Cisco DNA Center User Guide, Release 2.3.2

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

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CHAPTER 1

New and Changed Information

- New and Changed Information, on page 1

New and Changed Information

The following table summarizes the new and changed features and tells you where they are documented.

Table 1: New and Changed Features for Cisco DNA Center, Release 2.3.2

Feature	Description	Where Documented
3D Wireless Maps Enhancements	Enhancements to 3D wireless maps include: • Search and locator capability. • Enhanced Drop a Pin functionality that includes highlighting active arrows for ease of selection and movement. • Display improvements, such as keeping measurements in your field of view when resizing or changing the map display. • Ability to display multiple floors and their APs and define whether to include the APs in the heat map computation.	View a 3D Wireless Map, on page 158
Network Profiles for Assurance	You can configure issue settings in an Assurance network profile and apply the profile to a site or group of sites independently from the global issues settings. You can enable or disable an issue, and you can change its priority.	Create Network Profiles for Assurance, on page 225
Install Hosted Application on Switches Workflow Enhancements	You can view the configuration template before deploying an application on switches.	Install an Application on a Cisco Catalyst 9300 Device, on page 501
Device Pack Support for Legacy Devices	You can display the device pack support for legacy devices. In the **Provision** > **Network Devices** > **Inventory** window, the **Support Type** for legacy devices is shown as **Limited**.	Display Information About Your Inventory, on page 65

Feature	Description	Where Documented
Remote Teleworker Site	You can use Cisco DNA Center to configure remote teleworker sites. Remote teleworker sites provide a more secure connection, proper application prioritization, and a simple installation and onboarding experience for remote workers.	Remote Teleworker Deployment Overview, on page 431 Create a Remote Teleworker Site, on page 432
Network Bug Identifier Tool	The Network Bug Identifier Tool GUI has been enhanced due to integration improvements between the Network Bug Identifier Tool and the CX Cloud. The GUI no longer shows the number of affected routers, switches, and hubs in the summary pane at the top of the results window. Instead, the GUI shows the scan mode, either **Essential** using the Cisco Machine Reasoning Engine (MRE) or **CX Cloud**. The results table also shows the scan status for each device.	Scan the Network for Bugs, on page 645
Display Information About Your Inventory	You can display the following inventory details in the **Inventory** > **Provision** table: • **AP Ethernet Mac Address**: The Ethernet MAC address of an AP. • **AP CDP Neighbors**: Switch and port connected to an access point. This information is displayed even if the connected access switch is not managed by Cisco DNA Center.	Display Information About Your Inventory, on page 65
Schedule Maintenance for Devices	You can place devices into maintenance mode in Cisco DNA Center. If a device is in maintenance mode, Cisco DNA Center does not process any telemetry data associated with the device. By placing faulty devices into maintenance mode, you can avoid receiving unnecessary alerts from these devices.	Schedule Maintenance for Devices, on page 94
Learn Device Configuration from Existing Devices	Cisco DNA Center can learn configurations from devices, such as Cisco Wireless Controllers, in an existing deployment and save the configurations at the global level.	Learn Device Configurations from Brownfield Devices, on page 678
Supplicant-Based Extended Node	You can onboard supplicant-based extended nodes by configuring an authenticator port on the fabric edge with a Closed Authentication Template. Only specific platforms support supplicant-based extended node onboarding.	Configure Supplicant-Based Extended Nodes, on page 470
Bridge-Mode Virtual Machine in a Fabric-Enabled Wireless Network	You can configure a wireless IP address pool with **Bridge Mode VM** enabled to authenticate and profile wireless bridge-mode virtual machines.	Create Anycast Gateways, on page 460

Feature	Description	Where Documented
Resilient Ethernet Protocol (REP) Ring Topology Support for Extended Nodes	You can create a REP ring of extended node devices or policy extended node devices.	Configure a REP Ring Topology for Extended Nodes and Policy Extended Nodes, on page 467
Flow Count Details and Policy Enforcement Statistics	You can view additional details about scalable groups: • You can view the number of flows detected for a particular service, port, and protocol combination for a selected time period. The **Flow Count** column in the **View Contract** window displays this information. You can click the flow count link to view the flow details for each endpoint. To launch the **View Contract** window, from the **Explore Scalable Groups** window, click **View Contract**. • You can view a time-series graph of permit and deny counts for any source and destination group pair. In the **Explore Scalable Groups** window, click the **View Policy Enforcement Stats** option. You can use the **All Packets** drop-down list to select only the permitted or dropped packets.	Explore Groups and Endpoints, on page 539
Enable Application Telemetry for Wireless Controllers	When you enable Application Telemetry for a device, you can now select the SSID type. Available SSID types are **Local** and **Flex/Fabric**. You can also select **Guest SSID**.	Enable Application Telemetry for Wireless Controllers, on page 27
Artificial Intelligence (AI) Radio Frequency (RF) Profile	You can create, edit, delete, configure, assign, and unassign an AI RF profile. An AI RF profile allows you to define the behavior of an RF network within a building that is enabled with enhanced Radio Resource Management (RRM). You can also upgrade a basic RF profile to an AI RF profile.	Configure Network Settings, on page 171
Create an Event Notification	You can use the Cisco DNA Center event notification to associate multiple channels inside one notification. The notification delivers the details of selected events that occur at multiple points.	Create an Event Notification, on page 685

Feature	**Description**	**Where Documented**
Default Home Page	The default home page includes the following enhancements: - **Remote Support Authorization**: You can grant remote access to a Cisco specialist to access Cisco DNA Center and troubleshoot your network. - **Keyboard Shortcuts**: You can view keyboard shortcut names, shortcut keys, and shortcut key combinations for shortcut groups.	Default Home Page, on page 13
Create Remote Support Authorization	You can create a remote support authorization to grant remote access to a Cisco specialist for troubleshooting your network.	Create a Remote Support Authorization, on page 684
Remote Support Authorization Dashboard	You can create, cancel, and view past authorizations along with total, scheduled, and completed remote support authorizations. **Note** In this release, the Cisco DNA Center remote support authorization is supported with only LM Console version 0.40.5.	View the Remote Support Authorization Dashboard, on page 17
Return Material Authorization (RMA) support for new device	RMA support is extended for devices with Classic and Policy Extended nodes.	Replace a Faulty Device, on page 105

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

PART I

Get Started

- Get Started with Cisco DNA Center, on page 7
- Configure Telemetry, on page 23

CHAPTER 2

Get Started with Cisco DNA Center

- Cisco DNA Center Overview, on page 7
- Log In, on page 7
- Complete the Quick Start Workflow, on page 8
- Default Home Page, on page 13
- Use Global Search, on page 18
- Enable Localization, on page 19

Cisco DNA Center Overview

Cisco Digital Network Architecture offers centralized, intuitive management that makes it fast and easy to design, provision, and apply policies across your network environment. The Cisco DNA Center GUI provides end-to-end network visibility and uses network insights to optimize network performance and deliver the best user and application experience.

Log In

Access Cisco DNA Center by entering its network IP address in your browser. For compatible browsers, see the Cisco DNA Center Release Notes. This IP address connects to the external network and is configured during the Cisco DNA Center installation. For more information about installing and configuring Cisco DNA Center, see the Cisco DNA Center Installation Guide.

You should continuously use Cisco DNA Center to remain logged in. If you are inactive for too long, Cisco DNA Center logs you out of your session automatically.

Step 1 Enter an address in your web browser's address bar in the following format. Here, *server-ip* is the IP address (or the hostname) of the server on which you have installed Cisco DNA Center:

https://*server-ip*

Example: https://192.0.2.1

Depending on your network configuration, you might have to update your browser to trust the Cisco DNA Center server security certificate. Doing so will help ensure the security of the connection between your client and Cisco DNA Center.

Step 2 Enter the Cisco DNA Center username and password assigned to you by the system administrator. Cisco DNA Center displays its home page.

If your user ID has the SUPER-ADMIN-ROLE and no other user with the same role has logged in before, you will see a first-time setup wizard instead of the home page.

Step 3 To log out, click the menu icon (☰) and choose **Sign Out**.

Complete the Quick Start Workflow

After you have installed and configured the Cisco DNA Center appliance, you can log in to its GUI. Use a compatible, HTTPS-enabled browser when accessing Cisco DNA Center.

When you log in for the first time as the admin superuser (with the username `admin` and the SUPER-ADMIN-ROLE assigned), the Quick Start workflow automatically starts. Complete this workflow to discover the devices that Cisco DNA Center will manage and enable the collection of telemetry from those devices.

Before you begin

To log in to Cisco DNA Center and complete the Quick Start workflow, you will need:

- The *admin* superuser username and password that you specified while completing one of the following procedures in the Cisco DNA Center Second-Generation Appliance Installation Guide:
  - Configure the Primary Node Using the Maglev Wizard
  - Configure an Appliance Using the Install Configuration Wizard (44- or 56-core appliance)
  - Configure an Appliance Using the Install Configuration Wizard (112-core appliance)
  - Configure the Primary Node Using the Advanced Install Configuration Wizard (44- or 56-core appliance)
  - Configure the Primary Node Using the Advanced Install Configuration Wizard (112-core appliance)
- The information described in the installation guide's Required First-Time Setup Information topic.

Step 1 After the Cisco DNA Center appliance reboot is completed, launch your browser.

Step 2 Enter the host IP address to access the Cisco DNA Center GUI, using **`HTTPS://`** and the IP address of the Cisco DNA Center GUI that was displayed at the end of the configuration process.

After entering the IP address, one of the following messages appears (depending on the browser you are using):

- Google Chrome: `Your connection is not private`
- Mozilla Firefox: `Warning: Potential Security Risk Ahead`

Step 3 Ignore the message and click **Advanced**.

One of the following messages appears:

- Google Chrome:

```
This server could not prove that it is GUI-IP-address; its security certificate is not trusted
by your computer's
 operating system. This may be caused by a misconfiguration or an attacker intercepting your
connection.
```

- Mozilla Firefox:

```
Someone could be trying to impersonate the site and you should not continue.

Websites prove their identity via certificates. Firefox does not trust GUI-IP-address because
its certificate issuer is unknown,
the certificate is self-signed, or the server is not sending the correct intermediate certificates.
```

These messages appear because the controller uses a self-signed certificate. For information on how Cisco DNA Center uses certificates, see the "Certificate and Private Key Support" section in the Cisco DNA Center Administrator Guide.

Step 4 Ignore the message and do one of the following:

- Google Chrome: Click the **Proceed to** *GUI-IP-address* **(unsafe)** link.
- Mozilla Firefox: Click **Accept the Risk and Continue**.

The Cisco DNA Center login screen appears.

Step 5 Do one of the following and then click **Log In**:

- If you completed the Maglev configuration wizard and chose the **Start using DNAC pre manufactured cluster** option, enter the admin's username (**admin**) and password (**maglev1@3**).
- If you completed the Maglev configuration wizard and chose the **Start configuration of DNAC in advanced mode** option, enter the admin's username (**admin**) and password that you set when you configured your Cisco DNA Center appliance.
- If you completed the Install configuration wizard, enter the admin's username (**admin**) and paste the password (**maglev1@3**) that you copied from the wizard's final screen.
- If you completed the Advanced Install configuration wizard, enter the admin's username (**admin**) and password that you set when you configured your Cisco DNA Center appliance.

In the next screen, you are prompted to specify a new admin password (as a security measure).

Step 6 Do one of the following:

- If you don't want to change the admin password at this time, click **Skip**.
- To set a new admin password:
  a. Enter the same password that you specified in Step 5.
  b. Enter and confirm a new admin password.
  c. Click **Next**.

Step 7 Enter your cisco.com username and password (which are used to register software downloads and receive system communications) and then click **Next**.

Note If you don't want to enter these credentials at this time, click **Skip** instead.

The **Terms & Conditions** screen opens, providing links to the software End User License Agreement (EULA) and any supplemental terms that are currently available.

Step 8 After reviewing these documents, click **Next** to accept the EULA.

The **Quick Start Overview** slider opens. Click > to view a description of the tasks that the Quick Start workflow will help you complete in order to start using Cisco DNA Center.

Step 9 Complete the Quick Start workflow:

a) Click **Let's Do it**.

b) In the **Discover Devices: Provide IP Ranges** screen, enter the following information and then click **Next**:

- The name for the device discovery job.
- The IP address ranges of the devices you want to discover. Click + to enter additional ranges.
- Specify whether you want to designate your appliance's loopback address as its preferred management IP address. For more information, see the "Preferred Management IP Address" topic in the Cisco DNA Center User Guide.

c) In the **Discover Devices: Provide Credentials** screen, enter the information described in the following table for the type of credentials you want to configure and then click **Next**:

Field	**Description**
CLI (SSH) Credentials	
Username	Username used to log in to the CLI of the devices in your network.
Password	Password used to log in to the CLI of the devices in your network.
Name/Description	Name or description of the CLI credentials.
Enable Password	Password used to enable a higher privilege level in the CLI. Configure this password only if your network devices require it.
SNMP Credentials: SNMPv2c Read tab	
Name/Description	Name or description of the SNMPv2c read community string.
Community String	Read-only community string password used only to view SNMP information on the device.
SNMP Credentials: SNMPv2c Write tab	
Name/Description	Name or description of the SNMPv2c write community string.
Community String	Write community string used to make changes to the SNMP information on the device.
SNMP Credentials: SNMPv3	
Name/Description	Name or description of the SNMPv3 credentials.
Username	Username associated with the SNMPv3 credentials.

Field	Description
Mode	Security level that SNMP messages require: • **No Authentication, No Privacy** (noAuthnoPriv): Does not provide authentication or encryption. • **Authentication, No Privacy** (authNoPriv): Provides authentication, but does not provide encryption. • **Authentication and Privacy** (authPriv): Provides both authentication and encryption.
Authentication Password	Password required to gain access to information from devices that use SNMPv3. The password must be at least eight characters in length. Note the following points: • Some wireless controllers require that passwords be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.
Authentication Type	Hash-based Message Authentication Code (HMAC) type used when either **Authentication and Privacy** or **Authentication, No Privacy** is set as the authentication mode: • **SHA**: HMAC-SHA authentication. • **MD5**: HMAC-MD5 authentication.
Privacy Type	Privacy type used when **Authentication and Privacy** is set as the authentication mode. Choose one of the following privacy types: • **AES128**: 128-bit CBC mode AES for encryption. • **AES192**: 192-bit CBC mode AES for encryption. • **AES256**: 256-bit CBC mode AES for encryption. **Note** • Discovery and Inventory features support only AES192 and AES256 privacy types. • Cisco DNA Assurance does not support any of these privacy types.

Field	Description
Privacy Password	SNMPv3 privacy password that is used to generate the secret key for encrypting messages are exchanged with devices supported with AES128, AES192, and AES256 encryption standards. Passwords (or passphrases) must be at least eight characters long. Note the following points: • Some wireless controllers require that passwords be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.
NETCONF	
Port	The NETCONF port that Cisco DNA Center should use in order to discover wireless controllers that run Cisco IOS-XE.

d) In the **Create Site** screen, group the devices you are going to discover into one site in order to facilitate telemetry and then click **Next**.

   You can enter the site's information manually or click the location you want to use in the provided map.

e) In the **Enable Telemetry** screen, check the network components that you want Cisco DNA Center to collect telemetry for and then click **Next**.

f) In the **Summary** screen, review the settings that you have entered and then do one of the following:

   - If you want to make changes, click the appropriate **Edit** link to open the relevant screen.
   - If you're happy with the settings, click **Start Discovery and Telemetry**. Cisco DNA Center validates your settings to ensure that they will not result in any issues. After validation is complete, the screen updates.

     Cisco DNA Center begins the process of discovering your network's devices and enabling telemetry for the network components you selected. The process will take a minimum of 30 minutes (more for larger networks).

     A message appears at the top of the homepage to indicate when the Quick Start workflow has completed.

g) Do one of the following:

   - Click **View Discovery** to open the **Discovery** page and confirm that the devices in your network have been discovered.
   - Click the **Go to Network Settings** link to open the **Device Credentials** page. From here, you can verify that the credentials you entered previously have been configured for your site.
   - Click the **View Activity Page** link to open the **Tasks** page and view any tasks (such as a weekly scan of the network for security advisories) that Cisco DNA Center has already scheduled to run.
   - Click the **Workflow Home** link to access guided workflows that will help you set up and maintain your network.

Default Home Page

After you log in, Cisco DNA Center displays its home page. The home page has the following main areas: **Assurance Summary**, **Network Snapshot**, **Network Configuration**, and **Tools**.

Note By default, the login name you provided is displayed in the Welcome text. To change the name, click the name link; for example, **admin**. You are taken to the **User Management** window, where you can edit the display name.

Assurance Summary

This area includes:

- **Health**: Provides the health score of your overall enterprise, which includes network devices, wired clients, and wireless clients. Clicking **View Details** takes you to the **Overall Health** window.
- **Critical Issues**: Provides the count of P1 and P2 issues. Clicking **View Details** takes you to the **Open Issues** window.
  - **P1**: Critical issues that need immediate attention before they cause a wider impact on network operations.
  - **P2**: Major issues that can potentially impact multiple devices or clients.
- **Trends and Insights**: Provides insights about the performance of your network. Clicking **View Details** takes you to the **Network Insights** window.

Network Snapshot

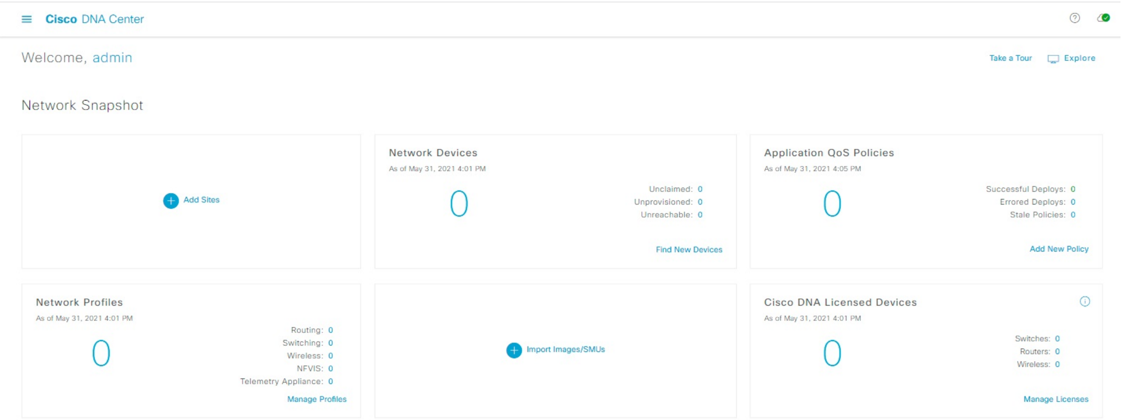
This area includes:

- **Sites**: Provides the number of sites discovered on your network along with the number of DNS and NTP servers. Clicking **Add Sites** takes you to the **Add Site** window.
- **Network Devices**: Provides the number of network devices discovered on your network along with the number of unclaimed, unprovisioned, and unreachable devices. Clicking **Find New Devices** takes you to the **New Discovery** window.
- **Application Policies**: Provides the number of application policies discovered on your network along with the number of successful and errored deployments. Clicking **Add New Policy** takes you to the **Application Policies** window.
- **Network Profiles**: Provides the number of profiles discovered on your network. Clicking **Manage Profiles** takes you to the **Network Profiles** window.
- **Images**: Provides the number of images discovered on your network along with the number of untagged and unverified images. Clicking **Import Images/SMUs** takes you to the **Image Repository** window.
- **Licensed Devices**: Provides the number of devices that have a Cisco DNA Center license along with the number of switches, routers, and access points. Clicking **Manage Licenses** takes you to the **License Management** window.

Tools

Use the **Tools** area to configure and manage your network.

Figure 1: Cisco DNA Center Home Page


Cisco DNA Center
Take a Tour
Explore
Network Snapshot
Add Sites
Network Devices
Find New Devices
Application QoS Policies
Add New Policy
Network Profiles
Manage Profiles
Import Images/SMUs
Cisco DNA Licensed Devices
Manage Licenses

Welcome, admin

Network Devices: As of May 31, 2021 4:01 PM: 0
Unclaimed: 0
Unprovisioned: 0
Unreachable: 0

Application QoS Policies: As of May 31, 2021 4:05 PM: 0
Successful Deploys: 0
Errored Deploys: 0
Stale Policies: 0

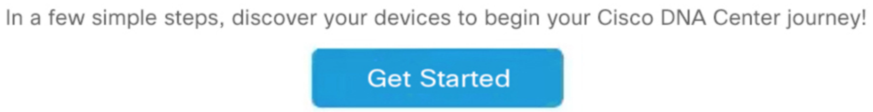
Network Profiles: As of May 31, 2021 4:01 PM: 0
Routing: 0
Switching: 0
Wireless: 0
NFVIS: 0
Telemetry Appliance: 0

Cisco DNA Licensed Devices: As of May 31, 2021 4:01 PM: 0
Switches: 0
Routers: 0
Wireless: 0

Different Views of Home Page

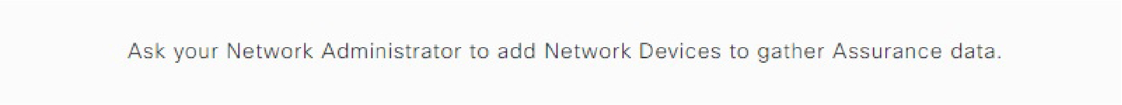
The home page can vary depending factors such as the different stages of Cisco DNA Center and what role is used to log in:

- **Getting Started**: When you log in to Cisco DNA Center for the first time as a Network Administrator or System Administrator, or when there are no devices in the system, you see the following dashlet. Click **Get Started** and complete the getting started workflow to discover new devices in your network.

  
  Get Started

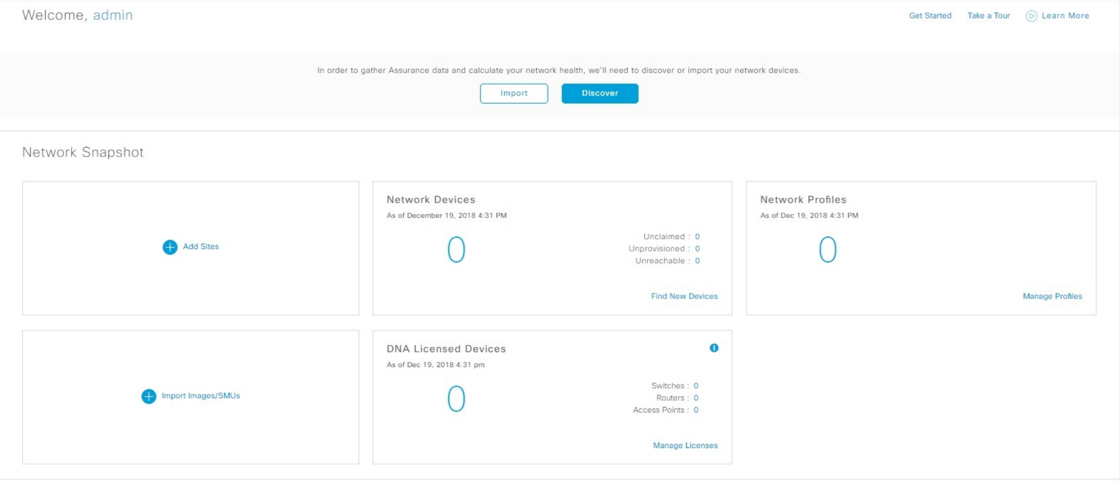
  In a few simple steps, discover your devices to begin your Cisco DNA Center journey!

  When you log in to Cisco DNA Center for the first time as an Observer, you see the following message:

  Ask your Network Administrator to add Network Devices to gather Assurance data.

- **Day 0 Home Page**: If you skipped getting started, or when there are no devices in the system, you see the following home page.


Get Started
Take a Tour
Learn More
Import
Discover
Add Sites
Import Images/SMUs
Find New Devices
Manage Profiles
Manage Licenses

Welcome, admin

In order to gather Assurance data and calculate your network health, we'll need to discover or import your network devices.

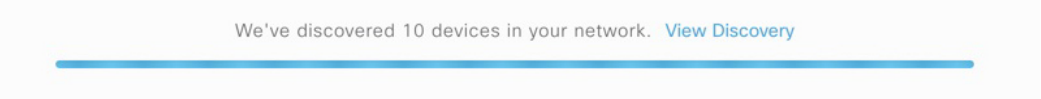
Network Snapshot

Network Devices
As of December 19, 2018 4:31 PM
0
Unclaimed : 0
Unprovisioned : 0
Unreachable : 0

Network Profiles
As of Dec 19, 2018 4:31 PM
0

DNA Licensed Devices
As of Dec 19, 2018 4:31 pm
0
Switches : 0
Routers : 0
Access Points : 0

When discovery is in progress, you see a progress message with a link to the **Discovery** window.



We've discovered 10 devices in your network. View Discovery

When there are devices in the system, you see a network snapshot of discovered devices.

Menu Bar

Click the menu icon (☰) at the left of the menu bar to access the following menu items:

- Design
- Policy
- Provision
- Assurance
- Workflows
- Tools
- Platform
- Activities
- Reports
- System
- Explore

Icons

Click the icons at the right of the menu bar to perform common tasks:

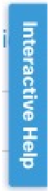
Icon	Description
🔍	**Search**: Search for devices, users, hosts, menus, and other items that are stored anywhere in the Cisco DNA Center database.
?	**Help** • **About**: Display the current Cisco DNA Center software version. Click **Release Notes** to launch the release notes in a separate browser tab. Click **Packages** to view the system and application package versions. Click **Serial number** to view the serial number of the Cisco DNA Center appliance. • **API Reference**: Open the Cisco DNA Center platform API documentation in Cisco DevNet. • **Developer Resources**: Open Cisco DevNet, where you can access developer tools. • **Contact Support**: Open a support case with the Cisco Technical Assistance Center (TAC). • **Remote Support Authorization**: Grant remote access to a Cisco specialist to access Cisco DNA Center for troubleshooting your network. For more information, see View the Remote Support Authorization Dashboard, on page 17. • **Help**: Launch context-sensitive online help in a separate browser tab. • **Keyboard Shortcuts**: Display the keyboard shortcut names, shortcut keys, and shortcut key combinations for shortcut groups. The supported shortcut groups are **Global**, **Geo Maps**, and **Topology**. • **Make a Wish**: Submit your comments and suggestions to the Cisco DNA Center product team.
☁✓	**Software Updates**: See a list of available software updates. Click the **Go to Software Updates** link to view system and application updates.
🔔	**Notifications**: View event notifications and set notification preferences. A red circle by the notification icon indicates that there are new notifications.

Interactive Help

Interactive Help contains walkthroughs for specific tasks in Cisco DNA Center. The walkthroughs provide onscreen guidance to help you complete the task.

The **Interactive Help** widget appears by default at the bottom-right corner of the Cisco DNA Center window. Click the widget to open the **Interactive Help** menu.

Figure 2: Interactive Help Widget



You can also move the **Interactive Help** widget from the default location to other locations. Drag and drop the widget to the possible locations, which are indicated by green dotted-line rectangles.

View the Remote Support Authorization Dashboard

Remote support authorization allows you to grant remote access to a Cisco specialist to access Cisco DNA Center for troubleshooting your network.

Note The Cisco DNA Center remote support authorization is supported with only LM Console version 0.40.5.

Step 1 In the Cisco DNA Center GUI, click the help icon in the top-right corner and choose **Remote Support Authorization**.

In the **Remote Support Authorization** dashboard, the **SUMMARY** area shows the total, scheduled, and completed remote support authorizations.

Step 2 Click the **Create New Authorization** tab to create a new authorization. For more information, see Create a Remote Support Authorization, on page 684.

Step 3 Click the **Current Authorization** tab to view the current remote support authorization tiles.

Current Authorization shows the remote support authorization status:

- **All**: Displays all the scheduled and active remote support authorizations.
- **Scheduled**: Displays the scheduled remote support authorizations.
- **Active**: Displays the active remote support authorizations.

The support authorization tile shows the schedule and duration of Cisco specialist access to Cisco DNA Center for troubleshooting purposes.

Step 4 If you want to cancel an authorization, click the **Cancel Authorization** link in the respective support authorization tile.

Step 5 Click **View Logs** to navigate to **Audit Logs** window, which lists the remote support authorization logs.

For more information, see **View Audit Logs** in the *Cisco DNA Center Administrator Guide*.

Step 6 Click the **Past Authorizations** tab to view the past authorizations.

The **Past Authorizations** table shows the support authorization based on **Cisco Specialist**, **Happened On**, **Session Status**, and **Log** and lists the following past authorizations status:

- **All**: Lists all the expired and canceled remote support authorizations.
- **Expired**: Lists all the expired remote support authorizations.

- **Canceled**: Lists all the canceled remote support authorizations.

In the **Remote Support Authorization** dashboard, the CX Cloud service connectivity status is shown:

- A green check mark in the top-right corner indicates that the remote support authorization is connected to the CX Cloud service.
- An exclamation point in the top-right corner indicates that the remote support authorization is not connected to the CX Cloud service.

Use Global Search

Use the global Search function to find items in the following categories anywhere in Cisco DNA Center:

- **Activities**: Search for Cisco DNA Center menu items, workflows, and features by name.
- **Applications**: Search for them by name.
- **Application Groups**: Search for them by name.
- **Authentication template**: Search for them by name or type.
- **Devices**: Search for them by collection status, reachability status, location, or tag.
- **Fabric**: Search by fabric name.
- **Help**: Search for topics that include your search string.
- **Hosts and Endpoints**: Search for them by name, IP address, or MAC address.
- **IP Pools**: Search for them by name or IP address.
- **Network Devices**: Search for them by name, IP address, serial number, software version, platform, product family, or MAC address.
- **Network Profiles**: Search by profile name.
- **Network Settings**
    - **Device Credentials**: Search by name.
    - **IP Address Pools**: Search for them by group name or pool CIDR.
    - **Service Provider Profiles**: Search for them by profile name, WAN provider, or model.
- **Policy**: Search for them by name or description.
- **Sites**: Search for them by name.
- **Traffic copy**: Search for them by name and description.
- **Transits**: Search by transit name.
- **Users**: Search for the system settings and users by username. Case-insensitivity and substring search are not supported for usernames.

- Other items, as new versions of Cisco DNA Center are released.

To start a global Search, click the 🔍 icon in the top-right corner of any Cisco DNA Center page. Cisco DNA Center displays a global search window, with a Search field where you can begin entering identifying information about an item.

You can enter all or part of the item's name, address, serial number, or other identifying information. The Search field is case-insensitive and can contain any character or combination of characters.

As you begin entering your search string, Cisco DNA Center displays a list of possible search targets that match your entry. If more than one category of item matches your search string, Cisco DNA Center sorts them by category, with a maximum of five items in each category. The first item in the first category is selected automatically, and summary information for that item appears in the summary panel on the right.

You can scroll the list as needed, and click any of the suggested search targets to see information for that item in the summary panel. If there are more than five items in a category, click **View All** next to the category name. To return to the categorized list from the complete list of search targets, click **Go Back**.

As you add more characters to the search string, global Search automatically narrows the displayed list.

Cisco DNA Center allows you to search for a device using its entire IPv6 address or any abbreviated form of the IPv6 address.

For example, to search for *2001:0db8:85a3:0000:0000:8a2e:0370:7334*, you can use the following search entries:

- `2001:0db8:85a3:0000:0000:8a2e:0370:7334` (using the full IPv6 address)
- `2001:db8:85a3:0:0:8a2e:0:7334` (truncating leading zeros)
- `2001:db8:85a3::8a2e:0:7334` (compressing consecutive zeros with a double colon)
- `2001:db8:85a3` (using a portion of the IPv6 address)

Cisco DNA Center allows you to search for an IPv6 address by using the double colon in the IPv6 address with prefix, postfix, or any combination.

For example, to search for *2001:db8:85a3::8a2e:0:7334*, you can use the following search entries:

- `::` (using double colon alone)
- `85a3::8a2e` (using prefix and postfix with double colon)
- `85a3::` (using prefix with double colon)
- `::8a2e` (using postfix with double colon)

You can search for devices in Cisco DNA Center by entering their MAC addresses in any format (with a hyphen or colon).

When you are finished, click ✖ to close the window.

Global search can display five results per category at a time.

Enable Localization

You can view the Cisco DNA Center GUI screens in English (the default), Chinese, Japanese, or Korean.

To change the default language, perform the following task:

Step 1 In your browser, change the locale to one of the supported languages: Chinese, Japanese, or Korean.

- From Google Chrome, do the following:

  a. Click the ⋮ icon in the top-right corner, and then choose **Settings**.

  b. Scroll down and click **Advanced**.

  c. From the **Languages** > **Language** drop-down list, choose **Add languages**.

  The **Add languages** pop-up window appears.

  d. Choose **Chinese**, **Japanese**, or **Korean**, and then click **Add**.

- From Mozilla Firefox, do the following:

  a. Click the ≡ icon in the top-right corner, and then choose **Options**.

  b. From the **Language and Appearance** > **Language** area, choose **Search for more languages**.

  The **Firefox Language Settings** pop-up window appears.

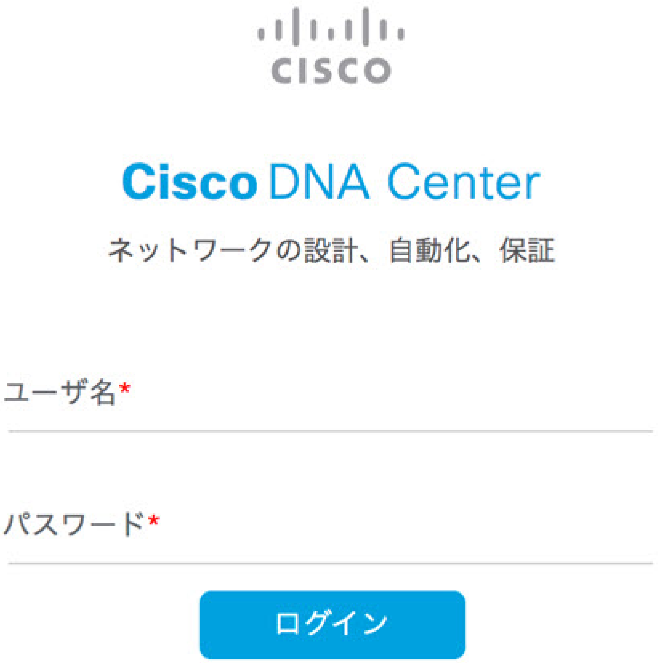
  c. From the **Select a language to add** drop-down list, choose **Chinese**, **Japanese**, or **Korean**.

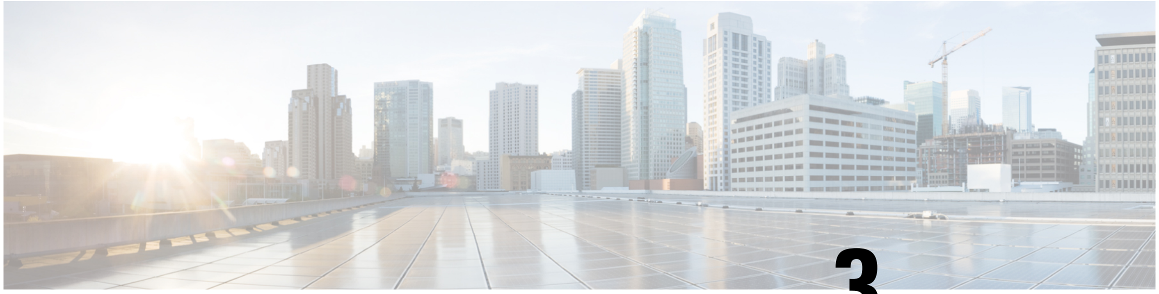
  d. Click **Ok**.

Step 2 Log in to Cisco DNA Center.

The GUI screens are shown in the selected language.

Figure 3: Example Localized Login Screen


Cisco DNA Center
ネットワークの設計、自動化、保証
ユーザ名*
パスワード*
ログイン



CHAPTER 3

Configure Telemetry

- Application Telemetry Overview, on page 23
- Configure Syslog, SNMP Traps, NetFlow Collector Servers, and Wired Client Data Collection Using Telemetry, on page 23
- Criteria for Enabling Application Telemetry on Devices, on page 24
- Provision Application Telemetry Settings, on page 26
- Enable Application Telemetry for Wireless Controllers, on page 27
- Update Telemetry Settings to Use a New Cluster Virtual IP Address, on page 27
- Update Device Configuration Using Telemetry, on page 29

Application Telemetry Overview

Application telemetry allows you to configure global network settings on devices for monitoring and assessing their health.

Configure Syslog, SNMP Traps, NetFlow Collector Servers, and Wired Client Data Collection Using Telemetry

With Cisco DNA Center, you can configure global network settings when devices are assigned to a specific site. Telemetry polls network devices and collects telemetry data according to the settings in the SNMP server, syslog server, NetFlow Collector, or wired client.

Before you begin

Create a site and assign a device to the site. See Create a Site in a Network Hierarchy, on page 122.

Step 1 Click the menu icon (☰) and choose **Design** > **Network Settings** > **Telemetry**.

Step 2 In the **SNMP Traps** area, do one of the following:

- Check the **Use Cisco DNA Center as SNMP trap server** check box.
- Check the **Add an external SNMP trap server** check box and enter the IP address of the external SNMP trap server. The selected server collects SNMP traps and messages from the network devices.

Step 3 In the **Syslogs** area, do one of the following:

- Check the **Use Cisco DNA Center as syslog server** check box.
- Check the **Add an external syslog server** check box and enter the IP address of the external syslog server.

Step 4 In the **NetFlow** area, do one of the following:

- Click the **Use Cisco DNA Center as NetFlow collector server** radio button. The NetFlow configuration on the device interfaces is completed only when you enable application telemetry on the device. Select the NetFlow collector at the site level to configure the NetFlow destination server to the device.
- Click the **Add Cisco Telemetry Broker (CTB)** radio button and add the IP address and port number of the Cisco Telemetry Broker. The Cisco Telemetry Broker collects NetFlow records from the device and sends the information to the destination.

Note Cisco DNA Center must be configured as a destination in Cisco Telemetry Broker to receive NetFlow records. If Cisco DNA Center is not configured as a destination, the Application Experience does not work.

Step 5 In the **Wired Client Data Collection** area, click the **Enable Cisco DNA Center IPDT on all devices** radio button to turn on IP Device Tracking (IPDT) on the access devices of the site.

If you don't want to enable IPDT for the site, click the **Disable** radio button (the default).

Note You must enable IPDT to preview the CLI configuration. When provisioning a device, you can preview the CLI configuration before deploying it on the device.

Step 6 In the **Wireless Controller, Access Point and Wireless Clients Health** area, check the **Enable Wireless Telemetry** check box to monitor the health of the wireless controllers, APs, and wireless clients in your network.

Step 7 Click **Save**.

Criteria for Enabling Application Telemetry on Devices

Cisco DNA Center automatically enables application telemetry on all applicable interfaces or WLANs that are selected based on the new automatic interfaces or WLAN selection algorithm.

Application telemetry is pushed to WLANs that are provisioned through Cisco DNA Center.

Note

- The conventional tagging-based algorithm is supported and has precedence over the newer automatic interfaces or WLAN selection algorithm.
- If you want to switch over from automatic selection algorithm to tagging-based algorithm, you must disable telemetry before provisioning the tagged SSIDs to the devices.

The following table provides the criteria for selecting interfaces and WLANs based on the conventional tagging-based algorithm (with **lan** keyword) and the new automatic selection algorithm for all the supported platforms:

Platform	Conventional Tagging-Based Algorithm	Automatic Selection Algorithm

Router	- Interface description has the **lan** keyword.[1][2]
	- Interface is a physical interface.
	- Interface has an IP address other than the management IP address.
		- Interface has an IP address other than the management IP address.
		- Interface is not any of the following:
		  - WAN
		  Note An interface is treated as a WAN-facing interface if it has a public IP address, and if there is a route rule with a public IP address that routes through the interface.
		  In this context, a public IP address is not in a private range (for example, not in 192.168.x.x, 172.16.y.y, 10.z.z.z), or is an IP address that is not in the system's IP pools.
		  Route rules can be dynamically learned. In this context, the **show ip route** command does not show a route to a public IP address that goes through this interface.
		  - Loopback.
		  - Management interface: IGABITETHERNET0, GIGABITETHERNET0/0, MGMT0, FASTETHERNET0, or FASTETHERNET1.

Switch	- Interface description has the **lan** keyword.[1, 2]
	- Switch port is configured as an access port.
	- Switch port is configured with the **switch-mode access** command.
		- Interface is a physical interface.
		- Access port does not have neighbors.
		- Interface is not any of the following:
		  - Management interface: FASTETHERNET0, FASTETHERNET1, GIGABITETHERNET0/0, or MGMT0
		  - LOOPBACK0, Bluetooth, App Gigabit, WPAN, Cellular, or Async
		  - VSL interface.

Platform	Conventional Tagging-Based Algorithm	Automatic Selection Algorithm
Cisco AireOS Controller	• WLAN profile name is tagged with the **lan** keyword.[1, 2]	If the SSIDs are mixed, that is Local mode, Flex mode, and Fabric mode, Wireless Service Assurance (WSA) processing is enabled. If all the SSIDs are in Local mode, Netflow is enabled.
Cisco Catalyst 9800 Series Wireless Controller with Optimized Application Performance Monitoring (APM) profile and IOS release 16.12.1 and later.	WLAN profile name is tagged with the **lan** keyword.[1, 2]	If the SSIDs are mixed, that is Local mode, Flex mode, and Fabric mode, the Cisco Application Visibility and Control (AVC) basic record is configured. If all the SSIDs are in Local mode, the Optimized APM record is configured.
	Note If you want to update the telemetry configuration, you must disable telemetry and then enable it after making the configuration changes.	
Cisco DNA Traffic Telemetry Appliance with Optimized APM profile and IOS release 17.3 and later.	• Interface description has the **lan** keyword.[1, 2] • Interface is a physical interface.	• Interface is a physical interface. • Interface is not a management interface: GIGABITETHERNET0, GIGABITETHERNET0/0, MGMT0, FASTETHERNET0, and FASTETHERNET1.

[1] The **lan** keyword is case insensitive and can be separated by a space, hyphen, or underscore.
[2] Resynchronize the network device to read the **lan** interface description.

Provision Application Telemetry Settings

Configure global telemetry settings as described in Configure Syslog, SNMP Traps, NetFlow Collector Servers, and Wired Client Data Collection Using Telemetry, on page 23.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory window displays the device information gathered during the Discovery process. To view devices available in a particular site, expand the Global site in the left pane and select the site, building, or floor.

Step 2 Choose the devices that you want to provision.

Step 3 From the **Actions** drop-down list, choose **Telemetry** and do one of the following:

Note The application telemetry option is enabled only if the device supports application telemetry enablement from Cisco DNA Center.

a) **Enable Application Telemetry**: To configure application telemetry for the selected devices.
b) **Disable Application Telemetry**: To remove the application telemetry configuration from the chosen devices.

Step 4 Click **Apply**.

The **Application Telemetry** column shows the telemetry configuration status. If you don't see the **Application Telemetry** column in the default column setting, click the ellipsis icon (⋮) at the right end of the column headings and check the **Application Telemetry** check box.

Enable Application Telemetry for Wireless Controllers

You can enable application telemetry for new and existing devices.

Before you begin

To enable application telemetry, devices must have a Cisco DNA Advantage license.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

Step 2 To view devices available in a particular site, expand the **Global** site in the left pane, and choose the site, building, or floor.

Step 3 In the **Inventory** window, choose the device. You can choose multiple devices at a time.

Step 4 From the **Action** drop-down list choose **Telemetry** > **Enable Application Telemetry**.

Step 5 In the **Enable Telemetry** slide-in pane, complete the following settings:

a) AP mode: Check the **Flex/Fabric** or **Local** check box. You can also choose both options.

b) Check the **Include Guest SSID** check box to enable telemetry for guest SSIDs.

c) **Telemetry Source**:

- Embedded Wireless Controllers - NetFlow
- AireOS wireless controller (Local mode) - NetFlow
- AireOS wireless controller (Flex/Fabric mode) - Wireless Service Assurance (WSA)

d) To apply the same settings for all wireless controllers, check **Apply this selection to all wireless controllers**.

Step 6 Click **Enable**.

Step 7 In the **Application Telemetry** window, click **ok**.

To skip this screen in the future, check **Don't show again**.

The telemetry status is shown in the **Application Telemetry** column in the **Inventory** window.

Update Telemetry Settings to Use a New Cluster Virtual IP Address

If you are using the Cisco DNA Center application telemetry to monitor device data, and you need to change the Cisco DNA Center cluster virtual IP address (VIP), complete the following steps to change the VIP and to ensure that node telemetry data is sent to the new VIP.

Before you begin

- Determine the version of Cisco DNA Center that you are using. You can check this by logging in to the Cisco DNA Center GUI and using the **About** option to view the Cisco DNA Center version number.
- Obtain SSH client software.
- Identify the VIP address that was configured for the 10-GB interface facing the enterprise network on the Cisco DNA Center primary node. Log in to the appliance using this address, on port 2222. To identify this port, see the rear-panel figure in the "Front and Rear Panels" section in the Cisco DNA Center Installation Guide.
- Obtain the Linux username (`maglev`) and password configured on the primary node.
- Identify the cluster VIP that you want to assign. The cluster VIP must conform to the requirements explained in the "Required IP Addresses and Subnets" section in the Cisco DNA Center Installation Guide.

Step 1 Access the Cisco DNA Center GUI and disable Application Telemetry at all the sites, as follows:

a) Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

   The Inventory window displays the device information gathered during the Discovery process. To view devices available in a particular site, expand the Global site in the left pane, and select the site, building, or floor.

b) Choose all the sites and devices currently being monitored.
c) From the **Actions** drop-down list, choose **Telemetry** > **Disable Application Telemetry**.
d) Wait for the sites and devices to show that telemetry has been disabled.

Step 2 Use the appliance Configuration wizard to change the cluster VIP, as follows:

a) Using an SSH client, log in to the VIP address that was configured for the 10-GB interface facing the enterprise network on the Cisco DNA Center primary node. Be sure to log in on port 2222.
b) When prompted, enter the Linux username and password.
c) Enter the following command to access the Configuration wizard on the primary node:

```
$ sudo maglev-config update
```

   If you are prompted for the Linux password, enter it again.

d) Click **[Next]** until the screen prompting you for the cluster virtual IP appears. Enter the new cluster VIP, then click **[Next]** to proceed through the remaining screens of the wizard.

   You must configure one virtual IP per configured interface. We recommend that you enter the `sudo maglev-config update` command so that the wizard prompts you to provide one VIP per configured interface.

   When you reach the final screen, a message appears, stating that the wizard is ready to apply your changes.

e) Click **[proceed]** to apply the cluster VIP change.

   At the end of the configuration process, a success message appears and the SSH prompt reappears.

Step 3 Restart the necessary Cisco DNA Center services by entering the following series of commands at the SSH prompt:

```
magctl service restart -d collector-netflow
magctl service restart -d collector-syslog
magctl service restart -d collector-trap
magctl service restart -d wirelesscollector
```

Step 4 Wait for all the services to restart. You can monitor the progress of the restarts by entering the following command, substituting service names as needed for the release train appropriate for your Cisco DNA Center version.

```
magctl appstack status | grep -i -e collector-netflow -e collector-syslog -e collector-trap -e
wirelesscollector
```

When all the necessary services are running, you see command output similar to the following, with a Running status for each service that has restarted successfully:

```
assurance-backend  wirelesscollector-123-bc99s  1/1   Running   0   25d   <IP>   <IP>
ndp   collector-netflow-456-lxvlx   1/1   Running   0   1d   <IP>   <IP>
ndp   collector-syslog-789-r0rr1    1/1   Running   0   25d   <IP>   <IP>
ndp   collector-trap-101112-3ppllm  1/1   Running   0   25d   <IP>   <IP>
```

Step 5 Access the Cisco DNA Center GUI and **Enable Application Telemetry** to all nodes as follows:

a) Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.
b) Choose all the sites and devices that you want to monitor.
c) From the **Actions** drop-down list, choose **Telemetry** > **Enable Application Telemetry**.
d) Wait for the sites and devices to show that telemetry has been enabled.

Update Device Configuration Using Telemetry

You can push the configuration changes to a device irrespective of whether the device controllability is enabled or disabled.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory window displays the device information gathered during the Discovery process. To view devices available in a particular site, expand the **Global** site in the left pane, and select the site, building, or floor.

Step 2 Choose the devices that you want to update the configuration changes.

Step 3 From the **Actions** drop-down list, choose **Telemetry** > **Update Telemetry Settings**.

The **Update Telemetry Settings** slide in pane appears.

Step 4 (Optional) Check the **Force Configuration Push** check box to push the configuration changes to the device. If there is no change in the configuration settings, the existing configuration is pushed again to the device.

If there is no change in the configuration settings, the existing configuration is pushed again to the device.

Step 5 Click **Next**.

Step 6 To immediately update the telemetry settings, click the **Now** radio button and click **Apply**.

Step 7 To schedule the telemetry settings update for a later date and time, click the **Later** radio button to specify the date and time of update and click **Apply**.

Step 8 To preview the CLI configuration, click the **Generate Configuration Preview** radio button.

To preview the CLI configuration, click the **Generate Configuration Preview** radio button and do the following:

a. In the **Task Name** name field, enter a task name of your choice and click **Preview**.

You can later use the created configuration preview to deploy on selected devices.

b. In the **Task Submitted** message, click the **View Work Items** link.

   Note If you didn't notice the **Task Submitted** message, click the menu icon and choose **Activities** > **Work Items**.

c. In the **Work Items** window, click the CLI preview task for which you submitted the configuration preview request.

d. View the CLI configuration details and click **Deploy**.

e. To immediately deploy the device, click the **Now** radio button, and click **Apply**.

f. To schedule the device deployment for a later date and time, click the **Later** radio button and define the date and time of the deployment.

g. In the subsequent confirmation window, click **Yes**.

   Note The CLI task is marked as completed in the **Work Items** window. You can view the CLI configuration for this task, but you cannot deploy it again.

PART II

Discover and Manage Network Inventory and Topology

- Discover Your Network, on page 33
- Manage Your Inventory, on page 63
- Display Your Network Topology, on page 111

CHAPTER 4

Discover Your Network

- Discovery Overview, on page 33
- Discovery Dashboard, on page 34
- Discovery Prerequisites, on page 34
- Discovery Credentials, on page 35
- Preferred Management IP Address, on page 37
- Discovery Configuration Guidelines and Limitations, on page 37
- Perform Discovery, on page 38
- Manage Discovery Jobs, on page 56

Discovery Overview

The Discovery feature scans the devices in your network and sends the list of discovered devices to inventory.

The Discovery feature also works with the Device Controllability feature to configure the required network settings on devices, if these settings are not already present on the devices.

There are three ways for you to discover devices:

- Use Cisco Discovery Protocol (CDP) and provide a seed IP address.
- Specify a range of IP addresses. (A maximum range of 4096 devices is supported.)
- Use Link Layer Discovery Protocol (LLDP) and provide a seed IP address.

When configuring the Discovery criteria, remember that there are settings that you can use to help reduce the amount of time it takes to discover your network:

- **CDP Level** and **LLDP Level**: If you use CDP or LLDP as the Discovery method, you can set the CDP or LLDP level to indicate the number of hops from the seed device that you want to scan. The default, level 16, might take a long time on a large network. So, if fewer devices have to be discovered, you can set the level to a lower value.
- **Subnet Filters**: If you use an IP address range, you can specify devices in specific IP subnets for Discovery to ignore.
- **Preferred Management IP**: Whether you use CDP, LLDP, or an IP address range, you can specify whether you want Cisco DNA Center to add any of the device's IP addresses or only the device loopback address.

Note For Cisco SD-Access Fabric and Cisco DNA Assurance, we recommend that you specify the device loopback address.

Regardless of the method you use, you must be able to reach the device from Cisco DNA Center and configure specific credentials and protocols in Cisco DNA Center to discover your devices. These credentials can be configured and saved in the **Design** > **Network Settings** > **Device Credentials** window or on a per-job basis in the **Discovery** window.

Note If a device uses a first hop resolution protocol, such as Hot Standby Router Protocol (HSRP) or Virtual Router Redundancy Protocol (VRRP), the device might be discovered and added to the inventory along with its floating IP address. Later, if HSRP or VRRP fails, the IP address might be reassigned to a different device. This situation can cause issues with the data that Cisco DNA Center retrieves for analysis.

Discovery Dashboard

Click the menu icon (≡) and choose **Tools** > **Discovery** to view the **Discovery Dashboard**. The **Discovery Dashboard** shows the inventory overview, latest discovery, discovery type, discovery status, and recent discoveries.

Discovery Prerequisites

Before you run Discovery, complete the following minimum prerequisites:

- Understand what devices will be discovered by Cisco DNA Center by viewing the Cisco DNA Center Compatibility Matrix.
- Understand that the preferred network latency between Cisco DNA Center and devices is 100 ms round-trip time (RTT). (The maximum latency is 200 ms RTT.)
- Ensure that at least one SNMP credential is configured on your devices for use by Cisco DNA Center. At a minimum, this can be an SNMPv2C read credential. For more information, see Discovery Credentials, on page 35.
- Configure SSH credentials on the devices you want Cisco DNA Center to discover and manage. Cisco DNA Center discovers and adds a device to its inventory if at least one of the following criteria is met:
    - The account that is being used by Cisco DNA Center to SSH into your devices has privileged EXEC mode (level 15).
    - You configure the device's enable password as part of the CLI credentials configured in the Discovery job. For more information, see Discovery Configuration Guidelines and Limitations, on page 37.

Discovery Credentials

Discovery credentials are the CLI, SNMPv2c, SNMPv3, HTTP(S), and NETCONF configuration values for the devices that you want to discover. You must specify the credentials based on the types of devices you are trying to discover:

- Network devices: CLI and SNMP credentials.

Note For NETCONF-enabled devices such as embedded wireless controllers, you must specify SSH credentials with admin privilege and select the NETCONF port.

- Compute devices (NFVIS): CLI, SNMP, and HTTP(S) credentials.

Because the various devices in a network can have different sets of credentials, you can configure multiple sets of credentials in Cisco DNA Center. The Discovery process iterates through all sets of credentials that are configured for the Discovery job until it finds a set that works for the device.

If you use the same credential values for the majority of devices in your network, you can configure and save them to reuse in multiple Discovery jobs. To discover devices with unique credentials, you can add job-specific Discovery credentials when you run Discovery jobs. You can configure up to 10 global credentials for each credential type and define any five of them. If you need to define job-specific credential, you can define four global credentials and one job-specific credential for each credential type.

Discovery Credentials and Cisco ISE

If you are using Cisco ISE as an authentication server, the Discovery feature authenticates devices using Cisco ISE as part of the discovery process. To make sure that your devices are discovered properly, follow these guidelines:

- Do not use Discovery credentials that have fewer than 4 alphanumeric characters. Although devices may have credentials with fewer than 4 alphanumeric characters, Cisco ISE allows 4 alphanumeric characters as the minimum username and password length. If the device credentials have fewer than 4 characters, Cisco DNA Center cannot collect the device's inventory data, and the device will go into a partial collection state.
- Do not use credentials that have the same username, but different passwords (cisco/cisco123 and cisco/pw123). While Cisco DNA Center allows the discovery of devices with the same username but different passwords, Cisco ISE does not allow this. If a duplicate username is used, Cisco DNA Center cannot authenticate the device and collect its inventory data, and the device will go into a partial collection state.

For information on how to define Cisco ISE as a AAA server, see Add Cisco ISE or Other AAA Servers, on page 172.

Guidelines and Limitations for Discovery Credentials

The following are the guidelines and limitations for the Cisco DNA Center Discovery credentials:

- To change the device credentials used in a Discovery job, you need to edit the Discovery job and deselect the credentials that you no longer want to use. Then, you need to add the new credentials and start the discovery. For more information, see Change Credentials in a Discovery Job, on page 57.
- If you change a device's credential after successfully discovering the device, subsequent polling cycles for that device fail. To correct this situation, use one of the following options:
    - Use the Discovery tool to:
        - Run a new Discovery job with job-specific credentials that match the device's new credential.
        - Edit the existing Discovery job and re-run the Discovery job.
    - Use the Design tool to:
        - Create a new global credential and run a new Discovery job using the correct global credential.
        - Edit an existing global credential and use Copy & Edit to recreate the Discovery job. Alternately, create a new Discovery job.
- If an ongoing Discovery polling cycle fails because of a device authentication failure, you can correct the situation using one of following options:
    - Use the Discovery tool to:
        - Stop or delete the current Discovery job and run a new Discovery job with job-specific credentials that match the device's credential.
        - Stop or delete the current Discovery job, edit the existing Discovery job, and re-run the Discovery job.
    - Use the Design tool to:
        - Create a new global credential and run a new Discovery job using the correct global credential.
        - Edit an existing global credential and use Copy & Edit to recreate the Discovery job. Alternately, create a new Discovery job.
- Deleting a global credential does not affect previously discovered devices. The status of the previously discovered devices does not indicate an authentication failure. However, the next Discovery job that tries to use the deleted credential will fail. The Discovery job will fail **before** it tries to contact any devices.

Discovery Credentials Example

The devices that form a typical network can have widely varying Discovery requirements. Cisco DNA Center lets you create multiple Discovery jobs to support these varying requirements. For example, assume that a network of 200 devices form a Cisco Discovery Protocol (CDP) neighborhood. In this network, 190 devices share a global credential (Credential 0) and the remaining devices each have their own unique credential (Credential-1 through Credential-10).

To discover all the devices in this network using Cisco DNA Center, perform the following task:

Step 1 Configure the CLI global credentials as Credential-0.

Step 2 Configure the SNMP (v2c or v3) global credentials.

Step 3 Run a Discovery job using one of the 190 device IP addresses (190 devices that share the global credentials) and the global Credential-0.

Step 4 Run 10 separate Discovery jobs for each of the remaining 10 devices using the appropriate job-specific credentials, for example, Credential-1, Credential-2, Credential-3, and so on.

Step 5 Review the results in the **Inventory** window.

Preferred Management IP Address

When Cisco DNA Center discovers a device, it uses one of the device's IP addresses as the preferred management IP address. The IP address can be that of a built-in management interface of the device, another physical interface, or a logical interface such as Loopback0. You can configure Cisco DNA Center to use the device's loopback IP address as the preferred management IP address, provided the IP address is reachable from Cisco DNA Center.

When you choose **Use Loopback IP** as the preferred management IP address, Cisco DNA Center determines the preferred management IP address as follows:

- If the device has one loopback interface, Cisco DNA Center uses that loopback interface IP address.
- If the device has multiple loopback interfaces, Cisco DNA Center uses the loopback interface with the highest IP address.
- If there are no loopback interfaces, Cisco DNA Center uses the Ethernet interface with the highest IP address. (Subinterface IP addresses are not considered.)
- If there are no Ethernet interfaces, Cisco DNA Center uses the serial interface with the highest IP address.

After a device is discovered, you can update the management IP address from the **Inventory** window. For more information, see Update a Device's Management IP Address, on page 97.

Discovery Configuration Guidelines and Limitations

The following are the guidelines and limitations for Cisco DNA Center to discover your Cisco Catalyst 3000 Series Switches and Catalyst 6000 Series Switches:

- Configure the CLI username and password with privileged EXEC mode (level 15). These credentials are the same CLI username and password that you configure in Cisco DNA Center for the Discovery function. Cisco DNA Center requires the highest access level to the device.
- Explicitly specify the transport protocols allowed on individual interfaces for both incoming and outgoing connections. Use the **transport input** and **transport output** commands for this configuration. For information about these commands, see the command reference document for the specific device type.
- Do not change the default login method for a device's console port and the VTY lines. If a device is already configured with a AAA (TACACS) login, make sure that the CLI credential defined in the Cisco DNA Center is the same as the TACACS credential defined in the TACACS server.
- Cisco wireless controllers must be discovered using the management IP address instead of the service port IP address. If not, the related wireless controller 360 and AP 360 windows will not display any data.

Perform Discovery

The following sections provide information about how to perform Discovery.

Discover Your Network Using CDP

You can discover devices using Cisco Discovery Protocol (CDP), an IP address range, or LLDP. This procedure shows you how to discover devices and hosts using CDP.

Note

- The Discovery function requires the correct SNMP read-only community string. If an SNMP read-only community string is not provided, as a *best effort*, the Discovery function uses the default SNMP read-only community string, public.
- CLI credentials are not required to discover hosts; hosts are discovered through the network devices to which they are connected.

Before you begin

- Enable CDP on your network devices.
- Configure your network devices, as described in Discovery Prerequisites, on page 34.
- Configure your network device host IP address as the client IP address. (A host is an end-user device, such as a laptop computer or mobile device.)

Step 1 Click the menu icon (≡) and choose **Tools** > **Discovery**.

Step 2 In the **Discovery** window, click **Add Discovery**.

Step 3 In the **New Discovery** window, enter a name in the **Discovery Name** field.

Step 4 If the **IP Address/Range** area is not already visible, expand it and configure the following fields:

- **Discovery Type**: Enable CDP by clicking the **CDP** radio button.
- **IP Address**: Enter a seed IP address for Cisco DNA Center to start the Discovery scan.
- **Subnet Filters**: Exclude an IP address or subnet from the Discovery scan. To exclude an IP address, enter an individual IP address (*x.x.x.x*). To exclude a subnet, enter a classless inter-domain routing (CIDR) address (*x.x.x.x/y*), where *x.x.x.x* is the IP address and *y* is the subnet mask. The subnet mask can be a value from 0 to 32.

  To exclude more IP addresses and subnets, click the add icon (⊕).
- **CDP Level**: Enter the number of hops from the seed device that you want to scan.

  Valid values are from 1 to 16. The default value is 16. For example, CDP level 3 means that CDP will scan up to three hops from the seed device.
- **Preferred Management IP Address**: Click one of the following radio buttons:
  - **None**: Allow the device to use any of its IP addresses.

- **Use Loopback IP**: Specify the device loopback interface IP address.

  Note If you choose **Use Loopback IP** and the device does not have a loopback interface, Cisco DNA Center chooses a management IP address using the logic described in Preferred Management IP Address, on page 37.

  Note To use the loopback interface IP address as the preferred management IP address, make sure that the IP address of the CDP neighbor is reachable from Cisco DNA Center.

Step 5 Expand the **Credentials** area and choose the credentials that you want to use.

Choose any of the global credentials that have already been created or configure your own Discovery credentials.

Step 6 To use existing credentials, select the global credentials that you want to use and proceed to Step 14. If you do not want to use a credential, deselect it.

Step 7 To configure new credentials, click **Add Credentials**.

Note If you configure your own credentials, you can save them future Discovery jobs by checking the **Save as global settings** check box.

Step 8 For CLI credentials, do the following:

a) Configure the following fields:

Table 2: CLI Credentials

Field	Description
Name/Description	Name or phrase that describes the CLI credentials.
Username	Name that is used to log in to the CLI of the devices in your network.
Password	Password that is used to log in to the CLI of the devices in your network. For security reasons, re-enter the password as confirmation. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.
Enable Password	Password used to move to a higher privilege level in the CLI. Configure this password only if your network devices require it. For security reasons, re-enter the enable password. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.

b) If you want to save these credentials for future use, click the **Save as global settings** check box. If you don't click this checkbox, the credentials can be used only for the current Discovery job.

c) Click **Save**.

Step 9 For SNMP v2c credentials, click **SNMP v2c** and do the following:

a) Configure the following fields:

Table 3: SNMPv2c Credentials

Field	Description
Read	• **Name/Description**: Name or description of the SNMPv2c settings that you are adding. • **Read Community**: Read-only community string password used only to view SNMP information on the device. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.
Write	• **Name/Description**: Name or description of the SNMPv2c settings that you are adding. • **Write Community**: Write community string used to make changes to the SNMP information on the device. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.

b) If you want to save these credentials for future use, click the **Save as global settings** check box. If you don't click this checkbox, the credentials can be used only for the current Discovery job.

c) Click **Save**.

Step 10 (Optional) For SNMP v3 credentials, click **SNMP v3** and do the following:

a) Configure the following fields:

Table 4: SNMPv3 Credentials

Field	Description
Name/Description	Name or description of the SNMPv3 settings that you are adding.
Username	Name associated with the SNMPv3 settings.
Mode	Security level that an SNMP message requires. Choose one of the following modes: • **noAuthNoPriv**: Does not provide authentication or encryption. • **AuthNoPriv**: Provides authentication, but does not provide encryption. • **AuthPriv**: Provides both authentication and encryption.
Auth Type	Authentication type to be used. (Enabled if you select **AuthPriv** or **AuthNoPriv** as **Mode**.) Choose one of the following authentication types: • **SHA**: Authentication based on HMAC-SHA. • **MD5**: Authentication based on HMAC-MD5.

Field	Description
Auth Password	SNMPv3 password used for gaining access to information from devices that use SNMPv3. These passwords (or passphrases) must be at least eight characters in length. **Note** • Some wireless controllers require that passwords (or passphrases) be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.
Privacy Type	Privacy type. (Enabled if you select **AuthPriv** as **Mode**.) Choose one of the following privacy types: • **AES128**: 128-bit CBC mode AES for encryption. • **AES192**: 192-bit CBC mode AES for encryption. • **AES256**: 256-bit CBC mode AES for encryption. **Note** • Discovery and Inventory features support only AES192 and AES256 privacy types. • Cisco DNA Assurance does not support any of these privacy types.
Privacy Password	SNMPv3 privacy password that is used to generate the secret key for encrypting messages that are exchanged with devices that support AES128, AES192, and AES256 encryption standards. Passwords (or passphrases) must be at least eight characters long. **Note** • Some wireless controllers require that passwords (or passphrases) be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.

b) If you want to save these credentials for future use, click the **Save as global settings** check box. If you don't click this checkbox, the credentials can be used only for the current Discovery job.

c) Click **Save**.

Step 11 (Optional) To configure SNMP properties, click **SNMP PROPERTIES** and do the following:

a) Configure the following fields:

Table 5: SNMP Properties

Field	Description
Retries	Number of times Cisco DNA Center tries to communicate with network devices using SNMP.
Timeout	Amount of time, in seconds, between retries.

b) If you want to save these credentials for future use, click the **Save as global settings** check box. If you don't click this checkbox, the credentials can be used only for the current Discovery job.

c) Click **Save**.

Step 12 (Optional) To configure HTTP(s) credentials, click **HTTP(S)** and do the following:

a) Configure the following fields:

Table 6: HTTP(S) Credentials

Field	Description
Type	Specifies the kind of HTTPS credentials you are configuring. Valid types are **Read** or **Write**.
Read	You can configure up to 10 HTTPS read credentials: • **Name/Description**: Name or description of the HTTPS credentials that you are adding. • **Username**: Name used to authenticate the HTTPS connection. • **Password**: Password used to authenticate the HTTPS connection. Passwords are encrypted for security and are not displayed in the configuration. • **Port**: Number of the TCP/UDP port used for HTTPS traffic. The default is port number 443 (the well-known port for HTTPS). The password must contain between 7 and 128 characters, including at least one of the following: • Lowercase letter (a to z) • Uppercase letter (A to Z) • Number (0 to 9) • Special character: # _ * ? – The password cannot contain spaces or angle brackets (< >). Note that some Cisco IOS XE devices do not allow a question mark (?).

Field	Description
Write	You can configure up to 10 HTTPS write credentials: • **Name/Description**: Name or description of the HTTPS credentials that you are adding. • **Username**: Name used to authenticate the HTTPS connection. • **Password**: Password used to authenticate the HTTPS connection. Passwords are encrypted for security and are not displayed in the configuration. • **Port**: Number of the TCP/UDP port used for HTTPS traffic. The default is port number 443 (the well-known port for HTTPS). The password must contain between 7 and 128 characters, including at least one of the following: • Lowercase letter (a to z) • Uppercase letter (A to Z) • Number (0 to 9) • Special character: # _ * ? – The password cannot contain spaces or angle brackets (< >). Note that some Cisco IOS XE devices do not allow a question mark (?).

b) (Optional) If you want to save these credentials for future use, click the **Save as global settings** check box. If you don't click this checkbox, the credentials can be used only for the current Discovery job.

c) Click **Save**.

Step 13 (Optional) If you have network devices with NETCONF enabled and want Cisco DNA Center to use NETCONF to install, manipulate, and delete the configurations of these devices, click **NETCONF** and do the following:

a) In the **Port** field, enter a port number. You can use one of the following ports:

- Port 830 (default)
- Any other port that is available on the device
- A custom port that Cisco DNA Center configures (You can use a custom port only if Device Controllability is enabled. For more information, see the Device Controllability section in the *Cisco DNA Center Administrator Guide*.)

)

Note NETCONF is disabled if you choose the **Telnet** protocol in the **Advanced** area of the **Add Discovery** window.

Note To discover Cisco Catalyst 9800 Series Wireless Controller devices, you must enable NETCONF.

b) If you want to save these credentials for future use, click the **Save as global settings** check box. If you don't click this checkbox, the credentials can be used only for the current Discovery job.

c) Click **Save**.

Step 14 (Optional) To configure the protocols that are used to connect with devices, expand the **Advanced** area and do the following:

a) Click the names of the protocols that you want to use. A green check mark indicates that the protocol is selected.

   Valid protocols are **SSH** (default) and **Telnet**.

b) Drag and drop the protocols in the order that you want them to be used.

Note NETCONF is disabled if you choose the **Telnet** protocol in the **Advanced** area of the **Add Discovery** window.

Step 15 Click **Discover**.

Step 16 To run Discovery now, click the **Now** radio button in the **Discover Devices** slide-in pane and click **Start**. Otherwise, proceed to the next step.

If you want to discover only new devices, click the **Discover only new devices** toggle button.

Step 17 To schedule Discovery for a later time, do the following:

a. Click the **Later** radio button.

b. Define the start date and time.

c. From the **Time Zone** drop-down list, choose a time zone.

d. In the **Recurrence** area, click **None**, **Daily**, or **Weekly**.

  - **None**: Discovery will not recur.
  - **Daily**: Enter the interval in days in the **Run at Interval (Days)** field.
  - **Weekly**: Enter the interval in weeks in the **Run at Interval (Weeks)** field.

e. If you have chosen **Daily** or **Weekly** for recurrence, check the **Set Schedule End** check box to define the end date and time.

Note You can discover only new devices in recurrence. The **Discover only new devices** toggle button at the top is enabled by default.

f. Click **End Date** or **End After**.

  - **End Date**: Enter month, date, and year for recurrence to end.
  - **End After**: Enter the number of occurrences after you want recurrence to end.

g. Click **Start**.

Click the notifications icon to view the scheduled Discovery. Before Discovery starts, you can click **Edit** to edit it, or **Cancel** to cancel it.

The **Discoveries** window displays the results of your scan.

The **Discovery Details** pane shows the status (active or inactive) and the Discovery configuration. The **Discovery Devices** pane displays the host names, IP addresses, and status of the discovered devices.

Discover Your Network Using an IP Address Range

You can discover devices using an IP address range, CDP, or LLDP. This procedure shows you how to discover devices and hosts using an IP address range.

Before you begin

Your devices must have the required device configurations, as described in Discovery Prerequisites, on page 34.

Step 1 Click the menu icon (≡) and choose **Tools** > **Discovery**.

Step 2 In the **Discovery** window, click **Add Discovery**.

Step 3 In the **New Discovery** window, enter a name in the **Discovery Name** field.

Step 4 If the **IP Address/Ranges** area is not already visible, expand it and configure the following fields:

- **Discovery Type**: Discover devices using an IP address or address range by clicking the **IP Address/Range** radio button.
- **From** and **To** fields: Enter the beginning IP address in the **From** field and the ending IP address in the **To** field.

  Click the add icon (+) to add more IP address ranges.

  Note Cisco Wireless Controllers must be discovered using the management IP address instead of the service port IP address. If not, the related wireless controller 360 and AP 360 pages will not display any data.

- **Subnet Filters**: Exclude an IP address or subnet from the Discovery scan. To exclude an IP address, enter an individual IP address (*x.x.x.x*). To exclude a subnet, enter a classless inter-domain routing (CIDR) address (*x.x.x.x/y*), where *x.x.x.x* is the IP address and *y* is the subnet mask. The subnet mask can be a value from 0 to 32.

  To exclude more IP addresses and subnets, click the add icon (⊕).

- **Preferred Management IP Address**: Click one of the following radio buttons:
  - **None**: Allow the device to use any of its IP addresses.
  - **Use Loopback IP**: Specify the device loopback interface IP address.

    Note If you choose **Use Loopback IP** and the device does not have a loopback interface, Cisco DNA Center chooses a management IP address using the logic described in Preferred Management IP Address, on page 37.

Step 5 Expand the **Credentials** area and choose the credentials that you want to use.

Choose any of the global credentials that have already been created or configure your own Discovery credentials.

Step 6 To use existing credentials, select the global credentials that you want to use and proceed to Step 14. If you do not want to use a credential, deselect it.

Step 7 To configure new credentials, click **Add Credentials**.

Note If you configure your own credentials, you can save them future Discovery jobs by checking the **Save as global settings** check box.

Step 8 For CLI credentials, do the following:

a) Configure the following fields:

Table 7: CLI Credentials

Field	Description
Name/Description	Name or phrase that describes the CLI credentials.
Username	Name that is used to log in to the CLI of the devices in your network.
Password	Password that is used to log in to the CLI of the devices in your network. For security reasons, re-enter the password as confirmation. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.
Enable Password	Password used to move to a higher privilege level in the CLI. Configure this password only if your network devices require it. For security reasons, re-enter the enable password. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.

b) If you want to save these credentials for future use, click the **Save as global settings** check box. If you don't click this checkbox, the credentials can be used only for the current Discovery job.

c) Click **Save**.

Step 9 For SNMP v2c credentials, click **SNMP v2c** and do the following:

a) Configure the following fields:

Table 8: SNMPv2c Credentials

Field	Description
Read	• **Name/Description**: Name or description of the SNMPv2c settings that you are adding. • **Read Community**: Read-only community string password used only to view SNMP information on the device. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.
Write	• **Name/Description**: Name or description of the SNMPv2c settings that you are adding. • **Write Community**: Write community string used to make changes to the SNMP information on the device. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.

b) If you want to save these credentials for future use, click the **Save as global settings** check box. If you don't click this checkbox, the credentials can be used only for the current Discovery job.

c) Click **Save**.

Step 10 (Optional) For SNMP v3 credentials, click **SNMP v3** and do the following:

a) Configure the following fields:

Table 9: SNMPv3 Credentials

Field	Description
Name/Description	Name or description of the SNMPv3 settings that you are adding.
Username	Name associated with the SNMPv3 settings.
Mode	Security level that an SNMP message requires. Choose one of the following modes: • **noAuthNoPriv**: Does not provide authentication or encryption. • **AuthNoPriv**: Provides authentication, but does not provide encryption. • **AuthPriv**: Provides both authentication and encryption.
Auth Type	Authentication type to be used. (Enabled if you select **AuthPriv** or **AuthNoPriv** as **Mode**.) Choose one of the following authentication types: • **SHA**: Authentication based on HMAC-SHA. • **MD5**: Authentication based on HMAC-MD5.
Auth Password	SNMPv3 password used for gaining access to information from devices that use SNMPv3. These passwords (or passphrases) must be at least eight characters in length. **Note** • Some wireless controllers require that passwords (or passphrases) be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.
Privacy Type	Privacy type. (Enabled if you select **AuthPriv** as **Mode**.) Choose one of the following privacy types: • **AES128**: 128-bit CBC mode AES for encryption. • **AES192**: 192-bit CBC mode AES for encryption. • **AES256**: 256-bit CBC mode AES for encryption. **Note** • Discovery and Inventory features support only AES192 and AES256 privacy types. • Cisco DNA Assurance does not support any of these privacy types.

Field	Description
Privacy Password	SNMPv3 privacy password that is used to generate the secret key for encrypting messages that are exchanged with devices that support AES128, AES192, and AES256 encryption standards. Passwords (or passphrases) must be at least eight characters long. **Note** • Some wireless controllers require that passwords (or passphrases) be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.

b) If you want to save these credentials for future use, click the **Save as global settings** check box. If you don't click this checkbox, the credentials can be used only for the current Discovery job.

c) Click **Save**.

Step 11 (Optional) To configure SNMP properties, click **SNMP PROPERTIES** and do the following:

a) Configure the following fields:

Table 10: SNMP Properties

Field	Description
Retries	Number of times Cisco DNA Center tries to communicate with network devices using SNMP.
Timeout	Amount of time, in seconds, between retries.

b) If you want to save these credentials for future use, click the **Save as global settings** check box. If you don't click this checkbox, the credentials can be used only for the current Discovery job.

c) Click **Save**.

Step 12 (Optional) To configure HTTP(s) credentials, click **HTTP(S)** and do the following:

a) Configure the following fields:

Table 11: HTTP(S) Credentials

Field	Description
Type	Specifies the kind of HTTPS credentials you are configuring. Valid types are **Read** or **Write**.

Field	Description
Read	You can configure up to 10 HTTPS read credentials: • **Name/Description**: Name or description of the HTTPS credentials that you are adding. • **Username**: Name used to authenticate the HTTPS connection. • **Password**: Password used to authenticate the HTTPS connection. Passwords are encrypted for security and are not displayed in the configuration. • **Port**: Number of the TCP/UDP port used for HTTPS traffic. The default is port number 443 (the well-known port for HTTPS). The password must contain between 7 and 128 characters, including at least one of the following: • Lowercase letter (a to z) • Uppercase letter (A to Z) • Number (0 to 9) • Special character: # _ * ? – The password cannot contain spaces or angle brackets (< >). Note that some Cisco IOS XE devices do not allow a question mark (?).
Write	You can configure up to 10 HTTPS write credentials: • **Name/Description**: Name or description of the HTTPS credentials that you are adding. • **Username**: Name used to authenticate the HTTPS connection. • **Password**: Password used to authenticate the HTTPS connection. Passwords are encrypted for security and are not displayed in the configuration. • **Port**: Number of the TCP/UDP port used for HTTPS traffic. The default is port number 443 (the well-known port for HTTPS). The password must contain between 7 and 128 characters, including at least one of the following: • Lowercase letter (a to z) • Uppercase letter (A to Z) • Number (0 to 9) • Special character: # _ * ? – The password cannot contain spaces or angle brackets (< >). Note that some Cisco IOS XE devices do not allow a question mark (?).

b) (Optional) If you want to save these credentials for future use, click the **Save as global settings** check box. If you don't click this checkbox, the credentials can be used only for the current Discovery job.

c) Click **Save**.

Step 13 (Optional) If you have network devices with NETCONF enabled and want Cisco DNA Center to use NETCONF to install, manipulate, and delete the configurations of these devices, click **NETCONF** and do the following:

a) In the **Port** field, enter a port number. You can use one of the following ports:

- Port 830 (default)
- Any other port that is available on the device
- A custom port that Cisco DNA Center configures (You can use a custom port only if Device Controllability is enabled. For more information, see the Device Controllability section in the *Cisco DNA Center Administrator Guide*.)

)

Note NETCONF is disabled if you choose the **Telnet** protocol in the **Advanced** area of the **Add Discovery** window.

Note To discover Cisco Catalyst 9800 Series Wireless Controller devices, you must enable NETCONF.

b) If you want to save these credentials for future use, click the **Save as global settings** check box. If you don't click this checkbox, the credentials can be used only for the current Discovery job.

c) Click **Save**.

Step 14 (Optional) To configure the protocols that are used to connect with devices, expand the **Advanced** area and do the following:

a) Click the names of the protocols that you want to use. A green check mark indicates that the protocol is selected.

Valid protocols are **SSH** (default) and **Telnet**.

b) Drag and drop the protocols in the order that you want them to be used.

Note NETCONF is disabled if you choose the **Telnet** protocol in the **Advanced** area of the **Add Discovery** window.

Step 15 Click **Discover**.

Step 16 To run the discovery now, click the **Now** radio button and click **Start**. Otherwise, proceed to the next step.

If you want to discover only new devices, click the **Discover only new devices** toggle button.

Step 17 To schedule the discovery for a later time, do the following:

a. Click the **Later** radio button.

b. Define the start date and time.

c. From the **Time Zone** drop-down list, choose a time zone.

d. In the **Recurrence** area, click **None**, **Daily**, or **Weekly**.

- **None**: Discovery will not recur.
- **Daily**: Enter the interval in days in the **Run at Interval (Days)** field.
- **Weekly**: Enter the interval in weeks in the **Run at Interval (Weeks)** field.

e. If you have chosen **Daily** or **Weekly** for recurrence, check the **Set Schedule End** check box to define the end date and time.

Note You can discover only new devices in recurrence. The **Discover only new devices** toggle button at the top is enabled by default.

f. Click **End Date** or **End After**.

  - **End Date**: Enter month, date, and year for recurrence to end.
  - **End After**: Enter the number of occurrences after you want recurrence to end.

g. Click **Start**.

Click the notifications icon to view the scheduled Discovery. Before Discovery starts, you can click **Edit** to edit it, or **Cancel** to cancel it.

The **Discoveries** window displays the results of your scan.

The **Discovery Details** pane shows the status (active or inactive) and the Discovery configuration. The **Discovery Devices** pane displays the host names, IP addresses, and status of the discovered devices.

Discover Your Network Using LLDP

You can discover devices using Link Layer Discovery Protocol (LLDP), CDP, or an IP address range. This procedure shows you how to discover devices and hosts using LLDP.

Note

- Discovery requires the correct SNMP read-only community string. If one is not provided, Discovery uses the default SNMP read-only community string, public, as a *best effort*.
- CLI credentials are not required to discover hosts; hosts are discovered through the network devices to which they are connected.

Before you begin

- Enable LLDP on your network devices.
- Configure your network devices, as described in Discovery Prerequisites, on page 34.
- Configure your network device's host IP address as the client IP address. (A host is an end-user device, such as a laptop computer or mobile device.)

Step 1 Click the menu icon (☰) and choose **Tools** > **Discovery**.

Step 2 In the **Discovery** window, click **Add Discovery**.

Step 3 In the **Discovery Name** field of the **New Discovery** window, enter a name.

Step 4 If the **IP Address/Range** area is not already visible, expand it and configure the following fields:

- **Discovery Type**: Enable LLDP by clicking the **LLDP** radio button.
- **IP Address**: Enter a seed IP address for Cisco DNA Center to start the Discovery scan.

- **Subnet Filters**: Exclude an IP address or subnet from the Discovery scan. To exclude an IP address, enter an individual IP address (*x.x.x.x*). To exclude a subnet, enter a classless inter-domain routing (CIDR) address (*x.x.x.x/y*), where *x.x.x.x* is the IP address and *y* is the subnet mask. The subnet mask can be a value from 0 to 32.

  To exclude more IP addresses and subnets, click the add icon (⊕).

- **LLDP Level**: Enter the number of hops from the seed device that you want to scan.

  Valid values are from 1 to 16. The default value is 16. For example, CDP level 3 means that CDP will scan up to three hops from the seed device.

- **Preferred Management IP Address**: Click one of the following radio buttons:
  - **None**: Allow the device to use any of its IP addresses.
  - **Use Loopback IP**: Specify the device loopback interface IP address.

    Note If you choose **Use Loopback IP** and the device does not have a loopback interface, Cisco DNA Center chooses a management IP address using the logic described in Preferred Management IP Address, on page 37.

    Note To use the loopback interface IP address as the preferred management IP address, make sure that the IP address of the LLDP neighbor is reachable from Cisco DNA Center.

Step 5 Expand the **Credentials** area and configure the credentials that you want to use for the Discovery job.

Choose any of the global credentials that have already been created, or configure your own Discovery credentials. If you configure the credentials, you can choose to save them for future jobs by checking the **Save as global settings** check box.

a) Make sure that the global credentials that you want to use are selected. If you do not want to use a credential, deselect it.
b) To add additional credentials, click **Add Credentials**.
c) For CLI credentials, configure the following fields:

Table 12: CLI Credentials

Field	Description
Name/Description	Name or phrase that describes the CLI credentials.
Username	Name that is used to log in to the CLI of the devices in your network.
Password	Password that is used to log in to the CLI of the devices in your network. For security reasons, re-enter the password as confirmation. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.
Enable Password	Password used to move to a higher privilege level in the CLI. Configure this password only if your network devices require it. For security reasons, re-enter the enable password. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.

d) Click **SNMP v2c** and configure the following fields:

Table 13: SNMPv2c Credentials

Field	Description
Read	• **Name/Description**: Name or description of the SNMPv2c settings that you are adding. • **Read Community**: Read-only community string password used only to view SNMP information on the device. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.
Write	• **Name/Description**: Name or description of the SNMPv2c settings that you are adding. • **Write Community**: Write community string used to make changes to the SNMP information on the device. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.

e) (Optional) Click **SNMP v3** and configure the following fields:

Table 14: SNMPv3 Credentials

Field	Description
Name/Description	Name or description of the SNMPv3 settings that you are adding.
Username	Name associated with the SNMPv3 settings.
Mode	Security level that an SNMP message requires. Choose one of the following modes: • **noAuthNoPriv**: Does not provide authentication or encryption. • **AuthNoPriv**: Provides authentication, but does not provide encryption. • **AuthPriv**: Provides both authentication and encryption.
Auth Type	Authentication type to be used. (Enabled if you select **AuthPriv** or **AuthNoPriv** as **Mode**.) Choose one of the following authentication types: • **SHA**: Authentication based on HMAC-SHA. • **MD5**: Authentication based on HMAC-MD5.

Field	Description
Auth Password	SNMPv3 password used for gaining access to information from devices that use SNMPv3. These passwords (or passphrases) must be at least eight characters in length. **Note** • Some wireless controllers require that passwords (or passphrases) be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.
Privacy Type	Privacy type. (Enabled if you select **AuthPriv** as **Mode**.) Choose one of the following privacy types: • **AES128**: 128-bit CBC mode AES for encryption. • **AES192**: 192-bit CBC mode AES for encryption. • **AES256**: 256-bit CBC mode AES for encryption. **Note** • Discovery and Inventory features support only AES192 and AES256 privacy types. • Cisco DNA Assurance does not support any of these privacy types.
Privacy Password	SNMPv3 privacy password that is used to generate the secret key for encrypting messages that are exchanged with devices that support AES128, AES192, and AES256 encryption standards. Passwords (or passphrases) must be at least eight characters long. **Note** • Some wireless controllers require that passwords (or passphrases) be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.

f) (Optional) Click **SNMP PROPERTIES** and configure the following fields:

Table 15: SNMP Properties

Field	Description
Retries	Number of times Cisco DNA Center tries to communicate with network devices using SNMP.
Timeout	Number of seconds between retries.

g) (Optional) Click **HTTP(S)** and configure the following fields:

Table 16: HTTP(S) Credentials

Field	Description
Type	Specifies the kind of HTTPS credentials you are configuring. Valid types are **Read** or **Write**.
Read	You can configure up to 10 HTTPS read credentials: • **Name/Description**: Name or description of the HTTPS credentials that you are adding. • **Username**: Name used to authenticate the HTTPS connection. • **Password**: Password used to authenticate the HTTPS connection. Passwords are encrypted for security and are not displayed in the configuration. • **Port**: Number of the TCP/UDP port used for HTTPS traffic. The default is port number 443 (the well-known port for HTTPS). The password must contain between 7 and 128 characters, including at least one of the following: • Lowercase letter (a to z) • Uppercase letter (A to Z) • Number (0 to 9) • Special character: # _ * ? – The password cannot contain spaces or angle brackets (< >). Note that some Cisco IOS XE devices do not allow a question mark (?).
Write	You can configure up to 10 HTTPS write credentials: • **Name/Description**: Name or description of the HTTPS credentials that you are adding. • **Username**: Name used to authenticate the HTTPS connection. • **Password**: Password used to authenticate the HTTPS connection. Passwords are encrypted for security and are not displayed in the configuration. • **Port**: Number of the TCP/UDP port used for HTTPS traffic. The default is port number 443 (the well-known port for HTTPS). The password must contain between 7 and 128 characters, including at least one of the following: • Lowercase letter (a to z) • Uppercase letter (A to Z) • Number (0 to 9) • Special character: # _ * ? – The password cannot contain spaces or angle brackets (< >). Note that some Cisco IOS XE devices do not allow a question mark (?).

Step 6 (Optional) To configure the protocols to be used to connect with devices, expand the **Advanced** area and do the following tasks:

a) Click the names of the protocols that you want to use. A green check mark indicates that the protocol is selected. Valid protocols are **SSH** (default) and **Telnet**.
b) Drag and drop the protocols in the order that you want them to be used.

Step 7 Click **Discover**.

The **Discover Devices** slide-in pane appears.

Step 8 To run the discovery now, click the **Now** radio button and click **Start**.

If you want to discover only new devices, click the **Discover only new devices** toggle button.

Step 9 To schedule the discovery for a later time, do the following:

a. Click the **Later** radio button.

b. Define the start date and time.

c. From the **Time Zone** drop-down list, choose a time zone.

d. In the **Recurrence** area, click **None**, **Daily**, or **Weekly**.

- **None**: Discovery will not recur.
- **Daily**: Enter the interval in days in the **Run at Interval (Days)** field.
- **Weekly**: Enter the interval in weeks in the **Run at Interval (Weeks)** field.

e. If you have chosen **Daily** or **Weekly** for recurrence, check the **Set Schedule End** check box to define the end date and time.

Note You can discover only new devices in recurrence. The **Discover only new devices** toggle button at the top is enabled by default.

f. Click **End Date** or **End After**.

- **End Date**: Enter month, date, and year for recurrence to end.
- **End After**: Enter the number of occurrences after you want recurrence to end.

g. Click **Start**.

Click the notifications icon to view the scheduled Discovery. Before Discovery starts, you can click **Edit** to edit it, or **Cancel** to cancel it.

The **Discoveries** window displays the results of your scan.

The **Discovery Details** pane shows the status (active or inactive) and the Discovery configuration. The **Discovery Devices** pane displays the host names, IP addresses, and status of the discovered devices.

Manage Discovery Jobs

The following sections provide information about how to manage the Discovery jobs.

Stop and Start a Discovery Job

Step 1 Click the menu icon (≡) and choose **Tools** > **Discovery**.

Step 2 In the **Discovery** window, click **View All Discoveries**.

Step 3 To stop an active Discovery job, perform these steps:

a) In the left **Discoveries** pane, click a Discovery job.
b) In the bottom pane, on the right side, click **Stop**.

Step 4 To restart an inactive Discovery job, perform these steps:

a) In the left **Discoveries** pane, click a Discovery job.
b) In the bottom pane, on the right side, click **Re-discover**.

Edit a Discovery Job

You can edit an existing Discovery job and then rerun the Discovery job.

Step 1 Click the menu icon (≡) and choose **Tools** > **Discovery**.

Step 2 In the **Discovery** window, click **View All Discoveries**.

Step 3 From the **Discoveries** pane, select the Discovery job.

Step 4 Click **Edit**.

Step 5 Depending on the Discovery type, you can change the type of job, except for the following fields:

- **CDP**: Discovery name, Discovery type, IP address. For more information about the fields you can change, see Discover Your Network Using CDP, on page 38.
- **IP Range**: Discovery name, type, IP address range (although you can add additional IP address ranges). For more information about the fields you can change, see Discover Your Network Using an IP Address Range, on page 45.
- **LLDP**: Discovery name, type, IP address. For more information about the fields you can change, see Discover Your Network Using LLDP, on page 51.

Step 6 Click **Start**.

Change Credentials in a Discovery Job

You can change the credentials used in a Discovery job and then rerun the Discovery job.

Before you begin

You should have created at least one Discovery job.

Step 1 Click the menu icon (≡) and choose **Tools** > **Discovery**.

Step 2 In the **Discovery** window, click **View All Discoveries**.

Step 3 From the **Discoveries** pane, select the Discovery job.

Step 4 Click **Edit**.

Step 5 Expand the **Credentials** area.

Step 6 Deselect the credentials that you do not want to use.

Step 7 Configure the credentials that you want to use:

a) Click **Add Credentials**.

b) To configure CLI credentials, configure the following fields:

Table 17: CLI Credentials

Field	Description
Name/Description	Name or phrase that describes the CLI credentials.
Username	Name that is used to log in to the CLI of the devices in your network.
Password	Password that is used to log in to the CLI of the devices in your network. For security reasons, re-enter the password as confirmation. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.
Enable Password	Password used to move to a higher privilege level in the CLI. Configure this password only if your network devices require it. For security reasons, re-enter the enable password. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.

c) Click **SNMP v2c** and configure the following fields:

Table 18: SNMPv2c Credentials

Field	Description
Read	• **Name/Description**: Name or description of the SNMPv2c settings that you are adding. • **Read Community**: Read-only community string password used only to view SNMP information on the device. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.
Write	• **Name/Description**: Name or description of the SNMPv2c settings that you are adding. • **Write Community**: Write community string used to make changes to the SNMP information on the device. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.

d) (Optional) Click **SNMP v3** and configure the following fields:

Table 19: SNMPv3 Credentials

Field	Description
Name/Description	Name or description of the SNMPv3 settings that you are adding.
Username	Name associated with the SNMPv3 settings.
Mode	Security level that an SNMP message requires. Choose one of the following modes: • **noAuthNoPriv**: Does not provide authentication or encryption. • **AuthNoPriv**: Provides authentication, but does not provide encryption. • **AuthPriv**: Provides both authentication and encryption.
Auth Type	Authentication type to be used. (Enabled if you select **AuthPriv** or **AuthNoPriv** as **Mode**.) Choose one of the following authentication types: • **SHA**: Authentication based on HMAC-SHA. • **MD5**: Authentication based on HMAC-MD5.
Auth Password	SNMPv3 password used for gaining access to information from devices that use SNMPv3. These passwords (or passphrases) must be at least eight characters in length. **Note** • Some wireless controllers require that passwords (or passphrases) be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.
Privacy Type	Privacy type. (Enabled if you select **AuthPriv** as **Mode**.) Choose one of the following privacy types: • **AES128**: 128-bit CBC mode AES for encryption. • **AES192**: 192-bit CBC mode AES for encryption. • **AES256**: 256-bit CBC mode AES for encryption. **Note** • Discovery and Inventory features support only AES192 and AES256 privacy types. • Cisco DNA Assurance does not support any of these privacy types.

Field	Description
Privacy Password	SNMPv3 privacy password that is used to generate the secret key for encrypting messages that are exchanged with devices that support AES128, AES192, and AES256 encryption standards. Passwords (or passphrases) must be at least eight characters long. **Note** • Some wireless controllers require that passwords (or passphrases) be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.

Step 8 Click **Start**.

Clone a Discovery Job

You can clone a Discovery job and retain all the information defined for that job.

Before you begin

You should have run at least one Discovery job.

Step 1 Click the menu icon (≡) and choose **Tools** > **Discovery**.

Step 2 In the **Discovery** window, click **View All Discoveries**.

Step 3 In the left **Discoveries** pane, click a Discovery job.

Step 4 In the bottom pane, on the right side, click **Copy & Edit**.

Cisco DNA Center creates a copy of the Discovery job, named Clone of *Discovery_Job*.

Step 5 (Optional) To change the name of the Discovery job, replace the default name in the **Discovery Name** field with a new name.

Step 6 Define or update the parameters for the new Discovery job.

Delete a Discovery Job

You can delete a Discovery job whether it is active or inactive.

Step 1 Click the menu icon (≡) and choose **Tools** > **Discovery**.

Step 2 In the **Discovery** window, click **View All Discoveries**.

Step 3 In the left **Discoveries** pane, click the Discovery job that you want to delete.

Step 4 In the bottom pane, on the right side, click **Delete**.

Step 5 Click **OK** to confirm.

View Discovery Job Information

You can view information about a Discovery job, such as the settings and credentials that were used. You also can view the historical information about each Discovery job that was run, including information about the specific devices that were discovered or that failed to be discovered.

Before you begin

Run at least one Discovery job.

Step 1 Click the menu icon (☰) and choose **Tools** > **Discovery**.

Step 2 In the **Discovery** window, click **View All Discoveries**.

Step 3 In the left **Discoveries** pane, select the Discovery job. Alternatively, use the **Search** function to find a Discovery job by device IP address or name.

Step 4 Click the down arrow next to one of the following areas for more information:

- **Discovery Details**: Displays the parameters that were used to run the Discovery job. Parameters include attributes such as the CDP or LLDP level, IP address range, and protocol order.
- **Credentials**: Provides the names of the credentials that were used.
- **History**: Lists each Discovery job that was run, including the time the job started, and whether any devices were discovered.

  To successfully discover embedded wireless controllers, the NETCONF port must be configured. If the NETCONF port is not configured, wireless data is not collected.

  Use the **Filter** function to display devices by any combination of IP addresses or ICMP, CLI, HTTPS, or NETCONF values.

CHAPTER 5

Manage Your Inventory

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About Inventory

The Inventory function retrieves and saves details, such as host IP addresses, MAC addresses, and network attachment points about devices in its database.

The Inventory feature can also work with the Device Controllability feature to configure the required network settings on devices, if these settings are not already present on the device.

Inventory uses the following protocols, as required:

- Link Layer Discovery Protocol (LLDP).
- IP Device Tracking (IPDT) or Switch Integrated Security Features (SISF). (IPDT or SISF must be enabled on the device.)
- LLDP Media Endpoint Discovery. (This protocol is used to discover IP phones and some servers.)
- Network Configuration Protocol (NETCONF). For a list of devices, see Discovery Prerequisites, on page 34.

After the initial discovery, Cisco DNA Center maintains the inventory by polling the devices at regular intervals. The default interval is every 24 hours. However, you can change this interval as required for your network environment. For more information, see Update the Device Polling Interval, on page 98. Also, a configuration change in the device triggers an SNMP trap, which in turn triggers device resynchronization. Polling occurs for each device, link, host, and interface. Only the devices that have been active for less than one day are displayed. This prevents stale device data, if any, from being displayed. On average, polling 500 devices takes approximately 20 minutes.

Inventory and Cisco ISE Authentication

Cisco ISE has two different use cases in Cisco DNA Center:

- If your network uses Cisco ISE for device authentication, you need to configure the Cisco ISE settings in Cisco DNA Center. As a result, when provisioning devices, Cisco DNA Center configures the devices with the Cisco ISE server information that you defined. In addition, Cisco DNA Center configures the devices on the Cisco ISE server and propagates subsequent updates to the devices. For information about configuring Cisco ISE settings in Cisco DNA Center, see Configure Global Network Servers, on page 173.

Note If you are using Cisco ISE for authenticating Cisco Catalyst 9800 series devices, you must configure Cisco ISE to provide privilege for NETCONF users.

If a device is not configured or updated on the Cisco ISE server as expected due to a network failure or the Cisco ISE server being down, Cisco DNA Center automatically retries the operation after a certain wait period. However, Cisco DNA Center does not retry the operation if the failure is due to a rejection from Cisco ISE, as an input validation error.

When Cisco DNA Center configures and updates devices in the Cisco ISE server, the transactions are captured in the Cisco DNA Center audit logs. You can use the audit logs to help troubleshoot issues related to the Cisco DNA Center and Cisco ISE inventories.

After you provision a device, Cisco DNA Center authenticates the device with Cisco ISE. If Cisco ISE is not reachable (no RADIUS response), the device uses the local login credentials. If Cisco ISE is reachable, but the device does not exist in Cisco ISE or its credentials do not match the credentials configured in Cisco DNA Center, the device does not fall back to use the local login credentials. Instead, it goes into a partial collection state.

To avoid this situation, make sure that before you provision devices using Cisco DNA Center, you have configured the devices in Cisco ISE with the same device credentials that you are using in Cisco DNA Center. Also, make sure that you configured valid discovery credentials. For more information, see Discovery Credentials, on page 35.

- If required, you can use Cisco ISE to enforce access control to groups of devices.

Display Information About Your Inventory

The **Inventory** table displays information for each discovered device. Click the column header to sort the rows in ascending order. Click the column header again to sort the rows in descending order.

To choose which columns to show or to hide in the table, click ⋮ . Note that the column selection does not persist across sessions.

When you select devices and choose a different view from the **Focus** drop-down list, your selection persists in each new view.

By default, 25 entries are shown in the **Inventory** table. Click **Show More** to view more entries. You can view up to 200 entries in the **Inventory** table.

If there are more than 25 entries in the **Inventory** table and you choose a different view from the **Focus** drop-down list, the number of entries persists in each new view.

Before you begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** window displays the device information gathered during the discovery process. The following table describes the information that is available.

Table 20: Inventory

Column	Description
Device Name	

Column	Description

	Name of the device.
	Click the device name to view the following device details:
	Details: Displays details such as the device name, reachability status, manageability status, IP address, device model, role, uptime, site, and so on.
	• **View Assurance 360**: Displays the **Assurance 360** window. For the window to open, you must have installed the Assurance application.
	• **Interfaces**
	  • **Ethernet Ports** (for all devices): Displays the operational status and administrative status of the Ethernet ports.
	  For Cisco Catalyst 4000 Series, 6000 Series, and 9000 Series switches and Cisco ASR 1000 Series Aggregation Services Routers, the **Ports** view displays the details of line cards and supervisor cards if they are available.
	  Line card details include information about the platform, address, serial number, role, and stack member number. Supervisor card details include information about the part number, serial number, switch number, and slot number.
	  The **Ports** table displays the operational status, admin status, type, MAC address, PoE status, speed, MTU, and description. The table also displays the ID of the following types of VLANs:
	    • VLAN ID of the manufacturing-supplied default VLAN
	    • VLAN ID of the configured default VLAN
	    • VLAN ID of the configured VLAN
	  For Cisco Catalyst 2000, 3000, and 9000 Series switches, either click a port in the **Ports** view or click a port name in the **Ports** table to view the maximum allocated power and power drawn details of that port.
	  • **Neighbor Details**:
	  Click a port in the **Ports** view or a port name in the **Ports** table to view the port details. The **Port Details** window displays the details of the device connected to the port. In the **Neighbor Details** area, the device name, the name of the port to which the device is connected, and the capabilities of the device are shown.
	  The port shows the details of the CDP neighbor. If CDP is not present, the LLDP neighbor details are shown. If both CDP and LLDP neighbors are not present, **Neighbor Details** is hidden from the **Port Details** window.
	  • **Color Code**: This drop-down list catalogs the following views:
	    • **Status**: Displays the default view of Ethernet ports.
	    • **VLANs**: Displays the VLAN assigned to a particular port. The VLANs view allows you to select a maximum of five VLANs and list only the VLANs that are associated with the port.
	    The VLANs view displays the **Selected**, **Not Configured**, **Default**, and **VLAN** color code of the VLAN port mapping.

Column	Description
	• **Port Channels**: Displays the top five port channels configured on the device. The **Port Channels** view displays the **Selected** and the **Port-channel** color code of the configured port channels on the device. • **Port Actions**: • **Clear Mac Address**: You can clear the MAC address of a port. Click a port in the **Ports** view, and then, from the **Port Actions** drop-down list, choose **Clear Mac Address**. • **Port Shut**: You can shut down a port. Click a port in the **Ports** view, and then, from the **Port Actions** drop-down list, choose **Port Shut**. Click **Okay** to confirm. The admin status of the port changes to Down. To change the admin status of the port to Up, from the **Port Actions** drop-down list, choose **Port No Shut**, and click **Okay**. Error-disabled ports are shown in yellow. Click an error-disabled port in the **Ports** view to view the error reason. To activate an error-disabled port, clear the MAC address and shut down the port. • **Port Description**: Click the **Edit** icon next to **PORT DESCRIPTION**, enter a description, click **Save**, and then click **Okay** to add a description to the port. Click the **Delete** icon to delete the description. • **Update VLAN**: Click the **Edit** icon next to **VLAN**, choose a VLAN from the **Edit VLAN** drop-down list, and then click **Save** to update the VLAN. You cannot update VLAN for the ports that have two VLANs preconfigured. • The device software type must be Cisco IOS or Cisco IOS-XE to update a VLAN, add a port description, clear the MAC address, and shut down the port. • For Wireless Controller (WLC) devices, VLAN update, clear MAC address, and port shutdown are not supported. • VLAN update, clear MAC address, and port shutdown are supported only on access ports. • Port shutdown disrupts traffic on the port. • **VLANs** (only for switches and hubs): The VLAN table displays the operational status, admin status, VLAN type, and IP address. The table also displays the ID of the following types of VLANs: • VLAN ID of the manufacturing-supplied default VLAN • VLAN ID of the configured default VLAN • VLAN ID of the configured VLAN Click the **Search** or **Filter** to view the details of a VLAN.

Column	Description
	• **Virtual Ports** (only for wireless devices, controllers, and routers): The Ports table displays the operational status, admin status, type, MAC address, PoE status, speed, and MTU. Click the **Search** or **Filter** to view the details of ports. • **Hardware and Software**: Displays the hardware and software details of the device. • **Configuration**: Displays detailed configuration information that is similar to what is displayed in the output of the **show running-config** command. This feature is not supported for APs and wireless controllers. Therefore, configuration data is not returned for these device types. • **Power**: Displays details about the power budgeted for, power consumed by, and power remaining for the device. The **Power Supplies** table shows the operational status, serial number, and vendor equipment type details. • **Fans**: Displays the operational status, serial number, and vendor equipment type of fans. • **SFP Modules**: Displays the details of the platform, serial number, manufacturer, and ports to which Small Form-Factor Pluggable (SFP) modules are connected. Click **Search** or **Filter** to view the details of ports. • **User Defined Fields**: Displays the user-defined fields associated with the device. • **Config Drift**: Displays the configuration changes and allows you to pick any two versions of the same device and compare their running configuration data. **Note** Running configuration data is not supported for devices such as wireless or legacy controllers. • **Wireless Info**: Displays the primary and secondary managed locations. • **Mobility**: Displays the mobility group name, RF group name, virtual IP, and mobility MAC address. **Note** A device name that is displayed in red means that inventory has not polled the device and updated its information for more than 30 minutes.
IP Address	IP address of the device.

Column	Description

Support Type	Shows the device support level as follows:
	• **Supported**: The device pack is tested for all applications on Cisco DNA Center. You can open a service request if any of the Cisco DNA Center functionalities for these devices do not work.
	• **Limited**: The Device Pack for legacy devices is tested only for the following features on Cisco DNA Center.
	  • Discovery
	  • Topology
	  • Device Reachability
	  • Config Change Audit
	  • Inventory - Support is provided for device details such as Device name, IP Address, Support Type, Device Family, Site, Reachability, MAC Address, Device Role, Image Version, Uptime, Last Sync Status, Last Updated, Serial Number, Device Series, and Platform.
	  • Software Image Management - Software Images may not be available for EOL devices on cisco.com. Not recommended for EOL devices.
	  • Template Provisioning - Applicable only for Switches.
	For more information, see Cisco DNA Center Compatibility Matrix.
	• **Unsupported**: All remaining Cisco and third-party devices that are not tested and certified on Cisco DNA Center. You may try out various functionalities on Cisco DNA Center for these devices, as a best effort. However, we do not expect you to raise a service request or a bug if Cisco DNA Center features do not work as expected.
	• **Third Party**: Device pack is built by customers or business partners and goes through the certification process. Third-party devices will support base automation capabilities such as Discovery, Inventory, Topology, and so on. Cisco TAC provides an initial level of support for these devices. However, if there is a problem with the device pack, you need to contact the business partner.

Reachability	The following is a list of the various statuses: • **Reachable**: The device is reachable by Cisco DNA Center using SNMP, HTTP(S), and NETCONF polling. • **Ping Reachable**: The device is reachable by Cisco DNA Center using ICMP polling and not reachable using SNMP, HTTP(S), and NETCONF polling. • **Unreachable**: The device is not reachable using SNMP, HTTP(S), NETCONF, or ICMP polling.

Column	Description
Manageability	Shows the device status as follows: - **Managed with green tick icon**: Device is reachable and is fully managed. - **Managed with orange error icon**: Device is managed with some error such as unreachable, authentication failure, missing NETCONF ports, internal error, and so on. You can hover the cursor over the error message to view more details about the error and the impacted applications. - **Unmanaged**: Device cannot be reached and no inventory information was collected due to device connectivity issues.
MAC Address	MAC address of the device.
Image Version	Cisco IOS software that is currently running on the device.
Platform	Cisco product part number.
Serial Number	Cisco device serial number.
Uptime	Period of time that the device has been up and running.
Device Role	Role assigned to each discovered device during the scan process. The device role is used to identify and group devices according to their responsibilities and placement within the network. If Cisco DNA Center is unable to determine a device role, it sets the device role to Unknown. **Note** If you manually change the device role, the assignment remains static. Cisco DNA Center does not update the device role even if it detects a change during a subsequent device resynchronization. If required, you can use the drop-down list in this column to change the assigned device role. The following device roles are available: - **Unknown** - **Access** - **Core** - **Distribution** - **Border Router**
Site	The site to which the device is assigned. Click **Assign** if the device is not assigned to any site. Click **Choose a Site**, select a site from the hierarchy, and click **Save**. For more information, see Network Hierarchy Overview, on page 121.
Last Updated	Most recent date and time that Cisco DNA Center scanned the device and updated the database with new information about the device.
Device Family	Group of related devices, such as routers, switches, hubs, or wireless controllers.
Device Series	Series number of the device, such as Cisco Catalyst 4500 Series Switches.

Column	Description
Resync Interval	The polling interval for the device. This interval can be set globally in Settings or for a specific device in Inventory. For more information, see the *Cisco DNA Center Administrator Guide*.
Last Sync Status	Status of the last Discovery scan for the device: • **Managed**: Device is in a fully managed state. • **Partial Collection Failure**: Device is in a partial collected state and not all the inventory information has been collected. Hover the cursor over the **Information (i)** icon to display additional information about the failure. • **Unreachable**: Device cannot be reached and no inventory information was collected due to device connectivity issues. This condition occurs when periodic collection takes place. • **Wrong Credentials**: If device credentials are changed after adding the device to the inventory, this condition is noted. • **In Progress**: Inventory collection is occurring.
AP Ethernet Mac Address	Displays details about the AP Ethernet MAC address.
AP CDP Neighbors	Displays details about the switch and port connected to an AP in the inventory listing page. The inventory listing page displays the information about AP CDP neighbors, even if the connected access switch is managed by Cisco DNA Center.

Manage User-Defined Fields

User-defined fields are custom labels that you can create and assign to any device in Cisco DNA Center. These labels allow you to display more details about the device in the device details page. For a user-defined field to be displayed, you must assign it to a device and add a value to it.

Create User-Defined Fields

Cisco DNA Center allows you to create user-defined fields and assign them to any device.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** page displays the device information that is gathered during the discovery process.

Step 2 From the **Actions** drop-down list, choose **Provision** > **Inventory** > **Manage User Defined Fields**.

Step 3 In the **Manage User Defined Fields** dialog box, click **Create New Field**.

Step 4 In the **Create New Field** dialog box, enter a name and description for user-defined field in the **Field Name** and **Field Description** fields.

Note You can add device details that are not already present in the device details page, such as customer IP address and customer device name, in user-defined fields.

Step 5 Click **Save**.

Similarly, you can create more user-defined fields. The user-defined fields appear in a table.

Step 6 If you want to edit a user-defined field, click the corresponding edit icon, make the required changes, and click **Save**.

Step 7 If you want to delete a user-defined field, click the corresponding delete icon and click **Yes** in the subsequent warning message.

Add User-Defined Fields to a Device

Before you begin

You must have created at least one user-defined field in the **Manage User Defined Fields** window. See Create User-Defined Fields, on page 72.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** page displays the device information that is gathered during the discovery process.

Step 2 Click the name of the device for which you want to add user-defined fields.

Step 3 In the left pane, click **User Defined Fields**.

Step 4 Click **Add**.

Step 5 From the **Field Name** drop-down list, choose a user-defined field and enter its value in the **Value** field.

For example, if you created a user-defined field for the customer IP address, choose it in the **Field Name** drop-down list, and enter the customer IP address in the **Value** field.

Step 6 If you want to remove a user-defined field from the device, click the corresponding delete icon.

Step 7 Click **Save**.

Launch Topology Map from Inventory

You can launch the Topology map for the discovered devices from the Inventory window.

Step 1 Click the menu icon (≡) and choose **Provisioning** > **Inventory**.

Step 2 Use the Toggle button to switch between the Topology map view and the Inventory view. The Topology map view displays the topology and the provisioning status of the device. Click on each node to view the device details. See About Topology for more information on Topology map.

Note Click **Collapse All** or **Expand All** to collapse and expand the Topology map view.

Types of Devices in the Cisco DNA Center Inventory

Devices show up in inventory one of two ways: by being discovered or by being added manually. Cisco DNA Center Inventory supports the following types of devices:

- **Network Devices**: Supported network devices include Cisco routers, switches, and wireless devices such as wireless controllers (WLCs) and access points (APs).
- **Compute Devices**: Supported compute devices include the Cisco Unified Computing System (UCS), devices running Cisco Enterprise Network Functions Virtualization Infrastructure Software (NFVIS), and other data center devices.
- **Meraki Dashboard**: Dashboard to the Cisco cloud management platform for managing Cisco Meraki products.
- **Firepower Management Center (FMC)**: Provides complete and unified management over Firepower Threat Defense (FTD) devices for managing Cisco network security solutions.

For a complete list of supported devices, see the Cisco DNA Center Compatibility Matrix.

Manage Network Devices

Add a Network Device

You can add a network device to your inventory manually.

Before you begin

Make sure you configure your network device. For more information, see Discovery Prerequisites, on page 34.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information that is gathered during the Discovery process.

Step 2 Click **Add Device**.

Step 3 From the **Type** drop-down list, choose **Network Device**.

Step 4 In the **Device IP / DNS Name** field, enter the IP address or name of the device.

Note If the device uses HSRP protocol, you must enter the primary IP address and not the virtual IP address.

Step 5 Expand the **CLI** area, if it is not already expanded, and do one of the following:

a) Click the **Select global credential** radio button if you want to use the global CLI credentials that have been already created.

Note If no CLI global credentials are available, create the global CLI credentials in the **Network Settings > Device Credentials** page. See Configure Global CLI Credentials.

b) Click the **Add device specific credential** radio button and configure the following fields:

Table 21: CLI Credentials

Field	Description
Username	Name that is used to log in to the CLI of the devices in your network.
Password	Password that is used to log in to the CLI of the devices in your network. For security reasons, re-enter the password as confirmation. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.
Enable Password	Password used to move to a higher privilege level in the CLI. For security reasons, re-enter the enable password. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.

Step 6 Expand the **SNMP** area, if it is not already visible and do one of the following:

a) Click the **Select global credential** radio button if you want to use the global SNMP credentials that have been already created.

Note If no SNMP global credentials are available, create the global SNMP credentials in the **Network Settings** > **Device Credentials** page. See Configure Global SNMPv2c Credentials and Configure Global SNMPv3 Credentials.

b) Click the **Add device specific credential** radio button and do the following:

Step 7 From the **Version** drop-down list, choose **V2C** (SNMP Version 2c) or **V3** (SNMP Version 3).

If you chose **V2C**, configure the following fields:

Table 22: SNMPv2c Credentials

Field	Description
Read	• **Name/Description**: Name or description of the SNMPv2c settings that you are adding. • **Read Community**: Read-only community string password used only to view SNMP information on the device. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.
Write	• **Name/Description**: Name or description of the SNMPv2c settings that you are adding. • **Write Community**: Write community string used to make changes to the SNMP information on the device. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.

If you chose **V3**, configure the following fields:

Table 23: SNMPv3 Credentials

Field	Description
Name/Description	Name or description of the SNMPv3 settings that you are adding.
Username	Name associated with the SNMPv3 settings.
Mode	Security level that an SNMP message requires. Choose one of the following modes: • **noAuthNoPriv**: Does not provide authentication or encryption. • **AuthNoPriv**: Provides authentication, but does not provide encryption. • **AuthPriv**: Provides both authentication and encryption.
Auth Type	Authentication type to be used. (Enabled if you select **AuthPriv** or **AuthNoPriv** as **Mode**.) Choose one of the following authentication types: • **SHA**: Authentication based on HMAC-SHA. • **MD5**: Authentication based on HMAC-MD5.
Auth Password	SNMPv3 password used for gaining access to information from devices that use SNMPv3. These passwords (or passphrases) must be at least eight characters in length. **Note** • Some wireless controllers require that passwords (or passphrases) be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.
Privacy Type	Privacy type. (Enabled if you select **AuthPriv** as **Mode**.) Choose one of the following privacy types: • **AES128**: 128-bit CBC mode AES for encryption. • **AES192**: 192-bit CBC mode AES for encryption. • **AES256**: 256-bit CBC mode AES for encryption. **Note** • Discovery and Inventory features support only AES192 and AES256 privacy types. • Cisco DNA Assurance does not support any of these privacy types.

Field	Description
Privacy Password	SNMPv3 privacy password that is used to generate the secret key for encrypting messages that are exchanged with devices that support AES128, AES192, and AES256 encryption standards. Passwords (or passphrases) must be at least eight characters long. **Note** • Some wireless controllers require that passwords (or passphrases) be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.

Step 8 Expand the **SNMP RETRIES AND TIMEOUT** area, if it is not already expanded, and configure the following fields.

Table 24: SNMP Properties

Field	Description
Retries	Number of attempts allowed to connect to the device. Valid values are from 1 to 3. The default is 3.
Timeout	Number of seconds Cisco DNA Center waits when trying to establish a connection with a device before timing out. Valid values are from 1 to 300 seconds in intervals of 5 seconds. The default is 5 seconds.

Step 9 Expand the **HTTP(S)** area, if it is not already visible, and do one of the following:

a) Click the **Select global credential** radio button if you want to use the global HTTP(S) credentials that have been already created.

Note If no HTTP(S) global credentials are available, create the global HTTP(S) credentials in the **Network Settings** > **Device Credentials** page. See Configure Global HTTPS Credentials.

b) Click the **Add device specific credential** radio button and configure the following fields:

Table 25: HTTP(S)

Field	Description
Username	Name that is used to log in to the HTTP(S) of the devices in your network.
Password	Password that is used to log in to the HTTP(S) of the devices in your network. For security reasons, re-enter the password as confirmation. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.
Port	Specify the required http(s) port number.

Step 10 Expand the **NETCONF** area, if it is not already expanded, and configure the **Port** field.

NETCONF requires that you configure SSH as the CLI protocol and define the SSH credentials.

Step 11 Select one of the network **Protocol** radio button that enables Cisco DNA Center to communicate with remote devices. Valid values are **SSH2** or **Telnet**.

Step 12 (Optional) Click **Validate** next to **Credentials**. Cisco DNA Center validates the device credentials and shows valid credentials with a green tick mark and invalid credentials with a red cross mark.

All the credentials will be validated except the SNMP Write credentials.

Step 13 Click **Add**.

Update Network Device Credentials

You can update the discovery credentials of selected network devices. The updated settings override the global and job-specific settings for the selected devices.

Before you begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

Step 1 Click the menu icon (☰) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information gathered during the Discovery process.

Step 2 Select the network devices that you want to update.

Step 3 From the **Actions** drop-down list, choose **Inventory** > **Edit Device**.

Step 4 In the **Edit Device** dialog box, choose **Network Device** from the **Type** drop-down field, if it is not already selected.

Step 5 Expand the **CLI** area, if it is not already expanded, and do one of the following:

a) If you want to use the global CLI credentials that have been already created, click the **Select global credential** radio button.

Note If no CLI global credentials are available, create them in the **Network Settings** > **Device Credentials** page. See Configure Global CLI Credentials.

b) Click the **Edit device specific credential** radio button and configure the following fields:

Table 26: CLI Credentials

Field	Description
Username	Name that is used to log in to the CLI of the devices in your network.
Password	Password that is used to log in to the CLI of the devices in your network. For security reasons, re-enter the password as confirmation. Passwords are encrypted for security reasons and are not displayed in the configuration.

Field	Description
Enable Password	Password that is used to move to a higher privilege level in the CLI. For security reasons, re-enter the enable password. Passwords are encrypted for security reasons and are not displayed in the configuration.

Step 6 Expand the **SNMP** area, if it is not already expanded, and do one of the following:

a) If you want to use the global SNMP credentials that have been already created, click the **Select global credential** radio button.

Note If no SNMP global credentials are available, create them in the **Network Settings** > **Device Credentials** page. See Configure Global SNMPv2c Credentials and Configure Global SNMPv3 Credentials.

b) Click the **Edit device specific credential** radio button and do the following:

Step 7 From the **Version** drop-down list, choose **V2C** (SNMP Version 2c) or **V3** (SNMP Version 3).

If you chose **V2C**, configure the following fields:

Table 27: SNMPv2c Credentials

Field	Description
Read	• **Name/Description**: Name or description of the SNMPv2c settings that you are adding. • **Read Community**: Read-only community string password used only to view SNMP information on the device. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.
Write	• **Name/Description**: Name or description of the SNMPv2c settings that you are adding. • **Write Community**: Write community string used to make changes to the SNMP information on the device. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.

If you chose **V3**, configure the following fields:

Table 28: SNMPv3 Credentials

Field	Description
Name/Description	Name or description of the SNMPv3 settings that you are adding.
Username	Name associated with the SNMPv3 settings.

Field	Description
Mode	Security level that an SNMP message requires. Choose one of the following modes: • **noAuthNoPriv**: Does not provide authentication or encryption. • **AuthNoPriv**: Provides authentication, but does not provide encryption. • **AuthPriv**: Provides both authentication and encryption.
Auth Type	Authentication type to be used. (Enabled if you select **AuthPriv** or **AuthNoPriv** as **Mode**.) Choose one of the following authentication types: • **SHA**: Authentication based on HMAC-SHA. • **MD5**: Authentication based on HMAC-MD5.
Auth Password	SNMPv3 password used for gaining access to information from devices that use SNMPv3. These passwords (or passphrases) must be at least eight characters in length. **Note** • Some wireless controllers require that passwords (or passphrases) be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.
Privacy Type	Privacy type. (Enabled if you select **AuthPriv** as **Mode**.) Choose one of the following privacy types: • **AES128**: 128-bit CBC mode AES for encryption. • **AES192**: 192-bit CBC mode AES for encryption. • **AES256**: 256-bit CBC mode AES for encryption. **Note** • Discovery and Inventory features support only AES192 and AES256 privacy types. • Cisco DNA Assurance does not support any of these privacy types.
Privacy Password	SNMPv3 privacy password that is used to generate the secret key for encrypting messages that are exchanged with devices that support AES128, AES192, and AES256 encryption standards. Passwords (or passphrases) must be at least eight characters long. **Note** • Some wireless controllers require that passwords (or passphrases) be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.

