For Organization Name, click **View** and verify the orgnization name configured. This name must be identical to that configured on the Cisco vBond Orchestrator.
6. Click **Save**.

Configure Automatic or Manual vEdge Cloud Authorization

Signed certificates must be installed on each vEdge cloud router so that the router is authorized to participate in the overlay network. You can use the Cisco vManage as the CA to generate and install the signed certificate, or you can use an enterprise CA to install the signed certificate.

It is recommended that you use the Cisco vManage as a CA. In this role, Cisco vManage automatically generates and installs a signed certificate on the vEdge Cloud router. Having Cisco vManage act as a CA is the default setting. You can view this setting in the WAN vEdge Cloud Certificate Authorization, on the Cisco vManage **Administration** > **Settings** page.

To use an enterprise CA for generating signed certificates for vEdge Cloud routers:

1. From the Cisco vManage menu, select **Administration** > **Settings**.
2. For WAN Edge Cloud Certificate Authorization, select **Manual**.
3. Click **Save**.

Generate a Bootstrap Configuration File

To generate a bootstrap configuration file for a vEdge Cloud router:

1. From the Cisco vManage menu, select **Configuration** > **Devices**.
2. To generate a bootstrap configuration file for one or multiple vEdge Cloud routers:
   a. Click **WAN Edge List**, select **Export Bootstrap Configuration**.

   b. In the Generate Bootstrap Configuration field, select the file format:

      - For a vEdge Cloud router on a KVM hypervisor or on an AWS server, select **Cloud-Init** to generate a token, vBond orchestrator IP address, vEdge Cloud router UUID, and organization name.
      - For a vEdge Cloud router on a VMware hypervisor, select Encoded String to generate an encoded string.

   c. From the **Available Devices** column, select one or more routers.

   d. Click the arrow pointing to right to move the selected routers to **Selected Devices** column.

e. Click **Generate Generic Configuration**. The bootstrap configuration is downloaded in a .zip file, which contains one .cfg file for each router.

3. To generate a bootstrap configuration file individually for each vEdge Cloud router:

   a. Click **WAN Edge List**, select the desired vEdge Cloud router.

   b. For the desired vEdge Cloud router, click **...**, and select **Generate Bootstrap Configuration**.

   c. In the **Generate Bootstrap Configuration** window, select the file format:

      - For a vEdge Cloud router on a KVM hypervisor or on an AWS server, select Cloud-Init to generate a token, vBond orchestrator IP address, vEdge Cloud router UUID, and organization name.
      - For a vEdge Cloud router on a VMware hypervisor, select Encoded String to generate an encoded string.

Note Beginning with Cisco vManage Release 20.7.1, there is an option available when generating a bootstrap configuration file for a Cisco vEdge device, enabling you generate two different forms of the bootstrap configuration file.

- If you are generating a bootstrap configuration file for a Cisco vEdge device that is using Cisco SD-WAN Release 20.4.x or earlier, then check the **The version of this device is 20.4.x or earlier** check box.
- If you are generating a bootstrap configuration for a Cisco vEdge device that is using Cisco SD-WAN Release 20.5.1 or later, then do not use the check box.

   d. Click **Download** to download the bootstrap configuration. The bootstrap configuration is downloaded in a .cfg file.

   Then use the contents of the bootstrap configuration file to configure the vEdge Cloud router instance in AWS, ESXi, or KVM. For example, to configure a router instance in AWS, paste the text of the Cloud-Init configuration into the User data field:

By default, the **ge0/0** interface is the router's tunnel interface, and it is configured as a DHCP client. To use a different interface or to use a static IP address, and if you did not attach a device configuration template to the router, change the vEdge Cloud router's configuration from the CLI. See *Configuring Network Interfaces*.

Install the Certificate on the vEdge Cloud Router

If you are using automated vEdge Cloud certificate authorization, which is the default, after you configure the vEdge Cloud router instance, Cisco vManage automatically installs a certificate on the router and the router's token changes to its serial number. You can view the router's serial number in the **Configuration** > **Devices** page. After the router's control connections to the Cisco vManage come up, any templates attached to the router are automatically pushed to the router.

If you are using manual vEdge Cloud certificate authorization, after you configure the vEdge Cloud router instance, follow this procedure to install a certificate on the router:

1. Install the enterprise root certificate chain on the router:

```
vEdge# request root-cert-chain install filename [vpn vpn-id]
```

Then, Cisco vManage generates a CSR.

2. Download the CSR:
   a. From the Cisco vManage menu, select **Configuration** > **Certificates**.
   b. For the selected vEdge Cloud router for which to sign a certificate, click **...** and select **View CSR**.
   c. To download the CSR, click **Download**.
3. Send the certificate to a third-party signing authority, to have them sign it.
4. Import the certificate into the device:
   a. From the Cisco vManage menu, select **Configuration** > **Certificates**.
   b. Click **Controllers**, and select **Install Certificate**.
   c. In the **Install Certificate** page, paste the certificate into the Certificate Text field, or click **Select a File** to upload the certificate in a file.
   d. Click **Install**.
5. Issue the following REST API call, specifying the IP address of your Cisco vManage:

```
https://vmanage-ip-address/dataservice/system/device/sync/rootcertchain
```

Create the vEdge Cloud Router Bootstrap Configuration from the CLI

It is recommended that you generate the vEdge Cloud router's bootstrap configuration using Cisco vManage. If, for some reason, you do not want to do this, you can create the bootstrap configuration using the CLI. With this process, you must still, however, use Cisco vManage. You collect some of this information for the bootstrap configuration from Cisco vManage, and after you have created the bootstrap configuration, you use Cisco vManage to install the signed certificate on the router.

Installing signed certificates by creating a bootstrap configuration from the CLI is a three-step process:

1. Edit the router's configuration file to add the DNS name or IP address of the vBond orchestrator and your organization name.
2. Send the router's chassis and token numbers to Cisco vManage.
3. Have Cisco vManage authenticate the vEdge Cloud router and install the signed certificate on the router.

To edit the vEdge Cloud router's configuration file from the CLI:

1. Open a CLI session to the vEdge Cloud router via SSH. To do this in Cisco vManage, select **Tools** > **SSH Terminal** page, and select the desired router.
2. Log in as the user **admin**, using the default password, **admin**. The CLI prompt is displayed.
3. Enter configuration mode:

```
vEdge# config
vEdge(config)#
```

4. Configure the IP address of the vBond orchestrator or a DNS name that points to the vBond orchestrator. The vBond orchestrator's IP address must be a public IP address:

```
vEdge(config)# system vbond (dns-name | ip-address)
```

5. Configure the organization name:

   ```
   vEdge(config-system)# organization-name name
   ```

6. Commit the configuration:

   ```
   vEdge(config)# commit and-quit
   vEdge#
   ```

To send the vEdge Cloud router's chassis and token numbers to Cisco vManage:

1. Locate the vEdge Cloud router's token and chassis number:
   a. From the Cisco vManage menu, select **Configuration** > **Devices**.
   b. Click **WAN Edge List**, locate the vEdge Cloud router.
   c. Make a note of the values in the vEdge Cloud router's Serial No./Token and Chassis Number columns.

2. Send the router's bootstrap configuration information to Cisco vManage:

   ```
   vEdge# request vedge-cloud activate chassis-number chassis-number token token-number
   ```

Issue the **show control local-properties** command on the router to verify the vBond IP address, the organization name the chassis number, and the token. You can also verify whether the certificate is valid.

Finally, have Cisco vManage authenticate the vEdge Cloud router and install the signed certificate on the router.

If you are using automated vEdge Cloud certificate authorization, which is the default, the Cisco vManage uses the chassis and token numbers to authenticate the router. Then, Cisco vManage automatically installs a certificate on the router and the router's token changes to a serial number. You can display the router's serial number in the **Configuration** > **Devices** page. After the router's control connections to Cisco vManage come up, any templates attached to the router are automatically pushed to the router.

If you are using manual vEdge Cloud certificate authorization, after you configure the vEdge Cloud router instance, follow this procedure to install a certificate on the router:

1. Install the enterprise root certificate chain on the router:

   ```
   vEdge# request root-cert-chain install filename [vpn vpn-id]
   ```

   After you install the root chain certificate on the router, and after Cisco vManage receives the chassis and token numbers, Cisco vManage generates a CSR.

2. Download the CSR:
   a. From the Cisco vManage menu, select **Configuration** > **Certificates**.
   b. For the selected vEdge Cloud router for which to sign a certificate, click **...** and select **View CSR**.
   c. To download the CSR, click **Download**.

3. Send the certificate to a third-party signing authority, to have them sign it.

4. Import the certificate into the device:
   a. From the Cisco vManage menu, select **Configuration** > **Certificates**.
   b. Click Controllers and select **Install Certificate**.

c. In the **Install Certificate** page, paste the certificate into the Certificate Text field, or click **Select a File** to upload the certificate in a file.

d. Click **Install**.

5. Issue the following REST API call, specifying the IP address of your Cisco vManage:

   https://*vmanage-ip-address***/dataservice/system/device/sync/rootcertchain**

Install Signed Certificates in Releases 16.3 and Earlier

For vEdge Cloud router virtual machine (VM) instances running Releases 16.3 and earlier, when the vEdge Cloud router VM starts, it has a factory-default configuration, but is unable to join the overlay network because no signed certificate is installed. You must install a signed Symantec certificate on the vEdge Cloud router so that it can participate in the overlay network.

To generate a certificate signing request (CSR) and install the signed certificate on the vEdge Cloud router:

1. Log in to the vEdge Cloud router as the user **admin**, using the default password, **admin**. If the vEdge Cloud router is provided through AWS, use your AWS key pair to log in. The CLI prompt is displayed.

2. Generate a CSR for the vEdge Cloud router:

```
vEdge# request csr upload path
```

   path is the full path and filename where you want to upload the CSR. The path can be in a directory on the local device or on a remote device reachable through FTP, HTTP, SCP, or TFTP. If you are using SCP, you are prompted for the directory name and filename; no file path name is provided. When prompted, enter and then confirm your organization name. For example:

```
vEdge# request csr upload home/admin/vm9.csr
Uploading CSR via VPN 0
Enter organization name            : Cisco
Re-enter organization name         : Cisco
Generating CSR for this vEdge device
........[DONE]
Copying ... /home/admin/vm9.csr via VPN 0
CSR upload successful
```

3. Log in to the Symantec Certificate Enrollment portal:

   https://certmanager.<wbr/>websecurity.symantec.com/<wbr/>mcelp/enroll/index?jur_hash=<wbr/>f422d7ceb508a24e32ea7de4f78d37<wbr/>f8

4. In the **Select Certificate Type** drop-down, select **Standard Intranet SSL** and click **Go**. The Certificate Enrollment page is displayed. Cisco SD-WAN uses the information you provide on this form to confirm the identity of the certificate requestor and to approve your certificate request. To complete the Certificate Enrollment form:

   a. In the Your Contact Information section, specify the First Name, Last Name, and Email Address of the requestor.

   b. In the Server Platform and Certificate Signing section, select Apache from the Select Server Platform drop-down. In the Enter Certificate Signing Request (CSR) box, upload the generated CSR file, or copy and paste the contents of the CSR file. (For details about how to do this, log in to support.viptela.com. Click Certificate, and read the Symantec certificate instructions.)

   c. In the Certificate Options section, enter the validity period for the certificate.

d. In the Challenge Phrase section, enter and then re-enter a challenge phrase. You use the challenge phrase to renew, and, if necessary, to revoke a certificate on the Symantec Customer Portal. It is recommended that you specify a different challenge phrase for each CSR.

e. Accept the Subscriber Agreement. The system generates a confirmation message and sends an email to the requestor confirming the certificate request. It also sends an email to the Cisco to approve the CSR.

5. After Cisco approves the CSR, Symantec sends the signed certificate to the requestor. The signed certificate is also available through the Symantec Enrollment portal.

6. Install the certificate on the vEdge Cloud router:

```
vEdge# request certificate install filename [vpn vpn-id]
```

   The file can be in your home directory on the local device, or it can be on a remote device reachable through FTP, HTTP, SCP, or TFTP. If you are using SCP, you are prompted for the directory name and filename; no file path name is provided.

7. Verify that the certificate is installed and valid:

```
vEdge# show certificate validity
```

After you have installed the certificate on the vEdge Cloud router, the vBond orchestator is able to validate and authenticate the router, and the router is able to join the overlay network.

What's Next

See *Send vEdge Serial Numbers to the Controller Devices*.

Manage a Network Hierarchy

Table 99: Feature History

Feature Name	Release Information	Description
Network Hierarchy and Resource Management	Cisco SD-WAN Release 20.9.1 Cisco vManage Release 20.9.1	You can create a network hierarchy in Cisco vManage to represent the geographical locations of your network. You can create a region, an area, and a site in a network hierarchy. In addition, you can assign a site ID and a region ID to a device.

The Network Hierarchy and Resource Management feature enables you to do the following:

- Create a region
- Create an area
- Create, edit, and delete a site

Create a Region in a Network Hierarchy

Before You Begin

Ensure that the **Multi-Region Fabric** option in Cisco vManage is enabled.

1. From the Cisco vManage menu, choose **Administration** > **Settings**.
2. Click **Edit** adjacent to the **Multi-Region Fabric** option.
3. Click **Enabled**, and then click **Save**.

Create a Region

1. From the Cisco vManage menu, choose **Configuration** > **Network Hierarchy**.
2. Click **…** adjacent to a node (global or area) in the left pane and choose **Add MRF Region**.

Note In Cisco vManage Release 20.9.x, you can also use the **Add Node** option to add a region.

3. In the **Name** field, enter a name for the region. The name must be unique and can contain only letters, the digits 0 through 9, hyphens (-), underscores (_), and periods (.).
4. In the **Description** field, enter a description of the region.
5. From the **Parent** drop-down list, choose a parent node.
6. Click **Add**.

Create an Area in a Network Hierarchy

1. From the Cisco vManage menu, choose **Configuration** > **Network Hierarchy**.
2. Click **…** adjacent to a node (global, region, or area) in the left pane and choose **Add Area**.

Note In Cisco vManage Release 20.9.x, you can also use the **Add Node** option to add an area.

3. In the **Name** field, enter a name for the area. The name must be unique and can contain only letters, the digits 0 through 9, hyphens (-), underscores (_), and periods (.).
4. In the **Description** field, enter a description of the area.
5. From the **Parent** drop-down list, choose a parent node.
6. Click **Add**.

Create a Site in a Network Hierarchy

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

2. Click **…** adjacent to a node (global, region, or area) in the left pane and choose **Add Site**.

> **Note** In Cisco vManage Release 20.9.x, you can also use the **Add Node** option to add a site.

3. In the **Name** field, enter a name for the site. The name must be unique and can contain only letters, the digits 0 through 9, hyphens (-), underscores (_), and periods (.).
4. In the **Description** field, enter a description of the site.
5. From the **Parent** drop-down list, choose a parent node.
6. In the **Site ID** field, enter a site ID.

   If you do not enter the site ID, Cisco vManage generates a site ID for the site.
7. Click **Add**.

Assign a Site ID to a Device

You can assign a site ID to a device using one of the following ways.

Use the Quick Connect Workflow

1. From the Cisco vManage menu, choose **Workflows** > **Workflow Library**.
2. Start the **Quick Connect** workflow.
3. Follow the instructions provided in the workflow.
4. On the **Add and Review Device Configuration** page, enter the site ID of the device.

> **Note**
> - You can use any of the existing site IDs that are available in the network hierarchy or enter a new site ID. If you enter a new site ID without creating a node in the network hierarchy, the site is automatically created and listed on the **Configuration** > **Network Hierarchy** page.

Use a Template

1. From the Cisco vManage menu, choose **Configuration** > **Devices** > **WAN Edge List**.
2. Check if a device is attached to a device template.
3. From the Cisco vManage menu, choose **Configuration** > **Templates** > **Feature Templates**.
4. Click **…** adjacent to the System feature template and choose **Edit**.
5. Click the **Basic Configuration** tab and set the scope of the **Site ID** field to **Global** and enter the site ID.
6. Click **Update**.
7. Click **Configure Devices** to push the configuration to the device.

In Step 5, if you set the scope of the **Site ID** field to **Device Specific**, do the following:

1. From the Cisco vManage menu, choose **Configuration** > **Templates** > **Device Templates**.
2. Click **…** adjacent to the device template and choose **Edit Device Template**.
3. In the **Site ID** field, enter the site ID.

   You can use any of the existing site IDs that are available in the network hierarchy or enter a new site ID. If you enter a new site ID without creating a node in the network hierarchy, the site is automatically created and listed on the **Configuration** > **Network Hierarchy** page.
4. Click **Update**.
5. Click **Configure Devices** to push the configuration to the device.

Use a Configuration Group

The configuration group flow is applicable only for the Cisco IOS XE SD-WAN devices.

1. From the Cisco vManage menu, choose **Configuration** > **Templates** > **Configuration Groups**.
2. Click **…** adjacent to the configuration group name and choose **Edit**.
3. Click **Associated Devices**.
4. Choose a device that is associated with the configuration group and click **Deploy**.

   The **DeployConfiguration Group** workflow starts.
5. Follow the instructions provided in the workflow.
6. On the **Add and Review Device Configuration** page, enter the site ID of the device.

   You can use any of the existing site IDs that are available in the network hierarchy or enter a new site ID. If you enter a new site ID without creating a node in the network hierarchy, the site is automatically created and listed on the **Configuration** > **Network Hierarchy** page.

Assign a Region ID to a Device

Before You Begin

- Have access to the **Multi-Region Fabric** feature.
- Ensure that the region is available in the network hierarchy.

Assign a Region ID

1. From the Cisco vManage menu, choose **Configuration** > **Devices** > **WAN Edge List**.
2. Check if the corresponding device is attached to a device template.
3. From the Cisco vManage menu, choose **Configuration** > **Templates** > **Feature Templates**.
4. Click **…** adjacent to the System feature template and choose **Edit**.

5. Click the **Basic Configuration** tab and set the scope of the **Region ID** field to **Global** and enter the region ID.

   You can use any of the existing region IDs that are available in the network hierarchy. If the specified region ID is not available in the network hierarchy, the template push operation to the devices fails.

6. Click **Update**.

7. Click **Configure Devices** to push the configuration to the device.

In Step 5, if you set the scope of the **Region ID** field to **Device Specific**, do the following:

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

2. Click **…** adjacent to the device template and choose **Edit Device Template**.

3. In the **Region ID** field, enter the region ID.

4. Click **Update**.

5. Click **Configure Devices** to push the configuration to the device.

Manage Certificates in Cisco vManage

Perform certificate operations in Cisco vManage on the **Configuration** > **Certificates** page.

- Top bar—On the left are the menu icon, for expanding and collapsing the Cisco vManage menu, and the vManage product name. On the right are a number of icons and the user profile drop-down.

- Title bar—Includes the title of the screen, Certificates.

- WAN Edge List tab—Install the router authorized serial number file on the controllers in the overlay network and manage the serial numbers in the file. When you first open the Certificates screen, the WAN Edge List tab is selected.

  - Send to Controllers—Send the WAN edge router chassis and serial numbers to the controllers in the network.

  - Table of WAN edge routers in the overlay network—To re-arrange the columns, drag the column title to the desired position.

- Controllers tab—Install certificates and download the device serial numbers to the vBond orchestrator.

  - Send to vBond—Send the controller serial numbers to the Cisco vBond Orchestrator.

  - Install Certificate—Install the signed certificates on the controller devices. This button is available only if you select Manual in **Administration** > **Settings** > **Certificate Signing by Symantec**.

  - Export Root Certificate—Display a copy of the root certificate for the controller devices that you can download to a file.

  - Table of controller devices in the overlay network—To re-arrange the columns, drag the column title to the desired position.

  - Certificate status bar—Located at the bottom of the screen, this bar is available only if you select Server Automated in **Administration** > **Settings** > **Certificate Authorization**. It displays the states of the certificate installation process:

  - Device Added
  - Generate CSR
  - Waiting for Certificate
  - Send to Controllers

  A green check mark indicates that the step has been completed. A grey check mark indicates that the step has not yet been performed.

- Search box—Includes the Search Options drop-down, for a Contains or Match string.
- Refresh icon—Click to refresh data in the device table with the most current data.
- Export icon—Click to download all data to a file, in CSV format.
- Show Table Fields icon—Click the icon to display or hide columns from the device table. By default, all columns are displayed.

Authorize a Controller Certificate for an Enterprise Root Certificate

1. From the Cisco vManage menu, choose **Administration** > **Settings**.
2. In the **Controller Certificate Authorization** area, click **Edit**.
3. Click **Enterprise Root Certificate**. If a warning appears, click **Proceed** to continue.
4. Click **Set CSR Properties**.
5. Paste an SSL certificate into the **Certificate** field or click **Select a file** and navigate to an SSL certificate file.
6. (Optional) In the **Subject Alternative Name (SAN) DNS Names** field, you can enter multiple host names to use the same SSL certificate.

   Example: cisco.com and cisco2.com
7. (Optional) In the **Subject Alternative Name (SAN) URIs** field, you can enter multiple URIs to use the same SSL certificate.

   Example: cisco.com and support.cisco.com

   This is helpful for an organization that uses a single certificate for a host name, without using different subdomains for different parts of the organization.

Check the WAN Edge Router Certificate Status

In the **WAN Edge List** tab, check the **Validate** column. The status can be one of the following:

- Valid (shown in green)—The router's certificate is valid.
- Staging (shown in yellow)—The router is in the staging state.
- Invalid (shown in red)—The router's certificate is not valid.

Validate a WAN Edge Router

When you add Cisco vEdge devices and WAN routers to the network using the **Configuration** > **Devices** screen, you can automatically validate the routers and send their chassis and serial numbers to the controller devices by clicking the checkbox Validate the uploaded WAN Edge List and send to controllers. If you do not select this option, you must individually validate each router and send their chassis and serial numbers to the controller devices. To do so:

1. In the **WAN Edge List** tab, select the router to validate.
2. In the **Validate** column, click **Valid**.
3. Click **OK** to confirm the move to the valid state.
4. Repeat the steps above for each router you wish to validate.
5. Click the **Send to Controllers** button in the upper left corner of the screen to send the chassis and serial numbers of the validated routers to the controller devices in the network. Cisco vManage NMS displays the Push WAN Edge List screen showing the status of the push operation.

Stage a WAN Edge Router

When you initially bring up and configure a WAN Edge router, you can place it in staging state using the Cisco vManage instance. When the router is in this state, you can configure the router, and you can test that the router is able to establish operational connections with the vSmart controller and the vManage instance.

After you physically place the router at its production site, you change the router's state from staging to valid. It is only at this point that the router joins the actual production network. To stage a router:

1. In the WAN Edge List tab, select the router to stage.
2. In the **Validate** column, click **Staging**.
3. Click **OK** to confirm the move to the staging state.
4. Click **Send to Controllers** in the upper left corner of the screen to sync the WAN edge authorized serial number file with the controllers. vManage NMS displays the **Push WAN Edge List** screen showing the status of the push operation.
5. To unstage, validate the WAN Edge Router.

Invalidate a WAN Edge Router

1. In the **WAN Edge List** tab, select the router to invalidate.
2. In the **Validate** column, click **Invalid**.
3. Click **OK** to confirm the move to the invalid state.
4. Repeat the steps above for each router you wish to invalidate.
5. Click the **Send to Controllers** button in the upper left corner of the screen to send the chassis and serial numbers of the validated routers to the controller devices in the network. Cisco vManage instance displays the **Push WAN Edge List** screen showing the status of the push operation.

Send the Controller Serial Numbers to Cisco vBond Orchestrator

To determine which controllers in the overlay network are valid, the Cisco vBond Orchestrator keeps a list of the controller serial numbers. The Cisco vManage instance learns these serial numbers during the certificate-generation process.

To send the controller serial numbers to the Cisco vBond Orchestrator:

1. In the **Controllers** tab, check the certificate status bar at the bottom of the screen. If the **Send to Controllers** check mark is green, all serial numbers have already been sent to the Cisco vBond Orchestrator. If it is grey, you can send one or more serial numbers to the Cisco vBond Orchestrator.
2. Click the **Send to vBond** button in the **Controllers** tab. A controller's serial number is sent only once to the Cisco vBond Orchestrator. If all serial numbers have been sent, when you click **Send to vBond**, an error message is displayed. To resend a controller's serial number, you must first select the device and then select **Invalid in the Validity** column.

After the serial numbers have been sent, click the **Tasks** icon in the Cisco vManage toolbar to display a log of the file download and other recent activities.

Install Signed Certificate

If in **Administration** > **Settings** > **Certificate Signing by Symantec**, you selected the **Manual** option for the certificate-generation process, use the **Install Certificate** button to manually install certificates on the controller devices.

After Symantec or your enterprise root CA has signed the certificates, they return the files containing the individual signed certificates. Place them on a server in your local network. Then install them on each controller:

1. In the **Controllers** tab, click **Install Certificate**.
2. In the **Install Certificate** window, select a file, or copy and paste the certificate text.
3. Click **Install** to install the certificate on the device. The certificate contains information that identifies the controller, so you do not need to select the device on which to install the certificate.
4. Repeat Steps the steps above to install additional certificates.

Export Root Certificate

1. In the **Controllers** tab, click the **Export Root Certificate** button.
2. In the **Export Root Certificate** window, click **Download** to export the root certificate to a file.
3. Click **Close**.

View a Certificate Signing Request

1. In the WAN Edge List or **Controllers** tab, select a device.
2. Click the **More Actions** icon to the right of the row, and click **View CSR** to view the certificate signing request (CSR).

View a Device Certificate Signing Request

1. In the **WAN Edge List** or **Controllers** tab, select a Cisco IOS XE SD-WAN device.
2. Click the **More Actions** icon to the right of the row, and click **View Device CSR** to view the certificate signing request (CSR).

   For a Cisco IOS XE SD-WAN device where trustpoint has been configured, clicking the **More Actions** icon allows you to view three options:

   - View Device CSR
   - Generate Feature CSR
   - View Feature CSR

Note Cisco vManage will generate alarms only if device certificate is installed through Cisco vManage. If you install certificate manually, Cisco vManage will not generate alarms for certificate expiration.

View the Certificate

1. In the **Controllers** tab, select a device.
2. Click the **More Actions** icon to the right of the row and click **View Certificate**.

Generate a Controller Certificate Signing Request

1. From the Cisco vManage menu, choose **Configuration** > **Certificates**.
2. Click **Controllers**.
3. For the desired controller, click **…** and choose **Generate CSR**.

   The **Generate CSR** window is displayed.
4. In the **Generate CSR** window, click **Download** to download the file to your local PC (that is, to the PC you are using to connect to the Cisco vManage NMS).
5. Repeat the preceding steps to generate a CSR for another controller.

Generate a Feature Certificate Signing Request

1. From the Cisco vManage menu, choose **Configuration** > **Certificates**.
2. Click **WAN Edge List**.
3. For the desired device, click **…** and choose **Generate Feature CSR**.

   The **Generate Feature CSR** window is displayed.

4. In the **Generate Feature CSR** window, click **OK** to continue with the generation of feature CSR. This step authenticates the device trustpoint that has been set and extracts the CSR from the device.
5. Repeat the steps above for each device for which you are generating a CSR.

Reset the RSA Key Pair

1. In the **Controllers** tab, select a device.
2. Click the **More Actions** icon to the right of the row and click **Reset RSA**.
3. Click **OK** to confirm resetting of the device's RSA key and to generate a new CSR with new public or private keys.

Invalidate a Device

1. In the **Controllers** tab, select a device.
2. Click the **More Actions** icon to the right of the row and click **Invalidate**.
3. Click **OK** to confirm invalidation of the device.

View Log of Certificate Activities

To view the status of certificate-related activities:

1. Click the **Tasks** icon located in the vManage toolbar. Cisco vManage NMS 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 vManage NMS opens a status window displaying the status of the task and details of the device on which the task was performed.

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 vManage:

1. From the Cisco vManage menu, choose **Configuration** > **Certificates**.
2. Click **Controllers**.
3. For the desired device, click **...** and choose **View Certificate** to view the installed certificate.

Manage Root Certificate Authority Certificates in Cisco vManage

Feature Name	Release Information	Description
Support for Managing Root CA Certificates in Cisco vManage	Cisco IOS XE Release 17.4.1a Cisco SD-WAN Release 20.4.1 Cisco vManage Release 20.4.1	Add and manage root certificate authority (CA) certificates.

Add a Root Certificate Authority Certificate

1. In Cisco vManage, choose **Administration** > **Root CA Management**.
2. Click **Modify Root CA**.
3. In the **Root Certificate** field, paste in certificate text, or click **Select a File** to load a certificate from a file.
4. Click **Add**. The new certificate appears in the certificate table. The **Recent Status** column indicates that the certificate has not yet been installed.
5. Click **Next** and review the details of any certificates that have not been installed.
6. Click **Save** to install the certificate(s). The new certificate appears in the certificate table.

View a Root Certificate Authority Certificate

1. In Cisco vManage, choose **Administration** > **Root CA Management**.
2. (optional) In the search field, enter text to filter the certificate view. You can filter by certificate text or attribute values, such as serial number.
3. In the table of certificates, click **More Actions** (**…**) and choose **View**. A pop-up window appears, displaying the certificate and its details.

Delete a Root Certificate

Use this procedure to delete a root Certificate Authority (CA) certificate.

1. In Cisco vManage, choose **Administration** > **Root CA Management**.
2. Click **Modify Root CA**.
3. Select one or more root certificates in the table and click the **trash** icon in the **Action** column. The table shows the certificate as marked for deletion.
4. Click **Next** and review the details of any certificates that are marked for deletion.
5. Click **Save** to delete the certificate(s).

Manage Device Templates

Edit a Device Template

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Device Templates** or **Feature Templates**, and select a template.

> **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 click **Edit**.

You cannot change the name of a device or feature template when that is attached to a device.

> **Note** You can edit templates simultaneously from one or more vManage servers. For simultaneous template edit operations, the following rules apply:

- You cannot edit the same device or feature template simultaneously.
- When you are editing a device template, all other feature templates attached to that device template are locked and you cannot perform any edit operations on them.
- When you are editing a feature template that is attached to a device template, that device template as well as all other feature templates attached to it are locked and you cannot perform any edit operations on them.

Delete a Template

Deleting a template does not remove the associated configuration from devices.

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Device Templates** or **Feature Templates**, and select a template.

> **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 click **Delete**.
4. To confirm the deletion of the template, click **OK**.

Copy a Template

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

2. Click **Device Templates** or **Feature Templates**, and select a template.

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 click **Copy**.
4. Enter a new template name and description.
5. Click **Copy**.

Edit a CLI Device Template

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Device Templates**, and select a template.

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

3. Click **...**, and click **Edit**.
4. Under **Device CLI Template**, edit the template.
5. Click **Update**.

Manage Licenses for Smart Licensing Using Policy

Table 100: Feature History

Feature Name	Release Information	Description
License Management for Smart Licensing Using Policy, Using Cisco vManage	Cisco IOS XE Release 17.5.1a Cisco vManage Release 20.5.1	Cisco vManage shows available DNA licenses, assigns licenses to devices, and reports license consumption to Cisco Smart Software Manager (Cisco SSM).
Support for License Management Offline Mode and Compliance Alarms	Cisco IOS XE Release 17.6.1a Cisco vManage Release 20.6.1	You can manage Cisco SD-WAN licenses through a Cisco vManage instance that is not connected to the internet. To synchronize license and compliance information between Cisco vManage and Cisco SSM, you must periodically download synchronization files from Cisco vManage and upload the files to Cisco SSM.

Feature Name	Release Information	Description
Support for Postpaid MSLA License Billing Models	Cisco IOS XE Release 17.8.1a Cisco vManage Release 20.8.1	For postpaid Managed Services License Agreement (MSLA) program licenses, Cisco SD-WAN supports two distinct billing models for licenses—committed (MSLA-C) and uncommitted (MSLA-U). The procedure for assigning a postpaid license enables you to choose one of these two MSLA license types.
Support for License Management Using a Proxy Server	Cisco IOS XE Release 17.9.1a Cisco vManage Release 20.9.1	If you configure Cisco vManage to use a proxy server for internet access, Cisco vManage uses the proxy server to connect to Cisco SSM or an on-prem SSM.
Support for Managing Licenses Using Cisco Smart Software Manager On-Prem	Cisco IOS XE Release 17.9.1a Cisco vManage Release 20.9.1	Cisco vManage can synchronize device licenses using a Cisco SSM on-prem license server. This is useful for organizations that use Cisco SSM on-prem to accommodate a strict security policy that does not permit devices to communicate with Cisco SSM over a direct internet connection.

Configure the License Reporting Mode

Before You Begin

When using Cisco SD-WAN multitenancy, only the service provider configures the Cisco SSM license server details, using the license server credentials.

Configure the License Reporting Mode

1. For Cisco vManage Release 20.9.1 and later, from the Cisco vManage menu, choose **Administration** > **Settings**.

   Note In Cisco vManage Release 20.8.x and earlier, to configure the license reporting mode, from the Cisco vManage menu, choose **Administration** > **License Management**. Click **Sync Licenses & Refresh Devices** and choose a license reporting mode. Then continue with the procedure for synchronizing licenses.

2. In the **License Reporting** section, click **Edit** and choose one of the following:

   Note Changing the mode causes Cisco vManage to permanently clear any license information that it is currently storing.

   - Online
   - Offline

- On-prem

  Enter the following information for the Cisco SSM on-prem server:

Field	Description
SSM Server	IP address of the Cisco SSM on-prem license server.
SSM Credentials **Client ID** and **Client Secret**	Client ID and client secret credentials for the Cisco SSM on-prem license server. This information is available from the administrator who manages the license server.

3. Click **Save**.

Enter Smart Account Credentials in Cisco vManage

Before You Begin

Ensure that you have configured DNS host and next-hop IP route entries for the Cisco SSM servers under VPN 0 on Cisco vManage. Without this configuration, Cisco vManage cannot communicate with Cisco SSM.

Enter Smart Account Credentials

1. From the Cisco vManage menu, choose **Administration** > **License Management**.
2. Click **Sync Licenses & Refresh Devices**.

   The **Reporting Mode** area shows the reporting mode configured on the **Administration** > **Settings** page (requires administrator permissions).
3. Click **Smart Account Credentials**.
4. In the **Smart Account Credentials** dialog box, configure the following:

Field	Description
Username	Username of the account you use to access the Smart Accounts and Virtual Accounts for which you have administrative privileges.
Password	Password for the account you use to access Smart Accounts and Virtual Accounts.

5. Click **Save**.

   Cisco vManage authenticates the Smart Account credentials, and on successful authentication, saves the credentials in the database.

Synchronize Licenses

Before You Begin

- You use this procedure to specify Smart Account and Virtual Account information, or synchronize licenses on-demand, which is useful if you have recently added licenses to your Smart Account and want to bring those licenses into Cisco vManage.
- Ensure licenses belong to the correct Smart Accounts or Virtual Accounts on Cisco SSM.

  When the selected Smart Accounts and Virtual Accounts are registered with Cisco vManage, Cisco vManage fetches and synchronizes the license information with Cisco SSM, and reports usage of the licenses in these accounts.

Synchronize Licenses

1. From the Cisco vManage menu, choose **Administration** > **License Management**.
2. Click **Sync Licenses & Refresh Devices**.
3. In the **Sync Licenses & Refresh Devices** dialog box, configure the following:

Note If these details are already configured, you can skip this step and proceed to the next step to synchronize licenses again. This is useful if you have recently added licenses to your Smart Account and want to bring those licenses into Cisco vManage.

Item	Description
Select Smart/Virtual Accounts to Fetch/Sync Licenses	Select the Smart Accounts or Virtual Accounts for which Cisco vManage must fetch licenses from the Cisco SSM. Cisco vManage also reports license usage for the licenses in these accounts. **Note** Selecting an Smart Account automatically selects all the Virtual Accounts under the Smart Account. To stop Cisco vManage from fetching and synchronizing license information with Cisco SSM for an Smart Account or Virtual Account registered earlier, deselect the Smart Account or Virtual Account. You can deregister the Smart Account or Virtual Account only if you have not assigned any licenses from the account.

Item	Description
Advanced > **Type of Licenses**	Choose the type of licenses that must be fetched by Cisco vManage from among the license types that may belong to the selected Smart Accounts and Virtual Accounts. Select one of the following: • **Prepaid** • **Postpaid** • **Mixed** (both Prepaid and Postpaid) From Cisco vManage Release 20.8.1, if you choose to synchronize postpaid licenses, the license assignment procedure enables you to select committed MSLA licenses (MSLA-C) or uncommitted MSLA licenses (MSLA-U). See Assign a License to a Device.
Advanced > **Multiple Entitlement**	Select one of the following: • **On**: You can assign more than one license to a device. • **Off**: You can assign only one license to a device. **Note** Set this setting to **On** only if you need to map more than one DNA entitlement to a single device.

4. Click **Sync**.

Assign a License to a Device

1. From the Cisco vManage menu, choose **Administration** > **License Management**.
2. Click **Device**.
3. Select the devices to which to assign a license using the check box for each device.
4. Click **Assign License/Subscription**.

   The **Assign License/Subscription** dialog box appears.
5. In the **Assign License/Subscription** dialog box, configure the following:
   - In Cisco vManage Release 20.8.1 and later, the following options appear:

Template Name	To use a new template, enter a unique name for the template. To use an existing template, do the following: **a.** Turn on the **Use existing template** toggle. **b.** Choose an existing template.
Virtual Account	Choose the virtual account from which you wish to assign a license to the device.
MSLA Type	Choose one of the following: • **MSLA-C**: MSLA licenses using the committed billing model • **MSLA-U**: MSLA licenses using the uncommitted billing model
Subscription ID	Choose the subscription ID to track the license consumption. This option appears only if both of the following are true: • The license mode is postpaid. • You have chosen an option in the **MSLA Type** field.

License	Choose license to apply to the device. If you have enabled Multiple Entitlements in the **Sync Licenses & Refresh Devices** dialog box, you can assign up to three licenses to the device. **Note** • Select a license that belongs to the Virtual Account you have selected. On Cisco SSM, you can check the licenses that are available in a Virtual Account. • Check the device license applicability matrix in the Cisco DNA Software for SD-WAN and Routing Ordering Guide to ensure that you assign a license that is applicable to the device. Different device models support different throughputs. If you apply an incompatible license, the license may have no effect on device behavior. However, Cisco vManage will record the consumption of the license. • When assigning licenses, Cisco vManage shows the throughput entitlement levels as tiers. Select the tier that matches the license you have purchased. If you purchased a license with a throughput expressed as a throughput value, find the tier that corresponds to the throughput that the license provides. For example, for a Routing DNA Advantage license, Tier 2 provides up to 1 Gbps throughput. If your DNA Advantage license provides 1 Gbps, choose Tier 2. Tier 0: 10M-15M (up to 30M aggregate) Tier 1: 25M-100M (up to 200M aggregate) Tier 2: 250M-1G (up to 2G aggregate) Tier 3: 2.5G-10G (up to 20G aggregate) The list includes the predefined licenses that Cisco vManage provides, together with the licenses in the virtual account that you have chosen, that meet the MSLA type and subscription ID criteria.

- In Cisco vManage Release 20.7.x and earlier, the following options appear:

Are you using utility-based licensing (MSLA)?	Check this check box if you wish to apply an MSLA license. By default, the check box is unchecked.
Template Name	To use a new template, enter a unique name for the template. To use an existing template, do the following: **a.** Turn on the **Use existing template** toggle. **b.** Choose an existing template.
Virtual Account	Choose the virtual account from which you wish to assign a license to the device.

License	Choose license to apply to the device. If you have enabled Multiple Entitlements in the **Sync Licenses & Refresh Devices** dialog box, you can assign up to three licenses to the device. **Note** • Select a license that belongs to the Virtual Account you have selected. On Cisco SSM, you can check the licenses that are available in a Virtual Account. • Check the device license applicability matrix in the Cisco DNA Software for SD-WAN and Routing Ordering Guide to ensure that you assign a license that is applicable to the device. Different device models support different throughputs. If you apply an incompatible license, the license may have no effect on device behavior. However, Cisco vManage will record the consumption of the license. • When assigning licenses, Cisco vManage shows the throughput entitlement levels as tiers. Select the tier that matches the license you have purchased. If you purchased a license with a throughput expressed as a throughput value, find the tier that corresponds to the throughput that the license provides. For example, for a Routing DNA Advantage license, Tier 2 provides up to 1 Gbps throughput. If your DNA Advantage license provides 1 Gbps, choose Tier 2. Tier 0: 10M-15M (up to 30M aggregate) Tier 1: 25M-100M (up to 200M aggregate) Tier 2: 250M-1G (up to 2G aggregate) Tier 3: 2.5G-10G (up to 20G aggregate)
Subscription ID	Choose the subscription ID to be used to track the license consumption. The subscription ID field is displayed only for the following conditions: • if mode is postpaid. • if mode is mixed and MSLA is true and if there are any subscriptions available.

6. Click **Save**.

The license is assigned and you are returned to **License Management** > **Device** tab. In the table listing the devices, entries are made in the following columns in accordance with the license assignment:

- Template Name: name of the template used to assign the license
- Virtual Account: name of Virtual Account to which license belongs
- MSLA:
  - True for an MSLA license
  - False for an a la carte or EA license

- License Status: subscribed
- License Type: prepaid, postpaid, or mixed based on the types of licenses assigned to the device.
- Subscription ID: The subscription ID used for billing purposes in case of a postpaid license. For a prepaid license, this column has a blank entry.

Monitor License Usage

License Management Overview

From the Cisco vManage menu, choose **Administration** > **License Management** to display the **License Management Overview**.

The **License Management Overview** page shows license information, including what percentage of devices have licenses assigned, the top types of licenses assigned to devices, license usage, license alarms, and so on.

License alarms alert you to licensing issues affecting devices in the Cisco SD-WAN network. You can click the alarm icon to display details of the problem. Issues include the following:

- A device is not licensed.
- The interval for reporting license usage to Cisco SSM has been exceeded.
  - Prepaid licenses: A report is required every three months.
  - Postpaid licenses: A report is required each month.

License Management Overview

After you have assigned at least one license, the **Overview** tab in the **Administration** > **License Management** page provides the following information:

Device Assignment Distribution	• Percentage of licensed devices • Percentage of unlicensed devices
Top 5 licenses	Lists the top 5 licenses in use and shows the usage percentage for each license.
License Usage vs Availability	The dashlet features a bar chart with stacked columns. The chart uses two stacked columns for each of the three license packages Advantage, Essentials, and Premier. For each package, the column on the left represents the count of used licenses; the column on the right represents the count of available licenses. The stacked segments in each column represent a particular license tier (such as Tier 0 or Tier 1). The segment for each tier is of a different color, as identified in the legend.

License and Devices Overview	This section provides the following details for each license assigned: • Name (for example, Routing DNA Essentials: Tier 0) • Number of Licensed Devices: Number of devices to which this license is assigned. • Number of Total Licenses: Sum of the number of licenses assigned and number of licenses available. • Last Assigned On: Date and time when the license was most recently assigned.

Enable Offline Mode

Before You Begin

Note Changing the mode from online to offline, or from offline to online causes Cisco vManage to permanently clear any license information that it is currently storing.

Enable Offline Mode, Cisco vManage Release 20.9.1 and Later

1. From the Cisco vManage menu, choose **Administration** > **Settings**.
2. In the **License Reporting** area, click the **Offline** option.

Enable Offline Mode, Before Cisco vManage Release 20.9.1

1. From the Cisco vManage menu, choose **Administration** > **License Management**.
2. Click **Overview**.
3. Click **Sync Licenses & Refresh Devices**.
4. Click the **Offline** option.
5. (Optional) Click **Advanced** and select license types or configure multiple entitlement. For information about these options, see Fetch and Synchronize Licenses.
6. Click **Sync**.

Note If you are configuring offline mode for the first time, we recommend uploading a license summary file. See Generate a Cisco SSM License Summary File and Upload It into Cisco vManage.

Generate a Cisco SSM License Summary File and Upload It into Cisco vManage

Generating a license summary file in Cisco SSM and uploading the file to Cisco vManage brings all of the license information from your Cisco smart account into Cisco vManage.

1.

Note Generating a license summary file in the Cisco SSM portal is outside the scope of Cisco SD-WAN documentation and is subject to change.

In Cisco Software Central, navigate to **Manage Licenses**, then navigate to **Reports**.

