Cisco Unified Branch

Large Branch Deployment Guide

May 2026

Introduction

Branch offices commonly face IT challenges such as limited onsite technical resources, increased operational complexity from managing multiple disparate devices, and heightened security vulnerabilities due to fragmented solutions. These challenges are compounded by the need to scale quickly to support new technologies like AI and IoT, all while ensuring a consistent and reliable user experience across locations.

Cisco Unified Branch helps address these issues by providing an integrated, full-stack solution that consolidates essential networking and security functions—including routing, next-generation firewall, switching, and Wi-Fi—into a centrally managed solution. With Cisco Validated Designs (CVDs) and built-in automation toolkits like Cisco Workflows and Branch as Code (BaC), organizations can streamline deployment and management, reduce the risk of misconfiguration, and enforce consistent security policies. This unified approach not only simplifies branch operations but also enhances scalability, strengthens security, and delivers a seamless customer experience.

Cisco Validated Designs (CVDs) are thoroughly tested blueprints with prescriptive guidance for deploying Cisco solutions across various technologies. Cisco Unified Branch combines this validated design expertise with modern automation through Cisco Workflows and Branch as Code (BaC), allowing enterprises and partners to deploy, manage, and scale branch networks consistently and reliably, in line with modern DevOps approaches.

About this guide

The Cisco Unified Branch architecture, with supported platforms and a variety of use cases, is being developed, tested, and released in phases. This current phase supports multiple flavors of MXs, Cisco secure routers, Cisco switches, and access points at the branch using the Meraki cloud dashboard for management, and Auto VPN for the SD-WAN overlay. Catalyst switches must run in cloud mode (not device mode), meaning they must be managed and configured only from the Meraki Dashboard. Small, medium, and large branch designs have been defined.

The Cisco Validated Design (CVD) documentation for Cisco Unified Branch consists of a design guide and several deployment guides. The design guide provides an overview of the Unified Branch architecture for small, medium, and large branches, discussing the hardware, services, and features supported. It also includes the configuration choices for each branch design. The deployment guides cover an example small branch, medium branch, and large branch deployment, along with step-by-step instructions on how to deploy each of them using the Meraki Dashboard.

This guide covers an example Unified Branch large branch deployment, which consists of two WAN transports, two routers deployed as a High Availability (HA) pair, two switches in a physical stack for the distribution layer, two switches for the access layer, and one access point. The deployment includes firewall policy, performance-based routing, 802.1x and Mac Authentication Bypass (MAB), QoS, Wireless guest and corporate traffic, various security and management features, Cisco Secure Access secure internet access (SIA), Adaptive Policy, an external RADIUS server for VLAN and SGT assignment, and Thousand Eyes, Splunk, and XDR integrations.

This guide does not cover Branch as Code (BaC) or Cisco Workflows, as they are covered separately, however, the design and configuration closely reflect what is implemented by BaC and Workflows. Refer to Appendix D for additional documentation references.

Deployment example

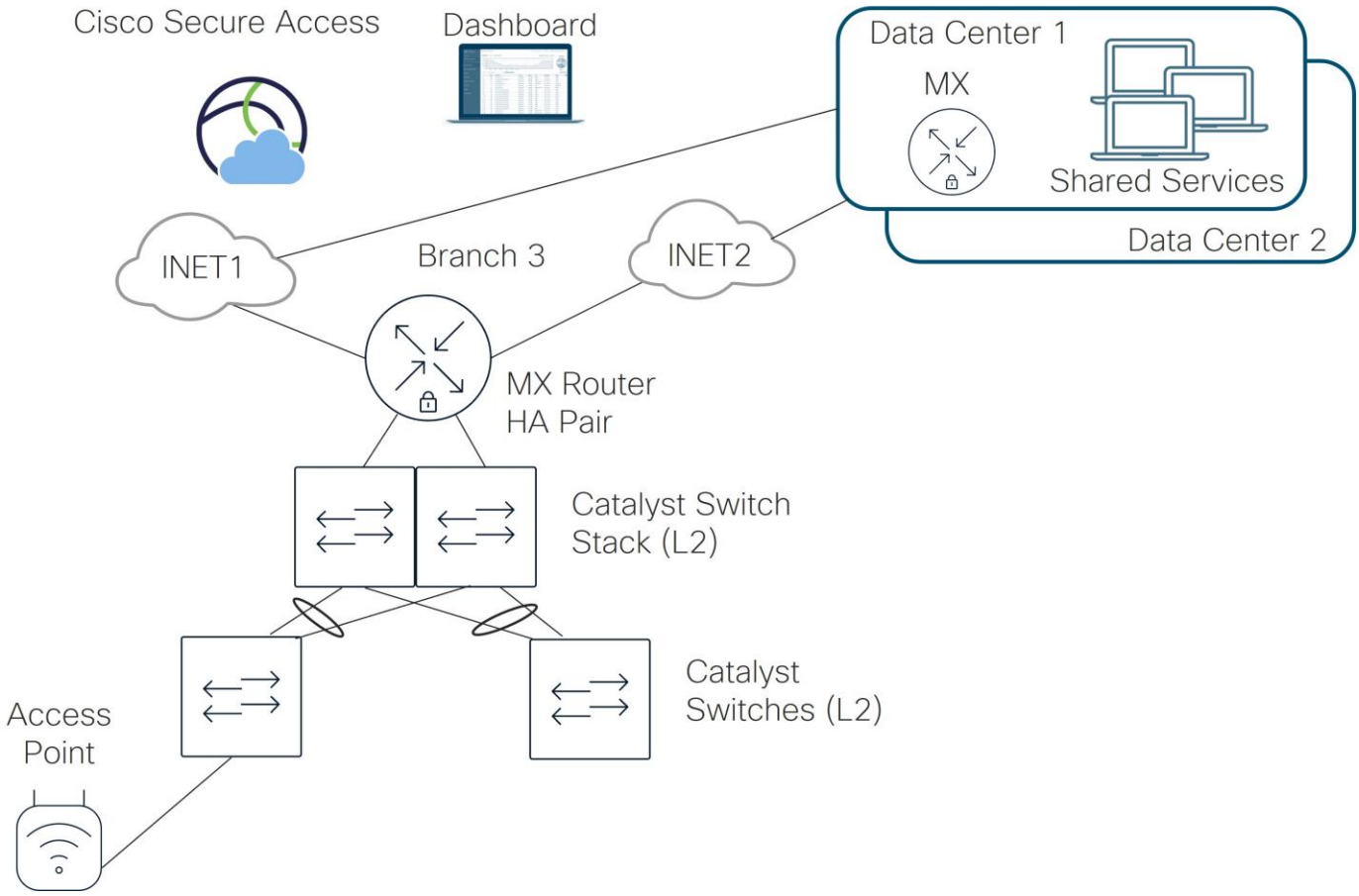
This topology depicts a branch (Branch 3/Site 3) composed of:

- 2 MX routers in an HA pair (MX105s)
- 1 switch stack consisting of 2 Catalyst Layer 2 switches for the distribution layer (C9300-24Ps (IOS XE))
- 2 Catalyst Layer 2 switches for the access layer (C9200L-24P-4Gs (IOS XE))
- 1 access point (CW9176I)

There are two WAN interfaces on each MX, each connected to an internet transport. Branch 3 is configured in a hub and spoke topology, with Data Center 1 as the primary hub and Data Center 2 as the secondary. Cisco Secure Access is leveraged to provide secure internet access (SIA) for most traffic at the branch. At the data center, multiple shared services exist, including DNS, DHCP, RADIUS, and various management platforms for SNMP, syslog, and NetFlow. For SNMP, traps from the dashboard and polling to the dashboard and devices are implemented. An external RADIUS server is leveraged for assignment of VLANs and SGT tags.

This diagram depicts a logical view of the topology:

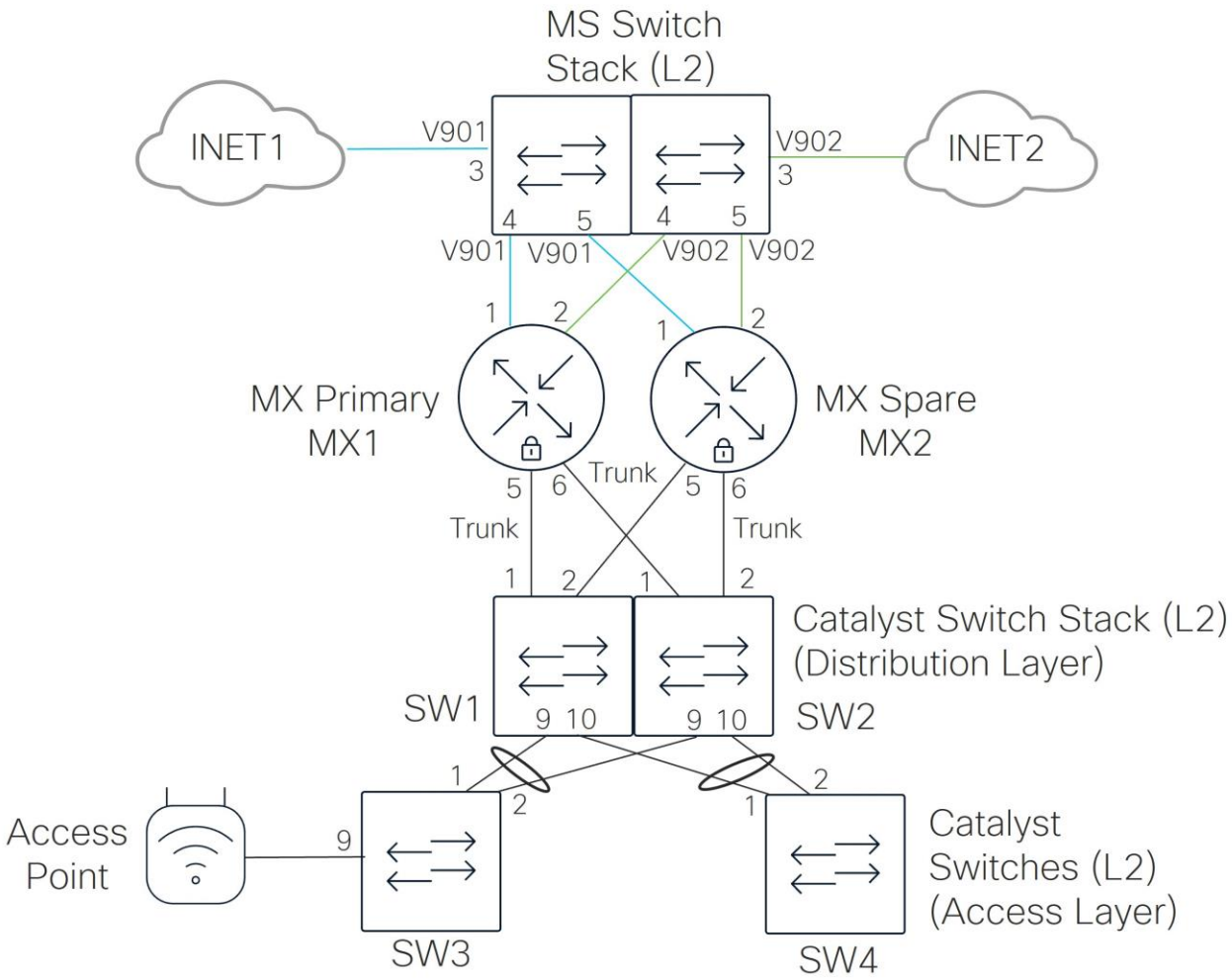
Figure 1. Unified Branch large branch deployment example (Branch 3) logical view



Refer to Appendix A to view the hardware models and code versions used in this example topology. New dashboard GUI versions were used wherever possible at the time of this writing (March 2026). Also, Appendix B provides the dashboard and device settings that were used so the step-by-step and screenshots can be skipped.

Physical topology

In this example, the MX routers operate in active/passive mode and share access to each internet transport. Only one MX router is active at any one time. The L2 switch stack is repurposed to front-end both internet transports so only one connection to each transport is needed for the pair of routers. A separate VLAN (901) is provisioned for one transport, and a separate VLAN (902) is provisioned for the other transport. These VLANs are not carried on the trunks on the LAN-side.



The table lists the ports used in this example:

Device	Port #	Device	Port #	Device	Port #	Device	Port #	Port Configuration
SW1	3	INET1	N/A	SW2	3	INET2	N/A	Access Port (VLAN 901 or 902)
SW1	4	MX1	1 or 3	SW2	4	MX1	2 or 4	Access Port (VLAN 901 or 902)
SW1	5	MX2	1 or 3	SW2	5	MX2	2 or 4	Access Port (VLAN 901 or 902)
SW1	1	MX1	5	SW2	1	MX1	6	Trunk Port (VLANs 1 (Native),40,50,999)

Device	Port #	Device	Port #	Device	Port #	Device	Port #	Port Configuration
SW1	2	MX2	5	SW2	2	MX2	6	Trunk Port (VLANs 1 (Native),40,50,999)
SW1	9	SW3	1	SW2	9	SW3	2	Trunk Port (VLANs 1 (Native),10,20,30,40,50,999)
SW1	10	SW4	1	SW2	10	SW4	2	Trunk Port (VLANs 1 (Native),10,20,30,40,50,999)
SW3	9	Access Point	0	---	---	---	---	Trunk Port (VLANs 1,10,20,30,40,50,999 (Native))

On the switches, the additional ports in this table are reserved for infrastructure, AP connections, and devices:

Device	Port #	Purpose	Port Configuration
MX1	7-10	Unused	Disabled
SW1 or SW2	6-8	Any Infrastructure	Disabled
SW1 or SW2	11-24 or 11-48	Dedicated to Access Switch Connections	Disabled
SW3 or SW4	3-4	Dedicated to Distribution Switch Connections	Disabled
SW3	5-8, 10-12	Dedicated to APs	Disabled
SW4	5-12	Dedicated to APs	Disabled
SW3 or SW4	13-24 or 13-48	Dedicated to Devices	Access Ports, protected by RADIUS

Tech tip: On the MX router, If the backup WAN interface will be enabled at some point, plan using the SFP ports, physical ports 1 and 2 from the beginning (instead of ports 3 and 4). When the backup WAN port is enabled, it will use physical port 4 and move the internet ports to physical port 1 and 2 (SFP ports). Enabling the backup WAN interface will cut off Dashboard control traffic to the devices if ports 3 and 4 are actively being used for internet access. If you add SFP modules to a running system, the MX will need a reboot in order to detect and start utilizing port 1 (or 3). Alternatively, the active port can be specified by configuring the port through the local status page.

Network description

These details further describe the network:

- The MX routers for the hubs and branch are deployed in routed mode.
- There is an active MX router and a passive MX router. Each MX connects to a switch which gives each MX access to the same internet transport through a shared VLAN. In this example, the MX routers leverage a virtual uplink IP address that is shared when sending traffic to the internet. This virtual uplink IP address must be in the same subnet as the IP addresses of the MXs and also must be different from both MX uplink IP addresses.

- This table describes the seven interface VLANs that are defined on the MX router. The subnet structure is designed so global firewall rules on the MX router can be minimized. SITE# refers to Branch/Site “3” in this example. DHCP can be local to the branch or relayed to the data center to a centralized DHCP server. The DNS server defined in the DHCP settings can be located on the internet or at the data center. Some VLANs defined on the MX router are not advertised across the auto VPN overlay (indicated by **Disabled** under the **VPN Mode** column).

VLANs	Subnet Structure	DHCP Location	DNS Location	VPN Mode
VLAN 1 (Default)	192.168.128.0/24	Local	Internet (Use OpenDNS)	Disabled
VLAN 10 (DATA)	10.<VLAN#>.<SITE#>.0/24	Data Center	Data Center	Enabled
VLAN 20 (VOICE)	10.<VLAN#>.<SITE#>.0/24	Data Center	Data Center	Enabled
VLAN 30 (IOT)	10.<VLAN#>.<SITE#>.0/24	Data Center	Data Center	Enabled
VLAN 40 (PCI)	10.<VLAN#>.<SITE#>.0/24	Data Center	Data Center	Enabled
VLAN 50 (GUEST)	172.16.99.0/24	Local	Internet (Use OpenDNS)	Disabled
VLAN 999 (INFRA)	10.250.<SITE#>.0/24	Local	Data Center	Enabled

- VLAN 1 is used for initial onboarding to the dashboard, then all device management is switched to tagged VLAN 999 with unique addressing so this traffic can use the various services in the data center, such as syslog, NetFlow, and SNMP services. One exception is the Access Point. The switch trunk to each access point is configured for Native VLAN 999 so the AP management traffic has reachability in VLAN 999.
- In general, traffic from one VLAN cannot access another VLAN due to firewall rules. Exceptions are made for shared services (DATA subnet can access printer services within the branch and DATA, IOT, VOICE, PCI, and INFRA subnets can access shared services within the data center). Guest and Default VLAN traffic and some traffic from the DATA and INFRA VLANs are permitted to go out direct internet access (DIA).
- The WAN uplinks on the MX router are set to rate limit on the provider sub-line rate, and VPN tunnels are formed on both WAN transports. No load-balancing is done for direct internet traffic. Internet break-out traffic, or direct internet traffic, is confined to Guest and Default VLAN traffic, a few corporate SaaS applications, and dashboard traffic for the INFRA VLAN for downstream devices (switch and AP dashboard traffic). All other traffic that is internet-bound goes through Cisco Secure Access tunnels at the site.
- Active/standby tunnels are set up from the active MX router to Cisco Secure Access. One pair of active/standby tunnels are sourced from one WAN transport (INET1) and another pair of active/standby tunnels are sourced from the second WAN transport (INET2). The tunnels leverage health checks. Traffic to the active tunnels is load balanced by default.
- Performance-based routing is enabled for corporate SaaS traffic using the internet break-out, and VoIP and video conferencing, a custom critical application, and default traffic using the Auto VPN overlay.
- All trunk port connections in this example carry just the necessary VLANs, including the Native VLAN 1. The Native VLAN is defined as 999 on trunks to any AP.
- Each MX router has one trunk connection to each switch of the 2-switch stack in the distribution layer, and all other ports on the MX are unused (ports 7-10). The unused ports on the MX are disabled. Each distribution switch has ports designated for any Infrastructure that are unused (ports 6-8) and are disabled, while the rest of the ports are designated for access switch connections (ports 11-24 or 11-

48). Unused access switch connection ports are disabled. Each access switch has ports dedicated for distribution switch connections (ports 1-4) while the unused ones (ports 3-4) are disabled. The AP port (port 9) in this example on access switch SW3 is configured as a trunk, and all unused AP trunk ports are disabled (ports 5-8 and port 10-12 on SW3 and ports 5-12 on SW4). The left-over ports on each access switch are configured as access ports and are configured for BPDU guard and 802.1x/MAB. All ports are enabled for rapid spanning-tree and storm control.

- Adaptive policy is enabled. Four groups are defined as part of DATA VLAN 10 (Finance_User_Group, Marketing_User_Group, Finance_Server_Group, and Marketing_Server_Group). It is assumed that the servers reside in the data centers, while the users reside in the branch. A policy is defined that dictates the permissions between groups. Configurations are set to ensure that SGT tags are trusted/propagated across the Auto VPN and between the MX/switch and switch/AP.
- 802.1x enabled on the access ports of each switch leverage an external server configured for RADIUS authentication and accounting. Multi-Auth mode is used. The policy type is hybrid authentication, meaning, if there is no authentication for 802.1x, Mac Authentication Bypass (MAB) can be used instead. Voice authentication is also enabled. There is no access to the network if either 802.1x or MAB authentication fails. If authentication succeeds, a VLAN is passed back from the RADIUS server, putting the user into the DATA, VOICE, IOT, or PCI VLANs. An SGT tag is also passed back from the RADIUS server. In this example, ISE (version 3.4) is used as the external RADIUS server. Refer to Appendix C for ISE settings used in this example.
- For QoS on each switch, the GUEST VLAN traffic DSCP is not trusted and set to DSCP 0. For other VLAN traffic, DSCP is trusted. On the MX router, default traffic rules are used, and rules are added to include guest traffic and custom critical application traffic.
- Wireless guest traffic is configured for Open authentication (no encryption), mandatory DHCP, and a click-through splash page which must be acknowledged before being allowed on the network. DHCP is performed by the MX router and traffic is tagged for the GUEST VLAN (VLAN 50). Layer 2 LAN isolation is enabled so guest users cannot communicate with each other, and a per-client bandwidth and per-SSID bandwidth limit is enabled. SSID availability is scheduled according to a custom schedule. The Guest Wi-Fi uses 2.4 and 5 GHz bands and AI-RRM is enabled.
- Corporate Wi-Fi traffic is configured to use 802.1x Enterprise authentication with RADIUS (authentication and accounting). WPA3 transition mode is used, and fast roaming and protected management frames are enabled (protected management frames allow unsupported clients). DHCP is performed by the MX router for the PCI VLAN and performed by the distribution switch stack for the DATA, VOICE, and IOT VLANs, and by default, traffic is tagged for the DATA VLAN, although the Override VLAN tag is enabled. RADIUS will respond back with a group policy name (DATA, VOICE, IOT, or PCI) which has a VLAN set based on the identity of the user. Separately, an SGT tag is passed back. SSID availability is scheduled according to a custom schedule. The Corp Wi-Fi uses 2.4, 5, and 6 GHz bands, band steering, and AI-RRM is enabled.
- Wi-Fi 7 is not enabled yet for the Corporate Wi-Fi as it requires a separate access point from the guest Wi-Fi due to security requirements. Per-group SSID configuration is available starting in MR release 32.1.4, where Wi-Fi 7-compliant SSIDs can co-exist on the same AP as non-Wi-Fi 7-compliant SSIDs as long as they are in separate SSID groups. The feature is still in Beta status as of 32.1.5, hence why it is not included yet in the Unified Branch design. Refer to WPA3 Encryption and Configuration Guide for additional information.
- Splunk, Thousand Eyes, and XDR are deployed in the example network.

For this deployment, these steps are discussed:

Step 1. Complete the prerequisites

Step 2. Create a new network

Step 3. Onboard the devices

Step 4. Upgrade devices (if needed)

Step 5. Configure devices

Step 6. Verify device operation

After your devices are onboarded, configured, and verified, you can optionally create and customize templates from your network configuration to speed up the deployment of new branches. Refer to Managing Multiple Networks with Configuration Templates for more details.

Complete the prerequisites

There are several prerequisites that need to be addressed before configuration and onboarding can begin. This includes ensuring internet connectivity for the network devices, creating a Meraki Dashboard account and Organization within the dashboard, ensuring the network devices are added to the Organization Inventory in the dashboard, ensuring the required licenses are added to the dashboard, and having account access for the feature integrations (Cisco Secure Access, ThousandEyes, Splunk, and XDR). There may also be hardware, software, and licensing requirements for certain features. Refer to the Cisco Unified Branch Design Guide for additional information.

Internet connectivity

All configurations can be performed on the Meraki cloud dashboard. Devices should have connectivity to the internet to connect to the Meraki cloud. Device onboarding is simplified if the provider provides an IP address, gateway, and DNS information through DHCP to the WAN uplink on the MX router, as device registration to the dashboard is automatic. In addition, it is important to ensure that if there are any firewalls upstream from the router, the proper rules are configured so the device can reach the proper cloud services. Refer to Upstream Firewall Rules for Cloud Connectivity for details on what IP addresses and ports should be allowed.

Meraki Dashboard account and organization

Ensure a Meraki Dashboard account and Organization is created. The organization is created at the same time as the account. From the account, organizations, networks, and devices are managed. An organization is made up of multiple networks, and each network is made up of one or more devices. A network typically correlates to a physical location. Refer to Creating a Dashboard Account and Organization for more information.

Organization device inventory

Ensure the devices to be managed are added in the Organization inventory on the dashboard (**Organization > Configure > Inventory**).

The inventory page contains all devices in the organization, including those that have been added to networks as well as those that are not currently assigned to a network within the organization. Devices must first be claimed before being able to be used or assigned to a network in the Dashboard.

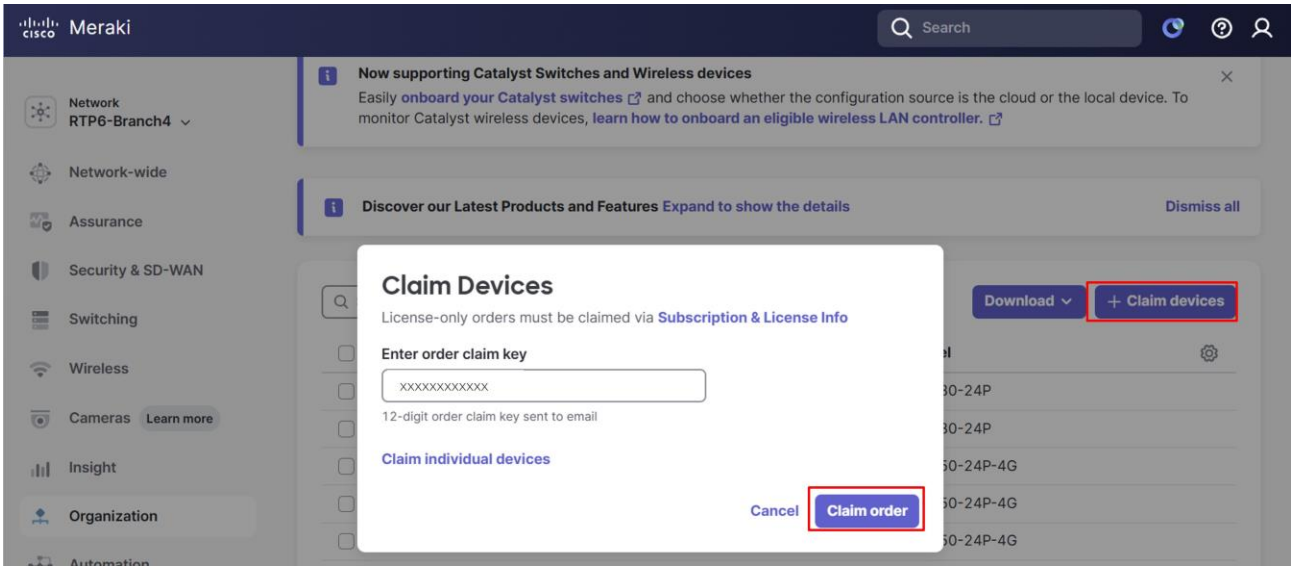
Devices can be entered using an order number/claim key or serial number/cloud ID. The preferred method is using the order claim key as this ensures that all hardware from an order is claimed. The order claim key can be found in order shipment email notifications or in the corresponding Cisco Commerce Workspace (CCW) order under the Order Claim Key field.

Note: If your order includes software subscription licenses, you can also claim the subscription along with your hardware using the order claim key.

Procedure 1. To claim the subscription along with your hardware using the order claim key:

Step 1. Go to **Organization > Configure > Inventory** and select **+ Claim devices**.

Step 2. In the pop-up window, enter the order claim key then click **Claim order**.



Individual devices can also be claimed. The Cloud ID for a device is a unique identifier used for claiming and managing the device in the Meraki Dashboard. For individual Meraki devices, the serial number and cloud ID are the same and can be found in the order shipment email notifications or on the devices themselves.

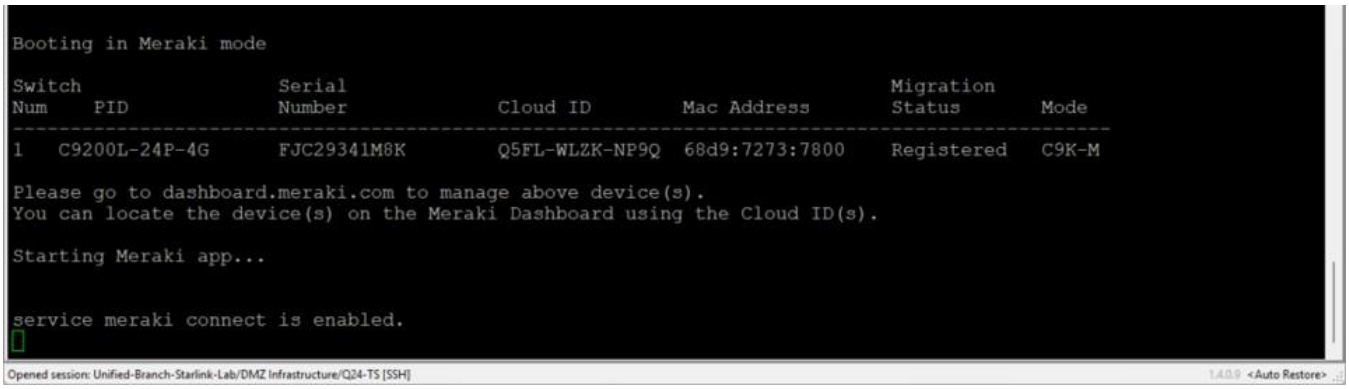
Procedure 2. To claim individual devices:

Step 1. Go to the **Organization > Configure > Inventory > + Claim devices** pop-up window.

Step 2. Select **Claim individual devices.**

Step 3. Enter the **Device Cloud ID** (Meraki serial number) then click **Claim devices**.

For individual Catalyst devices, the device serial number and cloud ID are not the same. The Meraki Dashboard accepts only the cloud ID for claiming and managing these devices. For -M devices, the Cloud ID can be found in the order shipment email notifications, or you may find a cloud ID label on the device. Also, if you are on the console while it boots, you can view the model number, serial number, cloud ID, and mac address before it becomes Meraki-managed.



For non -M Catalyst devices, the cloud ID is generated from the CLI after upgrading the switch to the minimum IOS XE image, which is IOS XE 17.15, but some models require IOS XE 17.18. Refer to Conversion from CLI-managed IOS XE Catalyst Switches to Cloud Management with Cloud Configuration.

For additional information on onboarding, refer to the Meraki Hardware and Software Onboarding Guide.

Licenses

Every device requires an active license. A license provides access to the Meraki Dashboard for cloud-based management and monitoring, offers support and firmware updates, and unlocks specific features depending on the product. Subscription licensing is recommended. If a subscription expires, after a grace period, the ability to manage devices is lost for all networks bound to that subscription.

Ensure the required licenses are added to the dashboard. License status can be found on the **Organization > Configure > License Info** page on the dashboard. Licenses are added automatically if they are part of an order number that was entered in the Inventory page, otherwise, they can be added manually using a Claim Key if the order number is not known or the license is ordered separately from the devices.

For more detailed information, review the Getting Started Checklist.

In addition to device licensing, additional licensing may be required depending on the feature. Refer to the Cisco Unified Branch Design Guide for more information about feature licensing and hardware and software requirements.

Create a new network

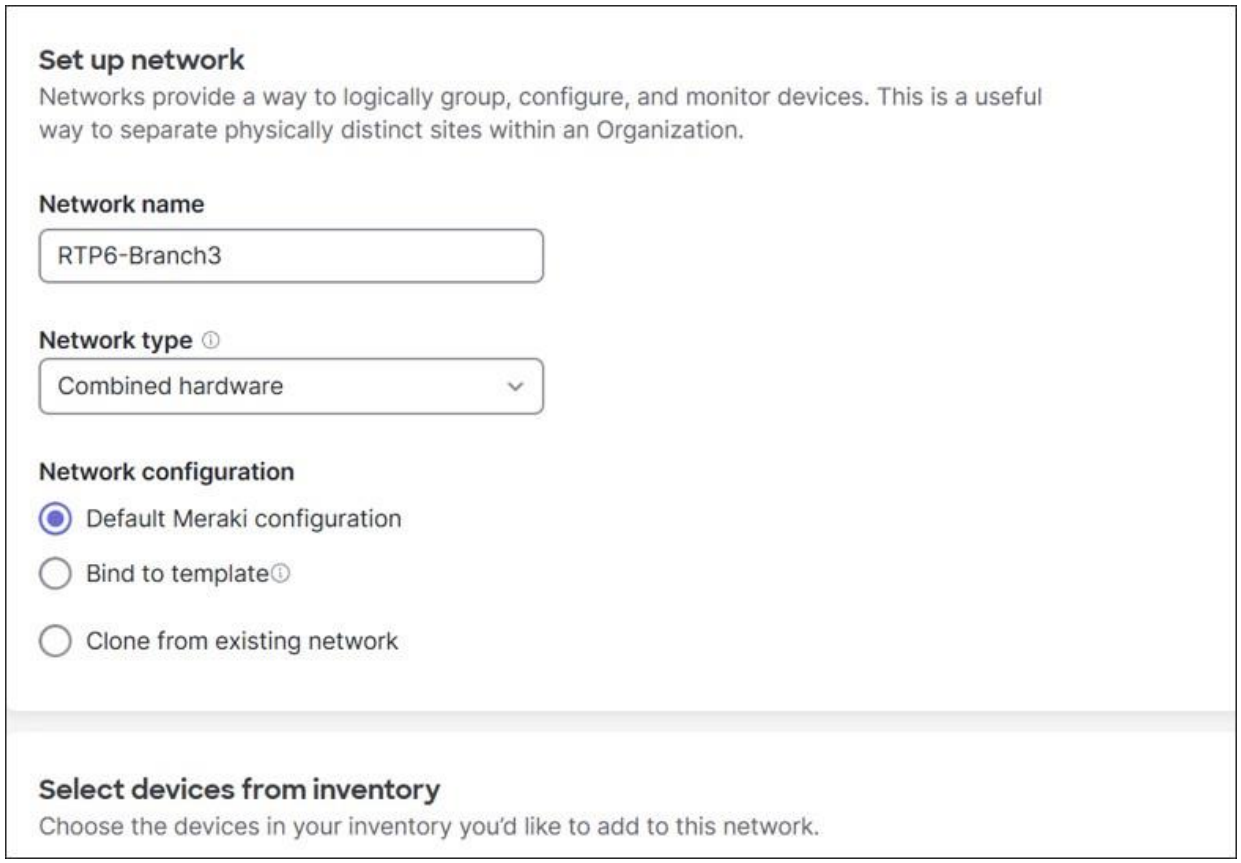
Procedure 3. To create a new network:

Step 1. On the dashboard, go to **Organization > Configure > Create Network**.

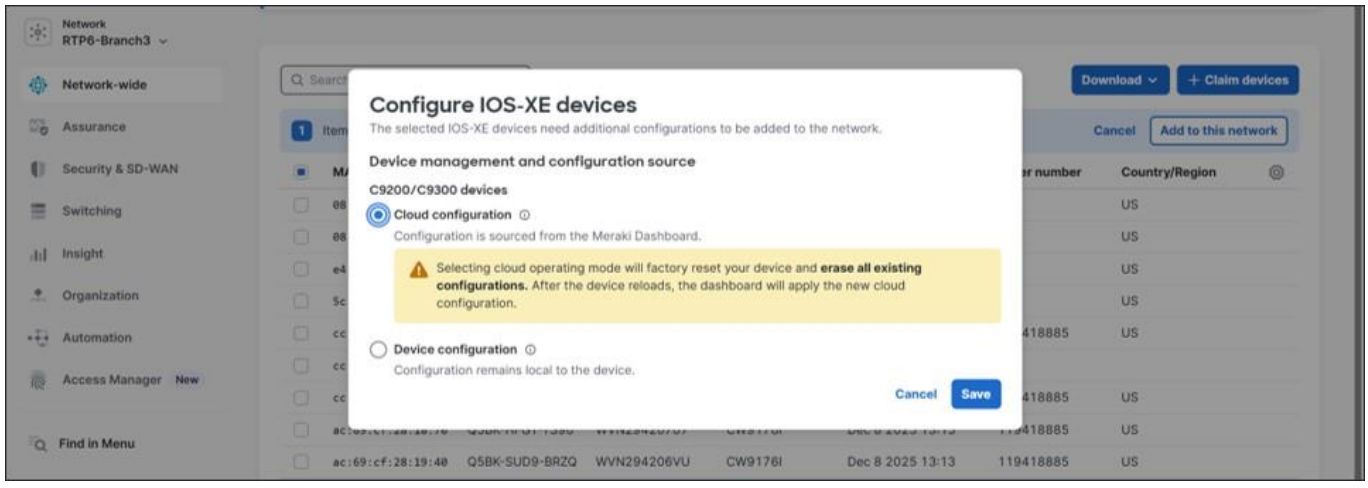
Step 2. In the text box, type the **Network name** (RTP6-Branch3) and specify the **Network type** (if needed) from the drop-down menu (Combined hardware). This network will use the **Default Meraki configuration** before additional configurations are added.

Step 3. Select the devices from inventory which should be included in the network (these should have been added during the prerequisite steps).

Step 4. Select **Create network**.



If Catalyst devices are added, a window may pop up to indicate the device management and configuration source before adding those devices to the network. Devices can be in cloud mode, where configuration is sourced from the Meraki Dashboard, or in device mode where the configuration is local to the device. In Unified Branch, only cloud mode is supported at this time.



The dashboard switches to the newly created network.

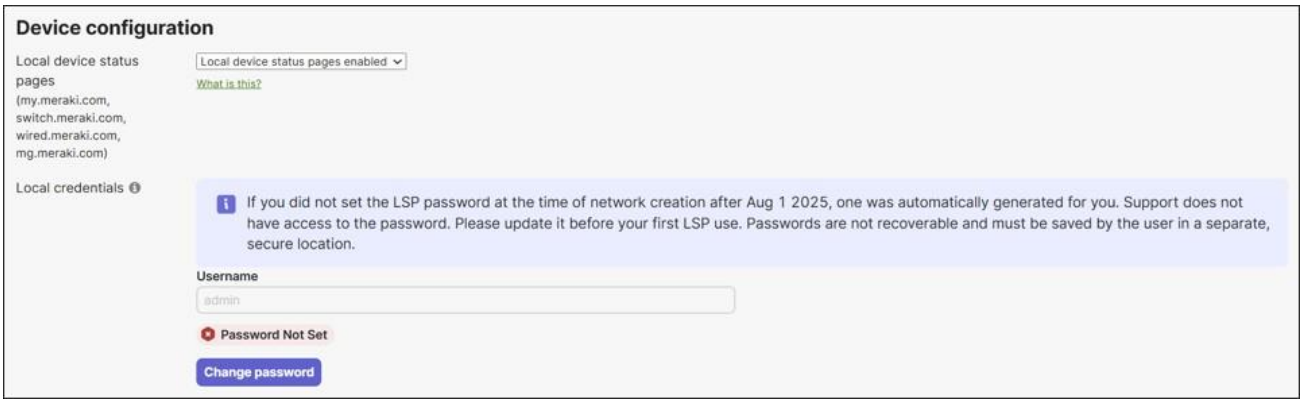
Tech tip: The local status page on a network device can be accessed to make limited local configuration changes and perform local troubleshooting. As of August 1, 2025, if a local status page password was not set at the time of network creation, one is automatically generated and cannot be viewed. When a device connects to the Dashboard, the password that was automatically generated becomes the new local status page password for that device. It is recommended to change the local status

page password under **Network-wide>Configure>General>Device configuration>Local credentials** when a network is created. When a device has never connected to the Dashboard, its local status page default username is *admin* and the password is the device's serial number (including upper-case letters and dashes).

Procedure 4. To set the local status page password for the devices connecting to this network:

Step 1. Under the new network, navigate to **Network-wide > Configure > General.** The local device status page is enabled by default.

Step 2. Under **Device configuration > Local credentials**, click **Change password**.

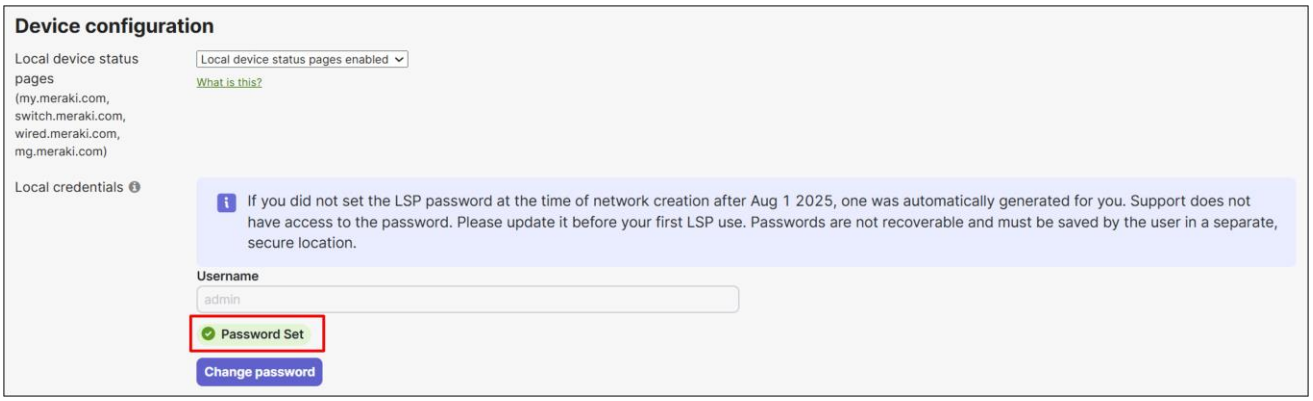


Step 3. Under **Password**, type a secure password, which must be 14 characters long and must include a number, uppercase letter, lowercase letter, and a symbol.

Step 4. Click **Update password**.

Step 5. Click **Save**.

Step 6. You may need to reload the web page to remove the "Password Not Set" notification outlined in red. Remember this password because it won't be visible in the dashboard when set.



Onboard the devices

For onboarding, the primary MX router is onboarded first, followed by the switches, APs, and spare MX router. The cabling is then completed. As part of the cabling completion, the switches are moved between the MX routers and internet transports.

These instructions assume the devices are powered off and not initially cabled:

Onboard the primary MX router

- First, onboard the primary MX router. Ensure the MX router can get a DHCP lease and internet connectivity from at least one of the WAN connections so the MX can connect to the Dashboard. If IP addressing to the service provider must be manual, connect locally to the MX and add an IP address, netmask, gateway, and DNS information to Internet 1 (physical port 1 (SFP) or 3 (RJ45)) or Internet 2 (physical port 2 (SFP) or 4 (RJ45)). Refer to Cisco Meraki Local Status Page: Overview and Cisco Meraki Local Status Page: Security and SD-WAN for additional information. This example assumes DHCP is available from both internet service providers.
- Power the primary MX router on and connect WAN interface 1 (SFP port 1 in this example) to its WAN transport. When it reaches the dashboard, a firmware upgrade may take place to update the device to the latest stable release. When the LED on the router turns solid white, the MX is connected to the dashboard, and its default configuration should be downloaded.

Onboard the switches

Procedure 5. To onboard the switches:

Step 1. When the MX router is fully on board and while the switches are still powered off, cable the switches together using their stacking cables:

- Stack port 1 switch 1 → stack port 2 switch 2
- Stack port 2 switch 1 → stack port 1 switch 2

Refer to Switch Stacks if needed for additional information.

Step 2. Connect the uplink of switch 1 (port 1) to the proper port on the primary MX router (port 5).

Step 3. Connect the uplink of switch 2 (port 1) to the proper port on the primary MX router (port 6).

- Power on the switch stack. When the switch management traffic reaches the dashboard, a firmware upgrade may take place to update the devices to the latest stable release. When the LED on the switch is solid white, the switch is connected to the dashboard, and its default configuration should be downloaded. Wait for both switches to be completely onboarded.

The access switches (switch 3 and switch 4) are onboarded.

Step 4. Connect the uplink of switch 3 (port 1) to the proper port on switch 1 (port 9) of the distribution stack.

Step 5. Connect the uplink of switch 4 (port 1) to the proper port on switch 1 (port 10) of the distribution stack.

Step 6. Power on the switches. When the switch management traffic reaches the dashboard, a firmware upgrade may take place to update the devices to the latest stable release. When the LED on a switch is solid white, the switch is connected to the dashboard, and its default configuration should be downloaded. Wait for both switches to be completely onboarded.

Onboard the access point (AP)

- When all switches are fully on board, connect the uplink of the access point (AP) to the proper port on the switch (switch 3 port 9 in this example). Through PoE, the AP is powered on. When AP management traffic reaches the dashboard, a firmware upgrade may take place to update the device to the latest stable release. When the LED on the AP is solid white, the AP is connected to the dashboard, and its default configuration should be downloaded.

Upgrade Catalyst switches (if needed due to mismatched code types)

Catalyst devices running CS code and IOS XE code should not be in the same network together, as the dashboard firmware management assumes one single code version in a network for Catalyst switches and one single code version for MS switches. If Catalyst switches were onboarded with different code types, move the CS switches needing upgrades to IOS XE into a new network, upgrade them, then move them back to the original network.

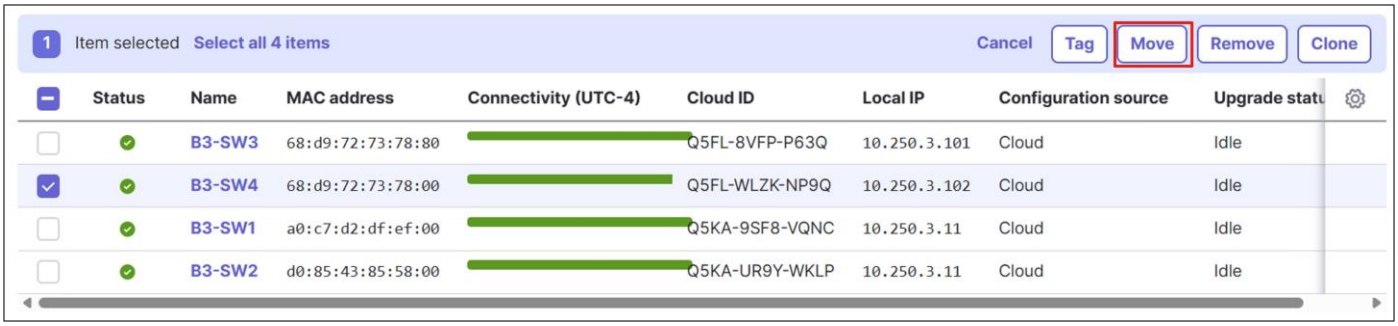
Note: When upgraded to IOS XE code, the switch is restricted from moving back to CS code.

Procedure 6. Upgrade Catalyst switches (if needed due to mismatched code types):

Step 1. Go to **Organization > Create Network** to create a temporary network (**Network Name**: TEMP).

Step 2. Click **Create network**.

Step 3. Find the switch under the original network under **Switching > Monitor > Switches**. Select the switch, click **Move**, select the network to move to, then click **Move**.



Step 4. Upgrade the switch under **Organization > Monitor > Firmware Upgrades**. Click the **Schedule upgrades** tab.

Step 5. Select the switch and click **Schedule upgrades**.

Step 6. When the upgrade is completed, the switch can be moved back to the original network.

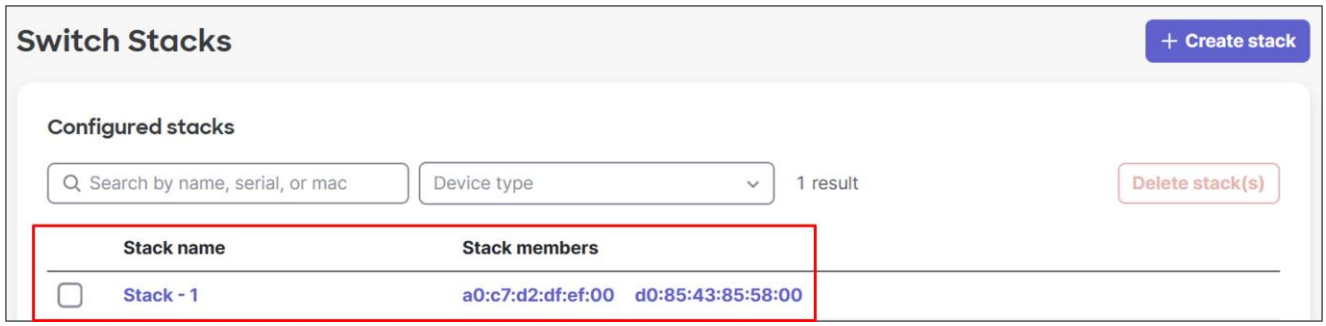
Step 7. Repeat for any additional switches.

Modify switch configurations

Stack configuration

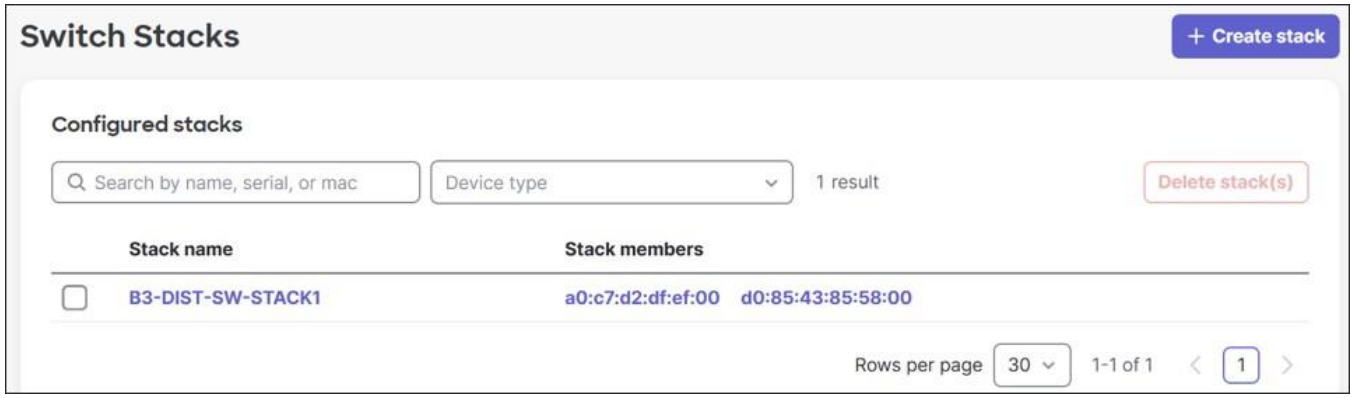
Procedure 7. To configure the stack:

Step 1. Ensure that the distribution switches are recognized as part of a stack on the dashboard. Under the newly created branch (RTP6-Branch3), go to **Switching > Monitor > Switch Stacks**. If the stack was auto provisioned by the dashboard, it shows up as a **Stack Name** with the listed **Stack Members** in mac addresses form.

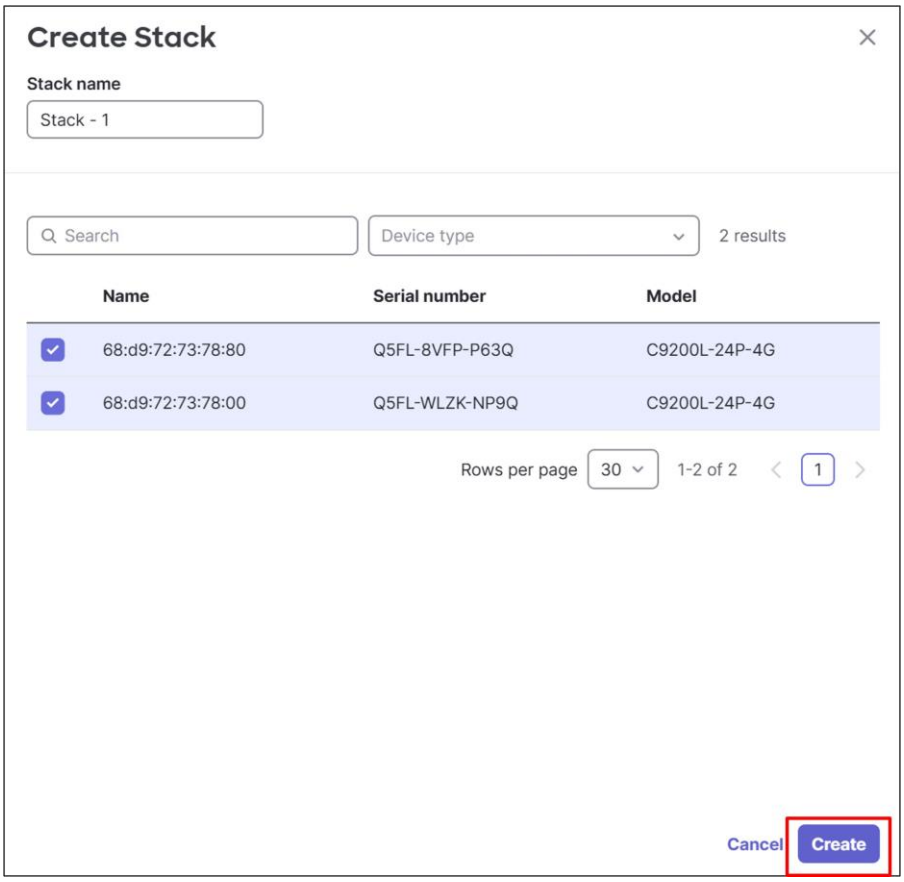


Step 2. To change the stack name, click the **Stack name** (Stack – 1), then click the edit symbol next to the stack name.

Step 3. Edit the name (B3-DIST-SW-STACK1) and click **Save**. Navigate back to the **Switching > Monitor > Switch Stacks** page.

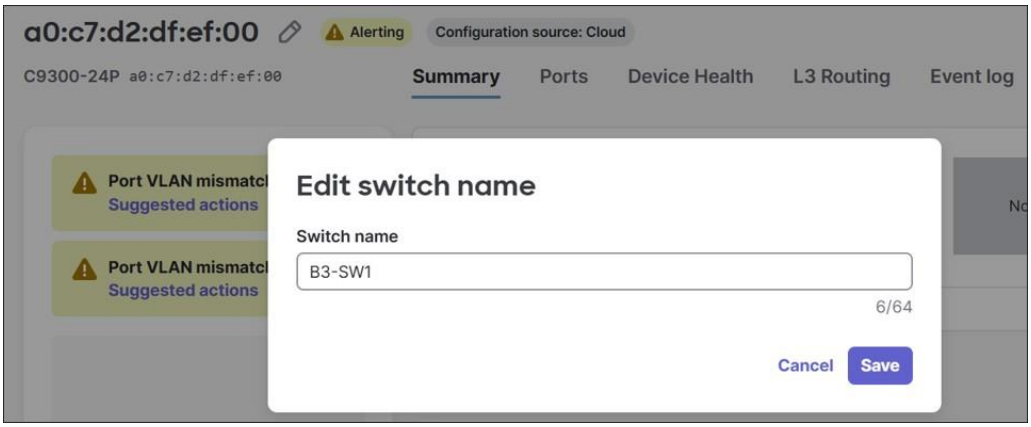


Step 4. If the switch stack was not detected automatically, the stack can be manually created by clicking **Create stack**, entering the **Stack name**, selecting the stack members, and clicking **Create**.