Step 8 Expand the **SNMP RETRIES AND TIMEOUT** area, if it is not already expanded, and configure the following fields.

Table 29: SNMP Properties

Field	Description
Retries	Number of attempts allowed to connect to the device. Valid values are from 1 to 3. The default is 3.
Timeout	Number of seconds Cisco DNA Center waits when trying to establish a connection with a device before timing out. Valid values are from 1 to 300 seconds in intervals of 5 seconds. The default is 5 seconds.

Step 9 Expand the **HTTP(S)** area, if it is not already expanded, and do one of the following:

a) If you want to use the global HTTP(S) credentials that have been already created, click the **Select global credential** radio button.

Note If no HTTP(S) global credentials are available, create them in the **Network Settings** > **Device Credentials** page. See Configure Global HTTPS Credentials.

b) Click the **Edit device specific credential** radio button and configure the following fields:

Table 30: HTTP(S)

Field	Description
Username	Name that is used to log in to the HTTP(S) of the devices in your network.
Password	Password that is used to log in to the HTTP(S) of the devices in your network. For security reasons, re-enter the password as confirmation. Passwords are encrypted for security reasons and are not displayed in the configuration.
Port	Specify the required HTTP(s) port number.

Step 10 Expand the **NETCONF** area, if it is not already expanded, and configure the **Port** field.

NETCONF requires that you configure SSH as the CLI protocol and define the SSH credentials.

Step 11 Select one of the network **Protocol** radio buttons that enables Cisco DNA Center to communicate with remote devices. Valid values are **SSH2** or **Telnet**.

Step 12 (Optional) Click **Validate** next to **Credentials**. Cisco DNA Center validates the device credentials and shows the valid credentials with green tick mark and invalid credentials with red cross mark.

If you have chosen more than one device for updating the credentials, the **Validation** button will be disabled.

Step 13 Click **Update**.

Security Focus for Network Devices

The Cisco DNA Center security focus allows you to view the results of the trustworthy checks on your devices.

Few security checks are performed to ensure that your Cisco devices are authentic and are not compromised or altered physically.

As a part of device identity verification, following checks are performed:

- Verification of Secure Unique Device Identifier (SUDI) certificate chain.
- Signature verification of SUDI certificate response of the device.
- Product ID verification with the SUDI certificate.
- Serial number verification with the SUDI certificate.

These checks are triggered under the following circumstances:

- Every time Inventory gets collected in the Cisco DNA Center.
- When you make any configuration changes on your devices.
- When you make any image upgrades in your devices.

The following CLI command is used to perform device identity verification check:

```
show platform sudi certificate sign nonce ${randomNonceValue}
```

Perform an Integrity Verification Check

This procedure explains how to view the status of the integrity verification check:

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information that is gathered during the Discovery process.

Step 2 From the **Inventory** drop-down menu, select **Security**.

Step 3 View the device details listed in the table.

Step 4 To customize the table, click the three vertical dots at the end of the table to choose either **Add** or **Delete**.
The **Integrity Verification** column displays the results.

Step 5 If the **Integrity Verification** column for your device displays **Failed** as the status, click the Information icon to display the reason.

The following integrity verification statuses are possible:

- **Passed**: Device identity verification passed.
- **Failed**: Device identity verification failed.
- **Unverified**: Unable to perform verification.
- **Not Available**: The device or software image version does not support verification.

Manage Compute Devices

Add a Compute Device

You can add a compute device to your inventory manually. A compute device includes devices such as the Cisco Unified Computing System (UCS), devices running Cisco Enterprise Network Functions Virtualization Infrastructure Software (NFVIS), and other data center devices.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information gathered during the Discovery process.

Step 2 Click **Add Device**.

Step 3 From the **Type** drop-down list, choose **Compute Device**.

Step 4 In the **Device IP / DNS Name** field, enter the IP address or name of the device.

Step 5 Expand the **HTTP(S)** area, if it is not already expanded, and do one of the following:

a) If you want to use the global HTTP(S) credentials that have been already created, click the **Select global credential** radio button.

Note If no HTTP(S) global credentials are available, create them in the **Network Settings** > **Device Credentials** page. See Configure Global HTTPS Credentials.

b) Click the **Add device specific credential** radio button and configure the following fields:

Table 31: HTTP(S)

Field	Description
Username	Name used to authenticate the HTTPS connection.
Password	Password used to authenticate the HTTPS connection.
Port	Number of the TCP/UDP port used for HTTPS traffic. The default is port number 443 (the well-known port for HTTPS).

Step 6 Expand the **CLI** area, if it is not already expanded, and do one of the following:

a) If you want to use the global CLI credentials that have been already created, click the **Select global credential** radio button.

Note If no CLI global credentials are available, create them in the **Network Settings** > **Device Credentials** page. See Configure Global CLI Credentials.

b) Click the **Add device specific credential** radio button and configure the following fields:

Table 32: CLI Credentials

Field	Description
Username	Name that is used to log in to the CLI of the devices in your network.

Field	Description
Password	Password that is used to log in to the CLI of the devices in your network. For security reasons, re-enter the password as confirmation. Passwords are encrypted for security reasons and are not displayed in the configuration.
Enable Password	Password that is used to move to a higher privilege level in the CLI. For security reasons, re-enter the enable password. Passwords are encrypted for security reasons and are not displayed in the configuration.

Step 7 Expand the **SNMP** area, if it is not already expanded, and do one of the following:

a) If you want to use the global SNMP credentials that have been already created, click the **Select global credential** radio button.

Note If no SNMP global credentials are available, create them in the **Network Settings** > **Device Credentials** page. See Configure Global SNMPv2c Credentials and Configure Global SNMPv3 Credentials.

b) Click the **Add device specific credential** radio button and do the following:

Step 8 From the **Version** drop-down list, choose **V2C** (SNMP Version 2c) or **V3** (SNMP Version 3).

If you chose **V2C**, configure the following fields:

Table 33: SNMPv2c Credentials

Field	Description
Read	• **Name/Description**: Name or description of the SNMPv2c settings that you are adding. • **Read Community**: Read-only community string password used only to view SNMP information on the device. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.
Write	• **Name/Description**: Name or description of the SNMPv2c settings that you are adding. • **Write Community**: Write community string used to make changes to the SNMP information on the device. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.

If you chose **V3**, configure the following fields:

Table 34: SNMPv3 Credentials

Field	Description
Name/Description	Name or description of the SNMPv3 settings that you are adding.

Field	Description
Username	Name associated with the SNMPv3 settings.
Mode	Security level that an SNMP message requires. Choose one of the following modes: • **noAuthNoPriv**: Does not provide authentication or encryption. • **AuthNoPriv**: Provides authentication, but does not provide encryption. • **AuthPriv**: Provides both authentication and encryption.
Auth Type	Authentication type to be used. (Enabled if you select **AuthPriv** or **AuthNoPriv** as **Mode**.) Choose one of the following authentication types: • **SHA**: Authentication based on HMAC-SHA. • **MD5**: Authentication based on HMAC-MD5.
Auth Password	SNMPv3 password used for gaining access to information from devices that use SNMPv3. These passwords (or passphrases) must be at least eight characters in length. **Note** • Some wireless controllers require that passwords (or passphrases) be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.
Privacy Type	Privacy type. (Enabled if you select **AuthPriv** as **Mode**.) Choose one of the following privacy types: • **AES128**: 128-bit CBC mode AES for encryption. • **AES192**: 192-bit CBC mode AES for encryption. • **AES256**: 256-bit CBC mode AES for encryption. **Note** • Discovery and Inventory features support only AES192 and AES256 privacy types. • Cisco DNA Assurance does not support any of these privacy types.

Field	Description
Privacy Password	SNMPv3 privacy password that is used to generate the secret key for encrypting messages that are exchanged with devices that support AES128, AES192, and AES256 encryption standards. Passwords (or passphrases) must be at least eight characters long. **Note** • Some wireless controllers require that passwords (or passphrases) be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.

Step 9 (Optional) Click **Validate** next to **Credentials**. Cisco DNA Center validates the device credentials and shows the valid credentials with green tick mark and invalid credentials with red cross mark.

All the credentials will be validated except the SNMP Write credentials.

Step 10 Click **Add**.

Update Compute Device Credentials

You can update the discovery credentials of selected compute devices. The updated settings override the global and job-specific settings for the selected devices.

Before you begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information that is gathered during the Discovery process.

Step 2 Select the devices that you want to update.

Step 3 From the **Actions** drop-down list, choose **Inventory** > **Edit Device**.

Step 4 In the **Edit Device** dialog box, from the **Type** drop-down list, choose **Compute Device**.

Step 5 Expand the **HTTP(S)** area, if it is not already expanded.

Step 6 In the **Username** and **Password** fields, enter the username and password.

Step 7 In the **Port** field, enter the port number.

Step 8 (Optional) Click **Validate** next to **Credentials**. Cisco DNA Center validates the device credentials and shows valid credentials with a green tick mark and invalid credentials with a red cross mark.

If you have chosen more than one device for updating the credentials, the **Validation** button is disabled.

Step 9 Click **Update**.

Manage Meraki Dashboards

Integrate the Meraki Dashboard

You can integrate your Meraki dashboard with Cisco DNA Center.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information that is gathered during the Discovery process.

Step 2 Click **Add Device**.

Step 3 In the **Add Device** dialog box, from the **Type** drop-down list, choose **Meraki Dashboard**.

Step 4 Expand the **HTTP(S)** area, if it is not already expanded.

Step 5 In the **API Key/Password** field, enter the API key and password credentials and click the **Get Organization details** link.

Step 6 From the **Organization** drop-down list, select the organization options, or search for an organization name.

Step 7 (Optional) Click **Validate** next to **Credentials**. Cisco DNA Center validates the device credentials and shows valid credentials with a green tick mark and invalid credentials with a red cross mark.

Step 8 Click **Add**.

Only the selected organizations start collecting for the Meraki dashboard and devices.

Update Meraki Dashboard Credentials

You can update the Meraki dashboard credentials of selected devices. The updated settings override the global and job-specific settings for the selected devices.

Before you begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information that is gathered during the Discovery process.

Step 2 Select the devices that you want to update.

Step 3 From the **Actions** drop-down list, choose **Inventory** > **Edit Device**.

Step 4 In the **Edit Device** dialog box, from the **Type** drop-down list, choose **Meraki Dashboard**.

Step 5 Expand the **HTTP(S)** area, if it is not already expanded.

Step 6 In the **API Key / Password** field, enter the API key and password credentials used to access the Meraki dashboard.

Step 7 In the **Port** field, enter the port number.

Step 8 (Optional) Click **Validate** next to **Credentials**. Cisco DNA Center validates the device credentials and shows valid credentials with a green tick mark and invalid credentials with a red cross mark.

If you have chosen more than one device for updating the credentials, the **Validation** button is disabled.

Step 9 Click **Update**.

Manage Firepower Management Center

Integrate Firepower Management Center

You can integrate your Firepower Management Center (FMC) with Cisco DNA Center.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information that is gathered during the discovery process.

Step 2 Click **Add Device**.

Step 3 In the **Add Device** dialog box, from the **Type** drop-down list, choose **Firepower Management Center**.

Step 4 In the **Device IP / DNS Name** field, enter the IP address or name of the device.

Step 5 Expand the HTTP(S) area if it is not already expanded.

The **Add device specific credential** radio button is chosen by default.

Step 6 Enter the following information:

a) **Username**: Name used to authenticate the HTTPS connection.
b) **Password**: Password used to authenticate the HTTPS connection. Passwords are encrypted for security and are not displayed in the configuration.
c) **Port**: The number of the TCP/UDP port used for HTTPS traffic. The default port number is 443.

Step 7 Click **Add**.

Note When you add FMC to inventory, the Firepower Threat Defense (FTD) devices managed by FMC are also added to inventory automatically.

Update Firepower Management Center Credentials

Cisco DNA Center allows you to update the Firepower Management Center (FMC) credentials. The updated settings override the global and job-specific settings for the selected devices.

Before you begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information that is gathered during the discovery process.

Step 2 Choose the FMC device that you want to update.

Note You cannot update, edit, or delete the Firepower Threat Defense (FTD) devices that are managed by FMC. You must manage FTD devices via FMC in inventory.

Step 3 From the **Actions** drop-down list, choose **Inventory** > **Edit Device**.

The **Edit Device** dialog box appears.

Step 4 Click **Credentials**.

Step 5 Expand the HTTP(S) area if it is not already expanded.

The **Add device specific credential** radio button is chosen by default.

Step 6 Enter the following information:

a) **Username**: Name used to authenticate the HTTPS connection.
b) **Password**: Password used to authenticate the HTTPS connection. Passwords are encrypted for security and are not displayed in the configuration.
c) **Port**: The number of the TCP/UDP port used for HTTPS traffic. The default port number is 443.

Step 7 Click **Management IP** and enter the IP address or name of the device in the **Device IP / DNS Name** field.

Step 8 Click **Resync Interval** and choose a resync interval type:

- **Custom**: You can enter the resync interval in minutes. The valid ranges are from 25 to 1440 minutes (24 hours).
- **Global**: By default, resync interval is set to 1440 minutes (24 hours).
- **Disable**: Resync interval is disabled or set to zero.

Step 9 Click **Role** and choose a role in the **Device Role** drop-down list.

Step 10 Click **Update**.

Filter Devices

Note To remove or change the filters, click **Reset**.

Before you begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

Step 1 Click the menu icon (☰) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information that is gathered during the Discovery process.

Step 2 Click **Filter**.

The following types of filters are available:

- Quick Filter
- Advanced Filter
- Recent Filters

Quick Filter: This filter allows you to retrieve the device details based on:

- **Device Family**
- **Device Role**
- **Last Sync Status**
- **Provision Status**
- **Credential Status**
- **OS Updated Status**
- **Image Needs Update**
- **Image Pre Check Status**
- **Support Type**

Advanced Filters: This filter allows you to set the filtering criteria using operators such as Contains, Starts With, Ends With, Equals, Does not contains and Regex (Regular Expression), to narrow down the device details. For example, you can choose the filter pattern by table column names and the operator from the drop-down list. In addition, you must enter filter criteria value based on the available data.

Recent Filters: This filter shows the recently used filters. To save the filter criteria, drag and drop the filters from the RECENT to the SAVED filters.

Step 3 Enter the appropriate value in the selected filter field. For example, for the **Device Name** filter, enter the name of a device.

Cisco DNA Center presents you with autocomplete values as you enter values in the other fields. Choose one of the suggested values or finish entering the desired value.

You also can use a wildcard (asterisk) with these filters. For example, you can enter values with an asterisk at the beginning, end, or in the middle of a string value. Then, press **Enter**.

Step 4 Click **Apply** to filter the information.

The data displayed in the **Devices** table updates automatically according to your filter selection.

Note You can use several filter types and more than one value per filter.

Step 5 (Optional) If needed, add more filters.

To remove a filter, click the **x** next to the corresponding filter value.

Manage Devices in Inventory

The following sections provide information about how to assign devices to sites and manage device tags by using the Inventory window.

Add a Device to a Site

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** window displays the device information gathered during the **Discovery** process.

Step 2 Check the check box for the devices that you want to assign to a site.

Step 3 From the **Actions** menu, choose **Provision** > **Assign Device to Site**.

Step 4 In the **Assign Device to Site** slide-in pane, click the link next to the 🏢 icon for the device.

Step 5 In the **Choose a floor** slide-in pane, select the floor to assign to the device.

Step 6 Click **Save**.

Step 7 (Optional) If you selected multiple devices to add to the same location, you can check the **Apply to All** check box for the first device to assign its location to the rest of the devices.

Step 8 Click **Next**.

Step 9 In the **Task Name** name field, enter a task name of your choice.

Step 10 To immediately assign the device to a site, click the **Now** radio button and click **Assign**.

Step 11 To schedule the device assignment to a site for a later date and time, click the **Later** radio button to define the date and time of the deployment and click **Assign**.

Step 12 To preview the CLI configuration, click the **Generate Configuration Preview** radio button and do the following:

- In the **Task Name** name field, enter a task name of your choice and click **Preview**.

  Later, you can use the created configuration preview to deploy to the selected devices.

- In the **Task Submitted** message, click the **Work Items** link.

  Note If you didn't notice the **Task Submitted** message, click the menu icon and choose **Activities** > **Work Items**.

- In the **Work Items** window, click the CLI preview task for which you submitted the configuration preview request.
- View the CLI configuration details and click **Deploy**.
- To immediately deploy the device, click the **Now** radio button, and click **Apply**.
- To schedule the device deployment for a later date and time, click the **Later** radio button and define the date and time of the deployment.
- In the confirmation window, click **Yes**.

  Note The CLI task is marked as completed in the **Work Items** window. You can view the CLI configuration for this task, but you cannot deploy it again.

Step 13 When assigning devices to a site, if Device Controllability is enabled, a workflow is automatically triggered to push the device configuration from the site to the devices.
From the **Focus** drop-down list, choose **Provision** and click **See Details** in the **Provision Status** column. The configuration that is pushed to the device is shown in a separate window if you enabled Device Controllability.

Tag Devices

A device tag allows you to group devices based on an attribute or a rule. A single device can have multiple tags; similarly, a single tag can be applied to multiple devices.

You can add tags to or remove tags from devices in the Provision window.

Step 1 Click the menu icon (≡) and choose **Provision**. The Device Inventory page displays device information gathered during the discovery process.

Step 2 Check the check box next to the device(s) for which you want to apply a tag, and then click **Tag Device**.

Step 3 Enter a tag name in the **Tag Name** field.

- If you are creating a new tag, click **Create New Tag**. You also can create a new tag with a rule. See Tag Devices Using Rules, on page 92.
- If you are using an existing tag, select the tag from the list, and then click **Apply**.

A tag icon and the tag name(s) appear under the device name(s) for which you applied the tag(s).

Step 4 To remove a tag from a device, do one of the following:

- Click **Create New Tag**, unselect all tags, and then click **Apply**.
- Hover the cursor over the tag icon or tag name, and then click **X** to disassociate the tag from the device.

Tag Devices Using Rules

You can group devices based on tags in which you define a rule. When you define a rule, Cisco DNA Center automatically applies the tag to all devices that match the specified rule. Rules can be based on device name, device family, device series, IP address, location, or version.

Step 1 Click the menu icon (≡) and choose **Provision**. The Device Inventory page displays device information gathered during the discovery process.

Step 2 Check the check box next to the device(s) for which you want to apply a tag, then click **Tag Device**.

Step 3 Enter a tag name in the **Tag Name** field, then click **Create New Tag with Rule**.

The Create New Tag window appears.

The **Manually Added** field under **Total Devices Tagged Count** indicates the number of devices you selected.

Step 4 Click **Add Condition**, then complete the required fields for the rule.

The **Matching Devices** number automatically changes to indicate how many devices match this condition.

You can have two options to create additional conditions:

- *And* conditions: Click the **Add Condition** link. **And** appears above the condition.
- *Or* conditions: Click the add icon (+) next to an existing condition. **Or** appears next to the condition.

You can add as many conditions as needed. As you make changes to the rule, the Matching Devices count changes to reflect how many devices in the inventory match the rule you specified. You can click on the device number to view the devices that match the rule.

Step 5 Click **Save** to save your tag with the defined rule.

A tag icon and the tag name(s) appear under the device name(s) for which you applied the tag(s).

As devices are added to the inventory, if they match the rules you defined, the tag is automatically applied to the devices.

Edit Device Tags

You can edit device tags that you previously created.

Step 1 Click the menu icon (≡) and choose **Provision**. The Device Inventory page displays device information gathered during the discovery process.

In the **Device Name** column, you can see any previously created device tags listed under the device names.

Step 2 Without selecting any devices, click **Tag Device**.

The previously created tags are listed.

Step 3 Hover your cursor over the tag you want to edit, then click the pencil icon next to the tag name.

Alternatively, you can select **Tag Device** > **View All Tags**, then click the pencil icon next to the tag that you want to edit.

Step 4 Make changes to the tag, then click **Save**.

Delete Tags

You can delete a device tag or template tag only if it is not associated with a device or template.

Before you begin

Remove the tag that is associated statically or dynamically (using rules) with the device.

Remove the tag that is associated with a template.

Step 1 Click the menu icon (≡) and choose **Provision**.

The Device Inventory page displays device information gathered during the discovery process.

Step 2 Without selecting any devices, choose **Tag Device** > **Manage Tags**.

Step 3 Hover your cursor over the tag that you want to delete, then click the delete icon next to the tag name.

Step 4 At the prompt, click **Yes**.

An error message is generated if the tag is associated with a device or template. Remove the tag associated with the device or template and delete the tag.

Maintenance Mode for Devices

Schedule Maintenance for Devices

You can place one or more devices under maintenance mode in Cisco DNA Center. If a device is placed under maintenance mode, Cisco DNA Center will not process any telemetry data associated with the device. By placing faulty devices under maintenance mode, you can avoid receiving unnecessary alerts from the devices.

Note From the devices in maintenance mode, you cannot collect any information and perform polling operations.

While scheduling the maintenance mode for Cisco Wireless Controllers and APs, note the following:

- When you schedule maintenance for a Cisco Wireless Controller, all the APs associated with the wireless controller are moved under maintenance mode with the same schedule.
- When a wireless controller is in maintenance mode, you cannot modify the maintenance schedule of a single AP associated with the wireless controller. A warning message saying that the device is already scheduled for maintenance is displayed. If you modify the schedule of the wireless controller, then all the APs under the wireless controller will be impacted.
- When an AP moves from one wireless controller to another, the maintenance mode is impacted as below:
  - If the AP is moving from a wireless controller which is in maintenance mode to a wireless controller which is not under maintenance, then the AP will not have maintenance mode after moving.
  - If the AP is moving from a wireless controller which is not in maintenance mode to a wireless controller which is under maintenance, then the AP will be in maintenance mode after moving.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** page displays the device information that is gathered during the discovery process.

Step 2 Choose the devices that you want to schedule maintenance.

Step 3 From the **Actions** drop-down list, choose **Inventory** > **Schedule Maintenance**.

The **Schedule Maintenance** slide-in pane appears.

Step 4 In the **Reason For Maintenance** field, enter a reason for placing the device under maintenance mode.

By default, Cisco DNA Center adds a reason, and you can modify it.

Step 5 In the **Define Maintenance Window** area, do the following:

a) Choose the start date and time for maintenance.
b) Choose the end date and time for maintenance.
c) Alternately, click **Days/Hours** and enter days and hours for maintenance.

Note: To choose recurrence for maintenance, choose **Days/Hours** option.

Step 6 In the **Maintenance Recurrence** area, click **None**, **Daily**, or **Weekly**.

- **None**: Maintenance will not recur.
- **Daily**: Enter the interval in days in the **Run at Interval (Days)** field.
- **Weekly**: Enter the interval in weeks in the **Run at Interval (Weeks)** field.

Step 7 If you have chosen **Daily** or **Weekly** for recurrence, check the **Set Schedule End** check box.

Step 8 Click **End Date** or **End After (Occurrences)**.

- **End Date**: Enter month, date, and year for maintenance end.
- **End After (Occurrences)**: Enter the number of occurrences after you want maintenance to end.

Step 9 In the **Maintenance Time Zone** area, choose time zone for maintenance.

Step 10 Click **Submit**.

Manage Maintenance Schedule for Devices

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

Step 2 From the **Actions** drop-down list, choose **Inventory** > **Manage Maintenance**.

The **Manage Maintenance** slide-in pane appears. The **Status** column shows the current status of maintenance schedules.

Step 3 Click the **Search** or **Filter** icon to search or filter maintenance schedules.

Step 4 In the **Actions** column, click the **Edit** icon to edit the maintenance schedule.

Note For in-progress maintenance schedules, you can only extend the maintenance end time.

Step 5 Click the **Delete** icon in the **Actions** column to delete the maintenance schedule.

Note You cannot delete in-progress maintenance schedules.

Inventory Insights

The **Inventory Insights** window displays devices that have configuration inconsistencies with other directly-connected devices. It also displays devices that are misconfigured, as compared with the Cisco DNA Center best-practice recommendations. Cisco DNA Center provides the following insights with suggested actions:

- Speed/Duplex settings mismatch
- VLAN mismatch

Speed/Duplex Settings Mismatch

Cisco DNA Center displays the devices that are connected with each other but configured with different speed and duplex values at the two ends of a device link.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory Insights**.

The **Inventory Insights** window appears.

Step 2 Click **Speed/Duplex settings mismatch** to see the suggested actions that can be performed on devices.

The suggested actions appear in the right pane.

Step 3 Click the number of instances to see the mismatches.

The **Speed/Duplex settings mismatch** window highlights the mismatches of speed and duplex.

Step 4 Make the required changes in the device configuration by following the suggested actions.

VLAN Mismatch

Cisco DNA Center displays the devices that are connected with each other but configured with different VLANs at the two ends of a device link.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory Insights**.

The **Inventory Insights** window appears.

Step 2 Click **VLAN Mismatch** to see the suggested actions that can be performed on devices.

The suggested actions appear in the right pane.

Step 3 Click the number of instances to see the mismatches.

The **VLAN Mismatch** window highlights the mismatches of Allowed VLAN and Native VLAN.

Step 4 Make the required changes in the device configuration by following the suggested actions.

Change the Device Role (Inventory)

During the Discovery process, Cisco DNA Center assigns a role to each of the discovered devices. Device roles are used to identify and group devices and to determine a device's placement on the network topology map in the Topology tool. The top tier is the internet. The devices underneath are assigned one of the following roles:

Table 35: Device Roles and Topology Positions

Topology Position	Device Role
Tier 1	Internet (not configurable)
Tier 2	Border Router
Tier 3	Core
Tier 4	Distribution
Tier 5	Access
Tier 6	Unknown

Note When you assign the **Access** role to a device, IP Device Tracking (IPDT) is either configured or removed from the device based on the IPDT settings of the Site.

Before you begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information gathered during the Discovery process.

Step 2 Locate the device whose role you want to change, click the pencil icon under the **Device Role** column, and choose a role from the **Update Device Role** dialog box. Valid choices are **Unknown**, **Access**, **Core**, **Distribution**, or **Border Router**.

Alternatively, you can update the device role in the **Edit Device** dialog box:

- Select the device whose role you want to change.
- Choose **Actions** > **Inventory** > **Edit Device**.
- Click the **Role** tab and choose an appropriate role from the **Device Role** drop-down list.

Note If you manually change the device role, the assignment remains static. Cisco DNA Center does not update the device role even if it detects a change during a subsequent device resynchronization.

Update a Device's Management IP Address

You can update the management IP address of a device.

Note You cannot update more than one device at a time. Also, you cannot update a Meraki device's management IP address.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information that is gathered during the Discovery process.

Step 2 Select the device that you want to update.

Step 3 From the **Actions** drop-down list, choose **Inventory** > **Edit Device**.

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

Step 4 Click the **Management IP** tab, and enter the new management IP address in the **Device IP/ DNS Name** field.

Note Make sure that the new management IP address is reachable from Cisco DNA Center and that the device credentials are correct. Otherwise, the device might enter an unmanaged state.

What to do next

Reprovision the device to update the source-interface configuration.

Update the Device Polling Interval

You can update the polling interval at the global level for all devices by choosing **System** > **Settings** > **Network Resync Interval** or at the device level for a specific device by choosing **Device Inventory**. When you set the polling interval using the **Network Resync Interval**, that value takes precedence over the **Device Inventory** polling interval value.

If you do not want a device to be polled, you can disable polling.

Before you begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

Step 2 Select the devices that you want to update.

Step 3 Click **Update Polling Interval**.

Step 4 From the **Update Resync Interval** dialog box, in the **Status** field, click **Enabled** to turn on polling or click **Disabled** to turn off polling.

Step 5 In the **Polling Time** field, enter the time interval (in minutes) between successive polling cycles. Valid values are from 25 to 1440 minutes (24 hours).

Note The device-specific polling time supersedes the global polling time. If you set the device-specific polling time and then change the global polling time, Cisco DNA Center continues to use the device-specific polling time.

Step 6 Click **Update**.

Resynchronize Device Information

You can immediately resynchronize device information for selected devices, regardless of their resynchronization interval configuration. A maximum of 40 devices can be resynchronized at the same time.

Step 1 Click the menu icon (☰) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information gathered during the Discovery process.

Step 2 Select the devices about which you want to gather information.

Step 3 From the **Actions** drop-down list, choose **Inventory** > **Resync Device**.

Step 4 Click **OK**.

Delete a Network Device

You can delete devices from the Cisco DNA Center database, as long as they have not already been added to a site.

When you remove a wireless sensor from the inventory, the sensor is reset to the factory defaults so that when it rejoins, it gets the current configuration.

Before you begin

You must have administrator (ROLE_ADMIN) permissions and access to all devices (RBAC Scope set to ALL) to perform this procedure.

Step 1 Click the menu icon (☰) and choose **Provision** > **Network Devices** > **Inventory**.
The **Inventory** window displays the device information gathered during the **Discovery** process.

Step 2 Check the check box next to the device or devices that you want to delete.

Note You can select multiple devices by checking additional check boxes, or you can select all the devices by checking the check box at the top of the list.

Step 3 From the **Actions** drop-down list, choose **Inventory** > **Delete Device**.

Step 4 In the **Warning** window, check the **Config Clean-Up** check box to remove the network settings and telemetry configuration from the selected device.

Step 5 Confirm the action by clicking **OK**.

Launch Command Runner (Inventory)

You can launch the Command Runner application for selected devices from within the **Inventory** window.

Before you begin

Install the Command Runner application. For more information, see the *Cisco DNA Center Administrator Guide*.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information that is gathered during the Discovery process.

Step 2 Select the devices on which you want to run commands.

Step 3 From the **Actions** drop-down list, choose **Others** > **Launch Command Runner**.

For information about the commands that you can run and how to run them, see Run Diagnostic Commands on Devices, on page 349.

Troubleshoot Device Reachability Issues Using Run Commands

You can launch the **Run Commands** window from the **Inventory** window and run platform commands such as ping, traceroute, and snmpget to troubleshoot device reachability issues.

Note If you want to execute the platform commands directly on a Cisco DNA Center cluster, do not select any device before launching **Run Commands**. Otherwise, the execution of commands will be for that device and not the platform.

Before you begin

Install the Command Runner application. For more information, see the *Cisco DNA Center Administrator Guide*.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

Step 2 From the **Actions** drop-down list, choose **Others** > **Run Commands**.

You can enter `man` anytime to retrieve a list of currently supported commands and shortcuts.

Use a CSV File to Import and Export Device Configurations

CSV File Import

You can use a CSV file to import your device configurations or sites from another source into Cisco DNA Center. If you want to download a sample template, go to the Provision Devices page and choose **Actions** > **Inventory** > **Import Inventory**. Click **Download Template** to download a sample CSV file template.

When you use a CSV file to import device or site configurations, the extent to which Cisco DNA Center can manage your devices depends on the information you provide in the CSV file. If you do not provide values for CLI username, password, and enable password, Cisco DNA Center will have limited functionality and cannot modify device configurations, update device software images, or perform any other valuable functions.

You can specify the credential profile in the CSV file to apply the corresponding credentials to a set of devices. If you specify the credential profile and also enter the values manually in the CSV file, the manually entered credentials take higher priority and the device is managed based on a combination of manually entered credentials and credential profile. For example, if the CSV file contains a credential profile with SNMP and SSH or Telnet credentials in addition to manually entered SNMP credentials, the device is managed based on the manually entered SNMP credentials and the SSH or Telnet credentials in the credential profile. Telnet is not recommended.

Note You also must provide values for the fields that correspond to the protocol you specify. For example, if you specify SNMPv3, you must specify values for the SNMPv3 fields in the sample CSV file such as the SNMPv3 username and authorization password.

For partial inventory collection in Cisco DNA Center, you must provide the following values in the CSV file:

- Device IP address
- SNMP version
- SNMP read-only community strings
- SNMP write community strings
- SNMP retry value
- SNMP timeout value

For full inventory collection in Cisco DNA Center, you must provide the following values in the CSV file:

- Device IP address
- SNMP version
- SNMP read-only community strings
- SNMP write community strings
- SNMP retry value
- SNMP timeout value
- Protocol

- CLI username
- CLI password
- CLI enable password
- CLI timeout value

CSV File Export

Cisco DNA Center enables you to create a CSV file that contains all or selected devices in the inventory. When you create this file, you must enter a password to protect the configuration data that the file will contain.

Import Device Configurations from a CSV File

You can import device configurations from a CSV file.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information gathered during the Discovery process.

Step 2 From the **Actions** drop-down list, choose **Inventory** > **Import Inventory** to import the device credentials.

Step 3 Drag and drop the CSV file into the boxed area in the **Bulk Import** dialog box or click the dotted-line boxed area and browse to the CSV file.

Step 4 Click **Import**.

Export Device Data

You can export specific data pertaining to selected devices to a CSV file. The CSV file is compressed. Click **Export** to export the data of filtered devices or all devices.

Caution Handle the CSV file with care because it contains sensitive information about the exported devices. Ensure that only users with special privileges perform a device export.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information gathered during the Discovery process.

Step 2 To export configuration information for only certain devices, check the check box next to the devices that you want to include. To include all devices, check the check box at the top of the device list.

Step 3 From the **Actions** drop-down list, choose **Inventory** > **Export Inventory** to export the device configurations.

The **Export Inventory** dialog box appears.

Step 4 In the **Password** field, enter a password that will be used to encrypt the exported CSV file.

Note The password is required to open the exported file.

Step 5 Confirm the encryption password.

Step 6 Check the **Include SSH key information** check box to include information such as initial SSH key, initial SSH key algorithm, current SSH key, and current SSH key algorithm in the exported CSV file.

Step 7 Click **Export**.

Note Depending on your browser configuration, you can save or open the compressed file.

Export Device Credentials

You can export device credentials to a CSV file. You are required to configure a password to protect the file from unwanted access. You need to supply the password to the recipient so that the file can be opened.

Caution Handle the CSV file with care because it lists all of the credentials for the exported devices. Ensure that only users with special privileges perform a device export.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information that is gathered during the Discovery process.

Step 2 Check the check box next to the devices that you want to include in the CSV file. To include all the devices, select the check box at the top of the list.

Step 3 From the **Actions** drop-down list, choose **Inventory** > **Export Inventory**.

The **Export** dialog box appears.

Step 4 In **Select Export Type**, click the **Credentials** radio button.

Step 5 Check the **Include SSH key information** check box to include information such as initial SSH key, initial SSH key algorithm, current SSH key, and current SSH key algorithm in the exported CSV file.

Step 6 In the **Password** field, enter a password that will be used to encrypt the exported CSV file.

Note The password is required to open the exported file.

Step 7 Confirm the encryption password and click **Export**.

Note Depending on your browser configuration, you can save or open the compressed file.

View Configuration Drift of a Device

Configuration changes made on your device are saved in the internal Cisco DNA Center server. You can view detailed information about config changes made to the device from outside Cisco DNA Center.

Step 1 Click the menu icon (≡) and choose **Provision** > **Inventory**.

Step 2 Click the device name.

The **Device Details** window appears.

Step 3 In the left pane, choose **Config Drift**.

The **Configuration Changes** window shows the number of configuration drifts saved, which includes labeled configs and config drift versions.

Step 4 Expand the **Change History** tab to view the following details:

a) **Config drift date range**: Click the **Start Date** and **End date** to choose the date range for which you want to view the config drift. By default, the start and end dates are set to display the config drift for the last 15 days.

b) **Config drift timeline graph**: Shows the config drift for the chosen date range. By default, the last 15 days of config drift are shown in the timeline graph.

The timeline graph shows the following details:

- **In-band Config Drift**: Configuration changes done by Cisco DNA Center are shown as a blue bubble in the timeline graph.
- **Out-of-band Config Drift**: Configuration changes done outside Cisco DNA Center are shown as a purple bubble in the timeline graph.
- **Labeled Config**: The config version labeled and archived in Cisco DNA Center is shown as an orange bubble in the timeline graph. For more information, see Label Configuration Drift.

c) **Config Drift Version**: Click the down arrow to view all the available config drift versions.

d) **Running Config**: Click the config drifts on the timeline graph. The comparison is shown under the **Running Config** tab. The differences between the config versions are marked in different colors for better visibility.

Label Configuration Drift

You can label the config drift on the time-line graph for future reference.

Step 1 Click the menu icon (≡) and choose **Provision** > **Inventory**.

Step 2 In the **Inventory** window, click the device name to view device details.

Step 3 From the left side pane, choose **Config Drift** tab. The **Configuration Changes** window appears.

Step 4 Choose the config drift in time-line graph that you want to label. The timestamp of the chosen config drift is shown in the **Config Drift Version** below the time-line graph.

Step 5 Click **Label Config** corresponding to the chosen config drift version.

Step 6 In the **Label Configuration** window, enter a name for the config version. The prefix of label config is fixed as CCA_.

Note Do not use special characters for config version name.

Step 7 Click **Save**. The labeled config drift is shown in orange in the time-line graph.

If the number of labeled config version is greater than the chosen range, change the total number of config drifts to be saved. For more information on how to configure number of config drifts to be saved, see the "Configure Device Configuration Backup Settings" section in the *Cisco DNA Center Administrator Guide*.

Step 8 To remove the label, select the labeled config version and click **Remove label**.

Replace a Faulty Device

Replacing devices that fail in the network is a critical part of device lifecycle management. The Return Material Authorization (RMA) workflow in Cisco DNA Center lets you replace failed devices quickly, thus improving productivity and reducing operational expense. RMA provides a common workflow to replace routers, switches, and APs.

When using the RMA workflow with routers and switches, the software image, configuration, and license are restored from the failed device to the replacement device. For wireless APs, the replacement device is assigned to the same site, provisioned with primary wireless LAN controller, RF profile, and AP group settings, and placed on the same floor map location in Cisco DNA Center as the failed AP.

Note You can also replace a faulty device using the **Replace Device** workflow. For more details, see Replace Device Workflow, on page 681.

Before you begin

- The software image version of the faulty device must be imported in the image repository before marking the device for replacement.
- The faulty device must be in an unreachable state.
- If the replacement device onboards Cisco DNA Center through Plug and Play (PnP), the faulty device must be assigned to a user-defined site.
- The replacement device must not be in a provisioning state while triggering the RMA workflow.

Step 1 To mark a faulty device for replacement, do the following:

a) Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

   The **Inventory** window displays the device information that is gathered during the Discovery process.

b) Select the faulty device that you want to replace.
c) From the **Actions** drop-down list, choose **Inventory** > **Device Replacement** > **Mark Device for Replacement**.
d) In the **Mark for Replacement** window, click **Mark**.

Note To achieve seamless replacement of fabric devices, a DHCP server is configured on the neighbor device. This is required to assign an IP address to the replacement device for onboarding the device to Cisco DNA Center through PnP. This DHCP server is removed after successful replacement of the faulty device.

The latest configuration changes from the faulty device are pushed to the replaced device during the RMA workflow.

e) From the **Inventory** drop-down list, choose **Marked for Replacement**.

A list of devices marked for replacement is displayed.

f) (Optional) If you do not want to replace the device, select the device and choose **Actions** > **Unmark for Replacement**.

Step 2 (Optional) To replace the device, do the following:

a) Select the device that you want to replace and choose **Actions** > **Replace Device**.

b) In the **Choose Replacement Device** window, choose a replacement device from the **Unclaimed** tab or **Managed** tab.

The **Unclaimed** tab shows the devices that are onboarded through PnP. The **Managed** tab shows the devices that are onboarded through Inventory or Discovery process.

c) (Optional) If the replacement device is not yet onboarded, do the following:

1. In the **Choose Replacement Device** window, click **Add Device**.
2. In the **Add New Device** window, enter the **Serial Number** of the device and click **Add New Device**.

Or

1. In the **Choose Replacement Device** window, click **Sync with Smart Account**.
2. In the **Sync with Smart Account** window, click **Sync**.

d) Click **Next**.

e) In the **Schedule Replacement** window, click **Now** to start the device replacement immediately or click **Later** to schedule the device replacement at a specific time.

If the replacement device is not yet onboarded, the **Now** option is disabled. You can click **Later** to schedule the device replacement at a specific time.

f) Click **Review** to the view the chosen device type, faulty device details, and replacement device details.

g) Click **Next** to view the details in the **Summary** window.

h) In the **Summary** window, do the following:

1. Click **Edit** if you want to change the device type, faulty device, or replacement device chosen in the previous steps.
2. Under **Replacement Device**, click **View** to view the configuration of the replacement device.
3. Click **Replace**.

i) Click **Monitor Replacement Status** to go to the **Mark for Replacement** view in the **Provision** window.

j) Click **Replace Status** for the replacement device to view the status of the RMA workflow progress, as follows:

- Claim the (PnP) replacement device.
- Distribute and activate the software image to the replacement device.

- Deploy licenses.
- Provision VLAN configurations.
- Provision startup configurations.
- Reload the replacement device.
- Check for reachability of the replacement device.
- Deploy SNMPv3 credentials to the replacement device.
- Synchronize the replacement device.
- Remove the faulty device from CSSM.
- Add the replacement device to CSSM.
- Revoke and create the PKI certificate.
- Update Cisco ISE.
- Delete the faulty device.

After the workflow is complete, the **Replace Status** is updated to **Replaced**.

k) If an error message appears, click the error link.
l) Click **Retry** to retrigger the workflow with the same set of faulty and replacement devices.

Note The main inventory window displays the details of the new replacement device that has replaced the faulty device.

The preceding tasks of marking the device for replacement and replacing the device can be done at different times.

Replace a Faulty Access Point

Using the AP RMA feature, you can replace a faulty AP with a replacement AP available in the device inventory.

Before you begin

- The AP Return Material Authorization (RMA) feature supports only like-to-like replacement. The replacement AP must have the same model number and PID as the faulty AP.
- The replacement AP must have joined the same Cisco Wireless Controller as the faulty AP.
- A Cisco Mobility Express AP that acts as the wireless controller is not a candidate for the replacement AP.
- The software image version of the faulty AP must be imported in the image repository before marking the device for replacement.
- The faulty device must be assigned to a user-defined site if the replacement device onboards Cisco DNA Center through Plug and Play (PnP).

- The replacement AP must not be in provisioning state while triggering the RMA workflow.
- The faulty device must be in an unreachable state.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** page displays the device information that is gathered during the Discovery process.

Step 2 Check the check box of the faulty AP that you want to replace.

Step 3 From the **Actions** drop-down list, choose **Device Replacement** > **Mark Device for Replacement**.

Step 4 In the **Mark for Replacement** window, click the radio button next to the faulty device name.

Step 5 From the **Actions** drop-down list, choose **Replace Device**.

Step 6 In the **Replace Device** window, click **Start**.

Step 7 In the **Available Replacement Devices** table, click the radio button next to the replacement device name.

Step 8 Click **Next**.

Step 9 Review the **Replacement Summary** and then click **Next**.

Step 10 In the Schedule Replacement window, select whether to replace the device now, or schedule the replacement for a later time, and then click **Submit**.

The RMA workflow begins.

Step 11 To monitor the replacement status, under **What's Next**, click **Monitor Replacement Status**.

The **Mark For Replacement** window lists the devices that are marked for replacement.

Check the status of the replacement in the **Replace Status** column, which initially shows **In-Progress**.

Step 12 Click **In-Progress** in the **Replace Status** column.

The **Replace Status** tab shows the various steps that Cisco DNA Center performs as part of the device replacement.

Step 13 In the **Marked for Replacement** window, click **Refresh** and click **Replace Status** to view the replacement status.

If the faulty AP replacement fails, then the **Replace Status** column shows the reason for failure with an error message.

You can either replace the faulty AP with another new AP or retry the failed replacement using the AP RMA Retry feature.

Step 14 To retry the failed replacement, click the error message in the **Replace Status** column against the device name.

Step 15 Click **Retry**.

Step 16 In the **Marked for Replacement** window, click **In-Progress** against the **Replace Status** column.

The **Replace Status** tab shows success after successful replacement of the faulty AP.

Step 17 The **Replace Status** in the **Replacement History** window shows **Replaced** after the faulty device is replaced successfully.

Step 18 (Optional) If you do not want to replace the device, select the device and choose **Actions** > **Unmark for Replacement**.

Limitations of the RMA Workflow in Cisco DNA Center

- RMA supports replacement of similar devices only. For example, a Cisco Catalyst 3650 switch can be replaced only with another Cisco Catalyst 3650 switch. Also, the platform IDs of the faulty and replacement devices must be the same.
- RMA supports replacement of all switches, routers, and Cisco SD-Access devices, *except for the following*:
  - Extended node that is a part of STP ring/Daisy chain.
  - Devices with embedded wireless controllers.
  - Wireless controllers (WLCs).
  - Chassis-based switches, including the Catalyst 4500e, Catalyst 6500, Catalyst 6800, Catalyst 9400, Catalyst 9600, and Nexus 7700 Series Switches.
  - Switch stacks (hardware and SVL stacking).
  - Devices with single and dual supervisor engines.
  - Devices that have third-party certificates.
  - Devices that have external SCEP broker PKI certificates.
- The RMA workflow supports device replacement only if:
  - Both faulty and replacement devices have the same extension cards.
  - The number of ports in both devices does not vary because of the extension cards.
  - The faulty device is managed by Cisco DNA Center with a static IP. (RMA is not supported for devices that are managed by Cisco DNA Center with a DHCP IP, except extended node and AP in fabric.)
- Make sure that the replacement device is connected to the same port to which the faulty device was connected.
- To achieve seamless replacement of fabric devices, a DHCP server is configured on the neighbor device. This is required to assign an IP address to the replacement device for onboarding the device to Cisco DNA Center through PnP. This is supported only for /30 networks. For other networks, you must manually assign the IP to the replacement device and onboard the device to Cisco DNA Center.
- Cisco DNA Center does not support legacy license deployment.

  The RMA workflow deregisters the faulty device from Cisco SSM and registers the replacement device with Cisco SSM.

  - If the software image installed on the faulty device is earlier than Cisco IOS XE 16.8, the **License Details** window does not display the Network and Feature License details and no warning message is displayed. Therefore, you should be aware of the legacy network license configured on the faulty device and manually apply the same legacy network license on the replacement device.
  - If the software image installed on the faulty device is Cisco IOS XE 16.8 or later, the **License Details** window displays details of the network license (for example, **Legacy** or **Network**) and the feature

license (for example, IP Base, IP Service, or LAN Base). The following warning message is displayed while marking the faulty device for replacement:

```
Some of the faulty devices don't have a Cisco DNA license. Please
ensure your replacement device has the same Legacy license of the
faulty device enabled.
```

- If the legacy network licenses of the replacement and faulty devices do not match, the following error message is displayed during the license deployment:

```
Cisco DNA Center doesn't support legacy license deployment. So
manually update the faulty device license on the replacement device
and resync before proceeding.
```

- If the replacement device onboards through PnP-DHCP functionality, make sure that the device gets the same IP address after every reload and the lease timeout of DHCP is longer than two hours.

Reboot the Access Point

Using the AP Reboot feature, you can reboot one or more APs for troubleshooting and maintenance.

Before you begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

Step 2 Check the check box of the APs that you want to reboot.

Step 3 From the **Actions** drop-down list, choose **Inventory** > **Reboot Device**.

Step 4 In the Reboot Device slide-in pane, you are prompted to reboot the AP now or schedule the reboot for a later time.

- To reboot the AP now, click the **Now** radio button, and enter a name for the reboot task.
- To schedule the reboot for a later time, click the **Later** radio button, enter a name for the task, and define the date and time of the reboot.

Step 5 Expand **Selected Devices** to view the AP name and floor details of the reboot AP.

Step 6 Click **Reboot**.

After the Cisco Wireless Controller initiates rebooting the selected APs, a message saying `Reboot Initiated Successfully` is displayed.

Step 7 In the **Task Submitted** pop-up, click the **Task** link.

If you missed the **Task Submitted** pop-up, click the menu icon (≡) and choose **Activities** > **Tasks**.

Step 8 Under AP Reboot, click the AP reboot task name to view the reboot initiation status.

CHAPTER 6

Display Your Network Topology

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- Display the Topology of Areas, Sites, Buildings, and Floors, on page 112
- Filter Devices on the Topology Map, on page 112
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- Assign Devices to Sites, on page 115
- Save a Topology Map Layout, on page 115
- Open a Topology Map Layout, on page 116
- Share a Topology Map Layout, on page 116
- Export the Topology Layout, on page 117

About Topology

The **Topology** window displays a graphical view of your network. Using the Discovery settings that you have configured, Cisco DNA Center discovers the devices in your network and assigns a device role to them. Based on the device role assigned during discovery (or changed in Device Inventory), Cisco DNA Center creates a physical topology map with detailed device-level data.

Using the topology map, you can do the following:

- Display the topology of a selected area, site, building, or floor.
- Display detailed device information.
- Display detailed link information.
- Filter devices based on a specific Layer 2 VLAN.
- Filter devices based on a Layer 3 protocol (such as Intermediate System - Intermediate System [IS-IS], Open Shortest Path First [OSPF], Enhanced Interior Gateway Routing Protocol [EIGRP], or static routing).
- Filter devices with Virtual Routing and Forwarding (VRF) capability.
- Pin devices to the topology map.
- Save a topology map layout.
- Open a topology map layout.

- Export screen shots of the complete topology layout in PNG format.

Display the Topology of Areas, Sites, Buildings, and Floors

You can display the topology of an area, site, building, or floor.

Before you begin

- Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.
- You must have defined a network hierarchy and provisioned devices to the buildings or floors within it.

Step 1 Click the menu icon (≡) and choose **Tools** > **Topology**.

Step 2 In the left tree view menu, select the area, site, building, or floor that you are interested in.

Step 3 Use the Toggle button to switch between the Geographical map view and the Layer 2 map view.

The Geographical map view displays the sites. The nearer sites are grouped together and indicated with the number of sites in the group. The device health is indicated in different colors. Hover over the site to view the detailed device health.

Use the Search field in the top right corner to find a building in the Geographical map view, and a device in the Layer 2 map view.

Note

- Click the ⓘ icon in the lower-right corner to open a legend that shows the available shortcut keys for the topology maps.
- Click the **Toggle Annotate** icon to draw annotations in the Layer 2 map. You can click the export icon to export the topology map along with the annotations.

Step 4 Click **Take a Tour** to know the details of various options available in the Topology page.

Filter Devices on the Topology Map

You can filter devices based on one of the following attributes:

- VLAN
- Routing
- VRF
- Tagging

Before you begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

Step 1 Click the menu icon (≡) and choose **Tools** > **Topology**.

Step 2 Click **Filter**.

Note If you are not able to view the **Filter**, click a site in the left tree view menu.

Step 3 Do one of the following:

- From the **VLAN** drop-down list, choose the VLAN that you want to view.
- From the **Routing** drop-down list, choose the protocol that interests you.
- From the **VRF** drop-down list, choose the VRF that you want to view.
- Click **View All Tags** and choose the tags you want to view. The devices associated with the selected tags will be highlighted. If you want to create a new tag, do the following:

a) Click **Create New Tag**.
b) Enter the **Tag Name**.
c) Click **Save**.

You can also associate a device with the tag by doing the following:

a) Click the device.
b) Click **Tag Device**.
c) Select the tag to which you want to associate the device.
d) Click **Apply**.

Display Device Information

Cisco DNA Center allows you to display the device name, IP address, and software version of devices.

Note The device information that is accessible in the **Topology** window is also accessible in the **Device Inventory** window.

Before you begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

Step 1 Click the menu icon (≡) and choose **Tools** > **Topology**.

Step 2 In the tree view menu, select the area, site, building, or floor that you are interested in.

Step 3 In the topology area, hover your mouse over the device or device group that interests you.

Note A device group is labeled with the number and types of devices it contains. A blue arrow under a switch indicates that switch has a host. Click the blue arrow to view the host.

Step 4 Click **Display** and enable the following items to view additional device details. For more information, hover your mouse over the ⓘ icon next to the items.

- **Device Health**: Displays the health of the devices.
- **Link Health**: Displays the health of the links between the devices.
- **License status**: Displays the license status of the device. Cisco DNA Center highlights a device if its license is about to expire and a warning icon appear next to it. Click the highlighted device to view its license details.
- **Device IP**: Displays device IP address under device label.
- **Device Suffixes**: Displays full name of the device, with its suffix.

Note Topology uses Link Layer Discovery Protocol (LLDP) to determine the neighbor devices when network devices are not configured with Cisco Discovery Protocol (CDP) in Cisco DNA Center.

Display Link Information

Cisco DNA Center allows you to display information about the links in the topology map. For simple links, the display shows information for the single link. For aggregated links, the display shows a listing of all the underlying links. The information includes the interface name, its speed, and its IP address.

Before you begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

Step 1 Click the menu icon (≡) and choose **Tools** > **Topology**.

Step 2 In the tree view menu, select the area, site, building, or floor that you are interested in.

Step 3 Hover your cursor over the link that interests you.

Step 4 Click **Display** and enable **Link Health**.

A down link is shown in red. If you want to delete the link, select it and click **Delete**. You can bring the link up by doing the following:

a) Log in to the device.
b) Enable the interface.
c) Resynchronize the device on the Inventory page.

Note Topology uses Link Layer Discovery Protocol (LLDP) to determine the links for devices that are discovered using LLDP in Cisco DNA Center.

Pin Devices to the Topology Map

Devices can be grouped or aggregated so that they take up less room on the map. However, at times, you might want to separate a device from its group. You can do this by pinning a device to the map.

Before you begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

Step 1 Click the menu icon (≡) and choose **Tools** > **Topology**.

Step 2 Do one of the following:

- To pin a device, click the device group, and in the dialog box, click the pin icon to the left of the device name.
- To pin all the devices, click the device group, and, in the dialog box, click **Pin All**.

Note Double click the group to unpin the devices in the group.

Assign Devices to Sites

Devices can be assigned to specific sites using the topology map.

Before you begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

Step 1 Click the menu icon (≡) and choose **Tools** > **Topology**.

Step 2 Click **Unassigned Devices** in the left pane. All the unassigned devices are displayed in the topology area.

Step 3 Click the device for which you want to assign a site. Device details are displayed in a pop-up window. In the **Assign devices to:** section, click the **choose the location** drop-down list to select a location.

Step 4 (Optional) To assign the site only for the selected device and not for the connected (downstream) devices, uncheck the **Auto-assign unclaimed downstream devices** check box.

Step 5 Click **Assign**.

Save a Topology Map Layout

Cisco DNA Center has a Cisco recommended topology layout that is displayed by default when you open the topology tool. You can customize multiple layouts and save them to view later. You can also set one of the layouts as the default to be displayed when you open the topology map.

Before you begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

Step 1 Click the menu icon (≡) and choose **Tools** > **Topology**.

Step 2 Click **Custom View**.

Step 3 In the **Enter View Title** field, enter a name for your customized map.

Step 4 Click **Save**.

Step 5 (Optional) To set your customized map as the default, click **Make Default**.

Open a Topology Map Layout

You can open previously saved topology maps.

Before you begin

You should have saved topology map layouts.

Step 1 Click the menu icon (≡) and choose **Tools** > **Topology**.

Step 2 Click **Custom View**.

Step 3 Click the name of the map that you want to display.

Share a Topology Map Layout

You can share a customized map with other users.

Before you begin

- You must have topology map layouts saved.
- You must have at least one topology view saved.

Step 1 Click the menu icon (≡) and choose **Tools** > **Topology**.

Step 2 Click **Custom View**.

Step 3 Hover the cursor over the name of the custom map and click the **Share Focus** icon.

Step 4 In the confirmation window, click **Yes**.

Export the Topology Layout

You can export a snapshot of the full topology layout. The snapshot is downloaded as a SVG, PDF, PNG file to your local machine.

Before you begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

Step 1 Click the menu icon (≡) and choose **Tools** > **Topology**.

Step 2 Click ⇪ (this icon represents **Export Topology**).

Step 3 Select a file format and click **Export**.

PART III

Design Your Network

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- Configure Network Settings, on page 171
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CHAPTER 7

Design the Network Hierarchy

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- Manage Sites in Your Network Hierarchy, on page 122
- Manage Buildings in Your Network Hierarchy, on page 127
- Manage Floors in Your Network Hierarchy, on page 128
- Work with 2D Maps, on page 135
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Network Hierarchy Overview

You can create a network hierarchy that represents your network's geographical locations. Your network hierarchy can contain sites, which in turn contain buildings and areas. You can create site and building IDs to easily identify where to apply design settings or configurations later. By default, there is one site called **Global**.

The network hierarchy has a predetermined hierarchy:

- **Areas** or **Sites** do not have a physical address, such as the United States. You can think of areas as the largest element. Areas can contain buildings and subareas. For example, an area called United States can contain a subarea called California, and the subarea California can contain a subarea called San Jose.

- **Buildings** have a physical address and contain floors and floor plans. When you create a building, you must specify a physical address and latitude and longitude coordinates. Buildings cannot contain areas. By creating buildings, you can apply settings to a specific area.

- **Floors** are within buildings and consist of cubicles, walled offices, wiring closets, and so on. You can add floors only to buildings.

You can change the site hierarchy for unprovisioned devices while preserving AP locations on sitemaps. Note, however, that you cannot move an existing floor to a different building.

The following is a list of tasks that you can perform:

- Create a new network hierarchy. For more information, see Create a Site in a Network Hierarchy, on page 122.

- Upload an existing network hierarchy from Cisco Prime Infrastructure. For more information, see Upload an Existing Site Hierarchy, on page 124.

Manage Sites in Your Network Hierarchy

Guidelines for Image Files to Use in Maps

- Use a graphical application that can save the map image files to any of these formats: .jpg, .gif, .png, .pdf, .dxf, and .dwg.
- Ensure that the dimension of an image is larger than the combined dimension of all the buildings and outside areas that you plan to add to the campus map.
- Map image files can be of any size. Cisco DNA Center imports the original image to its database at a full definition, but during display, it automatically resizes them to fit the workspace.
- Obtain the horizontal and vertical dimensions of the site in feet or meters before importing. This helps you to specify these dimensions during map import.

Design a New Network Infrastructure

The **Design** area is where you create the structure and framework of your network, including the physical topology, network settings, and device type profiles that you can apply to devices throughout your network. Use the **Design** workflow if you do not already have an existing infrastructure. If you have an existing infrastructure, use the **Discovery** feature. For more information, see Discovery Overview, on page 33.

You can perform these tasks in the **Design** area:

Step 1 Create your network hierarchy. For more information, see Create a Site in a Network Hierarchy, on page 122.

Step 2 Define global network settings. For more information, see Network Settings Overview, on page 171.

Step 3 Define network profiles.

Create a Site in a Network Hierarchy

Cisco DNA Center allows you to easily define physical sites and then specify common resources for those sites. The **Design** area uses a hierarchical format for intuitive use, while eliminating the need to redefine the same resource in multiple places when provisioning devices. By default, there is one site called **Global**. You can add more sites, buildings, and areas to your network hierarchy. You must create at least one site before you can use the provision features.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

A world map appears in the right pane.

Step 2 From the map toolbar, click **+ Add Site** and choose **Add Area**.

Note You can also hover your cursor over the ellipsis ••• next to the parent site in the left pane, and then choose **Add Area**.

Step 3 Enter the site name in the **Area Name** field.

The **Area Name** field has the following restrictions:

- The area name cannot exceed 40 characters.
- Special characters & > < ? ' " / [ ] aren't allowed.

Step 4 From the **Parent** drop-down list, choose a parent node.

Note By default, **Global** is the parent node.

Step 5 Click **Add**.

The site is created under the parent node in the left pane.

Export a Site Hierarchy from Cisco Prime Infrastructure and Import into Cisco DNA Center

A network hierarchy is a representation of your network's geographical locations. You create site and building IDs so that later you can easily identify where to apply design settings or configurations. If you have an existing network hierarchy on Cisco Prime Infrastructure, you can import it into Cisco DNA Center, saving time and effort spent in creating a new network hierarchy.

This is a simple process that requires you to export two files from Cisco Prime Infrastructure as a CSV file that contains location groups or site information, and a map archive file that contains various floor maps in your network hierarchy.

This procedure describes how to export an existing site hierarchy from Cisco Prime Infrastructure to Cisco DNA Center. You can export a site hierarchy from Cisco Prime Infrastructure Release 3.2 and later.

Before you begin

- Make sure that you have Cisco Wireless Controllers and APs in your inventory. If not, discover them using the **Discovery** feature.
- Add and position APs on a floor map.
- If you manually created any sites in Cisco DNA Center that are present in Cisco Prime Infrastructure, you must remove those sites manually before importing them into Cisco DNA Center.

Step 1 Export the location groups from Cisco Prime Infrastructure as a CSV file to your workstation. In Cisco Prime Infrastructure, choose **Inventory** > **Group Management** > **Network Device Groups**.

Step 2 In the **Device Groups** window, click **Export Groups**.

Step 3 In the **Export Groups** dialog box, click the **APIC-EM** radio button to download the CSV file, and click **OK**.

Note Wait for the CSV file to download. The CSV file contains information about the geographic locations of various sites, buildings, and floors and their hierarchy in the network.

Step 4 Export maps from Cisco Prime Infrastructure by choosing **Maps** > **Wireless Maps** > **Site Maps (New)**.

Note This downloads map information, such as floor dimension, and calibration information, such as the Radio Frequency (RF) attenuation model that has been applied to each floor in Cisco Prime Infrastructure.

Step 5 From the **Export** drop-down list, choose **Map Archive**.

The **Export Map Archive** window appears, and the **Select Sites** window appears by default.

Step 6 Check the check box of a specific site, campus, building, or floor that you want to export. Alternatively, check the **Select All** check box to export all the maps.

Step 7 Check if the **Map Information** and **Calibration Information** are selected. Selecting one option is mandatory. If not, click the **On** button for **Map Information** or **Calibration Information**.

- Selecting **Map Information** exports floor dimensions such as length, width, and height. It also exports details about the APs that have been placed on the floor maps, and the obstacles and areas overlayed on the floor maps within Cisco Prime Infrastructure.
- Selecting **Calibration Information** exports the RF attenuation model that has been applied to each floor in Cisco Prime Infrastructure. It is a good practice to export the existing calibration data from Cisco Prime Infrastructure. Otherwise, you must enter the calibration details manually in Cisco DNA Center.

Step 8 Click **Generate Map Archive**.

A tar file that contains the various floor maps in your network hierarchy is created and saved on your workstation.

Step 9 To import the site hierarchy to Cisco DNA Center, do the following:

a) In the Cisco DNA Center GUI, click the menu icon (≡) and choose **Design** > **Network Hierarchy**.
b) From the map toolbar, click **Import** and choose **Import Sites**.

Step 10 In the **Import Sites** window, drag and drop the Cisco Prime Infrastructure location groups CSV file.

Step 11 Click **Import**.

Step 12 Import the map archive file that contains floor maps and related map information by clicking **Import** from the map toolbar and choosing **Import Maps**.

Step 13 In the **Import Maps** window, drag and drop the map archive file.

Step 14 Click **Import**.

Upload an Existing Site Hierarchy

You can upload a CSV file or a map archive file that contains an existing network hierarchy. For example, you can upload a CSV file with location information that you exported from Cisco Prime Infrastructure. For information about exporting maps from Cisco Prime Infrastructure, see Export Maps Archive, on page 125.

Note Before importing a map archive file into Cisco DNA Center, make sure that the devices such as Cisco Wireless Controllers and the associated APs are discovered and listed on the Cisco DNA Center inventory page.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the tool bar, click **Import** and choose **Import Sites**.

Step 3 Drag and drop your CSV file, or navigate to where your CSV file is located, then click **Import**.

Note If you do not have an existing CSV file, click **Download Template** to download a CSV file that you can edit and upload.

Step 4 To import the Cisco Prime Infrastructure maps tar.gz archive file, choose **Import** > **Map Import**.

Step 5 Drag and drop the map archive file into the boxed area in the **Import Site Hierarchy Archive** dialog box.

Step 6 Click **Save** to upload the file.

The **Import Preview** window appears, which shows the imported file.

Export Maps Archive

You can export maps archive files from Cisco Prime Infrastructure and import them into Cisco DNA Center.

Step 1 From the Cisco Prime Infrastructure user interface, choose **Maps** > **Wireless Maps** > **Site Maps (New)**.

Step 2 From the **Export** drop-down list, choose **Map Archive**.

Step 3 On the **Select Sites** window, configure the following attributes. You can either select map information or calibration information to be included in the maps archive.

- **Map Information**: Click the **On or Off** button to include map information in the archive.
- **Calibration Information**: To export calibration information, click the **On or Off** button. Click the **Calibration Information for selected maps** or the **All Calibration Information** radio button. If you select **Calibration Information for selected maps**, the calibration information for the selected site maps is exported. If you select **All Calibration Information**, the calibration information for the selected map, along with additional calibration information that is available in the system, is also exported.
- In the **Sites** left pane, check one or more check boxes of the site, campus, building floor, or outdoor area that you want to export. Check the **Select All** check box to export all the maps.

Step 4 Click **Generate Map Archive**. A message `Exporting data is in progress` is displayed.

A tar file is created and is saved to your local machine.

Step 5 Click **Done**.

Export a Global Maps Archive

You can export a complete network global hierarchy map, or choose the hierarchy of a site, a building, or a floor that the hierarchy map downloads to an archive file. The map archive file contains data such as date and time, number of floors, and APs.

Note You can export up to 500 floors.

Before you begin

To perform the following task, you must be a **Super Admin** or **Network Admin**.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 To export the complete network map, click **Export** from the upper toolbar and choose **Export Maps**.

Alternatively, click the gear icon next to the desired site, building, or floor in the left pane and choose **Export Maps**.

- If you choose a site and click **Export Maps**, the site map containing all the subsites, buildings, and floors is exported.
- If you choose a building and click **Export Maps**, the building map containing all the floors is exported.
- If you choose a floor and click **Export Maps**, only the chosen floor map is exported.

Step 3 In the **Export Maps** window, do the following:

a) In the **File to be saved to** field, enter a filename.
b) For **Export Format**, choose a format.
c) Click **Export**.

A tar file containing the selected maps archive file is generated and saved to your computer.

Export Site Hierarchy

You can export the complete hierarchy of a site that downloads to a CSV format file. The site hierarchy file contains details such as site names, parent hierarchy, number of floors, location, and site address.

The following procedure explains how to export a site hierarchy:

Before you begin

To perform the following task, your account must be a **SUPER-ADMIN-ROLE** or **NETWORK-ADMIN-ROLE**.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 To export the complete site hierarchy, click **Export** from the map toolbar and choose **Export Sites**.

Step 3 In the **Export Sites** dialog box, click **OK**.

The complete site hierarchy file containing site names, parent hierarchy, number of floors, location, and address is exported in CSV format and saved in your computer.

Search the Network Hierarchy

You can search the network hierarchy to quickly find a site, building, or area. This is particularly helpful after you have added many sites, areas, or buildings.

To search the hierarchy, from the **Find Hierarchy** search field in the left pane, enter either the partial or full name of the site, building, or floor name that you are searching.

The hierarchy is filtered based on the text you enter in the search field.

Edit a Site

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 In the left pane, hover your cursor over the ellipsis ••• next to the site and choose **Edit Area**.

Step 3 In the **Edit Area** pop-up, make the necessary edits.

Step 4 Click **Update** to save your changes.

Delete a Site

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 In the left pane, hover your cursor over the ellipsis ••• next to the site and choose **Delete Area**.

Step 3 In the dialog box, click **OK** to confirm the deletion.

Manage Buildings in Your Network Hierarchy

Add a Building

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 In the **Network Hierarchy** window, click **+Add Site** > **Add Building**.

Note Alternatively, you can hover your cursor over the ellipsis ••• next to the parent site in the left pane, and choose **Add Building**.

Step 3 Add the building details in the **Add Building** pop-up:

a) In the **Building Name** field, enter a name for the building.

The **Building Name** field has the following restrictions:

- The building name cannot exceed 40 characters.
- Special characters & > < ? ' " / [ ] aren't allowed.

b) From the **Parent** drop-down list, choose a parent node.

Note By default, **Global** is the parent node.

c) In the **Address** field, enter an address.

Note Alternatively, you can click on the map to input the address. Adding an address causes the **Longitude** and **Latitude** coordinates fields to be automatically populated. You can manually change the longitude and latitude coordinates to change the address.

Step 4 Click **Add**.

The building is created and appears under the parent site in the left pane.

Edit a Building

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 In the left pane, hover your cursor over the ellipsis ••• next to the building and choose **Edit Building**.

Step 3 In the **Edit Building** pop-up, make the necessary edits.

Step 4 Click **Update** to save your changes.

Delete a Building

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 In the left pane, hover your cursor over the ellipsis ••• next to the building and choose **Delete Building**.

Step 3 In the dialog box, click **OK** to confirm the deletion.

Note Deleting a building deletes all its container maps. APs from the deleted maps are moved to Unassigned state.

Manage Floors in Your Network Hierarchy

Floors and Floor Maps Overview

There are several reasons to add floors and floor maps to a building in Cisco DNA Center. One reason is to see your wireless network the way it exists today. Another reason is to help you plan and visualize future changes.

You can visualize your wireless network by creating or importing a floor map that contains various building components, like walls and windows, and then positioning your wireless devices on it. Using the floorplan, Cisco DNA Center computes 2D and 3D heatmaps that show the relative intensity of the RF signals in the coverage area. For 2D wireless maps, the heatmap is only an approximation of the actual RF signal intensity because it does not consider the attenuation of various building materials, such as drywall or metal objects, nor does it display the effects of RF signals bouncing off obstructions. In either case, we recommend that you import a file with an existing floor plan to get started.

Interactive planning helps you plan a floor layout by drawing planned, or hypothetical, APs and obstacles with a raster image or a CAD floor plan as the backdrop. You can export the floor map as a PDF and share it with the technicians who are mounting the APs. The floor drawing helps the technicians to visualize the floor layout and the exact AP mount locations.

With interactive floor planning, you can:

- Create a floor layout with a raster or CAD floor plan as the canvas.
- Place the planned APs or hypothetical APs on the floor map based on the signal coverage requirement. These hypothetical APs or planned APs are not yet installed or discovered by Cisco DNA Center.
- Assign the antenna type and orientation.
- Draw obstacles, such as walls and shelving on the floor, that impact the signal attenuation.
- Plan all APs in sequence.
- Export the floor map as a PDF.

2D Wireless Maps Overview

Cisco DNA Center calculates the strength and quality of wireless signals. These RF predictions are commonly known as heatmaps, because they show the relative intensity of the RF signals on the 2D wireless coverages area map.

3D Wireless Maps Overview

With 3D wireless maps, you can view a 3D visualization of your wireless network. A near real-time predictive model dynamically updates the 3D visualization to show changes in RF coverage.

Here are some of the unique features and functionality that 3D wireless maps offers:

- Navigate through your wireless network in a 3D environment with a first person view or third person view.
- Gain insights into the areas in your wireless network where service-level agreements (SLAs) are not being met.
- View the RF coverage for different elevations and use the **Scanner** tool to view the RF coverage for specific elevations.
- Crop the Key Performance Indicator (KPI) heatmap with the clipping tools.
- Predict the x, y, z coordinates of a specific point on the floor plan with the pin tool to better plan for placement of APs or sensors.
- Visualize floor plan elements, such as walls, in 3D to see how they affect RF coverage and attenuation.

Floor Plans Overview

To view a wireless map, first you need to create a floor plan. There are three ways to create a floor plan for a wireless map:

- **Import a CAD file**: When you use a CAD file (DXF or DWG file type) to import the floor plan, Cisco DNA Center imports the CAD layers and allows you to specify which layers appear as floor elements in the wireless map.

  Because the computation of a 3D heatmap requires significant computing power, we recommend that you include only the CAD layers that contribute significantly to the heatmap computation. You should include enough information to get an accurate heatmap, but not unnecessary information that overloads the computation process and delays the heatmap display.

  Cisco DNA Center takes these initial steps to minimize the time it takes to generate a heatmap:

  - Restricts the maximum number of walls for 2D and 3D maps. The maximum number of walls for a 3D heatmap is 3000, after optimization. If your CAD file contains more, Cisco DNA Center alerts you and preserves the 3000 most relevant walls (based on the length of the wall multiplied by its attenuation).

    The maximum number of walls for a 2D heatmap is 300, after optimization. If your CAD file contains more, Cisco DNA Center alerts you and preserves the 300 most relevant walls (based on the length of the wall multiplied by its attenuation).

  - Automatically removes small obstructions (under 0.75 ft) and the second sides of the walls, leaving only one side per wall. (Cisco DNA Center applies an attenuation value for each wall, not for each side of a wall.)

  When deciding which layers and elements to import, focus on obstacles that create the most attenuation. In principle, the longer and thicker a wall is, the higher its attenuation. Low walls, like cubicles, and narrow walls, like columns, have low attenuation and have little affect on the heatmap. Even if the material of an obstacle is heavy, the attenuation is not significant, because the signal can radiate around the obstacle. Likewise, if you are not interested in the coverage outside of a building, do not include external walls or windows. Doing so provides better 3D visualization of the inside of the building.

  If your CAD file does not have walls in specific layers, but has walls mixed with other elements, do not select them for import. You can add walls manually later. For information, see Add Walls, on page 149.

  Block inserts and proxy entities cannot be imported. Please make imported layers contain only native elements like lines, polylines, arcs, and so on.

  For the procedure, see Create a Floor Map Using a CAD File, on page 131.

- **Import a non-CAD image file**: You can use the file types JPG, GIF, PNG, or PDF to import the floor plan. Typically, this type of file is used to create 2D floor maps. However, you need to manually create the floor elements, such as the walls and shelving, for them to be represented in the wireless map. For the procedure, see Create a Floor Map Using a Non-CAD File, on page 132.

- **Import a Ekahau Pro Project plan**: You can import Ekahau project data, such as the obstacles, APs, and more, into create a wireless map. For the procedure, see Create a Floor Map Using an Ekahau Project File, on page 134.

Create Floors with Floor Maps

After you add a building, you can create floors for it. As part of this process, you can also create corresponding floor maps. To get you started, Cisco DNA Center allows you to import various types of floor plan files.

Step 1 Determine the file type you want to use for your floor map (CAD, non-CAD, or Ekahau file).

Step 2 Add the floor using one of the following methods:

- Create a Floor Map Using a CAD File, on page 131
- Create a Floor Map Using a Non-CAD File, on page 132
- Create a Floor Map Using an Ekahau Project File, on page 134

Create a Floor Map Using a CAD File

To view a wireless map, you must create a floor map.

You can use CAD files (the DXF or DWG file type) to create a floor map.

For 2D floor maps, you must choose the CAD layers that you want to appear in the 2D view. For 3D floor maps, Cisco DNA Center imports the CAD layers as the walls, shelving, obstacles, and other elements in the map.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 In the left Hierarchy pane, hover your cursor over the ellipsis ••• next to the building and choose **Add Floor**.

Step 3 In the **Floor Name** field, enter a name for the floor.

The **Floor Name** field has the following restrictions:

- The floor name cannot exceed 40 characters.
- Special characters & > < ? ' " / [ ] aren't allowed.

Step 4 For the **Type (RF Model)** drop-down list, choose the RF model to apply to the floor.

Note The RF model determines how the RF is calculated based on the characteristics of the floor.

Step 5 Drag and drop the CAD file (the DXF or DWG file type) to the **Floor Image** area.

Note After you import a floor plan, make sure that you enable the overlay visibility. (From the floor, click **View Options** and enable the overlay toggles in **Overlay Objects**). By default, overlays are not displayed after you import a map.

Step 6 In the **Floormap** pop-up window, choose the CAD layers that you want to appear as floor elements in the map:

a) For the **2D** column, check the check boxes of the CAD layer that you want to appear in the 2D view.
b) For the **3D Wall/Shelving Type** column, use the drop-down list to choose a CAD layer that specifies the type of the wall or shelving.

Note For a layer to appear in the 3D view, a **3D Wall/Shelving Type** value is required. The wall/shelving type affects attenuation and how the heatmap is calculated. For more information, see Floor Plans Overview, on page 130.

c) Click **Use Selected Layers**.

Step 7 Enter the floor map dimensions in the **Width**, **Length**, and **Height** fields.

Step 8 Click **Add**.

Create a Floor Map Using a Non-CAD File

You can use non-CAD files (a JPG, GIF, PNG, or PDF file type) to create a floor map. However, when using a non-CAD file, the 3D floor elements, such as the walls and shelving, cannot be imported, and you need to add them manually later. For more information, see Configure Floor Map Elements and Overlays in 2D Maps, on page 135.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 In the left Hierarchy pane, hover your cursor over the ellipsis ••• next to the building and choose **Add Floor**.

Step 3 In the **Floor Name** field, enter a name for the floor.

The **Floor Name** field has the following restrictions:

- The floor name cannot exceed 40 characters.
- Special characters & > < ? ' " / [ ] aren't allowed.

Step 4 From the **Type (RF Model)** drop-down list, choose the RF model to apply to the floor.

Note The RF model determines how the RF is calculated based on the characteristics of the floor.

Step 5 Drag and drop the non-CAD file (a JPG, GIF, PNG, or PDF file type) onto the **Floor Image** area.

Note Be sure to provide the precise dimensions of floors that are in PDF format, because the image width and height ratio cannot be extracted from them.

Step 6 Click **Add**.

The floor map is created.

Step 7 From the map toolbar, click **Add/Edit**.

Step 8 To add walls as a 3D floor element, do the following:

a) From the map toolbar, click the **Walls** toggle to add the appropriate floor element.

b) From the left pane of the map, click the wall type that you want to add.

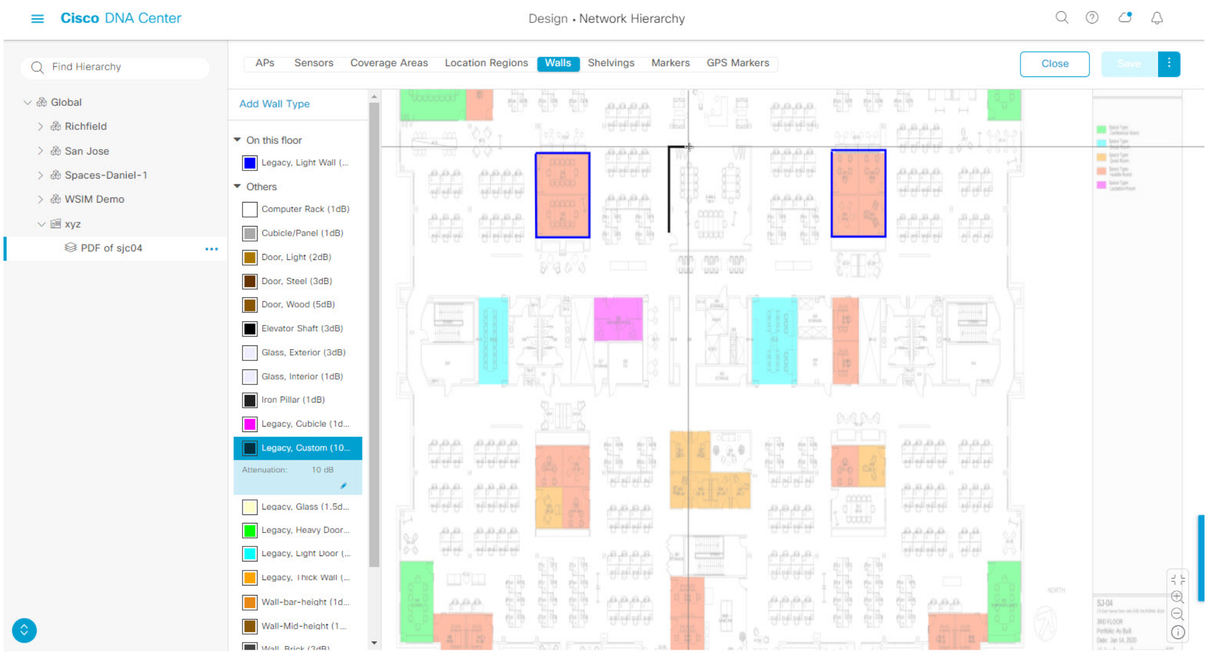
  - If the wall type is not in the list, click **Add Wall Type** to create a new wall type.

c) Use the drawing tool to create the wall area:

  - Click the map to create a point. Continue creating points until you have created the shape for the wall.

- To finalize a shape, click the wall type of the shape from the left pane to exit drawing mode. Alternatively, double-click the map to finalize the shape. If you want to cancel the shape, right-click the map.
- To change the type of an existing wall, right-click the shape and choose **Change Type**.
- To move an existing wall, drag and drop the shape to the new location.
- To remove an existing wall, right-click the shape and choose **Delete**.

Figure 4: Adding a Wall with the Drawing Tool


Cisco DNA Center
Design • Network Hierarchy
Find Hierarchy
Global
Richfield
San Jose
Spaces-Daniel-1
WSIM Demo
xyz
PDF of sjc04
APs
Sensors
Coverage Areas
Location Regions
Walls
Shelvings
Markers
GPS Markers
Close
Save
Add Wall Type
On this floor
Legacy, Light Wall (...
Others
Computer Rack (1dB)
Cubicle/Panel (1dB)
Door, Light (2dB)
Door, Steel (3dB)
Door, Wood (5dB)
Elevator Shaft (3dB)
Glass, Exterior (3dB)
Glass, Interior (1dB)
Iron Pillar (1dB)
Legacy, Cubicle (1d...
Legacy, Custom (10...
Attenuation: 10 dB
Legacy, Glass (1.5d...
Legacy, Heavy Door...
Legacy, Light Door (...
Legacy, Thick Wall (...
Wall-bar-height (1d...
Wall-Mid-height (1...
Wall, Brick (2dB)

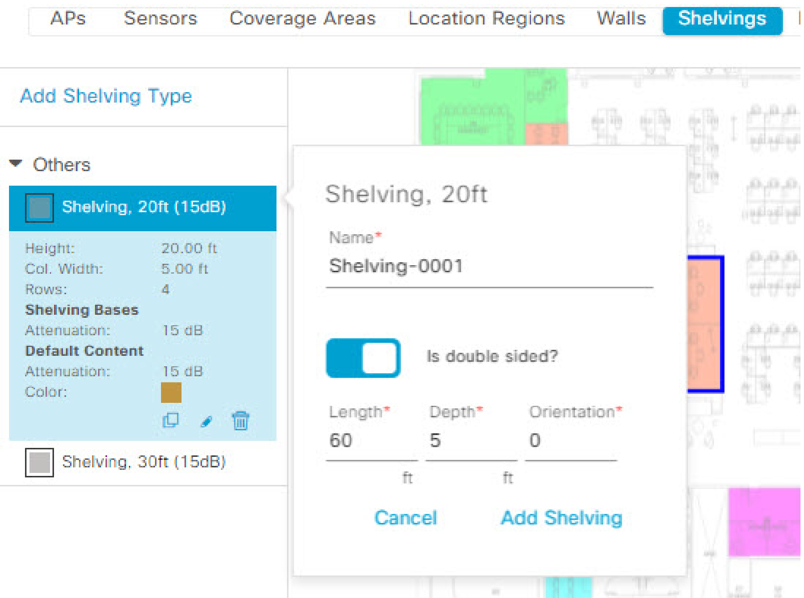
Step 9 To add shelving units as a 3D floor element, do the following:

a) In the map toolbar, click **Shelving Units**.

b) In the left pane of the map, click the shelving type that you want to add.

- In the **Shelving** dialog box, you can edit the name, dimensions, and orientation of the shelving type. Orientation refers to the angle of the shelving, for example, 0 means that the shelving is vertical and parallel to the y axis.
- If a shelving type is not in the list, click **Add Shelving Type** to create a new shelving type.

Figure 5: Choosing a Shelving Type to Add



Shelving, 20ft (15dB)

Height:	20.00 ft
Col. Width:	5.00 ft
Rows:	4
Shelving Bases	
Attenuation:	15 dB
Default Content	
Attenuation:	15 dB
Color:	🟫

Shelving, 30ft (15dB)

Shelving, 20ft

Name*: Shelving-0001

● Is double sided?

Length*: 60 ft

Depth*: 5 ft

Orientation*: 0

c) In the **Shelving** dialog box, click **Add Shelving** to add the shelving to the floor map.

d) Drag and drop the shelving to move it to a location on the floor map.

e) Right-click the shelving and choose one of the following actions:

- **Edit**: Edit the name, dimensions, and orientation of the shelving.
- **Clone**: Create a copy of the shelving.
- **Array**: Create an array of shelving by specifying the number of shelves and the distance between them.
- **Delete**: Remove the shelving from the floor map.

Step 10 When you are done, click **Save** on the map toolbar.

Create a Floor Map Using an Ekahau Project File

Before you begin

The Ekahau Pro tool allows you to create the complete network plan for your enterprise, including floor layout, AP locations, and obstacles. After creating the floor layout, you can export the simulated network plan and the real-world site survey data into a format that Cisco DNA Center can use. You can import the Ekahau project file into Cisco DNA Center for further planning.

The Ekahau Pro tool version 10.2 allows you to automatically create the site hierarchy, save it as a project file, and import it into Cisco DNA Center.

Step 1 Plan the floor layout in the Ekahau Pro tool.

- Create buildings and floors.

It is not mandatory to create buildings in the Ekahau Pro tool.

- Import the floor plan.
- Add the planned APs or hypothetical APs.
- Add building coordinates.
- Define the site name.

  The AP name that you provide here will be used to update the AP name on the Cisco Wireless Controller during the wireless controller configuration.
- Add obstacles.
- Export the project as a PDF.

Step 2 Deploy the planned APs at locations designed on the floor layout.

- The physical AP is mounted at the designed location that is specified on the floor layout. The MAC address of the planned AP is updated with the MAC address of the physical AP.
- The physical AP is connected to the VLAN of the intended wireless controller.

Step 3 Configure the Cisco Wireless Controller.

- Discover the Cisco Wireless Controller and APs in your network by running the **Discovery** job, so that the discovered wireless controllers and APs are listed on the **Inventory** window.
- Update the AP name on the wireless controller with the AP name given in the Ekahau Pro project during the floor planning.

Step 4 Import the Ekahau project into Cisco DNA Center.

Step 5 Map the planned APs to real APs in Cisco DNA Center.

Work with 2D Maps

2D maps are primarily used to configure elements on the floor map. Using 2D maps, you can add floor map elements and overlays and view heatmaps.

While viewing a 2D map, you can manipulate the display of the various elements and overlays. You can also filter device data and identify wireless interferers.

Configure Floor Map Elements and Overlays in 2D Maps

While viewing a 2D map, click **Add/Edit** from the map toolbar to enter edit mode. While in edit mode, you can do the following:

- Add, position, and delete the following devices:
  - Access points (APs) and planned access points (PAPs)
  - Sensors

- Add, edit, and delete the following overlay objects:
    - Coverage areas
    - Location regions
    - Walls
    - Shelving units
    - Markers
    - GPS markers

Work With APs on a Floor Map

Cisco DNA Center computes heatmaps for the entire map that show the relative intensity of the Radio Frequency (RF) signals in the coverage area. For 2D wireless maps, the heatmap is only an approximation of the actual RF signal intensity because it does not consider the attenuation of various building materials, such as drywall or metal objects, nor does it display the effects of RF signals bouncing off obstructions.

Follow these guidelines while placing APs on the floor map:

- Place APs along the periphery of coverage areas to keep devices close to the exterior of rooms and buildings. APs placed in the center of these coverage areas provide good data on devices that would otherwise appear equidistant from all other APs.
- Location accuracy can be improved by increasing overall AP density and moving APs close to the perimeter of the coverage area.
- In long and narrow coverage areas, avoid placing APs in a straight line. Stagger them so that each AP is more likely to provide a unique snapshot of the device location.
- Although the design provides enough AP density for high-bandwidth applications, location suffers because each AP view of a single device is not varied enough. Therefore, location is difficult to determine. Move the APs to the perimeter of the coverage area and stagger them. Each has a greater likelihood of offering a distinctly different view of the device, resulting in higher location accuracy.
- For optimal heatmap visibility on floor maps, configure the AP height to approximately 10 feet (3 meters) or lower.

Export Bulk APs from Prime Infrastructure and Import into Cisco DNA Center

Cisco DNA Center allows you to import, assign and position a collection of access points to the floor map. If you have an existing collection of access points on Cisco Prime Infrastructure, you can import it into Cisco DNA Center, saving time and effort spent in importing, assigning, and positioning access points to the floor map.

This procedure describes how to export an existing collection of access points from Cisco Prime Infrastructure, and import into Cisco DNA Center.

Before you begin

- To perform the following task, you must be a **Super Admin** or **Network Admin**.
- Make sure that you have APs in your inventory. If not, discover them using the **Discovery** feature.

- Add and position APs on a floor map.
- The site, building, and floor must be present in the site hierarchy.

Step 1 Export the bulk AP positions from Cisco Prime Infrastructure as a CSV file to your workstation.

Step 2 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 3 From the left Hierarchy pane, hover your cursor over the ellipsis ••• next to the site and choose **Import Bulk AP**.

Step 4 In the **Import Bulk AP** pop-up window, drag and drop the AP file, or click **Choose a file** to select the file from your workstation.

Note

- To manually create the **AP Positions** CSV file with Prime Template, export a Prime Template to your workstation by clicking **Download Prime Template**. Prime Template does not support nested files.
- To manually create the **AP Positions** CSV file with Cisco DNA Template, export a Cisco DNA Template to your workstation by clicking **Download Template**. Cisco DNA Template supports nested files.

Wait for the CSV file to download. The CSV file contains information about AP positions of various sites in the network.

Step 5 Click **Import**.

The **Import Summary** window appears.

- The **Information** tab shows the list of successfully imported APs.
- Click the **Warning** tab to see the list of warnings.
- Click the **Error** tab to see the list of errors.

Add APs to a Map

You can add APs one at a time or in bulk.

Before you begin

Make sure that you have Cisco APs in your inventory. If not, discover your APs using the Discovery feature. See Discovery Overview, on page 33.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 Ensure the **APs** option is enabled from the map toolbar.

Step 6 From the map left pane, click **Add APs**.

Step 7 From the **Add APs** slide-in pane, do one of the following:

- **To add a single AP**: Click **Add** next to an AP that you want to add.

- **To add multiple APs**: Check the check boxes next to APs you want to add and click **Add Selected**.

Note You can search for APs using the search option available. Use the **Filter** field to search for APs using the AP name, MAC address, model, or Cisco Wireless Controller. The search is case-insensitive. The search result appear in a table. Click **Add** to add one or more of these APs to the floor area.

Newly added APs appear in the **Unpositioned** category from the map left pane in edit mode. For more information, see Position an AP on a Map, on page 139.

Step 8 After adding the APs to a floor, close the **Add APs** window.

Add Planned APs to a Map

Using the AP Model Catalog feature, you can add a planned AP on a floor and configure its model, antenna type, azimuth, and elevation orientation. Then you can replicate that configuration to rest of the planned APs that belong to the same model type.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map left pane, in the **AP Models** area, click the AP model of the planned AP to add.

Note If the AP model is not listed, click **Add Model** to choose the AP model to add to the list.

Step 6 Using the drawing tool, click the location on the floor map to add the planned AP.

A planned AP of the selected model is added to the floor map and the **Edit Planned AP** slide-in pane appears on the right, with an AP name added to it by default.

Step 7 From the **Edit Planned AP** slide-in pane, click the gear icon, which is located next to the **AP Name** field.

The **Name pattern** dialog box appears.

Step 8 When you add the first AP to the floor, make sure that you enter a valid name pattern, for example SJC-BLD21-FL2-AP####, and then click **Set name pattern**.

Note The planned APs must be unique within Cisco DNA Center, so make sure that the name pattern identifies the floor.

The #### in the name pattern is replaced by numbers in the **AP Name**, for example SJC-BLD21-FL2-AP0001, SJC-BLD21-FL2-AP0002, and so on.

Step 9 From the **Antenna** drop-down list in the **Edit Planned AP** slide-in pane, choose the appropriate antenna type for each of the radio slots of the AP.

Note The antenna image reflects the antenna selected.

Step 10 Depending on the antenna type, enter the **Azimuth** and **Elevation** orientation, in degrees.

Step 11 To add another planned AP with the same properties as that of the planned AP that you just created, click a location in the floor map where you want to position the new AP.

A new AP icon appears on the map with all of the properties inherited and the AP name appended, for example BLD1-AP0002-TX.

Step 12 To add more planned APs with the same properties and appended AP Name, click the floor map.

Step 13 To stop adding planned APs to the floor map, press **Esc** or right-click the floor map.

Step 14 To reposition the planned APs, drag and drop them to the appropriate location in the floor map.

Step 15 To delete a planned AP, right-click the AP icon and click **Delete**.

Step 16 To edit a planned AP, right-click the AP icon and click **Edit**.

Step 17 When you are done, click **Save** from the map toolbar.

Assign Actual APs to Planned APs

When you are ready, you can assign actual APs to the planned APs on your map.

Step 1 Click the menu icon (☰) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map left pane, click **Assign PAPs**.

Step 6 On the floor map, click a planned AP.

Step 7 From the **Assign Planned APs** slide-in pane, check the check box next to the AP that you want to assign.

Step 8 Click **Assign**.

Step 9 When you are done, click **Save** from the map toolbar.

Position an AP on a Map

After adding the APs to a floor, you need to position them on the map.

Step 1 Click the menu icon (☰) and choose **Design** > **Network Hierarchy**.

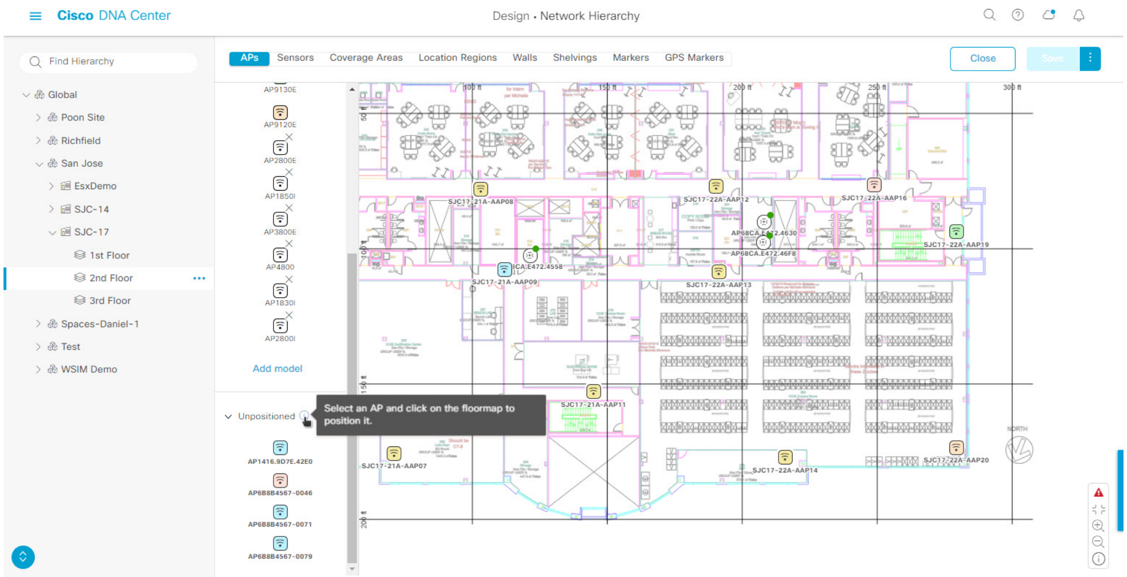
Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the **Unpositioned** category in the map left pane, click an AP.

Figure 6: Unpositioned APs


Cisco DNA Center
Design • Network Hierarchy
Find Hierarchy
Global
Poon Site
Richfield
San Jose
EsxDemo
SJC-14
SJC-17
1st Floor
2nd Floor
3rd Floor
Spaces-Daniel-1
Test
WSIM Demo
APs
Sensors
Coverage Areas
Location Regions
Walls
Shelvings
Markers
GPS Markers
Close
Save
AP9130E
AP9120E
AP2800E
AP1850I
AP3800E
AP4800
AP1830I
AP2800I
Add model
Unpositioned
AP1416.9D7E.42E0
AP6B8B4567-0046
AP6B8B4567-0071
AP6B8B4567-0079
SJC17-21A-AAP08
SJC17-21A-AAP09
SJC17-21A-AAP07
SJC17-21A-AAP11
SJC17-22A-AAP12
SJC17-22A-AAP13
SJC17-22A-AAP14
SJC17-22A-AAP16
SJC17-22A-AAP19
SJC17-22A-AAP20
100 ft
150 ft
200 ft
250 ft
300 ft
50 ft
NORTH

Select an AP and click on the floormap to position it.

Step 6 To position the AP, do one of the following:

- Click the location on the floor map where you want to position the AP.
- From the **Edit AP** slide-in pane, enter the x and y coordinates in the corresponding fields.
- Draw three points on the floor map and position the AP by using the selected points. To do this:

    a. From the **Edit AP** slide-in pane, click **Position by 3 points**.

    b. To define the points, click anywhere on the floor map to start drawing the first point. Click again to finish drawing a point. A dialog box appears to set the distance to first point. Enter the distance, in meters, and click **Set Distance**.

    c. Define the second and third points similarly, and click **Save**.

- Define two walls on the floor map and position the APs between the defined walls. This method helps you to know the position of APs between the two walls.

    a. From the **Edit AP** slide-in pane, click **Position by 2 walls**.

    b. To define the first wall, click anywhere on the floor map to start drawing the line. Click again to finish drawing a line. A dialog box opens to set the distance to the first wall. Enter the distance in meters and click **Set Distance**.

    c. Define the second wall similarly and click **Save**.

    The AP is placed based on the defined distance between the walls.

Step 7 From the map toolbar, click **Save**.

Note If a Cisco Connected Mobile Experiences (CMX) is synchronized with Cisco DNA Center, you can view the location of clients on the heatmap. See Create Cisco CMX Settings, on page 216.

Reposition an AP on a Map

At any time, you can reposition APs on a map.

Note This task can be performed in a 2D or 3D map.

Step 1 Click the menu icon (☰) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D** or **3D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 In the map, drag and drop the AP to the new position.

Step 6 When you are done, click **Save**.

Edit an AP

You can change the configuration of a single AP. To change the configuration of multiple APs, see Edit Multiple APs, on page 142.

Note This task can be performed in a 2D or 3D map.

Step 1 Click the menu icon (☰) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D** or **3D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 Click an AP.

To deselect it, press the **Shift** key and click the AP again.

Step 6 From the **Edit AP** slide-in pane, configure the following AP settings, as needed:

- **AP Name** or **Planned AP Name**: Name of the AP
- **MAC Address**: MAC address of the selected AP.
- **AP Model**: Model of the selected AP.
- **x**: X-axis coordinate of the AP. You can manually enter the value.
- **y**: Y-axis coordinate of the AP. You can manually enter the value.
- **AP Height**: Height of the AP. You can manually enter the value.
- **Antenna**: Antenna type for this AP.

  Note For external APs, you must select an antenna, or the AP will not be present in the map.

- **Azimuth**: Angle of the antenna, measured relative to the x axis, clockwise. The azimuth range is 0 to 360. In Cisco DNA Center, pointing right is 0 or 360 degrees; pointing down is 90 degrees.

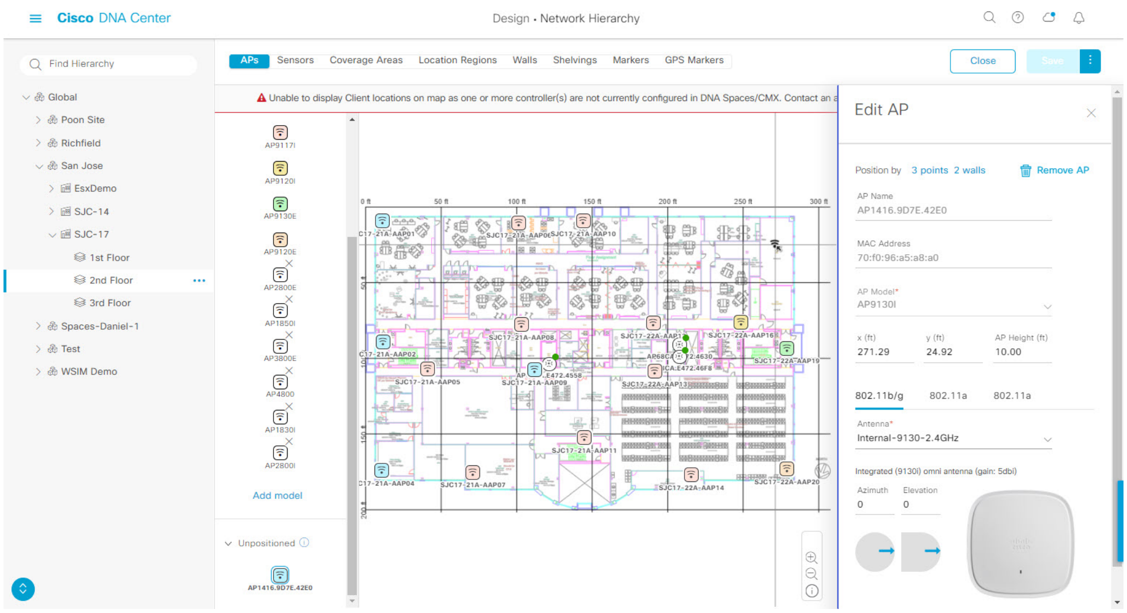
  You can manually enter the value or use the blue arrow under the field to change the value.

  Note For omnidirectional antennas, the azimuth is not relevant if the elevation is 0.

- **Elevation**: in degrees. You can manually enter the value or use the blue arrow under the field to change the value.

Note For APs and antenna models that are designed to be placed on a ceiling, 0 elevation means pointing down. For APs and antenna models that are designed to be placed on a wall, 0 elevation means pointing horizontally and negative values means pointing down.

Figure 7: Edit AP Slide-In Pane


Cisco DNA Center
Design • Network Hierarchy
Find Hierarchy
APs
Sensors
Coverage Areas
Location Regions
Walls
Shelvings
Markers
GPS Markers
Close
Save
Global
Poon Site
Richfield
San Jose
EsxDemo
SJC-14
SJC-17
1st Floor
2nd Floor
3rd Floor
Spaces-Daniel-1
Test
WSIM Demo
AP9117I
AP9120I
AP9130E
AP9120E
AP2800E
AP1850I
AP3800E
AP4800
AP1830I
AP2800I
Add model
Unpositioned
AP1416.9D7E.42E0
Edit AP
Position by
3 points
2 walls
Remove AP

Unable to display Client locations on map as one or more controller(s) are not currently configured in DNA Spaces/CMX. Contact an a

AP Name: AP1416.9D7E.42E0

MAC Address: 70:f0:96:a5:a8:a0

AP Model*: AP9130I

x (ft): 271.29

y (ft): 24.92

AP Height (ft): 10.00

802.11b/g 802.11a 802.11a

Antenna*: Internal-9130-2.4GHz

Integrated (9130i) omni antenna (gain: 5dbi)

Azimuth: 0

Elevation: 0

Step 7 Click **Save**.

Edit Multiple APs

When you select only one AP, you can change all editable attributes. However, when you select multiple APs, the following guidelines apply:

- When the selected devices have the same value for an attribute, the value is displayed. Otherwise, the value is blank. In either case, if you change the value, the new value is applied to all the selected devices.
- When the selected APs have the same model number and radios (number of radios and operating band), the antennas are editable. Otherwise, they are not editable.
- You can change the model numbers of planned APs, but not added APs. So, if you select an AP, the model number is not editable.
- Because bulk changes affect more devices, they do not take effect immediately. You need to click **Apply** to apply your changes.

Note This task can be performed in a 2D or 3D map.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D** or **3D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 Select the APs, using one of the following methods:

- Click the first device, then press and hold the **Shift** key while you click the rest of the devices.
- From the map navigation toolbar, click **Select by rectangle**. Then click an area of the map and drag the highlighted rectangle to select APs in a contiguous area. All the highlighted APs within the rectangle are selected.

To deselect APs, use one of the following methods:

- To deselect a single AP, press and hold the **Shift** key while you click the AP.
- To deselect all APs except one, click the AP you want to remain selected. All others are deselected.
- To deselect all APs, press the **ESC** key or close the **Edit** pane.
- Click **Save** to keep the changes, or **Discard** to reject them.

Step 6 From the **Edit AP** slide-in pane, configure the following AP settings, as available:

- **AP Name** or **Planned AP Name**: Name of the AP
- **MAC Address**: MAC address of the selected AP.
- **AP Model**: Model of the selected AP.
- **x**: X-axis coordinate of the AP. You can manually enter the value.
- **y**: Y-axis coordinate of the AP. You can manually enter the value.
- **AP Height**: Height of the AP. You can manually enter the value.
- **Antenna**: Antenna type for this AP.

  Note For external APs, you must select an antenna, or the AP will not be present in the map.

- **Azimuth**: Angle of the antenna, measured relative to the x axis, clockwise. The azimuth range is 0 to 360. In Cisco DNA Center, pointing right is 0 or 360 degrees; pointing down is 90 degrees.

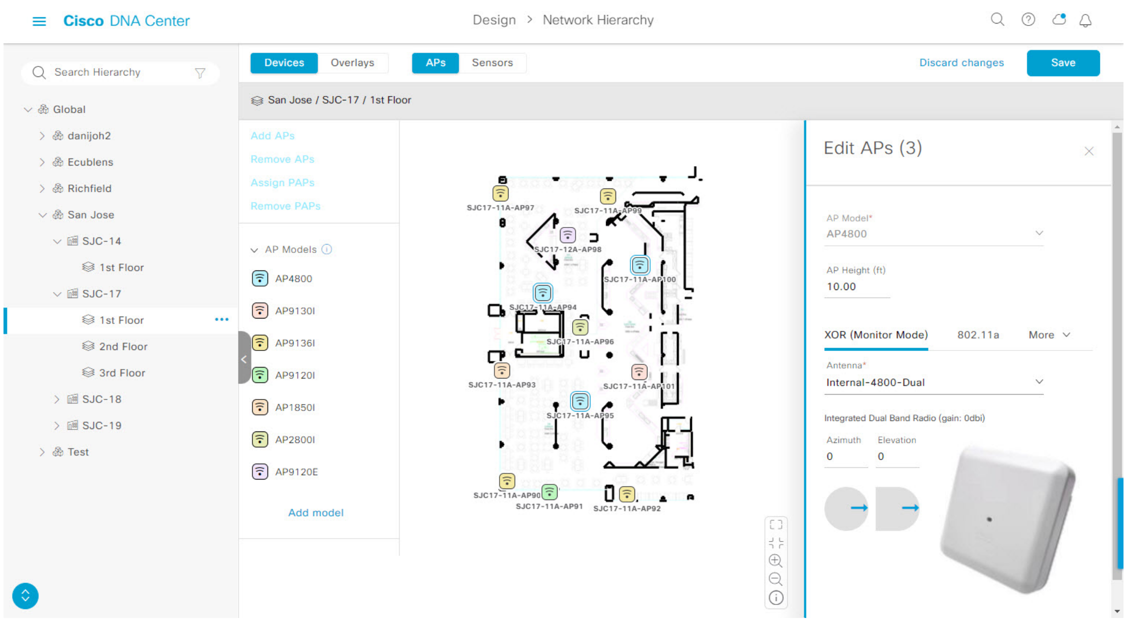
  You can manually enter the value or use the blue arrow under the field to change the value.

  Note For omnidirectional antennas, the azimuth is not relevant if the elevation is 0.

- **Elevation**: in degrees. You can manually enter the value or use the blue arrow under the field to change the value.

Note For APs and antenna models that are designed to be placed on a ceiling, 0 elevation means pointing down. For APs and antenna models that are designed to be placed on a wall, 0 elevation means pointing horizontally and negative values means pointing down.

Figure 8: Edit Multiple APs Slide-In Pane


Cisco DNA Center
Design > Network Hierarchy
Search Hierarchy
Global
danijoh2
Ecublens
Richfield
San Jose
SJC-14
1st Floor
SJC-17
1st Floor
2nd Floor
3rd Floor
SJC-18
SJC-19
Test
Devices
Overlays
APs
Sensors
Discard changes
Save
San Jose / SJC-17 / 1st Floor
Add APs
Remove APs
Assign PAPs
Remove PAPs
AP Models
AP4800
AP9130I
AP9136I
AP9120I
AP1850I
AP2800I
AP9120E
Add model
SJC17-11A-AP97
SJC17-11A-AP99
SJC17-12A-AP98
SJC17-11A-AP100
SJC17-11A-AP94
SJC17-11A-AP96
SJC17-11A-AP93
SJC17-11A-AP101
SJC17-11A-AP95
SJC17-11A-AP90
SJC17-11A-AP91
SJC17-11A-AP92
Edit APs (3)
XOR (Monitor Mode)
802.11a
More
Integrated Dual Band Radio (gain: 0dbi)

AP Model* AP4800

AP Height (ft) 10.00

Antenna* Internal-4800-Dual

Azimuth 0

Elevation 0

Step 7 Click **Apply**.

Step 8 Click **Save**.

Remove APs from a Map

You can remove APs and planned APs (PAPs) from a map without deleting them from the floor.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 To remove APs (including planned APs), do the following:

a) Click the AP, or to select multiple APs, click the first AP and while pressing the **Shift** key, click the rest of the APs.

b) In the **Edit** pane, click **Remove**.

Step 6 When you are done, click **Save**.

Work with Sensors on a Floor Map

Add Sensors to a Map

Note Make sure you have the Cisco AP 1800S sensor in your inventory. The Cisco Aironet 1800s Active Sensor must be provisioned using Plug and Play for it to show up in the Inventory.

A *sensor device* is a dedicated AP 1800s sensor. The Cisco Aironet 1800s Active Sensor gets bootstrapped using PnP. After it obtains the Assurance server reachability details, it directly communicates with the Assurance server. For more information, including information about sensor tests, see the Cisco DNA Assurance User Guide.

Step 1 Click the menu icon (☰) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map toolbar, click **Sensors**.

Step 6 From the **Add Sensors** slide-in pane, check the check boxes of the sensors that you want to add. Alternatively, click **Add** next to the sensor row to add sensors.

Note You can search for specific sensors using the search option. Use the **Filter** field and search using the name, MAC address, or model of a sensor. The search is case-insensitive. The search results are displayed in the table. Click **Add** to add one or more these sensors to the floor area.

Newly added sensors appear in the **Unpositioned** category from the map left pane in edit mode.

Position Sensors on a Map

Newly added sensors appear in the **Unpositioned** category from the map left pane in edit mode. This procedure shows you how to position a sensor after initially adding it.

Before you begin

Sensors must be added to the map before they can be positioned. For information, see Add Sensors to a Map, on page 145

Step 1 Click the menu icon (☰) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map toolbar, click **Sensors**.

Step 6 From the map left pane, click a sensor in the **Unpositioned** category to position the sensor.

Step 7 Click the location on the floor map where you want to position the sensor.

You can use the **x**, **y**, and **sensorHeight** fields in the **Sensor Details** slide-in pane to enter the exact x, y, and z coordinates for the sensor.

Step 8 When you are done, click **Save**.

Reposition a Sensor on a Map

At any time, you can reposition sensors on a map.

Note This task can be performed in a 2D or 3D map.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D** or **3D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 In the map, drag and drop the sensor to the new position.

Step 6 When you are done, click **Save**.

Remove Sensors from a Map

You can remove sensors from a floor map.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 To remove sensors, do the following:

a) Click the sensor, or to select multiple sensors, click the first sensor and while pressing the **Shift** key, click the rest of the sensors.

b) In the **Edit** pane, click **Remove**.

Step 6 When you are done, click **Save**.

Add Coverage Areas

By default, any floor area or outside area defined as part of a building map is considered as a wireless coverage area.

If you have a building that is nonrectangular or you want to mark a nonrectangular area within a floor, you can use the map editor to draw a coverage area or a polygon-shaped area.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map toolbar, click **Coverage Areas**.

Step 6 From the map left pane, click the **Coverage Area** icon.

Step 7 In the **Coverage Area** dialog box, enter a name for the coverage area in the field and click **Add Coverage**.

Step 8 Use the drawing tool to create the coverage area shape:

a) Click on the map to create a point and continue creating points to define the coverage area shape.

> **Note** The coverage area shape must have at least 3 points.

b) You can click and drag any points to redefine the coverage area shape.
c) Double-click to exit the drawing tool and finalize the coverage area shape.

Step 9 After you can finish creating the coverage area, click **Save** from the map toolbar.

Step 10 To edit a coverage area, do the following:

a) From the map toolbar, click **Add/Edit**.
b) From the map toolbar, click **Coverage Areas**.
c) You can click and drag the points of the coverage area to redefine the shape.
d) To edit the coverage area name, right-click a coverage area and choose **Edit**.
e) After finishing making edits, click **Save** from the map toolbar.

Step 11 To delete a coverage area, do the following:

a) From the map toolbar, click **Add/Edit**.
b) From the map toolbar, click **Coverage Areas**.
c) Right-click the coverage area and choose **Delete**.
d) After finishing deleting, click **Save** from the map toolbar.

Add Location Regions

You can create inclusion and exclusion areas to further refine location calculations on a floor. You can define the areas that are included (inclusion areas) in the calculations and those areas that are not included (exclusion areas). For example, you might want to exclude areas such as an atrium or stairwell within a building, but include a work area, such as cubicles, labs, or manufacturing floors.

Use the following guidelines to define inclusion and exclusion areas on a map:

- Inclusion and exclusion areas can be any polygon-shaped area and must have at least 3 points.
- You can only define one inclusion region on a floor. By default, an inclusion region is defined for each floor area when it is created. The inclusion region is indicated by a solid aqua line, and generally outlines the entire floor area.
- You can define multiple exclusion regions in a floor area.

Add an Inclusion Region to a Floor

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map toolbar, click **Location Regions**.

Step 6 From the map left pane, click the **Inclusion** icon.

Step 7 Use the drawing tool to create the inclusion area:

- Click on the map to create point and continue creating points until you have created the shape for the inclusion area.
- To finalize the shape, click the **Inclusion** icon from the left pane to exit drawing mode. Alternatively, you can double-click on the map to finalize the shape. If you want to cancel the shape, right-click on the map.
- To move an existing inclusion area, drag and drop the shape to the new location.
- To remove an existing inclusion area, right-click the shape and choose **Delete**.

Step 8 When you are done, click **Save** from the map toolbar.

Add an Exclusion Region to a Floor

To further refine location calculations on a floor, you can define areas that are excluded (exclusion areas) in the calculations. For example, you might want to exclude areas such as an atrium or stairwell within a building. As a rule, exclusion areas are defined within the borders of an inclusion area.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map toolbar, click **Location Regions**.

Step 6 From the map left pane, click the **Exclusion** icon.

Step 7 Use the drawing tool to create the exclusion area:

- Click on the map to create point and continue creating points until you have created the shape for the exclusion area.
- To finalize the shape, click the **Exclusion** icon from the left pane to exit drawing mode. Alternatively, you can double-click on the map to finalize the shape. If you want to cancel the shape, right-click on the map.
- To move an existing exclusion area, drag and drop the shape to the new location.
- To remove an existing exclusion area, right-click the shape and choose **Delete**.

Step 8 When you are done, click **Save** from the map toolbar.

Add Walls

Add walls to a floor for a more accurate heatmap. Walls affect the signal attenuation and how the RF is calculated in the heatmap.

Step 1 Click the menu icon (☰) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Walls**.

Step 5 From the map left pane, click a wall type from the **Others** or **On this floor** categories.

Note If a wall type is not listed, click **Add Wall Type** to create a custom wall type.

Step 6 Use the drawing tool to create walls:

a) Click on the map where you want to start a wall.
b) Drag your cursor to where you want to end the wall or where you want to create a corner.
c) To end a wall, double click. To create a corner, click and drag your cursor to the next point. Continue this process until you have created the shape for the wall or walls.
d) To finalize a shape, double-click on the map where you want the wall to end. Alternatively, from the left pane, click the wall type to exit drawing mode.
e) To cancel the shape, finish creating it, and then delete it.

Step 7 To make changes to the wall, do the following:

a) Double-click the map.

The points on the map become visible. This means the elements on the map are editable.

b) Hover your cursor over the wall that you want to edit. When a wall is selected, it turns black.
c) You can now do one of the following:

- **Change the wall type**: Right-click the wall and choose **Change Type**.
- **Delete the wall**: Right-click the wall and choose **Delete**.
- **Move the wall**: Click the wall and drag and drop it to the new location.

Step 8 When you are done, click **Save** from the map toolbar.

Add Shelving Units

Shelving units are obstacles that affects signal attenuation. An example of a location with shelving units would be a high-ceiling warehouse.

Step 1 Click the menu icon (☰) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Shelving Units**.

Step 5 From the map left pane, click the shelving type to add.

- In the shelving dialog box, you can edit the name, dimensions, and orientation of the shelving unit. The orientation means the angle of the shelving unit. A shelving unit with an orientation of 0 means that the shelving is vertical and parallel to the y axis.
- If a shelving type is not in the list, click **Add Shelving Type** to create a new shelving type.

Step 6 Click **Add Shelving**.

Step 7 Drag and drop the shelving to move it to its location on the floor map.

Step 8 Right-click the shelving for the following actions:

- **Edit**: Edit the name, dimensions, and orientation for the shelving.
- **Clone**: Create a copy of the shelving.
- **Array**: Create an array of shelving by specifying the number of shelving units and the distance between them.
- **Delete**: Remove the shelving from the floor map.

Step 9 When you are done, click **Save** from the map toolbar.

Add Markers

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map toolbar, click **Markers**.

Step 6 Enter the name for the marker, and then click **Add Marker**.

Step 7 Use the drawing tool to place the marker:

- Click the map to place the marker.
- To move the marker, drag and drop the marker to the new location.
- To edit an existing marker, right-click the marker and choose **Edit**.
- To remove an existing marker, right-click the marker and choose **Delete**.

Step 8 When you are done, click **Save** from the map toolbar.

Add GPS Markers

To locate the physical position of a building on the world map and increase the accuracy of a client's position, you can place a GPS marker on a 2D map.

Note The GPS marker is an attribute of the building and can be applied to all the floors of the building.

Step 1 Click the menu icon (☰) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map toolbar, click **GPS Markers**.

Step 6 From the map left pane, click the **GPS Markers** icon.

Step 7 Use the drawing tool to place the GPS marker:

a) Click a location on the map to place the GPS marker.
b) In the **Place Markers** dialog box, enter the name, latitude, longitude, x and y coordinates in the appropriate fields.
c) Click **Add GPS Marker**.

Step 8 Repeat Steps 6 and 7 until there are three GPS markers on the floor map in a polygon-shape.

Step 9 To edit an existing GPS marker, right-click the GPS marker and choose **Edit**.

Step 10 To remove an existing GPS marker, right-click the GPS marker and choose **Delete**.

Step 11 When you are done, click **Save** from the map toolbar.

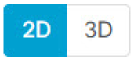
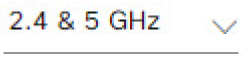
View a 2D Wireless Floor Map

Step 1 Click the menu icon (☰) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 In the map toolbar, click **2D**.

Step 4 Use the map toolbar for the following actions and settings:

Item	Description
	Click **2D** to view the wireless map in 2D or **3D** to view it in 3D.
	**Wi-Fi Band Filter**: Use this filter to view the heatmap for the 2.4 GHz and 5 GHz Wi-Fi bands.

Item	Description

Add/Edit	Click to enter add and edit mode which allows to do the following:
	• Add, position, and delete floor elements such as:
	  • Access points. For details, see Work With APs on a Floor Map, on page 136.
	  • Sensors. For details, see Add Sensors to a Map, on page 145.
	• Add, edit, and delete overlay objects such as:
	  • Coverage areas. For details, see Add Coverage Areas, on page 146.
	  • Location regions. For details, see Add Location Regions, on page 147.
	  • Walls. For details, see Add Walls, on page 149.
	  • Shelving Units. For details, see Add Shelving Units, on page 149.
	  • Markers. For details, see Add Markers, on page 150.
	  • GPS markers. For details, see Add GPS Markers, on page 150.

Data	Apply filters to the access point, sensor, and client data that appears in the wireless map. For details, see Filter Device Data on a Floor, on page 155.
View Options	Click to open the **View Options** slide-in pane which contains the view options for the map, devices, and floor map elements.

⚙	**Gear Icon**: Hover your cursor over the icon for the following options:
	• **Recompute**: Recomputes the heatmap.
	• **Export**: Export the floor map to a PDF or CSV file format.
	• **Edit Floor**: Edit the floor details such as its name
	• **Set Scale**: Change the scale by doing the following:
	  a. Click on a point and then on another point to specify a known measurement on the map.
	  b. In the **New line length (ft)** field, enter the length of the measurement.
	  c. Click **OK**.
	  The floor map dimensions are recalculated based on the length of the measurement.
	• **Measure Distance**: Measure a distance on the floor map. Click on a point and then another point to specify the distance.

⟳	**Refresh Icon**: Click to refresh the device and map data. To the left of the icon is the timestamp for the last refresh
🔍 Search	**Search**: Use this search field to perform a search for specific floor map elements such as APs, sensors, clients, and so on.

Step 5 Use the map for the following functionality:

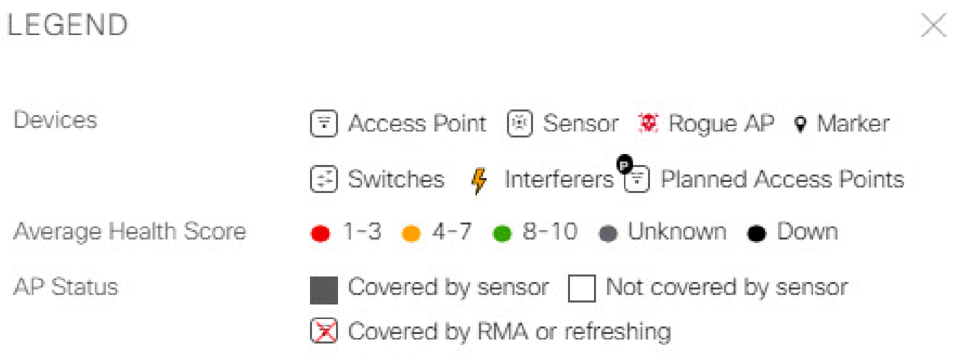
- View the heatmap of the 2D wireless floor map. You can customize the view option settings from the **View Options** slide-in pane.
- View an AP's details by hovering your cursor over an AP icon.