2. Locate the option for downloading a synchronization file for device controllers. Specify Cisco vManage as the controller type, and include all virtual accounts.
3. Download the license summary file, which is in tar.gz format.
4. From the Cisco vManage menu, choose **Administration** > **License Management**.
5. Click **Overview**.
6. Click **Sync Licenses & Refresh Devices**.
7. Click the **Offline** option.
8. In the **Attach License File** area, click the option to upload a file. Browse to the license summary file and upload it.
9. Click **Sync**.

Generate a Usage Report File in Cisco vManage and Synchronize with Cisco SSM

When managing licenses with Cisco vManage in the offline mode, use manually generated files to enable Cisco vManage to provide information about license assignment to Cisco SSM.

To generate a usage report file in Cisco vManage, upload it to Cisco SSM, receive an acknowledgement file from Cisco SSM, and upload the acknowledgement file to Cisco vManage, perform the following steps.

1. From the Cisco vManage menu, choose **Administration** > **License Management**.
2. Click **Reporting**.
3. In the table, in the row with the Cisco Smart Account, click **…** and choose **Generate Report** to generate the usage report file.

   When you generate a report, the Cisco vSmart Controller starts a 48-hour timer. If you do not upload an acknowledgement file from Cisco SSM within that time, an alert appears in the **License Management Overview** dashboard.

4. In Cisco SSM, upload the usage report file.

Note The details of procedures in the Cisco SSM portal are outside the scope of this documentation and subject to change.

a. In Cisco Software Central, navigate to **Manage Licenses**.

b. Navigate to **Reports**.

c. Navigate to **Upload Usage Data** > **Select and Upload File** or the equivalent, and upload the report file generated by Cisco vManage.

d. If prompted to select a virtual account, select the desired virtual account.

Note In a scenario where you have not yet generated a license summary in Cisco SSM and uploaded it to Cisco vManage, Cisco SSM prompts you to select a virtual account. After you have generated a license summary in Cisco SSM and uploaded it to Cisco vManage, Cisco vManage has the virtual account information that it needs to associate licenses with the correct virtual account.

For information about the scenario of assigning licenses to devices before providing Smart Account details to Cisco vManage, see Information About Offline Mode

.

Cisco SSM generates an acknowledgement file.

e. When Cisco SSM finishes generating an acknowledgement file, click **Download** or the equivalent to download the file.

5. From the Cisco vManage menu, choose **Administration** > **License Management**.

6. Click **Reporting**.

7. In the table, in the row with the Cisco Smart Account, click **...** and choose **Upload Ack** to upload the acknowledgement file from Cisco SSM.

Manage HSEC Licenses

Table 101: Feature History

Feature Name	Release Information	Description
Manage HSEC Licenses	Cisco IOS XE Release 17.9.1a Cisco vManage Release 20.9.1	You can use Cisco vManage to install HSEC licenses on devices An HSEC license is required to enable devices to support encrypted traffic throughput of 250 Mbps or higher.

Synchronize HSEC Licenses, Online Mode

Before You Begin

- This procedure requires Cisco vManage to have internet access. If Cisco vManage does not have internet access, such as for security reasons, use the Synchronize HSEC Licenses, Offline Mode, on page 254 procedure.
- This procedure requires entering credentials for your Cisco Smart Account

Synchronize HSEC Licenses, Online Mode

1. From the Cisco vManage menu, choose **Workflows** > **Workflow Library**.
2. Click the **Sync and Install HSEC Devices** workflow.
3. Click **Sync Licenses** and then click **Next**.
4. Click **Online** and then click **Next**.
5. Enter the credentials for your Cisco SSM account and then click **Next**.
6. On the **HSEC Device Activation Overview** page, click **Next**.
7. On the **Select Virtual Account** page, choose a virtual account from the drop-down list. The list is populated by the Cisco SSM account that you logged into in a previous step.
8. On the **Select HSEC-Compatible Devices** page, select the devices on which you want to install an HSEC license and then click **Summary**.

Note If an HSEC-compatible device already has an HSEC license installed by Cisco vManage, then the device is not selectable.

9. Review the summary and then click **Assign** to begin the synchronization. Cisco vManage loads the requested licenses from Cisco SSM and assigns them to the devices.
10. The process of loading and assigning licenses may take several minutes. You can monitor the progress by viewing the Cisco vManage task list.
11. After the HSEC licenses have been loaded and assigned, to install them, use the Install HSEC Licenses, on page 256 procedure.

Synchronize HSEC Licenses, Offline Mode

Before You Begin

- If Cisco vManage has internet access, we recommend using the Synchronize HSEC Licenses, Online Mode, on page 254 procedure.
- Use this procedure if Cisco vManage does not have internet access, such as for security reasons.
- This procedure requires entering credentials for your Cisco SSM Account.

Synchronize HSEC Licenses, Offline Mode

1. From the Cisco vManage menu, choose **Workflows** > **Workflow Library**.
2. Click the **Sync and Install HSEC Licenses** workflow.
3. Click **Sync Licenses** and then click **Next**.
4. Click **Offline** and then click **Next**.
5. On the **HSEC Device Activation Overview** page, click **Next**.
6. Click **Download Process** and then click **Next**.
7. On the **Offline Mode - Sync Licenses Task** page, select the devices on which to install an HSEC license.
8. Click **Next**.
9. Click **Download HSEC Device File**.
10. On the summary page, click **Download** to download a file to a local location.

    The file contains the list of devices that require an HSEC license.
11. Click **Done**.
12. Click **Cisco Smart Software Manager** to open Cisco SSM.
13. Log in to Cisco SSM and complete the following two steps:

    Note The details of procedures in the Cisco SSM portal are outside the scope of this documentation and subject to change.

    a. Upload the file that you downloaded from Cisco vManage. The procedure is identical to uploading a usage report file, as described in License Management Offline Mode.

    b. Download the Acknowledgement file.

       This file contains the HSEC licenses required for the devices that you selected.
14. From the Cisco vManage menu, choose **Workflows** > **Workflow Library**.
15. Click the **Sync and Install HSEC Devices** workflow.
16. Click **Sync Licenses** and then click **Next**.
17. Click **Offline** and then click **Next**.
18. On the **HSEC Device Activation Overview** page, click **Next**.
19. Click **Upload Process** and then click **Next**.
20. On the **Upload Smart License Authorization Code File** page, upload the acknowledgement file that you downloaded from Cisco SSM.
21. Click **Summary**.

    The process of loading and assigning licenses may take several minutes. You can monitor the progress by viewing the Cisco vManage task list.

After the HSEC licenses have been loaded and assigned, to install them, use the Install HSEC Licenses, on page 256 procedure.

Install HSEC Licenses

1. From the Cisco vManage menu, choose **Workflows** > **Workflow Library**.
2. Click the **Sync and Install HSEC Licenses** workflow.
3. Click **Install Devices**.
4. Select the desired devices on which to install an HSEC license.
5. Click **Install** to install the licenses.

   You can monitor the progress by viewing the Cisco vManage task list.

Verify HSEC License Installation

1. From the Cisco vManage menu, choose **Administration** > **License Management**.
2. Above the table click **Device**. The HSEC license information appears in two columns.

Column	Description
HSEC Compatible	**Yes** or **No** indicate HSEC compatibility.
HSEC Status	• **scheduled**: An HSEC license is pending installation on the device. • **success**: An HSEC license is installed on the device.

Preview Device Configuration and View Configuration Differences

For a configuration that you have created from the CLI:

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Device Templates**, and choose the desired 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 **Config Preview** is selected.
4. Click the name of a device.

5. Click **Config Diff** to view the differences between this configuration and the configuration currently running on the device, if applicable. Click **Back** to edit the variable values entered in the previous screen.
6. Click **Configure Devices** to push the configuration to the devices. The Status column displays whether the configuration was successfully pushed. Click the right angle bracket to display details of the push operation.

Reset Interfaces

Use the Interface Reset command to shutdown and then restart an interface on a device in a single operation without having to modify the device's configuration.

1. From the Cisco vManage menu, choose **Tools** > **Operational Commands**.
2. For the desired template, click **…** and choose **Reset Interface**.
3. In the **Interface Reset** dialog box, choose the desired interface.
4. Click **Reset**.

Reset a Locked User

If a user is locked out after multiple password attempts, an administrator with the required rights can update passwords for this user.

There are two ways to unlock a user account, by changing the password or by getting the user account unlocked.

Note Only a **netadmin** user or a user with the User Management Write role can perform this operation.

To reset the password of a user who has been locked out:

1. In **Users** (**Administration** > **Manage Users**), choose the user in the list whose account you want to unlock.
2. Click **. . .** and choose **Reset Locked User**.
3. Click **OK** to confirm that you want to reset the password of the locked user. Note that this operation cannot be undone.

   Alternatively, you can click **Cancel** to cancel the operation.

Steps to Bring Up the Overlay Network

Bringing Up the Overlay Network

The following table lists the tasks for bringing up the overlay network using Cisco vManage.

Table 102:

Bring-Up Task	Step-by-Step Procedure
Step 1: Start the Cisco vManage.	1. On the hypervisor, create a VM instance. 2. Boot Cisco vManage server, start the VM, and enter login information. 3. From the Cisco vManage menu, choose **Administration** > **Settings**, configure certificate authorization settings. Select Automated to allow the certificate-generation process to occur automatically when a CSR is generated for a controller device. 4. From the Cisco vManage menu, choose **Configuration** > **Certificates**, generate the CSR. 5. Check for a confirmation email from Symantec that your request has been received. 6. Check for an email from Symantec that Viptela has approved your request and the certificate is signed. 7. From the Cisco vManage menu, choose **Configuration** > **Devices**, and check if the certificate has been installed.
Step 2: Start the Cisco vBond Orchestrator.	1. On the hypervisor, create a VM instance. 2. Boot the vBond server and start the VM. 3. From the Cisco vManage menu, choose **Configuration** > **Devices** > **Controllers**, add Cisco vBond Orchestrator and generate the CSR. 4. Check for a confirmation email from Symantec that your request has been received. 5. Check for an email from Symantec that Viptela has approved your request and the certificate is signed. 6. From the Cisco vManage menu, choose **Configuration** > **Devices**, and check if the certificate has been installed. 7. From the Cisco vManage menu, choose **Configuration** > **Templates**: a. Create a configuration template for the Cisco vBond Orchestrator. b. Attach the template to Cisco vBond Orchestrator. 8. From the Cisco vManage menu, choose **Monitor** > **Overview**, and verify that the Cisco vBond Orchestrator is operational. Cisco vManage Release 20.6.x and earlier: From the Cisco vManage menu, choose **Dashboard** > **Main Dashboard**, and verify that the Cisco vBond Orchestrator is operational.

Bring-Up Task	Step-by-Step Procedure
Step 3: Start the Cisco vSmart Controller.	1. On the hypervisor, create a VM instance. 2. Boot the vSmart server and start the VM. 3. From the Cisco vManage menu, choose **Configuration** > **Devices** > **Controller**, add Cisco vSmart Controller and generate the CSR. 4. Check for a confirmation email from Symantec that your request has been received. 5. Check for an email from Symantec that Viptela has approved your request and the certificate is signed. 6. From the Cisco vManage menu, choose **Configuration** > **Devices**, check that the certificate has been installed. 7. From the Cisco vManage menu, choose **Configuration** > **Templates**: a. Create a configuration template for Cisco vSmart Controller. b. Attach the template to Cisco vSmart Controller. 8. From the Cisco vManage menu, choose **Monitor** > **Overview**, and verify that Cisco vSmart Controller is operational. Cisco vManage Release 20.6.x and earlier: From the Cisco vManage menu, choose **Dashboard** > **Main Dashboard**, and verify that Cisco vSmart Controller is operational.
Step 4: Configure the router.	1. From the Cisco vManage menu, choose **Configuration** > **Devices** > **WAN Edge List**, upload the router authorized serial number file. 2. From the Cisco vManage menu, choose **Configuration** > **Certificates** > **WAN Edge List**, check that the router's chassis and serial number are in the list. 3. From the Cisco vManage menu, choose **Configuration** > **Certificates** > **WAN Edge List**, authorize each router by marking it Valid in the Validity column. 4. From the Cisco vManage menu, choose **Configuration** > **Certificates** > **WAN Edge List**, send the WAN Edge list to the controller devices. 5. From the Cisco vManage menu, choose **Configuration** > **Templates**: a. Create a configuration template for the router. b. Attach the template to the router.

Bring-Up Task	Step-by-Step Procedure
Step 5: Connect AC power and boot a hardware router.	1. Connect AC power to the router. 2. If needed, flip the On/Off switch on the rear of the router to the ON position. 3. From the Cisco vManage menu, choose **Monitor** > **Overview** or choose **Monitor** > **Devices** > **Device Dashboard**, verify that the router is operational. Cisco vManage Release 20.6.x and earlier: From the Cisco vManage menu, choose **Dashboard** > **Main Dashboard** or choose **Monitor** > **Network** > **Device Dashboard**, verify that the router is operational.

Summary of the User Portion of the Bring-Up Sequence

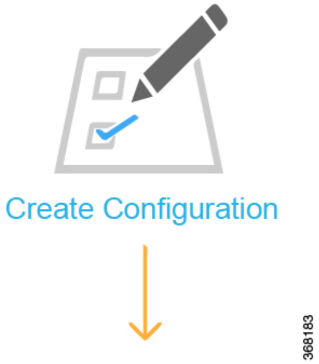
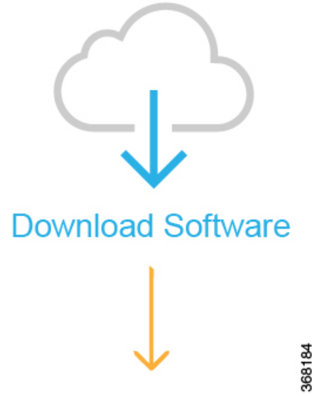
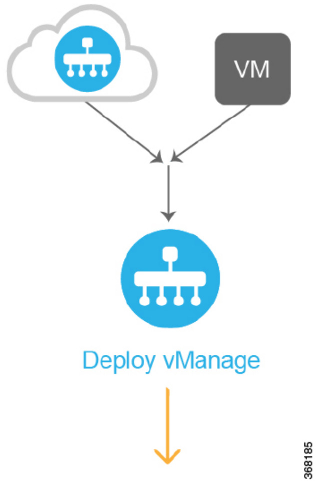
Generally, what you do to bring up the Cisco SD-WAN overlay network is what you do to bring up any network. You plan out the network, create device configurations, and then deploy the network hardware and software components. These components include all the Cisco vEdge devices, all the traditional routers that participate in the overlay network, and all the network devices that provide shared services across the overlay network, such as firewalls, load balancers, and IDP systems.

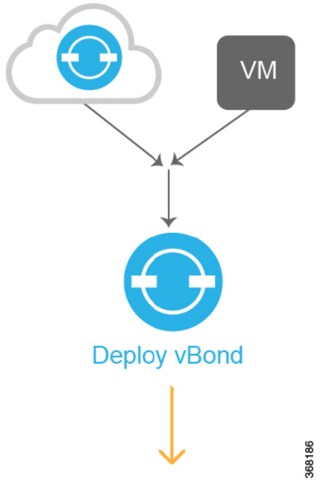
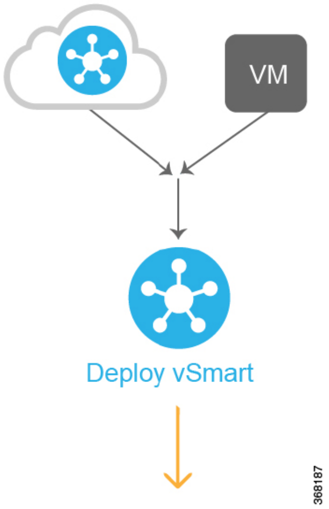
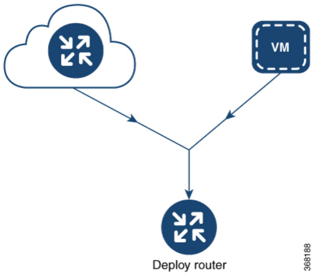
The following table summarizes the steps for the user portion of the Cisco SD-WAN overlay network bring-up sequence. The details of each step are provided in the articles that are listed in the **Procedure** column. While you can bring up the Cisco vEdge devices in any order, it is recommended that you deploy them in the order listed below, which is the functional order in which the devices verify and authenticate themselves.

If your network has firewall devices, see Firewall Ports for Cisco SD-WAN Deployments.

Table 103:

	Workflow	Procedure
1		Plan out your overlay network. See Components of the Cisco SD-WAN Solution.

	Workflow	Procedure
2		On paper, create device configurations that implement the desired architecture and functionality. See the Software documentation for your software release.
3		Download the software images.
4		Deploy Cisco vManage in the data center: 1. Create a Cisco vManage VM instance, either on an ESXi or a KVM hypervisor. 2. Create either a minimal or a full configuration for each Cisco vManage server. 3. Configure certificate settings and generate a certificate for Cisco vManage. 4. Create a Cisco vManage cluster.

	Workflow	Procedure
5	 	Deploy the Cisco vBond Orchestrator: 1. Create a Cisco vBond Orchestrator VM instance, either on an ESXi or a KVM hypervisor. 2. Create a minimal configuration for the Cisco vBond Orchestrator. 3. Add the Cisco vBond Orchestrator to the overlay network. During this process, you generate a certificate for the Cisco vBond Orchestrator. 4. Create a full configuration for the Cisco vBond Orchestrator.
6	 	Deploy the Cisco vSmart Controller in the data center: 1. Create a Cisco vSmart Controller VM instance, either on an ESXi or a KVM hypervisor. 2. Create a minimal configuration for the Cisco vSmart Controller. 3. Add the Cisco vSmart Controller to the overlay network. During this process, you generate a certificate for the Cisco vSmart Controller. 4. Create a full configuration for the Cisco vSmart Controller.
7	 	Deploy the Cisco vEdge routers in the overlay network: 1. For software vEdge Cloud routers, create a VM instance, either on an AWS server, or on an ESXi or a KVM hypervisor. 2. For software vEdge Cloud routers, send a certificate signing request to Symantec and then install the signed certificate on the router. 3. From Cisco vManage, send the serial numbers of all Cisco vEdge routers to the Cisco vSmart Controller and Cisco vBond Orchestrators in the overlay network. 4. Create a full configuration for the Cisco vEdge routers.

Use Variable Values in Configuration Templates

An overlay network might have multiple devices of the same type that have nearly identical configurations. This situation most commonly occurs with routers when the routers that are located in multiple stores or branch locations provide identical services, but each individual router has its own hostname, IP address, GPS location, and other site-specific properties, such as BGP neighbors. This situation also occurs in a network with redundant controller devices, such as Cisco vSmart Controllers, which must all be configured with identical policies, and Cisco vManage systems. Again, each controller has its own individual parameters, such as hostname and IP address.

To simplify the configuration process for these devices, you can create a single configuration template that contains both static configuration values and variable values. The static values are common across all the devices, and the variable values apply only to an individual device. You provide the actual values for the variables when you attach the individual device to the device configuration template.

You can configure a variable value for a parameter in a feature configuration template in two ways:

- Select the parameter scope to be Device Specific—For an individual configuration parameter, select Device Specific to mark the parameter as a variable. Each variable must be identified by a unique text string, which is called a *key*. When you select Device Specific, an Enter Key box opens and displays the default key. You can use the default key, or you can change it by typing a new string and then moving the cursor out of the Enter Key box.

- Mark a group of related parameters as optional—For some features in some feature configuration templates, you can mark the entire feature as optional. To mark the feature in this way, click Mark as Optional Row in a section of a feature configuration template. The variable parameters are then dimmed, and you cannot configure values for them in the feature configuration template.

You enter the device-specific values for the variables when you attach the device to the configuration, in one of the following ways:

- From a file—When you are attaching a template to a device, you load a file to the vManage NMS. This is an Excel file in CSV format that lists all the variables and defines the variable's value for each device.

- Manually—When you attach a device template to a device, the Cisco vManage prompts you for the values for each of device-specific parameters, and you type in the value for each parameter.

Note Cisco SD-WAN supports up to 500 variables in a template push operation.

Use a File for Variable Parameters

To load device-specific variable values from a file, you create a template variables file. This file is an Excel file in CSV format that lists all the variables in your the configurations of your devices and defines the values for each variable. You create this file offline and then import it into Cisco vManage server when you attach a device configuration to one or more devices in the overlay network.

We recommend that you create a template variables CSV file when your overlay network has more than a small number of Cisco vEdge devices.

CSV File Format

The CSV file is an Excel spreadsheet that contains one column for each variable that is required for the configuration of a device. The header row contains the variable names (one variable per column), and each row after that corresponds to a device and defines the values of the variables for that device.

You can create a single spreadsheet for all devices in the overlay network—Cisco vEdge devices, Cisco vManage systems, Cisco vSmart Controllers, and Cisco vBond Orchestrators—or you can create one spreadsheet for each device type. The system determines the device type from its serial number.

In the spreadsheet, for each device type and for each individual device, you specify values only for the required variables. When you do not need to specify a value for a variable, simply leave that cell blank.

The first three columns in the spreadsheet must be the following items and must be in the order shown:

Column	Column Heading	Description
1	csv-deviceId	Serial number of the device (used to uniquely identify the device). For Cisco vEdge devices, you receive the serial numbers in the authorized serial number file sent to you from Cisco. For other devices, the serial number is included in the signed certificate you receive from Symantec or from your root CA.
2	csv-deviceIP	System IP address of the device (used to populate the **system ip address** command).
3	csv-host-name	Hostname of the device (used to populate the **system hostname** command).

The headings for the remaining columns must be unique variable keys that are defined in the Enter Key box of a feature configuration template. These remaining columns can be in any order.

Generate a Skeleton CSV File

You can create a template variables CSV file manually, with the format described in the previous section, or you can haveCisco vManage generate a skeleton CSV file that contains all the required columns and column headings. This generated CSV file has one row for each Cisco device type, and it has the column headings for each of the variables that are required by all the feature templates included in the device configuration. The column heading text corresponds to the key string that identifies a device-specific parameter. Then you populate the rows with values for each variable.

To have Cisco vManage generate a skeleton CSV file:

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Feature Templates**, and click **Add Template**.

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

3. Create the required feature templates for one Cisco vEdge device router, one Cisco vSmart Controller, one Cisco vManage system, and one Cisco vBond Orchestrator.

In each feature template:

a. For fields that have default values, verify that you want to use that value for all devices. If you do not want to use the default, change the scope to **Global** or **Device-specific**.

b. For fields that apply to all devices, select the **Global** icon next to the field and set the desired global values.

c. For fields that are device specific, select the **Device-specific** icon next to the field and leave the field blank.

4. For each Cisco device type, create a device template.
5. From the Cisco vManage menu, choose **Configuration** > **Templates**.
6. Click **Device Templates**, and select the desired device template from the template list table.

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

7. Click **…**, and click **Export CSV**.
8. Repeat Steps 7 and 8 for each device template.

Edit the exported CSV file, adding at a minimum the device serial number, device system IP address, and device hostname for each device in the overlay network. Then add values for desired device-specific variables for each device. Note that variable names cannot contain forward slashes (/), backwards slashes (\), or parentheses (( )).

If desired, you can combine the CSV files into a single file.

Import a CSV File

To use the device-specific variable values in the CSV file, import the file when you are attaching a device template to the Viptela device:

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Device Templates**.

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

3. For the desired template, click **...**, and select **Attach Devices**.
4. In the **Attach Devices** dialog box, select the desired devices in **Available Devices** and click the arrow to move them to **Selected Devices**.
5. Click **Attach**.
6. Click the Up arrow. The Upload CSV File box displays.
7. Choose the CSV file to upload, and click **Upload**.

During the attachment process, click Import file to load the Excel file. If Cisco vManage detects duplicate system IP addresses for devices in the overlay network, it displays a warning message or a pop-up window. You must correct the system IP addresses to remove any duplicates before you can continue the process of attaching device templates to Viptela devices.

Manually Enter Values for Device-Specific Variables and for Optional Rows

For parameters in a feature template that you configure as device-specific, when you attach a device template to a device, Cisco vManage prompts you for the values to use for these parameters. Entering device-specific values in this manner is useful in test or POC networks, or if you are deploying a small network. This method generally does not scale well for larger networks.

For situations in which the configuration for many devices is identical except for a few parameters, in the feature configuration template, you can specify that the parameter be an optional row in the configuration. By selecting optional row, the feature template automatically marks the parameters as device-specific, and these parameters are dimmed so that you cannot set them in the template. You do not have to individually mark the parameters as device specific. Then, when you attach a device template to a device, Cisco vManage prompts you for the values to use for these parameters. Using optional rows to enter device-specific values is useful when a group of many Cisco vEdge devices provide identical services at their branch or site, but individual routers have their own hostname, IP address, GPS location, and other site or store properties, such as BGP neighbors.

Optional rows are available for some parameters in some feature configuration templates. To treat a parameter or set of parameters as an optional row, click the **Mark as Optional Row** box. For these types of parameters, the feature configuration template has a table listing all the configured parameters. The Optional column indicates which are optional rows,

To manually enter values for device-specific variables or for variables in optional rows when you attach the template to a device:

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Device Templates**, and select the desired device template.

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

3. Click **…**, and click **Attach Devices**. The **Attach Devices** dialog box opens.
4. Choose one or more devices from **Available Devices** and move them to **Selected Devices**.
5. Click **Attach**.
6. In the **Chassis Number** list, select the desired device.
7. Click **…**, and click **Edit Device Template**. The **Update Device Template** dialog box opens.
8. Enter values for the optional parameters. When you are using optional rows, if you do not want to include the parameter for the specific device, do not specify a value.
9. Click **Update**.
10. Click **Next**.

If any devices have the same system IP address, a dialog box appears or an error message is displayed when you click **Next**. Modify the system IP addresses so that there are no duplicates, and click **Save**. Then click **Next** again.

Note You need to shut down the OMP on the device, before changing the system-ip on the device.

11. In the left pane, select the device. The right pane displays the device configuration and the **Config Preview** tab in the upper right corner is selected.

12. Click **Config Diff** to preview the differences between this configuration and the configuration currently running on the device, if applicable. To edit the variable values entered in the previous screen, click **Back**.

13. Click **Configure Devices** to push the configuration to the devices.

    The Status column displays whether the configuration was successfully pushed. Click the **right angle bracket** to the left of the row to display details of the push operation.

Upgrade the Software Image on a Device

Note

- This procedure does not enable downgrading to an older software version. If you need to downgrade, see Downgrade a Cisco vEdge Device to an Older Software Image in the Cisco SD-WAN Getting Started Guide.
- If you want to perform a vManage cluster upgrade see, Upgrade Cisco vManage Cluster.
- 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*

To upgrade the software image on a device:

1. From the Cisco vManage menu, choose **Maintenance** > **Software Upgrade**.

2. Click **WAN Edge**, **Controller**, or **vManage** based on the type of device for which you wish to upgrade the software.

3. In the table of devices, select the devices to upgrade by selecting the check box on the far left.

Note While upgrading Cisco vManage clusters, select all the nodes of the cluster in the table.

4. Click **Upgrade**.

5. In the **Software Upgrade** slide-in pane, do as follows:

a. Choose the server from which the device should download the image: **vManage**, **Remote Server**, or **Remote Server – vManage**.

Note

- The Remote Server option is introduced in Cisco vManage Release 20.7.1. If you chose **Remote Server**, ensure that the device can reach the remote server.
- Starting from Cisco vManage Release 20.9.1, when downloading an image from a remote server manually, ensure that only the following valid characters are used:
  - User ID: a-z, 0-9, ., _, -
  - Password: a-z, A-Z, 0-9, _, *, ., +, =, %, -
  - URL Name or Path: a-z, A-Z, 0-9, _, *, ., +, =, %, -, :, /, @, ?, ~

b. For **vManage**, choose the image version from the **Version** drop-down list.

c. For **Remote Server – vManage**, choose the **vManage OOB VPN** from the drop-down list and choose the image version from the **Version** drop-down list.

d. For **Remote Server**, configure the following:

Remote Server Name	Choose the remote server that has the image.
Image Filename	Choose the image filename from the drop-down list.

e. Check the **Activate and Reboot** check box.

If you do not check this check box, the software image is downloaded and installed on the device, but, the image is not activated, and the device is not rebooted. You must activate the image after the upgrade task is completed.

f. Click **Upgrade**.

The device restarts, using the new software version, preserving the current device configuration. The **Task View** page opens, showing the progress of the upgrade on the devices.

6. Wait for the upgrade process, which takes several minutes, to complete. When the **Status** column indicates Success, the upgrade is complete.
7. From the Cisco vManage menu, choose **Maintenance** > **Software Upgrade** and view the devices.
8. Click **WAN Edge**, **Controller**, or **vManage** based on the type of device for which you wish to upgrade the software.
9. In the table of devices, confirm that the **Current Version** column for the upgraded devices shows the new version. Confirm that the **Reachability** column says reachable.

Note

- If the control connection to Cisco vManage does not come up within the configured time limit, Cisco vManage automatically reverts the device to the previously running software image. The configured time limit for all Cisco SD-WAN devices to come up after a software upgrade is 5 minutes, except for Cisco vEdge devices, which have a default time of 12 minutes.
- If you upgrade the Cisco vEdge device software to a version higher than that running on a controller device, a warning message is displayed that software incompatibilities might occur. It is recommended that you upgrade the controller software first before upgrading the Cisco vEdge device software.
- When upgrading a Cisco CSR1000V or Cisco ISRv device to Cisco IOS XE Release 17.4.1a or later, the software upgrade also upgrades the device to a Cisco Catalyst 8000V. After the upgrade, on the Devices page, the **Chassis Number** and **Device Model** columns show the device as a Cisco CSR1000V or Cisco ISRv, but the device has actually been upgraded to a Cisco Catalyst 8000V. The reason for preserving the old name is to avoid invalidating licenses, and so on. To confirm that the device has been upgraded to a Cisco Catalyst 8000V, note that the **Current Version** column for the device indicates 17.4.1 or later.

Upload WAN Edge Router Authorized Serial Number File

The WAN eEdge router authorized serial number file contains the chassis number and the certificate serial numbers of all valid Cisco vEdge devices in the overlay network. You retrieve a serial number file from the Cisco Plug-and-Play (PnP) portal and upload it to Cisco vManage. (For more information abou Cisco PnP, see Cisco Plug and Play Support Guide for Cisco SD-WAN Products.) From Cisco vManage, you send the file to the controllers in the network. This file is required to allow the Cisco SD-WAN overlay network components to validate and authenticate each other and to allow the overlay network to become operational.

To upload the WAN edge router authorized serial number file to Cisco vManage and then download it to controllers in the network:

1. From the Cisco vManage menu, choose **Configuration** > **Devices**.
2. Click **WAN Edge List**, and click **Upload WAN Edge List**.
3. Under **Upload WAN Edge List** screen:
   a. Click **Choose File** and select the WAN edge router authorized serial number file you received from Cisco PnP.
   b. To automatically validate the routers and send their chassis and serial numbers to the controllers, ensure that the **Validate the uploaded vEdge List and send to controllers** check box is selected. If you do not select this option, you must individually validate each router in **Configuration** > **Certificates** > **WAN Edge List**.
   c. Click **Upload**.

A list of routers in the network is displayed in the router table, with details about each router.

Starting from Cisco vManage Release 20.9.2, you can monitor the newly added WAN Edge devices in the **Monitor** > **Devices** page.

Upload WAN Edge Router Serial Numbers from Cisco Smart Account

To allow Cisco SD-WAN overlay network components to validate and authenticate each other and to allow the overlay network to become operational, Cisco SD-WAN requires chassis numbers of all valid Cisco vEdge devices in the overlay network.

In addition, certificate serial numbers, are required for all devices.

To upload the WAN edge router authorized serial numbers from a Cisco Smart account to the vManage NMS and then download it to all the controllers in the overlay network:

1. From the Cisco vManage menu, choose **Configuration** > **Devices**.
2. Click **WAN Edge List**, and click **Sync Smart Account**.
3. In the **Sync Smart Account** window:
   a. Enter the **Username** and **Password** for your Smart account.
   b. To automatically validate the routers and send their chassis and serial numbers to the controllers, check the **Validate the Uploaded WAN Edge List and Send to Controllers** check box. If you do not select this option, you must individually validate each router in **Configuration** > **Certificates** > **WAN Edge List**.
   c. Click **Sync**.

A list of routers in the network is displayed in the router table, with details about each router.

Starting from Cisco vManage Release 20.9.2, you can monitor the newly added WAN Edge devices in the **Monitor** > **Devices** page.

View and Copy Device Configuration

View a Device's Running Configuration

Running configuration is configuration information that vManage obtains from the memory of a device. This information can be useful for troubleshooting.

To view a device's running configuration:

1. From the Cisco vManage menu, choose **Configuration** > **Devices**.
2. Click **WAN Edge List** or **Controllers**, and select the device.
3. Click **…**, and click **Running Configuration**.

View a Device's Local Configuration

Local configuration is configuration that vManage has stored for a device. This information can be useful for troubleshooting or for determining how to access a device if, for example, a device is not reachable from vManage.

To view a device's local configuration created using Configuration ► Templates:

1. From the Cisco vManage menu, choose **Configuration** > **Devices**.
2. Click **WAN Edge List** or **Controllers**, and select the device.
3. Click **…**, and click **Local Configuration**.

Copy Router Configuration

When you are replacing one router at a site with another router, you copy the old router's configuration to the new router. Then you remove the old router from the network and add the new one.

To copy the configuration from the old router to the new router:

1. From the Cisco vManage menu, choose **Configuration** > **Certificates**.
2. Mark the new Cisco vEdge device as invalid.
3. From the Cisco vManage menu, choose **Configuration** > **Devices**.
4. Under **WAN Edge List**, select the old router.
5. Click **…**, and click **Copy Configuration**.
6. In the **Copy Configuration** window, select the new router.
7. To confirm the copy of the configuration, click **Update**.

After you have copied the configuration to the new router, you can add the new router to the network. First, delete the old router from the network, as described below. Then add the new router to the network:

1. From the Cisco vManage menu, choose **Configuration** > **Certificates**.
2. Mark the new router as valid.
3. Click **Send to Controller**.

View Device Templates

View a Template

1. From the Cisco vManage 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 vManage 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 vManage 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 vManage 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**.

Web Server Certificate for Cisco vManage

To establish a secure connection between your web browser and the Cisco vManage server using authentication certificates, you must generate a CSR to create a certificate, have it signed by a root CA, and then install it. You must install a separate certificate on each Cisco vManage server in a cluster by performing the following steps for each server:

1. From the Cisco vManage menu, choose **Administration** > **Settings**.
2. In the **Web Server Certificate** area, click **CSR**.

3. In the **Common Name** field, enter the domain name or IP address of the Cisco vManage server. For example, the fully-qualified domain name of Cisco vManage could be vmanage.org.local.

4. In the **Organizational Unit** field, enter the unit name within your organization — for example, Network Engineering.

5. In the **Organization** field, enter the exact name of your organization as specified by your root CA — for example, Viptela Inc.

6. In the **City** field, enter the name of the city where your organization is located — for example, San Jose.

7. In the **State** field, enter the state in which your city is located — for example, California.

8. In the **2-Letter Country Code** field, enter the two-letter code for the country in which your state is located. For example, the two-letter country code for the United States of America is US.

9. Click **Validity** and choose the validity period for the certificate.

10. Optionally, in the **Subject Alternative Name (SAN) DNS Names** field, enter the names of DNS severs to which the certificate trust should be extended. If you enter more than one DNS server name, separate each name with a space or a comma.

Note Cisco SD-WAN supports SAN DNS names, from Cisco IOS XE SD-WAN release 16.11 and Cisco SD-WAN release 19.1.

11. Optionally, in the **Subject Alternative Name (SAN) URIs** field, enter the URIs of resources to which the certificate trust should be extended. If you enter more than one URI, separate each URI with a space or a comma.

    Enter each URI in *scheme***:***value* format, where *scheme* is the protocol for accessing the resource and *value* is the resource. For example, **`https://example.example.com`** or **`scp://example.example.com`**.

Note Cisco SD-WAN supports SAN URIs beginning with Cisco IOS XE SD-WAN release 16.11 and Cisco SD-WAN release 19.1.

12. Click **Generate** to generate the CSR.

13. Send the CSR to your CA server to have it signed.

14. When you receive the signed certificate, click **Certificate** near the **Web Server Certificate** bar to install the new certificate. The **View** box displays the current certificate on the Cisco vManage server.

15. Copy and paste the new certificate in the box. Alternatively, click **Import** and **Select a File** to download the new certificate file.

16. Restart the application server and log in to Cisco vManage.

View Web Server Certificate Expiration Date

When you establish a secure connection between your web browser and the Cisco vManage server using authentication certificates, configure the time period for which the certification is valid (in Step 8 in the previous section). At the end of this time period, the certificate expires. The **Web Server Certificate** bar shows the expiration date and time.

Starting 60 days before the certificate expires, the Cisco vManage dashboard displays a notification indicating that the certificate will expire soon. This notification is then displayed again 30, 15, and 7 days before the expiration date, and then daily.

Workflow to Configure IPv4 Static Route Tracking

Table 104: Feature History

Feature Name	Release Information	Description
Static Route Tracker for Service VPNs for Cisco vEdge Devices	Cisco SD-WAN Release 20.4.1 Cisco vManage Release 20.4.1	To configure Static Route Tracking on Cisco vManage, configure an endpoint tracker using Cisco System template, and Configure a static route using the Cisco VPN template.
TCP/UDP Endpoint Tracker and Dual Endpoint Static Route Tracker for Cisco vEdge devices	Cisco SD-WAN Release 20.7.1 Cisco vManage Release 20.7.1	You can now configure static route tracker with TCP/UDP endpoint using Cisco system template, and configure a static route using the Cisco VPN template. You can then add the configured dual trackers in a tracker group using **New Endpoint Tracker Groups** option.

1. Configure an endpoint tracker using the System template.
2. Configure a static route using the VPN template.
3. Apply the tracker to the next-hop address.

Create a Static Route Tracker

Use the **System Template** to create a tracker for static routes.

1. From Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Feature Templates**.

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

3. Navigate to the **Cisco System** template for the device.

Note For information about creating a System template, see Create System Template.

4. Click **Tracker**. Click **New Endpoint Tracker** to configure the tracker parameters.

Table 105: Tracker Parameters

Field	Description
Name	Name of the tracker. The name can be up to 128 alphanumeric characters.
Threshold	Wait time for the probe to return a response before declaring that the configured endpoint is down. Range is from 100 to 1000 milliseconds. Default is 300 milliseconds.
Interval	Time interval between probes to determine the status of the configured endpoint. Default is 60 seconds (1 minute). Range is from 10 to 600 seconds.
Multiplier	Number of times probes are sent before declaring that the endpoint is down. Range is from 1 to 10. Default is 3.
Tracker Type	From the drop-down, choose Global. From the Tracker Type field drop-down, choose Static Route. From Cisco SD-WAN Release 20.7.1, you can configure a tracker group with dual endpoints on Cisco vEdge devices and associate this tracker group to a static route.
Endpoint Type	Choose endpoint type IP Address.
End-Point Type: IP Address	IP address of the static route end point. This is the destination on the internet to which the router sends probes to determine the status of the route.

5. Click **Add**.
6. Click **Save**.
7. To create a tracker group, click **New Endpoint Tracker**.

   From the **Tracker Type** drop-down list, choose **tracker-group** and configure the tracker group parameters.

Note Ensure that you have created two trackers to form a tracker group.

Table 106: Tracker Group Parameters

Fields	Description
Name	Name of the tracker group.

Fields	Description
Tracker Type	From the drop-down, choose **Global**. From the Tracker Type field drop-down, choose **Static Route**. From Cisco SD-WAN Release 20.7.1, you can configure a tracker group with dual endpoints on Cisco vEdge devices and associate this tracker group to a static route.
Tracker Elements	This field is displayed only if you chose **Tracker-group** as the tracker type. Add the existing interface tracker names (separated by a space). When you add this tracker to the template, the tracker group is associated with these individual trackers, and you can then associate the tracker group to a static route.
Tracker Boolean	From the drop-down list, choose **Global**. This field is displayed only if you chose **tracker-group** as the **Tracker Type**. By default, the **OR** option is selected. Choose **AND** or **OR**. **OR** ensures that the static route status is reported as active if either one of the associated trackers of the tracker group report that the route is active. If you select **AND**, the static route status is reported as active if both the associated trackers of the tracker group report that the route is active.

8. Click **Add**.

9. Click **Save**.

Note Complete all the mandatory actions before you save the template.

Configure a Next Hop Static Route with Tracker

Use the **VPN** template to associate a tracker to a static route next hop.

Note You can apply only one tracker per static route next hop.

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

2. Click **Feature Templates**.

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

3. Navigate to the **Cisco VPN Template** for the device.

Note: For information about creating a VPN template, see Create VPN Template.

4. Enter **Template Name** and **Description** as required.
5. In Basic Configuration, by default, VPN is set to 0. Set a VPN value within (1–511, 513–65530) range for service VPNs, for service-side data traffic on Cisco IOS XE SD-WAN devices.

Note: You can configure static route tracker only on service VPNs.

6. Click **IPv4 Route**.
7. Click **New IPv4 Route**.
8. In the **IPv4 Prefix** field, enter a value.
9. Click **Next Hop**.
10. Click **Add Next Hop** and enter values for the fields listed in the table.

Parameter Name	Description
Address	Specify the next-hop IPv4 address.
Distance	Specify the administrative distance for the route.
Tracker	Enter the name of the gateway tracker to determine whether the next hop is reachable before adding that route to the route table of the device.
Add Next Hop	Enter the name of the gateway tracker with the next hop address to determine whether the next hop is reachable before adding that route to the route table of the device.

11. Click **Add** to create the static route with the next-hop tracker.

Note: Configuring a static route with a next-hop 'X.X.X.255' is not supported.

Cisco vEdge device does not implement RFC 3021.

12. Click **Save**.

Note: You need to fill all the mandatory fields in the form to save the VPN template.

Monitor Static Route Tracker Configuration

View Static Route Tracker

To view information about a static tracker on a transport interface:

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

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

2. Choose a device from the list of devices.
3. Click **Real Time**.
4. From the **Device Options** drop-down list, choose **Static Route Tracker Info**.

Verify Static Route Tracking Configuration Using CLI

Command Verification

Use the following command to verify if the configuration is committed. The following sample configuration shows tracker definition for a static route tracker and it's application to an IPv4 static route:

```
Device# show running-config system tracker
system
 tracker tracker1
 endpoint-ip 10.1.1.1
 interval 60
 multiplier 5
 tracker-type static-route

 tracker tracker2
 endpoint-ip 10.1.1.12
 interval 40
 multiplier 2
 tracker-type static-route
```

Use the following command to verify the IPv4 route:

```
Device# show running-config vpn 1 ip route

vpn 1
 ip route 10.20.30.0/24 10.20.30.1
 ip route 192.168.2.0/16 10.20.24.16 100
 ip route 192.168.2.0/16 10.20.24.17 tracker tracker1
!
```

The following is a sample output from the **show tracker static-route** command displaying individual static route tracker status:

```
Device#  show tracker static-route
TRACKER                RTT IN
NAME      VPN  STATUS  MSEC
--------------------------------
tcp-10001  1    UP      0
udp-10002  1    UP      0
```

The following is a sample output from the **show tracker static-route-group** command displaying tracker group status:

```
Device# show tracker static-route-group
                                                 TRACKER     TRACKER  TRACKER
                                                 ELEMENT     ELEMENT  ELEMENT
TRACKER NAME                VPN  BOOLEAN  STATUS  NAME       STATUS   RTT
----------------------------------------------------------------------------------
group-tcp-10001-udp-10002    1    and      UP     tcp-10001    UP       0
                                                  udp-10002    UP       0
```

The following is a sample output from the **show ip route static** command:

```
Device# show ip route static
 Codes Proto-sub-type:
  IA -> ospf-intra-area, IE -> ospf-inter-area,
  E1 -> ospf-external1, E2 -> ospf-external2,
  N1 -> ospf-nssa-external1, N2 -> ospf-nssa-external2,
  e -> bgp-external, i -> bgp-internal
Codes Status flags:
  F -> fib, S -> selected, I -> inactive,
  B -> blackhole, R -> recursive, L -> import

                                         PROTOCOL  NEXTHOP      NEXTHOP   NEXTHOP

VPN  PREFIX          PROTOCOL  SUB TYPE  IF NAME     ADDR        VPN      TLOC IP   COLOR
 ENCAP  STATUS
------------------------------------------------------------------------------------------
1    192.168.2.0/16  STATIC      -         ge0/4   10.20.24.17    -        -        -
 -      F,S
1    192.168.2.0/16  STATIC      -         ge0/4   10.20.24.16    -        -        -
 -      F,S
```

Workflow to Configure RBAC for Policies

Table 107: Feature History

Feature Name	Release Information	Description
Role-Based Access Control By Resource Group	Cisco SD-WAN Release 20.5.1 Cisco vManage Release 20.5.1	You can configure role-based access control (RBAC) based on sites or resource groups in Cisco vManage.
RBAC for Policies	Cisco vManage Release 20.6.1 Cisco SD-WAN Release 20.6.1	Configure RBAC for policies in Cisco vManage.
Co-Management: Granular Role-Based Access Control for Feature Templates	Cisco vManage Release 20.7.1	This feature introduces greater granularity in assigning RBAC permissions for template use. This enables you to give a tenant self-management of network configuration tasks. Network administrators and managed service providers can use this feature to assign permissions to their end customers.