Switch naming

- Under the new branch, go to **Switching > Monitor > Switches**. Select one of the switches. Click the edit symbol next to the mac address in the top left corner and fill in the **Switch name** (B3-SW1). Click **Save**. In this example, B3-SW1 is the distribution switch connecting to the first internet transport and the one connecting to the access switches. Repeat the process with the other three switches (B3-SW2, B3-SW3, and B3-SW4).



Allowed VLANs trunk configuration

By default, switches carry all VLANs on trunks.

In the MS models, the **Allowed VLANs** on trunks are configured as “all”, which equates to VLANs 1-4094.

In the C9300/C9200 models, allowed VLANs are represented on trunks as 1-[# of active VLANs].

For some switch models, active VLANs are 1000. For some switches, it is less.

In the case of the 9200L-M, the number of active VLANs supported when spanning-tree is enabled is 512. VLANs above 512 cannot be added unless other VLANs are pruned off the trunks.

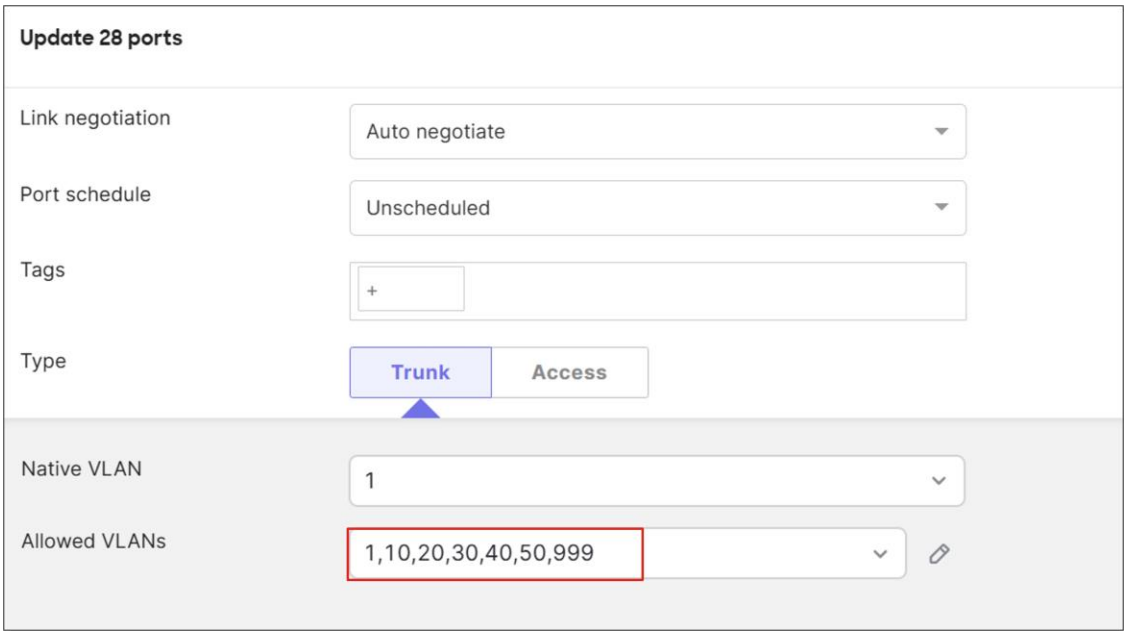
In this section, for any switches supporting less than 999 VLANs, all ports are configured as trunks carrying VLANs 1,10,20,30,40,50,999. Individual ports may be modified later.

Procedure 8. To remove VLANs from trunks of switches supporting less than 999 VLANs:

Step 1. Go to **Switching > Monitor > Switch Ports**. If all switches have trunks with an **Allowed VLANs** setting of "all", or "1-N", where N is greater than or equal to 999, skip to the next section (**Transport Configuration**).

Step 2. For other switches, pick a switch, select all ports on the switch, and click **Edit**. In this example, B3-SW3 is chosen.

Step 3. Next to **Allowed VLANs**, type in 1,10,20,30,40,50,999. Click **Update**.



Step 4. Repeat for any additional switches (B3-SW4 is also configured in this example).

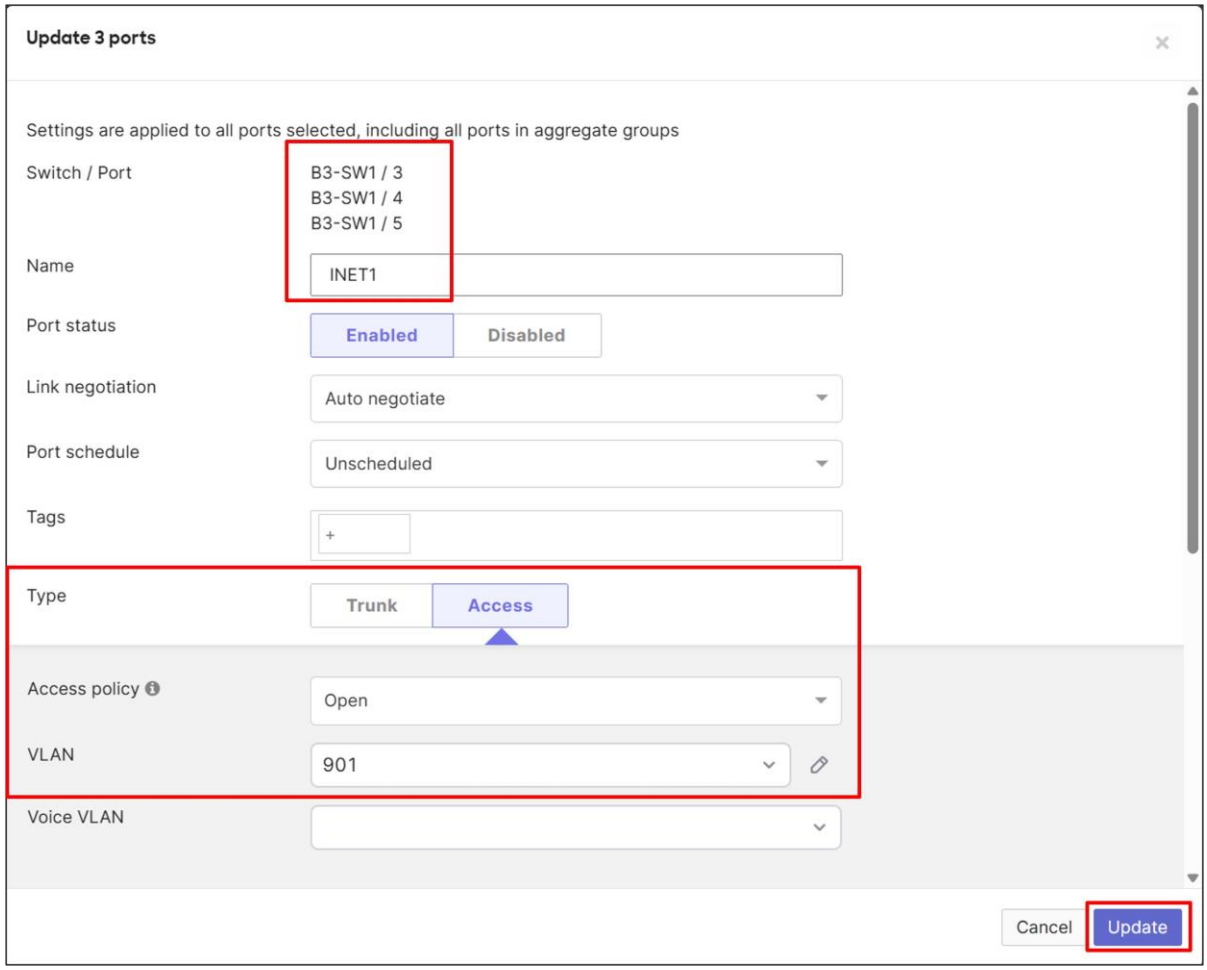
Transport configuration

The switch configurations should be modified to accommodate the WAN transport connections.

Procedure 9. To configure the transport VLANs:

Step 1. Go to **Switching > Monitor > Switch Ports**. On the switch connected to the first WAN transport (B3-SW1), select ports 3, 4, and 5, then click **Edit** at the top of the page.

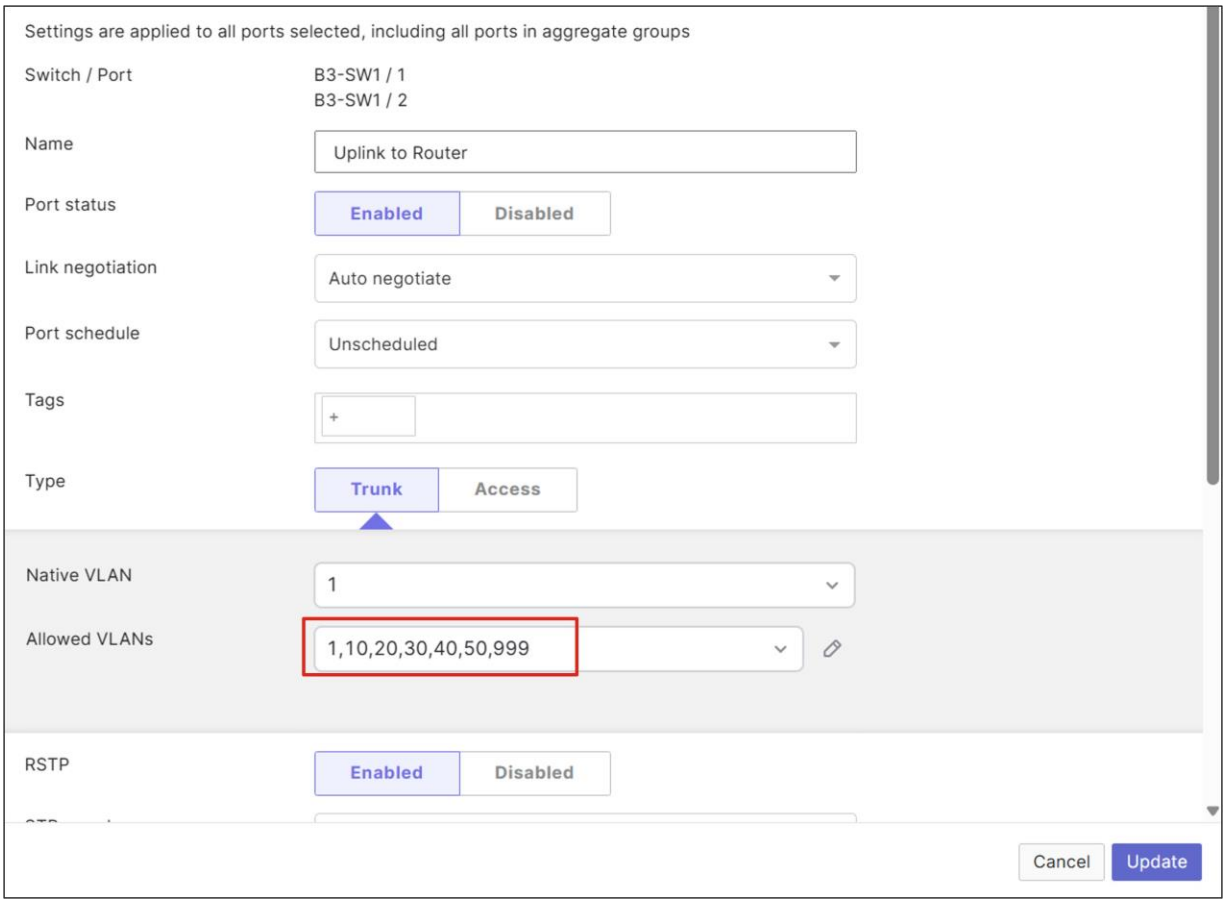
Step 2. Fill in the **Name** (INET1), choose **Type Access**, and type in the **VLAN** (901). Click **Update**.



Step 3. Remove VLAN 901 from the trunk ports going to the MX routers on B3-SW1. On this same page, select ports 1 and 2, then click **Edit** at the top of the page.

Step 4. Fill in the **Name** (Uplink to Router) and next to **Allowed VLANs**, type in the VLANs to be configured on the MX router (1, 10, 20, 30, 40, 50, 999).

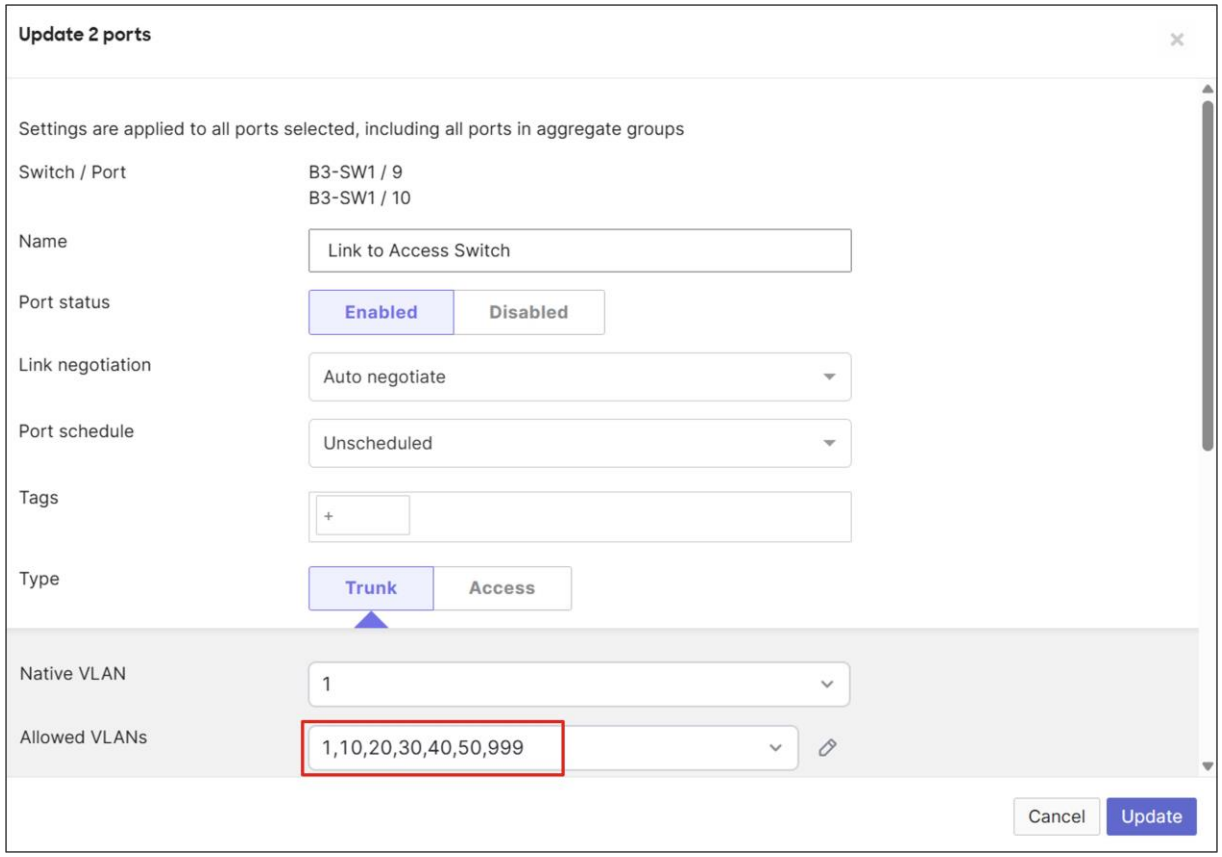
Step 5. Click **Update**.



Step 6. Remove VLAN 901 from the trunk ports going to the access switches on B3-SW1. On this same page, select ports 9 and 10, then click **Edit** at the top of the page.

Step 7. Fill in the **Name** (Link to Access Switch) and next to **Allowed VLANs**, type in all VLANs to be trunked to the access switches (1, 10, 20, 30, 40, 50, 999).

Step 8. Click **Update**.



Step 9. Repeat for the second switch (B3-SW2). For ports 3, 4, and 5, the port **Name** should be set to INET2, the **Type** to **Access**, and the **VLAN** to 902.

Note: To view any missing columns, click the gear in the top right corner of the column headers and select the preferred category under **Configuration**. Click outside the box to return. Move columns as needed.

Step 10. Remove VLAN 902 from the trunk ports going to the MX routers on B3-SW2. On this same page, select ports 1 and 2, then click **Edit** at the top of the page.

Step 11. Fill in the Name (Uplink to Router) and next to **Allowed VLANs**, type in the VLANs that will be configured on the MX router (1, 10, 20, 30, 40, 50, 999). Click **Update**.

Step 12. Remove VLAN 902 from the trunk ports going to the access switches on B3-SW2. On this same page, select ports 9 and 10, then click **Edit** at the top of the page.

Step 13. Fill in the **Name** (Link to Access Switch) and next to **Allowed VLANs**, type in all VLANs to be trunked to the access switches (1, 10, 20, 30, 40, 50, 999).

Step 14. Click **Update**.

Complete the cabling

When the switch configurations have been modified, the cabling can be completed.

Note: The spare MX router is still powered off at this point.

Transport cabling

- The switch stack is inserted between the transports and the MX routers. Move the cable from port 1 on the primary MX router to port 3 on switch 1 (B3-SW1) so switch 1 is connected to the first internet transport provider (INET1). On switch 2 (B3-SW2), cable the connection from port 3 to the second internet transport provider (INET2).
- Cable these ports:
  - Switch 1 port 4 → Primary MX router port 1
  - Switch 1 port 5 → Spare MX router port 1
  - Switch 2 port 4 → Primary MX router port 2
  - Switch 2 port 5 → Spare MX router port 2

MX LAN cabling

- The LAN cabling for the spare MX router is completed. Cable these ports:
  - Switch 1 port 2 → Spare MX router port 5
  - Switch 2 port 2 → Spare MX router port 6

Distribution and Access layer cabling

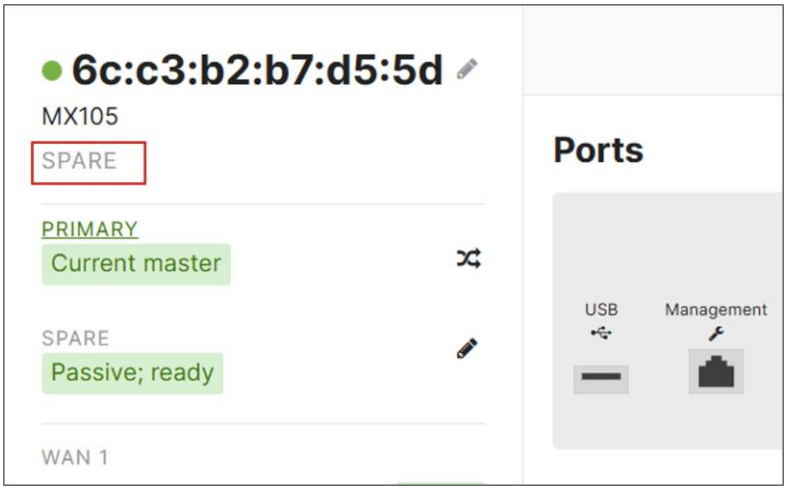
- The distribution and access layer cabling is completed. Cable these ports:
  - Switch 3 port 2 → Switch 2 port 9
  - Switch 4 port 2 → Switch 2 port 10

Onboard the spare MX router

When an MX is added to a network that already contains an active MX of the same model type, the new MX is automatically added to the network in warm spare mode.

- Power the spare MX router on. When the management traffic reaches the dashboard, a firmware upgrade may take place to update the device to the latest stable release. When the LED on the router turns solid white, the MX is connected to the dashboard, and its default configuration should be downloaded.

The new MX should show up in the Dashboard as a warm spare. The status of the spare MX router can be viewed by selecting the preferred **Network** (RTP6-Branch3) and going to **Security & SD-WAN > Monitor > Spare Status**.



Upgrade devices (if needed)

The primary and spare MX routers are upgraded to the latest stable release candidate/latest recommended version at the time of this writing (19.2.7) to pick up an additional feature (active/active tunnels for Cisco Secure Access).

Note: When selecting to upgrade the MX routers in a primary/spare pair, the routers cannot be specified separately. Both primary and spare MX routers are upgraded but steps are taken to attempt a zero-downtime MX upgrade, meaning, the primary is upgraded after the spare MX becomes active, then the spare MX is upgraded when the primary MX becomes active again.

For additional information, refer to MX Warm Spare – High-Availability Pair.

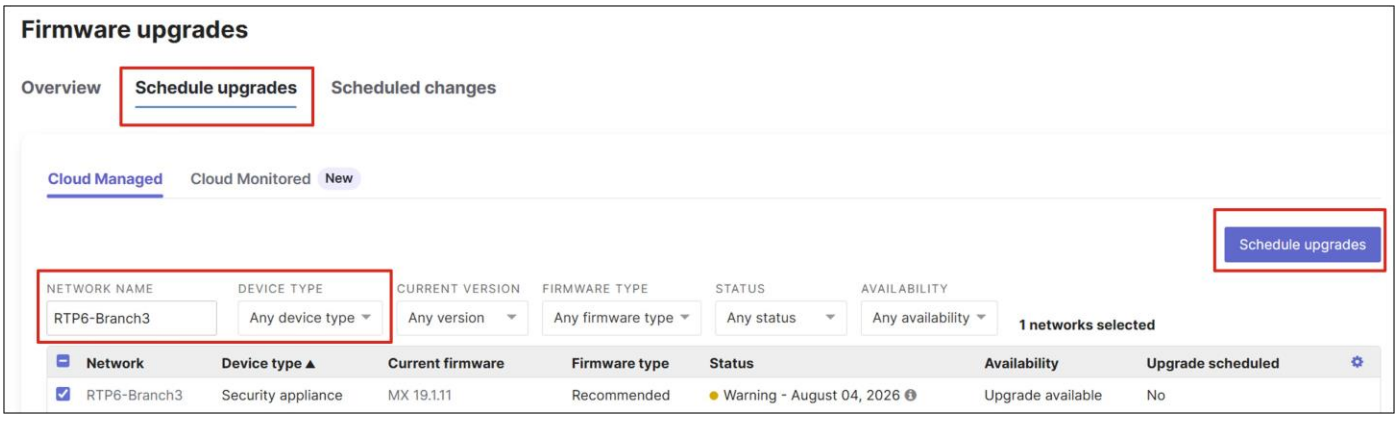
Procedure 10. To upgrade devices (if needed):

Step 1. Go to **Organization > Monitor > Firmware Upgrades**.

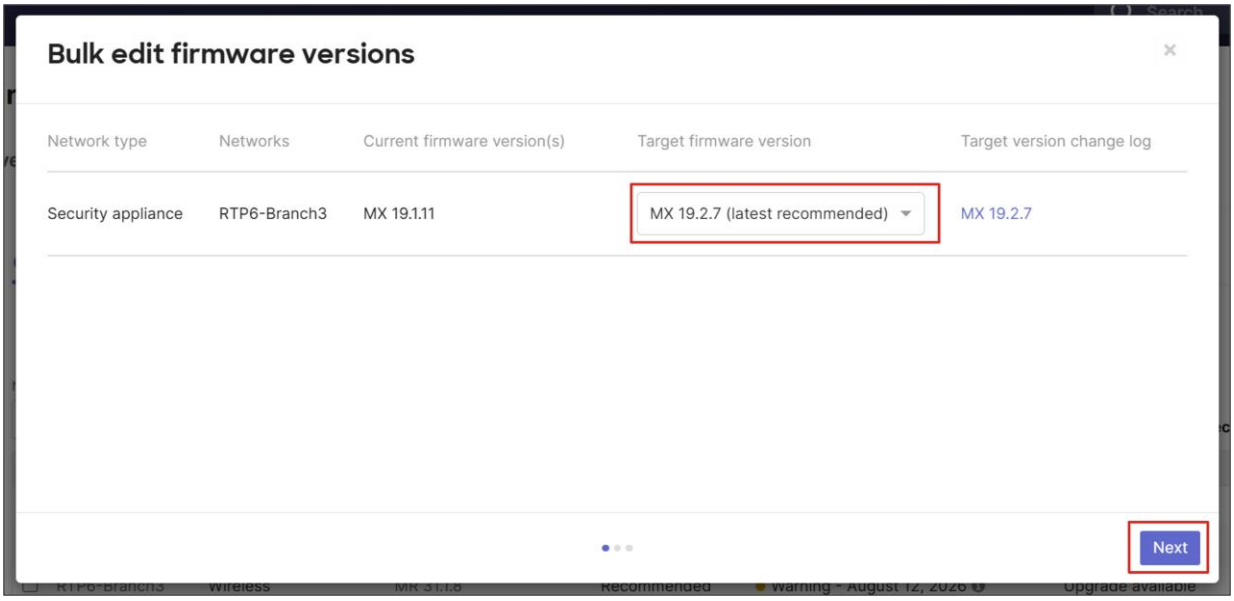
Step 2. Click the **Schedule upgrades** tab.

Step 3. Specify the search criteria and select the MX router to upgrade (RTP6-Branch3).

Step 4. Click the **Schedule upgrades** button.

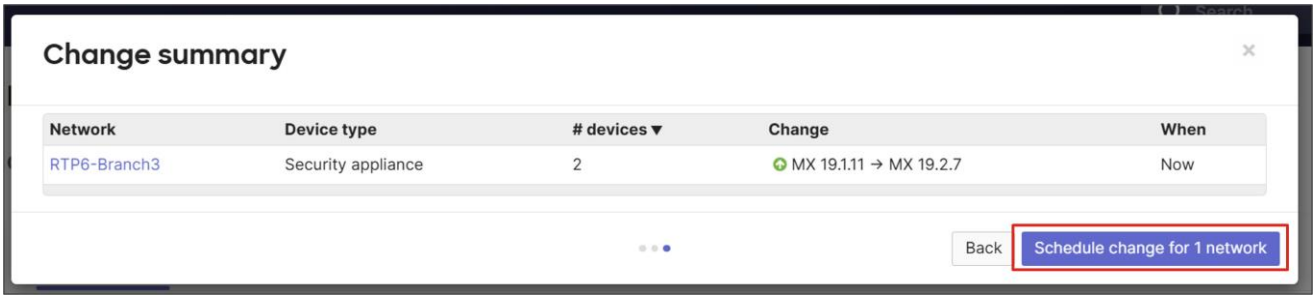


Step 5. In the next window, select the **Target firmware version** and click **Next**.



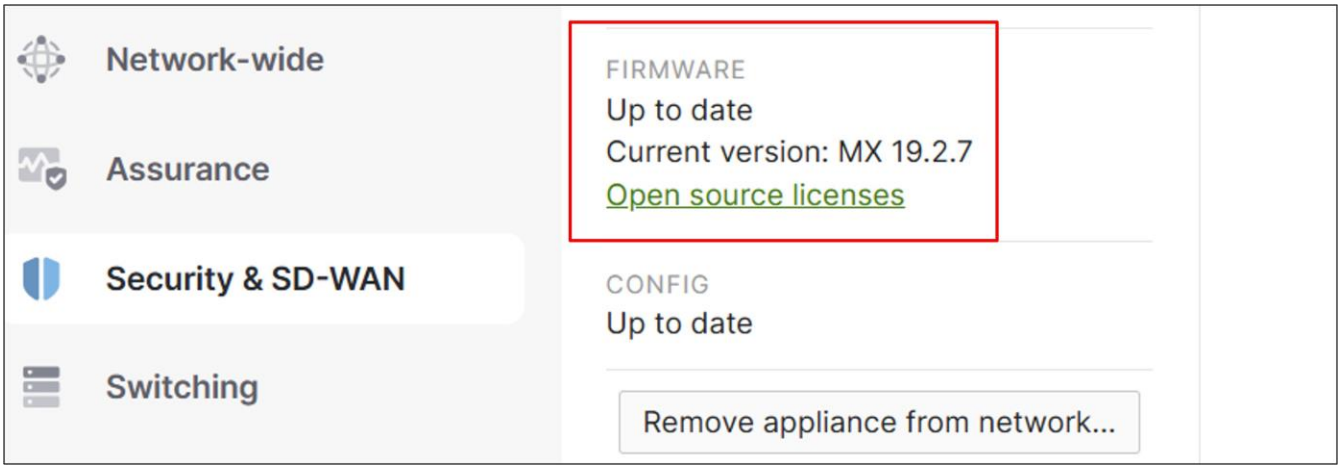
Step 6. Under **Schedule firmware change**, select **Perform the upgrade now** and select **Next**.

Step 7. Under **Change summary**, review the firmware change and select **Schedule change for 1 network**.



The dashboard schedules the upgrade (within 5 minutes). After the primary MX router is upgraded, the secondary MX router waits for several minutes to ensure the primary is stable before continuing with its upgrade.

Step 8. When the upgrade is complete, and both MX routers are again reachable, verify the MX version under **Security & SD-WAN > Monitor > Appliance Status** under the network (RTP6-Branch3). For the MX spare version, go to **Security & SD-WAN > Monitor > Spare Status**.



Step 9. Go to **Network-wide > Monitor > Event Log** to view the network events as the devices are upgraded. Repeat the steps if needed for any additional devices.

Configure devices

In this example, the devices have already been cabled and onboarded to the Meraki Dashboard. The switches and AP use VLAN 1 to reach the dashboard through the primary MX router. In general, the network is configured in this order:

1. The network devices are named and their locations set. The time zone is configured for the network.
2. The primary MX router is configured for a virtual uplink IP address for the WAN. It is then configured for VLANs, DHCP, site-to-site VPN settings, firewall rules, Cisco Secure Access tunnels, local internet breakout, SD-WAN policies, traffic shaping, threat protection, and content filtering.
3. The switches and AP are then moved into the INFRA VLAN 999.
4. The switches are then configured for spanning-tree, QoS, storm control, port access policies (802.1x/RADIUS), and the ports are then configured. Ports are aggregated to form two port channels between the distribution stack and access switches.
5. The wireless Guest SSID is set up, group policy is configured, corporate SSID is set up, and SSID availability and radio settings are configured.
6. Other network services are configured, such as SNMP dashboard polling and dashboard traps, syslog, SNMP device polling, and network.
7. Finally, Adaptive policy is configured, and ThousandEyes, Splunk, and XDR are integrated with the Merak Dashboard.

Name the devices and set the location

By default, the MXs, switches, and AP devices are named by their mac-addresses. The switch names have already been modified during the onboarding steps.

Procedure 11. To give devices more user-friendly names and configure their locations:

MXs (In this example, the primary is named B3-MX1 and the spare is named B3-MX2):

Step 1. Go to **Security & SD-WAN > Monitor > Appliance Status**.

Step 2. Click edit next to the mac address in the top left corner.

Step 3. Fill in the **Appliance name** (B3-MX1), then click **Save**.

Step 4. Next to **ADDRESS**, click edit, enter the street address or GPS coordinates of the location of the device, then click **Save**.

Step 5. Go to **Security & SD-WAN > Monitor > Spare Status** to name the spare MX (B3-MX2). There is no location option for the spare MX.

Switches:

Step 1. Go to **Switching > Monitor > Switches** and select the switch name to view.

Step 2. Next to **ADDRESS**, click edit, enter the street address or GPS coordinates of the location of the device, then click **Save**.

Step 3. Repeat for the other switches.

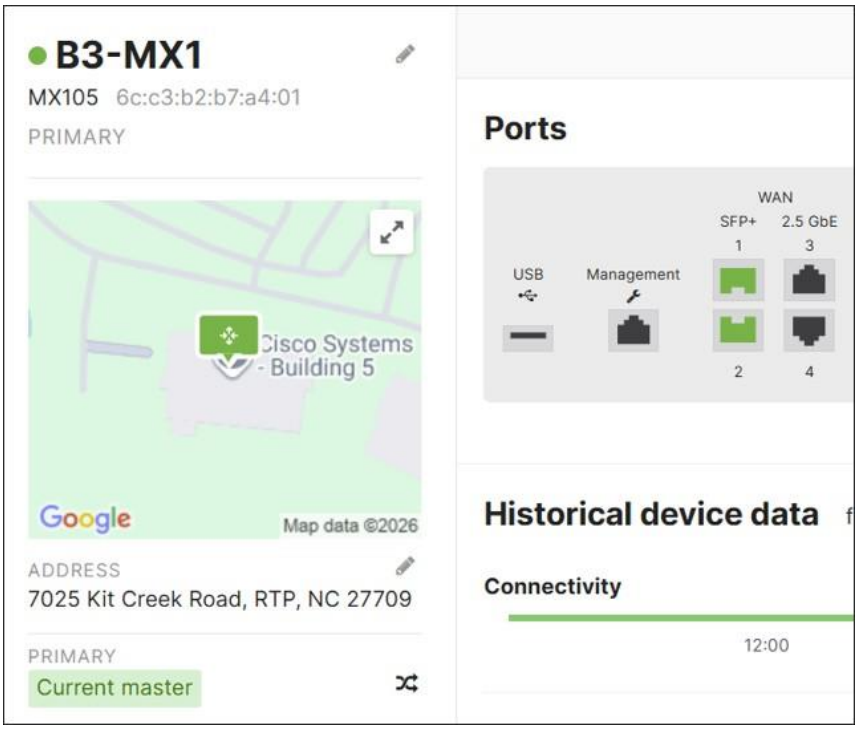
AP:

Step 1. Go to **Wireless > Monitor > Access Points**, and choose the AP mac address to view

Step 2. Click on edit next to the mac address in the top left corner and fill in the **Access point name** (B3-AP1). Click **Save**.

Step 3. Next to **Address**, click edit, enter the street address or GPS coordinates of the location of the device, then click **Save**.

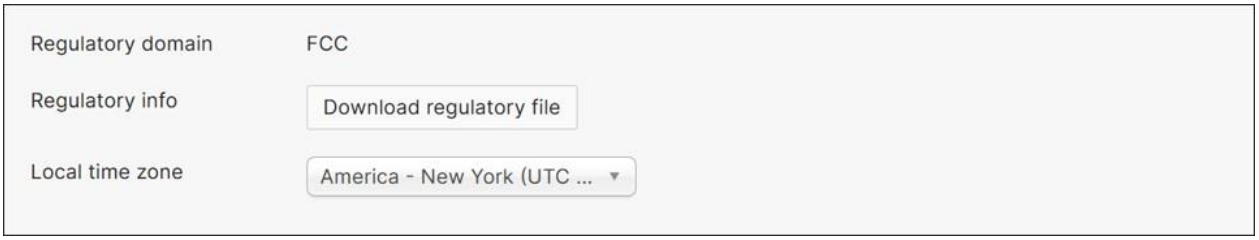
Step 4. Repeat for other APs.



Network-wide: Configure time zone

Time zone is used for time-sensitive features such as SSID Availability or Port Scheduling. In this example, it is used to set the schedule for SSID availability and for event logging.

In this example, America – New York (UTC -4.0, DST) is selected.



Procedure 12. To configure a time zone:

Step 1. Go to **Network-wide > Configure > General**.

Step 2. Next to **Local time zone**, select the appropriate time zone from the drop-down menu if it's not already configured.

Step 3. Click **Save** or **Save Changes**.

Network-wide: Configure traffic analysis settings

In this section, hostname visibility is enabled under Traffic Analysis settings. Activating hostname visibility provides detailed statistical insights into the hostnames and IP addresses accessed by clients across the network. When configured, the menu item **Network-wide > Monitor > Traffic Analytics** appears in the dashboard.

Information can also be accessed under **Network-wide > Monitor > Clients**.

Procedure 13. To activate hostname visibility:

Step 1. Go to **Network-wide > Configure > General**.

Step 2. Under **Traffic analysis**, select **Detailed: collect destination hostnames** from the drop-down menu.

Step 3. Click **Save** or **Save Changes**.

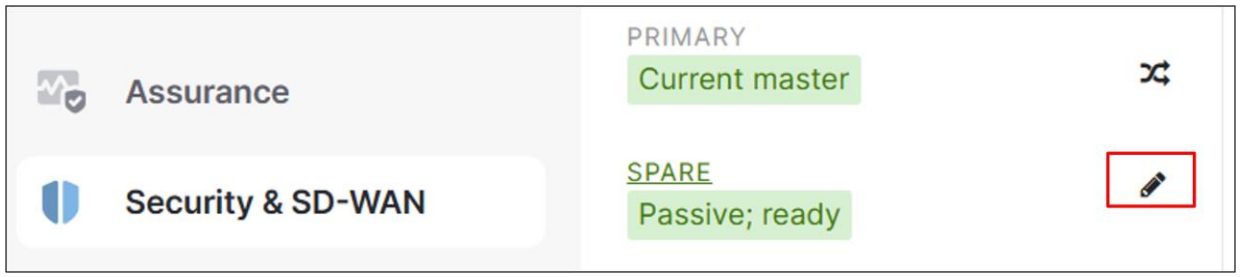
MX router: Configure warm spare uplink IP address

By default, when the warm spare becomes active, it leverages its own WAN uplink IP addresses that were configured or received from DHCP from the transport provider. There is an option to use a virtual uplink IP address on each transport, so when the warm spare takes over, the same virtual IP address becomes active on the spare. The virtual IP addresses must be within the same subnet but must be distinct from the appliance WAN uplink IP addresses. This reduces traffic convergence time during a failover.

Procedure 14. To configure warm spare uplink IP address:

Step 1. Go to **Security & SD-WAN > Monitor > Appliance Status**.

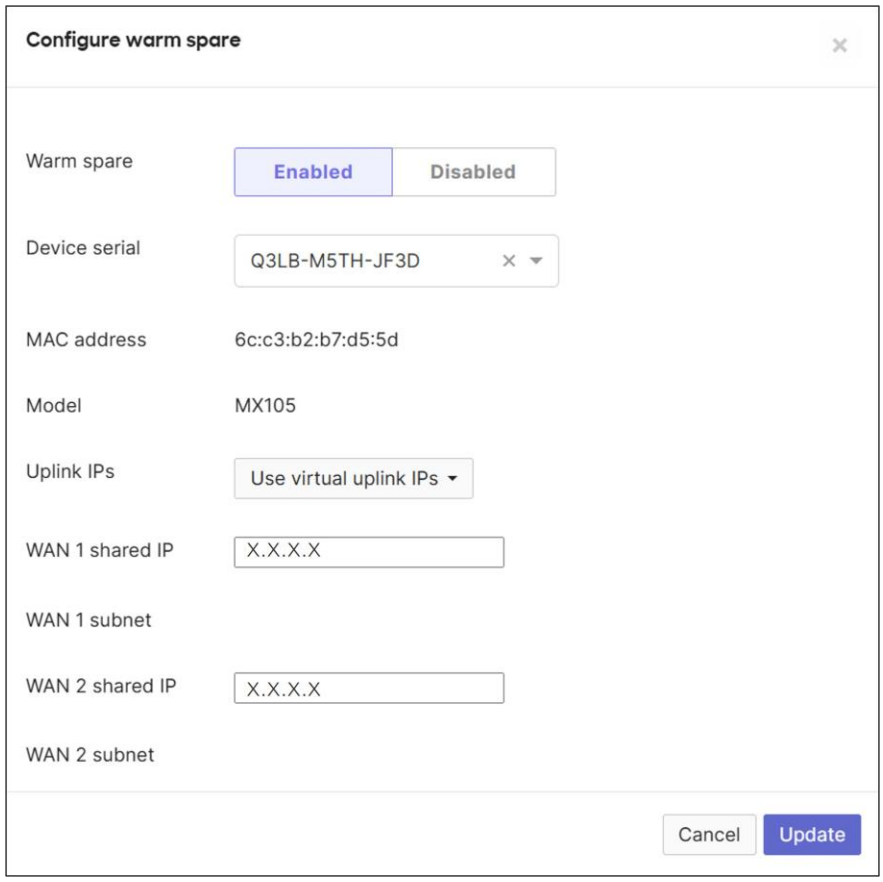
Step 2. Next to **Spare**, click the **Edit** symbol.



Step 3. Next to **Uplink IPs**, select **Use virtual uplink IPs** from the drop-down menu.

Step 4. Next to **WAN 1 shared IP**, type in the virtual IP address for the first WAN transport.

Step 5. Next to **WAN 2 shared IP**, type in the virtual address for the second transport.



Step 6. Click **Update**.

MX router: Configure VLAN interfaces

Procedure 15. To configure VLAN interfaces on MX:

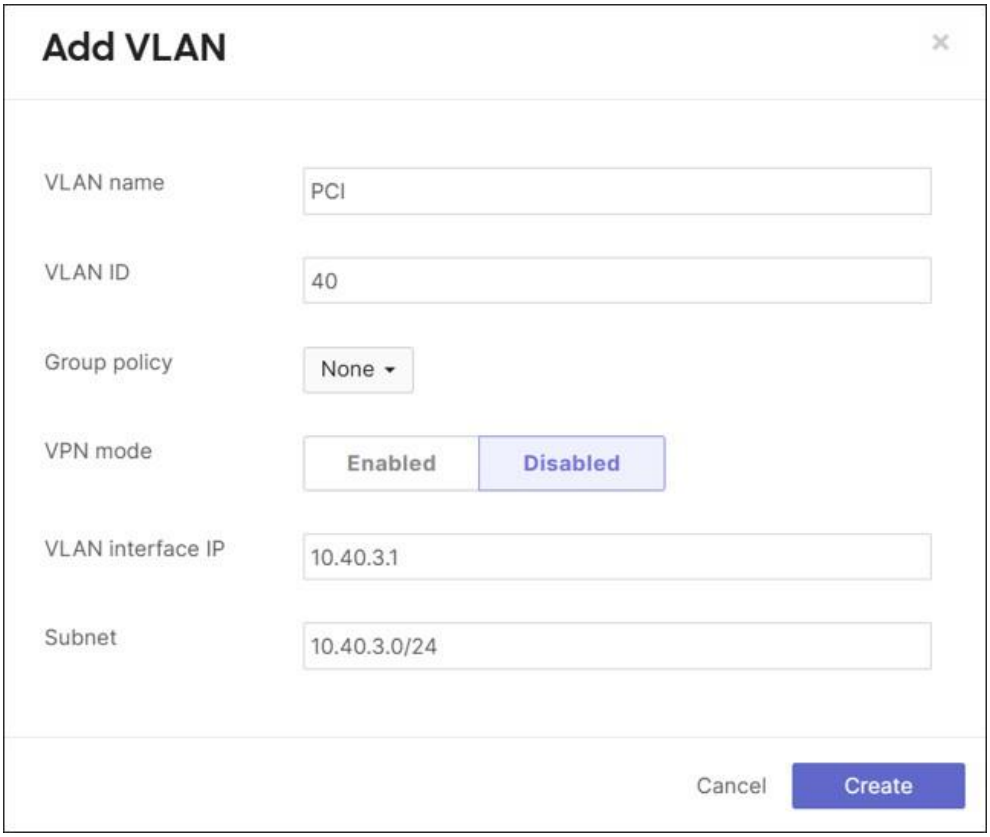
Step 1. Under **Security & SD-WAN > Configure > Addressing & VLANs > Routing > LAN setting**, select **VLANs**. VLAN 1 is automatically created with a VLAN interface IP of 192.168.128.1/24.

Step 2. In the **Subnets** section, click **Add VLAN**. Enter **VLAN name** (PCI) and **VLAN ID** (40).

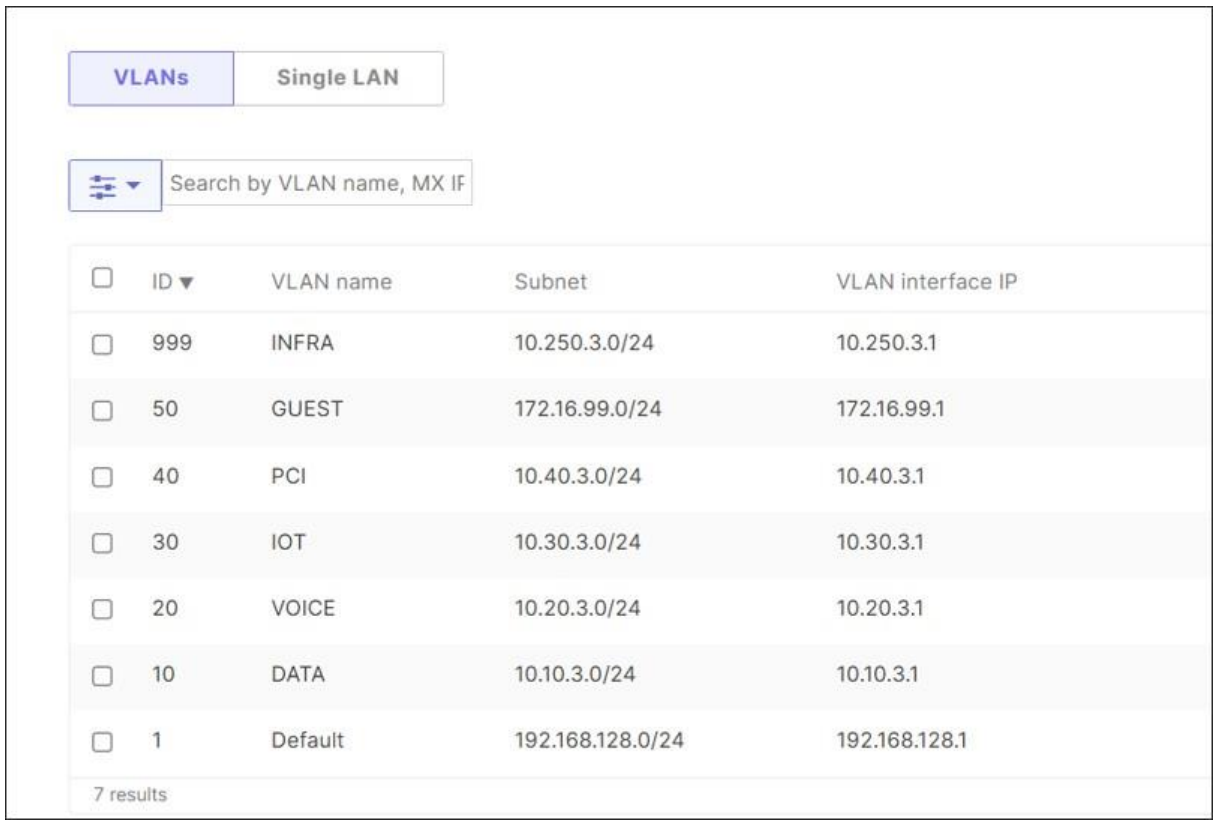
Step 3. Next to **VLAN interface IP**, enter the IP address of the MX gateway address for VLAN 40 (PCI) (10.40.3.1). This is in the form 10.<VLAN#><SITE#>.1 so global firewall rules for site-to-site VPNs can be efficiently applied.

Step 4. Next to **Subnet**, enter the VLAN subnet (10.40.3.0/24), then click **Create**.

Step 5. Click **Save**, which may be at the bottom of the page.



Step 6. Repeat the steps to add additional VLANs for DATA (10), VOICE (20), IOT (30), GUEST (50), and INFRA (999). The VLAN 1 interface IP address is left at default (192.168.128.1) and the VLAN 999 (INFRA) interface IP address is configured as 10.250.<site#>.1. VLANs 10, 20, 30, and 40 interface IPs follow the scheme 10.<VLAN#><Site#>.1. Site # in this example is 3. All subnets are /24 masks. All guest traffic on all branches shares the same subnet (172.16.99.0/24), and the GUEST VLAN interface IP address is configured for 172.16.99.1.



Step 7. Click **Save**, which may be at the bottom of the page.

MX router: Modify unused ports

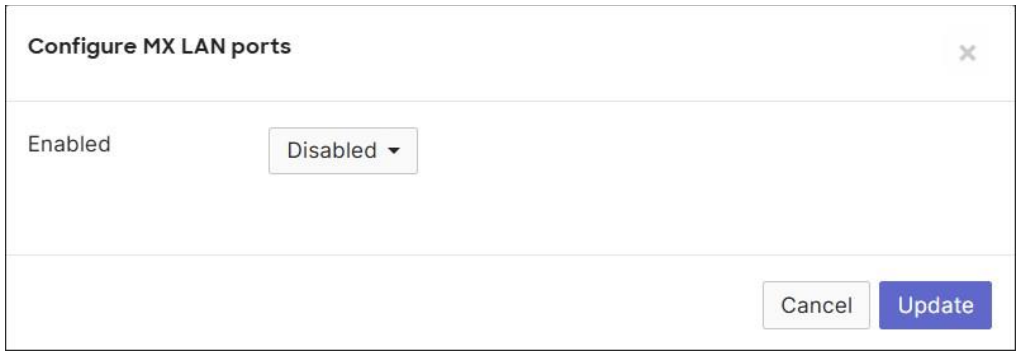
Procedure 16. To modify unused ports on MX:

Step 1. Navigate to **Security & SD-WAN > Configure > Addressing & VLANs** under **Per-port VLAN Settings**.

Step 2. Select the unused ports (ports 7-10 in this case) and click **Edit**.

Step 3. Next to **Enabled**, select **Disabled** from the drop-down menu.

Step 4. Click **Update**.



Step 5. Click **Save**.

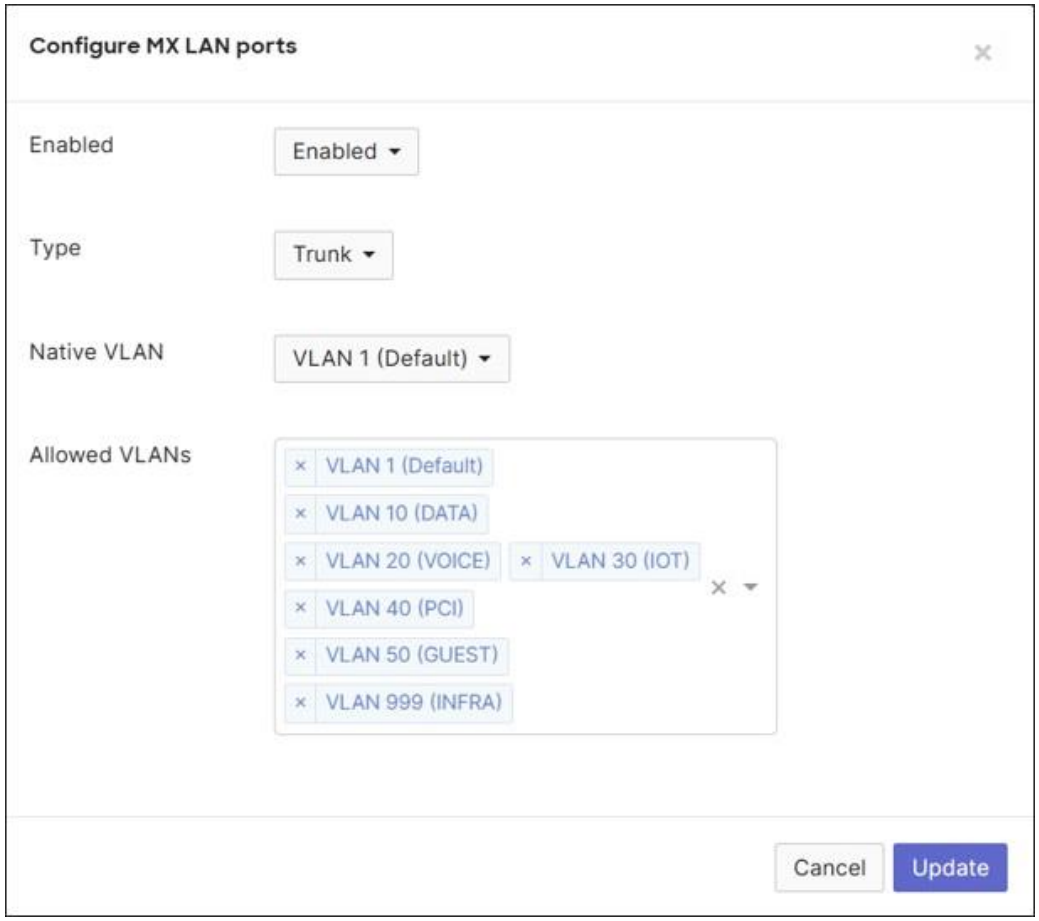
MX router: Modify VLANs allowed on trunks

Procedure 17. To modify VLANs allowed on trunks on MX:

Step 1. Under the **Per-port VLAN Settings**, there are two trunk ports (ports 5 and 6), one to B3-SW1 and one to B3-SW2. Select ports 5 and 6 and click **Edit**.

Step 2. Next to **Allowed VLANs**, delete **All VLANs** or **Existing Values**.

Step 3. From the drop-down, select **VLAN 1 (Default)**, **VLAN 10 (DATA)**, **VLAN 20 (VOICE)**, **VLAN 30 (IOT)**, **VLAN 40 (PCI)**, **VLAN 50 (GUEST)**, and **VLAN 999 (INFRA)**, then click **Update**.



Step 4. Click **Save**.

MX router: Configure DHCP

By default, on the MX router, all DHCP pools are local and proxy to an upstream DNS, which is out on the internet transport.

In this network, the Default, INFRA, and GUEST VLANs use local DHCP pools, while the other subnets use DHCP services in the data center. INFRA devices use reserved IP addresses from the DHCP pool. Only GUEST and Default VLANs should use an internet DNS server (OpenDNS), while everything else uses DNS services in the data center.