  You can view the basic info, RX neighbors, clients, interferers, and health score for an AP.

  Click **Device 360** to get a 360° view of the AP.

  Note For **Device 360**, the package *Assurance - Base* is required.

- View a sensor's status and test results by hovering your cursor over a sensor icon.
- View a switch's details by hovering your cursor over a switch icon.
- Use the map navigation controls at bottom-right of the map for the following controls:

Map Navigation Controls	Description
⛶	**Default Map View**: Click to reset the map view to the default.
⊕ ⊖	**Zoom In / Zoom Out**: Zoom in and out of the map. Alternatively, you can use your mouse wheel to zoom in and out.
ⓘ	**Map Legend**: Click this icon to view the map legend which describes the map icons such as the device type, average health score, and AP status.  LEGEND × Devices: Access Point, Sensor, Rogue AP, Marker, Switches, Interferers, Planned Access Points Average Health Score: ● 1-3 ● 4-7 ● 8-10 ● Unknown ● Down AP Status: ■ Covered by sensor ☐ Not covered by sensor ☒ Covered by RMA or refreshing

Step 6 Click **View Options** from the map toolbar to open the **View Options** slide-in pane. This allows you to configure the view option settings. Expand the categories to view the settings:

- **Map**: Contains various floor map and heatmap settings:

Item	Description
Show Grid	Click this toggle button to enable or disable a grid on the floor map. The grid provides the dimensions of the floor map.
Map Opacity %	Use this slider to customize the opacity or transparency of the floor map.

Item	Description
Heatmap Type	The heatmap provides a graphical representation of Radio Frequency (RF) wireless data where the values taken by variable are represented in maps as colors. RSSI heatmaps are computed based on a floor's RSSI prediction model, antenna type, and its orientation. 2D heatmaps use fixed transmit powers: 18 dB for 2.4 GHz; 15 dB for 5 GHz; and 5dB for 6 GHz. 3D heatmaps use real-time transmit power of operational APs and 11 dB for planned APs. Use the drop-down list to choose the heatmap type: • **Operational RSSI**: Coverage heatmap, which identifies the wireless signal strength of operational APs. • **Planned Heatmap**: Hypothetical heatmap that shows the coverage that planned access points would have on a floor. • **Operational + Planned RSSI**: (3D-only) Coverage heatmap created using both operational and planned APs. 2D maps only show operational AP coverage, so you need to switch to 3D maps to view this combined coverage heatmap. • **Client Density**: Density of associated clients. • **IDS**: Heatmap that shows the monitor mode access point coverage provided to the wireless clients on a floor map.
RSSI Cut off (dBm)	Use this slider to set the threshold for the RSSI value to appear on the heatmap. RSSI values that do not meet the threshold are faded.
Heatmap Opacity %	Use this slider to customize the opacity or transparency of the heatmap.
Heatmap Color Scheme	Customize the color scheme for the heatmap. Options are **Legacy** and **Natural**.

- **Access Points**: Click this toggle button to enable or disable the AP icons on the floor map.
  - **Display Label**: Use the drop-down list to choose the type of label to appear for APs on the floor map such as the AP's name, MAC address, or IP address, and so on.
- **Planned Access Points**: Click this toggle button to enable or disable the appearance of planned AP icons on the floor map.
  - **Display Label**: Use this drop-down list to choose the type of label to appear for the planned AP icons, such as the AP's name.
- **Switches**: Click this toggle button to enable or disable the appearance of switch icons on the floor map.
  - **Display Label**: Use this drop-down list to choose the type of label to appear for switch icons on the floor map, such as the switch's name, MAC address, or AP count.
- **Sensors**: Click this toggle button to enable or disable the appearance of sensor icons on the floor map.
  - **Display Label**: Use this drop-down list to choose the type of label to appear for sensor icons on the floor map, such as the sensor's name, MAC address, or IP address.

- **Overlay Objects**: Click the toggle button for an overlay object to enable or disable it on the floor map.

  The following overlay objects are available:

  - **Coverage Areas**
  - **Location Regions**
  - **Walls 2D & 3D**
  - **Walls 3D only**
  - **Shelvings**
  - **Markers**
  - **GPS Markers**

- **Clients**: Click this toggle button to enable or disable the appearance of client icons on the floor map.
  - **Display Label**: Use this drop-down list to choose the type of label to appear for client icons on the floor map, such as client name, IP address, MAC address, and so on.
  - **Show Client Clusters**: Click this toggle button to enable or disable clients in close proximity to be grouped together.

- **Interferers**: Click this toggle button to enable or disable the appearance of client icons on the floor map.
  - **Show Zone of Impact**: Click this toggle to enable or disable the appearance of the zone of impact from interferers.

- **Map Properties**: Contains the **Auto Refresh** setting. Use the **Auto Refresh** drop-down list to specify the time interval between each auto refresh for map data to occur.

- **Global Map Properties**: Contains the **Units of Measure** setting. Use the **Units of Measure** setting to change the preferred measurement system to imperial system (feet) or metric system (meters). This setting applies to all wireless maps.

Filter Device Data on a Floor

For 2D wireless maps, you can apply various filters to network devices such as access points, sensors, and so on. Based on the filter criteria, the search results appear in a table. Filtering device data is helpful in locating specific devices for floors with many devices.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Data**.

Step 5 From the **Data** slide-in pane, click the device type that you want to apply a filter to.

Step 6 Define the filter rules by using the drop-down lists to choose the parameters.

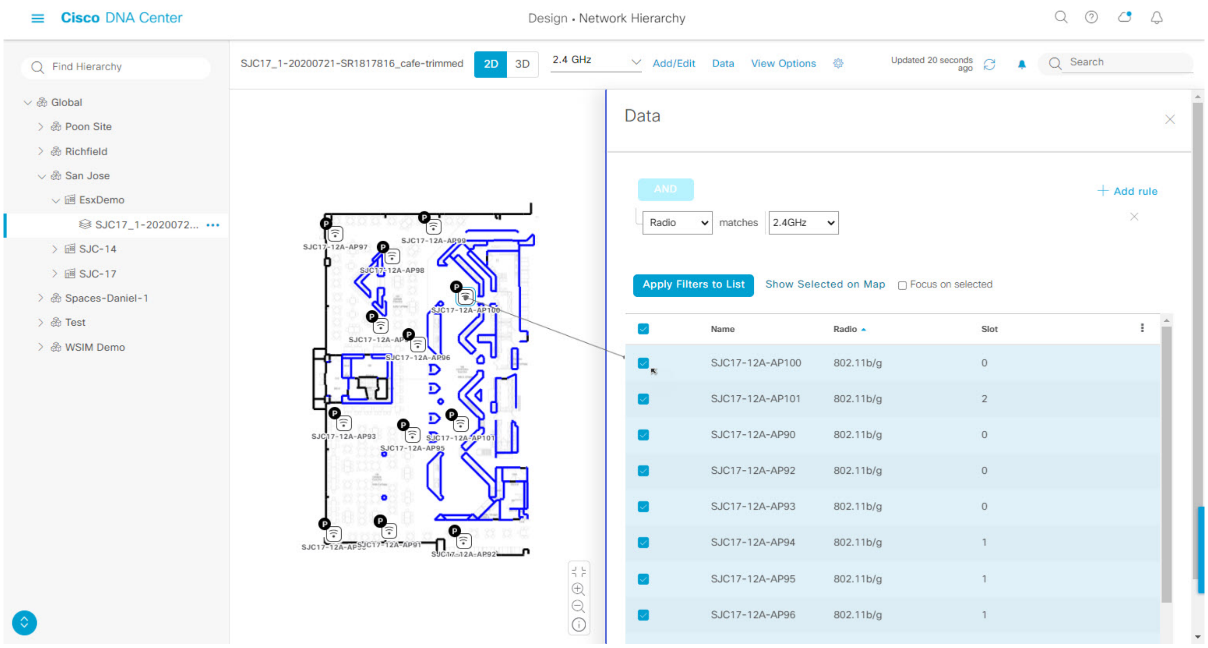
Step 7 To add more filter rules, click the + icon near the top of the slide-in pane.

Step 8 When you are done, click **Apply Filters to List**.

The filter results appear in the table at the bottom of the slide-in pane.

Step 9 You can hover your cursor over a device in the table to locate its position on the floor map.

Figure 9: Locating a Device from the Filter Results



Cisco DNA Center
Design • Network Hierarchy
Find Hierarchy
Global
Poon Site
Richfield
San Jose
EsxDemo
SJC17_1-2020072...
SJC-14
SJC-17
Spaces-Daniel-1
Test
WSIM Demo
SJC17_1-20200721-SR1817816_cafe-trimmed
2D
3D
2.4 GHz
Add/Edit
Data
View Options
Updated 20 seconds ago
Search
Data
AND
+ Add rule
Apply Filters to List
Show Selected on Map
Focus on selected

Radio matches 2.4GHz

☑	Name	Radio	Slot
☑	SJC17-12A-AP100	802.11b/g	0
☑	SJC17-12A-AP101	802.11b/g	2
☑	SJC17-12A-AP90	802.11b/g	0
☑	SJC17-12A-AP92	802.11b/g	0
☑	SJC17-12A-AP93	802.11b/g	0
☑	SJC17-12A-AP94	802.11b/g	1
☑	SJC17-12A-AP95	802.11b/g	1
☑	SJC17-12A-AP96	802.11b/g	1

Step 10 To remove applied filters, do the following:

a) Close the **Data** slide-in pane.

b) From the map toolbar, click **Data**.

c) Click the filter icon next to the device type to remove the filter.

Identify Wireless Interferers on the Floor Map

This is a 2D map feature.

Cisco DNA Center detects interference and disables the interference source for a specific band on a floor map. Any interference in the 2.4-GHz band disrupts the network traffic of the 802.11 wireless network.

Cisco DNA Center identifies the position, area of impact, and intensity of the interferer.

This procedure shows how to identify network interferers on a floor map.

Before you begin

Ensure that either Cisco Connected Mobile Experiences (CMX) or Cisco Spaces is synchronized with Cisco DNA Center.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 Hover your cursor over the ellipsis icon ••• next to the floor and choose **Sync: DNA Spaces/CMX** to synchronize **DNA Spaces** or **CMX** with the floor.

Note (Optional) In the world map, hover your cursor over the floor and choose **Sync: DNA Spaces/CMX** to synchronize **DNA Spaces** or **CMX** with the floor.

Step 5 In the **Network Hierarchy** window, click **View Options**.

Step 6 In the **View Options** window, scroll down and click the **Interferers** toggle button to enable interferers to appear on the floor map.

Step 7 Expand the **Interferers** category and click the **Show Zone of Impact** toggle button to enable the zone of impact of interferers to appear on the floor map.

Note By default, **Zone of Impact** is disabled.

Step 8 In the floor map, hover your cursor over the interferer icon and click the impacted channel to view the interferer device details.

Work with 3D Maps

3D maps are primarily used to plan and analyze a wireless network on a floor. As such, there are minimal configuration and edit functions that you can perform in 3D maps.

You can visualize your wireless network in various circumstances by customizing the KPIs, telemetry, and 3D map element settings. You can gain different perspectives of your wireless network by displaying the heatmap from both first-person and third-person views. Insights provide useful information about degradations in network performance, where service-level agreements (SLA) are not being met.

Unlike 2D maps, 3D maps provide two modes of operation:

- **Operation Mode**: In operation mode, the heatmap is computed based on live device information. Changes made to the following attributes cannot be saved:
  - AP model, channel, and Tx power
  - Planned AP channel and Tx power
- **Simulation Mode**: In simulation mode, you can make changes to the map to see how they would affect wireless coverage on a floor. You can also save these changes as simulations, so that you can open them and make more changes later.

Prerequisite

The system you use to compute and display 3D wireless heatmaps must have a Graphical Processing Unit (GPU) installed and enabled on it. For example, if you're using a Windows virtual machine (VM), you need to make sure that it has a GPU.

Configure Floor Map Elements and Overlays in 3D Maps

In 3D maps, you are limited to the following configuration and edit functions:

- Clone an AP, on page 158
- Edit an AP, on page 141
- Edit Multiple APs, on page 142
- Reposition an AP on a Map, on page 141
- Reposition a Sensor on a Map, on page 146

To configure other floor map elements or overlays, you need to use the 2D map. For details, see Configure Floor Map Elements and Overlays in 2D Maps, on page 135.

Clone an AP

You can duplicate an AP with its configuration by cloning it.

Before you begin

You must have actual APs to clone.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **3D**.

Step 4 From the map toolbar, click the Simulation icon .

Step 5 From the map toolbar, click **Add/Edit**.

Step 6 From the map, click an AP.

Step 7 From the **AP Details** slide-in pane, click **Clone**.

A duplicate AP is created and displayed below the original AP. It's name is appended with **-1**. If you keep cloning the same AP, the name continues to be incrementally appended. For example, the first clone for **a-floor1-ap01** is named **a-floor1-ap01-1**, the second clone for the same AP is named **a-floor1-ap01-2**, and so on.

Step 8 In the map, right-click the cloned AP and choose **Move**.

Step 9 Drag and drop the AP to its new position.

Step 10 Click **Save**.

View a 3D Wireless Map

Use this procedure to view a 3D wireless map.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

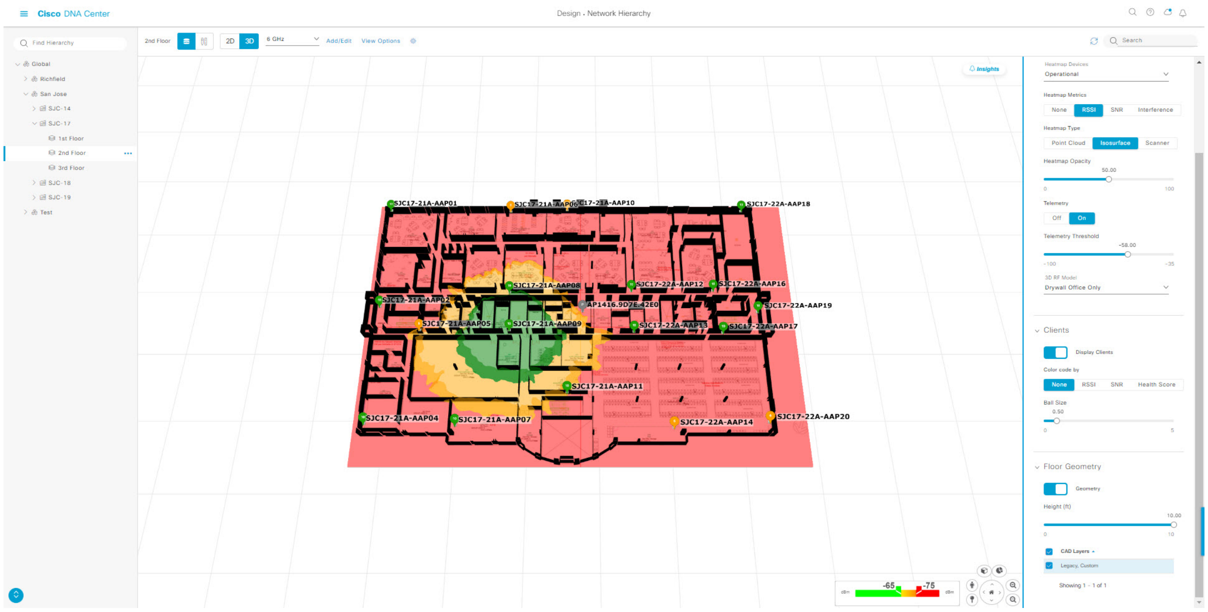
Step 2 From the left hierarchy tree, choose a floor.

Step 3 In the map toolbar, click **3D**.

Step 4 In the map toolbar, click **Operation**.

Note A 3D heatmap is delimited by its coverage area, which is the full floor width and length, by default. To specify a polygon for the heatmap boundaries, you need to edit the **Coverage Area** field value in the 2D map view. However, these boundaries do not apply to the 2D map view, as the full floor width and length is used for the 2D map view.

Figure 10: 3D Wireless Map in Operation Mode


Cisco DNA Center
Design · Network Hierarchy
Find Hierarchy
Global
Richfield
San Jose
SJC-14
SJC-17
1st Floor
2nd Floor
3rd Floor
SJC-18
SJC-19
Test
2nd Floor
2D
3D
6 GHz
Add/Edit
View Options
Insights
Search
SJC17-21A-AAP01
SJC17-21A-AAP06
SJC17-21A-AAP10
SJC17-22A-AAP18
SJC17-21A-AAP08
SJC17-22A-AAP12
SJC17-22A-AAP16
SJC17-21A-AAP02
AP1416.9D7E.42E0
SJC17-22A-AAP19
SJC17-21A-AAP05
SJC17-21A-AAP09
SJC17-22A-AAP13
SJC17-22A-AAP17
SJC17-21A-AAP11
SJC17-21A-AAP04
SJC17-21A-AAP07
SJC17-22A-AAP14
SJC17-22A-AAP20
-65
-75

Heatmap Devices: Operational

Heatmap Metrics: None, **RSSI**, SNR, Interference

Heatmap Type: Point Cloud, **Isosurface**, Scanner

Heatmap Opacity: 50.00 (0–100)

Telemetry: Off, **On**

Telemetry Threshold: -58.00 (-100 – -35)

3D RF Model: Drywall Office Only

Clients

Display Clients (on)

Color code by: **None**, RSSI, SNR, Health Score

Ball Size: 0.50 (0–5)

Floor Geometry

Geometry (on)

Height (ft): 10.00 (0–10)

☑ CAD Layers

☑ Legacy, Custom

Showing 1 - 1 of 1

Step 5 To view the heatmap for one or more APs, select and deselect the APs using one of the following methods:

- To select a single AP, click the AP.
- To select multiple APs, press the **`Shift`** key while clicking each AP, and then release the **`Shift`** key.
- To deselect a single AP, click the AP.

  Note If no APs are selected, the heatmap includes all APs.

- To deselect all APs, press the **`ESC`** key or double-click an area of the map that doesn't have any APs.

Step 6 Use the map toolbar for the following actions and settings:

Item	Description
	Click **Operation** to view the map in Operation mode and click **Simulation** to view it in Simulation mode. **Note** Simulation mode is available only in 3D maps, not in 2D maps.
2D 3D	Click **2D** to view the wireless map in 2D or click **3D** to view it in 3D.

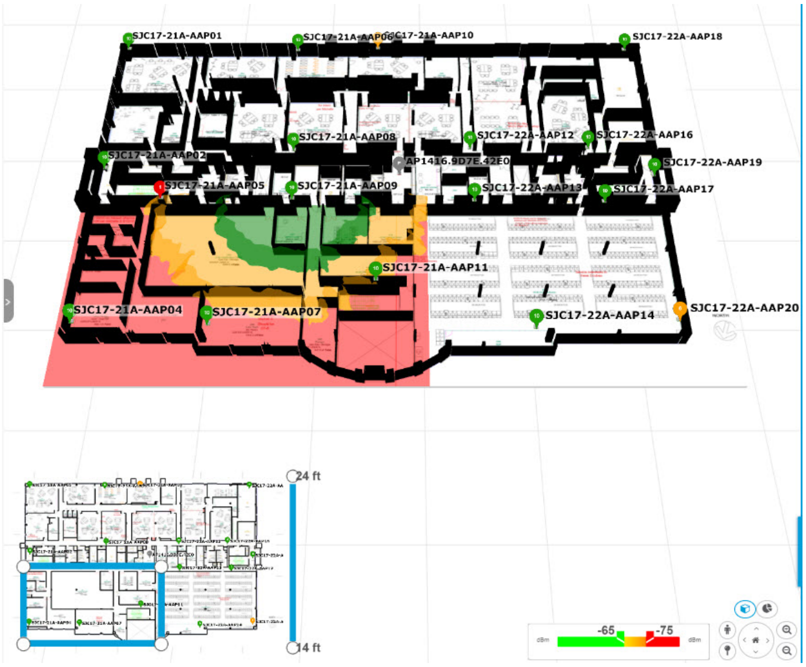
Item	Description
5 GHz ⌄	Use the **Wi-Fi Band Filter** filter to view the heatmap for the 2.4-GHz or 5-GHz Wi-Fi bands.
Add/Edit	Click **Add/Edit** to add planned APs by cloning existing APs or planned APs. For information, see Clone an AP. **Note** Adding operational APs from inventory is not available in 3D. To add operational APs, use **Add/Edit** from the 2D map.
View Options	Open the **3D Floormap** slide-in pane to display the contributing floors, KPI, telemetry, and floor element settings.
⚙	Hover your cursor over the Gear icon and click **Insights Configuration** to customize the conditions for insights.
⟳	Click the Refresh icon to update the device and map data. To the left of the icon is the timestamp for the last refresh.
🔍 Search	Use the **Search** field to perform a search for specific floor map elements such as APs, sensors, clients, and so on. Matches to your search criteria are listed below the **Search** field. When you hover your cursor over an element in the list, an indicator points to the element on the map. If the element is outside the field of view, the indicator displays as a broken red line. Reorient the map to see the element.

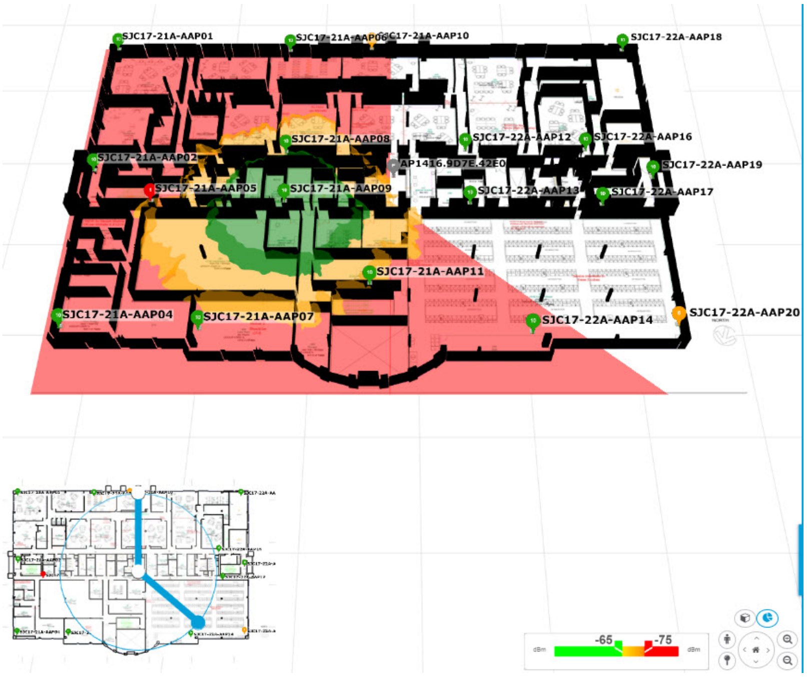
Step 7 At the top-right corner of the map, click **Insights** to view insights and potential issues in the wireless network.

For details, see Gain Insights from a 3D Wireless Map, on page 169.

Step 8 Use the map for the following functions:

- View the heatmap of the 3D wireless map. You can customize the KPIs, telemetry, and 3D map element settings from the **3D Floormap** slide-in pane.
- When the map is in default map view (Simulation mode), you can control the camera angle by clicking and dragging with the left or right mouse button.
- Use the map navigation controls at the bottom-right corner of the map for greater control of the map:

Map Navigation Control	Description
	Use clip box: Click this icon to crop the heatmap using a box shape. Use the clipper at the bottom-left corner of the map to specify the crop: - Click and drag one of the anchor points to change the size of the crop. - Click and drag one of the anchor points on the right vertical slider to specify the height range of the crop. *Figure 11: Clip Box*  SJC17-21A-AAP01 SJC17-21A-AAP06 SJC17-21A-AAP10 SJC17-22A-AAP18 SJC17-21A-AAP08 SJC17-22A-AAP12 SJC17-22A-AAP16 SJC17-21A-AAP02 AP1416.9D7E.42E0 SJC17-22A-AAP19 SJC17-21A-AAP05 SJC17-21A-AAP09 SJC17-22A-AAP13 SJC17-22A-AAP17 SJC17-21A-AAP11 SJC17-21A-AAP04 SJC17-21A-AAP07 SJC17-22A-AAP14 SJC17-22A-AAP20 24 ft 14 ft dBm -65 -75 dBm

Map Navigation Control	Description
◕	**Use clip planes**: Click this icon to crop the heatmap using a donut shape. Use the clipper at the bottom-left corner of the map to specify the crop: • Click and drag the anchor point in the center of the donut to reposition the donut. • Click and drag the two outer anchor points to change the shape of the crop. *Figure 12: Clip Planes in Use*  SJC17-21A-AAP01 SJC17-21A-AAP06 SJC17-21A-AAP10 SJC17-22A-AAP18 SJC17-21A-AAP08 SJC17-22A-AAP12 SJC17-22A-AAP16 SJC17-21A-AAP02 AP1416.9D7E.42E0 SJC17-22A-AAP19 SJC17-21A-AAP05 SJC17-21A-AAP09 SJC17-22A-AAP13 SJC17-22A-AAP17 SJC17-21A-AAP11 SJC17-21A-AAP04 SJC17-21A-AAP07 SJC17-22A-AAP14 SJC17-22A-AAP20 dBm -65 -75 dBm
👤	**First Person View**: Click this icon to switch between first-person view and third-person view. The blue sphere indicates your position on the map. As you move throughout the map, your field of view changes. You can use the mini map at the lower left corner to get an idea of your field of view and orientation. **Note** If you have more than one floor selected for display, the **First Person View** automatically positions you on the current floor. For details, such as the controls for view, see Use First-Person and Third-Person Views for 3D Wireless Maps, on page 166.

<table>
<tr><th>Map Navigation Control</th><th>Description</th></tr>
<tr><td></td><td>

Third Person View: Click this icon to switch between first person view and third person view.

The blue sphere indicates your position on the map. As you move throughout the map, your field of view changes. You can use the mini map at the lower left corner to get an idea of your field of view and orientation.

For details, such as the controls for view, see Use First-Person and Third-Person Views for 3D Wireless Maps, on page 166.

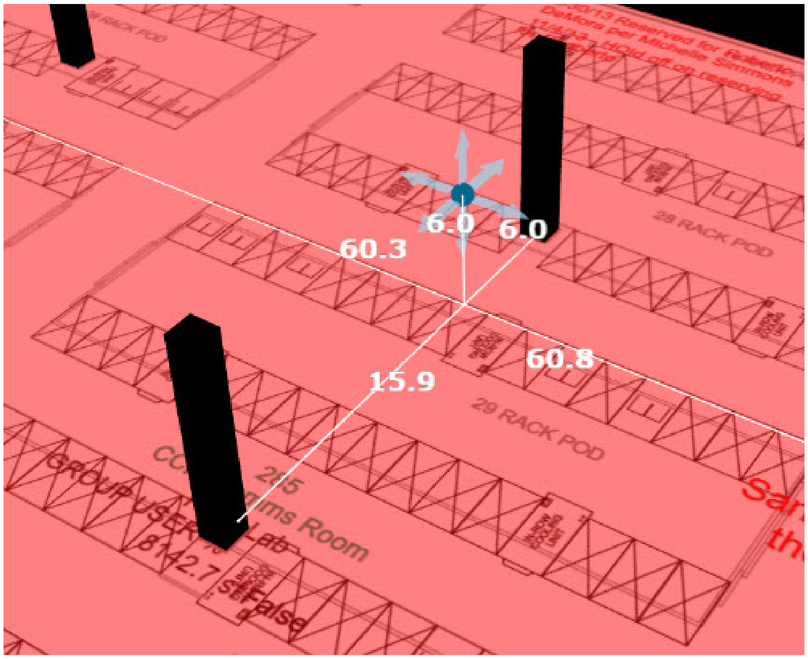
</td></tr>
<tr><td></td><td>

Place a pin: Click this icon to view a predicted measurement (x, y, and z coordinates) of a specific point on the floor map. By placing a pin, you can view the measurements of the distance from the pin to the end of the yard stick. As you zoom in or out, the position of the measurements is adjusted to stay in your view. Click and drag the arrows around the pin to change the position of the pin, as follows:

- **To move the pin horizontally**: Click the horizontal arrows and drag the pin left, right, forward, or backward. The selected arrows and yard stick are highlighted while active.
- **To move the pin vertically**: Click the vertical arrows and drag the pin up or down. The selected arrows and yard stick are highlighted while active.

For a video demonstration, click here.

Figure 13: Adjusting a Pin



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

Zoom In: Click this icon to enlarge the view. Alternatively, you can use your mouse wheel to zoom in.

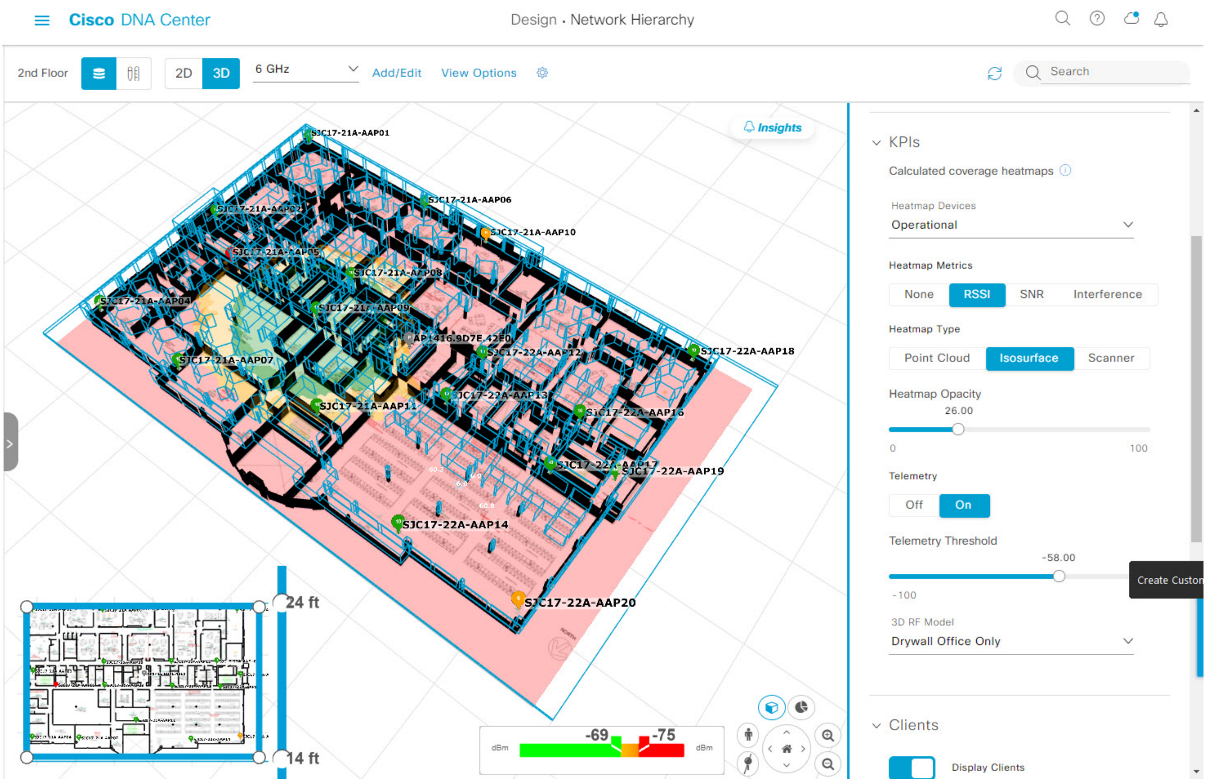
</td></tr>
</table>

Map Navigation Control	Description
🔍	**Zoom Out**: Click this icon to reduce the size of the image and to increase your field of view. Alternatively, you can use the scroll wheel on your mouse to zoom out.
‹ ˄ ⌂ ˅ ›	**Map Rotation and Default Map View**: Click the directional arrows to change the camera angle. Click the Return Home icon to reset the map to the default view.

Step 9 Use the **3D Floormap** slide-in pane to choose the contributing floors in 3D map metrics, KPIs, and other floor map element settings. Expand the following categories to view the settings:

- **Contributing Floors**: Lists the floor above and below the current floor and allows you to configure the settings listed in the table below on a per floor basis, while maintaining focus on the heatmap of the current floor. Click **Apply** to generate the heat map with your settings.

Figure 14: 3D Map of Multiple Floors


Cisco DNA Center
Design • Network Hierarchy
2nd Floor
2D
3D
6 GHz
Add/Edit
View Options
Search
Insights
SJC17-21A-AAP01
SJC17-21A-AAP06
SJC17-21A-AAP10
SJC17-21A-AAP02
SJC17-21A-AAP05
SJC17-21A-AAP08
SJC17-21A-AAP04
SJC17-21A-AAP09
AP1416.9D7E.4280
SJC17-22A-AAP12
SJC17-22A-AAP18
SJC17-21A-AAP07
SJC17-22A-AAP13
SJC17-21A-AAP11
SJC17-22A-AAP16
SJC17-22A-AAP17
SJC17-22A-AAP19
SJC17-22A-AAP14
SJC17-22A-AAP20
24 ft
14 ft
dBm
-69
-75
dBm
Create Custom

KPIs

Calculated coverage heatmaps

Heatmap Devices: Operational

Heatmap Metrics: None | **RSSI** | SNR | Interference

Heatmap Type: Point Cloud | **Isosurface** | Scanner

Heatmap Opacity: 26.00 (0–100)

Telemetry: Off | **On**

Telemetry Threshold: -58.00 (-100)

3D RF Model: Drywall Office Only

Clients

Display Clients

Item	Description
Compute APs check box	Check this check box to include the APs on the corresponding floor when computing the heatmap.
Display APs check box	Check this check box to display the APs on the corresponding floor.

Item	Description
Display Geometry check box	Check this check box to display the corresponding floor and its physical attributes in the heatmap.

- **KPI Category**: Contains the following KPI and telemetry settings:

Item	Description
Heatmap Metrics	Change the KPI to be displayed on the heatmap: • **None**: Disables the heatmap. • **RSSI**: Displays the Received Signal Strength Indication (RSSI) values. • **SNR**: Displays the signal-to-noise ratio (SNR) values. • **Interference**: Displays the SNR that is caused by co-channel interference (CCI) or adjacent channel interference.
Heatmap Type	Change the heatmap type: • **Point Cloud**: Provides a collection of data points in space. Each data point has x, y, and z coordinates. • **Isosurface**: Represents the RSSI with isolines or lines of a contiguous value. • **Scanner**: Displays the RSSI for a specific elevation.
Heatmap Opacity	Use the slider to customize the opacity or transparency of the heatmap.
Telemetry	Use this toggle button to enable or disable telemetry. When telemetry is enabled, click a sensor or AP to view its telemetry: • The telemetry for a sensor displays the predicted and measured RSSI values between a sensor AP and other APs. • The telemetry for an AP displays the predicted and measured RSSI values between neighbor APs.
Telemetry Threshold	When telemetry is enabled, use this slider to set the threshold for telemetry sources to appear. Telemetry sources with predicted values that do not meet the threshold are faded.
3D RF Model	Use this drop-down list to choose the RF model. The RF model determines how RF is calculated based on the floor type.

- **Floor Geometry Category**: Contains the following floor map element settings:

Item	Description
Geometry	Use this toggle button to enable or disable 3D map elements, such as walls.

Item	Description
CAD Layers	Choose the CAD layers that you want to be displayed on the map.

Use First-Person and Third-Person Views for 3D Wireless Maps

You can use the first-person and third-person views to gain different perspectives of your wireless network.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

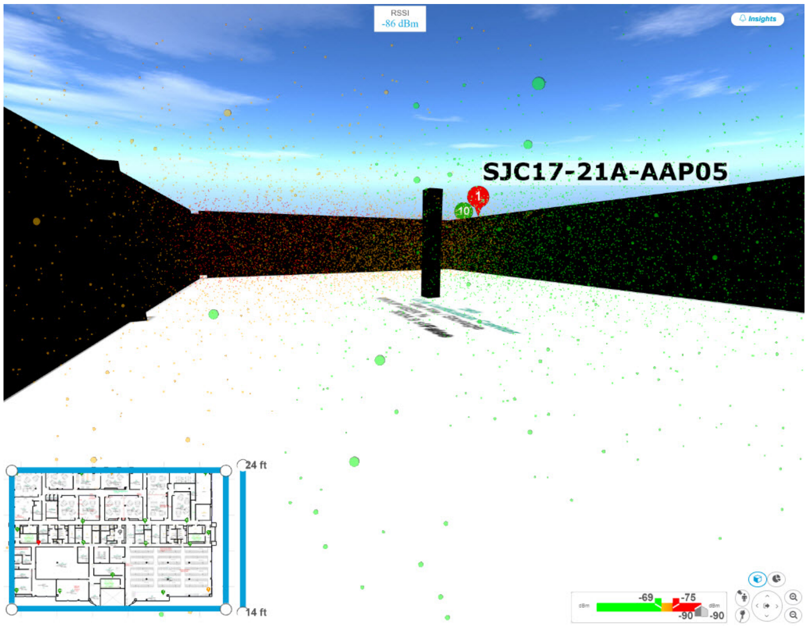
Step 2 From the left hierarchy tree, choose a floor.

Step 3 In the map toolbar, click **3D**.

Step 4 To use the first-person view, click the First-Person View icon in the map navigation controls. Optionally, you can drag and drop the Person icon to a specific location on the map.

The map view changes to the first-person view.

Figure 15: First-Person View



Step 5 You can control the first person view by doing the following:

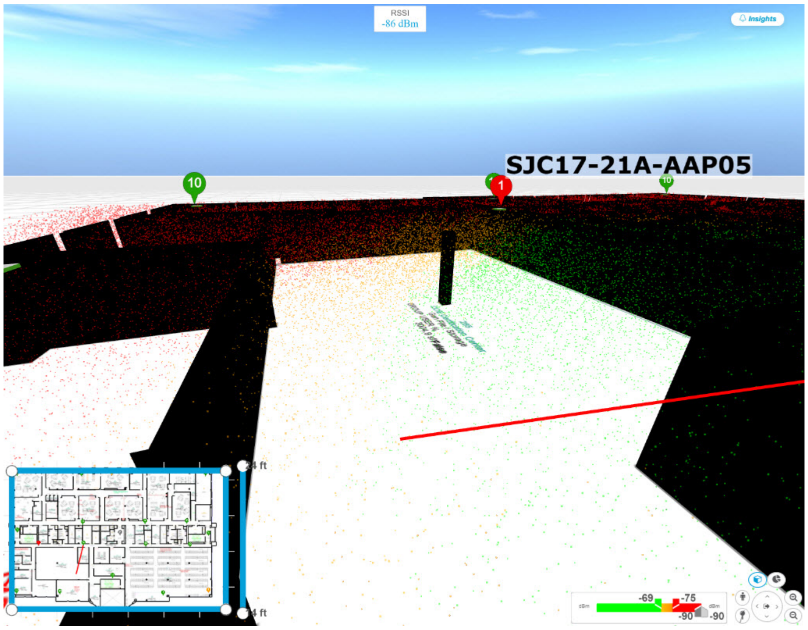
Action	Controls
Move forward/backward and right/left.	Use the **W**, **A**, **S**, and **D** keys or arrow keys.
Change the camera angle.	Click and hold the left mouse button on the map and move the mouse wheel.

Action	Controls
Raise the altitude of the camera angle.	Hold the **Spacebar**.
Lower the altitude of the camera angle.	Hold **Shift** + **Spacebar**.

Step 6 To use the third person view, click the Third-Person View icon from the map navigation controls.

The map view changes to the third person view.

Figure 16: Third Person View



Step 7 You can control the third person view by doing the following:

Action	Controls
Move forward/backward and right/left.	Use the **W**, **A**, **S**, and **D** keys or arrow keys.
Change the camera angle.	Click and drag on the map.
Raise the altitude of the camera angle.	Hold the **Spacebar**.
Lower the altitude of the camera angle.	Hold **Shift** + **Spacebar**.

Step 8 To return to the default view, click the Return Home icon .

Create Simulations for 3D Wireless Maps

You can create simulations for 3D wireless maps.

Note Simulation mode is available only in 3D maps, not in 2D maps.

Simulations allow you to make changes to device configurations without having to save those changes in Operation mode. You can create multiple simulations and load them at any time.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose

Step 3 In the map toolbar, click **3D**.

Step 4 In the map toolbar, click **Add/Edit**.

In simulation mode, only particular attributes are editable and only for previewing the impact of changes on the heatmap.

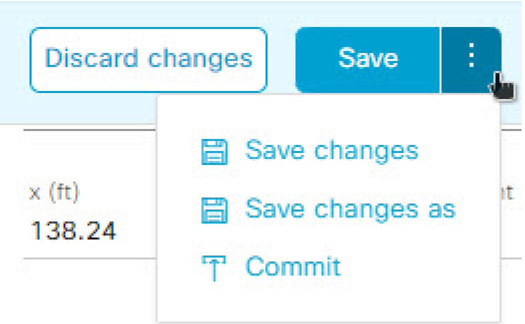
Step 5 Make the changes to the devices, as needed:

- **APs**: You can change the model, channel, and transmission power.
- **PAPs**: You can change the channel and transmission power.

a) Click **Apply**.

Step 6 In the map toolbar, hover your cursor over the vertical ellipsis and choose **Save changes as**.

Figure 17: Saving as a Simulation



Note Choosing **Save changes** saves your changes to Operation mode.

Choosing **Commit** saves your changes to production devices.

Step 7 In the **Save Simulation** dialog box, enter a name for the simulation and click **Save**.

Step 8 To load a simulation, click the Simulation icon in the map toolbar.

The 3D wireless map enters simulation mode, which is indicated by the map toolbar color changing to light blue.

Step 9 Use the drop-down list to the right of the Simulation icon to choose which simulation to open. If you have no saved simulations, **None available** is displayed.

Gain Insights from a 3D Wireless Map

Cisco DNA Center actively monitors the network performance of 3D wireless maps and provides insights into areas where service-level agreements (SLA) are not being met.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

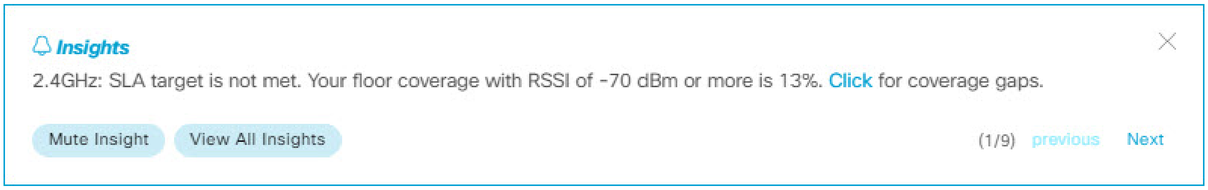
Step 2 From the left hierarchy tree, choose a floor.

Step 3 In the map toolbar, click **3D**.

Step 4 At the top-right corner of the map, click **Insights**.

The **Insights** area appears.

Figure 18: Insights Area



2.4GHz: SLA target is not met. Your floor coverage with RSSI of -70 dBm or more is 13%. Click for coverage gaps.

Step 5 From the **Insights** area, you can do the following:

Actions	Details
View insight details.	The **Insights** area displays the insight details. To view the insights, click **Next** and **Previous**. An insight reports the percentage of floor coverage area that does not meet a specific KPI threshold, for example, RSSI is ≥ -70 dBm. Click **Click** to view the affected areas.
Get an overview of all insights.	Click **View All Insights** to open the **All Insights** slide-in pane that displays all insights (active and muted).
Customize the insight settings.	Customizing an insight settings allows you to change the insight's KPI threshold value. Click **View All Insights** and then click **Edit Configuration** for the insight settings that you want to customize. Alternatively, you can hover your cursor over the Gear icon ⚙ in the map toolbar and choose **Insights Configurations** to customize insight settings.
Mute an insight.	Click **Mute Insight** to stop Cisco DNA Center from reporting the insight. Muted insights appear at the bottom of the list in the **All Insights** slide-in pane.

CHAPTER 8

Configure Network Settings

- Network Settings Overview, on page 171
- Add Cisco ISE or Other AAA Servers, on page 172
- Configure Global Network Servers, on page 173
- Global Device Credentials Overview, on page 173
- Configure IP Address Pools, on page 182
- Configure Service Provider Profiles, on page 187
- Configure Global Wireless Settings, on page 188

Network Settings Overview

You can create network settings that become the default for your entire network. There are two primary areas from which you can define the settings within your network:

- **Global settings**: Settings defined here affect your entire network and include settings for servers such as DHCP, DNS, AAA, NTP, and so on; IP address pools; Device Credential profiles; Telemetry settings such as Syslog, Traps, and Netflow.
- **Site settings**: Settings define here override global settings and can include settings for servers, IP address pools, and device credential profiles.

Note Changes in network settings that are being used by the active fabric are not supported. These network settings include site hierarchy, renaming IP pools, and several other features.

Note Certain network settings can be configured on devices automatically using the Device Controllability feature. When Cisco DNA Center configures or updates devices, the transactions are captured in the Cisco DNA Center audit logs. You can use the audit logs to help you track changes and troubleshoot issues.

You can define the following global network settings by choosing **Design** > **Network Settings** and clicking the appropriate tab.

- Network servers, such as AAA, DHCP, and DNS—For more information, see Configure Global Network Servers, on page 173.

- Device credentials, such as CLI, SNMP, and HTTP(S)—For more information, see Configure Global CLI Credentials, on page 173, Configure Global SNMPv2c Credentials, on page 174, Configure Global SNMPv3 Credentials, on page 175, and Configure Global HTTPS Credentials, on page 177.
- IP address pools—For more information, see Configure IP Address Pools, on page 182.
- Wireless settings as SSIDs, wireless interfaces, and wireless radio frequency profiles—For more information, see Configure Global Wireless Settings, on page 188.
- Configure global telemetry settings, such as syslog, SNMP, and NetFlow Collector servers using telemetry.

Add Cisco ISE or Other AAA Servers

You can define Cisco Identity Services Engine (ISE) servers or other, similar AAA servers for network, client, and endpoint authentication at the site or global level. For network authentication, RADIUS and TACACS protocols are supported. For client and endpoint authentication, only RADIUS is supported. Only one Cisco ISE is supported per Cisco DNA Center.

You can configure the source interface under the RADIUS or TACACS server group to support multi-ISE configuration, wherein each Cisco ISE cluster has its own server group. The source interface used for RADIUS and TACACS servers is determined in the following way:

- If the device has a Loopback0 interface configured, Loopback0 is configured as the source interface.
- Otherwise, the interface that Cisco DNA Center uses as the management IP is configured as the source interface.

After you configure a Cisco ISE server for a site, the devices that are assigned to the site are automatically updated on the corresponding Cisco ISE server with a /32 mask. Subsequently, any changes to those devices in Cisco ISE are sent automatically to Cisco DNA Center.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **Network**.

Step 2 Click **Add Servers** to add a AAA server.

Step 3 In the **Add Servers** window, check the **AAA** check box, and click **OK**.

Step 4 Set the AAA server for network users, client/endpoint users, or both.

Step 5 Check the **Network** and/or **Client/Endpoint** check boxes and configure servers and protocols for the AAA server.

Step 6 Choose the **Servers** for authentication and authorization: **ISE** or **AAA**.

- If you choose **ISE**, configure the following:
  - From the **Network** drop-down list, choose the IP address of the Cisco ISE server. The **Network** drop-down list contains all the IP addresses of the Cisco ISE servers that are registered in **System Settings** on the Cisco DNA Center home page. Selecting a Cisco ISE IP populates the primary and additional IP address drop-down lists with Policy Service Nodes (PSN) IP addresses for the selected Cisco ISE. You can either enter an IP address for the AAA server or choose the PSN IP address from the **IP Address (Primary)** and **IP Address (Additional)** drop-down lists.
  - Choose the **Protocol**: **RADIUS** or **TACACS**.

  Note AAA settings for a physical and managed site for a particular WLC must match, or provisioning fails.

- If you choose **AAA**, configure the following:
  - Enter an IP address for the AAA server or choose the IP addresses from the **IP Address (Primary)** and **IP Address (Additional)** drop-down lists. These drop-down lists contain the non-Cisco ISE AAA servers registered in the **System Settings**.

Step 7 Click **Save**.

Configure Global Network Servers

You can define global network servers that become the default for your entire network.

Note You can override global network settings on a site by defining site-specific settings.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **Network**.

Step 2 In the **DHCP Server** field, enter the IP address of a DHCP server.

Note You can click the plus icon and enter both IPv4 and IPv6 addresses.

You must define at least one DHCP server in order to create IP address pools.

Step 3 In the **DNS Server** field, enter the domain name of a DNS server.

Note You can click the plus icon and enter both IPv4 and IPv6 addresses.

You must define at least one DNS server in order to create IP address pools.

Step 4 Click **Save**.

Global Device Credentials Overview

"Global device credentials" refers to the common CLI, SNMP, and HTTPS credentials that Cisco DNA Center uses to discover and collect information about the devices in your network. Cisco DNA Center uses global credentials to authenticate and access the devices in a network that share these configured device credentials. You can add, edit, and delete global device credentials. You can also associate credentials to the Global site or a specific site.

Configure Global CLI Credentials

You can configure and save up to 10 global CLI credentials.

Step 1 Click the menu icon (☰) and choose **Design** > **Network Settings** > **Device Credentials**.

Step 2 With the Global site selected, in the **CLI Credentials** area, click **Add**.

Step 3 Enter information in the following fields:

Table 36: CLI Credentials

Field	Description
Name/Description	Name or phrase that describes the CLI credentials.
Username	Name that is used to log in to the CLI of the devices in your network.
Password	Password that is used to log in to the CLI of the devices in your network. For security reasons, re-enter the password as confirmation. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.
Enable Password	Password used to move to a higher privilege level in the CLI. Configure this password only if your network devices require it. For security reasons, re-enter the enable password. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.

Step 4 Click **Save**.

To apply the credential to a site, click on the site in the hierarchy on the left, select the button next to the credential, then click **Save**.

Step 5 If you are changing existing credentials, you are prompted to update the new credentials on devices now or schedule the update for a later time.

- To update the new credentials now, click the **Now** radio button and click **Apply**.
- To schedule the update for a later time, click the **Later** radio button, define the date and time of the update and click **Apply**.

Note Use the **Time Zone** check box to indicate whether you want the update to happen according to the site time zone or according to a specified time zone.

Configure Global SNMPv2c Credentials

You can configure global SNMPv2c credentials to monitor and manage your network devices.

Before you begin

You must have your network's SNMP information.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **Device Credentials**.

Step 2 With the Global site selected, in the **SNMP Credentials** area, click **Add**.

Step 3 For the Type, click **SNMP v2c** and enter the following information:

Table 37: SNMPv2c Credentials

Field	Description
Read	• **Name/Description**: Name or description of the SNMPv2c settings that you are adding. • **Read Community**: Read-only community string password used only to view SNMP information on the device. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.
Write	• **Name/Description**: Name or description of the SNMPv2c settings that you are adding. • **Write Community**: Write community string used to make changes to the SNMP information on the device. **Note** Passwords are encrypted for security reasons and are not displayed in the configuration.

Step 4 Click **Save**.

Step 5 If you are changing existing credentials, you are prompted to update the new credentials on devices now or schedule the update for a later time.

- To update the new credentials now, click the **Now** radio button and click **Apply**.
- To schedule the update for a later time, click the **Later** radio button, define the date and time of the update and click **Apply**.

Note Use the **Time Zone** check box to indicate whether you want the update to happen according to the site time zone or according to a specified time zone.

Configure Global SNMPv3 Credentials

You can configure global SNMPv3 credentials to monitor and manage your network devices.

Before you begin

You must have your network's SNMP information.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **Device Credentials**.

Step 2 With the Global site selected, in the **SNMP Credentials** area, click **Add**.

Step 3 For the Type, click **SNMP v3** and enter the following information:

Table 38: SNMPv3 Credentials

Field	Description
Name/Description	Name or description of the SNMPv3 settings that you are adding.
Username	Name associated with the SNMPv3 settings.
Mode	Security level that an SNMP message requires. Choose one of the following modes: • **noAuthNoPriv**: Does not provide authentication or encryption. • **AuthNoPriv**: Provides authentication, but does not provide encryption. • **AuthPriv**: Provides both authentication and encryption.
Auth Type	Authentication type to be used. (Enabled if you select **AuthPriv** or **AuthNoPriv** as **Mode**.) Choose one of the following authentication types: • **SHA**: Authentication based on HMAC-SHA. • **MD5**: Authentication based on HMAC-MD5.
Auth Password	SNMPv3 password used for gaining access to information from devices that use SNMPv3. These passwords (or passphrases) must be at least eight characters in length. **Note** • Some wireless controllers require that passwords (or passphrases) be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.
Privacy Type	Privacy type. (Enabled if you select **AuthPriv** as **Mode**.) Choose one of the following privacy types: • **AES128**: 128-bit CBC mode AES for encryption. • **AES192**: 192-bit CBC mode AES for encryption. • **AES256**: 256-bit CBC mode AES for encryption. **Note** • Discovery and Inventory features support only AES192 and AES256 privacy types. • Cisco DNA Assurance does not support any of these privacy types.

Field	Description
Privacy Password	SNMPv3 privacy password that is used to generate the secret key for encrypting messages that are exchanged with devices that support AES128, AES192, and AES256 encryption standards. Passwords (or passphrases) must be at least eight characters long. **Note** • Some wireless controllers require that passwords (or passphrases) be at least 12 characters long. Be sure to check the minimum password requirements for your wireless controllers. Failure to ensure these required minimum character lengths for passwords results in devices not being discovered, monitored, or managed by Cisco DNA Center. • Passwords are encrypted for security reasons and are not displayed in the configuration.

Step 4 Click **Save**.

Step 5 If you are changing existing credentials, you are prompted to update the new credentials on devices now or schedule the update for a later time.

- To update the new credentials now, click the **Now** radio button and click **Apply**.
- To schedule the update for a later time, click the **Later** radio button, define the date and time of the update and click **Apply**.

Note Use the **Time Zone** check box to indicate whether you want the update to happen according to the site time zone or according to a specified time zone.

Configure Global HTTPS Credentials

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **Device Credentials**.

Step 2 With the Global site selected, in the **HTTPS Credentials** area, click **Add**.

Step 3 Enter the following information:

Table 39: HTTP(S) Credentials

Field	Description
Type	Specifies the kind of HTTPS credentials you are configuring. Valid types are **Read** or **Write**.

Field	Description
Read	You can configure up to 10 HTTPS read credentials: • **Name/Description**: Name or description of the HTTPS credentials that you are adding. • **Username**: Name used to authenticate the HTTPS connection. • **Password**: Password used to authenticate the HTTPS connection. Passwords are encrypted for security and are not displayed in the configuration. • **Port**: Number of the TCP/UDP port used for HTTPS traffic. The default is port number 443 (the well-known port for HTTPS). The password must contain between 7 and 128 characters, including at least one of the following: • Lowercase letter (a to z) • Uppercase letter (A to Z) • Number (0 to 9) • Special character: # _ * ? – The password cannot contain spaces or angle brackets (< >). Note that some Cisco IOS XE devices do not allow a question mark (?).
Write	You can configure up to 10 HTTPS write credentials: • **Name/Description**: Name or description of the HTTPS credentials that you are adding. • **Username**: Name used to authenticate the HTTPS connection. • **Password**: Password used to authenticate the HTTPS connection. Passwords are encrypted for security and are not displayed in the configuration. • **Port**: Number of the TCP/UDP port used for HTTPS traffic. The default is port number 443 (the well-known port for HTTPS). The password must contain between 7 and 128 characters, including at least one of the following: • Lowercase letter (a to z) • Uppercase letter (A to Z) • Number (0 to 9) • Special character: # _ * ? – The password cannot contain spaces or angle brackets (< >). Note that some Cisco IOS XE devices do not allow a question mark (?).

Step 4 Click **Save**.

Step 5 If you are changing existing credentials, you are prompted to update the new credentials on devices now or schedule the update for a later time.

- To update the new credentials now, click the **Now** radio button and click **Apply**.

- To schedule the update for a later time, click the **Later** radio button, define the date and time of the update, and click **Apply**.

Note Use the **Time Zone** check box to indicate whether you want the update to happen according to the site time zone or according to a specified time zone.

Guidelines for Editing Global Device Credentials

The following are guidelines and limitations for editing existing global device credentials:

- Cisco DNA Center uses the following process when you edit, save, and then apply a global device credential:

  1. Cisco DNA Center pushes the credential to the device that has local authentication. With local authentication, credential changes are applied and Cisco DNA Center manages the devices using these credentials.

     (Cisco DNA Center does not push CLI credential changes to a device that is under a site with an inherited or configured AAA server. With AAA authentication, credential changes are not applied. Cisco DNA Center manages the devices using these credentials only if the same credentials exist on the AAA server.)

  2. After successfully pushing the credential to the device, Cisco DNA Center confirms it can reach the device using the new credential.

     Note If this step fails, Inventory uses the old credentials to manage the device even though Cisco DNA Center pushed the new credentials to the device. In this case, the **Provision** > **Inventory** window might indicate that the device is Unmanaged if you updated an existing credential.

  3. After successfully reaching the device using the new credential, the Cisco DNA Center Inventory starts managing the device using the new credential.

- Sites can contain devices that use SNMPv2c and SNMPv3 credentials. When you edit and save global SNMPv2c or SNMPv3 credentials, Cisco DNA Center pushes those changes to devices and enables that credential. For example, if you have a device that uses SNMPv2c, but you edit and save the SNMPv3 global credential, Cisco DNA Center pushes the new SNMPv3 credential to all devices in the associated site and enables it, meaning that all devices will be managed using SNMPv3, even the devices that previously had SNMPv2c enabled.

- To avoid any possible disruptions, modify the **User Name** when you edit CLI credentials. This creates a new CLI credential and leaves any existing CLI credentials unchanged.

Edit Global Device Credentials

You can edit and save global device credentials without Cisco DNA Center applying those credential changes until you're ready. When you decide to apply the changes, Cisco DNA Center searches all sites that reference the device credential you changed and pushes the change to all the devices.

You can update or create new global device credentials, but Cisco DNA Center never removes any credentials from devices.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **Device Credentials**.

Step 2 With the Global site selected, click **Manage Credentials**, check the check box for the device credential that you want to change, and choose **Actions** > **Edit**.

Step 3 In the **Edit Credentials** dialog box, make any changes, and click **Save**.

Note The CLI password credentials support only *ASCII-printable characters* (character code 32-127; see https://en.wikipedia.org/wiki/ASCII#Printable_characters).

Step 4 In the credential tile, click **Apply**.

Step 5 In the **Apply Credentials** dialog box, select whether to update the new credentials on devices now or schedule the update for a later time.

- To update the new credentials now, click the **Now** radio button and click **Apply**.
- To schedule the update for a later time, click the **Later** radio button, define the date and time of the update and click **Apply**.

  Note Use the **Time Zone** check box to indicate whether you want the update to happen according to the site time zone or according to a specified time zone.

A status message indicates whether the device credential change succeeded or failed.

Step 6 To view the status of the credential change, choose **Provision** > **Network Devices** > **Inventory**.

The **Credential Status** column displays one of the following statuses:

- Success: Cisco DNA Center successfully applied the credential change.
- Failed: Cisco DNA Center was unable to apply the credential change. Hover over the icon to display additional information about which credential change failed and why.
- Not Applicable: The credential is not applicable to the device type.

If you edited and saved more than one credential (for example, CLI, SNMP, and HTTPS), the **Credential Status** column displays **Failed** if Cisco DNA Center was unable to apply *any* of the credentials. Hover over the icon to display additional information about which credential change failed.

Associate Device Credentials to Sites

The sites you create under the Global site can inherit the global device credentials, or you can create different device credentials specific for a site.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **Device Credentials**.

Step 2 Select a site from the hierarchy in the left pane.

Step 3 Select the credential you want to associate with the selected site, then click **Save**.

A success message appears at the bottom of the screen indicating the device credential was successfully associated with the site.

Step 4 Click **Reset** to clear the entries on the screen.

Manage Device Credentials

The Manage Credentials workflow allows you to create, edit, assign, and apply credentials to devices.

Credentials are assigned to **Global** or to the sites, buildings, or floors that you choose. If you assign credentials at the global level, all the sites, buildings, and floors inherit the settings from the global level.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **Device Credentials**.

Step 2 In the left pane, choose **Global** or specific sites, buildings, or floors, as required.

Step 3 Click **Manage Credentials**.
The **Manage Credentials** window opens.

Step 4 From the **Add** drop-down list, choose any of the following credentials:

- **CLI**
- **HTTP(S) Read**
- **HTTP(S) Write**
- **SNMPv2c Read**
- **SNMPv2c Write**
- **SNMPv3**

Step 5 In the **Add New Credentials** window, do the following:

a. Complete the required fields.

b. Check the **Assign credential to site** check box.

Note If the box is not checked, the credential will get created but not assigned to any site.

c. Click **Save**.

The newly created credential appears in the **Manage Credentials** window.

Step 6 Choose the credential that you want to assign and click **Assign**.

Step 7 To apply the credentials, do any one of the following:

- To apply a credential across the entire site hierarchy, go to **Manage Credentials**, hover your mouse over the desired credential's **Actions** menu, and choose **Apply**.

- To apply a credential only to a specific site, choose the desired site in the left pane and click **Assign** on the card corresponding to that credential.

Step 8 In the **Apply Credentials** window, do the following:

- To apply the new credentials now, click the **Now** radio button and click **Apply**.
- To apply the new credentials at a later time, click the **Later** radio button. Then define the date and time of the update and click **Apply**.

The credentials are applied to all the applicable sites.

You can reschedule any apply credentials task that has not yet started.

Step 9 To view the status of your task, do any one of the following:

- In the **Device Credentials** page, click the refresh icon at the top right corner. Hover your cursor over the icon next to the heading in the credential card.
- Choose **Provision** > **Inventory**. The **Credential Status** column shows the status.
- Choose **Activities** > **Audit Log**.

Step 10 To edit the credentials, do the following:

a. Click the edit icon adjacent to the corresponding credential.

Alternatively, in the **Manage Credentials** window, hover your cursor over the ellipsis icon next to the credential name and click **Edit**.

b. In the **Edit Information** window, click **OK**.

c. In the **Edit Credentials** window, make the required changes.

d. Click **Save**.

Step 11 To reschedule the **Start** time of a credential application, do one of the following:

- **Task scheduled globally**: In the **Manage Credentials** window, hover your cursor over the horizontal ellipsis icon next to the credential name and choose **Apply**, and then click **Apply**.
- **Task scheduled from the main page for sites, buildings, or floors**: Return to the sites, buildings, or floors for which the task was originally scheduled and click **Apply** on the corresponding credential card.

Note You cannot change the time zone.

Configure IP Address Pools

Cisco DNA Center supports IPv4 and IPv6 dual-stack IP pools.

You can manually create IPv4 and IPv6 address pools.

You can also configure Cisco DNA Center to communicate with an external IP address manager. For more information, see the *Cisco DNA Center Administrator Guide*.

Step 1 Click the menu icon (☰) and choose **Design** > **Network Settings** > **IP Address Pools**.

Step 2 Click **Add** and complete the required fields in the **Add IP Pool** window.

If you have configured Cisco DNA Center to communicate with an external IP address manager, you cannot create an IP pool that overlaps an existing IP address pool in the external IP address manager.

Step 3 Click **Save**.

The newly added pool appears in the IP Address Pools table. You can click the **IPv4** or **IPv6** option in the **SUBNET TYPE** area if you prefer to view only the IPv4 or IPv6 address pools.

Note When you edit an IP address pool and make DHCP changes, you do not need to reprovision devices using that IP address pool.

Import IP Address Pools from an IP Address Manager

You can import IP address pools from Bluecat or Infoblox.

Note The IP address pools cannot have subpools and cannot have any assigned IP addresses from the IP address pool.

You must configure Cisco DNA Center to communicate with an external IP Address Manager (IPAM). For more information, see the *Cisco DNA Center Administrator Guide*.

Step 1 Click the menu icon (☰) and choose **Design** > **Network Settings** > **IP Address Pools**.

Step 2 From the **Actions** drop-down list, choose **Import from IPAM Server** and complete the required fields.

Step 3 Enter a CIDR and then click **Retrieve** to get the list of IP pools available to import.

Step 4 Click **Select All** or choose the IP address pools to import, then click **Import**.

Import IP Address Pools from a CSV File

You can import IP address pools from a CSV file.

Step 1 Click the menu icon (☰) and choose **Design** > **Network Settings** > **IP Address Pools**.

Step 2 From the **Actions** drop-down list, choose **Import from CSV File**.

Step 3 Click **Download Template** to download the latest sample file.

Step 4 Add the IP address pools to the file and save the file.

Step 5 Upload the CSV file by doing one of the following actions:

a) Drag and drop the file to the drag and drop area.

b) Click where it says "**click** to select" and select the file.

Step 6 Click **Import**.

Reserve an IP Pool

Before you begin

Ensure that one or more IP address pools have been created.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **IP Address Pools**.

Step 2 Expand the hierarchy pane and choose a site.

Step 3 Click **Reserve** and complete the following fields to reserve all or part of an available global IP address pool for the specific site:

- **IP Address Pool Name**: Unique name for the reserved IP address pool.
- **Type**: Type of IP address pool. For LAN automation, choose **LAN**. Options are:
    - **LAN**: Assigns IP addresses to LAN interfaces for applicable underlays.
    - **Management**: Assigns IP addresses to management interfaces.
    - **Service**: Assigns IP addresses to service interfaces.
    - **WAN**: Assigns IP addresses to WAN interfaces.
    - **Generic**: Used for all other network types.
- **IP Address Space**: IPv4 and IPv6 address pool from which you want to reserve all or part of the IP addresses.
- **CIDR Prefix/Number of IP Addresses**: IP subnet and mask address used to reserve all or part of the global IP address pool or the number of IP addresses you want to reserve. If you choose \64 as the **CIDR Prefix** for an IPv6 IP pool, the **SLAAC** option is checked. (When **SLAAC** is selected, the devices automatically acquire IP addresses without the need for DHCP servers.)
- **Gateway**: Gateway IP address.
- **DHCP Servers**: DHCP server IP address(es).
- **DNS Servers**: DNS server address(es).

Step 4 Click **Reserve**.

If you reserve both IPv4 and IPv6 address pools, which means the fabric is provisioned with a dual-stack IP pool, you cannot switch back to a single-stack IP pool if the IPv6 pool is already attached to a VN.

However, if the IPv6 pool is not attached to a VN, you can downgrade it from a dual-stack IPv6 to a single-stack IPv4 pool. To downgrade to a single stack, in the IP Address Pools window, click **Edit** for the dual-stack IP pool. In the **Edit IP Pool** window, uncheck the **IPv6** check box and click **Save**.

Edit IP Pools

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **IP Address Pools**.

Step 2 Choose the Global site or expand the hierarchy tree and choose the desired site.

Step 3 To edit all the IP pools in bulk, do the following:

a) From the **Actions** drop-down list, choose **Edit All**.
b) Click **Yes** in the **Warning** message.
c) In the **Edit IP Pool** window make the desired changes and click **Save**.

Step 4 To edit only the desired IP pools, do the following:

a) Choose the desired IP pools and from the **Actions** drop-down list, click **Edit Selected**.

   You can also click **Edit** corresponding to the chosen IP pools.

b) In the **Edit IP Pool** window make the desired changes and click **Save**.

Delete IP Pools

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **IP Address Pools**.

Step 2 Choose the Global site or expand the hierarchy tree and choose the desired site.

Step 3 To delete all the IP pools in bulk, do the following:

a) From the **Actions** drop-down list, choose **Delete All**.
b) Click **Yes** in the **Warning** message.

Step 4 To delete only the desired IP pools, do the following:

a) Choose the desired IP pools and from the **Actions** drop-down list, click **Delete Selected**.

   You can also click **Delete** corresponding to the chosen IP pools.

b) Click **Yes** in the **Warning** message.

Clone an IP Pool

You can clone an existing IP pool at the site level. When you clone an IP pool, the DHCP server and DNS server IP addresses are automatically filled.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **IP Address Pools**.

Step 2 Expand the hierarchy tree, and then choose a site.

Step 3 Locate the desired IP pool and, in the **Actions** area, click **Clone**.

Step 4 In the **Clone IP Pool** window, do the following:

a) Optionally, edit the pool name. (You cannot edit the Type, IP Address Space, or Global Pool values, which are inherited from the pool from which you are cloning.)
b) Edit the CIRD prefix values as necessary.
c) Click **Clone**.

Release IP Pools

You can release single-stack and dual-stack pools that are reserved at the site level.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **IP Address Pools**.

Step 2 Choose the Global site or expand the hierarchy tree and choose the desired site.

Step 3 To release all the IP pools in bulk, do the following:

a) From the **Actions** drop-down list, choose **Release All**.
b) Click **Yes** in the **Warning** message.
c) At the prompt, click **Release**.

Step 4 To release only the desired IP pools, do the following:

a) Choose the desired IP pools and from the **Actions** drop-down list, click **Release Selected**.
b) At the prompt, click **Release**.

View IP Address Pools

This procedure shows how to view 10 or more IP address pools in table view and tree view.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **IP Address Pools**.

Step 2 Select a site from the hierarchy in the left pane.

Step 3 Use the Toggle button to switch between the Table view and Tree view.

- When the view contains 10 or more IP pools, by default the GUI displays the pools in table view.
- When the view contains fewer than 10 IP pools, by default the GUI displays the pools in tree view.

Note Toggling between the table and tree map view is based on the pool count not on the user selection on the UI.

Tree view applies to the Global pool as well as to the site pool.

Step 4 The **IP Address Pools** table view displays list of IP address pools based on **Name**, **Type**, **IPv4 Subnet**, **IPv4 Used**, **IPv6 Subnet**, **IPv6 Used**, and **Actions**.

Note

- Hover your cursor over the **i** icon next to the **IPv4 Used** and **IPv6 Used**. A tooltip appears that displays more information about **IPv4 Used**, **IPv6 Used**, **Free**, **Unassignable**, **Assigned**, and **Default Assigned** IP address pool.
- In the **IPv4** and **IPv6** columns, hover your cursor over the **i** icon next to the corresponding used percentage of **IPv4** and **IPv6** for a given IP address pool. A tooltip displays the percentage of **Free**, **Unassignable**, **Assigned**, and **Default Assigned** IP addresses.

Step 5 In the Table view, click the **IPv4 only** or **Dual-Stack** option in the **Subnet Type** area if you prefer to view only the **IPv4** or **Dual-Stack** address pools.

Step 6 In the Tree view, hover your cursor over the IP address pool that you are interested in, and click to view the slide-in pane which contains the following information:

- Subnet type of an IP address pool.
- Percentage of available IP addresses along with **Pool CIDR**, **Gateway**, **DHCP Server(s)**, and **DNS Server(s)** under the respective pool.
- Percentage of used IP addresses under the respective pool.

Step 7 In the **Used** area, click **Assigned** to view the list of assigned IP addresses to a device filtered based on **Device Name**, **IP Address**, and **Site**.

Step 8 Click **Unassignable** to view the list of unassigned IP addresses which cannot be assigned to a device filtered based on **Device Name**, **IP Address**, and **Site**.

Step 9 Click **Edit** to edit an IP address pool.

Step 10 Click **Release** to release an IP address pool.

Note

- In the side bar for a global pool, you can view the usage of a given pool across all the child pool.
- Global and site IP address pool can have blocklisted IP addresses.
- Subpools cannot have blocklisted IP addresses.
  - Cisco DNA Center rejects the IP address pool creation request of a CIDR address pool if it contains blocklisted IP addresses.
  - In the next free IP address pools request, Cisco DNA Center skips the blocklisted IP addresses to find the next IP address free pool.

Step 11 (Optional) In the side bar click **Export** to export the table data.

Configure Service Provider Profiles

You can create a service provider (SP) profile that defines the class of service for a particular WAN provider. You can define 4-class, 5-class, 6-class, and 8-class service models. After you create an SP profile, you can assign it to an application policy and to the WAN interfaces in the application policy scope, including setting the subline rate on the interface, if needed.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **SP Profiles**.

Step 2 In the **QoS** area, click **Add**.

Step 3 In the **Profile Name** field, enter a name for the SP profile.

Step 4 From the **WAN Provider** drop-down list, enter a new service provider, or choose an existing one.

Step 5 From the **Model** drop-down list, choose a class model: **4 class**, **5 class**, **6 class**, and **8 class**.

For a description of these classes, see Service Provider Profiles, on page 561.

Configure Global Wireless Settings

Global wireless network settings include settings for Service Set Identifiers (SSIDs), wireless interfaces, RF, and sensors.

Note You can create a wireless sensor device profile for only Cisco Aironet 1800s Active Sensor devices.

Create SSIDs for an Enterprise Wireless Network

The following procedure describes how to configure SSIDs for an enterprise wireless network.

Note The SSIDs are created at the global level. The site, building, and floor inherit settings from the global level.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 In the left pane, select **Global**.

Step 4 In the **SSID** table, from the ⊕Add ∨ drop-down icon, choose **Enterprise**.

The **Wireless SSID** workflow appears.

Step 5 Complete the **Basic Settings** setup:

a) In the **Wireless Network Name (SSID)** field, enter a unique name for the wireless network.

b) For the **Wireless Option** setting, click one of the following radio buttons:

- **Dual band operation (2.4 GHz and 5 GHz)**: The WLAN is created for 2.4 GHz and 5 GHz, and band select is disabled.
- **Dual band operation with band select**: The WLAN is created for 2.4 GHz and 5 GHz, and band select is enabled.
- **5 GHz only**: The WLAN is created for 5 GHz, and band select is disabled.

- **2.4 GHz only**: The WLAN is created for 2.4 GHz, and band select is disabled.

c) For the **Type of Enterprise Network** setting, click one of the following radio buttons:

  - **Voice and Data**: QoS on the wireless network is optimized for voice and data traffic.
  - **Data Only**: QoS on the wireless network is optimized for wireless data traffic only.

d) For the **SSID STATE** setting, click the toggle buttons to enable or disable the following settings:

  - **Admin Status**: Use this toggle button to turn on or off the radios on the APs. When the **Admin Status** is disabled, the APs remain associated with the WLC and accessible, and the APs still require licenses.
  - **Broadcast SSID**: Use this toggle button to enable or disable the visibility of the SSID to all wireless clients within range.

Step 6 Complete the **Security Settings** setup:

a) For **Level of Security**, choose the encryption and authentication type for the network. Note that the sites, buildings, and floors inherit settings from the Global hierarchy. You can override the level of security at the site, building, or floor level.

  - **Enterprise**: You can configure both **WPA2** and **WPA3** security authentication by checking the respective check boxes. By default, the **WPA2** check box is enabled.

    Note Wi-Fi Protected Access (WPA2) uses the stronger Advanced Encryption Standard encryption algorithm using Counter Mode with Cipher Block Chaining Message Authentication Code Protocol (AES-CCMP).

    WPA3 is the latest version of WPA, which is a suite of protocols and technologies that provide authentication and encryption for Wi-Fi networks. WPA3-Enterprise provides higher-grade security protocols for sensitive data networks.

  - **Personal**: If you choose **Personal**, enter the passphrase key in the **Pass Phrase** field. This key is used as the pairwise master key (PMK) between clients and the authentication server.

    Note WPA3 Personal brings better protection to individual users by providing more robust password-based authentication, making the brute-force dictionary attack much more difficult and time-consuming.

    For WPA2 Personal, you can override a preshared key (PSK) at the site, building, or floor level. If you override a PSK at the building level, the subsequent floors inherit the new settings. For information, see Preshared Key Override, on page 192.

  - **Open Secured**: From the **Assign Open SSID** drop-down list, choose an open SSID to redirect the clients to open secured SSID. The open secured policy provides the least security.

    Note Fast Transition is not applicable for open-secured SSID.

    Since open-secured SSID is dependent on open SSID, you must have enabled anchor on open SSID before enabling it on open-secured SSID.

  - **Open**: The open policy provides no security. It allows any device to connect to the wireless network without any authentication.

b) For **Authentication, Authorization, and Accounting Configuration**, click **Configure AAA** to add and configure the AAA servers for the enterprise wireless network SSID.

For more information, see Configure AAA Server for an Enterprise Wireless Network.

c) Check one or more following check boxes:

- **Fast Lane**: Check this check box to enable fastlane capabilities on the network.

  Note By enabling fastlane, you can set the Cisco IOS devices to receive an optimized level of wireless connectivity and enhanced QoS.

- **Identity PSK** (for Personal Layer 2 Security): Check this check box to enable unique preshared keys that can be created for individuals or groups of users in the SSID.

- **MAC Filtering**: Check this check box to enable MAC-based access control or security on the wireless network.

  Note When MAC filtering is enabled, only the MAC addresses that you add to the wireless LAN are allowed to join the network.

- **Deny RCM Clients**: Check this check box to deny clients with randomized MAC addresses.

- **Enable Posture**: Check this check box to enable posture assessment. The **Pre-Auth ACL List Name** drop-down list appears when you enable posture. Posture is a service in Cisco Identity Services Engine (Cisco ISE) that allows you to check the state, also known as posture, of all the endpoints that are connecting to a network for compliance with corporate security policies. This allows you to control clients to access protected areas of a network.

- **Pre-Auth ACL List Name**: From the drop-down list, choose the ACL list name that you already created to map with the SSID.

  Note AAA configuration is mandatory for posturing. Click **Configure AAA** to add AAA servers for the enterprise wireless network SSID.

d) Click **Next**.

Step 7 Complete the **Advance Settings** setup:

a) For **Fast Transition (802.11r)**:

- Choose **Adaptive**, **Enable**, or **Disable** mode.

  Note 802.11r allows wireless clients to quickly roam from one AP to another AP. Fast transition ensures less disrupted connectivity when a wireless client roams from one AP to another AP.

- Check the **Over the DS** check box to enable fast transition over a distributed system.

b) For **MFP Client Protection**, choose a setting—**Optional**, **Required**, or **Disabled**.

Note Management Frame Protection (MFP) increases the security of management frames. It provides security for the otherwise unprotected and unencrypted 802.11 management messages that are passed between APs and clients. MFP provides both infrastructure and client support.

By default, **Optional** is selected. If you choose **Required**, the clients are allowed to associate only if the MFP is negotiated (that is, if WPA2 is configured on the wireless controller, and if the client is also configured for WPA2 and supports CCXv5 MFP).

c) For **11K**:

- **Neighbor List**: Check this check box to configure all the 11k-capable clients to request a neighbor report about the known neighboring APs that are candidates for roaming.

  Note To facilitate roaming, a 11k-capable client that is associated with an AP sends a request to a list of neighboring APs. The request is sent in the form of an 802.11 management frame, which is known as an action frame. The AP responds with a list of neighbor APs on the same WLAN with the Wi-Fi channel numbers. The response is also an action frame. The client identifies the AP candidates for next roam from the response frame.

- **Session Timeout**: Check this check box to set the maximum time for a client session to remain active before reauthorization.

  Note By default, the **Session Timeout** is enabled with a timeout of 1800 seconds.

- **Client Exclusion**: Check this check box to set the client exclusion timer.

  Note When a user fails to authenticate, the wireless controller excludes the client from connecting. The client is not allowed to connect to the network until the exclusion timer expires. By default, the **Client Exclusion** is enabled with a timeout of 180 seconds.

d) For **11v BSS Transition Support** setup:

- **BSS Max Idle Service**: Check this check box to set the idle period timer value. The idle period timer value is transmitted using the association and reassociation response frame from APs to the client.

  Note The BSS Max idle period is the time frame during which an AP does not disassociate a client because of nonreceipt of frames from the connected client.

- **Client User Idle Timeout**: Check this check box to set the user idle timeout for a WLAN.

  Note If the data sent by the client is more than the threshold quota specified as the user idle timeout, the client is considered to be active and the wireless controller begins another timeout period.

  By default, **Client User Idle Timeout** is enabled with a user idle timeout of 300 seconds.

- **Directed Multicast Service**: Check this check box to enable directed multicast service.

  Note By default, **Directed Multicast Service** is enabled. Using the Directed Multicast Service (DMS), the client requests APs to transmit the required multicast packets as unicast frames. This allows clients to sleep for a longer time and saves the battery power.

e) For **Radius Client Profiling**, use this toggle button to enable or disable RADIUS profiling on a WLAN.

Note At least one AAA or PSN server is required to enable this feature.

f) Click **Next**.

Step 8 Complete the **Associate SSID to Profile** setup:

a) From the left pane, select a profile and click **Associate Profile**.

If you do not have a profile, click **Add Profile** and configure the profile settings. For information, see Create Network Profiles for Wireless, on page 231

b) Click **Next**.

Step 9 Review the **Summary** settings. If changes are necessary, click **Edit**.

Step 10 Click **Save**.

The SSID is created.

Preshared Key Override

SSIDs are created at the Global hierarchy. The sites, buildings, and floors inherit settings from the Global hierarchy. You can override a preshared key (PSK) at the site, building, or floor level. If you override a PSK at the building level, the subsequent floor inherits the new setting.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **Wireless**.

Step 2 In the left pane, choose the site, building, or floor to edit the PSK.

Step 3 Under **Enterprise Wireless**, click the **Passphrase** field, and enter a new passphrase for the PSK SSID.

Step 4 Click **Save**.

A success message saying `Passphrase for the SSID(s) updated successfully` is displayed.

Hover your cursor over the inherit icon ≡ next to the SSID to view the origin of this setting.

Step 5 To reset the PSK override, check the check box of the PSK SSID on the site, building, or floor and click **Delete**. The PSK is reset to the global passphrase value.

Create Pre-Auth Access Control Lists

Using the Pre-Authentication ACL feature, you can create a pre-authentication ACL for web authentication to allow certain types of traffic before authentication is complete. This ACL is referenced in the access-accept of Cisco Identity Services Engine (ISE) and defines what traffic to be permitted and what traffic to be denied by the ACL. After ACLs are configured on the Cisco Wireless Controller, they can be applied to the management interface, the AP-manager interface, any of the dynamic interfaces, or a WLAN to control data traffic to and from wireless clients or to the controller central processing unit (CPU) to control all traffic destined for the CPU. You can configure both IPV4 and IPV6 ACLs.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 In the left pane, select **Global**.

Step 4 Under the **Pre-Auth Access Control Lists** area, click **Add** to create a new pre-auth ACL.

Step 5 In the **New Pre-Auth ACL** slide-in pane, configure the following:

- In the **Pre-Auth ACL List Name** field, enter a name for the ACL list.
- In the **Pre-Auth ACL Name** field, enter a name for the pre-auth ACL.
- Click the **IP Addresses** tab and choose the ACL type you are creating: **IPV4** or **IPV6**.

Step 6 Click the **IP Addresses** tab and choose the ACL type you are creating: **IPV4** or **IPV6**.

- From the **Protocol** drop-down list, choose the protocol ID of the IP packets to be used for this ACL. These are the protocol options: **Any**, **TCP**, or **UDP**.
- In the **Source Port** field, enter the source port number. The range is 0 to 65535. The port options are used by applications that send and receive data to and from the networking stack. Some ports are designated for certain applicaions such as Telnet, SSH, HTTP, and so on.
- In the **Source IP Address** field, enter the IP address and netmask of the source. If you are configuring an IPV6 ACL, enter the IPV6 address and prefix length of the source in the Source IP Address field.
- From the **Source Subnet** drop-down list, choose a value for the source subnet.
- In the **Destination Port**, enter the destination port number.
- In the **Destination IP Address**, enter the IP address and netmask of the destination. If you are configuring IPv6 ACL, enter the IPv6 address and prefix length of the destination.
- From the **Destination Subnet** drop-down list, choose a value for the destination subnet.
- You can add multiple rules by clicking ⊕ icon. You can add up to 256 rules.

Step 7 Click the **Walled Garden URLs** tab to add specific URLs to allowed list for web authentication of captive portal and walled garden. Authentication is not required to access the allowed list of URLs. When you try to access sites that are not in allowed list, you are redirected to the Login page.

- In the **URL** field, enter the URL and click ⊕ to add the URL to the allowed list for web authentication. You can add up to 32 URL entries.

Step 8 Click **Save**.

Step 9 Map the ACL with the SSID while creating SSIDs for enterprise wireless network.

Configure AAA Server for an Enterprise Wireless Network

Before you begin

- Make sure you have defined the AAA server under **System Settings** > **External Services** > **Authentication and Policy Servers** page.
- You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 Ensure that **Global** is selected from the left pane.

Step 4 From the **SSID** table, in the **Action** column, click **Configure AAA** against an SSID for which you want to configure the AAA server.

The **Configure AAA Server** slide-in pane appears.

Step 5 From the **Server** drop-down list, you can either search for a server IP address by entering its name in the **Search** field or choose the AAA IP address.

Note The **Configure AAA** feature is not supported for Mobility Express devices.

Step 6 Click+ to add an **Additional Server**.

Note You can configure a maximum of six AAA servers for an SSID of enterprise wireless network for Cisco Catalyst 9800 Embedded Wireless Controller for Catalyst 9000 Switches.

Step 7 From the **Additional Server** drop-down list, choose the server IP address.

Step 8 (Optional) To delete a server or an additional server, click the delete icon next to each server.

Step 9 Click **Configure**.

Note Cisco DNA Center allows you to override the set of AAA server configuration for SSID on the site level. For each set of overridden AAA settings per SSID, Cisco DNA Center creates a new WLAN profile with the corresponding AAA servers mapped to it. If an SSID is overridden for different floors, and you make changes in the AAA servers, Cisco DNA Center creates the new WLAN profiles equals to the number of floors.

You must reprovision the device to override the AAA servers on the site level. See Wireless Device Provisioning Overview.

Create SSIDs for a Guest Wireless Network

This procedure explains how to create SSIDs for a guest wireless network.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 In the left pane, ensure that **Global** is selected.

Step 4 In the **SSID** table, from the ⊕Add ∨ drop-down icon, choose **Enterprise**.

The **Wireless SSID** workflow appears.

Step 5 Complete the **Basic Settings** setup:

a) In the **Wireless Network Name (SSID)** field, enter a unique name for the wireless network.

b) For the **Wireless Option** setting, click one of the following radio buttons:

- **Dual band operation (2.4 GHz and 5 GHz)**: The WLAN is created for 2.4 GHz and 5 GHz, and band select is disabled.
- **Dual band operation with band select**: The WLAN is created for 2.4 GHz and 5 GHz, and band select is enabled.
- **5 GHz only**: The WLAN is created for 5 GHz, and band select is disabled.
- **2.4 GHz only**: The WLAN is created for 2.4 GHz, and band select is disabled.

c) For the **Type of Enterprise Network** setting, click one of the following radio buttons:

  - **Voice and Data**: QoS on the wireless network is optimized for voice and data traffic.
  - **Data Only**: QoS on the wireless network is optimized for wireless data traffic only.

d) For the **SSID STATE** setting, click the toggle buttons to enable or disable the following settings:

  - **Admin Status**: Use this toggle button to turn on or off the radios on the APs. When the **Admin Status** is disabled, the APs remain associated with the WLC and accessible, and the APs still require licenses.
  - **Broadcast SSID**: Use this toggle button to enable or disable the visibility of the SSID to all wireless clients within range.

Step 6 Complete the **Security Settings** setup:

a) For the **L2 Security** setting, choose the L2 encryption and authentication type:

  - **Enterprise**: You can configure either the **WPA2** or the **WPA3** security authentication type by checking the respective check boxes. By default, the **WPA2** check box is enabled.

    Note Wi-Fi Protected Access (WPA2) uses the stronger Advanced Encryption Standard encryption algorithm using Counter Mode with Cipher Block Chaining Message Authentication Code Protocol (AES-CCMP). Fast transition is applicable for enterprise WPA2 SSID.

    WPA3 security authentication is the latest version of WPA, which is a suite of protocols and technologies that provide authentication and encryption for Wi-Fi networks. WPA3-Enterprise provides higher grade security protocols for sensitive data networks.

  - **Personal**: You can configure both **WPA2** and **WPA3** or configure **WPA2** and **WPA3** individually by checking the respective check boxes.

    Note WPA3 personal security authentication brings better protection to individual users by providing more robust password-based authentication. This makes the brute-force dictionary attack much more difficult and time-consuming.

    Enter the passphrase key in the **Pass Phrase** field. This key is used as the pairwise master key (PMK) between the clients and the authentication server.

  - **Open Secured**: From the **Assign Open SSID** drop-down list, choose an open SSID to associate with the open SSID. Associating secures the open SSID. You must have an open SSID created before associating it with the open secured SSID.

    Note Fast Transition is not applicable for open-secured SSID.

    Since open-secured SSID is dependent on open SSID, you must have enabled anchor on open SSID before enabling it on open-secured SSID.

  - **Open**: The open policy provides no security. It allows any device to connect to the wireless network without any authentication.

b) For the **L3 Security** setting, choose the L3 encryption and authentication type:

  - **Web Policy**: Provides a higher level of L3 security.

    For **Authentication Server**, configure these authentication server settings:

Authentication Server Type	Description
ISE Authentication	Use Cisco ISE for authentication. Cisco ISE provides central web authentication (CWA).
• **Web Authentication Internal** • **Web Authentication External**	Web authentication or Web Auth is a Layer 3 security method that allows a client to pass Dynamic Host Configuration Protocol (DHCP) and Domain Name System (DNS) traffic only until they have passed some form of authentication. For web authentication internal, the client is redirected to a page that is constructed by the Cisco Wireless Controller. For web authentication external, the client is redirected to the specified URL. Enter a redirect URL in the **Web Auth Url** field.
• **Web Passthrough Internal** • **Web Passthrough External**	Web passthrough is a solution that is used for guest access and requires no authentication credentials. In web passthrough authentication, wireless users are redirected to the usage-policy page when they use the internet for the first time. After accepting the policy, users are allowed to use the internet.

- **Open**: There is no security at the Layer 3 level and any device can connect to the SSID.

c) For **Timeout Settings for sleeping clients** settings, choose the authentication for sleeping clients:

- **Always authenticate**: Enables authentication for sleeping clients.
- **Authenticate after**: Enter the duration for which sleeping clients are to be remembered before reauthentication becomes necessary. The valid range is 10 minutes to 43200 minutes, and the default duration is 720 minutes.

Note Clients with guest access and web authentication are allowed to sleep and wake up without having to go through another authentication process through the login page. You can configure the duration for which the sleeping clients are to be remembered for before reauthentication becomes necessary. The valid range is from 10 minutes to 43200 minutes; the default is 720 minutes. You can configure the duration on a WLAN and on a user group policy that is mapped to the WLAN. The sleeping timer becomes effective after the idle timeout. If the client timeout is less than the time configured on the sleeping timer of the WLAN, the lifetime of the client is used as the sleeping time.

d) For **Authentication, Authorization, and Accounting Configuration** settings, click **Configure AAA** to add and configure the AAA servers for the guest wireless network SSID.

For more information, see Configure AAA Server for a Guest Wireless Network.

e) Check one or more of the following check boxes:

- **Fast Lane**: Check this check box to enable fastlane capabilities on the network.

  Note By enabling fastlane, you can configure the Cisco IOS devices to receive an optimized level of wireless connectivity and enhanced QoS.

- **Identity PSK** (for Personal L2 Security): Check this check box to enable unique preshared keys that can be created for individuals or groups of users in the SSID.
- **MAC Filtering**: Check this check box to enable MAC-based access control or security in the wireless network.

Note When MAC filtering is enabled, only the MAC addresses that you add to the wireless LAN are allowed to join the network.

- **Deny RCM Clients**: Check this check box to deny clients with randomized MAC addresses.

f) Click **Next**.

Step 7 Complete the **Advance Settings** step:

a) For the **Fast Transition (802.11r)** settings:

- Choose **Adaptive**, **Enable**, or **Disable** mode.

  Note 802.11r allows wireless clients to quickly roam from one AP to another AP. Fast transition ensures less disrupted connectivity when a wireless client roams from one AP to another AP.

- Check the **Over the DS** check box to enable fast transition over a distributed system.

b) For the **MFP Client Protection** setting, choose **Optional**, **Required**, or **Disabled**.

Note Management Frame Protection (MFP) increases the security of management frames. It provides security for the otherwise unprotected and unencrypted 802.11 management messages that are passed between APs and clients. MFP provides both infrastructure and client support.

By default, **Optional** is selected. If you choose **Required**, the clients are allowed to associate only if the MFP is negotiated (that is, if WPA2 is configured on the wireless controller, and if the client is also configured for WPA2 and supports CCXv5 MFP).

c) For the **11K** settings:

- **Neighbor List**: Check this check box for all the 11k-capable clients to request a neighbor report about the known neighboring APs that are candidates for roaming.

  Note To facilitate roaming, a 11k-capable client that is associated with an AP sends a request to a list of neighboring APs. The request is sent in the form of an 802.11 management frame, which is known as an action frame. The AP responds with a list of neighbor APs on the same WLAN with the Wi-Fi channel numbers. The response is also an action frame. The client identifies the AP candidates for next roam from the response frame.

- **Session Timeout**: Check this check box to set the maximum time for a client session to remain active before reauthorization.

  Note By default, the **Session Timeout** is enabled with a timeout of 1800 seconds.

- **Client Exclusion**: Check this check box to set the client exclusion timer.

  Note When a user fails to authenticate, the wireless controller excludes the client from connecting. The client is not allowed to connect to the network until the exclusion timer expires. By default, the **Client Exclusion** is enabled with a timeout of 180 seconds.

d) For the **11v BSS Transition Support** settings:

- **BSS Max Idle Service**: Check this check box to set the idle period timer value. The idle period timer value is transmitted using the association and reassociation response frame from the APs to the client.

Note The BSS Max idle period is the timeframe during which an AP does not disassociate a client because of nonreceipt of frames from the connected client.

- **Client User Idle Timeout**: Check this check box to set the user idle timeout period for a WLAN.

  Note If the data sent by the client is more than the threshold quota specified as the user idle timeout period, the client is considered to be active and the wireless controller refreshes for another timeout period.

  By default, **Client User Idle Timeout** is enabled with a user idle timeout of 300 seconds.

- **Directed Multicast Service**: Check this check box to enable directed multicast service.

  Note By default, **Directed Multicast Service** is enabled. Using the Directed Multicast Service (DMS), the client requests APs to transmit the required multicast packets as unicast frames. This allows clients to sleep for a longer time and saves the battery power.

e) Click **Next**.

Step 8 Complete the **Associate SSID to Profile** step:

a) Click a profile from the left pane.

b) If you do not have a profile, click **Add Profile** and then configure the profile settings:

- **Profile Name**: Enter a name for the wireless profile.

- **Fabric**: Specify whether the SSID is fabric or nonfabric.

  Note A fabric SSID is a wireless network, which is a part of Software Defined-Access (SD-Access). SD-Access is a solution that automates and simplifies configuration, policy, and troubleshooting of wired and wireless networks. With fabric SSID, it is mandatory to have SD-Access. Nonfabric is a traditional wireless network that does not require SD-Access.

  For a nonfabric SSID, choose the following:

  - **Interface**: From the **Interface Management** drop-down list, choose an interface or click the plus icon ⊕ to add a new wireless interface.

    Note This is the VLAN ID that is associated with the wireless interface.

  - **VLAN Group**: From the **VLAN Group Name** drop-down list, choose a VLAN group or click the plus icon ⊕ to add a VLAN group.

- **Do you need Anchor for this SSID?**: Choose whether the SSID will be an anchor or not.

- **Flex Connect Local Switching**: Check this check box to enable local switching for the WLAN. When you enable local switching, any FlexConnect AP that advertises this WLAN is able to locally switch data packets.

  Note If you have enabled **Flex Connect Local Switching** for an SSID, then all the APs on that particular floor where the network profile is mapped will switch to FlexConnect mode.

c) Click **Associate Profile** to choose the profile.

d) Click **Next**.

Step 9 Review the **Summary** step. If any changes are necessary, click **Edit**.

Step 10 To save the SSID settings, click **Save**.

The SSID is created.

Configure AAA Server for a Guest Wireless Network

Before you begin

- Make sure you have defined the AAA server under **System Settings** > **External Services** > **Authentication and Policy Servers** page.
- You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 Ensure that **Global** is selected from the left pane.

Step 4 From the **SSID** table, in the **Action** column, click **Configure AAA** of SSID for which you want to configure the AAA server.

The **Configure AAA Server** slide-in pane appears.

Step 5 From the **Server** drop-down list, you can either search for a AAA IP address by entering its name in the **Search** field or choose AAA IP address.

Note

- You must configure at least one Policy Service Node (PSN) server for Central Web Authentication (CWA) SSIDs of guest wireless network.
- Cisco DNA Center allows you to map AAA server in any combination of identity services engine PSNs and third-party AAA IPs.
- In the **Server** drop-down list, the **AAA** IP addresses, and the PSN IP addresses are grouped in the corresponding sections.
- The **Configure AAA** feature is not supported for Mobility Express (ME) devices.

Step 6 Click+ to add an **Additional Server**.

Note You can configure a maximum of six AAA servers for an SSID of guest wireless network for Cisco Catalyst 9800 Embedded Wireless Controller for Catalyst 9000 Switches.

Step 7 From the **Additional Server** drop-down list, choose the server IP address.

Step 8 (Optional) To delete a server or an additional server, click the delete icon next to each server.

Step 9 Click **Configure**.

Note Cisco DNA Center allows you to override the set of AAA server configuration for SSID on the site level. For each set of overridden AAA settings per SSID, Cisco DNA Center creates a new WLAN profile with the corresponding AAA servers mapped to it. If an SSID is overridden for different floors, and you make changes in the AAA servers, Cisco DNA Center creates the new WLAN profiles equals to the number of floors.

You must reprovision the device to override the AAA servers on the site level. See Wireless Device Provisioning Overview.

Configure 802.1x Authentication Settings for APs

You can configure authentication settings to securely onboard APs using PnP. Based on the authentication settings configured at the global or site-level hierarchy in Cisco DNA Center, PnP pushes the 802.1x (Dot1x) supplicant and certificates when claiming an AP. The AP authenticates with Cisco ISE using the 802.1x supplicant.

Step 1 Click the menu icon (☰) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 In the left pane, ensure that **Global** is selected.

Note The 802.1x authentication, which is created at the global level, can be overridden at the site level.

Step 4 In the **Access Points Authentication for Plug n Play (PnP)** area, complete the following:

a) Choose an authentication method:

- **NO-AUTH**: By default, this authentication method is selected.
- **EAP-TLS**: Extensible Authentication Protocol-Transport Level Security (EAP-TLS), is an authentication method designed to mitigate several weaknesses of EAP. EAP-TLS provides many of the benefits that PEAP provides but differs from it in the lack of support for legacy authentication methods.

  If you select **EAP-TLS**, enter the user name in the **Username** field. A certificate is generated and applied during the PnP claim process.
- **EAP-PEAP**: EAP-Protected Extensible Authentication Protocol (EAP-PEAP) provides mutual authentication, ensures confidentiality and integrity to vulnerable user credentials, protects itself against passive (eavesdropping) and active (man-in-the-middle) attacks, and securely generates cryptographic keying material. PEAP is compatible with the IEEE 802.1X standard and RADIUS protocol.

  If you select **EAP-PEAP**, enter the user name and password. A certificate is generated and applied during the PnP claim process.
- **EAP-FAST**: EAP-Flexible Authentication via Secure Tunneling (EAP-FAST) is an authentication protocol that provides mutual authentication and uses a shared secret to establish a tunnel. The tunnel is used to protect weak authentication methods that are based on passwords. The shared secret, referred to as a Protected Access Credentials (PAC) key, is used to mutually authenticate the client and server while securing the tunnel.

  If you select **EAP-FAST**, enter the user name and password. A certificate is generated and applied during the PnP claim process.

b) Enter the **Username** and **Password**.
c) Click **Save**.

Create a Wireless Interface

You can create wireless interfaces only in nonfabric deployments.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 Ensure that **Global** is selected from the left pane.

Step 4 From the **Wireless Interfaces** table, click **+Add**.

Step 5 Configure the wireless interface settings in the **Create a Wireless Interface** slide-in pane:

a) In the **Interface Name** field, enter the dynamic interface name.
b) In the **VLAN ID** field, enter the VLAN ID for the interface.

Step 6 Click **Save**.

The wireless interface is created and appears in the **Wireless Interfaces** table.

Design and Provision Interface/VLAN Groups to Nonfabric Deployments

Cisco DNA Center allows you to configure networks with multiple broadcast domains through different VLANs. When the same set of APs broadcast the same WLAN, the broadcast domains are controlled through multiple VLANs on the same WLAN through interface groups.

Cisco DNA Center interface groups are logical groups of interfaces that facilitate user configuration, where the same interface group can be configured on multiple WLANs or while overriding a WLAN interface per AP group. An interface can be part of multiple interface groups. A WLAN can be associated with an interface or interface group.

Note The interface group name and the interface name cannot be the same.

The Cisco DNA Center VLAN group feature maps a WLAN to a single VLAN or multiple VLANs using VLAN groups. VLAN groups can be associated to policy profiles.

The following procedure explains how to design and provision the interface or VLAN groups for nonfabric deployments.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 For the **VLAN Group** table, click **Add**.

The **Add VLAN Group** slide-in pane appears.

Step 4 Enter a valid **VLAN Group Name**, select single or multiple interfaces from the list, and click **Save**.

Note If you select more than 15 interfaces, the selected interfaces might not be displayed correctly onscreen.

Step 5 In the **Edit Network Profile** page, the VLAN group is associated with the SSID.

For information on how to create an SSID, see Create SSIDs for an Enterprise Wireless Network.

Step 6 To add more SSIDs to the VLAN group, click **Add SSID**.

Step 7 Choose **Interface** or **VLAN** group.

Step 8 Click the add icon to create a new interface or VLAN group.

Note Interface or VLAN group is not applicable for FlexConnect local switching.

Step 9 Click **Save**.

Step 10 In **Configure Interface and VLAN**, you can view the list of interface names, interface groups names, and other parameters required to configure the interface and VLAN.

Note An interface group cannot contain more than 64 interfaces.

Step 11 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

Step 12 Select the device.

Step 13 From the **Actions** drop-down menu, choose **Provision** > **Provision Device**.

Step 14 Review the details in the **Assign Site**, **Configuration**, **Model Configuration**, **Advanced Configuration**, and **Summary** screens. From each screen, click **Next** to advance to the next screen.

Step 15 Click **Deploy**.

The **Provision Device** dialog box appears.

Step 16 Choose **Now** and click **Apply**.

The message **Task Scheduled view status in Tasks** appears.

Create a Wireless Radio Frequency Profile

You can either use the default radio frequency profiles (LOW, TYPICAL, HIGH), or create custom radio frequency profiles.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 From the **Wireless Radio Frequency Profile** table, click **Add**.

The **Wireless Radio Frequency Profile** window appears.

Step 4 In the **Profile Name** field, enter the RF profile name.

Step 5 Click the toggle next to **2.4 GHz** or **5 GHz** to enable or disable the radio band.

Note If you have disabled one of the radios, the base radio of the AP that you are going to configure this AP profile into will be disabled.

Step 6 Configure the following for the **2.4 GHz** radio type:

- Under **Parent Profile**, select **High**, **Medium (Typical)**, **Low**, or **Custom**. (The **Data Rate** and **Tx Configuration** fields change depending on the parent profile selected. For example, if you select **High**, it populates the profile configurations available in the device for 2.4 GHz. If you change any settings in the populated **Data Rate** and **Tx Configuration**, the **Parent Profile** automatically changes to **Custom**.) Note that a new RF profile is created only for the select custom profiles.

  Note Low, Medium (Typical), and High are the default RF profiles. If you select a default RF profile, the respective RF profile on the device is used and the new RF profile is not created on Cisco DNA Center.

- **DCA** dynamically manages channel assignment for an RF group and evaluates the assignments on a per-AP radio basis.
  - Check the **Select All** check box to select DCA channels **1**, **6**, and **11**. Alternatively, check the individual check boxes next to the channel numbers.
  - Click **Show Advanced** to select the channel numbers under the **Advanced Options**. Check the **Select All** check box to select DCA channels that are under **Advanced Options**, or check the check box next to the individual channel numbers. The channel numbers that are available for B profile are **2**, **3**, **4**, **5**, **7**, **8**, **9**, **10**, **12**, **13**, and **14**.

    Note You must configure these channels globally on Cisco Wireless Controllers.

- Use the **Supported Data Rate** slider to set the rates at which data can be transmitted between an access point and a client. The available data rates are **1**, **2**, **5.5**, **6**, **9**, **11**, **12**, **18**, **24**, **36**, **48**, and **54**.
- Under **Tx Power Configuration**, set the power level and power threshold for an AP.
  - **Power Level**: To determine whether the power of an AP needs to be reduced. Reducing the power of an AP helps mitigate co-channel interference with another AP on the same channel or in close proximity. Use the **Power Level** slider to set the minimum and maximum power level. The range is from -10 to 30 dBm and the default is -10 dBm.
  - **Power Threshold**: Is the cutoff signal level used by Radio Resource Management (RRM) to determine whether to reduce the power of an AP. Use the **Power Threshold** slider to increase and decrease the power value, which causes the AP to operate at higher or lower transmit power rates. The range is from -50 dBm to 80 dBm and the default threshold is -70 dBm.
  - **RX SOP**: Receiver Start of Packet Detection Threshold (RX SOP) determines the Wi-Fi signal level, in dBm, at which an AP's radio demodulates and decodes a packet. From the RX SOP drop-down list, choose **High**, **Medium**, **Low**, or **Auto** threshold values for each 802.11 band.

Step 7 Configure the following for the **5 GHz** radio type:

- From the **Parent Profile** drop-down list, choose **High**, **Medium (Typical)**, **Low**, or **Custom**. (The **Data Rate** and **Tx Configuration** fields change depending on the parent profile selected. For example, if you select **High**, it populates the configurations available in the device for 2.4 GHz. If you change any settings in the populated **Data Rate** and **Tx Configuration** fields, the **Parent Profile** automatically changes to **Custom**.) Note that a new RF profile is created only for select custom profiles.

  Note **Low**, **Medium (Typical)**, and **High** are the default RF profiles. If you select a default RF profile, the respective RF profile that is already present in the device is used and the new RF profile is not created on Cisco DNA Center.

- From the **Channel Width** drop-down list, choose one of the channel bandwidth options: **Best**, **20 MHz**, **40 MHz**, **80 MHz**, or **160 MHz**.
- Set the **DCA Channel** to manage channel assignments:

  Note You must configure the channels globally on Cisco Wireless Controllers.

  - **UNNI-1 36-48**: The channels available for UNII-1 band are **36**, **40**, **44**, and **48**. Check the **UNII-1 36-48** check box to include all channels, or check an individual check box.
  - **UNII-2 52-144**: The channels available for UNII-2 band are **52**, **56**, **60**, **64**, **100**, **104**, **108**, **112**, **116**, **120**, **124**, **128**, **132**, **136**, **140**, and **144**. Check the **UNII-2 52-144** check box to include all channels, or check an individual check box.
  - **UNII-3 149-165**: The channels available for UNII-3 band are **149**, **153**, **157**, **161**, and **165**. Check the **UNII-3 149-165** check box to include all channels, or check an individual check box.
- Use the **Data Rate** slider to set the rates at which data can be transmitted between an access point and a client. The available data rates are **6**, **9**, **12**, **18**, **24**, **36**, **48**, and **54**.
- Under **Tx Power Configuration**, set the power level and power threshold for an AP.
  - **Power Level**: Determines whether the power of an AP needs to be reduced. Reducing the power of an AP helps mitigate co-channel interference with another AP on the same channel or in close proximity. Use the **Power Level** slider to set the minimum and maximum power level. The range is from -10 to 30 dBm and the default is -10 dBm.
  - **Power Threshold**: Is the cutoff signal level used by Radio Resource Management (RRM) to determine whether to reduce the power of an AP. Use the **Power Threshold** slider to increase and decrease the power value, which causes the AP to operate at higher or lower transmit power rates. The range is from -50 dBm to 80 dBm and the default threshold is -70 dBm.
  - **RX SOP**: Receiver Start of Packet Detection Threshold (RX SOP) determines the Wi-Fi signal level in dBm at which an AP's radio demodulates and decodes a packet. From the RX SOP drop-down list, choose **High**, **Medium**, **Low**, or **Auto** threshold values for each 802.11 band.

Step 8 Click **Save**.

Step 9 To mark a profile as the default RF profile, check the **Profile Name** check box and click **Mark Default**.

Step 10 In the **Warning** window, click **OK**.

Edit or Delete a Basic Radio Frequency Profile

The following procedure describes how to edit or delete a basic RF profile.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 In the left pane, click the **Global** site.

Step 4 In the **Wireless Radio Frequency Profile** area, click the **Basic RF Profile** tab.

Note The **Basic RF Profile** table lists the number of created AI RF profiles based on **Profile Name**, **Type**, **2.4 GHz Data Rates**, **5 GHz Data Rates**, **6 GHz Data Rates**, **Channel Width**, and **Profile Type**.

Step 5 Check the check box next to the basic profile name that you want to edit.

Step 6 From the **Action** drop-down list, choose **Edit/View**.

Note You can edit one basic RF profile at a time.

Step 7 In the **Edit Wireless Radio Frequency Profile** window, configure the basic RF profile settings. For more information, see Create a Wireless Radio Frequency Profile, on page 202.

Step 8 Click **Save**.

Step 9 To delete a basic RF profile, check the check box next to the basic RF profile name.

Step 10 From the **Action** drop-down list, choose **Delete** and then click **Yes**.

Step 11 To mark a basic RF profile as the default, check the check box next to a basic RF profile name.

Step 12 From the **Action** drop-down list, choose **Mark Default** and then click **Yes**.

Create an AI Radio Frequency Profile

The following procedure describes how to create an artificial intelligence radio frequency profile for your building.

Before you begin

- You must enable Cisco AI Network Analytics under the system settings. For more information, see **Configure Cisco AI Network Analytics Data Collection** in *Cisco DNA Center Administrator Guide*.
- You must enable **AI Enhanced RRM** under **Cisco AI Analytics** in the system settings. Click the menu icon (≡) and choose **System** > **Settings** > **External Services**.

  In the **Cisco AI Analytics** window, under the **AI ENHANCED RRM** area, click the toggle button to enable the AI-enhanced RRM.
- Cisco AI RF profiles are supported only on Cisco Catalyst 9800 Series Wireless Controllers and Cisco IOS-XE 17.7.1 or later.
- To perform the following task, you must be a **Super Admin** or **Network Admin**.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 In the left pane, click the **Global** site.

Step 4 In the **Wireless Radio Frequency Profile** area, from the **Add** drop-down list, choose **AI RF Profile**.

The **Create AI Radio Frequency Profile** window appears.

Step 5 In the **Profile Name** field, enter the RF profile name.

Step 6 Expand **Basic Settings**.

Step 7 In the **Radio Frequency Settings** area, check the **2.4 GHz** or **5 GHz** check box.

The radio frequencies are checked by default. If you uncheck a radio frequency, the RF settings are disabled for that radio frequency.

Step 8 In the **Busy Hours** area, define the start and end time of the site time zone.

Note Busy hours are dependent upon the timezone of building. You must configure a timezone under network settings for the respective building.

Step 9 In the **Busy Hour Sensitivity** area, click the **Low**, **Medium**, or **High** radio button to define the threshold of Radio Resource Management (RRM) sensitivity for the busy hours interval.

Step 10 In the **Enable RF Settings** area, click the toggle buttons under the **2.4 GHz** or **5 GHz** columns to enable or disable the radio band for the respective RF setting.

The supported RF settings are:

- **Flexible Radio Assignment (FRA)**: FRA optimizes the radio coverage per band and determines the best role assignment for redundant radios.
- **Dynamic Channel Assignment (DCA)**: DCA dynamically manages channel assignment for an RF group and evaluates the assignments on a per-AP radio basis.
- **Transmit Power Control (TPC)**: TPC manages and transmits power for APs. It also maximizes the SNR during the reduction in interference.
- **Dynamic Bandwidth Selection (DBS)**: DBS monitors and adjusts the channel width to balance the performance and interference.

Note

- When you disable the 2.4-GHz radio band for FRA, it automatically disables the 5-GHz radio band for FRA, and vice versa.
- When you disable the 5-GHz radio band for DCA, it disables the 2.4-GHz radio band for FRA and the 5-GHz radio band for FRA and DBS.
- You can individually enable the 2.4-GHz radio band for DCA and TPC; and the 5-GHz radio band for DCA, TPC, and DBS.

Step 11 Expand **Advanced** and click the **2.4 GHz** toggle button.

Step 12 In the **DCA Channel** area, check the **Select All** check box to select DCA channels **1**, **6**, and **11**. Alternatively, check the individual check boxes next to the channel numbers.

Step 13 In the **Advanced Options** area, check the **Select All** check box to select all the DCA channels.

Step 14 Click **Show Advanced** to select the remaining channel numbers.

Step 15 Check the check box next to the individual channel numbers. The channel numbers that are available for the profile are **2**, **3**, **4**, **5**, **7**, **8**, **9**, **10**, **12**, **13**, and **14**.

Step 16 Use the **Supported Data Rate** slider to set the rates at which data can be transmitted between an AP and a client. The available data rates are **1**, **2**, **5.5**, **6**, **9**, **11**, **12**, **18**, **24**, **36**, **48**, and **54**.

Step 17 In the **Mandatory Data Rates** area, check the check box next to the individual data rates. You can choose up to two data rates. The available data rates are **1**, **2**, **5.5**, **6**, **9**, **11**, **12**, **18**, **24**, **36**, **48**, and **54**.

Step 18 Check the **Enable 802.11b data rates** check box to enable the 802.11b data rates. This action also enables the 802.11b supported data rate check box in the **Mandatory Data Rates** area.

Step 19 In the **Tx Power Configuration** area, set the following:

- **Power Level**: Determines whether the power of an AP needs to be reduced. Reducing the power of an AP helps mitigate co-channel interference.
- **Power Threshold**: Is the cutoff signal level used by RRM to determine whether to reduce the power of an AP.
- **RX SOP**: Receiver Start of Packet Detection Threshold (RX SOP) determines the Wi-Fi signal level, in dBm, at which an AP's radio demodulates and decodes a packet.

Step 20 Use the **Power Level** slider to set the minimum and maximum power level. The range is from -10 to 30 dBm and the default is -10 dBm.

Step 21 Use the **Power Threshold** slider to increase and decrease the power value, which causes the AP to operate at higher or lower transmit power rates. The range is from -50 dBm to 80 dBm and the default threshold is -70 dBm.

Step 22 From the **RX SOP** drop-down list, choose **High**, **Medium**, **Low**, or **Auto** threshold values for each 802.11 band.

Step 23 In the **Advanced** area, click the **5 GHz** toggle button.

Step 24 Use the **DBS Max Width** slider to set the channel width of the AI RF profile.

The available channel width options are **20 MHz**, **40 MHz**, **80 MHz**, or **160 MHz**.

The **Auto Channels Logic** area displays the color-coded channel logics for the channel widths.

You can select **DBS Max Width** only when DBS is enabled.

When you disable the DBS, Cisco DNA Center allows you to select channel width.

Step 25 Set the **DCA channels** to manage the following channel assignments:

- **UNII-1 36-48**: The channels available for UNII-1band are **36**, **40**, **44**, and **48**.
- **UNII-2 52-144**: The channels available for UNII-2band are **52**, **56**, **60**, **64**, **100**, **104**, **108**, **112**, **116**, **120**, **124**, **128**, **132**, **136**, **140**, and **144**.
- **UNII-3 149-165**: The channels available for UNII-3 band are **149**, **153**, **157**, **161**, and **165**.

Note You must configure the channels globally on the Cisco Wireless Controller.

Step 26 Check the **Select All** check box to include all DCA channels, or check an individual check box to select an individual DCA channel.

Step 27 Click **Show Advanced** to select the remaining DCA channel numbers.

Step 28 Check the **UNII-1 36-48** check box to include all channels, or check an individual check box.

Step 29 Check the **UNII-2 52-144** check box to include all channels, or check an individual check box.

Step 30 Check the **UNII-3 149-165** check box to include all channels, or check an individual check box.

Step 31 Use the **Supported Data Rate** slider to set the rates at which data can be transmitted between an AP and a client. The available data rates are **1**, **2**, **5.5**, **6**, **9**, **11**, **12**, **18**, **24**, **36**, **48**, and **54**.

Step 32 In the **Tx Power Configuration** area, set the **Power Level**, **Power Threshold**, and **RX SOP**.

Step 33 Use the **Power Level** slider to set the minimum and maximum power level. The range is from -10 to 30 dBm and the default is -10 dBm.

Step 34 Use the **Power Threshold** slider to increase and decrease the power value, which causes the AP to operate at higher or lower transmit power rates. The range is from **-50 dBm** to **80 dBm** and the default threshold is -70 dBm.

Step 35 From the **RX SOP** drop-down list, choose **High**, **Medium**, **Low**, or **Auto** threshold values.

Step 36 Click **Save**.

Edit and Delete an AI Radio Frequency Profile

The following procedure describes how to edit or delete an AI RF profile.

Before you begin

- Cisco AI RF profiles are supported only on Cisco Catalyst 9800 Series Wireless Controllers and Cisco IOS-XE 17.7.1 or later.
- To perform the following task, you must be a **Super Admin** or **Network Admin**.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 In the left pane, click the **Global** site.

Step 4 In the **Wireless Radio Frequency Profile** area, click the **AI RF Profile** tab.

The **AI RF Profile** table lists the number of created AI RF profiles based on **Profile Name**, **Busy Hours**, **Busy Hour Sensitivity**, **FRA**, **DCA**, **DBS**, **TPC**, and **Mapped Buildings**.

Step 5 Check the check box next to the AI RF profile that you want to edit.

You can edit one AI RF profile at a time.

Step 6 Click **Edit/View**.

Step 7 In the **Edit AI RF Profile** window, configure the AI RF profile settings. For more information, see Create an AI Radio Frequency Profile, on page 205.

Step 8 Click **Save**.

Step 9 To delete an AI RF profile, check the check box next to the AI RF profile that you want to delete.

Step 10 Click **Delete** and then click **Yes**.

Note Cisco DNA Center does not allow you to delete an AI RF Profile which is already assigned to a building.

Configure AI Radio Frequency Profile

The following procedure describes how to assign an AI RF profile to a building.

Before you begin

- Cisco AI RF profiles are supported only on Cisco Catalyst 9800 Series Wireless Controllers and Cisco IOS-XE 17.7.1 or later.
- To perform the following task, you must be a **Super Admin** or **Network Admin**.

Step 1 Click the menu icon (≡) and choose **Workflows** > **Configure AI RF Profile**.

Step 2 In the **Assign AI RF Profiles** window, click **Let’s Do it**.

Note To skip this screen in the future, check the **Don't show this to me again** check box.

The **Configure AI RF Profile** window appears.

Step 3 In the **Task Name** field, enter task name and click **Next**.

Step 4 In the **Select Locations to Assign AI RF Profiles** window, select the locations where you want to assign the AI-enabled RF profiles.

Step 5 You can either search for a site by entering its name in the **Find Hierarchy** field, or expand **Global** and choose the sites.

The **Site selection summary** table lists the sites based on the site selection in the site hierarchy and displays the **Selected Location** and **Impacted Location** of the selected sites.

- **Selected Locations**: A location that is being enabled for AI RF profile.
- **Impacted Locations**: A location that is being partially managed by the same wireless controller of selected location.

  Note When a controller manages more than one building and if you enable the AI RF profile only on one building, Cisco DNA Center automatically enables other building with same AI RF profile.

  For example, if two controllers manage three buildings and when you enable AI RF profile on one building, Cisco DNA Center automatically enables other two buildings with same AI RF profile.

Step 6 Click **Next**.

In the **Select AI RF Profiles to assign** window, the **Building** table lists AI RF profiles based on **Location**, **Floors**, **Current RF Profiles**, and **Replace with AI RF Profiles**.

Step 7 In the **Building** table, check the check box next to a location to choose an AI RF profile.

Step 8 Based on the location, choose an AI-enabled RF profile from the drop-down list under **Replace with AI RF Profiles** to replace with the current AI RF profile.

Step 9 If the AI RF profile is not created, click the three dots under the **Action** column to create a new RF profile, or copy the current RF profile and AI settings.

You can also create an AI RF profile from the **Create a new AI RF Profile to apply** link in the **Select AI RF Profiles to assign** window. For more information, see Create an AI Radio Frequency Profile, on page 205.

Step 10 Click **Next**.

Step 11 In the **Details of selected AI RF Profile** window, review the **AI Settings**, **Common Settings**, and **Assignment** details of the AI-enabled RF profiles.

Note AI-enhanced RRM computation occurs every 30 minutes. RRM decisions are updated and pushed to devices after the computation.

Step 12 Click **Next**.

Step 13 In the **Summary** window, review the **Task Details**, **Select Locations to Assign AI RF Profiles**, and **Select AI RF Profiles to assign**.

Step 14 In the **Deploy the AI RF Profiles window**, do one of the following:

- To deploy the AI RF profile immediately, click **Now** and **Deploy**.
- To schedule the deployment for a later time, click **Later**, define the date and time, and click **Deploy**.

Step 15 Click **Continue**.
The **Done! AI RF Profiles Assigned** window appears.

Step 16 Click the menu icon (≡) and choose **Activities** > **Tasks**.

Step 17 In the **Tasks** window, click the task link.

A slide-in pane displays the **Assigned Building(s)**, **Selected AI RF Profile**, and **Provision Details**.

Assign a Location to an Existing AI RF Profile

The following procedure describes how to assign a location to an existing AI RF profile.

Before you begin

- Cisco AI RF profiles are supported only on Cisco Catalyst 9800 Series Wireless Controllers and Cisco IOS-XE 17.7.1 or later.
- To perform the following task, you must be a **Super Admin** or **Network Admin**.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 In the left pane, click the **Global** site.