Feature Name	Release Information	Description
Co-Management: Improved Granular Configuration Task Permissions	Cisco vManage Release 20.9.1	To enable a user to self-manage specific configuration tasks, you can assign the user permissions to perform specific configuration tasks while excluding other tasks. This feature introduces numerous new permission options, enabling fine granularity in determining which configuration task permissions to provide to a user. .
RBAC for Security Operations and Network Operations Default User Groups	Cisco vManage Release 20.9.1	This feature provides the following default user groups: • network_operations user group for non-security policies • security_operations user group for security policies RBAC for policies allows you to create users and user groups with the required read and write permissions for security and non-security policies. Users can perform configuration and monitoring actions only for the authorized policy type.

Minimum supported releases: Cisco SD-WAN Release 20.6.1 and Cisco vManage Release 20.6.1

To configure RBAC for policies, use the following workflow:

1. Create user groups with required Read or Write (R/W) access to selected control or data policies. For details on creating user groups, refer Create User Groups .
2. Create users and assign them to required user groups. Refer Create Users.
3. Create or modify or view policy configurations as required. For information about configuring policies, see Configure Centralized Policies Using Cisco vManage.

Manage Users

From the Cisco vManage menu, choose **Administration** > **Manage Users** to add, edit, view, or delete users and user groups.

Please note the following:

- Only a user logged in as the **admin** user or a user who has Manage Users write permission can add, edit, or delete users and user groups from Cisco vManage.
- Each user group can have read or write permission for the features listed in this section. Write permission includes Read permission.
- All user groups, regardless of the read or write permissions selected, can view the information displayed in the Cisco vManage Dashboard.

Table 108: User Group Permissions: Cisco IOS XE SD-WAN devices

Feature	Read Permission	Write Permission
Alarms	Set alarm filters and view the alarms generated on the devices on the **Monitor** > **Logs** > **Alarms** page. Cisco vManage Release 20.6.x and earlier: Set alarm filters and view the alarms generated on the devices on the **Monitor** > **Alarms** page.	No additional permissions.
Audit Log	Set audit log filters and view a log of all the activities on the devices on the **Monitor** > **Logs** > **Alarms** page and the **Monitor** > **Logs** > **Audit Log** page. Cisco vManage Release 20.6.x and earlier: Set audit log filters and view a log of all the activities on the devices on the **Monitor** > **Alarms** page and the **Monitor** > **Audit Log** page.	No additional permissions.
Certificates	View a list of the devices in the overlay network under **Configuration** > **Certificates** > **WAN Edge List**. View a certificate signing request (CSR) and certificate on the **Configuration** > **Certificates** > **Controllers** window.	Validate and invalidate a device, stage a device, and send the serial number of valid controller devices to the Cisco vBond Orchestrator on the **Configuration** > **Certificates** > **WAN Edge List** window. Generate a CSR, install a signed certificate, reset the RSA key pair, and invalidate a controller device on the **Configuration** > **Certificates** > **Controllers** window.
CLI Add-On Template (Minimum supported release: Cisco vManage Release 20.7.1)	View the CLI add-on feature template on the **Configuration** > **Templates** window. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, delete, and copy a CLI add-on feature template on the **Configuration** > **Templates** window. **Note** These operations require write permission for **Template Configuration**.

Feature	Read Permission	Write Permission
Cloud OnRamp	View the cloud applications on the**Configuration** > **Cloud OnRamp for SaaS** and **Configuration** > **Cloud OnRamp for IaaS** window.	No additional permissions.
Cluster	View information about the services running on Cisco vManage, a list of devices connected to a Cisco vManage server, and the services that are available and running on all the Cisco vManage servers in the cluster on the **Administration** > **Cluster Management** window.	Change the IP address of the current Cisco vManage, add a Cisco vManage server to the cluster, configure the statistics database, edit, and remove a Cisco vManage server from the cluster on the **Administration** > **Cluster Management** window.
Colocation	View the cloud applications on the **Configuration** > **Cloud OnRamp for Colocation** window.	No additional permissions.
Config Group > **Device** > **Deploy** (Minimum supported release: Cisco vManage Release 20.9.1)	This permission does not provide any functionality.	Deploy a configuration onto Cisco IOS XE SD-WAN devices. **Note** To edit an existing feature configuration requires write permission for **Template Configuration**.
Device CLI Template (Minimum supported release: Cisco vManage Release 20.7.1)	View the device CLI template on the **Configuration** > **Templates** window. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, delete, and copy a device CLI template on the **Configuration** > **Templates** window. **Note** These operations require write permission for **Template Configuration**.

Feature	Read Permission	Write Permission
Device Inventory	View the running and local configuration of devices, a log of template activities, and the status of attaching configuration templates to devices on the **Configuration** > **Devices** > **WAN Edge List** window. View the running and local configuration of the devices and the status of attaching configuration templates to controller devices on the **Configuration** > **Devices** > **Controllers** window.	Upload a device's authorized serial number file to Cisco vManage, toggle a device from Cisco vManage configuration mode to CLI mode, copy a device configuration, and delete the device from the network on the **Configuration** > **Devices** > **WAN Edge List** window. Add and delete controller devices from the overlay network, and edit the IP address and login credentials of a controller device on the **Configuration** > **Devices** > **Controllers** window.

Feature	Read Permission	Write Permission
Device Monitoring	View the geographic location of the devices on the **Monitor** > **Geography** window. View events that have occurred on the devices on the **Monitor** > **Logs** > **Events** page. Cisco vManage Release 20.6.x and earlier: View events that have occurred on the devices on the **Monitor** > **Events** page. View a list of devices in the network, along with device status summary, SD-WAN Application Intelligence Engine (SAIE) and Cflowd flow information, transport location (TLOC) loss, latency, and jitter information, control and tunnel connections, system status, and events on the **Monitor** > **Devices** page (only when a device is selected). **Note** In Cisco vManage Release 20.7.x and earlier releases, the SAIE flow is called the deep packet inspection (DPI) flow. Cisco vManage Release 20.6.x and earlier: Device information is available in the **Monitor** > **Network** page.	Ping a device, run a traceroute, and analyze the traffic path for an IP packet on the **Monitor** > **Devices** page (only when a device is selected).
Device Reboot	View the list of devices on which the reboot operation can be performed on the **Maintenance** > **Device Reboot** window.	Reboot one or more devices on the **Maintenance** > **Device Reboot** window.
Disaster Recovery	View information about active and standby clusters running on Cisco vManage on the **Administration** > **Disaster Recovery** window.	No additional permissions.

Feature	Read Permission	Write Permission
Events	View the geographic location of the devices on the **Monitor** > **Logs** > **Events** page. View the geographic location of the devices on the **Monitor** > **Events** page.	Ping a device, run a traceroute, and analyze the traffic path for an IP packet on the **Monitor** > **Logs** > **Events** page (only when a device is selected).
Feature Profile > **Other** > **Thousandeyes** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **ThousandEyes** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **Other Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **ThousandEyes** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **Other Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **Service** > **Dhcp** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **DHCP** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **Service Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **DHCP** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **Service Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **Service** > **Lan/Vpn** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **LAN/VPN** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **Service Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **LAN/VPN** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **Service Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **Service** > **Lan/Vpn/Interface/Ethernet** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **Ethernet Interface** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **Service Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **Ethernet Interface** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **Service Profile** section. **Note** These operations require write permission for **Template Configuration**.

Feature	Read Permission	Write Permission
Feature Profile > **Service** > **Lan/Vpn/Interface/Svi** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **SVI Interface** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **Service Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **SVI Interface** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **Service Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **Service** > **Routing/Bgp** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **Routing/BGP** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **Service Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **Routing/BGP** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **Service Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **Service** > **Routing/Ospf** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **Routing/OSPF** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **Service Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **Routing/OSPF** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **Service Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **Service** > **Switchport** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **Switchport** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **Service Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **Switchport** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **Service Profile** section. **Note** These operations require write permission for **Template Configuration**.

Feature	Read Permission	Write Permission
Feature Profile > **Service** > **Wirelesslan** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **Wireless LAN** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **Service Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **Wireless LAN** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **Service Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **System** > **Interface/Ethernet** > **Aaa** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **AAA** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **System Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **AAA** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **System Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **System** > **Interface/Ethernet** > **Banner** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **Banner** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **System Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **Banner** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **System Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **System** > **Basic** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **Basic** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **System Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **Basic** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **System Profile** section. **Note** These operations require write permission for **Template Configuration**.

Feature	Read Permission	Write Permission
Feature Profile > **System** > **Bfd** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **BFD** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **System Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **BFD** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **System Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **System** > **Global** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **Global** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **System Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **Global** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **System Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **System** > **Logging** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **Logging** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **System Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **Logging** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **System Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **System** > **Ntp** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **NTP** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **System Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **NTP** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **System Profile** section. **Note** These operations require write permission for **Template Configuration**.

Feature	Read Permission	Write Permission
Feature Profile > **System** > **Omp** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **OMP** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **System Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **OMP** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **System Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **System** > **Snmp** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **SNMP** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **System Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **SNMP** settings on the **Configuration** > **Templates** > **(Add or edit configuration group)** page, in the **System Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **Transport** > **Cellular Controller** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **Cellular Controller** settings on the **Configuration** > **Templates** > **(View a configuration group)** page, in the **Transport & Management Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **Cellular Controller** settings on the **Configuration** > **Templates** > **(Add or edit a configuration group)** page, in the **Transport & Management Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **Transport** > **Cellular Profile** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **Cellular Profile** settings on the **Configuration** > **Templates** > **(View a configuration group)** page, in the **Transport & Management Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **Cellular Profile** settings on the **Configuration** > **Templates** > **(Add or edit a configuration group)** page, in the **Transport & Management Profile** section. **Note** These operations require write permission for **Template Configuration**.

Feature	Read Permission	Write Permission
Feature Profile > **Transport** > **Management/Vpn** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **Management VPN** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **Transport & Management Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **Management VPN** settings on the **Configuration** > **Templates** > **(Add or edit a configuration group)** page, in the **Transport & Management Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **Transport** > **Management/Vpn/Interface/Ethernet** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **Management Ethernet Interface** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **Transport & Management Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **Management VPN and Management Internet Interface** settings on the **Configuration** > **Templates** > **(Add or edit a configuration group)** page, in the **Transport & Management Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **Transport** > **Routing/Bgp** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **BGP Routing** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **Transport & Management Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **BGP Routing** settings on the **Configuration** > **Templates** > **(Add or edit a configuration group)** page, in the **Transport & Management Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **Transport** > **Tracker** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **Tracker** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **Transport & Management Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **Tracker** settings on the **Configuration** > **Templates** > **(Add or edit a configuration group)** page, in the **Transport & Management Profile** section. **Note** These operations require write permission for **Template Configuration**.

Feature	Read Permission	Write Permission
Feature Profile > **Transport** > **Wan/Vpn** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **Wan/Vpn** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **Transport & Management Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **Wan/Vpn** settings on the **Configuration** > **Templates** > **(Add or edit a configuration group)** page, in the **Transport & Management Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **Transport** > **Wan/Vpn/Interface/Cellular** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **Wan/Vpn/Interface/Cellular** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **Transport & Management Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **Wan/Vpn/Interface/Cellular** settings on the **Configuration** > **Templates** > **(Add or edit a configuration group)** page, in the **Transport & Management Profile** section. **Note** These operations require write permission for **Template Configuration**.
Feature Profile > **Transport** > **Wan/Vpn/Interface/Ethernet** (Minimum supported release: Cisco vManage Release 20.9.1)	View the **Wan/Vpn/Interface/Ethernet** settings on the **Configuration** > **Templates** > **(View configuration group)** page, in the **Transport & Management Profile** section. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, and delete the **Wan/Vpn/Interface/Ethernet** settings on the **Configuration** > **Templates** > **(Add or edit a configuration group)** page, in the **Transport & Management Profile** section. **Note** These operations require write permission for **Template Configuration**.
Integration Management	View information about controllers running on Cisco vManage, on the **Administration** > **Integration Management** window.	No additional permissions.
License Management	View license information of devices running on Cisco vManage, on the **Administration** > **License Management** window.	On the **Administration** > **License Management** page, configure use of a Cisco Smart Account, choose licenses to manage, and synchronize license information between Cisco vManage and the license server.

Feature	Read Permission	Write Permission
Interface	View information about the interfaces on a device on the **Monitor** > **Devices** > **Interface** page. Cisco vManage Release 20.6.x and earlier: View information about the interfaces on a device on the **Monitor** > **Network** > **Interface** page	Edit **Chart Options** to select the type of data to display, and edit the time period for which to display data on the **Monitor** > **Devices** > **Interface** page.
Manage Users	View users and user groups on the **Administration** > **Manage Users** window.	Add, edit, and delete users and user groups from Cisco vManage, and edit user group privileges on the **Administration** > **Manage Users** window.
Other Feature Templates (Minimum supported release: Cisco vManage Release 20.7.1)	View all feature templates except the SIG feature template, SIG credential template, and CLI add-on feature template on the **Configuration** > **Templates** window. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, delete, and copy all feature templates except the SIG feature template, SIG credential template, and CLI add-on feature template on the **Configuration** > **Templates** window. **Note** These operations require write permission for **Template Configuration**.
Policy	View the common policies for all Cisco vSmart Controllers or devices in the network on the **Configuration** > **Policies** window.	Create, edit, and delete the common policies for all Cisco vSmart Controllers or devices in the network on the **Configuration** > **Policies** window.
Policy Configuration	View the list of policies created and details about them on the **Configuration** > **Policies** window.	Create, edit, and delete the common policies for all theCisco vSmart Controllers and devices in the network on the **Configuration** > **Policies** window.
Policy Deploy	View the current status of the Cisco vSmart Controllers to which a policy is being applied on the **Configuration** > **Policies** window.	Activate and deactivate the common policies for all Cisco vManage servers in the network on the **Configuration** > **Policies** window.

Feature	Read Permission	Write Permission
RBAC VPN	View the VPN groups and segments based on roles on the **Monitor** > **VPN** page. Cisco vManage Release 20.6.x and earlier: View the VPN groups and segments based on roles on the **Dashboard** > **VPN Dashboard** page.	Add, edit, and delete VPNs and VPN groups from Cisco vManage, and edit VPN group privileges on the **Administration** > **VPN Groups** window.
Routing	View real-time routing information for a device on the **Monitor** > **Devices** > **Real-Time** page. Cisco vManage Release 20.6.x and earlier: View real-time routing information for a device on the **Monitor** > **Network** > **Real-Time** page.	Add command filters to speed up the display of information on the **Monitor** > **Devices** > **Real-Time** page.
Security	View the current status of the Cisco vSmart Controllers to which a security policy is being applied on the **Configuration** > **Security** window.	Activate and deactivate the security policies for all Cisco vManage servers in the network on the **Configuration** > **Security** window.
Security Policy Configuration	Activate and deactivate the common policies for all Cisco vManage servers in the network on the **Configuration** > **Security** > **Add Security Policy** window.	Activate and deactivate the security policies for all Cisco vManage servers in the network on the **Configuration** > **Security** > **Add Security Policy** window.
Session Management	View user sessions on the **Administration** > **Manage Users** > **User Sessions** window.	Add, edit, and delete users and user groups from Cisco vManage, and edit user sessions on the **Administration** > **Manage Users** > **User Sessions** window.
Settings	View the organization name, Cisco vBond Orchestrator DNS or IP address, certificate authorization settings, software version enforced on a device, custom banner on the Cisco vManage login page, and the current settings for collecting statistics on the **Administration** > **Settings** window.	Edit the organization name, Cisco vBond Orchestrator DNS or IP address, certificate authorization settings, software version enforced on a device, custom banner on the Cisco vManage login page, current settings for collecting statistics, generate a certificate signing request (CSR) for a web server certificate, and install a certificate on the **Administration** > **Settings** window.

Feature	Read Permission	Write Permission
SIG Template (Minimum supported release: Cisco vManage Release 20.7.1)	View the SIG feature template and SIG credential template on the **Configuration** > **Templates** window. **Note** This operation requires read permission for **Template Configuration**.	Create, edit, delete, and copy a SIG feature template and SIG credential template on the **Configuration** > **Templates** window. **Note** These operations require write permission for **Template Configuration**.
Software Upgrade	View a list of devices,the custom banner on Cisco vManage on which a software upgrade can be performed, and the current software version running on a device on the **Maintenance** > **Software Upgrade** window.	Upload new software images on devices, upgrade, activate, and delete a software image on a device, and set a software image to be the default image on devices on the **Maintenance** > **Software Upgrade** window.
System	View system-wide parameters configured using Cisco vManage templates on the **Configuration** > **Templates** > **Device Templates** window. **Note** In Cisco vManage Release 20.7.x and earlier releases, **Device Templates** is called **Device**.	Configure system-wide parameters using Cisco vManage templates on the **Configuration** > **Templates** > **Device Templates** window. **Note** In Cisco vManage Release 20.7.x and earlier releases, **Device Templates** is called **Device**.
Template Configuration	View feature and device templates on the **Configuration** > **Templates** window.	Create, edit, delete, and copy a feature or device template on the **Configuration** > **Templates** window. **Note** Beginning with Cisco vManage Release 20.7.1, to create, edit, or delete a template that is already attached to a device, the user requires write permission for the Template Deploy option.
Template Deploy	View the devices attached to a device template on the **Configuration** > **Templates** window.	Attach a device to a device template on the **Configuration** > **Templates** window.

Feature	Read Permission	Write Permission
Tools	Use the **admin tech** command to collect the system status information for a device on the **Tools** > **Operational Commands** window.	Use the **admin tech** command to collect the system status information for a device, and use the **interface reset** command to shut down and then restart an interface on a device in a single operation on the **Tools** > **Operational Commands** window. Rediscover the network to locate new devices and synchronize them with Cisco vManage on the **Tools** > **Operational Commands** window. Establish an SSH session to the devices and issue CLI commands on the **Tools** > **Operational Commands** window.
vAnalytics	Launch vAnalytics on **Cisco vManage** > **vAnalytics** window.	No additional permissions.
Workflows	Launch workflow library from **Cisco vManage** > **Workflows** window.	No additional permissions.

RBAC User Group in Multitenant Environment

The following is the list of user group permissions for role-based access control (RBAC) in a multitenant environment:

- R stands for read permission.
- W stands for write permission.

Table 109: RBAC User Group in Multitenant Environment

Feature	Provider Admin	Provider Operator	Tenant Admin	Tenant Operator
Cloud OnRamp	RW	R	RW	R
Colocation	RW	R	RW	R
RBAC VPN	RW	R	RW	R
Security	RW	R	RW	R
Security Policy Configuration	RW	R	RW	R
vAnalytics	RW	R	RW	R

Add User

1. From the Cisco vManage menu, choose **Administration** > **Manage Users**.
2. By default **Users** is selected. The table displays the list of users configured in the device.
3. To edit, delete, or change password for an existing user, click **…** and click **Edit**, **Delete**, or **Change Password** respectively.
4. To add a new user, click **Add User**.
5. Add **Full Name**, **Username**, **Password**, and **Confirm Password** details.
6. In the **User Groups** drop-down list, select the user group where you want to add a user.
7. In the **Resource Group** drop-down list, select the resource group.

Note This field is available from Cisco SD-WAN Release 20.5.1.

8. Click **Add**.

Delete a User

If a user no longer needs access to devices, you can delete the user. Deleting a user does not log out the user if the user is logged in.

To delete a user:

1. From the Cisco vManage menu, choose **Administration** > **Manage Users**.
2. For the user you wish to delete, click **...**, and click **Delete**.
3. To confirm the deletion of the user, click **OK**.

Edit User Details

You can update login information for a user, and add or remove a user from a user group. If you edit the details of a user who is logged in, the changes take effect after the user logs out.

To edit user details:

1. From the Cisco vManage menu, choose **Administration** > **Manage Users**.
2. For the user you wish to edit, click **...**, and click **Edit**.
3. Edit the user details.

   You can also add or remove the user from user groups.
4. Click **Update**.

Change User Password

You can update passwords for users, as needed. We recommend that you use strong passwords.

Before You Begin

If you are changing the password for an admin user, detach device templates from all Cisco vManage instances in the cluster before you perform this procedure. You can reattach the device templates after you complete this procedure.

To change a password for a user:

1. From the Cisco vManage menu, choose **Administration** > **Manage Users**.
2. For the user you wish to change the password, click **...** and click **Change Password**.
3. Enter the new password, and then confirm it.

Note Note that the user, if logged in, is logged out.

4. Click **Done**.

Check Users Logged In to a Device Using SSH Sessions

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

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

2. Select the device you want to use under the **Hostname** column.
3. Click **Real Time**.
4. From **Device Options**, choose **AAA users** for Cisco IOS XE SD-WAN devices or **Users** for Cisco vEdge devices.

   A list of users logged in to this device is displayed.

Check Users Logged In to a Device Using HTTP Sessions

1. From the Cisco vManage menu, choose **Administration** > **Manage Users**.
2. Click **User Sessions**.

   A list of all the active HTTP sessions within Cisco vManage is displayed, including, username, domain, source IP address, and so on.

Manage a User Group

Users are placed in groups, which define the specific configuration and operational commands that the users are authorized to view and modify. A single user can be in one or more groups. Cisco SD-WAN software provides standard user groups, and you can create custom user groups, as needed:

- **basic**: Includes users who have permission to view interface and system information.
- **netadmin**: Includes the admin user, by default, who can perform all operations on the Cisco vManage. You can add other users to this group.
- **operator**: Includes users who have permission only to view information.
- Minimum supported release: Cisco vManage Release 20.9.1

network_operations: Includes users who can perform non-security operations on Cisco vManage, such as viewing and modifying non-security policies, attaching and detaching device templates, and monitoring non-security data.

- Minimum supported release: Cisco vManage Release 20.9.1

  security_operations: Includes users who can perform security operations on Cisco vManage, such as viewing and modifying security policies, and monitoring security data.

Note: All user groups, regardless of the read or write permissions selected, can view the information displayed on the Cisco vManage Dashboard screen.

Delete a User Group

You can delete a user group when it is no longer needed. For example, you might delete a user group that you created for a specific project when that project ends.

1. From the Cisco vManage menu, choose **Administration** > **Manage Users**.
2. Click **User Groups**.
3. Click the name of the user group you wish to delete.

Note You cannot delete any of the default user groups—basic, netadmin, operator, network_operations, and security_operations.

4. Click **Trash** icon.
5. To confirm the deletion of the user group, click **OK**.

Edit User Group Privileges

You can edit group privileges for an existing user group. This procedure lets you change configured feature read and write permissions for the user group needed.

1. From the Cisco vManage menu, choose **Administration** > **Manage Users**.
2. Click **User Groups**.
3. Select the name of the user group whose privileges you wish to edit.

Note You cannot edit privileges for the any of the default user groups—basic, netadmin, operator, network_operations, and security_operations.

4. Click **Edit**, and edit privileges as needed.
5. Click **Save**.

If an **admin** user changes the privileges of a user by changing their group, and if that user is currently logged in to the device, the user is logged out and must log back in again.

Managing Resource Groups

Minimum supported releases: Cisco IOS XE Release 17.5.1a and Cisco vManage Release 20.5.1

To configure Resource Groups:

1. From the Cisco vManage menu, choose **Administration** > **Resource Groups**. The table dispalys a list of resource groups that are configured in Cisco vManage.
2. To edit or delete a resource group, click **...**, and click **Edit** or **Delete**.
3. To add new resource group, click **Add Resource Group**.
4. Enter **Resource Group Name** and the **Description**.
5. Under **Site ID**, enter **Range** or **Select ID(S)** from the drop-down list to include in the resource group.
6. To add the resource group to a device, click **Add**.

To add Users:

1. From the Cisco vManage menu, choose **Administration** > **Manage Users**. The Manage Users screen appears.
2. By default **Users** is selected. The table displays the list of users configured in the device.
3. To edit, delete, or change password for an existing user, click **...**, and click **Edit**, **Delete**, or **Change Password** respectively.
4. To add a new user, click **Add User**.
5. Add **Full Name**, **Username**, **Password**, and **Confirm Password** details.
6. From the **User Groups** drop-down list, select the user group where you want to add a user.
7. From the **Resource Group** drop-down list, select the resource group.

   Note This field is available from Cisco SD-WAN Release 20.5.1.

8. Click **Add**.

Modify Policy Configurations

Minimum supported releases: Cisco SD-WAN Release 20.6.1 and Cisco vManage Release 20.6.1

1. Login to Cisco vManage with the new user details.
2. You can modify or update the configurations based on the requirement.

When you login to Cisco vManage with new user details, you can view only the user group components that are assigned to you. For more details on configuring policies, see Policies Configuration Guide for vEdge Routers

Assign Users to Configure RBAC for Policies

Minimum supported releases: Cisco SD-WAN Release 20.6.1 and Cisco vManage Release 20.6.1

To Assign User to Create or Modify a CFlowd Data Policy

To create a CFlowd user group:

1. From the Cisco vManage, choose **Administration** > **Manage Users**.
2. Click **User Groups** and **Add User Group**.
3. Enter **User Group Name**.

   For example, cflowd-policy-only.
4. Check the Read or Write check box against the CFlowD Policy feature that you want to assign to a user group.
5. Click **Add**.
6. You can view the new user group in the left navigation path. Click **Edit** to edit the existing read or write rules.
7. Click **Save**.

To create a CFlowd user:

1. In Cisco vManage, choose **Administration** > **Manage Users**.
2. Click **Users**.
3. Click **Add User**.
4. In the Add New User page, enter **Full Name**, **Username**, **Password**, and **Confirm Password** details.
5. Choose **cflowd-policy-only** from the **User Groups** drop-down.

   Allow the **Resource Group** to select the default resource group.
6. Click **Add**. You can view the new user in the Users window.
7. To edit the existing read or write rules for a user, click **Edit**.

To modify a Cflowd policy:

1. Login to Cisco vManage with the new user credentials.

   You can view access only to CFlowd Policies as your login is assigend to **cflowd-policy-only** user group.
2. You can create, modify, or update the configurations based on the requirement.

Verify Granular RBAC Permissions

Minimum supported release: Cisco vManage Release 20.7.1

Use this procedure to verify the permissions that you have configured for a user group.

1. From the Cisco vManage menu, choose **Administration** > **Manage Users**.

2. Click **User Groups**.
3. In the pane that displays the user groups, select a user group to display the read and write permissions assigned to the user group.
4. Scroll to the permissions that control template access to verify your configuration for the user group.

Workflow to Configure Route Leaking Using Cisco vManage

Table 110: Feature History

Feature Name	Release Information	Description
Route Leaking Between Transport VPN and Service VPNs	Cisco SD-WAN Release 20.3.1 Cisco vManage Release 20.3.1	You can configure route leaking between transport VPN and service VPNs using the **Global Route Leak** option under the VPN feature template.
Route Manipulation for Leaked Routes with OMP Administrative Distance	Cisco vManage Release 20.6.1 Cisco SD-WAN Release 20.6.1	You can configure route redistribution between the transport VPN and service VPNs using the **Global Route Leak** option under the VPN feature template.
Route Leaking between Inter-Service VPN	Cisco SD-WAN Release 20.9.1 Cisco vManage Release 20.9.1	You can configure to leak routes between the service VPNs at the same site using the **Route Leak** option in the Cisco vManage.

1. Configure and enable the Localized Policy and attach the Route Policy.
2. Configure and enable the Route Leaking feature between Global and Service VPN.
3. Configure and enable the Route Leaking feature between Service VPNs.
4. Attach the Service Side VPN Feature Template to the Device Template.

Configure Localized Route Policy

Configure Route Policy

1. From the Cisco vManage menu, choose **Configuration** > **Policies**.
2. Select **Localized Policy**.
3. From the **Custom Options** drop-down, under Localized Policy, select **Route Policy**.
4. Click **Add Route Policy**, and select **Create New**.
5. Enter a name and description for the route policy.
6. In the left pane, click **Add Sequence Type**.

7. In the right pane, click **Add Sequence Rule** to create a single sequence in the policy. Match is selected by default.
8. Select a desired protocol from the **Protocol** drop-down list. The options are: IPv4, IPv6, or both.
9. Click a match condition.
10. On the left, enter the values for the match condition.
11. On the right enter the action or actions to take if the policy matches.
12. Click **Save Match and Actions** to save a sequence rule.
13. If no packets match any of the route policy sequence rules, the default action is to drop the packets. To change the default action:
    a. Click **Default Action** in the left pane.
    b. Click the **Pencil** icon.
    c. Change the default action to **Accept**.
    d. Click **Save Match and Actions**.
14. Click **Save Route Policy**.

Add the Route Policy

1. From the Cisco vManage menu, choose **Configuration** > **Policies**.
2. Choose the **Localized Policy**.
3. Click **Add Policy**.
4. Click **Next** in the Local Policy Wizard until you arrive at the **Configure Route Policy** option.
5. Click **Add Route Policy** and choose **Import Existing**.
6. From the **Policy** drop-down choose the route policy that is created. Click **Import**.
7. Click **Next**.
8. Enter the **Policy Name** and **Description**.
9. Click **Preview** to view the policy configurations in CLI format.
10. Click **Save Policy**.

Attach the Localized Policy to the Device Template

Note The first step in utilizing the Localized Policy that was created previously is to attach it to the device template.

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Device Templates** and select the desired template.

3. Click **…**, and click **Edit**.
4. Click **Additional Templates**.
5. From the **Policy** drop-down, choose the **Localized Policy** that is created.
6. Click **Update**.

Note Once the localized policy has been added to the device template, selecting the **Update** option immediately pushes a configuration change to all of the devices that are attached to this device template. If more than one device is attached to the device template, you will receive a warning that they are changing multiple devices.

7. Click **Next** and then **Configure Devices**.
8. Wait for the validation process and push configuration from Cisco vManage to the device.

Configure and Enable Route Leaking between Global and Service VPNs

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. To configure route leaking, click **Feature Templates**.

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

Do one of the following:

- To create a feature template:

  a. Click **Add Template**. Choose a device from the list of devices. The templates available for the selected device display in the right pane.

  b. Choose the **VPN** template from the right pane.

Note Route leaking can be configured on service VPNs only. Therefore, ensure that the number you enter in the **VPN** field under **Basic Configuration** is one of the following: 1—511 or 513—65530.

For details on configuring various VPN parameters such as basic configuration, DNS, Virtual Router Redundancy Protocol (VRRP) tracking, and so on, see Configure a VPN Template. For details specific to the route leaking feature, proceed to Step c.

  c. Enter Template Name and Description for the feature template.

  d. Click **Global Route Leak** below the **Description** field.

  e. To leak routes from the transport VPN, click **Add New Route Leak from Global VPN to Service VPN**.

1. In the **Route Protocol Leak from Global to Service** drop-down list, choose **Global** to choose a protocol. Otherwise, choose **Device-Specific** to use a device-specific value.

2. In the **Route Policy Leak from Global to Service** drop-down list, choose **Global**. Next, choose one of the available route policies from the drop-down list.

3. Click **Add**.

f. To leak routes from the service VPNs to the transport VPN, click **Add New Route Leak from Service VPN to Global VPN**.

1. In the **Route Protocol Leak from Service to Global** drop-down list, choose **Global** to choose a protocol. Otherwise, choose **Device-Specific** to use a device-specific value.

2. In the **Route Policy Leak from Service to Global** drop-down list, choose **Global**. Next, choose one of the available route policies from the drop-down list.

3. Click **Add**.

g. Click **Save/Update**. The configuration does not take effect till the feature template is attached to the device template.

h. To redistribute the leaked static routes to BGP or OSPF protocols, see one of the following:

- Configure BGP
- Configure OSPF

- To modify an existing feature template:

a. Choose a feature template you wish to modify.

b. Click **...** next to the row in the table, and click **Edit**.

c. Perform all operations from Step c of creating a feature template.

Note

- The configuration does not take effect till the Service VPN feature template is attached to the device template.

Attach the Service Side VPN Feature Template to the Device Template

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

2. Click **Device Templates** and select the desired template.

3. Click **…**, and click **Edit**.

4. Click **Service VPN**.

5. Click **Add VPN**. Select the Service VPN feature template listed in the Available VPN Templates pane. Click right-shift arrow and add the template to Selected VPN Templates list.

6. Click **Next** once it moves from the left (Available VPN Templates) to the right side (Selected VPN Templates).
7. Click **Add**.
8. Click **Update**.
9. Click **Next** and then **Configure Devices**.
10. Finally, wait for the validation process and push configuration from Cisco vManage to the device.

Workflow to Configure VRRP Tracking

Table 111: Feature History

Feature Name	Release Information	Description
VRRP Interface Tracking for Cisco vEdge Devices	Cisco SD-WAN Release 20.4.1 Cisco vManage Release 20.4.1	This feature enables VRRP to set the edge as active or standby based on the WAN Interface or SIG tracker events and increase the TLOC preference value on a new VRRP active to ensure traffic symmetry, for Cisco vEdge Devices.
VRRP Interface Tracking for Cisco vEdge Devices.	Cisco SD-WAN Release 20.7.1 Cisco vManage Release 20.7.1	Starting this release, you can configure VRRP interface tracking through Cisco vManage feature template on Cisco vEdge Device.

1. Configure an object tracker. For more information, see Configure an Object Tracker, on page 305.
2. Configure VRRP for a VPN Interface template and associate the object tracker with the template. For more information, see Configure VRRP for a VPN Interface Template and Associate Interface Object Tracker, on page 306.

Configure an Object Tracker

Use the **System** template to configure an object tracker.

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Feature**.
3. Navigate to the **System** template for the device.

Note To create a **System** template, see Create System Template

4. Click **Tracker**, and click **New Object Tracker** to configure the tracker parameters.

Table 112: Tracker Parameters

Field	Description
Tracker Type	Choose Interface or SIG to configure the Object tracker.
Tracker List	Enter the name of the tracker list.
Interface	Choose global or device-specific tracker interface name.

5. Click **Add**.
6. Click **Save**.

Configure VRRP for a VPN Interface Template and Associate Interface Object Tracker

To configure VRRP for a **VPN** template, do the following:

1. From the Cisco vManage menu, choose **Configuration** > **Templates**.
2. Click **Feature Templates**.

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

3. Navigate to the **VPN Interface Ethernet** template for the device.

Note For information about creating a new **VPN Interface Ethernet** template, see Configure VPN Ethernet Interface.

4. Click **VRRP** and choose **IPv4**.
5. Click **New VRRP** to create a new VRRP or edit the existing VRRP and configure the following parameters:

Parameter Name	Description
TLOC Preference Change	(Optional) Choose **On** or **Off** to set whether the TLOC preference can be changed or not.

6. Click the **Add Tracking Object** link, and in the **Tracking Object** dialog box that is displayed, click **Add Tracking Object**.
7. In the **Tracker Name** field, enter the name of the tracker.
8. From the **Action** drop-down list, choose **Decrement** and enter the **Decrement Value**.
9. Click **Add**.

10. Click **Add** to save the VRRP details.

11. Click **Save**.

Configure VRRP Tracking Using CLI Templates

You can configure VRRP tracking using the CLI add-on feature templates and CLI device templates. For more information, see CLI Templates.

VRRP Object Tracking Using CLI

Configure Track List Interface

Use the following configuration to add an interface to a track list using Cisco vManage device CLI tempale:

```
Device# config terminal
Device(config)# system
Device(config-system)# track-list zs1 interface ge0/1 gre1 ipsec1
Device(config-track-list-zs1)# commit
Device(config-system-tracker-list-zs1)# exit
Device(config-system)# exit
```

Configure Interface Tracking and Priority Decrement

```
Device(config)# vpn 1
Device(config-vpn-1)# name vpn-name
Device(config- vpn-1)# interface ge0/2
Device(config-interface-ge0/2)# ip address 172.16.10.1/24
Device(config-interface-ge0/2)# no shutdown
Device(config-interface-ge0/2)# vrrp 100
Device(config-vrrp-100)# track zs1 decrement 10
Device(config-vrrp-track-zs1)# exit
Device(config-vrrp-100)# ipv4 172.16.10.100
Device(config-vrrp-100)# tloc-change-pref
```

SIG Container Tracking

The following example shows how to configure a track list and tracking for SIG containers using the Cisco vManage device CLI template.

Note In SIG Object Tracking, you can only set *global* as the variable for Service Name.

Configure Track List for SIG Container

```
Device# config terminal
Device(config)# system
Device(config-system)# track-list SIG sig-container global
Device(config-system-tracker-list-SIG)# exit
Device(config-system)# exit
```

Configure SIG Container Tracking and Priority Decrement

```
Device(config)# vpn 1
Device(config-vpn-1)# name vpn-name
Device(config- vpn-1)# interface ge0/2
Device(config-interface-ge0/2)# ip address 172.16.10.1/24
Device(config-interface-ge0/2)# no shutdown
Device(config-interface-ge0/2)# vrrp 100
Device(config-vrrp-100)# track SIG decrement 10
Device(config-vrrp-track-zs1)# exit
Device(config-vrrp-100)# ipv4 172.16.10.100
Device(config-vrrp-100)# tloc-change-pref
```

Configure SIG Container Tracking for VRRP Group

```
Device(config-vpn-1)# int ge0/4
Device(config-interface-ge0/4)# vrrp 10
Device(config-vrrp-10)# track SIG decrement 10
Device(config-track-SIG)# commit
Commit complete.
Device(config-track-SIG)#
```

CHAPTER 4

Operations

Access the Software Upgrade Workflow

Table 113: Feature History

Feature Name	Release Information	Description
Software Upgrade Workflow	Cisco IOS XE 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 vManage.
Schedule the Software Upgrade Workflow	Cisco IOS XE 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.

Before You Begin

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

From the Cisco vManage toolbar, click the **Task-list** icon. Cisco vManage 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 vManage 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 vManage, 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 vManage toolbar, click the **Task-list** icon.

   Cisco vManage 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 vManage 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 vManage menu, choose **Monitor** > **Logs** > **ACL Log**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage displays a log of activities in table format.

Change the Device Rollback Timer

By default, when you attach a Cisco vEdge 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 vManage 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 the vManage NMS.

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 vManage.

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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.

Cluster Management

Table 114: Feature History

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

A Cisco vManage cluster consists of at least three Cisco vManage servers. These servers manage the Cisco SD-WAN edge devices in a network. Cisco vManage 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 vManage servers while sharing information between these servers. For scaling recommendations, see *Server Recommendations* for your release in Cisco SD-WAN Controller Compatibility Matrix and Server Recommendations.

Use the **Administration** > **Cluster Management** window to create a Cisco vManage cluster and perform related tasks.

From Cisco vManage Release 20.6.1, each Cisco vManage server has a *persona*. The persona is determined when the Cisco vManageserver first boots up after Cisco vManage 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 vManage Persona and Storage Device.

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

- Compute+Data: Includes all services that are required for Cisco vManage, 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 vManage 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 vAnalytics, 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 vManage 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 vManage:

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 vManage 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 115: 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 116: 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.

Field	Mandatory or Optional	Description
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, 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 117: 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.

Field	Mandatory or Optional	Description
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 118: 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.
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.

Field	Mandatory or Optional	Description
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 119: 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.
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 120: 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 121: Feature History

Feature Name	Release Information	Description
Customizable Monitor Overview Dashboard in Cisco vManage	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.

Add a Dashlet

1. From the Cisco vManage 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**.

Delete a Dashlet

1. From the Cisco vManage 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 vManage 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**.

Restore Default Settings

1. From the Cisco vManage 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 vEdge Cloud router) removes the device's serial number from Cisco vManage and generates a new token for the device. To do so:

1. From the Cisco vManage 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 vManage software repository:

Step 1 From the Cisco vManage 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 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 vManage menu, choose **Monitor** > **Overview**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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

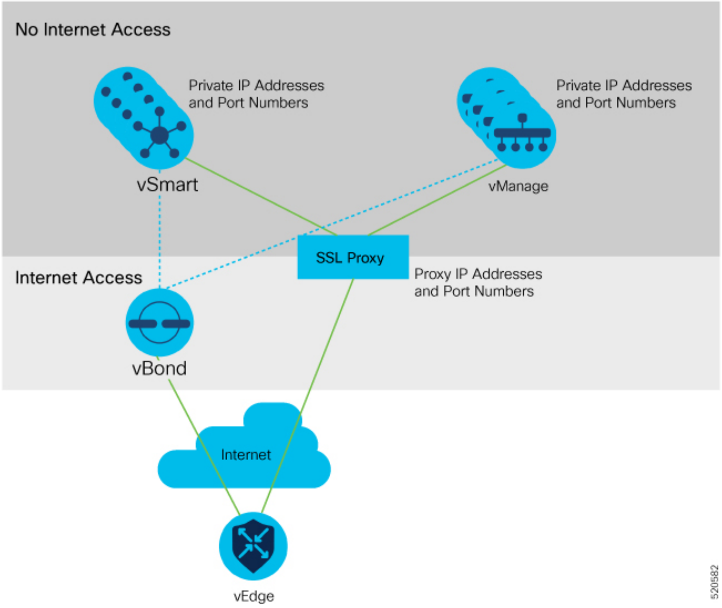
Table 122: Feature History

Feature Name	Release Information	Description
Support for Reverse Proxy with Cisco IOS XE SD-WAN Devices and Cisco 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 SD-WAN devices and Cisco vManage and Cisco vSmart 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 SD-WAN devices. In a multitenant deployment, the Service Provider manages reverse proxy and the associated configuration.

In a standard overlay network, Cisco SD-WAN edge devices initiate direct connections to the Cisco SD-WAN controllers (Cisco vManage and Cisco vSmart 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 vManage and Cisco vSmart 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 vManage and the Cisco vSmart Controllers, the WAN edge devices communicate with the reverse proxy, and the reverse proxy relays the traffic to and from Cisco vManage and Cisco vSmart Controllers.

The following figure illustrates a reverse proxy deployed between a WAN edge device and Cisco vManage and the Cisco vSmart 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 SD-WAN deployments.

Restrictions for Enabling Reverse Proxy Support

- In a multitenant Cisco SD-WAN overlay network, you can deploy a reverse proxy device with only a three-node Cisco vManage cluster. Deployment of the reverse proxy is only supported with a TLS-based control plane for Cisco vManage and Cisco vSmart 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". 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
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 vManage 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 vManage menu, choose **Configure** > **Devices**.
2. Click **Controllers**.
3. For the desired Cisco vManage instance or Cisco vSmart 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 vManage instance or Cisco vSmart 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 vManage instance or Cisco vSmart Controller, choose TLS as the transport protocol.

After you configure reverse proxy settings on a Cisco vManage instance or a Cisco vSmart 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 vBond Orchestrator 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 vManage.
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 vManage instances and Cisco vSmart Controller. See *Configure Reverse Proxy Settings on Cisco SD-WAN Controllers* for information on deleting the mappings.

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage menu, choose **Monitor** > **Network**.
2. Click on the hostname of a Cisco vManage instance, Cisco vSmart 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 vSmart 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 vManage 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 vBond Orchestrator

The following is a sample output from the execution of the **show orchestrator reverse-proxy-mapping** command on a Cisco vBond Orchestrator. 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 SD-WAN device. In the command output, check the entry in the PROXY column for a Cisco vManage instance or a Cisco vSmart 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 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 devices and controllers, make sure to 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 vManage, the Cisco vSmart Controller, and the Cisco vBond Orchestrator.