Tech tip: For MS switch stacks (except for MS390), each stack member receives its own IP address using its burned-in mac address (**Switching > Monitor > Switches > MAC address**). For Catalyst switch stacks running CS code and the MS390, each stack member shares a single IP address with the active member, and the stack leverages the burned-in mac address of the active member that is persistent when a new member takes over. For Catalyst switch stacks running IOS XE code, each stack member also shares a single IP address with the active member, but the stack leverages a single virtual mac address of the form, 00:18:0a:4f:00:XX. To find the mac address used for switch stack management, go to **Security & SD-WAN > Monitor > Appliance Status**. Click the **DHCP** tab

and search for the device which should have received an IP address in VLAN 1.

Ideally, management IP addresses should be statically configured and their addresses excluded from the DHCP pool. Due to limitations in automation at this time, DHCP has to be leveraged for IP assignment. Fixed IP address assignments in the DHCP pool allow devices to use DHCP to get an address but ensure those devices get the same IP address each time. To configure, a mac address of the device is needed.

Because IOS XE switch stacks use a virtual mac address, a new mac address could potentially be generated on complete power down and power back up of the entire switch stack (depending on what might be going on with other IOS XE switch stacks in the network at the time). The algorithm ensures that no other network devices share the same virtual mac address. If the mac address changes, the switch stack will receive a new management IP address from the DHCP pool instead of the one that was initially assigned.

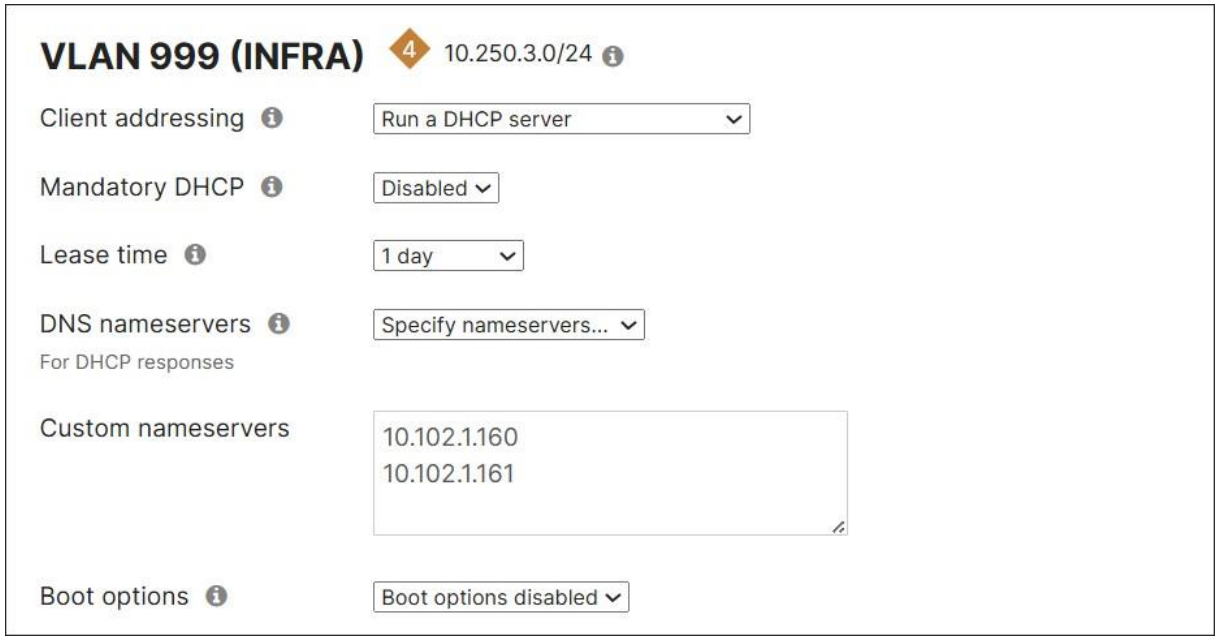
Before configuring this section, gather the mac addresses from any access-points and all switches/switch stacks so fixed IP address assignments can be created.

Device	Dashboard Location	Mac Address
B3-DIST-SW-STACK1	Security & SD-WAN>Monitor>Appliance Status>DHCP (VLAN 1)	00:18:0a:4f:00:01
B3-SW3	Switching>Monitor>Switches>MAC address	68:d9:72:73:78:80
B3-SW4	Switching>Monitor>Switches>MAC address	68:d9:72:73:78:00
B3-AP1	Wireless>Monitor>Access Points>MAC address	ac:69:cf:28:18:70

Procedure 18. To configure DHCP on MX:

Step 1. Go to **Security & SD-WAN > Configure > DHCP** and under **VLAN 999 (INFRA)** next to **DNS nameservers**, select **Specify nameservers**.

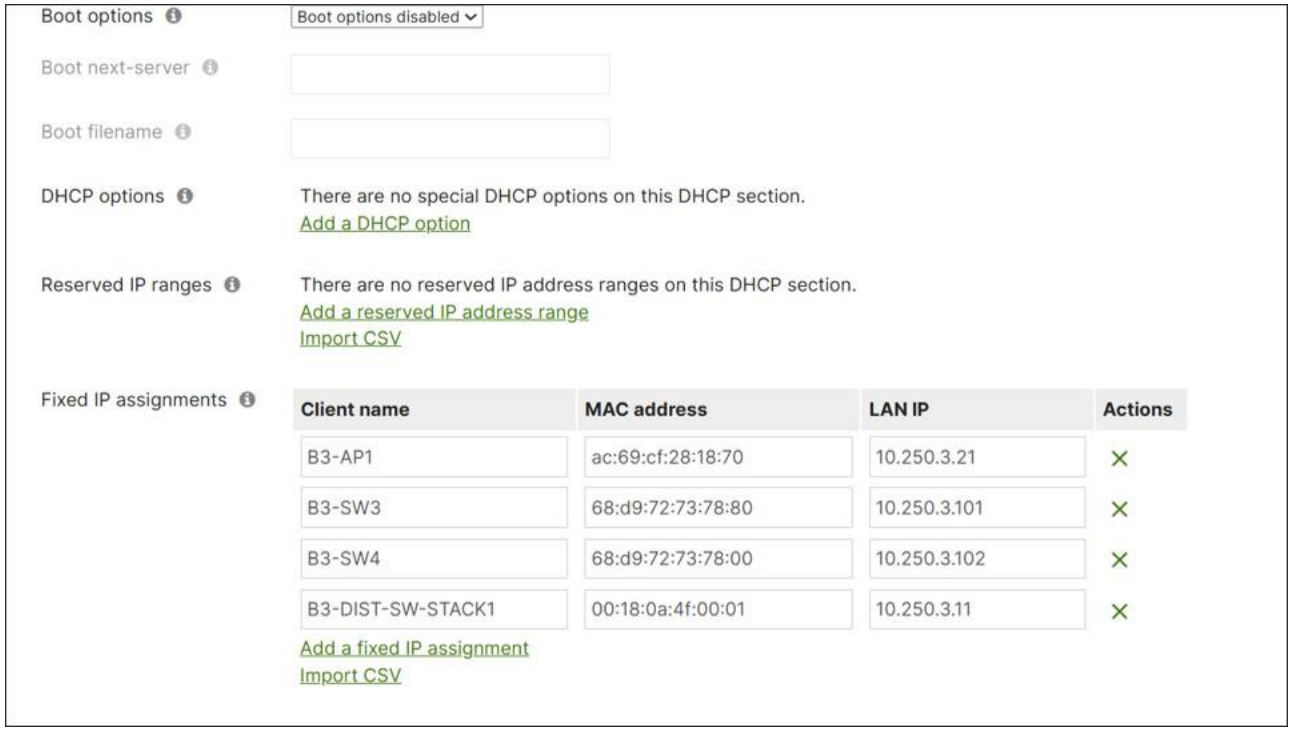
Step 2. Next to **Custom nameservers**, type in the DNS servers at the data center (10.102.1.160 and 10.102.1.161 in this example).



Step 3. Next to **Fixed IP assignments**, click **Add a fixed IP assignment**.

Step 4. Enter a name for the device, the mac address, and what LAN IP address is to be assigned.

Step 5. Repeat for all devices.



Step 6. Click **Save Changes** at the bottom of the page.

Step 7. For VLANs 10, 20, 30, and 40, next to **Client addressing**, select **Relay DHCP to another server** and next to **DHCP server IPs**, type in the data center DHCP servers (10.102.1.160 and 10.102.1.161 in this example).

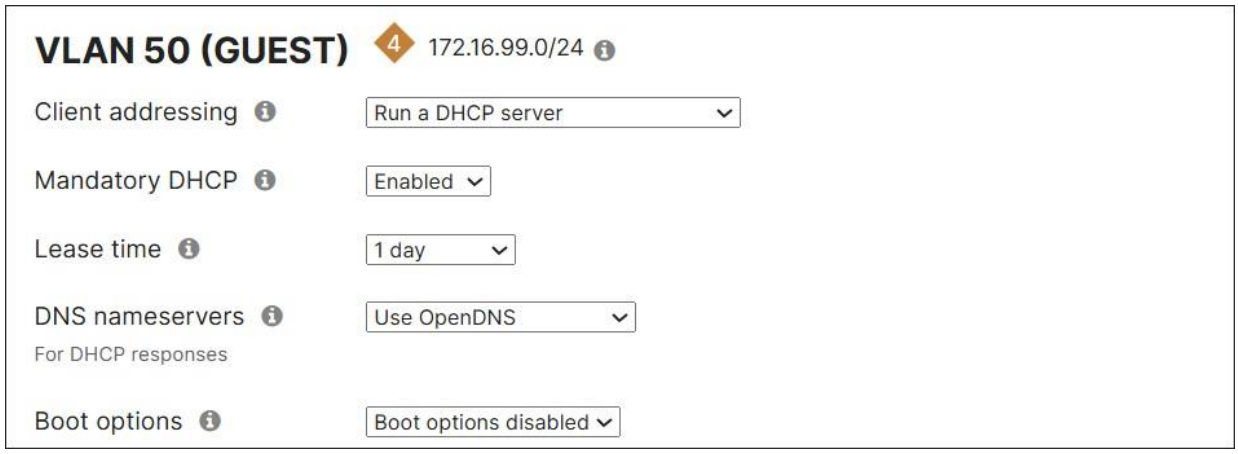
Step 8. Click **Save** or **Save Changes**.

Tech tip: The DHCP relay IP address must be in a subnet connected to the network or on a subnet reachable through the site-to-site VPN (not through the default route). In the example data center, there is a static route defined to reach the DC services network, and that static route is in VPN mode so it can be advertised to other Auto VPN members.

Step 9. For the Default VLAN (1) and GUEST VLAN (50), next to **Mandatory DHCP**, select **Enabled** from the drop-down menu.

Step 10. Next to **DNS nameservers**, select Use **OpenDNS** from the drop-down menu.

Step 11. Click **Save** or **Save Changes**.



MX router: Configure site-to-site VPNs

Hub and spoke settings

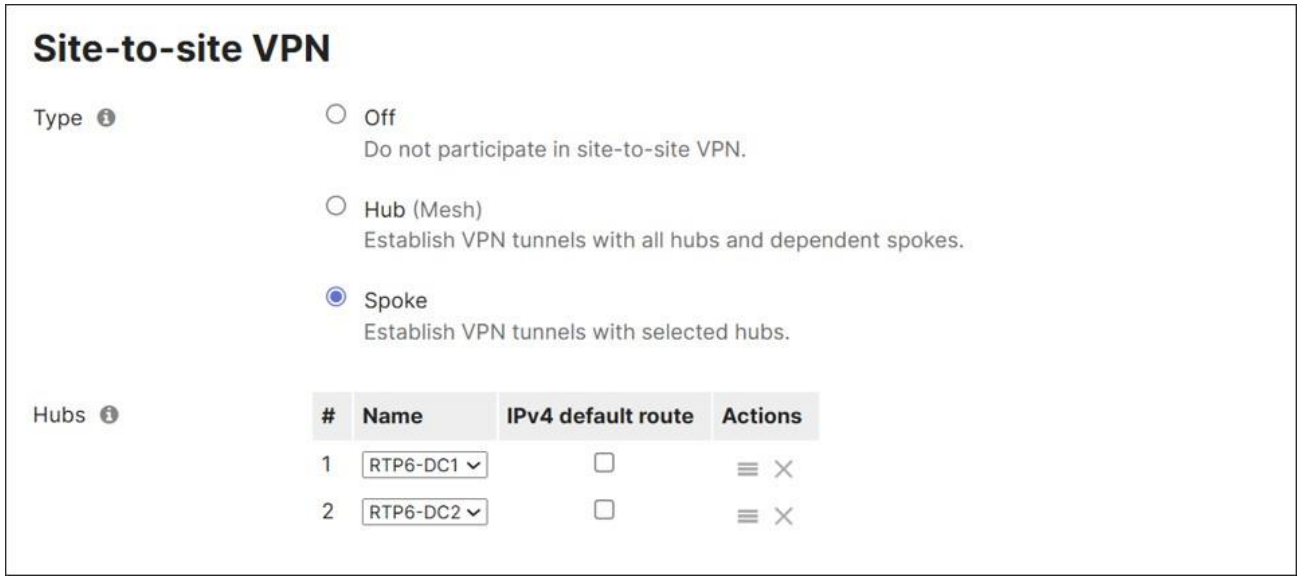
Procedure 19. To configure hub and spoke settings:

Step 1. Under **Security & SD-WAN > Configure > Site-to-site VPN**, next to **Type**, select **Spoke**.

Step 2. Next to **Hubs**, click **Add a hub** and select the primary hub (RTP6-DC1 in this example).

Step 3. Click **Add a hub** and select the secondary hub (RTP6-DC2 in this example). Since DC1 was selected first, this prioritizes DC1 as the primary hub, so if routes are equal, DC1 is selected to route the traffic.

Step 4. Click **Save** or **Save Changes**.



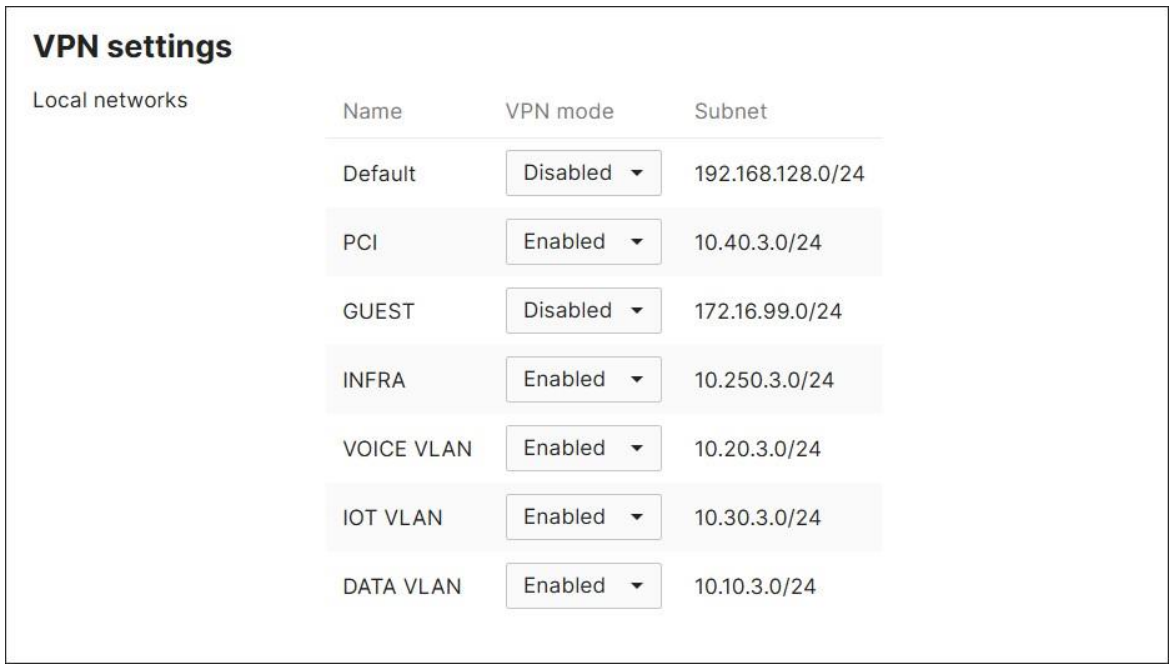
VPN settings for VLANs

By default, subnets are not advertised to other sites through the VPN registry.

Procedure 20. To configure VPN settings for VLANs:

Step 1. Under **Security & SD-WAN > Configure > Site-to-site VPN**, under **VPN settings > Local networks**, choose **Enabled** under **VPN mode** for DATA, VOICE, IOT, PCI and INFRA so these networks can be advertised.

Step 2. Click **Save** or **Save Changes**.



MX router: Configure firewall rules

VPN site-to-site outbound firewall

The VPN site-to-site outbound firewall rules apply to outbound VPN traffic destined to other VPN-connected sites and is applied at an organization level, meaning, these same rules apply to every MX router in the organization with site-to-site VPN enabled. This is important as it influences the way the rules should be crafted. In the example network, the network scheme is 10.<vlan#><site#>.0/24 so firewall rules can be applied more easily at the organizational level. The Data VLAN across the organization is represented by the subnet 10.10.0.0/16 instead of a list of disjointed 10.x networks.

If the policy objects and VPN site-to-site outbound firewall policy are already defined, go to the Local firewall section.

For the VPN site-to-site outbound firewall rules, only policy objects, policy object groups, IPv4/IPv6 addresses, or subnets can be referenced. This policy is implemented:

- Allow the DATA, VOICE, IOT, PCI, and INFRA subnets in any branch to reach Corporate shared services (DHCP, DNS, RADIUS, SNMP, and Management) and allow Corporate shared services to reach the DATA, VOICE, IOT, PCI, and INFRA subnets in any branch.
- Deny access from DATA, VOICE, IOT, PCI, and INFRA subnets to other subnets in other sites. Meaning, DATA subnets cannot reach VOICE, IOT, PCI, and INFRA subnets, and so on.
- Allow everything else. This is the default rule and allows DATA subnets to reach other DATA subnets as well as other routes through the hub. VOICE subnets can reach other VOICE subnets as well as other routes through the hub, and so on.

Note: Guest and Default traffic do not traverse the VPN overlay due to VPN mode being disabled for these VLANs. They can be included in the rule as “Deny GUEST subnet or Default subnet to Any” and “Deny

Any to GUEST subnet or Default subnet" if needed, in the event the GUEST or Default VLAN's VPN mode is enabled, and a unique subnet is configured.

Policy, or network, objects and groups provide easier management of firewall rules. They serve as labels for IP subnets, IP addresses, or FQDNs. Policy groups contain one or more IP/CIDR network objects or one or more FQDN network objects. When created, these objects and groups can be used in both site-to-site VPN outbound firewall rules as well as Layer 3 inbound/outbound firewall rules. Policy objects and groups are defined at the organization level.

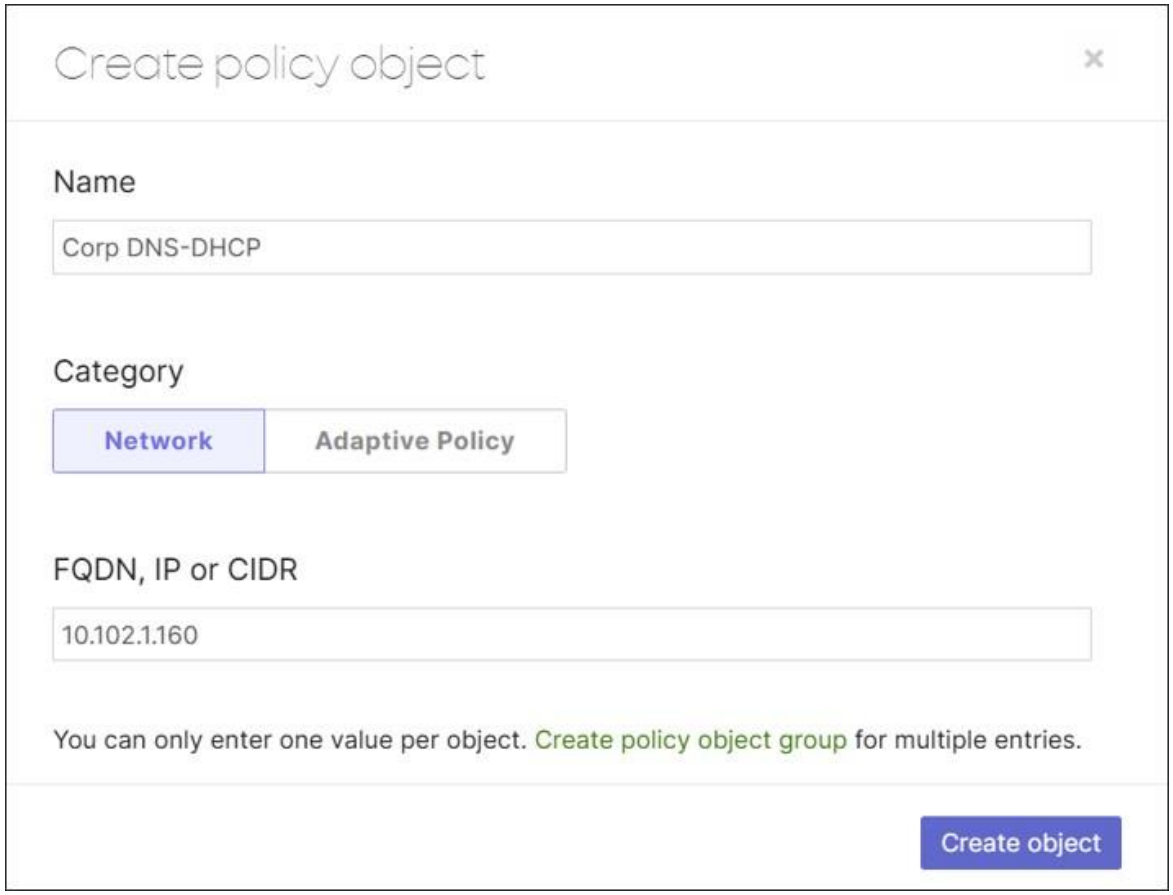
Procedure 21. To configure policy objects and site-to-site outbound firewall rules:

Step 1. Go to **Organization > Configure > Policy Objects**.

Step 2. Under the **All objects** tab, click **Add new**.

Step 3. Under **Name**, type in a name (Corp DNS-DHCP in this example) and under **FQDN, IP or CIDR**, add an IP host (10.102.1.160 in this example).

Step 4. Click **Create object**.



Step 5. When the objects are created, go to the **Groups** tab to create a grouping. In this example, a Corp Shared Services group is created for the various network services sitting in the data center.

Note: Objects within policy groups can be created before the policy group object is created or while the policy group object is being defined.

Step 6. Create these objects and object group. Create a GUEST and Default subnet as well which can be leveraged by layer 3 local firewall rules:

Object or Object Group	Name	Category	FQDN, IP, or CIDR
Object	Corp DNS-DHCP	Network	10.102.1.160
Object	Corp Mgt	Network	10.102.1.160
Object	Corp SNMP	Network	10.102.1.161
Object	Corp RADIUS	Network	10.102.1.157
Object	DATA Subnet	Network	10.10.0.0/16
Object	Default Subnet	Network	192.168.128.0/24
Object	GUEST Subnet	Network	172.16.99.0/24
Object	INFRA Subnet	Network	10.250.0.0/16
Object	IOT Subnet	Network	10.30.0.0/16
Object	PCI Subnet	Network	10.40.0.0/16
Object	VOICE Subnet	Network	10.20.0.0/16
Object Group	Corp Shared Services	--	Corp DNS-DHCP/Corp Mgt/Corp SNMP/Corp RADIUS

Step 7. Go to **Security & SD-WAN > Configure > Site-to-Site VPN**. Under **Site-to-site outbound firewall**, configure using these values:

Policy	Rule Description	Protocol	Source	Src Port	Destination	Dst Port
Allow	Shared Services	Any	DATA Subnet/VOICE Subnet/IOT Subnet/PCI Subnet/INFRA Subnet (Objects)	Any	Corp Shared Services (Object group)	Any
Allow	Shared Services	Any	Corp Shared Services (Object group)	Any	DATA Subnet/VOICE Subnet/IOT Subnet/PCI Subnet/INFRA Subnet (Objects)	Any
Deny	Data Access	Any	DATA Subnet (Object)	Any	VOICE Subnet/PCI Subnet/IOT Subnet/INFRA Subnet (Objects)	Any
Deny	Voice Access	Any	VOICE Subnet (Object)	Any	DATA Subnet/IOT Subnet/PCI Subnet/INFRA Subnet (Objects)	Any
Deny	IOT Access	Any	IOT Subnet (Object)	Any	DATA Subnet/VOICE Subnet/PCI Subnet/INFRA Subnet (Objects)	Any
Deny	PCI Access	Any	PCI Subnet (Object)	Any	DATA Subnet/VOICE Subnet/IOT Subnet/INFRA Subnet (Objects)	Any
Deny	Infra Access	Any	INFRA Subnet (Object)	Any	DATA Subnet/VOICE Subnet/IOT Subnet/PCI Subnet (Objects)	Any
Allow	Default Rule	Any	Any	Any	Any	Any

Step 8. Click **Finish editing**.

Step 9. Click **Save Changes**.

Local firewall

Local firewall rules apply to LAN traffic as well as direct internet traffic. It does not apply to VPN site-to-site traffic.

Tech tip: VLAN objects can be leveraged automatically in local firewall rules in single MX deployments but are not available to use in VPN site-to-site outbound firewall rules. VLAN objects used in firewall rules are not compatible with the MX warm spare feature. If VLAN objects are used in firewall rules and an MX warm spare is added to the network, any existing layer 3 rules referencing VLAN objects are removed.

The layer 3 policy will leverage the policy objects created for the VPN site-to-site outbound firewall rules. These policy objects can be leveraged at all branches. This policy is implemented.

- Allow the Data subnet to access local Printers (10.30.3.101 and 10.30.3.102) on the IOT subnet. The Layer 3 firewall rules are stateful, so traffic in the opposite direction is allowed back through.
- Deny access from Default, DATA, VOICE, IOT, PCI, GUEST, and INFRA subnets to other subnets at the same site. Meaning, DATA subnets cannot reach Default, VOICE, IOT, PCI, GUEST, and INFRA subnets, and so on.
- Allow direct internet access (DIA) for Default, INFRA, DATA, and GUEST subnets. Default and GUEST subnet traffic strictly uses DIA. For the INFRA subnet, dashboard traffic for devices behind the MX uses DIA. For the DATA subnet, Webex and Office 365 traffic uses DIA while the rest of the DATA subnet traffic leverages Cisco Secure Access for internet traffic.
- Deny everything else. This does not affect VPN site-to-site traffic, which is governed by site-to-site VPN firewall rules. This means that VOICE, IOT, and PCI subnets will be denied DIA.

Tech tip: When a default route is configured from the hub router or through Cisco Secure Access (as in this example), the MX is in full tunnel mode. In order for DIA to occur, VPN exclusions identifying traffic to be broken out must be configured (shown later in this example, under **Security & SD-WAN > Configure > SD-WAN & Traffic Shaping**). When broken out for DIA, this traffic is subjected to local firewall rules. These rules do not affect traffic going to Cisco Secure Access. VPN exclusions are configured based on IP destination or application. It is important to design the firewall rules carefully so they are not more restrictive than the defined VPN exclusions (unless that is needed), as this could unexpectedly blackhole traffic. For example, excluding ICMP with a destination of 8.8.8.8 sends all ICMP traffic regardless of the source VLAN with a destination of 8.8.8.8 to DIA. If the firewall blocks IOT traffic from DIA, ICMP traffic to 8.8.8.8 from the IOT VLAN is dropped. If this

traffic should go to Cisco Secure Access, ensure it is not configured in VPN exclusions.

Procedure 22. To configure policy objects and local firewall rules on the MX:

Step 1. Policy objects and a group can be optionally created for the branch printers. Go to **Organization > Configure > Policy Objects**.

Step 2. Create these objects and group. For each line, click **Add new** and after the line is configured, click **Create object** or **Create group**.

Object or Object Group	Name	Category	FQDN, IP, or CIDR
Object	Branch 3 Printer 1	Network	10.30.3.101
Object	Branch 3 Printer 2	Network	10.30.3.102
Object Group	Branch 3 Printers	---	Branch 3 Printer 1/Branch 3 Printer 2

Step 3. Select **Security & SD-WAN > Configure > Firewall** and under **Layer 3 > Outbound rules**, click **Add new**.

Step 4. Fill out the parameters and click **Add new** to add the next rule as shown in the table.

Policy	Rule Description	Protocol	Source	Src Port	Destination	Dst Port
Allow	Local Print Access	Any	DATA Subnet (Object)	Any	Branch 1 Printers (Object group)	Any
Deny	Default (VLAN 1) Access	Any	Default Subnet (Object)	Any	DATA Subnet/VOICE Subnet/IOT Subnet/PCI Subnet/GUEST Subnet/INFRA Subnet (Objects)	
Deny	Data Access	Any	DATA Subnet (Object)	Any	Default Subnet/VOICE Subnet/IOT Subnet/PCI Subnet/GUEST Subnet/INFRA Subnet (Objects)	Any
Deny	Voice Access	Any	VOICE Subnet (Object)	Any	Default Subnet/DATA Subnet/IOT Subnet/PCI Subnet/GUEST Subnet/INFRA Subnet (Objects)	Any
Deny	IOT Access	Any	IOT Subnet (Object)	Any	Default Subnet/DATA Subnet/VOICE Subnet/PCI Subnet/GUEST Subnet/INFRA Subnet (Objects)	Any
Deny	PCI Access	Any	PCI Subnet (Object)	Any	Default Subnet/DATA Subnet/VOICE Subnet/IOT Subnet/GUEST Subnet/INFRA Subnet (Objects)	Any

Policy	Rule Description	Protocol	Source	Src Port	Destination	Dst Port
Deny	Guest Access	Any	GUEST Subnet (Object)	Any	Default Subnet/DATA Subnet/VOICE Subnet/IOT Subnet/PCI Subnet/INFRA Subnet (Objects)	
Deny	Infra Access	Any	INFRA Subnet (Object)	Any	Default Subnet/DATA Subnet/VOICE Subnet/IOT Subnet/PCI Subnet/GUEST Subnet (Objects)	
Allow	Allow Direct Internet Access	Any	Default Subnet (Object)/INFRA Subnet (Object)/DATA Subnet (Object)/GUEST Subnet (Object)	Any	Any	Any
Deny	Deny All	Any	Any	Any	Any	Any
Allow	Default rule	Any	Any	Any	Any	Any

Step 5. When complete, click **Finish editing**, then **Save** or **Save Changes**.

Cisco Secure Access and MX router: Configure secure internet access tunnels

Secure tunnels are configured with Cisco Secure access and the MX router for branch direct internet access.

Note: When the tunnels are set up in the Meraki Dashboard to a particular network tunnel group in Cisco

Secure Access, the configurations are available in the Meraki Dashboard at the organizational level for other branches to leverage. To leverage an existing secure tunnel pair, the branch is tagged in the **Organization > Monitor > Overview** page using the same tag attached to the IPsec tunnel pair when created (SSE_East in this example). No additional configuration is required.

These steps show how to tag a branch to leverage a Cisco Secure Access tunnel pair, set up a network tunnel group in Cisco Secure Access and subsequently, configure the primary and secondary IPsec tunnel pairs in the Meraki Dashboard to connect to that network tunnel group if not already configured.

If Cisco Secure Access tunnels pairs are already set up, configure the network tag for the required branch and skip the tunnel configuration in Cisco Secure Access and on the MX router.

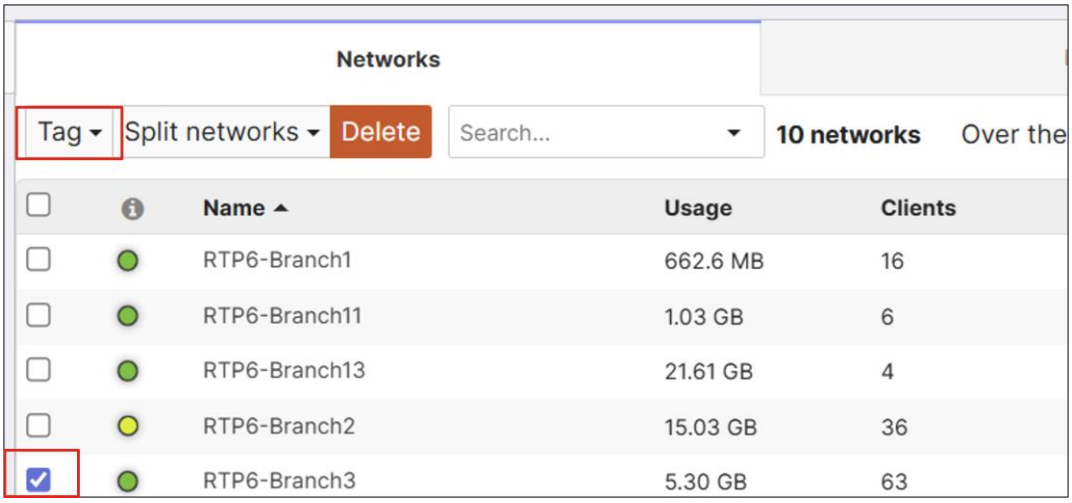
Organization level: Tag the branch to leverage Cisco Secure Access tunnels

In this example, a tag called “SSE_East” is selected or created in the Dashboard to reference an active/standby tunnel pair that exists or will be configured, connecting Branch 3 to Cisco Secure Access.

Procedure 23. To tag the branch to leverage Cisco Secure Access tunnels:

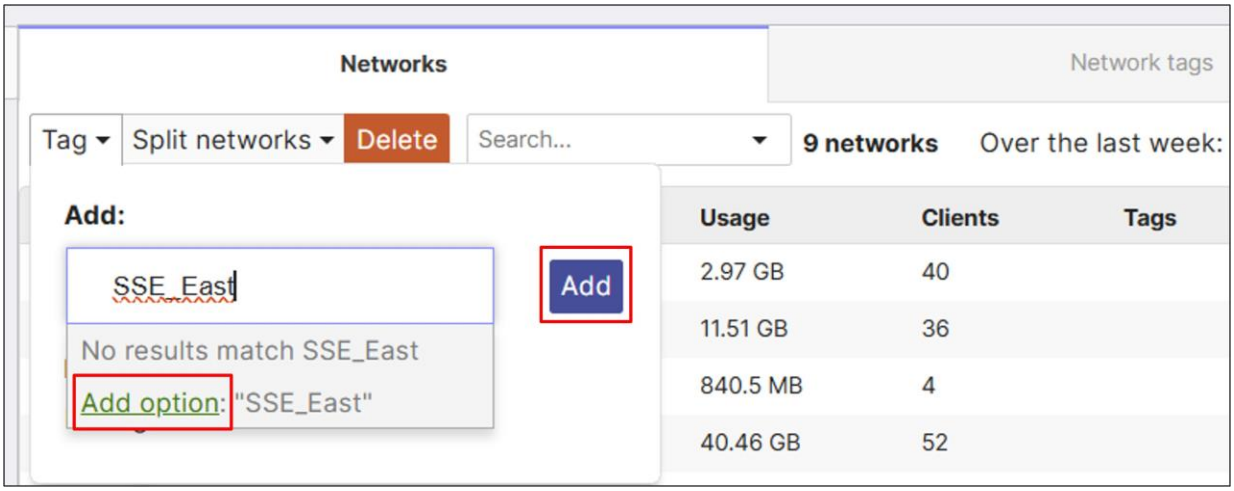
Step 1. On the Meraki Dashboard, navigate to **Organization > Monitor > Overview**.

Step 2. Select the branch network (RTP6-Branch3), then click **Tag**.

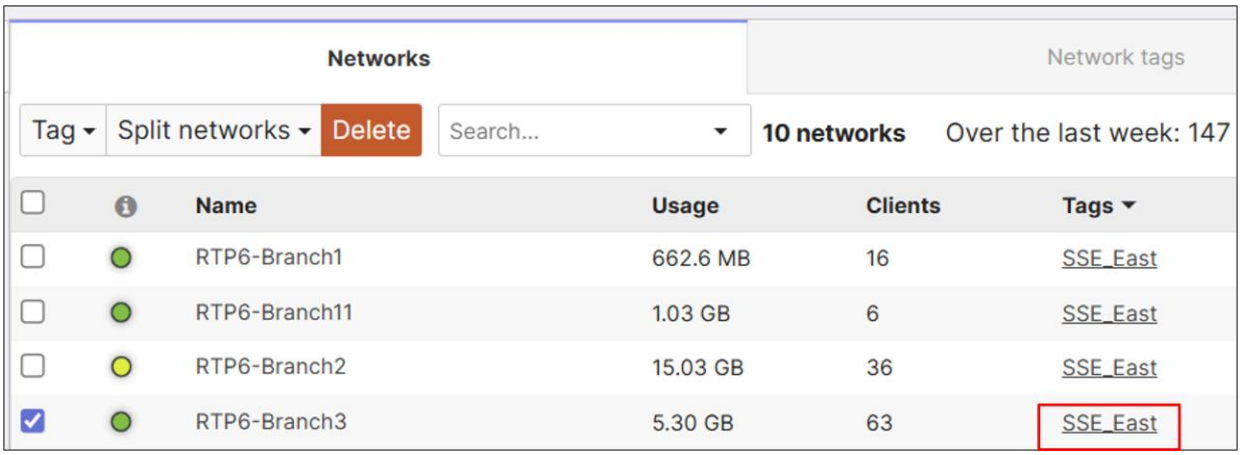


Step 3. In the text box, select the existing tag, SSE_East, then click **Add**.

Step 4. If the tag has not been created yet, type in the new tag (SSE_East), click **Add option** beneath the text box, then click **Add**.



Branch 3 now has an SSE_East tag.



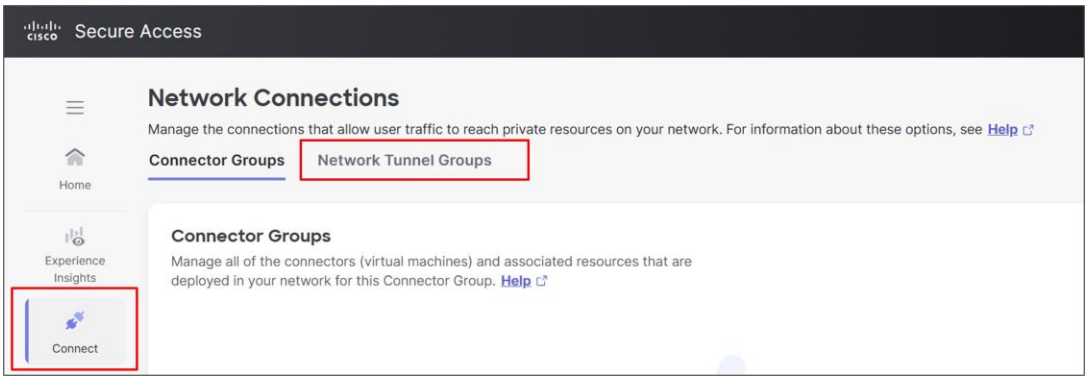
Step 5. If SSE tunnels are already configured, skip to the Validate Status of Cisco Secure Access Tunnels section to check the tunnel status.

Cisco Secure Access: Tunnel configuration

Procedure 24. To configure a Network Tunnel Group on Cisco Secure Access:

Step 1. Go to https://sse.cisco.com and log in with the proper credentials.

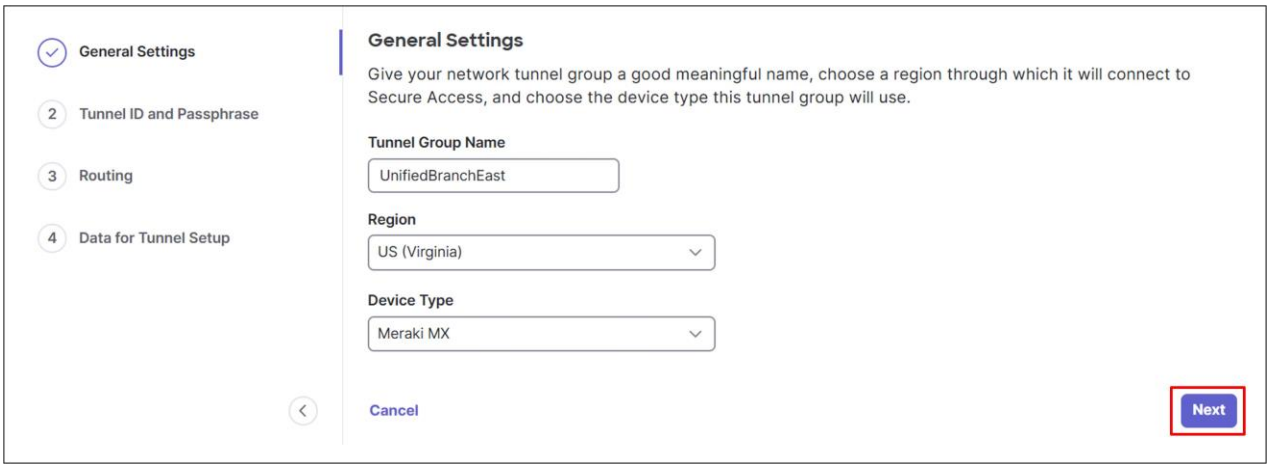
Step 2. From Cisco Secure Access, go to **Connect > Network Connections**. Click the **Network Tunnel Groups** tab.



Step 3. Click **+ Add** to add a new tunnel group.

Step 4. Type in a meaningful **Tunnel Group Name** (UnifiedBranchEast), choose a **Region** (US (Virginia) in this example), and choose a **Device Type** (Meraki MX).

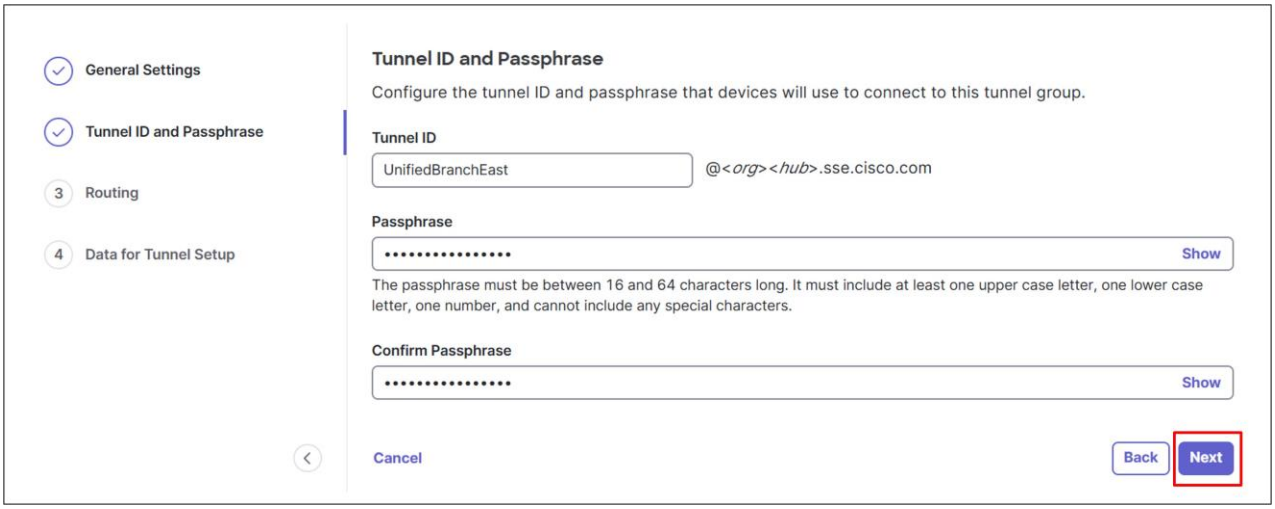
Step 5. Click **Next**.



Step 6. Configure a **Tunnel ID** and **Passphrase**.

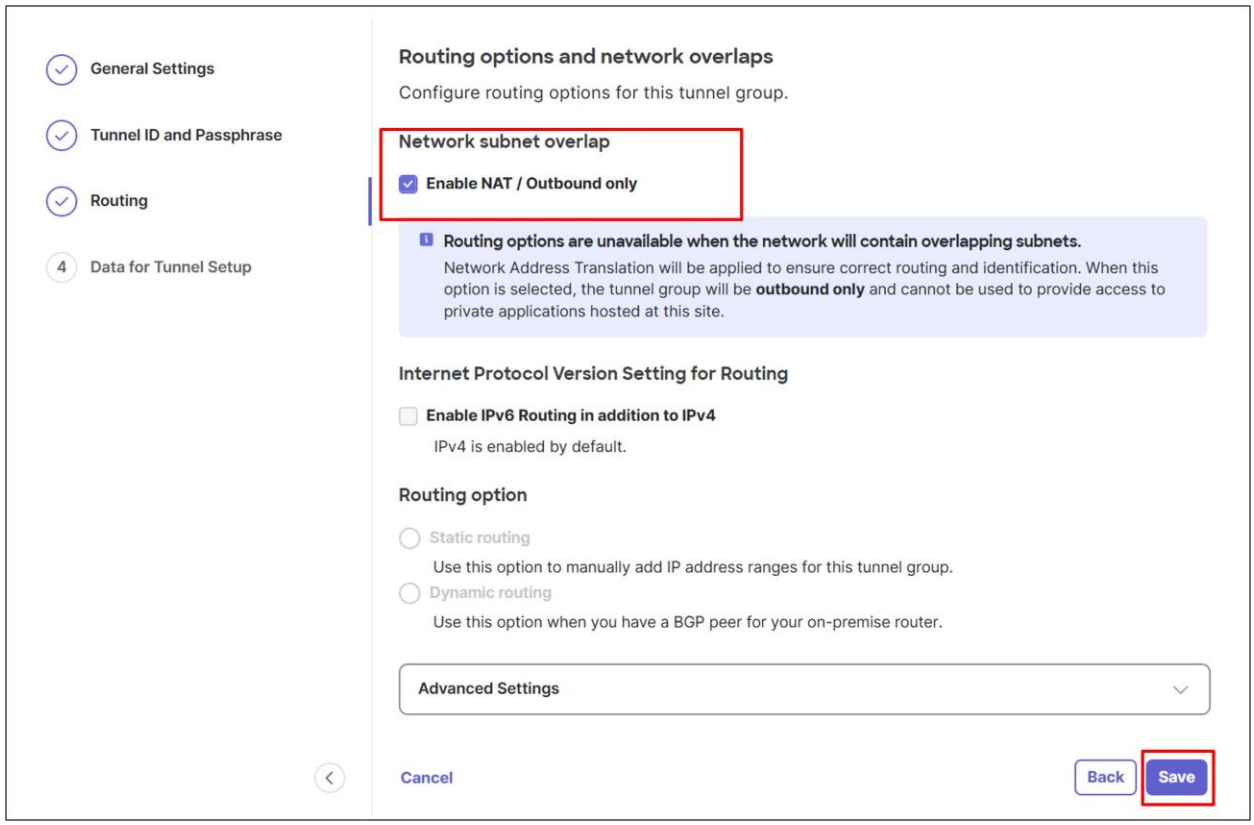
Step 7. Enter the passphrase again under **Confirm Passphrase**. The Tunnel ID is a unique identifier and paired with the pre-shared key, allows a tunnel on the router to authenticate to the Secure Access headend.

Step 8. Click **Next**.



Step 9. Under **Routing options and network overlaps > Network subnet overlap**, select the **Enable NAT / Outbound only** option.

Step 10. Click **Save**.

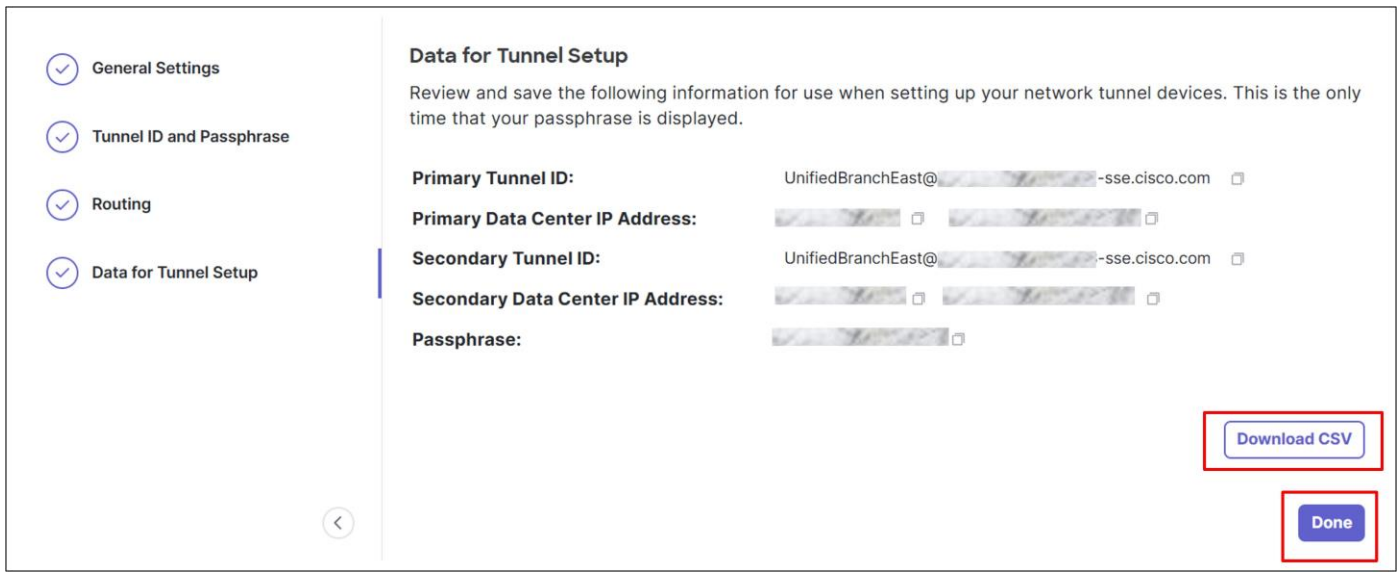


Step 11. On the **Data for Tunnel Setup** page, review the information.

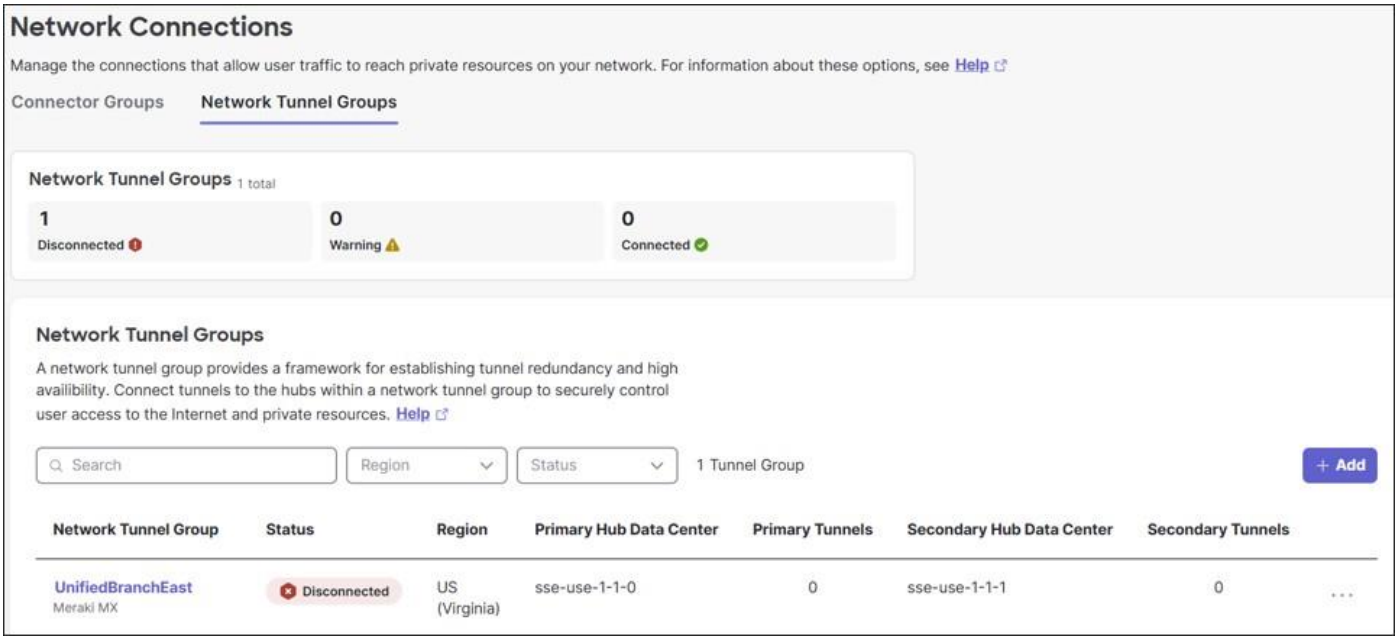
Step 12. Click the **Download CSV** button to save the Tunnel ID and Data Center IP address information to use when setting up the tunnels on the network devices.

Step 13. Remember or copy the passphrase for safe keeping. It will not be downloaded in the CSV file, and it won't be viewable in the tunnel setup information.

Step 14. Click **Done**.



The status is shown for the tunnel, but it shows a disconnected status until the tunnels are established from the router.