Step 4 In the **Wireless Radio Frequency Profile** area, click the **AI RF Profile** tab.
The **AI RF Profile** table lists the number of created AI RF profiles.

Step 5 Click the three dots under the **Action** column for an AI RF profile.

Step 6 From the drop-down list, choose **Assign Location**.

The **Manage Location Assignment** window appears.

Step 7 You can either search for a site by entering its name in the **Search** field, or expand **All Sites** to choose the sites.

Note
- The site hierarchy shows the AI-enabled locations.
- Sites or buildings that are not eligible for the AI profile are disabled.
- You cannot select a floor under a building. When you select a building for an AI-enabled RF profile, the floors underneath are assigned automatically.

If the same wireless controller manages other buildings, the **Confirm Impacted Sites** window appears.

Step 8 Review the confirmation and click **Confirm** to assign the chosen sites to the AI-enabled RF profile.

Step 9 Click **Assign**.

A **Download a Backup of Current RF Settings** window appears that allows you to download the backup of the RF settings across the selected buildings.

Step 10 (Optional) Click the backup link to download a .csv file to your local machine.

Step 11 Click **Confirm**.

Step 12 In the subsequent confirmation window, click **Confirm**.

In the **AI RF Profile** table, the locations assigned to the AI RF profile are displayed under the **Mapped Buildings** column.

What to do next

Provision Devices of an AI RF Profile-Enabled Building

The following procedure describes how to provision devices across the locations to deploy the AI RF profile.

1. Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

   In the **Inventory** window, the **Device** table lists the discovered AI RF profile associated devices.

2. Check the check box next to the AI RF profile associated device name that you want to provision.
3. From the **Actions** drop-down list, choose **Provision** > **Provision Device**.
4. Proceed through all the steps and in the **Summary** step, click **Deploy**.
5. In the **Summary** window, view the remaining network settings that will be pushed to the device. For more information, see Wireless Device Provisioning Overview, on page 377.

Unassign a Location from an Existing AI RF Profile

The following procedure describes how to unassign a location from an existing AI RF profile.

Before you begin

- Cisco AI RF profiles are supported only on Cisco Catalyst 9800 Series Wireless Controllers and Cisco IOS-XE 17.7.1 or later.
- To perform the following task, you must be a **Super Admin** or **Network Admin**.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 In the left pane, click the **Global** site.

Step 4 In the **Wireless Radio Frequency Profile** area, click the **AI RF Profile** tab.
The **AI RF Profile** table lists the number of created AI RF profiles.

Step 5 Click the three dots under the **Action** column for an AI RF profile.

Step 6 From the drop-down list, choose **Unassign Location**.

The **Unassign AI RF Profile** window appears.

Step 7 Check the check box next to a site to unassign an AI RF profile.

Step 8 Click the **Select from available RF Profiles** radio button to select an available RF profile that you want to assign to the chosen location.

Step 9 From the **Select RF Profile to Replace** drop-down list, choose an RF profile.

The **Select RF Profile to Replace** drop-down list shows AI RF profiles and basic RF profiles.

If you select a basic RF profile from the drop-down list, a **Confirm Impacted Sites** window validates whether the same wireless controller manages the other site.

Review the **Confirm Impacted Sites** window and click **Confirm** to assign the chosen sites to the selected RF profile.

Step 10 Click **Upload a CSV with RF settings back** to upload a backup of the RF settings from your local machine.

Step 11 Click **Choose a file** to import the CSV file, or drag and drop the CSV file to the drag and drop area.

Note The maximum size of the CSV file is 10 MB.

From the uploaded CSV file, if you find an RF setting based on the selected location name, a **Confirm RF Settings for Selected Locations** window shows the **Location** and **Matched RF Profiles**.

Step 12 Review the **Confirm RF Settings for Selected Locations** window and click **Confirm**.

Step 13 Click **Unassign**.

Step 14 In the confirmation window, click **Continue**.

Step 15 Click the menu icon (≡) and choose **Activities** > **Tasks** > to view upcoming, in progress, completed, and failed unassign location to AI RF profile tasks.

What to do next

Provision Devices of an AI RF Profile-Enabled Building

The following procedure describes how to provision the devices across the AI RF profile assigned locations to deploy the AI RF profile.

1. Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

   In the **Inventory** window, the **Device** table lists the discovered AI RF profile associated devices.

2. Check the check box next to the AI RF profile associated device name that you want to provision.
3. From the **Actions** drop-down list, choose **Provision** > **Provision Device**.
4. Proceed through all the steps and in the **Summary** step, click **Deploy**.
5. In the **Summary** window, review the remaining network settings that will be pushed to the device. For more information, see Wireless Device Provisioning Overview, on page 377.

Upgrade a Basic Radio Frequency Profile to an AI Radio Frequency Profile

Before you begin

To onboard a site in an AI-enhanced RRM service, at least one of the following services must be enabled:

- Flexible Radio Assignment (FRA)
- Dynamic Channel Assignment (DCA)
- Transmit Power Control (TPC)
- Dynamic Bandwidth Selection (DBS)

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 In the left pane, click the **Global** site.

Step 4 Check the check box next to the basic RF profile name that you want to upgrade to an AI RF profile.

Step 5 From the **Action** drop-down list, choose **Upgrade to AI**.

Step 6 In the confirmation window, click **Yes**.

Step 7 In the **Edit AI RF Profile** window, configure the AI RF profile settings. For more information, see Create an AI Radio Frequency Profile, on page 205.

Provision a Cisco Sensor SSID for Nonfabric Deployment

- The Cisco DNA Center sensor uses the Cisco sensor provisioning Service Set Identifier (SSID) to communicate with the Plug and Play (PnP) server and obtain day-0 configurations for running tests.

Note The Cisco sensor provisioning SSID is not applicable for APs working as sensors.

- For fabric deployments, the Cisco sensor provisioning SSID is mapped to an Infrastructure Virtual Network Access Point (INFRA VN–AP) pool to communicate with Cisco DNA Center.
- The following platforms support the Cisco sensor provisioning SSID:
  - Cisco AireOS Controller
  - Cisco Catalyst 9800 Series Wireless Controller (both fabric and nonfabric deployments)
- The Cisco sensor provisioning SSID supports the following network controllers:
  - Cisco Catalyst 9800 Wireless Controllers for Cloud
  - Cisco Catalyst 9800 Series Wireless Controller
  - Cisco AireOS Controller

The following procedure enables you to configure the Cisco sensor provisioning SSID for nonfabric deployments.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 From the **SSID** table, hover over ⊕Add ∨ and choose **Enterprise**.

The **Wireless SSID** workflow appears.

Step 4 Toggle the **Sensor** field and click **Next**.

Note The parameters for the SSID are automatically populated and cannot be edited.

Step 5 Click **Next**.

Step 6 In the **Wireless Profiles** screen, check a profile from the **Profiles** table.

The **Edit Wireless Profile** dialog box appears.

Step 7 In Fabric, select **Yes** and click **Save**.

The **Success Profile sensorProfile selected** message appears.

Step 8 Click **Finish**.

Step 9 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

Step 10 Check a device and from the **Actions** drop-down menu, choose **Provision** > **Provision Device**.

Step 11 Review the details under **Assign Site**, **Configuration**, **Model Configuration**, **Advanced Configuration**, and **Summary**. Click **Next** after each screen.

Step 12 Click **Deploy**.

The **Provision Device** dialog box is displayed.

Step 13 Choose **Now** and click **Apply**.

Result: The message **Task Scheduled view status in Tasks** appears at the bottom-right corner.

Manage Backhaul Settings

Use this procedure to view, create, and manage backhaul configurations for wireless sensors. A wireless sensor requires a backhaul SSID to communicate with Cisco DNA Center.

Step 1 Click the menu icon (≡) and choose **Assurance** > **Manage** > **Sensors**.

The **Sensor List** window appears.

Step 2 Hover your cursor over the **Settings** tab and choose **Backhaul Settings**.

Step 3 You can add and manage backhaul SSIDs by doing the following:

a) Click **+ Add Backhaul**.

The **Create Sensor Backhaul SSID Assignment** window appears with two areas: **Wired Backhaul** and **Wireless Backhaul**.

b) In the **Settings Name** field, enter a name for the backhaul SSID.

c) In the **Wired Backhaul** area, configure the following:

- **Level of Security**: Displays the encryption and authentication type used by the selected SSID. The available security options are:
  - **802.1x EAP**: Standard used for passing Extensible Authentication Protocol (EAP) over wired LAN.
  - **Open**: No security or authentication is used.
- **EAP Method**: If you choose **802.1x EAP**, you must choose one of the following EAP methods for user authentication from the drop-down list:

  - **EAP-FAST**: Enter the username and password in the fields provided.
  - **PEAP-MSCHAPv2**: Enter the username and password in the fields provided.
  - **EAP-TLS**: Choose **Enroll Using Certificate Bundle** or **Enroll Using SCEP**.

    If you choose **Enroll Using Certificate Bundle**, click the drop-down arrow under **Certificate Bundle**, click **+ Add New Certificate Bundle**, and enter the username and certificate bundle password.

  - **PEAP-TLS**: Choose **Enroll Using Certificate Bundle** or **Enroll Using SCEP**.

    If you choose **Enroll Using Certificate Bundle**, click the drop-down arrow under **Certificate Bundle**, click **+ Add New Certificate Bundle**, and enter the username and certificate bundle password.

d) In the **Wireless Network Name (SSID)** area, select the wireless network (SSID) and configure the following.

- **Level of Security**: Displays the encryption and authentication type used by the selected SSID. The available security options are:
  - **WPA2 Enterprise**: Provides a higher level of security using Extensible Authentication Protocol (EAP) (802.1x) to authenticate and authorize network users with a remote RADIUS server.
  - **WPA2-Personal**: Provides a good security using a passphrase or a preshared key (PSK). This allows anyone with the passkey to access the wireless network.

    If you select **WPA2 Personal**, enter the passphrase in the **Passphrase** text box.

  - **PSK Format**:The available preshared key formats are:
    - **ASCII**: Supports ASCII PSK passphrase.
    - **HEX**: Supports 64-character HEX key PSK password.
  - **Open**: No security or authentication is used.

e) Click **Save**.

Step 4 You can edit the existing backhaul configurations by doing the following:

a) Check the check box of the backhaul configuration.
b) Hover your cursor over the **Actions** drop-down list and choose **Edit**.

Step 5 You can delete a backhaul configuration by doing the following:

a) Check the check box of the backhaul configuration.
b) Hover your cursor over the **Actions** drop-down list and choose **Delete**.

About Cisco Connected Mobile Experiences Integration

Cisco DNA Center supports the integration of Connected Mobile Experiences (CMX) for wireless maps. With the CMX integration, you can get the exact location of your wireless clients, rogue access points and interferers on the floor map within the Cisco DNA Center user interface.

Depending on your requirements, you can create CMX settings either at the global level or at the site, building, or floor level. For a small enterprise, you can assign CMX at the global level, which is the parent node. All children inherit their settings from the parent node. For a medium enterprise, you can assign CMX at the building level and for a small enterprise, you can assign CMX at the floor level.

Note CMX should be anonymized for security purposes.

Create Cisco CMX Settings

Step 1 Click the menu icon (☰) and choose **System** > **Settings**.

Step 2 From the **External Services** section, click **DNA Spaces/CMX Servers**.

The **DNA Spaces/CMX Servers** window appears.

Step 3 From the **CMX Servers** table, click **Add**.

Step 4 Complete the fields in the **Add CMX Server** slide-in pane:

- **IP Address**: Enter the valid IP address of the CMX web GUI.
- **User Name**: Enter the CMX web GUI username.
- **Password**: Enter the password credentials.
- **SSH User Name**: Enter the CMX admin username.
- **SSH Password**: Enter the CMX admin password credentials.

Note Make sure that CMX is reachable.

Step 5 Click **Add**.

The CMX server is added successfully.

Step 6 To assign a CMX server to a site, building, or a floor, click the menu icon and choose **Design** > **Network Settings**.

Step 7 Click the **Wireless** tab.

Step 8 In the left tree view menu, select either Global or the area, building, or floor that you are interested in.

Step 9 In the **DNA Spaces/CMX Servers** section, use the drop-down list, choose the CMX server.

Step 10 Click **Save**.

The **Create CMX Settings** page appears.

After the CMX is added, if you make any changes to the floor on the **Network Hierarchy** page, the changes are synchronized automatically with the CMX.

When the CMX is synced, Cisco DNA Center starts querying the CMX for the client location and displays the location on the floor map.

Step 11 From the floor map, you can do the following:

- View the location of the client, which is shown as a blue dot.
- Hover your cursor over an AP. A dialog box is displayed with **Info**, **Rx Neighbor**, and **Clients** tabs. Click each tab for more information. Click **Device 360** to open the Device 360 window and view issues. Click an issue to see the location of the issue and the location of the client device.

- Click an AP to open a side bar with details about the AP.
- Perform real-time client tracking when Intelligent Capture and CMX are integrated.

Step 12 If the CMX was down when you made changes, you must synchronize manually. To do so, on the **Network Hierarchy** page, hover your cursor over the ellipsis ••• next to the building or floor on which you made the changes in the left tree pane, and then choose **Sync: DNA Spaces/CMX** to push the changes manually.

Step 13 To edit the CMX server details or delete a CMX server, do the following:

a) Click the menu icon (≡) and choose **System** > **Settings**.
b) From the **External Services** section, click **DNA Spaces/CMX Servers**.
c) Select the CMX server that you want to edit, make any changes, and click **Update**.
d) Select the CMX server that you want to delete and click **Delete**.
e) Click **OK** to confirm the deletion.

For CMX Authentication Failure

- Check if you are able to log in to the CMX web GUI with the credentials that you provided at the time of CMX settings creation on Cisco DNA Center.
- Check if you are able to log in to the CMX console using SSH.
- Check if you are able to exercise CMX REST APIs using the API Documentation link on the CMX GUI.

If Clients Do Not Appear on the Cisco DNA Center Floor Map

- Check if the Cisco wireless controller on the particular floor is configured with CMX and is active.
- Check if the CMX GUI shows clients on the floor map.
- Use the Cisco DNA Center Maps API to list the clients on the floor: `curl -k -u <user>:<password> -X GET /api/v1/dna-maps-service/domains/<floor group id>/clients?associated=true`

About Cisco DNA Spaces Integration

Enterprises operating in the physical world have limited to no visibility into the behavior of people and connected assets within their buildings. Cisco Spaces solves this physical blind-spot problem using location-sensing intelligence from all underlying Cisco wireless networks and translating the data into business-ready insights.

Cisco DNA Center supports the integration of Cisco Spaces. With the Cisco Spaces integration, you can get the exact location of your wireless clients, rogue APs, and interferers on the floor map in the Cisco DNA Center GUI. Depending on your requirements, you can create Cisco Spaces settings either at the global level or at the site, building, or floor level.

Note The Cisco DNA Center and Cisco Spaces integration is currently limited to only automatic map exports and synchronization for the location hierarchy. The integration does not support captive portal-based authentication features.

Integrate Cisco DNA Spaces with Cisco DNA Center

Use this procedure to integrate Cisco Spaces with Cisco DNA Center.

Step 1 Onboard the Cisco Spaces client:

a) Log in to Cisco Spaces using your email ID, and click **Continue**.
b) From the **Select Customer** drop-down list, choose the Spaces tenant for the Cisco DNA Center instance (for example, dna-center-dev-US), and then click **Proceed**.
c) In the Cisco Spaces GUI, click the menu icon and choose **Setup** > **Wireless Networks**.
d) In the **Connect your wireless network** window, complete Steps 1 to 3 as documented in the *Cisco Spaces Configuration Guide* to onboard the Cisco Spaces client.

You can access the *Cisco Spaces Configuration Guide* from the right pane under **Need Help?** > **View Configuration Steps**.

Step 2 Register Cisco DNA Center with Cisco Spaces:

a) Log in to Cisco Spaces using your email ID, and click **Continue**.
b) From the **Select Customer** drop-down list, choose the Spaces tenant for the Cisco DNA Center instance (for example, dna-center-dev-US), and then click **Proceed**.
c) In the Cisco Spaces GUI, click the menu icon and choose **Integrations** > **DNA Center**.
d) In the **DNAC Integration** window, click **Create Token**.

The **Create new token** dialog box appears.

e) In the **Instance Name** field, enter a unique name for the instance, and then click **Create Token**.

A new token for the instance opens.

f) Scroll to the right of the token and choose **Copy Token**.
g) To paste the token in to the Cisco DNA Center GUI, log in to Cisco DNA Center.
h) In the Cisco DNA Center GUI, click the menu icon (≡) and choose **System** > **Settings**.
i) In the left navigation pane, scroll down and choose **DNA Spaces/CMX Servers**.

The **DNA Spaces/CMX Servers** window appears.

j) From the **DNA Spaces** area, choose **Activate**.

The **Integrate DNA Spaces** dialog box appears.

k) In the **Tenant Token** text box, press **Ctrl V** to paste the token that you copied from Cisco Spaces, then click **Connect**.

The **Success** dialog box is displayed with the following information:

```
This cluster is integrated with Cisco Spaces successfully.
```

The DNA Spaces/CMX Servers window displays a green ✓ **Activated** status, and the tenant that you selected in Cisco Spaces (for example, dna-center-dev-US) is displayed in the **Tenant** field.

Step 3 Assign Cisco Spaces to sites in Cisco DNA Center:

a) In the Cisco DNA Center GUI, click the menu icon (≡) and choose **Design** > **Network Settings**.
b) Click the **Wireless** tab.
c) In the left tree view menu, select either **Global** or the area, building, or floor to which you want to assign Cisco Spaces.

d) From the **DNA Spaces/CMX Servers** section, use the drop-down list to select a site (for example, DNA Spaces - dna-center-dev-US).

e) Click **Save**.

Step 4 Monitor sites in Cisco DNA Center using Cisco Spaces:

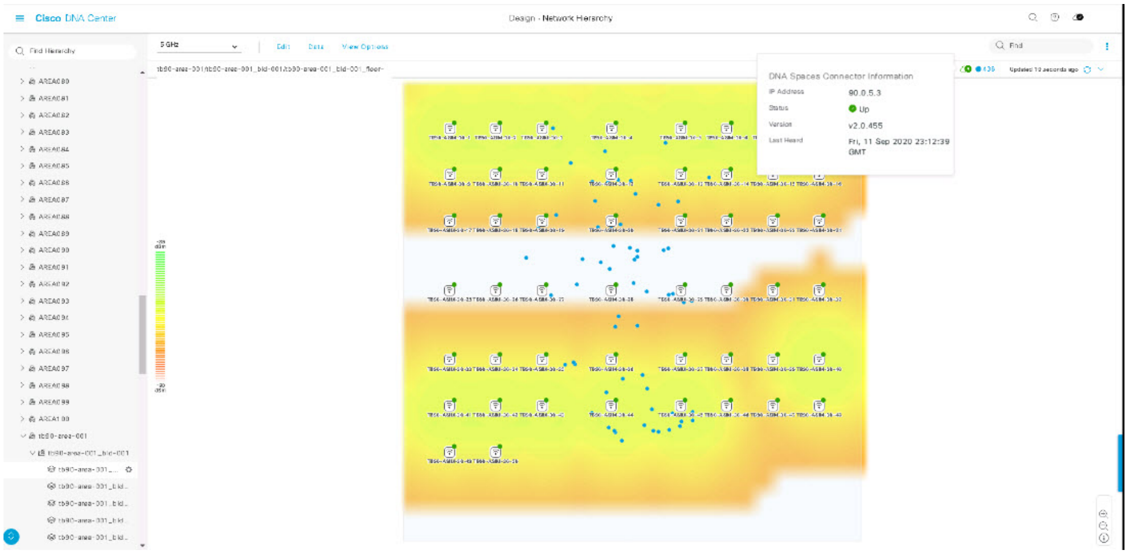
a) In the Cisco DNA Center GUI, click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

b) In the left tree view menu, select either **Global** or the area, building, or floor that you want Cisco Spaces to monitor.

Cisco DNA Center deploys the site information to Cisco Spaces automatically.

c) To confirm that Cisco Spaces is operational, verify that the Cisco Spaces/CMX status icon displays on the floor that you want to monitor, as shown in the following figure.

Figure 19: Cisco Spaces Status Icon



DNA Spaces Connector Information

IP Address 90.0.5.3
Status ● Up
Version v2.0.455
Last Heard Fri, 11 Sep 2020 23:12:39 GMT

Configure a FlexConnect VLAN

You can configure the following FlexConnect VLAN settings:

- **Native VLAN**: Allows a FlexConnect group to carry the management traffic between APs and Cisco Wireless Controllers.
- **AAA Override VLAN**: Provides dynamic VLAN assignment of locally switched clients.

You can apply these settings at the global level and override them at the site, building, or floor level.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 In the left pane, choose the appropriate scope:

- **Global**: Configures the VLAN at the global level for all sites.

- **Site**, **Building**, or **Floor**: Configures the VLAN at the chosen level only.

Step 4 In the **Native VLAN ID** field, enter a value for the VLAN ID. The valid range is from 1 to 4094.

Step 5 For the **AAA Override VLAN** settings, enter a VLAN ID and VLAN name mapping in the corresponding **VLAN ID** and **VLAN Name** fields. To add more mappings, click the Add icon.

Note The maximum VLAN mappings that you can define for a FlexConnect deployment is 16. However, for Cisco Catalyst 9800 Wireless Controllers, this number includes default WLAN VLANs and VLANs pushed by AAA.

Step 6 Click **Save**.

What to do next

Create a wireless network profile *or* configure an SSID:

- **Wireless Network Profile**: If you decide to create a wireless network profile, make sure that the **FlexConnect Local Switching** check box is checked. For more information, see Create Network Profiles for Wireless, on page 231.
- **SSID**: If you want to configure an SSID, see Create SSIDs for an Enterprise Wireless Network, on page 188 and Create SSIDs for a Guest Wireless Network, on page 194.

For the saved FlexConnect VLAN settings to get configured on the wireless controller, you must provision the wireless controller. For information, see Provision a Cisco AireOS Controller, on page 378 or Configure and Provision a Cisco Catalyst 9800 Series Wireless Controller, on page 390.

After provisioning the wireless controller, you must provision the AP that is associated with the controller.

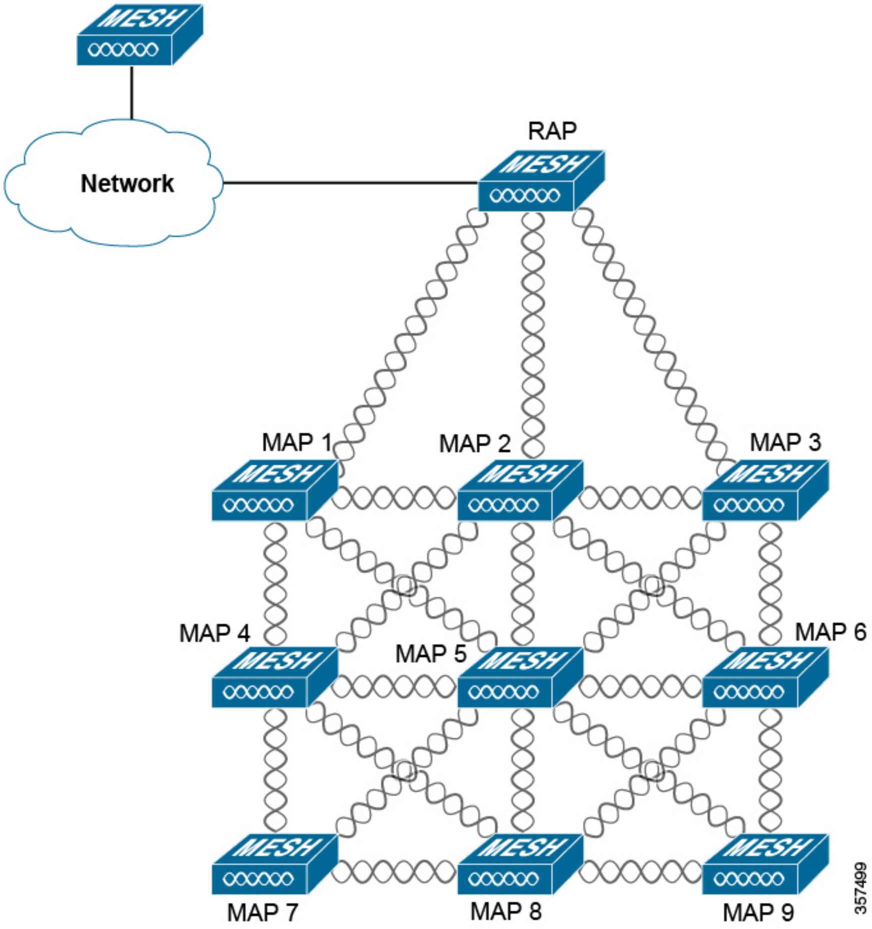
About Wireless Mesh Networks

In a Cisco wireless mesh network, Access Points (APs) operate in one of the following two ways:

- Root Access Point (RAP): Connected to the wired network at each location.
- Mesh Access Point (MAP): Communicate wirelessly while providing secure and scalable wireless LAN.

Note All APs are configured and shipped as MAPs. To use an AP as a RAP, you need to reconfigure the it as a RAP. In all mesh networks, make sure that there is at least one RAP.

RAPs are connected to the wired network at each location. All the downstream APs operate as MAPs and communicate using wireless links.



Both MAPs and RAPs can provide WLAN client access. However, typically, the location of RAPs is often not suitable for providing client access.

Some buildings have onsite controllers to terminate CAPWAP sessions from the MAPs, but it is not a mandatory requirement because CAPWAP sessions can be backhauled to a controller over a wide-area network (WAN).

In a Cisco wireless backhaul network, traffic can be bridged between MAPs and RAPs. This traffic can be from wired devices that are being bridged by the wireless mesh or CAPWAP traffic from the MAPs. This traffic is always AES encrypted when it crosses a wireless mesh link such as a wireless backhaul.

For more information about mesh networks, see the latest Cisco Wireless Mesh Access Points, Design and Deployment Guide.

AP Configuration

If you have existing APs that you want to use in mesh network mode, you must first change the AP Mode to Bridge or Flex+Bridge using the **Configure Access Point** workflow. For information, see Configure AP Workflow, on page 675.

After an AP is configured for Bridge or Flex+Bridge mode, the **AP 360** window shows the mesh configuration. At this point, you need to provision the APs with the new configuration. Provision a Cisco AP—Day 1 AP Provisioning, on page 384.

WLC Configuration

For mesh networks, you need to configure a list of authorized APs in the controllers. Controllers respond only to requests from the MAPs that are present in its authorization list.

Note Cisco DNA Center supports the configuration of authorization lists on Cisco Catalyst 9800 Wireless Controllers running Cisco IOS Release 17.5 and later.

On both AireOS and Catalyst 9800 Wireless Controllers can use Cisco DNA Center to configure the Bridge Group Name (BGN) and RAP downlink backhaul mesh settings. In Catalyst 9800 Wireless Controllers, you can also configure the maximum range of the MAPs, backhaul client access, and backhaul data rates.

These settings are configured at the floor level using the **Wireless Network Settings** window. For more information, see Configure Mesh Settings on WLCs, on page 222.

Configure Mesh Settings on WLCs

You can configure mesh settings on AireOS and Catalyst 9800 Wireless Controllers.

Note Range, Backhaul Client Access, and Backhaul Data Rates cannot be applied on AireOS Controllers through Cisco DNA Center.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 Click the **Wireless** tab.

Step 3 In the left pane, choose a floor.

Note Mesh settings are configured per floor only.

Step 4 Under **Authorized Access Points**, click **Manage Authorized Access Points**.

Step 5 In the **Manage Authorized Access Points** pane, enter the MAC addresses of MAPs that are allowed to join the controller. The controller responds only to those CAPWAP requests (from MAPs) that are in its authorization list.

Enter the MAC addresses in one of the following ways:

- **Upload a CSV File**: Download the CSV template file and add your MAC addresses to it. Then, upload the CSV file either by dragging and dropping it into the drop area or by clicking **Choose a file** and browsing to select the file.
- **Manually Add MAC Addresses**: If you have only a couple of MAC addresses to configure, click **Add**, and in the field that appears under **MAC Address**, enter the MAC address. To add more MAC addresses, click **Add**.

Step 6 Click **Save**.

Step 7 Under **Mesh Settings**, configure the following parameters:

- **Bridge Group Name**: Enter a name of up to 10 characters for the bridge group. A Bridge Group Name (BGN) controls the association of MAPs. By grouping radios, two networks on the same channel but in different BGNs cannot communicate with one another. This setting is also useful if you have more than one Root Access Point (RAP) in your network in the same sector (area).

A BGN of *NULL VALUE* is assigned by default. Although not visible to you, it allows MAPs to join the network before you assign a network-specific BGN.

- **Range (in Ft)**: Maximum range (in feet) of all the MAPs in the network.
- **Backhaul Client Access**: Allows wireless client association over the backhaul radio. Generally, the backhaul radio is a 5-GHz radio for most of the MAPs. This means that a backhaul radio can carry both backhaul traffic and client traffic.

  When **Backhaul Client Access** is disabled, only backhaul traffic is sent over the backhaul radio, and client association is only over the secondary radio or radios.
- **RAP Downlink Backhaul**: Click either the **5-GHz** or **2.4-GHz** radio button. If your country prohibits the use of 5-GHz, choose 2.4-GHz, or even if 5-GHz is allowed, you may prefer to use 2.4-GHz, because 2.4 GHz radio frequencies can achieve much larger mesh or bridge distances.

  Note When a RAP configuration is changed from 5- to 2.4-GHz, the update is propagated from the RAP to all the MAPs. At this point, the MAPs disconnect from the 5-GHz network and connect to the 2.4-GHz network.
- **Backhaul Data Rates**: From the **5GHz Band Radio Type**and **2.4GHz Band Radio Type** drop-down lists, choose an interface rate. Valid backhaul interface rates are **802.11abg**, **802.11n**, **802.11ac** (5-GHz band radio only), **802.11ax**, and **Auto**, depending on the access point. Backhaul is used to create a wireless connection between the access points. The rate selection is important for effective use of the available RF spectrum. The rate can also affect the throughput of client devices.

  With the **Auto** data rate, each link can arrive at the best possible rate for its link quality.

  We recommend that you configure the mesh backhaul data rate as **Auto**.

Step 8 Click **Save**.

CHAPTER 9

Configure Network Profiles

- Network Profiles Overview, on page 225
- Create Network Profiles for Assurance, on page 225
- Create Network Profiles for Firewall, on page 227
- Create Network Profiles for Routing, on page 228
- Create Network Profiles for Switching, on page 230
- Create Network Profile for Cisco DNA Traffic Telemetry Appliance, on page 231
- Create Network Profiles for Wireless, on page 231
- Preprovision the AP Group, Flex Group, and Site Tag in a Network Profile, on page 233

Network Profiles Overview

Network profiles allow you to configure settings and apply them to a specific site or group of sites. You can create network profiles for various elements in Cisco DNA Center:

- Create Network Profiles for Assurance, on page 225
- Create Network Profiles for Firewall, on page 227
- Create Network Profiles for Routing, on page 228
- Create Network Profiles for Switching, on page 230
- Create Network Profile for Cisco DNA Traffic Telemetry Appliance, on page 231
- Create Network Profiles for Wireless, on page 231
- Preprovision the AP Group, Flex Group, and Site Tag in a Network Profile, on page 233

Create Network Profiles for Assurance

Creating a network profile for Assurance allows you to configure issue settings and apply them to a site or group of sites independently from the global issues settings. You can enable or disable an issue, and you can change its priority.

Notes:

- In Assurance, synchronization to the network device health score is available only for global issue settings, not custom issue settings.
- Some global issues are not customizable. These issues are not displayed in the list of custom issues for you to modify.
- To display modified issues at the top of the list, sort by **Last Modified**.
- To delete custom settings, you must first unassign all the sites.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Profiles**.

Step 2 Click **+Add Profile** and choose **Assurance**.

Step 3 In the **Profile Name** field, enter a valid profile name and click **Next**.

Cisco DNA Center adds the profile and the **Edit Profile** window appears.

Step 4 Set the **DEVICE TYPE** and **CATEGORY** filters to view the type of issues you want to configure.

Step 5 Click an issue in the **Issue Name** column to open a slide-in pane with the settings.

Note For some issues, changes made to the settings are shared across multiple device types. In the slide-in pane, Cisco DNA Center displays a caution that indicates the affected device types.

Step 6 To enable or disable whether Cisco DNA Center monitors the issue, click the **Enabled** toggle button.

Step 7 To set the issue priority, click the **Priority** drop-down list and select the priority. The options are:

- **P1**: A critical issue that needs immediate attention and can have a wide impact on network operations.
- **P2**: A major issue that can potentially impact multiple devices or clients.
- **P3**: A minor issue that has a localized or minimal impact.
- **P4**: A warning issue that may not be an immediate problem but addressing it can optimize the network performance.

Step 8 (For certain issues) In the **Trigger Condition** area, you can change the threshold value for when the issue is reported.

Examples of a trigger condition:

```
No Activity on Radio(2.4 GHz) >= 60 minutes.
```

```
Memory Utilization of Access Points greater than 90%.
```

Step 9 (Optional) If there are any changes to the settings, you can hover your cursor over **View Default Settings** to display the default settings. Click **Use Default** to restore all the issue settings to the default values.

Step 10 Click **Apply**.

Step 11 (For certain issues) Click **Manage Subscription** to subscribe to external notifications for supported issues when they are triggered.

Step 12 To assign the profile to sites, click **Assign Sites**. Check the check box next to the sites that you want to associate with this profile and click **Save**.

The **Edit Profile** window appears.

Note You can select a parent node or the individual sites. If you select a parent node, all the children under the parent node are also selected. You can uncheck the check box to deselect a site.

Step 13 Click **Done**.

The newly added profile appears on the **Network Profiles** window.

Create Network Profiles for Firewall

This workflow shows how to:

1. Create custom configurations.
2. Create Firepower Threat Defense (FTD) configurations.
3. View the profile summary.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Profiles**.

Step 2 Click **+Add Profile** and choose **Firewall**.

The **Firewall Type** page appears.

Step 3 To create custom configurations for regular firewalls like Adaptive Security Appliance (ASA) firewalls, do the following:

a) In the **Name** field, enter the profile name.

b) Choose the number of devices from the **Devices** drop-down list.

Note You can choose up to 10 devices per profile.

c) Choose the type of device from the **Device Type** drop-down list.

d) (Optional) From the **Device Tag** drop-down list, choose the device tags.

e) Click **Next**.

The **Custom Configuration** page appears.

f) From the **Template** drop-down list, choose a template.

Note If there are no templates, you must create at least one template in **Tools** > **Template Editor**. For information, see Create Templates, on page 294.

g) Click **Next**.

The **Summary** page appears. This page summarizes the custom configurations. Based on the selected device type, a hardware recommendation is provided.

h) Click **Save**.

The **Network Profiles** page appears.

i) To assign a site to the network profile, click **Assign Sites**. For more information, see Create a Site in a Network Hierarchy, on page 122.

Step 4 To create FTD configurations to configure the FTD devices, do the following:

a) In the **Name** field, enter the profile name.

b) From the **Devices** drop-down list, choose the number of devices.

Note You can choose up to 10 devices per profile.

c) To provision an FTD firewall, check the **FTD** check box.
d) From the **Device Type** drop-down list, choose the type of device.
e) (Optional) Choose the device tags from the **Device Tag** drop-down list.
f) Click **Next**.

The **FTD Configuration** page appears.

g) Click the **Routed Mode** or **Transparent Mode** radio button.
h) Click **Next**.

The **Summary** page appears. This page summarizes the FTD configurations. Based on the selected device type, hardware recommendation is provided on this page.

i) Click **Save**.

The **Network Profiles** page appears.

j) To assign a site to the network profile, click **Assign Sites**. For information, see Create a Site in a Network Hierarchy, on page 122.

Create Network Profiles for Routing

This workflow shows how to:

1. Configure the router WAN.
2. Configure the router LAN.
3. Configure the integrated switch configuration.
4. Create custom configurations.
5. View the profile summary.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Profiles**.

Step 2 Click **+Add Profile** and choose **Routing**.

Step 3 The **Router WAN Configuration** window appears.

- Enter the profile name in the **Name** text box.
- Select the number of **Service Providers** and **Devices** from the drop-down list. Up to three service providers and ten devices are supported per profile.
- Select the **Service Provider Profile** from the drop-down list. For more information, see Configure Service Provider Profiles, on page 187.
- Select the **Device Type** from the drop-down list.
- Enter a unique string in the **Device Tag** to identify the different devices, or select an existing tag from the drop-down list. Use the device tag if two or more devices are of the same type. If all the devices are of a different type, the

device tag is optional. Select the appropriate tag, because your selection is used as part of the matching criteria for Day-0 and Day-N templates applied to the network profile.

- To enable at least one line link for each device to proceed, click **O** and check the check box next to **Connect**. Select the **Line Type** from the drop-down list. Click **OK**.

  If you select multiple service providers, you can select the primary interface as gigabit Ethernet and the secondary as cellular, or both the interfaces as gigabit Ethernet. You can also select the primary interface as cellular and the secondary interface as gigabit Ethernet.

  Note Only Cisco 1100 Series Integrated Services Routers, Cisco 4200 Series Integrated Services Routers, Cisco 4300 Series Integrated Services Routers, and Cisco 4400 Series Integrated Services Routers support the cellular interface.

- Click **Next**.

Step 4 The **Router LAN Configuration** page appears.

- Click the **Configure Connection** radio button and choose L2, L3, or both.
- If you choose **L2**, select the **Type** from the drop-down list and enter the **VLAN ID/Allowed VLAN** and the **Description**.
- If you choose **L3**, select the **Protocol Routing** from the drop-down list and enter the **Protocol Qualifier**.

You can click **Skip** to skip the configuration.

- Click **Next**.

Step 5 The **Integrated Switch Configuration** page appears.

The integrated switch configuration allows you to add new VLANs or retain the previous configuration selected in the router LAN configuration.

- To add one or more new VLANs, click **+**.
- To delete a VLAN, click **x**.
- Click **Next**.

Note Switchport Interface support is available only for Cisco 1100 Series and Cisco 4000 series Integrated Services Routers.

Step 6 The **Custom Configuration** page appears.

The custom configurations are optional. You can skip this step and apply the configurations at any time in the Network Profiles page.

If you choose to add custom configurations:

- Click the **Onboarding Template(s)** or **Day-N Templates** tab, as required.
- Choose a template from the drop-down list. The templates are filtered by **Device Type** and **Tag Name**.
- Click **Next**.

Step 7 On the **Summary** page, click **Save**.

This page summarizes the router configurations. Based on the devices and services selected, the hardware recommendation is provided.

Step 8 The **Network Profiles** page appears.

Click **Assign Sites** to assign a site to the network profile. For more information, see Create a Site in a Network Hierarchy, on page 122.

Create Network Profiles for Switching

You can apply two types of configuration templates to a switching profile:

- Onboarding template
- Day N template

Before you begin

Define the **Onboarding Configuration** template that you want to apply to the devices. Such templates contain basic network configuration commands to onboard a device so that it can be managed on the network. See Create Templates to Automate Device Configuration Changes, on page 293.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Profiles**.

Step 2 Click **+Add Profile** and choose **Switching**.

Step 3 In the Switching profile window, enter the profile name in the **Profile Name** text box.

Depending on the type of template that you want to create, click **OnBoarding Template(s)** or **Day-N Template(s)**.

- Click **+Add**.
- Select **Switches and Hubs** from the **Device Type** drop-down list.
- Select the **Tag Name** from the drop-down list. This step is optional. If the tag that you selected has already been associated with a template, only that template is available in the Template drop-down list.
- Select the **Device Type** from the drop-down list.
- Select a **Template** from the drop-down list. You can select the Onboarding Configuration template that you have already created.

Step 4 Click **Save**.

The profile that is configured on the switch is applied when the switch is provisioned. Note that you must add the network profile to a site for it to be effective.

Create Network Profile for Cisco DNA Traffic Telemetry Appliance

Before you begin

Define the template that you want to apply to the telemetry appliances. See Create Templates to Automate Device Configuration Changes, on page 293.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Profiles**.

Step 2 Click **+Add Profile** and choose **Telemetry Appliance**.

Step 3 In the **Telemetry Appliance Type** window, complete the following:

a) Enter the profile name in the **Name** text box.
b) From the **Devices** drop-down list, choose the number of devices.
c) From the **Device Tag** drop-down list, choose an existing device tag defined in Cisco DNA Center or enter a new tag. This step is optional. If the tag that you selected has already been associated with a template, only that template is available in the Template drop-down list.
d) Click **Next**.

Step 4 In the **Custom Configuration** window, choose the template. The chosen template will be applied to the device once it is managed in Cisco DNA Center inventory.

Step 5 Click **Next**.

Step 6 In the **Summary** window, click **Save.**

Create Network Profiles for Wireless

Step 1 Click the menu icon (≡) and choose **Design** > **Network Profiles**.

Step 2 Click **+Add Profile** and choose **Wireless**.

Before assigning a wireless network profile, make sure that you have created wireless SSIDs under **Design** > **Network Settings** > **Wireless** tab.

Step 3 In the **Add a Network Profile** window, enter a valid profile name in the **Profile Name** text box.

Step 4 Under the **Wireless SSID** area, click **+ Add SSID** and configure the following parameters:

- From the **SSID** drop-down list, choose the SSID which you have already created.
- Specify whether the SSID is fabric or nonfabric by selecting **Yes** or **No**.

  If you are creating a nonfabric SSID, select **No**, and configure the following parameters:

  - From the **Interface Name** drop-down list, choose an interface name for the SSID, or click **+ create a new wireless interface** to create a new wireless interface.

  - In the **Do you need Anchor for this SSID?** area, click **Yes** to add an anchor to SSID. By default, **No** is selected.

- Check the **Flex Connect Local Switching** check box to enable local switching for WLAN.

  If you have chosen to add anchor to SSID, you cannot enable **Flex Connect Local Switching**.

  If you have enabled **Flex Connect Local Switching** for an SSID, then all APs on that particular floor where the network profile is mapped will switch to FlexConnect mode.

  When you enable local switching, any FlexConnect AP that advertises this WLAN is able to locally switch data packets.

- The VLAN ID that is associated with the wireless interface is autopopulated based on the interface name selected.

  If you want to change the VLAN ID, in the **Local to VLAN** text box, enter a new value for the VLAN ID.

Step 5 Under the **Attach Model Configs** area, click **+ Add Model Config** to add model config designs to a network profile.

The **Add Model Config** window appears.

- From the **Device Type(s)** drop-down list, select the device type.

  You can either search for a device name by entering its name in the **Search** field or expand **Wireless Controller** and select the device type.

- Expand **Wireless** and select the model config design that you are attaching to this wireless profile.

- From the **Tags** drop-down list under **APPLICABILITY**, select the applicable tags.

- Click **Add**.

  The attached model config appears under the **Attach Model Config** area in the **Add a Network Profile** window.

Step 6 To associate a template with the network profile, click **+ Add Template** under the **Attach Templates** area.

- From the **Device Type(s)** drop-down list, choose the device type.

  You can either search for a device name by entering its name in the **Search** field or expand **Wireless Controller** and select the device type.

- You can choose the device tag and template from the **Device Tag** and **Template** drop-down lists.

  You can use tags on templates only when you have to push different templates for the same device type based on the device tag.

- Click **Add**.

  The created profile appears in the **Wireless Profiles** window.

Step 7 Click **Save** to add a network profile.

The newly added network profile appears on the **Design** > **Network Profiles** page.

Step 8 To assign this profile to a site, click **Assign Sites**.

Step 9 In the **Add Sites to Profile** window, check the check box next to the site to associate to this profile.

You can select a parent node or the individual sites. If you select a parent site, all the children under the parent node are also selected. You can uncheck the check box to deselect a site.

Step 10 Click **Save**.

Preprovision the AP Group, Flex Group, and Site Tag in a Network Profile

Cisco DNA Center allows you to preprovision the AP group, flex group, and site tag in a network profile. Preprovisioning saves time during AP provisioning by eliminating the need to make repetitive configuration changes and ensures consistency across your devices.

- AP group configuration is applicable to Wireless LAN controllers running an AireOS image.
- Flex group configuration is applicable to Wireless LAN controllers running an AireOS image.
- Site tag configuration is applicable to Catalyst 9800 series wireless controllers.

Before you begin

You must create a network profile and assign a site (floor) to the network profile to enable AP group, flex group, and site tag creation.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Profiles**.

Step 2 Click **Edit**.

Step 3 Click **Show Advanced Settings**.

Step 4 To create an AP group in the network profile, expand **AP Group** and click **+ Create an AP Group**.

The **Create an AP Group** window appears.

Step 5 In the **AP Group Name** field, enter the AP group name.

Step 6 From the **RF Profile** drop-down list, choose the RF profile.

The options are **High**, **Typical**, **Low**, **custom_rf_profile2**, and **rf_prof1_custom**.

Step 7 In the **Select Sites** field, you can either search for a site by entering its name or expand **Global** to select the site.

Step 8 (Optional) Click **Save & Add another** to add another AP group.

Step 9 Click **Save**.

The AP group is created based on the selected RF profile under the **AP Group** area in the **Edit Network Profile** window.

Step 10 To enable the flex group in the network profile, check the **Flex Connect Local Switching** check box and define the VLAN ID in the **Local to VLAN** text box to mark the nonfabric SSID as a flex-based SSID.

If you have enabled **Flex Connect Local Switching** for an SSID, then all APs on that particular floor where the network profile is mapped will switch to FlexConnect mode.

The **Flex Group** option is enabled under **View Advanced Settings**.

Step 11 To create a flex group in the network profile, expand **Flex Group** and click **+ Create Flex Group**.

The **Create Flex Group** window appears.

Step 12 In the **Flex Group** field, enter the flex group name.

Step 13 In the **Select Sites** field, you can either search for a site by entering its name or expand **Global** to select the site.

Step 14 (Optional) Click **Save & Add another** to add another flex group.

Step 15 Click **Save**.

The flex group is created under the **Flex Group** area in the **Edit Network Profile** window.

Step 16 To create a site tag in the network profile, expand **Site Tag** and click **+ Create a Site Tag**.

The **Create a Site Tag** window appears.

Step 17 In the **Site Tag** field, enter the site tag name.

Step 18 In the **Flex Profile Name** name field, enter the flex profile name.

Note To enable the **Flex Profile Name** name field, check the **Flex Connect Local Switching** check box in the **Edit Network Profile** window.

Step 19 In the **Select Sites** field, you can either search for a site by entering its name or expand **Global** to select the site.

Step 20 (Optional) Click **Save & Add another** to add another site tag.

Step 21 Click **Save**.

The site tag is created under the **Site Tag** area in the **Edit Network Profile** window.

CHAPTER 10

Work with Wireless 2D and 3D Floor Maps

- Work with Floor Maps, on page 235
- Add a Floor with a Map File, on page 236
- Work with 2D Maps, on page 240
- Work with 3D Maps, on page 268

Work with Floor Maps

There are several reasons to add floors with floor maps. One reason is to see your wireless network the way it exists today. Another reason is to help you plan and visualize future changes.

You can visualize your wireless network by creating or importing a floor map that contains various building components, like walls and windows, and then positioning your wireless devices on it. Using the floorplan, Cisco DNA Center computes 2D and 3D heatmaps that show the relative intensity of the RF signals in the coverage area. For 2D wireless maps, the heatmap is only an approximation of the actual RF signal intensity because it does not consider the attenuation of various building materials, such as drywall or metal objects, nor does it display the effects of RF signals bouncing off obstructions. In either case, we recommend that you import a file with an existing floor plan to get started.

Interactive planning helps you plan a floor layout by drawing planned, or hypothetical, APs and obstacles with a raster image or a CAD floor plan as the backdrop. You can export the floor map as a PDF and share it with the technicians who are mounting the APs. The floor drawing helps the technicians to visualize the floor layout and the exact AP mount locations.

With interactive floor planning, you can:

- Create a floor layout with a raster or CAD floor plan as the canvas.
- Place the planned APs or hypothetical APs on the floor map based on the signal coverage requirement. These hypothetical APs or planned APs are not yet installed or discovered by Cisco DNA Center.
- Assign the antenna type and orientation.
- Draw obstacles, such as walls and shelving on the floor, that impact the signal attenuation.
- Plan all APs in sequence.
- Export the floor map as a PDF.

Add a Floor with a Map File

When you create a floor, you can include a floor map at the same time. The following topics help you understand the different floor creation methods depending on the floor map file type that you use. Procedures for each method are also provided.

Floor Plans Overview

To view a wireless map, first you need to create a floor plan. There are three ways to create a floor plan for a wireless map:

- **Import a CAD file**: When you use a CAD file (DXF or DWG file type) to import the floor plan, Cisco DNA Center imports the CAD layers and allows you to specify which layers appear as floor elements in the wireless map.

  Because the computation of a 3D heatmap requires significant computing power, we recommend that you include only the CAD layers that contribute significantly to the heatmap computation. You should include enough information to get an accurate heatmap, but not unnecessary information that overloads the computation process and delays the heatmap display.

  Cisco DNA Center takes these initial steps to minimize the time it takes to generate a heatmap:

  - Restricts the maximum number of walls for 2D and 3D maps. The maximum number of walls for a 3D heatmap is 3000, after optimization. If your CAD file contains more, Cisco DNA Center alerts you and preserves the 3000 most relevant walls (based on the length of the wall multiplied by its attenuation).

    The maximum number of walls for a 2D heatmap is 300, after optimization. If your CAD file contains more, Cisco DNA Center alerts you and preserves the 300 most relevant walls (based on the length of the wall multiplied by its attenuation).

  - Automatically removes small obstructions (under 0.75 ft) and the second sides of the walls, leaving only one side per wall. (Cisco DNA Center applies an attenuation value for each wall, not for each side of a wall.)

  When deciding which layers and elements to import, focus on obstacles that create the most attenuation. In principle, the longer and thicker a wall is, the higher its attenuation. Low walls, like cubicles, and narrow walls, like columns, have low attenuation and have little affect on the heatmap. Even if the material of an obstacle is heavy, the attenuation is not significant, because the signal can radiate around the obstacle. Likewise, if you are not interested in the coverage outside of a building, do not include external walls or windows. Doing so provides better 3D visualization of the inside of the building.

  If your CAD file does not have walls in specific layers, but has walls mixed with other elements, do not select them for import. You can add walls manually later. For information, see Add Walls, on page 149.

  Block inserts and proxy entities cannot be imported. Please make imported layers contain only native elements like lines, polylines, arcs, and so on.

  For the procedure, see Create a Floor Map Using a CAD File, on page 131.

- **Import a non-CAD image file**: You can use the file types JPG, GIF, PNG, or PDF to import the floor plan. Typically, this type of file is used to create 2D floor maps. However, you need to manually create the floor elements, such as the walls and shelving, for them to be represented in the wireless map. For the procedure, see Create a Floor Map Using a Non-CAD File, on page 132.

- **Import a Ekahau Pro Project plan**: You can import Ekahau project data, such as the obstacles, APs, and more, into create a wireless map. For the procedure, see Create a Floor Map Using an Ekahau Project File, on page 134.

Guidelines for Image Files to Use in Maps

- Use a graphical application that can save the map image files to any of these formats: .jpg, .gif, .png, .pdf, .dxf, and .dwg.
- Ensure that the dimension of an image is larger than the combined dimension of all the buildings and outside areas that you plan to add to the campus map.
- Map image files can be of any size. Cisco DNA Center imports the original image to its database at a full definition, but during display, it automatically resizes them to fit the workspace.
- Obtain the horizontal and vertical dimensions of the site in feet or meters before importing. This helps you to specify these dimensions during map import.

Create a Floor Map Using a CAD File

To view a wireless map, you must create a floor map.

You can use CAD files (the DXF or DWG file type) to create a floor map.

For 2D floor maps, you must choose the CAD layers that you want to appear in the 2D view. For 3D floor maps, Cisco DNA Center imports the CAD layers as the walls, shelving, obstacles, and other elements in the map.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 In the left Hierarchy pane, hover your cursor over the ellipsis ••• next to the building and choose **Add Floor**.

Step 3 In the **Floor Name** field, enter a name for the floor.

The **Floor Name** field has the following restrictions:

- The floor name cannot exceed 40 characters.
- Special characters & > < ? ' " / [ ] aren't allowed.

Step 4 For the **Type (RF Model)** drop-down list, choose the RF model to apply to the floor.

Note The RF model determines how the RF is calculated based on the characteristics of the floor.

Step 5 Drag and drop the CAD file (the DXF or DWG file type) to the **Floor Image** area.

Note After you import a floor plan, make sure that you enable the overlay visibility. (From the floor, click **View Options** and enable the overlay toggles in **Overlay Objects**). By default, overlays are not displayed after you import a map.

Step 6 In the **Floormap** pop-up window, choose the CAD layers that you want to appear as floor elements in the map:

a) For the **2D** column, check the check boxes of the CAD layer that you want to appear in the 2D view.

b) For the **3D Wall/Shelving Type** column, use the drop-down list to choose a CAD layer that specifies the type of the wall or shelving.

Note For a layer to appear in the 3D view, a **3D Wall/Shelving Type** value is required. The wall/shelving type affects attenuation and how the heatmap is calculated. For more information, see Floor Plans Overview, on page 130.

c) Click **Use Selected Layers**.

Step 7 Enter the floor map dimensions in the **Width**, **Length**, and **Height** fields.

Step 8 Click **Add**.

Create a Floor Map Using a Non-CAD File

You can use non-CAD files (a JPG, GIF, PNG, or PDF file type) to create a floor map. However, when using a non-CAD file, the 3D floor elements, such as the walls and shelving, cannot be imported, and you need to add them manually later. For more information, see Configure Floor Map Elements and Overlays in 2D Maps, on page 135.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 In the left Hierarchy pane, hover your cursor over the ellipsis ••• next to the building and choose **Add Floor**.

Step 3 In the **Floor Name** field, enter a name for the floor.

The **Floor Name** field has the following restrictions:

- The floor name cannot exceed 40 characters.
- Special characters & > < ? ' " / [ ] aren't allowed.

Step 4 From the **Type (RF Model)** drop-down list, choose the RF model to apply to the floor.

Note The RF model determines how the RF is calculated based on the characteristics of the floor.

Step 5 Drag and drop the non-CAD file (a JPG, GIF, PNG, or PDF file type) onto the **Floor Image** area.

Note Be sure to provide the precise dimensions of floors that are in PDF format, because the image width and height ratio cannot be extracted from them.

Step 6 Click **Add**.

The floor map is created.

Step 7 From the map toolbar, click **Add/Edit**.

Step 8 To add walls as a 3D floor element, do the following:

a) From the map toolbar, click the **Walls** toggle to add the appropriate floor element.

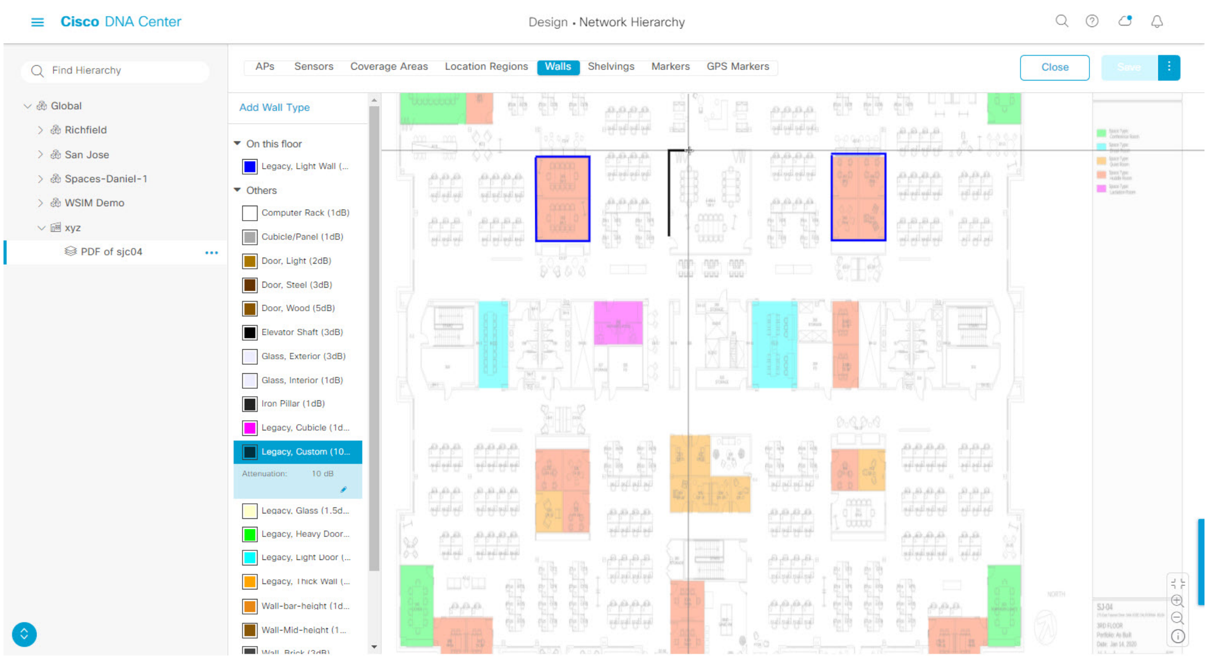
b) From the left pane of the map, click the wall type that you want to add.

- If the wall type is not in the list, click **Add Wall Type** to create a new wall type.

c) Use the drawing tool to create the wall area:

- Click the map to create a point. Continue creating points until you have created the shape for the wall.
- To finalize a shape, click the wall type of the shape from the left pane to exit drawing mode. Alternatively, double-click the map to finalize the shape. If you want to cancel the shape, right-click the map.
- To change the type of an existing wall, right-click the shape and choose **Change Type**.
- To move an existing wall, drag and drop the shape to the new location.
- To remove an existing wall, right-click the shape and choose **Delete**.

Figure 20: Adding a Wall with the Drawing Tool


Cisco DNA Center
Design • Network Hierarchy
Find Hierarchy
Global
Richfield
San Jose
Spaces-Daniel-1
WSIM Demo
xyz
PDF of sjc04
APs
Sensors
Coverage Areas
Location Regions
Walls
Shelvings
Markers
GPS Markers
Close
Save
Add Wall Type
On this floor
Legacy, Light Wall (...
Others
Computer Rack (1dB)
Cubicle/Panel (1dB)
Door, Light (2dB)
Door, Steel (3dB)
Door, Wood (5dB)
Elevator Shaft (3dB)
Glass, Exterior (3dB)
Glass, Interior (1dB)
Iron Pillar (1dB)
Legacy, Cubicle (1d...
Legacy, Custom (10...
Attenuation: 10 dB
Legacy, Glass (1.5d...
Legacy, Heavy Door...
Legacy, Light Door (...
Legacy, Thick Wall (...
Wall-bar-height (1d...
Wall-Mid-height (1...
Wall, Brick (2dB)

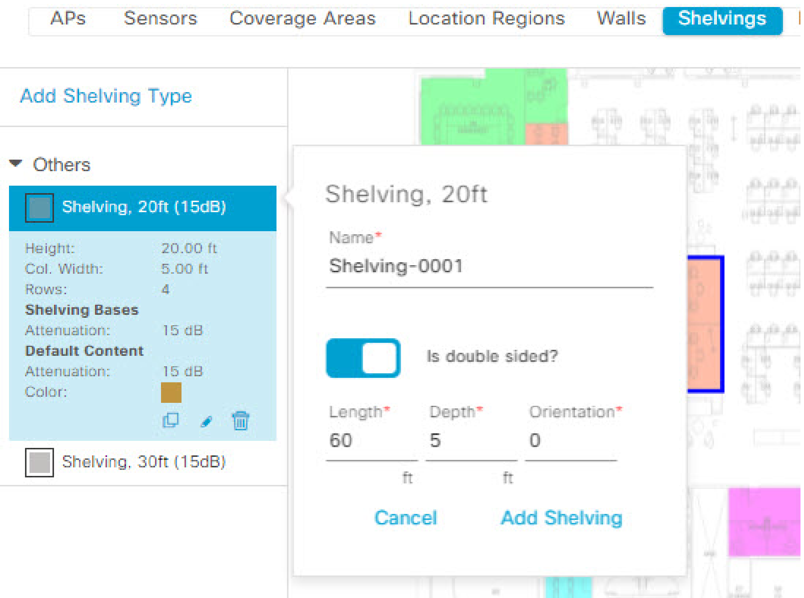
Step 9 To add shelving units as a 3D floor element, do the following:

a) In the map toolbar, click **Shelving Units**.

b) In the left pane of the map, click the shelving type that you want to add.

- In the **Shelving** dialog box, you can edit the name, dimensions, and orientation of the shelving type. Orientation refers to the angle of the shelving, for example, 0 means that the shelving is vertical and parallel to the y axis.
- If a shelving type is not in the list, click **Add Shelving Type** to create a new shelving type.

Figure 21: Choosing a Shelving Type to Add



Height: 20.00 ft
Col. Width: 5.00 ft
Rows: 4
Shelving Bases
Attenuation: 15 dB
Default Content
Attenuation: 15 dB
Color:

Shelving, 20ft

Name*: Shelving-0001

Is double sided? ●

Length*: 60 ft
Depth*: 5 ft
Orientation*: 0

c) In the **Shelving** dialog box, click **Add Shelving** to add the shelving to the floor map.

d) Drag and drop the shelving to move it to a location on the floor map.

e) Right-click the shelving and choose one of the following actions:

- **Edit**: Edit the name, dimensions, and orientation of the shelving.
- **Clone**: Create a copy of the shelving.
- **Array**: Create an array of shelving by specifying the number of shelves and the distance between them.
- **Delete**: Remove the shelving from the floor map.

Step 10 When you are done, click **Save** on the map toolbar.

Work with 2D Maps

2D maps are primarily used to configure elements on the floor map. Using 2D maps, you can add floor map elements and overlays and view heatmaps.

While viewing a 2D map, you can manipulate the display of the various elements and overlays. You can also filter device data and identify wireless interferers.

Configure Floor Map Elements and Overlays in 2D Maps

While viewing a 2D map, click **Add/Edit** from the map toolbar to enter edit mode. While in edit mode, you can do the following:

- Add, position, and delete the following devices:

  - Access points (APs) and planned access points (PAPs)
  - Sensors

- Add, edit, and delete the following overlay objects:
  - Coverage areas
  - Location regions
  - Walls
  - Shelving units
  - Markers
  - GPS markers

Work With APs on a Floor Map

Cisco DNA Center computes heatmaps for the entire map that show the relative intensity of the Radio Frequency (RF) signals in the coverage area. For 2D wireless maps, the heatmap is only an approximation of the actual RF signal intensity because it does not consider the attenuation of various building materials, such as drywall or metal objects, nor does it display the effects of RF signals bouncing off obstructions.

Follow these guidelines while placing APs on the floor map:

- Place APs along the periphery of coverage areas to keep devices close to the exterior of rooms and buildings. APs placed in the center of these coverage areas provide good data on devices that would otherwise appear equidistant from all other APs.
- Location accuracy can be improved by increasing overall AP density and moving APs close to the perimeter of the coverage area.
- In long and narrow coverage areas, avoid placing APs in a straight line. Stagger them so that each AP is more likely to provide a unique snapshot of the device location.
- Although the design provides enough AP density for high-bandwidth applications, location suffers because each AP view of a single device is not varied enough. Therefore, location is difficult to determine. Move the APs to the perimeter of the coverage area and stagger them. Each has a greater likelihood of offering a distinctly different view of the device, resulting in higher location accuracy.
- For optimal heatmap visibility on floor maps, configure the AP height to approximately 10 feet (3 meters) or lower.

Export Bulk APs from Prime Infrastructure and Import into Cisco DNA Center

Cisco DNA Center allows you to import, assign and position a collection of access points to the floor map. If you have an existing collection of access points on Cisco Prime Infrastructure, you can import it into Cisco DNA Center, saving time and effort spent in importing, assigning, and positioning access points to the floor map.

This procedure describes how to export an existing collection of access points from Cisco Prime Infrastructure, and import into Cisco DNA Center.

Before you begin

- To perform the following task, you must be a **Super Admin** or **Network Admin**.
- Make sure that you have APs in your inventory. If not, discover them using the **Discovery** feature.
- Add and position APs on a floor map.
- The site, building, and floor must be present in the site hierarchy.

Step 1 Export the bulk AP positions from Cisco Prime Infrastructure as a CSV file to your workstation.

Step 2 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 3 From the left Hierarchy pane, hover your cursor over the ellipsis ••• next to the site and choose **Import Bulk AP**.

Step 4 In the **Import Bulk AP** pop-up window, drag and drop the AP file, or click **Choose a file** to select the file from your workstation.

Note

- To manually create the **AP Positions** CSV file with Prime Template, export a Prime Template to your workstation by clicking **Download Prime Template**. Prime Template does not support nested files.
- To manually create the **AP Positions** CSV file with Cisco DNA Template, export a Cisco DNA Template to your workstation by clicking **Download Template**. Cisco DNA Template supports nested files.

Wait for the CSV file to download. The CSV file contains information about AP positions of various sites in the network.

Step 5 Click **Import**.

The **Import Summary** window appears.

- The **Information** tab shows the list of successfully imported APs.
- Click the **Warning** tab to see the list of warnings.
- Click the **Error** tab to see the list of errors.

Add APs to a Map

You can add APs one at a time or in bulk.

Before you begin

Make sure that you have Cisco APs in your inventory. If not, discover your APs using the Discovery feature. See Discovery Overview, on page 33.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 Ensure the **APs** option is enabled from the map toolbar.

Step 6 From the map left pane, click **Add APs**.

Step 7 From the **Add APs** slide-in pane, do one of the following:

- **To add a single AP**: Click **Add** next to an AP that you want to add.
- **To add multiple APs**: Check the check boxes next to APs you want to add and click **Add Selected**.

Note You can search for APs using the search option available. Use the **Filter** field to search for APs using the AP name, MAC address, model, or Cisco Wireless Controller. The search is case-insensitive. The search result appear in a table. Click **Add** to add one or more of these APs to the floor area.

Newly added APs appear in the **Unpositioned** category from the map left pane in edit mode. For more information, see Position an AP on a Map, on page 139.

Step 8 After adding the APs to a floor, close the **Add APs** window.

Add Planned APs to a Map

Using the AP Model Catalog feature, you can add a planned AP on a floor and configure its model, antenna type, azimuth, and elevation orientation. Then you can replicate that configuration to rest of the planned APs that belong to the same model type.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map left pane, in the **AP Models** area, click the AP model of the planned AP to add.

Note If the AP model is not listed, click **Add Model** to choose the AP model to add to the list.

Step 6 Using the drawing tool, click the location on the floor map to add the planned AP.

A planned AP of the selected model is added to the floor map and the **Edit Planned AP** slide-in pane appears on the right, with an AP name added to it by default.

Step 7 From the **Edit Planned AP** slide-in pane, click the gear icon, which is located next to the **AP Name** field.

The **Name pattern** dialog box appears.

Step 8 When you add the first AP to the floor, make sure that you enter a valid name pattern, for example SJC-BLD21-FL2-AP####, and then click **Set name pattern**.

Note The planned APs must be unique within Cisco DNA Center, so make sure that the name pattern identifies the floor.

The #### in the name pattern is replaced by numbers in the **AP Name**, for example SJC-BLD21-FL2-AP0001, SJC-BLD21-FL2-AP0002, and so on.

Step 9 From the **Antenna** drop-down list in the **Edit Planned AP** slide-in pane, choose the appropriate antenna type for each of the radio slots of the AP.

Note The antenna image reflects the antenna selected.

Step 10 Depending on the antenna type, enter the **Azimuth** and **Elevation** orientation, in degrees.

Step 11 To add another planned AP with the same properties as that of the planned AP that you just created, click a location in the floor map where you want to position the new AP.

A new AP icon appears on the map with all of the properties inherited and the AP name appended, for example BLD1-AP0002-TX.

Step 12 To add more planned APs with the same properties and appended AP Name, click the floor map.

Step 13 To stop adding planned APs to the floor map, press **Esc** or right-click the floor map.

Step 14 To reposition the planned APs, drag and drop them to the appropriate location in the floor map.

Step 15 To delete a planned AP, right-click the AP icon and click **Delete**.

Step 16 To edit a planned AP, right-click the AP icon and click **Edit**.

Step 17 When you are done, click **Save** from the map toolbar.

Assign Actual APs to Planned APs

When you are ready, you can assign actual APs to the planned APs on your map.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map left pane, click **Assign PAPs**.

Step 6 On the floor map, click a planned AP.

Step 7 From the **Assign Planned APs** slide-in pane, check the check box next to the AP that you want to assign.

Step 8 Click **Assign**.

Step 9 When you are done, click **Save** from the map toolbar.

Position an AP on a Map

After adding the APs to a floor, you need to position them on the map.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

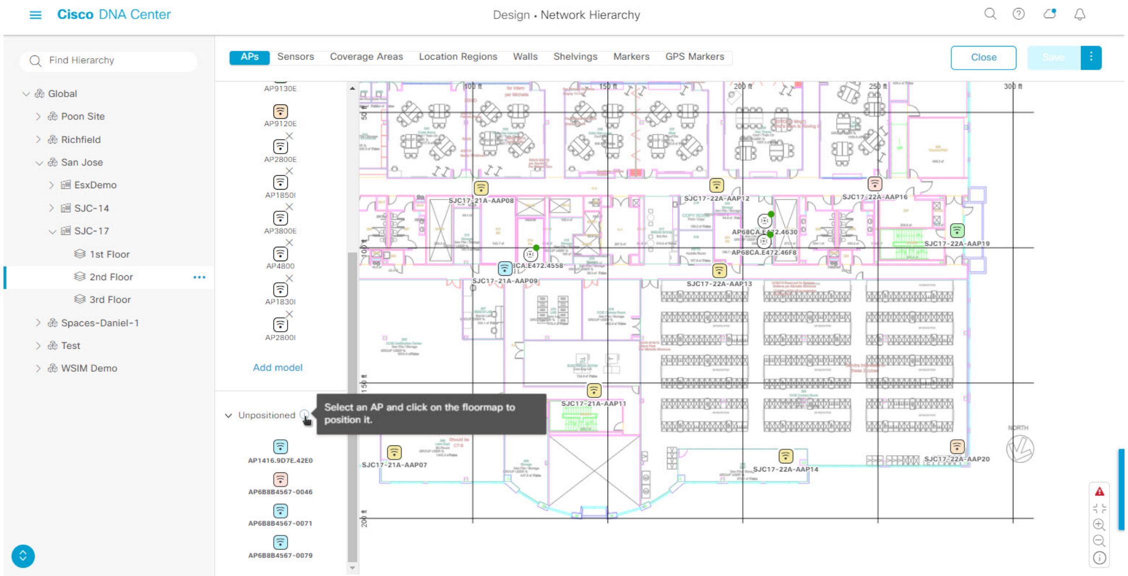
Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the **Unpositioned** category in the map left pane, click an AP.

Figure 22: Unpositioned APs


Cisco DNA Center
Design • Network Hierarchy
Find Hierarchy
Global
Poon Site
Richfield
San Jose
EsxDemo
SJC-14
SJC-17
1st Floor
2nd Floor
3rd Floor
Spaces-Daniel-1
Test
WSIM Demo
APs
Sensors
Coverage Areas
Location Regions
Walls
Shelvings
Markers
GPS Markers
Close
Save
AP9130E
AP9120E
AP2800E
AP1850I
AP3800E
AP4800
AP1830I
AP2800I
Add model
Unpositioned
Select an AP and click on the floormap to position it.
AP1416.9D7E.42E0
AP6B8B4567-0046
AP6B8B4567-0071
AP6B8B4567-0079
SJC17-21A-AAP08
SJC17-21A-AAP09
SJC17-21A-AAP07
SJC17-21A-AAP11
SJC17-22A-AAP12
SJC17-22A-AAP13
SJC17-22A-AAP14
SJC17-22A-AAP16
SJC17-22A-AAP19
SJC17-22A-AAP20
NORTH

Step 6 To position the AP, do one of the following:

- Click the location on the floor map where you want to position the AP.
- From the **Edit AP** slide-in pane, enter the x and y coordinates in the corresponding fields.
- Draw three points on the floor map and position the AP by using the selected points. To do this:

  a. From the **Edit AP** slide-in pane, click **Position by 3 points**.

  b. To define the points, click anywhere on the floor map to start drawing the first point. Click again to finish drawing a point. A dialog box appears to set the distance to first point. Enter the distance, in meters, and click **Set Distance**.

  c. Define the second and third points similarly, and click **Save**.

- Define two walls on the floor map and position the APs between the defined walls. This method helps you to know the position of APs between the two walls.

  a. From the **Edit AP** slide-in pane, click **Position by 2 walls**.

  b. To define the first wall, click anywhere on the floor map to start drawing the line. Click again to finish drawing a line. A dialog box opens to set the distance to the first wall. Enter the distance in meters and click **Set Distance**.

  c. Define the second wall similarly and click **Save**.

  The AP is placed based on the defined distance between the walls.

Step 7 From the map toolbar, click **Save**.

Note If a Cisco Connected Mobile Experiences (CMX) is synchronized with Cisco DNA Center, you can view the location of clients on the heatmap. See Create Cisco CMX Settings, on page 216.

Reposition an AP on a Map

At any time, you can reposition APs on a map.

Note This task can be performed in a 2D or 3D map.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D** or **3D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 In the map, drag and drop the AP to the new position.

Step 6 When you are done, click **Save**.

Edit an AP

You can change the configuration of a single AP. To change the configuration of multiple APs, see Edit Multiple APs, on page 142.

Note This task can be performed in a 2D or 3D map.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D** or **3D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 Click an AP.

To deselect it, press the **Shift** key and click the AP again.

Step 6 From the **Edit AP** slide-in pane, configure the following AP settings, as needed:

- **AP Name** or **Planned AP Name**: Name of the AP
- **MAC Address**: MAC address of the selected AP.
- **AP Model**: Model of the selected AP.
- **x**: X-axis coordinate of the AP. You can manually enter the value.
- **y**: Y-axis coordinate of the AP. You can manually enter the value.
- **AP Height**: Height of the AP. You can manually enter the value.
- **Antenna**: Antenna type for this AP.

Note For external APs, you must select an antenna, or the AP will not be present in the map.

- **Azimuth**: Angle of the antenna, measured relative to the x axis, clockwise. The azimuth range is 0 to 360. In Cisco DNA Center, pointing right is 0 or 360 degrees; pointing down is 90 degrees.

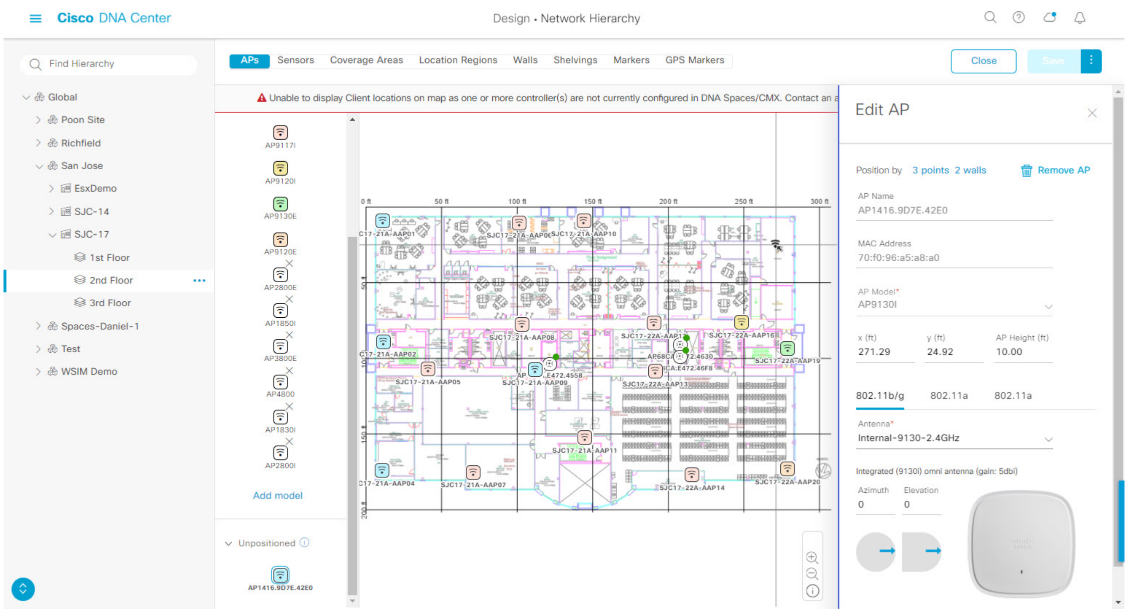
  You can manually enter the value or use the blue arrow under the field to change the value.

  Note For omnidirectional antennas, the azimuth is not relevant if the elevation is 0.

- **Elevation**: in degrees. You can manually enter the value or use the blue arrow under the field to change the value.

Note For APs and antenna models that are designed to be placed on a ceiling, 0 elevation means pointing down. For APs and antenna models that are designed to be placed on a wall, 0 elevation means pointing horizontally and negative values means pointing down.

Figure 23: Edit AP Slide-In Pane


Cisco DNA Center
Design • Network Hierarchy
Find Hierarchy
Global
Poon Site
Richfield
San Jose
EsxDemo
SJC-14
SJC-17
1st Floor
2nd Floor
3rd Floor
Spaces-Daniel-1
Test
WSIM Demo
APs
Sensors
Coverage Areas
Location Regions
Walls
Shelvings
Markers
GPS Markers
Close
Save
AP9117I
AP9120I
AP9130E
AP9120E
AP2800E
AP1850I
AP3800E
AP4800
AP1830I
AP2800I
Add model
Unpositioned
AP1416.9D7E.42E0
Edit AP
Position by
3 points
2 walls
Remove AP
802.11b/g
802.11a
802.11a

Unable to display Client locations on map as one or more controller(s) are not currently configured in DNA Spaces/CMX. Contact an a

AP Name: AP1416.9D7E.42E0

MAC Address: 70:f0:96:a5:a8:a0

AP Model*: AP9130I

x (ft): 271.29

y (ft): 24.92

AP Height (ft): 10.00

Antenna*: Internal-9130-2.4GHz

Integrated (9130i) omni antenna (gain: 5dbi)

Azimuth: 0

Elevation: 0

Step 7 Click **Save**.

Edit Multiple APs

When you select only one AP, you can change all editable attributes. However, when you select multiple APs, the following guidelines apply:

- When the selected devices have the same value for an attribute, the value is displayed. Otherwise, the value is blank. In either case, if you change the value, the new value is applied to all the selected devices.
- When the selected APs have the same model number and radios (number of radios and operating band), the antennas are editable. Otherwise, they are not editable.
- You can change the model numbers of planned APs, but not added APs. So, if you select an AP, the model number is not editable.
- Because bulk changes affect more devices, they do not take effect immediately. You need to click **Apply** to apply your changes.

Note This task can be performed in a 2D or 3D map.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D** or **3D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 Select the APs, using one of the following methods:

- Click the first device, then press and hold the **Shift** key while you click the rest of the devices.
- From the map navigation toolbar, click **Select by rectangle**. Then click an area of the map and drag the highlighted rectangle to select APs in a contiguous area. All the highlighted APs within the rectangle are selected.

To deselect APs, use one of the following methods:

- To deselect a single AP, press and hold the **Shift** key while you click the AP.
- To deselect all APs except one, click the AP you want to remain selected. All others are deselected.
- To deselect all APs, press the **ESC** key or close the **Edit** pane.
- Click **Save** to keep the changes, or **Discard** to reject them.

Step 6 From the **Edit AP** slide-in pane, configure the following AP settings, as available:

- **AP Name** or **Planned AP Name**: Name of the AP
- **MAC Address**: MAC address of the selected AP.
- **AP Model**: Model of the selected AP.
- **x**: X-axis coordinate of the AP. You can manually enter the value.
- **y**: Y-axis coordinate of the AP. You can manually enter the value.
- **AP Height**: Height of the AP. You can manually enter the value.
- **Antenna**: Antenna type for this AP.

  Note For external APs, you must select an antenna, or the AP will not be present in the map.

- **Azimuth**: Angle of the antenna, measured relative to the x axis, clockwise. The azimuth range is 0 to 360. In Cisco DNA Center, pointing right is 0 or 360 degrees; pointing down is 90 degrees.

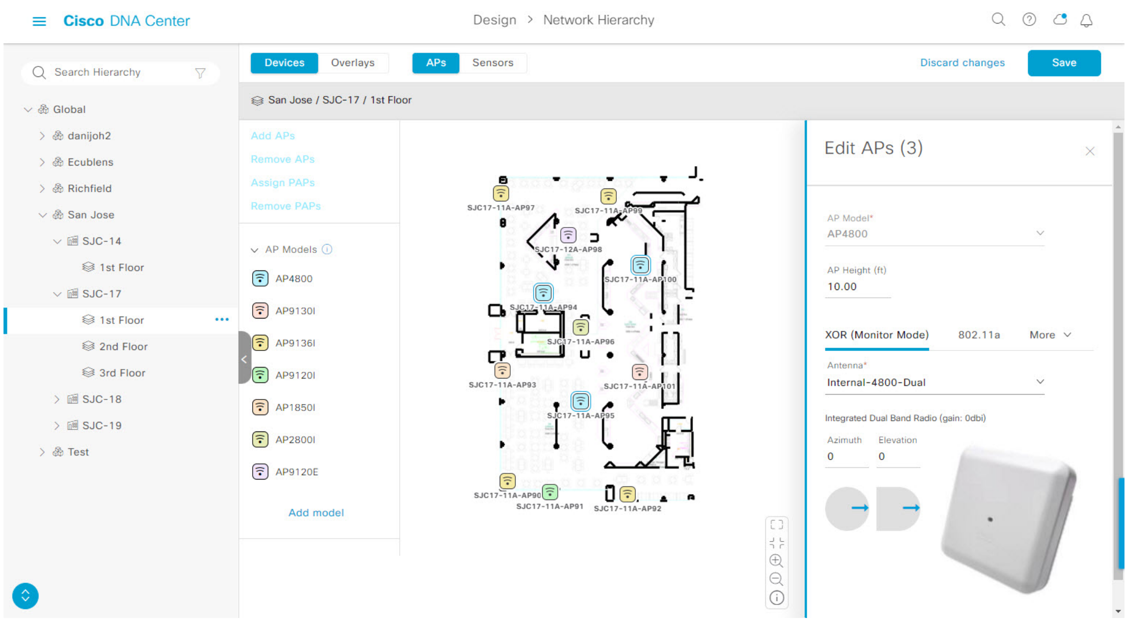
  You can manually enter the value or use the blue arrow under the field to change the value.

  Note For omnidirectional antennas, the azimuth is not relevant if the elevation is 0.

- **Elevation**: in degrees. You can manually enter the value or use the blue arrow under the field to change the value.

Note For APs and antenna models that are designed to be placed on a ceiling, 0 elevation means pointing down. For APs and antenna models that are designed to be placed on a wall, 0 elevation means pointing horizontally and negative values means pointing down.

Figure 24: Edit Multiple APs Slide-In Pane



Cisco DNA Center
Design > Network Hierarchy
Search Hierarchy
Global
danijoh2
Ecublens
Richfield
San Jose
SJC-14
1st Floor
SJC-17
1st Floor
2nd Floor
3rd Floor
SJC-18
SJC-19
Test
Devices
Overlays
APs
Sensors
Discard changes
Save
San Jose / SJC-17 / 1st Floor
Add APs
Remove APs
Assign PAPs
Remove PAPs
AP Models
AP4800
AP9130I
AP9136I
AP9120I
AP1850I
AP2800I
AP9120E
Add model
SJC17-11A-AP97
SJC17-11A-AP99
SJC17-12A-AP98
SJC17-11A-AP100
SJC17-11A-AP94
SJC17-11A-AP96
SJC17-11A-AP93
SJC17-11A-AP101
SJC17-11A-AP95
SJC17-11A-AP90
SJC17-11A-AP91
SJC17-11A-AP92
Edit APs (3)
XOR (Monitor Mode)
802.11a
More
Integrated Dual Band Radio (gain: 0dbi)

AP Model*: AP4800

AP Height (ft): 10.00

Antenna*: Internal-4800-Dual

Azimuth: 0

Elevation: 0

Step 7 Click **Apply**.

Step 8 Click **Save**.

Remove APs from a Map

You can remove APs and planned APs (PAPs) from a map without deleting them from the floor.

Step 1 Click the menu icon (☰) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 To remove APs (including planned APs), do the following:

a) Click the AP, or to select multiple APs, click the first AP and while pressing the **Shift** key, click the rest of the APs.

b) In the **Edit** pane, click **Remove**.

Step 6 When you are done, click **Save**.

Work with Sensors on a Floor Map

The following topics show you how to add sensors to floor maps and position, reposition, and delete them, if needed.

For more information about sensors, see Configure Floor Map Elements and Overlays in 2D Maps, on page 135.

Add Sensors to a Map

Note Make sure you have the Cisco AP 1800S sensor in your inventory. The Cisco Aironet 1800s Active Sensor must be provisioned using Plug and Play for it to show up in the Inventory.

A *sensor device* is a dedicated AP 1800s sensor. The Cisco Aironet 1800s Active Sensor gets bootstrapped using PnP. After it obtains the Assurance server reachability details, it directly communicates with the Assurance server. For more information, including information about sensor tests, see the Cisco DNA Assurance User Guide.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map toolbar, click **Sensors**.

Step 6 From the **Add Sensors** slide-in pane, check the check boxes of the sensors that you want to add. Alternatively, click **Add** next to the sensor row to add sensors.

Note You can search for specific sensors using the search option. Use the **Filter** field and search using the name, MAC address, or model of a sensor. The search is case-insensitive. The search results are displayed in the table. Click **Add** to add one or more these sensors to the floor area.

Newly added sensors appear in the **Unpositioned** category from the map left pane in edit mode.

Position Sensors on a Map

Newly added sensors appear in the **Unpositioned** category from the map left pane in edit mode. This procedure shows you how to position a sensor after initially adding it.

Before you begin

Sensors must be added to the map before they can be positioned. For information, see Add Sensors to a Map, on page 145

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map toolbar, click **Sensors**.

Step 6 From the map left pane, click a sensor in the **Unpositioned** category to position the sensor.

Step 7 Click the location on the floor map where you want to position the sensor.

You can use the **x**, **y**, and **sensorHeight** fields in the **Sensor Details** slide-in pane to enter the exact x, y, and z coordinates for the sensor.

Step 8 When you are done, click **Save**.

Reposition a Sensor on a Map

At any time, you can reposition sensors on a map.

Note This task can be performed in a 2D or 3D map.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D** or **3D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 In the map, drag and drop the sensor to the new position.

Step 6 When you are done, click **Save**.

Remove Sensors from a Map

You can remove sensors from a floor map.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 To remove sensors, do the following:

a) Click the sensor, or to select multiple sensors, click the first sensor and while pressing the **Shift** key, click the rest of the sensors.

b) In the **Edit** pane, click **Remove**.

Step 6 When you are done, click **Save**.

Add Coverage Areas

By default, any floor area or outside area defined as part of a building map is considered as a wireless coverage area.

If you have a building that is nonrectangular or you want to mark a nonrectangular area within a floor, you can use the map editor to draw a coverage area or a polygon-shaped area.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map toolbar, click **Coverage Areas**.

Step 6 From the map left pane, click the **Coverage Area** icon.

Step 7 In the **Coverage Area** dialog box, enter a name for the coverage area in the field and click **Add Coverage**.

Step 8 Use the drawing tool to create the coverage area shape:

a) Click on the map to create a point and continue creating points to define the coverage area shape.

> **Note** The coverage area shape must have at least 3 points.

b) You can click and drag any points to redefine the coverage area shape.
c) Double-click to exit the drawing tool and finalize the coverage area shape.

Step 9 After you can finish creating the coverage area, click **Save** from the map toolbar.

Step 10 To edit a coverage area, do the following:

a) From the map toolbar, click **Add/Edit**.
b) From the map toolbar, click **Coverage Areas**.
c) You can click and drag the points of the coverage area to redefine the shape.
d) To edit the coverage area name, right-click a coverage area and choose **Edit**.
e) After finishing making edits, click **Save** from the map toolbar.

Step 11 To delete a coverage area, do the following:

a) From the map toolbar, click **Add/Edit**.
b) From the map toolbar, click **Coverage Areas**.
c) Right-click the coverage area and choose **Delete**.
d) After finishing deleting, click **Save** from the map toolbar.

Add, Edit, Copy, and Remove Openings

Creating an opening is similar to creating an open space or atrium on a floor. On multifloor buildings, typically the opening extends vertically through multiple floors. This procedure shows you how to add, edit, and remove openings on a floor map. It also shows you how to copy openings to other floors.

For more information about openings, see Configure Floor Map Elements and Overlays in 2D Maps, on page 135.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 In the map toolbar, click **2D** > **Add/Edit** > **Overlays** > **Openings**.

Step 4 To add an opening, do the following:

a) From the left pane of the map, click **Opening**.
b) Click on the map to create a point and initiate the drawing tool.
c) Continue creating points to define the opening shape.

Note The opening shape must have at least three points. Click and drag a point to redefine the opening shape.

d) Double-click to exit the drawing tool and finalize the shape.

Step 5 To edit an opening, do the following:

a) In the map toolbar, click **Add/Edit** > **Openings**.
b) To redefine the shape of an opening, click and drag a point.
c) To move an opening, click inside the shaded area. Then, drag and drop the opening where you want to place it.

Step 6 To copy an opening from one floor to another, do the following:

a) In the map toolbar, click **Add/Edit** > **Openings**.
b) Right-click the opening and choose **Copy to other floors**.
c) In the dialog box, check the check boxes next to the relevant floors.
d) Click **Copy**.
e) Click **Close**.

Step 7 To remove an opening, do the following:

a) In the map toolbar, click **Add/Edit** > **Openings**.
b) Right-click the opening and choose **Remove**.

Step 8 In the map toolbar, click **Save**.

Add Location Regions

You can create inclusion and exclusion areas to further refine location calculations on a floor. You can define the areas that are included (inclusion areas) in the calculations and those areas that are not included (exclusion areas). For example, you might want to exclude areas such as an atrium or stairwell within a building, but include a work area, such as cubicles, labs, or manufacturing floors.

Use the following guidelines to define inclusion and exclusion areas on a map:

- Inclusion and exclusion areas can be any polygon-shaped area and must have at least 3 points.
- You can only define one inclusion region on a floor. By default, an inclusion region is defined for each floor area when it is created. The inclusion region is indicated by a solid aqua line, and generally outlines the entire floor area.
- You can define multiple exclusion regions in a floor area.

Add an Inclusion Region to a Floor

Step 1 Click the menu icon (☰) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map toolbar, click **Location Regions**.

Step 6 From the map left pane, click the **Inclusion** icon.

Step 7 Use the drawing tool to create the inclusion area:

- Click on the map to create point and continue creating points until you have created the shape for the inclusion area.
- To finalize the shape, click the **Inclusion** icon from the left pane to exit drawing mode. Alternatively, you can double-click on the map to finalize the shape. If you want to cancel the shape, right-click on the map.
- To move an existing inclusion area, drag and drop the shape to the new location.
- To remove an existing inclusion area, right-click the shape and choose **Delete**.

Step 8 When you are done, click **Save** from the map toolbar.

Add an Exclusion Region to a Floor

To further refine location calculations on a floor, you can define areas that are excluded (exclusion areas) in the calculations. For example, you might want to exclude areas such as an atrium or stairwell within a building. As a rule, exclusion areas are defined within the borders of an inclusion area.

Step 1 Click the menu icon (☰) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map toolbar, click **Location Regions**.

Step 6 From the map left pane, click the **Exclusion** icon.

Step 7 Use the drawing tool to create the exclusion area:

- Click on the map to create point and continue creating points until you have created the shape for the exclusion area.
- To finalize the shape, click the **Exclusion** icon from the left pane to exit drawing mode. Alternatively, you can double-click on the map to finalize the shape. If you want to cancel the shape, right-click on the map.
- To move an existing exclusion area, drag and drop the shape to the new location.
- To remove an existing exclusion area, right-click the shape and choose **Delete**.

Step 8 When you are done, click **Save** from the map toolbar.

Add Walls

Add walls to a floor for a more accurate heatmap. Walls affect the signal attenuation and how the RF is calculated in the heatmap.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Walls**.

Step 5 From the map left pane, click a wall type from the **Others** or **On this floor** categories.

Note If a wall type is not listed, click **Add Wall Type** to create a custom wall type.

Step 6 Use the drawing tool to create walls:

a) Click on the map where you want to start a wall.
b) Drag your cursor to where you want to end the wall or where you want to create a corner.
c) To end a wall, double click. To create a corner, click and drag your cursor to the next point. Continue this process until you have created the shape for the wall or walls.
d) To finalize a shape, double-click on the map where you want the wall to end. Alternatively, from the left pane, click the wall type to exit drawing mode.
e) To cancel the shape, finish creating it, and then delete it.

Step 7 To make changes to the wall, do the following:

a) Double-click the map.

The points on the map become visible. This means the elements on the map are editable.

b) Hover your cursor over the wall that you want to edit. When a wall is selected, it turns black.
c) You can now do one of the following:

- **Change the wall type**: Right-click the wall and choose **Change Type**.
- **Delete the wall**: Right-click the wall and choose **Delete**.
- **Move the wall**: Click the wall and drag and drop it to the new location.

Step 8 When you are done, click **Save** from the map toolbar.

Add Shelving Units

Shelving units are obstacles that affects signal attenuation. An example of a location with shelving units would be a high-ceiling warehouse.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Shelving Units**.

Step 5 From the map left pane, click the shelving type to add.

- In the shelving dialog box, you can edit the name, dimensions, and orientation of the shelving unit. The orientation means the angle of the shelving unit. A shelving unit with an orientation of 0 means that the shelving is vertical and parallel to the y axis.
- If a shelving type is not in the list, click **Add Shelving Type** to create a new shelving type.

Step 6 Click **Add Shelving**.

Step 7 Drag and drop the shelving to move it to its location on the floor map.

Step 8 Right-click the shelving for the following actions:

- **Edit**: Edit the name, dimensions, and orientation for the shelving.
- **Clone**: Create a copy of the shelving.
- **Array**: Create an array of shelving by specifying the number of shelving units and the distance between them.
- **Delete**: Remove the shelving from the floor map.

Step 9 When you are done, click **Save** from the map toolbar.

Add Markers

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map toolbar, click **Markers**.

Step 6 Enter the name for the marker, and then click **Add Marker**.

Step 7 Use the drawing tool to place the marker:

- Click the map to place the marker.
- To move the marker, drag and drop the marker to the new location.
- To edit an existing marker, right-click the marker and choose **Edit**.
- To remove an existing marker, right-click the marker and choose **Delete**.

Step 8 When you are done, click **Save** from the map toolbar.

Add GPS Markers

To locate the physical position of a building on the world map and increase the accuracy of a client's position, you can place a GPS marker on a 2D map.

Note The GPS marker is an attribute of the building and can be applied to all the floors of the building.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Add/Edit**.

Step 5 From the map toolbar, click **GPS Markers**.

Step 6 From the map left pane, click the **GPS Markers** icon.

Step 7 Use the drawing tool to place the GPS marker:

a) Click a location on the map to place the GPS marker.
b) In the **Place Markers** dialog box, enter the name, latitude, longitude, x and y coordinates in the appropriate fields.
c) Click **Add GPS Marker**.

Step 8 Repeat Steps 6 and 7 until there are three GPS markers on the floor map in a polygon-shape.

Step 9 To edit an existing GPS marker, right-click the GPS marker and choose **Edit**.

Step 10 To remove an existing GPS marker, right-click the GPS marker and choose **Delete**.

Step 11 When you are done, click **Save** from the map toolbar.

Add, Edit, and Remove Align Points

This procedure shows you how to add, edit, and remove align points. For more information about align points, see Configure Floor Map Elements and Overlays in 2D Maps, on page 135.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 In the map toolbar, click **2D** > **Add/Edit** > **Overlays** > **Align Points**.

Step 4 To add an alignment point, do the following:

a) In the left pane of the map, click the **Align Points** icon.
b) On the map, click the location where you want to place the alignment point.

Step 5 To edit the name of an alignment point, do the following:

a) Right-click the alignment point and choose **Edit**.
b) Change the name and click **Edit Marker**.

Step 6 To change the location of an alignment point, do the following:

a) Right-click the alignment point and choose **Edit**.

b) Click **Edit Marker**.

c) Drag and drop the alignment point to the new location.

Step 7 To remove an alignment point, right-click the alignment point and choose **Remove**.

Step 8 In the map toolbar, click **Save**.

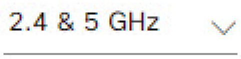
View a 2D Wireless Floor Map

Step 1 Click the menu icon (☰) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 In the map toolbar, click **2D**.

Step 4 Use the map toolbar for the following actions and settings:

Item	Description
	Click **2D** to view the wireless map in 2D or **3D** to view it in 3D.
	**Wi-Fi Band Filter**: Use this filter to view the heatmap for the 2.4 GHz and 5 GHz Wi-Fi bands.

Add/Edit	Click to enter add and edit mode which allows to do the following:
	• Add, position, and delete floor elements such as:
	  • Access points. For details, see Work With APs on a Floor Map, on page 136.
	  • Sensors. For details, see Add Sensors to a Map, on page 145.
	• Add, edit, and delete overlay objects such as:
	  • Coverage areas. For details, see Add Coverage Areas, on page 146.
	  • Location regions. For details, see Add Location Regions, on page 147.
	  • Walls. For details, see Add Walls, on page 149.
	  • Shelving Units. For details, see Add Shelving Units, on page 149.
	  • Markers. For details, see Add Markers, on page 150.
	  • GPS markers. For details, see Add GPS Markers, on page 150.

Data	Apply filters to the access point, sensor, and client data that appears in the wireless map. For details, see Filter Device Data on a Floor, on page 155.
View Options	Click to open the **View Options** slide-in pane which contains the view options for the map, devices, and floor map elements.

Item	Description
⚙	**Gear Icon**: Hover your cursor over the icon for the following options: • **Recompute**: Recomputes the heatmap. • **Export**: Export the floor map to a PDF or CSV file format. • **Edit Floor**: Edit the floor details such as its name • **Set Scale**: Change the scale by doing the following: **a.** Click on a point and then on another point to specify a known measurement on the map. **b.** In the **New line length (ft)** field, enter the length of the measurement. **c.** Click **OK**. The floor map dimensions are recalculated based on the length of the measurement. • **Measure Distance**: Measure a distance on the floor map. Click on a point and then another point to specify the distance.
⟳	**Refresh Icon**: Click to refresh the device and map data. To the left of the icon is the timestamp for the last refresh
🔍 Search	**Search**: Use this search field to perform a search for specific floor map elements such as APs, sensors, clients, and so on.

Step 5 Use the map for the following functionality:

- View the heatmap of the 2D wireless floor map. You can customize the view option settings from the **View Options** slide-in pane.
- View an AP's details by hovering your cursor over an AP icon.

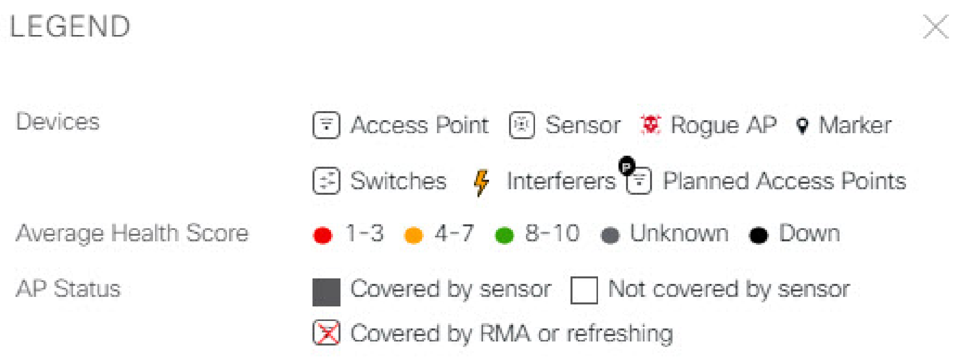
  You can view the basic info, RX neighbors, clients, interferers, and health score for an AP.

  Click **Device 360** to get a 360° view of the AP.

  Note For **Device 360**, the package *Assurance - Base* is required.

- View a sensor's status and test results by hovering your cursor over a sensor icon.
- View a switch's details by hovering your cursor over a switch icon.
- Use the map navigation controls at bottom-right of the map for the following controls:

Map Navigation Controls	Description
⛶	**Default Map View**: Click to reset the map view to the default.
⊕ ⊖	**Zoom In / Zoom Out**: Zoom in and out of the map. Alternatively, you can use your mouse wheel to zoom in and out.

Map Navigation Controls	Description
ⓘ	**Map Legend**: Click this icon to view the map legend which describes the map icons such as the device type, average health score, and AP status.  LEGEND Devices: Access Point, Sensor, Rogue AP, Marker, Switches, Interferers, Planned Access Points Average Health Score: ● 1-3 ● 4-7 ● 8-10 ● Unknown ● Down AP Status: ■ Covered by sensor ☐ Not covered by sensor ☒ Covered by RMA or refreshing

Step 6 Click **View Options** from the map toolbar to open the **View Options** slide-in pane. This allows you to configure the view option settings. Expand the categories to view the settings:

- **Map**: Contains various floor map and heatmap settings:

Item	Description
Show Grid	Click this toggle button to enable or disable a grid on the floor map. The grid provides the dimensions of the floor map.
Map Opacity %	Use this slider to customize the opacity or transparency of the floor map.

Item	Description
Heatmap Type	The heatmap provides a graphical representation of Radio Frequency (RF) wireless data where the values taken by variable are represented in maps as colors. RSSI heatmaps are computed based on a floor's RSSI prediction model, antenna type, and its orientation. 2D heatmaps use fixed transmit powers: 18 dB for 2.4 GHz; 15 dB for 5 GHz; and 5dB for 6 GHz. 3D heatmaps use real-time transmit power of operational APs and 11 dB for planned APs. Use the drop-down list to choose the heatmap type: • **Operational RSSI**: Coverage heatmap, which identifies the wireless signal strength of operational APs. • **Planned Heatmap**: Hypothetical heatmap that shows the coverage that planned access points would have on a floor. • **Operational + Planned RSSI**: (3D-only) Coverage heatmap created using both operational and planned APs. 2D maps only show operational AP coverage, so you need to switch to 3D maps to view this combined coverage heatmap. • **Client Density**: Density of associated clients. • **IDS**: Heatmap that shows the monitor mode access point coverage provided to the wireless clients on a floor map.
RSSI Cut off (dBm)	Use this slider to set the threshold for the RSSI value to appear on the heatmap. RSSI values that do not meet the threshold are faded.
Heatmap Opacity %	Use this slider to customize the opacity or transparency of the heatmap.
Heatmap Color Scheme	Customize the color scheme for the heatmap. Options are **Legacy** and **Natural**.

- **Access Points**: Click this toggle button to enable or disable the AP icons on the floor map.
  - **Display Label**: Use the drop-down list to choose the type of label to appear for APs on the floor map such as the AP's name, MAC address, or IP address, and so on.
- **Planned Access Points**: Click this toggle button to enable or disable the appearance of planned AP icons on the floor map.
  - **Display Label**: Use this drop-down list to choose the type of label to appear for the planned AP icons, such as the AP's name.
- **Switches**: Click this toggle button to enable or disable the appearance of switch icons on the floor map.
  - **Display Label**: Use this drop-down list to choose the type of label to appear for switch icons on the floor map, such as the switch's name, MAC address, or AP count.
- **Sensors**: Click this toggle button to enable or disable the appearance of sensor icons on the floor map.
  - **Display Label**: Use this drop-down list to choose the type of label to appear for sensor icons on the floor map, such as the sensor's name, MAC address, or IP address.

- **Overlay Objects**: Click the toggle button for an overlay object to enable or disable it on the floor map.

  The following overlay objects are available:

  - **Coverage Areas**
  - **Location Regions**
  - **Walls 2D & 3D**
  - **Walls 3D only**
  - **Shelvings**
  - **Markers**
  - **GPS Markers**

- **Clients**: Click this toggle button to enable or disable the appearance of client icons on the floor map.

  - **Display Label**: Use this drop-down list to choose the type of label to appear for client icons on the floor map, such as client name, IP address, MAC address, and so on.
  - **Show Client Clusters**: Click this toggle button to enable or disable clients in close proximity to be grouped together.

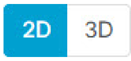
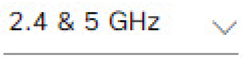
- **Interferers**: Click this toggle button to enable or disable the appearance of client icons on the floor map.

  - **Show Zone of Impact**: Click this toggle to enable or disable the appearance of the zone of impact from interferers.

- **Map Properties**: Contains the **Auto Refresh** setting. Use the **Auto Refresh** drop-down list to specify the time interval between each auto refresh for map data to occur.

- **Global Map Properties**: Contains the **Units of Measure** setting. Use the **Units of Measure** setting to change the preferred measurement system to imperial system (feet) or metric system (meters). This setting applies to all wireless maps.

2D Maps Toolbar

Item	Description
	Click **2D** to view the wireless map in 2D or **3D** to view it in 3D.
	**Wi-Fi Band Filter**: Use this filter to view the heatmap for the 2.4 GHz and 5 GHz Wi-Fi bands.
Add/Edit	Click to enter add and edit mode which allows to do the following: • Add, position, and delete floor elements • Add, edit, and delete overlay objects

Item	Description
Data	Apply filters to the access point, sensor, and client data that appears in the wireless map.
View Options	Click to open the **View Options** slide-in pane which contains the view options for the map, devices, and floor map elements.
⚙	**Gear Icon**: Hover your cursor over the icon for the following options: • **Recompute**: Recomputes the heatmap. • **Export**: Export the floor map to a PDF or CSV file format. • **Edit Floor**: Edit the floor details such as its name • **Set Scale**: Change the scale by doing the following: **1.** Click on a point and then on another point to specify a known measurement on the map. **2.** In the **New line length (ft)** field, enter the length of the measurement. **3.** Click **OK**. The floor map dimensions are recalculated based on the length of the measurement. • **Measure Distance**: Measure a distance on the floor map. Click on a point and then another point to specify the distance.
TBD	**Full Hierarchy Path**: Displays the full navigational path of the floor, including its associated building and site. Click the down arrow to navigate to a different floor.
🔄	**Refresh Icon**: Click to refresh the device and map data. To the left of the icon is the timestamp for the last refresh
Search	**Search**: Use this search field to perform a search for specific floor map elements such as APs, sensors, clients, and so on.

2D Map View Options

To access the 2D map, click the menu icon (☰) and choose **Design** > **Network Hierarchy**. From the left hierarchy tree, choose a floor, and in the map toolbar, click **2D** > **View Options**.

The **View Options** slide-in pane opens. Expand the categories to view the settings:

- **Map**: Contains various floor map and heatmap settings:

Item	Description
Show Grid	Click this toggle button to enable or disable a grid on the floor map. The grid provides the dimensions of the floor map.
Map Opacity %	Use this slider to customize the opacity or transparency of the floor map.

Item	Description
Heatmap Type	The heatmap provides a graphical representation of Radio Frequency (RF) wireless data where the values taken by a variable are represented in maps as colors. RSSI heatmaps are computed based on a floor's RSSI prediction model, antenna type, and its orientation. 2D heatmaps use fixed transmit powers: 18 dB for 2.4-GHz; 15 dB for 5-GHz; and 5 dB for 6-GHz. 3D heatmaps use real-time transmit power of operational APs and 11 dB for planned APs. Use the drop-down list to choose the heatmap type: • **Operational RSSI**: Coverage heatmap, which identifies the wireless signal strength of operational APs. • **Planned Heatmap**: Hypothetical heatmap that shows the coverage that planned access points would have on a floor. • **Operational + Planned RSSI**: (3D-only) Coverage heatmap created using both operational and planned APs. 2D maps only show operational AP coverage, so you need to switch to 3D maps to view this combined coverage heatmap. • **Client Density**: Density of associated clients. • **IDS**: Heatmap that shows the monitor mode access point coverage provided to the wireless clients on a floor map.
RSSI Cut off (dBm)	Use this slider to set the threshold for the RSSI value to appear on the heatmap. RSSI values that do not meet the threshold are faded.
Heatmap Opacity %	Use this slider to customize the opacity or transparency of the heatmap.
Heatmap Color Scheme	Customize the color scheme for the heatmap. Options are **Legacy** and **Natural**.

- **Access Points**: Click this toggle button to enable or disable the AP icons on the floor map.

  Expand this category to configure the type of label to display with each AP. Valid label types are **Name**, **AP MAC address**, **IP address**, **Bridge Group Names**, and so on. From the **Display Label** drop-down list, choose a label type.

  To display other details about APs, see View a 2D Wireless Floor Map, on page 151.

- **Planned Access Points**: Click this toggle button to enable or disable the appearance of planned AP icons on the floor map.

  Expand this category to display labels with the planned AP name. From the **Display Label** drop-down list, choose a label type.

- **Switches and Switch Stacks**: Click this toggle button to enable or disable the appearance of switch or switch stack icons on the floor map.

  Expand this category to display labels with the switch name, MAC address, or AP count. From the **Display Label** drop-down list, choose a label type.

  To display other details about switches, see View a 2D Wireless Floor Map, on page 151.

- **Sensors**: Click this toggle button to enable or disable the appearance of sensor icons on the floor map.

Expand this category to display labels with the sensor name, MAC address, or AP count. From the **Display Label** drop-down list, choose a label type.

To display other details about sensors, see View a 2D Wireless Floor Map, on page 151.

- **Mesh**: Click this toggle button to enable or disable the appearance of mesh APs on the floor map.

  Expand this category to configure options that control how the mesh AP-to-root AP link relationships are displayed:

  - **Link Label**: To disable link labels, click the **None** radio button. To display labels for link signal-to-noise ratios, click the **Link SNR** radio button. To display labels for packet error rates, click the **Packet Error Rate** radio button. The link label setting is reflected on the map immediately.
  - **Link Color**: To disable link color, click the **None** radio button. To display link signal-to-noise ratios in color, click the **Link SNR** radio button. To display packet error rates in color, click the **Packet Error Rate** radio button.

    The link color settings are reflected on the map immediately. See the following table for color definitions.

Link Color	Link Signal Noise Ratio (SNR)	Packet Error Rate (PER)
🟢	Represents an SNR above 25 dB (high value)	Represents a PER of one percent (1%) or lower
🟠	Represents an SNR between 20 dB and 25 dB (acceptable value)	Represents a PER that is less than ten percent (10%) and greater than one percent (1%)
🔴	Represents an SNR below 20 dB (low value)	Represents a PER that is greater than ten percent (10%)

  - **Mesh Parent-Child Hierarchical View**: Choose which mesh APs to display. From this drop-down list, choose **Select Only Root APs**, **Select up to 1st hops**, **Select up to 2nd hops**, **Select up to 3rd hops**, or **Select All**.

- **Overlay Objects**: Expand this category and click any of the overlay objects to enable or disable the overlay objects on the floor map.
- **Clients**: Click this toggle button to enable or disable the appearance of client icons on the floor map.

  Expand this category to display labels with the client name, MAC address, or AP count. From the **Display Label** drop-down list, choose a label type.

  To enable or disable clients in close proximity to be grouped together, click the **Show Client Clusters** toggle button.

- **Interferers**: Click this toggle button to enable or disable the appearance of client icons on the floor map.

  Expand this category to enable or disable the appearance of a zone of impact from interferers. Click the **Show Zone of Impact** toggle button.

- **Map Properties**: Expand this category to specify the time interval between each auto refresh of map data. From the **Auto Refresh** drop-down lists, choose a time interval.

  Additional information is provided depending on the types of devices displayed on the map. For example, when mesh APs are selected to be displayed, the **Map Properties** category shows mesh SNR and PER color charts. You can configure the mesh SNR and PER value ranges and their corresponding colors.

- **Global Map Properties**: Expand this category to change the preferred measurement system. From the **Units of Measure** drop-down list, choose either **Feet** (imperial system) or **Meters** (metric system).

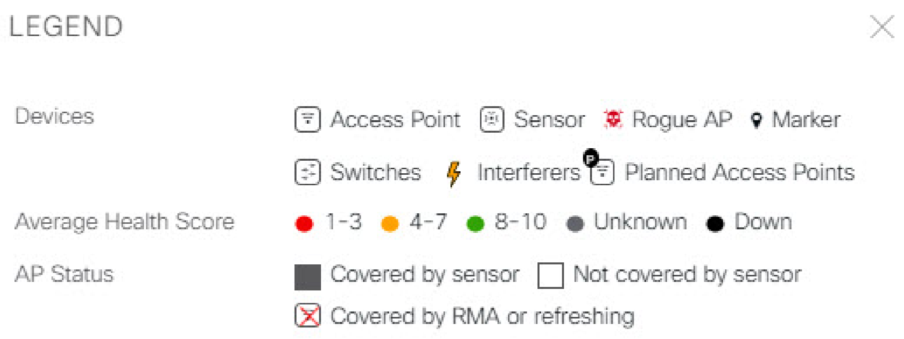
  This setting applies to all wireless maps.

2D Map Navigation Controls

To access the 2D map, click the menu icon (≡) and choose **Design** > **Network Hierarchy**. From the left hierarchy tree, choose a floor, and in the map toolbar, click **2D**.

The 2D map navigation controls are located at the bottom-right of the map. For details about the map, see View a 2D Wireless Floor Map, on page 151.

Use the map navigation controls for the following functions:

Map Navigation Controls	Description
⤡	**Default Map View**: Click to reset the map view to the default.
⊕ ⊖	**Zoom In / Zoom Out**: Click the zoom in and out icons to enlarge and reduce the size of the map. Alternatively, you can use your mouse wheel to zoom in and out.
ⓘ	**Map Legend**: Click this icon to view the map legend which describes the map icons such as the device type, average health score, and AP status.  LEGEND Devices: Access Point, Sensor, Rogue AP, Marker, Switches, Interferers, Planned Access Points Average Health Score: ● 1-3 ● 4-7 ● 8-10 ● Unknown ● Down AP Status: ■ Covered by sensor ☐ Not covered by sensor ☒ Covered by RMA or refreshing

AP Icon Legend

AP icons provide information about the configuration and health of the APs in your network.

Filter Device Data on a Floor

For 2D wireless maps, you can apply various filters to network devices such as access points, sensors, and so on. Based on the filter criteria, the search results appear in a table. Filtering device data is helpful in locating specific devices for floors with many devices.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 From the map toolbar, click **Data**.

Step 5 From the **Data** slide-in pane, click the device type that you want to apply a filter to.

Step 6 Define the filter rules by using the drop-down lists to choose the parameters.

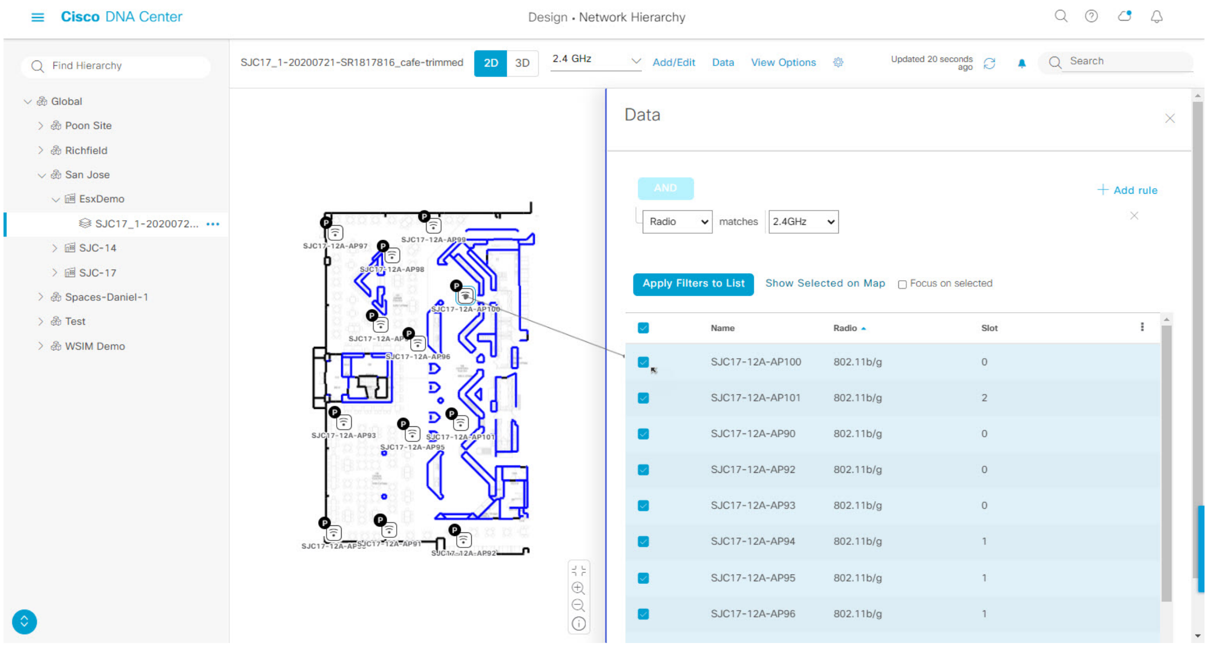
Step 7 To add more filter rules, click the + icon near the top of the slide-in pane.

Step 8 When you are done, click **Apply Filters to List**.

The filter results appear in the table at the bottom of the slide-in pane.

Step 9 You can hover your cursor over a device in the table to locate its position on the floor map.

Figure 25: Locating a Device from the Filter Results


Cisco DNA Center
Design • Network Hierarchy
Find Hierarchy
Global
Poon Site
Richfield
San Jose
EsxDemo
SJC17_1-2020072...
SJC-14
SJC-17
Spaces-Daniel-1
Test
WSIM Demo
SJC17_1-20200721-SR1817816_cafe-trimmed
2D
3D
2.4 GHz
Add/Edit
Data
View Options
Updated 20 seconds ago
Search
Data
AND
+ Add rule
Apply Filters to List
Show Selected on Map
Focus on selected

Radio matches 2.4GHz

☑	Name	Radio	Slot
☑	SJC17-12A-AP100	802.11b/g	0
☑	SJC17-12A-AP101	802.11b/g	2
☑	SJC17-12A-AP90	802.11b/g	0
☑	SJC17-12A-AP92	802.11b/g	0
☑	SJC17-12A-AP93	802.11b/g	0
☑	SJC17-12A-AP94	802.11b/g	1
☑	SJC17-12A-AP95	802.11b/g	1
☑	SJC17-12A-AP96	802.11b/g	1

Step 10 To remove applied filters, do the following:

a) Close the **Data** slide-in pane.
b) From the map toolbar, click **Data**.
c) Click the filter icon next to the device type to remove the filter.

Identify Wireless Interferers on the Floor Map

This is a 2D map feature.

Cisco DNA Center detects interference and disables the interference source for a specific band on a floor map. Any interference in the 2.4-GHz band disrupts the network traffic of the 802.11 wireless network.

Cisco DNA Center identifies the position, area of impact, and intensity of the interferer.

This procedure shows how to identify network interferers on a floor map.

Before you begin

Ensure that either Cisco Connected Mobile Experiences (CMX) or Cisco Spaces is synchronized with Cisco DNA Center.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **2D**.

Step 4 Hover your cursor over the ellipsis icon ••• next to the floor and choose **Sync: DNA Spaces/CMX** to synchronize **DNA Spaces** or **CMX** with the floor.

Note (Optional) In the world map, hover your cursor over the floor and choose **Sync: DNA Spaces/CMX** to synchronize **DNA Spaces** or **CMX** with the floor.

Step 5 In the **Network Hierarchy** window, click **View Options**.

Step 6 In the **View Options** window, scroll down and click the **Interferers** toggle button to enable interferers to appear on the floor map.

Step 7 Expand the **Interferers** category and click the **Show Zone of Impact** toggle button to enable the zone of impact of interferers to appear on the floor map.

Note By default, **Zone of Impact** is disabled.

Step 8 In the floor map, hover your cursor over the interferer icon and click the impacted channel to view the interferer device details.

Work with 3D Maps

3D maps are primarily used to plan and analyze a wireless network on a floor. As such, there are minimal configuration and edit functions that you can perform in 3D maps.

You can visualize your wireless network in various circumstances by customizing the KPIs, telemetry, and 3D map element settings. You can gain different perspectives of your wireless network by displaying the heatmap from both first-person and third-person views. Insights provide useful information about degradations in network performance, where service-level agreements (SLA) are not being met.

Unlike 2D maps, 3D maps provide two modes of operation:

- **Operation Mode**: In operation mode, the heatmap is computed based on live device information. Changes made to the following attributes cannot be saved:
  - AP model, channel, and Tx power
  - Planned AP channel and Tx power
- **Simulation Mode**: In simulation mode, you can make changes to the map to see how they would affect wireless coverage on a floor. You can also save these changes as simulations, so that you can open them and make more changes later.

Prerequisite

The system you use to compute and display 3D wireless heatmaps must have a Graphical Processing Unit (GPU) installed and enabled on it. For example, if you're using a Windows virtual machine (VM), you need to make sure that it has a GPU.

Configure Floor Map Elements and Overlays in 3D Maps

In 3D maps, you are limited to the following configuration and edit functions:

- Clone an AP, on page 158
- Edit an AP, on page 141
- Edit Multiple APs, on page 142
- Reposition an AP on a Map, on page 141
- Reposition a Sensor on a Map, on page 146

To configure other floor map elements or overlays, you need to use the 2D map. For details, see Configure Floor Map Elements and Overlays in 2D Maps, on page 135.

Clone an AP

You can duplicate an AP with its configuration by cloning it.

Before you begin

You must have actual APs to clone.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 From the map toolbar, click **3D**.

Step 4 From the map toolbar, click the Simulation icon .

Step 5 From the map toolbar, click **Add/Edit**.

Step 6 From the map, click an AP.

Step 7 From the **AP Details** slide-in pane, click **Clone**.