Note For additional information about enterprise certificates, see the Cisco 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 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 vManage that you generate these certificates and install them on the controller devices—Cisco vManage, Cisco vBond Orchestrators, and Cisco vSmart 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 SD-WAN, mark each router as valid or invalid, and then from Cisco vManage, 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 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 123: Feature History

Feature Name	Release Information	Description
Admin-Tech Enhancements	Cisco SD-WAN Release 20.1.1	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 vManage Cluster Using Admin Tech	Cisco SD-WAN Release 20.6.1 Cisco vManage Release 20.6.1	You can collect system status information for a Cisco vManage cluster. Prior to this feature, Cisco SD-WAN was only able to generate an admin-tech file for a single device.
View Generated Admin-Tech Files at Any Time	Cisco SD-WAN Release 20.6.1 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 vManage. You can then download the selected admin-tech files to your local device, or delete the downloaded admin-tech files from Cisco vManage, the device, or both.
Additional Diagnostics Information Added to Admin-Tech File	Cisco SD-WAN Release 20.7.1 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 SD-WAN Release 20.7.1 Cisco vManage Release 20.7.1	You can upload an admin-tech file to a TAC case from Cisco vManage.

Perform the following steps to generate admin-tech file.

1. From the Cisco vManage 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 vManage 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 vManage 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 vManage.
- Download the selected admin-tech files to your local device.
- Delete the selected admin-tech files from Cisco vManage, the device, or both.

1. From the Cisco vManage 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 vManage.

3. Click the **Copy** icon to copy the admin-tech file from the device to Cisco vManage.

   A hint appears letting you know that the file is being copied from the device to Cisco vManage.

4. After the file is copied from the device to Cisco vManage, 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 vManage.

5. After the admin-tech file is successfully copied to Cisco vManage, you can click the **Delete** icon and choose which files to delete from Cisco vManage, 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 Release 17.7.1a, and Cisco SD-WAN Release 20.7.1, you can upload an admin-tech file directly from Cisco vManage when opening a TAC case.

Before You Begin

Ensure that you have generated admin-tech files from Cisco vManage.

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 vManage 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 vManage Application Server Logo

To change the Cisco vManage 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 vManage 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 vManage Web Application Server

The Cisco vManage runs as a web application server through which you log in to a running Cisco vManage.

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

With a Cisco vManage 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 vManage attempts sequentially to validate the credentials. If none of the Cisco vManage servers validate you, only then do you see an invalid login error message.

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

Manage Data Collection for Cisco SD-WAN Telemetry

Table 124: Feature History

Feature Name	Release Information	Description
Manage Data Collection for Cisco SD-WAN Telemetry	Cisco IOS XE 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 SD-WAN telemetry using Cisco vManage. Data collection for telemetry is enabled by default.

From Cisco vManage Release 20.6.1, Cisco vManage has a new option to enable or disable data collection for Cisco 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 SD-WAN telemetry. The two options are described below:

Data Collection: This option is used to establish a connection to Cisco SD-WAN Data Collection Service (DCS) hosted on the cloud. The connection from Cisco vManage to DCS is used to collect required data from the controllers and the network, for different features such as Cisco vAnalytics and Cisco 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 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 SD-WAN Data Collection Service (DCS) through the **Data Collection** setting is a mandatory prerequisite for enabling Cisco SD-WAN telemetry.

Manage Service Groups

Table 125: Feature History

Feature Name	Release Information	Description
Support for Cisco VM Image Upload in qcow2 Format	Cisco SD-WAN Release 20.7.1 Cisco vManage Release 20.7.1	You can now upload a virtual machine image to Cisco vManage 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 126: Feature History

Feature Name	Release Information	Feature Description
Monitor Service Chain Health	Cisco SD-WAN Release 19.2.1	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 vManage 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 127: 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.
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 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 SD-WAN Cloud OnRamp Colocation Solution Guide. You can also create a customized service chain. See Create Custom Service Chain, on page 342.

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 vManage 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 350.

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:

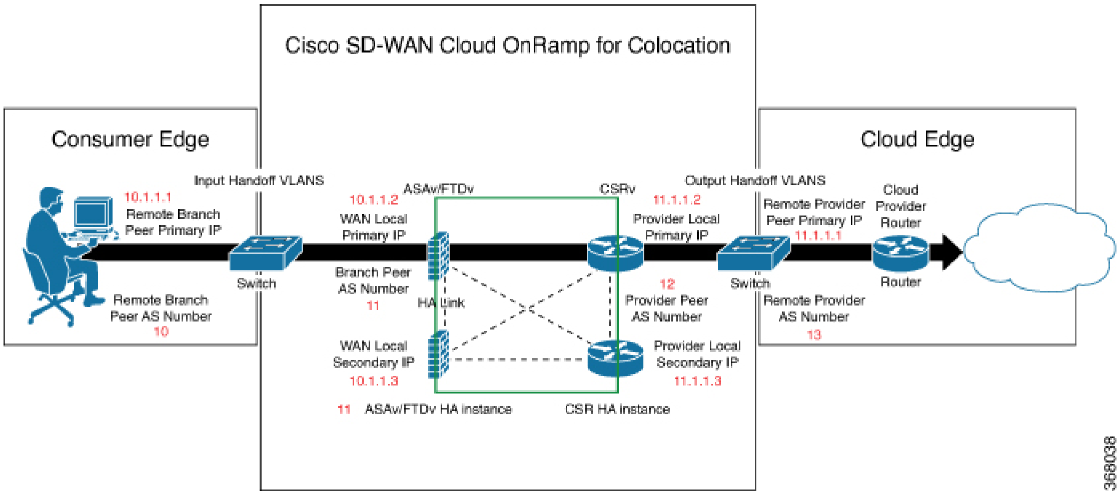
- **Disk Image/Image Package (Select File)**
- **Disk Image/Image Package (Filter by Tag, Name and Version)**
- **Scaffold File (Select File)**
- **Scaffold File (Filter by Tag, Name and Version)**

Table 128: VNF Properties of Router and Firewall

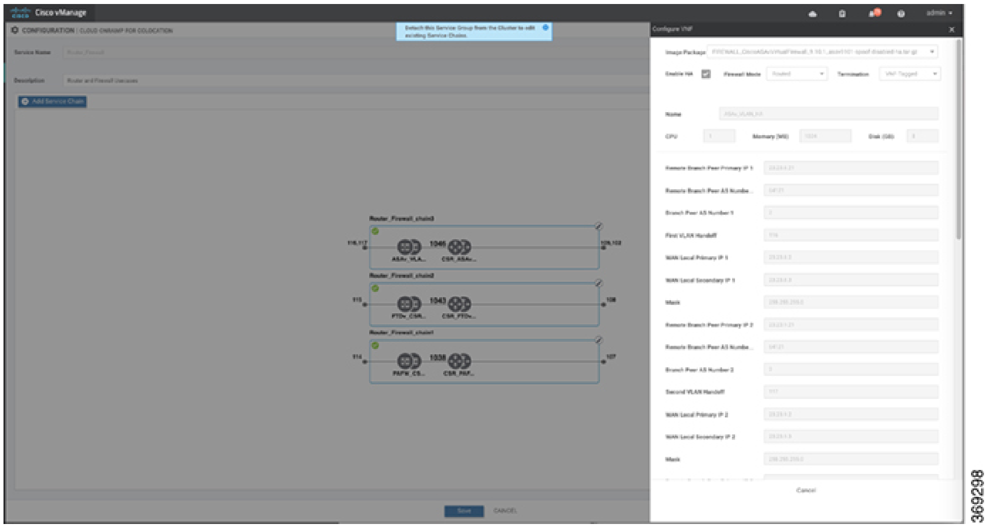
Field	Description
Image Package	Choose a router, firewall package.
Disk Image/Image Package (Select File)	Choose a tar.gz package or a qcow2 image file.
Disk Image/Image Package (Filter by Tag, Name and Version)	(Optional) Filter an image or a package file based on the name, version, and tags that you 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.	

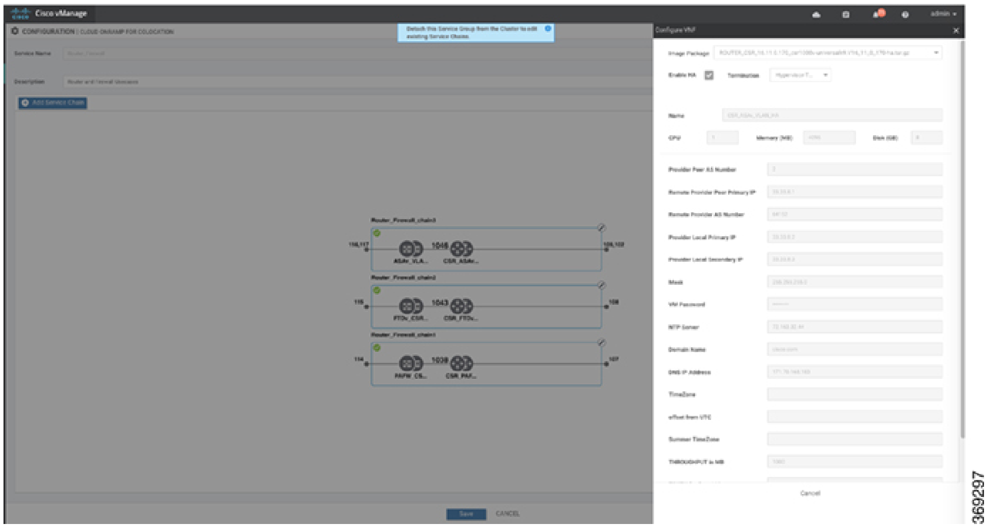
Field	Description
Name	VNF image name
CPU	(Optional) Specifies the number of virtual CPUs that are required for a VNF. The default value is 1 vCPU.
Memory	(Optional) Specifies the maximum primary memory in MB that the VNF can use. The default value is 1024 MB.
Disk	(Optional) Specifies disk in GB required 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 vManage.





If you're using a multitenant cluster and a comanged scenario, configure the Cisco 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 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 SD-WAN device that is available after authenticating it with Cisco SD-WAN Controllers. 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 SD-WAN overlay network domain in which the Cisco 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.

Field	Description
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 vBond Orchestrator. The service provider can get the Cisco vBond Orchestrator 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 129: 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 monotioring 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 336.

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 130: Feature History

Feature Name	Release Information	Description
Software Upgrade Using a Remote Server	Cisco SD-WAN Release 20.7.1 Cisco vManage Release 20.7.1	This feature enables you to register a remote server with Cisco vManage, and add locations of software images on the remote server to the Cisco vManage 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 vManage so that you can add locations of software images on the remote server to the Cisco vManage software repository and upgrade device or controller software using these software images. In multitenant Cisco 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 vManage 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 vManage 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 vManage 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 vManage software repository.

Add Software Images to Repository

Before you begin

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

The Cisco vManage software repository allows you to store images in three ways:

- On the local Cisco vManage server, to be downloaded over a control plane connection—Here, the software images are stored on the local Cisco vManage server, and they are downloaded to the Cisco 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 vManage server might not be able to monitor the software installation on the device even though it is proceeding correctly.
- On the local Cisco vManage server, to be downloaded over an out-of-band connection—Here, the software images are stored on the local Cisco vManage server, and they are downloaded to the Cisco 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 vManage 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 vManage server sends this URL to the Cisco SD-WAN device, which then establishes a connection to the file server over which to download the software images.

Step 1 From the Cisco vManage 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 vManage server and have it be downloaded to Cisco 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 vManage server.
2. Click **Upload** to add the image to the software repository.

Note NFVIS upgrade images require the local Cisco vManage 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 vManage server and have it be downloaded to Cisco 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 vManage 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 vManage server.
3. Click **Upload**.

View Software Images

From the Cisco vManage 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 controller software that is equivalent to the software version. The controller version is the minimum supported Cisco controller version. The software image can operate with the listed controller version or with a higher controller version.

The **Software Location** column indicates where the software images are stored, either in the repository on the Cisco vManage 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.x 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 vManage 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 vManage 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 vManage 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 vManage 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 vManage 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 vManage 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 vManage 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 vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage 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 vManage 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 vManage 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 SD-WAN device.

From a centralized Cisco vManage, you can upgrade the software on Cisco 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 vBond Orchestrator, Cisco vSmart Controllers, and Cisco IOS XE SD-WAN devices or Cisco vEdge devices in either a standalone or Cisco vManage cluster deployment, the software upgrade and reboot is performed first on the Cisco vBond Orchestrator, next on the Cisco vSmart Controller, and finally on the Cisco IOS XE SD-WAN devices or Cisco vEdge devices. Up to 40 Cisco IOS XE 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 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 vManage in a group software upgrade operation. You must upgrade and reboot the Cisco vManage server by itself.
- You can create a software upgrade workflow only for upgrading the Cisco SD-WAN edge devices.
- It is recommended that you perform all software upgrades from Cisco vManage rather than from the CLI.
- For software compatibility information, see Cisco SD-WAN Controller Compatibility Matrix and Server Recommendations.

Monitor Cloud onRamp Colocation Clusters

Table 131: Feature History

Feature Name	Release Information	Description
Network Assurance –VNFs: Stop/Start/Restart	Cisco SD-WAN Release 20.3.1 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 vManage menu, choose **Monitor** > **Devices**.

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

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

Cisco vManage Release 20.6.x 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.

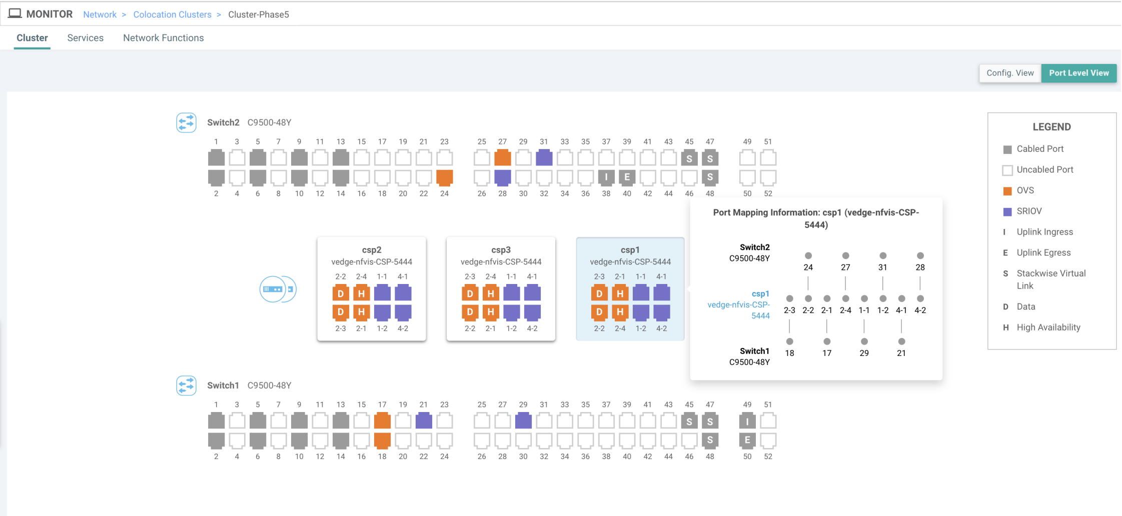
After you choose an operation on a VNF, wait until the operation is complete before you issue another operation. You can view the progress of an operation from the **Task View** window.

- **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 2: 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 enablemement, 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 vManage, 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**.

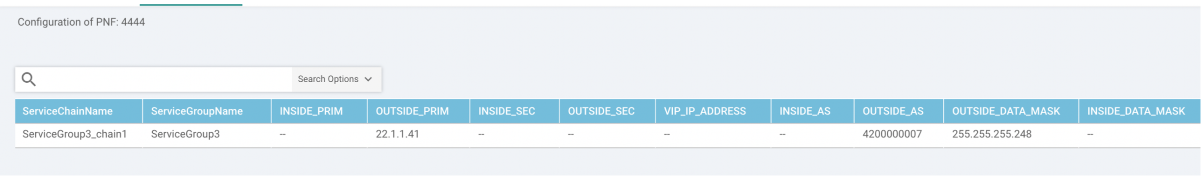
Here, you can view the following:

- 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.

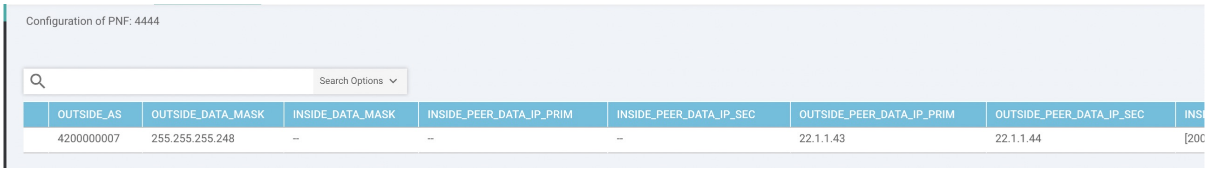
Figure 3: PNF in the First Position with Service Chain Side Parameters



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 4: PNF in the First Position with Outside Neighbor Information

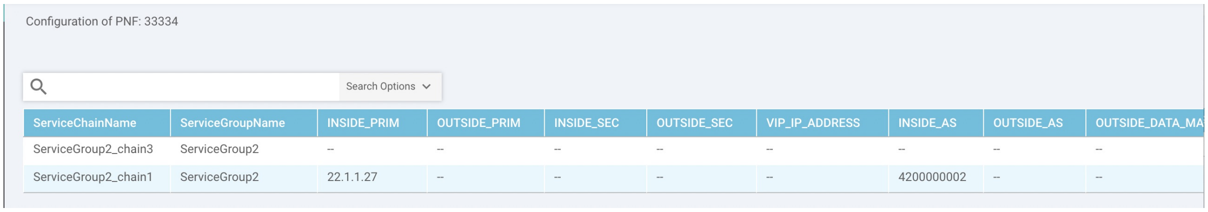


Configuration of PNF: 4444

	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 5: PNF Shared Across Two Service Chains

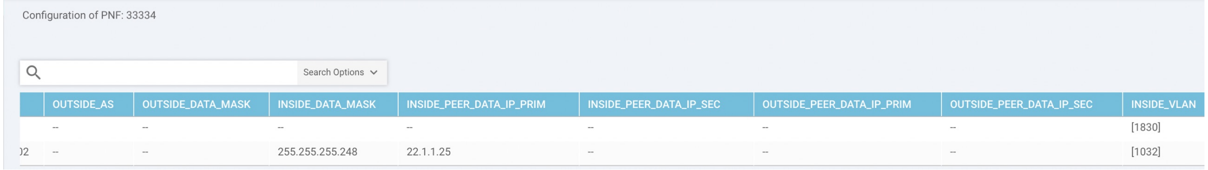
The ServiceGroup2_chain3 is a PNF-only service chain and therefore no configuration gets generated. The PNF is in the last position of the ServiceGroup2_chain1, so only INSIDE variables gets generated.



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 6: PNF Shared Across Two Service Chains with Outside Neighbor Information



Configuration of PNF: 33334

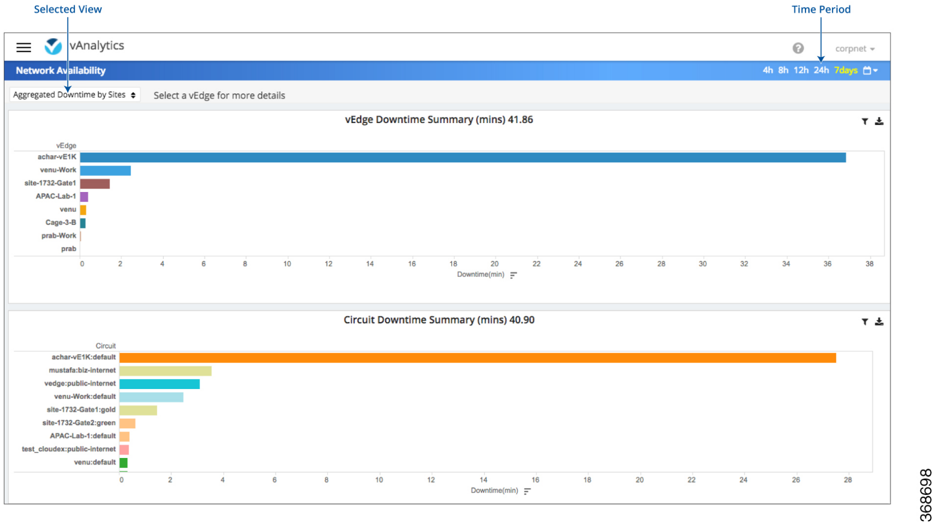
	OUTSIDE_AS	OUTSIDE_DATA_MASK	INSIDE_DATA_MASK	INSIDE_PEER_DATA_IP_PRIM	INSIDE_PEER_DATA_IP_SEC	OUTSIDE_PEER_DATA_IP_PRIM	OUTSIDE_PEER_DATA_IP_SEC	INSIDE_VLAN
	--	--	--	--	--	--	--	[1830]
)2	--	--	255.255.255.248	22.1.1.25	--	--	--	[1032]

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 SD-WAN edge devices and circuits.



Display Network Availability

To display downtime for Cisco 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 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 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 SD-WAN device to display average latency, loss, or jitter on all the tunnels on that device.

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

Reboot a Device

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

Reboot Devices

1. From the Cisco vManage 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 vManage toolbar, click the **Tasks** icon. Cisco vManage 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 vManage 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 356.

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 vManage menu, choose **Maintenance** > **Device Reboot**.
2. Under **WAN Edge**, check the check box for the Cisco 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 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 vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage.

1. From the Cisco vManage 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 vEdge Router

This section describes how to replace a vEdge router at a particular location. You might do this when a vEdge router has failed completely or when a component in a router, such as one of the power supplies, has failed, and you want to replace the entire router.

At a high level, to replace one vEdge router with another, you simply copy the configuration from the router you are removing to the new router and then put the new router into the network.

Before you can replace the vEdge router in Cisco vManage, Cisco vManage must have learned the chassis number and serial number of the replacement vEdge router.

- If the replacement vEdge router is a router that you have previously received, such as a router that part of your spares inventory, Cisco vManage will have already learned the router's chassis and serial number when you previously uploaded the serial number file to Cisco vManage.
- If you initiated an RMA process and have received a new router as a replacement, you need to upload the updated version of the authorized vEdge serial number file to Cisco vManage.

To replace a failed router using Cisco vManage, perform the following steps:

1. Copy the configuration from the failed router to the replacement router.
2. Invalidate the failed router. Invalidating a router deactivates its certificate and thus removes it from the overlay network.
3. Validate the replacement router, to activate its certificate.

The new router is a complete replacement for the failed router, its configuration is identical to that of the failed router. (Remember, though, that each router has a unique chassis number and a unique serial number in its certificate.) After you copy the configuration from the failed router to the replacement, both routers have the same configurations, including the same IP address. Two routers with the same IP address cannot be present in the network at the same time, one router must be in valid state on Cisco vManage and the other must be in invalid state—or both routers must be in invalid state.

Before You Begin

Ensure that you have uploaded the authorized serial number file to Cisco vManage.

Copy the Configuration from the Failed to the Replacement Router

From Cisco vManage, you copy the configuration from the failed vEdge router to the replacement router.

The vEdge router that you are copying the configuration from can be a device that is active in the overlay network (that is, it is in a valid state) or it can be one that is inactive (that is, it is in invalid state). For example, if you are replacing a router in which one of the two power supplies has failed, the router might still be active in the network, but if you are replacing one that has failed completely, you might have already marked it as invalid to remove it from the network.

The vEdge router that you are copying the configuration to must be in invalid state.

To view the state of a vEdge router or to change the validity state, see Validate or Invalidate a vEdge Router.

To copy the configuration from the failed router to the replacement router:

1. From the Cisco vManage menu, choose **Configuration** > **Devices**.
2. For the failed router, click **...** and choose **Copy Configuration**.
3. In the **Copy Configuration** window, choose the replacement router.
4. Click **Update**.

Remove the Failed Router

1. From the Cisco vManage menu, choose **Configuration** > **Certificates**.
2. For the failed router, in the **Validate** column, click **Invalid**.
3. Click **OK** to confirm invalidation of the device.
4. Click **Send to Controllers**.

Add the Replacement Router

1. From the Cisco vManage menu, choose **Configuration** > **Certificates**.
2. For the replacement router, in the **Validate** column, click **Valid**.
3. Click **OK** to confirm validation of the device.
4. Click **Send to Controllers**.

If you attempt to validate a router that has the same IP address as another router in the network, an error message is displayed, and the validation process is terminated.

Release Information

Introduced in Cisco vManage in Release 15.4.

Restore Cisco vManage

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.

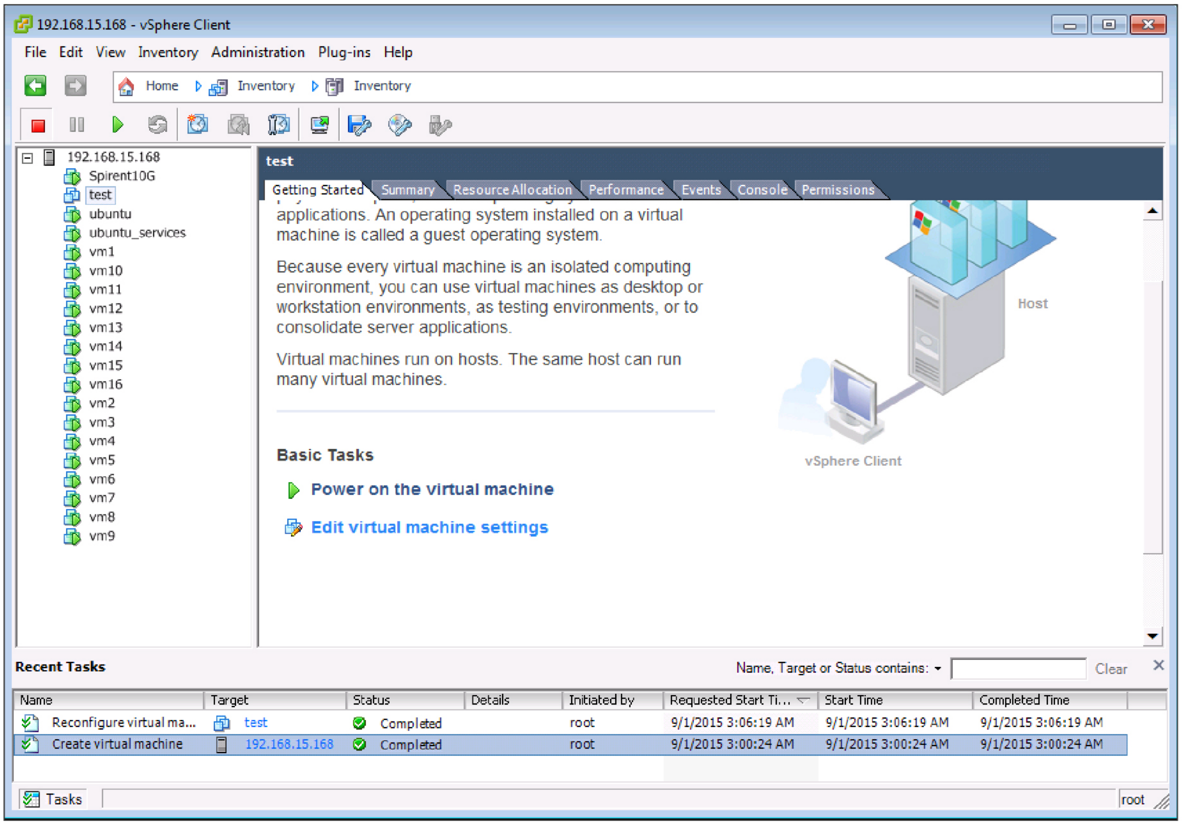
We recommend that you set up periodic crash-consistent backups of the vManage NMS database. (In a crash-consistent backup, all the VM's data are captured at exactly the same time.) Then, if the vManage NMS server fails, you simply create a new vManage NMS instance and attach the vManage NMS database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

Basic Tasks

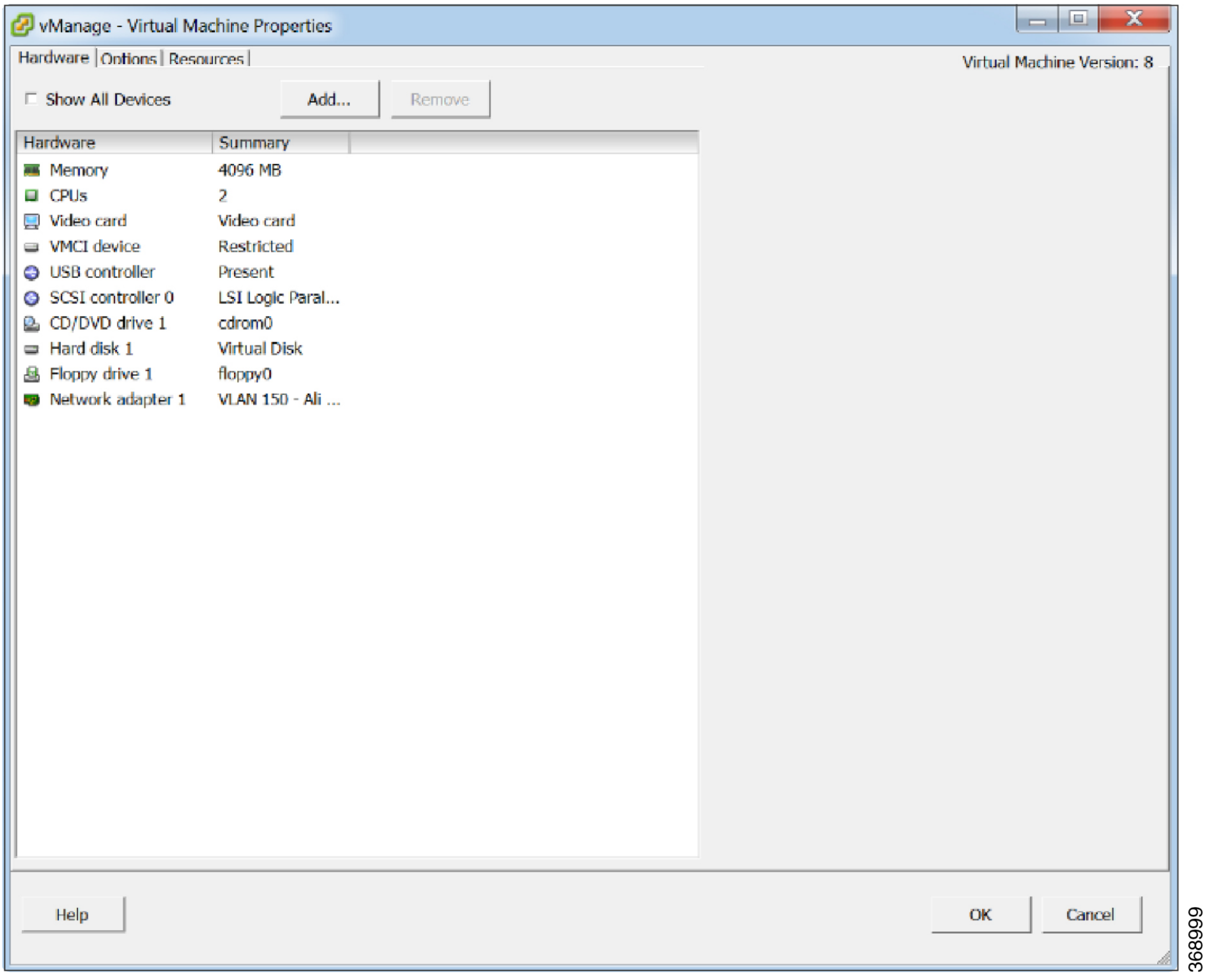
Power on the virtual machine

Edit virtual machine settings

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.

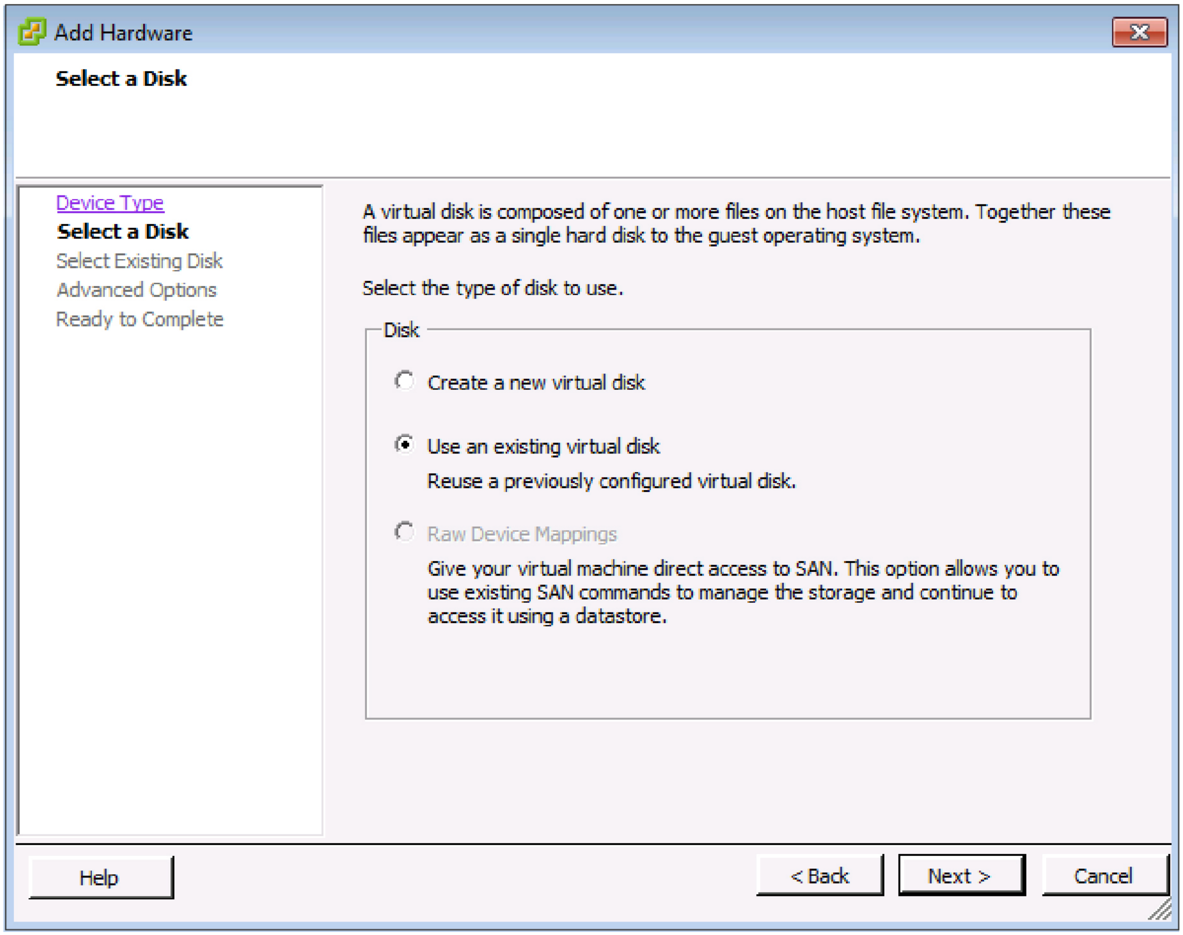


Hardware	Summary
Memory	4096 MB
CPUs	2
Video card	Video card
VMCI device	Restricted
USB controller	Present
SCSI controller 0	LSI Logic Paral...
CD/DVD drive 1	cdrom0
Hard disk 1	Virtual Disk
Floppy drive 1	floppy0
Network adapter 1	VLAN 150 - Ali ...

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

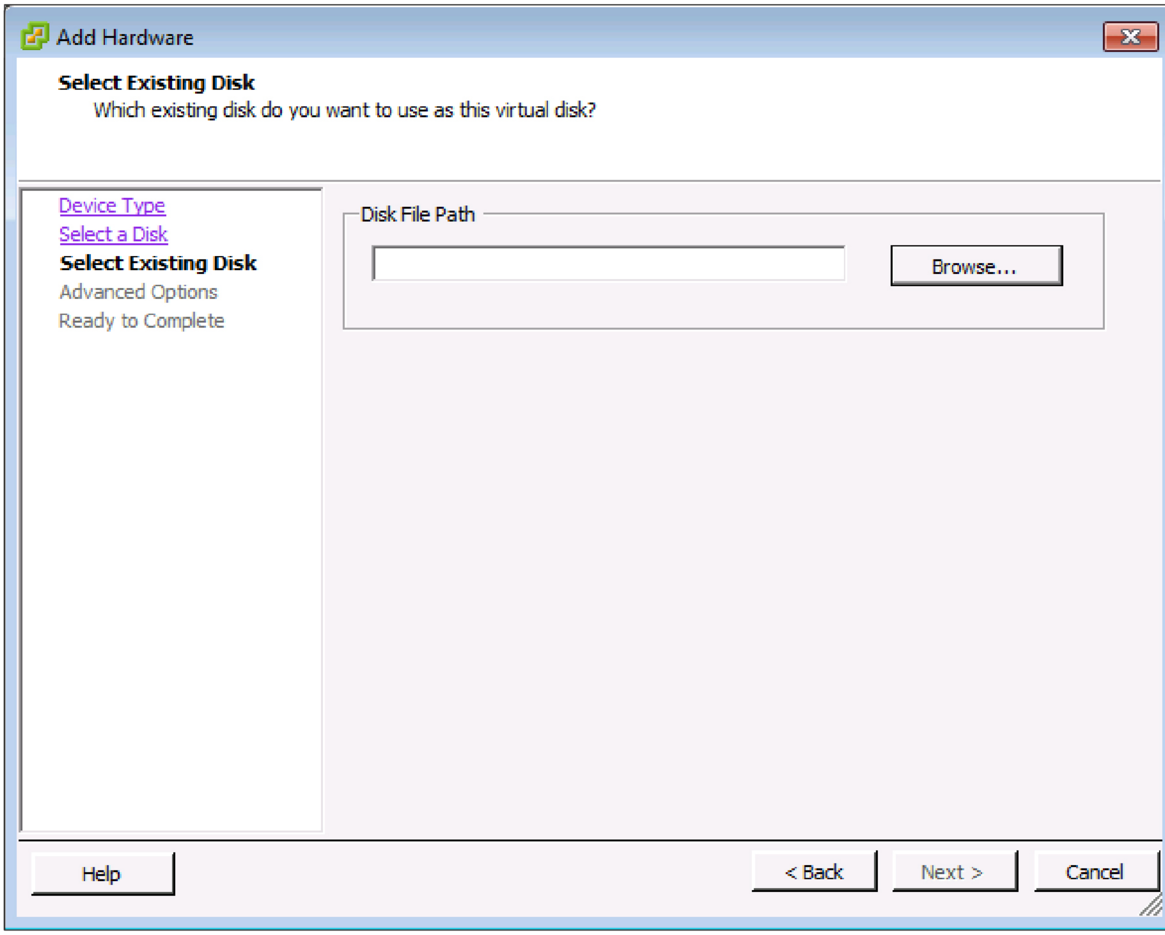
Reuse a previously configured virtual disk.

○ 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.



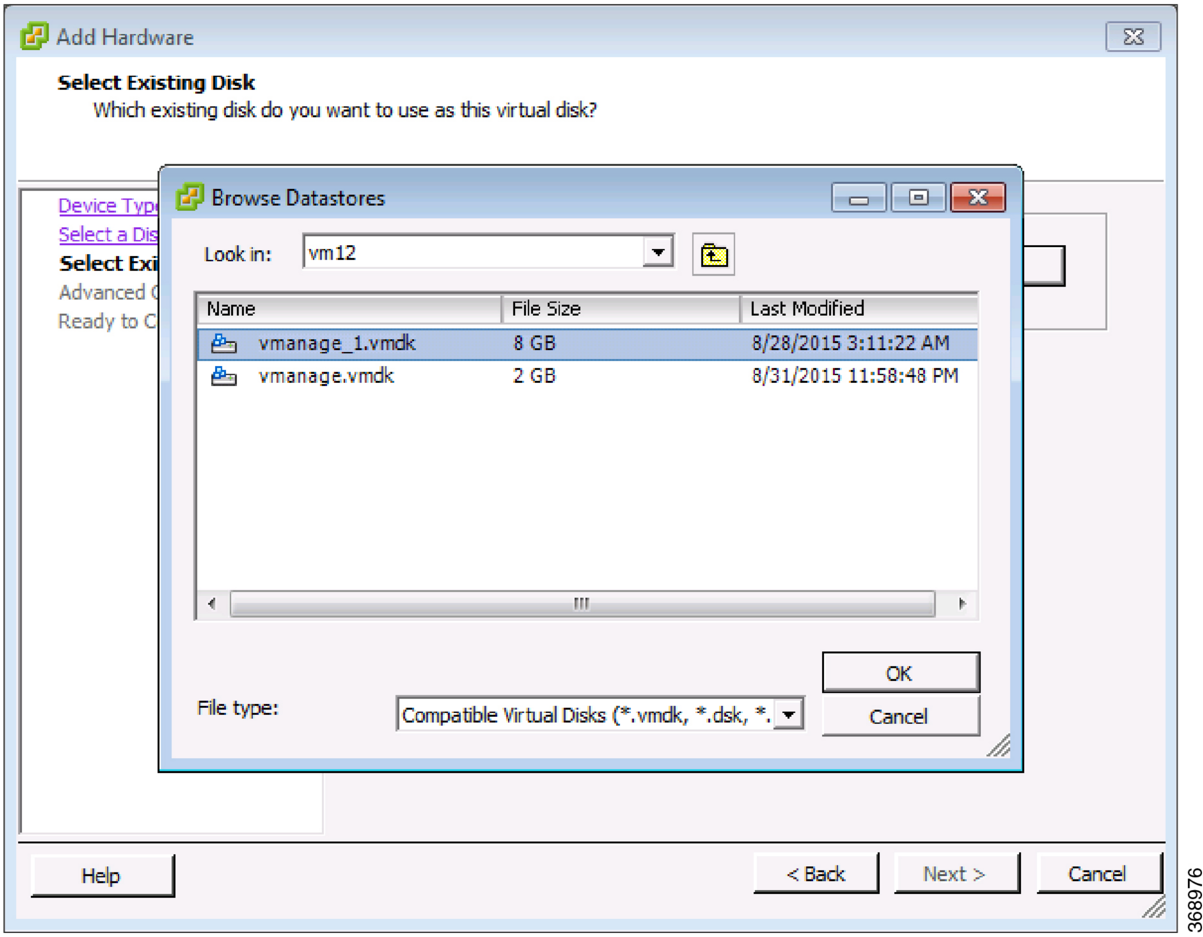
Add Hardware

Select Existing Disk

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

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

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



Select Existing Disk

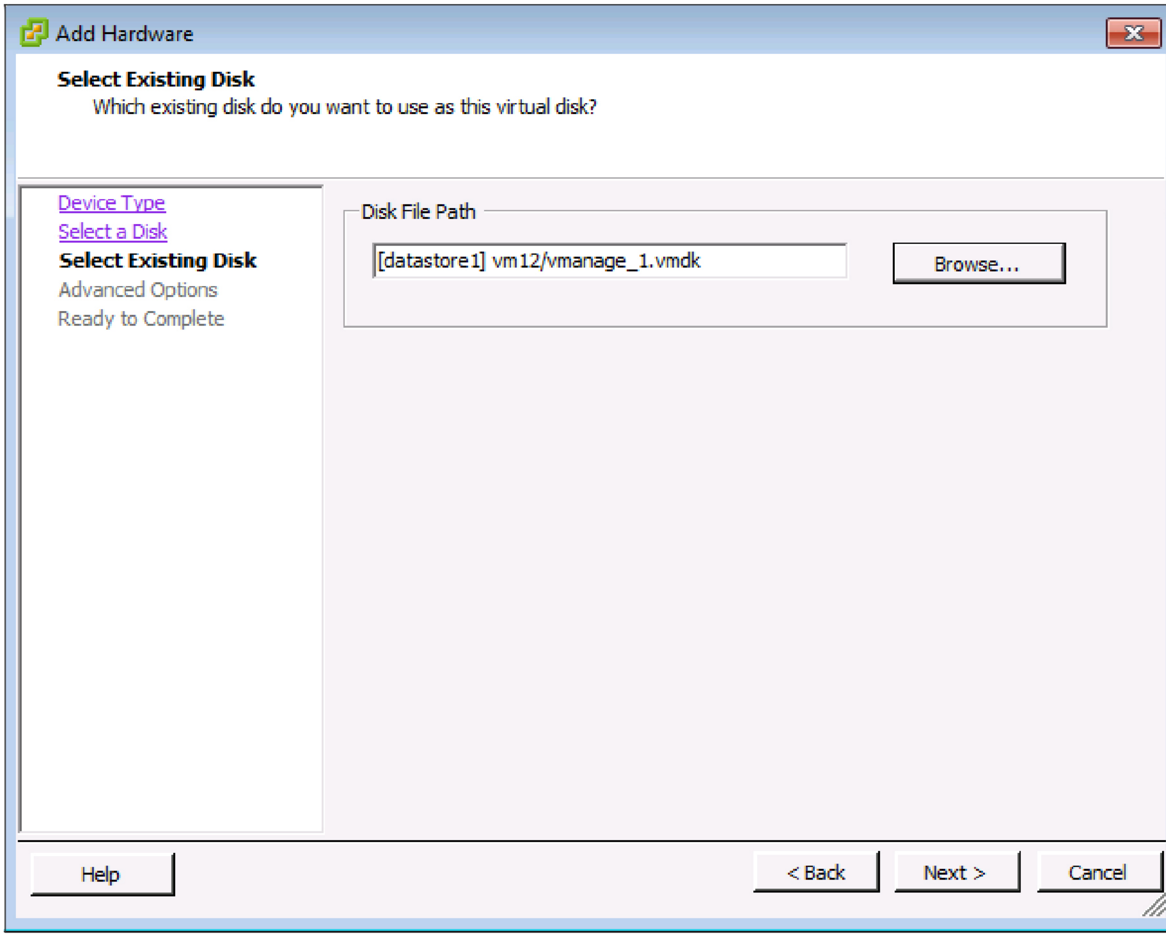
Which existing disk do you want to use as this virtual disk?