MX router: Cisco Secure Access tunnel configuration

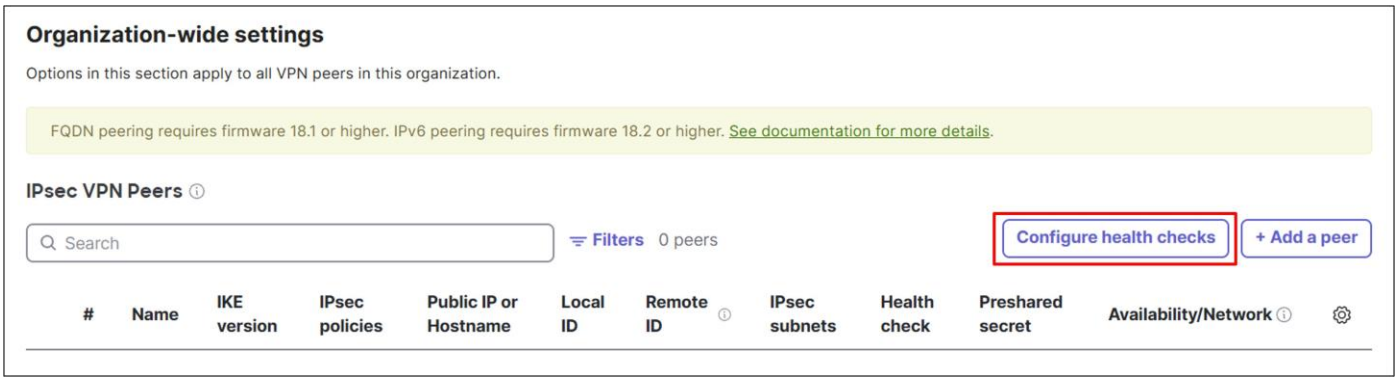
In this section, an active/standby tunnel pair is configured to connect Branch 3 to the Cisco Secure Access tunnel group that was configured in the previous section.

Procedure 25. To configure an active/standby tunnel pair:

Step 1. Select a branch already configured with site-to-site VPN tunnels (RTP-Branch3).

Step 2. Navigate to **Security & SD-WAN > Site-to-site VPN**.

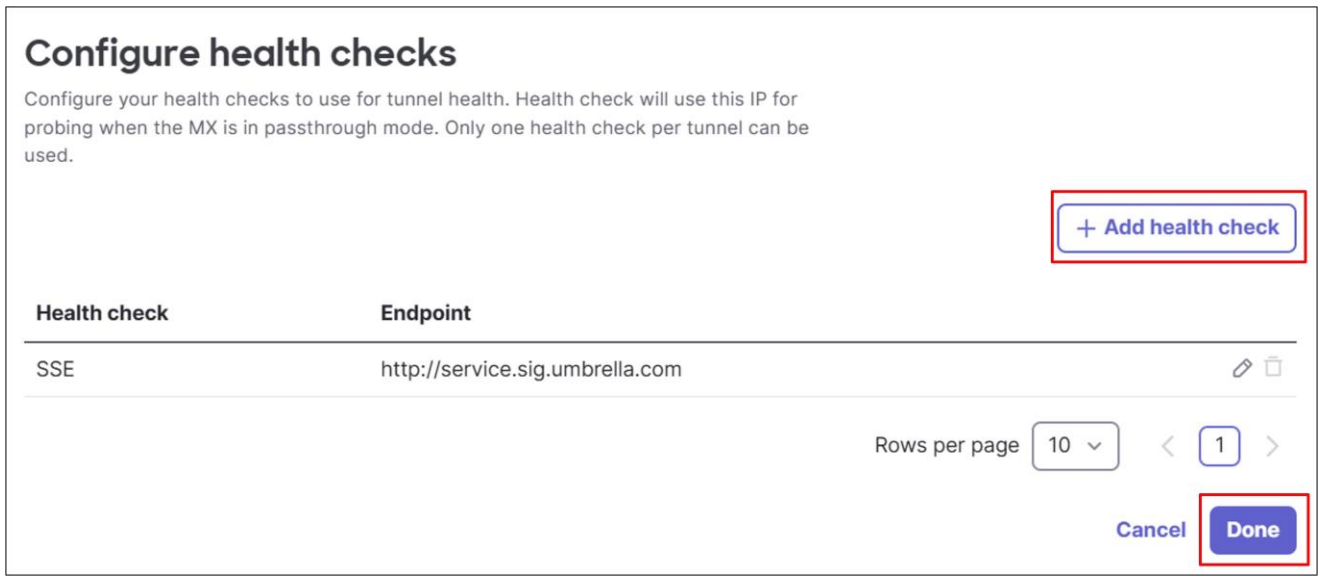
Step 3. Under **Organization-wide settings > IPsec VPN Peers**, click **Configure health checks**.



Step 4. Click **+ Add health check**.

Step 5. Type the name for the **Health check** (SSE) and configure the **Endpoint** URL (http://service.sig.umbrella.com).

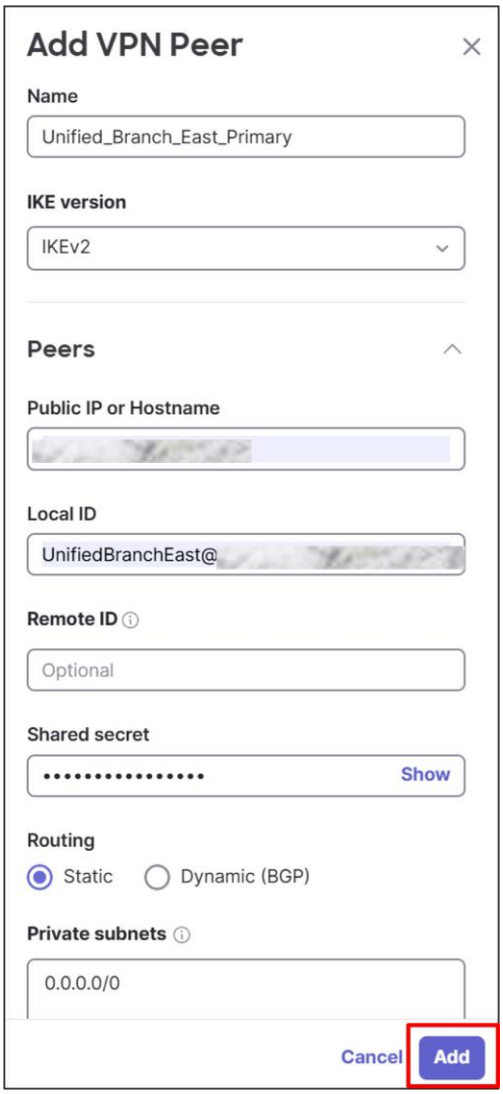
Step 6. Click **Done**.



Step 7. Click **+ Add a peer** and configure these settings for the Primary Tunnel:

- **Name**: Unified_Branch_East_Primary
- **IKE version**: IKEv2
- **Peers**
  - **Public IP or Hostname**: [Primary Data Center IP Address from Cisco Secure Access]
  - **Local ID**: [Primary Tunnel Group ID from Cisco Secure Access]
  - **Shared Secret**: [Passphrase from Cisco Secure Access]
  - **Routing**: Static
  - **Private subnets**: **0.0.0.0/0**
  - **Availability:** SSE_East
- **Multi-Uplink IPsec VPN**: **Enable**
- **Tunnel monitoring**
  - **Health check**: SSE
- **IPsec policy**
  - **Preset: Umbrella**

Step 8. Click **Add**. Click **Save** or **Save Changes**.



Step 9. You may get a warning that VLAN subnets overlap with the default route that was just configured for SSE. IP traffic is routed to the smallest subnet/longest prefix that contains the IP address, and the SSE default route is used for traffic not matching anything else in the routing table. Click **Confirm Changes**.

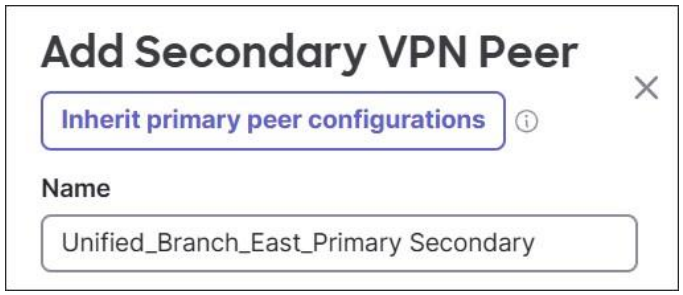
Tech tip: Under **IPsec Policy**, the Umbrella **Preset** configures these settings automatically:
Phase 1/Encryption: AES 256
Phase 1/Authentication: SHA1
Phase 1/Diffie-Hellman group: 14
Phase 1/Lifetime: 14400 sec
Phase 2/Encryption: AES 256
Phase 2/Authentication: SHA1
Phase 2/PFS group: Off
Phase 2/Lifetime: 3600 sec

Procedure 26. To add the secondary tunnel:

Step 1. To add the secondary tunnel, to the far right of the defined tunnel, click **...** under the gear column.

Step 2. Select **Add secondary peer**.

Step 3. At the top of the form, click **Inherit primary peer configurations** to fill out most of the fields for the secondary peer.

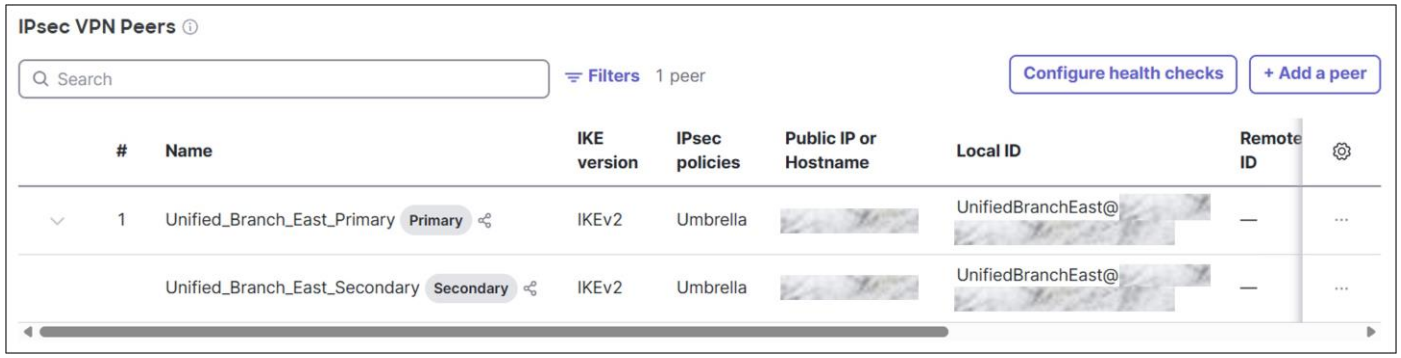


Step 4. Modify these fields:

- **Name**: Unified_Branch_East_Secondary
- **Peers**
  - **Public IP or Hostname**: [Secondary Data Center IP Address from Cisco Secure Access]
  - **Local ID**: [Secondary Tunnel Group ID from Cisco Secure Access]

Step 5. Click **Add**. Click **Save** or **Save Changes**.

Step 6. You may get a warning that VLAN subnets overlap with the default route that was just configured for SSE. IP traffic is routed to the smallest subnet/longest prefix that contains the IP address, and the SSE default route is used for traffic not matching anything else in the routing table. Click **Confirm Changes**.



Validate status of Cisco Secure Access tunnels

Procedure 27. To check the status of the tunnels on Cisco Secure Access:

Step 1. Go to **Connect > Network Connections** and click the **Network Tunnel Groups** tab.

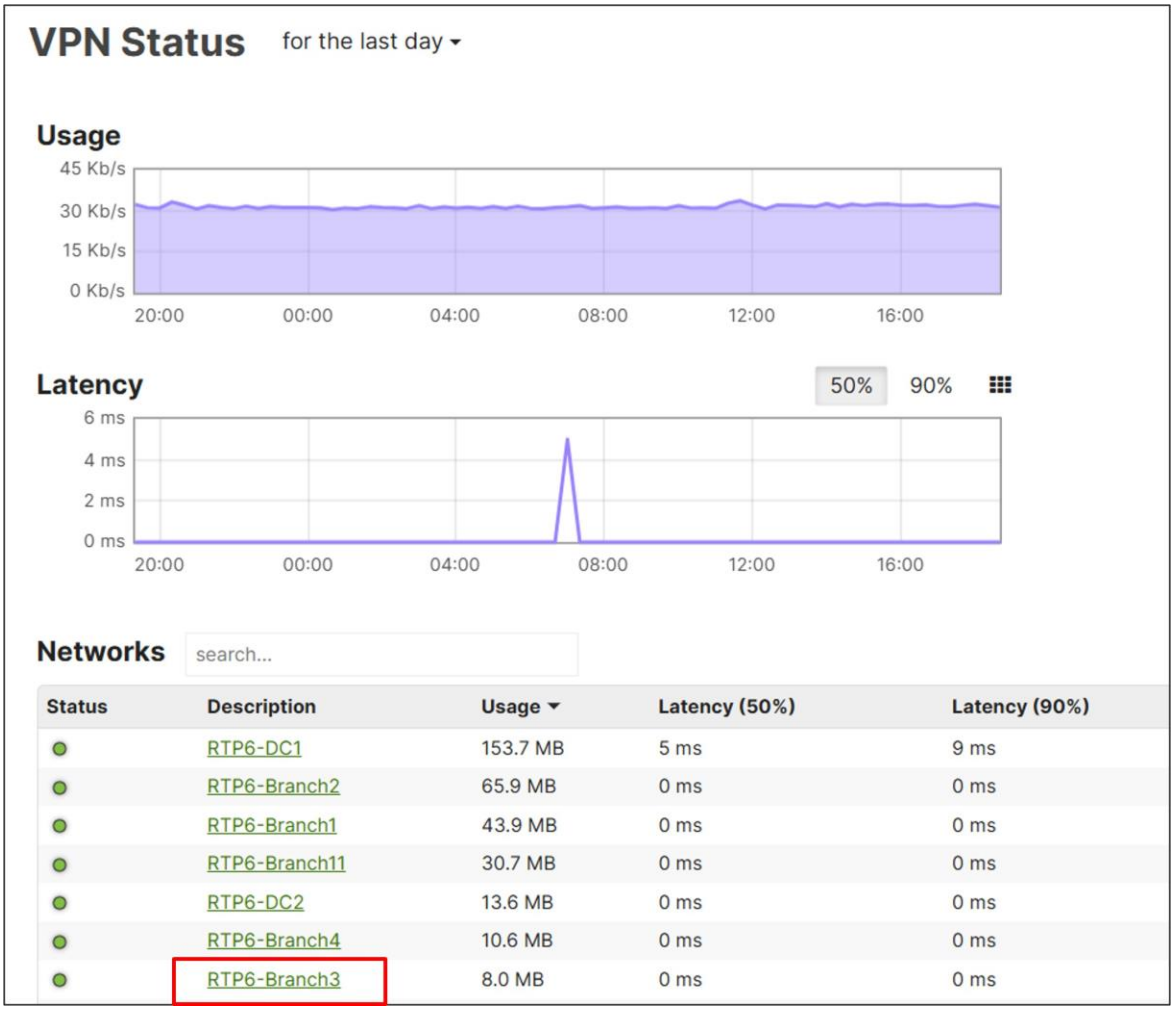
Step 2. Find the Network Tunnel Group created.

Step 3. Click **...** on the far right and choose **View Details** to refer to additional details about the connected tunnels.

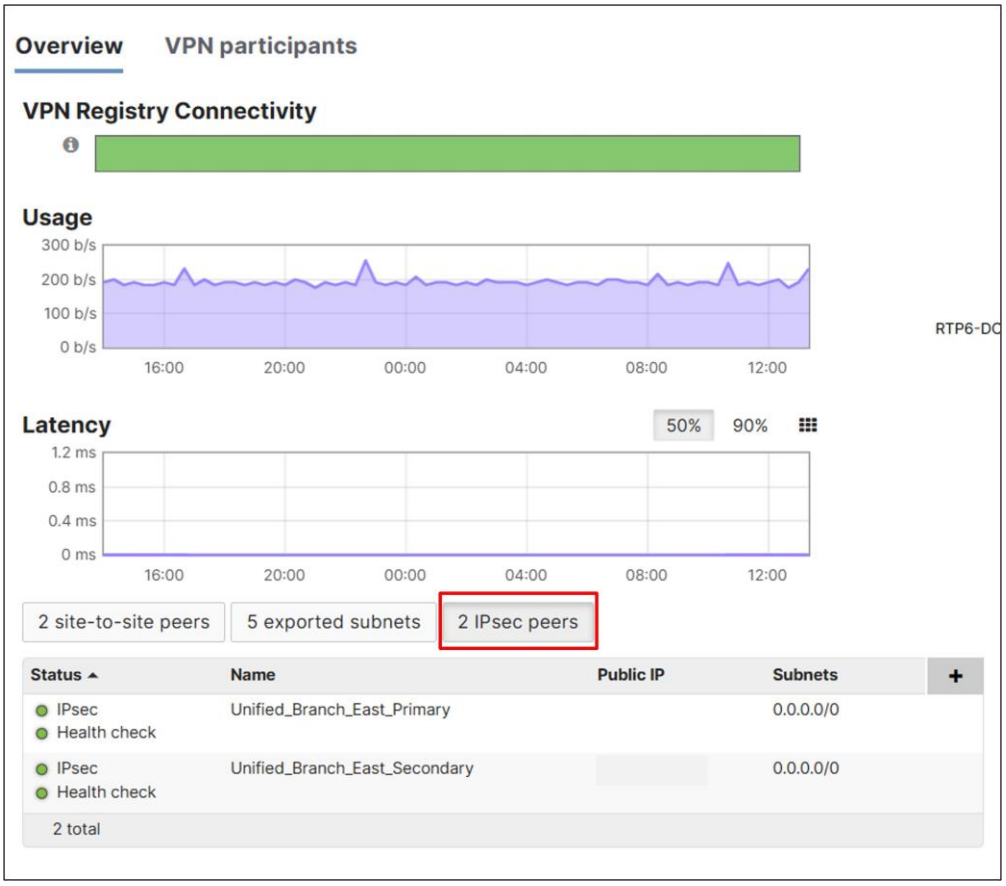
Procedure 28. To check the status of the tunnels on the MX router:

Step 1. Go to **Organization > Monitor > VPN Status**.

Step 2. Select the network to view (RTP6-Branch3).



Step 3. Click the **2 IPsec peers** box to view the status of the Cisco Secure Access peers.



MX router: Configure SD-WAN & traffic shaping

In this example, most internet traffic takes the Cisco Secure Access tunnels. The primary tunnels load balance automatically by default as long as they are going to the same data center. Guest traffic, Data/Corporate SaaS traffic (O365 and Webex), device (switch and AP) dashboard INFRA traffic, and Default traffic (if any) take direct internet access (DIA) from the branch.

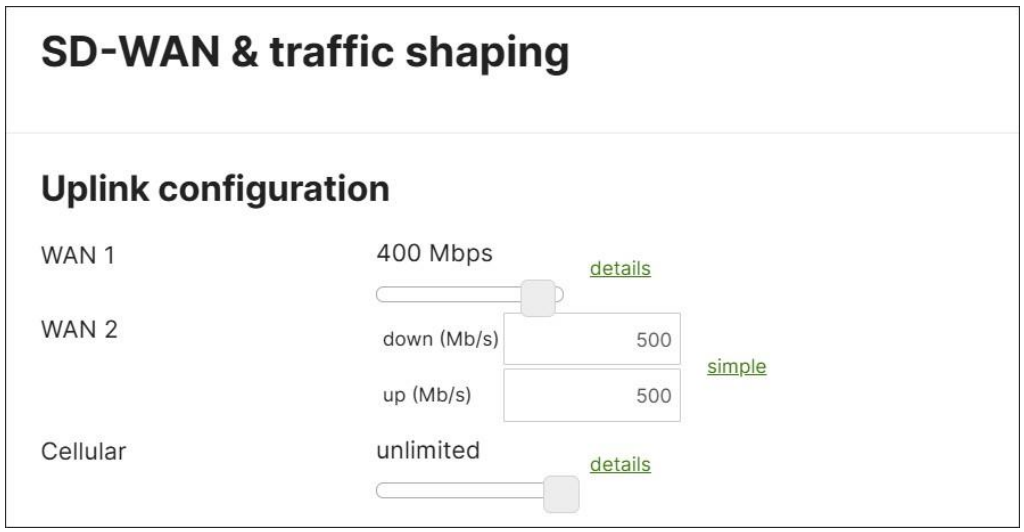
Uplink configuration

In this example, rate limiting is set on each WAN link to match the provider's service sub-line rate.

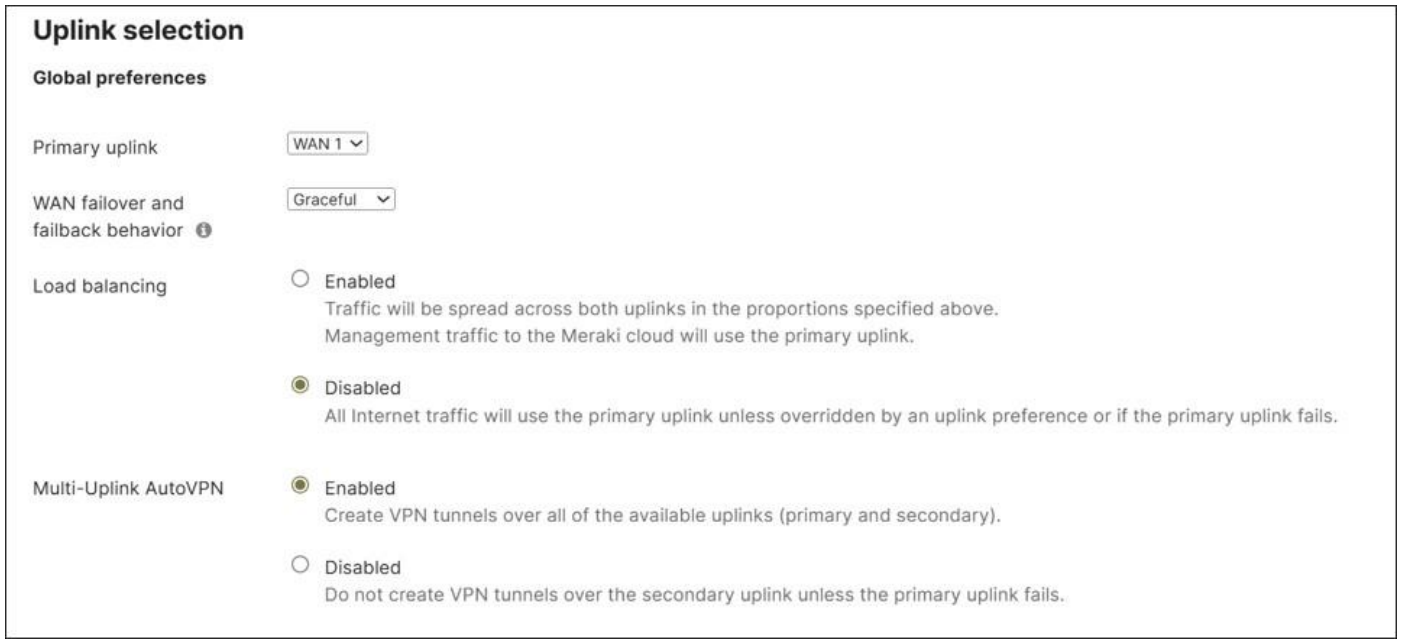
Procedure 29. To configure the WAN uplinks:

Step 1. Go to **Security & SD-WAN > Configure > SD-WAN & Traffic Shaping**.

Step 2. Under **Uplink configuration**, set **WAN 1** to 400 Mbps and **WAN 2** to 500 down (Mb/s) and 500 up (Mb/s) in this example.



Step 3. Under **Uplink selection > Global preferences**, the **Primary uplink** is kept as **WAN 1** (default), and **Load balancing** is disabled for direct internet traffic. In addition, VPN tunnels are created over both available uplinks (**Multi-Uplink AutoVPN** is Enabled). Click **Save** or **Save Changes**.



Local internet breakout

Because default routes are pointing to the Cisco Secure Access tunnels, the site is assumed to be in full-tunnel mode. This means that all internet traffic is sent through the Cisco Secure Access tunnels. The exception is GUEST and Default VLAN traffic because their VPN mode is set to disabled and internet access for these VLANs is allowed as a rule in the L3 firewall. To break out traffic for DIA, VPN exclusions first need to be configured. In this example, SaaS application (Office 365 and Webex) traffic from the DATA VLAN needs to be broken out, as well as dashboard INFRA VLAN traffic for the infrastructure device control planes.

Note: Traffic generated from the MX itself cannot be subjected to local internet breakout rules, but traffic from infrastructure devices and other clients behind the MX can. MX-generated management traffic takes the default route in the table, which is through the Cisco Secure Access tunnels.

Procedure 30. To break out traffic for DIA:

Step 1. Go to **Security & SD-WAN > Configure > SD-WAN & Traffic Shaping**.

Step 2. Under **Local internet breakout** next to **VPN exclusion rules**, click the **Add +** button.

Step 3. Select **Major applications** and choose **Office 365 Suite** and **Webex**.

Step 4. Under **Custom expressions**, specify the **Protocol**, **Destination** (click **Add**), and **Dst port**, then click **Add expression**.

Step 5. Use these custom expressions to allow dashboard cloud communication and VPN registry traffic for devices behind the MX routers. **Any** is used for the protocol to cover TCP, UDP, and ICMP traffic. **Any** is used for the destination port to cover multiple ports. Alternatively, multiple custom expressions can be configured so specific protocols and ports can be used. Refer to Upstream Firewall Rules for Cloud Connectivity for latest, up-to-date port requirements for the dashboard.

Protocol	Destination	Dst Port
UDP	64.62.142.12/32	Any
ANY	158.115.128.0/19	Any
ANY	209.206.48.0/20	Any
ANY	216.157.128.0/20	Any

Step 6. Click Save or Save Changes.

SD-WAN policies: internet

In this part of the configuration, traffic steering and performance-based routing policies are configured. The first section applies to direct internet traffic only. Because no load-balancing is configured, traffic chooses the primary uplink (WAN 1 in this case) unless there is a policy to steer it differently. In this example, these policies are preferred:

- Guest traffic is directed over WAN 1. If the link is declared down, the traffic is redirected to WAN 2.
- SaaS Traffic is directed over WAN 2 and should be redirected to WAN 1 if performance is poor.
- Device dashboard traffic is directed over WAN 2. If the link is declared down, the traffic is redirected to WAN 1.

Guest traffic doesn't need to be included in the policy since this is the default behavior when no load-balancing is chosen and the primary uplink is WAN 1. Also, note that traffic generated from the MX itself is not subjected to policy. Policy applied to dashboard traffic affects the infrastructure devices behind the MX (switches and AP).

A custom performance class for SaaS traffic should be configured before configuring the policy.

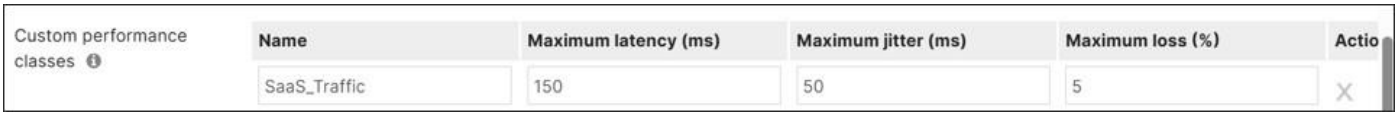
Procedure 31. To configure a custom performance class for internet traffic:

Step 1. Go to **Security & SD-WAN > Configure > SD-WAN & Traffic Shaping**.

Step 2. Under **SD-WAN policies** > **Custom performance classes**, select **Create a new custom performance class** and enter these values:

- **Name** (SaaS_Traffic)
- **Maximum latency (ms)** (150)
- **Maximum jitter (ms)** (50)
- **Maximum loss (%)** (5)

Step 3. Click **Save** or **Save Changes**.



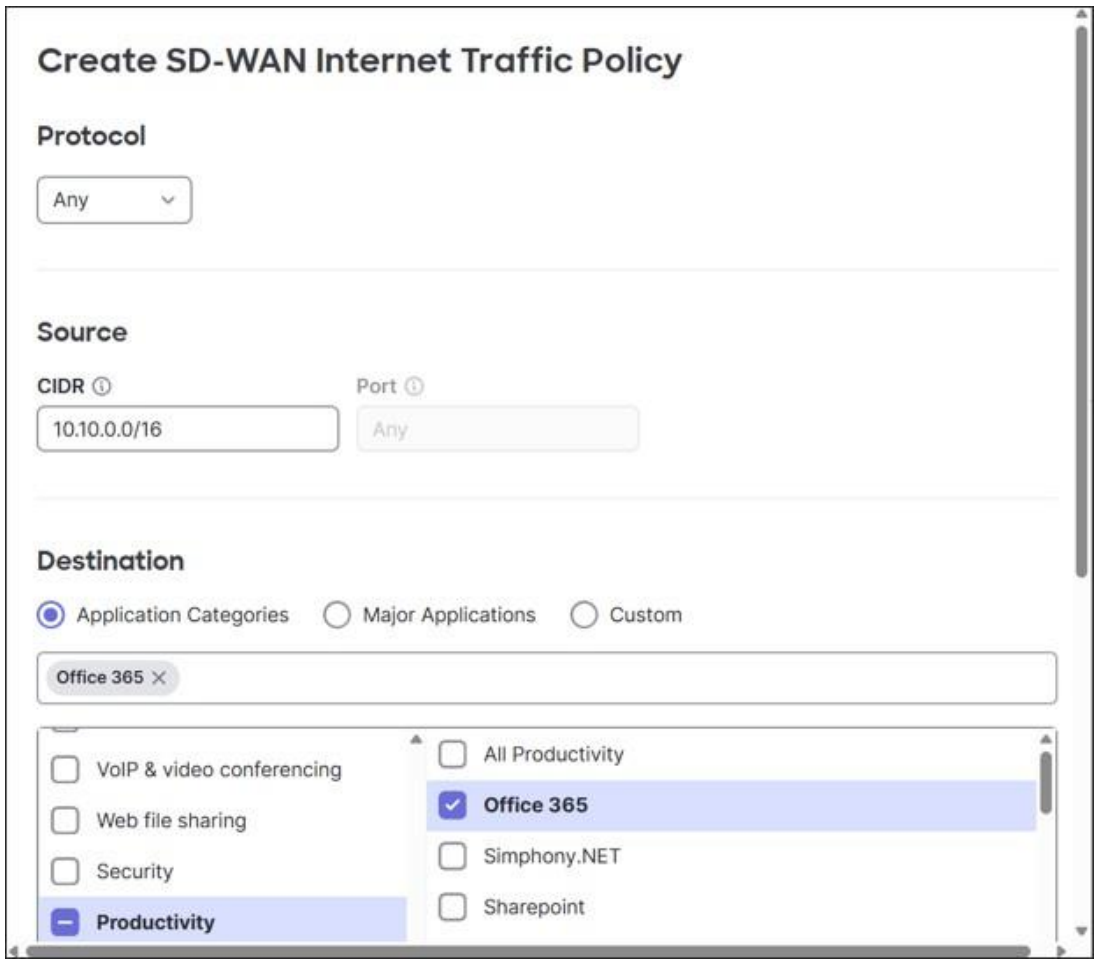
Step 4. When creating policy that leverages the custom performance class just created, the newly created custom performance class may not show up as an option during policy configuration. To work around this, reload the web page after saving the custom performance class and before creating the policy.

Procedure 32. To configure routing policy for internet traffic:

Step 1. Under **SD-WAN Policies > Internet Traffic**, click **+ Add policy**, specify the **Protocol**, **Source CIDR**, **Destination,** and **Uplink Selection**.

Step 2. Click **Save** to add the policy to the dashboard.

Step 3. Repeat to add additional lines of policy.



Step 4. Configure these two uplink selection policies for this example:

Protocol	Source CIDR	Destination Type	Destination Value	Preferred Uplink	Fail Over If:	Performance Class:
Any	10.10.0.0/16	Application Categories	Productivity>Office 365 VoIP & video conferencing>Webex	WAN 2	Poor performance	SaaS_Traffic
Any	10.250.0.0/16	Custom	CIDR=Any	WAN 2	Uplink Down	N/A

Note: Dashboard destination traffic is Any. The VPN exclusions already defined what specific destination traffic is DIA (dashboard IP address destinations).

Step 5. If the previously configured performance class is missing from the drop-down, reload the web page and re-enter the policy. Click **Save** or **Save Changes**.

SD-WAN policies: VPN traffic

In this part of the configuration, traffic steering and performance-based routing policies are configured for VPN traffic. Load-balancing doesn't apply to VPN traffic, so VPN traffic always chooses the primary link (WAN 1 in this case) unless there is a policy to steer it differently. This example needs these policies:

- All VoIP and Video Conferencing traffic is directed over WAN 2 and should be redirected to WAN 1 if performance is poor.
- A critical company application (TCP from Any to 10.102.1.161/32:443) is directed over WAN 2 and should be redirected to WAN 1 if performance is poor.
- All other traffic is directed over WAN 1 and should be redirected to WAN 2 if performance is poor.

Before configuring the policy, custom performance classes for the critical application traffic and default traffic should be configured.

Procedure 33. To configure custom performance classes for the critical application traffic:

Step 1. Go to **Security & SD-WAN > Configure > SD-WAN & Traffic Shaping.**

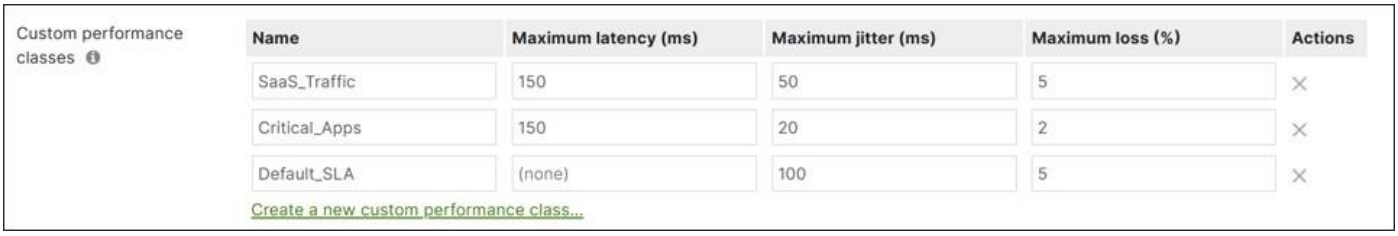
Step 2. Under **SD-WAN policies** > **Custom performance classes**, select **Create a new custom performance class** then enter these parameters:

- **Name** (Critical_Apps)
- **Maximum latency (ms)** (150)
- **Maximum jitter (ms)** (20)
- **Maximum loss (%)** (2)

Step 3. Select **Create a new custom performance class** then enter these parameters:

- **Name** (Default_SLA)
- **Maximum jitter (ms)** (100)
- **Maximum loss (%)** (5)

Step 4. Click **Save** or **Save Changes**.



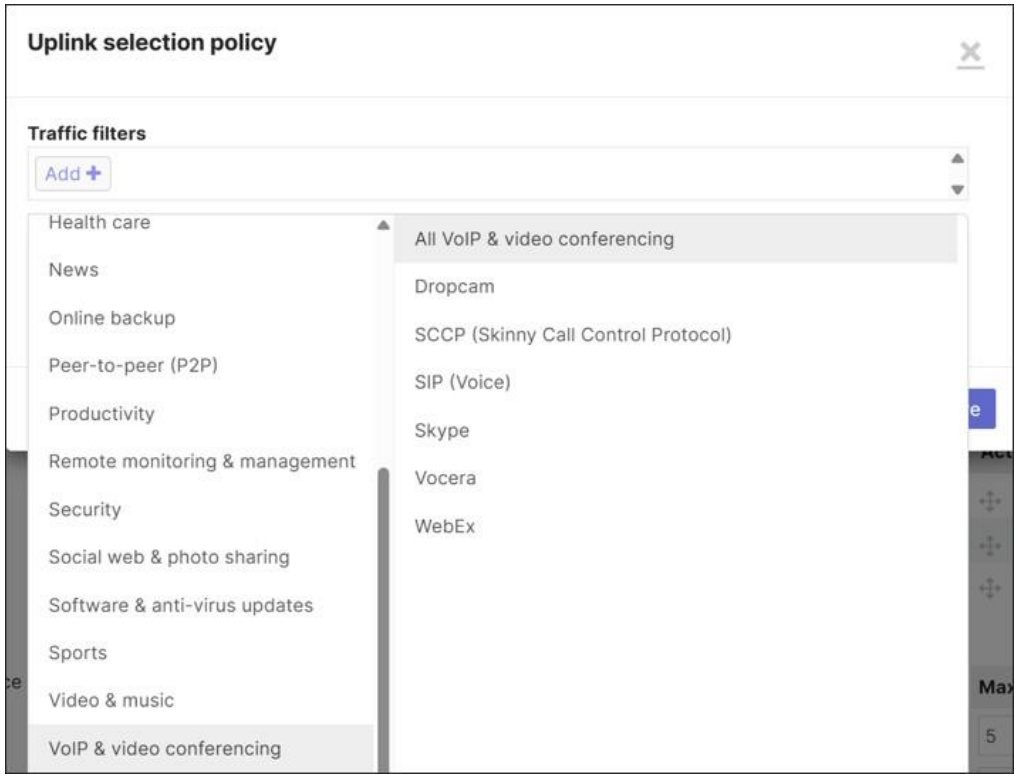
Procedure 34. To configure VPN traffic policies:

Step 1. Under **SD-WAN Policies > VPN traffic**, click **Add a preference**.

Step 2. Under **Traffic filters**, **click Add +** and select an application or application family or create a custom expression to match VPN traffic.

Step 3. Select the preferred uplink and click **Save**.

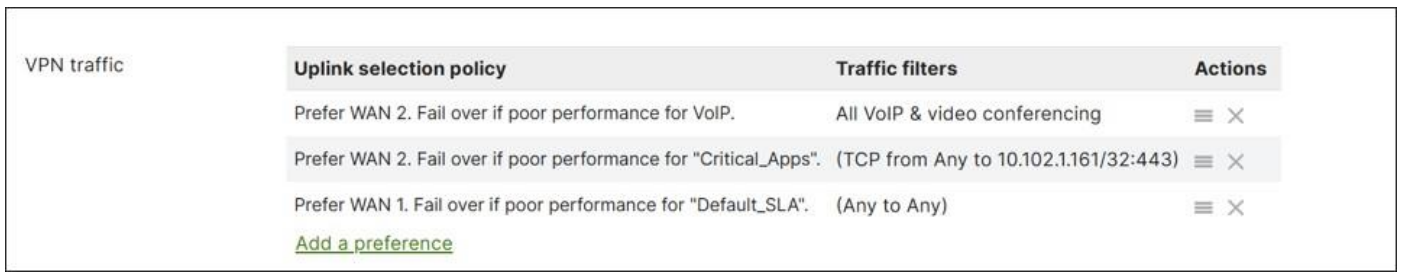
Step 4. Repeat to add any additional lines of policy.



This example configures these three uplink selection policies:

Traffic Filters	Preferred Uplink	Fail Over If:	Performance Class:
VoIP & video conferencing>All VoIP & video conferencing	WAN 2	Poor performance	VoIP
Custom expressions>Protocol TCP from Source Any/Src port Any to Destination IP 10.102.1.161/32 Dst port 443	WAN 2	Poor performance	Critical_Apps
Custom expressions>Protocol Any from Source Any Src port Any to Destination Any Dst port Any	WAN 1	Poor performance	Default_SLA

Step 5. Click **Save** or **Save Changes**.



Traffic shaping rules

In this example, the default traffic shaping rules are kept and only two additional rules are added. The two rules are to give lower priority to guest traffic and give higher priority to the critical application traffic that was referenced in **SD-WAN policies > VPN traffic**.

Procedure 35. To configure traffic shaping rules:

Step 1. Under **Security & SD-WAN > Configure > SD-WAN & Traffic Shaping > Traffic shaping rules**, next to **Default Rules**, ensure that **Enable default traffic shaping rules** is selected.

Step 2. Click **Create a new rule**.

Step 3. Specify these values:

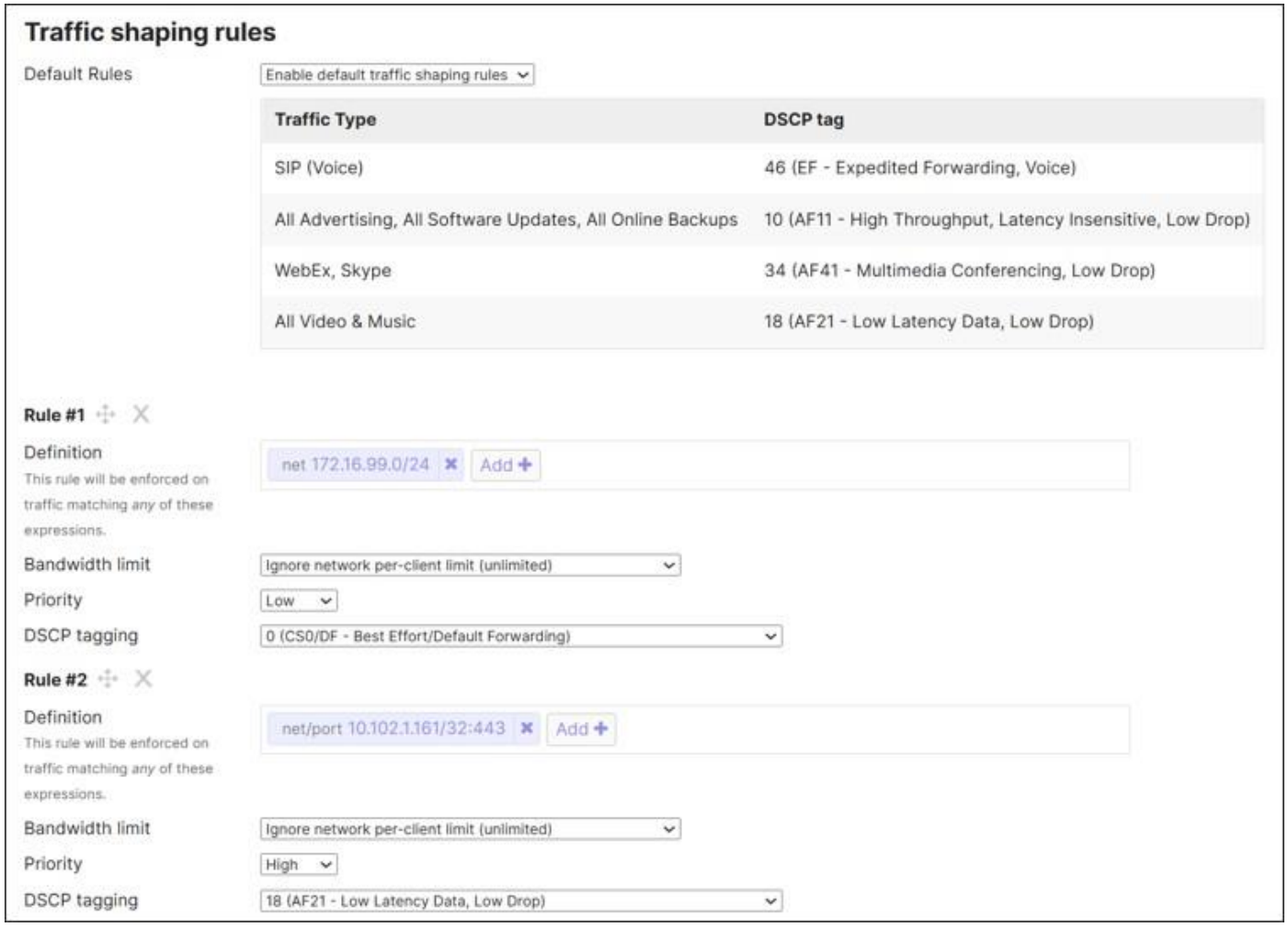
- what traffic should be matched?
- what bandwidth limit should be applied, if any?
- what is the designated priority for this traffic?
- are there any DSCP tagging requirements?

For additional rules, click **Add a new shaping rule**.

This is the configuration for this example:

Rule #	Definition	Bandwidth Limit	Priority	DSCP Tagging
1	Custom expressions>172.16.99.0/24 (guest)	Ignore network per-client limit (unlimited)	Low	0 (CS0/DF – Best Effort/Default Forwarding)
2	Custom expressions>10.102.1.161/32:443	Ignore network per-client limit (unlimited)	High	18 (AF21 – Low Latency Data, Low Drop)

Step 4. Click **Save Changes**.



MX router: Configure threat protection

Procedure 36. Configure threat protection

Step 1. Under the **Security & SD-WAN > Configure > Threat Protection** page, Advanced Malware Protection (AMP) and Intrusion detection and prevention can be configured.

Step 2. Under **Advanced Malware Protection (AMP)**, ensure the **Mode** is set to **Enabled**.

Step 3. Under **Intrusion detection and prevention**, set the **Mode** to **Prevention** and choose **Balanced** next to **Ruleset**.

Step 4. Click **Save** or **Save Changes**.

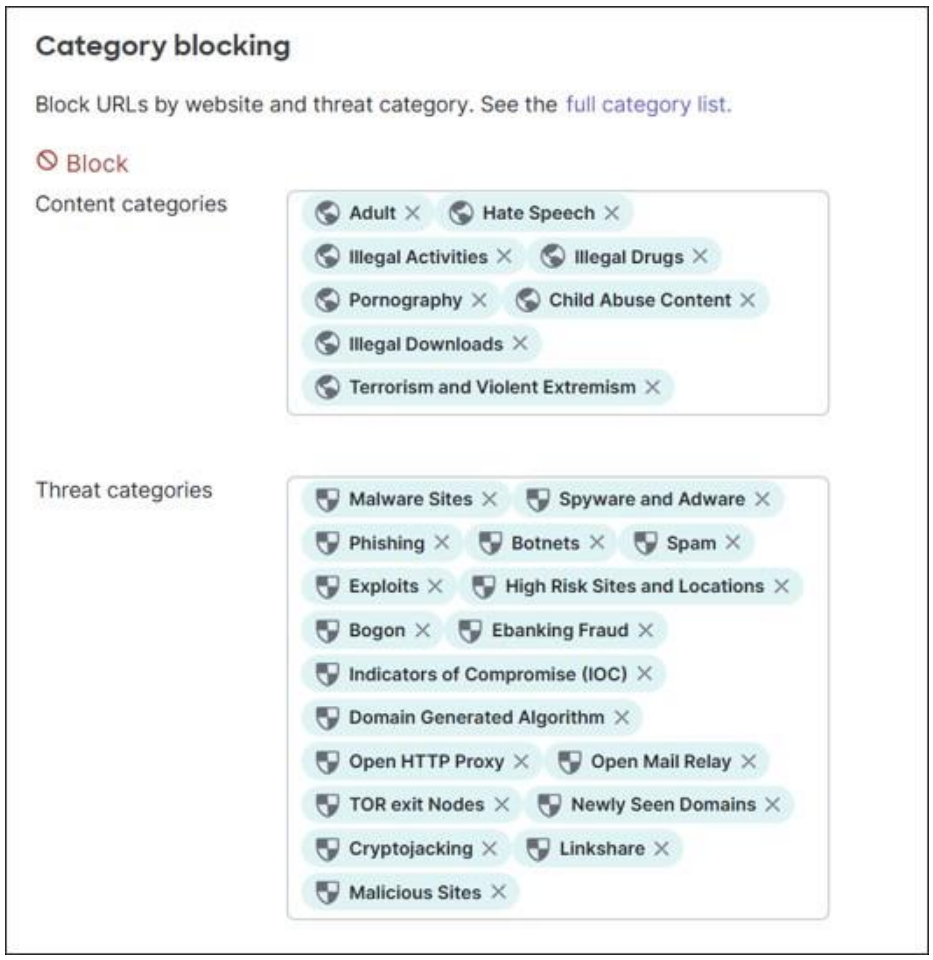
MX router: Configure content filtering

Procedure 37. To configure content filtering:

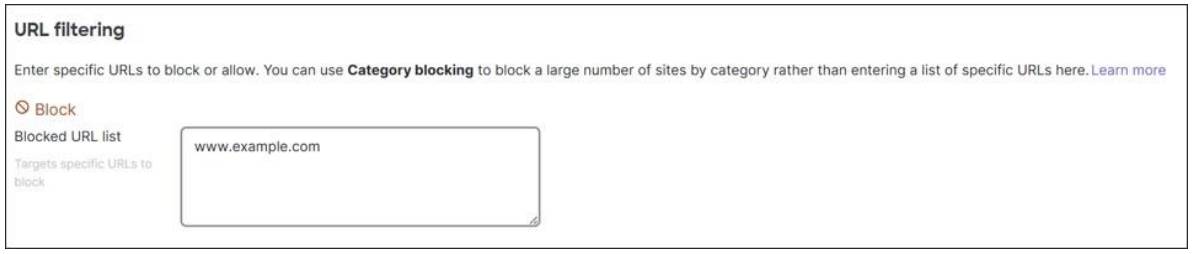
Step 1. Go to **Security & SD-WAN > Configure > Content Filtering**.

Step 2. Under **Category blocking**, select what content and threat categories should be blocked, as well as any URLs that should be allowed or blocked under **URL filtering**.

Configuration for this example:



www.example.com is included in the URL filtering blocked URL list>



Step 3. Click **Save**.

Modify INFRA device management

Now that the MX router and switch ports to the transports have been configured, the infrastructure devices (switches and AP) can be moved into VLAN 999. Ensure that centralized DNS is available before putting the devices into the INFRA VLAN 999.

Switch: Configure trunk to AP with native VLAN 999

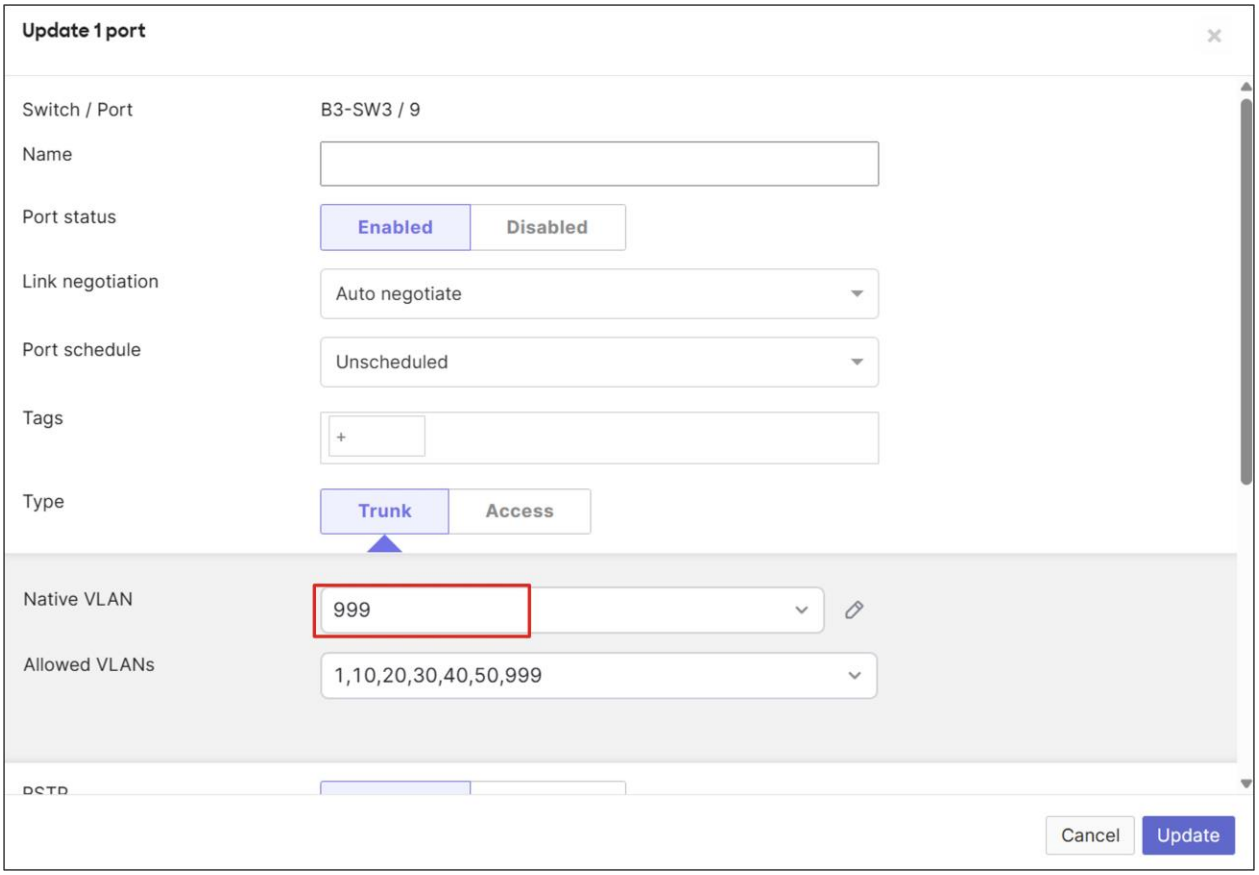
The AP is moved into VLAN 999 by modifying the native VLAN of the trunk port connected to it.

Procedure 38. To configure a trunk to the AP with native VLAN 999:

Step 1. Go to **Switching > Monitor > Switch Ports**.

Step 2. Click the switch port to the AP (B3-SW3/9) to edit the settings.

Step 3. Next to **Native VLAN**, type 999. Click **Update**.



Step 4. When configured, go to **Wireless > Monitor > Access Points,** and select the AP to validate the changes.