A duplicate AP is created and displayed below the original AP. It's name is appended with **-1**. If you keep cloning the same AP, the name continues to be incrementally appended. For example, the first clone for **a-floor1-ap01** is named **a-floor1-ap01-1**, the second clone for the same AP is named **a-floor1-ap01-2**, and so on.

Step 8 In the map, right-click the cloned AP and choose **Move**.

Step 9 Drag and drop the AP to its new position.

Step 10 Click **Save**.

View a 3D Wireless Map

Use this procedure to view a 3D wireless map.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

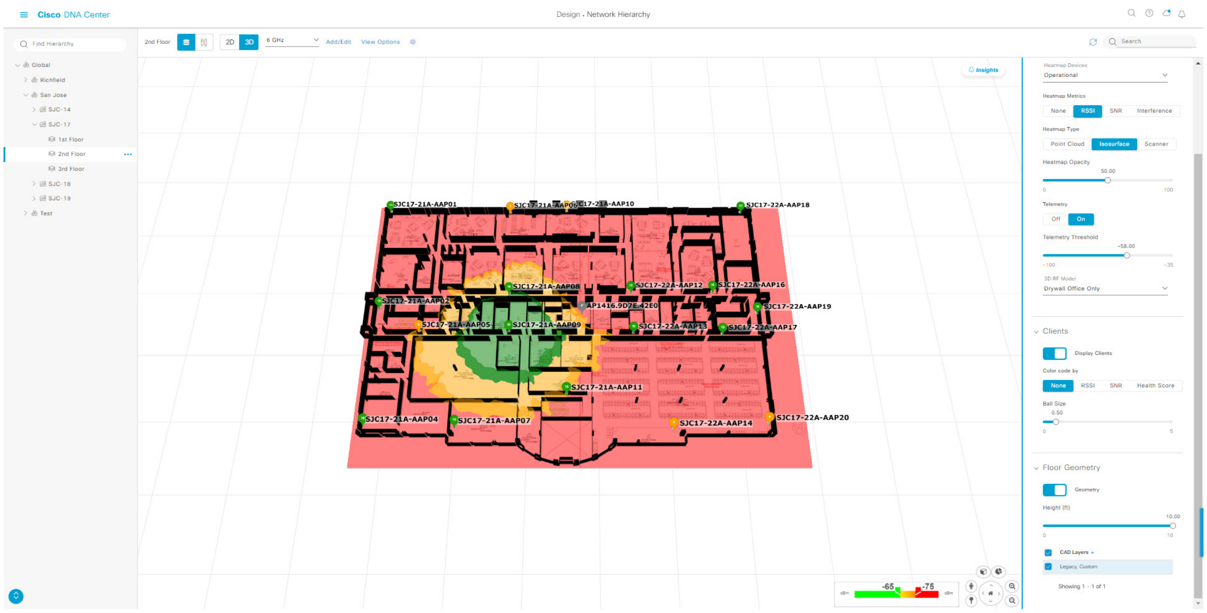
Step 2 From the left hierarchy tree, choose a floor.

Step 3 In the map toolbar, click **3D**.

Step 4 In the map toolbar, click **Operation**.

Note A 3D heatmap is delimited by its coverage area, which is the full floor width and length, by default. To specify a polygon for the heatmap boundaries, you need to edit the **Coverage Area** field value in the 2D map view. However, these boundaries do not apply to the 2D map view, as the full floor width and length is used for the 2D map view.

Figure 26: 3D Wireless Map in Operation Mode


Cisco DNA Center
Design · Network Hierarchy
Find Hierarchy
Global
Richfield
San Jose
SJC-14
SJC-17
1st Floor
2nd Floor
3rd Floor
SJC-18
SJC-19
Test
2nd Floor
2D
3D
6 GHz
Add/Edit
View Options
Search
Insights
SJC17-21A-AAP01
SJC17-21A-AAP06
SJC17-21A-AAP10
SJC17-22A-AAP18
SJC17-21A-AAP08
SJC17-22A-AAP12
SJC17-22A-AAP16
SJC17-21A-AAP02
AP1416.9D2E.42E0
SJC17-22A-AAP19
SJC17-21A-AAP05
SJC17-21A-AAP09
SJC17-22A-AAP13
SJC17-22A-AAP17
SJC17-21A-AAP11
SJC17-21A-AAP04
SJC17-21A-AAP07
SJC17-22A-AAP14
SJC17-22A-AAP20
-65
-75
Heatmap Devices
Operational
Heatmap Metrics
None
RSSI
SNR
Interference
Heatmap Type
Point Cloud
Isosurface
Scanner
Heatmap Opacity
50.00
0
100
Telemetry
Off
On
Telemetry Threshold
-58.00
-100
-35
3D RF Model
Drywall Office Only
Clients
Display Clients
Color code by
None
RSSI
SNR
Health Score
Ball Size
0.50
0
5
Floor Geometry
Geometry
Height (ft)
10.00
0
10
CAD Layers
Legacy, Custom
Showing 1 - 1 of 1

Step 5 To view the heatmap for one or more APs, select and deselect the APs using one of the following methods:

- To select a single AP, click the AP.
- To select multiple APs, press the `Shift` key while clicking each AP, and then release the `Shift` key.
- To deselect a single AP, click the AP.

  Note If no APs are selected, the heatmap includes all APs.

- To deselect all APs, press the `ESC` key or double-click an area of the map that doesn't have any APs.

Step 6 Use the map toolbar for the following actions and settings:

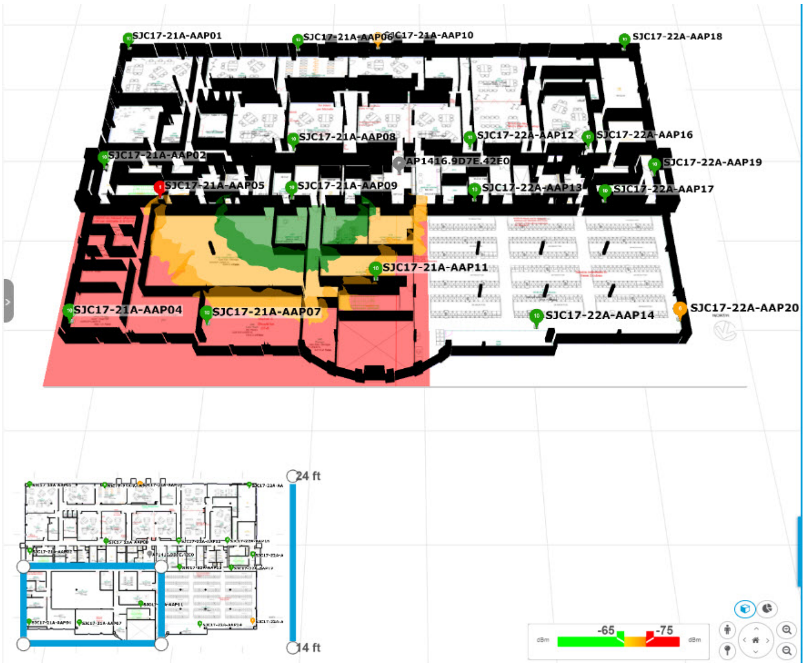
Item	Description
	Click **Operation** to view the map in Operation mode and click **Simulation** to view it in Simulation mode. **Note** Simulation mode is available only in 3D maps, not in 2D maps.
2D 3D	Click **2D** to view the wireless map in 2D or click **3D** to view it in 3D.
5 GHz ⌄	Use the **Wi-Fi Band Filter** filter to view the heatmap for the 2.4-GHz or 5-GHz Wi-Fi bands.
Add/Edit	Click **Add/Edit** to add planned APs by cloning existing APs or planned APs. For information, see Clone an AP. **Note** Adding operational APs from inventory is not available in 3D. To add operational APs, use **Add/Edit** from the 2D map.
View Options	Open the **3D Floormap** slide-in pane to display the contributing floors, KPI, telemetry, and floor element settings.
⚙	Hover your cursor over the Gear icon and click **Insights Configuration** to customize the conditions for insights.
⟳	Click the Refresh icon to update the device and map data. To the left of the icon is the timestamp for the last refresh.
🔍 Search	Use the **Search** field to perform a search for specific floor map elements such as APs, sensors, clients, and so on. Matches to your search criteria are listed below the **Search** field. When you hover your cursor over an element in the list, an indicator points to the element on the map. If the element is outside the field of view, the indicator displays as a broken red line. Reorient the map to see the element.

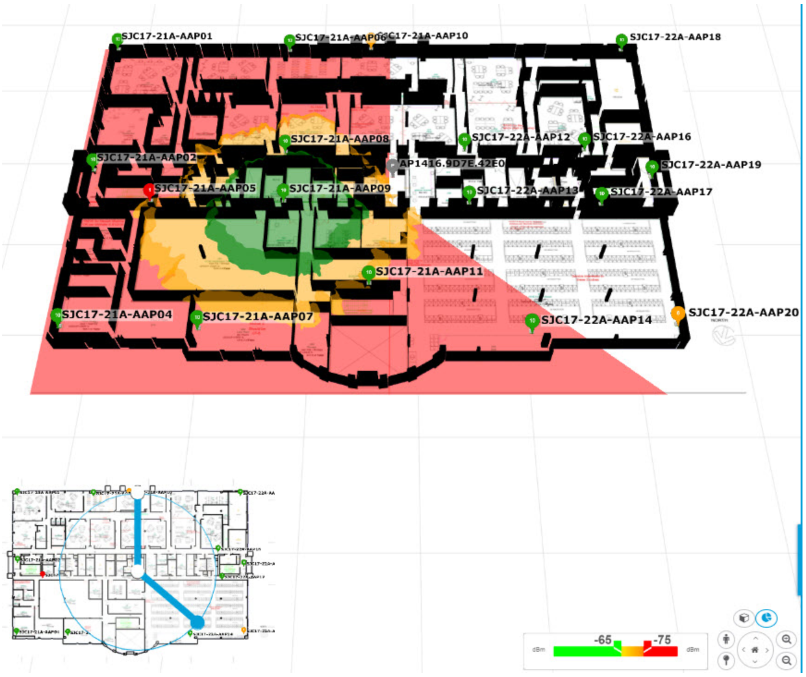
Step 7 At the top-right corner of the map, click **Insights** to view insights and potential issues in the wireless network.

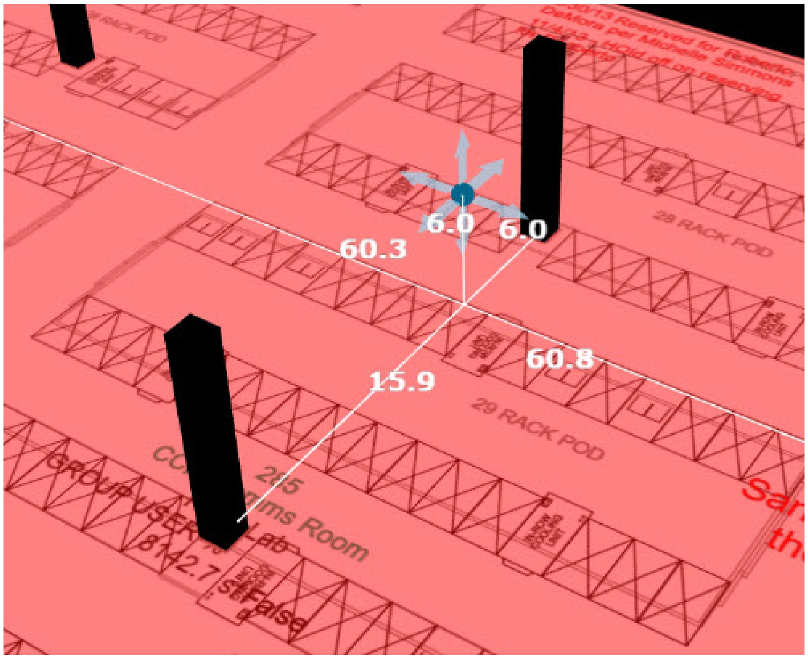
For details, see Gain Insights from a 3D Wireless Map, on page 169.

Step 8 Use the map for the following functions:

- View the heatmap of the 3D wireless map. You can customize the KPIs, telemetry, and 3D map element settings from the **3D Floormap** slide-in pane.
- When the map is in default map view (Simulation mode), you can control the camera angle by clicking and dragging with the left or right mouse button.
- Use the map navigation controls at the bottom-right corner of the map for greater control of the map:

Map Navigation Control	Description
	Use clip box: Click this icon to crop the heatmap using a box shape. Use the clipper at the bottom-left corner of the map to specify the crop: • Click and drag one of the anchor points to change the size of the crop. • Click and drag one of the anchor points on the right vertical slider to specify the height range of the crop. *Figure 27: Clip Box*  SJC17-21A-AAP01 SJC17-21A-AAP06 SJC17-21A-AAP10 SJC17-22A-AAP18 SJC17-21A-AAP08 SJC17-22A-AAP12 SJC17-22A-AAP16 SJC17-21A-AAP02 AP1416.9D7E.42E0 SJC17-22A-AAP19 SJC17-21A-AAP05 SJC17-21A-AAP09 SJC17-22A-AAP13 SJC17-22A-AAP17 SJC17-21A-AAP11 SJC17-21A-AAP04 SJC17-21A-AAP07 SJC17-22A-AAP14 SJC17-22A-AAP20 24 ft 14 ft -65 -75 dBm dBm

Map Navigation Control	Description
◔	**Use clip planes**: Click this icon to crop the heatmap using a donut shape. Use the clipper at the bottom-left corner of the map to specify the crop: - Click and drag the anchor point in the center of the donut to reposition the donut. - Click and drag the two outer anchor points to change the shape of the crop. *Figure 28: Clip Planes in Use*  SJC17-21A-AAP01 SJC17-21A-AAP06 SJC17-21A-AAP10 SJC17-22A-AAP18 SJC17-21A-AAP08 SJC17-22A-AAP12 SJC17-22A-AAP16 SJC17-21A-AAP02 AP1416.9D7E.42E0 SJC17-22A-AAP19 SJC17-21A-AAP05 SJC17-21A-AAP09 SJC17-22A-AAP13 SJC17-22A-AAP17 SJC17-21A-AAP11 SJC17-21A-AAP04 SJC17-21A-AAP07 SJC17-22A-AAP14 SJC17-22A-AAP20 -65 -75 dBm
🧍	**First Person View**: Click this icon to switch between first-person view and third-person view. The blue sphere indicates your position on the map. As you move throughout the map, your field of view changes. You can use the mini map at the lower left corner to get an idea of your field of view and orientation. **Note** If you have more than one floor selected for display, the **First Person View** automatically positions you on the current floor. For details, such as the controls for view, see Use First-Person and Third-Person Views for 3D Wireless Maps, on page 166.

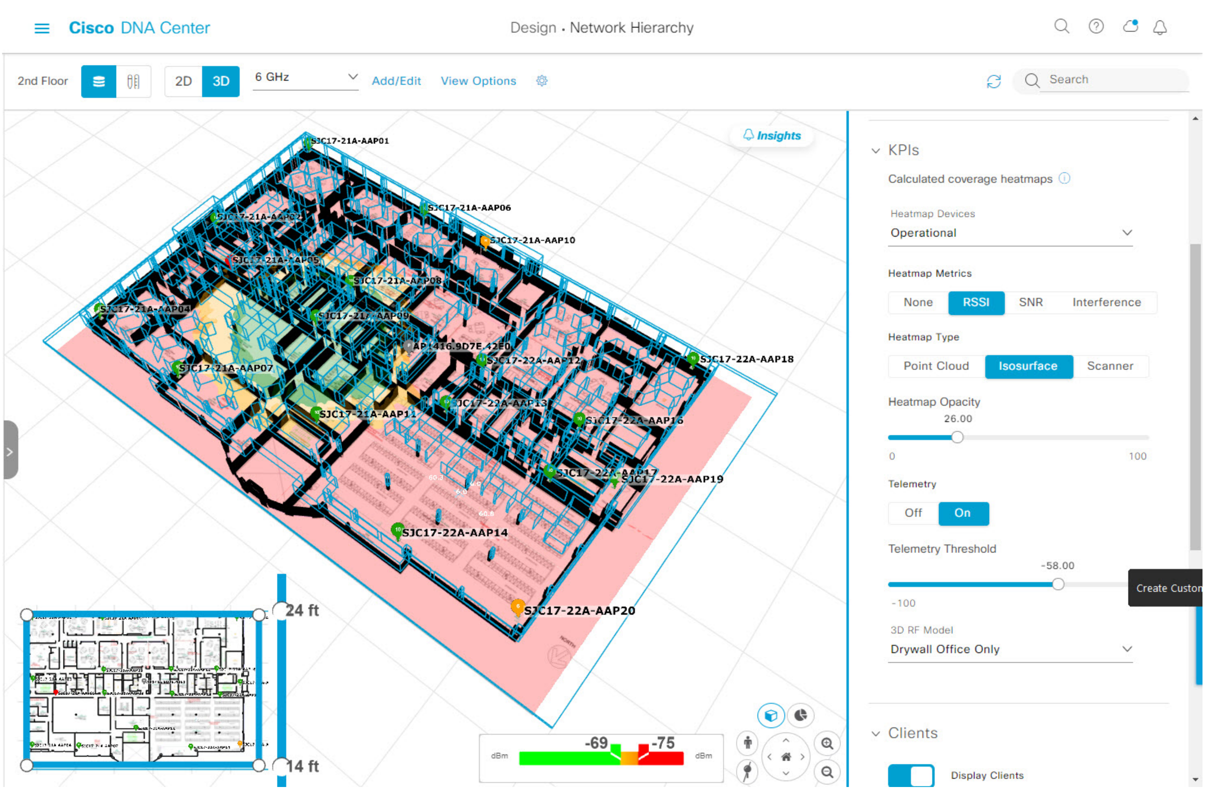
Map Navigation Control	Description
🚶	**Third Person View**: Click this icon to switch between first person view and third person view. The blue sphere indicates your position on the map. As you move throughout the map, your field of view changes. You can use the mini map at the lower left corner to get an idea of your field of view and orientation. For details, such as the controls for view, see Use First-Person and Third-Person Views for 3D Wireless Maps, on page 166.
📍	**Place a pin**: Click this icon to view a predicted measurement (x, y, and z coordinates) of a specific point on the floor map. By placing a pin, you can view the measurements of the distance from the pin to the end of the yard stick. As you zoom in or out, the position of the measurements is adjusted to stay in your view. Click and drag the arrows around the pin to change the position of the pin, as follows: • **To move the pin horizontally**: Click the horizontal arrows and drag the pin left, right, forward, or backward. The selected arrows and yard stick are highlighted while active. • **To move the pin vertically**: Click the vertical arrows and drag the pin up or down. The selected arrows and yard stick are highlighted while active. For a video demonstration, click here. *Figure 29: Adjusting a Pin*  6.0 6.0 60.3 60.8 15.9 28 RACK POD 29 RACK POD
🔍	**Zoom In**: Click this icon to enlarge the view. Alternatively, you can use your mouse wheel to zoom in.

Map Navigation Control	Description
🔍	**Zoom Out**: Click this icon to reduce the size of the image and to increase your field of view. Alternatively, you can use the scroll wheel on your mouse to zoom out.
⌂	**Map Rotation and Default Map View**: Click the directional arrows to change the camera angle. Click the Return Home icon to reset the map to the default view.

Step 9 Use the **3D Floormap** slide-in pane to choose the contributing floors in 3D map metrics, KPIs, and other floor map element settings. Expand the following categories to view the settings:

- **Contributing Floors**: Lists the floor above and below the current floor and allows you to configure the settings listed in the table below on a per floor basis, while maintaining focus on the heatmap of the current floor. Click **Apply** to generate the heat map with your settings.

Figure 30: 3D Map of Multiple Floors


Cisco DNA Center
Design • Network Hierarchy
2nd Floor
2D
3D
Add/Edit
View Options
Search
Insights
SJC17-21A-AAP01
SJC17-21A-AAP06
SJC17-21A-AAP10
SJC17-21A-AAP08
SJC17-21A-AAP04
SJC17-21A-AAP07
SJC17-21A-AAP11
AP4416.9D7E.42E0
SJC17-22A-AAP12
SJC17-22A-AAP13
SJC17-22A-AAP18
SJC17-22A-AAP19
SJC17-22A-AAP14
SJC17-22A-AAP20
24 ft
14 ft
dBm
-69
-75
dBm
Create Custom

6 GHz

KPIs

Calculated coverage heatmaps

Heatmap Devices: Operational

Heatmap Metrics: None [✓ RSSI] SNR Interference

Heatmap Type: Point Cloud [✓ Isosurface] Scanner

Heatmap Opacity: 26.00 (0 – 100)

Telemetry: Off [✓ On]

Telemetry Threshold: -58.00 (-100)

3D RF Model: Drywall Office Only

Clients

Display Clients

Item	Description
Compute APs check box	Check this check box to include the APs on the corresponding floor when computing the heatmap.
Display APs check box	Check this check box to display the APs on the corresponding floor.

Item	**Description**
Display Geometry check box	Check this check box to display the corresponding floor and its physical attributes in the heatmap.

- **KPI Category**: Contains the following KPI and telemetry settings:

Item	**Description**
Heatmap Metrics	Change the KPI to be displayed on the heatmap: • **None**: Disables the heatmap. • **RSSI**: Displays the Received Signal Strength Indication (RSSI) values. • **SNR**: Displays the signal-to-noise ratio (SNR) values. • **Interference**: Displays the SNR that is caused by co-channel interference (CCI) or adjacent channel interference.
Heatmap Type	Change the heatmap type: • **Point Cloud**: Provides a collection of data points in space. Each data point has x, y, and z coordinates. • **Isosurface**: Represents the RSSI with isolines or lines of a contiguous value. • **Scanner**: Displays the RSSI for a specific elevation.
Heatmap Opacity	Use the slider to customize the opacity or transparency of the heatmap.
Telemetry	Use this toggle button to enable or disable telemetry. When telemetry is enabled, click a sensor or AP to view its telemetry: • The telemetry for a sensor displays the predicted and measured RSSI values between a sensor AP and other APs. • The telemetry for an AP displays the predicted and measured RSSI values between neighbor APs.
Telemetry Threshold	When telemetry is enabled, use this slider to set the threshold for telemetry sources to appear. Telemetry sources with predicted values that do not meet the threshold are faded.
3D RF Model	Use this drop-down list to choose the RF model. The RF model determines how RF is calculated based on the floor type.

- **Floor Geometry Category**: Contains the following floor map element settings:

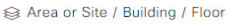
Item	**Description**
Geometry	Use this toggle button to enable or disable 3D map elements, such as walls.

Item	Description
CAD Layers	Choose the CAD layers that you want to be displayed on the map.

3D Wireless Map Toolbar

To access the 3D map, click the menu icon (☰) and choose **Design** > **Network Hierarchy**. From the left hierarchy tree, choose a floor, and in the map toolbar, click **3D**.

The map toolbar consists of two bars and is located above the map. Use the map toolbar for the following actions and settings:

Item	Description
	Click **3D** to view the wireless map in 3D or click **2D** to view it in 2D.
	Click the Wi-Fi band down arrow and choose a Wi-Fi band.
Add/Edit	Click **Add/Edit** to add planned APs by cloning the existing APs or planned APs. For details, see Clone an AP, on page 158. **Note** The option to add operational APs from the inventory is not available in 3D. To add operational APs, click **Add/Edit** in the 2D map toolbar.
View Options	Open the **3D Floormap** slide-in pane to display the contributing floors, KPIs, telemetry, device and client information, and floor element settings. For details, see 3D Map View Options, on page 278.
⚙	Hover your cursor over the gear icon and click **Insights Configuration** to customize the conditions for insights. For details, see Gain Insights from a 3D Wireless Map, on page 169.
Simulation	Click the **Simulation** toggle button to view the map in simulation mode. The default view is operation mode. For details, see Create Simulations for 3D Wireless Maps, on page 167. **Note** Simulation mode is available only in 3D maps, not in 2D maps.
 Area or Site / Building / Floor	**Full Hierarchy Path**: Displays the full navigational path of the floor, including its associated building and site. Click the down arrow to navigate to a different floor.
⟳	Click the refresh icon to update the device and map data. To the left of the icon is the timestamp for the last refresh.

Item	Description
Search	Use the **Search** field to find specific floor map elements such as APs, sensors, clients, and so on. The results of your search are listed below the **Search** field. When you hover your cursor over an element in the list, an indicator points to the element on the map. If the element is outside the field of view, the indicator is displayed as a broken red line. Reorient the map to see the element.

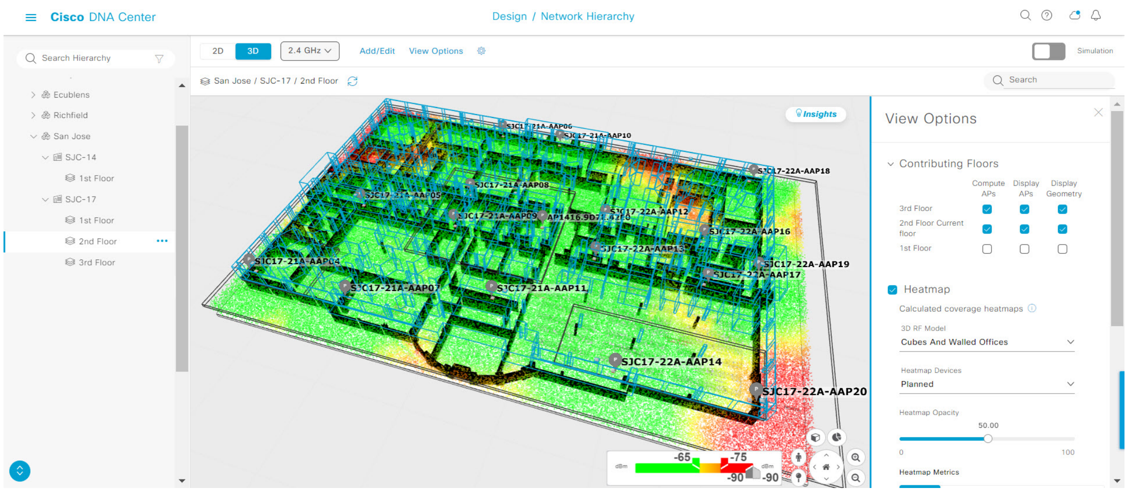
3D Map View Options

To access the 3D map, click the menu icon (☰) and choose **Design** > **Network Hierarchy**. From the left hierarchy tree, choose a floor, and in the map toolbar, click **3D** > **View Options**.

The **View Options** slide-in pane opens. Expand the categories to view the settings:

- **Contributing Floors**: Expand this option to include more floors in the heatmap computation. When including a floor, you can choose to add its APs in the heatmap computation and display its APs and floor geometry. Click **Apply** to generate the heatmap with your settings.

  Figure 31: 3D Map of Multiple Floors

  Cisco DNA Center
Design / Network Hierarchy
Search Hierarchy
Ecublens
Richfield
San Jose
SJC-14
1st Floor
SJC-17
1st Floor
2nd Floor
3rd Floor
2D
3D
2.4 GHz
Add/Edit
View Options
Simulation
San Jose / SJC-17 / 2nd Floor
Search
Insights
SJC17-21A-AAP06
SJC17-21A-AAP10
SJC17-22A-AAP18
SJC17-21A-AAP08
SJC17-21A-AAP05
SJC17-21A-AAP09
SJC17-22A-AAP12
SJC17-22A-AAP16
SJC17-22A-AAP13
SJC17-21A-AAP04
SJC17-22A-AAP19
SJC17-22A-AAP17
SJC17-21A-AAP07
SJC17-21A-AAP11
SJC17-22A-AAP14
SJC17-22A-AAP20
-65
-75
-90
-90
View Options
Heatmap Metrics

  Contributing Floors

	Compute APs	Display APs	Display Geometry
3rd Floor	☑	☑	☑
2nd Floor Current floor	☑	☑	☑
1st Floor	☐	☐	☐

  ☑ Heatmap

  Calculated coverage heatmaps

  3D RF Model: Cubes And Walled Offices

  Heatmap Devices: Planned

  Heatmap Opacity: 50.00 (0–100)

Item	Description
Compute APs	Check this check box to include a floor's APs when computing the heatmap.
Display APs	Check this check box to display a floor's APs in the heatmap.
Display Geometry	Check this check box to display a floor's physical attributes in the heatmap.

- **Heatmap**: Check this check box to display the heatmap and to configure the settings in the following table:

Item	Description
3D RF Model	Use this drop-down list to choose the RF model. The RF model determines how RF is calculated based on the floor geometry. Available models include drywall offices, cubes and walled offices, free space, outdoor open space, and indoor high ceiling. **Note** We recommend that you choose **Free Space** if you manually placed the walls or imported them from a CAD file or Ekahau project. If you didn't manually place the walls, use an RF model other than **Free Space**.
Heatmap Devices	Use this drop-down list to choose whether to display operational devices, operational and planned devices, or only planned devices on the heatmap.
Heatmap Opacity	Use this slider to customize the opacity or transparency of the heatmap.
Heatmap Metrics	Choose the type of metrics to display on the heatmap: • **RSSI**: Displays the Received Signal Strength Indicator (RSSI) values. • **SNR**: Displays the signal-to-noise ratio (SNR) values. • **Interference**: Displays the SNR that is caused by co-channel interference (CCI) or adjacent channel interference. • **Leakage**: Displays signal leakage between floors. For this option to be available, you must compute the heatmap with two or more contributing floors.
Heatmap Type	Choose the heatmap type: • **Point Cloud**: Provides a collection of data points in space. Each data point has x, y, and z coordinates. • **Isosurface**: Represents the RSSI with isolines or lines of a contiguous value. • **Scanner**: Displays the RSSI for a specific elevation.
Apply Reflection	Check this check box to show signal reflection, which can be caused when a signal bounces off materials such as glass, whiteboards, and plastic.
Telemetry	Use this toggle button to enable or disable telemetry. When telemetry is enabled, click a sensor or AP to view its telemetry: • The telemetry for a sensor displays the predicted and measured RSSI values between a sensor AP and other APs. • The telemetry for an AP displays the predicted and measured RSSI values between neighbor APs.

- **Telemetry**: Check this check box and use the **Telemetry Threshold** slider to set the threshold for telemetry sources to be displayed on the heatmap.

Telemetry sources with predicted values that do not meet the threshold are faded.

- **Devices and Clients**: Click this option to configure the settings in the following table:

Item	Description
APs	Check this check box to display APs on the map.
Planned APs	Check this check box to display planned APs on the map.
Sensors	Check this check box to display sensors on the map.
Clients	Check this check box to display clients on the map. Additionally, you can do the following: • Display clients in their default blue color (**None**) or by their **RSSI**, **SNR**, or **Health Score**. For **RSSI**, **SNR**, and **Health Score**, clients are colored blue, yellow, or red, depending on their current condition. • Use the slider to change the size of the ball that represents a client on the map.

- **Overlay Objects**: Click this option to configure the settings in the following table:

Item	Description
Geometry	Check this check box to display the floor geometry.
Height	Use this slider to set the height of walls on the heatmap.

- **Map**: Click this option to configure the settings in the following table:

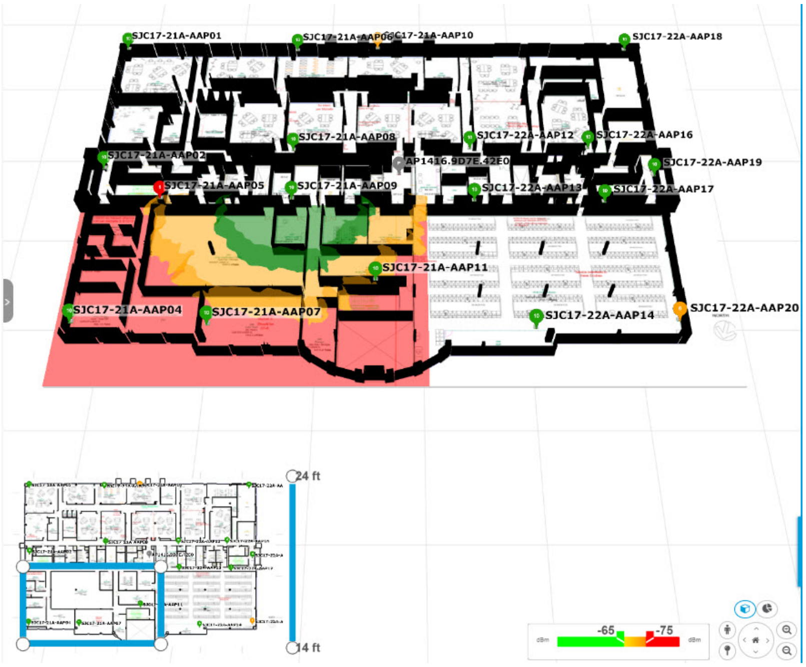
Item	Description
Sky	Check this check box to display the sky in the heatmap.
Floor	Check this check box to display the floor in the heatmap.

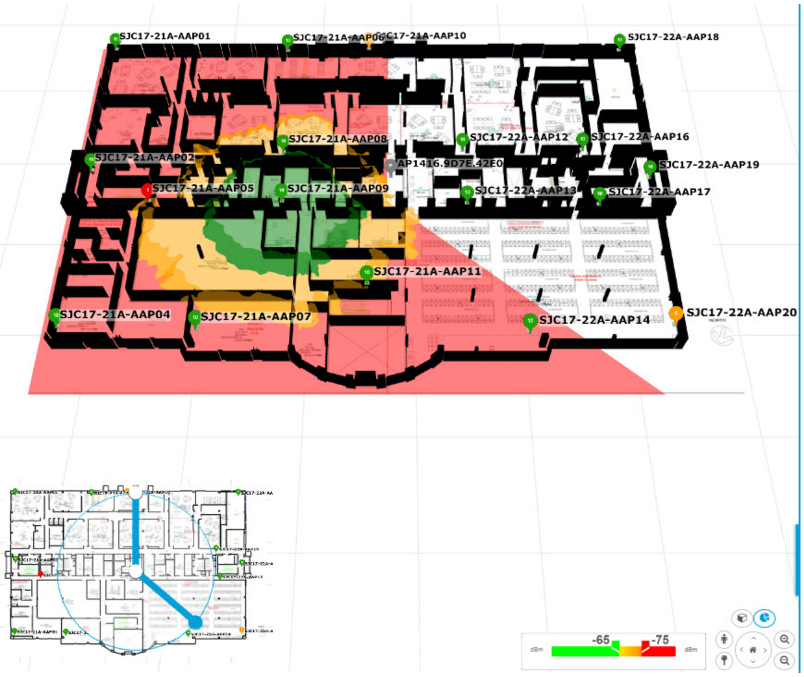
3D Map Navigation Controls

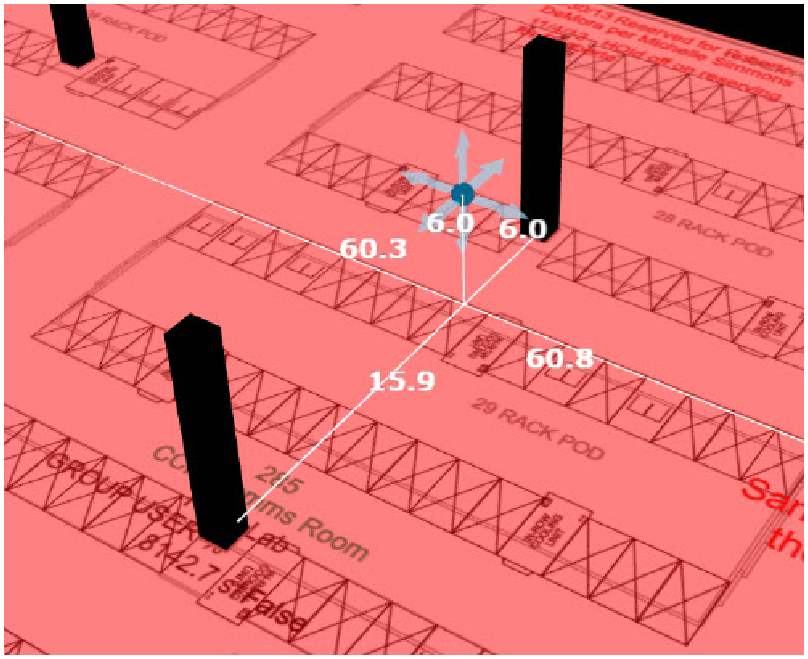
To access the 2D map, click the menu icon (☰) and choose **Design** > **Network Hierarchy**. From the left hierarchy tree, choose a floor, and in the map toolbar, click **3D**.

The 3D map navigation controls are located at the bottom-right corner of the map. For details about the map, see View a 3D Wireless Map, on page 158.

Use the map navigation controls at the bottom-right corner of the map to control the map view.

Map Navigation Control	Description
⬢	**Use clip box**: Click this icon to crop the heatmap using a box shape. Use the clipper at the bottom-left corner of the map to specify the crop: - Click and drag one of the anchor points to change the size of the crop. - Click and drag one of the anchor points on the right vertical slider to specify the height range of the crop. *Figure 32: Clip Box*  SJC17-21A-AAP01 SJC17-21A-AAP06 SJC17-21A-AAP10 SJC17-22A-AAP18 SJC17-21A-AAP08 SJC17-22A-AAP12 SJC17-22A-AAP16 SJC17-21A-AAP02 AP1416.9D7E.42E0 SJC17-22A-AAP19 SJC17-21A-AAP05 SJC17-21A-AAP09 SJC17-22A-AAP13 SJC17-22A-AAP17 SJC17-21A-AAP11 SJC17-21A-AAP04 SJC17-21A-AAP07 SJC17-22A-AAP14 SJC17-22A-AAP20 24 ft 14 ft dBm -65 -75 dBm

Map Navigation Control	Description
◔	**Use clip planes**: Click this icon to crop the heatmap using a donut shape. Use the clipper at the bottom-left corner of the map to specify the crop: - Click and drag the anchor point in the center of the donut to reposition the donut. - Click and drag the two outer anchor points to change the shape of the crop. *Figure 33: Clip Planes in Use*  SJC17-21A-AAP01 SJC17-21A-AAP06 SJC17-21A-AAP10 SJC17-22A-AAP18 SJC17-21A-AAP08 SJC17-22A-AAP12 SJC17-22A-AAP16 SJC17-21A-AAP02 AP1416.9D7E.42E0 SJC17-22A-AAP19 SJC17-21A-AAP05 SJC17-21A-AAP09 SJC17-22A-AAP13 SJC17-22A-AAP17 SJC17-21A-AAP11 SJC17-21A-AAP04 SJC17-21A-AAP07 SJC17-22A-AAP14 SJC17-22A-AAP20 -65 -75 dBm dBm
🧍	**First Person View**: Click this icon to switch between first-person view and third-person view. The blue sphere indicates your position on the map. As you move throughout the map, your field of view changes. You can use the mini map at the lower-left corner to get an idea of your field of view and orientation. **Note** If you have more than one floor selected for display, the **First Person View** automatically positions you on the current floor. For details, such as the controls for view, see Use First-Person and Third-Person Views for 3D Wireless Maps, on page 166.

Map Navigation Control	Description
🧍	**Third Person View**: Click this icon to switch between first person view and third person view. You can also drag and drop the icon on the map where you want to be positioned. The blue sphere indicates your position on the map. As you move throughout the map, your field of view changes. You can use the mini map at the lower-left corner to get an idea of your field of view and orientation. For details, such as the controls for view, see Use First-Person and Third-Person Views for 3D Wireless Maps, on page 166.
📍	**Place a pin**: Click this icon to view a predicted measurement (x, y, and z coordinates) of a specific point on the floor map. By placing a pin, you can view the measurements of the distance from the pin to the end of the yard stick. As you zoom in or zoom out, the position of the measurements is adjusted to stay in your view. Drag and drop the pin to change its position, as follows: - **To move the pin horizontally**: Click the horizontal arrows and drag the pin left, right, forward, or backward. The selected arrows and yard stick are highlighted while active. - **To move the pin vertically**: Click the vertical arrows and drag the pin up or down. The selected arrows and yard stick are highlighted while active. For a video demonstration, click here. *Figure 34: Adjusting a Pin*  60.3 6.0 6.0 60.8 15.9 29 RACK POD 29 RACK POD
🔍	**Zoom In**: Click this icon to enlarge the view. Alternatively, you can use your mouse wheel to zoom in.

Map Navigation Control	Description
🔍	**Zoom Out**: Click this icon to reduce the size of the image and to increase your field of view. Alternatively, you can use the scroll wheel on your mouse to zoom out.
◎	**Map Rotation and Default Map View**: Click the directional arrows to change the camera angle. Click the Return Home icon to reset the map to the default view.

Use First-Person and Third-Person Views for 3D Wireless Maps

You can use the first-person and third-person views to gain different perspectives of your wireless network.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

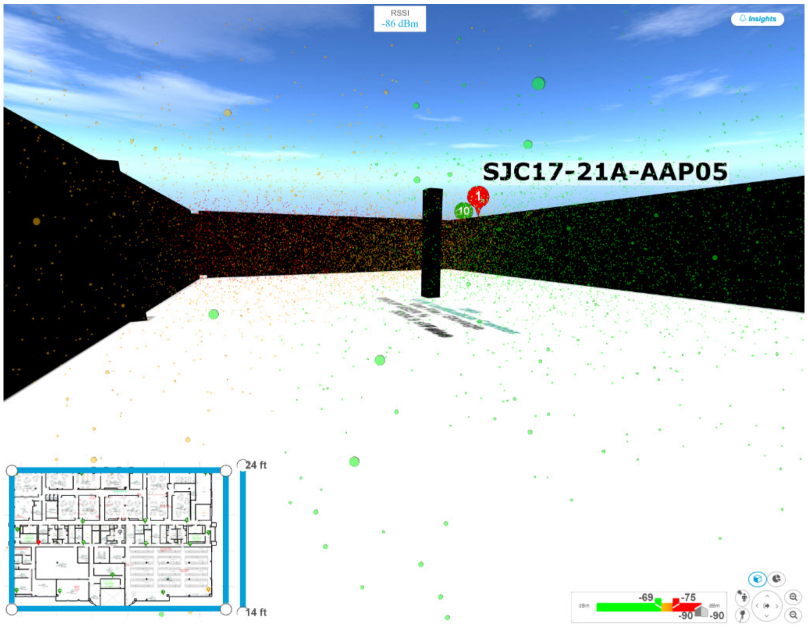
Step 2 From the left hierarchy tree, choose a floor.

Step 3 In the map toolbar, click **3D**.

Step 4 To use the first-person view, click the First-Person View icon 🧍 in the map navigation controls. Optionally, you can drag and drop the Person icon 🧍 to a specific location on the map.

The map view changes to the first-person view.

Figure 35: First-Person View



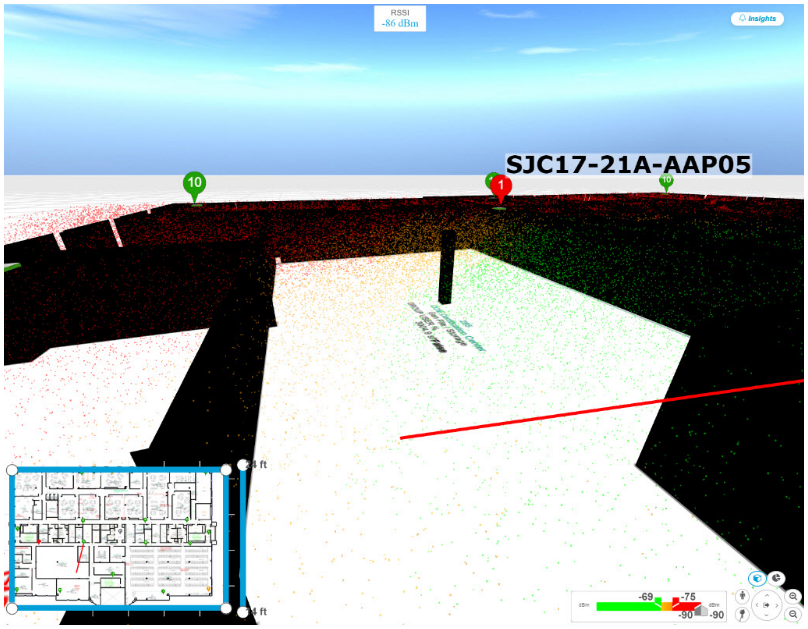
Step 5 You can control the first person view by doing the following:

Action	Controls
Move forward/backward and right/left.	Use the **W**, **A**, **S**, and **D** keys or arrow keys.
Change the camera angle.	Click and hold the left mouse button on the map and move the mouse wheel.
Raise the altitude of the camera angle.	Hold the **Spacebar**.
Lower the altitude of the camera angle.	Hold **Shift** + **Spacebar**.

Step 6 To use the third person view, click the Third-Person View icon from the map navigation controls.

The map view changes to the third person view.

Figure 36: Third Person View



Step 7 You can control the third person view by doing the following:

Action	Controls
Move forward/backward and right/left.	Use the **W**, **A**, **S**, and **D** keys or arrow keys.
Change the camera angle.	Click and drag on the map.
Raise the altitude of the camera angle.	Hold the **Spacebar**.
Lower the altitude of the camera angle.	Hold **Shift** + **Spacebar**.

Step 8 To return to the default view, click the Return Home icon .

Display Details About APs and Clients

If you have a location service, such as Cisco Spaces or Cisco Connected Mobile Experiences (CMX), installed on Cisco DNA Center, you can view the locations of clients on a floor. Clients are identified as a small blue ball (●) on the map.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 In the map toolbar, click **3D**.

Note A 3D heatmap is delimited by its coverage area, which is the full floor width and length, by default. To specify a polygon for the heatmap boundaries, edit the **Coverage Area** field value in the 2D map view. However, these boundaries do not apply to the 2D map view because the full floor width and length are used for the 2D map view.

Step 4 To display details about an AP, click the AP.

Step 5 To display information about a client, hover your cursor over the ball (client).

A line is drawn between the client and its associated AP. A dialog box is displayed with information, such as the client's IPv4 address, IPv6 IP address, RSSI value, and so on. To open the **Client 360** window, click the **Client 360** link in the dialog box.

Step 6 To display the client in a color that corresponds to its RSSI, SNR, or health score, do the following:

a) Click **View Options** > **Devices and Clients**.
b) Check the **Clients** check box.
c) Under the **Clients** check box, click **None** (default blue color), **RSSI**, **SNR**, or **Health Score**.

Step 7 To resize the ball, use the **Ball Size** slider in the **View Options** pane. This feature helps you to view clients in cases where there are many clients or only a few. For example, in cases where there are many clients, you can make the ball smaller, and in cases where there are only a few clients, you can make the ball larger.

Gain Insights from a 3D Wireless Map

Cisco DNA Center actively monitors the network performance of 3D wireless maps and provides insights into areas where service-level agreements (SLA) are not being met.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

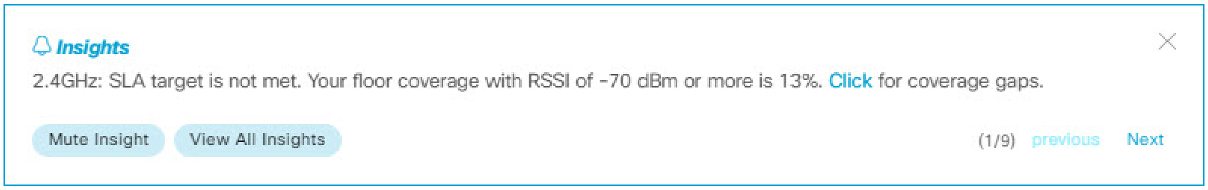
Step 2 From the left hierarchy tree, choose a floor.

Step 3 In the map toolbar, click **3D**.

Step 4 At the top-right corner of the map, click **Insights**.

The **Insights** area appears.

Figure 37: Insights Area



2.4GHz: SLA target is not met. Your floor coverage with RSSI of -70 dBm or more is 13%. Click for coverage gaps.

Step 5 From the **Insights** area, you can do the following:

Actions	Details
View insight details.	The **Insights** area displays the insight details. To view the insights, click **Next** and **Previous**. An insight reports the percentage of floor coverage area that does not meet a specific KPI threshold, for example, RSSI is ≥ -70 dBm. Click **Click** to view the affected areas.
Get an overview of all insights.	Click **View All Insights** to open the **All Insights** slide-in pane that displays all insights (active and muted).
Customize the insight settings.	Customizing an insight settings allows you to change the insight's KPI threshold value. Click **View All Insights** and then click **Edit Configuration** for the insight settings that you want to customize. Alternatively, you can hover your cursor over the Gear icon ⚙ in the map toolbar and choose **Insights Configurations** to customize insight settings.
Mute an insight.	Click **Mute Insight** to stop Cisco DNA Center from reporting the insight. Muted insights appear at the bottom of the list in the **All Insights** slide-in pane.

Run the Wireless Coverage Optimizer

For wireless areas that aren't meeting their SLA, the optimizer takes your input of the maximum number of APs that you are prepared to move and add, and computes a configuration where the wireless coverage is maximized.

This procedure shows you how to run the wireless coverage optimizer.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose a floor.

Step 3 In the map toolbar, click **3D**.

Step 4 At the top-right corner of the map, click **Insights**.

The **Insights** area opens and displays information about the coverage areas that don't meet a specific KPI threshold, for example, RSSI is ≥ -70 dBm.

Step 5 (Optional) To display the wireless coverage area, click **View**.

Red areas show where the SLA is not being met. Green areas show where the SLA is being met.

Step 6 (Optional) If there are specific APs that you don't want the optimizer to move, you can right-click them and choose **Lock** to lock their position. To remove the lock, right-click the AP and choose **Unlock**.

Step 7 Click **Optimizer**.

Step 8 In the **Coverage Optimizer** dialog box, enter the maximum number of APs that you are prepared to move and add.

If you don't want to move or add APs, leave the corresponding field blank or enter **0**.

Step 9 Click **Run Optimizer**.

If needed, you can manually move any of the APs to other locations.

Step 10 When the analysis is complete, click **View Results**.

Cisco DNA Center displays a proposed layout that increases the wireless coverage to maximize the SLA. If the optimizer recommends moving an AP, the new layout displays a blue line to the recommended new location. Any new APs that have been added to the layout are displayed as blue markers (N).

Step 11 To save the new layout as a simulation, click **Save as a plan**. To exit without saving, click the **x** at the top-right corner of the map.

Later, if you implement the recommended changes to your physical wireless network, you can save the simulation as an operational map. For information, see Create Simulations for 3D Wireless Maps, on page 167.

Create Simulations for 3D Wireless Maps

You can create simulations for 3D wireless maps.

Note Simulation mode is available only in 3D maps, not in 2D maps.

Simulations allow you to make changes to device configurations without having to save those changes in Operation mode. You can create multiple simulations and load them at any time.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Hierarchy**.

Step 2 From the left hierarchy tree, choose

Step 3 In the map toolbar, click **3D**.

Step 4 In the map toolbar, click **Add/Edit**.

In simulation mode, only particular attributes are editable and only for previewing the impact of changes on the heatmap.

Step 5 Make the changes to the devices, as needed:

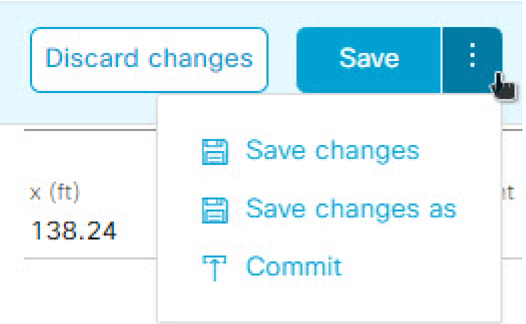
- **APs**: You can change the model, channel, and transmission power.

- **PAPs**: You can change the channel and transmission power.

a) Click **Apply**.

Step 6 In the map toolbar, hover your cursor over the vertical ellipsis and choose **Save changes as**.

Figure 38: Saving as a Simulation



Note Choosing **Save changes** saves your changes to Operation mode.

Choosing **Commit** saves your changes to production devices.

Step 7 In the **Save Simulation** dialog box, enter a name for the simulation and click **Save**.

Step 8 To load a simulation, click the Simulation icon in the map toolbar.

The 3D wireless map enters simulation mode, which is indicated by the map toolbar color changing to light blue.

Step 9 Use the drop-down list to the right of the Simulation icon to choose which simulation to open. If you have no saved simulations, **None available** is displayed.

PART IV

Configure and Maintain Network Devices

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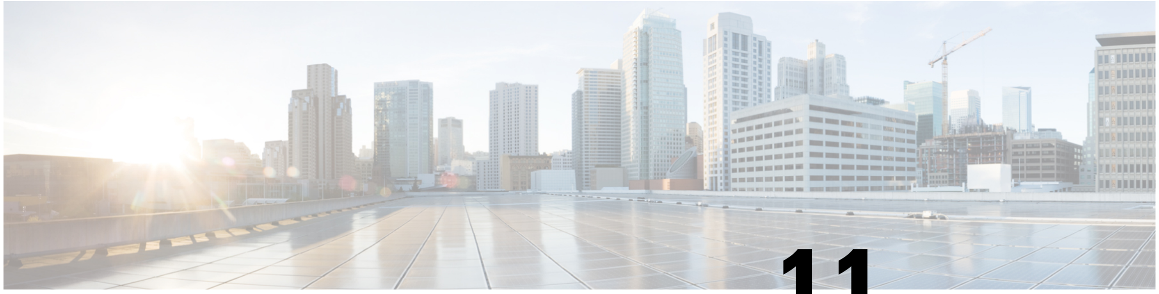
- Design Model Configuration, on page 311
- Manage Software Images, on page 327
- Compliance Audit for Network Devices, on page 343
- Run Diagnostic Commands on Devices, on page 349



CHAPTER 11

Create Templates to Automate Device Configuration Changes

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- Create Projects, on page 294
- Create Templates, on page 294
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- Clone a Template, on page 300
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About Template Editor

Cisco DNA Center provides an interactive editor called Template Editor to author CLI templates. You can design templates easily with a predefined configuration by using parameterized elements or variables. After creating a template, you can reuse the template to deploy your devices in one or more sites that are configured anywhere in your network.

With Template Editor, you can:

- Create, edit, and delete a template
- Add interactive commands
- Validate errors in templates
- Version control the templates for tracking purposes
- Simulate templates

Note Be careful that your template does not overwrite a network-intent configuration pushed by Cisco DNA Center.

Create Projects

Step 1 Click the menu icon (≡) and choose **Tools** > **Template Editor**.

Step 2 In the left pane, click ⊕ > **Create Project**.

The **Add New Project** slide-in pane appears.

Step 3 In the **Name** field, enter a name for the project.

Step 4 (Optional) In the **Description** field, enter a description for the project.

Step 5 Click **Add**.

The project is created and appears in the left pane.

Create Templates

Templates provide a method to easily predefine configurations using parameter elements and variables. Templates allow an administrator to define a configuration of CLI commands that can be used to consistently configure multiple network devices, reducing deployment time. Variables in the template allow customization of specific settings per device.

Create a Regular Template

Step 1 Click the menu icon (≡) and choose **Tools** > **Template Editor**.

Note By default, the **Onboarding Configuration** project is available for creating day-0 templates. You can create your own custom projects. Templates created in custom projects are categorized as day-N templates.

Step 2 In the left pane, select the project under which you are creating templates.

Step 3 Click the gear icon ⚙ and choose **Add Template** in the left pane.

Note The template that you create for day-0 can also be applied for day-N.

Step 4 Configure the settings for the regular template:

a) For **Template Type**, leave the option set to **Regular Template**.
b) For **Template Language**, choose either the **Velocity** or **Jinja** language to be used for the template content.
c) In the **Name** field, enter a unique name for the template.
d) (Optional) In the **Description** field, enter a description for the template.
e) In the **Tags** field, click the drop-down list and choose tags for your template.

Note Tags are like keywords that help you locate your template more easily.

If you use tags to filter the templates, you must apply the same tags to the device to which you want to apply the templates. Otherwise, you get the following error during provisioning: `Cannot select the device. Not compatible with template.`

f) For **Device Type (s)**, click **Edit** to choose the device types that you want this template to apply to.

The **Select Device Type(s)** slide-in pane appears. By default, all device types are displayed.

Note
- In the **Select Device Type(s)** slide-pane, you can toggle between the **Full Device List** view and **Favorite Devices** view.
- In the **Full Device List** view each device model in the device type hierarchy is sorted alphabetically.

- Use the **Find** feature to quickly search for the device by entering the device name or expand the device type and check the check boxes next to the device types that you want to apply to the template.

  To view the devices that are selected, choose **Selected** from the **Show** drop-down list.

There are different granularity levels for selecting the device type from the hierarchical structure. The device type is used during provisioning to ensure that templates are deployed to devices that match the specified device-type criteria. This lets you create specialized templates for specific device models.

Template Editor does not show device product IDs (PIDs); instead, it shows the device series and model description. You can use cisco.com to look up the device data sheet based on the PID, find the device series and model description, and choose the device type appropriately.

g) In the hierarchy, expand the device type and click the star mark appearing next to the device model that you want mark as favorite.

Note You can toggle to **Favorite Devices** view to view the list of favorite marked device models.

h) After selecting device types, click **Back to Add New Template**.
i) For **Software Type**, click the drop-down list and choose the software type.

Note For more information on the Cisco Wireless Controller supported software versions and the minimum supported version, see the Cisco DNA Center Compatibility Matrix.

For example, if you select IOS as the software type, the commands apply to all software types, including IOS-XE and IOS-XR. This value is used during provisioning to check whether the selected device conforms to the selection in the template.

j) In the **Software Version** field, enter the software version.

Note During provisioning, Cisco DNA Center checks to see if the selected device has the software version listed in the template. If there is a mismatch, the template is not provisioned.

Step 5 Click **Add**.

The template is created and appears under the project you selected in the left pane.

Step 6 You can edit the template content by selecting the template that you created in the left pane. For more information about editing the template content, see Edit Templates, on page 298.

Blocked List Commands

Blocked list commands are commands that cannot be added to a template or provisioned through a template. If you use blocked list commands in your templates, it shows a warning in the template that it may potentially conflict with some of the Cisco DNA Center provisioning applications.

The following commands are blocked in this release:

- **router lisp**
- **hostname**

Sample Templates

Refer to these sample templates while creating variables for your template.

Configure Hostname

```
hostname$name
```

Configure Interface

```
interface $interfaceName
description $description
```

Configure NTP on Cisco Wireless Controllers

```
config time ntp interval $interval
```

Create a Composite Template

Two or more regular templates are grouped into a composite sequence template. You can create a composite sequential template for a set of templates, which are applied collectively to devices. For example, when you deploy a branch, you must specify the minimum configurations for the branch router. The templates that you create can be added to a single composite template, which aggregates all the individual templates that you need for the branch router. You must specify the order in which templates that are in the composite template are deployed to devices.

Note You can add only a committed template to a composite template.

Step 1 Click the menu icon (≡) and choose **Tools** > **Template Editor**.

Step 2 In the left pane, select the project under which you are creating templates.

Step 3 Click the gear icon ⚙ > **Add Template** in the left pane.

The **Add New Template** slide-in pane appears.

Step 4 Configure the settings for the composite template:

a) For **Template Type**, choose **Composite Sequence** for a composite template.
b) For **Template Language**, choose either the **Velocity** or **Jinja** language to be used for the template content.

c) In the **Name** field, enter a unique name for the template.
d) (Optional) In the **Description** field, enter a description for the template.
e) In the **Tags** field, click the drop-down list and choose tags for your template.

Note Tags are like keywords that help you locate your template more easily.

f you use tags to filter the templates, you must apply the same tags to the device to which you want to apply the templates. Otherwise, you get the following error during provisioning: `Cannot select the device. Not compatible with template.`

f) For **Device Type (s)**, click **Edit** to choose the device types that you want this template to apply to.

The **Select Device Type(s)** slide-in pane appears. By default, all device types are displayed.

Note
- In the **Select Device Type(s)** slide-pane, you can toggle between the **Full Device List** view and **Favorite Devices** view.
- In the **Full Device List** view each device model in the device type hierarchy is sorted alphabetically.

- Use the **Find** feature to quickly search for the device by entering the device name or expand the device type and check the check boxes next to the device types that you want to apply to the template.

  To view the devices that are selected, choose **Selected** from the **Show** drop-down list.

g) In the hierarchy, expand the device type and click the star mark appearing next to the device model that you want mark as favorite.

Note You can toggle to the **Favorite Devices** view to view the list of favorite marked device models.

h) After selecting device types, click **Back to Add New Template**.
i) For **Software Type**, click the drop-down list and choose the software type.

Note You can select the specific software type (such as IOS-XE or IOS-XR) if there are commands specific to these software types. If you select IOS as the software type, the commands apply to all software types, including IOS-XE and IOS-XR. This value is used during provisioning to check whether the selected device confirms to the selection in the template.

j) In the **Software Version** field, enter the software version.

Note During provisioning, Cisco DNA Center checks to see if the selected device has the similar software version listed in the template. If there is a mismatch, the provision skips the template.

Step 5 Click **Add**.

The composite template is created and appears under the project you selected in the left pane.

Step 6 Click the composite template that you created in the left view pane.

Step 7 In the **Template Editor** window, drag and drop templates from the left pane to order or sequence the templates.

The templates are deployed based on the order in which they are sequenced. You can change the order of templates in the **Template Editor** window.

Note By default, the **Applicable** option is chosen in the **View** filter. Only the applicable templates that can be added to the composite template are shown in the **Template Editor** window. You can choose the **All** option in the **View** filter to view all the templates in the **Template Editor** window. In the **All** option view, the templates that match the chosen device types and software version are marked by a plus icon.

You can drag and drop templates that have the same device type, software type, and software version as that of the composite template.

Step 8 To cancel the deployment process upon failure of the first template, select the first template in the **Template Editor** window and check the **Abort sequence on targets if deployment fails** check box.

Step 9 From the **Actions** drop-down list, choose **Commit** to commit the template content.

Edit Templates

After creating a template, you can edit the template to include content.

Step 1 Click the menu icon (≡) and choose **Tools** > **Template Editor**.

Step 2 In the left pane, choose the template that you want to edit.

The **Template Editor** window appears.

Step 3 In the **Template Editor** window, enter the template content. You can have a template with a single-line configuration or a multi-select configuration.

Step 4 From **Template Language**, choose the language with which to write the content:

- **Velocity**: Use the Velocity Template Language (VTL). For information, see http://velocity.apache.org/engine/devel/vtl-reference.html.

  The Velocity template framework restricts the use of variables that start with a number. Make sure that the variable name starts with a letter and not with a number.

  Note Do not use the dollar ($) sign while using the velocity templates. If you have used the dollar($) sign, any value behind it is treated as a variable. For example, if a password is configured as "$a123$q1ups1$va112", then the Template Editor treats this as variables "a123", "q1ups", and "va112". To workaround this issue, use Linux shell style for text processing with Velocity templates.

  Note Use the dollar ($) sign in the velocity templates only when declaring a variable.

- **Jinja**: Use the Jinja language. For information, see https://www.palletsprojects.com/p/jinja/.

Step 5 From the **Actions** drop-down list, choose **Check for errors** to validate the template.

Cisco DNA Center checks for these errors and reports them:

- Language syntax errors.
- Conflicts with blocked list commands. For more information, see Blocked List Commands, on page 296.

Step 6 From the **Actions** drop-down list, choose **Save**.

After saving the template, Cisco DNA Center checks for any errors in the template. If there are any syntax errors, the template content is not saved and all input variables that are defined in the template are automatically identified during the save process. The local variables (variables that are used in **for** loops, assigned though a set, and so on) are ignored.

Step 7 From the **Actions** drop-down list, choose **Commit**.

Note You can associate only a committed template to a network profile.

Template Simulation

The interactive template simulation lets you simulate the CLI generation of templates by specifying test data for variables before sending them to devices. You can save the test simulation results and use them later, if required.

Step 1 Click the menu icon (≡) and choose **Tools** > **Template Editor**.

Step 2 From the left pane, expand a project and click a template to run a simulation for.

The template appears.

Step 3 In the top-right corner, click the **Simulator Editor** toggle .

Step 4 Click the **Actions** drop-down list and choose **Create Simulation**.

The **Simulation Input** form appears.

Step 5 In the **Simulation Name** field, enter a name for the simulation.

Note If there are implicit variables in your template then click **edit** link to select a device or site in the **Simulation Input** form to run the simulation against real devices based on your bindings.

Step 6 In the **Simulation Input** form, complete the required fields, and click **Run**.

The results are displayed in the **Template Preview** window.

Export Template(s)

You can export a template or multiple templates to a single file, in JSON format.

Step 1 Click the menu icon (≡) and choose **Tools** > **Template Editor**.

Step 2 In the left pane, select the template that you want to export. Choose ⚙ > **Export**.

- To export multiple templates under a project, select a project in the left pane and choose ⚙ > **Export Template(s)**.

  Select the templates from the **Export Template(s)** window and, click **Export**.

- To export multiple templates under different projects, click ⊕ > **Export Project(s)**, in the left pane.

Select the templates to be exported, from the **Export Project(s)** window, and click **Export**.

Step 3 Click **Save**, if prompted.

The latest version of the template is exported.

To export an earlier version of the template, open the template from **Actions** > **Show History** > **View**.

Click **Actions** > **Export**.

Import Template(s)

You can import a template or multiple templates under a project.

Step 1 Click the menu icon (≡) and choose **Tools** > **Template Editor**.

Step 2 In the left pane, select a project to which you want to import the template(s). Choose ⚙ > **Import Template(s)**.

Step 3 Click **Select a File from your computer** on the **Import Template(s)** window and browse to the location of your JSON template file.

Step 4 Select the JSON file and click **Open**.

The template is imported under the selected project. If a template with the same name exists, Cisco DNA Center displays an error message and does not import the template.

Note To import a template with the same name as an existing one, check the **Create new version of imported template/project when template/project with the same name already exists in the hierarchy** check box on the **Import Template(s)** window.

Selecting this option creates a new version of the existing template.

Clone a Template

You can make a copy of a template to reuse portions of it.

Step 1 Click the menu icon (≡) and choose **Tools** > **Template Editor**.

Step 2 In the left pane, select the template that you want to export. Choose ⚙ > **Clone**.

Step 3 Enter the name of the cloned template in the **Name** field of the **Clone Template** window.

Step 4 Choose a project from the **Project Name** drop-down list.

Step 5 Click **Clone**.

Step 6 To commit the cloned template, select the template from the left pane of the window and click **Actions** > **Commit**.

The latest version of the template is cloned.

To clone an earlier version of the template, open the template from **Actions** > **Show History** > **View**.

Click **Actions** > **Clone**.

Export Project(s)

You can export a project or multiple projects, including their templates, to a single file in JSON format.

Step 1 Click the menu icon (≡) and choose **Tools** > **Template Editor**.

Step 2 In the left pane, select the project that you want to export. Choose ⚙ > **Export Project**.

To export projects in bulk, click ⊕ > **Export Project(s)** in the left pane.

Select the projects to be exported and click **Export**.

Step 3 Click **Save**, if prompted.

Import Project(s)

You can import a project or multiple projects with their templates, into the Cisco DNA Center Template Editor.

Step 1 Click the menu icon (≡) and choose **Tools** > **Template Editor**.

Step 2 In the left pane, click ⊕ > **Import Project(s)**.

Step 3 Click **Select a File from your computer** on the **Import Project(s)** window and browse to the location of your JSON project file.

Step 4 Select the JSON file and click **Open**.

The project and its templates are imported. If a project with the same name exists, Cisco DNA Center displays an error message and does not import the project.

Note To import a project with the same name as an existing one, check the **Create new version of imported template/project when template/project with the same name already exists in the hierarchy** check box on the **Import Project(s)** window.

Selecting this option creates a new version of the existing project.

Template Form Editor

The Template form editor is used for adding additional metadata information to the template variables in the template. You can also use the form editor to provide validations for variables such as maximum length, range, and so on.

Step 1 Click the menu icon (≡) and choose **Tools** > **Template Editor**.

Step 2 From the left pane, expand a project and click a template.

The template appears.

Step 3 Click the **Form Editor** toggle .

The Form Editor enables you to add meta data to the template variables. All the variables that are identified in the template are displayed. You can configure the following metadata:

- Choose the variable and check the **Not a Variable** check box if you do not want the string to be considered as a variable.
- Enter the field name in the **Field Name** text box. This is the label that is used for the UI widget of each variable during provisioning.
- Enter the tooltip text that is displayed for each variable in the **Tooltip** text box.
- Enter the default value in the **Default Value** text box. This value appears during provisioning as the default value.
- Enter any instructional text in the **Instructional Text** text box. Instructional text appears within the UI widget (for example, **Enter the hostname here**). The text within the widget is cleared when you click the widget to enter any text.
- Choose the data type from the **Data Type** drop-down list: **String**, **Integer**, **IP Address**, or **Mac Address**.
- Check the **Required** check box if this is a required variable during the provisioning. All the variables by default are marked as Required, which means you must enter the value for this variable at the time of provisioning. If the parameter is not marked as **Required** and if you do not pass any value to the parameter, it substitutes an empty string at run time. A lack of a variable can lead to command failure, which may not be syntactically correct. If you want to make an entire command optional based on a variable not marked as **Required**, use the **if-else** block in the template.
- Choose the type of UI widget you want to create at the time of provisioning from the **Display Type** drop-down list: **Text Field**, **Single Select**, or **Multi Select**.
- Enter the number of characters that are allowed in the **Maximum Characters** text box. This is applicable only for the string data type.

Step 4 After configuring metadata information, from the **Actions** drop-down list, choose **Save**.

Step 5 After saving the template, you must version it. You must version the template every time you make changes to it. From the **Actions** drop-down list, choose **Commit**. The **Commit** window appears. You can enter a commit note in the **Commit Note** text box. The version numbers are automatically generated by the system.

Step 6 To view the history, from the **Actions** drop-down list, select **Show History** to view previously created and versioned templates.

A pop-up window appears.

- Click **View** in the pop-up window to see the content of the old version.
- Click **Edit** in the pop-up window to edit the template.

Variable Binding

While creating a template, you can specify variables that are contextually substituted. Many of these variables are available in the Template Editor drop-down list.

Template Editor provides an option to bind or use variables in the template with the source object values while editing or through the input form enhancements; for example, DHCP server, DNS server, and syslog server.

Some variables are always bound to their corresponding source and their behavior cannot be changed. To view the list of implicit variables, click the **Template System Variables** link in the **Code Editor** or the **Form Editor** window.

The predefined object values can be one of the following:

- Network Profile
  - SSID
  - Policy profile
  - AP group
  - Flex group
  - Flex profile
  - Site tag
  - Policy tag
- Common Settings
  - DHCP server
  - Syslog server
  - SNMP trap receiver
  - NTP server
  - Timezone site
  - Device banner
  - DNS server
  - NetFlow collector
  - AAA network server
  - AAA endpoint server
  - AAA server pan network
  - AAA server pan endpoint
  - WLAN info
  - RF profile info
- Cloud Connect

  - Cloud router-1 Tunnel IP
  - Cloud router-2 Tunnel IP
  - Cloud router-1 Loopback IP
  - Cloud router-2 Loopback IP
  - Branch router-1 Tunnel IP
  - Branch router-2 Tunnel IP
  - Cloud router-1 Public IP
  - Cloud router-2 Public IP
  - Branch router-1 IP
  - Branch router-2 IP
  - Private subnet-1 IP
  - Private subnet-2 IP
  - Private subnet-1 IP mask
  - Private subnet-2 IP mask

- Inventory
  - Device
  - Interface
  - AP group
  - Flex group
  - WLAN
  - Policy profile
  - Flex profile
  - Webauth parameter map
  - Site tag
  - Policy tag
  - RF profile

- **Common Settings**: Settings available under **Design** > **Network Settings** > **Network**. The common settings variable binding resolves values that are based on the site to which the device belongs.

Step 1 Click the menu icon (≡) and choose **Tools** > **Template Editor**.

Step 2 Choose the template and click the **Input Form** icon to bind variables in the template to network settings.

Step 3 Select the variables in the **Input Form** pane and check the **Required** check box to bind variables to the network settings.

Step 4 From the **Display** drop-down list, choose the type of UI widget to create at the time of provisioning: **Text Field**, **Single Select**, or **Multi Select**.

Step 5 To bind variables to network settings, select each variable in **Input Form**, and check the **Bind to Source** check box under **Content**.

- Choose the **Source**, **Entity**, and **Attributes** from the respective drop-down lists.
- For the source type **CommonSettings**, choose one of these entities: **dhcp.server**, **syslog.server**, **snmp.trap.receiver**, **ntp.server**, **timezone.site**, **device.banner**, **dns.server**, **netflow.collector**.

  You can apply a filter on the **dns.server** or **netflow.collector** attributes to display only the relevant list of **bind** variables during provisioning of devices. To apply a filter on an attribute, select an attribute from the **Filter by** drop-down list. From the **Condition** drop-down list, select a condition to match the **Value**.
- For the source type **NetworkProfile**, choose **SSID** as the entity type. The SSID entity that is populated is defined under **Design** > **Network Profile**. The binding generates a user-friendly SSID name, which is a combination of SSID name, site, and SSID category. From the **Attributes** drop-down list, choose **wlanid**. This attribute is used during the advanced CLI configurations at the time of template provisioning.
- For the source type **Inventory**, choose one of these entities: **Device**, **Interface**, **AP Group**, **Flex Group**, **Wlan**, **Policy Profile**, **Flex Profile**. For the entity type **Device** and **Interface**, the **Attribute** drop-down list shows the device or interface attributes. The variable resolves to the AP Group and Flex Group name that is configured on the device to which the template is applied.

  You can apply filter on the **Device**, **Interface**, or **Wlan** attributes to display only the relevant list of **bind** variables during provisioning of devices. To apply a filter on an attribute, select an attribute from the **Filter by** drop-down list. From the **Condition** drop-down list, select a condition to match the **Value**.

After binding variables to a common setting, when you assign templates to a wireless profile and provision the template, the network settings that you defined under **Network Settings** > **Network** appear in the drop-down list. You must define these attributes under **Network Settings** > **Network** at the time of designing your network.

Step 6 If the template contains variable bindings that bind to specific attributes and the template code accesses those attributes directly, you must do one of the following:

- Change the binding to the object instead of to the attributes.
- Update the template code to not access the attributes directly.

For example, if the template code is as follows, where **$interfaces** binds to specific attributes, you must update the code as shown in the following example, or modify the binding to the object instead of to the attributes.

Old sample code:

```
#foreach ( $interface in $interfaces )
 $interface.portName
      description "something"
#end
```

New sample code:

```
#foreach ( $interface in $interfaces )
 interface $interface
           description "something"
#end
```

Special Keywords

All commands executed through templates are always in the **config t** mode. Therefore, you do not have to specify the **enable or config t** commands explicitly in the template.

Day-0 templates do not support special keywords.

Enable Mode Commands

Specify the **#MODE_ENABLE** command if you want to execute any commands outside of the **config t** command.

Use this syntax to add **enable mode** commands to your CLI templates:

```
#MODE_ENABLE
<<commands>>
#MODE_END_ENABLE
```

Interactive Commands

Specify **#INTERACTIVE** if you want to execute a command where a user input is required.

An interactive command contains the input that you must enter following the execution of a command. To enter an interactive command in the CLI Content area, use the following syntax:

```
CLI Command<IQ>interactive question 1 <R> command response 1 <IQ>interactive question
2<R>command response 2
```

Where **<IQ>** and **<R>** tags evaluate the text provided against what is seen on the device.

The Interactive question uses regular expressions to validate if the text received from the device is similar to the text entered. If the regular expressions entered in the **<IQ><R>** tags are found, then the interactive question passes and a part of the output text appears. This means that you need to enter a part of the question and not the entire question. Entering Yes or No between the **<IQ>** and **<R>** tags is sufficient but you must make sure that the text Yes or No appears in the question output from the device. The best way to do this is by running the command on the device and observing the output. In addition, you need to ensure that any regular expression metacharacters or newlines entered are used appropriately or avoided completely. The common regular expression metacharacters are **. ( ) [ ] { } | * + ? \ $ ^ : &**.

For example, the following command has output that includes metacharacters and newlines.

```
Switch(config)# no crypto pki trustpoint DNAC-CA
% Removing an enrolled trustpoint will destroy all certificates received from the related
Certificate Authority
Are you sure you want to do this? [yes/no]:
```

To enter this in a template, you need to select a portion that does not have any metacharacters or newlines. Here are a few examples of what could be used.

```
#INTERACTIVE
no crypto pki trustpoint DNAC-CA<IQ>yes/no<R>yes
#ENDS_INTERACTIVE
```

```
#INTERACTIVE
no crypto pki trustpoint DNAC-CA<IQ>Removing an enrolled<R>yes
#ENDS_INTERACTIVE
```

```
#INTERACTIVE
no crypto pki trustpoint DNAC-CA<IQ>Are you sure you want to do this<R>yes
#ENDS_INTERACTIVE
```

```
#INTERACTIVE
crypto key generate rsa general-keys <IQ>yes/no<R> no
#ENDS_INTERACTIVE
```

Where **<IQ>** and **<R>** tags are case-sensitive and must be entered in uppercase.

Note In response to the interactive question after providing a response, if the newline character is not required, you must enter the **<SF>** tag. Include one space before the **<SF>** tag. When you enter the **<SF>** tag, the **</SF>** tag pops up automatically. You can delete the **</SF>** tag because it is not needed.

For example:

```
#INTERACTIVE
config advanced timers ap-fast-heartbeat local enable 20 <SF><IQ>Apply(y/n)?<R>y
#ENDS_INTERACTIVE
```

Combining Interactive Enable Mode Commands

Use this syntax to combine interactive **Enable Mode** commands:

```
#MODE_ENABLE
#INTERACTIVE
commands<IQ>interactive question<R> response
#ENDS_INTERACTIVE
#ENDS_END_ENABLE
```

```
#MODE_ENABLE
#INTERACTIVE
mkdir <IQ>Create directory<R>xyz
#ENDS_INTERACTIVE
#MODE_END_ENABLE
```

Multiline Commands

If you want multiple lines in the CLI template to wrap, use the **MLTCMD** tags. Otherwise, the command is sent line by line to the device. To enter multiline commands in the CLI Content area, use the following syntax:

```
<MLTCMD>first line of multiline command
second line of multiline command
...
...
last line of multiline command</MLTCMD>
```

- Where **<MLTCMD>** and **</MLTCMD>** are case-sensitive and must be in uppercase.
- The multiline commands must be inserted between the **<MLTCMD>** and **</MLTCMD>** tags.
- The tags cannot start with a space.
- The **<MLTCMD>** and **</MLTCMD>** tags cannot be used in a single line.

Associate Templates to Network Profiles

Before you begin

Before provisioning a template, ensure that the template is associated with a network profile and the profile is assigned to a site.

During provisioning, when the devices are assigned to specific sites, the templates associated with the site through the network profile appear in the advanced configuration.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Profiles**, and click **Add Profile**.

The following types of profiles are available:

- **Firewall**: Click this to create a firewall profile.
- **Routing**: Click this to create a routing profile.
- **Switching**: Click this to create a switching profile.
  - Click the **Onboarding Templates** or **Day-N Templates**, as required.
  - In the **Profile Name** field, enter the profile name.
  - Click **+Add Template** and choose the device type, tag, and template from the **Device Type**, **Tag Name**, and **Template** drop-down lists.

    If you do not see the template that you need, create a new template in Template Editor, as described in Create a Regular Template, on page 294.
  - Click **Save**.
- **Telemetry Appliance**: Click this to create a Cisco DNA Traffic Telemetry Appliance profile.
- **Wireless**: Click this to create a wireless profile. Before assigning a wireless network profile to a template, ensure that you have created wireless SSIDs.
  - In the **Profile Name** field, enter the profile name.
  - Click **+ Add SSID**. The SSIDs that were created under **Network Settings** > **Wireless** are populated.
  - Under **Attach Template(s)**, from the **Template** drop-down list, choose the template that you want to provision.
  - Click **Save**.

Note You can view the Switching and Wireless profiles in the **Cards** and the **Table** view.

Step 2 The **Network Profiles** window lists the following:

- **Profile Name**
- **Type**
- **Version**
- **Created By**
- **Sites**: Click **Assign Site** to add sites to the selected profile.

Step 3 For Day-N provisioning, choose **Provision** > **Network Devices** > **Inventory**.

- Check the check box next to the device name that you want to provision.
- From the **Actions** drop-down list, choose **Provision**.
- In the **Assign Site** window, assign a site to which the profiles are attached.
- In the **Choose a Site** field, enter the name of the site to which you want to associate the controller, or choose from the **Choose a Site** drop-down list.
- Click **Next**.
- The **Configuration** window appears. In the **Managed AP Locations** field, enter the AP locations managed by the controller. You can change, remove, or reassign the site. This is applicable only for wireless profiles.
- Click **Next**.
- The **Advanced Configuration** window appears. The templates associated with the site through the network profile appear in the advanced configuration.
    - Use the **Find** feature to quickly search for the device by entering the device name, or expand the templates folder and select the template in the left pane. In the right pane, select values for those attributes that are bound to the source.
    - To export the template variables into a CSV file while deploying the template, click **Export** in the right pane. You can use the CSV file to make necessary changes in the variable configuration and import it into Cisco DNA Center at a later time by clicking **Import** in the right pane.
- Click **Next** to deploy the template.
- You are prompted to deploy the template now or to schedule it for a later time.
- To deploy the template now, click the **Now** radio button and click **Apply**. To schedule the template deployment for a later date and time, click the **Later** radio button and define the date and time of the deployment.

  The **Status** column in the **Device Inventory** window shows SUCCESS after the deployment succeeds.

Step 4 Click **Export Deployment CSV** to export template variables from all the templates in a single file.

Step 5 Click **Import Deployment CSV** to import template variables from all the templates in a single file.

Step 6 For Day-0 provisioning, choose **Provision** > **Network Devices** > **Plug and Play**.

- Choose a device and from the **Actions** drop-down list, choose **Claim**.
- Click **Next**, and in the **Site Assignment** window, choose a site from the **Site** drop-down list.
- Click **Next**, and in the **Configuration** window, choose the image and the Day-0 template.
- Click **Next**, and in the **Advanced Configuration** window, enter the location.
- Click **Next** to view the **Device Details**, **Image Details**, **Day-0 Configuration Preview**, and **Template CLI Preview**.

CHAPTER 12

Design Model Configuration

- Introduction to Model Config Editor, on page 311
- Discover and Create Designs from a Legacy Device, on page 312
- Create a Model Config Design for AAA RADIUS Attributes, on page 312
- Create a Model Config Design for Advanced SSID, on page 314
- Create a Design for Cisco CleanAir, on page 317
- Create a Model Config Design for Dot11ax Configuration, on page 319
- Create a Model Config Design for Event-Driven RRM, on page 320
- Create a Design for Flex Configuration, on page 321
- Create a Design for Global IPv6, on page 323
- Create a Model Config Design for Multicast, on page 324
- Create a Model Config Design for RRM General Parameters, on page 325

Introduction to Model Config Editor

Model Config allows you to define advanced customizations of the Cisco Validated Designs (CVD) that are encapsulated within the provisioning applications. Model Configs are a set of model-based, discoverable, and customizable configuration capabilities, which you can deploy on your network devices with high-level service intent and device-specific CLI templates.

The Model Configs feature simplifies network provision by extracting complex device configurations and facilitating customizable network configurations using an intuitive GUI instead of device-specific CLIs. A common design is deployed to various device hardware platforms and software types in a uniform way. During deployments, the Cisco DNA Center infrastructure automatically validates and translates extracted designs to device-specific CLI commands.

To provision model config design, do the following:

1. Create a new model config design using the **Model Config Editor** window (menu icon > **Tools** > **Model Config Editor**).
2. Apply the model config design to different network profiles.
3. Using the provision workflow, apply the model config design that is specified in network profiles to a network device.

Supported Model Config Design Types

Cisco DNA Center supports the following wireless Model Config design types:

- AAA Radius attributes
- Advanced SSID configuration
- CleanAir configuration
- Dot11ax Configuration
- Global IPv6 configuration
- Multicast configuration

Discover and Create Designs from a Legacy Device

Instead of manually creating designs using the Model Config Editor, you can use the Discover Model Configs feature to discover the existing model config designs available on legacy devices and use them as a template to create new designs.

Step 1 Click the menu icon (≡) and choose **Tools** > **Model Config Editor**.

Step 2 Click the **Discovery** tab.

A list of discovered devices that are available in the **Inventory** window appears.

Step 3 Click the radio button next to the device name and click **Discover Model Configs**.

Step 4 In the right pane, expand **Wireless** and choose a model config design type.

The configuration available for the selected model config type appears. For example, if you choose **CleanAir Configuration** under **Wireless**, the available configuration for the CleanAir appears.

Step 5 Click the radio button next to the configuration that you want to use as a template to create a new design, and click **Create Design**.

Step 6 In the window that appears, make the necessary changes and click **Save**.

Create a Model Config Design for AAA RADIUS Attributes

Use the **AAA Radius Attributes Configuration** model config to define the Called-station-id parameter value for Cisco AireOS Controllers and Cisco Catalyst 9800 Series Wireless Controllers.

The **Default AAA_Radius_Attributes_Configuration** defines the called-station ID as **ap-macaddress-ssid**. You cannot edit or delete this default model config. However, you can create a custom model config for your specific network design.

This procedure describes how to create a new AAA Radius Attributes Configuration model config.

Before you begin

You should have discovered the devices in your network using the **Discovery** feature so that the discovered devices are listed in the **Inventory** window.

Step 1 Click the menu icon (☰) and choose **Tools** > **Model Config Editor**.

Step 2 In the left pane, you can either search for a model config by entering its name in the **Search** field, or by expanding **Wireless** and choosing **AAA Radius Attributes Configuration**.

Step 3 In the **Design Instances** window, click **Add**.

The **Add Called-station-id** slide-in pane appears.

Step 4 In the **Design Name** field, enter a name for the model config design.

Step 5 From the **Called-station-id** drop-down list, choose one of the following attribute values:

- **ap-ethmac-only**
- **ap-ethmac-ssid**
- **ap-group-name**
- **ap-label-address**
- **ap-label-address-ssid**
- **ap-location**
- **ap-macaddress**
- **ap-macaddress-ssid**
- **ap-name**
- **ap-name-ssid**
- **ipaddress**
- **macaddress**
- **vlan-id**

Step 6 Click **Save**.

The new design instance appears in the **Design Instances** window.

Step 7 (Optional) To edit a design, check the check box next to the design name that you want to edit, and click **Edit**. Make the changes and click **Save**.

Step 8 Attach the created config design to a network profile so that it can be deployed on a wireless controller. Click the menu icon (☰) and choose **Design** > **Network Profiles**.

For more information, see Create Network Profiles for Wireless, on page 231.

Step 9 Provision the model config design specified in the network profile to network devices. Click the menu icon (☰) and choose **Provision** > **Network Devices** > **Inventory**.

For more information, see Provision a Cisco AireOS Controller, on page 378 or Provision a Cisco Catalyst 9800 Series Wireless Controller, on page 409.

Create a Model Config Design for Advanced SSID

A WLAN associates an SSID to an interface or an interface group. The WLAN is configured with security, quality of service (QoS), radio policies, and other wireless network parameters. You can configure up to 512 WLANs for each wireless controller.

Use the advanced service set identifier (SSID) model config to configure the advanced SSID parameters on devices.

Before you begin

You should have discovered the devices in your network using the **Discovery** feature so that the discovered devices are listed in the **Inventory** window.

Step 1 Click the menu icon (≡) and choose **Tools** > **Model Config Editor**.

Step 2 In the left pane, you can either search for a model config by entering its name in the **Search** field, or expand **Wireless** and choose **Advanced SSID Configuration**.

Step 3 In the **Design Instances** pane, check the **Default Advanced SSID Design** check box to use the default advanced SSID design.

Note You cannot edit or delete the Default Advanced SSID Design.

Step 4 In the **Design Instances** pane, click **Add Design**.

The **Add Advanced SSID Configuration** window appears.

Step 5 In the **Design Name** field, enter a name for the model config.

Step 6 In the General tab, click the **Peer-to-Peer Blocking** drop-down list and choose an option for peer-to-peer blocking.

Peer-to-peer blocking is applied to individual WLANs. Each client inherits the peer-to-peer blocking setting of the WLAN to which it is associated. Peer-to-peer blocking enables you to have more control over how traffic is directed.

- **DISABLE**: Disables peer-to-peer blocking and forwards traffic locally within the wireless controller whenever possible.
- **DROP**: Causes the wireless controller to discard the client packets.
- **FORWARD UP**: Causes the client packets to be forwarded on an upstream VLAN. The device above the wireless controller decides what action to take regarding the packets. The device can either be a router or a Layer 3 switch.
- **ALLOW PVT GROUP**: Applicable to preshared key (PSK) clients only. Traffic is forwarded based on the associated identity PSK (IPSK) tags for the source and destination client devices.

Step 7 Click the **Passive Client Enable** toggle button to enable the Passive Client feature.

Passive clients are wireless devices, such as scales and printers, that are configured with a static IP address. These clients do not transmit any IP information (such as IP address, subnet mask, and gateway information) when they associate with an access point. As a result, when passive clients are used, the wireless controller never knows the IP address unless they use DHCP.

Step 8 Click the **Assisted Roaming Prediction Optimization** toggle button to configure an assisted roaming prediction list for a WLAN.

Step 9 Click the **Neighbor List Dual Band** toggle button to configure a neighbor list on a dual radio band.

Step 10 Click the **Network Admission Control (NAC-SNMP)** toggle button to enable SNMP NAC support on the WLAN.

Step 11 Click the **Network Admission Control (NAC-Radius)** toggle button to enable RADIUS NAC support on the WLAN.

Step 12 From the **DHCP Required** drop-down list, choose **Yes** or **No** to pass the DHCP request before going into the RUN state (a state where the client can pass traffic through the wireless controller).

Step 13 Expand **DHCP Server** and enter the IP address of the DHCP server in the **IP Address** field.

Step 14 Click the **FlexConnect Local Authentication** toggle button to enable FlexConnect local authentication.

Step 15 Click the **802.11ax Status** toggle button to enable 802.11ax configuration parameters.

Step 16 Click the **Aironet IE** toggle button to enable support for Aironet IE on this SSID.

Step 17 Click the **Load Balance Enable** toggle button to enable the load balancing feature.

Step 18 In the **DTIM Period 5GHz Band (In Beacon Intervals) [1-255]** field, enter a value for the 5GHz radio.

The valid range is from 1 to 255. The default value is 1 (to transmit broadcast and multicast frames after every beacon).

If the beacon period of the 802.11 network is 100 ms and the DTIM value is set to 1, the access point transmits buffered broadcast and multicast frames for 10 times every second. If the beacon period is 100 ms and the DTIM value is set to 2, the access point transmits buffered broadcast and multicast frames for 5 times every second. Either of these settings are suitable for applications, including Voice Over IP (VoIP), that expect frequent broadcast and multicast frames.

However, the DTIM value can be set as high as 255 (to transmit broadcast and multicast frames after every 255th beacon).

Step 19 In the **DTIM Period 2.4GHz Band (In Beacon Intervals) [1-255]** field, enter a value for the 2.4GHz radio. The valid range is from 1 to 255. The default value is 1 (transmit broadcast and multicast frames after every beacon).

Step 20 Set the time in milliseconds in the **Scan Defer Time [0-60000msecs]** field.

The valid values are between 0 and 60000 milliseconds; the default value is 100 milliseconds. If you sent the time to 0, the scan deferral does not happen. The scan defer time is common for all priorities on the same WLAN and the scan is deferred if a packet is transmitted or received in any one of the defer priorities.

Step 21 In the **Max Clients Per WLAN** field, enter the maximum number of clients that are allowed to join the WLAN.

The valid range is between 0 and 10000.

Step 22 In the **Max Clients Per AP Radio Per WLAN [0-200]** field, enter the maximum number of clients that are allowed to join the WLAN per AP.

The valid range is between 0 and 200.

Step 23 In the **Max Clients Per AP Radio Per WLAN [0-400]** field, enter the maximum number of client connections that are allowed per AP.

The valid range is between 0 and 400.

Step 24 From the **WMM Policy** drop-down list, choose the WMM policy as **Allowed**, **Disabled**, or **Required**.

By default, the WMM policy is Allowed.

Step 25 In the **NAS ID** field, enter the network access server identifier.

Step 26 Click **Client Data Rates** to configure the following client data rate limits per client by entering values in the respective fields:

- Average Downstream Data Rate Per Client (kbps)
- Burst Downstream Data Rate Per Client (kbps)
- Average Downstream Real-Time Rate Per Client (kbps)
- Burst Downstream Real-Time Rate Per Client (kbps)
- Average Upstream Data Rate Per Client (kbps)
- Burst Upstream Data Rate Per Client (kbps)
- Average Upstream Real-Time Rate Per Client (kbps)
- Burst Upstream Real-Time Rate Per Client (kbps)

Step 27 Click the **SSID Data Rates** to configure the following SSID data rate limits per SSID by entering values in the respective fields:

- Average Upstream Data Rate Per SSID (kbps)
- Burst Upstream Data Rate Per SSID (kbps)
- Average Upstream Real-Time Rate Per SSID (kbps)
- Burst Upstream Real-Time Rate Per SSID (kbps)
- Average Downstream Data Rate Per SSID (kbps)
- Burst Downstream Data Rate Per SSID (kbps)
- Average Downstream Real-Time Rate Per SSID (kbps)
- Burst Downstream Real-Time Rate Per SSID (kbps)

Note To lock all the properties in the design, click **Lock all**. To lock a specific property, click the lock symbol next to that property.

Step 28 Click **802.11ax Configuration** to configure the 802.11ax BSS Configuration parameters. You can use the toggle button to enable or disable the following configuration parameters:

- BSS Target Wake Up Time
- Downlink OFDMA
- Uplink OFDMA
- Downlink MU-MIMO
- Uplink MU-MIMO

Note To lock all the properties in the design, click **Lock all**. To lock a specific property, click the lock symbol next to that property.

Step 29 Click **Save**.

The created design instance appears in the **Design Instances** window under the **Advanced SSID Configuration - Model Configs** area.

Step 30 To edit a design, check the check box next to the design name that you want to edit, and click **Edit**. Make the changes and click **Save**.

Step 31 Attach the created config design to a network profile so that it can be deployed on the wireless controller. Click the menu icon (≡) and choose **Design** > **Network Profiles**.

For more information, see Create Network Profiles for Wireless, on page 231.

Step 32 Provision the model config design specified in the network profile to network devices. Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

For more information, see Provision a Cisco AireOS Controller, on page 378.

Create a Design for Cisco CleanAir

CleanAir is a spectrum intelligence solution designed to proactively manage the challenges of a shared wireless spectrum. It allows you to see all the users of the shared spectrum (both native devices and foreign interferers). It also enables you or your network to act on this information. For example, you can manually remove the interfering device, or the system can automatically steer the channel away from the interference. CleanAir provides spectrum management and Radio Frequency (RF) visibility.

Before you begin

You should have discovered the devices in your network using the **Discovery** functionality so that the discovered devices are listed in the **Inventory** window.

Step 1 Click the menu icon (≡) and choose **Tools** > **Model Config Editor**.

Step 2 In the left pane, you can either search for a model config capability by entering its name in the **Search Capability** field, or by expanding the **Wireless** Model Configs and choosing **CleanAir Configuration**.

Step 3 In the **Design Instances** pane, check the **Default CleanAir 802.11a Design** or **Default CleanAir 802.11b Design** check box to use the default CleanAir design.

Note You cannot edit and delete the **Default CleanAir 802.11a Design** or **Default CleanAir 802.11b Design**.

Step 4 In the **Design Instances** window, click **Add**.

The **Add CleanAir Configuration** window is displayed.

Step 5 In the **Design Name** field, enter a name for the design.

Step 6 From the **Radio Band** drop-down list, choose **2.4 GHz** or **5 GHz**.

Step 7 Click the **CleanAir Enable** toggle button to enable the CleanAir functionality on the 2.4-GHz or 5-GHz radio band.

If the **CleanAir Enable** toggle button is enabled, click it to prevent the Cisco Wireless Controller from detecting spectrum interference.

Step 8 Click the **CleanAir Device Reporting Enable** toggle button to enable the CleanAir system to report detected sources of interference, if any.

If the **CleanAir Device Reporting Enable** toggle button is enabled, click it to prevent the Cisco Wireless Controller from reporting interferers.

Step 9 Click the **Persistent Device Propagation** toggle button to enable propagation of information about persistent devices that can be detected by CleanAir.

Persistent device propagation enables you to propagate information about persistent devices to the neighboring APs that are connected to the same Cisco Wireless Controller. Persistent interferers are present at the location, and interfere with WLAN operations even if they are not detectable at all times.

Step 10 Expand **Enable Interferers Features** and check the check box next to the source of interference that needs to be detected and reported by the CleanAir system:

- Ble Beacon
- Bluetooth Paging Inquiry
- Bluetooth SCO ACL
- Generic Dect
- Generic TDD
- Generic Waveform
- Jammer
- Microwave Oven
- Motorola Canopy
- SI FHSs
- Spectrum 802.11 FH
- Spectrum 802.11 Non STD Channel
- Spectrum 802.11 Spec Inverted
- Spectrum 802.11 Super AG SuperAG
- Spectrum 802.15.4
- Video
- Wimax Fixed
- Wimax Mobile
- Xbox

Step 11 In the **CleanAir Description** field, enter a description.

Step 12 Click **Apply**.
The created design instance appears in the **Design Instances** window under the **CleanAir Configuration - Model Configs** area.

Step 13 To edit a design, check the check box next to the design name that you want to edit, and click **Edit**. Make the changes and click **Save**.

Step 14 Attach the created config design to a network profile so that it can be deployed on the wireless controller. Click the menu icon (≡) and choose **Design** > **Network Profiles**.

For more information, see Create Network Profiles for Wireless, on page 231.

Step 15 Provision the model config design specified in the network profile to network devices. Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

For more information, see Provision a Cisco AireOS Controller, on page 378.

Create a Model Config Design for Dot11ax Configuration

The Cisco DNA Center Dot11ax model config feature configures Dot11ax parameters on devices.

Dot11ax configuration involves the 802.11ax wireless specifications standard, also known as High Efficiency (HE) Wireless. Dot11ax is a dual-band 2.4-GHz and 5-GHz technology. You can configure Dot11ax configuration parameters only on Wi-Fi 6-supported Cisco Catalyst 9100 series Access Points.

Note BSS color is used to identify an overlapping basic service set (OBSS). BSS configs are pushed on Wi-Fi 6-supported access points only. The Cisco Catalyst 9100 series Access Points are the next-generation Wi-Fi 802.11ax access point, and ideal for high-density, high-definition applications.

Before you begin

You must discover the devices in your network using the **Discovery** feature so that the discovered devices are listed in the **Inventory** window.

Step 1 Click the menu icon (≡) and choose **Tools** > **Model Config Editor**.

Step 2 In the left pane, you can either search for a model config by entering its name in the **Search Capability** field, or by expanding **Wireless** and choosing **Dot11ax Configuration**.

Step 3 In the **Design Instances** pane, check the **Default Dot11ax Design** check box to use the default dot11ax design.

Note You cannot edit and delete the **Default dot11ax Design**.

Step 4 In the **Design Instances** window, click **Add Design**.

The **Add Dot11ax Configuration** window appears.

Step 5 In the **Design Name** field, enter a name for the model config design.

Step 6 Click the **BSS Color** toggle button to enable the BSS color functionality on the 2.4-GHz or 5-GHz radio band. The default value is disabled.

Step 7 Click the **Target Wakeup Time** toggle button to enable the target wakeup time. The default value is disabled.

Step 8 From the **Radio Band** drop-down list, choose a 2.4-GHz or 5-GHz radio band.

Note To lock all the properties in the design, click **Lock all**. To lock a specific property, click the lock symbol that is next to each property.

Step 9 Click **Save**.

The created design instance appears in the Design Instances window under the **Dot11ax Configuration – Model Configs** area.

Step 10 To edit a design, check the check box next to the design name that you want to edit, and click **Edit**. Make the changes and click **Save**.

Step 11 Attach the created config design to a network profile so that it can be deployed on the access points. Click the menu icon (☰) and choose **Design** > **Network Profiles**. For more information, see Create Network Profiles for Wireless.

Step 12 Provision the model config design specified in the network profile to network devices. Click the menu icon (☰) and choose **Provision** > **Network Devices** > **Inventory**. For more information, see Provision a Cisco AireOS Controller, on page 378.

Create a Model Config Design for Event-Driven RRM

The event-driven RRM model config feature configures event-driven RRM parameters for 2.4-GHz, 5-GHz, and 6-GHz radios.

Before you begin

You should have discovered the devices in your network using the **Discovery** feature so that the discovered devices are listed in the **Inventory** window.

Step 1 Click the menu icon (☰) and choose **Tools** > **Model Config Editor**.

Step 2 In the left pane, you can either search for a model config by entering its name in the **Search** field, or expand **Wireless** and choose **Event Driven RRM Configuration**.

Step 3 In the **Design Instances** pane, check the **Default Event Driven 2.4GHz Design** or **Default Event Driven 5 GHz Design** check box to use the default advanced SSID design.

Note You cannot edit or delete the Default Event Driven RRM Design.

Step 4 In the **Design Instances** pane, click **Add Design**.

The **Add Event Driven RRM Configuration** slide-in window appears.

Step 5 In the **Design Name** field, enter a name for the model config.

Step 6 From the **Radio Band** drop-down list, select the radio band: **2.4GHz**, **5GHz**, or **6GHz**.

Note The 6-GHZ radio band is not supported on Cisco AireOS Wireless Controllers.

Cisco Catalyst 9800 Series Wireless Controller version 17.6 and later support the 6-GHz radio band.

Step 7 Click the **Event Driven RRM** toggle button to run RRM when CleanAir-enabled AP detects a significant level of interference.

Step 8 From the **Sensitivity Threshold** drop-down list, choose the sensitivity threshold level at which you want the RRM to be triggered from the following options.

When the interference for the AP rises above the threshold level, RRM initiates a local dynamic channel assignment (DCA) run and changes the channel of the affected AP radio, if possible, to improve network performance.

- **Low**: Specifies the least sensitivity to non-Wi-Fi interference as indicated by the AQ value.
- **Medium**: Specifies medium sensitivity to non-Wi-Fi interference as indicated by the AQ value.
- **High**: Specifies the most sensitivity to non-Wi-Fi interference as indicated by the AQ value.
- **Custom**: Specifies custom sensitivity to non-Wi-Fi interference as indicated by the AQ value. If you choose this option, you must specify a custom value in the **Custom Threshold [1-99]** field.

Step 9 Click **Save**.

The created design instance appears in the **Design Instances** window under the **Event Driven RRM Configuration - Model Configs** area.

Step 10 To edit a design, check the check box next to the design name that you want to edit, and click **Edit**. Make the changes and click **Save**.

Step 11 Attach the created config design to a network profile so that it can be deployed on the wireless controller. Click the menu icon (≡) and choose **Design** > **Network Profiles**.

For more information, see Create Network Profiles for Wireless, on page 231.

Step 12 Provision the model config design specified in the network profile to network devices. Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

For more information, see Provision a Cisco AireOS Controller, on page 378.

Create a Design for Flex Configuration

Use the flex model config feature to configure the FlexConnect configuration on devices.

Before you begin

You should have discovered the devices in your network using the Discovery feature so that the discovered devices are listed in the Inventory window.

Step 1 Click the menu icon (≡) and choose **Tools** > **Model Config Editor**.

Step 2 In the left pane, you can either search for a model config capability by entering its name in the **Search Capability** field, or by expanding the **Wireless** Model Configs and choosing **Flex Configuration**.

Step 3 In the **Design Instances** pane, check the **Default Flex Configuration** check box to use the default FlexConnect design.

Note You cannot edit and delete the **Default Flex Configuration** design.

Step 4 In the **Design Instances** window, click **Add**.

The **Add CleanAir Configuration** window is displayed.

Step 5 In the **Design Name** field, enter a name for the design.

Step 6 From the **Radio Band** drop-down list, choose **2.4 GHz** or **5 GHz**.

Step 7 Click the **CleanAir Enable** toggle button to enable the CleanAir functionality on the 2.4-GHz or 5-GHz radio band.

If the **CleanAir Enable** toggle button is enabled, click it to prevent the Cisco Wireless Controller from detecting spectrum interference.

Step 8 Click the **CleanAir Device Reporting Enable** toggle button to enable the CleanAir system to report detected sources of interference, if any.

If the **CleanAir Device Reporting Enable** toggle button is enabled, click it to prevent the Cisco Wireless Controller from reporting interferers.

Step 9 Click the **Persistent Device Propagation** toggle button to enable propagation of information about persistent devices that can be detected by CleanAir.

Persistent device propagation enables you to propagate information about persistent devices to the neighboring APs that are connected to the same Cisco Wireless Controller. Persistent interferers are present at the location, and interfere with WLAN operations even if they are not detectable at all times.

Step 10 Expand **Enable Interferers Features** and check the check box next to the source of interference that needs to be detected and reported by the CleanAir system:

- Ble Beacon
- Bluetooth Paging Inquiry
- Bluetooth SCO ACL
- Generic Dect
- Generic TDD
- Generic Waveform
- Jammer
- Microwave Oven
- Motorola Canopy
- SI FHSs
- Spectrum 802.11 FH
- Spectrum 802.11 Non STD Channel
- Spectrum 802.11 Spec Inverted
- Spectrum 802.11 Super AG SuperAG
- Spectrum 802.15.4
- Video
- Wimax Fixed
- Wimax Mobile

- Xbox

Step 11 In the **CleanAir Description** field, enter a description.

Step 12 Click **Apply**.
The created design instance appears in the **Design Instances** window under the **CleanAir Configuration - Model Configs** area.

Step 13 To edit a design, check the check box next to the design name that you want to edit, and click **Edit**. Make the changes and click **Save**.

Step 14 Attach the created config design to a network profile so that it can be deployed on the wireless controller. Click the menu icon (≡) and choose **Design** > **Network Profiles**.

For more information, see Create Network Profiles for Wireless, on page 231.

Step 15 Provision the model config design specified in the network profile to network devices. Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

For more information, see Provision a Cisco AireOS Controller, on page 378.

What to do next

Create a Design for Global IPv6

Before you begin

You should have discovered the devices in your network using the **Discovery** feature so that the discovered devices are listed in the **Inventory** window.

Step 1 Click the menu icon (≡) and choose **Tools** > **Model Config Editor**.

Step 2 In the left pane, you can either search for a model config by entering its name in the **Search Capability** field, or expand **Wireless** and choose **Global IPV6 Configuration**.

Step 3 In the **Design Instances** pane, check the **Default Global IPv6 Design** check box to use the default global IPV6 design.

Note You cannot edit or delete the **Default Global IPv6 Design**.

Step 4 In the **Design Instances** window, click **Add Design**.

The **Add Global IPV6 Configuration** window appears.

Step 5 In the **Design Name** field, enter a name for the model config.

Step 6 Click the **Global IPV6 Config** toggle button to enable IPv6 globally on devices.

Step 7 Click **Apply**.

The created design instance appears in the **Design Instances** window under the **Global IPV6 Configuration - Model Config** area.

Step 8 To edit a design, check the check box next to the design name that you want to edit, and click **Edit**. Make the changes and click **Save**.

Step 9 Attach the created config design to a network profile so that it can be deployed on the wireless controller. Click the menu icon (≡) and choose **Design** > **Network Profiles**.

For more information, see Create Network Profiles for Wireless, on page 231.

Step 10 Provision the model config design specified in the network profile to network devices. Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

For more information, see Provision a Cisco AireOS Controller, on page 378.

Create a Model Config Design for Multicast

Use the multicast model config feature to configure multicast parameters on devices.

If your network supports packet multicasting, you can configure the multicast method that the Cisco Wireless Controller uses. The wireless controller performs multicasting in one of these modes:

- Unicast mode: In this mode, the wireless controller unicasts every multicast packet to every access point associated to the wireless controller. This mode is not very efficient, but is required on networks that do not support multicasting.
- Multicast mode: In this mode, the wireless controller sends multicast packets to a CAPWAP multicast group. This method reduces the overhead on the wireless controller processor and shifts the work of packet replication to your network. This method is more efficient than the unicast method.

Before you begin

You should have discovered the devices in your network using the **Discovery** feature so that the discovered devices are listed in the **Inventory** window.

Step 1 Click the menu icon (≡) and choose **Tools** > **Model Config Editor**.

Step 2 In the left pane, you can either search for a model config by entering its name in the **Search Capability** field, or by expanding **Wireless** and choosing **Multicast Configuration**.

Step 3 In the **Design Instances** pane, check the **Default Multicast Design** check box to use the default multicast design.

Note You cannot edit or delete the **Default Multicast Design**.

Step 4 In the **Design Instances** window, click **Add Design**.

The **Add Multicast Configuration** window appears.

Step 5 In the **Design Name** field, enter a name for the model config design.

Step 6 Click the **Enable Global Multicast Mode** toggle button to configure sending multicast packets. The default value is disabled.

Step 7 From the **AP Multicast Mode** drop-down list, choose **UNICAST** or **MULTICAST**.

- Choose **UNICAST** to configure the wireless controller to use the unicast method to broadcast packets.

- Choose **MULTICAST** to configure the wireless controller to use the multicast method to broadcast packets to a CAPWAP multicast group.

Step 8 Expand **IPV4 Multicast Group Address** and enter the IPv4 multicast address in the **IP Address** field.

Step 9 Expand **IPV6 Multicast Group Address** and enter the IPv6 multicast address in the **IP Address** field.

Step 10 Click **Apply**.

The created design instance appears in the **Design Instances** window under the **Multicast - Model Config** area.

Step 11 To edit a design, check the check box next to the design name that you want to edit, and click **Edit**. Make the changes and click **Save**.

Step 12 Attach the created config design to a network profile so that it can be deployed on the wireless controller. Click the menu icon (☰) and choose **Design** > **Network Profiles**.

For more information, see Create Network Profiles for Wireless, on page 231.

Step 13 Provision the model config design specified in the network profile to network devices. Click the menu icon (☰) and choose **Provision** > **Network Devices** > **Inventory**.

For more information, see Provision a Cisco AireOS Controller, on page 378.

Create a Model Config Design for RRM General Parameters

The RRM (Radio Resource Management) general configuration model config feature configures the RRM general parameters for 2.4GHz, 5GHz, and 6GHz radios.

Before you begin

You should have discovered the devices in your network using the **Discovery** feature so that the discovered devices are listed in the **Inventory** window.

Step 1 Click the menu icon (☰) and choose **Tools** > **Model Config Editor**.

Step 2 In the left pane, you can either search for a model config by entering its name in the **Search** field, or expand **Wireless** and choose **RRM General Configuration**.

Step 3 The **Design Instances** pane shows the following default RRM general configuration designs. You can check the respective default **RRM General Design** check box to use the default design.

You cannot edit or delete the Default RRM General Design.

- Default RRM General 2.4GHz Design
- Default RRM General 5GHz Design
- Default RRM General 6GHz Design

Note 6GHZ radio band is not supported on Cisco AireOS Wireless Controller.

Note Cisco Catalyst 9800 Series Wireless Controller version 17.6 and later releases support 6GHz radio band.

Step 4 In the **Design Instances** pane, click **Add Design**.

The **Add RRM General Configuration** slide-in window appears.

Step 5 To lock all the properties in the design, click **Lock all**. To lock a specific property, click the lock symbol next to that property.

Step 6 In the **Design Name** field, enter a name for the model config.

Step 7 In the **Radio Band** tab, choose the radio band from the **Radio Band** drop-down list: 2.4GHz, 5GHz, or 6GHz.

Step 8 In the **Threshold** tab, set the throughput threshold value for the radio band selected in the Throughput Threshold (1000-10000000 Bps) field.

Step 9 In the **Monitoring** tab, configure the monitoring channels and neighbor discover type.

- From the **Monitoring Channels** drop-down list, choose one of the following options to specify the set of channels that the AP uses for RRM scanning. By default, the monitoring channel is set to Country.
  - **All**: RRM channel scanning happens on all channels supported by the selected radio, which includes channels not allowed in the country of operation.
  - **Country**: RRM channel scanning happens only on the data channels in the country of operation. This is the default value.
  - **DCA**: RRM channel scanning happens only on the channel set used by the DCA algorithm.
- From the **Neighbor Discover Type** drop-down list, choose the neighbor discovery type. By default, the mode is set to Transparent.
  - **Transparent**: Sets the neighbor discover type to transparent. Packets are sent as is.
  - **Protected**: Sets the neighbor discover type to protected. Packets are encrypted.

Step 10 In the **Coverage** tab, click the **Global Coverage Hole Detection Enabled** toggle button to enable coverage hole detection. By default, this value is selected.

If you enable coverage hole detection, the Cisco Wireless Controller automatically determines, based on data received from the APs, if any APs have clients that are potentially located in areas with poor coverage.

Step 11 Click **Save**.

The created design instance appears in the **Design Instances** window under the **RRM General Configuration - Model Configs** area.

Step 12 To edit a design, check the check box next to the design name that you want to edit, and click **Edit**. Make the changes and click **Save**.

Step 13 Attach the created config design to a network profile so that it can be deployed on the wireless controller. Click the menu icon (≡) and choose **Design** > **Network Profiles**.

For more information, see Create Network Profiles for Wireless, on page 231.

Step 14 Provision the model config design specified in the network profile to network devices. Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

For more information, see Provision a Cisco AireOS Controller, on page 378.

CHAPTER 13

Manage Software Images

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About Image Repository

Cisco DNA Center stores all of the software images, software maintenance updates (SMUs), subpackages, ROMMON images, and so on for the devices in your network. Image Repository provides the following functions:

- Image Repository: Cisco DNA Center stores all the unique software images according to image type and version. You can view, import, and delete software images.
- Provision: You can push software images to the devices in your network.

Before using Image Repository features, you must enable Transport Layer Security protocol (TLS) on older devices such as Cisco Catalyst 3000, 4000, and 6000. After any system upgrades, you must re-enable TLS. For more information, see “Configure Security for Cisco DNA Center” in the Cisco DNA Center Administrator Guide.

Integrity Verification of Software Images

The Integrity Verification application monitors software images that are stored in Cisco DNA Center for unexpected changes or invalid values that could indicate your devices are compromised. During the import process, the system determines image integrity by comparing the software and hardware platform checksum value of the image that you are importing to the checksum value identified for the platform in the Known Good Values (KGV) file to ensure that the two values match.

On the **Image Repository** window, a message displays if the Integrity Verification application cannot verify the selected software image using the current KGV file. For more information about the Integrity Verification application and importing KGV files, see the *Cisco DNA Center Administrator Guide*.

View Software Images

After you run Discovery or manually add devices, Cisco DNA Center automatically stores information about the software images, SMUs, and subpackages for the devices.

Step 1 Click the menu icon (☰) and choose **Design** > **Image Repository**.

The software images are organized and displayed based on the device type. By default, software images for physical devices are displayed. Click the **Virtual** tab to view software images for virtual devices.

Note When cisco.com credentials are not set, a warning alert is displayed.

Step 2 In the **Family** column, click the downward arrow to view all the software images for the specified device type family. The **Device(s)** column indicates how many devices are using the specific image shown in the **Image Name** field. Click the number of devices to view the devices that are using the image.

Step 3 In the **Version** column, click the **Add On** link to view the applicable **SMUs**, **Subpackages**, **ROMMON**, **APSP**, and **APDP** upgrades for the base image.

Subpackages are the additional features that can be added to the existing base image. The subpackage version that matches the image family and the base image version is displayed here.

AP Service Pack (APSP) and AP Device Pack (APDP) are images for upgrading APs associated with wireless controllers.

- When a new AP hardware model is introduced, APDP is used to connect to the existing wireless network.
- For associated APs, critical AP bug fixes are applied through APSP.

Note If you tag any SMU as golden, it is automatically activated when the base image is installed.

You cannot tag a subpackage as golden.

For ROMMON upgrades, the cisco.com configuration is mandatory. When a device is added, the latest ROMMON details are retrieved from cisco.com for applicable devices. Also, when the base image is imported or tagged, the ROMMON image is automatically downloaded from cisco.com.

Step 4 In the **Advisory** column, click the number of critical or high advisories to view the advisories for a specific software image.

The **Image Advisory** slide-in pane shows **Family Name**, **Version**, and **Advisories** of the software image. The advisories are classified as **Critical**, **High**, **Medium**, **Low**, and **Informational**.

Click **CRITICAL**, **HIGH**, or **MEDIUM** to view the advisories specific to each category.

To fix the advisories, do the following:

a) Click **Fix Advisories**.
The **Image Update** window appears.

b) Select a recommended software image to update the device.

If the recommended software image is not available in the image repository, you can download it from cisco.com.

c) Click **Download and Mark Golden**.

d) From the **Download Image** dialog box, do one of the following:

- Keep the **Mark the image as golden after download** check box checked (the default). Then, click **Download**. The software image is downloaded and marked as golden.
- Uncheck the **Mark the image as golden after download** check box and click **Download**. The software image is downloaded to the repository but is not marked as golden.

e) Click **OK**.
The software image is downloaded. You can view the progress in **Show Tasks**.

Step 5 In the **Device Role** column, select a device role for which you want to indicate that this is a *golden* software image. For more information, see About Golden Software Images, on page 331 and Specify a Golden Software Image, on page 332.

Use a Recommended Software Image

Cisco DNA Center displays and allows you to select Cisco-recommended software images for the devices that it manages.

Note Only the latest Cisco-recommended software images are available for download.

Step 1 Click the menu icon (≡) and choose **System** > **Settings** > **Cisco.com Credentials**.

Step 2 Verify that you have entered the correct credentials to connect to cisco.com.

Step 3 Click the menu icon (≡) and choose **Design** > **Image Repository**.

Cisco DNA Center displays the Cisco-recommended software images according to device type.

Step 4 Designate the recommended image as golden. See Specify a Golden Software Image, on page 332 for more information.

Step 5 Push the recommended software image to the devices in your network. See Provision a Software Image, on page 334 for more information.

Import a Software Image

You can import software images and software image updates from your local computer or from a URL.

Imported images are categorized based on different supervisors that are present in a specific device family. Categorization under different supervisors supports only the Cisco Catalyst 9400 series family.

If you use FTP to import an image from an FTP server, use the FTP standard:

```
ftp://username:password@ip_or_hostname/path
```

Step 1 Click the menu icon (≡) and choose **Design** > **Image Repository**.

Step 2 Click **Import**.

Step 3 Click **Choose File** to navigate to a software image or software image update stored locally. Alternately, enter the image URL to specify an HTTP or FTP source from which to import the software image or software image update.

Step 4 If the image you are importing is for a third-party (non-Cisco) vendor, select **Third Party** under **Source**. Choose an **Application Type**, describe the device **Family**, and identify the **Vendor**.

Step 5 Click **Import**.

A window displays the progress of the import.

Step 6 Click **Show Tasks** to verify that the image was imported successfully.

If you imported a SMU, Cisco DNA Center automatically applies the SMU to the correct software image, and an **Add-On** link appears below the corresponding software image.

Step 7 Click the **Add-On** link to view the SMU.

Step 8 In the **Device Role** field, select the role for which you want to mark this SMU as golden. See Specify a Golden Software Image, on page 332.

You can only mark a SMU as golden if you previously marked the corresponding software image as golden.

Note Cisco DNA Center does not allow you to import software images for the FTD devices that are managed by FMC. When you add FMC to inventory and it goes to the 'Managed' state, the software images present in FMC are shown in Image Repository and are categorized based on device family.

Assign a Software Image to a Device Family

After importing a software image, you can assign or unassign it to available device families. The imported image can be assigned to multiple devices at any time.

To assign an imported software image to a device family:

Step 1 Click the menu icon (≡) and choose **Design** > **Image Repository**.

Step 2 Click **Imported Images**.

Step 3 Click **Assign** in the corresponding image name row.

Step 4 In the **Assign Device Family** window, choose the **Device Series from Cisco.com** or **All Device Series** and click **Assign** link to which you want to map the image.

Note: If cisco.com credentials are not set, specify the credentials in **System** > **Settings** > **Cisco.com Credentials**.

Step 5 Select appropriate site from the Global hierarchy and click **Assign** and then click **Save**.

Step 6 To unassign an image, choose a site from the Global hierarchy and click **Unassign** link in the **Action** column.

The software image is assigned to the device family and the number of devices using that image are shown in the **Device(s)** column. After assigning the image, you can mark it as a golden image. See Specify a Golden Software Image.

If the device family is marked as a golden image, you cannot delete that image from the device family.

Note For PnP devices, you can import a software image and assign it to a device family even before the device is available. You can also mark the image as a golden image. When the device is made available in the inventory, the image that is assigned to the device family is automatically assigned to the newly added devices of that device family.

When the image is imported and Cisco DNA Center has cisco.com credentials added, Cisco DNA Center provides the list of device families that are applicable for the image. You can select the required device family from the list.

When the image is not available in cisco.com or when credentials are not added in Cisco DNA Center, you must design the right device family for the image.

Upload Software Images for Devices in Install Mode

The Image Repository page might show a software image as being in Install Mode. When a device is in Install Mode, Cisco DNA Center is unable to upload its software image directly from the device. When a device is in Install Mode, you must first manually upload the software image to the Cisco DNA Center repository before marking the image as golden, as shown in the following steps.

Step 1 Click the menu icon (≡) and choose **Design** > **Image Repository**.

Step 2 In the **Image Name** column, find the software image of the device that is running in **Install Mode**.

Step 3 Click **Import** to upload the binary software image file for the image that is in Install Mode.

Step 4 Click **Choose File** to navigate to a software image stored locally or **Enter image URL** to specify an HTTP or FTP source from which to import the software image.

Step 5 Click **Import**.

A window displays the progress of the import.

Step 6 Click **Show Tasks** and verify that the software image you imported is green, indicating it has been successfully imported and added to the Cisco DNA Center repository.

Step 7 Click **Refresh**.

The Image Repository window refreshes. Cisco DNA Center displays the software image, and the Golden Image and Device Role columns are no longer dimmed.