Look in: vm12

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

File type: Compatible Virtual Disks (*.vmdk, *.dsk, *.

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



Add Hardware

Select Existing Disk

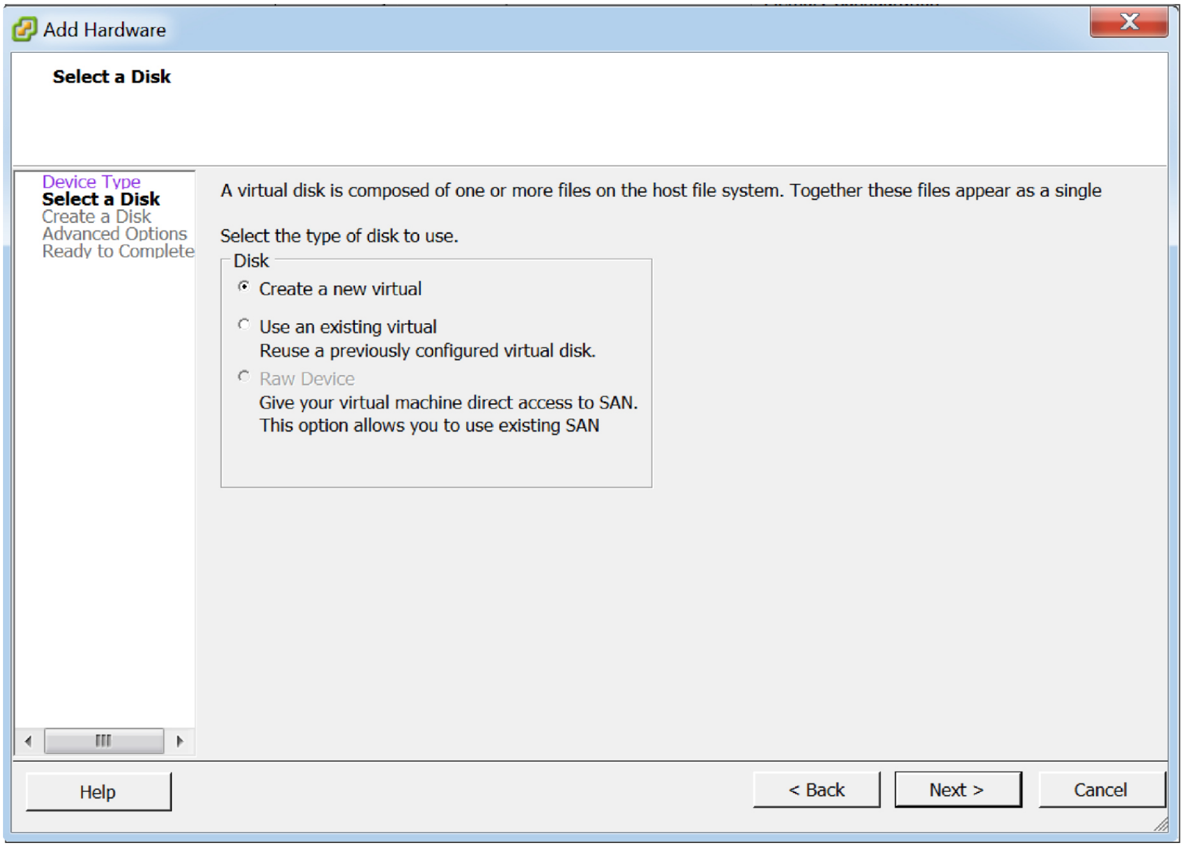
Which existing disk do you want to use as this virtual disk?

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

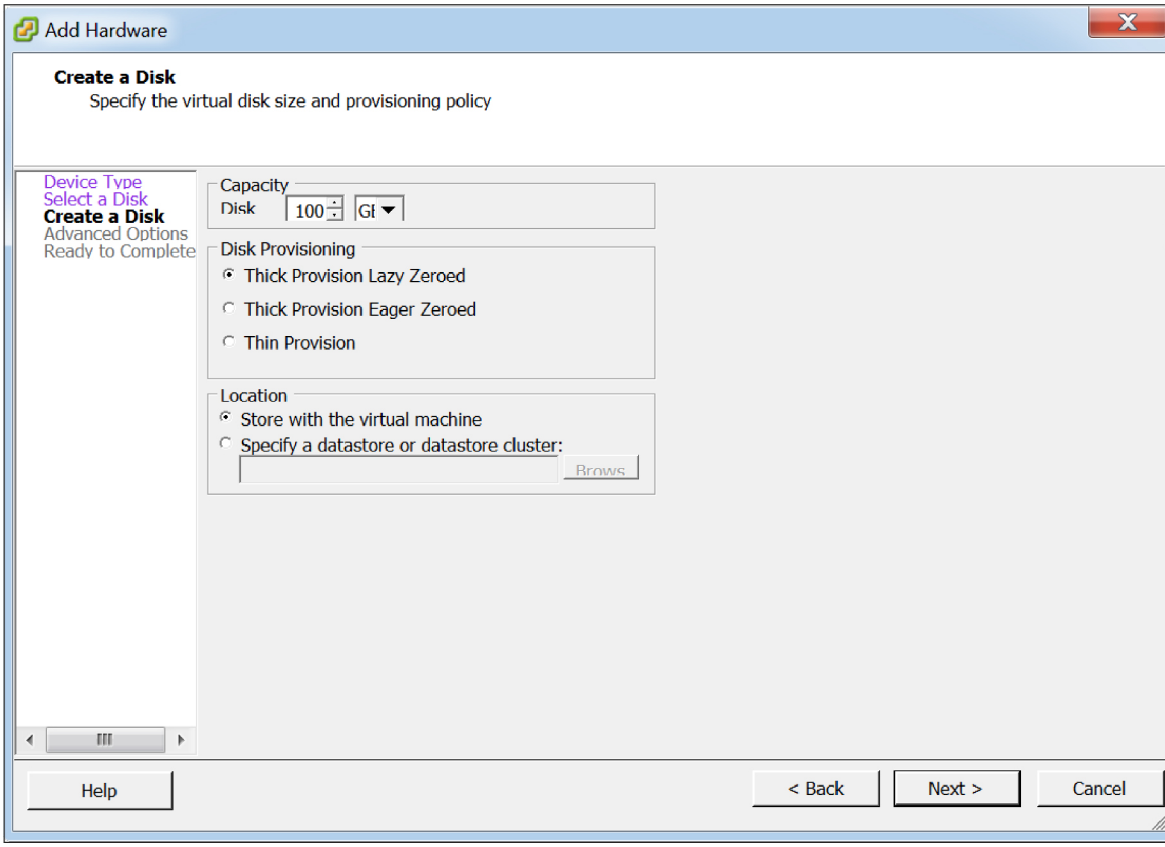
● Create a new virtual

○ 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.



Create a Disk

Specify the virtual disk size and provisioning policy

Capacity

Disk 100 GB

Disk Provisioning

● Thick Provision Lazy Zeroed

○ Thick Provision Eager Zeroed

○ Thin Provision

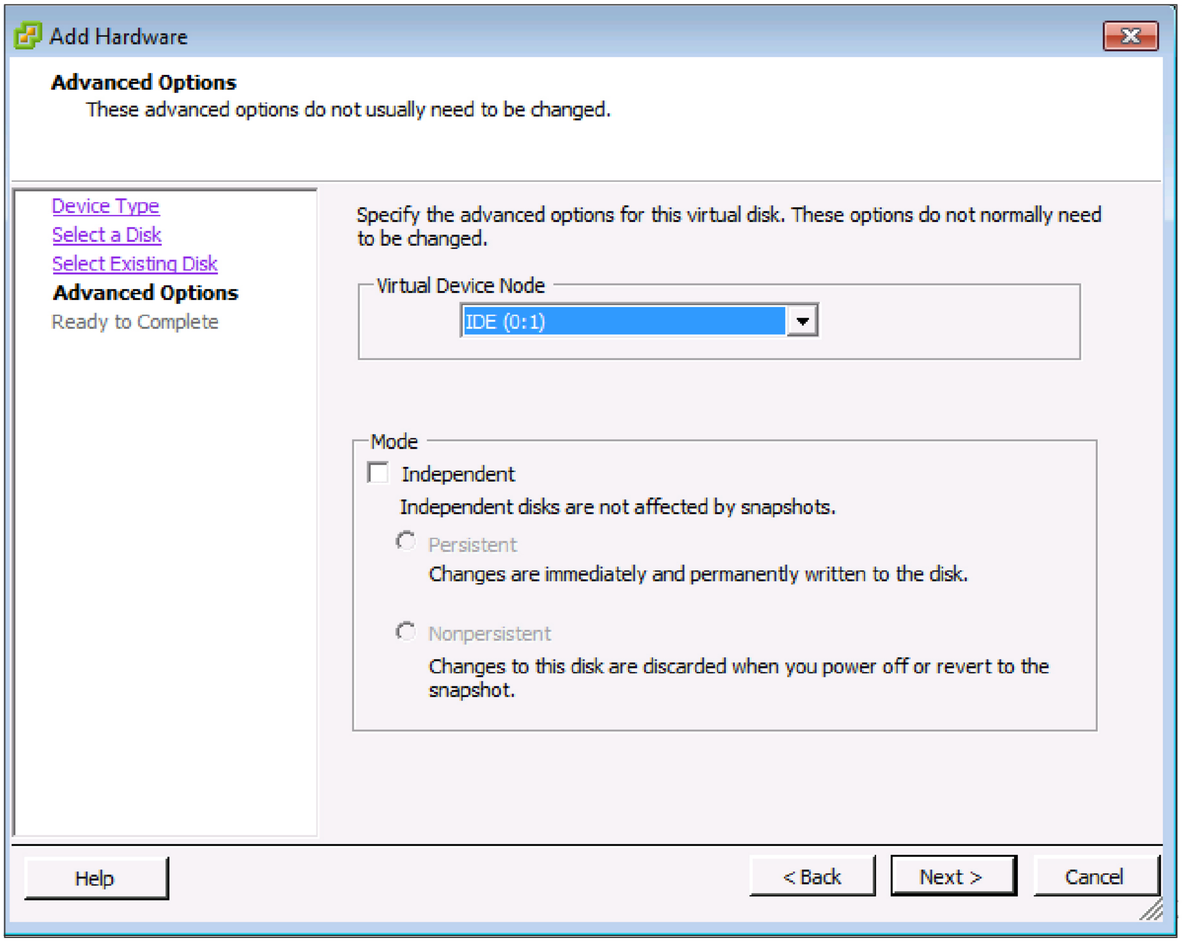
Location

● 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.



Add Hardware

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

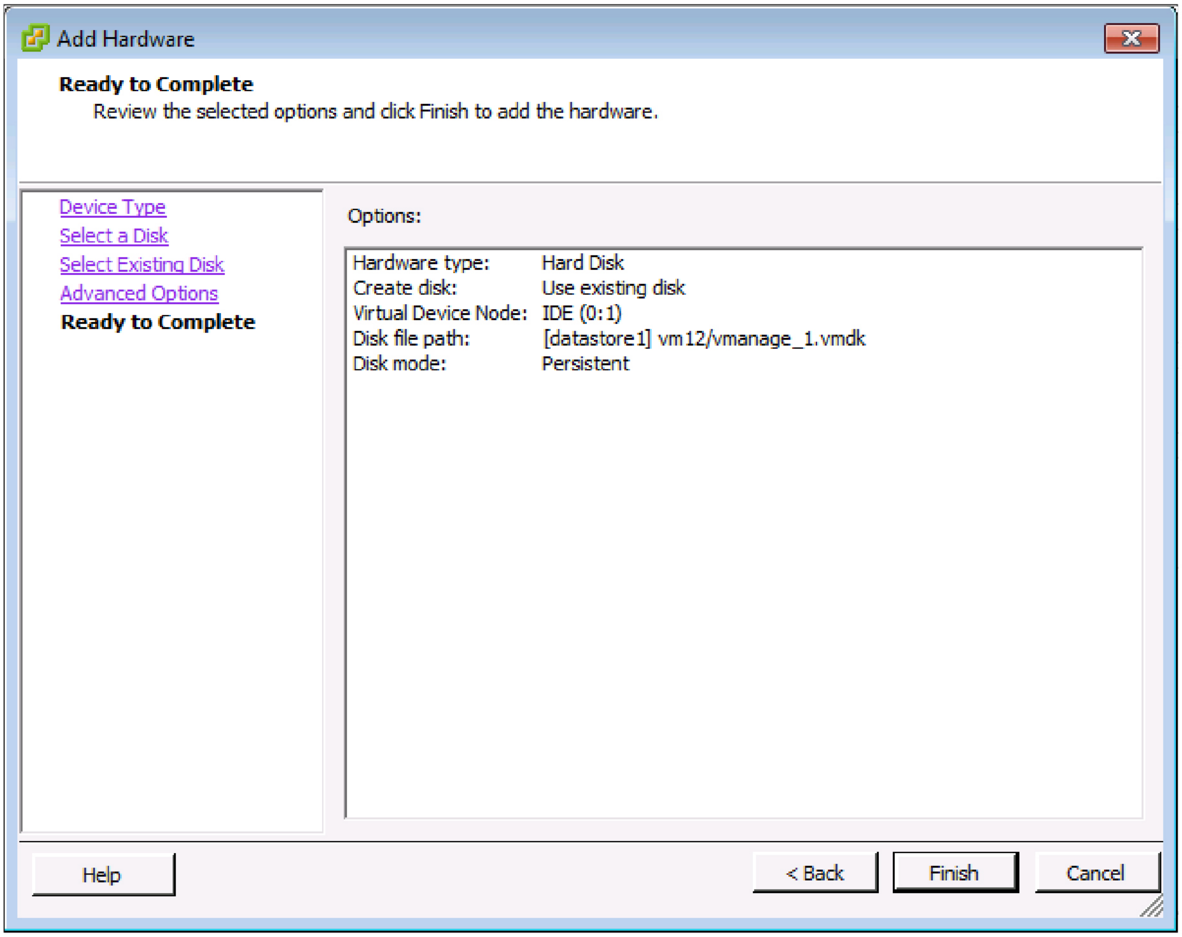
Changes are immediately and permanently written to the disk.

○ Nonpersistent

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

The Ready to Complete screen is displayed.

4. Click Finish.



Add Hardware

Ready to Complete

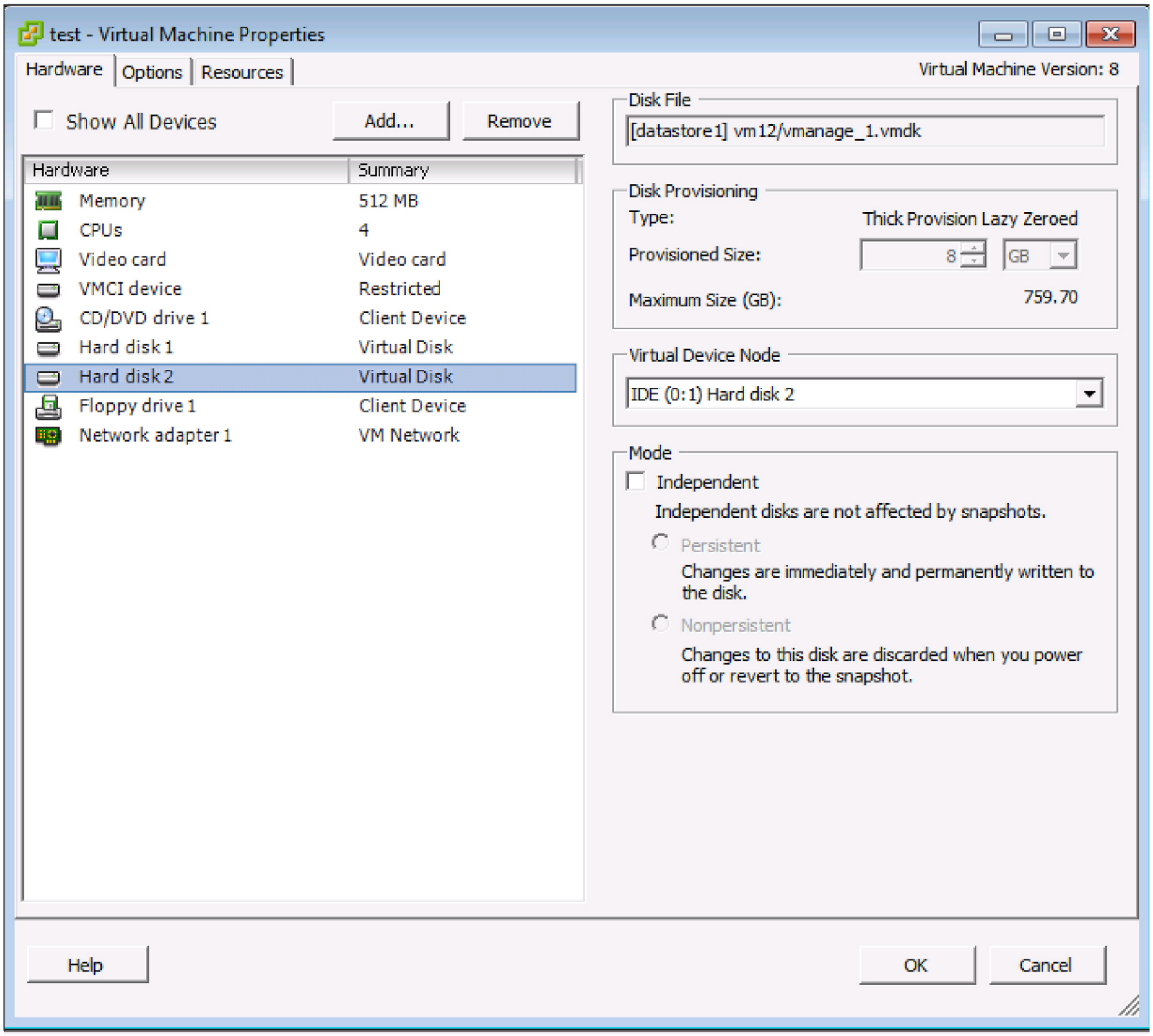
Review the selected options and click Finish to add the hardware.

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.



Virtual Machine Version: 8

□ Show All Devices

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

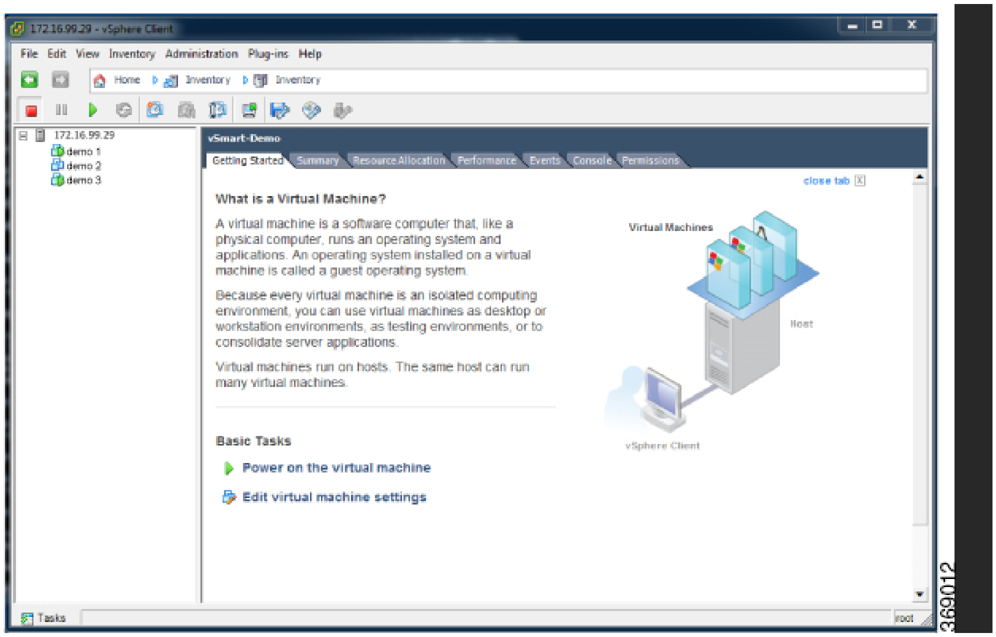
Changes are immediately and permanently written to the disk.

○ Nonpersistent

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

368983

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
Virtual Machines
Host
vSphere Client
Tasks
root
369012

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.

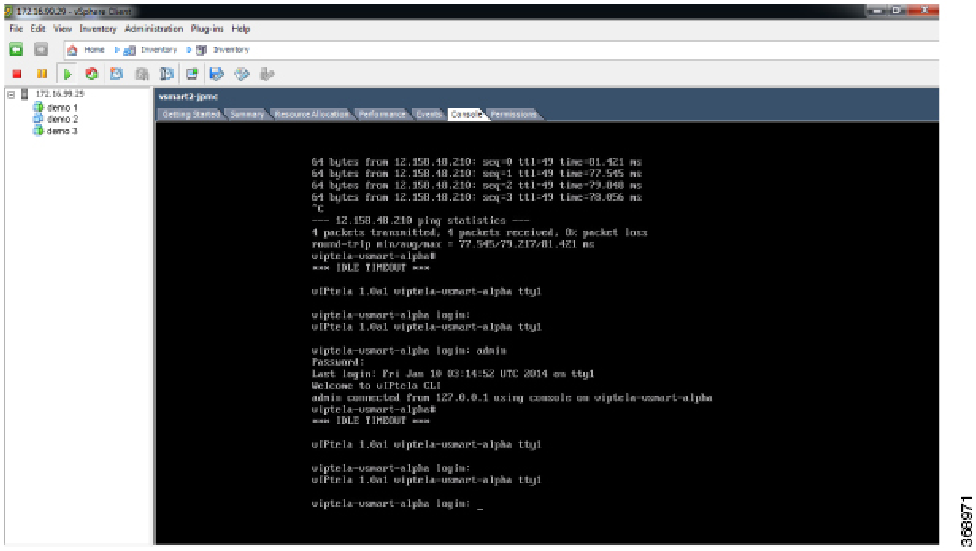
Basic Tasks

Power on the virtual machine

Edit virtual machine settings

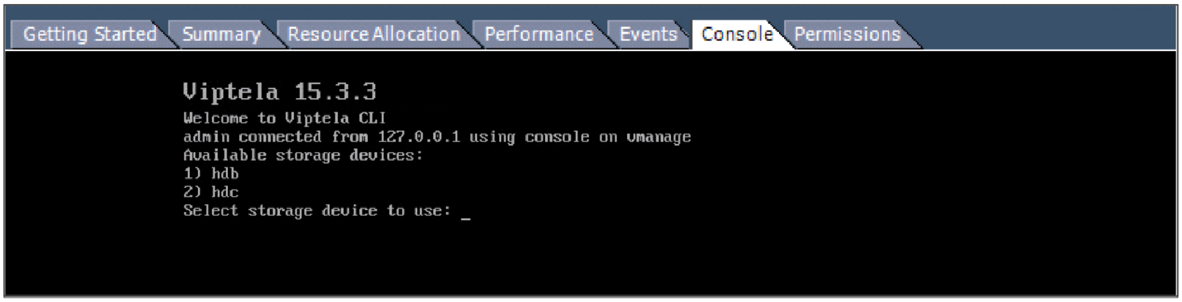
The vManage virtual machine is powered on.

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
172.16.99.25
demo 1
demo 2
demo 3
vsmart3-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.



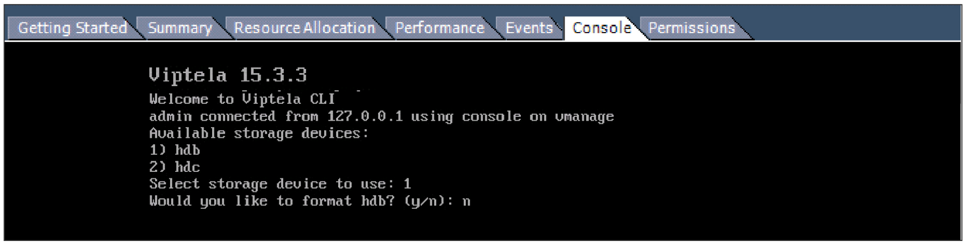
```
Viptela 15.3.3
Welcome to Viptela CLI
admin connected from 127.0.0.1 using console on vmanage
Available storage devices:
1) hdb
2) hdc
Select storage device to use: _
```

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**.

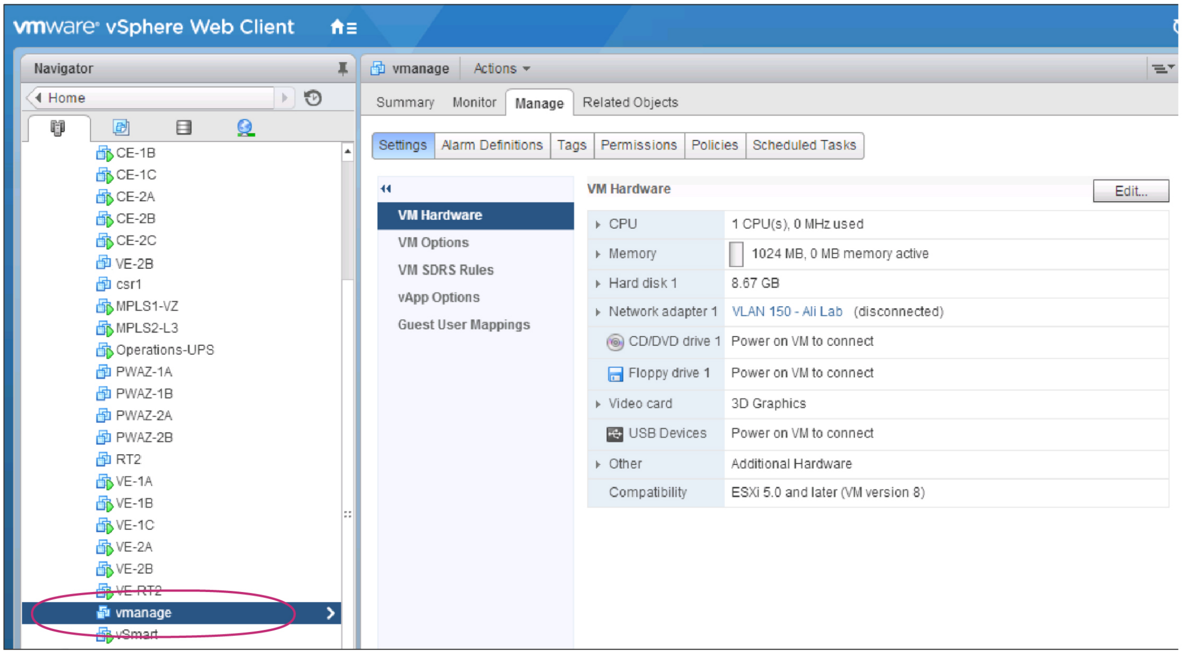
   ```
   Viptela 15.3.3
   Welcome to Viptela CLI
   admin connected from 127.0.0.1 using console on vmanage
   Available storage devices:
   1) hdb
   2) hdc
   Select storage device to use: 1
   Would you like to format hdb? (y/n): n
   ```

   - 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.



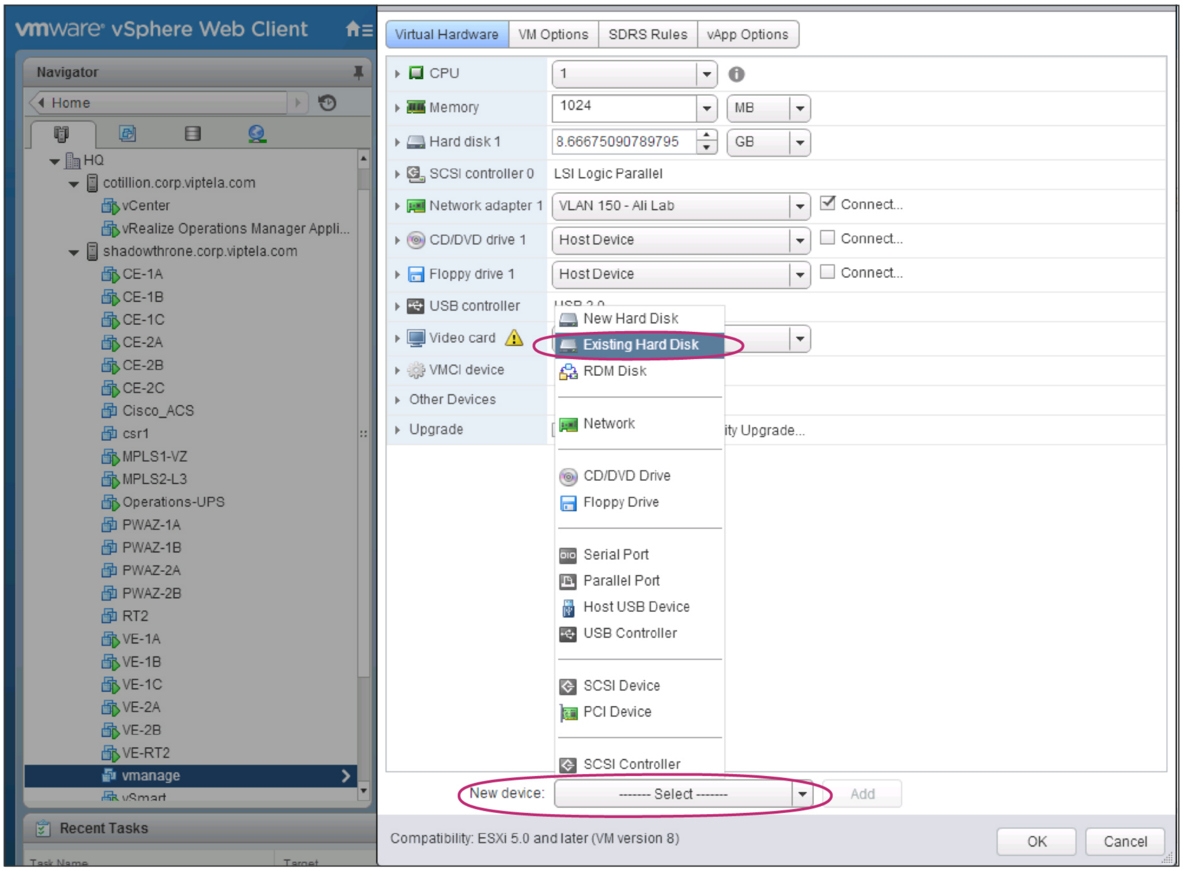
VM Hardware

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)

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

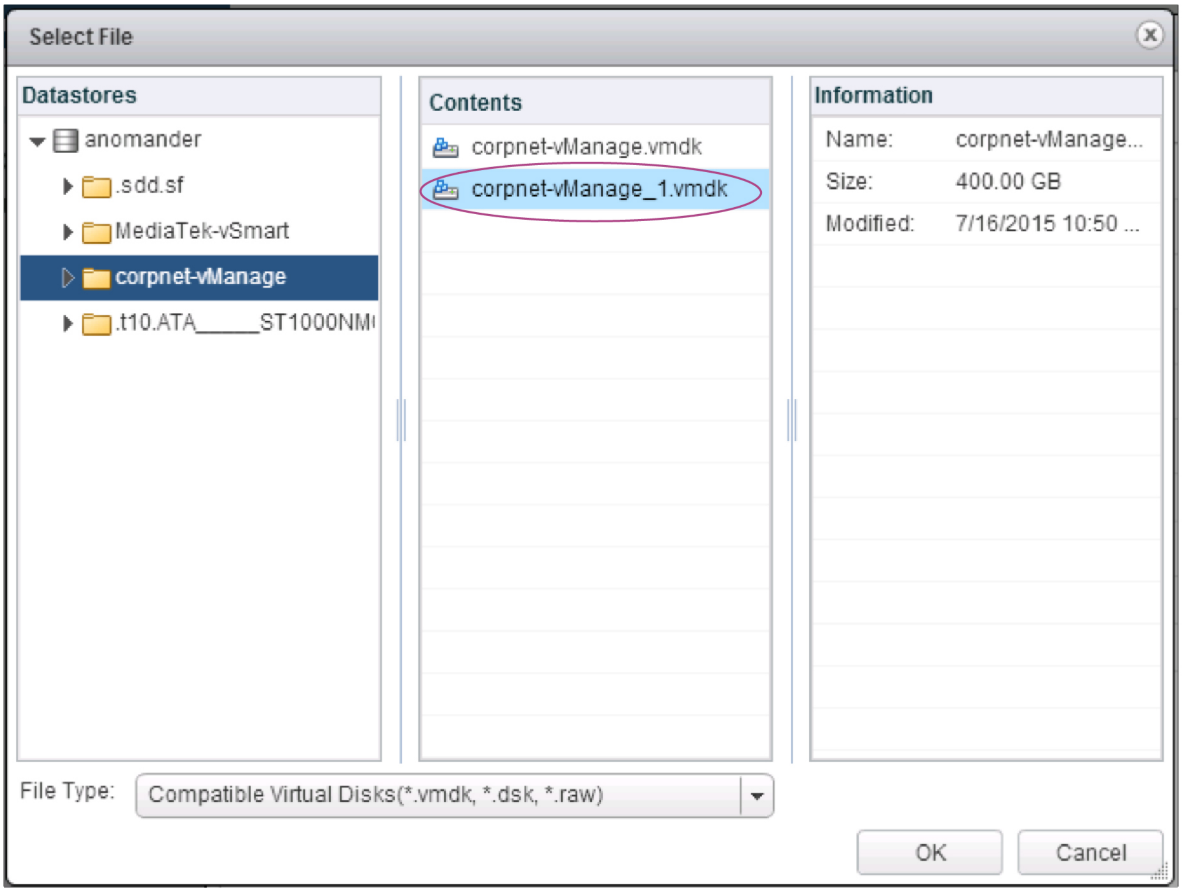
Upgrade ity Upgrade...

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

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.

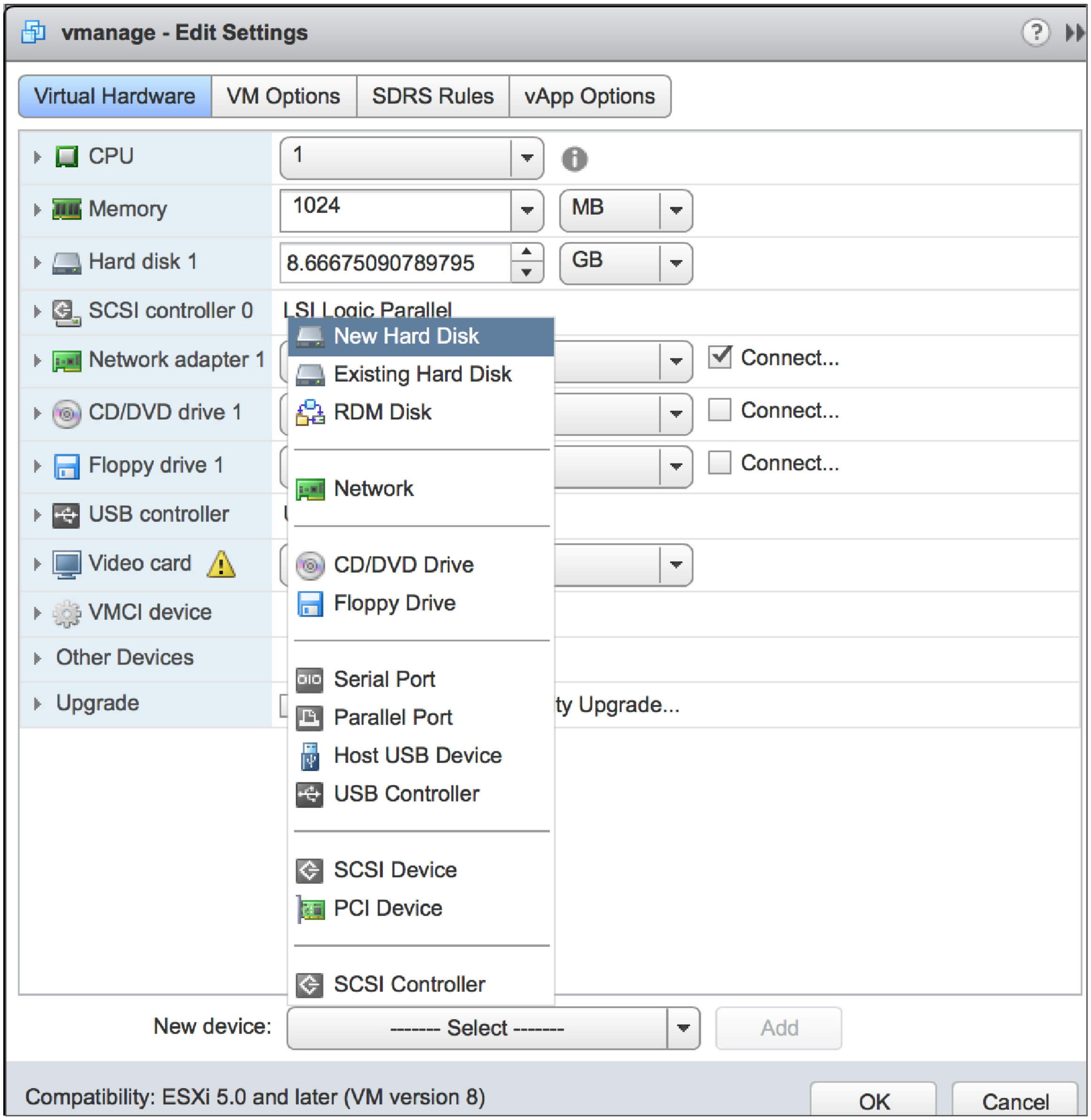
c. In the Select File window, under Datastores, navigate to and select the appropriate .vmdk file, and click



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.



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...