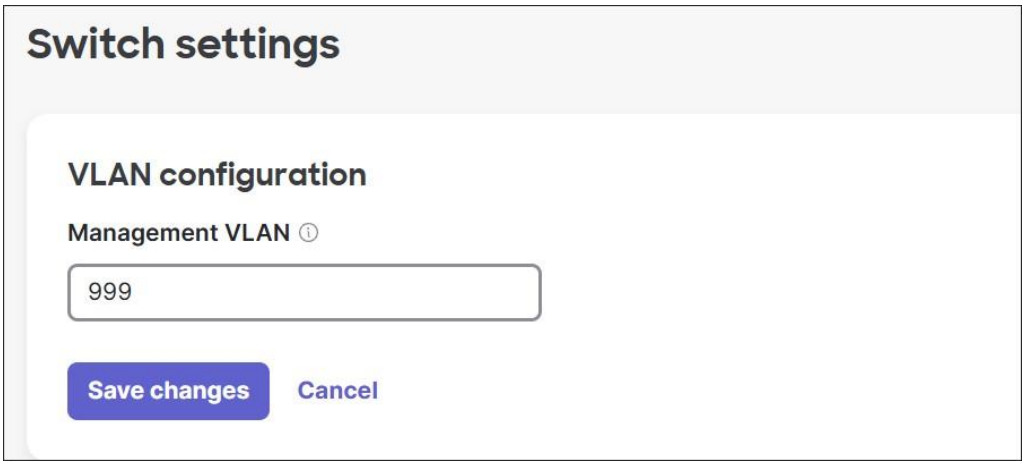
It could take a few minutes for the IP changes to take place. The new IP address is the one that was reserved configuring DHCP pools for the INFRA VLAN on the MX router.

Switch: Configure switch management VLAN

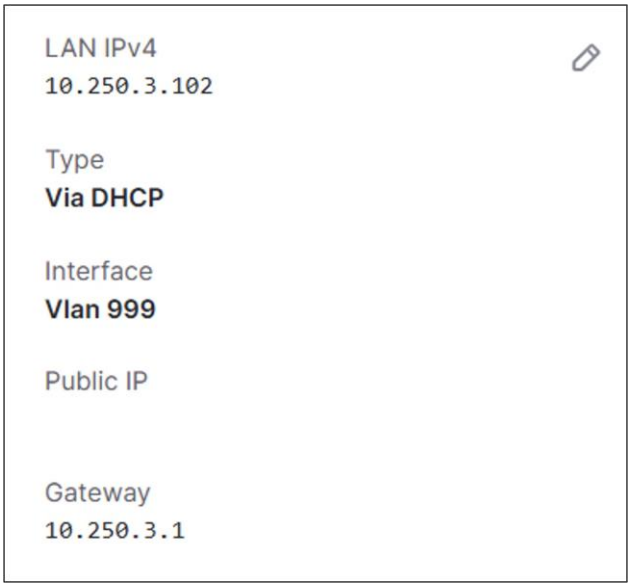
For all switches and switch stacks, switch management traffic is tagged with VLAN 999.

Step 5. **Go to Switching > Configure > Switch Settings** and under **VLAN configuration > Management VLAN**, configure 999.

Step 6. Click **Save changes**. This sets the management VLAN for all the switches in the network. The local switch setting overrides this setting.



Step 7. When configured, go to **Switching > Monitor > Switches**, select a switch to validate the changes. It could take a few minutes for the IP changes to take place. The new IP address is one that was reserved configuring DHCP pools for the INFRA VLAN on the MX router.



Tech tip: For some MS switch stack models (such as the MS150, but not the MS390), there may be an issue moving all switch members into VLAN 999. Some members may switch to VLAN 999, and others may stay in VLAN 1. If any switch stays in VLAN 1, there will be no reachability to centralized services (such as RADIUS) in the data center for that switch. If this issue occurs, instead of modifying the switch settings, configure the native VLAN 999 on the trunk of the MX router (go to **Security & SD-WAN > Configure > Addressing & VLANs**, **Edit** the trunk ports connected to the downstream switches, and configure the **Native VLAN** as 999). This may generate a VLAN mismatch error on the switch, but the switch should be able to obtain an IP address and have reachability in VLAN 999 using the workaround. Any devices that are onboarded afterwards should obtain an IP address in VLAN 999 instead of VLAN 1. If this workaround is implemented, any switch trunk to an Access Point must be configured for Native VLAN 1 (and not VLAN 999).

Switch: Configure switch settings

Spanning tree root

The distribution switch stack is configured to be the root of spanning tree.

Procedure 39. To configure spanning-tree settings:

Step 1. Go to **Switching > Configure > Switch Settings** under **STP configuration**.

Step 2. Click **Set the bridge priority for another switch or stack**.

Step 3. A window may pop up warning that changing the STP bridge priority may cause a short disruption on all switches in the network as spanning tree is re-calculated. Click **Got it**.

Step 4. Click the text box under **Default**.

Step 5. From the drop-down menu, choose the **Switches/Stacks** name (B3-DIST-SW-STACK1) and under **Bridge priority**, from the drop-down menu, select **4096**.

Step 6. Click **Confirm**.

Step 7. Click **Save changes**.

Access switches in the network are configured with a bridge priority of 8192.

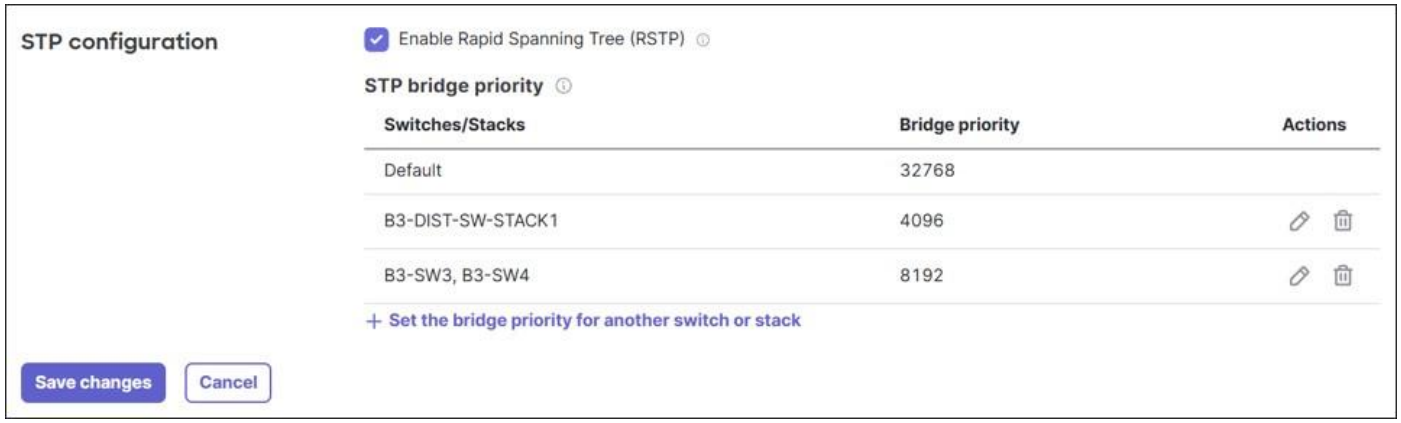
Step 8. Go to **Switching > Configure > Switch Settings** under **STP configuration**.

Step 9. Click **Set the bridge priority for another switch or stack**.

Step 10. A window may pop up warning that changing the STP bridge priority may cause a short disruption on all switches in the network as spanning tree is re-calculated. Click **Got it**.

Step 11. Click the text box under **Default**. Choose the **Switches/Stacks** name from the drop-down menu (B3-SW3 and B3-SW4) and under **Bridge priority**, from the drop-down menu, select **8192**.

Step 12. Click **Confirm**.



Step 13. Click **Save changes**.

Quality of Service

In this example, minimal Quality of Service configurations are made. Under **Switching > Configure > Switch Settings > Quality of service**, default DSCP-to-CoS mappings are retained. Guest traffic (VLAN 50) is untrusted with all traffic set to 0 (default), while incoming DSCP is trusted for Data (VLAN 10), Voice (VLAN 20), IOT (VLAN 30), and PCI traffic (VLAN 40).

Procedure 40. To configure QoS:

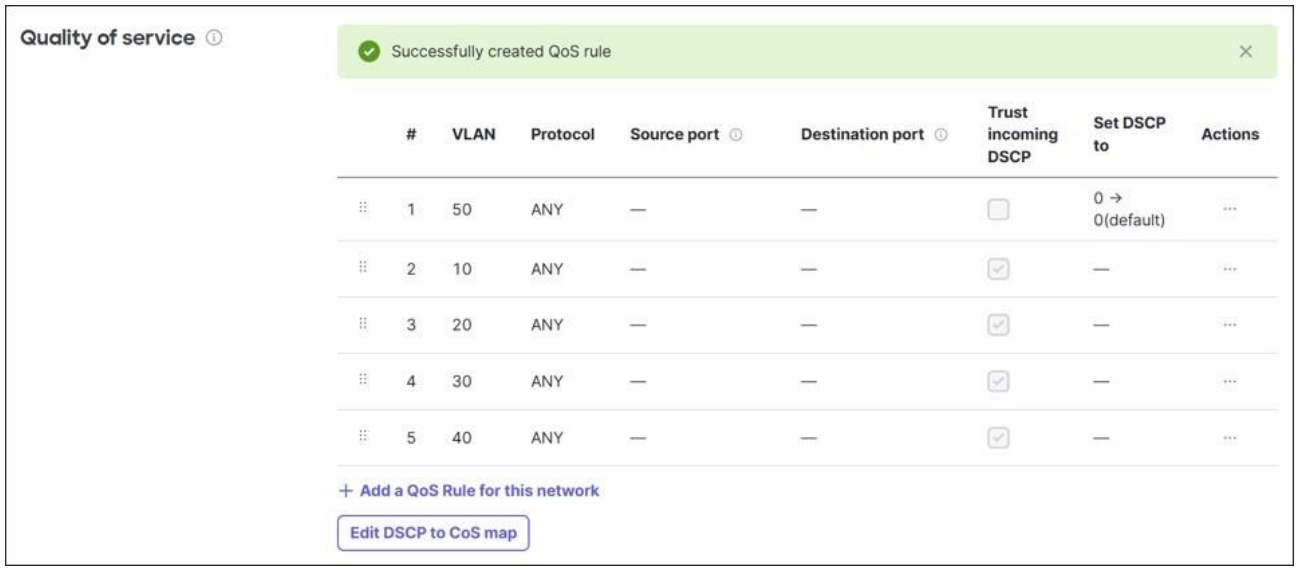
Step 1. Click **+ Add a QoS Rule for this network**.

Step 2. Fill in **VLAN**, **Protocol** (ANY), and whether to **Trust incoming DSCP**.

Step 3. If DSCP is not trusted, **set DSCP to** a value.

Step 4. Click **Save**.

Step 5. Repeat until all VLANs are entered.



Storm control

In this example, storm control is configured on the wired access ports.

Procedure 41. To configure storm control:

Step 1. Go to **Switching > Configure > Switch Settings** and under **Storm control**, click **+ Set the port bandwidth for another traffic type**.

Step 2. Enter the **Traffic type** and **% of available port bandwidth**.

Step 3. Click **Confirm**.

Step 4. Repeat to finish the traffic types.

Step 5. When finished, click **Save changes**.

Tech tip: While percentages for what is normal traffic varies for each network, in this example, multicast traffic is set to 30%, broadcast traffic is set to 20%, and unknown unicast is set to 10%. It is important to understand the network applications and to monitor interface statistics for broadcast/multicast traffic to determine what is normal for the network. Ensure the percentages allow normal network traffic to flow correctly, especially before applying the settings to uplink and AP ports.

Switch: Configure access policies

Procedure 42. To configure 802.1x on the switch:

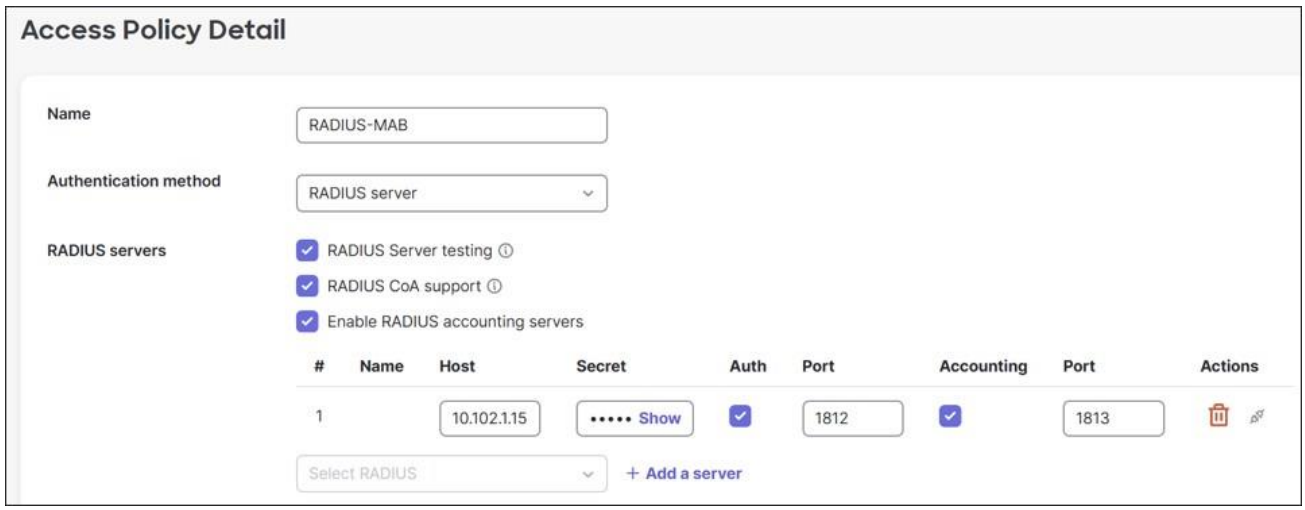
Step 1. In this example, go to **Switching > Configure > Access Policies**.

Step 2. Click **+ Add policy**.

Step 3. Configure a **Name** (RADIUS-MAB) and **Authentication method** (RADIUS server).

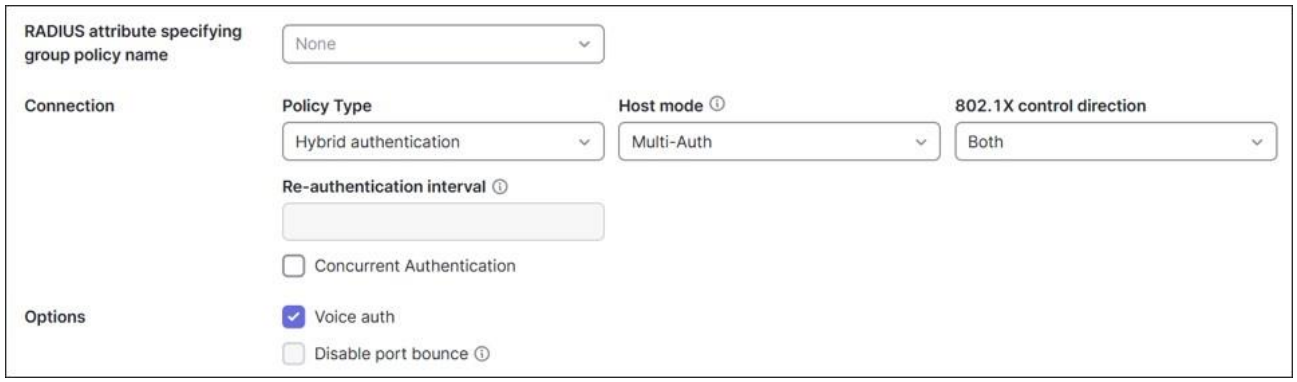
Step 4. Enable **RADIUS Server testing**, **RADIUS CoA support**, and **RADIUS accounting servers**.

Step 5. Click **+ Add a server** and fill in the **Host**, **Secret**, and **Port** number for RADIUS Auth and Accounting.

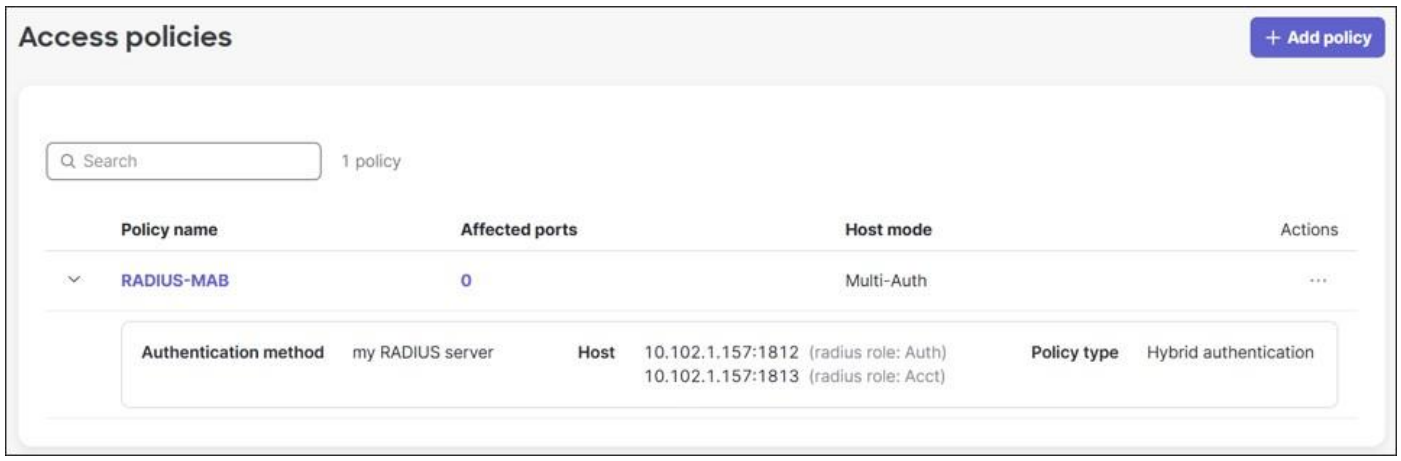


Step 6. Next to **Connection** under **Policy Type**, select **Hybrid authentication** since both 802.1x and Mac Authentication Bypass can be used. **Host mode** is set to **Multi-Auth** and **802.1x control direction** defaults to **Both**.

Step 7. Next to **Options**, select **Voice auth**.



Step 8. Click **Save**.



Distribution switch stack: Configure switch ports

On the distribution switch stack, ports 1-2 (MX Uplink ports), ports 3-5 (transport ports), and ports 9-10 (links to access switches) have already been configured.

Note: Storm control has been enabled on these ports by default since storm control settings were configured in a previous section. In this section, ports 6-8 and 11-24 are unused on B3-SW1 and B3-SW2, so they are disabled.

Procedure 43. To configure switch ports on the distribution stack switch:

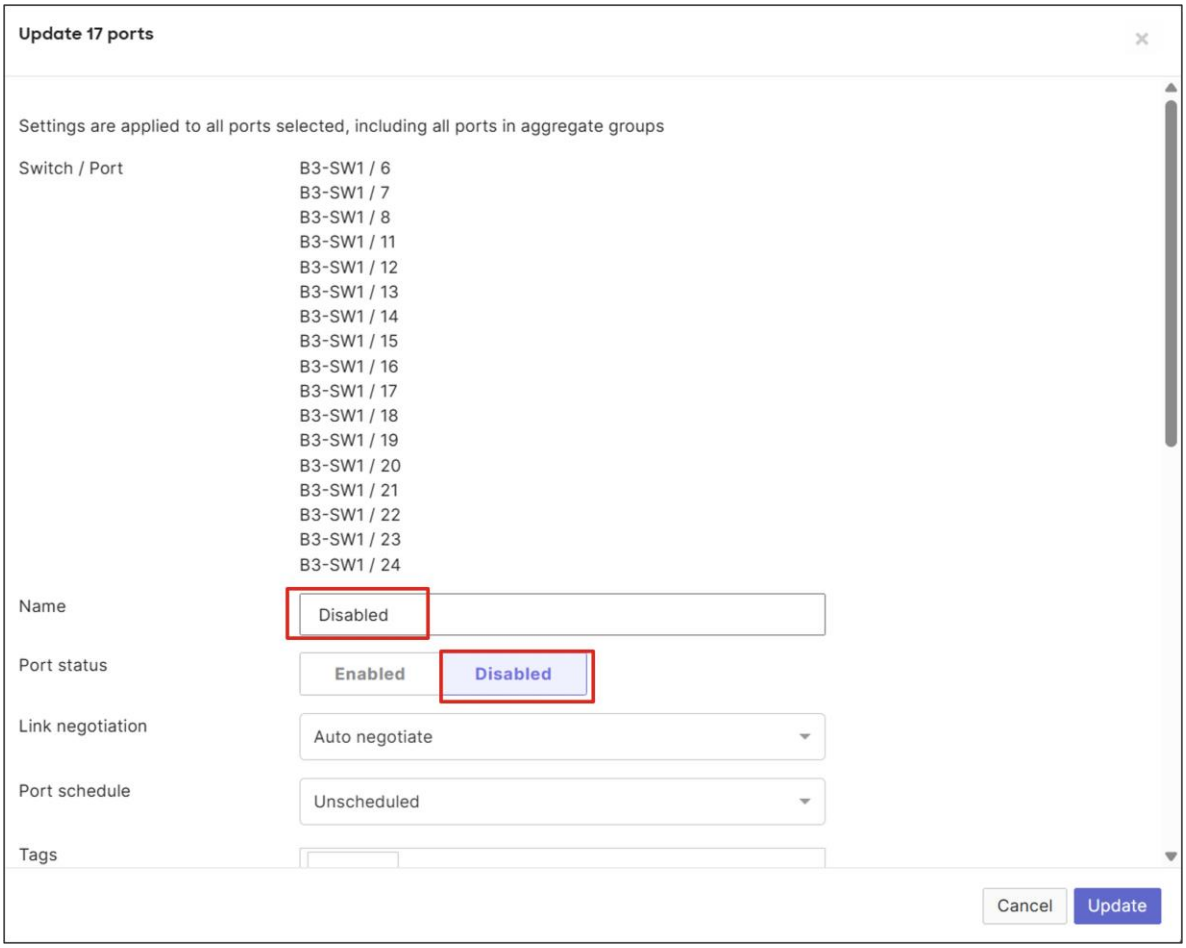
Step 1. Go to **Switching > Monitor > Switch Ports**.

Step 2. Select the check box to the left of each port on B3-SW1 for ports 6-8 and 11-24.

Step 3. Click **Edit** at the top of the screen.

Step 4. Next to **Name**, type Disabled.

Step 5. Next to **Port status**, click **Disabled**.



Step 6. Click **Update**.

Step 7. Repeat for B3-SW2 ports 6-8 and 11-24.

Access switches: Configure switch ports

In this example, these port configurations are completed.

- Ports 1-2 (SW3/SW4): Uplink ports to the distribution switch
- Port 9 (SW3): Link to the access point (AP)
- Ports 3-4 (SW3/SW4): Unused Infrastructure (disabled)
- Ports 5-8, 10-12 (SW3): Unused AP ports (disabled)
- Ports 5-12 (SW4): Unused AP ports (disabled)
- Ports 13-28 (SW3/SW4): Wired client ports

Ports 1-2: Uplink ports

Procedure 44. To configure uplink ports on the access switches:

Step 1. Go to **Switching > Monitor > Switch Ports**. Ports 1 and 2 on each access switch are the uplinks to the distribution switch stack in our example and retains most of the default settings.

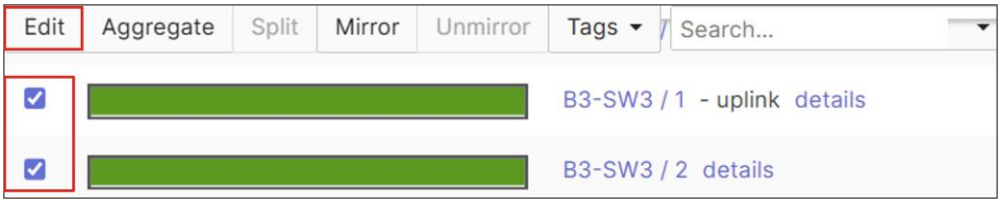
Step 2. Select the check boxes to the far left of ports 1 and 2 on access switches B3-SW3 and B3-SW4 and click **Edit**.

Note: The **Storm control** option appears when the storm control settings are configured. It is important to not set the storm control settings too low before applying them to ports as legitimate traffic can be dropped.

Step 3. Configure these settings:

- Name: Uplink to Distribution Stack
- Port Status: Enabled
- Link negotiation: Auto negotiate
- Port schedule: Unscheduled
- Type: Trunk
  - Access policy: Open
  - Native VLAN: 1
  - Allowed VLANs: 1,10,20,30,40,50,999
- STP guard: Disabled
- Port isolation: Disabled
- Trusted DAI: Disabled
- UDLD: Alert only
- PoE: Enabled
- Storm control: Enabled

Step 4. Click **Update**.



Port 9: Access point (AP) port

In this example, port 9 on B3-SW3 is connected to the access point. By default, the port is configured as a trunk carrying all VLANs.

Note: The native VLAN was originally 1 but now set to VLAN 999 in a previous step in order to put the AP management traffic into VLAN 999.

RSTP is also already enabled, UDLD is set to Alert only, PoE is enabled, and Storm control is enabled because it is enabled by default when storm control settings have been configured under **Switching > Monitor > Switch settings**.

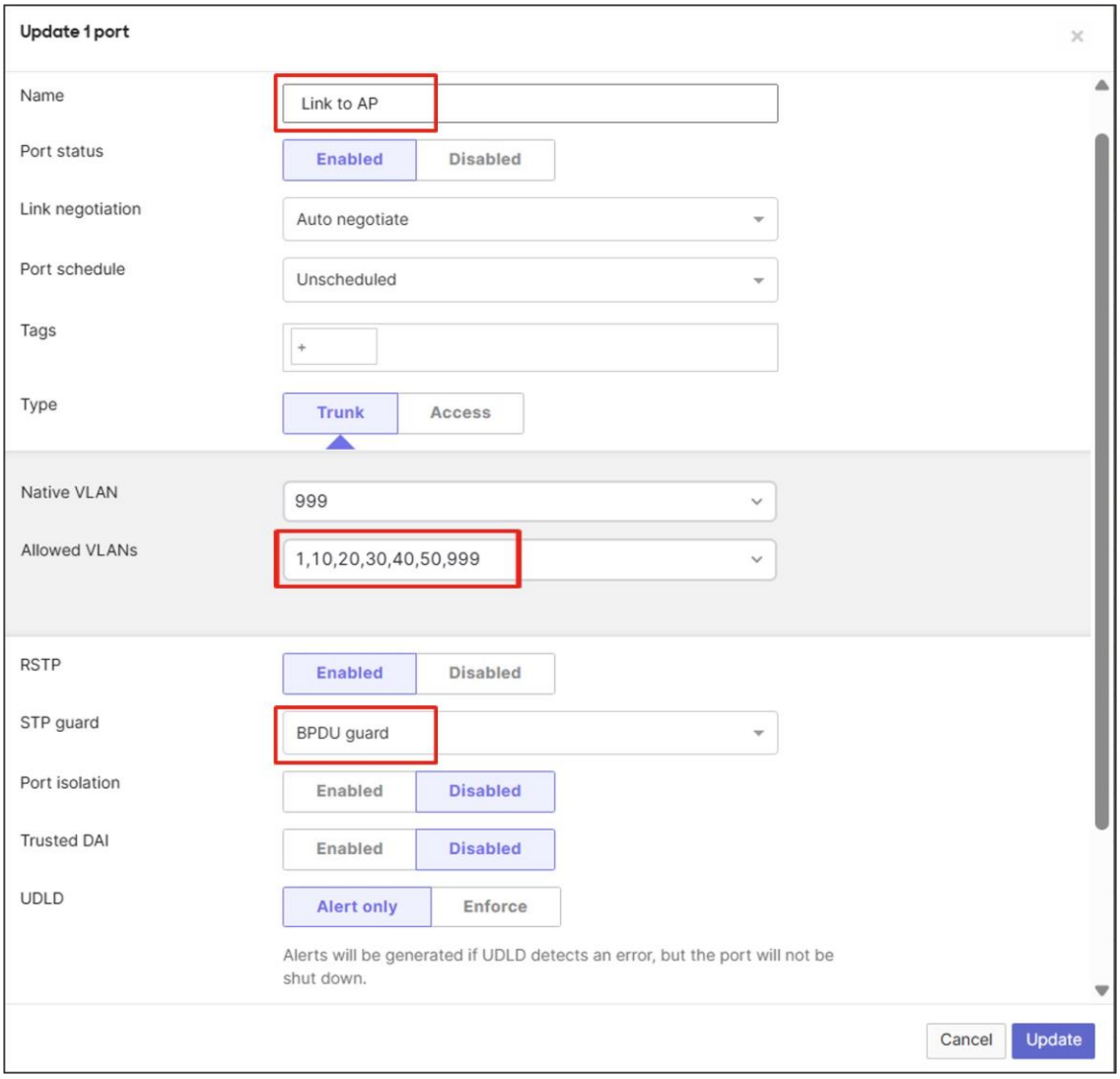
Procedure 45. To configure the link to the access point (AP) on the access switch:

Step 1. Click port 9 on B3-SW3 or select the port on the far left and click **Edit**.

Step 2. Configure these settings if not already configured (Allowed VLANs were configured previously in this example):

- **Name:** Link to AP

- **Allowed VLANs**: 1,10,20,30,40,50,999
- **STP Guard:** BPDU guard



Step 3. Click **Update**.

Ports 3-12: Unused infrastructure and AP ports

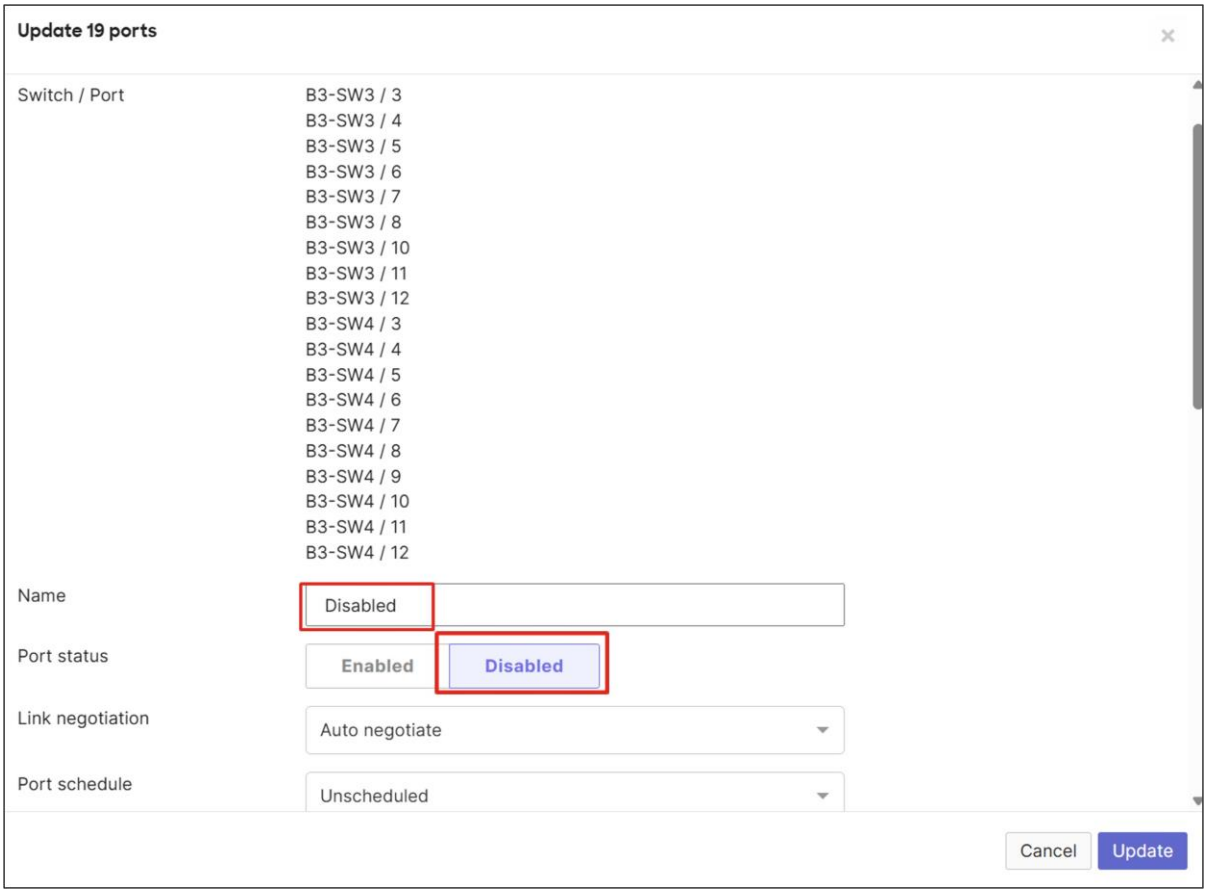
Unused ports 3-8 and 10-12 on both access switches are disabled, and port 9 is disabled on B3-SW4.

Procedure 46. To configure unused infrastructure/AP ports on the access switches:

Step 1. Select the check box to the left of each port and click **Edit** at the top of the screen.

Step 2. Next to **Name**, type Disabled.

Step 3. Next to **Port status**, click **Disabled**.



Step 4. Click **Update**.

Ports 13-28: Wired client ports

The rest of the ports (ports 13-28) on both access switches are configured as access ports/wired client ports.

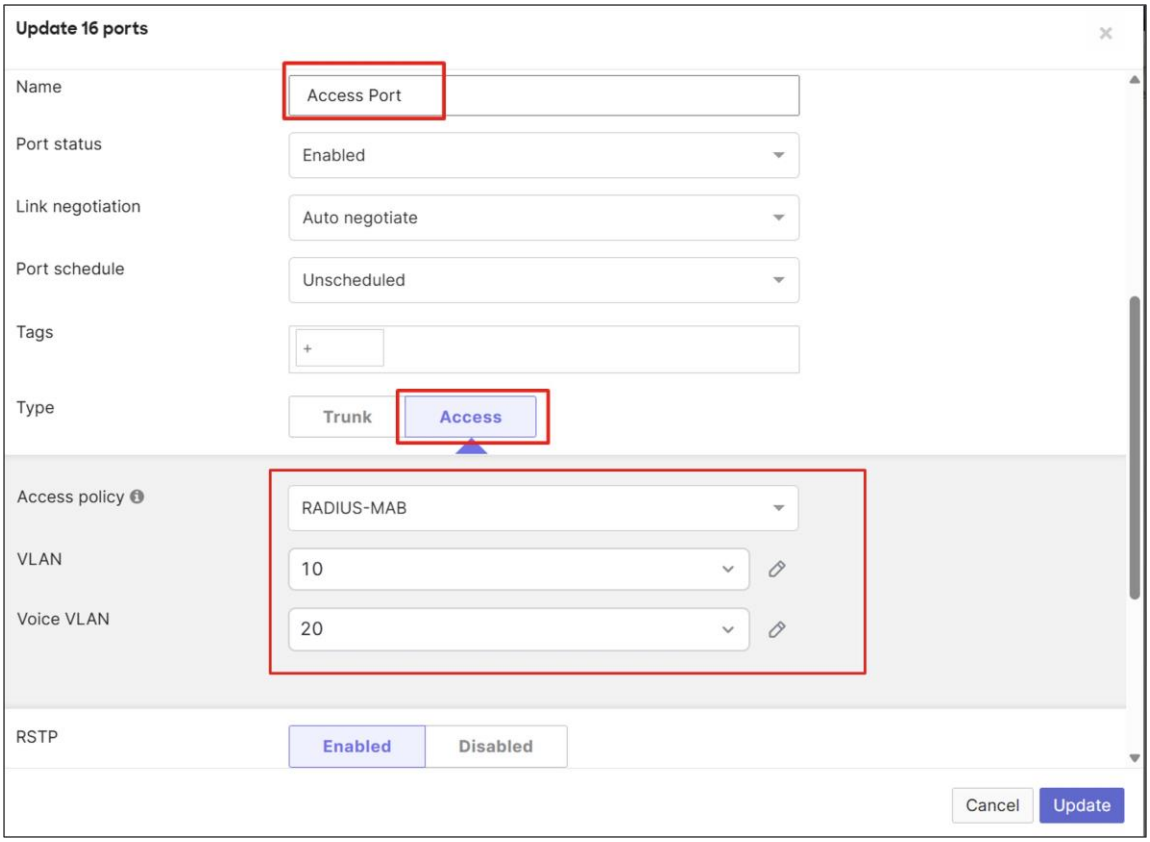
Procedure 47. To configure wired client ports on the access switches:

Step 1. On B3-SW3, select the check box to the left of each port and click **Edit** at the top of the screen. Clicking a box, then holding the shift key and clicking a box further down the list will select a range.

> **Note:** RSTP and Storm control are already enabled, and UDLD is set to Alert only.

Step 2. Configure these settings:

- **Name**: Access Port
- **Port Status**: Enabled
- **Type**: Access
- **Access policy**: RADIUS-MAB
- **VLAN**: 10
- **Voice VLAN**: 20
- **STP Guard**: BPDU Guard



Step 3. Click **Update**.

Step 4. Repeat for B3-SW4.

Distribution stack and access switches: Configure link aggregation

In this section, port channels are created from SW3 to the distribution switch stack and from SW4 to the distribution switch stack. It is recommended to configure the downstream device first.

Procedure 48. To configure link aggregation:

Step 1. Go to **Switching > Monitor > Switch Ports**.

Step 2. Select B3-SW3 ports 1 and 2 and click **Aggregate**.

The Aggregate link now shows up on SW3 in the port table as B3-SW3 / AGGR/0.

Step 3. Select port 9 on both B3-SW1 and B3-SW2 and click **Aggregate**.

The Aggregate link on the distribution switch side shows B3-DIST-SW-STACK1: AGGR/0.

Step 4. Repeat by aggregating B3-SW4 ports 1 and 2, then aggregate port 10 on both B3-SW1 and B3-SW2.

Wireless access point: Configure guest SSID

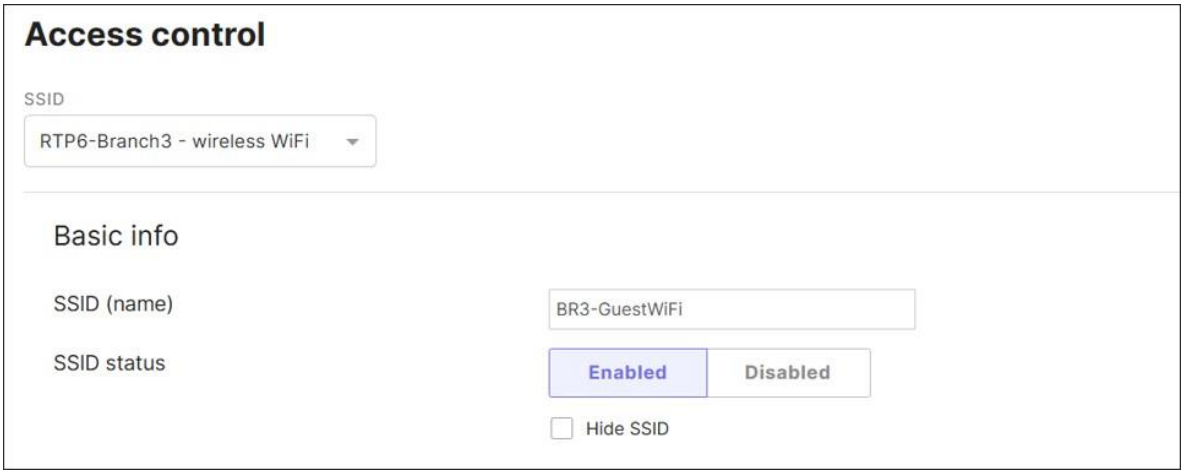
Access control

Procedure 49. To configure guest wireless access control:

Step 1. Go to **Wireless > Configure > Access Control**.

Step 2. From the drop-down menu, select an unconfigured SSID (SSID 1, labeled RTP6-Branch3 – wireless WiFi).

Step 3. Provide an **SSID name** (in this example BR3-GuestWiFi), and next to **SSID status**, select **Enabled**. The SSID will not be hidden.

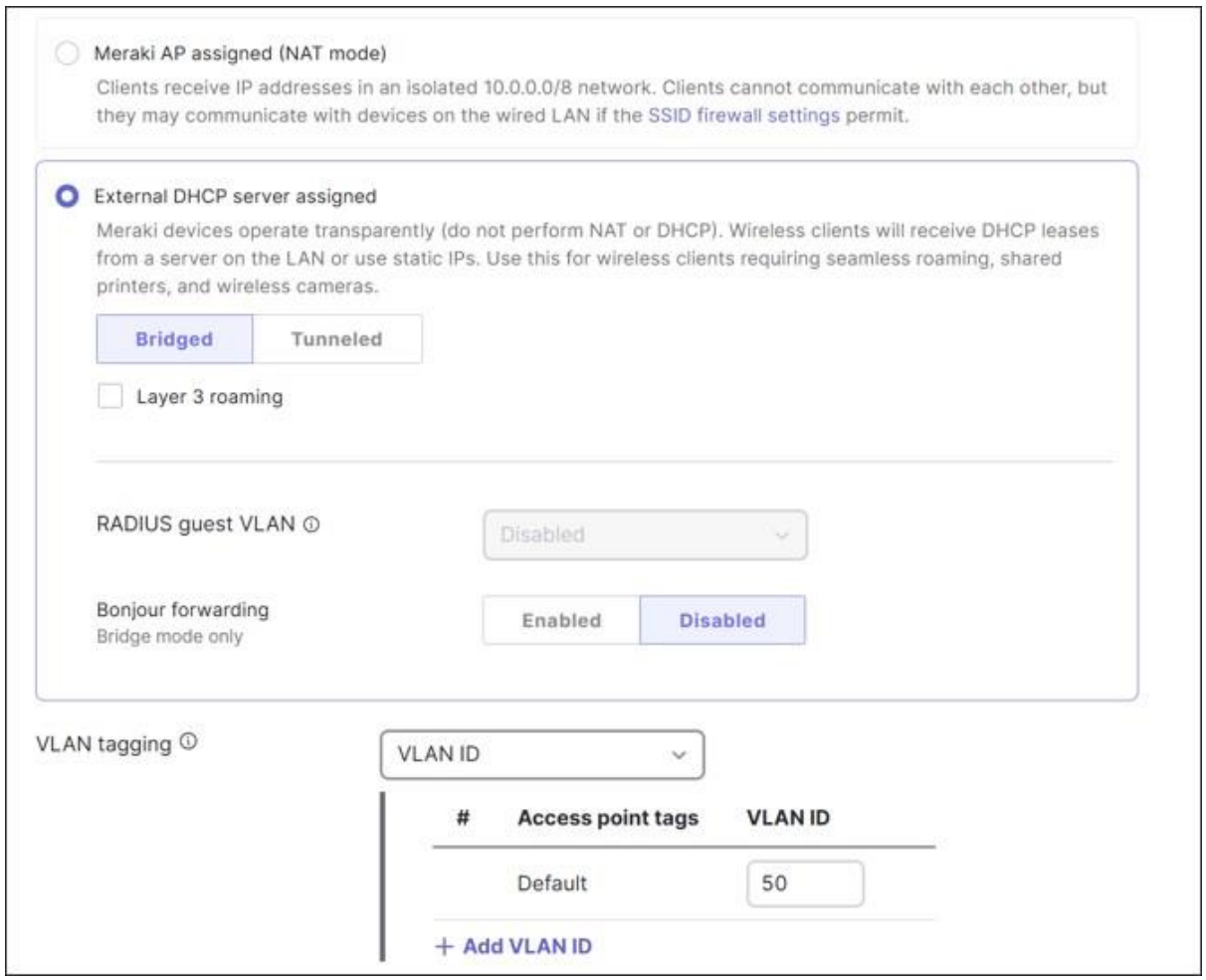


Step 4. Select **Security (Open (no encryption))**, enable **Mandatory DHCP**, and under **Splash page**, choose **Click-through** – this requires guests to view and acknowledge a splash page before being allowed on the network.

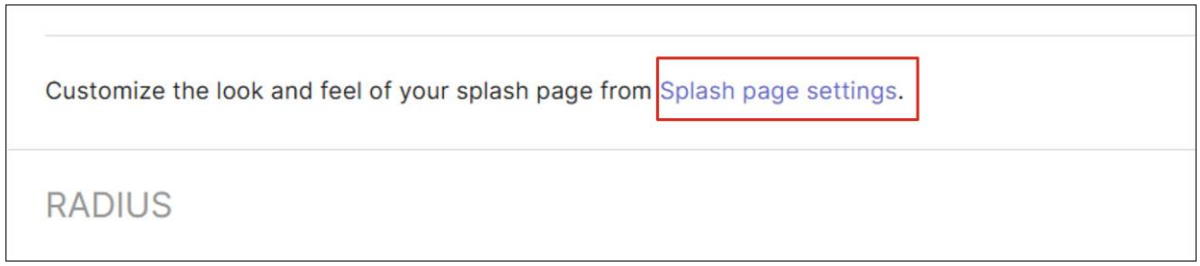
Step 5. Under **Client IP and VLAN**, select **External DHCP server assigned** and leave the setting in **Bridged** mode.

Step 6. Next to **VLAN tagging**, choose **VLAN ID** from the drop-down menu, and in the **VLAN ID** box, type 50, which is the Guest VLAN already defined on the MX router and is carried on the trunk between the AP/switch and the MX router/switch.

Step 7. Click **Save**.



Step 8. On this same page, scroll up above the RADIUS section and click **Splash page settings**.

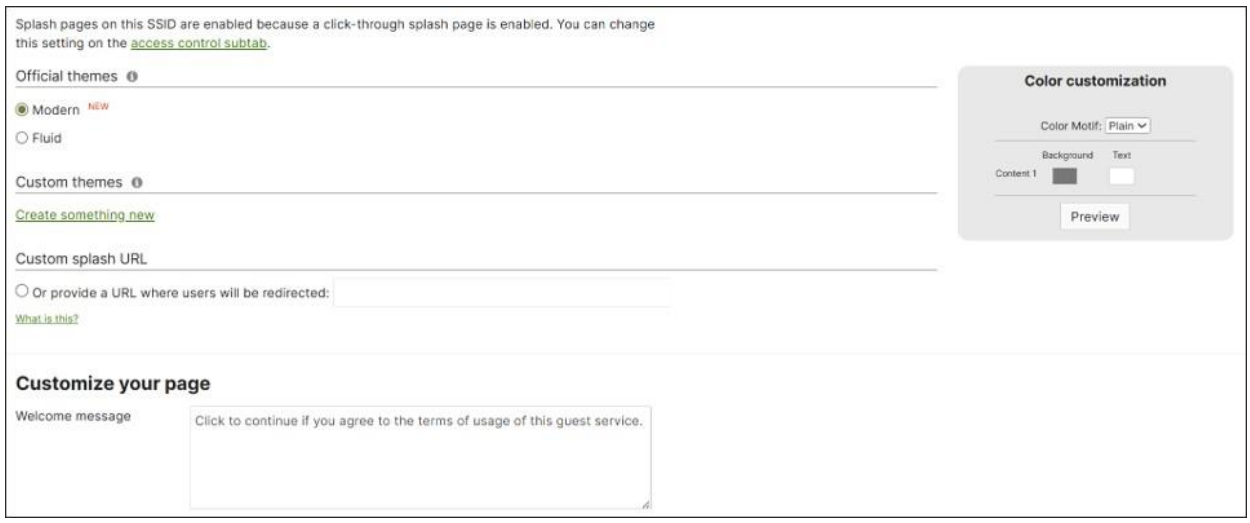


Step 9. Under the **Splash page**, select the guest SSID (BR3-GuestWiFi).

Step 10. Under **Official themes**, ensure **Modern** is selected.

Step 11. Under **Customize your page** next to **Welcome message**, type “Click to continue if you agree to the terms of usage of this guest service.”

Step 12. Click **Save** or **Save Changes**.



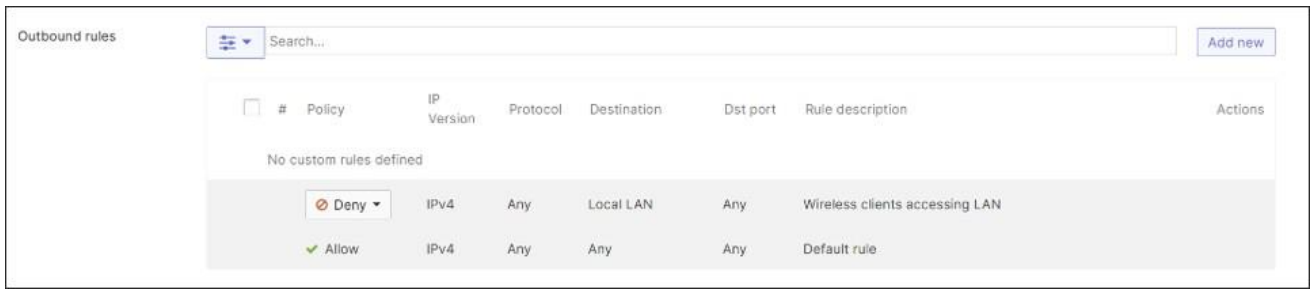
Firewall and traffic shaping

Procedure 50. To configure guest wireless firewall and traffic shaping:

Step 1. Under **Wireless > Firewall & Traffic Shaping**, select the guest SSID from the drop-down menu (BR3-GuestWiFi).

Step 2. Under **Block IPs and ports** next to **Layer 2 LAN isolation**, select **Enabled**.

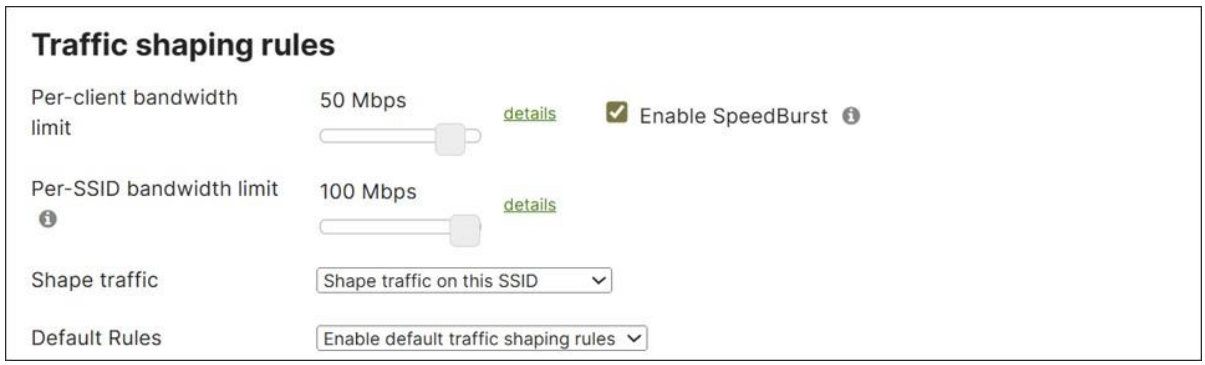
Step 3. Next to **Outbound rules**, ensure that **Deny** is selected for "IPv4 Any Local LAN Any" for the **Wireless clients accessing LAN** rule.



Step 4. For this example, under **Traffic shaping rules**, set the **Per-client bandwidth limit** to 50 Mbps and **Enable SpeedBurst**.

Step 5. Set the **Per-SSID bandwidth limit** to 100 Mbps.

Step 6. Next to **Shape traffic**, choose **Shape traffic on this SSID** and ensure next to **Default Rules** that **Enable default traffic shaping rules** is selected.



Step 7. Click **Save Changes**.

Network-Wide: Configure group policy

In this example, group policy is applied after RADIUS authentication occurs in the Corp wireless SSID. The RADIUS server passes back a filter-ID parameter, which corresponds to a group policy name and is applied to the wireless user accessing the network. In this example, there are 4 policy groups: DATA, VOICE, IOT, and PCI. The policy groups assign a VLAN but do not assign an SGT in this example. The SGT is assigned through a separate RADIUS attribute. If SGTs were assigned, more policies would need to be created to cover different user groups under the DATA VLAN.

Procedure 51. To configure group policy for corporate wireless

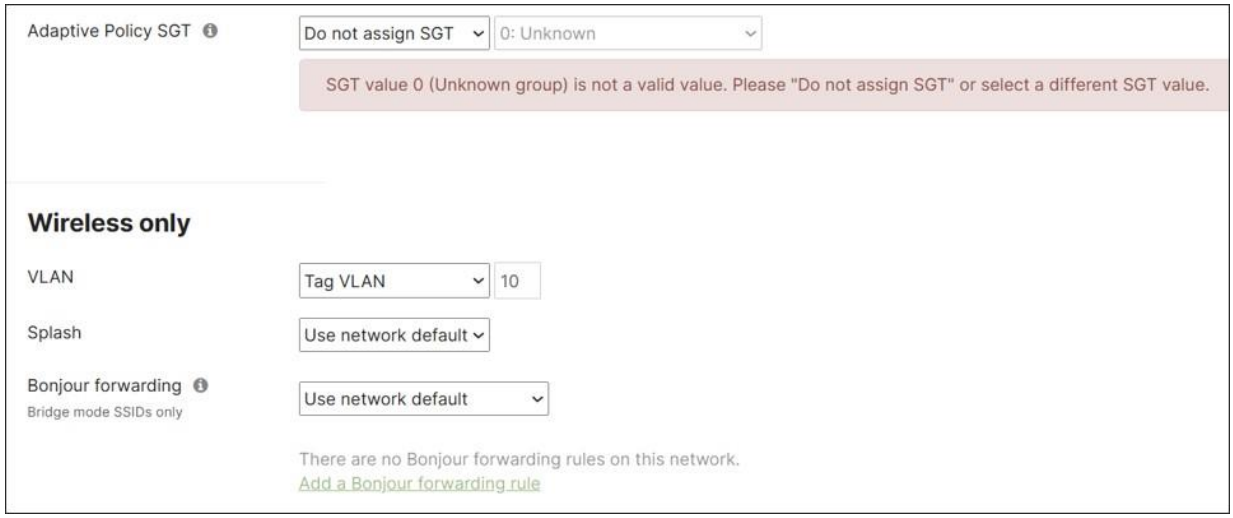
Step 1. Go to **Network-wide > Group Policies** and click **Add a group**.