About Golden Software Images

Cisco DNA Center allows you to designate software images and SMUs as *golden*. A golden software image or SMU is a validated image that meets the compliance requirements for the particular device type. Designating a software image or SMU as golden saves you time by eliminating the need to make repetitive configuration changes and ensures consistency across your devices. You can designate an image and a corresponding SMU as golden to create a standardized image. You can also specify a golden image for a specific device role. For example, if you have an image for the Cisco 4431 Integrated Service Routers device family, you can further specify a golden image for those Cisco 4431 devices that have the Access role only.

You cannot mark a SMU as golden unless the image to which it corresponds is also marked golden.

Specify a Golden Software Image

You can specify a golden software image for a device family or for a particular device role. The device role is used for identifying and grouping devices according to their responsibilities and placement within the network.

Step 1 Click the menu icon (≡) and choose **Design** > **Image Repository**.

The software images are displayed according to device type.

Step 2 From the **Family** column, select a device family for which you want to specify a golden image.

Step 3 From the **Image Name** column, select the software image that you want to specify as golden.

Step 4 If the software image that you specify as golden is already uploaded into the Cisco DNA Center repository, click the star icon in the **Golden Image** column.

The software image is marked as golden.

Step 5 If the software image that you specify as golden is not already uploaded into the Cisco DNA Center repository, click the download icon in the **Golden Image** column.

This process might take some time.

Note Importing software images from devices is not allowed.

Step 6 From the **Download Image** dialog box, do one of the following:

- Keep the **Mark the image as golden after download** check box checked by default and click **Download**. The software image is downloaded and marked as golden.

  Note If Cisco.com credentials are not set, you are prompted to specify them.

  The in-progress software image download is shown in the **Device Role** column.

  If the software image is downloaded and successfully marked as golden, the color of the star icon turns gold. If the software image download fails, the color of the star icon turns red and a **Please Retry** status is displayed.

- Uncheck the **Mark the image as golden after download** check box and click **Download**. The software image is downloaded to the repository but is not marked as golden.

Step 7 In the **Device Role** column, select a device role for which you want to specify a golden software image. Even if you have devices from the same device family, you can specify a different golden software image for each device role. Note that you can select a device role for physical images only, not virtual images.

Configure an Image Distribution Server

An image distribution server helps in storage and distribution of software images. You can configure an external image distribution server to distribute software images. You can also set up one or more protocols for newly added image distribution server.

Step 1 Click the menu icon (≡) and choose **System** > **Settings** > **Device Settings**.

Step 2 From the **Device Settings** drop-down list, choose **Image Distribution Servers**.

Step 3 In the **Image Distribution Servers** window, click **Servers**.

The **Image Distribution Servers** table displays details of host, username, SFTP, SCP, and connectivity of image distribution servers.

Step 4 Click **Add** to add a new image distribution server.

The **Add a New Image Distribution Server** slide-in pane appears.

Step 5 Configure the following image distribution server settings:

- **Host**: Enter the hostname or IP address of the image distribution server.
- **Root Location**: Check the **Use root directory for file transfers** check box to use the root directory for file transfers, or uncheck the **Use root directory for file transfers** check box and enter the root location.

  Note For Cisco AireOS Controllers, image distribution fails if the configured path is more than 16 characters.
- Expand the **SFTP and SCP** area.
- **Username**: Enter username to log in to the image distribution server. The username have read/write privileges in the working root directory of the server.
- **Password**: Password that is used to log in to the image distribution server.
- **Port Number**: Enter the port number on which the image distribution server is running.

Step 6 Click **Save**.

Step 7 (Optional) To edit the settings, click the **Edit** icon adjacent to the corresponding image distribution server in the **Action** column, make the required changes in the **Edit** window, and click **Save**.

Step 8 (Optional) To delete an image distribution server, click the **Delete** icon adjacent to the corresponding image distribution server in the **Action** column and click **Delete**.

Change the Protocol Order of an Image Distribution Server

You can change the protocol order of an image distribution server. Protocol order helps in performing verification checks on the image distribution servers. By default, the software images are distributed using the first protocol in the protocol order.

Step 1 Click the menu icon (≡) and choose **System** > **Settings** > **Device Settings** > **Image Distribution Servers**.

Step 2 In the **Image Distribution Servers** window, click **Preferences**.

The default protocol order is shown.

Step 3 Click the **On/Off** toggle button to enable or disable a protocol.

Note The HTTPS or SCP protocol must be enabled for image distribution. The SFTP protocol must be enabled for all protocol orders.

If the HTTPS protocol is disabled or image distribution has failed while using the HTTPS protocol, the software image will be distributed using the SCP protocol.

Step 4 Drag and drop the protocols to change the protocol order.

Step 5 Click **Save**.

Add Image Distribution Servers to Sites

You can associate SFTP servers located in different geographical regions to sites, buildings, and floors. All the devices under the network hierarchy use the associated image distribution server during a network upgrade.

Before you begin

You must configure an image distribution server. See Configure an Image Distribution Server, on page 333.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings**.

Step 2 In the left pane, choose the desired site to which you want to associate the image distribution server.

Step 3 Click **Add Servers**.

Step 4 In the **Add Servers** window, check the **Image Distribution** check box.

Step 5 Click **OK**.

Step 6 Click the **Primary** drop-down list and choose the image distribution server that you want to configure as primary.

Step 7 Click the **Secondary** drop-down list and choose the image distribution server that you want to configure as secondary.

Step 8 Click **Save**.

Provision a Software Image

You can push software images to the devices in your network. Before pushing a software image to a device, Cisco DNA Center performs upgrade readiness prechecks on the device, such as checking the device management status, disk space, and so on. If any prechecks fail, you cannot perform the software image update. After the software image of the device is upgraded, Cisco DNA Center checks for the CPU usage, route summary, and so on, to ensure that the state of the network remains unchanged after the image upgrade.

Note You can perform prechecks on multiple devices.

Cisco DNA Center compares each device software image with the image that you have designated as golden for that specific device type. If there is a difference between the software image of the device and the golden image, Cisco DNA Center specifies that the software image of the device is outdated. The upgrade readiness prechecks are triggered for those devices. If all the prechecks are cleared, you can distribute (copy) the new image to the device and activate it (that is, make the new image the running image). The activation of the new image requires a reboot of the device. Because a reboot might interrupt the current network activity, you can schedule the process for a later time.

If you have not designated a golden image for the device type, the device's image cannot be updated. See Specify a Golden Software Image, on page 332.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

Step 2 From the **Focus** drop-down list, choose **Software Images**. Select the device whose image you want to upgrade.

Note If the prechecks succeed for a device, the **Outdated** link in the Software Image column has a green tick mark. If any of the upgrade readiness prechecks fail for a device, the **Outdated** link has a red mark, and you cannot update the software image for that device. Click the **Outdated** link and correct the errors before proceeding. See List of Device Upgrade Readiness Prechecks.

Step 3 From the **Actions** drop-down list, choose **Software Images** > **Update Image**.

The **Image Upgrade** window appears.

Step 4 **Analyze Selection**: Choose the devices that you want to upgrade and click **Next**.

Step 5 **Distribute**: Click **Now** to start the distribution immediately or click **Later** to schedule the distribution at a specific time.

To choose the validators you want to run for the current workflow and add new custom checks, do the following:

a) Hover your mouse over the Info icon to view the validation criteria and the CLI commands that are used for validation.
b) Click the on or off toggle button to uncheck the validators that you do not want to run for the current workflow.
c) (Optional) To add new custom prechecks and postchecks, do the following:

   - Click **add a new check** link to launch the **Add a New Custom Check** window.
   - Enter the **Name** for the custom check.
   - Click the **When** drop-down arrow and choose pre, post, or both.
   - Click **Select a Test Device** drop-down arrow and choose a device for which you want to run these custom checks.
   - Click **Open Command Runner** and enter the CLI commands.
   - Expand the **Additional Criteria** area.
   - Click the **Operation** drop-down arrow and choose **Distribution**.
   - Click the **Device Series** drop-down arrow and choose the device series for which you want to run these custom checks.
   - Click **Save**.
   - If you want to edit a custom check, click the corresponding More icon, choose **Edit**, make the required changes, and click **Save**.

- If you want to delete a custom check, click the corresponding More icon, choose **Delete**, and click **Delete** in the **Confirm Delete** message.

Note

- If you associated the external image distribution server with a network hierarchy, the image distribution server distributes the image to all devices under the network hierarchy. See Add Image Distribution Servers to Sites, on page 334.
- If the image has been distributed to the selected device, click **Next**.
- If the **SWIM Events for ITSM (ServiceNow)** bundle is enabled, you need to update the image (distribute and activate) at a later time. Do not click **Now** to update the image. If you must update the image now, then the bundle and its integration workflow (image update schedule approval in ServiceNow) must first be disabled. To access the bundle, choose **Platform** > **Manage** > **Bundles** > **SWIM Events for ITSM (ServiceNow)**. Click the **Disable** button in the **SWIM Events for ITSM (ServiceNow)** window. Wait a few seconds before proceeding to update the image, because the process to disable the bundle and workflow takes a few seconds.

Step 6 Click **Next**.

Step 7 **Activate**: Click **Now** to start the activation immediately or click **Later** to schedule the activation at a specific time.

FLASH CLEANUP: Stores only the running software image and removes all the previous software images saved on the device.

Check the **Initiate Flash Cleanup after Activation** check box to remove all the previous software images saved on the device.

To choose the validators you want to run for the current workflow and add new custom checks, do the following:

a) Hover your mouse over the Info icon to view the validation criteria and the CLI commands that are used for validation.
b) Click the on or off toggle button to uncheck the validators that you do not want to run for the current workflow.
c) (Optional) To add new custom prechecks and postchecks, do the following:

    - Click **add a new check** link to launch the **Add a New Custom Check** window.
    - Enter the **Name** for the custom check.
    - Click the **When** drop-down arrow and choose pre, post, or both.
    - Click **Select a Test Device** drop-down arrow and choose a device for which you want to run these custom checks.
    - Click **Open Command Runner** and enter the CLI commands.
    - Expand the **Additional Criteria** area.
    - Click the **Operation** drop-down arrow and choose **Activation**.
    - Click the **Device Series** drop-down arrow and choose the device series for which you want to run these custom checks.
    - Click **Save**.
    - If you want to edit a custom check, click the corresponding More icon, choose **Edit**, make the required changes, and click **Save**.

- If you want to delete a custom check, click the corresponding More icon, choose **Delete**, and click **Delete** in the **Confirm Delete** message.

Step 8 Click **Next**.

Step 9 In the **Summary** window, review the image upgrade settings. To make any changes, click **Back**; otherwise, click **Submit**.

Step 10 From the **Actions** drop-down list, choose **Software Images** > **Image Update Status** and check the status of the update.

Import ISSU Compatibility Matrix

In-Service Software Upgrade (ISSU) is a process that upgrades the image on a device without rebooting or with minimal interruption of service. For an example of the Cisco IOS XE ISSU compatibility matrix for Catalyst Switches, see https://software.cisco.com/download/home/286315874/type/286326638/release/17.4.1. You can download and import the ISSU compatibility matrix in Cisco DNA Center when you want to upgrade devices with ISSU.

Step 1 Click the menu icon (≡) and choose **Design** > **Image Repository**.

Step 2 Click **Import**.

The **Import Image/Add-On** window appears.

Step 3 To import the ISSU compatibility matrix with a software image, do the following:

a) Click **Choose File** and browse to a software image or enter the URL of an HTTP or FTP source from which to import a software image.
b) If the image you are importing is for a third-party (non-Cisco) vendor, select **Third Party** under **Source**. Choose an **Application Type**, describe the device **Family**, and identify the **Vendor**.
c) Under **Select ISSU compatibility matrix**, click **Choose File** and browse to the ISSU compatibility matrix file.
d) Click **Import**.

Step 4 (Optional) To import the ISSU compatibility matrix for software images that are already imported, do the following:

a) Under **Select ISSU compatibility matrix**, click **Choose File** and browse to the ISSU compatibility matrix file.
b) Click **Import**.

Step 5 Click **Show Tasks** to view the ISSU compatibility matrix file **Import** status.

Upgrade a Software Image with ISSU

Upgrading devices using the In-Service Software Upgrade (ISSU) eliminates the need to reboot and reduces service interruption.

Before you begin

Before you upgrade a device using the ISSU, you must import the ISSU compatibility matrix file. See Import ISSU Compatibility Matrix, on page 337.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

Step 2 From the **Focus** drop-down list, choose **Software Images**. Select the device whose image you want to upgrade.

Step 3 From the **Actions** drop-down list, choose **Software Images** > **Update Image**.

The **Image Upgrade** window appears.

Step 4 In the **Analyze Selection** window, enable the ISSU upgrade:

a) Choose the device that you want to upgrade with ISSU.

Note The **To Image** column shows the ISSU validation status.

- **ISSU shown in amber**: ISSU validation failed because the selected image is not ISSU compatible.
- **ISSU shown in gray**: ISSU validation succeeded and the device supports ISSU.

b) From the **ISSU** drop-down list, choose **Enable ISSU Upgrade**.

c) Click **Next**.

Step 5 From the **Distribute** window, click **Now** to start the image distribution immediately or **Later** to schedule the distribution at a specific time.

To choose the validators you want to run for the current workflow and add new custom checks, do the following:

a) Hover your cursor over the Info icon to view the validation criteria and the CLI commands that are used for validation.

b) Click the toggle button to uncheck the validators that you do not want to run for the current workflow.

c) (Optional) To add new custom prechecks and postchecks, do the following:

- Click **add a new check** to launch the **Add a New Custom Check** window.
- Enter the **Name** for the custom check.
- Click the **When** drop-down list and choose **pre**, **post**, or **both**.
- From the **Select a Test Device** drop-down list, choose a device for which you want to run the custom checks.
- Click **Open Command Runner** and enter the CLI commands.
- Expand the **Additional Criteria** area.
- Click the **Operation** drop-down arrow and choose **Distribution**.
- Click the **Device Series** drop-down arrow and choose the device series for which you want to run the custom checks.
- Click **Save**.
- If you want to edit a custom check, click the corresponding More icon, choose **Edit**, make the required changes, and click **Save**.
- If you want to delete a custom check, click the corresponding More icon, choose **Delete**, and in the **Confirm Delete** message, click **Delete**.

Note

- If associated with a network hierarchy, the external image distribution server distributes the image to all devices in the network hierarchy. See Add Image Distribution Servers to Sites, on page 334.
- If the image has been distributed to the selected device, click **Next**.
- If the **SWIM Events for ITSM (ServiceNow)** bundle is enabled, you need to update the image (distribute and activate) at a later time. Do not click **Now** to update the image.

  If you must update the image now, the bundle and its integration workflow (image update schedule approval in ServiceNow) must first be disabled. To access the bundle, choose **Platform** > **Manage** > **Bundles** > **SWIM Events for ITSM (ServiceNow)**. Click the **Disable** button in the **SWIM Events for ITSM (ServiceNow)** window. Wait several seconds before updating the image, because the process to disable the bundle and workflow takes several seconds.

Step 6 Click **Next**.

Step 7 From the **Activate** window, click **Now** to start the activation immediately or click **Later** to schedule the activation at a specific time.

FLASH CLEANUP: Stores only the running software image and removes all the previous software images saved on the device.

Check the **Initiate Flash Cleanup after Activation** check box to remove all the previous software images saved on the device.

To choose the validators you want to run for the current workflow and add new custom checks, do the following:

a) Hover your cursor over the Info icon to view the validation criteria and the CLI commands that are used for validation.
b) Click the toggle button to uncheck the validators that you do not want to run for the current workflow.
c) (Optional) To add new custom prechecks and postchecks, do the following:

   - Click **add a new check** link to launch the **Add a New Custom Check** window.
   - Enter the **Name** for the custom check.
   - Click the **When** drop-down list and choose **pre**, **post**, or **both** as required.
   - Click **Select a Test Device** drop-down list and choose a device for which you want to run these custom checks.
   - Click **Open Command Runner** and enter the CLI commands.
   - Expand the **Additional Criteria** area.
   - Click the **Operation** drop-down list and choose **Activation**.
   - Click the **Device Series** drop-down list and choose the device series for which you want to run these custom checks.
   - Click **Save**.
   - If you want to edit a custom check, click the corresponding More icon, choose **Edit**, make the required changes, and click **Save**.
   - If you want to delete a custom check, click the corresponding More icon, choose **Delete**, and click **Delete** in the **Confirm Delete** message.

Step 8 Click **Next**.

Step 9 From the **Summary** page, review the image upgrade settings. To make any changes, click **Back**; otherwise click **Submit**.

Step 10 From the **Actions** drop-down list, choose **Software Images** > **Image Update Status** and check the status of the update.

List of Device Upgrade Readiness Prechecks

Precheck	Description
File transfer check	Checks if the device is reachable through HTTPS and SCP. The default order of protocols is HTTPS first and then SCP.
NTP clock check	Compares device time and Cisco DNA Center time to ensure successful Cisco DNA Center certificate installation.
Flash check	Verifies if there is enough disk space for the update. If there is not enough disk space, a warning or error message is returned. For information about the supported devices for Auto Flash cleanup and how files are deleted, see Auto Flash Cleanup.
Config register check	Verifies the config registry value.
Crypto RSA check	Checks whether an RSA certificate is installed.
Crypto TLS check	Checks whether the device supports TLS 1.2.
IP Domain name check	Checks whether the domain name is configured.
Startup config check	Checks whether the startup configuration exists for the device.
NFVIS Flash check	Checks if the golden image is ready to be upgraded in the NFVIS device.
Service Entitlement check	Checks if the device has valid license.

View Image Update Status

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

Step 2 From the **Focus** drop-down list, choose **Software Images**.

Step 3 From the **Actions** drop-down list, choose **Software Images** > **Image Update Status**.

By default, the **Image Upgrade Status** window shows all the image update tasks.

Step 4 To filter the tasks based on the update status, click **In Progress**, **Success**, or **Failure**.

Step 5 In the left pane, click **Task Names** or **Image Versions** to filter the tasks based on operations or image versions.

The **Status** column shows the current status of the tasks. For in-progress tasks, a progress bar shows the progress of the image update.

Step 6 Click the device name to view detailed information about a task.

- **Operations**: Shows the status of each operation that is associated with the task and the time taken to complete each operation.
- **Tasks**: Shows the status and details of prechecks and postchecks that are associated with the task.

  Click the number of differences in the **Differences** column, corresponding to each script, to view the differences between precheck and postcheck.

Step 7 Click **Upcoming Tasks** to view the tasks that are scheduled for a later time.

The **Upcoming Tasks** slide-in pane appears.

Step 8 Click the number of devices in the **Devices Scheduled** column to view the devices for which the image update task is scheduled.

Step 9 Select the devices for which tasks failed by checking check boxes and click **Retry** to retry the image update.

The **Image Upgrade** window appears. From this window, you can schedule an image update task immediately or later. For more information, see Provision a Software Image, on page 334.

Auto Flash Cleanup

During the device upgrade readiness precheck, the flash check verifies whether there is enough space on the device to copy the new image. If there is insufficient space:

- **For devices that support auto flash cleanup**, the flash check fails with a warning message. For these devices, the auto cleanup is attempted during the image distribution process to create the sufficient space. As a part of the auto flash cleanup, Cisco DNA Center identifies unused .bin, .pkg, and .conf files and deletes them iteratively until enough free space is created on the device. Image distribution is attempted after the flash cleanup. You can view these deleted files in **System** > **Audit Logs**.

Note Auto flash cleanup is supported on all devices except Nexus switches and wireless controllers.

- **For devices that do not support auto flash cleanup**, the flash check fails with an error message. You can delete files from the device flash to create space before starting the image upgrade.

CHAPTER 14

Compliance Audit for Network Devices

- Compliance Overview, on page 343
- Manual Compliance Run, on page 343
- View Compliance Summary, on page 344
- Synchronize Startup and Running Configurations of a Device, on page 344
- Types of Compliance, on page 345
- Compliance Behavior After Device Upgrade, on page 347

Compliance Overview

Compliance helps in identifying any intent deviation or *out-of-band* changes in the network that may be injected or reconfigured without affecting the original content.

A network administrator can conveniently identify devices in Cisco DNA Center that do not meet compliance requirements for the different aspects of compliance, such as software images, PSIRT, network profiles, and so on.

Compliance checks can be automated or performed on demand.

- Automated compliance check: Uses the latest data collected from devices in Cisco DNA Center. This compliance check listens to the traps and notifications from various services, such as inventory and SWIM, to assess data.
- Manual compliance check: Lets you manually trigger the compliance in Cisco DNA Center.
- Scheduled compliance check: A scheduled compliance job is a weekly compliance check that runs every Saturday at 11:00 pm.

Manual Compliance Run

You can trigger a compliance check manually in Cisco DNA Center.

Step 1 Click the menu icon (≡) and choose **Provision** > **Inventory**.

Step 2 For a bulk compliance check, do the following:

a) Choose all the applicable devices.

b) From the **Actions** drop-down list, choose **Compliance** > **Run Compliance**.

Step 3 For a per-device compliance check, do the following:

a) Choose the devices for which you want to run the compliance check.
b) From the **Actions** drop-down list, choose **Compliance** > **Run Compliance**.
c) Alternatively, click the compliance column (if available) and then click **Run Compliance**.

Step 4 To view the latest compliance status of a device, do the following:

a) Choose the device and inventory. See Resynchronize Device Information, on page 99.
b) From the **Actions** drop-down list, choose **Compliance** > **Run Compliance**.

Note

- A compliance run cannot be triggered for unreachable or unsupported devices.
- If compliance is not run manually for a device, the compliance check is automatically scheduled to run after a certain period of time, which depends on the type of compliance.

View Compliance Summary

The inventory page shows an aggregated status of compliance for each device.

Step 1 Click the menu icon (≡) and choose **Provision** > **Inventory**.

The compliance column shows the aggregated compliance status of each device.

Step 2 Click the compliance status to launch the compliance summary window, which shows the following compliance checks applicable for the selected device:

- Startup versus Running Configuration
- Software Image
- Critical Security Vulnerability
- Network Profile
- Fabric
- Application Visibility

Note Network Profile, Fabric, and Application Visibility are optional and are displayed only if the device is provisioned with the required data.

Synchronize Startup and Running Configurations of a Device

When there is a mismatch in the startup and running configurations of a device, you can do a remediation synchronization to match the configurations.

Step 1 Click the menu icon (≡) and choose **Provision** > **Inventory**.

Step 2 For a bulk remediation, do the following:

a) Choose all the applicable devices.
b) From the **Actions** drop-down list, choose **Compliance** > **Sync Start vs Run Configuration**.

For a per-device remediation, do the following:

a) Choose the devices for which you want to do a remediation synchronization.
b) From the **Actions** drop-down list, choose **Compliance** > **Sync Start vs Run Configuration**. Alternatively, click the Compliance column and then choose **Compliance Summary** > **Startup vs Running Configuration** > **Sync Device Config**.

Step 3 To view the remedial status of the device, do the following:

a) Click the menu icon (≡) and choose **Provision** > **Inventory**.
b) From the **Actions** drop-down list, choose **Compliance** > **Compliance Remedial Status**.

Types of Compliance

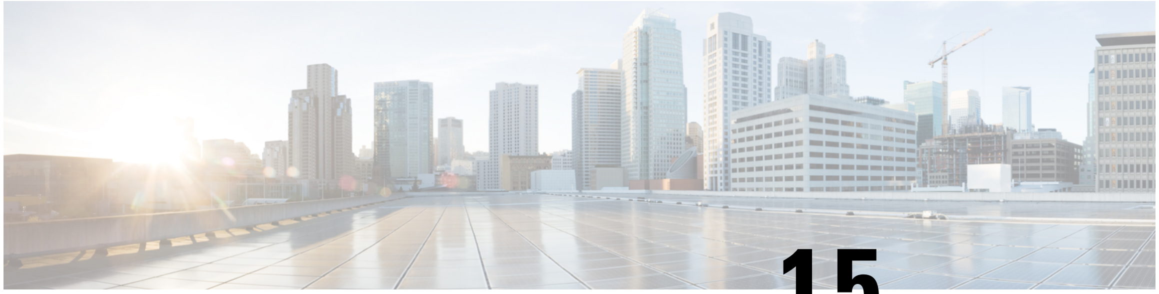
Compliance Type	Compliance Check	Compliance Status
Startup versus Running Configuration	This compliance check helps in identifying whether the startup and running configurations of a device are in sync. If the startup and running configurations of a device are out of sync, compliance is triggered and a detailed report of the out-of-band changes is displayed. The compliance for startup vs. running configurations is triggered within 5 minutes of any out-of-band changes.	• Noncompliant: The startup and running configurations are not the same. In the detailed view, the system shows different startup vs. running between or running vs. previous running. • Compliant: The startup and running configurations are the same. • NA (Not Applicable): The device, such as AireOS, is not supported for this compliance type.
Software Image	This compliance check helps a network administrator to see if the tagged golden image in Cisco DNA Center is running on the device. It shows the difference between the golden image and the running image for a device. When there is a change in the software image, the compliance check is triggered immediately without any delay.	• Noncompliant: The device is not running the tagged golden image of the device family. • Compliant: The device is running the tagged golden image of the device family. • NA (Not Applicable): The golden image is not available for the selected device family.

Compliance Type	Compliance Check	Compliance Status
Critical Security (PSIRT)	This compliance check enables a network administrator to check whether the network devices are running without critical security vulnerabilities.	• Noncompliant: The device has critical advisories. A detailed report displays various other information. • Compliant: There are no critical vulnerabilities in the device. • NA (Not Applicable): The security advisory scan has not been done by the network administrator in Cisco DNA Center, or the device is not supported.
Network Profile	Cisco DNA Center allows you to define its intent configuration using Network Profiles and push the intent to the device. If any violations are found at any time due to out-of-band or any other changes, this check identifies, assesses, and flags it off. The violations are shown to the user under **Network Profiles** in the compliance summary window. **Note** Network profile compliance is applicable for routers and wireless LAN controllers.	• Noncompliant: The device is not running the intent configuration of the profile. • Compliant: While applying a network profile to the device, the device configurations that are pushed to Cisco DNA Center are actively running on the device. • Error: The compliance could not compute the status because of an underlying error. For details, see the error log.
Fabric (SDA) This feature is in beta.	Fabric compliance helps to identify fabric intent violations, such as any out-of-band changes for fabric-related configurations.	• Noncompliant: The device is not running the intent configuration. • Compliant: The device is running the intent configuration.
Application Visibility	Cisco DNA Center allows you to create an application visibility intent and provision it to a device through CBAR and NBAR. If there is an intent violation on the device, this check identifies, assesses, and shows the violation as compliant or noncompliant under **Application Visibility**. The automatic compliance check is scheduled to run every 5 hours.	• Noncompliant: The CBAR/NBAR configuration is not running on the device. • Compliant: The intent configuration of CBAR/NBAR is running on the device.
Model Config	This compliance check enables the network administrator to check any mismatch from the designed intent of Model Config. The mismatch is shown under **Network Profile** in the **Compliance Summary** window.	• Noncompliant: There is mismatch in the actual and intended value of attributes in Model Config. • Compliant: No mismatch of attributes in Model Config from the intended value.

Compliance Behavior After Device Upgrade

- A compliance check for all applicable devices (devices for which compliance never ran in the system) is triggered after successful device upgrade.
- Compliance calculates and shows the status of the devices in the inventory, except the Startup vs Running type.
- After upgrade, the Startup vs Running tile shows as NA with the text "Configuration data is not available."
- After a day of successful upgrade, a one-time scheduler runs and makes configuration data available for devices. The Startup vs Running tile starts showing the correct status (Compliant/Noncompliant) and detailed data.
- If any traps are received, the config archive service collects configuration data and the compliance check runs again.

Note In the upgrade setup, ignore any compliance mismatch for the **Flex Profile** interface. For the interface name, **1** maps to **management**.



CHAPTER 15

Run Diagnostic Commands on Devices

- Command Runner Overview, on page 349
- Run Diagnostic Commands on Devices, on page 349

Command Runner Overview

The Command Runner tool allows you to send diagnostic CLI commands to selected devices. Currently, **show** and other read-only commands are permitted.

Run Diagnostic Commands on Devices

Command Runner lets you run diagnostic CLI commands on selected devices and view the resulting command output. Command Runner supports only a subset of the shortcuts that are available as part of a standalone terminal.

Before you begin

Begin using Command Runner, do the following:

1. Click the menu icon (≡) and choose **System** > **Software Updates** > **Installed Apps**.
2. Find the **Command Runner** application and click **Install**.
3. After installation, run a Discovery job to populate Cisco DNA Center with devices. You are presented with a list of devices from which to run diagnostic CLI commands.

Step 1 Click the menu icon (≡) and choose **Tools** > **Command Runner**.

Step 2 In the **Search** field of the **Command Runner** window, click the drop-down arrow to search by **Device IP** or **Device Name**.

Step 3 Choose a device or devices on which to run diagnostic CLI commands.

Device List displays your selection.

Step 4 (Optional) Select another device to add to the list. You can select up to 20 reachable devices.

Note Although the device list displays everything available in inventory, Command Runner is not supported for wireless access points and Cisco Meraki devices. If you choose an access point device or Cisco Meraki device, a warning message appears, stating that no commands will be executed on them.

Step 5 In the **Select/Enter commands** field, enter a CLI command and click **Add**.

Command Runner supports type ahead. As you begin typing, Command Runner displays the commands available for you to choose. You can also type a new, valid command.

Step 6 Click **Run Command(s)**.

If successful, a `Command(s) executed successfully` message appears.

Step 7 Click the command displayed underneath the device to view the command output.

Note The complete command output is displayed in the **Command Runner** window. Any sensitive information, such as passwords, is masked in the command output.

Step 8 (Optional) Click **Export all CLI Output** to export the command output to a text file that you can save locally.

Step 9 Click **Go Back** to return to the previous window.

Note If necessary, click the **x** next to a device name to remove the device from the device list. Similarly, click the **x** next to a command to remove the command from the list.

PART V

Provision Your Network

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- Provision Wireless Devices, on page 377
- Provision a Routing Profile, on page 435
- Provision Firewall Profiles, on page 439
- Provision a LAN Underlay, on page 441
- Provision Fabric Networks, on page 447
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CHAPTER 16

Onboard and Provision Devices with Plug and Play

- Plug and Play Provisioning Overview, on page 353
- Controller Discovery Prerequisites, on page 355
- Plug and Play Deployment Guidelines, on page 358
- View Devices, on page 359
- Add or Edit a Device, on page 361
- Add Devices in Bulk, on page 362
- Register or Edit a Virtual Account Profile, on page 363
- Add Devices from a Smart Account, on page 364
- Provision a Device with Plug and Play, on page 365
- Delete a Device, on page 374
- Reset a Device, on page 374

Plug and Play Provisioning Overview

Plug and Play provisioning provides a way to automatically and remotely provision and onboard new network devices with minimal network administrator and field personnel involvement.

Using Plug and Play provisioning, you can do the following:

- Provision devices by assigning a site, deploying site settings, installing a device software image, and applying a custom onboarding configuration.
- Plan devices before their installation by entering device information and choosing provisioning operations. When the device comes online, it contacts Cisco DNA Center and Plug and Play provisions and onboards the device automatically.
- Provision unclaimed network devices, which are new devices that appear on the network, without prior planning.
- Synchronize the device inventory from the Cisco Plug and Play Connect cloud portal in a Cisco Smart Account to Plug and Play, so that all the devices appear in Cisco DNA Center.
- Display the detailed onboarding status of network devices.

Prerequisites

Before using Plug and Play provisioning, do the following:

- Set the Cisco Smart Account credentials in the main Cisco DNA Center settings by using **System** > **Settings** > **Smart Account**.
- Accept the End User License Agreement (EULA) in the main Cisco DNA Center settings by using **System** > **Settings** > **Device EULA Acceptance**.
- Ensure that Cisco network devices to be provisioned have a supported software release and are in a factory default state. If you are using a network device that was previously configured or is in an unknown state, see the device clean-up and reset details in Network Plug and Play Troubleshooting Guide for Cisco DNA Center.

The following sections describe typical use cases and workflows for Plug and Play provisioning.

Planned Provisioning

An administrator can plan the provisioning of a new site or other group of network devices as follows:

1. Define the site within the network hierarchy. See Network Hierarchy Overview, on page 121.
2. Optionally, define Onboarding Configuration templates to be applied to devices. Such templates contain basic network configuration commands to onboard a device so that it can be managed on the network. In many cases, such templates are not necessary unless you need to customize the Day 0 configuration. See Create Templates to Automate Device Configuration Changes, on page 293.
3. Define network profiles for the types of devices you are deploying. See Network Profiles Overview, on page 225.
4. Define the device credentials (CLI and SNMP) for the devices you are deploying. If you are using SNMPv2c, both Read and Write credentials must be provided.
5. Optionally, ensure that software images for the devices to be provisioned are uploaded and marked as golden in the Image Repository. See Import a Software Image, on page 329.
6. Add details about planned devices one at a time or in bulk with a CSV file. See Add or Edit a Device, on page 361 or Add Devices in Bulk, on page 362.
7. Devices boot up and are automatically provisioned.

Unclaimed Provisioning

If a new network device is added to the network before it can be planned, it is labeled as an unclaimed device. An unclaimed device can be added manually by an administrator, or automatically through one of the discovery methods described in Controller Discovery Prerequisites, on page 355. An administrator can provision the device as follows:

1. Find the device on the devices list by filtering on unclaimed devices or searching for it by name. See View Devices, on page 359.
2. Claim the device by assigning a site, image, configuration template, or profile. See Provision a Device with Plug and Play, on page 365.

Cisco Smart Account Synchronization and Provisioning

Network devices can be automatically registered through a Cisco Smart Account with the Cisco Plug and Play Connect cloud service. An administrator can synchronize the device inventory from Cisco Plug and Play Connect to Cisco DNA Center Plug and Play, so that all the devices appear in Cisco DNA Center. These devices can then be claimed and provisioned.

1. Register a Smart Account and virtual account with which to synchronize. See Register or Edit a Virtual Account Profile, on page 363.
2. Synchronize the device inventory from the Smart Account. See Add Devices from a Smart Account, on page 364.
3. Find the device on the devices list by filtering on unclaimed devices or searching for it by name. See View Devices, on page 359.
4. Claim the device by assigning a site, image, configuration template, or profile. See Provision a Device with Plug and Play, on page 365.
5. Devices boot up and are automatically provisioned.

Controller Discovery Prerequisites

Plug and Play automates device onboarding and requires that devices must be able to discover and contact the Cisco DNA Center controller. Devices must be able to automatically discover the controller in one of the following ways:

- DHCP—See DHCP Controller Discovery, on page 355.
- DNS—See DNS Controller Discovery, on page 357.
- Cisco Plug and Play Connect cloud service—See Plug and Play Connect Controller Discovery, on page 357.

DHCP Controller Discovery

When a Cisco network device first starts up with no startup configuration, it attempts to discover the Cisco DNA Center controller by using DHCP Option 43.

The prerequisites for the DHCP discovery method are as follows:

- New devices can reach the DHCP server.
- The DHCP server is configured with Option 43 for Cisco Plug and Play. This option informs the network device of the IP address of the Cisco DNA Center controller.

  When the DHCP server receives a DHCP discover message from the device, with Option 60 containing the string “ciscopnp”, it responds to the device by returning a response that contains the Option 43 information. The Cisco Plug and Play IOS Agent in the device extracts the Cisco DNA Center controller IP address from the response and uses this address to communicate with the controller.

DHCP Option 43 consists of a string value that is configured as follows on a Cisco router CLI that is acting as a DHCP server:

```
ip dhcp pool pnp_device_pool         <-- Name of DHCP pool
network 192.168.1.0 255.255.255.0    <-- Range of IP addresses assigned to clients
default-router 192.168.1.1           <-- Gateway address
option 43 ascii "5A1N;B2;K4;I172.19.45.222;J80;"    <-- Option 43 string
```

The Option 43 string has the following components, delimited by semicolons:

- 5A1N;—Specifies the DHCP suboption for Plug and Play, active operation, version 1, no debug information. It is not necessary to change this part of the string.
- B2;—IP address type:
  - B1 = hostname
  - B2 = IPv4 (default)
- I*xxx.xxx.xxx.xxx*;—IP address or hostname of the Cisco DNA Center controller (following a capital letter i). In this example, the IP address is 172.19.45.222.
- J*xxxx*—Port number to use to connect to the Cisco DNA Center controller. In this example, the port number is 80. The default is port 80 for HTTP and port 443 for HTTPS.
- K4;—Transport protocol to be used between the device and the controller:
  - K4 = HTTP (default)
  - K5 = HTTPS
- T*trustpoolBundleURL*;—Optional parameter that specifies the external URL of the trustpool bundle if it is to be retrieved from a different location than the default, which is the Cisco DNA Center controller, which gets the bundle from the Cisco InfoSec cloud (http://www.cisco.com/security/pki/). For example, to download the bundle from a TFTP server at 10.30.30.10, you would specify the parameter like this: Tftp://10.30.30.10/ios.p7b

  If you are using trustpool security and you do not specify the T parameter, the device retrieves the trustpool bundle from the Cisco DNA Center controller.
- Z*xxx.xxx.xxx.xxx*;—IP address of the NTP server. This parameter is mandatory when using trustpool security to ensure that all devices are synchronized.

See the *Cisco IOS Command Reference* for additional details on DHCP configuration.

If DHCP Option 43 is not configured, the device cannot contact the DHCP server, or this method fails for another reason, the network device attempts discovery using DNS. For more information, see DNS Controller Discovery, on page 357.

If the Cisco DNA Center system certificate has an FQDN-only SAN field, you must edit the DHCP pool on the seed device to contain the Option 43 string with FQDN, B2 to B1, dns-server, and domain-name before starting PnP.

If the DHCP pool relies on Cisco switches or routers, a sample configuration is as follows:

```
ip dhcp pool PnP_Pool
network 214.2.64.0255.255.255.0
default-router 214.2.64.1
option 43 ascii "5A1D;B1;K4;I<FQDN>;J80;"
domain-name sitdns.com
dns-server 17.1.104.100
```

DNS Controller Discovery

If DHCP discovery fails to get the IP address of the Cisco DNA Center controller, the network device falls back on the DNS lookup method. Based on the network domain name returned by the DHCP server, it constructs a fully qualified domain name (FQDN) for the controller, using the preset hostname pnpserver. The NTP server name is based on the preset hostname pnpntpserver.

For example, if the DHCP server returns the domain name “customer.com”, the network device constructs the controller FQDN of pnpserver.customer.com. It then uses the local name server to resolve the IP address for this FQDN. The NTP server name FQDN would be pnpntpserver.customer.com.

The prerequisites for the DNS discovery method are as follows:

- New devices can reach the DHCP server.
- The Cisco DNA Center controller is deployed with the hostname “pnpserver”.
- The NTP server is deployed with the hostname pnpntpserver.

Plug and Play Connect Controller Discovery

In situations where using the DHCP or DNS discovery methods is not an option, the Cisco Plug and Play Connect cloud service allows devices to discover the IP address of the Cisco DNA Center controller. When the network device boots up, if it cannot locate the controller through DHCP or DNS, then it tries Plug and Play Connect by contacting devicehelper.cisco.com to obtain the IP address of the appropriate controller that is defined for your organization. To secure the communications, the first thing that the device does when contacting Plug and Play Connect is to download and install the Cisco trustpool bundle.

The following steps summarize how to use Cisco Plug and Play to deploy a Cisco network device by using Plug and Play Connect for discovery.

Before you begin

Cisco network devices are running Cisco IOS images that support Cisco Plug and Play and have connectivity to the Cisco Plug and Play Connect cloud service.

Step 1 The network administrator configures the controller profile for the appropriate Cisco DNA Center controller for your organization by using Plug and Play Connect in the Cisco Smart Account web portal. For more information, see the Smart Account documentation in the web portal.

Step 2 If you order plug and play network devices through Cisco Commerce Workspace (CCW), these network devices are automatically registered with Plug and Play Connect as long as a Cisco Smart Account is assigned to the order and you include the NETWORK-PNP-LIC option for each device that you want to use with Cisco Plug and Play.

This option causes the device serial number and PID to be automatically registered in your Smart Account for plug and play. If you have specified a default controller, then the devices are automatically assigned to that controller when the order is processed.

Step 3 Alternatively, you can manually add devices in the Plug and Play Connect web portal.

Step 4 Register the Cisco DNA Center controller as a controller for Cisco Plug and Play Connect in a Cisco Smart Account, for redirection services. See Register or Edit a Virtual Account Profile, on page 363.

This step is required if you order plug and play network devices through CCW and these network devices are automatically registered with Plug and Play Connect through your Smart Account.

Step 5 Synchronize the device inventory from the Smart Account in the Cisco Plug and Play Connect cloud portal to Cisco DNA Center Plug and Play.

Devices registered in the Plug and Play Connect web portal are synced to the controller and appear in the plug and play device list with a source of SmartAccount.

Step 6 Claim the newly synced devices. See Provision a Device with Plug and Play, on page 365.

Step 7 The device installer installs and powers up the Cisco network device.

Step 8 The device discovers the Cisco DNA Center controller by querying the Plug and Play Connect service, identifies itself by serial number to Plug and Play in Cisco DNA Center, then is provisioned according to what was planned for it during the claim process.

Note The device will fail to contact Plug and Play Connect if the device cannot synchronize with the predefined NTP servers **time-pnp.cisco.com** or **pool.ntp.org**. To resolve this problem, either unblock NTP traffic to these two host names, or map these two NTP host names to local NTP server addresses on the DNS server.

Plug and Play Deployment Guidelines

Follow these recommendations when using Plug and Play:

- Device bring up order: In general, routing and upstream devices should be brought up first. Once the router and all upstream devices are up and provisioned, switches and downstream devices can be brought up. The Plug and Play agent in a device attempts to auto-discover the Cisco DNA Center controller only during initial device startup. If at this time, the device cannot contact the controller, device provisioning fails, so upstream devices should be provisioned first.
- Cisco Router Trunk/Access Port Configuration: Typical branch networks include routers and switches. One or more switches are connected to the WAN router and other endpoints like IP phones and access points connect to the switches. When a switch connects to an upstream router, the following deployment models are supported for Plug and Play:
    - Downstream switch is connected to the router using a switched port on the router. In this type of connection, the switched port on the router can be configured as a trunk or access port.
    - Downstream switch is connected to the router using a routed port on the router. In this case, the routed port can support multiple VLANs using sub-interfaces. During the Plug and Play process, the switch would automatically configure its port as a trunk port. In a large branch scenario, it becomes necessary to carry multiple VLANs between the router and the downstream switch. To support this use case, the switch must be connected to a routed port.
- Non-VLAN 1 configuration: Plug and Play supports devices using VLAN 1 by default. If you want to use a VLAN other than 1, adjacent upstream devices must use supported releases and you must configure the following global CLI command on the upstream device to push this CLI to the upcoming Plug and Play device: **pnp startup-vlan** *x*. When you execute this command on an adjacent upstream device, the VLAN membership change does not happen on that device. However, the active interfaces on the upcoming Plug and Play device that are connected to the upstream device are changed to the specified VLAN. This guideline applies to both routers and switches and should be used only for trunk mode scenarios and not access mode.

View Devices

This procedure shows how to view Plug and Play devices, how to perform actions on them, and how to add new devices.

Step 1 Click the menu icon (≡) and choose **Provision** > **Plug and Play**.

Step 2 View the devices in the table. The **Devices** table shows all the Plug and Play devices.

Step 3 In the **Device Status** area, click **Unclaimed**, **Error**, **Provisioned**, or **All**.

- **Unclaimed**: Shows the devices that are not claimed and the devices that are being claimed.
- **Error**: Shows the devices in which error appears while being claimed.
- **Provisioned**: Shows the devices that are claimed.
- **All**: Shows all the devices.

Step 4 From the **Focus** drop-down list, choose **Basic** or **Default**.

- **Basic**: Shows the **Device Name**, **Serial Number**, **Product ID**, **IP Address**, **Source**, **State**, **Site**, and **Last Contact** details of the devices.
- **Default**: Shows the **Device Name**, **Serial Number**, **Product ID**, **IP Address**, **Source**, **State**, **Onboarding Progress**, **Site**, **Last Contact**, **Smart Account**, **Virtual Account**, and **Created** details of the devices.

Step 5 From the **Auto-Refresh** drop-down list, choose **30 s**, **1 min**, **5 min**, or **10 min** to auto refresh the **Devices** table in the specified time span or choose **Off** to turn off auto refresh.

Step 6 Click the Gear icon to customize the appearance of the **Devices** table.

In the **Table Settings** slide-in pane, do the following:

a. Click **Table Appearance**, choose **Default** or **Compact** under **Table Density**, and enable **Table Striping** if you want striping in alternate rows.
b. Click **Enable Table Columns** and choose the columns that you want to see in the table.
c. Click **Apply**.
d. Click **Reset All Settings** if you want to reset the table settings.

Step 7 Click the Search or Filter icon to find specific devices.

Step 8 Click **Refresh Now** to refresh the **Devices** table manually.

Step 9 For devices with status as **Error**, hover your cursor over the progress bar on the **Onboarding Progress** column to view the error.

For more information about error, click the name of the device and view the error details in the **History** tab.

Step 10 Click the name of a device.

A slide-in pane with the device details is displayed.

Step 11 Click the **Details**, **History**, and **Configuration** or **Stack** tabs to view the different types of information for the device.

The **Stack** tab appears only for a switch stack device.

Step 12 Choose a device in the **Devices** table and perform any of the following options from the **Actions** drop-down list:

- **Claim**: See Provision a Device with Plug and Play, on page 365.
- **Edit**: See Add or Edit a Device, on page 361.

- **Reset**: See Reset a Device, on page 374.
- **Delete**: See Delete a Device, on page 374.

To perform an action on multiple devices, click the check box next to each device in the **Devices** table and choose an action from the **Actions** drop-down menu.

Step 13 Click **Add Device** to add a new device.

See the following topics for more information about adding devices in different ways:

- Add or Edit a Device, on page 361
- Add Devices in Bulk, on page 362
- Add Devices from a Smart Account, on page 364

The **Devices** table displays the information shown in the following table for each device. Some of the columns support sorting. Click the column header to sort the rows in ascending order, if sorting is supported. Click the column header again to sort the rows in descending order.

The Device table displays the information shown in the following table for each device. Some of the columns support sorting. Click the column header to sort the rows in ascending order, if sorting is supported. Click the column header again to sort the rows in descending order.

Table 40: Device Information

Column	Description
#	Row number.
Device Name	Hostname of the device. Click this link to open the device details window. A stack icon indicates a switch stack.
Serial Number	Device serial number.
Product ID	Device product ID.
IP Address	Device IP address.
Source	Source of the device entry: • User: User added the device through the GUI or API. • Network: Unclaimed device that has contacted the controller. • SmartAccount: Device was synced from a Smart Account.
State	• Unclaimed: Device has not been provisioned. • Planned: Device has been claimed but has not yet contacted the server. • Onboarding: Device onboarding is in progress. • Provisioned: Device is successfully onboarded and added to inventory. • Error: Device had an error and could not be provisioned.

Column	Description
Onboarding State	Onboarding state of the device. Click on the progress bar to go to the device history.
Site	Site with which the device is associated.
Last Contact	Last date and time the device contacted Plug and Play.
Smart Account	Cisco Smart Account with which the device is associated.
Virtual Account	Virtual Account (within the Cisco Smart Account) with which the device is associated.
Created	Date and time when the device was added to Plug and Play.

Add or Edit a Device

This procedure shows how to add or edit a device from the Plug and Play Devices list. Alternatively, you can edit a device from the device details window by clicking **Edit**.

Table 41: Device Fields

Field	Description
Serial Number	Device serial number (read only if you are editing a device).
Product ID	Device product ID (read only if you are editing a device).
Device Name	Device name.
Enable SUDI Authorization	Enables secure unique device identifier (SUDI) authorization on devices that support it.
SUDI Serial Numbers	Devices that support SUDI have two serial numbers: the chassis serial number and the SUDI serial number (called the License SN on the device label). Enter one or more comma-separated SUDI serial numbers in this field when adding a device that uses SUDI authorization. This field appears only if **Enable SUDI Authorization** is checked.
This Device Represents a Stack	Device represents a stack (this item is read only if you are editing a device). Applicable only for supported stackable switches.

Before you begin

If the device requires credentials, be sure that the global device credentials are set in the **Design** > **Network Settings** > **Device Credentials** page. For more information, see Configure Global CLI Credentials, on page 173.

Step 1 Click the menu icon (≡) and choose **Provision** > **Plug and Play**.

Step 2 View the devices in the table.

You can filter on device state by using one of the **Device State** buttons, or use the **Filter** option to find specific devices. Click **Refresh** to refresh the device list.

Step 3 Add or edit a device as follows:

- To add a device, click **Add Devices** and then click **Single Device**.
- To edit a device, check the check box next to the name of the device you want to edit and click **Actions > Edit** in the menu bar above the device table. The **Edit Device** dialog is displayed.

Step 4 Set the fields as needed, referring to the preceding table for more information.

Step 5 Save the settings by doing one of the following:

- If you are adding a device and will claim it later, click **Add Device**.
- If you are adding a device and want to claim it immediately, click **Add + Claim**. For more information on claiming a device, see Provision a Device with Plug and Play, on page 365.
- If you are editing a device, click **Edit Device**.

Add Devices in Bulk

This procedure shows how to add devices in bulk from a CSV file.

Step 1 Click the menu icon (≡) and choose **Provision** > **Plug and Play**.

Step 2 Click **Add Device**.

The **Add Devices** dialog is displayed.

Step 3 Click **Bulk Devices**.

Step 4 Click **Download File Template** to download the file template.

See the file template for information on which fields are mandatory and optional for different devices.

Step 5 Add the information for each device to the file and save the file. Note that certain fields are required, depending on the device type.

Step 6 Upload the CSV file by doing one of the following actions:

- Drag and drop the file to the drag and drop area.
- Click where it says "**click** to select" and select the file.

Step 7 Click **Import Devices**.

The devices in the CSV file are listed in a table.

Step 8 Check the box next to each device to import, or click the check box at the top to select all devices.

Step 9 Add the devices by doing one of the following:

- To add the devices and claim them later, click **Add Devices**.

- To add the devices and claim them immediately, click **Add + Claim**. For more information on claiming a device, see Provision a Device with Plug and Play, on page 365.

Register or Edit a Virtual Account Profile

This procedure lets you register the Cisco DNA Center controller as the default controller for Cisco Plug and Play Connect in a Cisco Smart Account, for redirection services. Also, this lets you synchronize the device inventory from the Cisco Plug and Play Connect cloud portal to Cisco DNA Center Plug and Play.

Table 42: Virtual Account Fields

Field	Description
Select Smart Account	Cisco Smart Account name.
Select Virtual Account	Virtual account name. Virtual accounts are subaccounts within a Cisco Smart Account.
Use as Default Controller Profile	Check this check box to register this Cisco DNA Center controller as the default controller in the Cisco Plug and Play Connect cloud portal.
Controller IP or **FQDN**	IP address or fully qualified domain name of this Cisco DNA Center controller.
Profile Name	Controller profile name.

Before you begin

Set the Cisco Smart Account credentials in the main Cisco DNA Center settings by using **System** > **Settings** > **Smart Account**.

Step 1 Click the menu icon (≡) and choose **System** > **Settings** > **PnP Connect**.

Step 2 View the virtual accounts in the table.

The table lists all of the registered Plug and Play Connect virtual account profiles.

Step 3 Either add or edit a virtual account profile, as follows:

- To register a virtual account, click **Register**. The register virtual account dialog is displayed.
- To edit a registered virtual account profile, click the radio button next to the name of the profile that you want to edit and click **Edit Profile** in the menu bar above the table. The edit virtual account dialog is displayed.

Step 4 Set the fields as needed by referring to the preceding Virtual Account Fields table.

Step 5 Save the settings by doing one of the following:

- If you are registering a new virtual account profile, click **Register**.
- If you are editing a virtual account profile, click **Change**.

What to do next

Synchronize the device inventory from the Cisco Plug and Play Connect cloud portal to Cisco DNA Center Plug and Play. For more information, see Add Devices from a Smart Account, on page 364.

Add Devices from a Smart Account

This task allows you to synchronize the device inventory from a Smart Account in the Cisco Plug and Play Connect cloud portal to Cisco DNA Center Plug and Play.

The Virtual Accounts table displays the following information for each profile.

Table 43: Virtual Accounts Information

Column	Description
Virtual Accounts	Virtual account name
Smart Accounts	Smart account that the virtual account is associated with
Sync Status	Status of the last synchronization process
Sync Result	Result of the last synchronization process

Before you begin

Before you can synchronize the device inventory from the Cisco Plug and Play Connect cloud portal, you must register a virtual account. See Register or Edit a Virtual Account Profile, on page 363. You can go directly to the PnP Connect settings page by clicking the **PnP Connect** link in the **Add Devices** > **Smart Account Devices** dialog.

Step 1 Click the menu icon (≡) and choose **Provision** > **Plug and Play**.

Step 2 Click **Add Device**.

The **Add Devices** dialog is displayed.

Step 3 Click **Smart Account Devices**.

Step 4 If you need to enter a Cisco.com ID (Cisco.com ID shows as Not Associated), follow these steps:

a) Click the **Add** link.
b) Enter the Cisco.com username and password.
c) Click **Save For Later** if you want to save the credentials permanently in Cisco DNA Center, or leave this check box unchecked to use these credentials one time only.
d) Click **Submit**.

Step 5 Click the radio button next to the name of the Plug and Play Connect virtual account profile from which you want to add devices.

If you need to register a PnP Connect virtual account profile, click the **PnP Connect** link. If you need to add Cisco.com credentials, click the **Add** link next to **Cisco.com ID**. If you want to change the Cisco ID, click the **Not me?** link.

Step 6 Click **Sync** to synchronize the device inventory from Cisco Plug and Play Connect in this virtual account to Cisco DNA Center Plug and Play.

Added devices appear in the Plug and Play Devices table with the source set to SmartAccount.

What to do next

Claim the newly synchronized devices. For more information on claiming a device, see Provision a Device with Plug and Play, on page 365.

Provision a Device with Plug and Play

Provisioning or claiming a device deploys an image and an onboarding configuration to the device. In the case of wireless devices, a network profile is configured. The device is then added to the inventory. If you claim a device that has not yet booted for the first time, you are planning the device configuration so that it is automatically provisioned when it boots up.

When provisioning or claiming a device, Cisco DNA Center does the following:

1. Deploys an image to the device.
2. Deploys an onboarding configuration for physically connected devices or a network profile for wireless devices.
3. Adds the device to the inventory.

The workflow for provisioning a device varies depending on the type of device, as follows:

- Switches and routers: See Provision a Switch or Router Device, on page 365
- Wireless LAN controllers, access points, and sensors: See Provision a Wireless or Sensor Device, on page 369

Provision a Switch or Router Device

Claiming a device provisions it by assigning it to a site, installing an image, deploying the site settings and onboarding configuration to it, and adding it to the inventory. If you claim a device that has not yet booted for the first time, you are planning the device so that it is automatically provisioned when it boots up.

When a device is claimed, some system configuration CLI commands from Cisco DNA Center are pushed to the device first, before the Onboarding Configuration (Day-0) template that you have defined. If your Onboarding Configuration template has any of the same CLI commands, these will override the system configuration, because they are applied last. The CLI commands pushed by the system include the following:

- Device credentials (CLI and SNMP)
- Enable SSH v2 and SCP server
- Disable HTTP and HTTPS servers
- For switches, vtp mode transparent is enabled

Note When Device Controllability is enabled for a device (it is enabled by default), additional configurations are pushed to the device when it is added to the inventory or assigned to a site. For more information, see the Device Controllability section in the *Cisco DNA Center Administrator Guide*.

This procedure shows how to claim a device from the Plug and Play Devices list. Alternatively, you can claim a device from the device details window by clicking **Claim**.

Before you begin

- Ensure that Cisco network devices to be provisioned have a supported software release and are in a factory default state. If you are using a network device that was previously configured or is in an unknown state, see the device clean-up and reset details in the Network Plug and Play Troubleshooting Guide for Cisco Digital Network Architecture Center.
- Ensure that the devices being provisioned can discover and contact Cisco DNA Center. For more information, see Controller Discovery Prerequisites, on page 355.
- Define the site within the network hierarchy. See Network Hierarchy Overview, on page 121.
- Define the CLI and SNMP credentials for the devices. If you are using SNMPv2c, you must provide both Read and Write credentials. See Global Device Credentials Overview, on page 173.
- Optionally, ensure that software images for the devices to be provisioned are uploaded and marked as golden in the Image Repository, if you want to deploy images. See Import a Software Image, on page 329.

  Note The image deployment process used by Plug and Play during Day-0 provisioning is not the same as that used when updating a device image later, which is described in Provision a Software Image, on page 334. During Plug and Play provisioning, there are no device prechecks, auto flash cleanup, or post-checks done, as it is expected that devices are in the factory default state.

- Optionally, define Onboarding Configuration templates to be applied to devices. Such templates contain basic network configuration commands to onboard a device so that it can be managed on the network. See Create Templates to Automate Device Configuration Changes, on page 293.

  Note You can use the `ip http client source-interface` CLI command in the Onboarding Configuration template, which makes Cisco DNA Center use that IP address as the management IP address for the device, especially for the scenario of multiple IPs or VRFs.

- Define network profiles for the devices. See Network Profiles Overview, on page 225.

Step 1 Click the menu icon (≡) and choose **Provision** > **Plug and Play**.

Step 2 View the devices in the table.

You can use the **Filter** or **Find** option to find specific devices.

Step 3 Check the check box next to one or more devices that you want to claim.

Step 4 Click **Actions** > **Claim** in the menu bar above the device table.

The **Claim Devices** window opens, showing the first step, **Assign Site**. If, instead, you see a window that shows mandatory tasks such as defining a site and defining device credentials, you must click **Add Site** to define a site, and **Add device credentials** to define device credentials. These are prerequisites for the claim process and, after these tasks are completed, you can return to claiming a device by clicking **Refresh** in this window.

Step 5 (Optional) Change the device hostname, if needed, in the first column.

Step 6 From the **Select a Site** drop-down list, choose a site to assign to each device.

To apply the same site as the first device to all other devices, click the **Apply Site to All** check box. To assign the site from any device to some other devices, click **Assign this Site to Other Devices**, choose the devices, and click **Assign**.

Step 7 Click **Next**.
The **Assign Configuration** window appears.

Step 8 (Optional) Make global changes to the device table:

a) Change which columns are displayed in the table by clicking the three dots at the right end of the table headings and choosing the desired columns. Click **Apply** to save the changes.
b) Click **Clear Device Certificates** to clear any device certificates configured for devices. Check the check box for each device you want to clear the certificate from, and click **Clear**.
c) Click **Clear Images** to clear the default images configured for devices. Check the check box for each device you want to clear the image from, and click **Clear**.
d) Click **Clear Templates** to clear the default templates configured for devices. Check the check box for each device you want to clear the template from, and click **Clear**.
e) Click **Clear License Levels** to clear the license levels configured for devices. Check the check box for each device you want to clear the license level from, and click **Clear**.
f) You can apply an image or template from one device to other devices by clicking the three dots in the **Actions** column next to a device and choosing **Apply Image to Other Devices** or **Apply Template to Other Devices**. For stacked devices, you can apply the device license level to other devices by clicking **Apply License Level to Other Devices**.

Step 9 In the **Configuration** column, click **Assign** for the device that you want to configure and follow these steps:

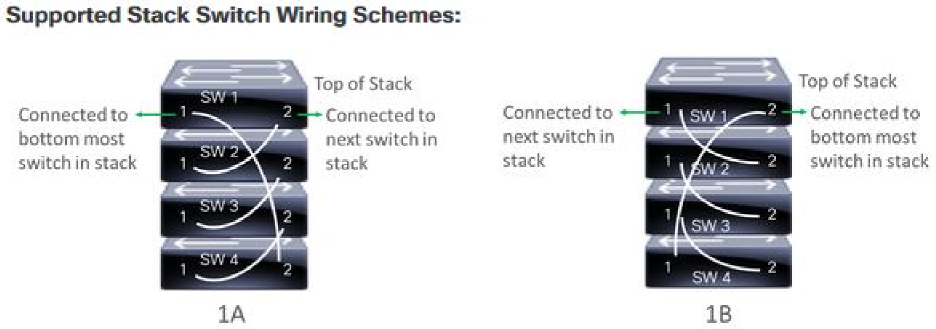
a) View the device configuration summary and click **Cancel** if no changes are needed.
b) (Optional) Check **Apply the PKCS12 device certificate on the device** to deploy a PKCS12 certificate to the device. This option is available only for routers.
c) (Optional) In the **Device Name** field, change the device hostname, if needed.
d) (Optional) In the **Image** drop-down list, choose a golden software image to apply to the device. If there is only one golden image for this device type in the image repository, it is chosen by default.
e) (Optional) In the **Template** drop-down list, choose an onboarding configuration template to apply to the device. If there is only one onboarding configuration template for this device type defined, it is chosen by default.

   Click **Preview** next to a selected template to view the template.

f) (Optional) In the **Select a Cabling Scheme** drop-down list, choose the stack cabling scheme, if you want to renumber the stack.

   This item appears only for switches that support stacking, and only if they are connected as shown in one of the following cabling schemes.

Figure 39: Cabling Schemes


Supported Stack Switch Wiring Schemes:
Top of Stack
Connected to bottom most switch in stack
Connected to next switch in stack
SW 1
SW 2
SW 3
SW 4
1
2
1A
Top of Stack
Connected to next switch in stack
Connected to bottom most switch in stack
1B

g) (Optional) In the **Select a Top of Stack serial Number** drop-down list, choose the serial number of the top-of-stack switch, if you want to renumber the stack.

This item appears only for switches that support stacking, and only if they are connected as shown in the image.

h) (Optional) In the **Select a License Level** drop-down list, choose the stack license level.

This item appears only for switches that support stacking.

i) If you made any changes, click **Save**; otherwise, click **Cancel** to return to the list and configure other devices.

Step 10 If you selected multiple devices to provision, click **Assign** for the next device in the list and repeat the configuration steps, until you have done this for all devices.

Step 11 Click **Next**.

The **Provision Templates** window appears, where you can specify the values for parameters that were defined in the template.

Step 12 Click the name of a device that you want to configure and follow these steps:

a) Specify the values for the parameters that were defined in the template, if the device was assigned a configuration template.

Enter the values for each parameter in the fields for each device. A red asterisk indicates a required field.

b) If you want to copy the running configuration to the startup configuration on the selected device, check **Copy running config to startup config**.

c) If you selected multiple devices to provision, click the next device in the list at the left side of the window and enter the parameter values, until you have done this for all devices.

Step 13 To specify parameter values for all devices in bulk, do the following:

a) Click **Export** to save the CSV template file.
b) Add the values for each of the parameters to the file and save the file.
c) Click **Import**.
d) Drag and drop the file to the drag and drop area, or click where it says "**click** to select" and select the file.
e) Click **Import**.

Step 14 Click **Next**.

The **Summary** window appears, where you can view details about the devices and their configuration preview status.

Step 15 Check the **Day-0 Config** column for each device to see if the configuration preview was successful.

If the preview shows an error, click the **Actions** link in the error message above the table to see what actions you need to take. You can click an action to open a new tab with the window where a change is needed. You must resolve any issues before claiming the device, to avoid provisioning errors. You may need to go back to the **Provision Templates** step and change parameter values, change the template, revisit the **Design** area to update network design settings, or resolve any network connectivity issues. After you have resolved the problem, you can go back to this tab, click **Retrying getting Day-0 configuration preview for failed device(s)**, and click **OK**.

Step 16 Click the link in the **Day-0 Config** column to see more information about the device, its configuration, and any configuration preview errors.

Step 17 Click **Claim**.

Step 18 In the confirmation dialog box, click **Yes** to claim the devices.

What to do next

To complete the provisioning process, after the device is added to the inventory, go to the **Inventory** tab, select the device, and choose **Actions** > **Provision** > **Provision Device**. Proceed through all the steps and click **Deploy** in the **Summary** step. In the **Summary**, you can see the remaining network settings that will be pushed to the device. For more information, see Wireless Device Provisioning Overview, on page 377. This process is required if you intend to push the network settings that you may have configured in the **Design** area. During Plug and Play provisioning, only the device credentials and the Onboarding Configuration are pushed to the device; no other network settings are pushed until provisioning is completed from **Inventory**. Additionally, the device is added to Cisco ISE by Cisco DNA Center as a AAA client for RADIUS and TACACS, if these are configured.

Provision a Wireless or Sensor Device

Claiming a wireless device provisions it by assigning a configuration to the device and adding it to the inventory. If you claim a device that has not yet booted for the first time, you are planning the device so that it is automatically provisioned when it boots up.

Note When Device Controllability is enabled for a device (it is enabled by default), additional configurations are pushed to the device when it is added to the inventory or assigned to a site. For more information, see the Device Controllability section in the *Cisco DNA Center Administrator Guide*.

This procedure explains how to claim a device from the Plug and Play Devices list. Alternatively, you can claim a device from the device details window by clicking **Claim**.

Before you begin

- Ensure that Cisco network devices to be provisioned have a supported software release and are in a factory default state. If you are using a network device that was previously configured or is in an unknown state, see the device clean-up and reset details in the Network Plug and Play Troubleshooting Guide for Cisco DNA Center.
- Ensure that the devices being provisioned can discover and contact Cisco DNA Center. For more information, see Controller Discovery Prerequisites, on page 355.
- Define the site within the network hierarchy. See Network Hierarchy Overview, on page 121.

- Define the CLI and SNMP credentials for the devices. See Global Device Credentials Overview, on page 173.

Note You can claim wireless devices using CLI, SNMPv2c, or SNMPv3 credentials. If you use SNMPv2c, provide both Read Only and Read Write credentials.

- For provisioning a wireless AP device, ensure that the wireless LAN controller that is managing the wireless AP has been added to the inventory and assigned to the site where the wireless device is to be assigned. This is not needed for a Mobility Express AP.
- Optionally, ensure that the software images for any Cisco Catalyst 9800-CL devices to be provisioned are uploaded and marked as golden in the Image Repository, if you want to deploy images. See Import a Software Image, on page 329.

Note The image deployment process used by Plug and Play during Day-0 provisioning is not the same as that used when updating a device image later, which is described in Provision a Software Image, on page 334. During Plug and Play provisioning, there are no device prechecks, auto flash cleanup, or postchecks done, as it is expected that devices are in the factory default state.

- For provisioning a sensor device, ensure that the sensor is reachable through the Cisco DNA Center enterprise IP address (private/enp9s0). A DHCP option 43 string makes the device reachable in unclaimed mode in Cisco DNA Center; however, to claim the device, it must be reachable from the interface enp9s0 IP address. In the DHCP server, configure the NTP server (DHCP option 42) and the vendor-specific DHCP option 43 with ACSII value "5A1D;B2;K4;I172.16.x.x;J80;", where 172.16.x.x is the virtual IP address of Cisco DNA Center associated with the enp9s0 interface.
- Define wireless radio frequency profiles for wireless AP devices, except for Mobility Express APs. See Create a Wireless Radio Frequency Profile, on page 202.
- For Mobility Express APs, define an IP address pool and a management interface. See Configure IP Address Pools, on page 182.

Step 1 Click the menu icon (≡) and choose **Provision** > **Plug and Play**.

Step 2 View the devices in the table.

You can use the **Filter** or **Find** option to find specific devices.

Step 3 Check the check box next to one or more wireless devices that you want to claim.

Step 4 From the menu bar above the device table, choose **Actions** > **Claim**.

The **Claim Devices** window opens, showing the first step, **Assign Site**. If, instead, you see a window that shows mandatory tasks such as defining a site and defining device credentials, you must click **Add Site** to define a site, and **Add device credentials** to define device credentials. These are prerequisites for the claim process and, after these tasks are completed, you can return to claiming a device by clicking **Refresh** in this window.

Step 5 (Optional) Change the device name, if needed, in the first column.

Step 6 (Optional) Change the device type, if needed, in the second column. You can choose AP or ME (Mobility Express), depending on which mode the device is using.

Choosing the wrong mode causes an error provisioning the device. This item does not appear for wireless LAN controller or sensor devices.

Step 7 From the **Select a Site** drop-down list, choose a site and floor to assign to each device. AP devices must be assigned to a floor with a wireless controller.

To apply the same site as the first device to all other devices, check the **Apply Site to All** check box. To assign the site from any device to some other devices, click **Assign this Site to Other Devices**, choose the devices, and click **Assign**. Wireless devices can be assigned only to floors within a building, not to the building itself.

Step 8 Click **Next**.
The **Assign Configuration** window appears.

Step 9 (Optional) You can change which columns are displayed in the table by clicking the three dots at the right end of the table headings and choosing the desired columns. Click **Apply** to save the changes.

Step 10 In the **Configuration** column, click **Assign** for the device that you want to configure and follow these steps:

a) View the device configuration summary and click **Cancel** if no changes are needed.
b) (Optional) In the **Device Name** field, change the device name, if needed.
c) For an AP device, in the **Radio Frequency Profile** drop-down list, choose a radio frequency profile to apply to the device. This may be set if you designated one profile as a default.
d) For a wireless LAN controller, enter values in the following fields: **Wireless management IP**, **Subnet mask**, **Gateway**, **IP interface name**, and optionally, **VLAN ID**.
e) For a Mobility Express device, enter values in the following fields: **Wireless management IP**, **Subnet mask**, and **Gateway**.
f) For a wireless sensor device, in the **Sensor Settings** drop-down list, choose the sensor device profile (backhaul) to apply to the device.

Note For Cisco Aironet 1800s Active Sensor earlier than Release 1.3.1.2, make sure that you do not choose the sensor device profile `CiscoProvisioningSSID`. Instead, choose your own SSID for backhaul purposes.

g) If you made any changes, click **Save**; otherwise, click **Cancel** to return to the list and configure other devices.
h) You can apply a configuration that you assigned to one device to other devices of the same type by clicking **Apply … to Other Devices** in the **Actions** column.

Step 11 If any devices are a Cisco Catalyst 9800-CL Wireless Controller, click **Assign** next to **Image** in the **Configuration** column and follow these steps:

a) (Optional) In the **Image** drop-down list, choose a golden software image to apply to the device. If there is only one golden image for this device type in the image repository, it is chosen by default.
b) Click **Save**.

Step 12 If you selected multiple devices to provision, click **Assign** for the next device in the list and repeat the configuration, until you have done this for all devices.

Step 13 Click **Next**.
The **Summary** window appears, where you can view details about the devices and configuration.

Step 14 Check the **Day-0 Config** column for each device to see if the configuration preview was successful.

If the preview shows an error, you can click the **Actions** link in the error message above the table to see what actions you need to take. You can click an action to open a new tab with the window where a change is needed. You must resolve any issues before claiming the device, to avoid provisioning errors. You may need to go back to the **Assign**

Configuration step and change the configuration, revisit the **Design** area to update network design settings, or resolve any network connectivity issues. After you have resolved the problem, you can go back to this tab, click **Retrying getting Day-0 configuration preview for failed device(s)**, and click **OK**. Ensure that the wireless LAN controller that is managing a device has been added to the inventory and assigned to the site where the wireless device is assigned.

Step 15 Click **Claim**.

Step 16 In the confirmation dialog box, click **Yes** to claim the devices and start the provisioning process.

What to do next

To complete the provisioning process, after the device is added to the inventory, go to the **Inventory** tab, select the device, and choose **Actions** > **Provision** > **Provision Device**. Proceed through all the steps and click **Deploy** in the **Summary** step. In the **Summary**, you can see the remaining network settings that will be pushed to the device. For more information, see Wireless Device Provisioning Overview, on page 377. This process is required if you intend to push the network settings that you may have configured in the **Design** area. During Plug and Play provisioning, only the device credentials and the Onboarding Configuration are pushed to the device; no other network settings are pushed until provisioning is completed from **Inventory**. Additionally, the device is added to Cisco ISE by Cisco DNA Center as a AAA client for RADIUS and TACACS, if these are configured.

Provision a Cisco DNA Traffic Telemetry Appliance

This procedure explains how to claim a Cisco DNA Traffic Telemetry Appliance from the Plug and Play Devices list.

Before you begin

- Ensure that the Cisco network devices to be provisioned have a supported software release and are in a factory default state. If you are using a network device that was previously configured or is in an unknown state, see the device clean-up and reset details in Network Plug and Play Troubleshooting Guide for Cisco DNA Center.
- Ensure that the devices being provisioned can discover and contact Cisco DNA Center.
- Define the site within the network hierarchy. See Network Hierarchy Overview, on page 121.
- Define the CLI and SNMP credentials for the devices. If you are using SNMPv2c, you must provide both Read and Write credentials.

Note SNMPv3 limitations:

- Supports SHA for Auth and AES128 for privacy.
- Does not support MD5.

- If you want to deploy images, ensure that the software images for the devices to be provisioned are uploaded and marked as golden in the Image Repository. See Import a Software Image, on page 329.

Note The image deployment process that Plug and Play uses during Day-0 provisioning is not the same as the deployment process used when updating a device image later. For information, see Provision a Software Image, on page 334. During provisioning, Plug and Play performs no device prechecks, auto flash cleanup, or postchecks. The device must be in the factory default state.

- Define network profiles for the devices. See Create Network Profile for Cisco DNA Traffic Telemetry Appliance, on page 231.

Step 1 Click the menu icon (≡) and choose **Provision** > **Plug and Play**.

Step 2 View the devices in the table.

You can use the **Filter** or **Find** option to find the Cisco DNA Traffic Telemetry Appliance.

Step 3 Check the check box next to one or more devices that you want to claim.

Step 4 From the menu bar above the device table, choose **Actions** > **Claim**.

The **Claim Devices** window opens, showing the first step, **Assign Site**. If instead, you see a window that shows mandatory tasks such as defining a site and defining device credentials, you must click **Add Site** to define a site, and **Add device credentials** to define device credentials. These mandatory tasks are prerequisites for the claim process. After these tasks are completed, you can return to claiming a device by clicking **Refresh** in this window.

Step 5 (Optional) Change the device hostname, if needed, in the first column.

Step 6 From the **Select a Site** drop-down list, choose a site to assign to each device.

To apply the same site as the first device to all other devices, check the **Apply Site to All** check box. To assign the site from any device to some other devices, click **Assign this Site to Other Devices**, choose the devices, and click **Assign**.

Step 7 Click **Next**.
The **Assign Configuration** window appears.

Step 8 In the **Configuration** column, click **Assign** for the device that you want to configure and follow these steps:

a) View the device configuration summary and, if no changes are needed, click **Cancel**.
b) (Optional) In the **Device Name** field, change the device hostname, if needed.
c) (Optional) In the **Image** drop-down list, choose a golden software image to apply to the device. If there is only one golden image for this device type in the image repository, it is chosen by default.
d) If you made any changes, click **Save**. Otherwise, click **Cancel** to return to the list and configure other devices.

Step 9 If you selected multiple devices to provision, click **Assign** for the next device in the list. Repeat the configuration steps until you have configured all devices.

Step 10 Click **Next**.

The **Summary** window appears, where you can view details about the devices and their configuration preview status.

Step 11 Check the **Day-0 Config** column for each device to see if the configuration preview was successful.

If the preview shows an error, click the **Actions** link in the error message above the table to see what actions you need to take. Click an action to open a new tab with the window where a change is needed. To avoid provisioning errors, you must resolve any issues before claiming the device. You may need to revisit the **Design** area to update network design settings or resolve any network connectivity issues. After you resolve the problem, return to this tab, click **Retrying getting Day-0 configuration preview for failed device(s)**, and click **OK**.

Step 12 Click the link in the **Day-0 Config** column to see more information about the device, its configuration, and any configuration preview errors.

Step 13 Click **Claim**.

Step 14 In the confirmation dialog box, click **Yes** to claim the devices.

What to do next

To complete the provisioning process, after the device is added to the inventory, go to the **Inventory** tab, select the device, and choose **Actions** > **Provision** > **Provision Device**. Proceed through all the steps and click **Deploy** in the **Summary** step. In the **Summary** window, you can see the remaining network settings that are pushed to the device. For more information, see Wireless Device Provisioning Overview, on page 377. This process is required if you intend to push the network settings that you may have configured in the **Design** area. During Plug and Play provisioning, only the device credentials and the Onboarding Configuration are pushed to the device; no other network settings are pushed until provisioning is completed from **Inventory**.

Delete a Device

Deleting a device removes it from the Plug and Play database but does not reset the device. Use **Reset** if you want to reset a device that is in the Error state.

This procedure explains how to delete a device from the Plug and Play Devices list. Alternatively, you can delete a device from the device details window by clicking **Delete**.

Note If a device is in the Provisioned state, it can be deleted only from the **Inventory** tab.

Step 1 Click the menu icon (≡) and choose **Provision** > **Plug and Play**.

Step 2 View the devices in the table.

You can filter on device state by using one of the **Device State** buttons, or use the **Filter** option to find specific devices. Click **Refresh** to refresh the device list.

Step 3 Check the check box next to one or more devices that you want to delete.

Step 4 From the menu bar above the device table, choose **Actions** > **Delete**.

Step 5 Click **Yes** to confirm that you want to delete the devices.

Reset a Device

Resetting a device applies only to devices in the Error state and resets its state to Unclaimed and reloads the device, but does not remove it from the Plug and Play database. Use **Delete** if you want to delete a device.

Note If the saved configuration on the device is the factory default or a similar minimal configuration, then this option causes the device to restart the provisioning process. However, if the device has a previously saved startup configuration, then this could prevent the device from restarting the provisioning process and it will need to be reset to factory defaults. On wireless and sensor devices, only the device state is reset and the device is not reloaded.

This procedure shows how to reset a device from the Plug and Play Devices list. Alternatively, you can reset it from the device details window by clicking **Reset**.

Step 1 Click the menu icon (≡) and choose **Provision** > **Plug and Play**.

Step 2 View the devices in the table.

You can filter on device state by using one of the **Device State** buttons, or use the **Filter** option to find specific devices. Click **Refresh** to refresh the device list.

Step 3 Check the check box next to one or more devices that you want to reset.

Step 4 Click **Actions** > **Reset** in the menu bar above the device table.

A confirmation dialog box is displayed.

Step 5 Choose one of the following options:

- **Reset and keep current claim parameters**—Keep the current claim parameters and the device goes to the Planned state.
- **Reset and remove all claim parameters**—Remove the current claim parameters and the device goes to the Unclaimed state.

Step 6 Click **Reset**.

CHAPTER 17

Provision Wireless Devices

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- Provision a Cisco AireOS Controller, on page 378
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- Enable ICMP Ping on APs in FlexConnect Mode, on page 385
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- Brownfield Support for Cisco AireOS Controllers, on page 387
- Configure and Provision a Cisco Catalyst 9800 Series Wireless Controller, on page 390
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Wireless Device Provisioning Overview

The following sections provide information about how to provision various Cisco wireless devices.

About Wireless Devices and Country Codes

Controllers and access points are designed for use in many countries with varying regulatory requirements. The radios within the access points are assigned to a specific regulatory domain at the factory (such as -E for Europe), but the country code enables you to specify a particular country of operation within that regulatory domain (such as FR for France or ES for Spain). Configuring a country code ensures that each radio's broadcast frequency bands, interfaces, channels, and transmit power levels are compliant with country-specific regulations.

Cisco DNA Center provisions controllers with country codes according to the site they are assigned. In the case of controllers, they can be assigned to more than one site. So, they can be assigned more than one country code. During provisioning, Cisco DNA Center assigns sites to the controller along with the sites' country codes. For example, a controller that manages both India and US sites is assigned the IN and US country codes.

When access points are provisioned, they are assigned to a floor. If the access point is a ROW AP, Cisco DNA Center gets the country code for the site and assigns it to the AP. Any additional APs on the same floor are assigned the same country code.

The country code information is displayed on the device 360 page for controllers and access points.

For a complete list of country codes supported per product, see https://www.cisco.com/c/dam/assets/prod/wireless/wireless-compliance-tool/index.html.

Provision a Cisco AireOS Controller

Before you begin

- Make sure that you have defined the following global network settings before provisioning a Cisco Wireless Controller:
    - Network servers, such as AAA, DHCP, and DNS.

      For more information, see Configure Global Network Servers, on page 173.
    - Device credentials, such as CLI, SNMP, HTTP, and HTTPS.

      For more information, see Configure Global CLI Credentials, on page 173, Configure Global SNMPv2c Credentials, on page 174, Configure Global SNMPv3 Credentials, on page 175, and Configure Global HTTPS Credentials, on page 177.
    - IP address pools.

      For more information, see Configure IP Address Pools, on page 182.
    - Wireless settings, such as SSIDs, wireless interfaces, and wireless radio frequency profiles.

      For more information, see Configure Global Wireless Settings, on page 188.
- Make sure that you have the Cisco Wireless Controller in your inventory. If not, use the **Discovery** feature to discover the controller.
- Make sure that the Cisco Wireless Controller is added to a site. For more information, see Add a Device to a Site, on page 90.
- You cannot reuse any pre-existing VLANs on devices. Provisioning fails if Cisco DNA Center pushes the same VLAN that already exists on the device.
- You cannot make any configuration changes to the wireless controller that is being managed by the Cisco DNA Center manually. You must perform all configurations from the Cisco DNA Center GUI.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** window appears, with the discovered devices listed.

Step 2 Expand the **Global** site in the left pane, and select the site, building, or floor that you are interested in.

The available devices in the selected site is displayed in the **Inventory** window.

Step 3 From the **DEVICE TYPE** list, click the **WLCs** tab, and from the **Reachability** list, click the **Reachable** tab to get the list of wireless controllers that are discovered and reachable.

Step 4 Check the check box next to the device name that you want to provision.

Step 5 From the **Actions** drop-down list, choose **Provision** > **Provision Device**.

The **Assign Site** window appears.

Step 6 Click **Choose a site** to assign a site for the wireless controller.

Step 7 In the **Add Sites** window, check the check box next to the site name to associate the wireless controller, and click **Save**.

Step 8 Click **Apply**.

Step 9 Click **Next**.

The **Configuration** window appears.

Step 10 Select a role for the wireless controller: **Active Main WLC** or **Guest Anchor WLC**.

Step 11 Click **Select Primary Managed AP Locations** to select the managed AP location for the wireless controller.

Step 12 In the **Managed AP Location** window, check the check box next to the site name. You can either select a parent site or the individual sites. If you select a parent site, the children under that parent site automatically gets selected.

Note Inheritance of managed AP locations allows you to automatically choose a site along with the buildings and floors under that site. One wireless controller can manage only one site.

Step 13 Click **Save**.

Step 14 Under **Interface and VLAN Configuration**, click **+ Add** and configure the interface and VLAN details for an active main wireless controller.

Interface and VLAN configuration is applicable for nonfabric wireless controller provisioning only.

The **Configure Interface and VLAN** window appears.

Step 15 From the **Interface Name** drop-down list, choose the interface name.

Step 16 In the **VLAN ID** field, enter a value for the VLAN.

Step 17 In the **Interface IP Address** field, enter a value for the interface IP address.

Step 18 In the **Interface Net Mask (in bits)** field, enter the subnet mask for the interface.

Step 19 In the **Gateway IP Address** field, enter the gateway IP address.

Step 20 From the **LAG/Port Number** drop-down list, choose the link aggregation or the port number.

Step 21 Click **OK**.

Step 22 (Optional) For a guest anchor wireless controller, change the VLAN ID configuration by changing the **VLAN ID** under **Assign Guest SSIDs to DMZ site**.

Step 23 Under **Mobility Group**, click **Configure** to configure the wireless controller as the mobility peer.

The **Configure Mobility Group** side panel appears.

Step 24 From the **Mobility Group Name** drop-down list, you can either add a new mobility group by clicking **+**, or choose a mobility group from the existing mobility groups.

The existing mobility peers information is loaded from the intent available in the Cisco DNA Center.

Step 25 In the **RF Group Name** text box, enter a name for the RF group.

Step 26 Under **Mobility Peers**, click **Add** to configure the wireless controller as a mobility peer.

Step 27 From the **Device Name** drop-down list, choose the controller.

After the device is provisioned, Cisco DNA Center creates a mobility group in the device, assigns the RF group, and configures all ends of peers. The mobility group configuration is deployed automatically to all the selected peer devices.

Step 28 Click **Save**.

Step 29 To reset the mobility group name and the RF group name, you can do one of the following:

- In the **Configure Mobility Group** side panel, choose **default** from the **Mobility Group Name** drop-down list.
- On the **Provision** > **Configuration** page, under **Mobility Group**, click **Reset**.

This automatically sets the **RF Group Name** to **default** and removes all peers. After provisioning, the mobility on the device is set and the device is removed from all other peers.

Step 30 Click **Next**.

The **Model Configuration** window appears.

Step 31 In the **Devices** pane, you can either search for a model config design by entering its name in the **Find** field, or expand the device and select a model config design.

The selected model config design appears in the right pane.

Step 32 Check the check box next to the **Design Name** that you want to provision, and click **Configure** to edit the model config design.

You cannot edit all the configurations at this step.

Step 33 After making the necessary changes, click **Apply**.

Step 34 Click **Next**.

The **Advanced Configuration** window appears, where you can enter values for predefined template variables.

Step 35 Search for the device or the template in the **Devices** panel.

Step 36 Enter a value for the predefined template variable in the **wlanid** field.

Step 37 Click **Next**.
The **Summary** window displays the following information:

- **Device Details**
- **Network Settings**
- **SSID**
- **Managed Sites**
- **Interfaces**
- **Advanced Configuration**
- **Mobility Group Configuration**
- **Model Config**

Step 38 Click **Deploy** to provision the controller.

Step 39 In the **Provision Devices** window, do the following to preview the CLI configuration:

- Click **Generate Configuration Preview** radio button.

- In the **Task Name** field, enter a name for the CLI preview task and click **Apply**.
- In the **Task Submitted** message, click the **Work Items** link.

  Note If you didn't notice the **Task Submitted** message, click the menu icon (≡) and choose **Activities** > **Work Items**.

- In the **Work Items** window, click the CLI preview task for which you submitted the configuration preview request.
- View the CLI configuration details and click **Deploy**.
- To immediately deploy the device, click the **Now** radio button, and click **Apply**.
- To schedule the device deployment for a later date and time, click the **Later** radio button and define the date and time of the deployment.
- In the **Information** pop-up, do the following:
  - Click **Yes**, if you want to delete the CLI preview task from the **Work Items** window.
  - Click **No**, if you want to retain the task in the **Work Items** window.

    Note The CLI task will be marked as completed in the **Work Items** window. You can view the CLI configuration for this task but you cannot deploy it again.

Step 40 Provision the secondary controller.

Step 41 The **Status** column in the **Device Inventory** window shows `SUCCESS` after a successful deployment.

After provisioning, if you want to make any changes, click **Design**, change the site profile, and provision the wireless controller again.

Step 42 After the devices are deployed successfully, the **Provision Status** changes from **Configuring** to **Success**.

Step 43 In the **Device Inventory** window, click **See Details** in the **Provision Status** column to get more information about the network intent or to view a list of actions that you need to take.

Step 44 Click **See Details** under **Device Provisioning**.

Step 45 Click **View Details** under **Deployment of network intent**, and click the device name.

Step 46 Expand the **Configuration Summary** area to view the operation details, feature name, and the management capability.

The configuration summary also displays any errors that occurred while provisioning the device.

Step 47 Expand the **Provision Summary** area to view details of the exact configuration that is sent to the device.

Configure Cisco Wireless Controller High Availability

Cisco Wireless Controller High Availability (HA) can be configured through Cisco DNA Center. Currently, both the formation and breaking of wireless controller HA is supported; switchover options are not supported.

Prerequisites for Configuring Cisco Wireless Controller High Availability

- The discovery and inventory features of wireless controller 1 and wireless controller 2 must be successful. The devices must be in Managed state.

- The service ports and the management ports of wireless controller 1 and wireless controller 2 must be configured.
- The redundancy ports of wireless controller 1 and wireless controller 2 must be physically connected.
- The management address of wireless controller 1 and wireless controller 2 must be in the same subnet. The redundancy management address of wireless controller 1 and wireless controller 2 must also be in the same subnet.
- Manually configure the following boot variables on the wireless controller:

```
config t
boot system bootflash::<device_iosxe_image_filename>
config-register 0x2102

show boot.  (IOSXE cli)

BOOT variable = bootflash:<device_iosxe_image_filename>,12;
Configuration register is 0x2102
```

Configure Cisco Wireless Controller HA

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** window appears, with the discovered devices listed.

Step 2 Check the check box next to the controller name that you want to configure as the primary controller.

Step 3 From the **Actions** drop-down list, choose **Provision** > **Configure WLC HA**.

The **High Availability** page appears.

Step 4 Enter the **Redundancy Management IP** and the **Peer Redundancy Management IP** address in the respective text boxes.

The IP addresses used for redundancy management IP and peer redundancy management IP should be configured in the same subnet as the management interface of the Cisco Wireless Controller. Ensure that these IP addresses are unused IP addresses within that subnet range.

Step 5 From the **Select Secondary WLC** drop-down list, choose the secondary controller.

Note When you select secondary controller, based on the wireless management interface IP subnet of primary controller, redundancy management IP auto populates and an **i** icon appears on the top of **High Availability** window, saying **Please make sure the Redundancy Management IP and Peer Redundancy Management IP are not assigned to any other network entities. If used, kindly change the IP accordingly and configure**.

Step 6 Click **Configure HA**.
The HA configuration is initiated in the background using the CLI commands. First, the primary wireless controller is configured. On success, the secondary wireless controller is configured. After the configuration is complete, both wireless controllers reboot. This process may take up to 2.5 minutes to complete.

Step 7 To verify the HA configuration, on the **Devices** > **Inventory** page, click the device that you configured as a HA device.

Step 8 Click the **Wireless Info** tab.

The **Redundancy Summary** displays the **Sync Status** as **In Progress**. When Cisco DNA Center finds that HA pairing succeeded, the **Sync Status** changes to **Complete**.

This is triggered by the inventory poller or by manual resynchronization. By now, the secondary wireless controller (wireless controller 2) is deleted from Cisco DNA Center. This flow indicates successful HA configuration on the wireless controller.

What Happens During or After the High Availability Process is Complete

1. Cisco wireless controller 1 and wireless controller 2 are configured with redundancy management, redundancy units, and SSO. The wireless controllers reboot in order to negotiate their role as active or stand by. Configuration is synced from active to stand by.
2. On the **Show Redundancy Summary** window, you can see these configurations:
    - SSO is Enabled
    - Wireless Controller is in Active state
    - Wireless Controller is in Hot Stand By state
3. The management port of the active wireless controller is shared by both the controllers and will be pointing to active controller. The user interface, Telnet, and SSH on the stand by wireless controller will not work. You can use the console and service port interface to control the stand by wireless controller.

Commands to Configure and Verify High Availability

Cisco DNA Center sends the following commands to configure Cisco Wireless Controller HA.

Cisco DNA Center sends the following commands to wireless controller 1:

- **config interface address redundancy-management 198.51.100.xx peer-redundancy-management 198.51.100.yy**
- **config redundancy unit primary**
- **config redundancy mode sso**

Cisco DNA Center sends the following commands to wireless controller 2:

- **config interface address redundancy-management 198.51.100.yy peer-redundancy-management 198.51.100.xx**
- **config redundancy unit secondary**
- **config port adminmode all enable**
- **config redundancy mode sso**

Enter the following commands to verify the HA configuration from the wireless controller:

- To check HA-related details: **config redundancy mode sso**
- To check the configured interfaces: **show redundancy summary**

Disable High Availability Configured Brownfield Device from Cisco DNA Center

The Cisco DNA Center disable high-availability feature is supported on Cisco Catalyst 9800 Series Wireless Controllers and Cisco AireOS Controllers.

Before you begin

Ensure that the high availability brownfield device is configured outside of Cisco DNA Center.

Step 1 Click the menu icon (≡) and choose **Provision** > **Device** > **Inventory**.

The **Inventory** window appears, with the discovered devices listed.

Step 2 Check the check box next to the name of the wireless controller that has the high-availability feature that you want to disable.

Step 3 From the **Actions** drop-down list, choose **Provision** > **Configure WLC HA**.

The **High Availability** page appears.

High Availability page shows the **REDUNDANCY SUMMARY** of selected wireless controller configured from outside Cisco DNA Center.

Step 4 In the **Warning** window, click **OK**.

A success message appears at the bottom of the screen indicating that high availability has been successfully disabled for the selected wireless controller.

Provision a Cisco AP—Day 1 AP Provisioning

Before you begin

Make sure that you have Cisco APs in your inventory. If not, use the Discovery feature to discover APs. For more information, see Discover Your Network, on page 33.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** window displays the device information that is gathered during the Discovery process.

Note You can either search for a site by entering its name or expand **Global** to select the site. Devices that are available in the selected site are displayed in the **Inventory** window.

To filter the devices based on various criteria, such as **Device Family** or **Reachability Status**, click **Filter**, make your selections, then click **Apply**.

Step 2 Check the check box next to the AP that you want to provision.

Step 3 From the **Action** drop-down list, choose **Provision** > **Provision Device**.

Step 4 In the **Assign Site** step, configure the following parameters:

a) Click **Choose a floor** and assign an AP to the site.

b) In the **Choose a floor** slide-in pane, select the floor where the AP resides, and click **Save**.
c) Click **Next**.

Step 5 In the **Configuration** step, configure the following parameters:

a) Click **Advanced Configuration** to configure radio antenna profiles on antenna slots.

Note Advanced configuration is supported on Cisco Catalyst 9130AXE Unified Access Points with Cisco Catalyst 9800 Series Wireless Controller software release 17.6 or later.

b) Configure the beam selection value for AP radio slot 1 and slot 2 from the **Slot 1** and **Slot 2** drop-down list.
c) Click **Save**.
d) In the **RF Profile** drop-down list, leave the default setting or choose a different value from the list. The options are **High**, **Typical**, and **Low**.

The default RF profile is the custom profile that you marked as default under **Design** > **Network Settings** > **Wireless** > **Wireless Radio Frequency Profile**.

e) In the **Mesh Role** drop-down list, choose **Root** or **Mesh**.
f) Click **Next**.

Step 6 In the **Summary** step, review the device details, and click **Deploy** to provision the AP.

The **Provision Device** slide-in pane appears.

Step 7 In the **Provision Device** slide-in pane, do the following:

- To immediately deploy the device, click the **Now** radio button, and click **Apply**.
- To schedule the device deployment for a later date and time, click the **Later** radio button and define the date and time of the deployment.
- To preview the CLI configuration, click the **Generate Configuration Preview** radio button.

Step 8 You are prompted with a message that creation or modification of an AP group is in progress, and then a message that APs will reboot after provisioning. Click **OK**.

The **Last Sync Status** column in the **Inventory** window shows `SUCCESS` for a successful deployment.

Enable ICMP Ping on APs in FlexConnect Mode

You can enable Internet Control Message Protocol (ICMP) ping on APs that are in FlexConnect mode and in an unreachable state. Cisco DNA Center uses the ICMP to ping FlexConnect APs that are in unreachable state every 5 minutes to enhance reachability and then updates the reachability status in the **Inventory** window.

Step 1 Click the menu icon (☰) and choose **System** > **Settings** > **Device Settings** > **ICMP Ping**.

Step 2 Check the **Enable ICMP ping for unreachable access points in FlexConnect mode** check box to enable the ICMP ping.

Step 3 Click **Save**.

A success message saying `ICMP Ping status updated successfully` appears.

Cisco DNA Center starts pinging FlexConnect APs that are disassociated from Cisco Wireless Controllers but are reachable. You can view the reachability status in the **Inventory** window.

Step 4 To view the reachability status, choose **Provision** > **Inventory**.

Step 5 The **Reachability** column shows **Ping Reachable** when the device is reachable by the ICMP ping.

Day 0 Workflow for Cisco AireOS Mobility Express APs

Before you begin

The Cisco Mobility Express wireless network solution comprises at least one 802.11ac Wave 2 Cisco Aironet Series access point with an in-built, software-based wireless controller managing other APs in the network. The AP acting as the wireless controller is referred to as the *primary AP*. The other APs in the Cisco Mobility Express network, which are managed by this primary AP, are referred to as *subordinate APs*.

- Design your network hierarchy with sites, buildings, floors, and so on. For more information, see Create a Site in a Network Hierarchy, on page 122, Add a Building, on page 127, and Create Floors with Floor Maps, on page 131.
- Define the device credentials, such as CLI, SNMP, HTTP, and HTTPS at the global level. The credentials that are defined at the global level are inherited by the sites. For more information, see Configure Global CLI Credentials, on page 173, Configure Global SNMPv2c Credentials, on page 174, and Configure Global SNMPv3 Credentials, on page 175.
- Create WLANs, interfaces, and RF profiles.
- Configure the DHCP server with Option #43 or Option #60. This is the IP address of the Cisco DNA Center Plug and Play server. Using this IP address, the APs contact the PnP server and download the configuration.
- Make sure that you have Mobility Express APs in the inventory. If not, discover them using the Discovery feature. For more information, see Discover Your Network Using CDP, on page 38, Discover Your Network Using an IP Address Range, on page 45, and About Inventory, on page 63.
- The APs should be in the factory reset state without any Cisco Wireless Controller configurations.

Step 1 The Cisco Mobility Express contacts the DHCP server and connects to the Cisco DNA Center Plug and Play server.

Step 2 The DHCP server allocates the IP address with Option #43, which is the IP address of the Cisco DNA Center Plug and Play server.

Step 3 The Mobility Express AP starts the PnP agent and contacts the PnP server.

Note If you have a set of Mobility Express APs in the network, they go through an internal protocol. The protocol selects one Mobility Express AP, which will be configured on the Cisco Wireless Controller as the primary AP to reach the PnP server.

Step 4 Find the unclaimed AP in the **Provision** > **Network Devices** > **Plug and Play** tab.

The table lists all the unclaimed devices. The **State** column shows as **Unclaimed**. Use the **Filter** or **Find option** to find specific devices.

You must wait for the **Onboarding Status** to become **Initialized**.

Step 5 To claim the AP, check the check box next to the AP device name.

Step 6 Choose **Actions** > **Claim** in the menu bar above the device table.

The **Claim Devices** window appears.

Step 7 In the **Site Assignment** window, choose a site from the **Site** drop-down list.

Claiming the selected AP to this particular site also applies the associated configurations.

Step 8 Click **Next**.

Step 9 To configure a device, click the device name in the **Configuration** window.

Step 10 In the **Configuration for device name** window, assign the static IP details for the device:

- **Management IP**
- **Subnet Mask**
- **Gateway**

Step 11 Click **Save**.

Step 12 Click **Next**.

The **Summary** window appears.

Step 13 Click **Claim** in the **Summary** window.

After the Mobility Express AP is claimed, the IP address configured is assigned to the Mobility Express AP.

Step 14 The claimed device, which is an AP, and the wireless controller are now available under **Provision** > **Device Inventory** > **Inventory**.

Step 15 You can also add devices in bulk from a CSV file.

For more information, see Add Devices in Bulk, on page 362.

When you bulk import Mobility Express APs through a CSV, all the Mobility Express APs appear on the **Devices** > **Plug and Play** window. Based on the VRRP protocol, only one Mobility Express AP among the imported ME APs becomes the primary AP. The remaining APs become subordinate APs. After claiming the primary AP, you don't need to claim the subordinate APs. Cisco DNA Center does not clear the subordinate APs from the Plug and Play window. You must delete those subordinate APs manually from the **Devices** > **Plug and Play** window.

Step 16 To provision the Cisco Wireless Controller, see Provision a Cisco AireOS Controller, on page 378.

Brownfield Support for Cisco AireOS Controllers

Before you begin

With Cisco DNA Center, you can add and provision brownfield devices such as Cisco Wireless Controllers. Brownfield refers to devices that belong to existing sites with pre-existing infrastructure.

This procedure shows how to provision a brownfield Cisco AireOS Controller with Cisco DNA Center.

- Start by running a Discovery job on the device. All your devices are displayed on the **Inventory** window. For more information, see Discover Your Network, on page 33 and About Inventory, on page 63.
- The wireless controller should be reachable and in Managed state on the **Inventory** window. For more information, see About Inventory, on page 63.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** window appears, with the discovered devices listed.

Step 2 Click **Filter** and enter the appropriate values in the selected filter field. For example, for the **Device Name** filter, enter the name of the device.

The data that is displayed in the **Devices** table is automatically updated according to your filter selection.

Step 3 Check the check box next to the wireless controller device name that you want to provision.

Step 4 From the **Action** drop-down list, choose **Provision** > **Learn Device Config**.

Step 5 Associate a site to the controller in the **Assign Site** step:

a) Click **Choose a site** to assign a site to the controller.

b) In the **Choose a site** slide-in pane, select a site to which you want to associate the wireless controller, and click **Save**.

c) Click **Next**.

Step 6 The **Resolve Conflict** step shows any conflicting configurations in Cisco DNA Center that you need to resolve.

Step 7 Click **Next**.

Step 8 The **Design Object** window lists all the learned configurations.

a) Click **Network** in the left pane.

The right pane displays network configurations that were learned as part of device configuration learning, and shows the following information:

- **AAA Server** details.
- **Systems Settings**, with details about the IP address and protocol of the AAA server.
- **DHCP Server** details.
- Enter the **Shared Secret** for the AAA server.

b) Click **Wireless** in the left pane.

The right pane lists the enterprise SSIDs, guest SSIDs, antenna radio profiles, and wireless interface details.

For an SSID with a preshared key (PSK), enter the **passphrase key**.

c) Click **Discarded Config** in the left pane.

The right pane lists the conflicting or the existing configurations on Cisco DNA Center. The discarded configuration entries are categorized as:

- Duplicate design entity
- Unknown device configuration for Radio Policy

d) Click **Next**.

The **Network Profile** window lists the network profile or site profile that is created based on the AP and WLAN combination.

e) Click **Save**.

A message saying `Brownfield Configuration is Successful` is displayed.

Step 9 Choose **Design** > **Network Profiles** to assign a site to the network profile.

Step 10 In the **Network Profiles** window, configure the following:

a) Click **Assign Site** to add sites to the selected profile.
b) In the **Add Sites to Profile** window, choose a site from the drop-down list, and click **Save**.

Step 11 Click the menu icon (☰) and choose **Provision** > **Network Devices** > **Inventory**.

a) Click **Filter** to locate the device that you want to provision.

The data that is displayed in the **Devices** table is automatically updated according to your filter selection.

b) Check the check box next to the controller device name that you want to provision.
c) From the **Action** drop-down list, choose **Provision**.
d) Review the details in the **Assign Site** window, and click **Next**.

The **Configurations** step appears.

e) Under **Interface and VLAN Configuration**, click **+Add** to configure interface and VLAN details.
f) In the **Configure Interface and VLAN** window, configure the required fields, and click **OK**.
g) Click **Next**.

Step 12 Review the **Summary** step which displays the following information:

- **Device Details**
- **Network Setting**
- **SSID**
- **Managed Sites**
- **Interfaces**

Step 13 Click **Deploy**.

Step 14 In the **Provision Devices** slide-in pane, do the following to preview the CLI configuration:

- Click the **Generate Configuration Preview** radio button.
- In the **Task Name** field, enter a name for the CLI preview task and click **Apply**.
- In the **Task Submitted** pop-up, click the **Work Items** link.

Note If you missed the **Task Submitted** pop-up, click the menu icon (☰) and choose **Activities** > **Work Items**.

- In the **Work Items** window, click the CLI preview task for which you submitted the configuration preview request.
- View the CLI configuration details and click **Deploy**.
- To immediately deploy the device, click the **Now** radio button, and click **Apply**.

- To schedule the device deployment for a later date and time, click the **Later** radio button and define the date and time of the deployment.
- In the **Information** pop-up, do the following:
    - Click **Yes** if you want to delete the CLI preview task from the **Work Items** window.
    - Click **No** if you want to retain the task in the **Work Items** window.

Note The CLI task will be marked as completed in the **Work Items** window. You can view the CLI configuration for this task, but you cannot deploy it again.

Configure and Provision a Cisco Catalyst 9800 Series Wireless Controller

Cisco Catalyst 9800 Series Wireless Controller Overview

The Cisco Catalyst 9800 Series Wireless Controller is the next generation of wireless controllers built for intent-based networking. The Cisco Catalyst 9800 Series Wireless Controller is Cisco IOS XE based and integrates the RF excellence from Aironet with the intent-based networking capabilities of Cisco IOS XE to create the best-in-class wireless experience for your organization.

The Cisco Catalyst 9800 Series Wireless Controller is built on a modular operating system and uses open, programmable APIs that enable automation of day-0 and day-N network operations.

The Cisco Catalyst 9800 Series Wireless Controller is available in multiple form factors:

- Catalyst 9800-40 Wireless Controller.
- Catalyst 9800-80 Wireless Controller.
- Catalyst 9800-CL Cloud Wireless Controller: Deployable on private cloud (ESXi, KVM, Cisco ENCS, and Hyper-V) and manageable by Cisco DNA Center.
- Catalyst 9800 Embedded Wireless Controller for Catalyst 9300 Series Switches, Catalyst 9400 Series Switches, and Catalyst 9500H Series Switches.
- Cisco Catalyst 9800-L Wireless Controller: Provides seamless software updates for small- to mid-size enterprises. The Cisco Catalyst 9800-L Wireless Controller is available in two variations. You can choose between copper and fiber uplinks, which gives you flexibility in your network.

The following table lists the supported virtual and hardware platforms for the Cisco Catalyst 9800 Series Wireless Controller:

Platform	Description
Cisco Catalyst 9800-80 Wireless Controller	Supports up to 6000 access points and 64,000 clients. Supports up to 80 Gbps throughput and occupies a 2-rack unit space. Modular wireless controller with up to 100-GE uplinks and seamless software updates.

Platform	**Description**
Cisco Catalyst 9800-40 Wireless Controller	A fixed wireless controller with seamless software updates for mid-sized organizations and campus deployments. Supports up to 2000 access points and 32,000 clients. Supports up to 40 Gbps throughput and occupies a 1-rack unit space. Provides four 1-GE or 10-GE uplink ports.
Cisco Catalyst 9800-CL Cloud Wireless Controller	Cisco Catalyst 9800-CL Cloud Wireless Controller can be deployed in a private cloud or a public cloud as Infrastructure as a Service (IaaS). Cisco Catalyst 9800-CL Cloud Wireless Controller is the next generation of enterprise-class virtual wireless controllers built for high availability and security. A virtual form factor of Cisco Catalyst 9800-CL Cloud Wireless Controller for private cloud supports ESXi, KVM, Cisco ENCS, and Hyper-V hypervisors.
Cisco Catalyst 9800 Embedded Wireless Controller for Catalyst 9000 Series Switches	Cisco Catalyst 9800 Embedded Wireless Controller for Catalyst 9000 Series Switches bring the wired and wireless infrastructure together with consistent policy and management. This deployment model supports only Cisco SD-Access, which is a highly secure solution for small campuses and distributed branches. The embedded controller supports access points (APs) only in Fabric mode.
Cisco Catalyst 9800-L Wireless Controller	Cisco Catalyst 9800-L Wireless Controller provides seamless software updates for small to mid-size enterprises. The Cisco Catalyst 9800-L Wireless Controller is available in two variations. You can choose between copper and fiber uplinks, which gives you flexibility in your network. • Cisco Catalyst 9800-L Copper Series Wireless Controller (9800-L-C RJ45) • Cisco Catalyst 9800-L Fiber Series Wireless Controller 9800-L-F SFP)

The following table lists the host environments supported by the Cisco Catalyst 9800 Series Wireless Controller:

Host Environment	**Software Version**
VMware ESXi	• VMware ESXi vSphere 6.0 • VMware ESXi vSphere 6.5[3] • VMware ESXi vCenter 6.0 • VMware ESXi VCenter 6.5
KVM	• Linux KVM based on Red Hat Enterprise Linux 7.1 and 7.2 • Ubuntu 14.04.5 LTS, Ubuntu 16.04.5 LTS
NFVIS	Cisco ENCS 3.8.1 and 3.9.1

---

[3] Installing the .ova file of C9800-CL using ESXi vSphere does not work. This is not limited to the C9800 ova but affects other products. Cisco and VMware are actively working to fix the issue. Contact your Cisco account representative to see if the problem is fixed. There are issues specific to VMware 6.5 and C9800-CL OVA file deployment in which deployment fails with

the warning "A required disk image was missing" and the error "Failed to deploy VM: postNFCData failed: Cannot POST to non-disk files." To install C9800-CL on VMware ESXi 6.5, do one of the following: 1) Install the .iso file of C9800-CL using the ESXi embedded GUI (ESXI 6.5 client version 1.29.0 is tested and required). 2) Install the .ova file of C9800-CL using the OVF tool.

The following table lists the Cisco Enterprise Network Function Virtualization Infrastructure Software (NFVIS) versions supported in Cisco DNA Center:

Note Cisco Enterprise NFVIS devices support the N-1 to N upgrade path only. For example, upgrade from Cisco Enterprise NFVIS 3.11.x to Cisco Enterprise NFVIS 3.12.x only is supported. Upgrade from Cisco Enterprise NFVIS 3.11.x to Cisco Enterprise NFVIS 4.1.x is not supported.

Cisco Enterprise NFVIS Version	Enterprise Network Compute System Device Platform	Notes
4.1.2 4.1.1 3.12.3 3.11.3 3.11.2 3.11.1	ENCS 5400 UCS-E UCS-C	Cisco DNA Center supports the following NFVIS upgrade paths: NFVIS v3.11.1 > 3.11.2 > 3.11.3 > 3.12.3 > 4.1.1 > 4.1.2. Cisco Enterprise NFVIS 3.12.1 is not supported on any versions of Cisco DNA Center. Upgrade to Cisco Enterprise NFVIS 3.12.1 from Cisco Enterprise NFVIS 3.11.x using Cisco DNA Center is not supported. Upgrade to Cisco Enterprise NFVIS 3.12.2 from Cisco Enterprise NFVIS 3.12.1 using Cisco DNA Center is not supported. Upgrade to Cisco Enterprise NFVIS 3.12.2 from 3.11.2 is supported using Cisco DNA Center. Cisco Enterprise NFVIS 3.12.2 is supported on Cisco DNA Center.
3.12.2 3.11.3 3.11.2 3.11.1	ENCS 5100	Cisco 5100 ENCS does not support Cisco Enterprise NFVIS 3.10.x.

Workflow to Configure a Cisco Catalyst 9800 Series Wireless Controller in Cisco DNA Center

1. Install Cisco DNA Center.

   For more information, see the Cisco DNA Center Installation Guide.

2. For information on software image upgrade, see Software Image Upgrade Support for Cisco Catalyst 9800 Series Wireless Controller, on page 395.

3. Log in to the Cisco DNA Center GUI and verify that the applications you need are in the **Running** state.

Click the menu icon (☰) and choose **System Settings** > **Software Updates** > **Installed Apps**.

4. Integrate Cisco Identity Services Engine with Cisco DNA Center. After integration, any devices that Cisco DNA Center discovers along with relevant configurations and data are pushed to Cisco ISE.

5. Discover the Cisco Catalyst 9800 Series Wireless Controller.

   You must enable NETCONF and set the port to 830 to discover the Cisco Catalyst 9800 Series Wireless Controller. NETCONF provides a mechanism to install, manipulate, and delete configurations of network devices.

   For more information, see Discover Your Network Using CDP, on page 38 or Discover Your Network Using an IP Address Range, on page 45.

   You must add the wireless management IP address manually.

   While performing discovery using the Cisco Discovery Protocol (CDP) or an IP address range in the **Discovery** window, choose **Use Loopback** from the **Preferred Management IP** drop-down list to specify the device's loopback interface IP address.

6. Make sure that the discovered devices appear in the Device Inventory page and are in **Managed** state.

   For more information, see About Inventory, on page 63 and Display Information About Your Inventory, on page 65.

   You must wait for the devices to move to a **Managed** state.

7. To verify the Assurance connection with the Cisco Catalyst 9800 Series Wireless Controller, use the following commands:

   - **#show crypto pki trustpoints | sec DNAC-CA**

```
Trustpoint DNAC-CA
    Subject Name:
    cn=kube-ca
          Serial Number (hex): 00E***************
    Certificate configured.
```

   - **#show crypto pki trustpoints | sec sdn-network**

```
Trustpoint sdn-network-infra-iwan:
    Subject Name:
    cn=sdn-network-infra-ca
        Serial Number (hex): 378***************
    Certificate configured.
```

   - **#show telemetry ietf subscription all**

```
Telemetry subscription brief

  ID               Type        State       Filter type
  -----------------------------------------------------
  1011             Configured  Valid       tdl-uri
  1012             Configured  Valid       tdl-uri
  1013             Configured  Valid       tdl-uri
```

   - **#show telemetry internal connection**

```
Telemetry connection

Address Port Transport State Profile
```

```
---------------------------------------------------------
IP address 25103 tls-native Active sdn-network-infra-iwan
```

- **#show network-assurance summary**

```
Network-Assurance                          : True
Server Url                                 : https://10.***.***.***
ICap Server Port Number                    : 3***
Sensor Backhaul SSID                       :
Authentication                             : Unknown
```

8. Configure a TACACS server while configuring authentication and policy servers.

Configuring TACACS is not mandatory if you have configured the username locally on the Cisco Catalyst 9800 Series Wireless Controller.

9. Design your network hierarchy by adding sites, buildings, and floors so that later you can easily identify where to apply design settings or configurations.

You can either create a new network hierarchy, or if you have an existing network hierarchy on Cisco Prime Infrastructure, you can import it into Cisco DNA Center.

To import and upload an existing network hierarchy, see Upload an Existing Site Hierarchy, on page 124.

To create a new network hierarchy, see Create a Site in a Network Hierarchy, on page 122, Add a Building, on page 127, and Create Floors with Floor Maps, on page 131.

10. Add the location information of APs, and position them on the floor map to visualize the heatmap coverage.

For more information, see Work With APs on a Floor Map, on page 136.

11. Define network settings, such as AAA (Cisco ISE is configured for Network and Client Endpoint), NetFlow Collector, NTP, DHCP, DNS, syslog, and SNMP traps. These network servers become the default for your entire network. You can add a TACACS server while adding a AAA server.

For more information, see Network Settings Overview, on page 171, Configure Global Network Servers, on page 173, and Add Cisco ISE or Other AAA Servers.

12. Create a wireless radio frequency profile with the parent profile as custom.

For more information, see Create a Wireless Radio Frequency Profile, on page 202.

13. Create IP address pools at the global level.

Cisco DNA Center uses IP address pools to automate the configuration and deployment of SD-Access networks.

To create an IP address pool, see Configure IP Address Pools, on page 182.

You must reserve an IP address pool for the building that you are provisioning. For more information, see Provision a LAN Underlay.

14. Create enterprise and guest wireless networks. Define the global wireless settings once; Cisco DNA Center then pushes the configurations to various devices across geographical locations.

Designing a wireless network is a two-step process. First, you must create SSIDs, and then associate the created SSID to a wireless network profile. This profile helps you to construct a topology, which is used to deploy devices on a site.

For more information, see Create SSIDs for an Enterprise Wireless Network, on page 188 and Create SSIDs for a Guest Wireless Network, on page 194. For information about other wireless settings, see Configure Global Wireless Settings, on page 188.

15. Configure the backhaul settings. For more information, see Manage Backhaul Settings, on page 214.
16. Configure the following in the **Policy** window for the Cisco Catalyst 9800 Series Wireless Controller:
    - Create a virtual network. The virtual network segments your physical network into multiple logical networks.
    - Create a group-based access control policy and add a contract. For more information, see Create Group-Based Access Control Policy, on page 532.
17. Configure high availability.

    For more information, see Configure High Availability for the Cisco Catalyst 9800 Series Wireless Controller, on page 396.
18. Provision the Cisco Catalyst 9800 Series Wireless Controller with the configurations added during the design phase.

    For more information, see Provision a Cisco Catalyst 9800 Series Wireless Controller, on page 409.
19. Configure and deploy application policies on the Cisco Catalyst 9800 Series Wireless Controller.

    For more information, see Create an Application Policy, on page 570, Deploy an Application Policy, on page 575, and Edit an Application Policy, on page 574.

Note You must provision Cisco Catalyst 9800 Series Wireless Controller devices before deploying an application policy.

For Cisco Catalyst 9800 Series Wireless Controller devices, two different policies with different business relevance for two different SSIDs do not work. The last deployed policy always takes precedence when you are setting up relevance.

For Cisco Catalyst 9800 Series Wireless Controller devices, changing the default business relevance for an application does not work in FlexConnect mode.

You can apply an application policy only on a nonfabric SSID.

Software Image Upgrade Support for Cisco Catalyst 9800 Series Wireless Controller

Before you begin

- Discover the Cisco Catalyst 9800 Series Wireless Controller.

  Enable NETCONF and set the port to 830 to discover Cisco Catalyst 9800 Series Wireless Controller. NETCONF enables wireless services on the controller and provides a mechanism to install, manipulate, and delete the configuration of network devices.

For more information, see Discover Your Network Using CDP, on page 38, or Discover Your Network Using an IP Address Range, on page 45.

- Make sure that the devices appear in the device inventory and are in the **Managed** state.

  For more information, see About Inventory, on page 63 and Display Information About Your Inventory, on page 65.

Step 1 Click the menu icon (≡) and choose **Design** > **Image Repository**.

The **Inventory** window appears, with the discovered devices listed.

Step 2 Import Cisco Catalyst 9800 Series Wireless Controller software image from your local computer or from a URL.

For more information, see Import a Software Image, on page 329.

Step 3 Assign the software image to a device family.

For more information, see Assign a Software Image to a Device Family, on page 330.

Step 4 You can mark a software image as golden by clicking star for a device family or for a particular device role.

For more information, see Specify a Golden Software Image, on page 332.

Step 5 Provision the software image.

Click the menu icon (≡) and choose **Provision** > **Device** > **Inventory**.

Step 6 In the **Inventory** window, check the check box next to the Cisco Catalyst 9800 Series Wireless Controller whose image you want to upgrade.

Step 7 From the **Actions** drop-down list, choose **Software Image** > **Update Image**.

For more information, see Provision a Software Image, on page 334.

Configure High Availability for the Cisco Catalyst 9800 Series Wireless Controller

Before you begin

Configuring High Availability (HA) on the Cisco Catalyst 9800 Series Wireless Controller involves the following prerequisites:

- Both the Cisco Catalyst 9800 Series Wireless Controller devices are running the same software version and have active software image on the primary Catalyst 9800 Series Wireless Controller.
- The service port and the management port of Catalyst 9800 Series Wireless Controller 1 and Catalyst 9800 Series Wireless Controller 2 are configured.
- The redundancy port of Catalyst 9800 Series Wireless Controller 1 and Catalyst 9800 Series Wireless Controller 2 are physically connected.

- Preconfigurations such as interface configurations, route addition, ssh line configurations, netconf-yang configurations are completed on the Catalyst 9800 Series Wireless Controller appliance.
- The management interface of Catalyst 9800 Series Wireless Controller 1 and Catalyst 9800 Series Wireless Controller 2 are in the same subnet.
- The discovery and inventory of Catalyst 9800 Series Wireless Controller 1 and Catalyst 9800 Series Wireless Controller 2 devices are successful from Cisco DNA Center.
- The devices are reachable and are in **Managed** state.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** window appears, with the discovered devices listed.

Step 2 To view devices available in a particular site, expand the **Global** site in the left pane, and select the site, building, or floor that you are interested in.

All the devices available in that selected site is displayed in the **Inventory** window.

Step 3 From the **Device Type** list, click the **WLCs** tab, and from the **Reachability** list, click the **Reachable** tab to get the list of wireless controllers that are discovered and reachable.

Step 4 In the Inventory window, click the desired Cisco Catalyst 9800 Series Wireless Controller name to configure as a primary controller.

Step 5 Click the **High Availability** tab.

The selected Catalyst 9800 Series Wireless Controller by default becomes the primary controller and the **Primary C9800** field is grayed out.

Step 6 From the **Select Primary Interface** and **Secondary Interface** drop-down lists, choose the interface that is used for HA connectivity.

The HA interface serves the following purposes:

- Enables communication between the controller pair before the IOSd boots up.
- Provides transport for IPC across the controller pair.
- Enables redundancy across control messages exchanged between the controller pair. The control messages can be HA role resolution, keepalives, notifications, HA statistics, and so on.

Step 7 From the **Select Secondary C9800** drop-down list, choose the secondary controller to create a HA pair.

Note When you select secondary controller, based on the wireless management interface IP subnet of primary controller, redundancy management IP auto populates and an **i** icon appears on the top of **High Availability** window, saying **Please make sure the Redundancy Management IP and Peer Redundancy Management IP are not assigned to any other network entities. If used, kindly change the IP accordingly and configure**.

Step 8 Enter the **Redundancy Management IP** and **Peer Redundancy Management IP** addresses in the respective fields.

Note The IP addresses used for redundancy management IP and peer redundancy management IP should be configured in the same subnet as the management interface of the Cisco Catalyst 9800 Series Wireless Controller. Ensure that these IP addresses are unused IP addresses within the subnet range.

Step 9 In the **Netmask** field, enter the netmask address.

Step 10 Click **Configure HA**.

The HA configuration is initiated at the background using the CLI commands. First, the primary controller is configured. On success, the secondary controller is configured. Both the devices reboot once the HA is enabled. This process may take up to 2.5 minutes to complete.

Step 11 After the HA is initiated, the **Redundancy Summary** under **High Availability** tab displays the **Sync Status** as **HA Pairing is in Progress**. When Cisco DNA Center finds that the HA pairing is successful, the **SyncStatus** becomes **Complete**.

This is triggered by the inventory poller or by manual resynchronization. By now, the secondary controller (Catalyst 9800 Series Wireless Controller 2) is deleted from Cisco DNA Center. This flow indicates successful HA configuration in the Catalyst 9800 Series Wireless Controller.

Step 12 To manually resynchronize the controller, on the **Provision** > **Inventory** window, select the controller that you want to synchronize manually.

Step 13 From the **Actions** drop-down list, choose **Resync**.