USB controller

Video card ⚠

VMCI device

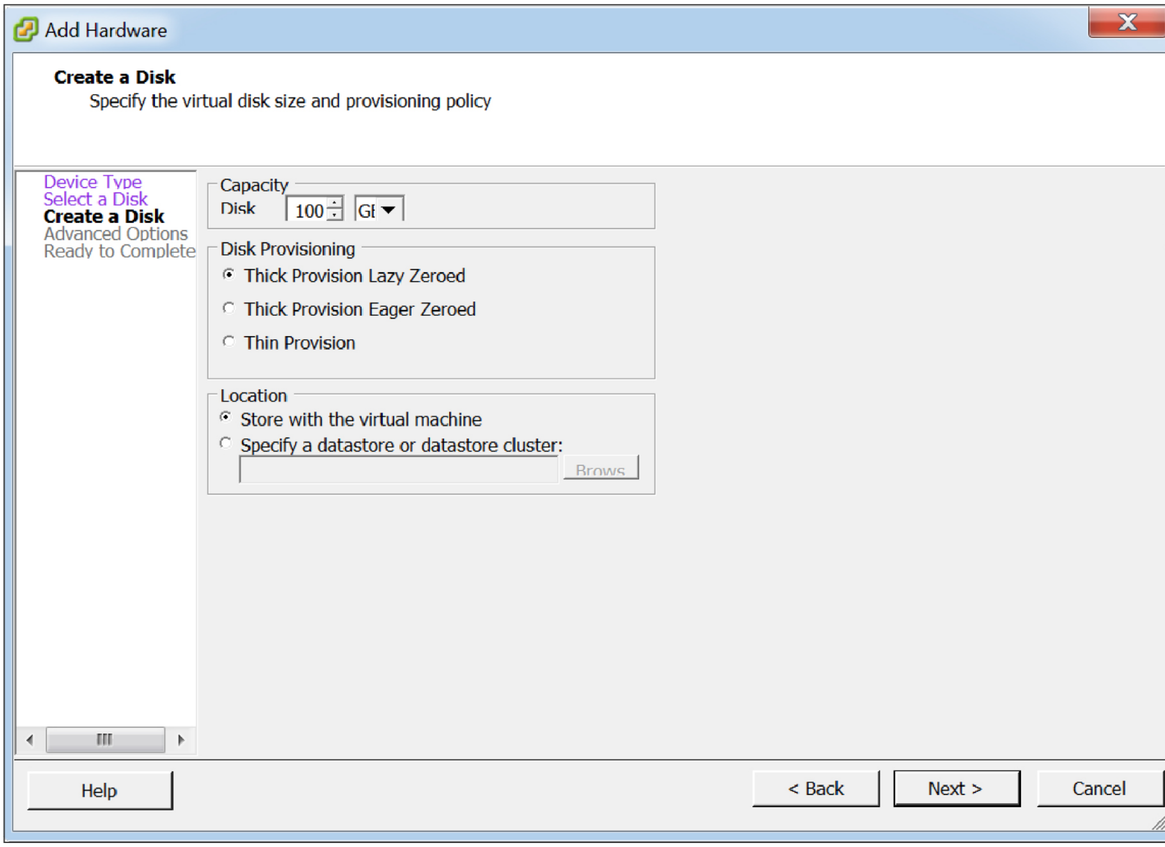
Other Devices

Upgrade

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

Capacity

Disk 100 GB

Disk Provisioning

● Thick Provision Lazy Zeroed

○ Thick Provision Eager Zeroed

○ Thin Provision

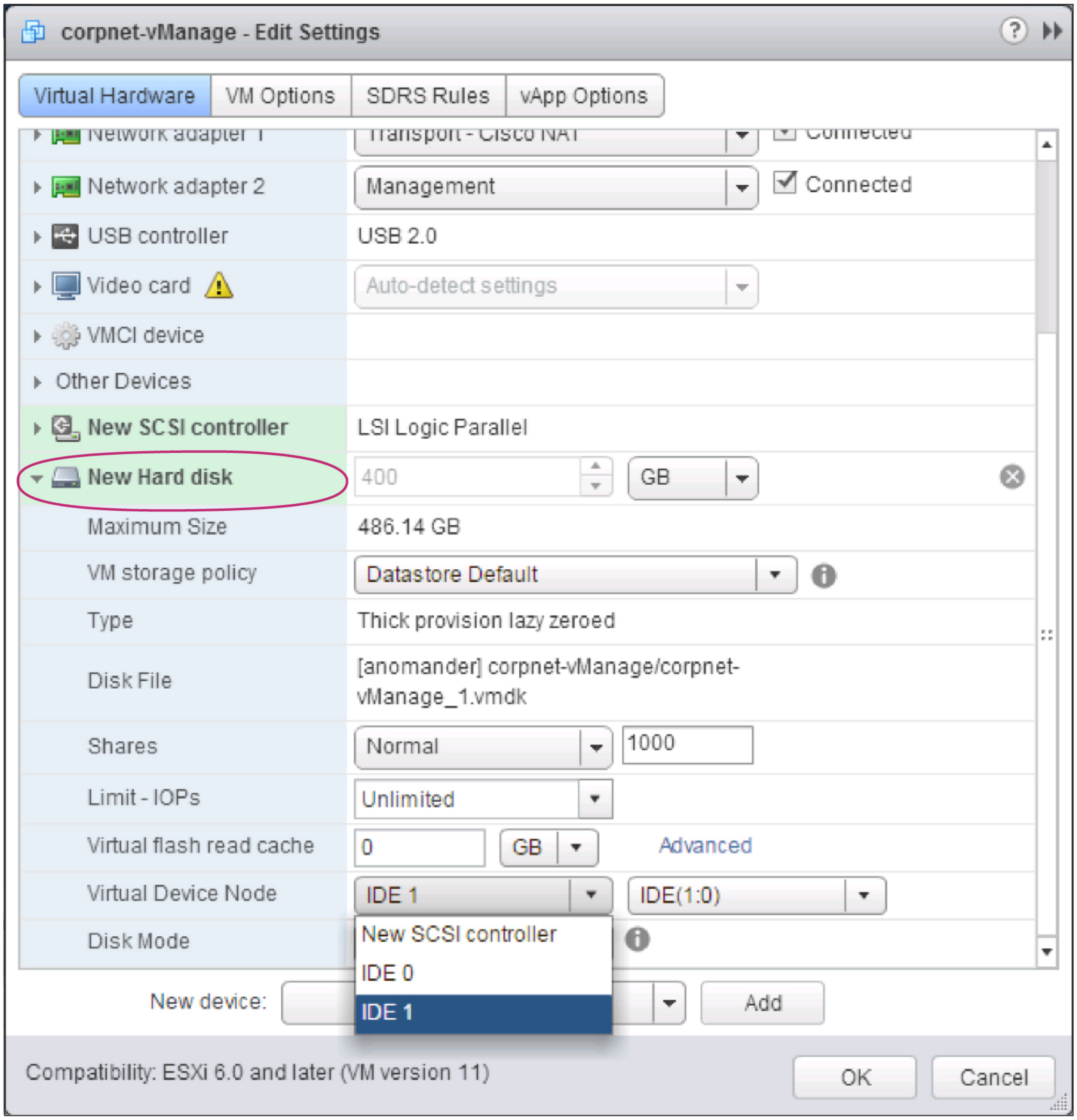
Location

● 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

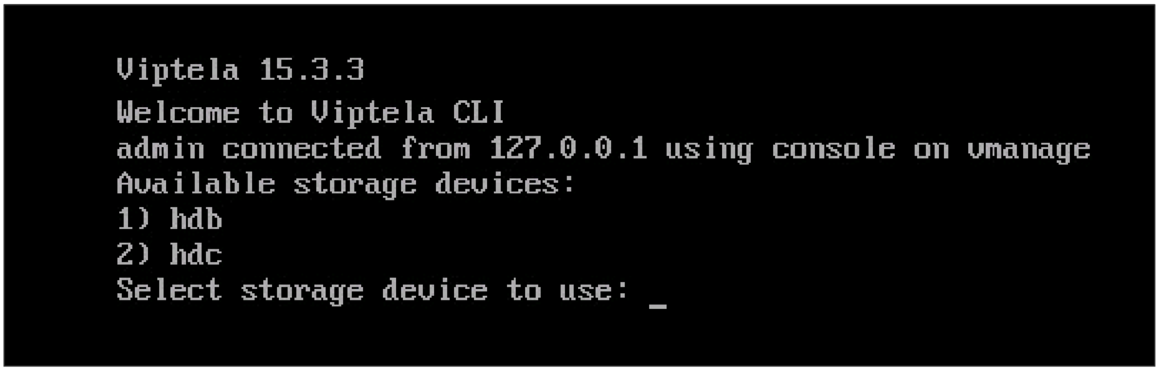
Network adapter 1	Transport - Cisco NAT	☑ Connected
Network adapter 2	Management	☑ Connected
USB controller	USB 2.0	
Video card ⚠	Auto-detect settings	
VMCI device		
Other Devices		
New SCSI controller	LSI Logic Parallel	
New Hard disk	400	GB
Maximum Size	486.14 GB	
VM storage policy	Datastore Default	
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		

Compatibility: ESXi 6.0 and later (VM version 11)

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:



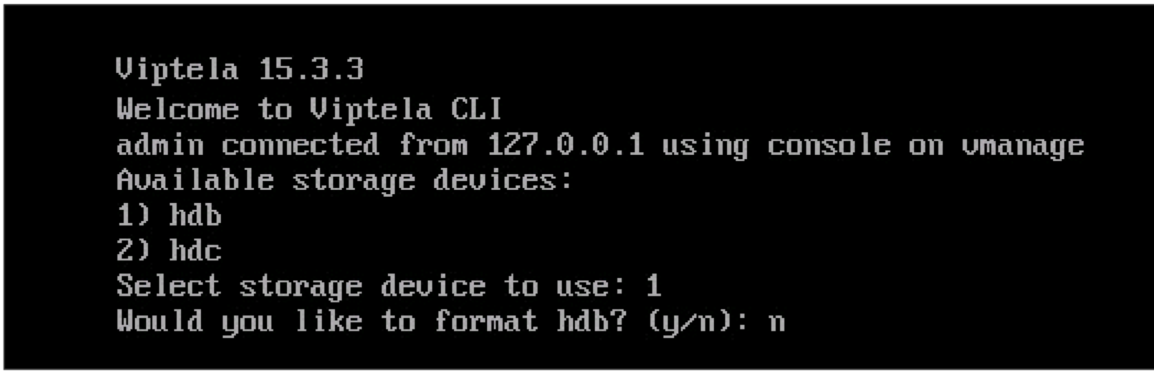
```
Viptela 15.3.3
Welcome to Viptela CLI
admin connected from 127.0.0.1 using console on vmanage
Available storage devices:
1) hdb
2) hdc
Select storage device to use: _
```

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
   ```

   - 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 132: Feature History

Feature Name	Release Information	Description
Geofencing	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 vManage operational commands. For more information, see the Cisco SD-WAN Monitor and Maintain Configuration Guide.
Added Support for Configuring Geofencing Using a **Cisco System** Feature Template	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		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 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 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 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**.

Run a Traceroute

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage menu, choose **Monitor** > **Network**.
2. To choose a device, click the device name under the **Hostname** column.
3. Click **Troubleshooting** in the left pane.
4. Under **Connectivity**, click **Trace Route**.
5. Enter the following details:
   - **Destination IP**: Enter the IP address of the device on the network.

- **VPN**: From the drop-down list, choose a VPN to use to reach the device.
- **Source/Interface for VPN**: From the drop-down list, choose the interface to use to send the traceroute probe packets.

6. Click **Advanced Options**.
7. In the **Size** field, enter the size of the traceroute probe packets, in bytes.
8. Click **Start** to trigger a traceroute to the requested destination.

The lower part of the right pane displays:

- Output—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.

If the traceroute is for the service-side traffic, a Cisco vEdge device generates traceroute responses from any of the interfaces on the service VPN.

Security Monitoring

Table 133: Feature History

Feature Name	Release Information	Description
Enhanced Security Monitoring on Cisco SD-WAN Devices	Cisco SD-WAN Release 20.5.1 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 vManage **Monitor** > **Devices** page, select the device.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage **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 vManage **Monitor** > **Devices** page, select the device.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage **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 vManage 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 vManage Cluster

Table 134: Feature History

Feature Name	Release Information	Description
Cisco vManage Cluster Upgrade	Cisco SD-WAN Release 20.3.1 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 vManage 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 vManage 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 vManage 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 vManage 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 vManage 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 vManage servers. Take a backup of the configuration database and save it in a location outside of the Cisco vManage 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 vManage server in the cluster and install the image on each Cisco vManage 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 vManage 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 vManage Release 18.4.x or 19.2.x to Cisco vManage 20.3.x or 20.4.x
   - Cisco vManage Release 20.3.x or 20.4.x to Cisco vManage Release 20.5.x or 20.6.x

   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 vManage 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 vManage 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 vManage 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 vManage clusters by using the Cisco vManage GUI, see the *Upgrade the Software Image on a Device* section in Cisco SD-WAN Monitor and Maintain Configuration Guide.

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 vManage.
- Download the selected admin-tech files to your local device.
- Delete the selected admin-tech files from Cisco vManage, the device, or both.

1. From the Cisco vManage 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 vManage.

3. Click the **Copy** icon to copy the admin-tech file from the device to Cisco vManage.

   A hint appears letting you know that the file is being copied from the device to Cisco vManage.

4. After the file is copied from the device to Cisco vManage, 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 vManage.

5. After the admin-tech file is successfully copied to Cisco vManage, you can click the **Delete** icon and choose which files to delete from Cisco vManage, 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 vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage menu, choose **Monitor** > **Overview**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage 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 vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage to view information about the Cisco 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 vManage 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 vManage 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 vBond, Cisco vSmart, and Cisco vManage.
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 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 vManage 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 vManage 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 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)#
```

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 vEdge 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 vManage menu, choose **Monitor** > **Devices**.

    Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 Device Templates

View a Template

1. From the Cisco vManage 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 vManage 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 vManage 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 vManage 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 SD-WAN devices.

Monitor Cellular Interfaces

You can verify signal strength and service availability using either Cisco vManage or the LED on the router. You can view the last-seen error message for cellular interfaces from Cisco vManage.

Verify Signal Strength

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 135:

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)

Color	Signal Strength	State	Description
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 vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage:

1. From the Cisco vManage 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 vManage 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 SD-WAN devices.

View Cisco vBond Orchestrator Information

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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.
Orchestrator Statistics	show orchestrator statistics	Displays statistics about the packets that a Cisco vBond Orchestrator has transmitted and received in the process of establishing and maintaining secure DTLS connections to a Cisco IOS XE SD-WAN devices in the overlay network.
Orchestrator Valid vManage ID	show orchestrator valid-vmanage-id	Lists the chassis numbers of the valid Cisco vManage instance in the overlay network.

View Control Connections

To view all control connections for a device:

1. From the Cisco vManage menu, choose **Monitor** > **Geography**.
2. Choose a device to view its control connections.

   If you select a controller device—a Cisco vBond Orchestrator, Cisco vManage, or a Cisco vSmart 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 vManage 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 vSmart 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 SD-WAN overlay network.

To view ACL information on a router, do the following

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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
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 vSmart Controller Policy

To view policy information from Cisco vSmart Controller on a device, perform the following steps:

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

Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 policy from-vsmart	Displays a centralized data policy, an application-aware policy, or a cflowd policy that a Cisco vSmart Controller has pushed to the Edge devices.

View Policy Zone-Based Firewall

To view policy information about zone-based firewalls on a device, perform the following steps:

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 Option	CLI Command	Description
Policy Zone Based Firewall Statistics	`show policy zbfw filter-statistics`	Displays a count of the packets that match a zone-based firewall's match criteria and the number of bytes that match the criteria.
Policy Zone Pair Sessions	`show policy zbfw sessions`	Displays the session flow information for all zone pairs that are configured with a zone- based firewall policy.

View Devices Connected to Cisco vManage

1. From the Cisco vManage menu, choose **Administration** > **Cluster Management**.
2. Under **Service Configuration**, click the hostname of the desired Cisco vManage server. The **vManage Details** screen appears.
3. Or alternatively:

   Under **Service Configuration**, for the desired Cisco vManage 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 vManage 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 vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage using the options available on the **Configuration** > **Devices** page.

View DHCP Server and Interface Information

When you configure a tunnel interface on a device, a number of 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 vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vSmart controller

View SAIE Flows

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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.x and earlier releases, **On Demand Troubleshooting** is part of the **Monitor** menu.
   - In Cisco vManage Release 20.7.x 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 vManage 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 vManage. Cisco vManage displays only available data and then plots that data in the appropriate axis.
   - In Cisco vManage Release 20.7.x 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 vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 SD-WAN.

View Logging Information

To view logging information on a device, perform the following steps:

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage **Configuration** > **Certificates** window.

1. From the Cisco vManage toolbar, click the tasks icon . Cisco vManage 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 vManage 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 vManage 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 vManage.

Table 136: Feature History

Feature Name	Release Information	Description
View Loss Percentage, Latency, Jitter, and Octet Information for Tunnels	Cisco IOS XE 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 vManage.

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 vManage:

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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

Device Option	Command	Description
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 vManage menu, choose **Monitor** > **Devices**.

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

2. Choose a Cisco vManage 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 vManage NMS server is operational. This device option is available from Cisco vManage Release 20.6.1.

View Device Configuration

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vSmart and the routers.
OMP Received Routes or OMP Advertised Routes	show omp routes show sdwan omp routes	Displays OMP routes. Displays the IPv6 entries in the local route table.
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.

Device Options	Command	Description
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 SD-WAN devices. From Cisco vManage Release 20.6.1, this device option is available on all Cisco IOS XE SD-WAN devices and Cisco vEdge devices.

View Services Running on Cisco vManage

1. From the Cisco vManage menu, choose **Administration** > **Cluster Management**.
2. Under **Service Configuration**, click the hostname of the desired Cisco vManage server. The screen displays the process IDs of all the Cisco vManage services that are enabled on Cisco vManage.

View SFP Information

To view SFP information on a router, perform the following steps:

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 the Software Versions Installed on a Device

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 137: Feature History

Feature Name	Release Information	Description
Access TAC Cases from Cisco vManage	Cisco IOS XE 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 vManage. You can create, view, or edit the support cases directly from Cisco vManage without having to go to a different Case Manager portal.

Supported Devices

This feature is supported on both Cisco SD-WAN and Cisco IOS XE SD-WAN devices.

Overview

For any Cisco vManage troubleshooting issues, you raise a support case in the SCM portal. In Cisco vManage, 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 vManage. 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

- Ensure that you have an active Cisco single sign-on (SSO) login to access the SCM Wizard and the cloud server.

View TAC Cases

Perform the following steps to view TAC cases from Cisco vManage.

1. From the Cisco vManage menu, choose **Tools** > **TAC Cases**.

   The TAC Support Cases portal displays a list of cases.

2. Login to the SCM portal using Cisco SSO login.

Open a TAC Case

Perform the following steps to open a TAC Case from Cisco vManage.

1. From the Cisco vManage menu, choose **Tools** > **TAC Cases**.
2. In the TAC Cases wizard, click **Open a Case**.
3. Enter all the relevant details.
4. Click **Create**.

   The TAC Support Cases portal displays a 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 vManage 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 vManage 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 vBond Orchestrator

You have the following options to view the status of a Cisco vBond Orchestrator.

Use the Dashboard Screen

1. From the Cisco vManage menu, choose **Monitor** > **Overview**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vBond orchestrators in your overlay network.
3. To know the status of the Cisco vBond Orchestrator, see the **Reachability** column in the dialog box that opens.

Use the Geography Screen

1. From the Cisco vManage menu, choose **Monitor** > **Geography**.
2. Click **Filter** and choose **vBond** under **Types**.
3. Click the Cisco vBond icon to check its status.

Use the Network Screen

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage menu, choose **Monitor** > **Network**.
2. Locate the Cisco vBond Orchestrator 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 vBond Orchestrator 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 vManage menu, choose **Monitor** > **Overview**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage 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 vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage **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.x 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.x 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.x and earlier releases, Cisco vManage 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 vManage on schedule, but processed on user requests. Flow DPI based reports are available after data is processed.

View the Status of a Cisco vSmart Controller

You have the following options to view the status of a Cisco vSmart Controller.

Use the Dashboard Screen

1. From the Cisco vManage menu, choose **Monitor** > **Overview**.

Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vSmart controllers in your overlay network.

3. To know the status of the Cisco vSmart Controller, see the **Reachability** column in the dialog box that opens.

Use the Geography Screen

1. From the Cisco vManage menu, choose **Monitor** > **Geography**.
2. Click **Filter** and choose **vSmart** under **Types**.
3. Click the Cisco vSmart icon to check its status.

Use the Network Screen

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

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

2. Locate the Cisco vSmart 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 vSmart 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 SD-WAN devices with the lowest average latency, do the following:

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 IPSec Tunnel Information

To view IPSec tunnel information on a device, perform the following steps:

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

Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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	CLI Command	Description
IPsec Inbound Connections	show tunnel inbound-connections	Displays information about the IPsec tunnel connections that originate on the local router, showing the TLOC addresses for both ends of the tunnel.
IPsec Local SAs	show tunnel local-sa	Displays the IPsec tunnel security associations for the local TLOCs.

View Tunnel Loss Statistics

View Data Plane Tunnel Loss Statistics

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage menu, choose **Monitor** > **Overview**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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**.

Interface Pane

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 VRRP Information

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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.

CHAPTER 5

Troubleshooting

Alarms

When something of interest happens on an individual device in the overlay network, the device reports it by sending a notification to Cisco vManage. Cisco vManage then filters the event notifications and correlates related events, and it consolidates major and critical events into alarms.

For a list of alarms that Cisco vManage generates, see Permanent Alarms and Alarm Fields.

Use the Alarms screen to display detailed information about alarms generated by controllers and routers in the overlay network.

Alarm States

Cisco vManage alarms are assigned a state based on their severity:

- Critical (red)—Serious events that impair or shut down the operation of an overlay network function.
- Major (yellow)—Serious events that affect, but do not shut down, the operational of a network function.
- Medium (blue)—Events that might impair the performance of a network function.
- Minor (green)—Events that might diminish the performance of a network function.

The alarms listed as Active generally have a severity of either critical or major.

When the notification events that Cisco vManage receives indicate that the alarm condition has passed, most alarms clear themselves automatically. Cisco vManage then lists the alarm as Cleared, and the alarm state generally changes to medium or minor.

Changes to Alarms in Cisco vManage Release 20.5.1

Table 138: Feature History

Feature	Release Information	Description
Optimization of Alarms	Cisco SD-WAN Release 20.5.1 Cisco vManage Release 20.5.1	This feature optimizes the alarms on Cisco vManage by automatically suppressing redundant alarms. This allows you to easily identify the component that is causing issues. You can view these alarms from the Cisco vManage menu, choose **Monitor** > **Logs** > **Alarms**.

When a site is down, Cisco vManage reports the following alarms:

- Site down
- Node down
- TLOC down

Cisco vManage displays alarms for each component that is down. Depending on the size of your site, you may see several redundant alarms such as alarms for each TLOC in a node as well as the node alarm. In Cisco vManage Release 20.5.1, Cisco vManage intelligently suppresses redundant alarms. For example, if all the TLOCs in a node are down, Cisco vManage suppresses the alarms from each TLOC and displays only the alarm from the node. For multitenant configurations, each tenant displays alarms for the sites in its tenancy.

Scenario	Alarms Displayed	
Cisco vManage Release 20.5.1	**Previous Releases**	bfd-tloc-1_down
Link 1 down Link 2 up.	bfd-tloc-1_down	

Scenario	Alarms Displayed	
Link 1 down Link 2 down	bfd-site-1_down bfd-node-1_down, bfd-tloc-1_down, and bfd-tloc-2_down are suppresed by the site alarm.	bfd-site-1_down bfd-tloc-1_down
Link 1 up Link 2 down	bfd-site-1_up bfd-node-1_up bfd-tloc-1_up bfd-tloc-2_up	bfd-site-1_up bfd-tloc-1_up

View Alarms

You can view alarms from the Cisco vManage Dashboard by clicking the Alarm Bell icon in the top bar. In the Alarm Bell, the alarms are grouped into Active or Cleared.

Alternatively, follow these steps to view alarms from the Alarms screen in Cisco vManage.

1. From the Cisco vManage menu, choose **Monitor** > **Logs** > **Alarms**.

   From the Cisco vManage menu, choose **Monitor** > **Alarms**.

   The alarms are displayed in graphical and tabular formats.

2. To view more details for a specific alarm, click **...** for the desired alarm, and then click **Alarm Details**.

   The Alarm Details window opens and displays the probable cause of the alarm, impacted entities, and other details.

Set Alarm Filters

1. From the Cisco vManage menu, choose **Monitor** > **Logs** > **Alarms**.

   From the Cisco vManage menu, choose **Monitor** > **Alarms**.

2. Click **Filter**.

3. In the **Severity** field, choose an alarm severity level from the drop-down list. You can specify more than one severity level.

4. In the **Active** field, choose active, cleared, or both types of alarm from the drop-down list. Active alarms are alarms that are currently on the device but have not been acknowledged.

5. In the **Alarm Name** field, choose an alarm name from the drop-down list. You can specify more than one alarm name.

6. Click **Search** to look for alarms that match the filter criteria.

Cisco vManage displays the alarms in both table and graphical formats.

Export Alarm Data in CSV Format

To export data for all alarms to a file in CSV format, click the **Download** icon.

Cisco vManage downloads all data from the alarms table to an Excel file in CSV format. The file is downloaded to your browser's default download location and is named Alarms.csv.

Alarms data displayed on the graph can also be looked up in the Excel file.

For example, if the graph displays an alarm data (Critical 2, Major 274, Medium 4, Minor 405) with date and time as 15/Feb/2022 3:30 AM, the same alarm data is also available in the Excel file against a date and time range between 15/Feb/2022 3:00 AM and 15/Feb/2022 3:29 AM.

Enable Email Notifications

You can configure Cisco vManage to send email notifications when alarms occur on devices in the overlay network. This requires you to first configure SMTP and email recipient parameters. First configure the SMTP and email recipient parameters on this screen:

1. From the Cisco vManage menu, choose **Administration** > **Settings**.
2. Click **Edit** next to the **Alarm Notifications** option.
3. For **Enable Email Notifications** , choose **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 noreply 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**.

Note The email is sent from vManage Public-IP of VPN0 (Transport Interface) as a source interface.

Send Alarm Notifications

Before you begin: Ensure that Email Notifications are enabled under **Administration** > **Settings**. Click **Edit** next to **Alarm Notifications** to check whether **Alarm Notifications** are enabled and the **Email Settings** check box is checked.

To send email notifications when alarms occur:

1. From the Cisco vManage menu, choose **Monitor** > **Logs** > **Alarms**.

   From the Cisco vManage menu, choose **Monitor** > **Alarms**.

2. Click **Alarm Notifications**. A list of configured notifications is displayed in the table.

3. Click **Add Alarm Notification**.

4. In the **Name** field, enter a name for the email notification. The name can be up to 128 characters and can contain only alphanumeric characters.

5. In the **Severity** field, choose one or more alarm severity levels from the drop-down list.

6. In the **Alarm Name** field, choose one or more alarms.

7. In the **Account Details** are, enter the following:

   a. In the **Email** field, enter one or more email addresses.

   b. (Optional) Click **Add New Email List** and enter an email list, if desired.

   c. In the **Email Threshold** field, set the maximum number of emails to be sent per minute. The number can be a value from 1 through 30. The default is 5.

   d. Check the **WebHook** check box to trigger an HTTP callback when an alarm notification event occurs:

      1. In the **WebHook URL** field, enter the URL of the webhook server.

      2. Enter the **Username** and **Password** to authenticate the webhook server.

      3. In the **WebHook Threshold** field, enter the threshold value.

Note The value you enter indicates the number of notifications to be posted for that webhook URL per minute. For example, if **WebHook Threshold** equals 2, you receive two notifications for that webhook URL per minute. Notifications that are generated beyond the threshold get dropped.

8. Under **Selected Devices**, choose **All Devices** or **Custom**.

   If you choose **Custom**, a device list is displayed:

   a. In the **Available Devices** list on the left, choose one or more devices.

   b. Click the right arrow to move the devices to the **Selected Devices** list on the right.

   c. Click **Add**.

9. Click **Add**.

View and Edit Email Notification

1. From the Cisco vManage menu, choose **Monitor** > **Logs** > **Alarms**.

   From the Cisco vManage menu, choose **Monitor** > **Alarms**.

2. Click **Alarm Notifications**. A list of configured notifications is displayed in the table.

3. For the desired notification, click the **View** icon to the right of the row.
4. When you are done viewing the notification, click **OK**.

Edit an Email Notification

1. From the Cisco vManage menu, choose **Monitor** > **Logs** > **Alarms**.

   From the Cisco vManage menu, choose **Monitor** > **Alarms**.
2. Click **Alarm Notifications**. A list of configured notifications is displayed in the table.
3. For the desired email notification, click the **Edit** icon.
4. When you are done editing the notification, click **Update**.

Delete an Email Notification

1. From the Cisco vManage menu, choose **Monitor** > **Logs** > **Alarms**.

   From the Cisco vManage menu, choose **Monitor** > **Alarms**.
2. Click **Alarm Notifications**. A list of configured notifications is displayed in the table.
3. For the desired email notification, click the **Trash Bin** icon.
4. In the confirmation dialog box, click **OK**.

Capture Packets

Table 139: Feature History

Feature Name	Release Information	Description
Embedded Packet Capture	Cisco IOS XE Release 17.3.1a Cisco vManage Release 20.3.1	This feature is an onboard packet capture facility that allows network administrators to capture packets flowing to, through, and from the device. The administrator can manage to analyze these packets locally or save and export them for offline analysis through Cisco vManage. This feature gathers information about the packet format and therefore helps in application analysis, security, and troubleshooting.
Embedded Packet Capture for Cisco vEdge Devices Using CLI Commands	Cisco SD-WAN Release 20.6.1	This feature provides an alternative method to capture traffic data to troubleshoot connectivity issues between Cisco vEdge devices and Cisco vManage using supported CLI commands. As part of this feature, the following commands are introduced to capture traffic details: request stream capture show packet-capture

Feature Name	Release Information	Description
Bidirectional Packet Capture for Cisco IOS XE SD-WAN Devices	Cisco IOS XE Release 17.7.1a Cisco vManage Release 20.7.1	You can now enable the **Bidirectional** option using Cisco vManage to capture bidirectional packets.
IPv6 Support for Bidirectional Packet Capture	Cisco IOS XE Release 17.9.1a	This feature adds support for bidirectional capture of IPv6 traffic data to troubleshoot connectivity issues using a CLI template.

Packet Capture for Cloud onRamp Colocation Clusters

Table 140: Feature History

Feature Name	Release Information	Description
Packet Capture for Cloud onRamp Colocation Clusters	Cisco SD-WAN Release 20.7.1 Cisco vManage Release 20.7.1	You can now capture packets at either the physical network interface card (PNIC) level or the virtual network interface card (VNIC) level on a Cloud Services Platform (CSP) device of a colocation cluster. To do this, you need to choose a PNIC or VNIC on the Cisco vManage interface and set the required traffic filters.

You can capture packets flowing to, through, and from a CSP device of a colocation cluster. You can capture packets at either the PNIC or the VNIC level on the CSP device.

Supported Ports for Packet Capture for Cloud onRamp Colocation Clusters

Packet capture is supported for the following ports:

Table 141: Supported Ports for Packet Capture

Mode	VNIC Level	PNIC Level
Single Tenancy	OVS-DPDK, HA-OVS-DPDK, SR-IOV, OVS-MGMT	SR-IOV, MGMT
Multitenancy (Role-Based Access Control)	OVS-DPDK, HA-OVS-DPDK, OVS-MGMT	MGMT

Enable Packet Capture on Cisco vManage

Enable the packet capture feature on Cisco vManage before capturing packets at the PNIC or VNIC level on a CSP device of a colocation cluster:

1. From the Cisco vManage menu, choose **Administration** > **Settings**.
2. In **Data Stream**, choose **Enabled**.

Capture Packets at PNIC Level

1. From the Cisco vManage menu, choose **Monitor** > **Devices**.
2. Click **Colocation Cluster**, and choose a cluster.
3. From the list of devices that is displayed, click a CSP device name.
4. In the left pane, click **Packet Capture**.
5. From the **PNIC ID** drop-down list, choose a PNIC.
6. (Optional) Click **Traffic Filter** to filter the packets that you want to capture based on the values in their IP headers.

Table 142: Packet Capture Filters

Field	Description
Source IP	Source IP address of the packet.
Source Port	Source port number of the packet.
Protocol	Protocol ID of the packet. The supported protocols are: ICMP, IGMP, TCP, UDP, ESP, AH, ICMP Version 6 (ICMPv6), IGRP, PIM, and VRRP.
Destination IP	Destination IP address of the packet.
Destination Port	Destination port number of the packet.

7. Click **Start**.

   The packet capture begins, and its progress is displayed:

   - Packet Capture in Progress: Packet capture stops after the file size reaches 20 MB, or 5 minutes after you started packet capture, or when you click **Stop**.
   - Preparing file to download: Cisco vManage creates a file in libpcap format (a .pcap file).
   - File ready, click to download the file: Click the download icon to download the generated file.

Capture Packets at VNIC Level

1. From the Cisco vManage menu, choose **Monitor** > **Devices**.
2. Click **Colocation Cluster**, and choose a cluster.
3. From the list of devices that is displayed, click a CSP device name.
4. Choose a VNF, and then click **Packet Capture** in the left pane.

5. Alternatively, choose **Monitor** > **Devices** > **Colocation Cluster**. Next, choose a cluster and click **Network Functions**, choose a VNF, and then click **Packet Capture** in the left pane.
6. From the **VNIC ID** drop-down list, choose a VNIC.
7. (Optional) Click **Traffic Filter** to filter the packets to capture based on values in their IP headers. For more information on these filters, see the above section.
8. Click **Start**. The packet capture begins, and displays its progress.

Check Traffic Health

View Tunnel Health

To view the health of a tunnel from both directions:

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage menu, choose **Monitor** > **Network**.
2. To choose a device, click the device name under the **Hostname** column.
3. Click **Troubleshooting** in the left pane.
4. In the **Traffic** area, click **Tunnel Health**.
5. From the **Local Circuit** drop-down list, choose a source TLOC.
6. From the **Remote Device** drop-down list, choose a remote device.
7. From the **Remote Circuit** drop-down list, choose a destination TLOC.
8. Click **Go**. The lower part of the screen displays:
9. From the Chart Options drop-down list, choose one of these: Loss Percentage, Latency/Jitter, Octets.
10. (Optional) Choose a predefined or a custom time period on the left to view data for the specified time period.

The window displays:

- App-route data (either loss, latency, or jitter) in graphical format for all tunnels between the two devices in each direction.
- App-route graph legend—Identifies selected tunnels from both directions.

Check Application-Aware Routing Traffic

To check application-aware routing traffic from the source device to the destination device:

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage menu, choose **Monitor** > **Network**.
2. Choose a device from the list of devices that appears.
3. Click **Troubleshooting** in the left pane.

4. In the right pane, click **App Route Visualization** under **Traffic**.
5. From the **Remote Device** drop-down list, choose a destination device.
6. (Optional) Click **Traffic Filter**. Choose **No Filter** or **SAIE**. **No Filter** is chosen by default.

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.

7. Click **Go**. The lower part of the screen displays:
8. From the Chart Options drop-down list, choose one of these: Loss Percentage, Latency/Jitter, Octets.
9. (Optional) Choose a predefined or a custom time period on the left to view data for the specified time period.

Collect System Information Using Admin Tech

Table 143: Feature History

Feature Name	Release Information	Description
Admin-Tech Enhancements	Cisco SD-WAN Release 20.1.1	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 vManage Cluster Using Admin Tech	Cisco SD-WAN Release 20.6.1 Cisco vManage Release 20.6.1	This feature adds support for generating an admin-tech file for a Cisco vManage cluster. The admin-tech file is a collection of system status information intended for use by Cisco SD-WAN Technical Support for troubleshooting. Prior to this feature, Cisco SD-WAN was only able to generate an admin-tech file for a single device.

Send the `admin-tech.tar.gz` file to Cisco SD-WAN Technical Support for analysis and resolution of the issue.

Note All in-progress admin-tech requests are purged every three hours.

1. From the Cisco vManage menu, choose **Tools** > **Operational Commands**.
2. For the desired device, click **. . .** and choose **Generate Admin Tech** from the options.
3. In the **Generate admin-tech File** window, choose the information to include in the admin-tech file if desired:

a. The **Include Logs** check box is checked by default. Uncheck this check box if you do not want to include the log files in the admin-tech 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 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 detail, and operations.

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

4. Click **Generate**.

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

Configure Packet Trace

Table 144: Feature History

Feature Name	Release Information	Description
Bidirectional Support for Packet Tracing	Cisco IOS XE Release 17.8.1a Cisco SD-WAN Release 20.8.1 Cisco vManage Release 20.8.1	You can configure packet tracing on edge devices.

Use the **debug platform packet-trace** command to configure a packet tracer on edge devices with various conditions such as bidirectional, VPN, circular, destination IP, source IP, interface, start, stop, logging, and clear.

Configure Packet Trace on Cisco IOS XE SD-WAN devices

1. Enable packet trace for the traffic and specify the maximum number of packets:

   ```
   Device# debug platform packet-trace packet [number of traced packets]
   ```

2. Specify the matching criteria for tracing packets. Matching criteria provides the ability to filter by protocol, IP address and subnet mask, interface, and direction:

   ```
   Device# debug platform condition [interface interface name] {match ipv4|ipv6|mac src
   dst}  {both|ingress|egress} [bidirectional]
   ```

3. Enable the specified matching criteria and start packet tracing:

```
Device# debug platform condition start
```

4. Deactivate the condition and stop packet tracing:

```
Device# debug platform condition stop
```

5. Exit the privileged EXEC mode:

```
exit
```

Configure Packet Trace on Cisco vEdge devices

The following example shows how to configure conditions for packet tracing:

```
Device# debug packet-trace condition source-ip 10.1.1.1
Device# debug packet-trace condition vpn-id 0
Device# debug packet-trace condition interface ge0/1
Device# debug packet-trace condition stop
```

For more information, see debug packet-trace condition command page.

Configure SNMP Traps on Cisco vEdge Devices

The SNMP traps are asynchronous notifications that a Cisco device sends to an SNMP management server. Traps notify the management server of events, whether normal or significant, that occur on the device. By default, SNMP traps aren’t sent to an SNMP server. Note that for SNMPv3, the PDU type for notifications is either SNMPv2c inform (InformRequest-PDU) or trap (Trapv2-PDU).

To configure SNMP traps, define the traps and configure the SNMP server that receives the traps.

Note The **trap group** UI option isn’t supported from Cisco SD-WAN Release 20.1.1 and later.

To configure groups of traps to be collected on Cisco vEdge devices, use the **trap group** command:

Note You don't need to configure groups of traps on Cisco IOS XE SD-WAN devices.

```
vEdge(config-snmp)#  trap group group-name
vEdge(config-group)# trap-type level severity
```

A single trap group can contain multiple trap types. In the configuration, specify one trap type per line, and each trap type can have one, two, or three severity levels. See the following configuration example for an illustration of the configuration process.

To configure the SNMP server to receive the traps, use the **trap target** command on Cisco vEdge devices:

Note You don't need to configure the SNMP server to receive the traps on Cisco IOS XE SD-WAN devices.

```
vedge(config-snmp)#  trap target vpn  vpn-id ipv4-address udp-port
vedge(config-target)# group-name name
vedge(config-target)# community-name community-name
vedge(config-target)# source-interface interface-name
```

For each SNMP server, specify the identifier of VPN where the server is located, the server's IPv4 address, and the UDP port on the server to connect to. When configuring the trap server's address, you must use an IPv4 address. You can’t use an IPv6 address.

In the **group-name** command, associate a previously configured trap group with the server. The traps in that group are sent to the SNMP server.

In the **community-name** command, associate a previously configure SNMP community with the SNMP server.

In the **source-interface** command, configure the interface to use to send traps to the SNMP server that is receiving the trap information. This interface cannot be a subinterface.

In the following configuration example, all traps are sent to one SNMP server and only critical traps to another SNMP server. Two SNMP trap groups and the two target SNMP servers are configured:

```
vEdge# config
Entering configuration mode terminal
vEdge(config)# snmp
vEdge(config-snmp)# view community-view
vEdge(config-view-community-view)# exit
vEdge(config-snmp)# community public
vEdge(config-community-public)# authorization read-only
vEdge(config-community-public)# view community-view
vEdge(config-community-public)# exit
vEdge(config-snmp)# trap group all-traps
vEdge(config-group-all-traps)# all level critical major minor
vEdge(config-group-all)# exit
vEdge(config-group-all-traps)# exit
vEdge(config-snmp)# trap group critical-traps
vEdge(config-group-critical-traps)# control level critical
vEdge(config-group-control)# exit
vEdge(config-group-critical-traps)# exit
vEdge(config-snmp)# trap target vpn 0 10.0.0.1 162
vEdge(config-target-0/10.0.0.1/162)# group-name all-traps
vEdge(config-target-0/10.0.0.1/162)# community-name public
vEdge(config-target-0/10.0.0.1/162)# exit
vEdge(config-snmp)# trap target vpn 0 10.0.0.2 162
vEdge(config-target-0/10.0.0.2/162)# group-name critical-traps
vEdge(config-target-0/10.0.0.2/162)# community-name public
vEdge(config-target-0/10.0.0.2/162)# exit
vEdge(config-snmp)# show full-configuration
snmp
 view community-view
 !
 community public
  view          community-view
  authorization read-only
 !
 group groupAuthPriv auth-priv
  view v2
 !
 user u1
  auth          sha
  auth-password $8$UZwdx9eu49iMElcJJINm0f202N8/+RGJvxO+e9h0Uzo=
  priv          aes-cfb-128
  priv-password $8$eB/I+VXrAWDw/yWmEqLMsgTcs0omxcHldkVN2ndU9QI=
  group         groupAuthPriv
 !
 trap target vpn 0 10.0.0.1 162
  group-name     all-traps
  community-name public
 !
 trap target vpn 0 10.0.0.2 162
  group-name     critical-traps
  community-name public
 !
 trap group all-traps
  all
   level critical major minor
  !
 !
 trap group critical-traps
  bfd
   level critical
  !
  control
   level critical
  !
  hardware
   level critical
  !
  omp
   level critical
  !
 !
!
vEdge(config-snmp)#
```

Events

Use the Events screen to display detailed information on events generated by Cisco SD-WAN devices.

Set Event Filters

To set filters for searching events generated on one or more Cisco SD-WAN devices:

1. From the Cisco vManage menu, choose **Monitor** > **Logs** > **Events**.

   From the Cisco vManage menu, choose **Monitor** > **Events**.

2. Click the **Filter**.

3. In the **Severity** field, choose the even severity level from the drop-down list.

   Events generated by Cisco SD-WAN devices are collected by Cisco vManage and classified as:

   - Critical—indicates that action needs to be taken immediately.
   - Major—indicates that the problem needs to be looked into but is not critical enough to bring down the network.
   - Minor—is informational only.

   You can specify more than one severity level.

1. In the **Component** field, from the drop-down list, choose one or more configuration components that caused the event.

2. In the **System IP** field, choose the system IP of the devices, for which to view generated events, from the drop-down list.

3. In the **Event Name** field, choose the event name, for which to view generated events, from the drop-down list. You can chose more than one event name.
4. Click **Search** to search events that match the filter criteria.

Cisco vManage displays the events both in table and graphical format.

Export Event Data in CSV Format

To export data for all events to a file in CSV format, click the **Download** icon.

Cisco vManage downloads all data from the events table to an Excel file in CSV format. The file is downloaded to your browser's default download location and is named Events.csv.

View Device Details

To view detailed information about a device on which an event was generated:

1. From the Cisco vManage menu, choose **Monitor** > **Logs** > **Events**.

   From the Cisco vManage menu, choose **Monitor** > **Events**.

   The window displays events in both graphical and table format.

2. To view detailed information about any event generated on a device, choose the event row from the table.
3. For the desired device, click **...** and choose **Device Details**.

   The **Device Details** dialog box opens, displaying the hostname of the device originating the event and other details.

Using the CLI

If using the CLI to view information about a device on which an event was generated, for Cisco vEdge devices, you can use the **show notification stream viptela** command. Here is an example of the command output. The first line of the output shows the time when the message was generated (the SNMP eventTime). The time is shown in UTC format, not in the device's local time. The second line of the notification contains a description of the event, and the third line indicates the severity level.

```
vEdge# show notification stream viptela
notification
 eventTime 2015-04-17T14:39:41.687272+00:00
 bfd-state-change
  severity-level major
  host-name vEdge
  system-ip 1.1.4.2
  src-ip 192.168.1.4
  dst-ip 108.200.52.250
  proto ipsec
  src-port 12346
  dst-port 12406
  local-system-ip 1.1.4.2
  local-color default
  remote-system-ip 1.1.9.1
  remote-color default
  new-state down
 !
!
notification
 eventTime 2015-04-17T15:12:20.435831+00:00
 tunnel-ipsec-rekey
```

```
   severity-level minor
   host-name vEdge
   system-ip 1.1.4.2
   color default
  !
 !
 notification
  eventTime 2015-04-17T16:56:50.314986+00:00
  system-login-change
   severity-level minor
   host-name vEdge
   system-ip 1.1.4.2
   user-name admin
   user-id 9890
  !
```

On-Demand Troubleshooting

Table 145: Feature History

Feature Name	Release Information	Description
On-Demand Troubleshooting	Cisco IOS XE Release 17.6.1a Cisco SD-WAN Release 20.6.1 Cisco vManage Release 20.6.1	You can view detailed information about the flow of traffic from a device. and use this information to assist with troubleshooting.

Information About On-Demand Troubleshooting

On-demand troubleshooting lets you view detailed information about the flow of traffic from a device.

By default, Cisco vManage captures aggregated information about flows. You can obtain detailed information for specific devices and for specific historical time periods by adding an on-demand troubleshooting entry. When you add an entry, Cisco vManage compiles detailed information according to parameters that you configure.

To conserve system resources, Cisco vManage compiles detailed information only when you request it by adding an entry. In addition, Cisco vManage stores the information for a limited time (3 hours by default), then removes it. You can request the same information again, if needed.

Restrictions for On-Demand Troubleshooting

Ensure that no Cisco or third-party APIs that instruct on-demand troubleshooting to stop are called when you are using on-demand troubleshooting. These APIs prevent on-demand troubleshooting from compiling information.

Page Elements

The **On Demand Troubleshooting** window provides options for configuring and adding an on-demand troubleshooting entry. The **On Demand Troubleshooting** window displays information about existing on-demand troubleshooting entries and provides the following information and options.

Item (Field)	Description
ID	System-assigned identifier of the entry.
Device ID	System IP of the device to which the entry applies.
Data Type	Type of data for which the entry provides detailed information.
Creation Time	Date and time that you added the entry.
Expiration Time	Date and time that the entry expires. At this expiration time, the entry is removed from the table automatically, and the corresponding detailed information is no longer available. By default, an entry is removed 3 hours after its creation time.
Data Backfill Start Time	Start date and time of the data backfill period.
Data Backfill End Time	End date and time of the data backfill period.
Status	Status of the entry: • **IN_PROGRESS**: Detailed troubleshooting information is in the process of being compiled. • **QUEUED**: Detailed troubleshooting information is queued for compilation. • **COMPLETED**: Detailed troubleshooting information has been compiled.

Configure On-Demand Troubleshooting

You can configure on-demand troubleshooting for a device from the **Tools** > **On Demand Troubleshooting** window in Cisco vManage. This window provides options for adding an on-demand troubleshooting entry, and for managing existing entries.

Cisco vManage Release 20.6.x and earlier: You can configure on-demand troubleshooting for a device from the **Monitor** > **On Demand Troubleshooting** window in Cisco vManage.

You can also start on-demand troubleshooting from various locations in the **Monitor** > **Devices** window for a device. See View On-Demand Troubleshooting Information for a Device, on page 437.

Cisco vManage Release 20.6.x and earlier: You can start on-demand troubleshooting from various locations in the **Monitor** > **Network** window for a device.

On-demand troubleshooting is qualified for troubleshooting entries for up to 10 devices concurrently.

Add an On-Demand Troubleshooting Entry

Adding an entry in the **On Demand Troubleshooting** window instructs Cisco vManage to compile detailed troubleshooting information for the device that you specify, using the parameters that you configure.

To add an on-demand troubleshooting entry, follow these steps:

1. From the Cisco vManage menu, choose **Tools** > **On Demand Troubleshooting**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage menu, choose **Monitor** > **On Demand Troubleshooting**.

2. From the **Select Device** drop-down list, choose the Cisco IOS XE SD-WAN device or the Cisco vEdge device for which you want to enable on-demand troubleshooting.

3. From the **Select Data Type** drop-down list, choose **SAIE** or **ConnectionEvents**.

4. Choose an option for the data backfill period:

   - **Last 1 hour**: Provides detailed stream information for the period beginning 1 hour before you add the troubleshooting entry and ending at the time that you add the entry.