Step 2. Next to **Name**, type DATA, and next to **Adaptive Policy SGT**, choose **Do not assign SGT**.

Step 3. Under **Wireless only** next to **VLAN**, select **Tag VLAN** from the drop-down menu and type 10 in the box.

Step 4. Click **Save Changes**.

Step 5. Repeat for VOICE (VLAN 20), IOT (VLAN 30), and PCI (VLAN 40).



Wireless access point: Configure corporate SSID

Access control

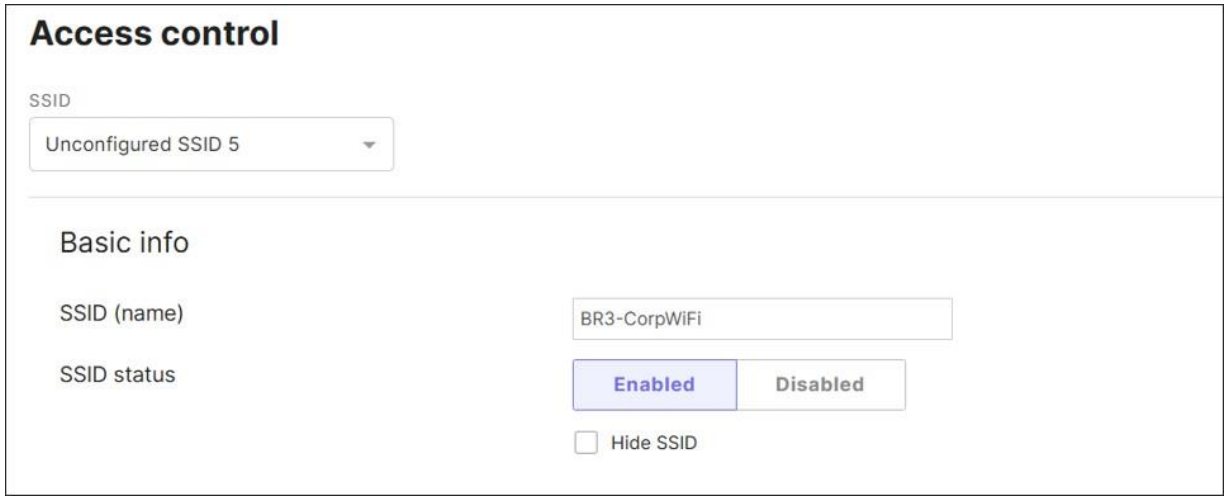
Procedure 52. To configure corporate wireless access control:

Step 1. Go to **Wireless > Configure > Access Control**.

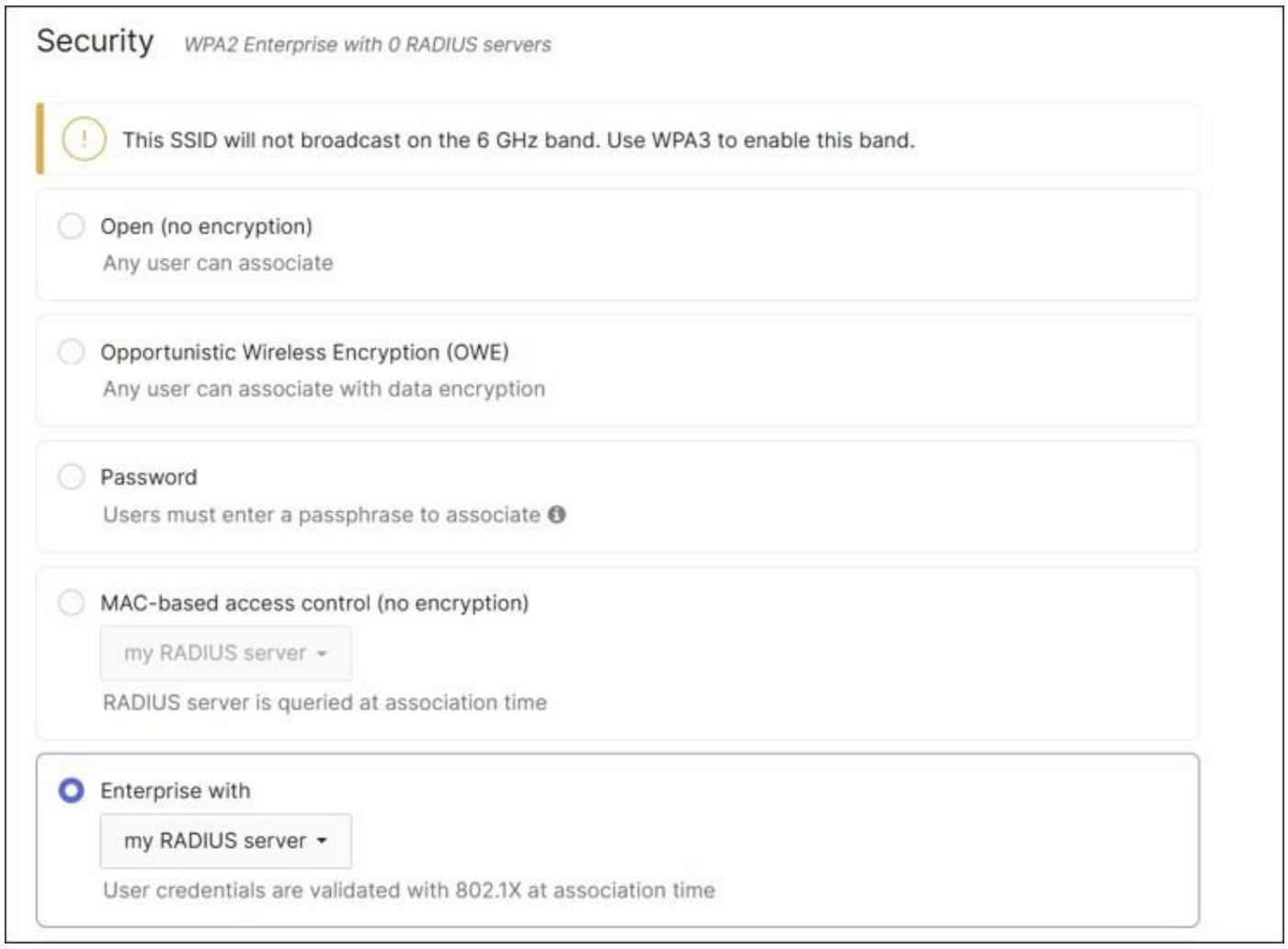
> **Tech tip:** In order for Corporate WiFi with WiFi 7 to co-exist with a less secure Guest WiFi on the same AP, the SSIDs must be placed into separate SSID groups. The SSID group feature is still in BETA in the latest stable release candidate at the time of this writing, so the access points are still on the latest stable release (31.1.8) and are not yet upgraded. To prevent having to migrate to another SSID in the future, put the Corporate WiFi on a different SSID group from the less-secure Guest WiFi. There are four SSIDs per group (SSID #1-4, SSID #5-8, SSID #9-12, and SSID #13-15).

Step 2. Select an unconfigured SSID (in a separate SSID group from Guest WiFi) from the drop-down menu, which can be any SSID from #5-15 in this example.

Step 3. Provide an **SSID name** (in this example, BR3-CorpWiFi) and next to **SSID status**, select **Enabled**. The SSID will not be hidden.



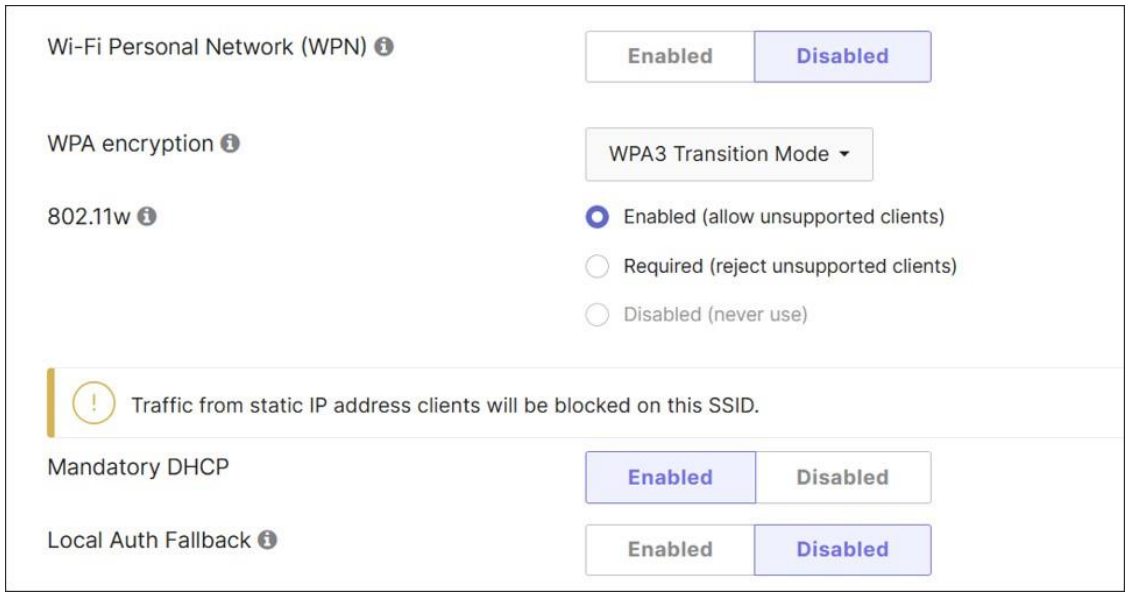
Step 4. Under **Security**, choose **Enterprise with my RADIUS server**.



Step 5. Next to **WPA encryption**, choose **WPA3 Transition Mode**.

Step 6. Next to **802.11w** (management frame protection) ensure that **Enabled (allow unsupported clients)** is chosen.

Step 7. Next to **Mandatory DHCP**, select **Enabled**.



Step 8. Under the **Splash page**, ensure that **None (direct access)** is selected.

Step 9. Scroll down and click **RADIUS** to open the RADIUS settings.

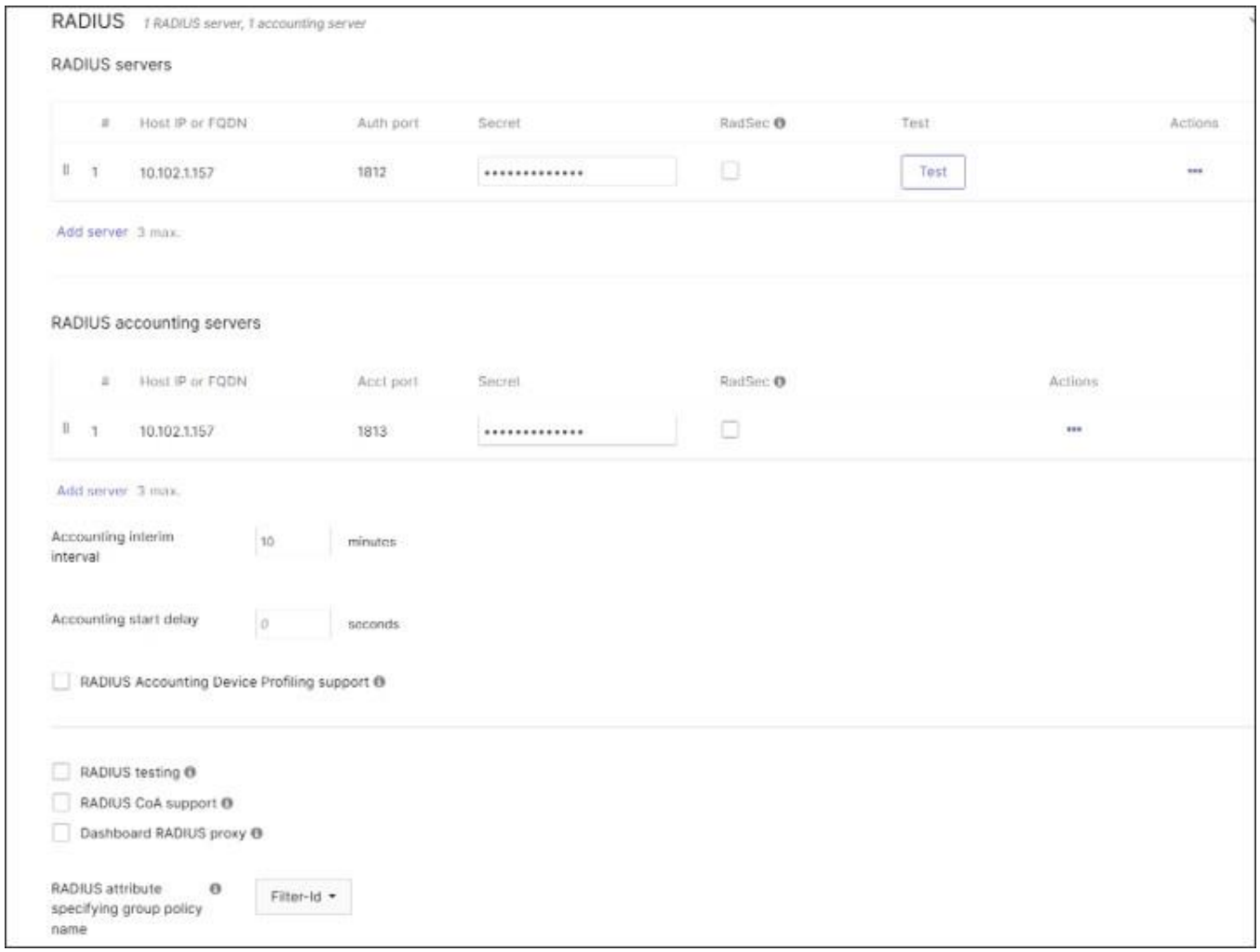
Step 10. Under **RADIUS servers**, click **Add server** and enter the Host **IP or FQDN** (10.102.1.157), **Auth** (Authentication) **port** (1812), and **Secret** password.

Step 11. Optionally, test the server connectivity.

Step 12. Click **Done**.

Step 13. Under **RADIUS accounting servers**, select **Add server** and enter the **Host IP or FQDN** (10.102.1.157), **Acct** (Accounting) **port** (1813), **Secret** password, and click **Done**.

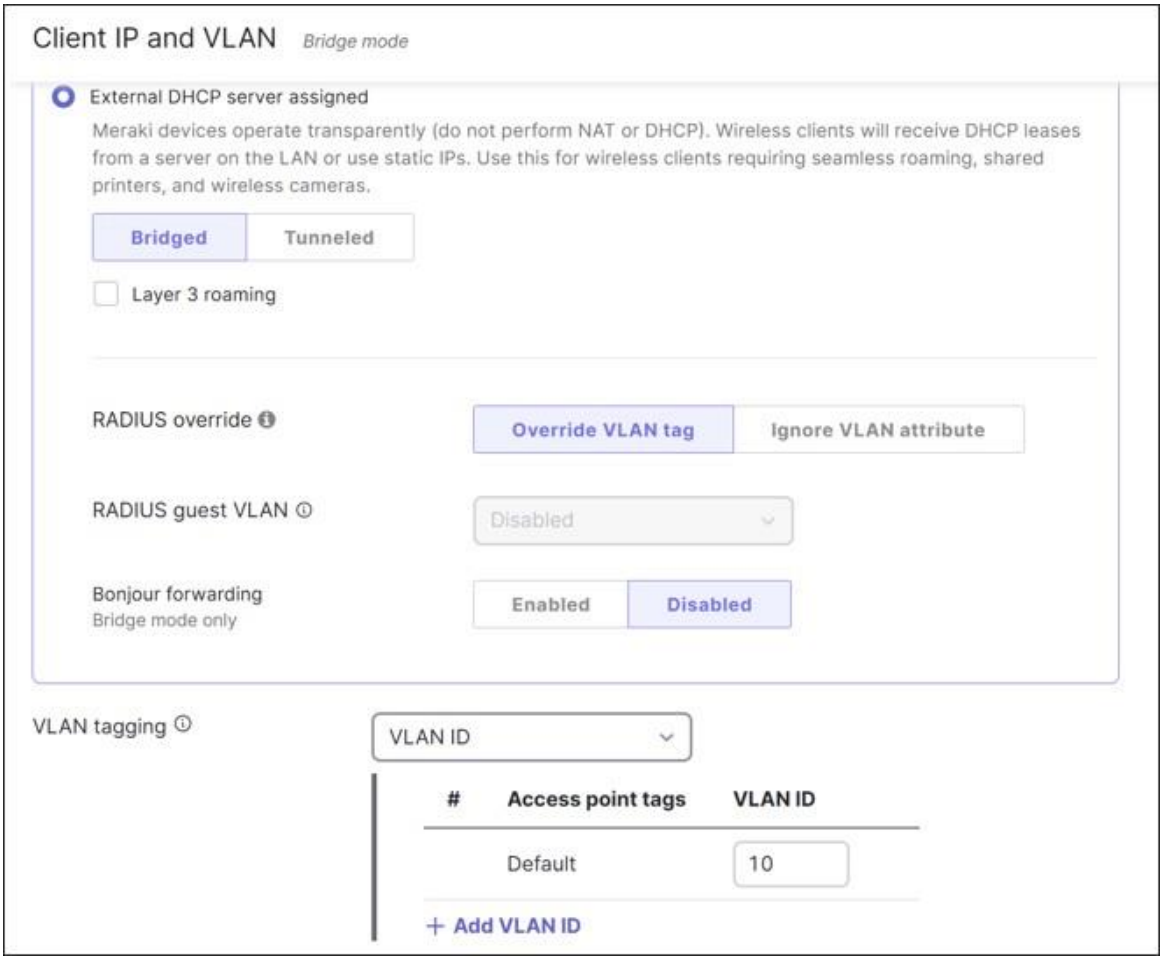
Step 14. RADIUS CoA is not enabled due to the enabling of the fast-roaming feature. Next to **RADIUS attribute specifying group policy name**, ensure that **Filter-Id** is selected.



Step 15. Under **Client IP and VLAN**, select **External DHCP server assigned** and ensure **Bridged** mode is selected.

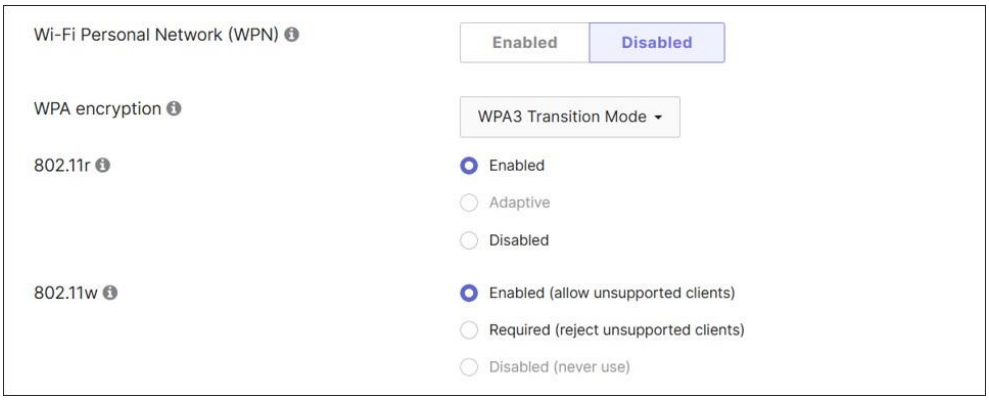
Step 16. Next to **RADIUS override**, ensure that **Override VLAN tag** is selected.

Step 17. Under **VLAN tagging**, select **VLAN ID**, and under **VLAN ID**, type in 10. This is the default VLAN for authenticated users if VLAN IDs or group policy names are not passed by RADIUS. VLAN 10 is the DATA VLAN already defined on the distribution switch and carried on the trunk between the AP/switch and the MX router/switch.



Step 18. Scroll back up to the **Security** section.

Step 19. Next to **802.11r** (fast roaming) choose **Enabled**. This feature is not available under **Meraki AP assigned (NAT mode)** and becomes available when **External DHCP server assigned** is selected. In this version of code, fast roaming cannot be enabled if RADIUS CoA support is enabled.



Step 20. Click **Save**.

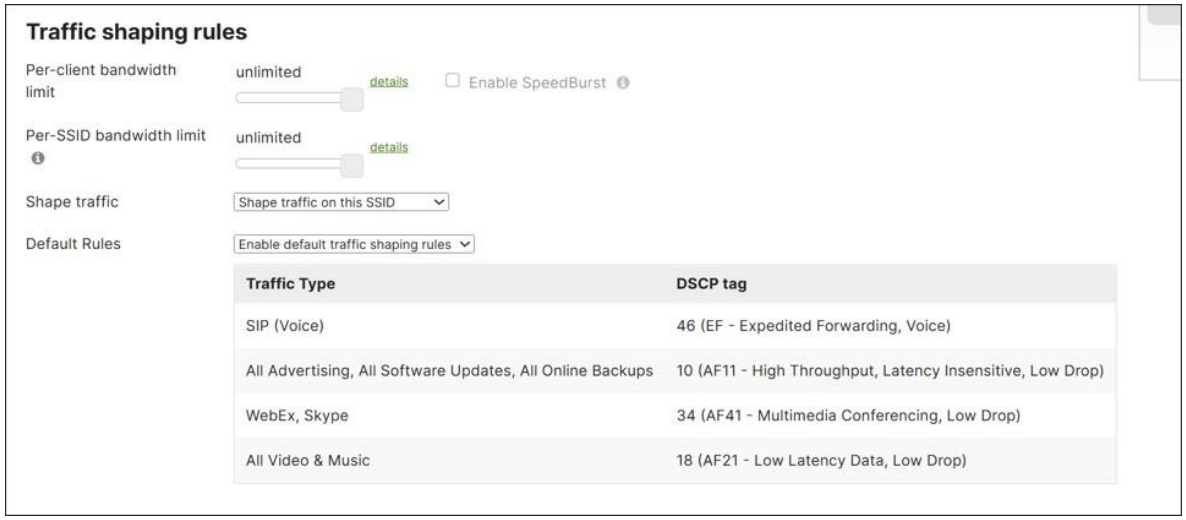
Firewall and traffic shaping

Procedure 53. To configure corporate wireless firewall and traffic shaping:

Step 1. Under **Wireless > Firewall & traffic Shaping**, select the Corp SSID from the drop-down menu (BR3-CorpWiFi).

Step 2. Leave the defaults. The configuration should look like:

- **Block IPs and ports**
  - **Layer 2 LAN isolation**: disabled
  - **DHCP guard**: Disabled
  - **RA guard**: Enabled
  - **Outbound rules**: Allow IPv4 Any Local LAN Any (Wireless clients accessing LAN)
  - **Outbound rules**: Allow IPv4 Any Any Any (Default rule)
- **Traffic shaping rules**
  - **Per-client bandwidth limit**: unlimited
  - **Per-SSID bandwidth limit**: unlimited
  - **Shape traffic**: Shape traffic on this SSID
  - **Default Rules**: Enable default traffic shaping rules



Wireless access point: Configure SSID availability

This section configures SSID availability.

Procedure 54. To configure SSID availability:

Step 1. Go to **Wireless > Configure > SSID Availability** and select an **SSID** (BR3-CorpWiFi).

Step 2. Next to **Scheduled availability**, select **enabled**.

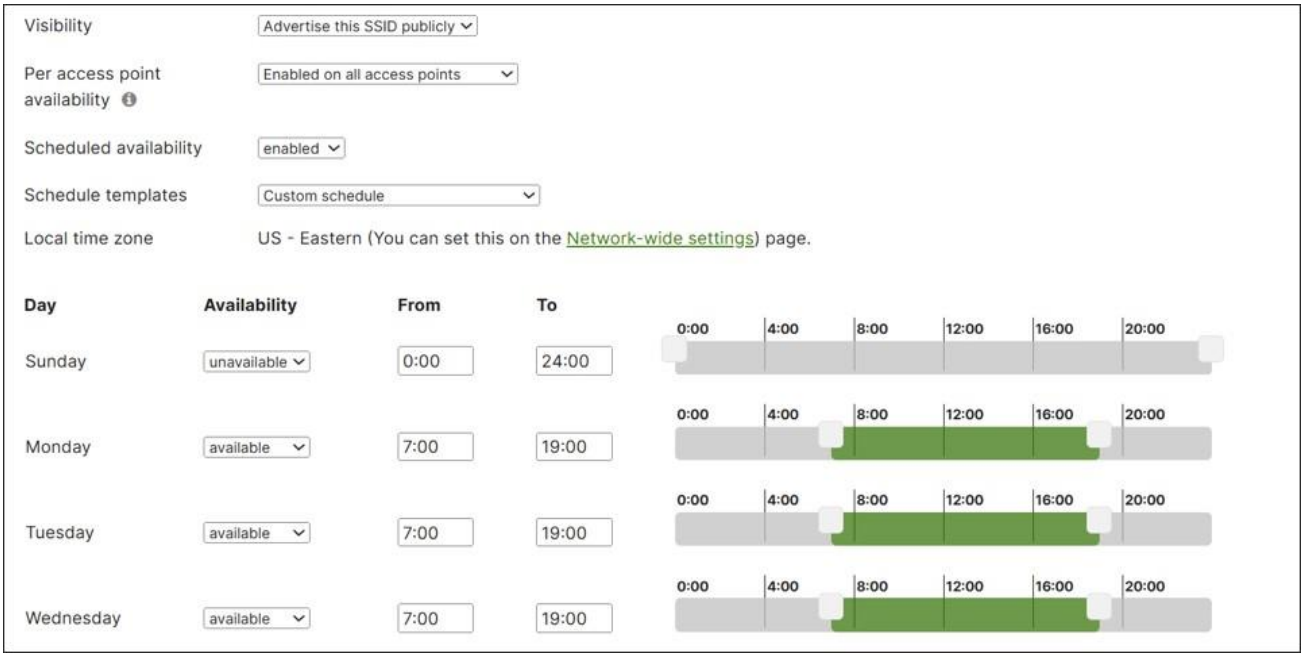
Step 3. Next to **Schedule templates**, ensure **Custom schedule** is selected.

Step 4. Configure these schedules:

- Sunday, unavailable, From 0:00 to 24:00
- Monday-Friday, available, From 7:00 to 19:00
- Saturday, unavailable, From 0:00 to 24:00

Step 5. Click **Save Changes**.

Step 6. Repeat for other SSIDs (BR3-GuestWiFi).



Wireless access point: Configure radio settings

Procedure 55. To configure radio settings:

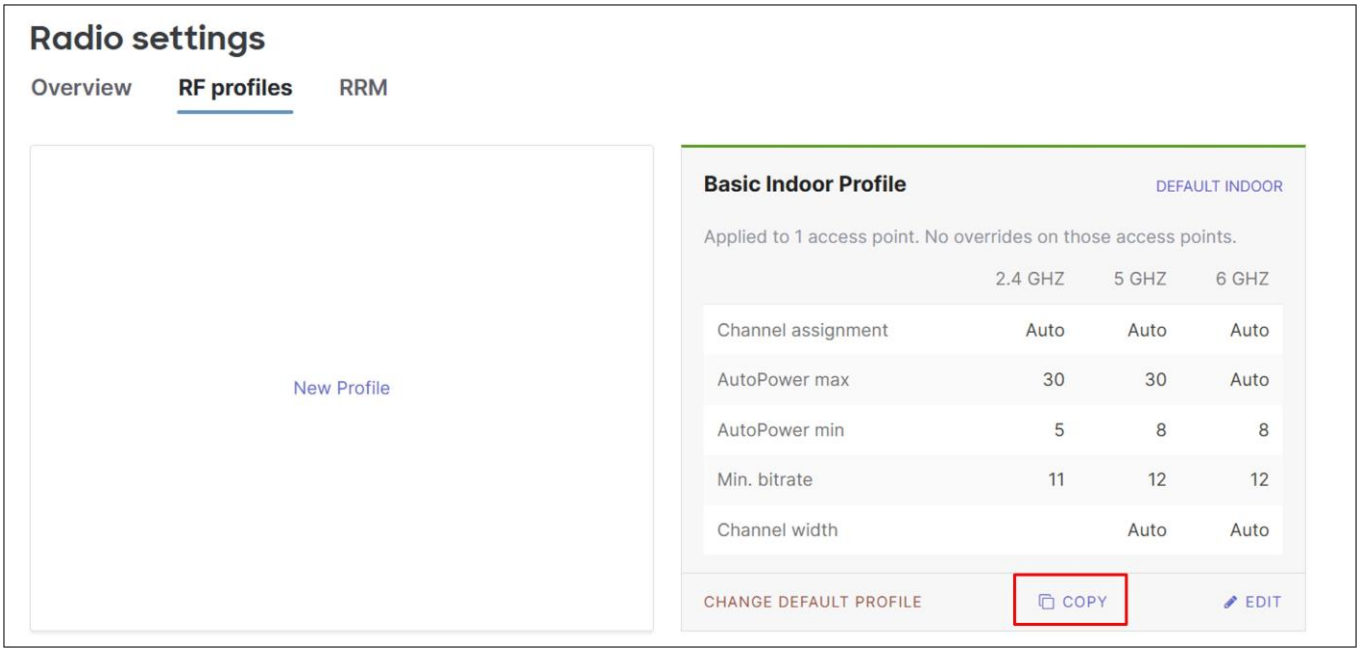
Step 1. Go to **Wireless > Configure > Radio Settings**. Select the **RRM** tab.

Step 2. Next to **AI-RRM**, select **Enable**.

Step 3. Click **Save changes** at the bottom of the page.

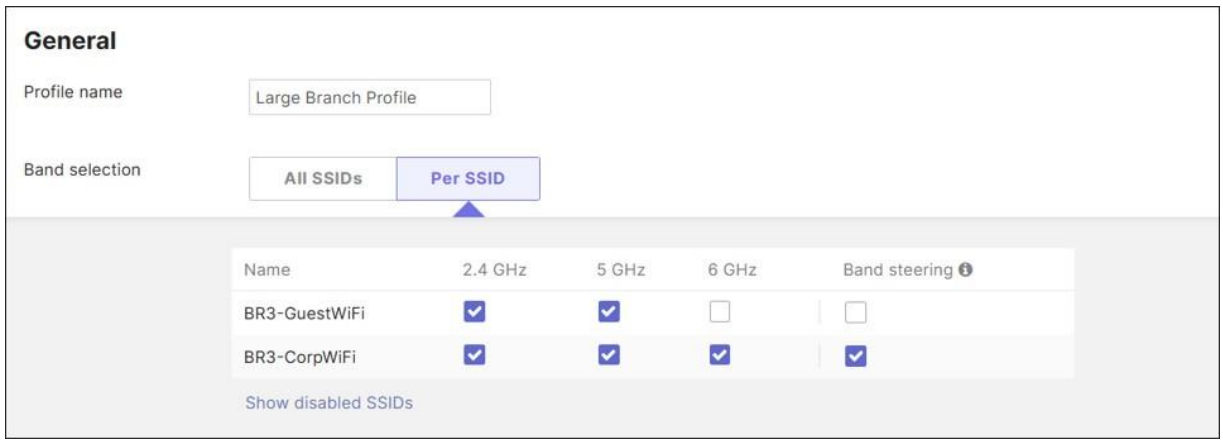
Step 4. Under **Wireless > Configure > Radio Settings**, select the **RF profiles** tab.

Step 5. Copy the **Basic Indoor Profile**.



Step 6. Next to **Profile name**, type a new name (Large Branch Profile).

Step 7. Next to **Band selection**, select **Per SSID**, and enable **6 GHz** and **Band steering** for BR3-CorpWiFi (**2.4 GHz** and **5 GHz** should already be selected for both BR3-GuestWiFi and BR3-CorpWiFi).



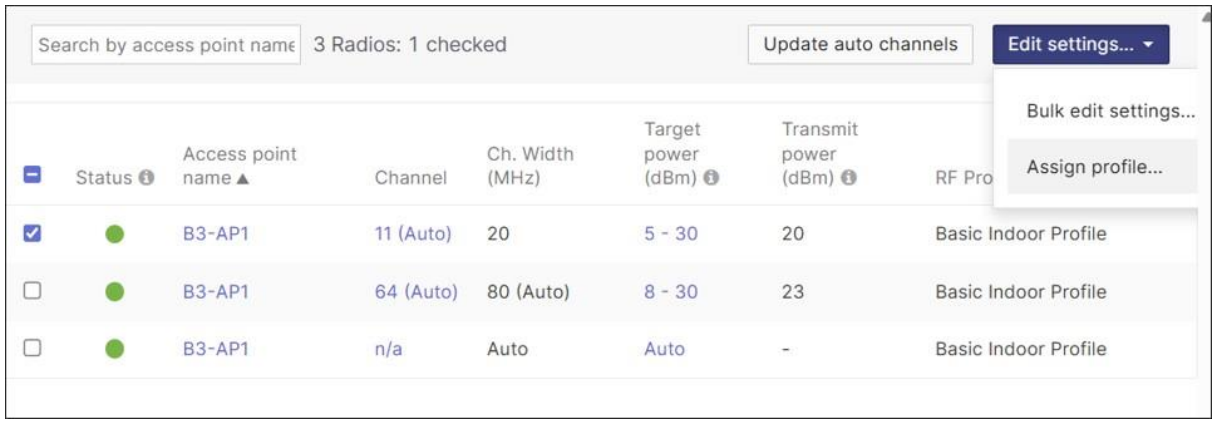
Step 8. Click **Save**.

Procedure 56. To associate the AP with the newly-edited RF profile:

Step 1. Go to **Wireless > Configure > Radio Settings** and select the **Overview** tab.

Step 2. Select the AP and click **Edit settings**.

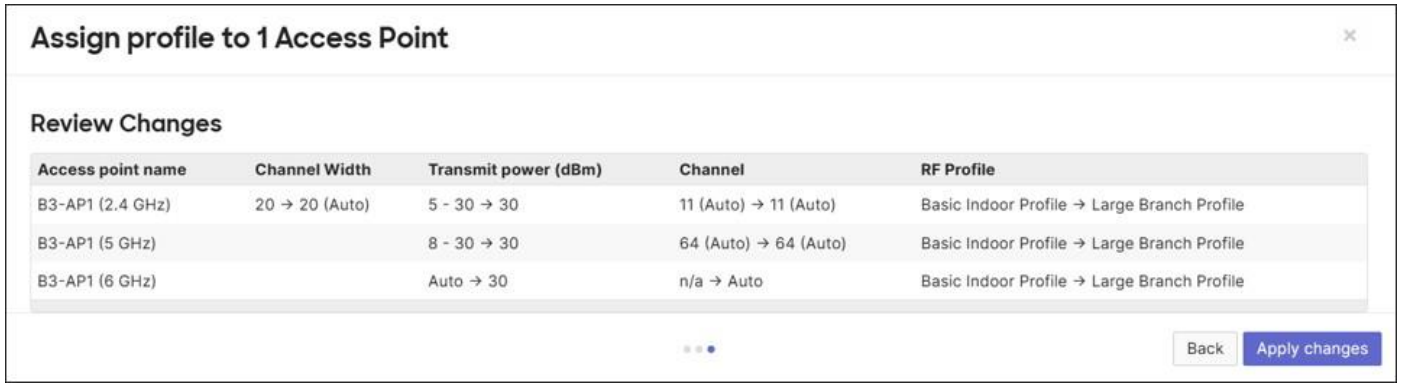
Step 3. Select **Assign profile** from the drop-down menu.



Step 4. Select the Large Branch Profile and click **Next**.

Step 5. A window appears that states that some APs have manually configured settings (power, channel, and channel-width settings) which override profile settings. Clear their manual overrides if needed and select **Review changes**.

Step 6. Click **Apply changes**.



Configure other network services

SNMP (dashboard polling)

This is configured at the Organization level.

Procedure 57. To configure SNMP, if not already configured:

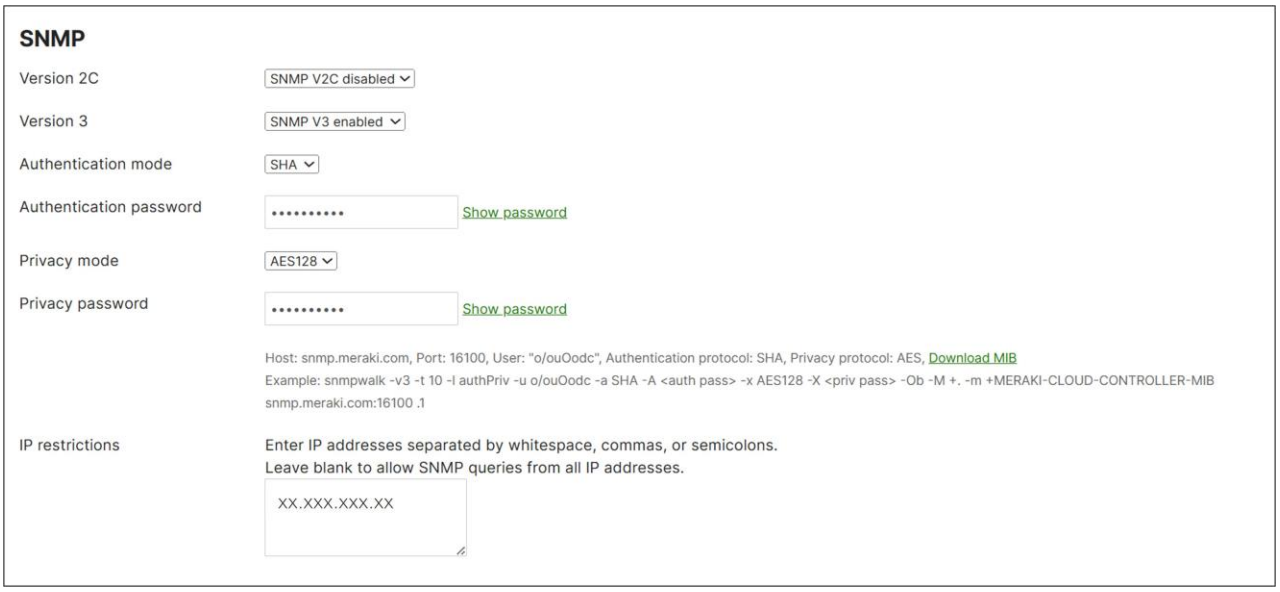
Step 1. Go to **Organization > Configure > Settings**.

Step 2. Under **SNMP**, verify these settings are configured:

- SNMP V2C disabled

- SNMP V3 enabled
- Authentication mode: SHA
- Privacy mode: AES128

Step 3. Verify strong passwords are chosen for Authentication and Privacy and configure any IP restrictions (public IP address endpoints that are authorized to poll the dashboard).



SNMP (dashboard traps)

SNMP traps originating from the dashboard are configured at the network-level.

Procedure 58. To configure SNMP traps:

Step 1. Go to **Network-wide > Configure > Alerts > SNMP traps**.

Step 2. Next to **Access**, select **V3 (username/password)**.

Step 3. Click **Add an SNMP user** and fill out an SNMP **Username** and **Passphrase**. The same passphrase is used for authentication and privacy. The authentication protocol is SHA1, and privacy protocol is AES128.

Step 4. Enter the public IP address of the server that will receive the SNMP traps and configure its receiving port as well

Step 5. Scroll up to **Alerts Settings**.

Step 6. Add **snmp** in the **Default recipients** box and select any conditions where alerts should be triggered. These are the conditions selected for alerts in this example:

- Network-wide: A rogue access point is detected
- WAN appliance: Malware is downloaded

Step 7. Click **Save**.

Syslog

This is configured at the network level.

Procedure 59. To configure syslog for the network devices:

Step 1. Go to **Network-wide > Configure > General.**

Step 2. Under **Reporting > Syslog servers**, click **+ Add a syslog server**.

Step 3. Enter these values:

- **Server address** (10.102.1.160)
- **Port** (514)
- **Protocol** (UDP)
- **Roles** (Wireless Event log, Wireless Air Marshal events, Switch Event log, Appliance Event log, Appliance Security events).

Step 4. Click **Update syslog servers**.

Step 5. Click **Save Changes**.

SNMP (device polling)

The SNMP device polling configuration is done at the network level.

Procedure 60. To configure SNMP device polling:

Step 1. Go to **Network-wide > Configure > General**.

Step 2. Under **Reporting** next to **SNMP access**, configure **V3 (username/password)**.

Step 3. Click **Add an SNMP user** and configure an SNMP **Username** and strong **Passphrase** that will be used for the authentication and privacy passwords.

Step 4. Select **AES128** for **Privacy Mode** (the Authentication Algorithm protocol will be SHA1).

In this example, the SNMP server is in the data center and rules are already configured to allow the traffic in the outbound VPN firewall, so no further configuration is needed.

Step 5. Click **Save** or **Save Changes**.

NetFlow

This is configured at the network level.

Procedure 61. To configure NetFlow:

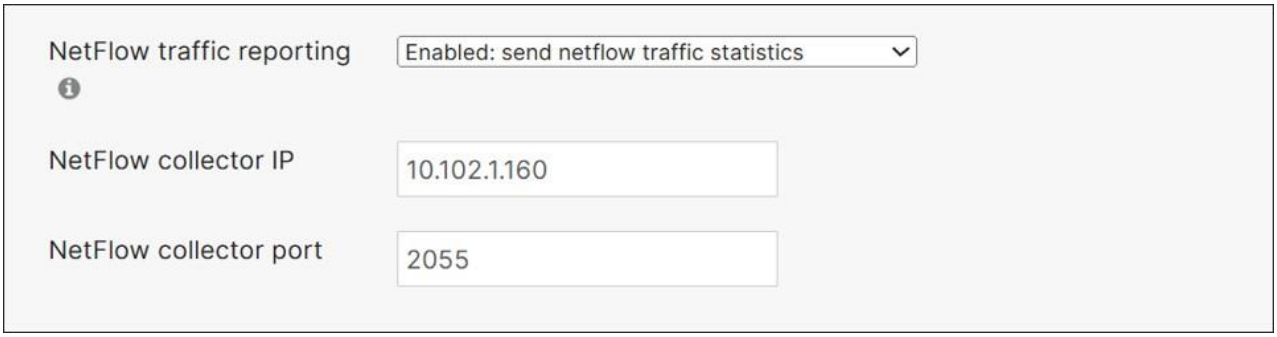
Step 1. Go to **Network-wide > Configure > General**.

Step 2. Under **Reporting** next to **NetFlow traffic reporting**, select **Enabled: send netflow traffic statistics**.

Step 3. Next to **NetFlow collector IP**, type the IP address of the NetFlow collector.

Step 4. Next to **NetFlow collector port**, type the port number of the NetFlow collector.

Step 5. Click **Save** or **Save Changes**.



In this example, NetFlow is only enabled for the MX router since it is not supported on MS switches.

Organization: Configure Adaptive Policy

Adaptive Policy is enabled at the Organization level. When Adaptive Policy is enabled for a network, additional configuration options for Adaptive Policy appear in the MX site-to-site VPN configuration, MX port configurations, and switch port configurations.

Note: The C81xx series routers do not properly propagate SGT tags under certain software versions. This is fixed in MX version 26.1.4.

If groups and traffic policies have already been defined, skip to the Enable Networks for Adaptive Policy section.

In this example, 4 groups are created which are all part of the DATA VLAN. Finance users can communicate with Finance servers and Marketing users but cannot reach Marketing servers. Marketing users can communicate with Marketing servers and Finance users but cannot reach Finance servers.

Procedure 62. To configure Adaptive Policy groups:

Step 1. On the dashboard, go to **Organization > Adaptive Policy.**

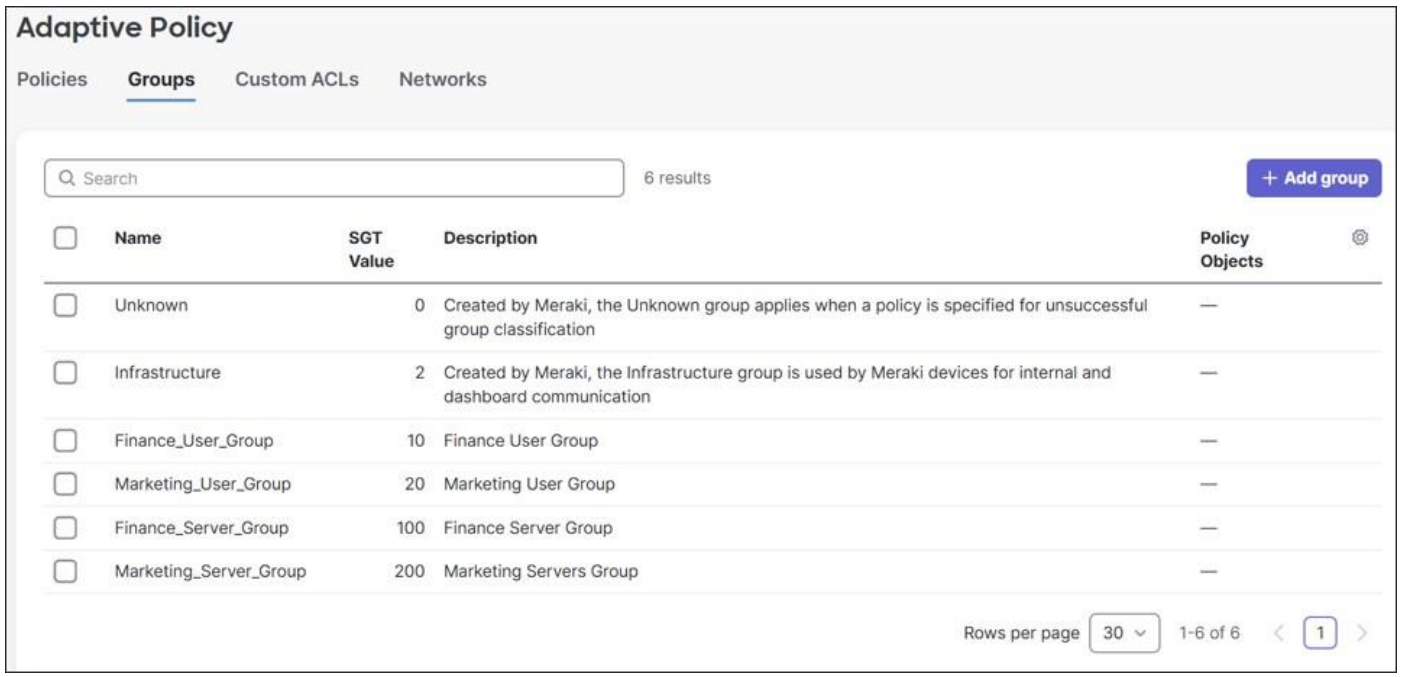
Step 2. Click the **Groups** tab. Click **+ Add group**.

Step 3. Configure a **Name** (Finance_User_Group), **SGT Value** (10), and **Description** (Finance User Group).

Step 4. Click **Create**.

Step 5. Repeat until the group configuration is complete.

Name	SGT Value	Description
Finance_User_Group	10	Finance User Group
Marketing_User_Group	20	Marketing User Group
Finance_Server_Group	100	Finance Server Group
Marketing_Server_Group	200	Marketing Server Group



Traffic policies can now be created.

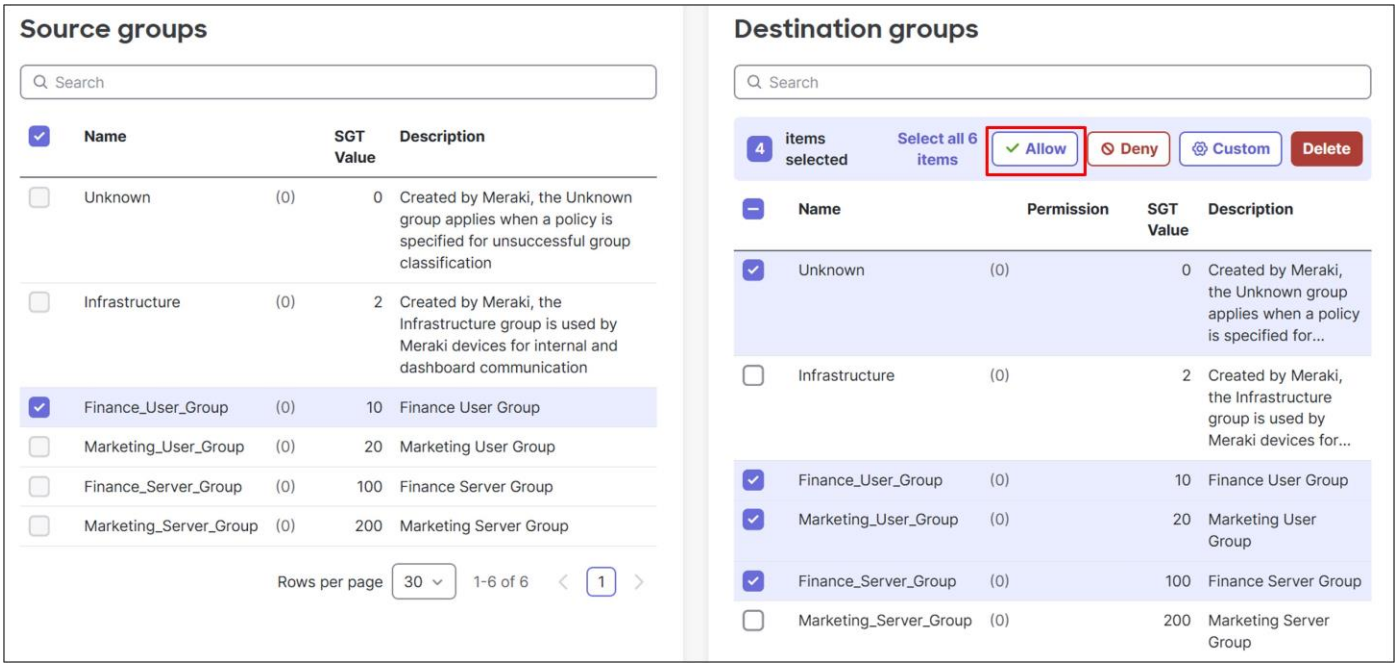
Procedure 63. To create Adaptive Policy traffic policies:

Step 1. On the **Adaptive Policy** page, click the **Policies** tab.

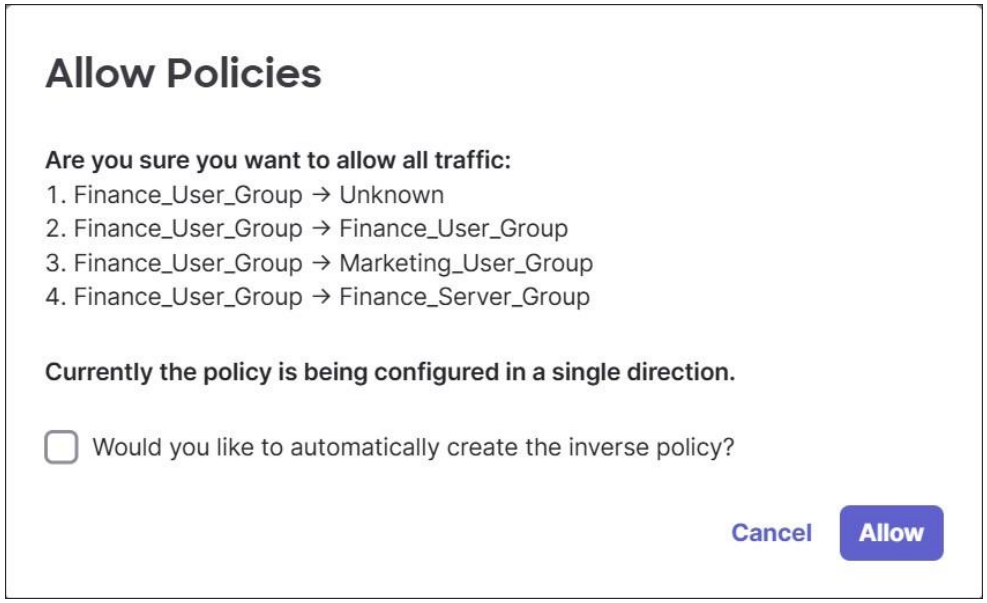
Step 2. Click **+ Add policies**.

Step 3. Under **Source groups**, select a **Name** (Finance_User_Group), then under **Destination groups**, select all groups that will be allowed (Finance_User_Group, Marketing_User_Group, and Finance_Server_Group).

Step 4. At the top of **Destination groups**, click **Allow**.



Step 5. A window pops up and displays the changes. A box can be checked to automatically create the inverse policy. An error occurs if a reverse policy already exists. In this case, do not automatically create the inverse policy since Finance_User_Group → Finance_User_Group would attempt to be created twice, generating an error. Click **Allow**.



Step 6. Continue adding policy, selecting **Allow** or **Deny** between groups.

> **Note:** In this example, Unknown and Infrastructure groups are permitted to reach all other defined groups. This is so Finance and Marketing devices can ping their IP default gateways and perform other troubleshooting and monitoring tasks.