Step 14 The following is the list of actions that occur after the process is complete:

- Catalyst 9800 Series Wireless Controller 1 and Catalyst 9800 Series Wireless Controller 2 are configured with redundancy management, redundancy units, and Single sign-on (SSO). The devices reboot in order to negotiate their role as an active controller or a standby controller. Configuration is synchronized from active to standby.
- On the **Show Redundancy Summary** window, you can see these configurations:
  - SSO is enabled
  - Catalyst 9800 Series Wireless Controller 1 is in active state
  - Catalyst 9800 Series Wireless Controller 2 is in standby state

Information About High Availability

High Availability (HA) allows you to reduce the downtime of wireless networks that occurs because of the failover of controllers. You can configure high availability for the Cisco Catalyst 9800 Series Wireless Controller through Cisco DNA Center.

Commands to Configure High Availability on Cisco Catalyst 9800 Series Wireless Controllers

Step 1 Use the following commands to configure HA on primary for Cisco Catalyst 9800 Series Wireless Controller:

- Run the **chassis ha-interface GigabitEthernet <redundancy interface num> local-ip <redundancy ip> <netmask> remote-ip <peer redundancy ip>** command to configure the HA chassis interface.

  This example shows how to configure a HA chassis interface:

  ```
  chassis ha-interface GigabitEthernet 3 local-ip 1.1.1.2 255.255.255.0 remote-ip
  1.1.1.3
  ```

- Run the **reload** command to reload devices for the changes to become effective.

Step 2 Use the following commands to configure HA on secondary for Cisco Catalyst 9800 Series Wireless Controller:

- Run the **chassis ha-interface GigabitEthernet <redundancy interface num> local-ip <redundancy ip> <netmask> remote-ip <peer redundancy ip>** command to configure the HA chassis interface.

  This example shows how to configure a HA chassis interface:

  ```
  chassis ha-interface GigabitEthernet 2 local-ip 1.1.1.3 255.255.255.0 remote-ip
  1.1.1.2
  ```

Step 3 Run the **chassis clear** command to clear or delete all the HA-related parameters, such as local IP, remote IP, HA interface, mask, timeout, and priority.

Note Reload the devices for changes to take effect by running the **reload** command.

Step 4 Use the following commands to configure HA on primary for Cisco Catalyst 9800-40 Wireless Controller and Cisco Catalyst 9800-80 Wireless Controller devices:

- Run the **chassis ha-interface local-ip <redundancy ip> <netmask> remote-ip <peer redundancy ip>** command to configure the HA chassis interface.

  This example shows how to configure a HA chassis interface:

  ```
  chassis ha-interface local-ip 1.1.1.2 255.255.255.0 remote-ip 1.1.1.3
  ```

- Run the **reload** command to reload devices for the changes to become effective.

Step 5 Use the following commands to configure HA on secondary for Cisco Catalyst 9800-40 Wireless Controller and Cisco Catalyst 9800-80 Wireless Controller devices:

- Run the **chassis ha-interface local-ip <redundancy ip> <netmask> remote-ip <peer redundancy ip>** command to configure the HA chassis interface.

  This example shows how to configure a HA chassis interface:

  ```
  chassis ha-interface local-ip 1.1.1.3 255.255.255.0 remote-ip 1.1.1.2
  ```

Step 6 Run the **chassis clear** command to clear or delete all the HA-related parameters, such as local IP, remote IP, HA interface, mask, timeout, and priority.

Note Reload the devices for changes to take effect by running the **reload** command.

Commands to Verify Cisco Catalyst 9800 Series Wireless Controllers High Availability

Use the following commands to verify the high availability configurations from Cisco Catalyst 9800 Series Wireless Controller:

- Run the **config redundancy mode sso** command to check the HA-related details.
- Run the **show chassis** command to view chassis configurations about the HA pair, including the MAC address, role, switch priority, and current state of each controller device in the redundant HA pair.
- Run the **show ip interface brief** command to view the actual operating redundancy mode running on the device, and not the configured mode as set by the platform.

- Run the **show redundancy states** command to view the redundancy states of the active and standby controllers.
- Run the **show redundancy summary** command to check the configured interfaces.
- Run the **show romvar** command to verify high availability configuration details.

N+1 High Availability

Overview of N+1 High Availability

Cisco DNA Center supports N+1 High Availability (HA) on Cisco AireOS Wireless LAN Controllers and Cisco Catalyst 9800 Series Wireless Controllers.

Cisco AireOS Wireless LAN Controllers have a dedicated stock-keeping unit (SKU) for their N+1 controllers. Cisco Catalyst 9800 Series Wireless Controllers don't have a dedicated SKU; the same model must be used for HA.

The N+1 HA architecture provides redundancy for controllers across geographically separated data centers with low-cost deployments.

N+1 HA allows Cisco Wireless Controllers to be used as backup controllers for multiple primary controllers. These wireless controllers are independent of each other and do not share configuration or IP addresses on any of their interfaces. When a primary wireless controller resumes operation, the APs fall back automatically from the backup wireless controller to the primary wireless controller if the AP fallback option is enabled.

Cisco DNA Center supports primary and secondary controller configurations for N+1 HA.

N+1 HA is configured at the AP level, not at the global level. Configurations are pushed directly to the AP.

Note The primary and secondary controllers must be of the same device type. For example, if the primary device is a Catalyst 9800 Series Wireless Controller, the secondary device must also be a Catalyst 9800 Series Wireless Controller.

APs with higher priority on the primary controller always connect first to the backup controller, even if they have to push out the lower priority APs.

The N+1 HA configuration has the following limitations:

- Auto provisioning of a secondary controller is not supported because of the VLAN ID configuration.
- You must reprovision the secondary controller manually with the latest design configuration if you made any changes to the primary controller.
- Cisco DNA Center does not support fault tolerance.
- Access Point Stateful Switch Over (AP SSO) functionality is not supported for N+1 HA. The AP Control and Provisioning of Wireless Access Points (CAPWAP) state machine is restarted when the primary controller fails.

Prerequisites for Configuring N+1 High Availability from Cisco DNA Center

- Discover primary and the secondary controller by running the **Discovery** feature.

For more information, see Discover Your Network Using CDP, on page 38, or Discover Your Network Using an IP Address Range, on page 45.

- Make sure that the wireless controllers are reachable and in the managed state.

  For more information, see About Inventory, on page 63 and Display Information About Your Inventory, on page 65.

- Verify the network connectivity between devices. If the primary controller goes down, the AP should be able to join the secondary controller as per the N+1 configuration.

- Create two buildings to manage the primary and secondary locations for both devices. For example, create two buildings, *Building A* and *Building B*, where Building A is the primary managed location for controller-1 and also the secondary managed location for controller-2, and Building B is configured only as a primary managed location for controller-2.

  For more information, see Create a Site in a Network Hierarchy, on page 122, Add a Building, on page 127, and Create Floors with Floor Maps, on page 131.

- Add and position APs on a floor map to get a coverage heatmap visualization during the design phase.

  For more information, see Work With APs on a Floor Map, on page 136.

- Create two SSIDs and associate them as the backhaul SSIDs.

  For more information, see Create SSIDs for an Enterprise Wireless Network, on page 188 and Create SSIDs for a Guest Wireless Network, on page 194.

Configure N+1 High Availability from Cisco DNA Center

This procedure shows how to configure N+1 High Availability (HA) on Cisco Wireless Controller and Cisco Catalyst 9800 Series Wireless Controller.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** window appears, with the discovered devices listed.

Step 2 Check the check box next to the desired controller to provision it as a primary controller.

Step 3 From the **Actions** drop-down list, choose **Provision** > **Provision**.

The **Assign Site** window appears.

Step 4 Click **Choose a site** to assign a primary managed AP location for the primary controller.

Step 5 In the **Choose a site** window, select a site and click **Save**.

Step 6 Click **Next**.

The **Configuration** window appears, which displays the primary AP managed location for the primary device.

Step 7 Add or update the managed AP locations for the primary controller by clicking **Select Primary Managed AP Locations**.

Step 8 In the **Managed AP Location** window, check the check box next to the site name, and click **Save**.

You can either select a parent site or the individual sites.

Step 9 Configure the interface and VLAN details.

Step 10 Under **Configure Interface and VLAN** area, configure the IP address and subnet mask details, and click **Next**.

Step 11 In the **Advanced Configuration** window, configure values for the predefined template variables, and click **Next**.

Step 12 In the **Summary** window, verify the managed AP locations for the primary controller and other configuration details, and click **Deploy**.

- To deploy the device immediately, click the **Now** radio button and click **Apply**.
- To schedule the device deployment for a later date and time, click the **Later** radio button and define the date and time of the deployment.

Step 13 Next, provision the secondary controller.

Step 14 On the **Inventory** window, check the check box next to the desired controller to provision it as a secondary controller.

Step 15 From the **Actions** drop-down list, choose **Provision** > **Provision**.

The **Assign Site** window appears.

Step 16 Click **Choose a site** to assign the managed AP location for the secondary controller.

The managed AP location for the secondary controller should be same as the managed AP location of the primary controller.

Step 17 In the **Choose a site** window, check the check box next to the site name to associate the secondary controller, and click **Save**.

Step 18 Click **Next**.

The **Configuration** window appears, which displays the primary AP managed and secondary AP managed locations for the secondary device.

Step 19 Add or update the managed AP locations for the secondary controller by clicking **Select Secondary Managed AP Locations**.

Step 20 In the **Managed AP Location** window, check the check box next to the site name, and click **Save**.

You can either select a parent site or the individual sites.

Step 21 Configure the interface and VLAN details for the secondary controller.

Step 22 Under the **Configure Interface and VLAN** area, configure the IP address and subnet mask details for the secondary controller, and click **Next**.

Step 23 In the **Advanced Configuration** window, configure values for the predefined template variables, and click **Next**.

Step 24 In the **Summary** window, verify the managed AP locations for the secondary controller and other configuration details and click **Deploy**.

- To deploy the device immediately, click the **Now** radio button and click **Apply**.
- To schedule the device deployment for a later date and time, click the **Later** radio button and define the date and time of the deployment.

Step 25 To verify the managed locations of the primary and secondary controllers, click the device name of the controllers that you provisioned on the **Provision** > **Network Devices** > **Inventory** window.

Step 26 In the **Device details** window, click the **Managed ap locations** tab to view the primary and secondary managed location details.

Step 27 Provision the AP for the primary controller.

Step 28 On the **Network Devices** > **Inventory** window, check the check box next to the AP that you want to provision.

Step 29 From the **Action** drop-down list, choose **Provision** > **Provision**.

Step 30 In the **Assign Site** window, click **Choose a Floor** to select the floor from the primary managed location.

Step 31 Click **Next**.

The **Configuration** window appears.

Step 32 By default, the custom RF profile that you marked as the default under **Design** > **Network Settings** > **Wireless** > **Wireless Radio Frequency Profile** is chosen in the **RF Profile** drop-down list.

You can change the default RF Profile value for an AP by selecting a value from the **RF Profile** drop-down list.

Step 33 Click **Next**.

Step 34 In the **Summary** window, review the details.

Step 35 Click **Deploy** to provision the primary AP.

Step 36 You are prompted with a message that creation or modification of an AP group is in progress.

You are prompted with a message stating `After provisioning AP(s) will reboot. Do you want to continue?`.

Step 37 Click **OK**.

When deployment succeeds, the **Last Sync Status** column in the **Device Inventory** window shows `SUCCESS`.

Mobility Configuration Overview

The mobility configuration in Cisco DNA Center allows you to group a set of Cisco Wireless Controllers into a mobility group for a seamless roaming experience of wireless clients.

By creating a mobility group, you can enable multiple wireless controllers in a network to dynamically share information and forward traffic when inter-controller or inter-subnet roaming occurs. Mobility groups enable you to limit roaming between different floors, buildings, or campuses in the same enterprise by assigning different mobility group names to different wireless controllers within the same wireless network.

Cisco DNA Center allows you to create mobility groups between various platforms such as Cisco Catalyst 9800 Series Wireless Controller and Cisco AireOS Controllers.

Mobility configuration has the following guidelines and limitations:

- You cannot select multiple controllers for configuring mobility on the **Provision** page.
- You cannot create mobility groups with the group name as default. This resets the mobility and RF group names as default and deletes all the peers.
- You cannot configure a mobility group name on the anchor controller.
- You must reboot the wireless controller manually if there is change to the virtual IP address when configuring mobility groups on Cisco AireOS Controllers.
- Wireless controllers with the same mobility group name are automatically grouped into a single mobility group and are added as peers to each other.
- When configuring mobility groups on Cisco AireOS Controllers, if the wireless controllers do not have the IP address 192.0.2.1, Cisco DNA Center pushes the virtual IP address 192.0.2.1 to all the wireless controllers.
- Do not explicitly add guest anchor controllers to the mobility group. The provisioned guest anchor controllers do not appear in the drop-down list while adding peers in the mobility configuration page.

- If you provision a wireless controller as a guest anchor, ensure that it is not added to the mobility group.

Mobility Configuration Workflow

Here is the workflow that you can follow to configure mobility on Cisco Wireless Controller:

- To configure mobility, you must provision a wireless controller with mobility group name, RF group name, and mobility peers.
- The configuration that is applied during the wireless controller provisioning is automatically replicated to all the mobility peers configured in that group.
- Resynchronize the wireless controllers to get the latest tunnel status.

Mobility Configuration Use Cases

The following use cases explain the steps to configure mobility between controllers.

Use Case 1

Cisco Wireless Controller 1, wireless controller 2, and wireless controller 3 are newly added to Cisco DNA Center with the mobility group name as Default and is not provisioned yet.

1. Provision the wireless controller 1 by configuring mobility group name, RF group name, and adding wireless controller 2 and wireless controller 3 as peers.
2. Provision the wireless controller 2.

   In the **Provision** window, the mobility configuration is automatically populated for wireless controller 2 with the group name and peers.
3. Provision the wireless controller 3.
4. After provisioning all wireless controllers, resynchronize the wireless controllers to receive the latest tunnel status.

Use Case 2

Cisco Wireless Controller 1, wireless controller 2, and wireless controller 3 with different mobility group names are already added to Cisco DNA Center and are provisioned.

1. Provision the wireless controller 1 by configuring mobility group name, RF group name, and adding wireless controller 2 and wireless controller 3 as peers.
2. The mobility configuration is automatically replicated across other peers, such as wireless controller 2 and wireless controller 3.
   - After the successful provisioning of wireless controller 1, the wireless controller 2 and wireless controller 3 are added as peers on the wireless controller1.
   - The wireless controller 1 and wireless controller 3 are added as peers on wireless controller 2.
   - The wireless controller 1 and wireless controller 2 are added as peers on wireless controller 3.

Configure Mobility Group

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** window appears, which lists all the discovered devices.

Step 2 Choose **Provision** > **Network Devices** > **Inventory**.

Step 3 Check the check box next to the Catalyst 9800 Series Wireless Controller name for which you want to configure mobility.

Step 4 From the **Actions** drop-down list, choose **Provision** > **Provision WLC Mobility**.

The **Configure Mobility Group** panel appears.

For more information, see Mobility Configuration Overview, on page 403.

Step 5 From the **Mobility Group Name** drop-down list, you can either add a new mobility group by clicking **+**, or choose from the existing mobility groups.

The existing mobility peers information is loaded from the intent available in the Cisco DNA Center.

Step 6 In the **RF Group Name** text box, enter a name for the RF group.

Step 7 To enable or disable Cipher configuration for mobility, click the **DTLS High Cipher Only** button on.

Cipher configuration is applicable for Cisco Catalyst 9800 Series Wireless Controller Release 17.5 or later. You need to manually reboot the device for changes to take effect.

Step 8 To manually reboot the device after making changes in the DTLS (Data Datagram Transport Layer Security) cipher configuration to take effect after provision, click the **Restart for DTLS Ciphers to take effect** button on.

Step 9 To enable DTLS data encryption, click the **Data Link Encryption** button on.

Step 10 Under **Mobility Peers**, click **Add** to configure a mobility peer.

Step 11 From the **Device Name** drop-down list, choose the controller.

After the device is provisioned, the Cisco DNA Center creates a mobility group in device, assigns the RF group, and configures all ends of peers. The mobility group configuration is deployed automatically to all the selected peer devices.

Step 12 Click **Save**.

Step 13 You can reset the mobility group name and the RF group name using one of the following methods:

- In the **Configure Mobility Group** panel, choose **default** from the **Mobility Group Name** drop-down list.
- On the **Provision** > **Configuration** page, under **Mobility Group**, click **Reset**.

This automatically sets the **RF Group Name** to **default** and removes all peers. Once you provision, the mobility on the device is set and the device is removed from all other peers.

About DTLS Ciphersuites

Ciphersuites are a set of encryption and integrity algorithms designed to protect radio communication on your wireless LAN.

You can configure multiple DTLS (Data Datagram Transport Layer Security) Ciphersuites on Cisco Catalyst 9800 Series Wireless Controller, Cisco Catalyst 9800 Embedded Wireless Controller for Catalyst 9000 Series Switches, and Cisco Embedded Wireless Controller on Catalyst Access Points platforms running Release 17.5 or later.

Configure Multiple DTLS Ciphersuites

You can configure DTLS Ciphersuites either at the global level or at the site level.

Before you begin

- Make sure that the Device Controllability feature is enabled on the **System** > **Settings** > **Device Settings** > **Device Controllability** page.
- Discover Cisco Catalyst 9800 Series Wireless Controllers in your network using the **Discovery** functionality so that the discovered devices are listed in the Inventory window.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **Wireless**.

Step 2 In the left tree menu, select **Global** to configure all sites with the same DTLS Ciphersuite configuration.

In the left tree menu, select a site to configure DTLS Ciphersuites at the site level. The DTLS Ciphersuite configuration will be pushed to the controller available on that particular site.

Step 3 Uncheck the **Skip DTLS Ciphersuite Config** check box to configure Ciphersuites as part of Device Controllability.

Step 4 Configure either default Ciphersuites or custom Ciphersuites.

By default, the **Default** Ciphersuite is selected.

The Default Ciphersuite box shows the list of default Ciphersuites and these Ciphersuites are configured as default on the device. You cannot change the priority of these default ciphersuites.

Step 5 To configure custom Ciphersuites, click the **Custom** button.

Custom Ciphersuite overrides the default Ciphersuites with priority.

Step 6 From the **Version** drop-down list, choose the DTLS version.

Based on the DTLS version, Cisco DNA Center shows the available Ciphersuites.

Step 7 Click the blue button next to the Ciphersuite if you do not want to apply any of the Ciphersuites.

Step 8 To change the priority of Ciphersuites, hold and drag each Ciphersuite.

Step 9 Click **Save**.

The message `DTLS Ciphersuite Config Saved successfully` is displayed.

Step 10 To apply the Ciphersuite configuration, you must provision the device.

For more information, see Provision a Cisco Catalyst 9800 Series Wireless Controller, on page 409.

About N+1 Rolling AP Upgrade

The rolling AP upgrade feature is supported on the Cisco AireOS Controller and Cisco Catalyst 9800 Series Wireless Controller in an N+1 High Availability setup. This feature helps you upgrade software images on the APs associated with the Cisco AireOS Controller or Cisco Catalyst 9800 Series Wireless Controller in your wireless LAN network. To achieve the zero downtime, it is possible to upgrade APs in a staggered way using the N+1 Rolling AP upgrade feature.

The primary controller identifies the candidate APs through the radio resource management neighbor AP map. The upgrade process starts with the software image downloading to the primary controller while the image is predownloaded to the candidate APs. After the candidate APs have been upgraded and rebooted, they join the secondary controller in a staggered manner. After all the APs have joined the secondary controller, the primary controller reboots. The APs rejoin the primary controller in a staggered manner after it is rebooted.

Here are the prerequisites for configuring Rolling AP Upgrade:

- An N+1 High Availability setup with two wireless controllers, one as the primary controller and the other one as the secondary.
- The primary and the N+1 controllers have the same configuration and managing the same location in the network.
- The N+1 controller is already running the Golden image so that rolling AP upgrade works with zero downtime.

  Golden images are standardized images for network devices and Cisco DNA Center automatically downloads the images from Cisco.com. Image standardization helps in device security and optimal device performance.
- The N+1 controller is reachable and in **Managed** state in Cisco DNA Center.
- Both the controllers are part of the same mobility group and a mobility tunnel is established between the primary and N+1 controller. The upgrade information between the primary and N+1 controllers are exchanged through the mobility tunnel.

Workflow to Configure a Rolling AP Upgrade

This procedure shows how to configure a rolling AP upgrade on Cisco AireOS Controllers and Cisco Catalyst 9800 Series Wireless Controllers.

Note N+1 rolling AP upgrade is supported on fabric and nonfabric deployments.

Step 1 Install Cisco DNA Center.

For more information, see the Cisco Digital Network Architecture Center Installation Guide.

Step 2 Log in to the Cisco DNA Center GUI and verify that the applications you need are in the **Running** state.

Click the menu icon (≡) and choose **System** > **Software Updates** > **Installed Apps**.

Step 3 Discover the wireless controller using the Discovery feature.

You must enable NETCONF and set the port to 830 to discover the Catalyst 9800 Series Wireless Controller. NETCONF provides a mechanism to install, manipulate, and delete configurations of network devices.

For more information, see Discover Your Network Using CDP, on page 38 or Discover Your Network Using an IP Address Range, on page 45.

Step 4 Make sure that the discovered devices appear in the **Device Inventory** window and are in the **Managed** state.

For more information, see About Inventory, on page 63 and Display Information About Your Inventory, on page 65.

You must wait for devices to move to a **Managed** state.

Step 5 Design your network hierarchy by adding sites, buildings, and floors so that later you can easily identify where to apply design settings or configurations.

You can either create a new network hierarchy, or if you have an existing network hierarchy on Cisco Prime Infrastructure, you can import it into Cisco DNA Center.

To import and upload an existing network hierarchy, see Upload an Existing Site Hierarchy, on page 124.

To create a new network hierarchy, see Create a Site in a Network Hierarchy, on page 122, Add a Building, on page 127, and Create Floors with Floor Maps, on page 131.

Step 6 Add the location information of APs, and position them on the floor map to visualize the heatmap coverage.

For more information, see Work With APs on a Floor Map, on page 136.

Step 7 Provision the primary controller with the primary managed AP location, rolling AP upgrade enabled, and mobility group configured with the secondary controller as its peer.

To do this, choose **Provision** > **Network Devices** > **Inventory**, and check the check box next to the primary controller name.

Step 8 Configure the N+1 controller as the mobility peer in the Mobility Group configuration.

For more information, see Mobility Configuration Overview, on page 403.

Step 9 Provision the N+1 HA controller by configuring the primary controller's primary managed AP location as the N+1 controller's secondary managed AP location. This configures the secondary controller as the N+1 controller.

For more information, see Provision a Cisco AireOS Controller, on page 378 and Provision a Cisco Catalyst 9800 Series Wireless Controller, on page 409.

Step 10 Provision the APs that are associated with the primary controller.

Step 11 Import the software images to repository.

For more information, see Import a Software Image, on page 329.

Step 12 Assign the software image to a device family.

For more information, see Assign a Software Image to a Device Family, on page 330.

Step 13 Mark the software image as golden by clicking the star for a device family or a device role.

For more information, see Specify a Golden Software Image, on page 332.

Step 14 Before upgrading the image, make sure that the image readiness checks are successful for both devices.

Also make sure that the status of the **N+1 Device Check** and the **Mobility Tunnel Check** has a green tick mark.

- To do the image update readiness check, choose **Provision** > **Network Devices** > **Software Images**.

- From the **Focus** drop-down list, choose **Software Images**. Select the device whose image you want to upgrade.
- If the prechecks are successful for a device, the **Status** link in the **Image Precheck Status** column has a green tick mark. If any of the upgrade readiness prechecks fail for a device, the Image Precheck Status link has a red mark, and you cannot update the OS image for that device. Click the **Status** link and correct any errors before proceeding.

Step 15 Initiate the upgrade on primary controller.

Step 16 On the **Software Images** window, check the check box next to the primary controller.

Step 17 From the **Actions** drop-down list, choose **Software Image** > **Update Image**.

For more information, see Provision a Software Image, on page 334.

Step 18 To monitor the progress of the image upgrade, click **In Progress** in the **Software Image** column.

The **Device Status** page displays the following information:

- **Distribution Operation**: Provides information about the image distribution process. The image gets copied from the Cisco DNA Center to the primary device. The activate operation starts after the distribution process is complete.
- **Activate Operation**: Provides the activate operation details. The rolling AP upgrade starts during this process.
- **Rolling AP Upgrade Operation**: Provides a summary of the rolling AP upgrade, such as whether the rolling AP upgrade task is complete, the number of APs pending, the number of rebooting APs, and the number of APs that have joined the N+1 controller.

  Click **View AP Status** to view details about the primary controller, N+1 controller, device names, current status, and iterations.

Provision a Cisco Catalyst 9800 Series Wireless Controller

Before you begin

Before provisioning a Cisco Catalyst 9800 Series Wireless Controller make sure that you have completed the steps in Workflow to Configure a Cisco Catalyst 9800 Series Wireless Controller in Cisco DNA Center, on page 392.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** window appears, which lists all the discovered devices.

Step 2 Check the check box next to the Catalyst 9800 Series Wireless Controller name that you want to provision.

Step 3 From the **Actions** drop-down list, choose **Provision** > **Provision Device**.

Step 4 In the **Assign Site** window, click **Choose a Site** to associate with a site.

Step 5 In the **Choose a site** slide-in window, check the check box next to the site name to associate a Catalyst 9800 Series Wireless Controller, and click **Save**.

You can either select a parent site or the individual sites. If you select a parent site, all the children under the parent site are also selected. You can uncheck the check box to deselect an individual site.

Step 6 Click **Next**.

The **Configuration** window appears.

Step 7 Select a role for the Cisco Catalyst 9800 Series Wireless Controller: **Active Main WLC** or **Anchor**.

Step 8 Click **Select Primary Managed AP Locations** to select the managed AP location for primary controller.

Step 9 Click **Select Secondary Managed AP Locations** to select the managed AP location for the secondary controller.

Step 10 You can either select a parent site or the individual sites, and click **Save**.

If you select a parent site, all the children under the parent site are also selected. You can uncheck the check box to deselect a particular site.

Note Inheritance of managed AP locations allows you to automatically choose a site along with the buildings and floors under that particular site. One site is managed by only one wireless controller.

Step 11 For an active main wireless controller, you need to configure interface and VLAN details.

Step 12 Under the **Assign Interface** area, do the following:

- **VLAN ID**: Enter a value for the VLAN ID.
- **Interface IP Address**: Enter a value for the interface IP address.
- **Gateway IP Address**: Enter the gateway IP address.
- **Subnet Mask (in bits)**: Enter the subnet mask details for the interface.

Note Assigning an IP address, gateway IP address, and subnet mask is not required for the Cisco Catalyst 9800 Series Wireless Controller.

Step 13 Check the **Skip AP Provision** check box to skip configuring AP related commands while provisioning the Cisco Catalyst 9800 Series Wireless Controller.

Step 14 Click **Next**.

The **Model Configuration** window appears.

Step 15 In the **Devices** pane, you can either search for a model config design by entering its name in the **Find** field, or expand the device and select a model config design.

The selected model config design appears in the right pane.

Step 16 Check the check box next to the **Design Name** that you want to provision, and click Configure to edit the model config design. You cannot edit all the configurations at this step.

Step 17 After making the necessary changes, click **Apply**.

Step 18 Click **Next**.

The **Advanced Configuration** window appears, where you enter values for the predefined template variables.

Step 19 Search for the device or the template in the **Devices** panel.

Step 20 Enter a value for the predefined template variable in the **wlanid** field, and click Next.

Step 21 On the **Summary** window, review the following configurations:

- Device Details
- Network Setting

- SSID
- Managed Sites
- Rolling AP Upgrade
- Model Configs
- Interfaces
- Advanced Configuration

Step 22 Click **Deploy** to provision the Cisco Catalyst 9800 Series Wireless Controller.

- To deploy the device immediately, click the **Now** radio button and click **Apply**.
- To schedule the device deployment for a later date and time, click the **Later** radio button and define the date and time of the deployment.

Step 23 To verify configurations that are pushed from Cisco DNA Center to the device, use the following commands on the Cisco Catalyst 9800 Series Wireless Controller device:

- #show wlan summary
- #show run | sec line
- #show running-configuration

Step 24 Once the devices are deployed successfully, the **Provision Status** changes from **Configuring** to **Success**.

Step 25 In the **Inventory** window, click **See Details** in the **Provision Status** column against a device to get more information about network intent or to view a list of actions.

Step 26 Click **See Details** under **Device Provisioning**.

Step 27 Click **View Details** under **Deployment of network intent**, and click the device name.

Step 28 Click and expand the device name.

Step 29 Expand the **Configuration Summary** area to view the operation details, feature name, and the management capability. The configuration summary also displays any error that occurred while provisioning device with reasons for failure.

Step 30 Expand the **Provision Summary** area to view details of the exact configuration that is sent to the device.

Step 31 Provision the AP.

Brownfield Support for Cisco Catalyst 9800 Series Wireless Controller

With Cisco DNA Center, you can add and provision brownfield devices such as the Cisco Wireless Controller and the Cisco Catalyst 9800 Series Wireless Controller to the network. Brownfield refers to devices that belong to existing sites with pre-existing infrastructure.

This section provides information on provisioning a brownfield Cisco Catalyst 9800 Series Wireless Controller with the Cisco DNA Center.

Before you begin

- Make sure that you have Cisco Catalyst 9800 Series Wireless Controller in the inventory. If you do not, discover devices using the Discovery feature.

  To discover the Cisco Catalyst 9800 Series Wireless Controller, you must enable NETCONF and set the port to 830. For more information, see Discovery Overview, on page 33.

- Ensure that the Catalyst 9800 Series Wireless Controller is reachable and in **Managed** state on the **Inventory** window. For more information, see About Inventory, on page 63.

- Design your network hierarchy by adding sites, buildings, and floors so that later you can easily identify where to apply design settings or configurations. You can either create a new network hierarchy or, if you have an existing network hierarchy on Cisco Prime Infrastructure, import it into Cisco DNA Center.

  For more information about importing and uploading an existing network hierarchy, see Upload an Existing Site Hierarchy, on page 124.

  For more information about creating a new network hierarchy, see Create a Site in a Network Hierarchy, on page 122, Add a Building, on page 127, and Create Floors with Floor Maps, on page 131.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** window, which lists all the discovered devices that are available in the network, appears.

Step 2 Check the check box next to the Catalyst 9800 Series Wireless Controller that you want to provision.

Step 3 From the **Action** drop-down list, choose **Provision** > **Learn Device Config**.

Step 4 Configure the following parameters in the **Assign Site** step:

a) Click **Choose a site** to assign a site to the Catalyst 9800 Series Wireless Controller.

b) In the **Choose a site** window, select the location to which you want to associate the Catalyst 9800 Series Wireless Controller, and click **Save**.

c) Click **Next**.

Step 5 The **Resolve Conflict** step shows the configurations that are available on the Cisco DNA Center and the Catalyst 9800 Series Wireless Controller. The conflicting configurations that you need to resolve are highlighted with a red box around them.

The **Choose this config in Cisco DNA Center** section shows the available configurations in Cisco DNA Center, while the **Choose this config in Device** section shows the available configurations on the Catalyst 9800 Series Wireless Controller device.

a) To retain the Cisco DNA Center configuration, from the **Choose this config** section, select the configuration that you want to retain by clicking the respective red box. This overwrites the device configuration.

For example, if the Cisco DNA Center is using Open as the authentication type for an SSID, and the device is using wpa2_enterprise as the authentication type, you can decide the configuration that you want to retain. To retain the Cisco DNA Center configuration, from the **Choose this config** section, select Open. Retaining the Cisco DNA Center configuration overwrites the device configuration.

To retain the device configuration, from the **Choose this config in Device** section, select the configuration that you want to retain by clicking the respective red box. Note that retaining the device configuration overwrites the Cisco DNA Center configuration.

b) Click **OK** in the **Warning** dialog box.

c) Click **Next**.

The **Design Object** window lists the configurations learned by the device.

Step 6 Configure the following in the **Design Object** step:

a) Click **Network** in the left pane. The right pane displays network configurations that were learned as part of the device configuration learning process, and shows the following information:

- **AAA Server** details.
- **Systems Settings**, with details about the IP address and protocol of the AAA server.
- **DHCP Server**, with details about all the DHCP servers available in the device.
- **NTP Server**, with details about all the NTP servers available in the device.
- Enter the **Shared Secret** for the AAA server.

b) Click **Wireless** in the left pane. This displays the enterprise SSIDs, guest SSIDs, wireless interfaces, antenna radio profiles, and RF profiles that are present on the device.

For an SSID with a preshared key (PSK), you must provide the **Passphrase key**.

c) Click **Ignored Config** in the left pane.

This displays the conflicting and the existing configurations on the Cisco DNA Center. The discarded configuration entries are available under the following categories:

- Duplicate design entity
- Unknown device configuration for radio policy

d) Click **Next**.

Step 7 Review the **Network Profile** step which lists the network profile or site profile that is created based on the AP and WLAN combination, and click **Save**.

A message saying `Brownfield Configuration is Successful` is displayed.

Step 8 Click the menu icon (≡) and choose **Design** > **Network Profiles** to assign a site to the network profile.

Step 9 In the **Network Profiles** window, configure the following:

a) Click **Assign Site** to add sites to the selected profile.
b) In the **Add Sites to Profile** slide-in pane, check the check box next to the site to associate this profile.
c) Click **Save**.

Step 10 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

Step 11 Click **Filter** to locate the device that you want to provision.

The data that is displayed in the **Devices** table is automatically updated according to your filter selection.

Step 12 Check the check box next to the Catalyst 9800 Series Wireless Controller name that you want to provision.

Step 13 From the **Action** drop-down list, choose **Provision** > > **Provision Device**.

Step 14 Review the details in the **Assign Site** step, and click **Next**.

Step 15 In the **Configuration** step, configure the following:

a) Under **Interface and VLAN Configuration**, click **+Add** to configure interface and VLAN details.
b) In the **Configure Interface and VLAN** window, configure the required fields, and click **OK**.
c) Click **Next**.

Step 16 Review the **Summary** step which displays the following information:

- **Device Details**
- **Network Setting**
- **SSID**
- **Managed Sites**
- **Rolling AP Upgrade**
- **Interfaces**

Step 17 Click **Deploy** to provision the device.

a) You are prompted to deploy the device immediately or to schedule the deployment for a later time.

To deploy the device now, click the **Now** radio button, and click **Apply**.

To schedule device deployment for a later date and time, click the **Later** radio button, and define the date and time of the deployment.

Step 18 Next, provision the AP.

For more information, see Provision a Cisco AP—Day 1 AP Provisioning, on page 384.

Day 0 Workflow for Cisco Embedded Wireless Controller on Catalyst Access Points

The Cisco Embedded Wireless Controller on Catalyst Access Points (EWC-APs) is the next-generation Wi-Fi solution, which combines the Cisco Catalyst 9800 Series Wireless Controller with Cisco Catalyst 9100 Series Access Points, creating the best-in-class wireless experience for the evolving and growing organization.

Before you begin

- Design your network hierarchy with sites, buildings, floors, and so on.

  For more information, see Create a Site in a Network Hierarchy, on page 122, Add a Building, on page 127, and Create Floors with Floor Maps, on page 131.

- Define the device credentials, such as CLI, SNMP, HTTP, and HTTPS at the global level. The credentials that are defined at the global level are inherited by the sites.

  For more information, see Configure Global CLI Credentials, on page 173, Configure Global SNMPv2c Credentials, on page 174, and Configure Global SNMPv3 Credentials, on page 175.

- Create wireless SSIDs, wireless interfaces, and wireless Radio Frequency profiles.

  For more information, see Create SSIDs for an Enterprise Wireless Network, on page 188, Create SSIDs for a Guest Wireless Network, on page 194, Create a Wireless Interface, on page 201, and Create a Wireless Radio Frequency Profile, on page 202.

Note For Cisco Embedded Wireless Controller on Catalyst Access Points, only Flex-based SSID creation is supported.

- Configure the DHCP server with Option #43 on the switch where the Cisco Embedded Wireless Controller on Catalyst Access Points is connected. This is IP address of the Cisco DNA Center Plug and Play server. Using this IP address, the APs contact the PnP server and download the configuration.
- Make sure that you have the Cisco Embedded Wireless Controller on Catalyst Access Points in the inventory. If not, discover them using the Discovery feature. For more information, see Discover Your Network Using CDP, on page 38, Discover Your Network Using an IP Address Range, on page 45, and About Inventory, on page 63.
- The APs should be in the factory reset state without any Cisco Wireless Controller configurations.

The Cisco Embedded Wireless Controller on Catalyst Access Points is available in multiple form factors:

- Cisco Embedded Wireless Controller on Catalyst 9115AX Access Points
- Cisco Embedded Wireless Controller on Catalyst 9117AX Access Points
- Cisco Embedded Wireless Controller on Catalyst 9120AX Access Points
- Cisco Embedded Wireless Controller on Catalyst 9130AX Access Points

---

Step 1 The Cisco Embedded Wireless Controller on Catalyst Access Points contacts the DHCP server.

In response, the DHCP server provides the IP address along with Option #43, which contains the IP address of the Cisco Plug and Play server.

Step 2 Based on Option #43, the Cisco Embedded Wireless Controller on Catalyst Access Points turns on the Plug and Play agent and contacts the Cisco DNA Center Plug and Play server.

Note If you have a set of Cisco Embedded Wireless Controller on Catalyst Access Points in the network, they go through an internal protocol. The protocol selects one Cisco Embedded Wireless Controller on Catalyst Access Points, which is configured on the Cisco Wireless Controller as the primary AP to reach the PnP server.

Step 3 Find the unclaimed Cisco Embedded Wireless Controller on Catalyst Access Points in the **Provision** > **Network Devices** > **Plug and Play** tab.

The table lists all the unclaimed devices. The **State** column shows as **Unclaimed**. Use the **Filter** or **Find option** to find specific devices.

You must wait for the onboarding status to become **Initialized** under the **Onboarding State** column.

Step 4 To claim the Cisco Embedded Wireless Controller on Catalyst Access Points, check the check box next to the AP device name.

Step 5 Choose **Actions** > **Claim** in the menu bar above the device table.

The **Claim Devices** window appears.

Step 6 In the **Site Assignment** window, choose a site from the **Site** drop-down list.

Claiming the selected AP to this particular site also applies the associated configurations.

Step 7 Click **Next**.

Step 8 To configure a device, click the device name in the **Configuration** window.

Step 9 In the **Configuration for device name** window, assign the static IP details for the device:

- **Management IP**
- **Subnet Mask**
- **Gateway**

Step 10 Click **Save**.

Step 11 Click **Next**.

The **Summary** window appears.

Step 12 Click **Claim** in the **Summary** window.

After the Cisco Embedded Wireless Controller on Catalyst Access Points is claimed, the IP address configured is assigned to the Cisco Embedded Wireless Controller.

The claimed device, which is a Cisco Embedded Wireless Controller with an internal AP, is now available under **Provision** > **Network Devices** > **Inventory**.

Step 13 To provision the additional controller, see Provision a Cisco AireOS Controller, on page 378.

Step 14 To bulk import devices from a CSV file, see Add Devices in Bulk, on page 362.

Step 15 To add devices manually, see Add or Edit a Device.

Migrate Cisco AireOS Controller to Cisco Catalyst 9800 Series Wireless Controller Using Cisco DNA Center

Before you begin

- Design your network hierarchy by adding sites, buildings, and floors.
- Discover the Cisco Catalyst 9800 Series Wireless Controller by running the discovery feature and add it to the Inventory. Make sure that the device status is reachable and in managed state.

  You must enable NETCONF and set the port to 830 to discover the Catalyst 9800 Series Wireless Controller. NETCONF provides a mechanism to install, manipulate, and delete configurations of network.
- Discover the Cisco AireOS Controllers and add it to the Inventory. Make sure that the device status is reachable and in managed state.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** window appears, which lists the discovered devices.

Step 2 Check the check box next to the Cisco AireOS Controller.

Step 3 From the **Action** drop-down list, choose **Provision** > **Assign Device to Site**.

Step 4 In the **Assign Device to Site** window, click **Choose a Site**.

Step 5 In the **Add Sites** window, check the check box next to the site name to associate a Cisco AireOS Controller.

Step 6 Click **Save**.

Step 7 From the **Action** drop-down list, choose **Provision** > **Learn Device Config** to learn the configuration from the Cisco AireOS Controller device.

Step 8 In the **Assign Site** window, click **Next**.

Step 9 The **Resolve Conflict** window shows any conflicting configurations in Cisco DNA Center that you need to resolve. Click **Next**.

Step 10 In the **Design Object** window, click **Next**.

Step 11 In the left pane, click **Network**.

The right pane displays network configurations that were learned as part of the device configuration learning process, and shows the following information:

- AAA server details.
- Systems settings, with details about the IP address and protocol of the AAA server. Enter the shared secret for the AAA server, because the passwords are encrypted and Cisco DNA Center cannot learn passwords.
- DHCP server, with details about all the DHCP servers available in the device.
- NTP server, with details about all the NTP servers available in the device.

Step 12 Click **Next**.

Step 13 In the left pane, click **Wireless**.

The Wireless window displays the enterprise SSIDs, guest SSIDs, wireless interfaces, and RF profiles that are present on the device.

Step 14 For an SSID with a preshared key (PSK), enter the passphrase key.

Step 15 In the left pane, click **Discarded Config**.

This displays the conflicting and the existing configurations on Cisco DNA Center. The discarded configuration entries are available under the following categories:

- Duplicate design entity
- Unknown device configuration for radio policy

Step 16 Click **Next**.

Step 17 The **Network Profile** window lists the network profile or site profile that is created based on the AP and WLAN combination.

Step 18 Click **Save**.

A success message is displayed.

Step 19 Choose **Design** > **Network Settings** > **Wireless** to view the SSID and interface configurations that Cisco DNA Center has learned from the Cisco AireOS Controller.

Step 20 Choose **Design** > **Network Profiles** to assign a site to the network profile.

Step 21 In the **Network Profiles** window, click **Assign Site** to add sites to the selected profile.

Step 22 In the **Add Sites to Profile window**, choose a site from the drop-down list, and click **Save**.

Step 23 Click the **Provision** tab.

Step 24 Check the check box next to the Cisco Catalyst 9800 Series Wireless Controller that you want to provision.

Step 25 From the **Action** drop-down list, choose **Provision**.

Step 26 Click **Choose a site** to assign a site for the Cisco Catalyst 9800 Series Wireless Controller.

Step 27 In the **Choose a site** window, check the check box next to the site name to associate a Catalyst 9800 Series Wireless Controller.

Step 28 Click **Next**.

The **Configuration** window appears.

Step 29 Select a role for the Cisco Catalyst 9800 Series Wireless Controller as **Active Main WLC**.

Step 30 Click **Select Primary Managed AP Locations** to configure a managed AP location for the primary controller.

Step 31 In the **Managed AP Location** window, check the check box next to the site name. You can either select a parent site or the individual sites. If you select a parent site, the children under that parent site are automatically selected.

Step 32 Click **Save**.

Step 33 Click **Next**.

Step 34 The summary window shows the configurations that will be pushed to the Cisco Catalyst 9800 Series Wireless Controller from the Cisco AireOS Controller.

Review the following details:

- Device Details
- Network Setting
- SSID
- Managed Sites
- Interfaces
- Advanced Configuration

Step 35 Click **Deploy** to provision the Catalyst 9800 Series Wireless Controller.

- To deploy the device immediately, click the **Now** radio button and click **Apply**.
- To schedule the device deployment for a later date and time, click the **Later** radio button and define the date and time of the deployment.

Step 36 After the devices are deployed successfully, the **Provision Status** changes from **Configuring** to **Success**.

Step 37 In the **Device Inventory** window, click **See Details** in the **Provision Status** column to get more information about the network intent or to view a list of actions that you need to take.

Step 38 To manually resynchronize the Cisco Catalyst 9800 Series Wireless Controller, on the **Provision** > **Inventory** window, select the controller that you want to manually synchronize.

Step 39 From the **Actions** drop-down list, choose **Resync**.

Step 40 Provision the AP.

Configure and Provision a Cisco Catalyst 9800 Embedded Wireless Controller for Catalyst 9000 Series Switches

Supported Hardware Platforms

Device Role	Platforms
Embedded Wireless Controller	Cisco Catalyst 9300 Series Switches Cisco Catalyst 9400 Series Switches Cisco Catalyst 9500H Series Switches
Fabric Edge	Cisco Catalyst 9300 Series Switches Cisco Catalyst 9400 Series Switches Cisco Catalyst 9500H Series Switches Cisco Catalyst 3600 Series Switches Cisco Catalyst 3850 Series Switches
APs	Cisco 802.11ac Wave 2 APs: • Cisco Aironet 1810 Series OfficeExtend Access Points • Cisco Aironet 1810W Series Access Points • Cisco Aironet 1815i Access Point • Cisco Aironet 1815w Access Point • Cisco Aironet 1815m Access Point • Cisco 1830 Aironet Series Access Points • Cisco Aironet 1850 Series Access Points • Cisco Aironet 2800 Series Access Points • Cisco Aironet 3800 Series Access Points • Cisco Aironet 4800 Series Access Points Cisco 802.11ac Wave 1 APs • Cisco Aironet 1700 Series Access Points • Cisco Aironet 2700 Series Access Points • Cisco Aironet 3700 Series Access Points Cisco Catalyst 9105 Series Wi-Fi 6 Access Points Cisco Catalyst 9115 Series Wi-Fi 6 Access Points

Device Role	Platforms
	Cisco Catalyst 9117 Series Wi-Fi 6 Access Points Cisco Catalyst 9120 Series Wi-Fi 6 Access Points Cisco Catalyst 9124 Series Wi-Fi 6 Access Points Cisco Catalyst 9130 Series Wi-Fi 6 Access Points Cisco Catalyst 9136 Series Wi-Fi 6 Access Points

Preconfiguration

On the Cisco Catalyst 9800 Series Wireless Controller, make sure that the following commands are present if the switch is already configured with **aaa new-model**:

```
aaa new-model

aaa authentication login default local

aaa authorization exec default local

aaa session-id common
```

This is required for NETCONF configuration. These configurations are not required if you are using an automated underlay for provisioning.

Workflow to Configure Cisco Catalyst 9800 Embedded Wireless Controller for Catalyst 9000 Switches

1. Install Cisco DNA Center.

   For more information, see the Cisco DNA Center Installation Guide.

2. Log in to the Cisco DNA Center GUI and verify that the applications you need are in the **Running** state.

   Click the menu icon (≡) and choose **System** > **Software Updates** > **Installed Apps**.

3. Integrate Cisco Identity Services Engine with Cisco DNA Center. After Cisco ISE is registered with Cisco DNA Center, any device that Cisco DNA Center discovers, along with relevant configurations and other data, is pushed to Cisco ISE.

4. Discover Cisco Catalyst 9000 Series Switches and the edge switches.

   You must enable NETCONF and set the port to 830 to discover Cisco Catalyst 9800 Embedded Wireless Controller for Catalyst 9000 Series Switches.

   Do not enable NETCONF to discover the edge switches.

   For more information, see Discover Your Network Using CDP, on page 38 and Discover Your Network Using an IP Address Range, on page 45.

   Change the **Preferred Management IP** to **Use Loopback**.

5. Make sure that the devices appear in the device inventory and are in **Managed** state.

   For more information, see About Inventory, on page 63 and Display Information About Your Inventory, on page 65.

Ensure that the devices are in the **Managed** state.

6. Design your network hierarchy, which represents your network's geographical location. You create sites, buildings, and floors so that later you can easily identify where to apply design settings or configurations.

   You can either create a new network hierarchy, or if you have an existing network hierarchy on Cisco Prime Infrastructure, you can import it into Cisco DNA Center.

   To import and upload an existing network hierarchy, see the Upload an Existing Site Hierarchy, on page 124.

   To create a new network hierarchy, see the Create a Site in a Network Hierarchy, on page 122, Add a Building, on page 127, and Create Floors with Floor Maps, on page 131.

7. For a nonfabric network, add and position APs on a floor map to get heatmap visualization during the design phase.

   For a fabric network, you cannot place APs on a floor map during the design time. The APs are onboarded after adding devices to a fabric network.

   For more information, see Work With APs on a Floor Map, on page 136.

8. Define network settings, such as AAA (Cisco ISE is configured for Network and Client Endpoint), NetFlow Collector, NTP, DHCP, DNS, syslog, and SNMP traps. These network servers become the default for your entire network.

   You can configure up to six AAA servers on the **Wireless** page during the SSID creation.

   For more information, see Network Settings Overview, on page 171, Configure Global Network Servers, on page 173, and Add Cisco ISE or Other AAA Servers.

9. Configure device credentials such as CLI, SNMP, and HTTPs.

   For more information, see Global Device Credentials Overview, on page 173, Configure Global CLI Credentials, on page 173, Configure Global SNMPv2c Credentials, on page 174, Configure Global SNMPv3 Credentials, on page 175, and Configure Global HTTPS Credentials, on page 177.

10. Configure IP address pools at the global level.

    To configure an IP address pool, see Configure IP Address Pools, on page 182.

    To reserve an IP address pool for the building that you are provisioning, see Provision a LAN Underlay.

11. Create enterprise and guest wireless networks. Define global wireless settings once and Cisco DNA Center then pushes configurations to various devices across geographical locations.

    Designing a wireless network is a two-step process. First, you must create SSIDs on the **Wireless** page. Then, associate the created SSID to a wireless network profile. This profile helps you to construct a topology, which is used to deploy devices on a site.

    For more information, see Create SSIDs for an Enterprise Wireless Network, on page 188 and Create SSIDs for a Guest Wireless Network, on page 194.

12. Configure backhaul settings.

13. Configure the following on the **Policy** page:

    - Create a virtual network. The virtual network segments your physical network into multiple logical networks.

- Create a group-based access control policy, and add a contract. For more information, see Create Group-Based Access Control Policy, on page 532.

14. Provision Cisco Catalyst 9000 Series Switches and the edge node switches with the configurations added during the design phase.
    - Create a fabric site.
    - Add devices to the fabric network by creating a CP+Border+Edge or CP+Border.
    - Enable embedded wireless capabilities on the Cisco Catalyst 9800 Embedded Wireless Controller for Catalyst 9000 Series Switches.
    - Onboard APs in the fabric site.

    After the devices are deployed successfully, the deploy status changes from **Configuring** to **Success**.

Provision Embedded Wireless on Cisco Catalyst 9000 Series Switches

Before you begin

Before provisioning a Cisco Catalyst 9800 Embedded Wireless Controller on Catalyst 9000 Series Switches, ensure that you have completed the steps in Workflow to Configure Cisco Catalyst 9800 Embedded Wireless Controller for Catalyst 9000 Switches, on page 420.

This procedure explains how to provision embedded wireless on Cisco Catalyst 9300 Series Switches, Cisco Catalyst 9400 Series Switches, and Cisco Catalyst 9500H Series Switches.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** window appears, with the discovered devices listed.

Step 2 Check the check box next to the Catalyst 9000 Series Switch device and an edge switch that you want to associate to a site.

Step 3 From the **Actions** drop-down list, choose **Provision** > **Assign Device to Site**.

Step 4 In the **Assign Device to Site** step, do the following:

a) Click **Choose a site**.
b) In the **Choose a site** slide-in pane, check the check box next to the site to associate the device.
c) Click **Save**.
d) Click **Apply**.
The next step is to provision the Catalyst 9000 Series Switch and the edge node with the configurations that were added during the design phase.

Step 5 In the **Devices** > **Inventory** window, check the check box next to the device name that you want to provision.

a) From the **Actions** drop-down list, choose **Provision** > **Provision Device**.
b) Click **Next**.
c) In the **Summary** step, verify the configurations, and click **Deploy**.
d) In the **Provision Devices** window, do the following to preview the CLI configuration:

    - Click **Generate Configuration Preview** radio button.

- In the **Task Name** field, enter a name for the CLI preview task and click **Apply**.
- In the **Task Submitted** pop-up, click the **Work Items** link.

  Note If you missed the **Task Submitted** pop-up, click the menu icon (≡) and choose **Activities** > **Work Items**.

- In the **Work Items** window, click the CLI preview task for which you submitted the configuration preview request.
- View the CLI configuration details and click **Deploy**.
- To immediately deploy the device, click the **Now** radio button, and click **Apply**.
- To schedule the device deployment for a later date and time, click the **Later** radio button and define the date and time of the deployment.
- In the **Information** pop-up, do the following:
  - Click **Yes** if you want to delete the CLI preview task from the **Work Items** window.
  - Click **No** if you want to retain the task in the **Work Items** window.

    Note The CLI task will be marked as completed in the **Work Items** window. You can view the CLI configuration for this task, but you cannot deploy it again.

Step 6 To provision the edge switch, check the check box next to the edge switch that you want to provision.

a) From the **Actions** drop-down list, choose **Provision**.
b) Click **Next**.
c) In the **Summary** window, verify the configurations, and click **Deploy**.

   After the devices are deployed successfully, the **Provision Status** changes from **Configuring** to **Success**.

Step 7 To add devices to a fabric site, click the menu icon (≡) and choose **Provision** > **Fabric Sites**.

Step 8 Create a fabric site. For more information, see Add a Fabric Site, on page 450.

Step 9 Add an IP transit network.

Step 10 Add devices and associate virtual networks to a fabric site.

Step 11 Add the Cisco Catalyst 9000 Series Switch as a control plane, a border node, and an edge node or a control plane and a border node.

a) Click the device and choose **Add as CP+Border+Edge** or **Add as CP+Border**.
b) Click the edge node and choose **Add to Fabric**.
c) Click **Save**.

Step 12 To enable embedded wireless on the device, click the device that is added as a **Edge**, **CP+Border+Edge** or **CP+Border**, and click the **Embedded Wireless**.

a) If you have not installed the wireless package on Cisco Catalyst 9000 Series Switches before enabling the wireless functionality, Cisco DNA Center displays a warning message saying `9800-SW image is necessary for turning on the capability. Click "OK" to import the 9800-SW image manually.`
b) Click **OK** to install the image manually.
c) On the **Download Image** window, click **Choose File** to navigate to a software image stored locally or **Enter image URL** to specify an HTTP or FTP source from which to import the software image.
d) Click **Import**.

The progress of the import is displayed.

e) Click **Activate image on device**.

A warning message saying `Activate image on device will reboot the device. Are you sure you want to reboot the device?` appears.

f) Click **Yes**.

The device reboots and comes online after the device package upgrade is complete.

g) In the dialog box that appears, the AP locations that are managed by the controllers are displayed. You can change, remove, or reassign the site here.
h) Click **Next**.

Step 13 Review the details on the **Summary** step, and click **Save**.

Step 14 On the **Modify Fabric** step, click **Now** to commit the changes, and click **Apply** to apply the configurations.
The next step is to onboard APs in a fabric site.

Step 15 In the Cisco DNA Center GUI, click the **Provision** tab.

Step 16 Click the **Fabric** tab.

A list of fabric sites is displayed.

Step 17 Select the fabric site that was created, and click the **Host Onboarding** tab to enable IP pool for APs.

Step 18 Select the authentication template that is applied for devices in the fabric site. These templates are predefined configurations that are retrieved from Cisco ISE. After selecting the authentication template, click **Save**.

Step 19 Under **Virtual Networks**, click **INFRA_VN** to associate one or more IP pools with the selected virtual network.

Step 20 Under **Virtual Network**, click the guest virtual networks to associate IP pools for the selected guest virtual network.

Step 21 Check the **IP Pool Name** check box that was created for APs during the design phase.

Step 22 Click **Update** to save the setting.

The AP gets the IP address from the specified pool, which is associated with the AP VLAN and registers with the Cisco wireless controller through one of the discovery methods.

Step 23 Specify wireless SSIDs within the network that hosts can access. Under the **Wireless SSID** section, select the guest or enterprise SSIDs and assign address pools, and click **Save**.

Step 24 Manually trigger resynchronization by performing an **Inventory** > **Resync** to see the APs on Cisco DNA Center for embedded wireless.
The discovered APs are now displayed under **Inventory** in the **Provision** page and the **Status** is displayed as **Not Provisioned**.

Step 25 Provision the AP.

For more information, see Provision a Cisco AP—Day 1 AP Provisioning, on page 384.

Step 26 Configure and deploy application policies. For more information, see Create an Application Policy, on page 570, Deploy an Application Policy, on page 575, and Edit an Application Policy, on page 574.

Provision the Catalyst 9300 Series Switches and Cisco Catalyst 9500H Series Switches before deploying an application policy.

Two different policies with different business relevance for two different SSIDs do not work. Always the last deployed policy takes precedence when you are setting up the relevance.

Changing the default business relevance for an application does not work in FlexConnect mode.

You can apply an application policy only on a nonfabric SSID.

Fabric in a Box with Catalyst 9800 Embedded Wireless on Cisco Catalyst 9000 Series Switches

Information About Fabric in a Box

Cisco Catalyst 9000 Series Switches have the capability to host fabric edge, control plane, border, and embedded wireless functionalities on a single switch, which you can configure using Cisco DNA Center.

With this feature, configurations at the small site locations are simplified and the cost to deploy Cisco SD-Access is reduced.

For information on how to add CP+Border+Edge nodes on Cisco Catalyst 9000 Series Switches, see Provision a Cisco Catalyst 9800 Series Wireless Controller, on page 409.

Scale Information

This table shows the device scalability information.

Fabric Constructs	Cisco Catalyst 9300 Series Switches	Cisco Catalyst 9400 Series Switches	Cisco Catalyst 9500 Series Switches	Cisco Catalyst 9500-H Series Switches
Virtual Networks	256	256	256	256
Local End Points/Hosts	4K	4K	4K	4K
SGT/DGT Table	8K	8K	8K	8K
SGACLs (Security ACEs)	5K	18K	18K	18K

Inter-Release Controller Mobility Introduction

Inter-Release Controller Mobility (IRCM) supports seamless mobility and wireless services across different Cisco Wireless Controllers with different software versions.

Cisco DNA Center supports guest anchor feature for the following device combinations:

- Configuration of a Cisco AireOS controller as a foreign controller with a Cisco AireOS controller as an anchor controller.

- Configuration of a Cisco AireOS controller as a guest anchor controller with a Cisco Catalyst 9800 Series Wireless Controller as a foreign controller.
- Configuration of a Cisco Catalyst 9800 Series Wireless Controller as a foreign controller with a Cisco Catalyst 9800 Series Wireless Controller as an anchor controller.

Configuring IRCM on controller devices has the following limitations:

- Configuration of a Cisco AireOS controller as a foreign controller and Cisco Catalyst 9800 Series Wireless Controller as an anchor controller is not supported.
- Configuration of a fabric guest anchor is not supported.
- Configuration of multiple anchor controllers and one foreign controller is not supported.
- Only guest SSID is supported.
- Broadcast of a nonguest anchor SSID in a guest anchor mode is not supported.
- Mobility tunnel is not encrypted.

Guest Anchor Configuration and Provisioning

Follow these steps to configure a guest anchor Cisco Wireless Controller.

Note Guest anchor configuration is not supported on the Cisco Catalyst 9800 Series Wireless Controller.

Step 1 Design a network hierarchy, with sites, buildings, floors, and so on. For more information, see Create a Site in a Network Hierarchy, on page 122, Add a Building, on page 127, and Create Floors with Floor Maps, on page 131.

Step 2 Configure network servers, such as AAA, DHCP, and DNS servers. For more information, see Configure Global Network Servers, on page 173 and Add Cisco ISE or Other AAA Servers, on page 172.

Step 3 Create SSIDs for a guest wireless network with external web authentication and central web authentication along with configuring Cisco Identity Services Engine. For more information, see Create SSIDs for a Guest Wireless Network, on page 194.

Step 4 Discover the wireless controller using the Cisco Discovery Protocol (CDP) or an IP address range and that the devices are in the **Devices** > **Inventory** window and are in the **Managed** state. For more information, see Discovery Overview, on page 33.

Step 5 Provision a foreign wireless controller as the active main wireless controller. See Provision a Cisco AireOS Controller, on page 378.

Step 6 Choose the role for the wireless controller as guest anchor and provision the guest anchor controllers. For more information, see Provision a Cisco AireOS Controller, on page 378.

Step 7 Configure device credentials, such as CLI, SNMP, HTTP, and HTTPS. For more information, see Configure Global CLI Credentials, on page 173, Configure Global SNMPv2c Credentials, on page 174, Configure Global SNMPv3 Credentials, on page 175, and Configure Global HTTPS Credentials, on page 177.

IRCM: Cisco AireOS Controller and Cisco Catalyst 9800 Series Wireless Controller

Before you begin

- Discover the Cisco Catalyst 9800 Series Wireless Controller and Cisco AireOS Controllers.

  You must enable NETCONF and set the port to 830 to discover the Catalyst 9800 Series Wireless Controller. NETCONF provides a mechanism to install, manipulate, and delete configurations of network devices.

  For more information, see Discover Your Network Using CDP, on page 38 or Discover Your Network Using an IP Address Range, on page 45.

- Design your network hierarchy by adding sites, buildings, and floors so that later you can easily identify where to apply design settings or configurations.

  To create a new network hierarchy, see Create a Site in a Network Hierarchy, on page 122, Add a Building, on page 127, and Create Floors with Floor Maps, on page 131.

- Add the location information of APs, and position them on the floor map to visualize the heatmap coverage.

  For more information, see Work With APs on a Floor Map, on page 136.

- Define network settings, such as AAA (Cisco ISE is configured for Network and Client Endpoint), NetFlow Collector, NTP, DHCP, DNS, syslog, and SNMP traps. These network servers become the default for your entire network. You can add a TACACS server while adding a AAA server.

  For more information, see Network Settings Overview, on page 171, Configure Global Network Servers, on page 173, and Add Cisco ISE or Other AAA Servers.

- Create SSIDs for a guest wireless network.

  For more information, see Create SSIDs for a Guest Wireless Network, on page 194.

- The WLAN profile name of the foreign controller and anchor controller should be the same for mobility.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The **Inventory** window appears, with the discovered devices listed.

Step 2 Check the check box next to the Catalyst 9800 Series Wireless Controller that you want to provision as a foreign controller.

Step 3 From the **Actions** drop-down list, choose **Provision** > **Provision**.

Step 4 In the **Assign Site** window, click **Choose a Site** to assign a site for the Catalyst 9800 Series Wireless Controller device.

Step 5 In the **Add Sites** window, check the check box next to the site name to associate a Catalyst 9800 Series Wireless Controller.

Step 6 Click **Save**.

Step 7 Click **Apply**.

Step 8 Click **Next**.

Step 9 Select a role for the Catalyst 9800 Series Wireless Controller as **Active Main WLC**.

Step 10 For an active main wireless controller, you need to configure interface and VLAN details.

Step 11 Under the **Assign Interface** area, do the following:

- **VLAN ID**: Enter a value for the VLAN ID.
- **IP Address**: Enter the interface IP address.
- **Gateway IP Address**: Enter the gateway IP address.
- **Subnet Mask (in bits)**: Enter the interface net mask details.

Note Assigning an IP address, gateway IP address, and subnet mask is not required for the Catalyst 9800 Series Wireless Controller.

Step 12 Click **Next**.

Step 13 In the **Summary** window, review the configurations details.

Step 14 Click **Deploy** to provision the Catalyst 9800 Series Wireless Controller as a foreign controller.

Step 15 On the **Devices** > **Inventory** window, check the check box next to the Cisco AireOS Controller that you want to provision as a guest anchor controller.

Step 16 Repeat Step 3 through Step 8.

Step 17 Select a role for the Cisco AireOS Controller as **Guest Anchor**.

Step 18 For a guest anchor wireless controller, you need to configure interface and VLAN details.

Step 19 Repeat Step 11 through Step 14.

Provision a Meraki Device

This procedure explains how to provision SSIDs to Cisco Meraki devices managed by a Meraki dashboard.

Before you begin

- Integrate the Meraki dashboard with Cisco DNA Center. See Integrate the Meraki Dashboard, on page 87.
- Create the SSID. See Create SSIDs for an Enterprise Wireless Network, on page 188.

Note The Meraki dashboard supports the following types of SSIDs:

- Open: This SSID corresponds to Open in the Meraki dashboard.
- WPA2 Personal: This SSID corresponds to the preshared key with WAP2 in the Meraki dashboard.
- WPA2 Enterprise: This SSID corresponds to WAP-2 Encryption with Meraki authentication or My Radius server in the Meraki dashboard. If you have defined AAA or Cisco ISE servers for client and endpoint authentication at the building level in Cisco DNA Center, the configuration is provisioned to **my Radius server** in the Meraki dashboard. Otherwise, **Meraki Radius** is used for authentication by the Meraki devices.

For every SSID, you can choose an interface name. If you choose the **Management** interface in Cisco DNA Center and the VLAN ID is 0, the configuration is not supported in the Meraki dashboard and VLAN tagging is disabled in the Meraki dashboard. If you create a custom interface for the SSID in Cisco DNA Center, an AP tag is created with the custom interface name and VLAN ID in the Meraki dashboard.

- Create the network profile and assign it to the sites for which the SSID is provisioned.

Note The Network Hierarchy **Sites** > **Buildings** in Cisco DNA Center corresponds to **Organization** > **Network** in the Meraki dashboard. We recommend that you choose **Buildings** in the **Add Sites to Profile** window in the workflow.

Note Cisco DNA Center creates the Meraki network and provisions the SSIDs to the network. The Meraki dashboard provisions the Meraki network configuration to the Meraki devices.

Step 1 Click the menu icon (≡) and choose **Provision**.

The **Network Devices** > **Inventory** window appears, listing all discovered devices.

Step 2 To view the Meraki dashboard, expand the **Global** site in the left pane, and select a building.

All Meraki dashboards available in the selected building are displayed.

Step 3 Check the check box next to the Meraki dashboard name that you want to provision.

Step 4 From the **Actions** drop-down list, choose **Provision** > **Provision Device**.

The **Assign Site** window appears, where you can view the Meraki dashboard and the associated building.

Step 5 To change the associated building, click **Choose a site**.

Step 6 In the **Choose a site** window, select a building and click **Save**.

Step 7 Click **Next**.

The **Configuration** window appears. You can view the managed building in the Primary location.

Step 8 Click **Select Secondary Managed AP Locations** to select the secondary managed location for the Meraki dashboard.

Step 9 In the **Managed AP Location** window, check the check box next to the building name.

Step 10 Click **Save**.

Step 11 Click **Next**.
The **Summary** window displays the following information:

- **Device Details**
- **Network Settings**
- **SSID**

  Note Meraki deployment supports a maximum of 15 SSIDs in each network.

- **Managed Sites**

Step 12 Click **Deploy**.

Step 13 In the **Provision Devices** window, do the following to preview the CLI configuration:

- Click the **Generate Configuration Preview** radio button.
- In the **Task Name** field, enter a name for the CLI preview task and click **Apply**.
- In the **Task Submitted** pop-up, click the **Work Items** link.

  Note If you missed the **Task Submitted** pop-up, click the menu icon (☰) and choose **Activities** > **Work Items**.

- In the **Work Items** window, click the CLI preview task for which you submitted the configuration preview request.
- View the CLI configuration details and click **Deploy**.
- To immediately deploy the device, click the **Now** radio button, and click **Apply**.
- To schedule the device deployment for a later date and time, click the **Later** radio button and define the date and time of the deployment.
- In the **Information** pop-up, do the following:
  - Click **Yes** if you want to delete the CLI preview task from the **Work Items** window.
  - Click **No** if you want to retain the task in the **Work Items** window.

    Note The CLI task will be marked as completed in the **Work Items** window. You can view the CLI configuration for this task, but you cannot deploy it again.

The **Provision Status** column in the **Device Inventory** window shows `SUCCESS` after a successful deployment.

Provision Remote Teleworker Devices

Remote Teleworker Deployment Overview

Deployment Components

The Cisco remote teleworker deployment is built around three main components: Cisco wireless controllers, Cisco OfficeExtend access points (APs) and a Corporate firewall. The following models are supported in this deployment:

- **Wireless Controllers**: Cisco AireOS 5520, 8540, 3504 Controller[4], Cisco Catalyst 9800-40, 9800-80, and 9800-L Wireless Controller
- **Access Points**: Cisco Aironet 1815T (Teleworker) Access Point, Cisco Catalyst 9800 Series Access Point

Cisco wireless controllers

Cisco controllers are responsible for system-wide WLAN functions, such as security policies, intrusion prevention, RF management, quality of service (QoS), and mobility. They work in conjunction with Cisco APs to support business-critical wireless applications for teleworkers. Controllers provide the control, scalability, security, and reliability that network managers need to build a secure, scalable teleworker environment.

To allow users to connect their corporate devices to the organization's on-site wireless network, the remote teleworking solution offers the same wireless Secure Set Identifiers (SSIDs) at a teleworker's home as those that support data and voice inside the organization.

Cisco OfficeExtend Access Points

APs cannot act independently of controllers. As an AP communicates with the controller resources, it downloads its configuration and synchronizes its software or firmware image, if required. The AP establishes a secure Datagram Transport Layer Security (DTLS) connection to the controller, which offers remote WLAN connectivity using the same profile as at the corporate office. Secure tunneling allows all traffic to be validated against centralized security policies and minimizes the management overhead associated with home-based firewalls.

Corporate Firewall

The controller should be placed in a demilitarized zone (DMZ) and the corporate firewall must allow CAPWAP control and data traffic through the firewall to the controller. The general configuration on the firewall is to allow CAPWAP control and CAPWAP management port numbers through the firewall. The UDP 5246 and 5247 ports need to be opened on the firewall for communication between the controller and the AP.

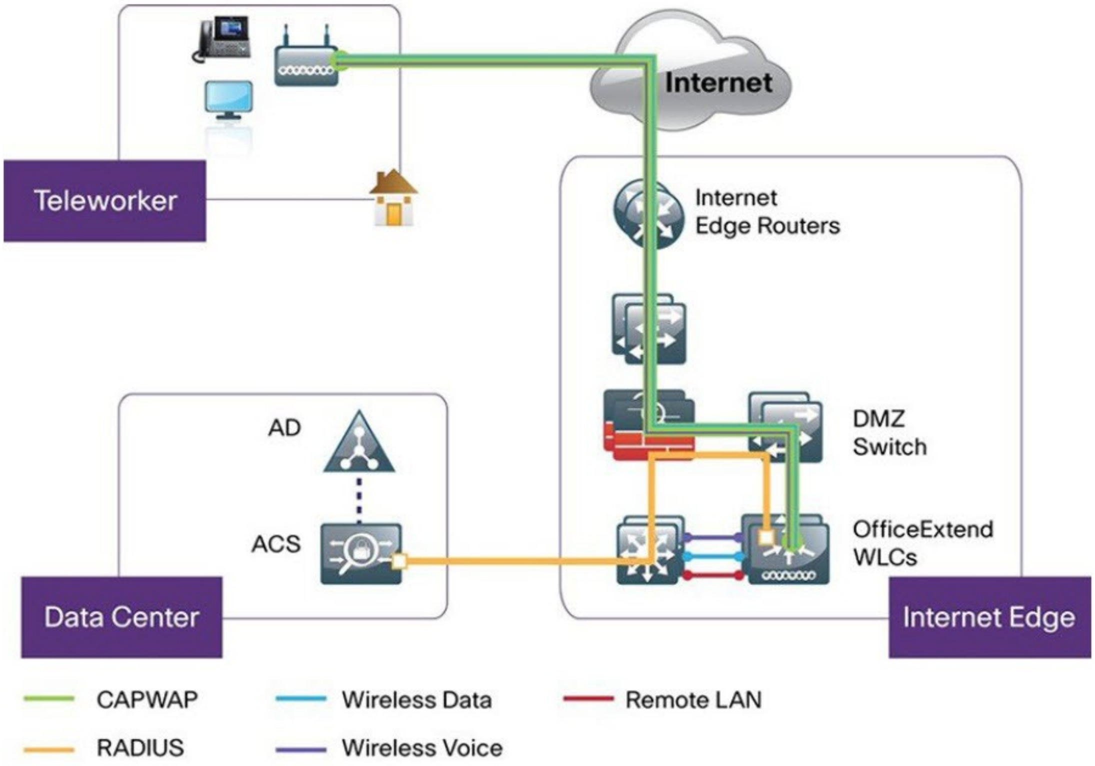
Deployment Configuration

For the most flexible and secure remote teleworker configuration, deploy a dedicated controller pair in a dedicated to the Internet edge DMZ. Traffic from the Internet terminates in the DMZ versus in the internal network, while the remote AP is still directly connected to the internal network.

---

[4] Supported with Cisco Aironet 1815 Teleworker Access Point only.

Figure 40: Sample Remote Teleworker Deployment Scenario


Internet
Teleworker
Internet Edge Routers
DMZ Switch
AD
ACS
OfficeExtend WLCs
Data Center
Internet Edge
CAPWAP
Wireless Data
Remote LAN
RADIUS
Wireless Voice

Create a Remote Teleworker Site

A remote teleworker site is a dedicated site that is used only to manage wireless controllers and remote teleworker access points (APs). To create a remote teleworker site, you need to enable the remote teleworker function on the site. Once enabled, the remote teleworker function cannot be independently disabled for a site, building, or floor within the site's hierarchy. The site can only manage remote teleworker functions.

In a teleworker site, switching is performed centrally from the controller. You cannot configure the network profile for Flex Connect with local switching.

Before you begin

- Understand the supported devices that are used in a teleworker deployment.
- Make sure that you have a Cisco wireless controller and Cisco APs in your inventory. If not, discover the devices or add them manually. For information, see Discover Your Network, on page 33 or Add a Network Device, on page 74.
- Configure global wireless network settings appropriate for your network. For information, see Configure Global Wireless Settings, on page 188.

Step 1 Create a site to manage remote teleworker APs. See Create a Site in a Network Hierarchy, on page 122.

Step 2 Add buildings and floors. See Add a Building, on page 127 and Create Floors with Floor Maps, on page 131.

Step 3 Configure the wireless network settings for the remote teleworker site.

a) Click the menu icon (≡) and choose **Design** > **Network Settings** > **Wireless**.
b) From the navigation tree, select the remote teleworker site.
c) Scroll down and check the **Enable Remote Teleworker** check box.
d) Click **Save**.

Step 4 Assign the controller to the site. See Add a Device to a Site, on page 90.

Step 5 Assign the APs to the site. See Add a Device to a Site, on page 90.

You can use serial numbers or MAC addresses but not a mixture of both, or you can upload a CSV file.

Step 6 In the wireless network settings, add the APs to the authorized APs list.

a) From the navigation tree, select the floor where the APs reside.
b) Click the menu icon (≡) and choose **Design** > **Network Settings** > **Wireless**.
c) Under **Authorized Access Points**, click **Manage Authorized Access Points**.
d) In the **Manage Authorized Access Points** pane, enter the MAC addresses of APs that are allowed to join the controller. The controller responds only to those CAPWAP requests from APs that are in its authorization list.

Step 7 Provision the controller.

a) Click the menu icon (≡) and choose **Provision** > **Inventory**.

The Inventory window appears, with the discovered devices listed.

b) Locate the controller that you want to provision.
c) Check the check box next to the device name.
d) From the **Actions** drop-down list, choose **Provision** > **Provision Device**.
e) On the **Assign Site** page, verify the assigned site and click **Save**.
f) Click **Next**.
g) (Optional) On the **Configuration** page, under **NAT Address for Remote Teleworker**, click the **Enable NAT Address** check box and enter the NAT IP address.
h) Click **Next**.
i) On the **Model Configuration** page, click **Next**.
j) On the **Advanced Configuration** page, click **Next**.
k) On the **Summary** page, verify the configuration and click **Deploy**.
l) In the **Provision Device** slide-in pane, choose **Now** and click **Apply**.

Step 8 After the WLC is provisioned, you can provision the APs.

a) Click the menu icon (≡) and choose **Provision** > **Inventory**.

The Inventory window appears, with the discovered devices listed.

b) Locate the APs that you want to provision.
c) Check the check box next to the device names.
d) From the **Actions** drop-down list, choose **Provision** > **Provision Device**.
e) On the **Assign Site** page, click **Choose a floor** and assign the APs to a floor.
f) Click **Save**.
g) Click **Next**.
h) On the **Configuration** page, click **Next**.
i) On the **Summary** page, verify the configuration and click **Deploy**.

j) In the **Provision Device** slide-in pane, choose **Now** and click **Apply**.

CHAPTER 18

Provision a Routing Profile

- Provision a Routing Profile, on page 435
- VPC Inventory Collection, on page 437

Provision a Routing Profile

Before you begin

Make sure that you have defined the following global network settings before provisioning a routing profile:

- Network servers, such as AAA, DHCP, and DNS. For more information, see Configure Global Network Servers, on page 173.
- Device credentials, such as CLI, SNMP, HTTP, and HTTPS. For more information, see Configure Global CLI Credentials, on page 173, Configure Global SNMPv2c Credentials, on page 174, Configure Global SNMPv3 Credentials, on page 175, and Configure Global HTTPS Credentials, on page 177.
- IP address pools. For more information, see Configure IP Address Pools, on page 182.
- SP profiles. For more information, see Configure Service Provider Profiles, on page 187.

Step 1 Click the menu icon (≡) and choose **Provision**.

The **Network Devices** > **Inventory** window appears, and all the discovered devices are listed in this window.

Step 2 To view devices available in a particular site, expand the Global site in the left pane, and select the site, building, or floor that you are interested in.

All the devices available in that selected site are displayed in the **Inventory** window.

Step 3 From the **Device Type** list, click the **Routers** tab, and from the **Reachability** list, click the **Reachable** tab to get a list of devices that are discovered and reachable.

Step 4 Check the check box next to the device name that you want to provision.

Step 5 Click **Assign** under the site; the **Assign Device to Site** window appears. Click **Choose a Site**.

Step 6 From the **Actions** drop-down list, choose **Provision** > **Provision Device**.

To provision a router, do the following:

- Review the details in the **Confirm Profile** window, and click **Next**.

- Review the details in the **Router WAN Configuration** window.
    - If you selected Gigabit Ethernet as the line interface, click **O** and enter the WAN IP address if you select a static IP address. If you select DHCP, enter the IP address from the DHCP server. If the primary WAN is already configured using PnP, you can select **Do not Change** and select the interface that is configured as the primary WAN from the drop-down list.
    - If you selected cellular as the line interface, click **O**, choose **IP Negotiated**, select the **Interface Name** from the drop-down list, and enter the **Access Point Name (APN)**. Depending on your service provider, check the **PAP** or **CHAP** check box.
    - Enter the **IP SLA Address** for the backup WAN interface when you have multiple service providers.

  This window does not appear if you are provisioning a virtual router.
- Review the details in the **Router LAN Configuration** window, and click **Next**.

  You can now select one L3 interface or one or multiple L2 interfaces from the **Interface(s)** drop-down list.
- Review the details in the **Integrated Switch Configuration** window, and click **Next**.
- Review the details in the **Summary** page.

Step 7 Click **Deploy**.

Step 8 In the **Provision Devices** window, do the following to preview the CLI configuration:

- Click the **Generate Configuration Preview** radio button.
- In the **Task Name** field, enter a name for the CLI preview task and click **Apply**.
- In the **Task Submitted** pop-up, click the **Work Items** link.

  Note If you missed the **Task Submitted** pop-up, click the menu icon (☰) and choose **Activities** > **Work Items**.
- In the **Work Items** window, click the CLI preview task for which you submitted the configuration preview request.
- View the CLI configuration details and click **Deploy**.
- To immediately deploy the device, click the **Now** radio button, and click **Apply**.
- To schedule the device deployment for a later date and time, click the **Later** radio button and define the date and time of the deployment.
- In the **Information** pop-up, do the following:
    - Click **Yes** if you want to delete the CLI preview task from the **Work Items** window.
    - Click **No** if you want to retain the task in the **Work Items** window.

      Note The CLI task will be marked as completed in the **Work Items** window. You can view the CLI configuration for this task, but you cannot deploy it again.

The **Provision Status** column in the `Device Inventory` window shows **SUCCESS** after a successful deployment. Click **SUCCESS** to see a detailed provisional log status.

VPC Inventory Collection

After successful cloud inventory collection, the **Cloud** tab in the **Provision** section provides a view of the collected AWS VPC Inventory. The navigation on the left can be expanded to show the cloud regions for a cloud profile or access key. You can filter the left navigation items by keyword and click to see the VPCs just for the selected region or access key.

In the VPC Inventory view you can also click on a VPC to see more details about it, like the subnets and virtual instances in that VPC and some more details about them. AWS VPC inventory collection is scheduled to occur at the default interval for all inventory collection and can also be triggered on demand by using the **Sync** action from the gear menu for a cloud access key. The status of the inventory collection can be viewed by clicking on **Show Sync Status** in the **VPC Inventory** view.

CHAPTER 19

Provision Firewall Profiles

- Provision Firewall Profiles, on page 439

Provision Firewall Profiles

This procedure explains how to provision a Firepower Threat Defense (FTD) device managed by Firepower Management Center (FMC).

Before you begin

- Integrate FMC with Cisco DNA Center. See Integrate Firepower Management Center, on page 88.
- Create a site in a network hierarchy. See Create a Site in a Network Hierarchy, on page 122.
- Create a network profile for firewall and assign it to a site for which the FTD device is provisioned. See Create Network Profiles for Firewall, on page 227.

Step 1 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

The Inventory page displays the device information that is gathered during the discovery process.

Step 2 Check the check box next to the FTD device that you want to provision and click **Assign** under the **Site** column.

Step 3 In the **Assign Device to Site** window, click **Choose a Site**.

Step 4 In the **Choose a Site** window, select a site from the hierarchy and click **Save**.

Step 5 Click **Next**.

Step 6 Click **Now** to assign the device to site immediately or click **Later** to schedule at a specific time.

Step 7 Click **Assign**.

Note You can view the status of assigning device to site in **Activities** > **Tasks**.

Step 8 From the **Actions** drop-down list, choose **Provision** > **Provision Device**.

The **Provision Firewall Profile** window appears.

Step 9 Review the details in the **Confirm Profile** page and click **Next**.

Step 10 Review the details in the **Firewall Type** page and click **Next**.

The **FTD Configuration** page appears.

Step 11 If you have associated a routed mode firewall with the site, do the following:

a) Expand the **Outside Interface** area, choose an outside interface from the **Select Physical Interface** drop-down list, and choose **Static IP** or **DHCP** radio button.

  - **Static IP**: Enter the IP address and a subnet mask.
  - **DHCP**: The IP address is obtained from DHCP.

b) Expand the **Inside Interface** area, choose an inside interface from the **Select Physical Interface** drop-down list, and choose **Static IP** or **DHCP** radio button.

  - **Static IP**: Enter the IP address and a subnet mask.
  - **DHCP**: The IP address is obtained from DHCP.

Step 12 If you have associated a transparent mode firewall with the site, do the following:

a) Expand the **Outside Interface** area and choose an outside interface from the **Select Physical Interface** drop-down list.

b) Expand the **Inside Interface** area and choose an inside interface from the **Select Physical Interface** drop-down list.

c) Expand the **Bridge Virtual Interface** area, and do the following:

  - **Bridge Group Number**: Enter a bridge group number. The valid number is from 1 to 250.
  - **IP**: Enter the IP address of the FTD device.
  - **Subnet Mask**: Enter a subnet mask.

Step 13 Click **Next**.

The **Summary** page appears. This page summarizes the device specifications.

Step 14 Review the details in the **Summary** page and click **Deploy**.

The **Provision Firewall device(s)** dialog box appears.

Step 15 Click **Now**, **Later**, or **Generate configuration preview** radio button.

- **Now**: Starts the provision immediately.
- **Later**: Schedules the provisioning at a specific time.
- **Generate configuration preview:** Generates preview which can be later used to deploy on selected devices.

Step 16 Click **Apply**.

Note You can view the status of provisioning firewall device in **Activities** > **Tasks**. If you have chosen **Generate configuration preview** in the **Provision Firewall device(s)** dialog box, you can view the status in **Activities** > **Work Items**.

CHAPTER 20

Provision a LAN Underlay

- Provision a LAN Underlay, on page 441
- Peer Device in LAN Automation Use Case, on page 444
- Check the LAN Automation Status, on page 445

Provision a LAN Underlay

Use LAN automation to provision a LAN underlay.

Before you begin

- Configure your network hierarchy. (See Add a Device to a Site, on page 90.)
- Make sure you have defined the following global network settings:
  - Network servers, such as AAA, DHCP, and DNS servers. (See Configure Global Network Servers, on page 173.)
  - Device credentials, such as CLI, SNMP, HTTP, and HTTPS credentials. (See Configure Global CLI Credentials, on page 173, Configure Global SNMPv2c Credentials, on page 174, Configure Global SNMPv3 Credentials, on page 175, and Configure Global HTTPS Credentials, on page 177.)
  - IP address pools. (See Configure IP Address Pools, on page 182.)
- Make sure that you have at least one device in your inventory. If not, discover devices using the Discovery feature.

Note LAN automation is blocked if the discovered site is configured with CLI credentials that has a username "cisco".

- If you have a Cisco Catalyst 9400 Switch configured in the network, ensure that the following operations are done on the switch for LAN automation to automatically enable the 40G port:
  - Day-0 Configuration is performed on the switch.
  - A 40G Quad Small Form-Factor Pluggable (QSFP) transceiver is inserted in either port 9 or port 10 of the Supervisor, and the ports numbered 1 to 8 on the Supervisor do not have a 10G or 1G

Small Form-Factor Pluggable (SFP) transceiver inserted in them. If there are dual supervisor engines, ensure that the 40G QSFP is inserted in port 9.

For more information on the Catalyst 9400 Series Supervisor, see Cisco Catalyst 9400 Series Supervisor Installation Note.

Step 1 Reserve an IP address pool for the site that you will be provisioning.

Note The size of the LAN automation IP address pool must be at least 25 bits of netmask or larger.

a) Click the menu icon (≡) and choose **Design** > **Network Settings** > **IP Address Pools**.
b) From the **Network Hierarchy** pane, choose a site.
c) Click **Reserve** and complete the following fields in the **Reserve IP Pool** window to reserve all or part of an available global IP address pool, for the specific site:

  - **IP Address Pool Name**: Unique name for the reserved IP address pool.
  - **Type**: Type of IP address pool. For LAN automation, choose **LAN**.
  - **IP Address Space**: Check **IPv4** or **IPv6** to create an address pool. To create a dual-stack pool, check both **IPv4** and **IPv6** check boxes.
  - **Global IP Pool**: IPv4 address pool from which you want to reserve all or part of the IP addresses.

    Note LAN automation uses only the IPv4 subnet.

  - **Prefix length / Number of IP Addresses**: IP subnet and mask address used to reserve all or part of the global IP address pool or the number of IP addresses that you want to reserve.
  - **Gateway**: Gateway IP address.
  - **DHCP Server(s)**: DHCP server(s) IP address(es).
  - **DNS Server(s)**: DNS Server(s) IP address(es).

d) Click **Reserve**.

Step 2 Discover and provision the devices.

a) Click the menu icon (≡) and choose **Provision** > **Inventory**.

   All the discovered devices are displayed.

b) Click **Actions** > **Provision** > **LAN Automation**.
c) In the **LAN Automation** window, complete the following fields:

  - **Primary Site**: Select your Primary Device from this site.
  - **Peer Site**: This site is used for selection of Peer Device. Note that this site can be different from the Primary Site.
  - **Primary Device**: Select the primary device that Cisco DNA Center uses as the starting point to discover and provision new devices.
  - **Peer Device**: Select the peer device.

- **SELECTED PORTS OF PRIMARY DEVICE**: Ports to be used to discover and provision new devices. Click **Modify Selections** to enter the port numbers.
- **Discovered Device Site**: All newly discovered devices are assigned to this site. This site can be different from Primary and Peer Sites.
- **Main IP Pool**: IP address pool that was reserved for LAN automation. (See Step 1.)
- **Link Overlapping IP Pool**: IP address pool that is shared with other sites, is used to specifically configure the /31 IP addresses on point-to-point links in the underlay.

  A link overlapping IP pool can be a subpool that is inherited from a parent site or a subpool that is defined in any other site.

  A link overlapping IP pool allows you to overlap /31 IP addresses in a multisite deployment. Hosts in different sites will be able to reuse IP addresses on the /31 links.

  If you choose to define a link overlapping IP pool, the addresses defined in the **Main IP Pool** field are used for Management IPs (like loopback address, VLAN address, and so on).
- **ISIS Domain Password**: A user-provided IS-IS password when LAN automation starts. If the password already exists on the seed device, it is reused and is not overwritten. If no user-provided password is entered and there is no existing IS-IS password on the device, the default domain password is used. If both primary and secondary seeds have domain passwords, ensure that they match.
- **Enable Multicast**: Check this check box to enable underlay native multicast. LAN automation creates a multicast tree from seed devices as RPs and discovered devices as subscribers.
- **Device Name Prefix**: Name prefix for the devices being provisioned. As Cisco DNA Center provisions each device, it prefixes the device with the text that you provide and adds a unique number at the end. For example, if you enter **Access** as the name prefix, as each device is provisioned, it is named Access-1, Access-2, Access-3, and so on.
- **Choose a File**: Click **Browse** to choose a hostname map File. Configures user-provided names for discovered devices using the chosen CSV file that contains a mapping between serial numbers and hostnames. If the discovered device is a stack, all serial numbers of the stack are provided in the CSV file.

  Here is a sample CSV file:

  ```
  standalone-switch,FCW2212L0NF
  stack-switch,"FCW2212E00Y,FCW2212L0GV"
  ```

d) Click **Start**.

Cisco DNA Center begins to discover and provision the new devices.

LAN automation configures an IP address on the seed device of VLAN 1. If this VLAN 1 IP address of the seed device is not reachable from Cisco DNA Center, an error message is displayed on the LAN Automation Status window. Hover your cursor over the **See Details** link on this window to see the error details and possible remedial actions.

Step 3 Monitor and review the progress of the devices being provisioned.

a) Click **Actions** > **Provision** > **LAN Automation Status**.

The **LAN Automation Status** window displays the progress of the devices being provisioned.

Note The provisioning of new devices may take several minutes.

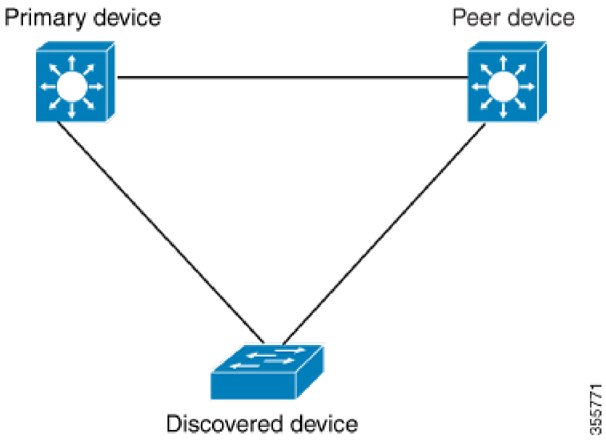
b) After all devices have been discovered, added to Inventory, and are in Managed state, click **Stop** in the **LAN Automation Status** window.

The LAN automation process is complete, and the new devices are added to the Inventory.

Peer Device in LAN Automation Use Case

Provision a Dual-Homed Switch

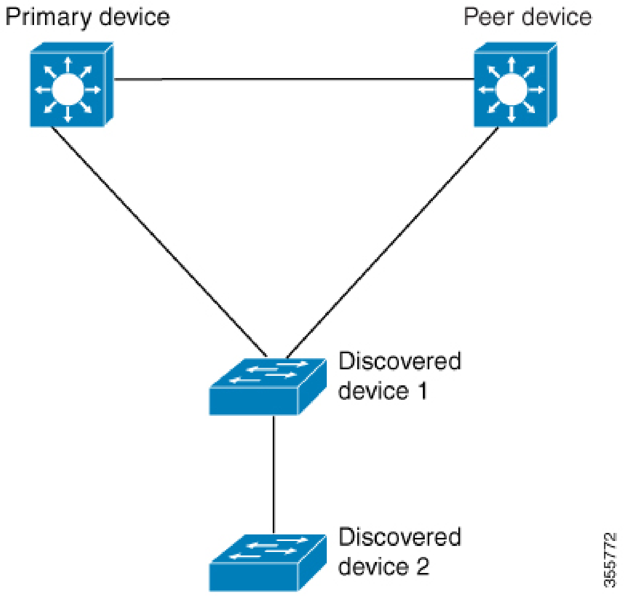
You must always select a peer device to provision the dual-homed switch.



Cisco DNA Center configures the DHCP server on the primary device. Because Cisco DNA Center understands that the discovered device is connected to both the primary and peer devices, it configures two Layer 3 point-to-point connections when the LAN automation task is stopped. One connection is established between the discovered device and the primary device; the other connection is established between the discovered device and the peer device.

Note If the link between the primary and the peer device is not configured before the LAN automation job is executed, you must select the interface of the primary device that connects to the peer device as part of the LAN automation configuration in Cisco DNA Center.

LAN Automation's Two-Hop Limitation



For the preceding topology, Cisco DNA Center configures the following links:

- A point-to-point Layer 3 routed connection from *Discovered device 1* to *Primary device*
- A point-to-point Layer 3 routed connection from *Discovered device 1* to *Peer device*
- A point-to-point Layer 3 routed connection from *Discovered device 1* to *Discovered device 2*

Consider the scenario where a device—named *Discovered device 3*—is directly connected below *Discovered device 2*. The connection between *Discovered device 2* and *Discovered device 3* is not configured as part of the LAN automation job, because it is more than two hops away from *Primary device*.

Check the LAN Automation Status

You can view the status of in-progress LAN automation jobs.

Before you begin

You must have created and started a LAN automation job.

Step 1 Click the menu icon (≡) and choose **Provision** > **Inventory**.

All discovered devices are displayed.

Step 2 Choose **Actions** > **Provision** > **LAN Automation Status**.
The **LAN Automation Status** window displays the status of all running or completed LAN automation jobs.

CHAPTER 21

Provision Fabric Networks

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About Fabric Networks

A fabric network is a logical group of devices that is managed as a single entity in one or multiple locations. Having a fabric network in place enables several capabilities, such as the creation of virtual networks and user and device groups, and advanced reporting. Other capabilities include intelligent services for application recognition, traffic analytics, traffic prioritization, and steering for optimum performance and operational effectiveness.

Cisco DNA Center allows you to add devices to a fabric network. These devices can be configured to act as control plane, border, or edge devices within the fabric network.

Fabric Sites

A fabric site is an independent fabric area with a unique set of network devices: control plane, border, edge, wireless controller, ISE PSN. Different levels of redundancy and scale can be designed per site by including local resources: DHCP, AAA, DNS, Internet, and so on.

A fabric site can cover a single physical location, multiple locations, or only a subset of a location:

- Single location: branch, campus, or metro campus
- Multiple locations: metro campus + multiple branches
- Subset of a location: building or area within a campus

A Software-Defined Access fabric network may comprise multiple sites. Each site has the benefits of scale, resiliency, survivability, and mobility. The overall aggregation of fabric sites accommodates a large number of endpoints and scales modularly or horizontally. Multiple fabric sites are interconnected using a transit site.

Transit Sites

A transit site is a site that interconnects two or more fabric sites or connects the fabric site with external networks (Internet, data center, and so on). There are two types of transit networks:

- IP transit: Uses a regular IP network to connect to an external network or to connect two or more fabric sites. It leverages a traditional IP-based (VRF-LITE, MPLS) network, which requires remapping of VRFs and SGTs between sites.
- SD-Access transit: Uses LISP/VxLAN encapsulation to connect two fabric sites. The SD-Access transit area may be defined as a portion of the fabric that has its own control plane nodes, but does not have edge or border nodes. However, it can work with a fabric that has an external border. With an SD-Access transit, an end-to-end policy plane is maintained using SGT group tags.

Fabric Readiness and Compliance Checks

Fabric Readiness Checks

Fabric readiness checks are a set of preprovisioning checks done on a device to ensure that the device is ready to be added to the fabric. Fabric readiness checks are now done automatically when the device is provisioned. Interface VLAN and Multi VRF configuration checks are not done as part of fabric readiness checks.

Fabric readiness checks include the following:

- Connectivity checks: Checks for the necessary connectivity between devices; for example, connectivity from the edge node to map server, from edge node to border, and so on.
- Existing configuration check (brownfield check): Checks for any configuration on the device that conflicts with the configuration that is pushed through SD-Access and can result in a failure later.
- Hardware version: Checks if the hardware version of the device is supported.
- Image type: Checks if the device is running with a supported image type (IOS-XE, IOS, NXOS, Cisco Controller).
- Loopback interface: Checks for the loopback interface configuration on the device. A device must have a loopback interface configured on it to work with the SDA application.

- Software license: Checks if the device is running with an appropriate software license.
- Software version: Checks if the device is running with an appropriate software image.

For more information on the software versions supported, see the Cisco SD-Access Hardware and Software Compatibility Matrix.

If an error is detected during any of the fabric readiness checks, an error notification is displayed on the topology area. You can correct the problem and continue with the provisioning workflow for the device.

Fabric Compliance Checks

Fabric compliance is a state of a device to operate according to the user intent configured during the fabric provisioning. Fabric compliance checks are triggered based on the following:

- Every 24 hours for wired devices and every six hours for wireless devices.
- When there is a configuration change on the wired device.

  A configuration change on the wired device triggers an SNMP trap, which in turn triggers the compliance check. Ensure that you have configured the Cisco DNA Center server as an SNMP server.

The following compliance checks are done to ensure that the device is fabric compliant:

- Virtual Network: Checks whether the necessary VRFs are configured on the device to comply with the current state of user intent for the VN on Cisco DNA Center.
- Fabric Role: Checks whether the configuration on the device is compliant with the user intent for a fabric role on Cisco DNA Center.
- Segment: Checks the VLAN and SVI configuration for segments.
- Port Assignment: Checks the interface configuration for VLAN and Authentication profile.

New Automation for SD-Access

The new enhanced Cisco SD-Access user interface (UX) integrates simplicity, flexibility, and a rich, intuitive context. The Beta version of the new Cisco SD-Access UX provides greater clarity in the association between the fabric elements like virtual networks and fabric site, enhanced workflows, and a succinct view of the fabric elements and their attributes; all of which augment the user experience.

The new Cisco SD-Access UX has the following enhancements:

- A summary page, each for Virtual Networks, Fabric Sites, and Transit Networks.
- The Virtual Networks overview page has four sections:
  - The first section displays a count of tasks at different stages, a count of Layer 3 virtual networks and anycast gateways, a count of Layer 2 virtual networks and their VLANs
  - The second section shows a graphical representation of the virtual network tasks.
  - The third section displays a list of the Tips that are saved.
  - The final section displays a card-based view of the different workflows offered.

- The Fabric Sites page provides three views: Overview, Map view and Table view.

  The Overview page shows Tips and Insights, and Workflows that are in progress. It also provides a summary of the number of fabric sites, fabric zones, fabric devices, control planes, and border nodes.

- The Transits and Peer Networks page displays a summary of the number of SD-Access transits, SDWAN transits and IP-based transits. This page also gives you the option to create a transit network.

Use the **Preview New SD-Access** toggle button on the Cisco DNA Center menu bar to switch between the old GUI and the new one.

Note All the tasks described in this chapter pertain to the new Cisco SD-Access UX.

Add a Fabric Site

Before you begin

You can create a new fabric site only if IP Device Tracking (IPDT) is already configured for the site. This means that you should have enabled **Monitor wired clients** while configuring Telemetry settings for the site.

Step 1 Click the menu icon (≡) and choose **Provision** > **SD-Access**.

Step 2 In the **Fabric Sites** tab, under SUMMARY, click the number that indicates the count of fabric sites.

Step 3 Click **Add fabric site**.

Alternatively, instead of the first three steps, click the menu icon and choose **Workflow** > **Create a Fabric Site and Fabric Zones**.

Follow the workflow wizard.

Step 4 In the **Create a Fabric Site** window, click **Let’s Do it**.

Step 5 Select an area, building, or floor to add as a fabric site and click **Next**.

Step 6 (Optional) To designate fabric zones and create scoped subnets, select **Yes Setup Zones**.

To enable a fabric zone, select a fabric site from the network hierarchy displayed.

Step 7 Click **Next**.

Step 8 Review the fabric site settings on the **Summary** window.

You can edit any of the fabric site or zone settings here.

Step 9 Click **Create**.

It takes a few seconds for the site and zones to be provisioned. Upon successful creation of the site, a **Success! Your fabric site is created** message is displayed.

Add a Device to a Fabric

After you have created a fabric site, you can add devices to the fabric site. You can also specify whether the device should act as a control plane node, an edge node, or a border node.

You can add a new device to the fabric site only if IP Device Tracking (IPDT) is configured for the fabric site.

A device which is assigned the Access role and has been provisioned before enabling IPDT on the site can’t be added to the fabric. Reprovision such devices before adding them to the fabric site. Check the Provision workflow to confirm the status of **Deployment of IPDT** on the device.

Note

- It’s optional to designate the devices in a fabric site as control plane nodes or border nodes. You might have devices that don’t occupy these roles. However, every fabric site must have at least one control plane node device and one border node device. In the current release for wired fabric, you can add up to six control plane nodes for redundancy.
- Currently, the Cisco Wireless Controller communicates only with two control plane nodes.

Before you begin

Provision the device if you haven’t already provisioned it:

- The **Provision** > **Network Devices** > **Inventory** window displays the discovered devices.
- The topology view shows a device in gray color if it has passed the fabric readiness checks and is ready to be provisioned.
- If an error is detected during any of the fabric readiness checks, an error notification is displayed on the topology area. Click **See more details** to check the problem area listed in the resulting window. Correct the problem and click **Re-check** to ensure that the problem is resolved.
- If you update the device configuration as part of problem resolution, ensure that you resynchronize the device information by performing an **Inventory** > **Resync** for the device.

Note You can continue to provision a device that has failed the fabric readiness checks.

Step 1 Click the menu icon (≡) and choose **Provision** > **SD-Access**.
The Fabric Sites tab in the resulting window displays a summary of fabric sites in the network.

Step 2 Under **SUMMARY**, click the number that indicates the count of **Fabric Sites**.

The Fabric Sites tab in the resulting window displays a summary of fabric sites in the network.

Step 3 Select the fabric site to add a device.

The resulting topology view displays all devices in the network that have been inventoried. In the topology view, any device that is added to the fabric is shown in blue.

Step 4 Form the List View under **Fabric Infrastructure** tab, click a device. A slide-in pane displays the following **Fabric** options:

Option	Description
Edge	Toggle the button next to this option to enable the selected device as an edge node.
Border	Toggle the button next to this option to enable the selected device as a border node.
Control Plane	Toggle the button next to this option to enable the selected device as a control plane node.

To configure a device as a fabric-in-a-box, select the **Control Plane**, **Border**, and **Edge** options.

To configure the device as a control plane and a border node, select both **Control Plane** and **Border**.

Step 5 Click **Add**.

What to do next

After a device is added to the fabric, fabric compliance checks are automatically performed to ensure that the device is fabric-compliant. The topology displays a device that has failed the fabric compliance check in blue color with a cross-mark beside it. Click **See more details** on the error notification to identify the problem area and correct it.

Add a Device as a Border Node

When you are adding a device to a fabric, you can add it in various combinations to act as a control plane, border node, or edge node as explained in Add a Device to a Fabric, on page 451.

To add a device as a border node:

Step 1 Click the menu icon (≡) and choose **Provision** > **SD-Access**.
The **Fabric Sites** tab in the resulting window displays all the provisioned sites.

Step 2 Select the fabric site to add a border node.
The resulting topology view displays all devices in the network that have been inventoried. In the topology view, any device that is added to the fabric is shown in blue.

Step 3 Click a device.

Step 4 In the slide-in window that appears, click the **Border** toggle button.

Step 5 In the resulting window, click the **Layer 3 Handoff** tab.

Step 6 Check the **Enable Layer-3 Handoff** check box.

Step 7 Enter the **Local Autonomous Number** for the device.

If the Local Autonomous Number is already configured on the device, this field displays the configured number and is disabled. You cannot change the Local Autonomous Number if it is already configured on the device.

Step 8 Choose a transit network that is to be enabled on the border device:

a) To enable SD-Access transit on the border, choose an SD-Access transit domain from the **Select Transit/Peer Network** drop-down list.

b) To enable IP transit on the border, choose a user-created IP transit domain from the **Select Transit/Peer Network** drop-down list.

   - Click **Add External Interface**.
   - Do the following steps in the resulting window:
     1. Choose an **External Interface** from the drop-down list.
     2. Enter the **Interface Description**.
     3. The **Remote AS Number** is automatically derived from the selected Transit or Peer network.
     4. Toggle the **Enable Layer-3 Handoff** button for the intended virtual network. This virtual network is advertised by the border to the remote peer. You can select one, multiple, or all virtual networks.
     5. Enter a VLAN ID for the selected virtual network.
     6. Click **Save**.
   - Choose an IP pool from **Select IP Pool** drop-down list. The selected pool is used to automate IP routing between the border node and the IP peer.

Step 9 By default, a border is designated as an external border, wherein it acts as a gateway to all unknown traffic, without importing any external routes. A border can be configured to be an internal border, wherein it acts as a gateway to known traffic and imports specific external routes. A border can also have a combined role of internal and external borders.

- Check both **Default to all Virtual Networks** and **Do not Import External Routes** check boxes to designate the border as an external border, providing connectivity to unknown networks.
- Do not check both **Default to all Virtual Networks** and **Do not Import External Routes** check boxes to designate the border as an internal border, operating as a gateway for specific network addresses.
- Check the **Default to all Virtual Networks** check box to designate this border node as an internal and external border. It acts as a gateway to all known and unknown traffic sent from the edge nodes. (Do not check the **Do not Import External Routes** check box.)

Step 10 (Optional) Perform this step only if you are connecting a nonfabric network to the fabric network or you are migrating from a traditional network to an SDA network. Click the **Layer 2 Handoff** tab. A list of virtual networks and the count of IP pools in each virtual network is displayed.

a) Click a virtual network that is to be handed off.

   A list of IP address pools that are present in the virtual network and a list of interfaces through which you can connect nonfabric devices are displayed.

b) Select an **External Interface**.

   In Cisco DNA Center Release 2.1.2.6, you can select more than one interface on which you can do a Layer 2 handoff.

c) Enter the **Interface Description**.

d) Enter the **External VLAN** number into which the fabric must be extended.

   In releases earlier than Cisco DNA Center 2.1.2.6, a virtual network can only be handed off on a single interface. The same virtual network cannot be handed off through multiple interfaces.

In Cisco DNA Center Release 2.1.2.6 and later releases, a virtual network can be handed off on a single interface or on multiple interfaces. Layer 2 handoff for a segment can also be done on two different devices. In both cases, ensure that there are no loops formed in the network.

e) Click **Save**.

Step 11 Click **Add**.

Configure LISP Pub/Sub

You can configure LISP Pub/Sub on a fabric site only when you add the first control plane to your fabric.

Before you begin

Ensure that the fabric devices operate on Cisco IOS XE 17.6.1 or later releases.

Step 1 Click the menu icon (≡) and choose **Provision** > **SD-Access**.

Step 2 In the **Fabric Sites** tab, click the site to be configured with LISP Pub/Sub.

The **SITE** window displays a summary of the site elements.

Step 3 Click the device that is to be configured as a control plane.

Step 4 In the slide-in pane that appears, click the **Control Plane** toggle button to configure this plane.

Step 5 In the **Configure Control Plane** window, choose **LISP PubSub** route distribution protocol and click **Add**.

Step 6 Click **Deploy**.

Step 7 In the **Modify Fabric** window, schedule the operation and click **Apply**.

To verify the configuration of LISP Pub/Sub in the fabric site, see the LISP Pub/Sub status on the **SITE SUMMARY** window.

Create an IP Transit Network

Step 1 Click the menu icon (≡) and choose **Provision** > **SD-Access**.

The **Transits and Peer Networks** tab displays a summary of the transits created for the fabric network.

Step 2 In the **Transits and Peer Networks** window, click **Create Transit or Peer Network**.

Step 3 In the **Transit/Peer Network** slide-in window, enter a name for the transit network.

Step 4 Choose **IP-Based Transit/Peer Network Type**.
The routing protocol is set to BGP by default.

Step 5 Enter the Autonomous System Number (ASN) for the transit network.

Step 6 Click **Save**.

Create an SDA Transit Network

To add a new SD-Access transit network:

Step 1 Click the menu icon (≡) and choose **Provision** > **SD-Access**.

Step 2 In the **Transits and Peer Networks** window, click **Create Transit or Peer Network**.

Step 3 In the **Transit/Peer Network** slide-in window, enter a name for the transit network.

Step 4 Choose an SD-Access **Transit/Peer Network Type**.

To configure a transit for fabric sites that do not have LISP Pub/Sub control plane, choose **SD-Access (LISP/BGP)**.

To configure a transit for fabric sites that have LISP Pub/Sub control plane, choose **SD-Access (LISP PubSub)**.

To share the **SD-Access (LISP PubSub)** transit with other Cisco DNA Center, choose **Yes, Share**. Otherwise, choose **No, keep it local**.

Note The **Yes, Share** option is visible only if the Multiple Cisco DNA Center package is installed.

You can share an SD-Access (LISP Pub/Sub) Transit with up to four other Cisco DNA Center nodes.

Step 5 Select a **Site for the Transit Control Plane** from the drop-down list. Choose at least one transit map server.

Step 6 Select a **Transit Control Plane** for the transit network from the drop-down list.

Step 7 Repeat Step 5 and Step 6 to add a second map server.

Step 8 Click **Save**.

After creating the transit network, the **Transits and Peer Networks** window displays the newly created transit and its attributes.

Note You cannot add an **SD-Access (LISP PubSub)** transit to a fabric site that uses LISP/BGP control plane and similarly you cannot add **SD-Access (LISP/BGP)** transit to a fabric site that uses LISP PubSub control plane.

What to do next

To interconnect the fabric sites with an SD-Access transit, add the transit to the border node.

Configure Host Onboarding

The **Host Onboarding** tab lets you configure settings for the various kinds of devices or hosts that can access the fabric network.

The **Host Onboarding** tab has the following subtabs:

- **Authentication** tab: Select an authentication template for the fabric. An Authentication template is a predefined set of configurations that are retrieved from Cisco ISE. After selecting the authentication template, click **Save**.
- **Wireless SSIDs** tab: Specify wireless SSIDs within the network that hosts can access. You can select the guest or enterprise SSIDs and assign address pools, and click **Save**.
- **Port Assignment** tab: Apply specific configurations to each port, depending on the type of device that connects to the fabric site. To do this, select the ports that need a specific assignment, click **Assign**, and choose the port type from the drop-down list.

  Note the following constraints:

  - Cisco SD-Access deployments support only APs, extended nodes, user devices (such as a single computer or a single computer plus phone), and devices that need trunk ports like single servers.
  - Servers with internal switches or virtual switches aren’t supported.
  - Other networking equipments (such as hubs, routers, or switches) aren’t supported.

Select the Authentication Template

You can configure an authentication template that applies to all devices in the fabric site.

Step 1 Click the menu icon (≡) and choose **Provision** > **SD-Access**.
The **Fabric Sites** tab in the resulting window displays all the provisioned sites.

Step 2 In the **Fabric Sites** window, select a fabric site.

Step 3 Click the **Host Onboarding** > **Authentication** tab.

Step 4 Under **Select Authentication Template**, choose an authentication template for the site:

- **Closed Authentication**: Any traffic prior to authentication is dropped, including DHCP, DNS, and ARP.

  To enable the Bridge Protocol Data Unit (BPDU) Guard on all the Closed Authentication ports, check the **Enable BPDU Guard** check box.
- **Low Impact**: Security is added by applying an ACL to the switch port, to allow very limited network access prior to authentication. After a host has been successfully authenticated, additional network access is granted.
- **No Authentication**
- **Open Authentication**: A host is allowed network access without having to go through 802.1X authentication.

You can edit the settings of the selected authentication template to address site-specific authentication requirements.

Before you change the site-level authentication, you must resychronize any fabric device whose Access Points were onboarded through macros or autoconf and haven't yet undergone the periodic resynch.

Step 5 (Optional) To edit the settings of the chosen authentication method, click **Edit**.

The slide-in window displays the parameters of the selected authentication method: **First Authentication Order**, **802.1x to MAB Fallback**, **Wake on LAN**, and **Number of hosts**.

Note **Number of hosts** specifies the number of data hosts that can be connected to a port. With **Single**, you can have only one data client on the port. With **Unlimited**, you can have multiple data clients and one voice client on the port.

Make the required changes and click **Save**.

The edit window closes. The saved modifications apply only to the site for which the authentication template is edited.

Step 6 Click **Deploy**.
The Hitless Authentication Change feature lets you switch from one authentication method to another without removing the devices from the fabric.

Configure Ports Within the Fabric Site

The **Port Assignment** tab lets you configure each access device in the fabric site. You can specify network behavior settings for each port on a device.

Step 1 Click the menu icon (☰) and choose **Provision** > **SD-Access**.

Step 2 In the resulting **Fabric Sites** window, click a fabric site.

Step 3 Click the **Port Assignment** tab.

Step 4 From the list of fabric devices displayed in the left pane, choose the device that you want to configure.
The ports available on the device are displayed in the right pane.

Step 5 Select the ports of the device and click **Assign**.

Step 6 In the **Port Assignment** slide-in window, select the **Connected Device Type** from the following options in the drop-down list:

Option	Description
Trunk	Configure the port as trunk port.
Access Point(AP)	Configures the port to connect to an access point.
User Devices (IP phone, computer, laptop)	Configures the port to connect to a host device.
Supplicant-Based Extended Node	Configures the port to receive a supplicant-based extended node.

a) To connect a trunk port, select **Trunk** and provide a **Description** for this port.

b) To connect an access point, select **Access Point (AP)** and do the following:

1. Select the VLAN and IP address from the **VLAN Name / IP Address Pool (Data)** drop-down list.
2. Select the **Authentication** type from the drop-down list.
3. Provide a **Description** about the connected device.

c) To connect host devices, select **User Devices (IP phone, computer, laptop)** and do the following:

1. Select the IP address pool for data from the **VLAN Name / IP Address Pool (Data)** drop-down list.
2. Select the **Scalable Groups**, which are the groups you have provisioned.

   Scalable groups are supported only with No Authentication profile.
3. Select the IP address pool for voice from the **VLAN Name / IP Address Pool (Voice)** drop-down list.

4. Select the authentication template from the **Authentication** drop-down list.
5. Enter a **Description** for the connected device.

d) To connect a supplicant-based extended node device, select **Supplicant-Based Extended Node**.
e) Click **Update**.

Step 7 After completing all port assignments, click **Deploy**.

Configure Wireless SSIDs for Fabric Networks

Step 1 From the **Wireless SSID** section, specify the wireless SSIDs within the network that the hosts can access.

Step 2 Click **Choose Pool** and select an IP pool reserve for the SSID.

Step 3 From the **Assign SGT** drop-down list, choose a scalable group for the SSID.

Step 4 Check the **Enable Wireless Multicast** check box to enable wireless multicast on the SSIDs.

Virtual Networks

Virtual networks are overlays that are used to segment traffic within a common physical network infrastructure; this is also known as macro-segmentation. Layer 2 Virtual Networks segment switched traffic and Layer 3 Virtual Networks segment routed traffic. Each endpoint that is connected to a Cisco SD-Access fabric is assigned to a specific virtual network based on the static edge port configurations or the dynamic policy from Identity Service Engine. Within a virtual network, endpoints can communicate with each other unless explicitly blocked by micro-segmentation policy. Endpoints across different virtual networks cannot communicate with each other by default. Inter-virtual network traffic requires connectivity policy to be implemented outside of the Cisco SD-Access fabric, such as on a fusion device.

A typical use case for virtual networks is an office building containing both corporate endpoints and building management systems. The corporate endpoints need to be segmented from building systems, such as lighting, heating, ventilation, and air conditioning. In this case a network administrator could macro-segment the corporate endpoints and the building systems using two or more virtual networks to block unauthorized access between the building systems and corporate endpoints.

A Layer 3 virtual network may span multiple fabric sites and across network domains (wireless LAN, campus LAN, and WAN). A Layer 2 virtual network resides within a single fabric site.

Create a Layer 3 Virtual Network

Step 1 Click the menu icon (≡) and choose **Workflows** > **Create Layer 3 Virtual Network**.

Alternatively, you can navigate to the **Layer 3** tab under **Provision** > **SD-Access** > **Virtual Networks** and click **Create Layer 3 Virtual Networks**.

Step 2 In the **Add Virtual Network** workflow window, click **Let's Do it**.

Step 3 In the **Create Layer 3 Virtual Networks** window, enter the number of Layer 3 virtual networks that you wish to create.

Step 4 Click **Next**.

Step 5 Enter the name of the Layer 3 virtual network and click **Next**.

Step 6 To associate the Layer 3 virtual networks to fabric sites and fabric zones, select the Layer 3 virtual network from the drop-down list and select a fabric site from the corresponding drop-down list. You can assign a virtual network to multiple fabric sites. Repeat this association for all the Layer 3 virtual networks that you created.

Alternatively, in the **By Fabric Site** tab, you can assign multiple virtual networks to a fabric site.

Step 7 Click **Next**.

Step 8 Configure the exit behavior of the traffic when this virtual network is associated with multiple fabric sites.

a) By default, **Local Exit** is selected. This allows the traffic to exit through the local border of each associated fabric site.

b) To anchor a virtual network and enable the traffic to exit at a designated border, choose **Remote Exit**.

From the list of associated fabric sites, choose a site whose border will serve as an exit for all traffic in this virtual network. The other associated fabric sites will inherit the virtual network.

Step 9 Click **Next**.

Step 10 Review the virtual network settings on the **Summary** window before configuring the virtual networks.

Step 11 To create the context of the virtual network, click **Create**.

Step 12 To assign the virtual network to the selected sites, click **Deploy**.

Step 13 To verify the virtual network creation, click **View All Virtual Networks**.

The **Virtual Networks** window displays the details of all the Layer 3 virtual networks in the fabric.

Create a Layer 2 Virtual Network

Step 1 Click the menu icon (≡) and choose **Workflows** > **Create Layer 2 Virtual Network**.

Alternatively, you can navigate to the **Layer 2** tab under **Provision** > **SD-Access** > **Virtual Networks** and click **Create Layer 2 Virtual Networks**.

Step 2 In the **Create L2 Virtual Network** window, click **Let's Do it**.

Step 3 Enter the number of VLANs that you want to connect to the fabric.

Step 4 Click **Next**.

Step 5 In the **Configure VLANs** window, do the following:

a) Enter a **VLAN Name** and optional **VLAN ID** for each of the VLANs.

b) From the **Traffic Type** drop-down list, choose **Data** or **Voice**.
Flooding is enabled by default for a Layer 2 virtual network.

c) Click **Next**.

Step 6 In the **Select your CPs for each L2VN** window, choose a fabric site and Layer 3 virtual network for each Layer 2 virtual network created.

If a Layer 2 virtual network is deployed to more than one fabric site, Cisco DNA Center stretches the subnet with a common pool.

Step 7 Click **Next**.

Step 8 In the **Summary** window, review your Layer 2 virtual network settings. Click **Create**.

Step 9 To confirm the provisioning of the Layer 2 virtual network, click **Submit**.

After the Layer 2 virtual network is provisioned, a success message is displayed.

Step 10 To verify the creation of the Layer 2 virtual network, click **Virtual Network overview**. In the **Virtual Networks** window, the **Layer 2** tab displays the details of all the Layer 2 virtual networks in the fabric.

Associate a Layer 3 Virtual Network to a Fabric Site

Step 1 Click the menu icon (≡) and choose **Provision** > **SD-Access**.

Step 2 In the **Virtual Networks** window, under **LAYER 3**, click the number that indicates the count of **Layer 3 Virtual Networks**.

The resulting window displays all the Layer 3 virtual networks at the global level.

Step 3 In the **Layer 3** tab, for a desired Layer 3 virtual network, click **Actions (…)** > **Add to fabric site**.

Step 4 In the **Select Fabric Site** slide-in window, select a site and click **Select**.

Create Anycast Gateways

Before you begin

Ensure that a Layer 3 virtual network is already created.

Step 1 Click the menu icon (≡) and choose **Provision** > **SD-Access**.

Step 2 In the **Virtual Networks** window, under **LAYER 3**, click the number that indicates the count of **Layer 3 Virtual Networks**.

The resulting window displays all the Layer 3 virtual networks at the global level.

Step 3 In the **Layer 3** tab, click **Create Anycast Gateways**.

a) In the resulting workflow window, click **Let's do it**.
b) In the **Select Layer 3 Virtual Networks to Configure** window, select one or more virtual networks to add a gateway.

Alternatively, in the **Layer 3** tab, for a particular Layer 3 virtual network, click **Actions (…)** > **Create Anycast Gateways**.

The **Add IP Pools and VLANs** window displays all the sites to which the selected Layer 3 virtual network is associated.

Step 4 In the left pane of the **Add IP Pools and VLANs** window, select the Layer 3 virtual network for which the gateway is to be created and choose your settings:

a) Choose an **IP Pool** from the drop-down list.
b) For an INFRA_VN, do the following:
    - Choose **AP** or **Extended** from the **Pool Type** drop-down list.

- To onboard a supplicant-based extended node, check the **Supplicant-Based Extended Node Onboarding** check box.

c) Enter a valid **VLAN Name** or select **Auto generate VLAN name**.

d) Enter a custom **VLAN ID** for the virtual network.

Note the following about VLAN IDs:

- VLAN IDs 1, 1002-1005, 2046, and 4095 are reserved and can't be used.
- If you don't provide a custom VLAN ID, Cisco DNA Center generates a VLAN ID in the range of 1021 to 2020.

e) Choose **Data** or **Voice** from the **Traffic Type** drop-down list.

f) Choose a **Scalable Group** from the drop-down list.

g) To enable Layer 2 flooding, click the **Flooding** toggle button on.

Note Layer 2 flooding requires underlay multicast, which is configured during LAN automation. If you do not provision the underlay through LAN automation, configure underlay multicast manually.

h) To include this IP pool in the critical IP address pool, click the **Critical VLAN** toggle button on.