   - **Last 3 hours**: Provides detailed stream information for the period beginning 3 hours before you add the troubleshooting entry and ending at the time that you add the entry.

   - **Custom Date and Time Range**: Use the **Start date and time** and the **End date and time** fields to designate the backfill period that you want. Note that the **End date and time** value cannot be later than the current date and time.

5. Click **Add**.

   The troubleshooting entry appears in the table of entries. When the value in the **Status** field for the entry shows the value **Completed**, you can view the troubleshooting information from the **Monitor** > **Devices** window, as described in View On-Demand Troubleshooting Information for a Device, on page 437.

Update an On-Demand Troubleshooting Entry

Update an on-demand troubleshooting entry to make changes to its configuration settings. For example, update an entry to adjust its backfill period.

Only entries that are in the QUEUED state can be updated.

To update an on-demand troubleshooting entry, follow these steps:

1. From the Cisco vManage menu, choose **Tools** > **On Demand Troubleshooting**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage menu, choose **Monitor** > **On Demand Troubleshooting**.

2. In the table of entries, click **…** adjacent to the entry that you want to update and choose **Update**.

3. In the **Update Troubleshoot Status** dialog box that is displayed, configure the settings as needed, and click **Add**.

Delete an On-Demand Troubleshooting Entry

Deleting an on-demand troubleshooting entry removes the entry from Cisco vManage. After you delete an entry, you can no longer view its detailed information.

Deleting an entry can help free resources in Cisco vManage.

To delete an on-demand troubleshooting entry, follow these steps:

1. From the Cisco vManage menu, choose **Tools** > **On Demand Troubleshooting**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage menu, choose **Monitor** > **On Demand Troubleshooting**.

2. In the table of entries, click **...** adjacent to the entry that you want to delete and choose **Delete on demand queue**.

3. In the **Delete On Demand Status** window that is displayed, click **OK**.

View On-Demand Troubleshooting Information for a Device

You can view on-demand troubleshooting information for a device from the **Network** window for that device.

Before you can view this information, at least one on-demand troubleshooting entry must exist for the device. Add an entry from the **On Demand Troubleshooting** window as described in Add an On Demand Troubleshooting Entry, or add an entry from the **Network** window as described in the following procedure.

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

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

2. In the **Hostname** column, click the device for which you want to view the information.

3. Perform either of these actions:

   - To view the troubleshooting information for an SAIE application:

     a. Click **SAIE Applications**.

     Note In Cisco vManage Release 20.7.x and earlier releases, **SAIE Applications** is called **DPI Applications**.

     b. In the **Applications Family** table, click an application family.

     c. In the **Applications** table, click an application.

   - To view troubleshooting information for a specific metric, in the left pane, under **ON-DEMAND TROUBLESHOOTING** click an option. Not all options apply to all device types.

     - **FEC Recovery Rate**
     - **SSL Proxy**
     - **AppQoe TCP Optimization**
     - **AppQoE DRE Optimization**
     - **WAN Throughput**
     - **Flows**
     - **Top Talkers**

   If on-demand troubleshooting is configured for the device, detailed troubleshooting information appears. This information includes traffic statistics and metrics such as source IP address, destination IP address, number of packets, number of bytes, and more. Use the options that are available and hover your cursor over elements on the graphs to view the information that you need.

Note Starting from Cisco IOS XE Release 17.9.1a, use the **policy ip visibility features enable** command to manually enable or disable the feature fields in Flexible Netflow (FNF). Use the **show sdwan policy cflowd-upgrade-status** command to check which features were enabled before the version upgrade. You have to manually control the features after a version upgrade using the disable or enable commands.

For more information, see policy ip visibility command page.

If on-demand troubleshooting information is not configured, the **Enable On Demand Troubleshooting** option is displayed. Continue to Step 4.

4. If the **Enable On Demand Troubleshooting** option is displayed, perform these actions to start this feature for the selected device:

   a. Click **Enable On Demand Troubleshooting**.

   b. Choose one of the following options:

      - **Quick Enable**: Starts an on-demand troubleshooting entry with a backfill period of 3 hours. With this option, detailed stream information for the past 3 hours becomes available.

        After you choose this option, click **Refresh** to view the detailed troubleshooting information. It can take a few minutes for this information to become available. Alternatively, click **Go to On Demand Troubleshooting** to display the **On Demand Troubleshooting** window that includes the entry that you just added.

      - **Go to On Demand Troubleshooting**: Displays the **On Demand Troubleshooting** window. Add an entry in this window as described in Add an On Demand Troubleshooting Entry. Repeat Steps 1 to Step 3 in this procedure to view the detailed information.

View Detailed Top Source Data

After on-demand troubleshooting is configured, you can view detailed information about top application usage for a device. To do so, follow these steps:

1. From the Cisco vManage menu, choose **Monitor** > **Overview** > **Top Applications**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage menu, choose **Dashboard** > **Main Dashboard** > **Top Applications**.

2. In the **SAIE Application** tab, click an application usage bar in the chart.

Note In Cisco vManage Release 20.7.x and earlier releases, **SAIE Application** is called **DPI Application**.

3. In the chart for the application that you selected, click the device usage bar.

   If on-demand troubleshooting is configured for the device, detailed top source data appears.

   If on-demand troubleshooting information is not configured, the **Go to On Demand Troubleshooting** option appears. Continue to Step 4.

4. If the **Go to On Demand Troubleshooting** option appears, perform these actions:

a. Click **Go to On Demand Troubleshooting** to display the **On Demand Troubleshooting** window.

b. In the **On Demand Troubleshooting** window, add an entry, as described in Add an On Demand Troubleshooting Entry.

c. Repeat Step 1 to Step 3 in this procedure to view the detailed information.

Simulate Flows

Table 146: Feature History

Feature Name	Release Information	Description
Forwarding Serviceability		This feature enables service path and tunnel path under Simulate Flows function in the Cisco vManage template and displays the next-hop information for an IP packet. This feature enables Speed Test and Simulate Flow functions on the Cisco IOS XE SD-WAN devices.

To view the next-hop information for an IP packet available on routers:

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

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

2. Choose a device from the list of devices that appears.

3. Click **Troubleshooting** in the left pane.

4. Under **Traffic**, click **Simulate Flows**.

5. To specify the data traffic path, choose values or enter data in the required fields:

   - VPN—VPN in which the data tunnel is located.
   - Source/Interface—Interface from which the cflowd flow originates.
   - Source IP—IP address from which the cflowd flow originates.
   - Destination IP—Destination IP address of the cflowd flow.
   - Application—Application running on the router.
   - Custom Application (created in CLI)

6. Click **Advanced Options**.

   a. In the **Path** field, choose **Tunnel** or **Service** to indicate whether the data traffic path information comes from the service side of the router or from the tunnel side.

   b. In the **Protocol** field, enter the protocol number.

   c. In the **Source Port** field, enter the port from which the cflowd flow originates.

   d. In the **Destination Port** field, enter the destination port of the cflowd flow.

   e. In the **DSCP** field, enter the DSCP value in the cflowd packets.

   f. (Optional) Check the **All Paths** check box to view all possible paths for a packet.

7. Click **Simulate** to determine the next hop that a packet with the specified headers would take.

For service path and tunnel path commands, see show sdwan policy service-path and show sdwan policy tunnel-path.

Syslog Messages

When something of interest happens on an individual device in the overlay network, one of the ways the device reports it is by generating a system logging (syslog) message and place it in a syslog file in the /var/log directory on the local device and, if configured, on a remote device.

On Cisco SD-WAN devices, you can log event notification system log (syslog) messages to files on the local device or on a remote host, or both. On the local device, syslog files are placed in the /var/log directory.

Configure System Logging

Logging syslog messages with a priority level of "error," to the local device's hard disk, is enabled by default. Log files are placed in the local /var/log directory. By default, log files are 10 MB in size, and up to 10 files are stored. After 10 files have been created, the oldest one is discarded to create a file for newer syslog messages.

To modify the default syslog parameters from Cisco vManage, use the Logging feature template. From the CLI, include the **logging disk** or **logging server** commands in the device configuration.

View Syslog Logging Information

1. From the Cisco vManage menu, choose **Administration** > **Settings** and, ensure that **Data Stream** is enabled.

2. From the Cisco vManage menu, choose **Monitor** > **Devices**, and choose a device from the list of devices that appears.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage menu, choose **Monitor** > **Network**, and choose a device from the list of devices that appears.

3. Click **Troubleshooting** in the left pane.

4. In the **Logs** area, click **Debug Log**.

5. In the **Log Files** field, choose the name of the log file. The lower part of the screen displays the log information.

To view the contents of a syslog file from the CLI, use the **show log** command. For example:

```
Device# show log auth.log tail 10==> /var/log/auth.log <==auth.info: Nov 14 14:33:35 vedge
 sshd[2570]: Accepted publickey for admin from 10.0.1.1 port 39966 ssh2: RSA
SHA256:pkFQ5wE//DmiA0d0JU1rOt91CMTVGkscm9wLSYQrI1sauth.info: Nov 14 14:39:42 vedge sshd[2578]:
 Received disconnect from 10.0.1.1 port 39966:11: disconnected by userauth.info: Nov 14
14:39:42 vedge sshd[2578]: Disconnected from 10.0.1.1 port 39966auth.info: Nov 16 10:51:45
 vedge sshd[6106]: Accepted publickey for admin from 10.0.1.1 port 40012 ssh2: RSA
SHA256:pkFQ5wE//DmiA0d0JU1rOt91CMTVGkscm9wLSYQrI1sauth.info: Nov 16 11:21:55 vedge sshd[6108]:
 Received disconnect from 10.0.1.1 port 40012:11: disconnected by userauth.info: Nov 16
```

```
11:21:55 vedge sshd[6108]: Disconnected from 10.0.1.1 port 40012auth.info: Nov 17 12:59:52
 vedge sshd[15889]: Accepted publickey for admin from 10.0.1.1 port 40038 ssh2: RSA
SHA256:pkFQ5wE//DmiA0d0JU1rOt91CMTVGkscm9wLSYQrI1sauth.info: Nov 17 13:45:13 vedge
sshd[15894]: Received disconnect from 10.0.1.1 port 40038:11: disconnected by userauth.info:
 Nov 17 13:45:13 vedge sshd[15894]: Disconnected from 10.0.1.1 port 40038auth.info: Nov 17
 14:47:31 vedge sshd[30883]: Accepted publickey for admin from 10.0.1.1 port 40040 ssh2:
RSA SHA256:pkFQ5wE//DmiA0d0JU1rOt91CMTVGkscm9wLSYQrI1s
```

To view the configured system logging settings for a device, use the **show logging** command from the CLI. For example:

```
Device# show logging
System logging to host  in vpn 0 is disabled
Priority for host logging is set to: emerg

System logging to disk is disabled
Priority for disk logging is set to:  err
File name for disk logging is set to:  /var/log/vsyslog
File size for disk logging is set to:  10 MB
File recycle count for disk logging is set to:  10

Syslog facility is set to: all facilities
```

System Log Files

Syslog messages at or above the default or configured priority value are recorded in a number of files in the /var/log directory on the local device. These files include the following:

- auth.log—Login, logout, and superuser access events, and usage of authorization systems.
- kern.log—Kernel messages
- messages—Consolidated log file that contains syslog messages from all sources
- vconfd—All configuration-related syslog messages
- vdebug—All debug messages for modules whose debugging is turned on and all syslog messages above the configured priority value. Debug logging supports various levels of logging based on the module. Different modules implement the logging levels differently. For example, the system manager (sysmgr) has two logging levels (on and off), while the chassis manager (chmgr) has four different logging levels (off, low, normal, and high). You cannot send debug messages to a remote host. To enable debugging, use the **debug** operational command
- vsyslog—All syslog messages from Cisco SD-WAN processes (daemons) above the configured priority value. The default priority value is "informational" (severity level 6), so by default, all "notice", "warning", "error", "critical", "alert", and "emergency" syslog messages (severity levels 5 through 0, respectively) are saved

The Cisco SD-WAN software does not use the following standard LINUX files, which are present in /var/log, for logging: cron.log, debug, lpr.log, mail.log, and syslog.

The writing of messages to syslog files is not rate-limited. This means that if many syslog messages are generated in a short amount of time, the overflow messages are buffered and placed in a queue until they can be written to a syslog file. The overflow messages are not dropped.

For repeating syslog messages—identical messages that occur multiple times in succession—only one copy of the message is placed in the syslog file. The message is annotated to indicate the number of times that the message occurred.

The maximum length of a syslog message is 1024 bytes. Longer messages are truncated.

Syslog messages related to AAA authentication and Netconf CLI access and usage are placed in the auth.log and messages files. Each time Cisco vManage logs in to a Cisco vEdge device to retrieve statistics and status information and to push files to the router, the router generates AAA and Netconf log messages. So, over time, these messages can fill the log files. To prevent these messages from filling the log files, you can disable the logging of AAA and Netconf syslog messages:

```
Device(config)# system aaa logsViptela(config-logs)# audit-disableViptela(config-logs)#
netconf-disable
```

Syslog Message Format

Syslog message generated by the Cisco SD-WAN software have the following format:

```
facility.source
date - source - module - level - MessageID: text-of-syslog-message
```

Here is an example syslog message. This is logged with local7 facility and level "notice".

Syslog Message Acronyms

The following acronyms are used in syslog messages and in the explanations of the messages:

Table 147:

Acronym	Meaning
confd	CLI configuration process
FTM	Forwarding table manager
FP	Forwarding process
RTM	Route table manager
TTM	Tunnel table manager

To see a list of the various syslog messages generated, see Syslog Messages in the Appendix.

Syslog Messages

The tables below list the syslog messages generated by Cisco vEdge devices and Cisco IOS XE SD-WAN devices. The messages are grouped based on the software module that generates them. The software modules are typically processes (daemons) that run on the device.

All syslog messages are generated on all the devices unless otherwise indicated.

Each syslog message has a corresponding number. The tables list all syslog messages and their number even if the messages are defined in the header files but are not currently used in the operating software. For these messages, the Message Format, Description, and Action fields are empty.

In these tables, the Action field indicates the recommended action you should take in response to the syslog message:

- A—Automatically open a ticket in your organization's support team.
- AE—Automatically open a support ticket and escalate the ticket
- E—Send email to the appropriate team within your organization.

If you see a syslog message that is not listed in one of the tables below, please send the message, along with the device and software version, to Cisco support.

CFGMGR: Configuration Manager Process

Priority: Informational

Message	Number	Message Format	Description	Action
CFGMGR_SYSLOG_END	399999	Terminating cfgmgr	Configuration manager is stopping	E
CFGMGR_SYSLOG_SPEED_DUPLEX_NOT_SUPPORTED	300003	—	Interface does not support duplex mode	E
CFGMGR_SYSLOG_SPURIOUS_TIMER	300002	—	Internal error	A
CFGMGR_SYSLOG_IF_STATE	300004	—	Interface state reported by configuration manager	E
CFGMGR_SYSLOG_START	300001	Starting cfgmgr	Configuration manager is starting	E

CFLOWD: Cflowd Traffic Flow Monitoring Process

Priority: Informational

Message	Number	Message Format	Description	Action
CFLOWD_SYSLOG_MSG	2200002	Received information about vpn_id %ld, vpn_id	Cflowd detected a VPN change	E

Priority: Notice

Message	Number	Message Format	Description	Action
CFLOWD_SYSLOG_END	2299999	Terminating module cflowd because sysmgr terminated	Cflowd module going down at request of sysmgr	E

Message	Number	Message Format	Description	Action
CFLOWD_SYSLOG_END	2299999	Terminating module cflowd with error code %d	Cflowd initialization failed and cflowd is about to go down, or cflowd module is going down	A
CFLOWD_SYSLOG_START	2200001	Starting module cflowd	Cflowd module is starting	E

CHMGR: Chassis Manager

The chassis manager process runs only on physical routers.

Priority: Informational

Message	Number	Message Format	Description	Action
CHMGR_CHASSIS_INFO	100009	Chassis-Type %s max-modules %d	Informational message indicating chassis type and maximum number of modules (PIMs + fixed) supported by chassis	E
CHMGR_FAN_SPEED_HIGH	100003	—	Fan speed is high	E
CHMGR_FAN_SPEED_NORMAL	100004	—	Fan speed is normal	E
CHMGR_FANTRAY_INSERTED	100052	Fantray %d inserted	Fan tray inserted (on vEdge 2000 only)	E
CHMGR_FANTRAY_REMOVED	100053	Fantray %d removed	Fan tray removed (on vEdge 2000 only)	E
CHMGR_MODULE_INSERTED	100007	Module %d inserted - port type: %s, num_ports: %s	PIM module inserted	E
CHMGR_MODULE_REMOVED	100008	Module %d removed	PIM module removed	E
CHMGR_PIM_OK	100057	—	PIM module status is normal	E
CHMGR_PORT_INSERTED	100005	Port %s inserted in module %d	SFP inserted	E
CHMGR_PORT_REMOVED	100006	Port %s removed from module %d	SFP removed	E
CHMGR_SIGTERM	100024	Received sigterm, exiting gracefully	Debug-level message indicating that chassis manager is going down	E
CHMGR_SYSLOG_START	100001	Starting chassis manager	Chassis manager process is starting	E
CHMGR_USB_INSERTED	100058	USB media inserted in slot %d	USB media inserted	E

Message	Number	Message Format	Description	Action
CHMGR_USB_REMOVED	100059	USB media removed from slot %d	USB media removed	E

Priority: Notice

Message	Number	Message Format	Description	Action
CHMGR_EMMC_OK	100039	eMMC read successful	EMMC read was successful	E
CHMGR_FAN_OK	100041	Fan Tray %d Fan %d fault cleared, ftrayid, id	Fan fault cleared	E
CHMGR_FANTRAY_OPER	100055	Fan tray '%d' up, ftrayid	Fan tray detected	A
CHMGR_FLASH_OK	100037	Flash memory status read successful	Flash read successful	E
CHMGR_PEM_OK	100043	Power supply '%d' fault cleared	Power supply fault cleared	E
CHMGR_PEM_OPER	100045	Power supply '%d' up	Power supply inserted or detected	E
CHMGR_SDCARD_OK	100047	SD card read successful	SD card read successful	E
CHMGR_SFP_UNSUPPORTED	10060	SFP %s is not supported	SFP is not supported	E
CHMGR_SHORT_RESET_REQUEST	100018	—	Chassis manager received a request to reboot the router	E
CHMGR_TEMP_GREEN	100030	%s temperature (%d degrees C) is below yellow threshold (%d degrees C)	Temperature sensor reading below yellow threshold	E
CHMGR_TEMP_OK	100027	%s temperature sensor fault cleared	Temperature sensor read successful after a previous failed attempt	E

Priority: Warning

Message	Number	Message Format	Description	Action
CHMGR_HOTSWAP_DIFF_MOD	100051	Hot-Insertion of a module of different type requires reboot. Module %d will remain down,	PIM module of a different type was inserted in the slot; it was detected, but will remain down until the next reboot	E

Priority: Error

Message	Number	Message Format	Description	Action
CHMGR_CONFD_DATACB_REGISTER_FAILED	100023	Failed to register data cb	Internal error registering a data callback function with confd	AE
CHMGR_CONFD_REPLY_FAILED	100022	Failed to send oper data reply - %s (%d)	Internal error occurred when processing chassis manager–related configuration of **show** command	A
CHMGR_EEPROM_READ_FAILED	100011	Failed to read module %d eeprom on chassis %s, module, chassis-name	Failed to read details of inserted PIM	AE
CHMGR_EEPROM_VERSION_ERROR	100012	Unsupported eeprom format version for module %d	EEPROM version of PIM module is supported; module will not be recognized	AE
CHMGR_EMMC_FAULT	100038	eMMC fault detected	Error occurred reading EMMC information	A
CHMGR_FAN_FAULT	100040	Fan Tray %d Fan %d fault detected, ftrayid, id	Fan fault detected	A
CHMGR_FANTRAY_DOWN	100054	Fan tray '%d' not present, ftrayid id	Fan tray not detected	A
CHMGR_FLASH_FAULT	100036	Flash memory status fault	Internal error reading flash	AE
CHMGR_GET_HWADDR_FAILED	100010	Failed to get macaddr for %s, p_ifname	Internal error resulting from failure to obtain an interface's MAC address	A

Message	Number	Message Format	Description	Action
CHMGR_GET_IFFLAG_FAILED	100016	Failed to get ifflags for %s err %d, p_port->kernel_name, errno	Interface initialization failure; interface may remain down, or device may reboot	A
CHMGR_IFFLAGS_SET_FAIL	100050	—	Setting an interface flag failed	E
CHMGR_IF_GSO_OFF_FAILED	100025	—	Setting interface options failed	E
CHMGR_PEM_DOWN	100044	Power supply '%d' down or not present	Power supply removed or not detected	A
CHMGR_PEM_FAULT	100042	Power supply '%d' fault detected	Power supply fault detected	AE
CHMGR_PIM_FAULT	100056	PIM %d power fault	PIM power fault detected	AE
CHMGR_PIM_FAULT	100056	PIM %d power fault cleared	PIM power fault cleared	A
CHMGR_SDCARD_FAULT	100046	SD card fault detected (no present or unreadable)	SD card fault detected	A
CHMGR_SET_IFFLAG_FAILED	100017	Failed to set ifflags to %x for %s err %d	Interface initialization failure; interface may remain down, or device may reboot	A
CHMGR_SHORT_RESET_CLEAR_FAILED	100019	—	Clearing a reboot request failed.	A
CHMGR_SHORT_RESET_FAILED	100020	—	Request to reset the router by rebooting failed	A

Message	Number	Message Format	Description	Action
CHMGR_SPURIOUS_TIMER	100035	Spurious timer ignored what = %#x arg = %p	Internal error	A
CHMGR_SYSOUT_OF_RESOURCES	100049	Timer add failed. Out of resources	Interal error; if fatal, device may reboot to recover	A
CHMGR_UNKNOWN_MODULE_TYPE	100013	Invalid module-type %x in module-slot %d on chassis %s,	Unrecognized PIM module type in slot	AE
CHMGR_UNSUPPORTED_MODULE_TYPE	100014	Module-Type %s not supported in slot %d on chassis %s	PIM module is not supported in slot in which it is inserted	A

Priority: Critical

Message	Number	Message Format	Description	Action
CHMGR_IF_RENAME_FAILED	100015	Unable to rename %s to %s	Interface initialization failed; interface may remain down or the device may reboot	A
CHMGR_TEMP_FAULT	100026	%s temperature sensor fault detected. Unable to read temperature	Failed to read from a temperature sensor; possible temperature sensor failure	A
CHMGR_TEMP_RED	100028	%s temperature (%d degrees C) is above red threshold (%d degrees C).	Temperature sensor reading above red threshold	AE
CHMGR_TEMP_YELLOW	100029	%s temperature (%d degrees C) is above yellow threshold (%d degrees C),	Temperature sensor reading above yellow threshold	A

Priority: Alert

Message	Number	Message Format	Description	Action
CHMGR_CONFD_INIT_FAILED	100021	Initialization failed. vconfd_module_init returned %d	Chassis manager failed to initialize and start	AE

CVMX: Internal Cavium Driver Process

Priority: Informational

Message	Number	Message Format	Description	Action
CVMX_SYSLOG_END	999999	Terminating Cavium drivers	Internal Cavium drivers ending	E
CVMX_SYSLOG_START	900001	Starting Cavium drivers	Internal Cavium drivers starting	E

CXP: Cloud onRamp for SaaS Process

Priority: Informational

Message	Number	Message Format	Description	Action
CXP_SYSLOG_END	2799999	Terminating Cloud onRamp process	Cloud onRamp for SaaS ending	E
CXP_SYSLOG_START	2700001	Starting Cloud onRamp process	Cloud onRamp for SaaS starting	E

CONTAINER: Containers

Priority: Informational

Message	Number	Message Format	Description	Action
CONTAINER_SYSLOG_END	2699999	Terminating container process	Container process ending	E
CONTAINER_SYSLOG_START	2600001	Starting container process	Container process starting	E

DBGD: Debug Process

Priority: Informational

Message	Number	Message Format	Description	Action
DBGD_SYSLOG_END	2900001	Terminating debug process	Debug process ending	E
DBGD_SYSLOG_START	2999999	Starting debug process	Debug process starting	E

DHCPC: DHCP Client

The DHCP client process runs only on Cisco vEdge devices.

Priority: Informational

Message	Number	Message Format	Description	Action
DHCP_SYSLOG_CLEAR_INTERFACE	1300006	Clearing dhcp state for interface %s,	DHCP client cleared DHCP state for interface	E

Message	Number	Message Format	Description	Action
DHCP_SYSLOG_DISCOVER_TIMEOUT	1300005	No response for dhcp discover packets for interface %s,	DHCP discovery failure	E
DHCP_SYSLOG_END	1300001	Terminating syslog process	Syslog process ending	E
DHCP_SYSLOG_IP_ADDR_ASSIGNED	1300002	Assigned address %s to interface %s	DHCP client assigned address to interface	E
DHCP_SYSLOG_IP_ADDR_RELEASED	1300003	Released address for interface %s	DHCP client released address	E
DHCP_SYSLOG_IP_ADDR_RENEWED	1300010	Renewed address %s for interface %s	DHCP client address renewed	E
DHCP_SYSLOG_IP_ADDR_REQUEST_RENEW	1300004	Requesting renew [50%%] for interface %s address %s/%d	DHCP client renewal request at 50% of lease expiration time	E
DHCP_SYSLOG_IP_ADDR_REQUEST_RENEW	1300004	Requesting renew [85%%] for interface %s address %s/%d	DHCP client renewal request at 85% of lease expiration time	E
DHCP_SYSLOG_IP_ADDR_REQUEST_RENEW	1300004	Requesting renew [100%%] for interface %s address %s/%d	DHCP client renewal request at 100% of lease expiration time	E
DHCP_SYSLOG_START	1399999	Starting syslog process	Syslog paroces starting	E

Priority: Critical

Message	Number	Message Format	Description	Action
DHCP_SYSLOG_IP_ADDR_CONFLICT	1300007	Interface %s IP Address %s conflict with interface %s,	DHCP client detected IP address conflict with another interface	E

DHCP: DHCP Server

The DHCP server process runs only on Cisco vEdge devices.

Priority: Informational

Message	Number	Message Format	Description	Action
DHCP_SYSLOG_CLEAR_SERVER_BINDINGS	1300008	Clearing dhcp server bindings for interface %s, vpn %ld,	DHCP server cleared bindings for interface	E
DHCP_SYSLOG_CLEAR_SERVER_BINDINGS	1300008	Clearing dhcp server binding for interface %s, vpn %ld, mac addr %x:%x:%x:%x:%x:%x,	DHCP server cleared bindings for interface	E

FPMD: Forwarding Policy Manager Process

Priority: Informational

Message	Number	Message Format	Description	Action
FPMD_SYSLOG_ACL_PROGRAM_SUCCESS	1100005	Successfully reprogrammed access list - %s	Access list successfully created	E
FPMD_SYSLOG_END	1199999	Terminating fpmd	Forwarding policy manager process is ending	E
FPMD_SYSLOG_POLICY_PROGRAM_SUCCESS	1100004	Successfully reprogrammed policy %s - %s	Policy created successfully	E
FPMD_SYSLOG_START	1100001	Starting fpmd	Forwarding policy manager process is starting	E

Priority: Alert

Message	Number	Message Format	Description	Action
FPMD_SYSLOG_ACL_PROGRAM_FAILED	1100003	Failed to allocate memory for access list %s. Continuing without the access	Access list could not be created	A
FPMD_SYSLOG_POLICY_PROGRAM_FAILED	1100002	Failed to allocate memory for policy %s - %s. Continuing without the policy	Policy could not be created	A

FTMD: Forwarding Table Management Process

The forwarding table management process runs only on Cisco vEdge devices.

Priority: Informational

Message	Number	Message Format	Description	Action
FTMD_SLA_CLASS_ADD	1000020	SLA Class %s added at index %d: loss = %d%%, latency = %d ms	SLA class added	E
FTMD_SYSLOG_BFD_STATE	1000009	record with discriminator %u invalid	BFD state is invalid	E
FTMD_SYSLOG_BFD_STATE	1000009	BFD Session %s.%u->%s.%u %s:%u->%s:%u %s %s %s %d	BFD state changed	E
FTMD_SYSLOG_DBGD_STATE	1000036	Connection to DBGD came up Connection to DBGD went down DBGD FTM: Initialized message queue DBGD FTM oper %d vpn %u sip %s:%u dip %s %u DBGD FTM: oper %d vpn %lu localc %d remote %d remoteip %s	Messages related to the FTM debugging process	E
FTMD_SYSLOG_DPI_FLOW_OOM	1000024	Out-of-memory status for DPI flows: %s	Memory status for SAIE flows **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.	E

Message	Number	Message Format	Description	Action
FTMD_SYSLOG_DPI_WRITE_OFF	1000032	Turning off writing DPI records to disk	SAIE records are no longer being written to disk **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.	E
FTMD_SYSLOG_END	1999999	Terminating FTM process	Forwarding table management process ending	E
FTMD_SYSLOG_FIB_GROW	1000012	Growing FIB6 memory to accommodate larger tables):	IPv6 forwarding table size is being increased	E
FTMD_SYSLOG_FIB_GROW	1000012	Growing FIB memory to accommodate larger tables):	IPv4 forwarding table size is being increased	E
FTMD_SYSLOG_IF_STATE	1000001	VPN %lu Interface %s %s,	FTM detected interface state change	E
FTMD_SYSLOG_LR_ADD	1000027	LR: Adding Iface %s as LR	Last-resort interface is being added	E
FTMD_SYSLOG_LR_ADD	1000027	LR: Iface %s has become an LR	Interface has become a last-resort interface	E
FTMD_SYSLOG_LR_DEL	1000028	LR: Found iface %s while looking for iface %s	Last-resort interface found while looking for another interface	E
FTMD_SYSLOG_LR_DEL	1000028	LR: iface %s has become non-LR. Hence set OPER UP on that interface	Last-resort interface has become an active interface	E

Message	Number	Message Format	Description	Action
FTMD_SYSLOG_LR_DEL	1000028	LR: Iface %s has become a non-LR LR: Removing Iface %s as LR	Messages related to an interface that is no longer a last-resort interface	E
FTMD_SYSLOG_LR_DOWN	1000030	LR: At least one bfd session of non-LR is active LR: At least one non-LR's bfd session in Up LF bfd session = SIP:%s DIP:%s SPORT:%u DPORT:%u PROTO:%u is Up for at least &u interval msecs LR: Bringing LR's wan if Down in %u msecs LR: Bringing LR's wan if Down right away LR: Cleared LR down_in-progress	Messages related to shutting down an interface of last resort	E
FTMD_SYSLOG_LR_UP	1000029	LR: All bfd sessions gone down. Setting LR %s's OPER state to UP	Last-resort interface's status set to Up because no other circuits on the router are active	E
FTMD_SYSLOG_LR_UP	1000029	LR: Bring LR's wan if up immediately as no other circuit's bfd sessions are up	Last-resort interface activated because no other circuits on the router are active	E
FTMD_SYSLOG_LR_UP	1000029	LR: Starting hold up timer immediately !!	Hold timer for last-resort interface activated because no other circuits on the router are active	E

Message	Number	Message Format	Description	Action
FTMD_SYSLOG_NAT_FLOW_ADD	1000039	NAT flow add: Private %s, Public %s	FTM detected the addition of a NAT flow with the specified private and public IP addresses	E
FTMD_SYSLOG_NAT_FLOW_DELETE	1000040	NAT flow delete: Private %s, Public %s	FTM detected the deletion of a NAT flow with the specified private and public IP addresses	E
FTMD_SYSLOG_PIM_DOWN	1000017	—	FTM detected that PIM ended	E
FTMD_SYSLOG_PIM_UP	1000018	—	FTM detected that PIM started	E
FTMD_SYSLOG_ROUTE_ADD_FAIL	1000004	Route Add for prefix %s Failed. Reason %s	FTM failed to add a route received from the RTM	E
FTMD_SYSLOG_ROUTE_VERIFY	1000033	Successfully verified RIB and FIB routes on the Cisco vEdge device	FTM verified the routes in the router's RIB and FIB	E
FTMD_SYSLOG_ROUTE_VERIFY_FAIL	1000034	—	RIB and FIB router verification failed	E
FTMD_SYSLOG_SIGTERM	1000005	Received Cleanup signal. Exiting gracefully	FTM received termination signal from sysmgr and is about to go down	E
FTMD_SYSLOG_START	1000001	Starting FTM process	Forwarding table management process starting	E
FTMD_SYSLOG_TCPD_STATE	1000035	Sent tcp_opt_disable successfully for vpn %ld	Disabling of TCP options was successful on the interface	E
FTMD_SYSLOG_TUNNEL_ADD_FAIL	1000015	Tunnel Add to TLOC %s.%s Failed. Reason %s	Failed to add new TLOC; reported by TTM	E
FTMD_SYSLOG_WWAN_STATE	1000025	Bring %s last resort circuit	Up or down status of circuit of last resort	E
FTMD_SYSLOG_WWAN_STATE	1000025	Connection to WWAN came up	Circuit of last resort came up	E

Message	Number	Message Format	Description	Action
FTMD_SYSLOG_WWAN_STATE	1000025	Connection to WWAN went down	Circuit of last resort went down	E

Priority: Notice

Message	Number	Message Format	Description	Action
FTMD_SLA_CLASS_DEL	1000022	Sla class %s at index %d removed: loss = %d%%, latency = %d ms, jitter = %d ms	SLA class deleted	A
FTMD_SLA_CLASS_MOD	1000021	Sla class %s at index %d modified: loss = %d%%, latency = %d ms, jitter = %d ms	SLA class changed	A
FTMD_SLA_CLASS_VIOLATION	1000023	[%lu] SLA class violation application %s %2:%u._%s:&u protocol: %d dscp: %d %s, status - %s	SLA class violation for application in specified VPN, with specified source address and port, destination address and port, protocol, DSCP, and reason	A
FTMD_SYSLOG_DOT1X_HOST	1000031	Host %s denied access on interface %s in single host mode	An 802.1X interface in single-host mode is denying access, because it has already granted access to a client	E
FTMD_SYSLOG_FLOW_LOG	1000026	%s	FTM detected a new flow	E
FTMD_SYSLOG_FP_CORE_FAIL	1000013	FP core watchdog expired (rc = %d). %s, rc, action_str	FTM detected that FP may not be functioning; device will reboot soon	A
FTMD_SYSLOG_PMTU_LOWERED	1000016	Tunnel %s/%d -> %s/%d MTU Changed to %u due to Path-MTU Discovery,	MTU size on a tunnel changed due to path MTU discovery	E
FTMD_SYSLOG_ZBFW_FLOW_ADD	1000037	ZBF flow created zone-air %s key %s src_vpn %d dst_vpn %d expiry secs %d state %s	FTM detected the creation of a zone pair	E
FTMD_SYSLOG_ZBFW_FLOW_DEL	1000038	ZBF flow deleted zone-air %s key %s src_vpn %d dst_vpn %d state %s	FTM detected the deletion of a zone pair	E

Priority: Critical

Message	Number	Message Format	Description	Action
FTMD_SYSLOG_BUFFER_POOL_LOW **Note** This error message is available from Cisco SD-WAN Release 20.7.1.	1000041	Critical Alert: Buffer Pool <num>: available buffers are x% of total buffers	FTM detected that the specified buffer pool has gone below 20% of its capacity	E

Priority: Warning

Message	Number	Message Format	Description	Action
FTMD_SYSLOG_BUFFER_POOL_LOW **Note** This error message is available from Cisco SD-WAN Release 20.7.1.	1000041	Warning Alert: Buffer Pool <num>: available buffers are x% of total buffers	FTM detected that the specified buffer pool has gone below 50% of its capacity	E
FTMD_SYSLOG_TTM_DOWN	1000008	Connection to TTM went down. p_msgq %p p_ftm %p,	FTM connection with TTM went down; BFD sessions will be cleared	E
FTMD_SYSLOG_TTM_UP	1000007	Connection to TTM came up. p_msgq %p p_ftm %p,	FTM connected with TTM	E
FTMD_TUNNEL_SLA_CHANGED	1000019	SLA changed for session: %s.%u->%s:%u->%s:%u. New loss = %d%%, latency = %d ms, jitter = %d ms, SLA Classes: %s (ox%x) %s%s	FTM detected SLA changes on a tunnel	E

Priority: Error

Message	Number	Message Format	Description	Action
FTMD_SYSLOG_CONFD_FAIL	1000003	Failed to register bfd show data cb	FTM failed to register data callback wtih confd; device may reboot	AE
FTMD_SYSLOG_CONFD_FAIL	1000003	Failed to register policer show data cb	FTM failed to register data callback with confd; device may reboot	AE
FTMD_SYSLOG_CONFD_FAIL	1000003	%s: Failed to register data cb, __FUNCTION__	FTM failed to register data callback with confd; device may reboot	AE

FTMD_SYSLOG_CONFD_FAIL	1000003	%s: Failed to send oper data reply - %s (%d) : %s,	FTM failed to respond correctly to confd; some **show** commands may not work	A
FTMD_SYSLOG_FP_COREDUMP	1000011	FP Core %d Died. Core file recorded at %s,	FTM detected an FP crash; device will reboot soon	AE
FTMD_SYSLOG_IFADD_FAIL	1000014	Failed to add interface %s in vpn %lu. Out of forwarding interface records	Interface not added because of insufficient forwarding interface database records	A
FTMD_SYSLOG_IFADD_FAIL	1000014	Failed to add interface %s in vpn %lu. Out of snmp interface indices	Interface not added because of insufficient SNMP interface indices	A
FTMD_SYSLOG_INIT_FAIL	1000002	vconf_module_init returned %d	FTM failed to start with confd	A
FTMD_SYSLOG_LR_DEL	1000028	LR: LR is not enabled...while we are trying to remove iface %s as last resort	Interface being removed is not configured as a last-resort interface	A
FTMD_SYSLOG_LR_DEL	1000028	LR: Unable to remove iface %s as LR	Interface is no longer a last-resort interface so it cannot be deleted	A
FTMD_SYSLOG_RTM_DECODE_FAIL	1000006	Bad RTM Msg: Msg-Type %u Msg-Len %u len: %u decoded-len %u,	Could not process route or interface change message from RTM	A
FTMP_SYSLOG_SPURIOUS_TIMER	1000010	Spurious timer ignored what = %#x arg = %p,	Internal error	A

GPS: Global Positioning System

Priority: Informational

Message	Number	Message Format	Description	Action
GPS_SYSLOG_END	2599999	Terminating GPS	GPS process is ending	E
GPS_SYSLOG_GGA_FIX	2500002	GGA %d:%d:%d lat=%f lon=%f alt=%f sat=%d hdop %f fix%d	GPS fix information	E
GPS_SYSLOG_GSA_FIX	2500004	GSA %s pdop=%.2f hdop=%.2f vdop=%.2f	GPS satellite and dilution of precision (DOP) information	E

Message	Number	Message Format	Description	Action
GPS_SYSLOG_PSTOP	2500005	Polling disabled Stopping polling timers	Messages related to polling for GPS information	E
GPS_SYSLOG_RMC_FIX	2500003	RMC %s %d %d lat=%f lon=%f speed %f course=%s status valid	Essential minimum GPS information	E
GPS_SYSLOG_START	2500001	Starting GPS	GPS process is starting	E

IGMP: Internet Group Management Protocol

Priority: Informational

Message	Number	Message Format	Description	Action
IGMP_SYSLOG_END	1800001	Terminating IGMP	IGMP process is ending	E
IGMP_SYSLOG_START	1899999	Starting IGMP	IGMP process is starting	E

LIBBSS: UNIX BSS Library

Unused Messages

Message	Number	Message Format	Description	Action
LIBBSS_SYSLOG_END	1699999	Terminating libbss	UNIX BSS library process is ending	E
LIBBSS_SYSLOG_START	1600001	Starting libbss	UNIX BSS library process is starting	E

LIBCHMGR: Chassis Manager Library Process

Unused Messages

Message	Number	Message Format	Description	Action
LIBCHMGR_SYSLOG_END	1599999	Terminating libchmrg	Chassis manager library process is ending	E
LIBCHMGR_SYSLOG_START	1500001	Starting libchmgr	Chassis manager libryary process is starting	E

MSGQ: Message Queue Process

Ununsed Messages

Message	Number	Message Format	Description	Action
MSGQ_SYSLOG_END	899999	Terminating msgq	Message queue process is ending	E
MSGQ_SYSLOG_START	800001	Starting msgq	Message queue process is starting	E

OMP: Overlay Management Protocol

Priority: Informational or Other

Message	Number	Message Format	Description	Action
OMP_NUMBER_OF_CISCO_VSMARTS	400005	Number of Cisco vSmarts connected: %u	Number of Cisco vSmart Controllers to which device is connected (on Cisco vEdge devices only)	E
OMP_PEER_STATE_CHANGE	400002	%s peer %s state changed to %s,	OMP peer stated changed to up or down	E
OMP_POLICY_CHANGE	400007	Using policy from peer %s,	Forwarding policy received from Cisco vSmart Controller (on Cisco vEdge devices only)	E
OMP_STATE_CHANGE	400003	Operational state changed to %s,	OMP internal operational state changed	E
OMP_TLOC_STATE_CHANGE	400004	TLOC %s state changed to %s for address-family: %s,	TLOC state changed	E

Priority: Notice

Message	Number	Message Format	Description	Action
OMP_SYSLOG_END	400006	Terminating	OMP process is stopping	E
OMP_SYSLOG_START	400001	Starting	OMP process is starting	E

PIM: Protocol-Independent Multicast Process

Priority: Informational

Message	Number	Message Format	Description	Action
IGMP_SYSLOG_END	1900001	Terminating	PIM process is ending	E

Message	Number	Message Format	Description	Action
IGMP_SYSLOG_START	1999999	Starting	PIM process is starting	E

Priority: Notice

Message	Number	Message Format	Description	Action
PIM_SYSLOG_IF_STATE_CHANGE	1900003	VPN %lu Interface %s %s	In specified VPN, interface state changed to up or down	E
PIM_SYSLOG_NBR_STATE_CHANGE	1900002	Neighbor %s state changed to up	PIM neighbor came up	E
PIM_SYSLOG_TUNNEL_STATE_CHANGE	1900004	Tunnel %s state changed to %s	Tunnel used for PIM when down or came up	E

Priority: Error

Message	Number	Message Format	Description	Action
PIM_SYSLOG_NBR_STATE_CHANGE	1900002	Neighbor %s stated changed to down	PIM neighbor went down	E

POLICY: Policy Process

Unused Messages

Message	Number	Message Format	Description	Action
POLICY_SYSLOG_END	799999	Terminating policy	Policy process is ending	E
POLICY_SYSLOG_START	700001	Starting policy	Policy process is starting	E

RESOLV: Resolver Process

Unused Messages

Message	Number	Message Format	Description	Action
RESOLV_SYSLOG_END	2000001	Terminating resolver	Resolver process is ending	E
RESOLV_SYSLOG_START	2099999	Starting resolver	Resolver process is starting	E

SNMP Listener Process

Unused Messages

Message	Number	Message Format	Description	Action
SNMP_SYSLOG_END	2100001	Terminating SNMP listener	SNMP listener process is ending	E
SNMP_SYSLOG_START	2199999	Starting SNMP listener	SNMP listener process is starting	E

SYSMGR: System Manager Process

The system manager process (daemon) spawns, monitors, and terminates all the processes in the system, and it collects and logs vital system information, such as memory and CPU status.