Group	Unknown	Infra-structure	Finance_User_ Group	Marketing_User_ Group	Finance_Server_ Group	Marketing_Server _Group
Unknown			Allow	Allow	Allow	Allow
Infrastructure			Allow	Allow	Allow	Allow
Finance_User_ Group	Allow	Allow	Allow	Allow	Allow	Deny
Marketing_User_ Group	Allow	Allow	Allow	Allow	Deny	Allow
Finance_Server_ Group	Allow	Allow	Allow	Deny	Allow	Deny
Marketing_Server_ Group	Allow	Allow	Deny	Allow	Deny	Allow

Step 7. The resulting policy can be viewed in grid format or list format, which can be selected in the upper right corner of the **Adaptive Policy** page:

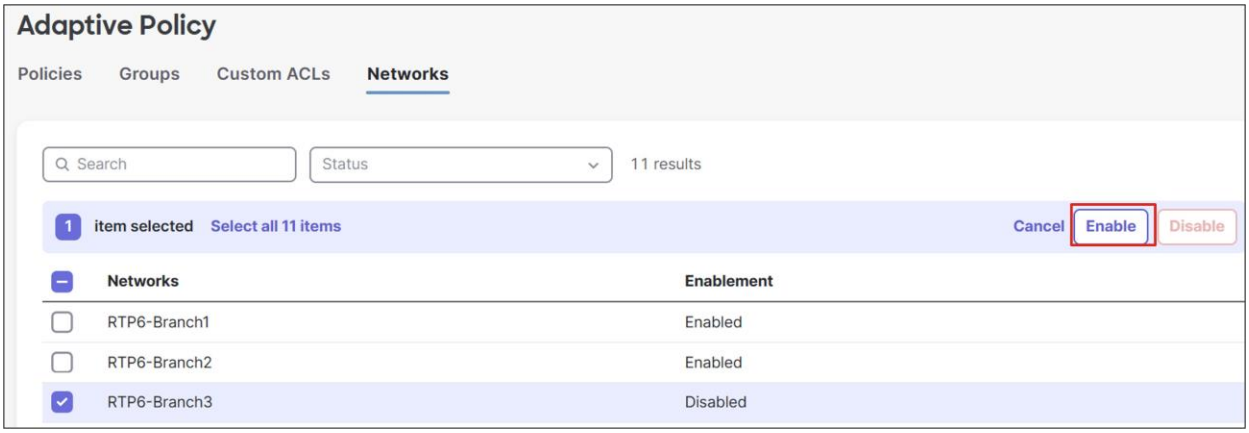
Enable networks for Adaptive Policy

Procedure 64. To enable Adaptive Policy in the individual branches:

Step 1. Go to **Organization > Adaptive Policy** and click on the **Networks** tab.

Step 2. Select the branches that need to be enabled for Adaptive Policy and click **Enable**.

Step 3. Verify DC1 and DC2 hub sites are also enabled.



Step 4. A pop-up window may caution that making modifications to the Adaptive Policy on a network may cause a momentary disruption of all traffic due to SGT configuration changes. Click **Enable**.

RTP6-Branch3 is now enabled for Adaptive Policy.

Step 5. To ensure tags can be propagated from end-to-end, Auto VPN and trunk ports in the branches need to be enabled as “Peer SGT capable”. Assignment of SGTs in this example network is done through RADIUS when a client joins the network.

Auto VPN configuration

Procedure 65. To configure Adaptive Policy for Auto VPN:

Step 1. Go to **Network** RTP6-Branch3.

Step 2. Go to **Security & SD-WAN > Configure > Site-to-site VPN**.

Step 3. Under **VPN settings** next to **Peer SGT capable**, select **Enabled**.

Step 4. Click **Save** or **Save Changes**.

Step 5. Repeat the configuration for sites that need SGT tag propagation over Auto VPN (DC1, DC2, and any other branch sites).

Step 6. Both Auto VPN peers need to be enabled in order for SGT tags to be propagated between those peers. In the hub and spoke topology, the data center hubs need this configuration in order for SGT tags to be propagated from site to hub and from site to site.

LAN trunk configuration

Before SGT tags can be propagated to a neighbor on the LAN, the trunk port to that neighbor needs to be marked as Peer SGT capable.

Procedure 66. To configure Adaptive Policy for LAN trunks:

Step 1. For the MX router, go to **Security & SD-WAN > Configure > Addressing & VLANs**.

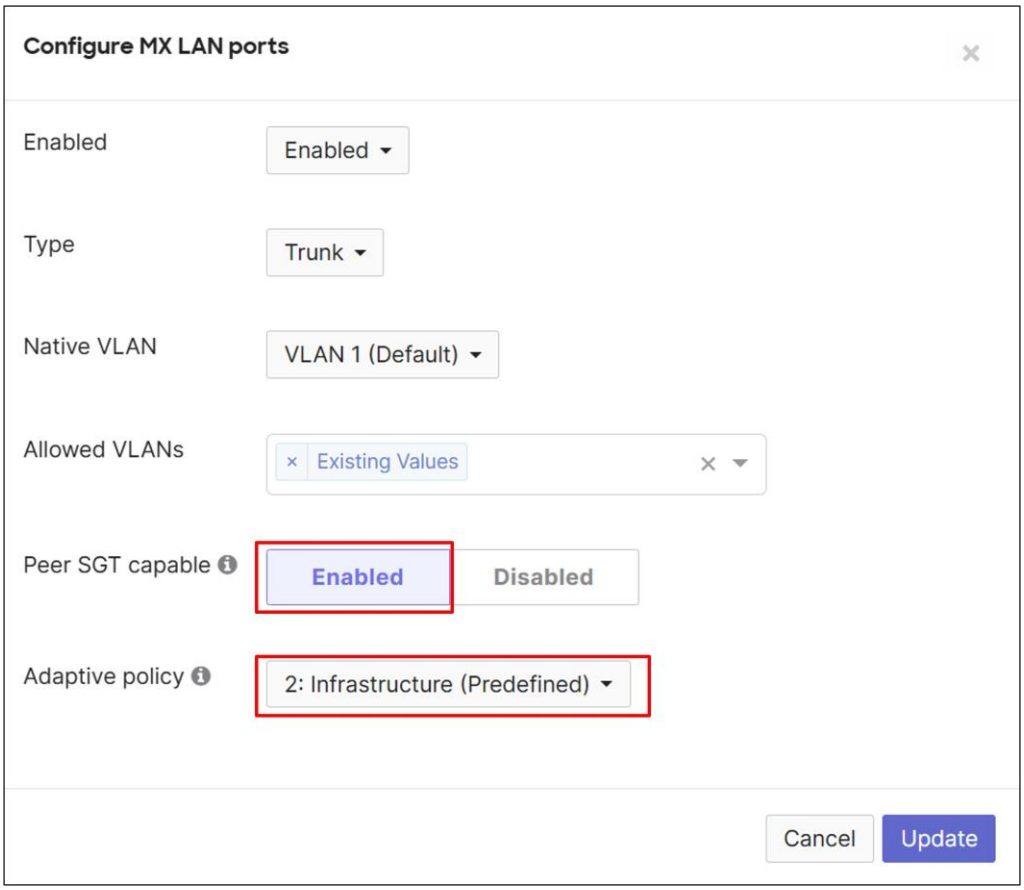
Step 2. Select the ports to the LAN switches (Ports 5 and 6 in this example) and click **Edit** at the top next to **Per-port VLAN Settings**.

Step 3. Next to **Peer SGT capable**, select **Enabled**.

Step 4. Next to **Adaptive policy**, select a group (2: Infrastructure (Predefined)) from the drop-down to add to untagged traffic, which should be device management and dashboard traffic in this example.

Step 5. Click **Update**.

Step 6. Click **Save**.



On the switches, the trunks to the MX routers, the trunk to the AP, and the trunks between switches will all have to be marked as Peer SGT capable.

Step 7. Go to **Switching > Monitor > Switch Ports**.

Step 8. Select all uplink ports to the MX routers (B3-SW1/1, B3-SW1/2, B3-SW2/1, and B3-SW2/2 and the port to the AP (B3-SW3/9) and click **Edit**.

Step 9. Next to **Peer SGT capable**, click **Enabled**.

Step 10. Next to **Adaptive policy group**, select 2: Infrastructure from the drop-down menu.

Step 11. Click **Update**.

The AP automatically detects SGT tags coming from the switch and will then send SGT-tagged traffic, so no manual configuration is required on the AP.

Step 12. Select the aggregation ports between the distribution switch stack and access switches (B3-DIST-SW-STACK1: AGGR/0, B3-DIST-SW-STACK1: AGGR/1, B3-SW3 / AGGR/0, and B3-SW4 / AGGR/0) and click **Edit**.

Step 13. Next to **Peer SGT capable**, click **Enabled**.

Step 14. Next to **Adaptive policy group**, select 2: Infrastructure from the drop-down menu.

Step 15. Click **Update**.

Step 16. Repeat for other sites.

Organization Configuration: ThousandEyes

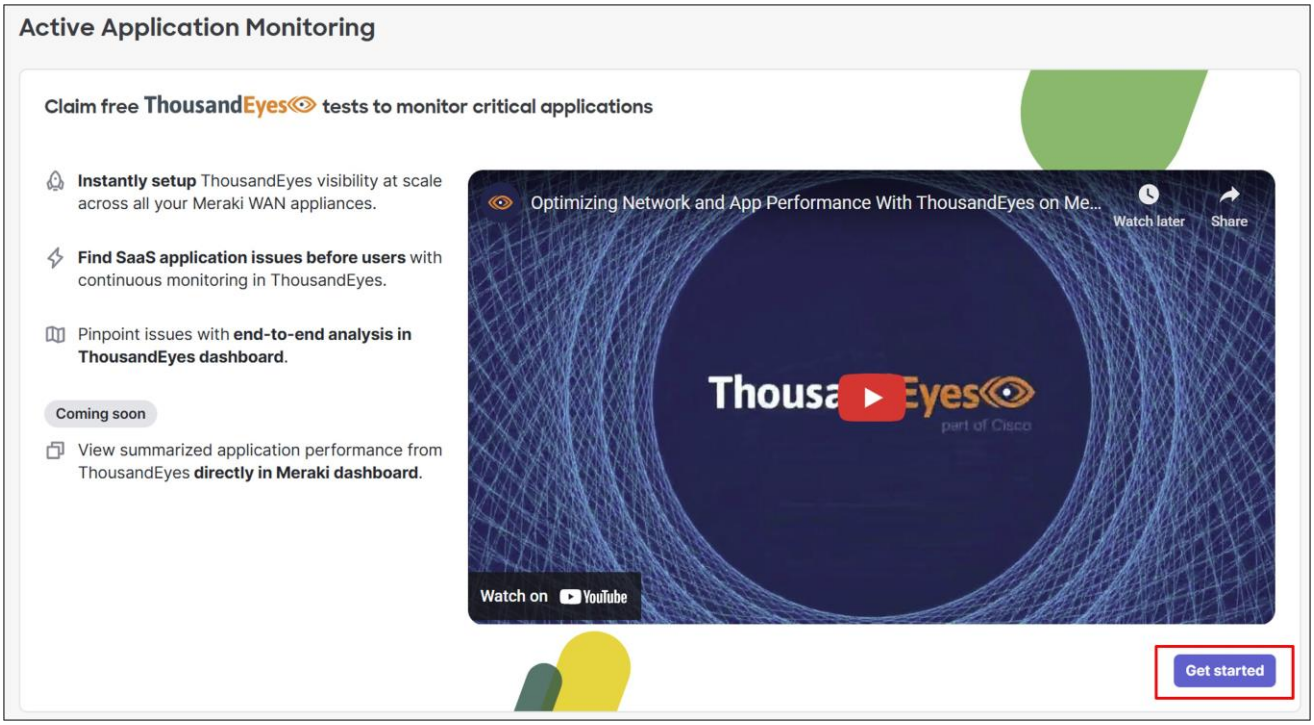
ThousandEyes must be enabled on a network-by-network basis.

Procedure 67. To configure ThousandEyes integration:

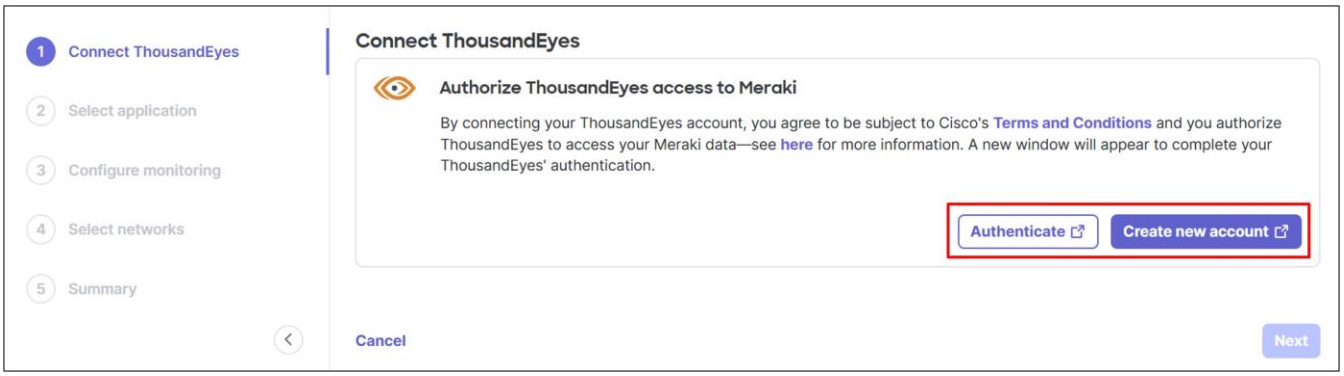
Step 1. Go to **Insight > Configure > Active Application Monitoring**.

Step 2. If ThousandEyes has already been set up, a list of monitored networks appears. To add monitoring for another application or network, click the **Add tests** button. ThousandEyes shows as connected to a specific account group that was previously configured. Click **Next**. Skip to the Application Selection section.

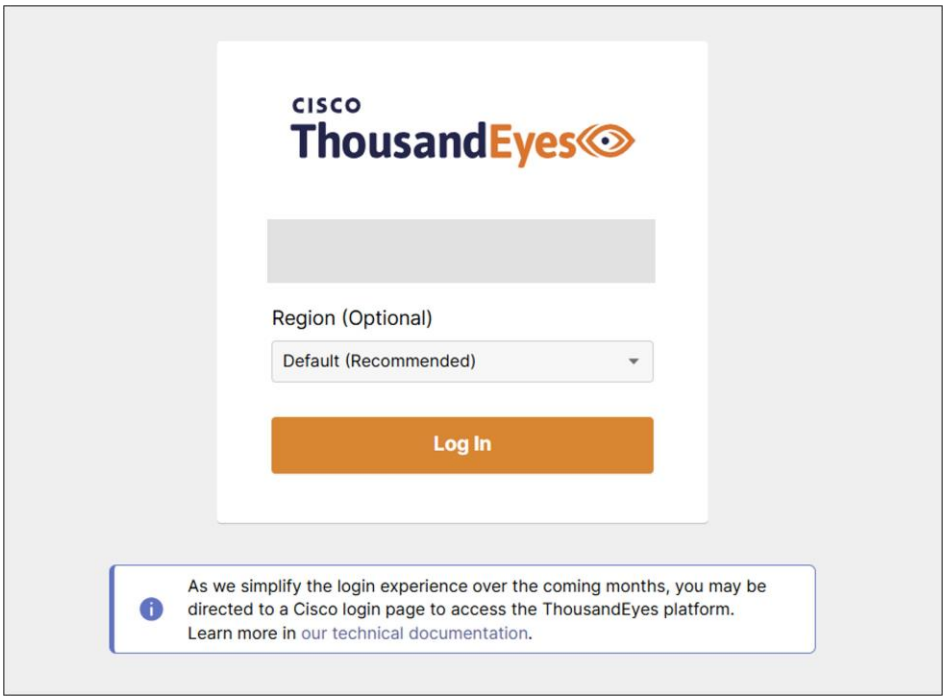
Step 3. If ThousandEyes has not been configured yet, click **Get started**.



Step 4. Click **Authenticate** if you have an existing ThousandEyes account or click **Create new account**. This workflow assumes a ThousandEyes account already exists.

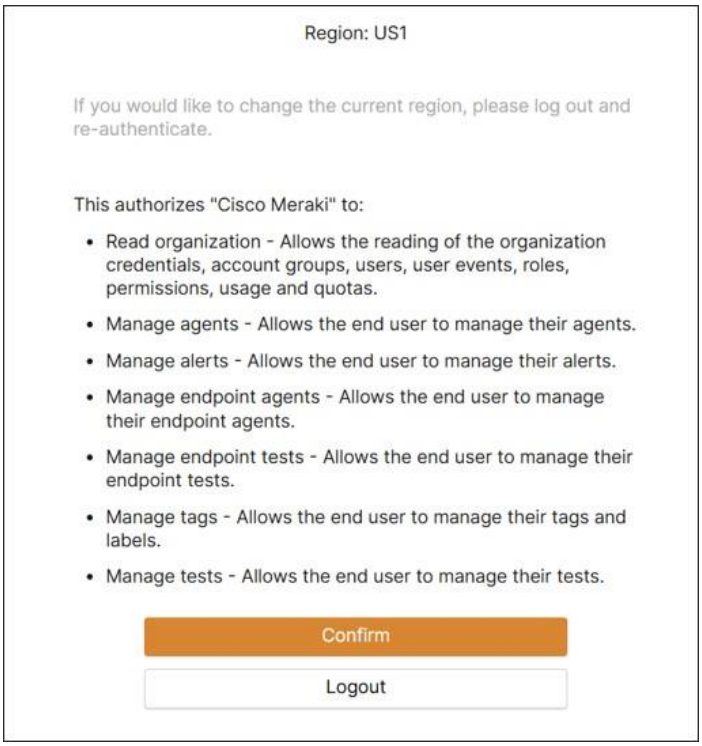


Step 5. After clicking Authenticate, a window appears to log into Cisco ThousandEyes. Enter the email address and optional region. The region for ThousandEyes should be in the same region as Meraki. Click **Log In**.



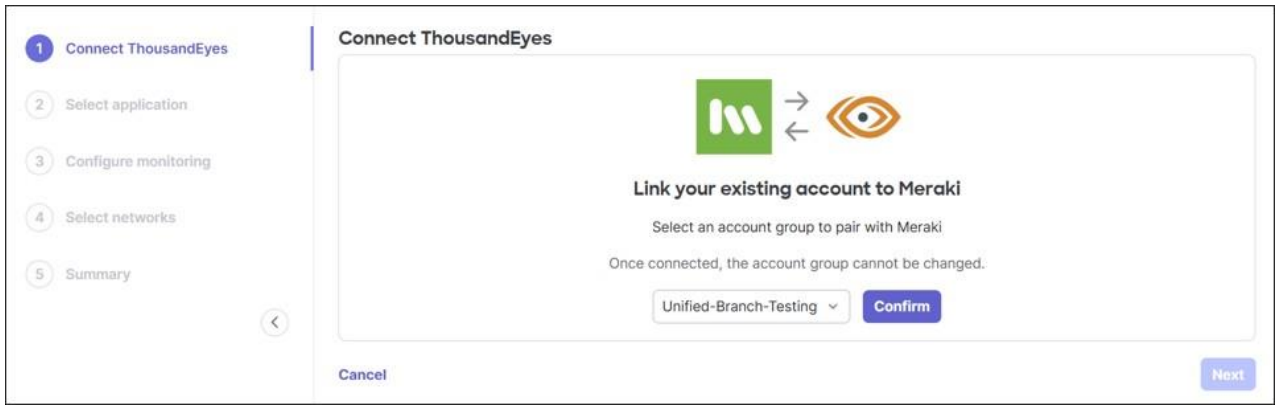
Step 6. In the next window, type in the password, then click **Next**.

Step 7. A window pops up explaining what Cisco Meraki is authorized to do after the integration is complete. Click **Confirm**.



The authentication to ThousandEyes is now complete.

Step 8. Back on the Meraki Dashboard, select an account group from ThousandEyes from the drop-down menu to pair with Meraki and click **Confirm**.



Step 9. The account group shows up as connected. Then click **Next**.

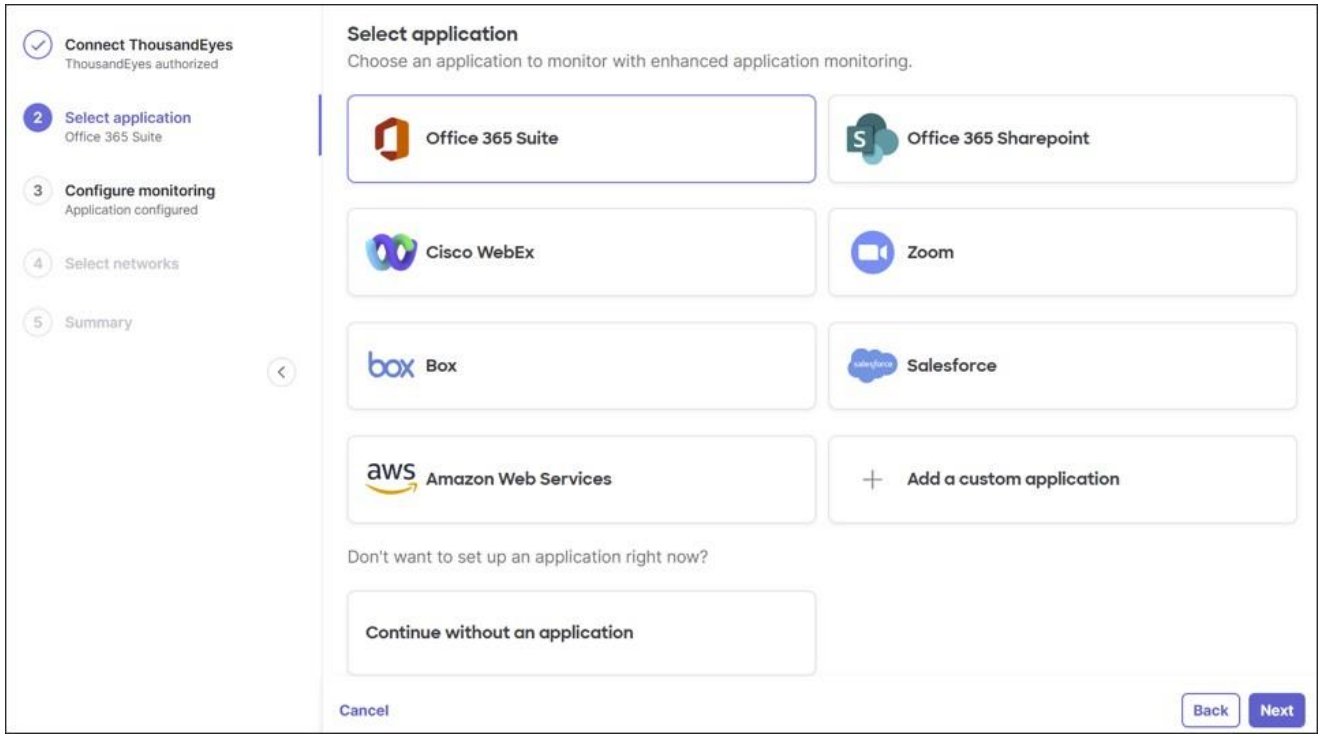
Application selection

In this example, Office 365 Suite is selected.

Procedure 68. To select an application to monitor:

Step 1. Select an application to monitor with enhanced application monitoring. Alternatively, add a custom application or continue without an application for now.

Step 2. Click **Next**.

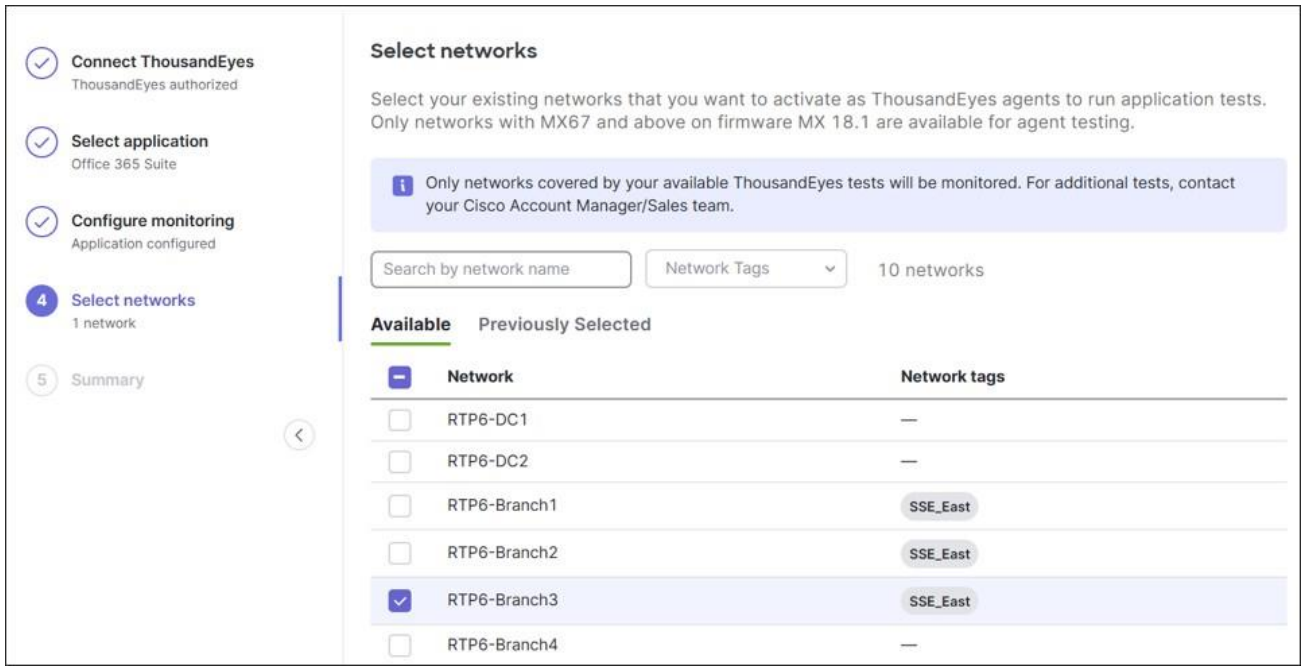


Network selection

In this example, the RTP6-Branch3 network is selected.

Procedure 69. To select networks to activate ThousandEyes agents on:

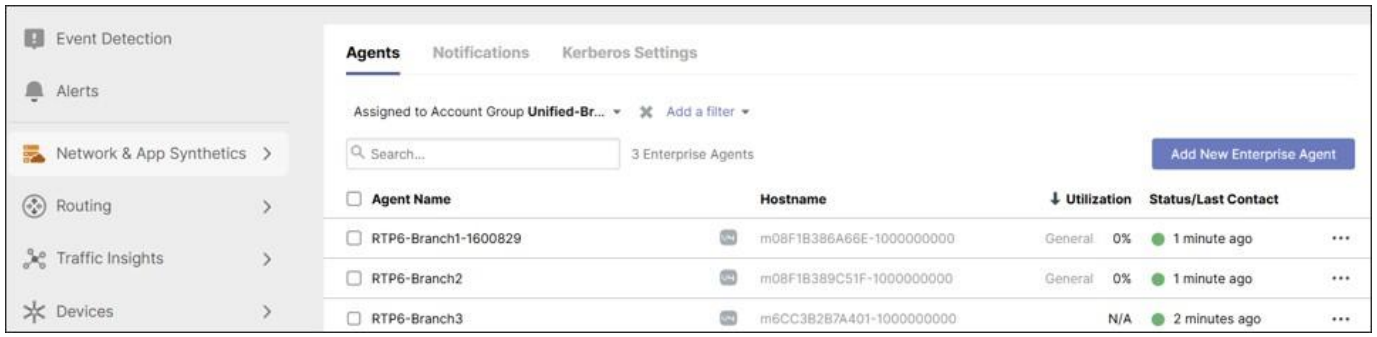
Step 1. To run application tests, select the networks to activate ThousandEyes agents on, then click **Next**.



Step 2. Click **Start monitoring**.

Step 3. After a brief period of time, the monitored network shows active. Click **View applications** to go directly to the ThousandEyes dashboard.

Step 4. There will be prompts to set up monitoring by deploying templates, which can be skipped. The agent can be seen from the ThousandEyes dashboard.



Organization configuration: Splunk

Basic Splunk integration is at the Meraki organization level. If it is not already configured, follow these steps:

Procedure 70. To integrate Splunk:

Step 1. Before integrating the Meraki Dashboard Organization with Splunk, go to the Dashboard and retrieve the **Organization ID** and **Organization API Key**.

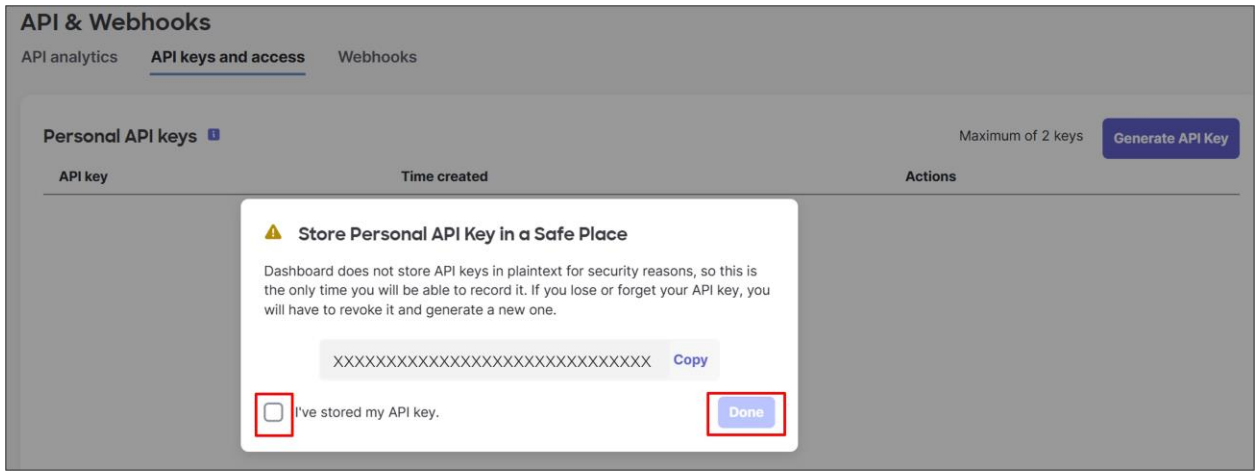
Step 2. On the Meraki Dashboard, go to the bottom of any page and record the organization ID.

Step 3. To generate an API key, on the Meraki Dashboard, go to **Organization > Configure > API & Webhooks**. Go to the **API keys and access** tab.

Step 4. Click the **Generate API Key** button. Copy the API key to use in the Splunk integration.

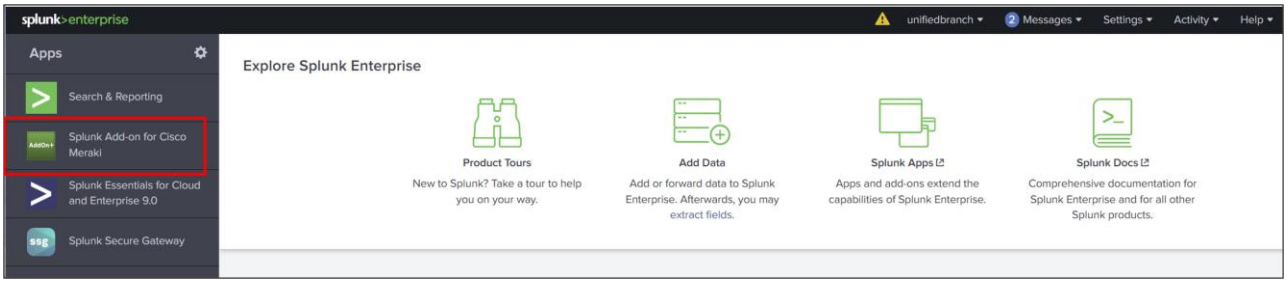
Note: The API key is generated, and this is the only chance to record it. If it is forgotten, it will need to be revoked and a new one generated.

Step 5. Select **I've stored my API key** and click **Done**.



Step 6. Log into the Splunk dashboard.

Step 7. On the left-side, choose **Splunk Add-on for Cisco Meraki**.

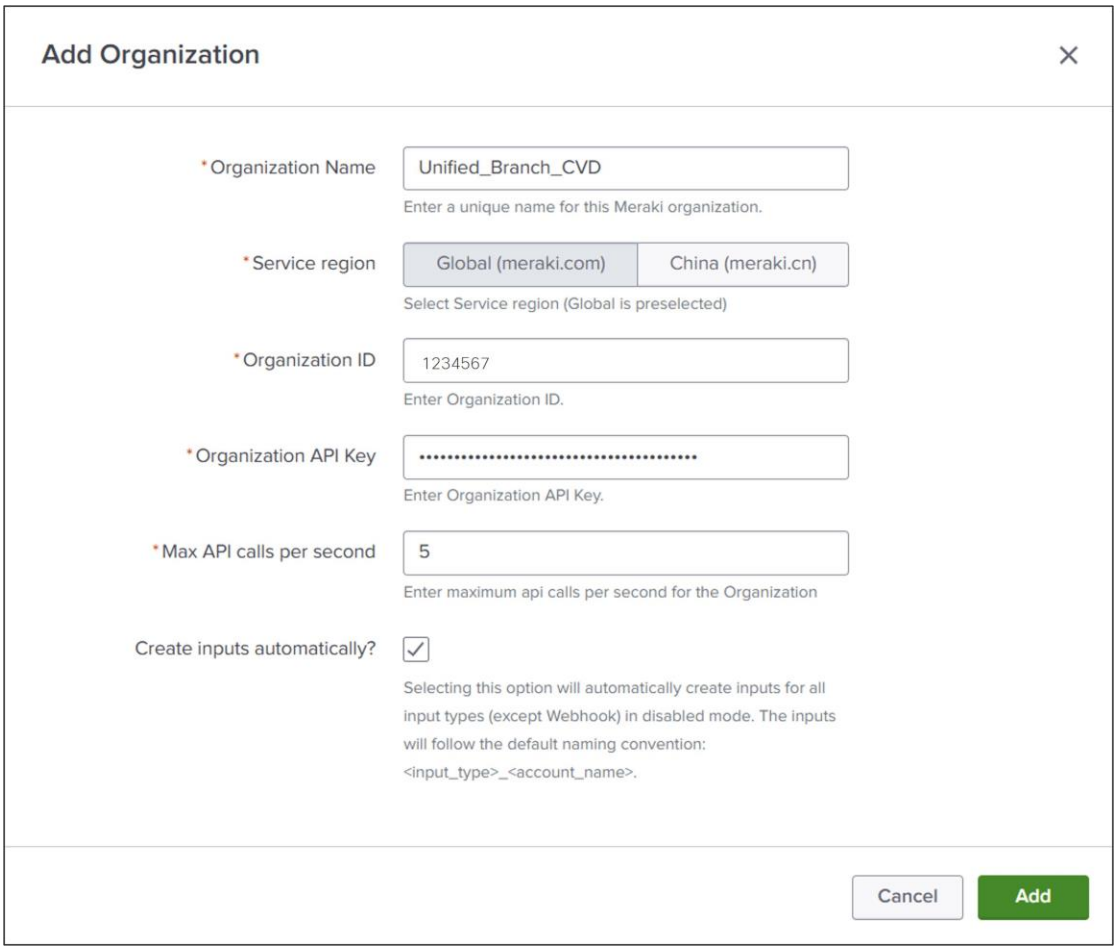


Step 8. Go to the **Configuration > Organization** tab, then click **Add**. In the pop-up window, enter values for these fields:

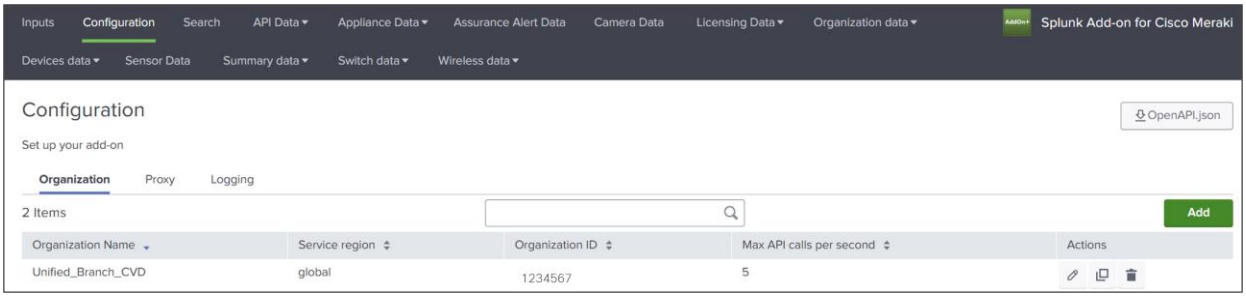
- **Organization Name**: [Enter a unique name] (Unified_Branch_CVD)
- **Service region**: [Choose a service region] Global (Meraki.com)
- **Organization ID**: [Enter the Organization ID found on the Meraki Dashboard]
- **Organization API Key**: [Enter the API Key created in the Meraki Dashboard]
- **Max API calls per second**: [Enter a value. It defaults to 5 calls per second] (5)
- **Create inputs* automatically?** [Click the box for yes] [yes]

*Inputs refer to the data sources that Splunk collects from Cisco Meraki devices and networks. These inputs allow users to monitor and analyze network data, including device status and alerts. If created automatically, all input types (except for webhook) are created in disabled mode.

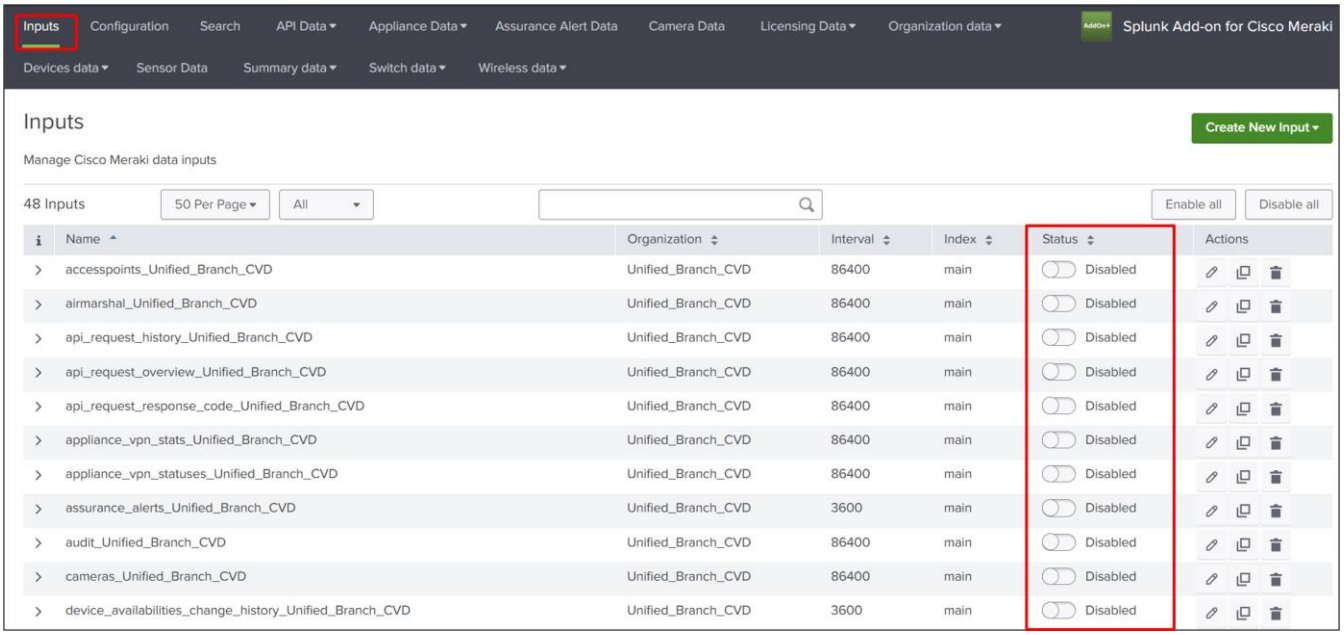
Step 9. Click **Add**.



The Organization information is added to the Splunk Dashboard. Optionally, the logging level can be changed, or proxy information can be set up from this page.



Step 10. To manage inputs, go to the **Inputs** tab on the Splunk dashboard and enable the ones of interest.



Webhooks can also be configured through the Dashboard for alerts on a network-by-network basis. Refer to Cisco Meraki Add-on for Splunk for additional information.

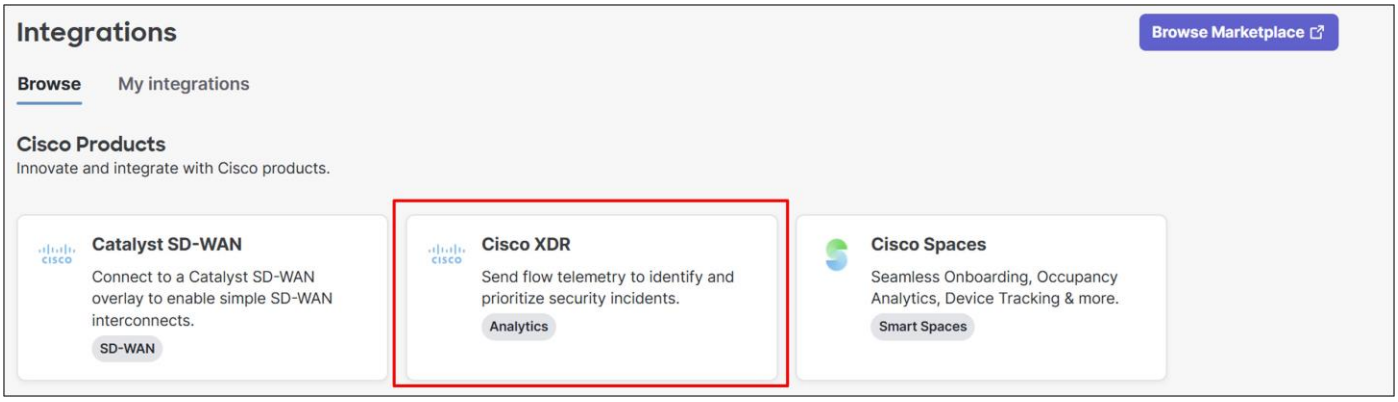
Organization configuration: XDR

The XDR integration to the Meraki Dashboard is performed once but is then enabled on a network-by-network basis. If XDR has already been integrated and is being enabled for additional networks, skip to the Enable Networks for XDR section.

Procedure 71. To integrate XDR:

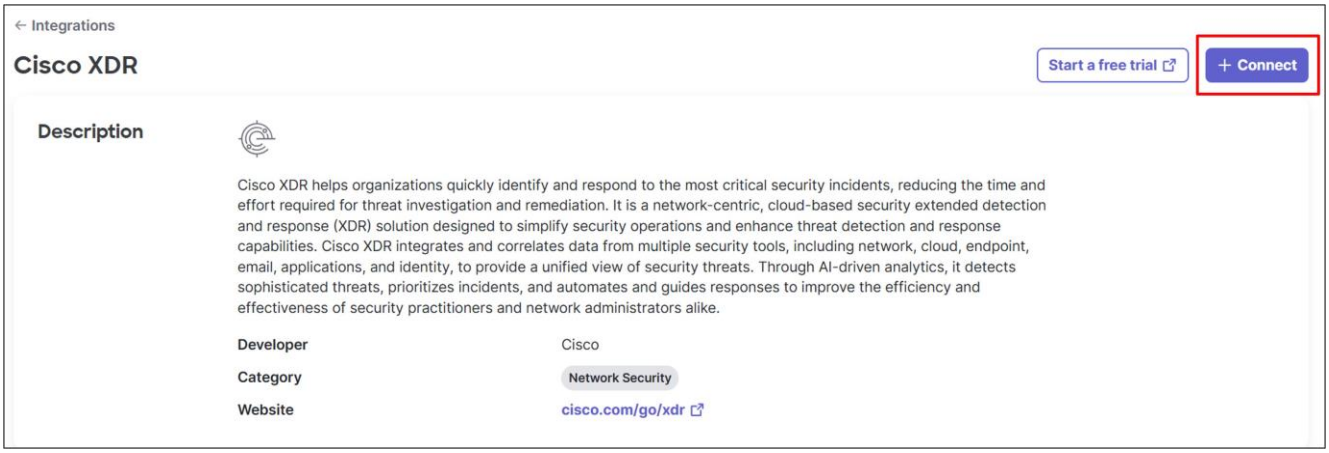
Step 1. Go to **Organization > Configure > Integrations**.

Step 2. Select the **Cisco XDR** tile.

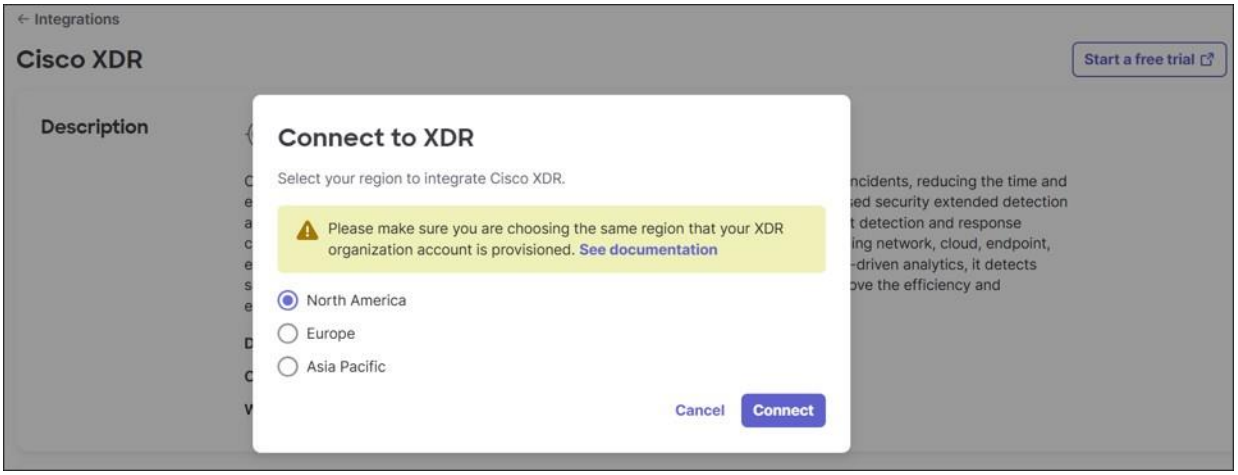


Step 3. From this window, if an XDR account does not exist, click **Start a free trial**. This workflow assumes an XDR account already exists.

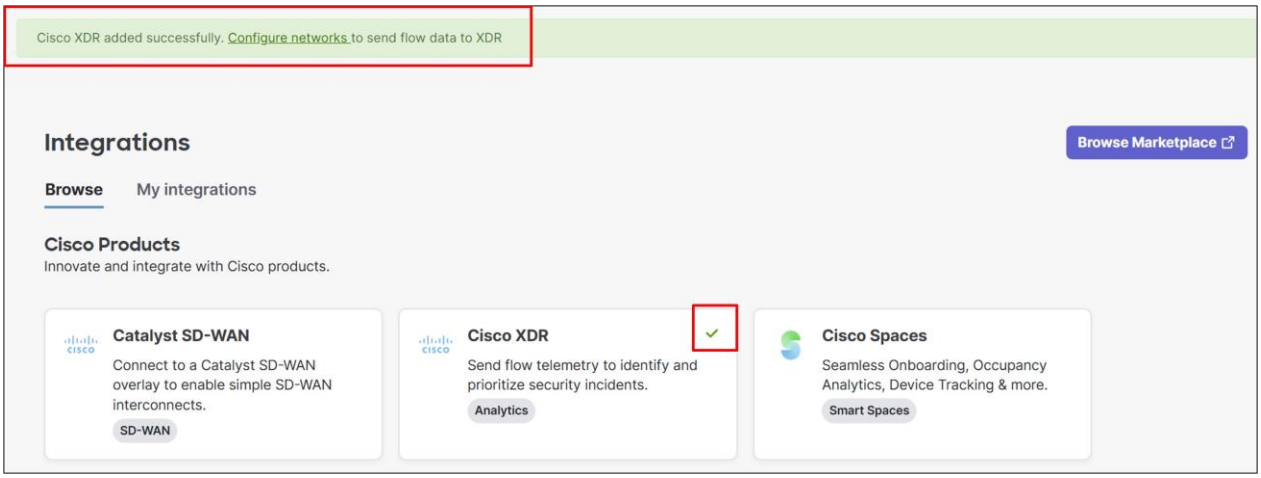
Step 4. Click **+Connect**.



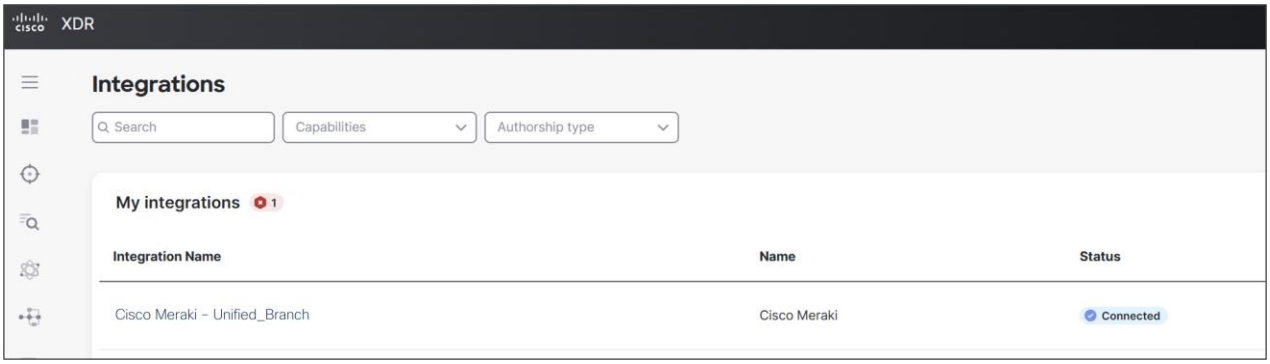
Step 5. Select the region where the XDR organization account is provisioned, then click **Connect**.



The login is verified and XDR is now connected and integrated into the Meraki Dashboard.



Step 6. The Meraki Organization can now be seen on the XDR dashboard under **Administration > Integrations**, in a list called **My Integrations**.



Enable networks for XDR

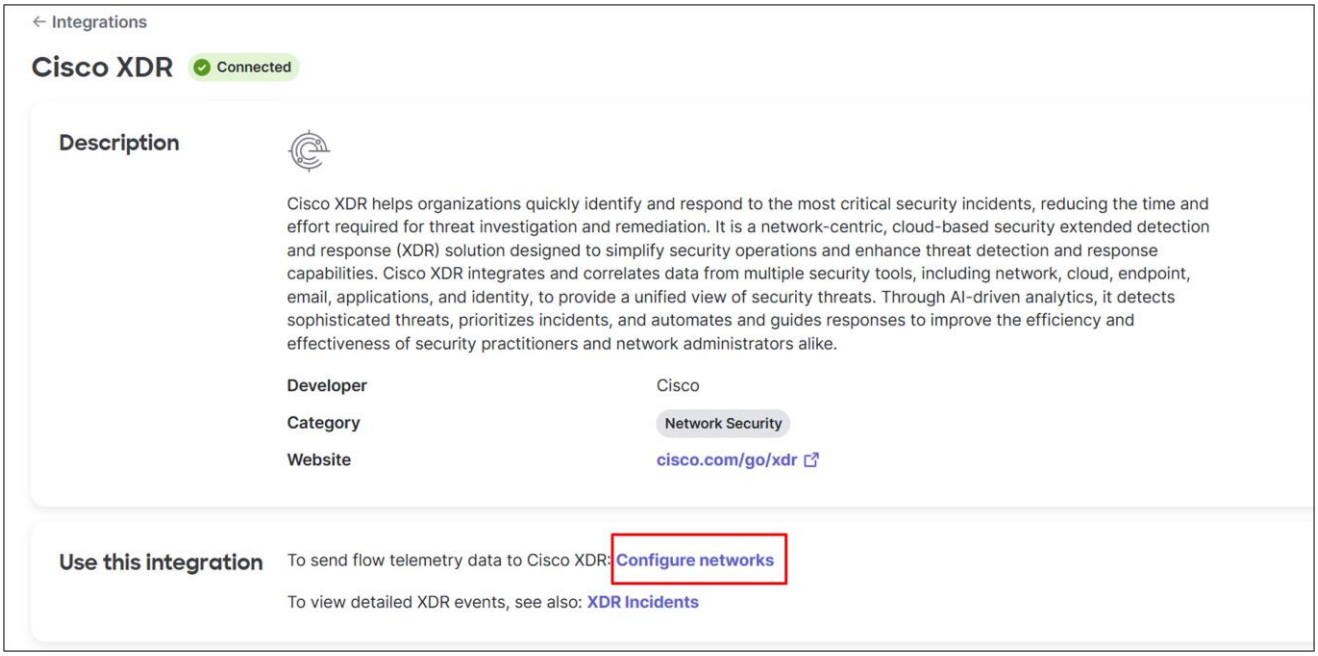
Procedure 72. To enable XDR for the network:

Step 1. Go **to Organization > Integrations**.

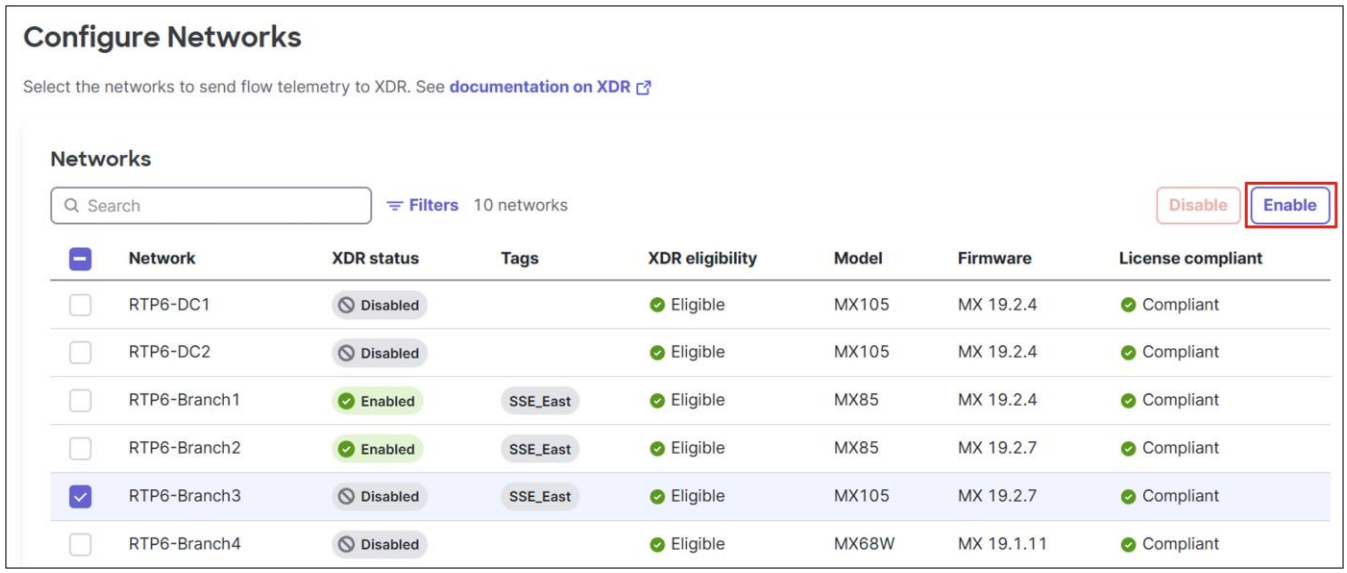
Step 2. Go to the **My integrations** tab.

Step 3. Click on the XDR integration with the Meraki Organization name.

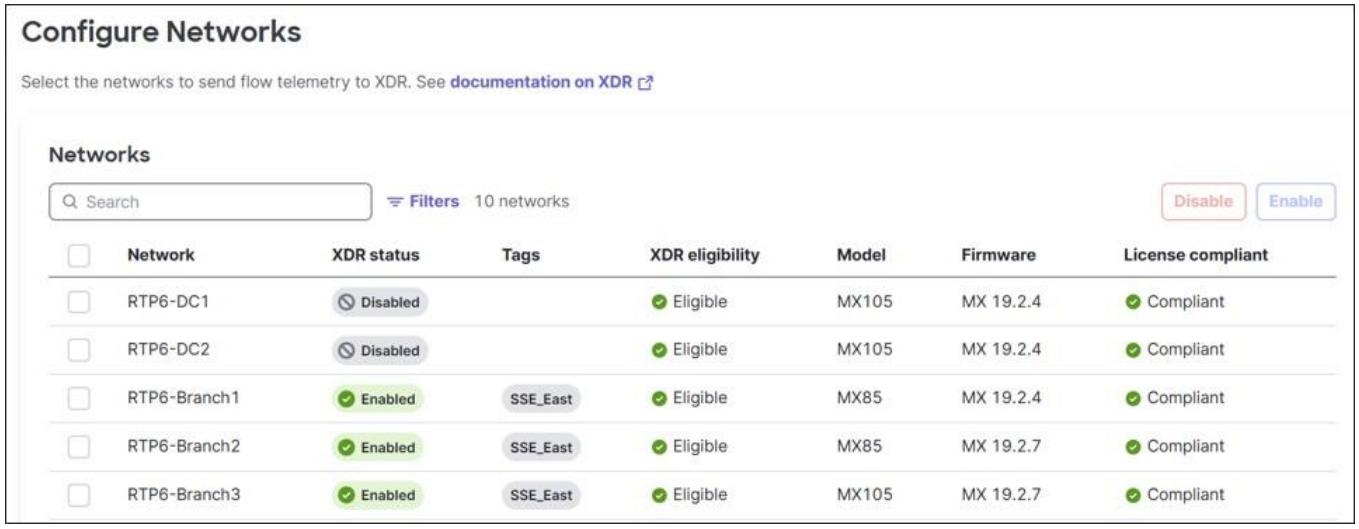
Step 4. Select **Configure networks**.



Step 5. Click the box beside RTP6-Branch3 to select it, then click **Enable**.

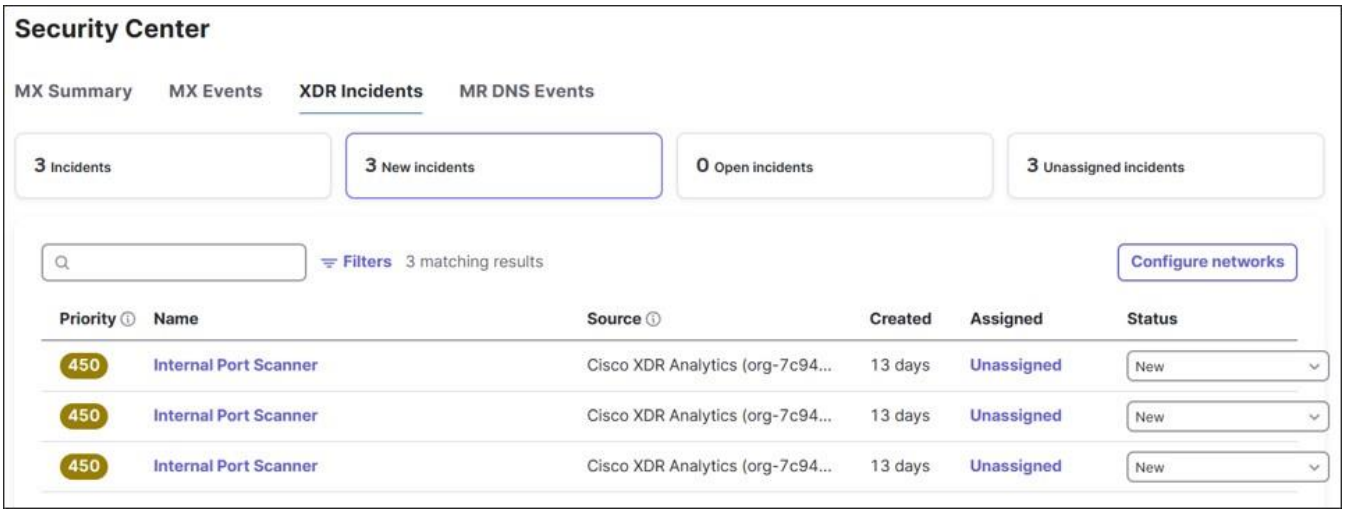


Step 6. A pop-up window asks to proceed with enabling XDR for RTP6-Branch3. Click **Enable**. The XDR status for Branch 3 now shows **Enabled**.



Data is now flowing to XDR.

Step 7. View XDR incidents from the Meraki Dashboard at **Organization > Monitor > Security Center** under the **XDR Incidents** tab.

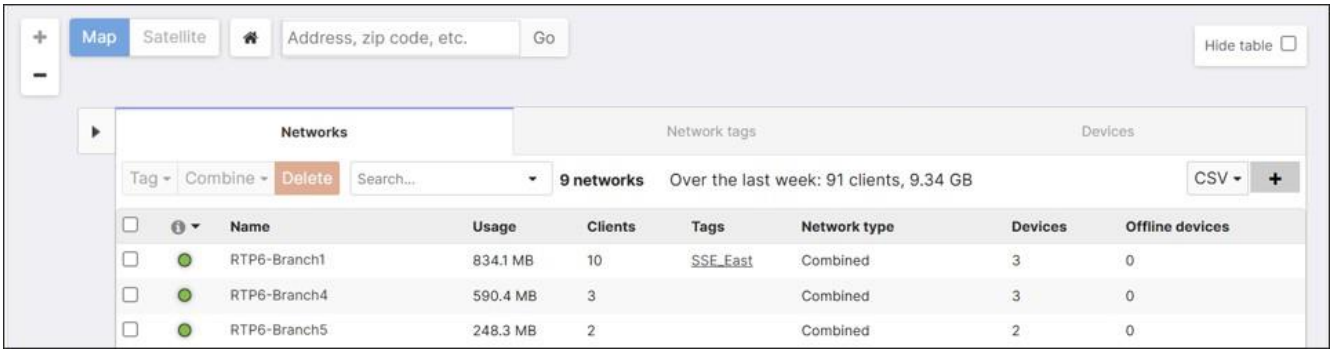


Verify device operation

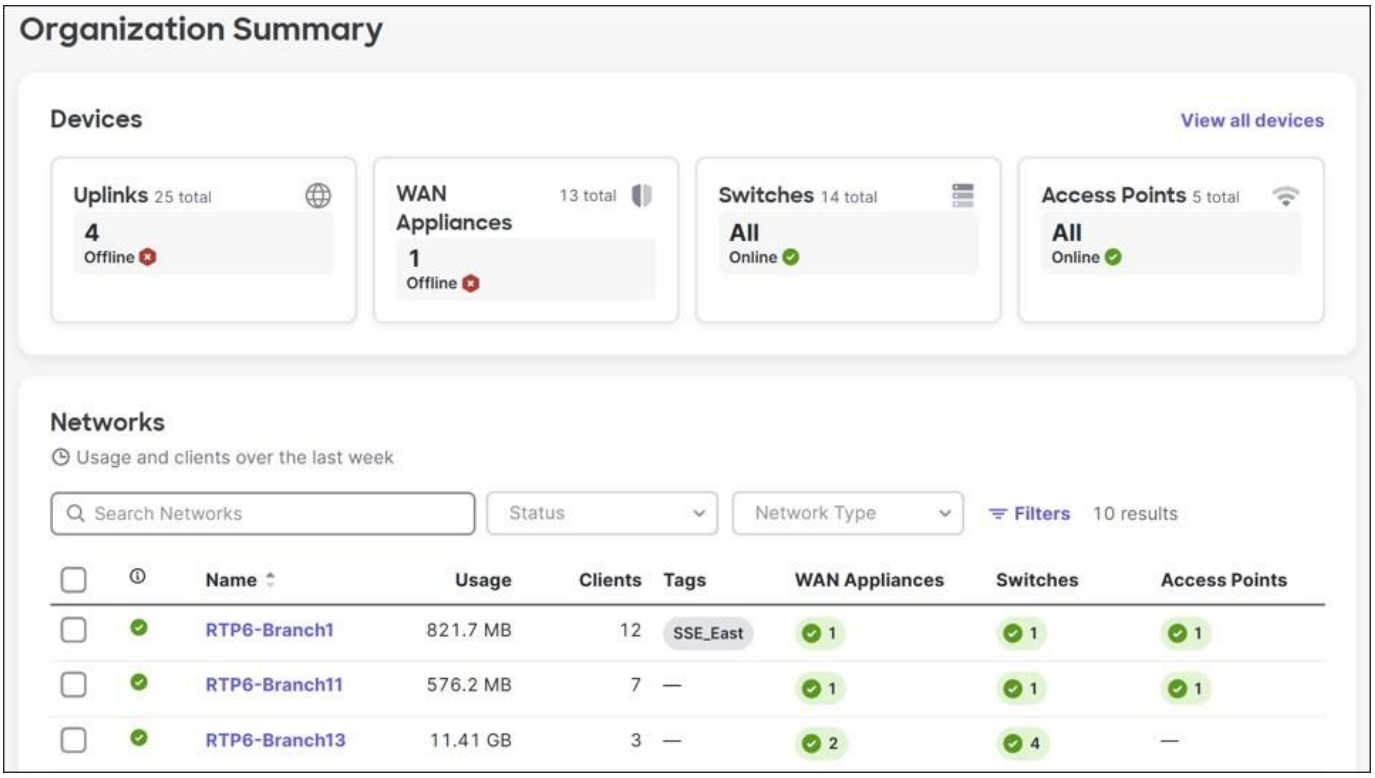
Verify the operation of the devices using the dashboard.

Procedure 73. To verify device operation:

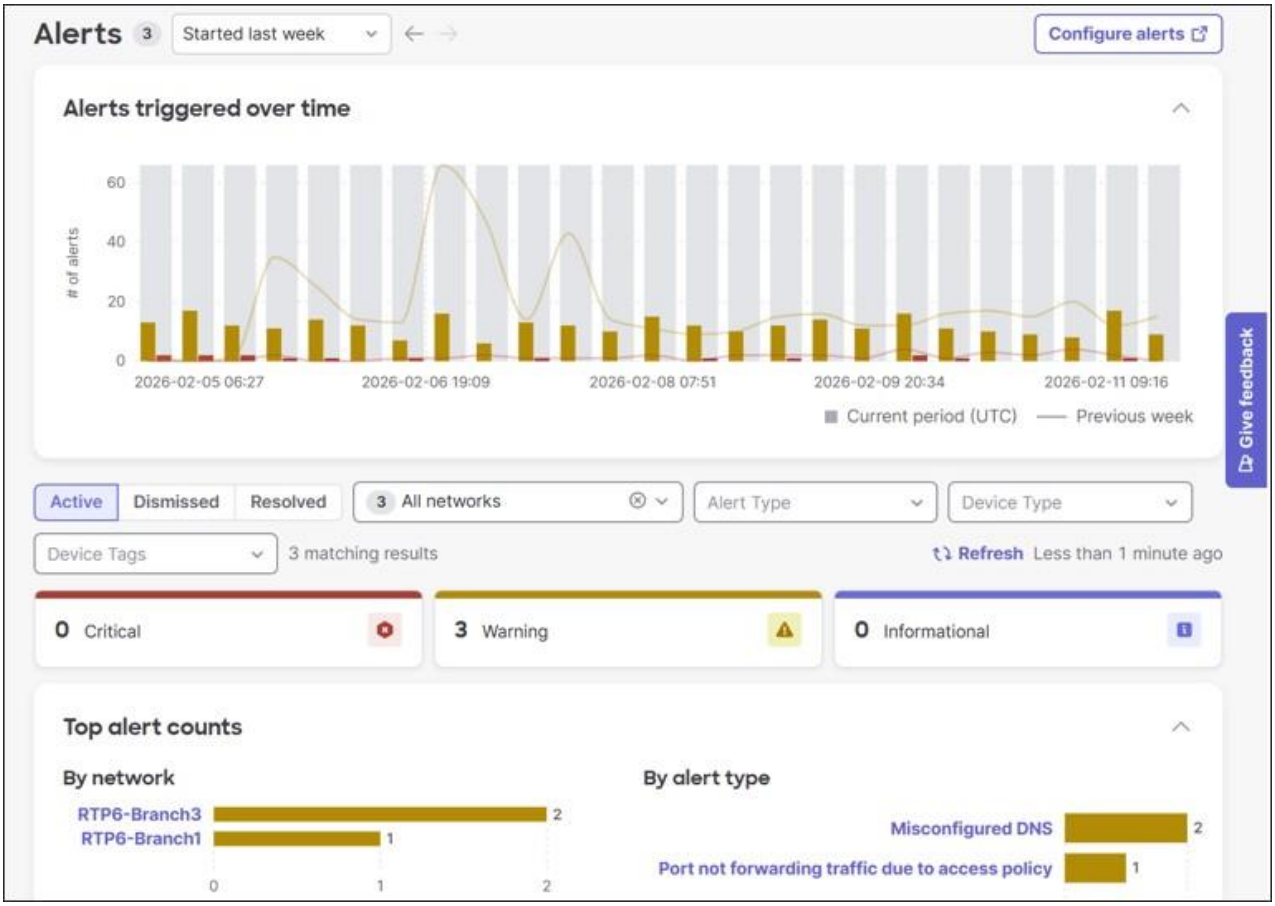
Step 1. Go to **Organization > Monitor > Overview** to get a big-picture view of the network. Only dashboard connectivity-related alerts are reflected on this page.



Step 2. Go to **Organization > Monitor > Summary** to get a more granular view of the device and uplink status for each network.



Step 3. Go to **Organization > Monitor > Alerts** to find additional alerts for the Organization.

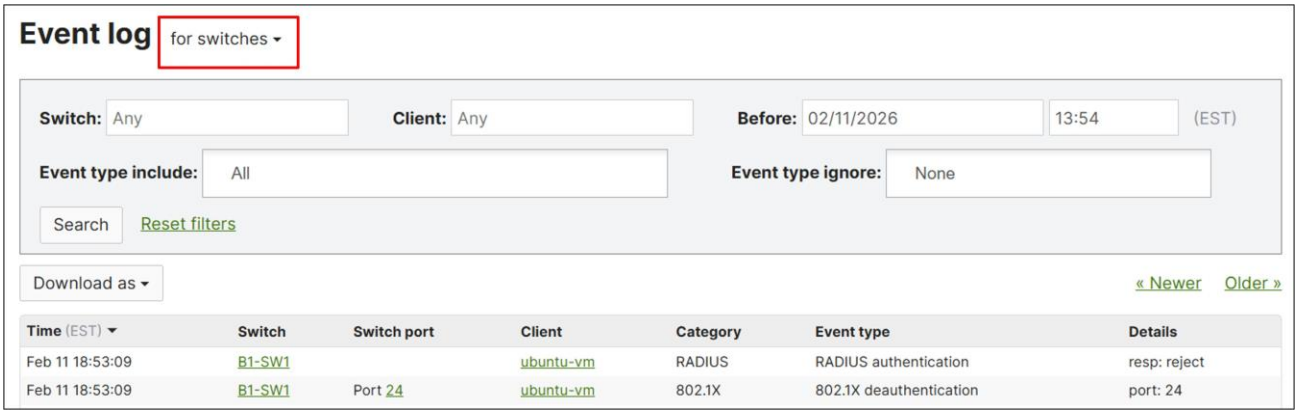


Procedure 74. To view an individual network:

Step 1. On the left of the dashboard (RTP6-Branch3), select the preferred **Network**.

Step 2. Select **Network-wide > Monitor >Clients**. Drill into any devices to review status, configurations, or troubleshoot issues. View clients connected to the network on this page as well.

Step 3. View network-wide events by going to **Network-wide > Monitor > Event Log** and selecting the device type to view.

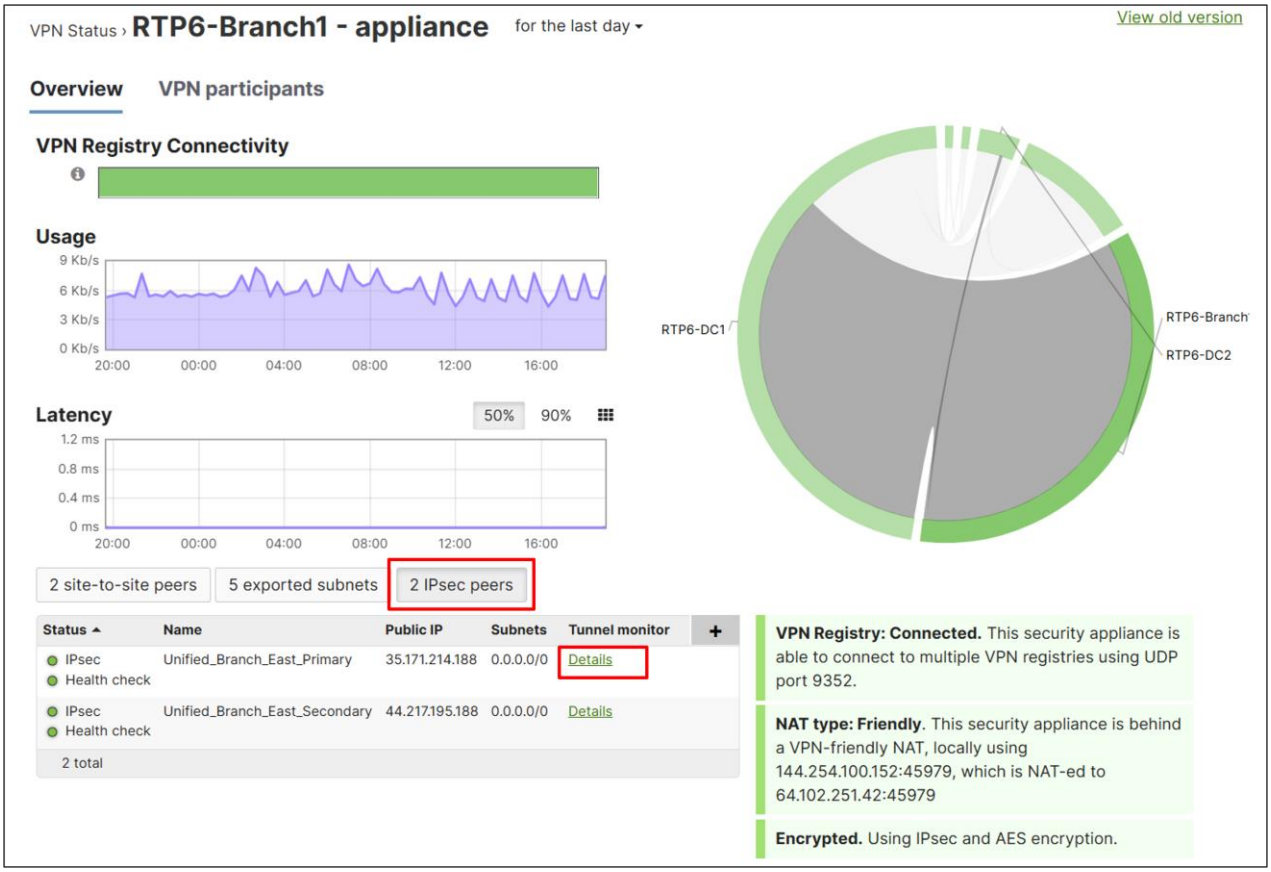


Procedure 75. To view IPsec tunnel status for Cisco Secure Access:

Step 1. Select the network and go to **Security & SD-WAN > Monitor > VPN Status**.

Step 2. Click the **IPsec peers** tab.

Step 3. Click **Details** for tunnel monitoring information.



Step 4. For security events and incidents, go to **Organization > Monitor > Security Center**, where MX events and XDR incidents can be viewed.

For more information, refer to the Meraki Security Center documentation.

Appendix A: Hardware and software versions used

Hardware	Software
2x MX105	MX 19.2.7
2x 9300-24P stack	IOX XE 17.15.5
2x 2900L-24P-4G	IOS XE 17.15.5
1x CW9172I	MR 31.1.8

Appendix B: Example deployment settings

These tables summarize the configurations used in this example deployment. If a setting is not mentioned, the default has been taken. Some of the example values may use default values.

Organization settings

On the dashboard under **Organization > Configure**

Main Menu	Section	Subsection	Values
Adaptive Policy	Groups	Name/SGT Value/Description	Finance_User_Group/10/Finance User Group Marketing_User_Group/20/Marketing User Group Finance_Server_Group/100/Finance Server Group Marketing_Server_Group/200/Marketing Server Group
Adaptive Policy	Networks	Networks/Enablement	RTP6-Branch3/Enabled RTP6-DC1/Enabled RTP6-DC2/Enabled
Adaptive Policy	Policies	Source/Dest/Permission	Unknown/Finance_User_Group/Allow Unknown/Marketing_User_Group/Allow Unknown/Finance_Server_Group/Allow Unknown/Marketing_Server_Group/Allow Infrastructure/Finance_User_Group/Allow Infrastructure/Marketing_User_Group/Allow Infrastructure/Finance_Server_Group/Allow Infrastructure/Marketing_Server_Group/Allow Finance_User_Group/Finance_User_Group/Allow Finance_User_Group/Marketing_User_Group/Allow Finance_User_Group/Finance_Server_Group/Allow Finance_User_Group/Marketing_Server_Group/Deny Finance_User_Group/Unknown/Allow Finance_User_Group/Infrastructure/Allow Marketing_User_Group/Finance_User_Group/Allow Marketing_User_Group/Marketing_User_Group/Allow Marketing_User_Group/Marketing_Server_Group/Allow Marketing_User_Group/Finance_Server_Group/Deny Marketing_User_Group/Unknown/Allow Marketing_User_Group/Infrastructure/Allow Finance_Server_Group/Finance_User_Group/Allow Finance_Server_Group/Finance_Server_Group/Allow Finance_Server_Group/Unknown/Allow

Main Menu	Section	Subsection	Values
			Finanace_Server_Group/Infrastructure/Allow Finance_Server_Group/Marketing_User_Group/Deny Finance_Server_Group/Marketing_Server_Group/Deny Marketing_Server_Group/Finance_User_Group/Deny Marketing_Server_Group/Finance_Server_Group/Deny Marketing_Server_Group/Marketing_User_Group/Allow Marketing_Server_Group/Marketing_Server_Group/Allow Marketing_Server_Group/Unknown/Allow Marketing_Server_Group/Infrastructure/Allow
Settings	SNMP	Version 2C Version 3 Authentication mode Authentication password Privacy mode Privacy password IP restrictions	SNMP V2C disable SNMP V3 enabled SHA <passphrase> AES128 <passphrase> <IP address>
Policy Objects	All objects	Corp SNMP Corp DNS-DHCP Corp Mgt Corp RADIUS	10.102.1.161 10.102.1.160 10.102.1.160 10.102.1.157
Policy Objects	All objects	DATA Subnet Default Subnet GUEST Subnet INFRA Subnet IOT Subnet PCI Subnet VOICE Subnet	10.10.0.0/16 192.168.128.0/24 172.16.99.0/24 10.250.0.0/16 10.30.0.0/16 10.40.0.0/16 10.20.0.0/16
Policy Objects	All objects	Branch 3 Printer 1 Branch 3 Printer 2	10.30.3.101 10.30.3.102
Policy Objects	Groups	Corp Shared Services Branch 3 Printers	Corp DNS-DHCP, CORP RADIUS, Corp Mgt, Corp SNMP Branch 3 Printer 1, Branch 3 Printer 2

Organization settings

On the dashboard under **Organization** > **Monitor**

Main Menu	Section	Subsection	Values
Overview	RTP6-Branch3	Tag	SSE_East

Network-side settings

On the dashboard under **Network-wide** > **Configure**

Main Menu	Section	Subsection	Values
General	General	Network name	RTP6-Branch3
General	General	Local time zone	America – New York (UTC -4.0, DST)
General	Device configuration	Local credentials	<Password>
General	Reporting	Syslog servers	10.102.1.160, port 514, Appliance Event log, Appliance Security events, Switch Event log, Wireless Air Marshal events, Wireless Event log
General	Reporting	SNMP access SNMP users Authentication Algorithm Privacy Mode	V3 (username/passwords) Username: snmpuser/Passphrase: <passphrase> SHA AES128
General	Reporting	Network traffic reporting NetFlow collector IP NetFlow collector port	Enabled: send netflow traffic statistics 10.102.1.160 2055
Alerts	Alerts Settings	Default recipients	snmp
Alerts	Alerts Settings	Network-wide WAN appliance	A rogue access point is detected Malware is downloaded
Alerts	SNMP traps	Access Users Receiving server IP Receiving server port	V3 (username/password) Username: snmpuser, Passphrase: <passphrase> <IP address> 162
Group policies	DATA	Adaptive Policy SGT	Do not assign SGT
Group policies	DATA	Wireless only/VLAN	Tag VLAN 10
Group policies	VOICE	Adaptive Policy SGT	Do not assign SGT
Group policies	VOICE	Wireless only/VLAN	Tag VLAN 20
Group policies	IOT	Adaptive Policy SGT	Do not assign SGT
Group policies	IOT	Wireless only/VLAN	Tag VLAN 30
Group policies	PCI	Adaptive Policy SGT	Do not assign SGT

Main Menu	Section	Subsection	Values
Group policies	PCI	Wireless only/VLAN	Tag VLAN 40

Cisco Secure Access settings

From the **https://sse.cisco.com** > **Connect** > **Essentials** > **Network Connections** > **Network Tunnel Groups** tab

Main Menu	Section	Subsection	Values
Network Tunnel Groups	General Settings	Tunnel Group Name Region Device Type	UnifiedBranchEast <Region> Meraki MX
	Tunnel ID and Passphrase	Tunnel ID Passphrase Confirm Passphrase	UnifiedBranchEast@<org><hub>.sse.cisco.com <Cisco Secure Access Passphrase> <Cisco Secure Access Passphrase>
	Routing	Network Address Translation (NAT)	Enable NAT/Outbound only

MX router settings

On the dashboard under **Security & SD-WAN** > **Monitor**

Main Menu	Section	Subsection	Values
Appliance Status	Summary	Appliance name (top left, edit mac address)	B3-MX1
		Address	<Location>
		SPARE (edit)	Uplink IPs: Use virtual uplink IPs WAN 1 shared IP (x.x.x.x) (unique IP address part of WAN 1 subnet) WAN 2 shared IP (x.x.x.x) (unique IP address part of WAN 2 subnet)
Spare Status	Summary	Appliance name (top left, edit mac address)	B3-MX2

On the dashboard under **Security & SD-WAN > Configure**

Main Menu	Section	Subsection	Values
Site-to-site VPN	Site-to-site VPN	Type	Spoke
Site-to-site VPN	Site-to-site VPN	Hubs	RTP6-DC1 RTP6-DC2
Site-to-site VPN	VPN settings	Peer SGT capable	Enabled
Site-to-site VPN	Organization-wide settings	IPsec Peers>Configure	• Health check: SSE • Endpoint: http://service.sig.umbrella.com

Main Menu	Section	Subsection	Values
		Health checks	
Site-to-site VPN	Organization-wide settings	IPsec Peers>Add a Peer	• Name: Unified_Branch_East_Primary • IKE version: IKEv2 • Peers>Public IP or Hostname: <Cisco Secure Access Primary IP> • Peers>Local ID: <Cisco Secure Access Primary Tunnel Group ID> • Peers>Shared secret: <Cisco Secure Access Passphrase> • Peers>Routing: Static • Peers>Private subnets: 0.0.0.0/0 • Peers>Availability: SSE_East • Multi-Uplink IPsec VPN: Enable • Tunnel monitoring>Health check: SSE • IPsec policy>Preset: Umbrella
Site-to-site VPN	Organization-wide settings	IPsec Peers>Unified_Branch_East_Primary>Add secondary peer	• Inherit primary peer configurations • Name: Unified_Branch_East_Secondary • Peers>Public IP or Hostname: <Cisco Secure Access Secondary IP> • Peers>Local ID: <Cisco Secure Access Secondary Tunnel Group ID>
Addressing & VLANs	Deployment Settings	Mode	Routed
Addressing & VLANs	Routing	LAN Setting	VLANs
Addressing & VLANs	Routing	Subnets	• 999, INFRA, 10.250.2.1/24, VPN mode = Enabled • 50, GUEST, 172.16.99.1/24, VPN mode = Disabled • 40, PCI, 10.40.2.1/24, VPN mode = Enabled • 30, IOT, 10.30.2.1/24, VPN mode = Enabled • 20, VOICE, 10.20.2.1/24, VPN mode = Enabled • 10, DATA, 10.10.2.1/24, VPN mode = Enabled • 1, Default, 192.168.128.1/24, VPN mode = Disabled
Addressing & VLANs	Routing	Per-port VLAN Settings	• Port 5 & 6 Enabled, Type Trunk, Native VLAN 1, Allowed VLANs = 1,10,20,30,40,50,999, Peer SGT Capable = Enabled, Adaptive policy – 2: Infrastructure (Predefined) • Ports 7-10 Disabled
DHCP	VLAN 1 (Default)	Client addressing Mandatory DHCP DNS nameservers	Run a DHCP server Enabled Use OpenDNS
DHCP	VLAN 10 (DATA)	Client addressing DHCP server IPs Mandatory DHCP	Relay DHCP to another server 10.102.1.160 10.102.1.161 Disabled
DHCP	VLAN 20 (VOICE)	Client addressing DHCP server IPs Mandatory DHCP	Relay DHCP to another server 10.102.1.160 10.102.1.161 Disabled

Main Menu	Section	Subsection	Values
DHCP	VLAN 30 (IOT)	Client addressing DHCP server IPs Mandatory DHCP	Relay DHCP to another server 10.102.1.160 10.102.1.161 Disabled
DHCP	VLAN 40 (PCI)	Client addressing DHCP server IPs Mandatory DHCP	Relay DHCP to another server 10.102.1.160 10.102.1.161 Disabled
DHCP	VLAN 50 (GUEST)	Client addressing Mandatory DHCP DNS nameservers	Run a DHCP server Enabled Use OpenDNS
DHCP	VLAN 999 (INFRA)	Client addressing Mandatory DHCP DNS nameservers Custom nameservers Fixed IP assignments	Run a DHCP server Disabled Specify nameservers 10.102.1.160 10.102.1.161 B3-DIST-SW-STACK1, 00:18:0a:4f:00:01, 10.250.3.11 B3-SW3, 68:d9:72:73:78:80, 10.250.3.101 B3-SW4, 68:d9:72:73:78:00, 10.250.3.102 B3-AP1, ac:69:cf:28:18:70, 10.250.3.21
Site-to-site VPN	Organization-wide settings	Site-to-site outbound firewall	• Shared Services: Allow prot:Any Src:[DATA Subnet, IOT Subnet, VOICE Subnet, INFRA Subnet, PCI Subnet] Any Dest:Corp Shared Services Any • Shared Services: Allow prot:Any Src:Corp Shared Services Any Dest:[DATA Subnet, IOT Subnet, VOICE Subnet, INFRA Subnet, PCI Subnet] Any • Data Access: Deny prot:Any Src:DATA Subnet Any Dest:[IOT Subnet, VOICE Subnet, INFRA Subnet, PCI Subnet] Any • IOT Access: Deny prot:Any Src:IOT Subnet Any Dest:[DATA Subnet, INFRA Subnet, VOICE Subnet, PCI Subnet] Any • Infra Access: Deny prot:Any Src:INFRA Subnet Any Dest:[DATA Subnet, IOT Subnet, VOICE Subnet, PCI Subnet] Any • Voice Access: Deny prot:Any Src:Voice Subnet Any Dest:[IOT Subnet, INFRA Subnet, DATA Subnet, PCI Subnet] Any • PCI Access: Deny prot:Any Src:PCI Subnet Any Dest:[DATA Subnet, IOT Subnet, VOICE Subnet, INFRA Subnet] Any • Default rule: Allow prot:Any Src:Any Any Dest:Any Any
Firewall	Layer 3	Outbound rules	• Local Print Access: Allow prot:Any Src:[DATA Subnet] Any Dest:[Branch 3 Printers] Any • Default (VLAN 1) Access: Deny prot:Any Src:Default Subnet Any Dest:[DATA Subnet, VOICE Subnet, IOT Subnet, PCI Subnet, GUEST Subnet, INFRA Subnet] Any • Data Access: Deny prot:Any Src:DATA Subnet Any Dest:[Default Subnet, VOICE Subnet, IOT Subnet, PCI Subnet, GUEST Subnet, INFRA Subnet] Any • IOT Access: Deny prot:Any Src:IOT Subnet Any Dest:[Default Subnet, DATA Subnet, VOICE Subnet, PCI Subnet, GUEST Subnet, INFRA Subnet] Any • Infra Access: Deny prot:Any Src:INFRA Subnet Any Dest:[Default

Main Menu	Section	Subsection	Values
			Subnet, DATA Subnet, VOICE Subnet, IOT Subnet, PCI Subnet, GUEST Subnet] Any • Voice Access: Deny prot:Any Src:Voice Subnet Any Dest:[Default Subnet, DATA Subnet, IOT Subnet, PCI Subnet, GUEST Subnet, INFRA Subnet] Any • PCI Access: Deny prot:Any Src:PCI Subnet Any Dest:[Default Subnet, DATA Subnet, VOICE Subnet, IOT Subnet, GUEST Subnet, INFRA Subnet] Any • Guest Access: Deny prot:Any Src:GUEST Subnet Any Dest:[Default Subnet, DATA Subnet, VOICE Subnet, IOT Subnet, PCI Subnet, INFRA Subnet] Any • Allow Direct Internet Access: Allow prot:Any Src:[INFRA Subnet, DATA Subnet, GUEST Subnet, Default Subnet] Any Dest:Any Any • Deny All: Deny prot:Any Src:Any Any Dest: Any Any • Default Rule: Allow prot:Any Src: Any Any Dest: Any Any
Firewall	Layer 3	WAN appliance services	ICMP Any, Web None, SNMP None
SD-WAN & traffic shaping	Uplink configuration	WAN 1	400 Mbps
SD-WAN & traffic shaping	Uplink configuration	WAN 2	500 up/500 down
SD-WAN & traffic shaping	Uplink selection	Load balancing	Disabled
SD-WAN & traffic shaping	Uplink selection	Multi-Uplink AutoVPN	Enabled
SD-WAN & traffic shaping	SD-WAN policies	Custom performance classes	• SaaS_Traffic, 150, 50, 5 • Critical_Apps, 150, 20. 2 • Default_SLA, (none), 100, 5
SD-WAN & traffic shaping	SD-WAN policies	Internet traffic	• Prefer WAN 2. Fail over if uplink down • 10.250.0.0/24:any to any:any
SD-WAN & traffic shaping	SD-WAN policies	Internet traffic	• Prefer WAN 2. Fail over if poor performance for SaaS_Trafic • 10.10.0.0/24 to Office 365 or Webex
SD-WAN & traffic shaping	SD-WAN policies	VPN traffic	• Prefer WAN 2. Fail over if poor performance for VoIP • All VoIP & Video conferencing
SD-WAN & traffic shaping	SD-WAN policies	VPN traffic	• Prefer WAN 2. Fail over if poor performance for “Critical_Apps” • TCP from Any to 10.102.1.161/32:443
SD-WAN & traffic shaping	SD-WAN policies	VPN traffic	• Prefer WAN 1. Fail over if poor performance for “Default_SLA” • Any to Any
SD-WAN & traffic shaping	Local internet breakout	VPN exclusion rules	• Office 365 Suite • Webex • Layer 3 udp from Any to 64.62.142.12/32 • Layer 3 Any from Any to 158.115.128.0/19 • Layer 3 Any from Any to 209.206.48.0 • Layer 3 Any from Any to 216.157.128.0/20

Main Menu	Section	Subsection	Values
SD-WAN & traffic shaping	Global bandwidth limits	Per-client limit	unlimited
SD-WAN & traffic shaping	Traffic shaping rules	Default Rules	Enable default traffic shaping rules
SD-WAN & traffic shaping	Traffic shaping rules	Rule #1	• Definition: localnet 172.16.99.0/24 • Bandwidth limit: Ignore network per-client limit (unlimited) • Priority: Low • DSCP tagging: 0 (CS0/DF – Best Effort/Default Forwarding)
SD-WAN & traffic shaping	Traffic shaping rules	Rule #2	• Definition: net/port 10.102.1.161/32 • Bandwidth limit: Ignore network per-client limit (unlimited) • Priority: High • DSCP tagging: 18 (AF21 – Low Latency Data, Low Drop)
Threat Protection	Advanced Malware Protection (AMP)	Mode	Enabled
Threat Protection	Intrusion detection and prevention	Mode Ruleset	Prevention Balanced
Content Filtering	Category blocking	Content categories	Adult, Hate Speech, Illegal Activities, Illegal Drugs, Pornography, Child Abuse Content, Illegal Downloads, Terrorism and Violent Extremism
Content Filtering	Category blocking	Threat categories	Malware Sites, Spyware and Adware, Phishing, Botnets, Spam, Exploits, High Risk Sites and Locations, Bogon, Ebanking Fraud, Indicators of Compromise (IOC), Domain Generated Algorithm, Open HTTP Proxy, Open Mail Relay, TOR exit Nodes, Newly Seen Domains, Cryptojacking, Linkshare, Malicious Sites
Content Filtering	URL filtering	Blocked URL list	www.example.com

Switch settings

On the dashboard under **Switching > Monitor**

Main Menu	Section	Subsection	Values
Switches (select one switch)	Summary	Switch name (top left, edit mac address)	B3-SW1, B3-SW2, B3-SW3. B3-SW4
		Address	<location>
Switch Stacks (select stack)	--	Stack name (top left, edit)	B3-DIST-SW-STACK1
Switch Ports (select all ports on switches which support less than	Switch Ports	All ports on switch	Type: Trunk Allowed VLANs: 1,10,20,30,40,50,999

Main Menu	Section	Subsection	Values
999 VLANs) (not needed in this example)			

On the dashboard under **Switching > Configure**

Main Menu	Section	Subsection	Values
Switch Settings	Switch settings	STP configuration	Enable Rapid Spanning Tree (RSTP): Enabled STP bridge priority: Switches/Stacks (B3-DIST-SW-STACK1), STP bridge priority: Bridge priority (4096) STP bridge priority: Switches/Stacks (B3-SW3, B3-SW4), STP bridge priority: Bridge priority (8192)
Switch Settings	Switch settings	Quality of service	VLAN: 50, Trust: Disabled, Set DSCP: 0 (default) VLAN 10, Trust: Enabled VLAN 20, Trust: Enabled VLAN 30, Trust: Enabled VLAN 40, Trust: Enabled
Switch Settings	Switch settings	Storm control	• Broadcast, 20% • Multicast, 30% • Unknown Unicast, 10%
Access Policies	Access Policies	Name Authentication method RADIUS servers RADIUS servers RADIUS servers RADIUS server Connection Options	Radius-MAB Radius server RADIUS Server testing RADIUS CoA support enabled Enable RADIUS accounting servers Host 10.102.1.157, secret <secret>, Auth enabled, Port 1812, Accounting enabled, Port 1813 Hybrid authentication, Multi-Auth, Both Voice auth enabled

On the dashboard under **Switching > Monitor**

Main Menu	Section	Subsection	Values
Switch Ports	Switch Ports	B3-SW1/1 B3-SW1/2 B3-SW2/1 B3-SW2/2	• Name: Uplink to Router • Port status: Enabled • Type: Trunk • Access Policy: Open • Native VLAN: 1 • Allowed VLANs: 1, 10,20,30,40,50,999 • Peer SGT capable: Enabled • Adaptive policy group: 2: Infrastructure • RSTP: Enabled • STP guard: Disabled

Main Menu	Section	Subsection	Values
			• UDLD: Alert only • PoE: Enabled • Storm control: Enabled
Switch Ports	Switch Ports	B3-SW1/3 B3-SW1/4 B3-SW1/5	• Name: INET1 • Port status: Enabled • Type: Access • Access Policy: Open • VLAN: 901 • RSTP: Enabled • STP guard: Disabled • UDLD: Alert only • PoE: Enabled • Storm control: Enabled
Switch Ports	Switch Ports	B3-SW2/3 B3-SW2/4 B3-SW2/5	• INET2 • Port status: Enabled • Type: Access • Access Policy: Open • VLAN: 902 • RSTP: Enabled • STP guard: Disabled • UDLD: Alert only • PoE: Enabled • Storm control: Enabled
Switch Ports	Switch Ports	B3-SW3/9	• Name: Link to AP • Port status: Enabled • Type: Trunk • Access Policy: Open • Native VLAN: 999 • Allowed VLANs: 1,10,20,30,40,50,999 • Peer SGT capable: Enabled • Adaptive policy group: 2: Infrastructure • RSTP: Enabled • STP guard: BPDU guard • UDLD: Alert only • PoE: Enabled • Storm control: Enabled
Switch Ports	Switch Ports	B3-SW1/9-10 B3-SW2/9-10	• Name: Link to Access Switch • Port status: Enabled • Type: Trunk • Access Policy: Open • Native VLAN: 1 • Allowed VLANs: 1,10,20,30,40,50,999 • Peer SGT capable: Enabled • Adaptive policy group: 2: Infrastructure

Main Menu	Section	Subsection	Values
			• RSTP: Enabled • STP guard: Disabled • UDLD: Alert only • PoE: Enabled • Storm control: Enabled
Switch Ports	Switch Ports	B3-SW3/1-2 B3-SW4/1-2	• Name: Uplink to Distribution Stack • Port status: Enabled • Type: Trunk • Access Policy: Open • Native VLAN: 1 • Allowed VLANs: 1,10,20,30,40,50,999 • Peer SGT capable: Enabled • Adaptive policy group: 2: Infrastructure • RSTP: Enabled • STP guard: Disabled • UDLD: Alert only • PoE: Enabled • Storm control: Enabled
Switch Ports	Switch Ports	B3-SW1/6-8,11-24 B3-SW2/6-8,11-24 B3-SW3/3-8,10-12 B3-SW4/3-12	• Name: Disabled • Port status: Disabled
Switch Ports	Switch Ports	B2-SW3/13-28 B2-SW4/13-28	• Name: Access Port • Port status: Enabled • Type: Access • Access Policy: RADIUS-MAB • VLAN: 10 • VOICE VLAN: 20 • RSTP: Enabled • STP guard: BPDU guard • UDLD: Alert only • PoE: Enabled • Storm control: Enabled
Switch Ports	Switch Ports	B3-SW3/1-2 B3-SW1/9, B3-SW2/9	Aggregate Aggregate
Switch Ports	Switch Ports	B3-SW4/1-2 B3-SW1/10, B3-SW2/10	Aggregate Aggregate

On the dashboard under **Switching > Configure**

Main Menu	Section	Subsection	Values
Switch Settings	Switch settings	VLAN configuration	999

Access Point settings

On the dashboard under **Wireless > Monitor**

Main Menu	Section	Subsection	Values
Access Points (select Access Point)	Summary	Access Point name (top left, edit mac address)	B2-AP1
		Address	<Location>

On the dashboard under **Wireless** > **Configure**

Main Menu	Section	Subsection	Values
Access Control	Basic info	SSID (name) (Unconfigured SSID 1)	BR3-GuestWiFi
Access Control	Security (Guest)		Open (no encryption)
Access Control	Security (Guest)	Mandatory DHCP	Enabled
Access Control	Splash page (Guest)		Click-through
Access Control	Client IP and VLAN (Guest)	External DHCP server assigned	Selected/Bridged
Access Control	Client IP and VLAN (Guest)	VLAN tagging	VLAN ID: Default AP tag, VLAN ID 50
Access Control>Splash page settings	Splash page (Guest)	Official themes	Modern
Access Control>Splash page settings	Customize your page (Guest)	Welcome message	Click to continue if you agree to the terms of usage of this guest service.
Access Control>Splash page settings	Splash behavior (Guest)	Splash frequency Where should users go after the splash page?	Every day The URL they were trying to fh
Access Control	Basic info	SSID (name) (Unconfigured SSID 5)	BR3-CorpWiFi
Access Control	Security (Corp)		Enterprise with my RADIUS server
Access Control	Security (Corp)	WPA encryption	WPA3 Transition Mode
Access Control	Security (Corp)	802.11w	Enabled (allow unsupported clients)
Access Control	Security (Corp)	Mandatory DHCP	Enabled
Access Control	Security (Corp)	Advanced WPA3 settings	WPA3 Cipher Suite: GCMP 256 enabled
Access Control	Splash Page (Corp)		None (direct access)

Main Menu	Section	Subsection	Values
Access Control	RADIUS (Corp)	RADIUS servers	10.102.1.157, 1812, <secret>
Access Control	RADIUS (Corp)	RADIUS accounting servers	10.102.1.157, 1813, <secret>
Access Control	RADIUS (Corp)	RADIUS CoA support	Disabled
Access Control	RADIUS (Corp)	RADIUS attribute specifying group policy name	Filter-Id
Access Control	Client IP and VLAN (Corp)	External DHCP server assigned RADIUS override	Selected/Bridged Override VLAN tag
Access Control	Client IP and VLAN (Corp)	VLAN tagging	VLAN ID: Default AP tag, VLAN ID 10
Access Control	Security (Corp)	802.11r	Enabled
Firewall & traffic shaping	Block IPs and ports (Guest)	Layer 2 LAN isolation	Enabled
Firewall & traffic shaping	Block IPs and ports (Guest)	Outbound rules	• Deny IPv4 Any Local LAN Any Wireless clients access LAN • Allow IPV4 Any Any Any Default rule
Firewall & traffic shaping	Traffic shaping rules (Guest)	Per-client bandwidth limit Enable SpeedBurst Per-SSID bandwidth limit Shape traffic Default Rules	50 Mbps Enabled 100 Mbps Shape traffic on this SSID Enable default traffic shaping rules
Firewall & traffic shaping	Block IPs and ports (Corp)	Outbound rules	• Allow IPv4 Any Local LAN Any Wireless clients access LAN • Allow IPV4 Any Any Any Default rule
Firewall & traffic shaping	Traffic shaping rules (Corp)	Per-client bandwidth limit Per-SSID bandwidth limit Shape traffic Default Rules	Unlimited Unlimited Shape traffic on this SSID Enable default traffic shaping rules
SSID Availability	SSID availability (all SSIDs)	Visibility Per access point availability Scheduled availability Schedule templates	Advertise this SSID publicly Enabled on all access points Enabled Custom schedule (Sun/Sat unavailable, M-F available 7:00-19:00)
Radio Settings	RRM	AI-RRM	Enable
Radio Settings	RF profiles	Basic Indoor Profile/Copy	Large Branch Profile

Main Menu	Section	Subsection	Values
Radio Settings	RF profiles (Small Branch Profile)	General/Band selection	Per SSID
Radio Settings	RF profiles (Small Branch Profile)	BR3-GuestWiFi BR3-CorpWiFi	2.4/5/Band steering Enabled 2.4/5/6/Band steering Enabled
Radio Settings	Overview	B3-AP1/Assign profile	Large Branch Profile

On the dashboard under **Security & SD-WAN > Configure**

Note: For some MS switch stack models (such as the MS150, but not the MS390), there may be an issue moving all switch members into VLAN 999. If this is the case, configure Native VLAN 999 on the MX trunk port as a workaround. If this workaround is implemented, the switch trunks to the APs must be moved back to VLAN 1.

Main Menu	Section	Subsection	Values
Addressing & VLANs	Routing	Per-port VLAN settings	Ports 5 and 6: Native VLAN 999
Switch Ports	Switch Ports	B3-SW3/9 (port to any APs)	Native VLAN: 1

Appendix C: ISE deployment settings

This table documents the ISE deployment settings for the example deployment:

Main Menu	Section	Subsection	Values
Administration	Groups	Endpoint Identity Groups	• MAB-IOT_Devices • MAB-VOICE_Devices • MAB-PCI_Devices
Administration	Groups	User Identity Groups	• Employee • Finance • Marketing • IOT • Voice • PCI
Policy	Policy Elements/Results	Authorization Profiles/DATA_VLAN	• Access Type = ACCESS_ACCEPT • Tunnel-Private-Group-ID = 1:10 • Tunnel-Type = 1:13 • Tunnel-Medium-Type = 1:6
Policy	Policy Elements/Results	Authorization Profiles/DATA-GP	• Access Type = ACCESS_ACCEPT • Filter-ID = DATA
Policy	Policy Elements/Results	Authorization Profiles/Voice_VLAN	• Access Type = ACCESS_ACCEPT • Tunnel-Private-Group-ID = 1:20 • Tunnel-Type = 1:13 • Tunnel-Medium-Type = 1:6 • cisco-av-pair = device-traffic-class=voice
Policy	Policy Elements/Results	Authorization Profiles/Voice-GP	• Access Type = ACCESS_ACCEPT • Filter-ID = VOICE
Policy	Policy Elements/Results	Authorization Profiles/IOT_VLAN	• Access Type = ACCESS_ACCEPT • Tunnel-Private-Group-ID = 1:30 • Tunnel-Type = 1:13 • Tunnel-Medium-Type = 1:6
Policy	Policy Elements/Results	Authorization Profiles/IOT-GP	• Access Type = ACCESS_ACCEPT • Filter-ID = IOT
Policy	Policy Elements/Results	Authorization Profiles/PCI_VLAN	• Access Type = ACCESS_ACCEPT • Tunnel-Private-Group-ID = 1:40 • Tunnel-Type = 1:13 • Tunnel-Medium-Type = 1:6
Policy	Policy Elements/Results	Authorization Profiles/PCI-GP	• Access Type = ACCESS_ACCEPT • Filter-ID = PCI
Policy	Policy Elements/Results	Authorization Profiles/Finance_SGT	• Access Type = ACCESS_ACCEPT • cisco-av-pair = cts:security-group-tag=000A-0
Policy	Policy Elements/Results	Authorization Profiles/Marketing_SGT	• Access Type = ACCESS_ACCEPT • cisco-av-pair = cts:security-group-tag=0014-0

Main Menu	Section	Subsection	Values
Policy	Policy Sets (Wired Access)	Conditions: Wired_802.1X or Wired_MAB	• Authentication Policy: ◦ Wired_MAB (Internal Endpoints) ◦ Default (All_User_ID_Stores) • Authorization Policy: ◦ IdentityGroup:Name = Endpoint Identity Groups:MAB-IOT_Devices or IdentityGroup:Name = User Identity Groups:IOT, Profile=IOT_VLAN ◦ IdentityGroup:Name = Endpoint Identity Groups:MAB-PCI_Devices or IdentityGroup:Name = User Identity Groups:PCI, Profile=PCI_VLAN ◦ IdentityGroup:Name = Endpoint Identity Groups:MAB-VOICE_Devices or IdentityGroup:Name = User Identity Groups:Voice, Profile=Voice_VLAN ◦ IdentityGroup:Name = Finance, Profile=DATA_VLAN, Finance_SGT ◦ IdentityGroup:Name = Marketing, Profile=DATA_VLAN, Marketing_SGT ◦ IdentityGroup:Name = Employee, Profile=DATA_VLAN
Policy	Policy Sets (Wireless Access)	Conditions: Wireless_802.1X	• Authentication Policy: ◦ Default (All_User_ID_Stores) • Authorization Policy: ◦ IdentityGroup:Name = User Identity Groups:IOT, Profile=IOT-GP ◦ IdentityGroup:Name = User Identity Groups:PCI, Profile=PCI-GP ◦ IdentityGroup:Name = User Identity Groups:Voice, Profile=Voice-GP ◦ IdentityGroup:Name = User Identity Groups:Finance, Profile=DATA-GP, Finance_SGT ◦ IdentityGroup:Name = User Identity Groups:Marketing, Profile=DATA-GP, Marketing_SGT ◦ IdentityGroup:Name = User Identity Groups:Employee, Profile=DATA-GP

Appendix D: References

- Unified Branch Solution Brief
- Unified Branch Design Guide (CVD)
- Unified Branch Small Branch Deployment Guide (CVD)
- Unified Branch Medium Branch Deployment Guide (CVD)
- Unified Branch Workflows Automation Toolkit
- Cisco Network as Code Website
- Branch as Code Github Repository
- From Fragmented to Future-ready with Unified Branch: Powering IT in the AI Era
- Cisco Unified Branch Product Page
- Meraki Documentation