Priority: Informational

Message	Number	Message Format	Description	Action
SYSMGR_CONFD_PHASE1_INFO	200041	Generated authorized keys on %s, p_sysmgr->cfg.my_personality	Generated authorized keys for SSH-based login between the Cisco vManage server and the Cisco SD-WAN device	E
SYSMGR_CONFD_PHASE2_SUCCESS	200007	Confd Phase2 Up	Successful device bringup	E
SYSMGR_DAEMON_START	200017	Started daemon %s @ pid %d in vpn %lu,	System manager started process in VPN	E
SYSMGR_DAEMON_UP	200011	Daemon %s @ pid %d came up in vpn %lu (%d %d)	Daemon started by system manager came up as expected	E
SYSMGR_SIGTERM	200001	Received sigterm, stopping all daemons except confd	System manager received termination signal and will initiate termination of all processes	E
SYSMGR_VPN_DESTROY	200022	vpn %lu destroy. lookup returned %p	Stopping all processes in VPN	E

Priority: Notice

Message	Number	Message Format	Description	Action
SYSMGR_CLOCK_SET	200025	System clock set to %s	System clock set by user	E
SYSMGR_CONFD_CDB_NOT_INITED	200031	Confd db initialization not complete. Deleting cdb and starting afresh.	First-time initialization of configuration database	E
SYSMGR_CONFD_PHASE1_INFO	200041	Install successfully completed from %s to %s	Failed to read installation ID; will fall back to default	E
SYSMGR_CORE_FILE_COMPRESSED	200045	—	Core file was compressed	E
SYSMGR_DAEMON_EXIT_NORMAL	200021	—	A process terminated normally	E
SYSMGR_DAEMON_RESTARTED	200043	—	A process restarted	E
SYSMGR_DISK_ALERT_OFF	200036	Disk usage is below 60%%.	Disk usage is below threshold	E
SYSMGR_MEMORY_ALERT_OFF	200058	System memory usage is below 50%	System memory usage is below 50%	E
SYSMGR_MISC	200065	—	Miscellaneous message	E
SYSMGR_REBOOT	200038	System going down for a reboot.. (%s), reason	System manager initiating a device reboot, possibly because of a process failure	E
SYSMGR_SHM_FAIL	200042	Created shared memory %s	Successfully initialized shared memory for communication with other processes	E

Message	Number	Message Format	Description	Action
SYSMGR_SHUTDOWN	200040	System shutting down.. (%s), reason	System manager is powering down the device; device will not come back up unless it is physically power-cycled	A
SYSMGR_SYSTEM_GREEN	200050	System up with software version %s	System status is green, indicating that all processes came up as expected	E
SYSMGR_SYSTEM_RED	200051	System status red (software version '%s')	System status is red, possibly because of a process failure	A
SYSMGR_SYSTEM_START	200002	Starting system with Cisco SD-WAN software version %s	System has stated; usually one of the first messages during device bringup	E
SYSMGR_TIMEZONE_SET	200028	System timezone changed from %s to %s	System timezone changed as result of configuration change	E
SYSMGR_UPGRADE_AUTO_CONFIRMED	200063	—	A software upgrade was automatically confirmed	E
SYSMGR_UPGRADE_NOT_CONFIRMED	200049	—	A software upgrade was as not confirmed	E
SYSMGR_UPGRADE_PENDING_CONFIRMATION	200059	—	A software upgrade is pending confirmation	E

Message	Number	Message Format	Description	Action
SYSMGR_VDEBUG_LOG_CLEANUP_NEEDED	200066	Debug logs exceed expected storage quota. Performing age-based cleanup to restore debug logging operations.	Debug logs were deleted to create space	A
SYSMGR_DAEMON_TERMINATED	200020	—	A process terminated	E
SYSMGR_WATCHDOG_EXPIRED	200062	—	The watchdog process expired	A

Priority: Warning

Message	Number	Message Format	Description	Action
SYSMGR_CORE_FILE_DELETED	200044	—	Core file was deleted	A
SYSMGR_DAEMON_RESTART_ABORTED	200060	—	The restarting of a process was terminated.	A
SYSMGR_DAEMON_STOP	200018	Stopping daemon %s @ pid %d. Sending signal %d	System manager stopped a daemon	E
SYSMGR_DISK_ALERT_ORANGE	200054	Disk usage is above 75%%. Please clean up unnecessary files.	Disk usage is above 75%	E
SYSMGR_DISK_ALERT_YELLOW	200035	Disk usage is above 60%%. Please clean up unnecessary files.	Disk usage is above 60%	E
SYSMGR_FILE_DELETED	200064	Deleted file %s (size %lu MB) to recover disk space	File deleted to free up disk space	A
SYSMGR_MEMORY_ALERT_ORANGE	200056	System memory usage is above 75%%	System memory usage is above 75%	E
SYSMGR_MEMORY_ALERT_YELLOW	200057	System memory usage is above 60%%	System memory usage is above 60%	E

Priority: Error

Message	Number	Message Format	Description	Action
SYSMGR_BAUD_RATE_SET	200046	Console baud rate changed to '%d', baud_rate	Console baud rate changed	E
SYSMGR_BAUD_RATE_SET_FAIL	200047	Failed to set console baud rate in OS to '%d'	Failed to set user-specified console baud rate in Linus	A
SYSMGR_BAUD_RATE_SET_FAIL	200047	Failed to set console baud rate in U-boot to '%d'	Failed to set user-specified console baud rate in Uboot	A
SYSMGR_CLOCK_SET_FAIL	200026	Cannot set system clock to %s	Failed to set system clock to time specified by user	A
SYSMGR_CONFD_CDB_INIT_OPEN_FAIL	200030	Failed to open cdb init file (%s)	Failed to open the configuration database	A
SYSMGR_DAEMON_EXIT_FAIL	200023	—	A process could not terminate	A
SYSMGR_CONFD_DATACB_REGISTER_FAIL	200010	Failed to register data cb	Failed to register data callback function with confd; device may reboot	A
SYSMGR_CONFD_CDB_DEL_FAIL	200032	Failed to remove cbd directory '%s'	Failed to reinitialize configuration database to recover from failure	AE
SYSMGR_CONFD_FORK_FAILURE	200003	Cannot move confd to phase2 (err %s)	Failed to move confd to Phase 2; device will reboot soon	A

Message	Number	Message Format	Description	Action
SYSMGR_CONFD_PHASE1_FAILURE	200005	Failed to generate archive keys	Failed to generate keys required for archiving configuration	E
SYSMGR_CONFD_PHASE1_FAILURE	200005	Failed to generate authorized keys on %s, p_sysmgr->cfg.my_personality	Failed to generate keys required for SSH-based login between the Cisco vManage server and the Cisco SD-WAN device	E
SYSMGR_CONFD_PHASE1_FAILURE	200005	Failed to generate SSH keys for archive	Failed to generate SSH keys	E
SYSMGR_CONFD_PHASE1_FAILURE	200005	Failed to get install id from file, using 00_00	Failed to read previous system version	A
SYSMGR_CONFD_PHASE1_FAILURE	200005	Failed to get previous version, using 0.0	Failed to read system version	A
SYSMGR_CONFD_PHASE1_FAILURE	200005	Failed to transition confd to phase1. Re-initializing CDB..	Confd module failed to move to Phase 1, indicating a possible configuration database failure; device will reboot soon	A
SYSMGR_CONFD_PHASE1_FAILURE	200005	Verified that archive keys exist	Verified that configuration archive keys exist	A
SYSMGR_CONFD_PHASE2_FAILURE	200006	Failed to get current version, using 0.0	Failed to read system version file	A

Message	Number	Message Format	Description	Action
SYSMGR_CONFD_PHASE2_FAILURE	200006	Failed to open %s, version_file	Failed to open system version file	A
SYSMGR_CONFD_PHASE2_FAILURE	200006	Failed to read %s, version_file	Failed to read system version file	A
SYSMGR_CONFD_PHASE2_FAILURE	200006	Failed to transition confd to phase2	Confd module failed to move to Phase 2, indicating a possible configuration database failure; device will reboot soon	A
SYSMGR_CONFD_REPLY_FAIL	200009	Failed to send oper data reply - %s (%d)	Failed to reply to confd; some **show** commands may not work	A
SYSMGR_CONFD_SETPGID_FAILURE	200004	setpgid(0,0) failed: %d	Process group failed to start	A
SYSMGR_DAEMON_DOWN	200012	Daemon %s [%u] went down in vpn %lu,	Process started by system manager went down	A
SYSMGR_DAEMON_EXECV_FAILURE	200016	execv %s failed	Internal failure occurred while starting a process	A
SYSMGR_DAEMON_FORK_FAILURE	200014	Cannot start daemon %s: %s	Internal failure occurred while starting a process	A

Message	Number	Message Format	Description	Action
SYSMGR_DAEMON_INACTIVE	200033	Daemon %s[%lu] @ pid %d died. Rebooting device..	System manager detected a process failure and is about to reboot the device	A
SYSMGR_DAEMON_MSGQ_FAILURE	200013	Could not start msgq to daemon %s. err %d	Failed to establish message queue with process; device may reboot soon	A
SYSMGR_DAEMON_MSGQ_FAILURE	200013	Could not start msgq to quagga daemon %s. err %d	Failed to establish message queue with routing process; device may reboot soon	A
SYSMGR_DAEMON_SETAFFINITY_FAILURE	200061	—	The scheduling of a process failed	E
SYSMGR_DAEMON_SETPGID_FAILURE	200015	setpgid(0,0) failed	Internal failure setting process group of a process	A
SYSMGR_DAEMON_STOPPED	200019	Daemon %s @ pid %u terminated - %s	Daemon started by system manager terminated; device may reboot soon (except for the Cisco vBond Orchestrator)	A

Message	Number	Message Format	Description	Action
SYSMGR_RTC_CLOCK_SET_FAIL	200027	Cannot set hardware clock to %s - %s (errno	Failed to update hardware clock to system time specified by user	A
SYSMGR_SHM_FAIL	200042	Failed to close shared memory %s with an error %d	Failed to completely and properly close the shared memory for communication with other processes	E
SYSMGR_SHM_FAIL	200042	Failed to map shared memory %s	Failed to initialize shared memory for communication with other processes	E
SYSMGR_SHM_FAIL	200042	Failed to open shared memory %s with an error %d	Failed to open shared memory for communication with other processes	E
SYSMGR_SHM_FAIL	200042	Failed to truncate shared memory %s with an error %d	Failed to initialize shared memory for communication with other processes	E
SYSMGR_SHM_FAIL	200042	Failed to unmap shared memory %s	Failed to completely and properly close shared memory for communication with other processes	E

Message	Number	Message Format	Description	Action
SYSMGR_SWITCHBACK_FAILED	200053	Software upgrade to version %s failed because of %s	Software upgrade failed	A
SYSMGR_TIMEZONE_SET_FAIL	200029	Failed to set system timezone to %s (rc = %d)	Failed to set system timezone to timezone specified by user	A
SYSMGR_TRACE_ERROR	200024	—	A trace error occurred	A

Priority: Critical

Message	Number	Message Format	Description	Action
SYSMGR_CONFD_INIT_FAIL	200008	Sysmgr child in charge of migrating confd/ncs to phase2 exited with error code %d	System manager detected a confd process failure; device may reboot	AE
SYSMGR_DISK_ALERT_RED	200034	Disk usage is above 90%% (critically high). Please clean up unnecessary files.	Disk usage is above 90%	AE
SYSMGR_MEMORY_ALERT_RED	200055	System memory usage is above 90%% (critically high)	System memory usage is above 90%	AE
SYSMGR_REBOOT_HALTED	200039	Reboot (reason: %s) terminated...too many reboots	System manager stopped short of rebooting the device because it detected too many reboots in a short period of time	AE
SYSMGR_UPGRADE_FAILED	200052	Software upgrade to version %s failed because of reason	Software upgrade failed	AE

TCPD: TCP Options Process

Priority: Informational

Message	Number	Message Format	Description	Action
TCPD_MSGQ_SERVER	2800002	Server Exception: %s	Proxy server did not accept connection	E

Message	Number	Message Format	Description	Action
TCPD_PROXY	2800004	Enabled TCP_OPT for vpn %lu: %s:%u %s Starting sysmgr_app object tcpd<->ftmd channel established tcpd<->ftmd = Will try connecting	Messages related to starting a proxy	E
TCPD_PROXY	2800004	tcpd error counters -%s	Count of TCP option errors	E
TCPD_SYSLOG_END	2800001	Terminating TCP options	TCP options process ending	E
TCPD_SYSLOG_START	2899999	Starting TCP options	TCP options process starting	E
TCPD_SYSMGR_APP	2800003	%s Exception: %s %s - Sysmgr app::connect -Exception - %s	Messages related to the connection between the system manager and the TCP proxy process	E

Priority: Debug

Message	Number	Message Format	Description	Action
TCPD_SYSMGR_APP	2800003	%s - Registering for send_hello-msg %s: Sending following register msg Sending msg of length %u %s - Sysmgr app::connect %s - Write %u bytes %s - Wrote register msg %u	Messages related to the connection between the system manager and the TCP proxy process	E

TRACKER: Interface Tracker Process

Priority: Informational

Message	Number	Message Format	Description	Action
TRACKER_SYSLOG_CONN_DOWN	1700003	Connection to %s %s Down	Connection to interface is down	E
TRACKER_SYSLOG_CONN_UP	1700002	Connection to %s %s Up	Connection to interface is up	E
TRACKER_SYSLOG_END	1700001	Terminating	Interface tracker process is ending	E
TRACKER_SYSLOG_START	1799999	Starting	Interface tracker process is starting	E

VCONFD: Cisco SD-WAN Configuration Process

Priority: Informational

Message	Number	Message Format	Description	Action
VCONFD_SYSLOG_END	1400001	Terminating	Configuration process is ending	E
TRACKER_SYSLOG_NOTIFICATION	1400002	Notification: %d/%d?%d %d:%d:%d %s severity level: %s hostname: %s system-ip %s process name: %s process id: %s reason: %s	Configuration at specified date and time for a process, with reason	E
TRACKER_SYSLOG_NOTIFICATION	1400002	Notification: %d/%d?%d %d:%d:%d %s severity level: %s hostname: %s system-ip %s status: %s install id: %s message %s	Configuration at specified date and time, with specified status (minor, major)	E
TRACKER_SYSLOG_NOTIFICATION	1400002	Notification: %d/%d?%d %d:%d:%d %s severity level: %s hostname: %s system-ip %s reason: %s	Configuration at specified date and time, with reason	E
TRACKER_SYSLOG_NOTIFICATION	1400002	Notification: %d/%d?%d %d:%d:%d %s severity level: %s hostname: %s system-ip %s reboot reason: %s	Configuration at specified date and time, with reboot reason	E
TRACKER_SYSLOG_NOTIFICATION	1400002	Notification: %d/%d?%d %d:%d:%d %s severity level: %s hostname: %s system-ip %s username: %s remote host: %s	Configuration at specified date and time, for username and remote host	E
TRACKER_SYSLOG_NOTIFICATION	1400002	Notification: %d/%d?%d %d:%d:%d %s severity level: %s hostname: %s system-ip %s vpn id: %s if name: %s mac addr: %s ip-addr:%s	Configuration at specified date and time, for VPN, interface, MAC address, and IP address	E
VCONFD_SYSLOG_START	1499999	Starting	Configuration process is starting	E

VDAEMON: Cisco SD-WAN Software Process

Priority: Informational

Message	Number	Message Format	Description	Action
VDAEMON_SYSLOG_DOMAIN_ID_CHANGE	500006	System Domain-ID changed from '%d' to '%d',	System domain ID changed	E
VDAEMON_SYSLOG_END	599999	—	Process ending	E
VDAEMON_SYSLOG_ORG_NAME_CHANGE	500008	System Organization-Name changed from '%s' to '%s'	System organization name changed	E
VDAEMON_SYSLOG_PEER_STATE	500003	Peer %s Public-TLOC %s Color %u %s,	Peer state changed to up or down	E
VDAEMON_SYSLOG_SITE_ID_CHANGE	500005	System Site-ID changed from '%d' to '%d'	System site ID changed	E
VDAEMON_SYSLOG_START	500001	—	Process starting	E
VDAEMON_SYSLOG_SYSTEM_IP_CHANGE	500007	System-IP changed from '%s' to '%s'	System IP address changed	E

Priority: Error

Message	Number	Message Format	Description	Action
VDAEMON_BOARD_ID_CHALLENGE_FAILED	500002	—	Board ID could not be verified	E
VDAEMON_BOARD_ID_INIT_FAILED	500001	—	Board initialization failed because board ID could not be verified	E
VDAEMON_SYSLOG_CERT_STORE_FAIL	500009	Certificate store init failed	Certificate not stored	AE
VDAEMON_SYSLOG_PEER_AUTH_FAIL	500004	Peer %s Public-TLOC %s Color %u %s	Authentication with a vdaemon peer failed	E
VDAEMON_SYSLOG_PEER_STATE	500003	Failed to read system host name	Internal error reading system hostname; device will not register with the Cisco vManage server or ZTP will fail	A

VRRP: Virtual Router Redundancy Protocol

The VRRP process runs only on Cisco vEdge devices.

Priority: Informational

Message	Number	Message Format	Description	Action
VRRPD_STATE_CHANGE	600002	Group %d, interface %s, vpn %lu state changed to %s	VRRP interface state change	E
VRRPD_SYSLOG_END	699999	Terminating VRRPD	VRRP process is ending	E
VRRPD_SYSLOG_START	600001	Starting VRRPD	VRRP process is starting	E

WLAN: Wireless LAN Process

The wireless LAN process runs only on Cisco vEdge devices.

Priority: Informational

Message	Number	Message Format	Description	Action
WLAN_SYSLOG_END	2300001	Terminating wlan	WLAN process is ending	E
WLAN_SYSLOG_START	2399999	Starting wlan	WLAN process is starting	E

WWAND: Cellular Process

The wireless WAN process runs only on Cisco vEdge devices.

Priority: Informational

Message	Number	Message Format	Description	Action
WWAN_SYSLOG_ADMIN_DWL	2400010	Cellular%d interface is set for deletion	Cellular interface is about to be deleted	E
WWAN_SYSLOG_ADMIN_DOWN	2400009	Cellular%d interface is set to admin down	Cellular interface is administratively Down	E
WWAN_SYSLOG_ADMIN_UP	2400008	Cellular%d interface is set to admin up	Cellular interface is administratively Up	E
WWAN_SYSLOG_CONNECT	2400002	Connected to Cellular%d modem	Connection to cellular modem established	E

Message	Number	Message Format	Description	Action
WWAN_SYSLOG_CONNECT_DATA	2400006	—	—	E
WWAN_SYSLOG_DATA_MONITOR	2400032	Info: %lld bytes left Info: exceeded by %lld bytes	Information about amount of data remaining in billing cycle	E
WWAN_SYSLOG_DATA_SESSION	2400019	Data session started successfully	Data session on cellular interface started successfully	E
WWAN_SYSLOG_DATA_SESSION_BEARER	2400028	Data bearer changed to %s (%lx)	Data carrier changed	E
WWAN_SYSLOG_DATA_SESSION_DISCONNECT	2400023	Data session disconnect: restarting session	Data session was disconnected and is restarting	E
WWAN_SYSLOG_DATA_SESSION_DISC_REASON	2400024	Data session disconnect reason: %s	Reason data session was disconnected	E
WWAN_SYSLOG_DATA_SESSION_DISC_VERB	2400025	Data session disconnect reason verbose: %s	More information about why data session disconnected	E
WWAN_SYSLOG_DATA_SESSION_DOMAIN	2400026	Packet-switched domain state change to %s: registration: %s ran: %s if: %s	Packet-switched domain changed	E
WWAN_SYSLOG_DATA_SESSION_DORMANCY	2400029	Dormancy state changed to %s	Session dormancy state changed	E
WWAN_SYSLOG_DATA_SESSION_NETWORK	2400027	Network registration changed to %s: domain: %s ran: %s if: %s	Network registration changed	E

Message	Number	Message Format	Description	Action
WWAN_SYSLOG_DATA_SESSION_START	2400018	Starting data session on Cellular%e	Data session on cellular interface is starting	E
WWAN_SYSLOG_DATA_SESSION_STATE	2400020	Data session state changed to %s	Data session status	E
WWAN_SYSLOG_DATA_SESSION_STOP	2400022	Data session stopped successfully	Data session stopped	E
WWAN_SYSLOG_DISCONNECT	2400003	Disconnected LTE modem %d	Disconnection from LTE modem	E
WWAN_SYSLOG_END	2400001	Terminating WWAND	Ending WWAN process	E
WWAN_SYSLOG_FIRMWARE	2400007	Failed to get firmware details after upgrade on modem %d Firmware upgrade failed on modem %d Firmware upgrade successful on modem %d Upgrading firmware configuration on modem %d Upgrading firmware image on modem %d	Messages related to firmware upgrade on the cellular modem	E
WWAN_SYSLOG_LR_DOWN	2400012	%s%d: bringing down	Last-resort interface is shutting down	E
WWAN_SYSLOG_LR_UP	2400011	%s%d: bringing up	Last-resort interface is starting	E

Message	Number	Message Format	Description	Action
WWAN_SYSLOG_MODEM_ACTIVATION	2400039	Modem activation status: %s (%lu)	Modem actual state and status	E
WWAN_SYSLOG_MODEM_PMODE	2400017	Modem is not in online mode Modem is not in online mode (tmp: %s degrees C) Modem power state is: %s (prev: %s) Modem set to %s (prev: %s) Powered off the modem %d	Messages related to modem power mode status	E
WWAN_SYSLOG_MODEM_STATE	2400034	Modem device state changed to %s	Modem state changed	E
WWAN_SYSLOG_MODEM_TEMP	2400037	Modem temperature %d degree C: %s	Modem temperature and state	E
WWAN_SYSLOG_MODEM_UP	2400035	WWAN cellular%d modem is back up	Modem reconnected	E
WWAN_SYSLOG_OMA_DM_DONE	2400041	Modem OMA DM configuration completed	Modem OMA-DM configuration finished	E
WWAN_SYSLOG_OPER_DOWN	2400014	Cellular%d set if down	Cellular interface is operationally Down	E
WWAN_SYSLOG_OPER_UP	2400013	Cellular%d set if up	Cellular interface is operationally Up	E

Message	Number	Message Format	Description	Action
WWAN_SYSLOG_PROFILE_CHECK	2400030	Profile %lu with PDP: %s APN: %s Auth: %s User: %s	Cellular profile information	E
WWAN_SYSLOG_REBOOT	2400040	Cellular%d modem mode updated: rebooting; %s reason	Reason why celluar modem rebooted	E
WWAN_SYSLOG_SDK_DOWN	2400005	SDK got terminated: %s	Connection to software development kit terminated	E
WWAN_SYSLOG_SDK_UP	2400004	Connected to Cellular%d sdk process	Connection to cellular software development kit established	E
WWAN_SYSLOG_SIM_STATUS	2400033	SIM status changed to: %s	SIM status changed	E
WWAN_SYSLOG_START	2499999	Starting WWAND	Starting WWAN process	E
WWAN_SYSLOG_TRACK_GW_UP	2400015	Cellular%d gateway %s is reachable	Cellular gateway is reachable	E

Priority: Error

Message	Number	Message Format	Description	Action
WWAN_SYSLOG_AUTO_PROFILE_MISS	2400031	Manually configure APN profile for the data connection	Data session could not start because required APN could not be located	E
WWAN_SYSLOG_MODEM_DOWN	2400036	WWAN cellular%d modem went down	Modem is disconnected	E
WWAN_SYSLOG_MODEM_RESET	2400038	Failed to recover Cellular %d modem	Connection to modem could not be reestablished	E
WWAN_SYSLOG_TRACK_GW_DOWN	2400016	Cellular%d gateway %s is not reachable	Cellular gateway is not reachable	E

Troubleshoot a Device

You can troubleshoot connectivity or traffic health for all devices in the overlay network.

Troubleshoot Common Cellular Interface Issues

Resolve Problems with Cellular Interfaces

This topic describes the most common issues and error messages that occur with cellular connections from the router to the cellular network, and the steps to resolve them.

Insufficient Radio Signal Strength

Problem Statement

The cellular module in the router cannot detect a radio signal from the service provider network.

Identify the Problem

- The signal strength displayed in the Cisco vManage Cellular Status screen or with the **show cellular status** CLI command, or in the Cellular Radio screen or with the **show cellular radio** command is no signal, poor, or good. It should be excellent. The following table lists the ranges of signal strengths:

Table 148:

Signal	Excellent	Good	Fair	Poor	No Signal
Received signal strength indicator (RSSI)	> –58 dBm	–81 through –58 dBm	—	–82 through –95 dBm	< –96 dBm
Reference signal receive power (RSRP)	–44 through –90 dBm	–91 through –105 dBm	–106 through –120 dBm	–121 through –140 dBm	< –140 dBm
Reference signal receive quality (RSRQ)	–3 through –8 dB	–9 through –12 dB	—	–13 through –20 dB	< –20 dB
Signal-to-noise ratio (SNR)	> 10 dB	6 through 10 dB	0 through 5 dB	< 0 dB	—

- The wireless LED on the router is lit (solid or blinking) and is red, orange or yellow, or it is blinking green. It should be solid green.

Resolve the Problem

1. Examine the router to verify that both basic antennas are correctly installed.
2. Contact the service provider to verify that the location has coverage.
3. Move the router to a new location within the building.
4. Procure an additional external cabled antenna and connect it to the router.

Modem Status Remains in Low-Power Mode

Problem Statement

End users cannot connect to the cellular network, and the modem status remains in low-power mode.

Identify the Problem

- End users cannot connect to the cellular network.
- The error message "Missing or unknown APN" is generated.
- The signal strength is less than excellent.

Resolve the Problem

1. Verify that there is sufficient radio signal strength. If there is not, follow the instructions in the Insufficient Radio Signal Strength section.
2. Verify that the cellular0 interface is operational. When the cellular interface is shut down, the modem status is set to Low Power mode. To do this, from the Cisco vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: To do this, from the Cisco vManage menu, choose **Monitor** > **Network**.

   Then click **Real Time**, and from the **Device Options** drop-down list, choose **Interface Detail**.

   To do this from the CLI, use the **show interface** command. Check that the Admin Status and Oper Status values are both Up.
3. Verify that the modem temperature is not above or below the threshold temperatures. To view the modem temperature, from the Cisco vManage menu, choose **Monitor** > **Devices** and select the router.

   Cisco vManage Release 20.6.x and earlier: To do this, from the Cisco vManage menu, choose **Monitor** > **Network**.

   Then click **Real Time**, and from the **Device Options** drop-down list, choose **Cellular Modem**.

   From the CLI, use the **show cellular modem** command.
4. Check that the access point name (APN) in the profile for the cellular0 interface matches the name expected by your service provider. Some service provides required that you configure the APN, and they include configuration instructions in the SIM card package.
   a. To check which APN name is configured, from the Cisco vManage menu, choose **Monitor** > **Devices** and select the router.

      Cisco vManage Release 20.6.x and earlier: To do this, from the Cisco vManage menu, choose **Monitor** > **Network**.

      Then click **Real Time**, and from the **Device Options** drop-down list, choose **Cellular Profiles**.

      From the CLI, use the ; **show cellular profiles** command. The APN column shows the name of the APN. Each profile specifies an access point name (APN), which is used by the service provider to determine the correct IP address and connect to the correct secure gateway. For some profiles, you must configure the APN.
   b. If the APN is not the one required by the service provider, configure the correct APN. From the Cisco vManage menu, choose **Configuration** > **Templates** and use the **Cellular Profile** feature template.

      To configure this from the CLI, use the **cellular cellular0 profile apn** command.

5. If none of the previous steps works, reset the cellular interface.

Error Messages

The following table list the most common error messages that are displayed regarding cellular interfaces:

Table 149:

Error Message	Problem Statement	How Do I Fix the Problem
Authentication failed	End user authentication failed, because the service provider cannot authenticate either the user's SIM card or the Cisco vEdge device SIM card.	Contact the cellular service provider.
Illegal ME	The service provider denied access to an end user, because the end user is blocked from the network.	Contact the cellular service provider.
Illegal MS	The service provider denied access to an end user, because the end user failed the authentication check.	Contact the cellular service provider.
Insufficient resources	The service provider network is experiencing congestion because of insufficient resources and cannot provide the requested service to an end user.	The Cisco vEdge device automatically tries to reconnect. (The duration between retries depends on the service provider.) If the issue does not resolve itself, contact the cellular service provider.
IPV4 data call throttled	The SIM card being used in the Cisco vEdge device requires that you configure static APN.	Verify whether the data plan associated with the SIM card requires a static APN. If so, change the APN to the name specified the SIM card instructions, as described in Modem Status Remains in Low-Power Mode , above.
Missing or unknown APN	End users cannot connect to the cellular network, either because an APN is required and is not included in the cellular profile or because the APN could not be resolved by the service provider.	See the profile's APN, as described in Modem Status Remains in Low-Power Mode , above.
MS has no subscription for this service	The service provided denied access to an end user, because the end user has no subscription.	Contact the cellular service provider.
Network failure	The service provider network is experiencing difficulties.	The Cisco vEdge device automatically tries to reconnect. (The duration between retries depends on the service provider.) If the issue does not resolve itself, contact the cellular service provider.

Error Message	Problem Statement	How Do I Fix the Problem
Network is temporarily out of resources	The service provider network is experiencing congestion because of insufficient resources and cannot provide the requested service to an end user.	The Cisco vEdge device automatically tries to reconnect. (The duration between retries depends on the service provider.) If the issue does not resolve itself, contact the cellular service provider.
Operator has barred the UE	The service provided denied access to an end user, because the operator has barred the end user.	Contact the cellular service provider.
Requested service option not subscribed	The SIM card being used in the Cisco vEdge device requires that you configure a static APN entry.	Verify whether the data plan associated with the SIM card requires a static APN. If so, change the APN to the name specified the SIM card instructions, as described in Modem Status Remains in Low-Power Mode , above.
Service not supported by the PLMN	The Public Land Mobile Network (PLMN) does not support data service.	Contact the cellular service provider.

Troubleshoot WiFi Connections

This topic describes how to check and resolve connection problems between a WiFi client and a WiFi network that is provided by a WiFi router. The procedures described here are applicable to devices that support WiFi only.

Check for WiFi Connection Problems

If a WiFi client is unable to connect to a WiFi network when a router is providing the WiFi network, follow these steps to determine the source of the problem. To perform each step, use a method appropriate for the WiFi client.

1. Verify that the WiFi client can locate the service identifier (SSID) advertised by the router. If the client cannot find the SSID, see the section, SSID Not Located.
2. Verify that the WiFi client can connect to the SSID advertised by the router. If the client cannot connect to the SSID, see the section, SSID Connection Fails.
3. Verify that the WiFi client has been assigned an IP address. If the client cannot obtain an IP address, see the section, Missing IP Address.
4. Verify that the WiFi client can access the Internet. If the client cannot connect to the Internet, see section, Internet Connection Failure.
5. If the WiFi client connection is slow or if you notice frequent disconnects, see section, WiFi Speed Is Slow.

Resolve Problems with WiFi Connections

This section describes the most common issues that occur with WiFi connections between a WiFi client and a router, and it describes steps to resolve the issues.

SSID Not Located

Problem Statement

The WiFi client cannot locate the SSID advertised by the router.

Resolve the Problem

1. Ensure that the basic service set identifier (BSSID) address for the SSID is valid:

   a. From the Cisco vManage menu, choose **Monitor** > **Devices**.

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

   b. Choose a device from the device list that appears.

   c. From the left pane, choose WiFi. The right pane displays information about WiFi configuration on the router.

   d. In the right pane, locate the SSID. Check that the BSSID for this SSID does not have a value of 00:00:00:00:00:00.

   e. If the BSSID is 00:00:00:00:00:00, the WLAN (VAP) interface for this SSID may be misconfigured. Ensure that the WLAN interface has been added to a bridge during the configuration process. To view the running configuration of the device, from the Cisco vManage menu, choose **Configuration** > **Devices**. For the desired device, click **...**and choose **Running Configuration**.

      To view the running configuration of the device from the CLI, use the **show running-config** command. To add the WLAN interface to a bridge — from the Cisco vManage, choose **Configuration** > **Templates**.

      Click **Feature Templates**, and choose the **Bridge** feature template.

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

2. Eliminate static channels. A static channel is one where you explicitly configure the radio channel rather than allowing the router to automatically select the best radio channel. A slow static channel may appear to be an unreachable SSID.

   a. View the current SSID channel setting for the router. To do this, from the Cisco vManage menu, choose **Monitor** > **Devices** and choose a device from the list of devices that appears. Then click **Real Time**, and in the **Device Options** drop-down list, choose WLAN Clients or WLAN Radios.

      From the CLI, use the **show wlan clients** or **show wlan radios** command.

   b. If the channel is set to a specific number, change the value to "auto". To do this, use the WiFi Radio feature template in Cisco vManage.

      From the CLI, use the **wlan channel auto** command.

3. Ensure that the WiFi client is using the same radio band as the router, either 2.4 GHz (for IEEE 802.11b/g/n) or 5 GHz (for IEEE802.11a/n/ac):
    a. Check which radio band the WiFi client supports.
    b. Check the router's Select Radio setting. To do this, from the Cisco vManage menu, choose **Monitor** > **Devices** and choose a device from the device list that appears. Then click **Real Time**, and in the **Device Options** drop-down list, choose **WLAN Radios**.

        From the CLI, use the **show wlan radios** command.
    c. If the router and WiFi client radio band settings do not match, either change the WiFi client's radio band or change the settings on the router so that they match. To do this, use the Wifi Radio feature template.

        From the CLI, use the **wlan** command.

SSID Connection Fails

Problem Statement

The WiFi client can locate the SSID advertised by the router but cannot connect to it.

Resolve the Problem

1. If you configure passwords locally on the router, ensure that the WiFi client's password matches the SSID's password.
2. If you are using a RADIUS server, ensure that the RADIUS server is reachable and that the WiFi client's username and password match the RADIUS configuration:
    a. To verify that the RADIUS server is reachable from the router, ping the server. To do this in Cisco vManage, ping a device. From the CLI, use the **ping** command.
    b. Check for matching passwords on the RADIUS server and WiFi client.
3. Ensure that you do not exceed the maximum number of clients for this SSID:
    a. Verify the number of used clients and the maximum number of clients:
        - From the Cisco vManage menu, choose **Monitor** > **Devices** and choose a device from the device list that appears. From the left pane, select WiFi. In the right pane, locate the SSID. Check the No. of Clients field. If the used/maximum values are equal, no more clients can connect to this SSID.
        - From the CLI, use the **show wlan interfaces detail** command.
    b. If needed, increase the maximum clients setting for your SSID. To do this use the WiFi SSID feature template in Cisco vManage.

        From the CLI, use the **max-clients** command.
4. Ensure that the WiFi client supports WPA2 management security:
    a. Check your Management Security setting. To do this, from the Cisco vManage menu, choose **Monitor** > **Devices** and choose a device from the device list that appears. Then click **Real Time**, and in the **Device Options** drop-down list, choose **WLAN Interfaces**.

From the CLI, use the **show wlan interfaces** command. If the management security value is set to "required," the WiFi client must support WPA2 security.

b. If necessary, change the Management Security setting for your SSID to "optional" or "none." To do this in Cisco vManage, use the WiFi SSID feature template.

From the CLI, use the **mgmt-security** command.

Missing IP Address

Problem Statement

The WiFi client can connect to the SSID, but cannot obtain an IP address.

Resolve the Problem

Ensure that a DHCP server is reachable and has an available IP address in its address pool:

1. If the router is acting as a DHCP helper (DHCP relay agent), ping the DHCP server to ensure that it is reachable from the router.. From the CLI, use the **ping** command.
2. If you are using a remote DHCP server, check that the remote DHCP server has an available IP address in its address pool.
3. If the router is acting as the local DHCP server:
   - **a.** View the number of addresses being used. From the Cisco vManage menu, **Monitor** > **Devices** and choose a device from the device list that appears. Next, click **Real Time**, and from the **Device Options** drop-down list, choose **DHCP Servers**.

     From the CLI, use the **show dhcp server** command.
   - **b.** Compute the number of IP addresses in the pool based on the configured DHCP address pool size and the number of addresses excluded from the DHCP address pool. To view these values in Cisco vManage, from the Cisco vManage menu, choose **Configuration** > **Devices**. For the desired router, click **...** and choose **Running Configuration**.

     To view them from the CLI, use the **show running-config** command.
   - **c.** If necessary, increase the range of addresses in the router's DHCP address pool using the DHCP-Server feature template in Cisco vManage.

Internet Connection Failure

Problem Statement

The WiFi client is connected to the SSID and has an IP address, but it cannot connect to the Internet.

Resolve the Problem

Ensure that the WiFi client has received the correct default gateway and DNS settings from the DHCP server:

1. If the DHCP server is remote, check the settings on the server.
2. If the router is the DHCP server, ensure that the default gateway and DNS server settings are the same as those on the WiFi client. To view the settings in Cisco vManage, from the Cisco vManage menu, choose **Monitor** > **Devices**, and choose a device from the device list that is displayed. Click **Real Time,** and in the **Device Options** drop-down list, choose **DHCP Interfaces**.

From the CLI, use the **show dhcp interface** command.

WiFi Speed Is Slow

Problem Statement

The WiFi client can connect to the Internet, but the connection speed is slow.

Resolve the Problem

Allow the router to choose the best WiFi channel:

1. View the current SSID channel setting for the router. To do this in Cisco vManage, from the Cisco vManage menu, choose **Monitor** > **Devices**, and choose a device from the device list that is displayed. Click **Real Time,** and in the **Device Options** drop-down list, choose **WLAN Clients**.

   From the CLI, use the **show wlan clients** or **show wlan radios** command.

2. If the channel is set to a specific number, change the value to "auto". To do this in Cisco vManage, use the WiFi Radio feature template.

   From the CLI, use the **wlan channel auto** command.

View Audit Log Information

Set Audit Log Filters

Table 150: Feature History

Feature Name	Release Information	Description
Compare Template Configuration Changes Using Audit Logs	Cisco IOS XE Release 17.9.1a Cisco vManage Release 20.9.1	This feature introduces a **Config Diff** option for audit logs of device templates and feature templates to view the configuration changes when a template is not attached to a device.

1. From the Cisco vManage menu, choose **Monitor** > **Logs** > **Audit Log**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage menu, choose **Monitor** > **Audit Log**.

2. Click the **Filter**.

3. In the **Module** field, choose the entity for which you are collecting audit logs. You can choose more than one entity.

4. Click **Search** to search for logs that match the filter criteria.

Cisco vManage displays a log of activities both in table and graphical format.

Export Audit Log Data in CSV Format

To export data for all audit logs to a file in CSV format, click **Export**.

Cisco vManage downloads all data from the audit logs table to an Excel file to a CSV format. The file is downloaded to your browser's default download location and is named Audit_Logs.csv.

View Audit Log Details

To view detailed information about any audit log:

1. Choose the audit log row of from the table
2. For the desired row, click **...** and choose **Audit Log Details**.

The **Audit Log Details** dialog box opens, displaying details of the audit log.

View Changes to a Configuration Template

You can view changes for previous and current configuration made on a template. To view configuration changes made to a template, do the following:

1. Click the audit log row in the table where the module type is a template.
2. Click **...** adjacent to the template module and click **Config Diff**.

   The **Config Difference** pane displays a side-by-side view of the differences between the configuration that was originally in the template and the changes made to the configuration. To view the changes inline, click **Inline Diff**.

To view the updated configuration on the device, click **Configuration**.

Starting from Cisco IOS XE Release 17.6.1a and Cisco SD-WAN Release 20.6.1, for template and policy configuration changes, the **Audit Logs** option displays the action performed. To view the previous and current configuration for any action, click **Audit Log Details**. Audit logs are collected when you create, update, or delete device or feature templates, and localized or centralized, and security policies. Audit logs shows the changes in API payloads when templates or policies are attached or not attached.

View and Monitor Cellular Interfaces

This topic describes how to monitor the status of cellular interfaces in Cisco SD-WAN devices.

Monitor Cellular Interfaces

You can verify signal strength and service availability using either Cisco vManage or the LED on the router. You can view the last-seen error message for cellular interfaces from Cisco vManage.

Verify Signal Strength

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 151:

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 vManage menu, choose **Monitor** > **Devices**.

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 Real Time Monitoring Options

Table 152: Feature History

Feature Name	Release Information	Description
Additional Real Time Monitoring Support for Routing, License, Policy, and Other Configuration Options	Cisco IOS XE Release 17.6.1a Cisco SD-WAN Release 20.6.1 Cisco vManage Release 20.6.1	This feature adds support for real-time monitoring of numerous device configuration details, including routing, policy, Cloud Express, Cisco vBond Orchestrator, TCP optimization, SFP, tunnel connection, license, logging, and Cisco Umbrella information. Real-time monitoring in Cisco vManage is similar to using **show** commands in the CLI of a device. There are many device configuration details for Cisco vManage. However, only a subset of the device configuration details is added in Cisco IOS XE Release 17.6.1a and Cisco vManage Release 20.6.1.
Additional Real Time Monitoring Support for AppQoE and Other Configuration Options	Cisco IOS XE Release 17.9.1a Cisco SD-WAN Release 20.9.1 Cisco vManage Release 20.9.1	This feature adds support for real-time monitoring of AppQoE and other device configuration details in Cisco vManage.

View AppQoE Information

Minimum release: Cisco vManage Release 20.9.1

To view AppQoE information on a device, perform the following steps:

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 the following commands:

Device Option	Command	Description
AppQoE Active Flow Details	show sdwan appqoe flow flow-id [flow_id]	Displays the details of a single specific flow.
AppQoE Expired Flows Summary	show sdwan appqoe flow closed all	Displays the summary of AppQoE expired flows.
AppQoE Active Flows Summary	show sdwan appqoe flow vpn-id [vpn_id] server-port [server_port]	Displays flows for a specific VPN.
AppQoE Expired Flow Details	show sdwan appqoe flow closed flow-id [flow_id]	Displays the AppQoE Expired Flow details for a single specific flow.

View a Configuration Commit List

Minimum release: Cisco vManage Release 20.9.1

To view a configuration commit list on a device, perform the following steps:

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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
Configuration Commit List	show configuration commit list	Displays the configuration commit list.

View the System Clock

Minimum release: Cisco vManage Release 20.9.1

To view the system clock on a device, perform the following steps:

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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
System Clock	show clock	Displays the system clock date and time.

View TCP Optimization Information

View WAN Throughput

If TCP optimization is enabled on a router, you can view information about how the optimization affects the processing and throughput of TCP data traffic on the router:

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

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

2. Choose a device from the list of devices that displays.
3. In the left pane, click **WAN Throughput**. The right pane displays the WAN throughput, in megabits per second.

The upper part of the right pane contains the following elements:

- Chart Options bar—Located directly under the device name, this bar includes the Filter Options drop-down and time periods. Click **Filter** to limit the data to display based on VPN, local TLOC color, destination IP address, remote TLOC color, and remote system IP address. Click a predefined or custom time period for which to display data.
- Average optimized throughput information in graphical format.
- WAN graph legend—Identifies non-optimized and TCP optimized packet throughput.

The lower part of the right pane shows the hourly average throughput and the total optimized throughput, both in megabits per second.

Click **TCP Optimization–Connections** in the left pane to view status information about all the tunnels over which the most TCP-optimized traffic is flowing. The upper part of the right pane contains the following elements:

- TCP Optimization Connections in graphical format.
- Connection State boxes—Select the connection state or states to view TCP optimization information.

The lower part of the right pane contains the following elements:

- Filter criteria.
- Flow table that lists information about each of the tunnels, including the tunnel's connection state.

View TCP-Optimized Flows for Cisco vEdge Devices

To view information about TCP-optimized flows on a Cisco vEdge device:

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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:

Note The following options are available when you choose a Cisco vEdge device.

Device Option	Command	Description
TCP Optimization Active Flows	show app tcp-opt	Displays information about active TCP-optimized flows.
TCP Optimization Expired Flows	show app tcp-opt	Displays information about expired TCP-optimized flows.
TCP Optimization Summary	show app tcp-opt	Displays a summary of the TCP-optimized flows.

View TLOC Loss, Latency, and Jitter Information

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

   Cisco vManage Release 20.6.x and earlier: From the Cisco vManage 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 the aggregated average loss or latency/jitter information for all TLOC colors.

The upper part of the right pane contains the following elements:

- Chart Options— Includes the Chart Options drop-down and time periods. Click Chart Options to select the type of data to view. Click a predefined or custom time period for which to view data.
- TLOC information in graphical format. The time interval in the graph is determined by the value of the BFD application-aware routing poll interval .
- TLOC graph legend—Choose a TLOC color to display information for just that TLOC.

The lower part of the right pane contains the following elements:

- Search box—Includes the Search Options filter.
- TLOC color table that lists average jitter, loss, and latency data about all TLOCs. By default, the first six colors are selected. 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 TLOC colors. You can select and view information for a maximum of 30 TLOCs at one time.
  - 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 SD-WAN Application Intelligence Engine (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.