A critical pool is used for closed authentication profile when an authentication server is not available. A critical VLAN is assigned to the critical pool and all unauthenticated hosts are placed in the critical VLAN in the absence of an authentication server.

i) To enable this IP pool as a wireless IP address pool, click the **Wireless** toggle button on.

j) To enable onboarding of bridge-mode virtual machines that are connected to the fabric-enabled wireless network, click the **Bridge Mode VM** toggle button on.

Note that **Bridge Mode VM** toggle button is displayed only if you select wireless IP address pool.

k) To enable the IP Directed Broadcast feature, click the **Directed Broadcast** toggle button on.

Note

- Enable Layer 2 flooding before enabling Directed Broadcast.
- Routers and Nexus 7000 Series Switches do not support Directed Broadcast.
- Before enabling Directed Broadcast, ensure that underlay multicast is enabled.

l) To associate more IP pools, click the ⊕ icon and repeat the steps.

m) Click **Next**.

Step 5 Review the endpoint connectivity settings in the **Summary** window.

Step 6 In the **Provisions in progress** window, click **Submit**.

Step 7 To verify the gateway creation after you see a success message, click **Virtual Network overview**.

You can view the Layer 2 virtual networks and their details in the **Layer 2** tab under the **Virtual Networks** window.

Configure a Fabric Zone

A fabric site (parent site) can be divided into fabric zones with smaller subnets to help you manage the network easily. A fabric zone can have its own edge nodes and extended nodes, but it connects to the parent site for a control plane and border. If you migrated from an earlier release of Cisco DNA Center, you can create a fabric zone on the existing fabric site. This fabric zone inherits all the properties of its parent site.

Before you begin

- Ensure that your network hierarchy is created under the Global site.
- Select a parent site that is not at the lowest level in the hierarchy.

The following is the broad workflow to configure a fabric zone.

1. Create a fabric zone in either of the following ways:
    - Create a fabric site and its zones using the **Create a Fabric Site and Fabric Zones** workflow. For more information, see Create a Fabric Site and Its Fabric Zones, on page 462.
    - Edit an existing fabric site to add fabric zones to it. For more information, see Create a Fabric Zone within a Fabric Site, on page 463.
2. Add edge nodes and extended nodes to the fabric zone. For more information, see Add a Device to a Fabric, on page 451.
3. Assign Layer 3 virtual networks and segments to the fabric zone. Note that only the virtual networks and segments of the parent site are available to the fabric zone. For more information, see Add Virtual Networks to a Fabric Zone, on page 463.

Note After a segment is added to a fabric zone, it cannot be updated in the parent site.

You cannot edit edge nodes and extended nodes of a fabric zone in its parent site.

You can configure the edge node of a fabric zone as a control plane or a border of the parent site.

Create a Fabric Site and Its Fabric Zones

Step 1 Click the menu icon (≡) and choose **Provision** > **SD-Access**.

In the **Fabric Sites** window, click **Add Fabric Site**.

Alternatively, click the menu icon and choose **Workflow** > **Create a Fabric Site and Fabric Zones**.

Step 2 In the **Create a Fabric Site** window, click **Let’s Do it**.

Step 3 Select an area, building, or floor to add as a fabric site and click **Next**.

Step 4 To designate fabric zones and create scoped subnets, choose **Yes Setup Zones**.

To enable a fabric zone, choose a fabric site from the network hierarchy.

Step 5 Click **Next**.

Step 6 Review the fabric site settings that are displayed in the **Summary** window.

You can also edit the fabric site or fabric zone settings.

Step 7 Click **Create**.

It takes several seconds for the site and zones to be provisioned. A **Success! Your fabric site is created** message is displayed.

The newly created fabric zone is tagged with an “FZ” in the site hierarchy pane.

Create a Fabric Zone within a Fabric Site

Step 1 Click the menu icon (≡) and choose **Provision** > **SD-Access**.

Step 2 In the **Fabric Sites** window, select a fabric site.

In the **Site** window, click **More Actions** > **Edit Fabric Zone**.

Step 3 In the **Designate fabric zones** window, choose an area, building, or floor.

Step 4 Click **Next**.

Step 5 Review the fabric site settings that are displayed in the **Summary** window.

You can edit any of the fabric site or zone settings here.

Step 6 Click **Create**.

It takes several seconds for the site and zones to be provisioned. A **Success! Your fabric site is created** message is displayed.

The newly created fabric zone is tagged with an “FZ” in the site hierarchy pane.

What to do next

- Add only edge node and extended node devices to the newly created fabric zone.

  Devices assigned to a fabric zone cannot be assigned to the parent site. However, an edge node device assigned to a fabric zone can still be configured as a control plane or a border node for the parent site.

- Assign IP pools and virtual networks to the fabric zone.

Add Virtual Networks to a Fabric Zone

Before you begin

Ensure that the fabric zone is created.

Note that you can add only the virtual networks of a parent site to a fabric zone.

Step 1 Click the menu icon (≡) and choose **Provision** > **SD-Access**.

Step 2 In the **Virtual Networks** window, under **Layer 3**, click the number that indicates the count of **Layer 3 Virtual Networks**.

The resulting window displays all the Layer 3 virtual networks at a global level.

Step 3 Click Fabric Site: **Global**.

Step 4 In the **Select Fabric Site** slide-in pane, choose a fabric zone.

Step 5 In the **Layer 3** tab, click **Add Layer 3 VN**.

Step 6 In the **Add Virtual Network** slide-in pane, choose the virtual networks to add to the fabric zone. Click **Update**.

Add Layer 2 Virtual Networks to a Fabric Zone

Before you begin

Note that the gateways added to the fabric zone cannot be updated at the parent site.

Step 1 Click the menu icon (≡) and choose **Provision** > **SD-Access**.

Step 2 In the **Virtual Networks** window, under **LAYER 2**, click the number that indicates the count of **Layer 2 Virtual Networks**.

The resulting window displays all the Layer 2 virtual networks at a global level.

Step 3 Click Fabric Site: **Global**.

Step 4 In the **Select Fabric Site** slide-in pane, choose a fabric zone.

Step 5 In the **Layer 2** tab, click **Add Layer 2/ Gateways**.

Step 6 In the **Select L2VNs/Gateway(s)** slide-in pane, choose the Layer 3 virtual networks of the fabric zone to configure the gateways.

Step 7 Click **Next**.

Step 8 From the **L2VNs/Gateway(s)** drop-down list, choose the desired gateways.

Step 9 Click **Add**.

Configure an Extended Node Device

Extended nodes are those devices that run in Layer 2 switch mode and do not support fabric technology natively. An extended node is configured by an automated workflow. After configuration, the extended node device is displayed on the fabric topology view. **Port Assignment** on the extended nodes is done on the **Host Onboarding** window.

Note Extended nodes cannot be onboarded through the GUI-based provisioning workflows. Extended nodes are onboarded only through the SD-Access automated workflow after resetting the device configuration to the factory default and powering on the device.

Extended node devices support multicast traffic.

Policy extended nodes are extended nodes that support security policy within the virtual network. You can select a **Group** during port assignment for the policy extended node.

Policy extended node devices include Cisco Catalyst Industrial Ethernet (IE) 3400, IE 3400 Heavy Duty series switches, and Cisco Catalyst 9000 series switches that run Cisco IOS XE 17.1.1s or later.

Cisco Digital Building series switches, Cisco Catalyst 3560-CX switches, and Cisco Industrial Ethernet 4000, 4010, and 5000 series switches are not policy extended node devices. They do not support Cisco TrustSec and **Group** selection during port assignment.

Steps to Configure an Extended Node

When configured as a fabric edge, Cisco Catalyst 9300, Cisco Catalyst 9400, and Cisco Catalyst 9500 series switches support extended nodes.

The minimum supported software version on the edge nodes that support policy extended nodes is Cisco IOS XE 17.1.1s.

Note Cisco Catalyst 9200 series switches that are configured as fabric edge nodes do not support extended node devices.

The following are the minimum supported software versions on the extended nodes:

- Cisco Industrial Ethernet 4000, 4010, 5000 series switches: 15.2(7)E0s with LAN base license enabled.

  If you have an IP services license, you must change the Switch Database Management (SDM) template to `dual-ipv4-and-ipv6 default` manually.

- Cisco Catalyst IE 3400, 3400 Heavy Duty (X-coded and D-coded) series switches: IOS XE 17.1.1s.
- Cisco Catalyst IE 3300 series switches: IOS XE 16.12.1s.
- Cisco Digital Building series switches, Cisco Catalyst 3560-CX switches: 15.2(7)E0s.

Ensure the following before configuring a policy extended node:

- The minimum software version required on a policy extended node device and on the edge device supporting the policy extended node is Cisco IOS XE 17.1.1s.
- Both the policy extended node and the edge node supporting it must have the Network Advantage and DNA Advantage license levels enabled.

Step 1 Configure a network range for the extended node. See Configure IP Address Pools, on page 182. This comprises adding an IP address pool and reserving the IP pool at the site level. Ensure that the CLI and SNMP credentials are configured.

Step 2 Assign the extended IP address pool to INFRA_VN. See Create Anycast Gateways, on page 460. Choose **Extended** as the **Pool Type**.

Cisco DNA Center configures the extended IP address pool and VLAN on the supported fabric edge device. This enables the onboarding of extended nodes.

Step 3 Configure the DHCP server with the extended IP address pool and Option 43. Ensure that the extended IP address pool is reachable from Cisco DNA Center.

Note For a detailed description of Option 43, see DHCP Controller Discovery, on page 355.

Step 4 Connect the extended node device to the fabric edge device. You can have multiple links from the extended node device to the fabric edge.

Step 5 Create a port channel on the fabric edge node connected to the extended node. For a subsequent extended node in a ring or daisy chain, create the port channel on the previous extended node it connects to.

Note Complete this step only if the global authentication mode for the fabric is **Open**, **Low Impact**, or **Closed**. If the fabric site is set to **No Authentication** mode, the port channel is automatically created during the onboarding of the extended nodes using Plug and Play provisioning.

To create a port channel, complete the following steps:

a) Go to **Provision** > **Fabric Sites** > **Fabric Infrastructure** and select a fabric edge node (or an extended node, depending on the connection). A window with the device name as the title slides in.
b) In the **Port Channel** tab, click **Create Port Channel**.
c) Fill in all the fields:
    - Select **Extended Node** from the **Connected Device Type** drop-down list.
    - Select **Port Aggregation Protocol (PAgP)**.

      Starting with Cisco IOS XE Release 17.1.1s, IE 3300 and IE 3400 devices support PAgP.
    - Select **On** for IE 3300 and IE 3400 devices if they are running versions earlier than Cisco IOS XE 17.1.1s.
    - Note that Link Aggregation Control Protocol (LACP) does not work for extended node onboarding.
    - Select the ports to be bundled as a port channel.
d) Click **Done**.

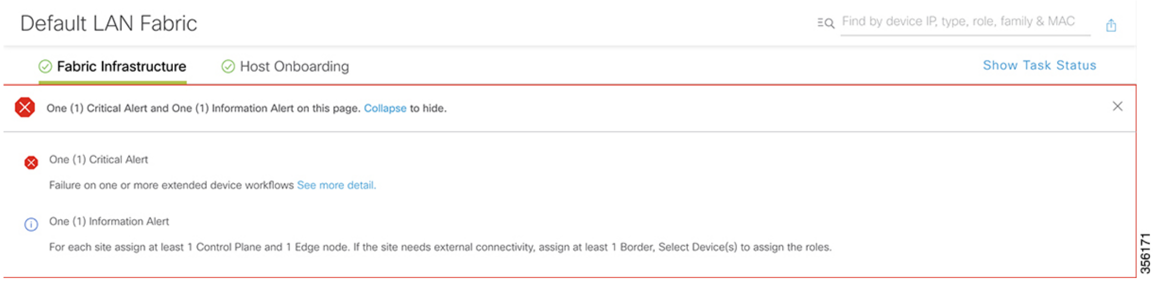
This creates a port channel on the fabric edge node (or the extended node) to onboard an extended device.

Step 6 Power up the extended node device if it has no previous configuration. If the extended node device has configurations, write-erase the previous configurations and reload the extended node device.

Cisco DNA Center adds the extended node device to the Inventory and assigns the same site as the fabric edge. The extended node device is then added to the fabric. Now the extended node device is onboarded and ready to be managed.

After the configuration is complete, the extended node appears in the fabric topology with a tag (X) to indicate that it is an extended node.

If there are errors in the workflow while configuring an extended node, an error notification is displayed as a banner on the topology window.



One (1) Critical Alert and One (1) Information Alert on this page. Collapse to hide.

One (1) Critical Alert

Failure on one or more extended device workflows See more detail.

One (1) Information Alert

For each site assign at least 1 Control Plane and 1 Edge node. If the site needs external connectivity, assign at least 1 Border, Select Device(s) to assign the roles.

Click **See more details** to see the error.

A Task Monitor window slides in, displaying the status of the extended node configuration task.

Click **See Details** to see the cause of error and possible solution.

Delete an Extended Node

This task describes the steps to delete an extended node, policy extended node, and authenticated extended node.

Step 1 Remove the extended node device from the fabric.

a) Click the menu icon (≡) and choose **Provision** > **SD-Access** > **Fabric Sites**.

b) In the **Fabric Infrastructure** tab, click the extended node device.

A slide-in window displays the details of the extended node device.

c) Click **Remove from Fabric**.

Step 2 Delete the device from Inventory.

For steps to delete the device from inventory, see Delete a Network Device, on page 99.

Step 3 For a supplicant-based extended node device, delete the port assignment from the fabric edge node or the FIAB.

Configure a REP Ring Topology for Extended Nodes and Policy Extended Nodes

To enable redundancy with a recovery time of less than 50 ms for network failures with extended nodes, configure a Resilient Ethernet Protocol (REP) ring for the fabric site.

Unless explicitly stated, the term *extended node* also represents a policy extended node.

The following devices can be configured in a REP ring:

- Extended Node:

  Cisco Industrial Ethernet (IE) 4000, 4010, 5000 series switches that operate Cisco IOS 15.2(7)E3 and later releases.

  Cisco Catalyst IE3300 series switches that operate Cisco IOS XE 17.3.3 and later releases.

- Policy Extended Node:

  Cisco Catalyst IE3400, IE3400H series switches that operate Cisco IOS XE 17.3.3 and later releases.

Limitations of a REP Ring

- To add an extended node into an existing REP ring, first delete the REP ring. Deleting the REP ring enables the Per VLAN Spanning Tree Protocol (PVSTP), which avoids Layer 2 loops. Then, add the new extended node to the fabric and recreate the REP ring to include the new extended node.
- Multiple rings within a given REP ring and a ring of rings aren't supported.
- A node in a REP ring can have other nodes connected to it in a daisy chain manner. However, a node in a daisy chain can’t have a ring of nodes connected to it.
- A REP ring or a daisy chain can't be a mix of extended nodes and policy extended nodes. A REP ring or a daisy chain must consist entirely of either extended nodes or policy extended nodes.
- By default, a maximum of 18 devices can be onboarded in a single REP ring. To onboard more than 18 devices, increase the BPDU timer using **spanning-tree vlan** *infra VN VLAN* **max-age 40** command. Use the Cisco DNA Center templates to configure the command.

Note that in some rare instances, when the last two nodes of the ring try to onboard simultaneously, a port channel might not be created between these nodes. A port channel is established between the last two nodes of the ring when a REP ring is created.

Unless otherwise stated, the following steps are applicable to both extended node and policy extended node.

Before you begin

Ensure that you have onboarded the fabric edge nodes and extended nodes.

Identify the fabric edge node and its interfaces that terminate the REP ring.

Note The REP ring configuration procedure may disrupt the network traffic for a brief period.

Step 1 Click the menu icon (≡) and choose **Workflows** > **Create REP Ring**.

Alternatively, you can navigate to the Fabric Site topology view, select the Fabric Edge node or the FIAB node on which you want to create the REP ring and click **Create REP Ring** under the **REP Rings** tab.

Step 2 In the workflow wizard, click **Let's Do it**.

Step 3 Choose a fabric site from the drop-down list and click **Next**.

Step 4 Choose a fabric edge node in the topology view and click **Next**.

Step 5 Choose the extended nodes that connect to the fabric edge node and click **Next**.

You can choose two extended nodes to connect to the fabric edge node.

Step 6 Review and edit (if required) your fabric site, edge node, and extended node selections.

Step 7 To initiate the REP ring configuration, click **Provision**.

You can see a detailed status of the configuration progress on the **REP Ring Configuration Status** window.

Step 8 The **REP Ring Summary** window displays the details of the REP ring that is created along with the discovered devices. Click **Next**.

Step 9 After the creation of the REP ring, a success message is displayed.

To verify the creation of the REP ring, go to the fabric site window and click the fabric edge node.

In the slide-in window, under the **REP Ring** tab, you can see the list of all REP rings that exist on that edge node.

Click a REP ring name in the list to view its details, such as the devices present in the ring, ports of each device that connect to the ring, and so on.

Delete a REP Ring

Step 1 Click the menu icon (≡) and choose **Provision** > **SD-Access** > **Fabric Sites**.

Step 2 In the **Fabric Infrastructure** tab, click the fabric edge node that terminates the REP Ring.

A slide-in window displays the details of the fabric edge node selected.

Step 3 In the **REP Rings** tab, for the desired REP Ring, click **Actions (…)** > **Delete**.

This deletes the REP Ring.

Delete a Node from REP Ring

This task describes the steps to delete one extended node or multiple extended nodes from a REP Ring.

Note After the extended nodes are removed, the downsized REP Ring should use the existing interfaces to create a link to the neighboring devices.

Before you begin

Ensure that the REP Ring to which the node belongs, is not incomplete.

Step 1 Manually remove the extended node devices from the network.

Alternatively, if a device in a REP Ring goes down, the **Fabric Infrastructure** window displays a notification.

Step 2 Click the menu icon (≡) and choose **Provision** > **SD-Access** > **Fabric Sites**.

Step 3 In the **Fabric Infrastructure** tab, click the fabric edge node that terminates the REP Ring.

A slide-in window displays the details of the fabric edge node selected.

Step 4 In the **REP Rings** tab, for the desired REP Ring, click **Actions (…)** > **Rediscover**.

The REP Ring is updated and the extended node device is deleted from the REP ring.

Configure Supplicant-Based Extended Nodes

Supplicant-based extended nodes, also called Authenticated Extended Nodes (AENs), are extended node devices that receive an IEEE 802.1x (Dot1x) supplicant configuration and are onboarded into the SD-Access network only after a complete authentication and authorization. To onboard a supplicant-based extended node device, the authenticator port on the fabric edge must be configured with a Closed Authentication Template.

The following platforms support supplicant-based extended node onboarding:

Fabric Edge or FIAB:

Cisco Catalyst 9000 Series – C9300, C9400, C9500, and C9500H switches that operate Cisco IOS XE 17.7.1 or later.

Supplicant-based Extended Node:

Cisco Catalyst 9000 Series – C9200, C9300, C9400, C9500, and C9500H switches that operate Cisco IOS XE 17.7.1 or later.

Steps to Configure a Supplicant-Based Extended Node

Before you begin

- Configure Cisco ISE and ensure that it operates Release 3.1 or later. See Configure Cisco Identity Services Engine to Onboard Supplicant-Based Extended Node, on page 472.
- Add the fabric edge node or FIAB device to the fabric and ensure that it operates Cisco IOS XE 17.7.1 or later.
- Set the Path MTU appropriately for the path between the fabric edge node and Cisco ISE. We recommend a value of 9100. Note that the Path MTU is set for all the devices in the fabric during LAN automation or when the underlay is configured.

Step 1 Configure AAA server settings in Cisco DNA Center.

a) Define Cisco ISE as the AAA server for device authentication in the **System** > **Settings** > **External Services** > **Authentication and Policy Server** window.

For the complete procedure, see "Configure Authentication and Policy Servers" in the Cisco DNA Center Administrator Guide.

b) Add the Cisco ISE server to the global site. For information, see Add Cisco ISE or Other AAA Servers, on page 172.

Step 2 (Optional) Configure Cisco DNA Center to authorize the device before onboarding.

a) Click the menu icon (≡) and choose **Settings** > **Device Settings** > **PNP Device Authorization**.
b) Check the **Device Authorization** check box to enable authorization on the device.

Step 3 Configure the Cisco DNA Center appliance to manage your PKI certificates.

a) Click the menu icon (≡) and choose **System** > **Settings** > **Trust & Privacy** > **PKI Certificates**.
b) In the **PKI Certificates** window, click **Use Cisco DNA Center**.
c) In the **CA Management** tab, click **Download CA Certificate**.

d) Add the certificate to the Cisco ISE Trusted Certificate Store. For more information, see the Cisco Identity Services Engine Administrator Guide.

If you use an external certificate, add that certificate to the Cisco ISE Trusted Certificate Store.

Step 4 Configure the DHCP server with the extended IP address pool and Option 43. Ensure that the extended IP address pool is reachable from Cisco DNA Center.

For a detailed description of Option 43, see DHCP Controller Discovery, on page 355.

Step 5 Enable **Closed Authentication** and disable Bridge Protocol Data Unit (BPDU) Guard on the fabric Site.

By default, selecting Closed Authentication pushes the BPDU Guard configuration on all the downlink access ports. When a remote switch like an extended node is connected, BPDU Guard pushes the port to error disabled mode. To disable BPDU Guard, uncheck the **Enable BPDU Guard** check box during the Closed Authentication configuration.

For more information, see Select the Authentication Template.

Step 6 Assign an extended IP address pool to INFRA_VN, as described in Create Anycast Gateways, on page 460.

In the **Create Anycast Gateways** workflow, choose **Extended Node** as the **Pool Type** and check the **Supplicant-Based Extended Node Onboarding** check box.

Cisco DNA Center configures the extended IP address pool and VLAN on the supported fabric edge device. This enables the onboarding of extended nodes.

Note Extended IP address pool is successfully assigned only if the fabric edge devices operate Cisco IOS XE 17.7.1 or later. If you upgraded from an earlier release of Cisco DNA Center, the supplicant-based extended node migration must be complete before configuring the extended IP address pool.

Step 7 Connect the extended node device to the fabric edge node or the FIAB.

After powering on, the extended node device is in **Pending Authorization** state if you have chosen to authorize the device before onboarding (Step 2). You can check the status of the device in the **Provision** > **Plug and Play** window Cisco DNA Center.

Step 8 (Optional) Authorize the device.

Perform this step only if the device is in **Pending Authorization** state.

a) Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Plug and Play**.
b) In the **Plug and Play** window, select the supplicant-based extended node device and choose **Actions** > **Authorize**.

The authorization process provisions the supplicant-based extended node device for completing a certificate-based EAP-TLS authentication with Cisco ISE. After authentication, Cisco ISE authorizes the supplicant-based extended node device for complete access. The supplicant-based extended node device is then fully onboarded into the SD-Access fabric.

After a supplicant-based extended node device is onboarded into the fabric, access to the fabric edge-supplicant port is only based on authentication status. If the device or the port goes down, the authentication session is cleared, and traffic is not allowed on the port. When the port comes up again, it goes through the IEEE 802.1x (Dot1x) authentication process to regain access to the SD-Access network.

Replace a Faulty Port

If the link between the authenticator (fabric edge or FIAB) port and the supplicant port goes down, you can replace the faulty port and configure a new port through the **Port Assignment** menu.

Step 1 To replace the supplicant port, follow these steps:

a) Clear the configuration on the new supplicant port.

b) Copy the existing configuration from the current supplicant port to the new supplicant port to allow 802.1X authentication.

Step 2 To replace the authenticator port, follow these steps:

a) Assign the supplicant port to the new interface of the authenticator. For information on Port Assignment, see Configure Ports within the Fabric Site. Choose **Supplicant-Based Extended Node** as the **Connected Device Type**.

b) Clear the existing port assignment on the old interface of the authenticator.

Step 3 Disconnect the physical connection between the old ports of the authenticator and the supplicant. Connect a cable between the new ports of the authenticator and the supplicant. Bring this link up.

Step 4 After the link between the new ports of the authenticator and supplicant is up, do the following steps:

a) Resynchronize the device information in Cisco DNA Center by performing an **Inventory** > **Resync Device** for both the authenticator and the supplicant. See Resynchronize Device Information.

b) Assign the new supplicant port to the authenticator. For information on Port Assignment, see Configure Ports within the Fabric Site. Choose **Authenticator Switch** as the **Connected Device Type**.

c) Clear the port assignment on the old supplicant port.

Configure Cisco Identity Services Engine to Onboard Supplicant-Based Extended Node

This task describes how to profile an Supplicant-Based Extended Node (SBEN) device in Cisco Identity Services Engine (ISE). The steps listed below are part of the Cisco ISE configuration procedure. For more information, refer the *Cisco Identity Services Engine Administrator Guide*.

Before you begin

Download the CA certificate from Cisco DNA Center.

Step 1 Import the CA certificate into Cisco ISE:

From the Cisco ISE home page, choose **Administration** > **System** > **Certificates** > **System Certificates** > **Import**. In the **Import** window, ensure that you select the **Trust for client authentication and Syslog** check box. For more information, see the "Import the Root Certificates to the Trusted Certificate Store" section in the *Cisco Identity Services Engine Administrator Guide*.

Step 2 Configure the following authorization profiles with their RADIUS attributes:

From the Cisco ISE main menu, choose **Policy** > **Policy Elements** > **Results** > **Authorization** > **Authorization Profiles**.

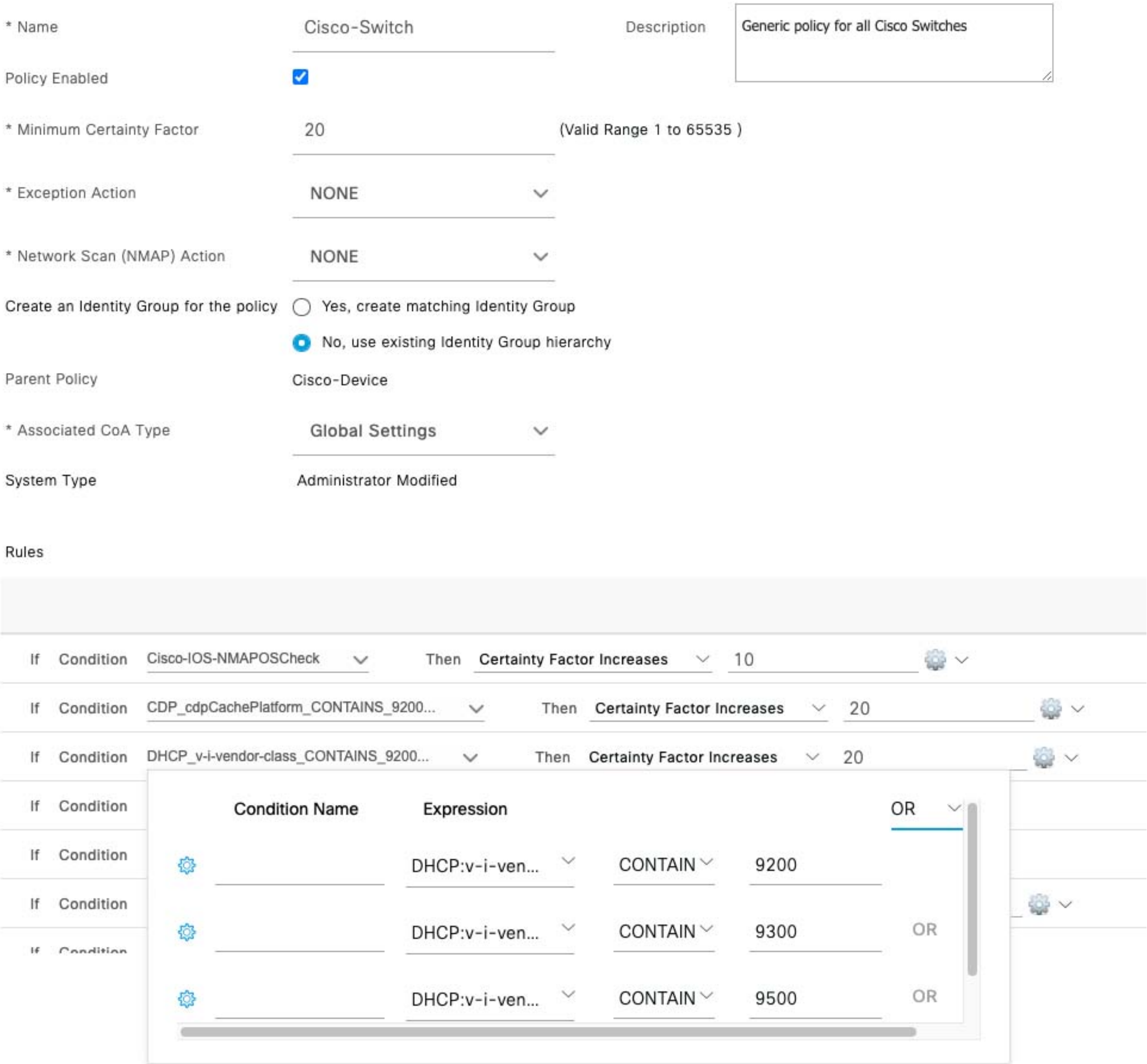
Configure the following profiles:

```
SBEN-DHCP:
Access Type = ACCESS_ACCEPT
Filter-ID = SBEN_DHCP_ACL.in

SBEN_LIMITED_ACCESS_AUTHZ:
Access Type = ACCESS_ACCEPT
Filter-ID = SBEN_MAB_ACL.in
cisco-av-pair = interface-template-name=SWITCH_SBEN_MAB_TEMPLATE

SBEN_FULL_ACCESS_AUTHZ :
Access Type = ACCESS_ACCEPT
cisco-av-pair = interface-template-name=SWITCH_SBEN_FULL_ACCESS_TEMPLATE
```

Step 3 Define the device profiling policy in the **Profiling Policies** window.

a) From the Cisco ISE main menu, choose **Policy** > **Profiling** > **Profiling Policies**.

b) In the **Profiling Policies** window, add a new **DHCP-v-i-vendor-class** condition for the **Cisco-Device**: **Cisco-Switch** policy.



* Name	Cisco-Switch
Description	Generic policy for all Cisco Switches
Policy Enabled	☑
* Minimum Certainty Factor	20 (Valid Range 1 to 65535)
* Exception Action	NONE
* Network Scan (NMAP) Action	NONE
Create an Identity Group for the policy	○ Yes, create matching Identity Group ● No, use existing Identity Group hierarchy
Parent Policy	Cisco-Device
* Associated CoA Type	Global Settings
System Type	Administrator Modified

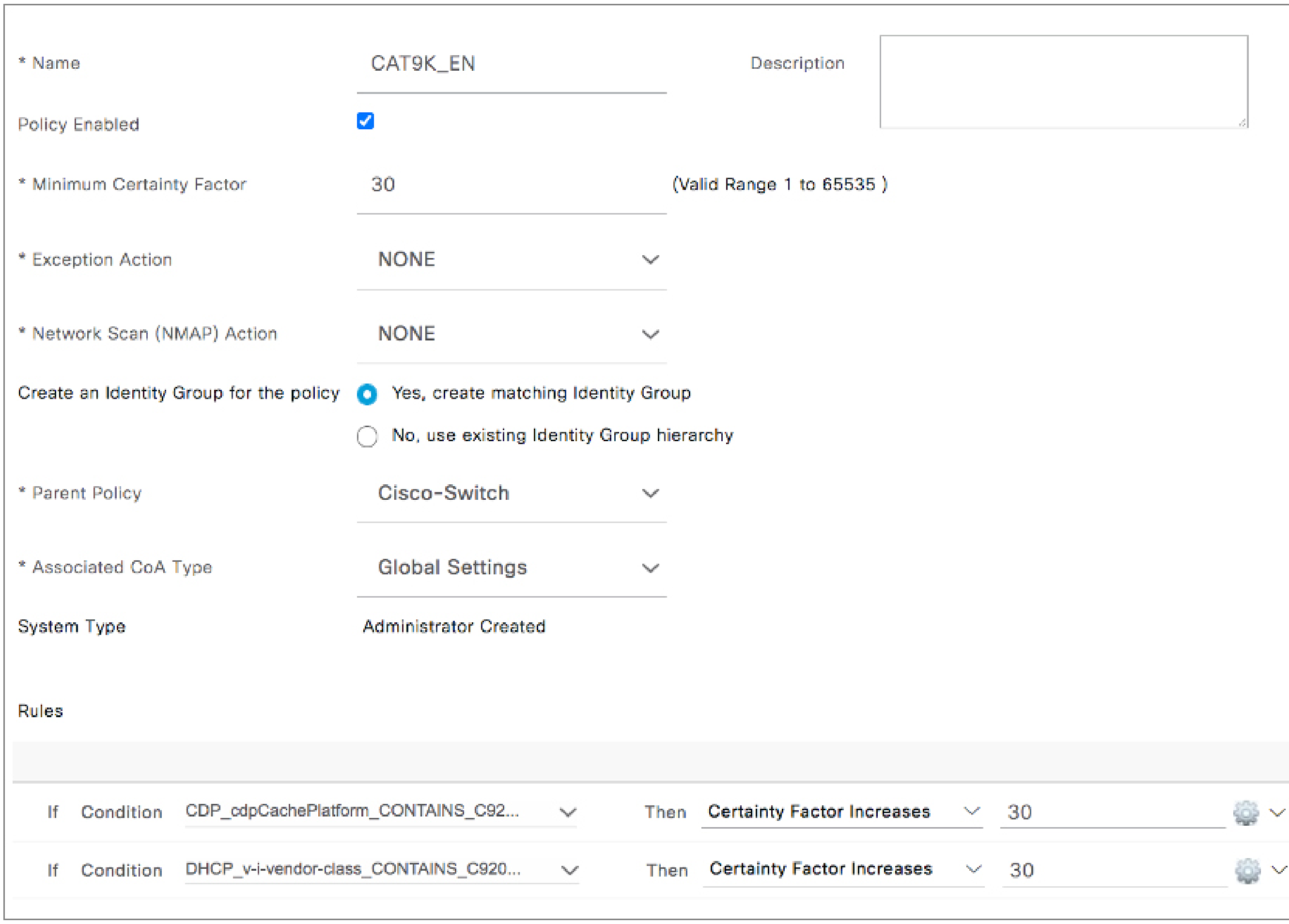
Rules

If	Condition	Cisco-IOS-NMAPOSCheck	Then	Certainty Factor Increases	10
If	Condition	CDP_cdpCachePlatform_CONTAINS_9200...	Then	Certainty Factor Increases	20
If	Condition	DHCP_v-i-vendor-class_CONTAINS_9200...	Then	Certainty Factor Increases	20
If	Condition				
If	Condition				
If	Condition				
If	Condition				

Condition Name	Expression			OR
	DHCP:v-i-ven...	CONTAIN	9200	
	DHCP:v-i-ven...	CONTAIN	9300	OR
	DHCP:v-i-ven...	CONTAIN	9500	OR

c) Create a new child policy for the supplicant device, under **Cisco-Switch** and apply the **CdpCachePlatform** and **V-I-Vendor-Class** conditions.

Ensure that the **Minimum Certainty Factor** value for the child policy is higher than that of the parent policy.



* Name: CAT9K_EN

Description:

Policy Enabled: ☑

* Minimum Certainty Factor: 30 (Valid Range 1 to 65535)

* Exception Action: NONE

* Network Scan (NMAP) Action: NONE

Create an Identity Group for the policy: ● Yes, create matching Identity Group ○ No, use existing Identity Group hierarchy

* Parent Policy: Cisco-Switch

* Associated CoA Type: Global Settings

System Type: Administrator Created

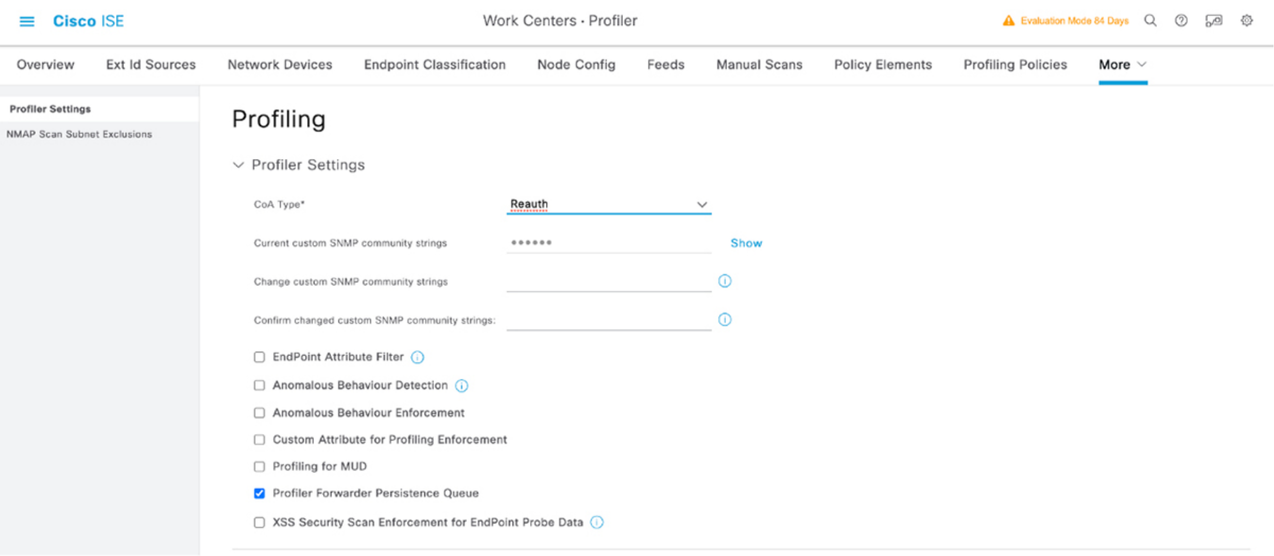
Rules

If	Condition	CDP_cdpCachePlatform_CONTAINS_C92...	Then	Certainty Factor Increases	30
If	Condition	DHCP_v-i-vendor-class_CONTAINS_C920...	Then	Certainty Factor Increases	30

Step 4 Set the global Change of Authorization (CoA) type to **Reauth**.

To configure the **CoA Type**, from the Cisco ISE home page, navigate to **Work Centers** > **Profiler** > **Settings**.

Choose **Reauth** from the **CoA Type** drop-down list.


Cisco ISE
Work Centers · Profiler
Evaluation Mode 84 Days
Overview
Ext Id Sources
Network Devices
Endpoint Classification
Node Config
Feeds
Manual Scans
Policy Elements
Profiling Policies
More
Profiler Settings
NMAP Scan Subnet Exclusions
Show

Profiling

Profiler Settings

CoA Type*: Reauth

Current custom SNMP community strings: ••••••

Change custom SNMP community strings:

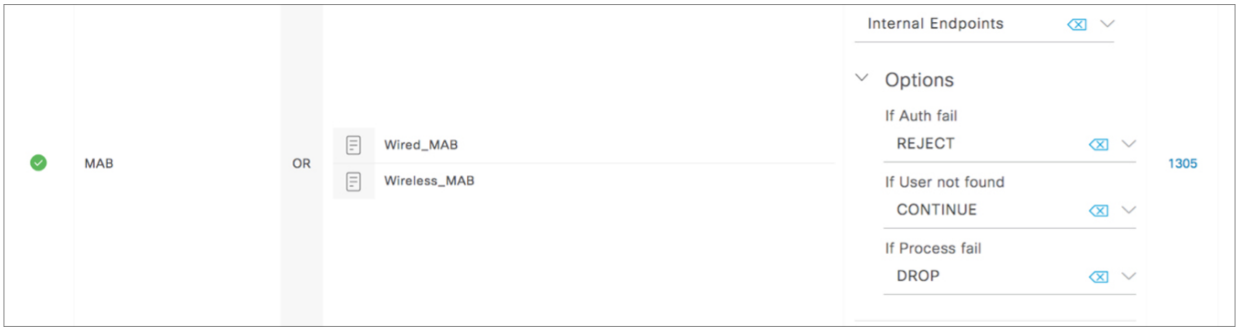
Confirm changed custom SNMP community strings:

☐ EndPoint Attribute Filter
☐ Anomalous Behaviour Detection
☐ Anomalous Behaviour Enforcement
☐ Custom Attribute for Profiling Enforcement
☐ Profiling for MUD
☑ Profiler Forwarder Persistence Queue
☐ XSS Security Scan Enforcement for EndPoint Probe Data

Step 5 Define the authorization policy in the **Authorization Policy** window.

a) From the Cisco ISE home page, choose **Policy** > **Policy Sets** > **Default** > **Authorization Policy**.

b) Ensure that the default MAB policy is set to **CONTINUE** option for the **If User not found** field.



MAB OR Wired_MAB, Wireless_MAB

Internal Endpoints

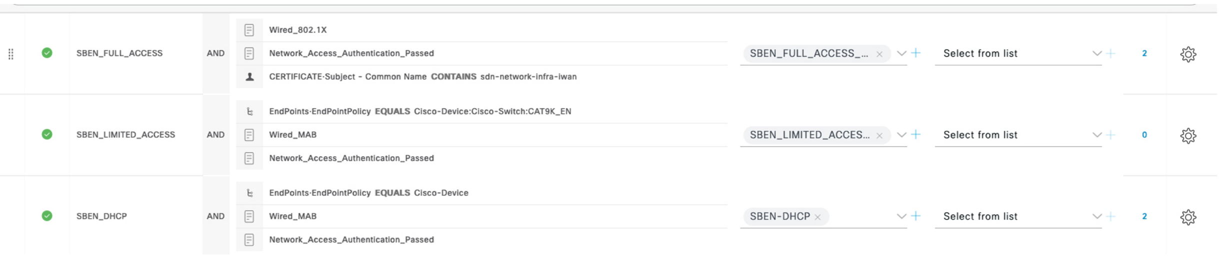
Options

If Auth fail: REJECT

If User not found: CONTINUE

If Process fail: DROP

c) In the **Authorization Policy** window, configure the authorization policies for the supplicant device and associate the policies with the authorization profiles that were created earlier (SBEN-DHCP, SBEN_LIMITED_ACCESS_AUTHZ, SBEN_FULL_ ACCESS_AUTHZ).



SBEN_FULL_ACCESS	AND	Wired_802.1X Network_Access_Authentication_Passed CERTIFICATE·Subject - Common Name **CONTAINS** sdn-network-infra-iwan	SBEN_FULL_ACCESS_...	Select from list	2
SBEN_LIMITED_ACCESS	AND	EndPoints·EndPointPolicy **EQUALS** Cisco-Device:Cisco-Switch:CAT9K_EN Wired_MAB Network_Access_Authentication_Passed	SBEN_LIMITED_ACCES...	Select from list	0
SBEN_DHCP	AND	EndPoints·EndPointPolicy **EQUALS** Cisco-Device Wired_MAB Network_Access_Authentication_Passed	SBEN-DHCP	Select from list	2

Configure a Port Channel

A group of ports bundled together to act as a single entity is called a port channel. Port channels between a fabric edge and its remotely connected devices like extended nodes or servers increase the connection resiliency and bandwidth.

Create a Port Channel

Do the following steps only when authentication is Closed Authentication. Note that the following steps are automated for other authentication modes.

Step 1 Click the menu icon (≡) and choose **Provision** > **SD-Access**.

Step 2 In the resulting **Fabric Sites** window, click a fabric site.

The **Fabric Infrastructure** tab displays all fabric devices.

Step 3 Click a fabric edge node.

A window with the device name as the title slides in.

Step 4 In the **Port Channel** tab, click **Create Port Channel**.

Step 5 From the **Connected Device Type** drop-down, select the type of connected device.

- To create a port channel between a fabric edge node and an extended node or between two extended nodes, choose **Extended Node**.
- To create a port channel with a fabric edge node or extended node on one side and a third party device or a server port on the other side, choose **Trunk**.

Step 6 Enter a suitable **Description** for the new port channel.

Step 7 Select an appropriate protocol:

- For the extended nodes that run Cisco IOS XE Release 16.12.1s and earlier releases, select **On** as the protocol.
- For the extended nodes that run Cisco IOS XE Release 17.1.1s and later releases, select **Port Aggregation Protocol (PAgP)** as the protocol.
- Do not select **Link Aggregation Control Protocol (LACP)** as the protocol for extended nodes. You can only connect the trunk ports or the server ports in the LACP mode.

Step 8 From the list of ports displayed, choose the ports to be bundled.

Note You cannot have more than 16 members in a port channel that is connected in the LACP mode.

You cannot have a more than eight members in a port channel that is connected in the PAgP mode.

Step 9 Click **Done**.

A new port channel that is created is displayed in the window.

Update a Port Channel

Before you begin

Ensure that at least one member interface exists before you update a port channel.

Step 1 Click the menu icon (≡) and choose **Provision** > **SD-Access**.

Step 2 In the **Fabric Sites** window, click a fabric site.

Step 3 In the **Fabric Infrastructure** tab, click a fabric edge node.

A slide-in window displays all details of the device.

Step 4 Click the **Port Channel** tab.

Step 5 From the list of port channels displayed, select the port channel to be updated.

The resulting window displays all the interfaces and the status of the selected port channel.

Step 6 Update the port channel.

You can either add interfaces to the port channel or delete existing interfaces on the port channel.

Step 7 Click **Done**.

Delete a Port Channel

Step 1 Click the menu icon (≡) and choose **Provision** > **SD-Access**.

Step 2 In the **Fabric Sites** window, click a fabric site.

Step 3 In the **Fabric Infrastructure** tab, click the device whose port channel you want to delete.

Step 4 In the slide-in window, click the **Port Channel** tab.

The **Port Channel** view lists all the existing port channels.

Step 5 Select the port channel and click **Delete**.

Step 6 At the prompt, click **Yes**.

Multicast

Multicast traffic is forwarded in different ways:

- Through shared trees by using a rendezvous point. PIM SM is used in this case.
- Through shortest path trees (SPT). PIM source-specific multicast (SSM) uses only SPT. PIM SM switches to SPT after the source is known on the edge router that the receiver is connected to.

See IP Multicast Technology Overview.

Configure Multicast

Cisco DNA Center provides a workflow that helps enable group communication or multicast traffic in the virtual networks. The workflow also allows you to choose multicast implementation in the network: native multicast or headend replication.

Note In Cisco DNA Center Release 2.2.2.4 and later, you can enable multicast on a virtual network whose border serves as a multisite remote border. Configuring multicast on such a virtual network configures multicast on the devices in the inherited virtual network too, provided the inherited virtual network already contains a segment. If the inherited virtual network doesn’t have a segment, multicast is deployed only after the first segment is created. Ensure that a virtual network and its inherited networks deploy the same type of multicast implementation. The edge devices of an inherited virtual network cannot be configured as rendezvous point (RP).

Step 1 Click the menu icon (≡) and choose **Workflows**.
The **Workflows** window displays all workflows offered by Cisco DNA Center.

Step 2 Click **Configure Multicast**.

A configuration wizard comes up.

Step 3 Click **Let's do it** in the multicast configuration wizard.

Step 4 Select a **Site** from the drop-down list and click **Next**.

Step 5 In the **Enabling Multicast** window, choose the method of multicast implementation for the network: **Native Multicast** or **Head-end replication**. Click **Next**.

Step 6 In the **Virtual Networks** window, select the virtual network on which you want to set up multicast. Click **Next**.

Note You can’t select an inherited virtual network to set up multicast.

Step 7 In the **Multicast pool mapping** window, select an IP address pool from the **IP Pools** drop-down list. The selected IP address pool is associated with the chosen virtual network. Click **Next**.

Step 8 From the **Select multicast type** window, choose the type of multicast to implement, and click **Next**:

- **SSM** (Source Specific Multicast)
- **ASM** (Any Specific Multicast)

Step 9 Do the following:

a) On selecting **SSM**, configure the SSM list by adding an IP group range for each virtual network. You can add multiple IP group ranges for a virtual network.

   1. Choose an IP group range from 225.0.0.0 to 239.255.255.255.
   2. Enter the **Wildcard Mask** for the IP group.
   3. Click **Next**.

b) On selecting **ASM**, choose the type of rendezvous point (RP):

   - **Internal RP**

- **External RP**

Click **Next**.

Step 10 To configure a rendezvous point, do the following:

If you choose to configure an internal rendezvous point:

a) Select the devices that you need configured as internal rendezvous points. The second rendezvous point that you select is the redundant rendezvous point. Click **Next**.
b) Assign internal rendezvous points to each of the listed virtual networks. Click **Next**.

If you choose to configure an external rendezvous point.:

a) In the **Setup your External RP** window, enter the IPv4 or IPv6 address of the external rendezvous point.

   (Optional) You can enter a second set of IPv4 or IPv6 addresses.

   Click **Next**.

b) In the **Select which RP IP Address(es) to utilize** window, select an IP address for each Virtual Network.

   Click **Next**.

Step 11 Review the multicast settings displayed in the **Summary** window and modify, if required, before submitting the configuration.

Click **Finish** to complete the multicast configuration.

CHAPTER 22

Provision Services

- Applications, on page 481
- Application Hosting, on page 497
- Application Hosting on Cisco Catalyst 9100 Series Access Points, on page 504
- Configure a Site-to-Site VPN, on page 507
- Create a User-Defined Network Service, on page 509
- Configure Cisco Umbrella, on page 512

Applications

The following sections provide information about applications.

About Application Visibility

The Application Visibility service lets you manage your built-in and custom applications and application sets.

The Application Visibility service, hosted as an application stack within Cisco DNA Center, lets you enable the Controller-Based Application Recognition (CBAR) function on a specific device to classify thousands of network and home-grown applications and network traffic.

You install the following packages:

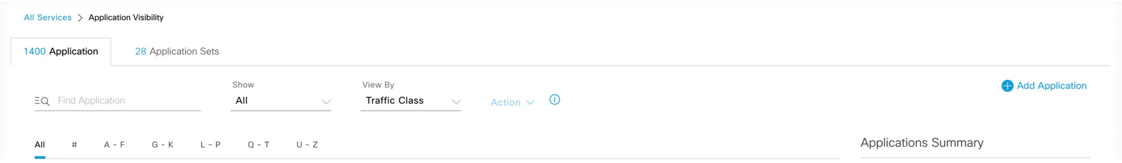
- **Application Policy**: Lets you automate QOS policies across LAN, WAN, and wireless within your campus and branch.
- **Application Registry**: Lets you view, manage, and create applications and application sets.
- **Application Visibility Service**: Provides application classification using Network-Based Application Recognition (NBAR) and CBAR techniques.

  NBAR supports provisioning of up to 450 interfaces on Cisco Catalyst 9000 devices. Cisco DNA Center Application Visibility does not exceed this 450-interface limit.

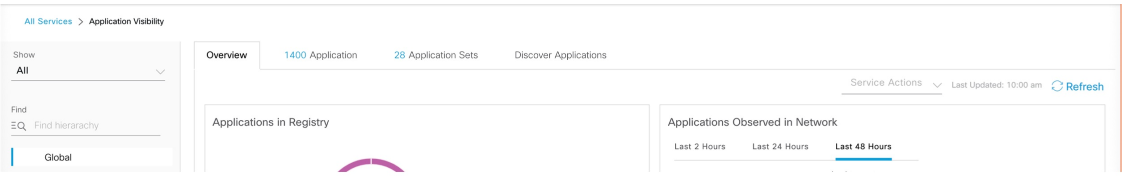
You can install the packages depending on your preferences.

Note To ensure compatibility, the preceding packages must have the same package version.

If you install Application Registry or both Application Registry and Application Policy, you can see the **Application** and **Application Sets** tabs when you click the menu icon (☰) and choose **Provision** > **Services** > **Application Visibility**.


All Services > Application Visibility
1400 Application
28 Application Sets
Find Application
Show
All
View By
Traffic Class
Action
Add Application
All
#
A - F
G - K
L - P
Q - T
U - Z
Applications Summary

If you install Application Registry and Application Visibility Service or Application Registry, Application Policy, and Application Visibility Service, you can see the **Application**, **Application Sets**, and **Discover Applications** tabs when you click the menu icon (☰) and choose **Provision** > **Services** > **Application Visibility**.


All Services > Application Visibility
Show
All
Find
Find hierarchy
Global
Overview
1400 Application
28 Application Sets
Discover Applications
Service Actions
Last Updated: 10:00 am
Refresh
Applications in Registry
Applications Observed in Network
Last 2 Hours
Last 24 Hours
Last 48 Hours

The Application Visibility service has the following phases:

- Day 0: First-time service enablement.
- Day N: Ongoing monitoring and configuration changes.

Day 0 Setup Wizard to Enable the Application Visibility Service

Follow the Day 0 **Setup** wizard to enable the Application Visibility service in Cisco DNA Center.

Step 1 Click the menu icon (☰) and choose **Provision** > **Services** > **Application Visibility**.

You can view a brief introduction about the Application Visibility feature.

Step 2 In the Application Visibility page, click **Next**.

A pop-up window for enabling the Application Visibility service appears. Click **Yes** in the pop-up window to enable CBAR on Cisco DNA Center.

Step 3 (Optional) Check the **Enable CBAR on all Ready Devices** check box or choose devices with **CBAR Readiness Status** in **Ready** state.

If you want to choose a device that is not ready for enabling CBAR, follow the info message to move it to Ready state before proceeding in the **Setup** wizard.

Step 4 Click **Next** to enable CBAR on the devices.

Step 5 (Optional) Choose an external authoritative source, such as Microsoft Office 365 Cloud Connector, to either help classify the unclassified traffic or help generate improved signatures.

Step 6 Click **Finish**.

The **Overview** page provides a quick view of the application registry, device recognition method, device CBAR readiness, application observed in the network for the past 2, 24, or 48 hours (valid only if CBAR is enabled on at least one device), service health, and CBAR health score.

Day-N Application Visibility View

The Day-N Application Visibility page provides a quick view of application registry, device recognition method, device CBAR readiness, application observed in the network for the past 2, 24, or 48 hours (valid only in case CBAR was enabled on at least one device), and CBAR health.

The following table describes the charts that are available in the **Overview** tab in **Provision** > **Services** > **Application Visibility**.

Table 44: Day-N Application Visibility View: Charts

Chart	Description
Applications in Registry	This chart displays the number of applications available in the Cisco DNA Center application registry that can be used in Application Policy. The applications are classified as follows: • Custom: Applications added by a user • Built-in: Preinstalled applications in Cisco DNA Center • Discovered: Applications discovered by different recognition methods and imported into the application registry
Applications Observed in Network	This chart shows the applications observed in the past 2, 24, or 48 hours and lists the applications with highest network traffic ratio. **Note** The chart shows the applications observed only on CBAR-enabled devices.
Devices by Active Recognition Method	This chart displays the number of devices classified by each of the application recognition methods: • CBAR-enabled devices: Routers and switches • NBAR-based devices: Routers, switches, Cisco Wireless Controllers, and Cisco Catalyst 9800 Series Wireless Controller • IP/port-based devices: Switches • Not supported devices: Devices that are not supported by any of the preceding methods

Chart	Description
CBAR Readiness Status	This chart displays the device count in each CBAR readiness status. • Enabled: Devices that are CBAR-enabled • Ready: Devices that are ready for enabling CBAR **Note** The info icon next to **Ready** status shows the respective device is wireless enabled. • Not Ready: Devices that support CBAR but are not ready for enabling CBAR due to some issues • Not Supported: Devices that do not support CBAR
Service Health and CBAR Health	This widget displays the service health and the average health score for all CBAR-enabled devices. The device is healthy if there are no outstanding errors or warnings on that device. The CBAR health score is calculated across all CBAR-enabled devices. You can view the CBAR health of each CBAR-enabled device. A 0% CBAR health score indicates that the device has at least one error (P1). A 50% CBAR health score indicates that the device has no errors but has at least one warning (P2). A 100% CBAR health score indicates a healthy device. This widget also shows the service issues and remedies (P1, P2, and P3). The green tick mark indicates healthy service. The red cross mark indicates at least one P1 issue. The warning icon indicates at least one P2 issue. Click P1, P2, and P3 to view more about the services issues and remedies.
CBAR Health Issues and Remedies	All issues are classified by priority: • Errors (P1) • Warnings (P2) • Others (P3) Click the **P1**, **P2**, and **P3** tabs to view the device issues and remedy details.

Site Devices Table: This table provides device information and statuses. You can filter the devices using the **Quick Filter** and **Device Table Filter**.

Table 45: Day-N Application Visibility View: Site Devices Table

Column	Description
Device Name	Name of the device. Click the device name to view the CBAR Service Status.
Management IP	IP address of the device.
Device Type	Group of related devices, such as routers, switches and hubs, or wireless controllers.

Column	Description
Site	The site to which the device is assigned.
Fabric	The fabric domain to which the device is assigned.
Role	Role assigned to each discovered device during the scan process. The device role is used to identify and group devices according to their responsibilities and placement within the network. If Cisco DNA Center cannot determine a device role, it sets the device role to Unknown.
Active Recognition Method	Shows the device recognition method (CBAR, NBAR, IP/Port, or Not Supported).
OS Version	Cisco IOS software that is currently running on the device.
CBAR Readiness Status	Hover over the status displayed in the CBAR Readiness Status column to view the Remedy message.
Protocol Pack Version	Shows the current version of the protocol pack installed on the device and the protocol pack update status.
Device Registry Status	Shows the synchronization status of the device with the application registry. Hover over the info icon or the error icon to view more details about the synchronization status.
Deployment Status	Shows the CBAR deployment status.
Service Health Status	Click the issues in the Service Health Status column to open the CBAR Service status page, which displays a complete list of issues and the service status information of a device. If you click the Cisco Catalyst 9K device name, you can view the footprint (service load, CPU, and flows) of the CBAR service.
Application QoS Policy	The application policy applied to the device. For Cisco Wireless Controllers with more than one application policy, the number of application policies applied and the name of all the applied application policies are displayed.
WAN Interfaces	Shows the number of WAN interfaces. Click the WAN interface details to view the WAN connectivity settings for the device.

Applications and Application Sets

Applications are the software programs or network signaling protocols that are used in your network. Cisco DNA Center supports all of the applications in the Cisco Next Generation Network-Based Application Recognition (NBAR2) library of approximately 1400 distinct applications.

Applications are grouped into logical groups called application sets. An application set can be assigned a business relevance within a policy.

Applications are mapped into industry standard-based traffic classes, as defined in RFC 4594, that have similar traffic treatment requirements. The traffic classes define the treatments (such as Differentiated Services Code

Point [DSCP] marking, queuing, and dropping) that will be applied to the application traffic, based on the business relevance group that is assigned.

If you have additional applications that are not included in Cisco DNA Center, you can add them as custom applications and assign them to application sets.

Unidirectional and Bidirectional Application Traffic

Some applications are completely symmetrical and require identical bandwidth provisioning on both ends of the connection. Traffic for such applications is described as bidirectional. For example, if 100 kbps of Low-Latency Queueing (LLQ) is assigned to voice traffic in one direction, 100 kbps of LLQ must also be provisioned for voice traffic in the opposite direction. This scenario assumes that the same Voice over IP (VoIP) coder-decoders (codecs) are being used in both directions and do not account for multicast Music-on-Hold (MoH) provisioning. However, certain applications, such as streaming video and multicast MoH, are most often unidirectional. Therefore, it might be unnecessary, and even inefficient, to provision any bandwidth guarantees for such traffic on a branch router for the branch-to-campus direction of traffic flow.

Cisco DNA Center lets you specify whether an application is unidirectional or bidirectional for a particular policy.

On switches and wireless controllers, NBAR2 and custom applications are unidirectional by default. However, on routers, NBAR2 applications are bidirectional by default.

Custom Applications

Custom applications are applications that you add to Cisco DNA Center. An orange bar is displayed next to custom applications to distinguish them from the standard NBAR2 applications and application sets. For wired devices, you can define applications based on server name, IP address and port, or URL. You can define custom applications for Cisco Catalyst 9800 Series Wireless Controllers and not for Cisco AireOS controllers.

When you define an application according to its IP address and port, you can also define a DSCP value and port classification.

To simplify the configuration process, you can define an application based on another application that has similar traffic and service-level requirements. Cisco DNA Center copies the other application's traffic class settings to the application that you are defining.

Cisco DNA Center does not configure ACLs for port numbers 80, 443, 53, 5353, and 8080, even if they are defined as part of a custom application. If the custom application has a transport IP defined, Cisco DNA Center configures the application on the devices.

Note For a custom application to be programmed on devices when a policy is deployed, you must assign the custom application to one of the application sets defined in the policy.

Discovered Applications

Discovered applications are applications that are discovered by importing from recommended customization such as an Infoblox DNS server or by importing from the recommended unclassified applications flow.

The unclassified traffic can come from any flow that the CBAR-enabled device identifies but that is not recognized by the NBAR engine. In such cases, the applications that have a meaningful bit rate are reported as unclassified and can be imported and used as applications in Cisco DNA Center.

The Application Visibility service lets Cisco DNA Center connect with external authoritative sources like the Microsoft Office 365 Cloud Connector to help classify the unclassified traffic or help generate improved signatures.

Note You must configure an NBAR cloud connector before configuring the Microsoft Office 365 Cloud Connector.

The discovered applications are imported to the application registry.

Favorite Applications

Cisco DNA Center lets you flag applications that you want to configure on devices before all other applications. Flagging an application as a favorite helps to ensure that the QoS policies for your favorite applications get configured on devices. For more information, see Processing Order for Devices with Limited Resources, on page 564.

When custom applications are created they are marked as favorite applications.

Although there is no limit to the number of applications that you can mark as favorites, designating only a small number of favorite applications (for example, fewer than 25) helps to ensure that these applications are treated correctly from a business-relevance perspective in deployments with network devices that have limited ternary content addressable memory (TCAM).

Favorite applications can belong to any business-relevance group or traffic class and are configured system-wide, not on a per-policy basis. For example, if you flag the Cisco Jabber video application as a favorite, the application is flagged as a favorite in all policies.

Keep in mind that not only can business-relevant applications be flagged as favorites, even business-irrelevant applications can be flagged as such. For example, if administrators notice a lot of unwanted Netflix traffic on the network, they might chose to flag Netflix as a favorite application (despite it being assigned as business-irrelevant). In this case, Netflix is programmed into the device policies before other business-irrelevant applications, ensuring that the business intent of controlling this application is realized.

Configure Applications and Application Sets

The following subsections describe the various tasks that you can perform in the context of applications and application sets.

Note You can edit or delete only custom and discovered applications. You can edit or delete a maximum of 100 custom and discovered applications at one instance. If you choose NBAR applications for editing or deleting, a notification message indicates the number of applications that can be edited or deleted, excluding the number of chosen NBAR applications.

Change an Application's Settings

You can change the application set or traffic class of an existing NBAR, custom, or discovered application.

Step 1 Click the menu icon (☰) and choose **Provision** > **Services** > **Application Visibility** > **Application**.

Step 2 Use the **Search**, **Show**, or **View By** fields to locate the application that you want to change.

You can search applications based on their name, port number, and traffic class.

Step 3 Click the application name.

Step 4 In the dialog box, change one or both settings:

- **Traffic Class**: Choose a traffic class from the drop-down list. Valid traffic classes are BROADCAST_VIDEO, BULK_DATA, MULTIMEDIA_CONFERENCING, MULTIMEDIA_STREAMING, NETWORK_CONTROL, OPS_ADMIN_MGMT, REAL_TIME_INTERACTIVE, SIGNALING, TRANSACTIONAL_DATA, VOIP_TELEPHONY.
- **Application Set**: Choose an application set from the drop-down list. Valid application sets are authentication-services, backup-and-storage, collaboration-apps, consumer-browsing, consumer-file-sharing, consumer-gaming, consumer-media, consumer-misc, consumer-social-networking, database-apps, desktop-virtualization, email, enterprise-ipc, file-sharing, generic-browsing, generic-media, generic-misc, tunneling, local-services, naming-services, network-control, network-management, remote-access, saas-apps, signaling, software-development-tools, software-updates, streaming-media.

Step 5 Click **Save**.

Create a Server Name-Based Custom Application

If you have applications that are not in Cisco DNA Center, you can add them as custom applications.

Step 1 Click the menu icon (☰) and choose **Provision** > **Services** > **Application Visibility**.

Step 2 Click the **Application** tab.

Step 3 Click **Add Application**.

Step 4 In the dialog box, provide the necessary information in the following fields:

Field	Description
Application name	Name of the custom application. The name can contain up to 24 alphanumeric characters, including underscores and hyphens. The underscore and hyphen are the only special characters allowed in the application name.
Type	Method by which users access the application. Choose **Server Name** for applications that are accessible through a server.
Server name	Name of the server that hosts the application.
Similar to	Application with similar traffic-handling requirements. Click the radio button to select this option, and then select an application from the drop-down list. Cisco DNA Center copies the other application's traffic class to the application that you are defining.

Field	Description
Traffic class	Traffic class to which the application belongs. Valid values are BULK_DATA, TRANSACTIONAL_DATA, OPS_ADMIN_MGMT, NETWORK_CONTROL, VOIP_TELEPHONY, MULTIMEDIA_CONFERENCING, MULTIMEDIA_STREAMING, BROADCAST_VIDEO, REAL_TIME_INTERACTIVE, and SIGNALING.
Application set	Application set is where you want the application to reside. Valid application sets are authentication-services, backup-and-storage, collaboration-apps, consumer-browsing, consumer-file-sharing, consumer-gaming, consumer-media, consumer-misc, consumer-social-networking, custom applications, database-apps, desktop-virtualization, email, enterprise-ipc, file-sharing, generic-browsing, generic-media, generic-misc, tunneling, local-services, naming-services, network-control, network-management, remote-access, saas-apps, signaling, software-development-tools, software-updates, streaming-media.

Step 5 Click **OK**.

Create an IP Address and Port-Based Custom Application

If you have applications that are not in Cisco DNA Center, you can add them as custom applications.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **Application Visibility**.

Step 2 Click the **Application** tab.

Step 3 Click **Add Application**.

Step 4 In the **Application name** field, enter a name for the custom application. The name can contain up to 24 alphanumeric characters, including underscores and hyphens. The underscore and hyphen are the only special characters allowed in the application name.

Step 5 In the **Type** area, click the **Server IP/Port** radio button to indicate that the application is accessible through an IP address and port.

Step 6 Check the **DSCP** check box and define a DSCP value. If you do not define a value, the default value is Best Effort. Best-effort service is essentially the default behavior of the network device without any QoS.

Step 7 Check the **IP/Port Classifiers** check box to define the IP address and subnet, protocol, and port or port range for an application. Valid protocols are IP, TCP, UDP, and TCP/UDP. If you select the IP protocol, you do not define a port number or range. Click + to add more classifiers.

Step 8 Define your application traffic-handling requirements using one of the following methods:

- **Similar To**: If your application has similar traffic-handling requirements as an existing application, click the **Similar To** radio-button and choose the application from the drop-down list. Cisco DNA Center copies the traffic class of the other application to the application that you are defining.
- **Traffic Class**: If you know the traffic class that you want to define for your application, click the **Traffic Class** radio button and choose the traffic class from the drop-down list. Valid values are BULK_DATA, TRANSACTIONAL_DATA, OPS_ADMIN_MGMT, NETWORK_CONTROL, VOIP_TELEPHONY, MULTIMEDIA_CONFERENCING, MULTIMEDIA_STREAMING, BROADCAST_VIDEO, REAL_TIME_INTERACTIVE, and SIGNALING.

Step 9 From the **Application Set** drop-down list, choose the application set to which the application will belong. Valid application sets are authentication-services, backup-and-storage, collaboration-apps, consumer-browsing, consumer-file-sharing, consumer-gaming, consumer-media, consumer-misc, consumer-social-networking, custom applications, database-apps, desktop-virtualization, email, enterprise-ipc, file-sharing, generic-browsing, generic-media, generic-misc, tunneling, local-services, naming-services, network-control, network-management, remote-access, saas-apps, signaling, software-development-tools, software-updates, streaming-media.

Step 10 Click **OK**.

Create a URL-Based Custom Application

If you have applications that are not in Cisco DNA Center, you can add them as custom applications.

Step 1 Click the menu icon (☰) and choose **Provision** > **Services** > **Application Visibility**.

Step 2 Click the **Application** tab.

Step 3 Click **Add Application**.

The **Add Application** dialog box appears.

Step 4 In the **Application name** field, enter the name of the custom application. The name can contain up to 24 alphanumeric characters, including underscores and hyphens. (Underscores and hyphens are the only special characters allowed in the application name.)

Step 5 For **Type**, click the **URL** radio button.

Step 6 In the **URL** field, enter the URL used to reach the application.

Step 7 Configure the traffic class:

- To use the same traffic class as another application with similar traffic-handling requirements, click the **Similar To** radio button and choose an application from the drop-down list.
- To specify the traffic class, click the **Traffic Class** radio button and choose a traffic class from the drop-down list. Valid values are BULK_DATA, TRANSACTIONAL_DATA, OPS_ADMIN_MGMT, NETWORK_CONTROL, VOIP_TELEPHONY, MULTIMEDIA_CONFERENCING, MULTIMEDIA_STREAMING, BROADCAST_VIDEO, REAL_TIME_INTERACTIVE, and SIGNALING.

Step 8 From the **Application Set** drop-down list, choose an application set in which you want the application to reside.

Step 9 Click **OK**.

Edit or Delete a Custom Application

If required, you can change or delete a custom application.

Note You cannot delete a custom application that is directly referenced by an application policy. Application policies typically reference application sets and not individual applications. However, if a policy has special definitions for an application (such as a consumer or producer assignment or bidirectional bandwidth provisioning), the policy has a direct reference to the application. As such, you must remove the special definitions or remove the reference to the application entirely before you can delete the application.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **Application Visibility**.

Step 2 Click the **Application** tab.

Step 3 Use the **Search**, **Show**, or **View By** fields to locate the application that you want to change.

You can search applications based on their name, port number, and traffic class.

Step 4 To edit the application:

a) Click the application name and make the required changes. For information about the fields, see Create a Server Name-Based Custom Application, on page 488, Create an IP Address and Port-Based Custom Application, on page 489, or Create a URL-Based Custom Application, on page 490.

b) Click **OK**.

Note When policy is redeployed, the edited custom applications are not reconfigured on Cisco Catalyst 9800 Series Wireless Controller.

Step 5 To delete the application, click 🗑 in the application box, and then click **OK** to confirm.

Mark an Application as Favorite

You can mark an application as a favorite to designate that the application's QoS configuration must be deployed to devices before other applications' QoS configuration. An application marked as favorite has a yellow star next to it.

When you add or edit a policy, applications marked as a favorites are listed at the top of the application set.

Applications are configured system-wide, not on a per-policy basis. For more information, see Favorite Applications, on page 487.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **Application Visibility**.

Step 2 Click the **Application** tab.

Step 3 Locate the application that you want to mark as a favorite.

Step 4 Click the star icon.

Create a Custom Application Set

If none of the application sets fits your needs, you can create a custom application set.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **Application Visibility**.

Step 2 Click the **Application Sets** tab.

Step 3 Click **Add Application Set**.

Step 4 In the dialog box, enter a name for the new application set.

Cisco DNA Center creates the new application set; however, it contains no applications.

Step 5 Click **OK**.

Step 6 Use the **Search**, **Show**, or **View By** fields to locate the application set.

You can search applications based on their name, port number, and traffic class.

Step 7 Locate the applications that you want to move into the new application set.

Step 8 Check the check box next to the applications that you want to move.

Step 9 Drag and drop the applications into the new application set.

Edit or Delete a Custom Application Set

If required, you can change or delete a custom application set.

Note You cannot delete a custom application set that is referenced by an application policy. You must remove the application set from the policy before you delete the application set.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **Application Visibility**.

Step 2 Click the **Application Sets** tab.

Step 3 Use the **Search**, **Show**, or **View By** fields to locate the application set that you want to change.

You can search applications based on their name, port number, and traffic class.

Step 4 Do one of the following:

- To edit the application set, drag and drop applications into or out of the application set. Click **OK** to confirm each change.
- To delete the application set, click 🗑 in the application set box, and then click **OK** to confirm.

Update the Protocol Pack on a CBAR-Enabled Device

You can upgrade the protocol pack on any device that supports CBAR to the latest or any specific protocol pack.

Before you begin

- Configure Cisco credentials on **System Settings**. For more information about configuring Cisco credentials, see the Cisco DNA Center Administrator Guide.
- Devices must support CBAR.
- CBAR must be enabled on the device.
- Protocol packs for the device must be available on cisco.com.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **Application Visibility**.

Step 2 In the Day-N **Overview** page, scroll down to view the **Site Devices** table.

Step 3 Check the status shown in the **Protocol Pack Version** column in the **Site Devices** table.

You can click the **Outdated** status to view the list of applicable protocols packs in the **Update Protocol Pack** window.

Step 4 Click **Update** corresponding to the required protocol pack version in the **Update Protocol Pack** window.

The **Protocol Pack Version** column shows **In progress** status. Click the info icon to view the current updating version. If the **Protocol Pack Version** column shows **Update failed** status, click the error icon to view the failure reason.

Step 5 If you want to update all the devices or selected devices to the latest protocol pack, do the following:

To update the protocol pack on all applicable CBAR-enabled devices:

- From the **Update Protocol Pack** drop-down list, choose **All Devices** and click **Yes** in the subsequent warning pop-up windows.

To update the protocol pack on the selected devices:

- Choose the devices in the **Site Devices** table.
- From the **Update Protocol Pack** drop-down list, choose **Selected Devices** and click **Yes** in the subsequent warning pop-up windows.

Discover Unclassified Applications

The Application Visibility service in Cisco DNA Center obtains information on classified and unclassified domains and sockets from devices and displays that information in the **Observed Traffic** chart. The number of unclassified server names and IP/ports that are discovered by the Application Visibility service is shown under **Recommendations**.

You can add the unclassified server names and IP/ports to the Application Registry.

Note You can add a maximum of 1100 discovered applications in the Application Registry.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **Application Visibility**.

Step 2 Click the **Discover Applications** tab.

Step 3 Under **Recommendations**, click the **discovered server names** link or the **discovered IP/Ports** link.

The table lists the discovered servers or IP/ports that are not classified. Choose the server and check the **Hide Ignored Applications** check box if you want to hide the selected server or IP/ports in the table.

Step 4 Choose the server or IP/ports that you want to import as an application in the Application Registry.

Step 5 Choose the required **Application**, **Application Set**, and **Traffic Class** from the drop-down list.

Step 6 Click **Import**.

Step 7 Click the **Applications** tab and choose **Show** > **Discovered** to view the imported application.

Configure the NBAR Cloud Connector

The Application Visibility service uses the NBAR cloud connector to enrich the protocol pack and enhance visibility for unknown applications by sending and receiving data from the cloud.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **Application Visibility**.

Step 2 Click the **Discover Applications** tab.

Step 3 In the **NBAR Cloud** window, click **Configure**.

Step 4 In the **Configure NBAR Cloud** window, click the toggle button to **Enable**.

Step 5 Click the **Cisco API Console** link to retrieve the key and client secret.

Step 6 Enter your Cisco credentials to open the **Cisco API Console** in a new browser tab and do the following:

a) In the **My Apps & Keys** tab, click **Register a New App**.

b) Complete the following fields in the **Register an Application** screen.

- **Name of Your Application**: Enter the application name.
- **OAuth2.0 Credentials**: Click the **Client Credentials** check box.
- **Select APIs**: Click the **Hello API** check box.

c) Click **Register**.

The registered application details appear in the **My Apps & Keys** tab.

d) Copy the key and client secret of the registered application from the **Cisco API Console**.

Step 7 Enter the copied key and client secret in the **Configure NBAR Cloud** window.

Step 8 Complete the following fields in the **Configure NBAR Cloud** window:

a) Enter the organization name.

b) Check the **Improve my network using NBAR Cloud telemetry** check box.

c) Choose the desired location in the **NBAR classification telemetry data is being sent to region** check box.

Step 9 Click **Save**.

Application Visibility Service Support for the Cisco DNA Traffic Telemetry Appliance

The Cisco DNA Traffic Telemetry Appliance generates endpoint telemetry from mirrored IP network traffic and shares the telemetry data with Cisco DNA Center for endpoint visibility and segmentation.

The prerequisites for enabling CBAR on the Cisco DNA Traffic Telemetry Appliance include:

- The device must be assigned to a site.
- The device role must be set to **Distribution** mode.

You can configure custom applications with attribute sets and maps on the Cisco DNA Traffic Telemetry Appliance without configuring a QoS policy. For more information, see Create an Application Policy, on page 570 and Deploy an Application Policy, on page 575.

Discover Infoblox Applications

You can integrate Cisco DNA Center with an organizational Infoblox DNS server to resolve unclassified traffic based on server names.

Before you begin

- The Infoblox WAPI version must be 1.5 or later. To check the Infoblox WAPI version, log in to the Infoblox server and choose **Help** > **Documentation** > **WAPI Documentation**.
- Create a role with at least Read Only permissions and assign the role to the Infoblox user. For more information, see Manage Users in the Cisco DNA Center Administrator Guide.

Step 1 Click the menu icon (☰) and choose **Provision** > **Services** > **Application Visibility**.

Step 2 Click the **Discover Applications** tab.

Step 3 Under **Infoblox DNS Server**, click **Configure**.

Step 4 In the **Infoblox Connector Settings** window, click the **Here** link to configure IPAM/DNS server credentials in Cisco DNA Center.

Step 5 Complete the IPAM settings. For more information, see Configure an IP Address Manager in the Cisco DNA Center Administrator Guide.

Step 6 Go back to **Infoblox Connector Settings** and complete the following settings:

- Check the **All DNS Zones** check box, or choose the required DNS zones from the **DNS Zones to Inspect** drop-down list. The drop-down list shows the DNS zones defined in the Infoblox server.
- From the **Inspect** drop-down list, choose the required inspection record.
- Check the **Read Application name from** check box and click the **Extensible Attribute** or **AVC RRTYPE format** radio button. If you click the **Extensible Attribute** radio button, enter the extensible attribute name that contains descriptive application names.
- From **Default Traffic Class**, choose the default traffic class for classifying the Infoblox applications.
- From **Default Application Set**, choose the default application set for classifying the Infoblox applications.

Step 7 Click **Save**.

The **Poll Infoblox to Import Applications** link appears under **Recommendations**.

Step 8 Click the **Poll Infoblox to Import Applications** link to get a list of applications from the DNS zones configured in the **Infoblox Connector Settings**.

Step 9 Choose the application that you want to import and complete the following:

- If the application does not have a name defined in the Infoblox server, edit the application name.
- Choose the required application set and traffic class from the drop-down list if you want to change the default application set and traffic class defined in the **Infoblox Connector Settings**.

Step 10 Click **Import**.

Step 11 Click the **Applications** tab and choose **Discovered** in the **Show** drop-down list to view or edit the imported Infoblox applications.

If you change the server name of an application after importing the application, the **Application Status** column in the **Infoblox Discovered Applications** window shows the status of the application as **Updated**. The application name that you see in the **Application Status** column is the new server name of the application. Click the info icon to view the old server names of the application.

Resolve Unclassified Traffic Using Microsoft Office 365 Cloud Connector

Cisco DNA Center can connect to external authoritative sources like Microsoft Office 365 Cloud Connector that can help classify the unclassified traffic or help generate improved signatures.

Before you begin

- Ensure that Cisco DNA Center has connectivity to the internet.
- Ensure that the NBAR cloud is enabled.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **Application Visibility**.

Step 2 Click the **Discover Applications** tab.

Step 3 Click the **MS Office 365 Cloud** toggle button to enable polling of MSFT signatures.

- When you enable Microsoft Office 365 Connector, the controller starts importing the new domains' information from Microsoft Office 365 and finds the correct application for the new domains.
- The new secondary pack is installed along with the Cisco DNA Center-based protocol pack and new domains are supported automatically.

Edit or Delete a Discovered Application

If required, you can edit or delete a discovered application.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **Application Visibility**.

Step 2 Click the **Application** tab.

Step 3 Use the **Search**, **Show**, or **View By** fields to locate the discovered application that you want to change.

You can search for applications based on their name, port number, and traffic class.

Step 4 To edit the application:

a) Click the application name and make the required changes.

For discovered applications, you can edit only the **Attribute Set** and **Traffic Class**.

b) Click **OK**.

Step 5 To delete the application, click 🗑 in the application box, and then click **OK**.

Application Hosting

The following sections provide information about application hosting.

About Application Hosting

Application hosting lets you manage the lifecycle of third-party applications on devices managed by Cisco DNA Center. You can host third-party docker applications on Cisco Catalyst 9300 Series switches running Cisco IOS-XE software version 16.12.1s or later, Cisco Catalyst 9100 Series Access Points running Cisco IOS-XE software version 17.3.1 or later, and Cisco Catalyst 9400 Series switches running Cisco IOS-XE software version 17.1 or later.

Note The disk space allocated in Cisco DNA Center for the hosted applications is limited to 5 GB.

Install or Update the Application Hosting Service Package

Before you begin

Only a user with SUPER-ADMIN-ROLE permissions can perform this procedure.

Step 1 Click the menu icon (☰) and choose **System** > **Software Updates**. Alternatively, click the cloud icon and click the **Go to Software Updates** link.

Step 2 In the Software Updates window, review the following tabs:

- **Updates**: Shows the system and application updates. System Update shows the system version that is installed and the system updates that are available and have been downloaded from the Cisco cloud. Application Updates shows the available applications that can be downloaded and installed from the Cisco cloud, the size of the application, and the appropriate action (**Download**, **Install**, or **Update**). Hover your cursor over the package to view the available version and a basic description.
- **Installed Apps**: Shows the application packages that are currently installed.

Step 3 To download the Application Hosting package, click **Install** next to the Application Hosting name under **Updates** > **Application Updates**.

Step 4 To update the Application Hosting package, click **Update** next to the Application Hosting name under **Updates** > **Application Updates**.

Step 5 Ensure that the application has been updated by reviewing the version on the **Installed Apps** tab.

Note After installing the Application Hosting service package, you must log out of Cisco DNA Center, clear your browser cache, and log in to Cisco DNA Center again.

Prerequisites for Application Hosting

To enable application hosting on a Cisco Catalyst 9000 device, the following prerequisites must be fulfilled:

- Configure a secure HTTP server on the switch where the applications will be hosted.
- Configure local or AAA authentication server for HTTPS user authentication on the switch. You must configure the username and password with privilege level 15.
- Ensure Cisco Catalyst 9300 Series switches are running Cisco IOS XE 16.12.x or later version and Cisco Catalyst 9400 Series switches are running Cisco IOS XE 17.1.x or later version.
- Ensure that the device has an external USB SSD pluggable storage (only for the switches of 9300 family).
- Verify that the configuration on the switch is correct. Open the WebUI on the switch and log in as the HTTPS user.

  The following example shows a working configuration on a switch:

  ```
  prompt# sh run | sec http
  ip http server
  ip http authentication local
  ip http secure-server
  ip http max-connections 16
  ip http client source-interface Loopback0
  ```

  Additional configuration for switches with a Cisco IOS XE release that is earlier than 17.3.3:

  ```
  ip http secure-active-session-modules dnac
  ip http session-module-list dnac NG_WEBUI
  ip http active-session-modules none
  ```

  Additional configuration for switches with Cisco IOS XE 17.3.3 or later:

  ```
  ip http secure-active-session-modules webui
  ip http session-module-list webui NG_WEBUI
  ip http session-module-list pki OPENRESTY_PKI
  ip http active-session-modules pki
  ```

- On Cisco DNA Center, configure the HTTPS credentials while manually adding the device. The HTTPS username, password, and port number are mandatory for application hosting. The default port number is 443. You can also edit the device credentials; see Update Network Device Credentials, on page 78. If you edit a device that is already managed, resynchronize that device in the inventory before it is used for application hosting-related actions.

Note Application hosting HA is not supported on three-node Cisco DNA Center clusters.

View Device Readiness to Host an Application

You must check the readiness of the Cisco Catalyst 9300 Series switch to host the application before you can install an application on the switch.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **App Hosting for Switches**.

Step 2 Click **All Devices**.

Step 3 View the list of devices that are capable of hosting applications. The **App Hosting Status** indicates the readiness of the device to host an application. Click **See Details** to view the list of readiness checks performed on the device.

Add an Application

You can add a Cisco package or a docker application.

Before you begin

- **Cisco Package**: You must package the application using IOS SDK tools so that the application is compatible with IOS XE operating systems.
- **Docker**: You must save the docker image as a tar file. Enter the following command to store the docker image as a tar file:

```
docker save -o <path for generated tar file> <image name:tag>
Example: docker save -o alpine-tcpdump.tar itsthenetwork/alpine-tcpdump:latest
```

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **App Hosting for Switches**.

Step 2 Click **New Application**.

Step 3 Choose the application and category from the drop-down list.

Step 4 Click **Select** and choose the application to upload.

Step 5 Click **Upload**.

You can view the newly added application in the **App Hosting** page.

Automatic Download of ThousandEyes Enterprise Agent Application

The ThousandEyes Enterprise Agent application lets you monitor your network and oversee the network traffic paths across internal, external, carrier, and internet networks in real time. The advantage of the ThousandEyes Enterprise Agent application is that you do not have to import this application manually in your Cisco DNA Center Application Hosting Service. When the switches and hubs in the network are enabled, the ThousandEyes Enterprise Agent application is downloaded automatically within 10 minutes of starting the Application Hosting Service. To manually download the application, click the following link to the ThousandEyes Enterprise Agent .tar file:

thousandeyes-enterprise-agent.cat9k.tar

If there is no internet connection, you can set a proxy connection from the console using the following command:

```
magctl service setenv app-hosting http_proxy <proxy-value>
```

Set the proxy value to connect to the ThousandEyes Enterprise Agent application.

Update an Application

You can update the application added in Cisco DNA Center.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **App Hosting for Switches**.

You can view the available applications in the **App Hosting** window.

Step 2 Choose the application that you want to update.

Step 3 Click **Update App**.

Step 4 Choose a new version of the application to be uploaded.

Step 5 Click **Upload**.

Start an Application

You can start an application in Cisco DNA Center.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **App Hosting for Switches**.

Step 2 Choose the application and click **Manage** to view the devices that use the application.

Step 3 Choose the device that has the application that you want to start.

Step 4 From the **Actions** drop-down list, choose **Start App**.

Stop an Application

You can stop an application in Cisco DNA Center.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **App Hosting for Switches**.

Step 2 Choose the application and click **Manage** to view the devices that use the application.

Step 3 Choose the device that has the application that you want to stop.

Step 4 From the **Actions** drop-down list, choose **Stop App**.

View Applications Hosted on Device

Before you begin

Complete the prerequisites. For more information, see Prerequisites for Application Hosting.

Step 1 Click the menu icon (☰) and choose **Provision** > **Services** > **App Hosting for Switches**.

Step 2 To view all devices, click **All Devices** at the top-right corner, or to view only the devices that use a particular application, choose the application and click **Manage**.

Note

- If you chose to view all devices, the **All Devices** page shows the following information about the devices that are capable of hosting applications: **Hostname**, **IP Address**, **Image Version**, **App Hosting Status**, and **Last Updated**.
- If you chose to view a list of devices for a particular application, the **Devices** page shows the following information about the devices that are capable of hosting applications: **Hostname**, **Device IP**, **App Version**, **App Status**, **Last Heard, Platform Version**, and **Action Status**.

Step 3 In the **Devices** page, click **Summary** to view a summary of failed, stopped, and running applications on a device.

Step 4 To take an action on an application, click the **Action** drop-down list and choose **Start**, **Stop**, **Edit**, **Upgrade**, or **Uninstall**.

Step 5 Click the device link in which you want to view the installed hosting applications.

The **Applications** page shows the **Name**, **Version**, **App Status**, **Monitor App**, **Health**, and **Details** of the installed applications.

Note **Monitor App** contains the link to the Application Monitoring Dashboard. This link is provided in the, Cisco DNA Center application package controller, .yaml file. If this file does not contain application dashboard URL, then this **Monitor App** column will not be applicable.

Step 6 In the **Details** column, click **View** to get more information about an application status on the device.

App details window shows the **RESOURCES**, **NETWORK**, and **DOCKER RUNTIME OPTIONS** information of an application.

Step 7 To download the log for a particular application, select the application and click **Application Logs**.

Step 8 To download tech support from the device, click **Tech Support Logs**.

Install an Application on a Cisco Catalyst 9300 Device

Cisco DNA Center allows you to install an application on a Cisco Catalyst 9300 Series switch.

Before you begin

- Complete the prerequisites. For more information, see Prerequisites for Application Hosting, on page 498.
- Add the application to Cisco DNA Center. For more information, see Add an Application, on page 499.
- Check the readiness of the switch to host the application. For more information, see View Device Readiness to Host an Application, on page 499.

Step 1 Click the menu icon (☰) and choose **Provision** > **Services** > **App Hosting for Switches**.

Step 2 Choose the application and click **Install**.

Step 3 In the **Get Started** window, enter a unique name for your workflow in the **Task Name** field and click **Next**.

Step 4 In the **Select Site** window, choose the site where you want to enable the application, and click **Next**.

Step 5 In the **Select Switches** window, choose the devices on which you want to install the application and click **Next**.

You can choose devices in **Ready** and **Partially Ready** status. Click **See Details** to view the list of readiness checks performed on the device.

If you don't find your device in the **Devices Table**, click **Import** to add devices from a CSV file.

Step 6 In the **Configuration App** window, complete the following settings:

- **Network Settings**:
  - Click the **Select Network** drop-down list and choose a VLAN to configure the application.
  - Click the **Address Type** drop-down list and choose **Static** or **Dynamic**. If you choose **Static**, click the thumbnail icon and enter the **IP Address**, **Gateway**, **Prefix/Mask**, and **DNS** for the application.
- **App Resources**: Check the **Allocate all resources available on a device** or **Customize resource allocation** check box. You can check the **Customize resource allocation** check box and modify the maximum **CPU**, **Memory**, and **Persistent Storage** values to a lower value.
- **Custom Settings**: Applicable only for Cisco package applications. Enter the configuration details for the attributes that are specified by the application.
- **App Data**: Browse and upload the application-specific files. To identify the required application-specific files, see the relevant application document.
- **Docker Runtime Options**: Enter the docker runtime options required by the application.

Step 7 Click **Next** and review the application configuration settings in the **Summary** window.

Step 8 (Optional) Click **Configuration Preview** to view the configuration template used to push the configuration settings on the selected devices.

Step 9 Click **Provision**.

Step 10 In the confirmation window, click **Yes** to complete the application installation on the selected devices.

What to do next

The installation of the application also modifies the Cisco IOS-XE configuration on the device. This change in the running configuration must be copied to the startup configuration to ensure applications function as expected after a router reload. After the application installation is complete, use the **Template Editor** to copy the running configuration to the startup configuration.

Uninstall an Application from a Cisco Catalyst 9300 Device

You can uninstall an application from a Cisco Catalyst 9300 Series switch.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **App Hosting for Switches**.

Step 2 Choose the application and click **Manage** to view the devices that use the application.

Step 3 Choose the devices that have the application that you want to uninstall.

Step 4 From the **Actions** drop-down list, choose **Uninstall App**.

Edit an Application Configuration in a Cisco Catalyst 9300 Device

You can edit an application configuration if the application requires a configuration to be up and running in a Cisco Catalyst 9300 Series switch.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **App Hosting for Switches**.

Step 2 Choose the application and click **Manage** to view the devices that use the application.

Step 3 Choose the device that has the application that you want to edit.

Step 4 From the **Actions** drop-down list, choose **Edit App Config**.

Delete an Application

You can delete an application from Cisco DNA Center.

Before you begin

You must uninstall the application from all devices that are using it. For more information, see Uninstall an Application from a Cisco Catalyst 9300 Device, on page 502.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **App Hosting for Switches**.

You can view the available hosted applications in the **App Hosting** window.

Step 2 Choose the application that you want to delete.

Step 3 Click **Delete Application**.

Step 4 In the confirmation dialog box, click **OK**.

The application is deleted only if it is not used by any of the devices managed by Cisco DNA Center.

Otherwise, an error message shows the number of devices that are using the application. Click **Cancel** in the confirmation dialog box and uninstall the application. For more information, see Uninstall an Application from a Cisco Catalyst 9300 Device, on page 502.

Download App Logs

You can download application logs from Cisco DNA Center.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **IoT Services**.

Step 2 Click **All Devices**.

You can view the list of devices that are capable of hosting applications.

Step 3 Click **App logs** to download the application logs from Cisco DNA Center.

Step 4 In the **App Logs** pop-up window, choose the application logs file that you want to download and click **Download**.

Download Device Tech Support Logs

You can download the device tech support logs from Cisco DNA Center for troubleshooting purposes.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **IoT Services**.

Step 2 Click **All Devices**.

A list of devices that are capable of hosting applications is displayed.

Step 3 Click **Tech Support logs** to download the device tech support logs.

Application Hosting on Cisco Catalyst 9100 Series Access Points

The following sections provide information about application hosting on Cisco Catalyst 9100 Series Access Points.

About Application Hosting on Cisco Catalyst Access Points

The move to virtual environments has prompted the need to build applications that are reusable, portable, and scalable. Application hosting gives administrators a platform for leveraging their own tools and utilities. An application, hosted on a network device, can serve a variety of purposes. This ranges from automation, configuration management monitoring, and integration with existing tool chains.

Application hosting lets you manage the lifecycle of third-party applications on devices managed by Cisco DNA Center. This release lets you bring in the third-party SES-imagotag IoT Connector application on Cisco Catalyst 9100 Series Access Points with Cisco IOS-XE software version 17.3 or later.

The SES-imagotag IoT Connector on Cisco Catalyst 9100 Series Access Points can handle all Electronic Shelf Label (ESL) communication.

Application Hosting Workflow to Install and Manage USB on Cisco Catalyst 9100 Series Access Points

Before you begin

To enable application hosting on a device, the following prerequisites must be completed:

- You must enable NETCONF and set the port to 830 to discover Cisco Catalyst 9100 Series Access Points.
- Cisco Catalyst 9100 Series Access Points must have direct IP reachability to Cisco DNA Center.
- Make sure that the Cisco Catalyst 9800 Series Wireless Controller is running Cisco IOS XE 17.3.x or later software.
- Make sure that the Cisco DNA Center appliance is running the latest Cisco DNA Center ISO.
- Make sure that the USB dongle is inserted in the AP. This is required for the SES-imagotag Connector application to run.

Step 1 Check the readiness of the Cisco Catalyst 9800 Series Wireless Controller and Cisco Catalyst 9100 Series Access Points to host the application before you install it.

For more information, see View Device Readiness to Host an Application, on page 499.

Step 2 Install the Application Hosting service on Cisco DNA Center.

For more information, see Install or Update the Application Hosting Service Package, on page 497.

Step 3 Add the Cisco Catalyst 9800 Series Wireless Controller to Cisco DNA Center.

For more information, see Add a Network Device, on page 74.

Note Make sure that you enable NETCONF and set the port to 830.

You must wait for the Cisco Catalyst 9800 Series Wireless Controller to move to a Managed state.

Step 4 Assign APs to a floor on the Network Hierarchy window.

For more information, see Work With APs on a Floor Map, on page 136.

Step 5 Upload the USB application (the SES-imagotag Connector) to Cisco DNA Center.

For more information, see Add an Application, on page 499.

Step 6 Enable the IoT services.

For more information, see Enable IoT Services on Cisco Catalyst 9100 Series Access Points, on page 673.

Step 7 Configure the container as described in the Application Hosting on Catalyst APs Deployment Guide.

View Installed Hosting Applications on Cisco Catalyst 9100 Series Access Points

Before you begin

Complete the prerequisites. For more information, see Prerequisites for Application Hosting.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **IoT Services**.

Step 2 To view all devices, click **All Devices** at the top-right corner, or to view only the devices that use a particular application, choose the application and click **Manage**.

Note

- If you chose to view all devices, the **All Devices** page shows the following information about the devices that are capable of hosting applications: **Hostname**, **IP Address**, **Image Version**, **App Hosting Status**, and **Last Updated**.
- If you chose to view a list of devices for a particular application, the **Devices** page shows the following information about the devices that are capable of hosting applications: **Hostname**, **Device IP**, **App Version**, **App Status**, **Last Heard, Platform Version**, and **Action Status**.

Step 3 In the **Devices** page, click **Summary** to view the summary of failed, stopped, and running applications on a device.

Step 4 Click the **Action** drop-down list to start, stop, edit, upgrade, and uninstall an application.

Step 5 Click the device link in which you want to view the installed hosting applications.

The **Applications** page shows the **Name**, **Version**, **App Status**, **IP Address**, **Health**, and **Details** of the installed applications.

Step 6 In the **Details** column, click **View** to get more information about an application status on the device.

App details window shows the **REOURCES** and **NETWORK** information of an application.

Step 7 To download the application log, select an application for which you want to download the application log and click **Application Logs**.

Step 8 To download the tech support log, select an application for which you want to download the tech support log and click **Tech Support Logs**.

Uninstall an Application from a Cisco Catalyst 9100 Device

You can uninstall an application from a Cisco Catalyst 9100 Series AP.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **IoT Services**.

Step 2 Choose the application and click **Manage** to view the devices that use it.

Step 3 Choose the devices that have the application that you want to uninstall.

Step 4 From the **Actions** drop-down list, choose **Uninstall App**.

Delete an Application from a Cisco Catalyst 9100 Device

You can delete an application from a Cisco Catalyst 9100 Series AP.

Before you begin

You must uninstall the application from all devices that are using it. For more information, see Uninstall an Application from a Cisco Catalyst 9100 Device.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **IoT Services**.

You can view the available hosted applications in the **IoT Services** page.

Step 2 Choose the application that you want to delete.

Step 3 Click **Delete Application**.

Step 4 In the confirmation dialog box, click **OK**.

The application is deleted only if it is not used by any of the devices managed by Cisco DNA Center.

Otherwise, an error message shows the number of devices using the application. Click **Cancel** and uninstall the application. For more information, see Uninstall an Application from a Cisco Catalyst 9100 Device.

Configure a Site-to-Site VPN

You can create a site-to-site VPN and edit or delete existing site-to-site VPNs.

Create a Site-to-Site VPN

This procedure shows how to create a site-to-site VPN from the **Provision** > **All Services** window. Alternatively, you can create a site-to-site VPN from the **Workflows** > **Site to Site VPN** window.

Before you begin

- Define the sites within the network hierarchy. See Network Hierarchy Overview, on page 121.
- Configure IP address pools to be used for the VPN tunnels. The IP address pools must have a minimum of six free IP addresses. See Configure IP Address Pools, on page 182.

Step 1 Click the menu icon (≡) and choose **Provision** > **Site to Site VPN**.

Step 2 To create a VPN, click **Add**.
The **Choose Your Sites** workflow is displayed.

Step 3 Enter a VPN name in the first field.

Step 4 Select the first site, a device in that site, and a WAN interface on that device from the Site 1 drop-down lists. The WAN interface is set by default if the device is provisioned.

Step 5 Select the second site, a device in that site, and a WAN interface on that device from the Site 2 drop-down lists. The WAN interface is set by default if the device is provisioned.

Step 6 Click **Next** to go to the **Select Networks** screen.

Step 7 From the **Tunnel IP Pool** drop-down list, choose an IP address pool.

Step 8 Check the boxes next to the subnets that you want to use for each site.

Step 9 (Optional) If you want to add a custom network for a site, click the **Add Custom Networks** link at the bottom and complete the required fields.

Step 10 Click **Next** to go to the **Configure VPN** screen.

Step 11 Enter a preshared key for encryption.

Step 12 Set the encryption and integrity algorithms as desired. We recommend that you use the default settings. If you change any settings, you can go back to the default choices by checking the **Use Cisco recommended IKEV2 & Transform Set Values** check box.

Step 13 Click **Next** to go to the **Summary** screen.

Step 14 Review the VPN settings and click **Edit** in any section if you want to make a change.

Step 15 Click **Create VPN**.

In the status screen that follows, a check mark is shown next to each step as it is completed. Click **Services** to return to the **Site to Site VPN** screen, which shows the newly created VPN.

Edit a Site-to-Site VPN

Step 1 Click the menu icon (☰) and choose **Provision** > **Site to Site VPN**.

Step 2 Check the check box next to the VPN that you want to edit.

Step 3 Click **Edit** in the menu bar above the list.

The **Summary** screen appears.

Step 4 Review the VPN settings and click **Edit** in any section if you want to make a change.

Step 5 Click **Edit VPN** to submit the changes.

In the status screen that follows, a check mark is shown next to each step as it is completed. Click **Services** to return to the **Site to Site VPN** screen.

Delete a Site-to-Site VPN

Step 1 Click the menu icon (☰) and choose **Provision** > **Site to Site VPN**.

Step 2 Check the check box next to the VPN that you want to delete.

Step 3 Click **Delete** in the menu bar above the list.

A confirmation dialog box is displayed.

Step 4 Click **Yes** to confirm that you want to delete the VPN.

Create a User-Defined Network Service

The following sections provide information about configuring and viewing the Cisco User-Defined Network Service site provisioning status from the **Provision** > **Services** window in Cisco DNA Center.

Create the User-Defined Network Service

This procedure shows how to configure the Cisco User-Defined Network service from **Provision** > **Services** > **Cisco User Defined Network**. Alternatively, you can create a User-Defined Network service from **Workflows** > **Configure Cisco User Defined Network**.

Before you begin

- Define sites within the network hierarchy.
- Use the Cisco DNA Center Cloud application to generate an authentication token.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **Cisco User Defined Network**.

Step 2 Click **Add Sites**.

The **OK, now let's complete the connection with the cloud service** workflow appears.

Step 3 In the **Authentication Token** text box, paste the authentication token that you generated and copied in **Cisco DNA Center Cloud**, and click **Connect**.

If the token validates successfully, the message `Connection validated, click Next to proceed` appears.

If the token validation fails, click **Retry**, re-enter the authentication token, and click **Connect**.

Step 4 Click **Next** to select the sites where you want to enable the Cisco User-Defined Network service.

Step 5 From the **Select Sites** drop-down list, choose the sites.

Step 6 Check the **Disable User Defined Network Service** check box to disable the User-Defined Network service for all sites.

Step 7 Click **Next** to select the SSIDs for the sites you selected.

The provisioned nonfabric SSIDs are displayed for all the sites selected in the previous step.

Step 8 From the **SSID(s)** drop-down list, choose the SSIDs.

Step 9 To limit the unicast traffic for the selected SSID, turn the **Unicast Traffic Containment** button on.

Step 10 Do one of the following, and then click **Next**:

- Click **Apply Individually** to apply the unicast traffic containment for a specific site.
- Click **Apply to all** to apply to the unicast traffic containment for all sites.

Step 11 Select whether you want to provision the Cisco User-Defined Network service on your network now or schedule it for a later time.

- To provision the service on your network now, click the **Now** radio button and click **Next**.
- To schedule the service on your network for a later time, click the **Later** radio button, define the date and time, and click **Next**.

The **Configuration Summary** screen appears.

Step 12 Review the settings and click **Edit** in any section if you want to make a change.

Step 13 Click **Configure**.

In the screen that follows, a check mark is shown next to each step as it is completed.

Step 14 Click **View Provisioning Status**.

For more information, see View the User-Defined Network Service Provisioning Status, on page 510.

View the User-Defined Network Service Provisioning Status

This procedure shows you how to view the Cisco User-Defined Network service provisioning status from the **Provision** > **All Services** window. You can also click the **View Provisioning Status** button in the **Configure Cisco User Defined Network** screen after configuring a Cisco User-Defined Network successfully.

Before you begin

Configure and provision the Cisco User-Defined Network service from the **Workflows** > **Configure Cisco User Defined Network** window.

Step 1 Click the menu icon (≡) and choose **Provision** > **All Services** > **Cisco User Defined Network**.

The **Site Provisioning Status** window displays the site name, device name, number of SSIDs used, and status of site provisioning.

Step 2 Click **Refresh** to see the latest provisioning status.

Step 3 Click the site name to view additional details for the provisioned device, such as SSID name, User-Defined Network (UDN) status, and Unicast Traffic Containment.

Step 4 Click **Activities** to track the scheduled task status in the **Scheduled Tasks** window.

Enable Telemetry on Switches

You can configure Switch Port Analyzer (SPAN) and Encapsulated Remote Switch Port Analyzer (ERSPAN) sessions on switches to share IP traffic for application assurance and endpoint analytics.

Before you begin

Confirm that the switches and the Traffic Telemetry Appliance (TTA) are reachable and managed through Cisco DNA Center. The switches must be assigned to a site and the **Distribution** device role.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **Service Catalog** > **Telemetry Appliance Setup**.

Step 2 Click **+ Setup** to create a new workflow.

Step 3 In the **Get Started** window, enter a workflow name and a description.

Step 4 Click **Next**.

Step 5 In the **Choose Source Endpoint** window, choose a device to source traffic to a telemetry appliance.

Note Switches and hubs are the supported source devices for your workflow that is managed with the Distribution role.

Step 6 Click **Next**.

Step 7 In the **Choose Destination Endpoint** window, choose the TTA device as the destination endpoint.

Note You can choose only one TTA device from the list.

Step 8 Click **Next**.

Step 9 In the **Choose Type for Configuration** window, choose **SPAN** or **ERSPAN**.

Step 10 Click **Next**.

Step 11 In the **Choose Mapping Between Source and Destination** window, do the following:

For SPAN:

a. Choose the source interface on which to monitor incoming traffic.

b. Choose the destination interface on the switch where the traffic telemetry appliance is connected and traffic can be forwarded.

c. Choose the receiver interface to process the incoming traffic for analytics.

d. Click **Next**.

For ERSPAN:

a. Choose the source interface on to monitor which incoming traffic.

b. Enter the VLAN to filter the incoming traffic.

c. Choose the receiver interface to process the incoming traffic for analytics.

d. Enter the destination IP address for the receiver interface.

e. Enter the destination netmask for the receiver interface.

f. Click **Next**.

Step 12 In the **Scheduler** window, click **Now** to start the configuration immediately, or click **Later** to schedule the configuration at a specific time later.

Step 13 In the **Summary** window, review the configuration settings and click **Deploy**.

Step 14 Click **View Status** to view the provisioning status of the individual devices.

Configure Cisco Umbrella

The following sections provide information about integrating Cisco Umbrella with Cisco DNA Center.

About Cisco Umbrella

The DNS-layer security in Cisco Umbrella provides the fastest and easiest way to improve your network security. It helps improve security visibility, detect compromised systems, and protect your users on and off the network by stopping threats over any port or protocol before they reach your network or endpoints.

Cisco DNA Center supports Cisco Umbrella configuration on the following devices:

- Cisco Catalyst 9800 Series Wireless Controllers with Cisco IOS-XE software version 16.12 or later
- Cisco Catalyst 9100 Series APs
- Cisco Catalyst 9200 Access Switch with Cisco IOS-XE software version 17.3.1 or later
- Cisco Catalyst 9300 Access Switch with Cisco IOS-XE software version 17.3.1 or later

Role-Based Access Control Settings for Cisco Umbrella

To configure Cisco Umbrella with Cisco DNA Center and to provision Cisco Umbrella on network devices, you must create a user role with the necessary RBAC permission for Cisco Umbrella. For more information, see "Manage Users" in the Cisco DNA Center Administrator Guide.

Table 46: RBAC Permission Matrix for Cisco Umbrella

Function	Access	Permission
Configure Cisco Umbrella with Cisco DNA Center	Network Design > Advanced Network Settings	Write
Add Umbrella dashlet in System 360	Network Design > Advanced Network Settings	Write
Provision Cisco Umbrella on network devices	Network Provision > Provision	Write
	Network Design > Network Hierarchy	Read
	Network Provision > Inventory Management	Read
	System	Read
	Network Provision > Scheduler	Write
	Network Services > Umbrella	Write

Configure Cisco Umbrella with Cisco DNA Center

Before you begin

- Create a Cisco Umbrella account.
- Log in to *login.umbrella.com* and create the necessary keys, such as the API key, legacy token, management key, and secret.
- Note down the organization ID from the Cisco Umbrella login URL.
- Create the local bypass domains in Cisco Umbrella.
- If Cisco DNA Center has a proxy server configured as an intermediary between itself and the network devices it manages or the Cisco cloud from which it downloads software updates, you must configure access to the proxy server. For more information, see the Configure the Proxy section in the Cisco DNA Center Administrator Guide.
- Install the Cisco Umbrella package in Cisco DNA Center. See the Download and Install Packages and Updates section in the Cisco DNA Center Administrator Guide.
- Create a user role with necessary RBAC permission for Cisco Umbrella. See Role-Based Access Control Settings for Cisco Umbrella, on page 512.

Note You cannot install Cisco Umbrella package on a Cisco DNA Center cluster configured with IPv6.

Step 1 Click the menu icon (≡) and choose **System** > **Settings** > **External Services** > **Umbrella**.

Step 2 Enter the following details that you retrieved manually from Cisco Umbrella:

- **Organization ID**
- **Network Device Registration API Key**
- **Network Device Registration Secret**
- **Management API Key**
- **Management Secret**
- **Legacy Device Registration Token**

Step 3 Click **Save**.

Add the Umbrella Dashlet

You can add the **Umbrella** dashlet in the **System 360** page. The **Umbrella** dashlet shows the configuration status of Cisco Umbrella with Cisco DNA Center.

Before you begin

You must install the Cisco Umbrella package.

Step 1 Click the menu icon (≡) and choose **System** > **System 360**.

Step 2 From the **Actions** menu, choose **Edit Dashboard** and click **Add Dashlet**.

Step 3 Choose **Umbrella Dashlet** and click **Add**.

The **Umbrella** dashlet appears under **Externally Connected Systems** in the **System 360** page. The **Umbrella** dashlet shows the status as **Available** and displays the organization ID, if Cisco Umbrella is configured with Cisco DNA Center.

If Cisco Umbrella is not configured with Cisco DNA Center, you can click the **Configure** link and complete the fields in **System** > **Settings** > **External Services** > **Umbrella**. See Configure Cisco Umbrella with Cisco DNA Center, on page 513.

If the keys are changed in Cisco Umbrella, you can click the **Update** link and update the keys in **System** > **Settings** > **External Services** > **Umbrella**. See Configure Cisco Umbrella with Cisco DNA Center, on page 513.

View the Umbrella Service Statistics Dashboard

Click the menu icon (≡) and choose **Provision** > **Services** > **Umbrella** to view the **Umbrella Service Stats** dashboard.

The dashboard displays the following dashlets:

- **Total Umbrella DNS Queries**: Shows the number of blocked DNS queries and allowed DNS queries for the selected site.
- **Blocked Umbrella DNS Queries**: Shows the number of DNS queries blocked by security policy and content policy for the selected site.

By default, the dashlet shows statistics for the last 3 hours. You can view statistics for the last 24 hours or 7 days by choosing the required time from the drop-down list in the top-left corner of the **Umbrella Service Stats** page.

Prerequisites for Provisioning Cisco Umbrella on Network Devices

Before provisioning Cisco Umbrella on network devices, ensure that:

- Cisco Umbrella is configured with Cisco DNA Center.
- Wireless provisioning is complete for the devices on which you want to provision Cisco Umbrella.
- The SSID configuration is nonfabric.
- The AP is provisioned, if the device is configured with a nonfabric SSID in FlexConnect mode.
- The device has direct internet access to establish connection with Cisco Umbrella.
- The Cisco Umbrella root certificate is available in the Cisco DNA Center trustpool. See Configure Trustpool in the Cisco DNA Center Administrator Guide.

- If the device has a Cisco Umbrella configuration that is not set from Cisco DNA Center, remove the Cisco Umbrella configuration from the device and resync the device with Cisco DNA Center.

Provision Cisco Umbrella on Network Devices

Step 1 Click the menu icon (≡) and choose **Workflows** > **Umbrella Deployment**.

Alternatively, do the following:

- Click the menu icon (≡) and choose **Provision** > **Services** > **Umbrella**.
- Choose a site from the network hierarchy for which you want to deploy Cisco Umbrella.
- The **Select Devices** window appears. Go to Step 4 to continue the deployment workflow.

Step 2 Click **Let's Start**.

To skip this screen in the future, check **Don't show this to me again**.

The **Choose Site** window appears. You can view the device readiness status in each site, as follows:

- **Eligible Devices**: Devices that are eligible for Cisco Umbrella configuration. See Prerequisites for Provisioning Cisco Umbrella on Network Devices, on page 514.
- **Enabled Devices**: Devices that are already configured from Cisco DNA Center.

Step 3 Choose a site to deploy and click **Next**.

You can choose only one site at a time. If you choose a parent site, Cisco Umbrella can be deployed on all child sites at the same time.

Step 4 In the **Select Device Type** window, choose **Switches** or **Wireless Controllers** and click **Next**.

Step 5 If you have chosen **Switches** in the **Select Device Type** window, do the following:

a) In the **Select Devices** window, choose the wired device and click **Next**.

b) In the **Configure Interface** window, do the following:

1. Choose the ports you want to configure and click **Define Umbrella Interfaces**.
2. In the **Select Configuration** dialog box, click the **Define Umbrella Interfaces** drop-down list and choose **IN(LAN)**, **OUT(WAN)** or **Disable Umbrella**.
3. Click **Save**.

Note You must choose at lease one **IN** and one **OUT** interface to proceed further.

c) In the **Define Umbrella Policy Mapping (Wired)** window, choose Umbrella policies at a global or interface level and click **Next**.

d) In the **Configure Policies for Your Devices** window, choose the **IN(LAN)** interface and click **Define Umbrella Policies**.

e) In the **Select Policy** dialog box, choose the policy for the selected interfaces and click **Save**.

Step 6 If you have chosen **Wireless Controllers** in the **Select Device Type** window, do the following:

a) In the **Select Devices** window, choose the wireless device and click **Next**.

b) Choose the SSIDs and select the required Cisco Umbrella policy for each SSID.

Note
- Only nonfabric SSIDs are listed on this page.
- If you choose an SSID and don't select the Cisco Umbrella policy, the default policy is mapped with the SSID.
- If you choose multiple policies, the order of enforcement of policies is defined in the Cisco Umbrella cloud portal.

c) Click **Next** and in the **Umbrella Policy Association (Wireless)** window, view the default policies applied to the SSIDs.

If you want to change the policies associated with the SSIDs, click the **Cisco Umbrella** link. In the Cisco Umbrella console, you can see the network identity after you have completed the deployment of Cisco Umbrella from Cisco DNA Center. For devices with Cisco IOS-XE software version 16.xx, the network identity is shown as global. For devices with a Cisco IOS-XE software version later than 16.xx, the network identity is shown as a custom name created based on the site and SSID name.

d) Click **Next**.

Step 7 In the **Review Internal Domains** window, add or delete the list of internal domains. The DNS queries that match a domain in the **Internal Domain** list are forwarded to the local DNS server instead of Cisco Umbrella.

Step 8 Click **Next**.

The **DNS Crypt** window appears. The **Enable DNS Packet Encryption** option is selected by default.

Step 9 In the **DNS Crypt** window, click **Next**.

If you don't want DNS packet encryption, uncheck the **Enable DNS Packet Encryption** check box and click **Next**.

Step 10 Review the details in the **Summary** window and click **Edit** if you want to make any changes.

Step 11 Click **Deploy**.

The **Schedule** window appears with **Now** and **Later** options.

Step 12 In the **Schedule** window, do one of the following:

- To deploy the configuration immediately, click the **Now** radio button and click **Apply**.
- To deploy the configuration at a later time, click the **Later** radio button, enter the **Task Name**, define the **Start Date and Time**, and click **Apply**.

Step 13 In the **Deployment** window, click **View Status** to view the deployment status in the **Scheduled Tasks** page.

You can view the Cisco Umbrella deployment status of the device and the device configuration status in Cisco Umbrella. You can also view the Cisco Umbrella deployment logs in the **Audit Logs** page.

Note Cisco umbrella deployment on your organization's network can be monitored only from *login.umbrella.com*.

Disable Cisco Umbrella on Network Devices

Step 1 Click the menu icon (≡) and choose **Workflows** > **Umbrella Deployment**.

Alternately, do the following:

- Click the menu icon (≡) and choose **Provision** > **Services** > **Umbrella**.
- Choose a site from the network hierarchy from which you want to disable Cisco Umbrella.
- The **Select Devices** window appears. Go to Step 4 to continue the disable workflow.

Step 2 Click **Let's Start**.

To skip this screen in the future, check **Don't show this to me again**.

The **Choose Site** window appears. You can view the device readiness status in each site, as follows:

- **Ready Devices**: Devices that meet the prerequisites for Cisco Umbrella configuration. See Prerequisites for Provisioning Cisco Umbrella on Network Devices, on page 514.
- **Not Ready Devices**: Devices that do not meet the prerequisites.
- **Enabled Devices**: Devices that are already configured from Cisco DNA Center.

Step 3 Choose the site that you want to disable, and click **Next**.

You can choose only one site at a time. If you choose a parent site, Cisco Umbrella is disabled on all the child sites at the same time.

Step 4 In the **Select Device Type** window, choose **Switches** or **Wireless Controllers** and click **Next**.

Step 5 In the **Select Devices** window, click the **Enabled** tab and choose the devices.

Step 6 Click the **Disable** radio button and choose the devices.

Step 7 Click **Next**.

Step 8 In the **Summary** window, click **Deploy**.

Step 9 In the **Schedule** window, do one of the following:

- To disable the configuration immediately, click the **Now** radio button and click **Apply**.
- To disable the configuration at a later time, click the **Later** radio button, enter the **Task Name**, define the **Start Date and Time**, and click **Apply**.

Step 10 In the Deployment window, click **View Status** to view the deployment status in the **Scheduled Tasks** page.

You can view the Cisco Umbrella deployment logs in the **Audit Logs** page.

Update the Cisco Umbrella Configuration on Network Devices

Step 1 Click the menu icon (≡) and choose **Workflows** > **Umbrella Deployment**.

Alternately, do the following:

- Click the menu icon (≡) and choose **Provision** > **Services** > **Umbrella**.
- Choose a site from the network hierarchy for which you want to update the Cisco Umbrella configuration.
- The **Select Devices** window appears. Go to Step 4 to continue the update workflow.

Step 2 Click **Let's Start**.

To skip this screen in the future, check **Don't show this to me again**.

The **Choose Site** window appears. You can view the device readiness status in each site, as follows:

- **Ready Devices**: Devices that meet the prerequisites for Cisco Umbrella configuration. See Prerequisites for Provisioning Cisco Umbrella on Network Devices, on page 514.
- **Not Ready Devices**: Devices that do not meet the prerequisites.
- **Enabled Devices**: Devices that are already configured from Cisco DNA Center.

Step 3 Choose the site that you want to update and click **Next**.

You can choose only one site at a time. If you choose a parent site, Cisco Umbrella is updated on all child sites at the same time.

Step 4 In the **Select Device Type** window, choose **Switches** or **Wireless Controllers** and click **Next**.

Step 5 If you have chosen **Switches** in the **Select Device Type** window, do the following:

a) In the **Select Devices** window, choose the wired device and click the **Update** radio button.
b) Click **Next**.
c) In the **Configure Interface** window, do the following:

   1. Choose the ports and click **Define Umbrella Interfaces**.
   2. In the **Select Configuration** dialog box, click the **Define Umbrella Interfaces** drop-down list and choose **IN(LAN)**, **OUT(WAN)** or **Disable Umbrella**.
   3. Click **Save**.

   Note You must choose at lease one **IN** and one **OUT** interface to proceed further.

d) In the **Define Umbrella Policy Mapping (Wired)** window, choose Umbrella policies at a global or interface level and click **Next**.
e) In the **Configure Policies for Your Devices** window, choose the **IN(LAN)** interface and click **Define Umbrella Policies**.
f) In the **Select Policy** dialog box, choose the policy for the selected interfaces and click **Save**.

Step 6 If you have chosen **Wireless Controllers** in the **Select Device Type** window, do the following:

a) In the **Select Devices** window, choose the wireless device and click the **Update** radio button.
b) Click **Next**.
c) In the **Define Umbrella Policy Map (Wireless)** window, choose the SSIDs and select the desired Cisco Umbrella policies to map, or unselect SSIDs to disable Cisco Umbrella.

Step 7 In the **Review Internal Domains** window, add or delete the list of internal domains. The DNS queries that match a domain in the **Internal Domain** list are forwarded to the local DNS server instead of Cisco Umbrella.

Step 8 Click **Next**.

The DNS Crypt window appears. The **Enable DNS Packet Encryption** option is selected by default.

Step 9 In the DNS Crypt window, click **Next**.

If you don't want DNS packet encryption, uncheck the **Enable DNS Packet Encryption** check box and click **Next**.

Step 10 In the **Summary** window, click **Deploy**.

Step 11 In the **Schedule** window, do one of the following:

- To update the configuration immediately, click the **Now** radio button and click **Apply**.
- To update the configuration at a later time, click the **Later** radio button, enter the **Task Name**, define the **Start Date and Time**, and click **Apply**.

Step 12 In the Deployment window, click **View Status** to view the deployment status in the **Scheduled Tasks** page.

You can view the Cisco Umbrella deployment logs in the **Audit Logs** page.

PART VI

Configure Policies

- Configure Group-Based Access Control Policies and Analytics, on page 523
- Configure IP-Based Access Control Policies, on page 549
- Configure Application Policies, on page 557
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CHAPTER 23

Configure Group-Based Access Control Policies and Analytics

- Group-Based Access Control, on page 523
- Cisco Group-Based Policy Analytics, on page 534

Group-Based Access Control

Cisco DNA Center implements Software-Defined Access in two ways:

- Virtual networks (VNs) provide macro-level segmentation, such as to separate IoT devices from the corporate network.
- Group-based policies provide micro-level segmentation, such as to control what types of network traffic to permit or deny between engineering and HR groups.

Group-Based Access Control policies provide the following benefits:

- Rich identity-based access control functionality with network automation and assurance benefits.
- Granular access control.
- Scalable groups apply to all virtual networks, which simplifies policy management.
- Policy views help you to understand the overall policy structure, and create or update required access control policies.
- Eliminates the need to switch between different applications to manage scalable groups and define protected assets.
- Provides enhanced features for deploying enterprise-wide access control policies.
- Restricts lateral movement of threats like ransom ware before you have identity or Network Admission Control (NAC) applications in place.
- Provides an easy migration path to Cisco Identity Services Engine (Cisco ISE) for users who are using third-party identity applications, but want to move to Cisco ISE.

For information about creating IP pools, sites, and virtual networks in Cisco DNA Center, see the Cisco DNA Center User Guide.

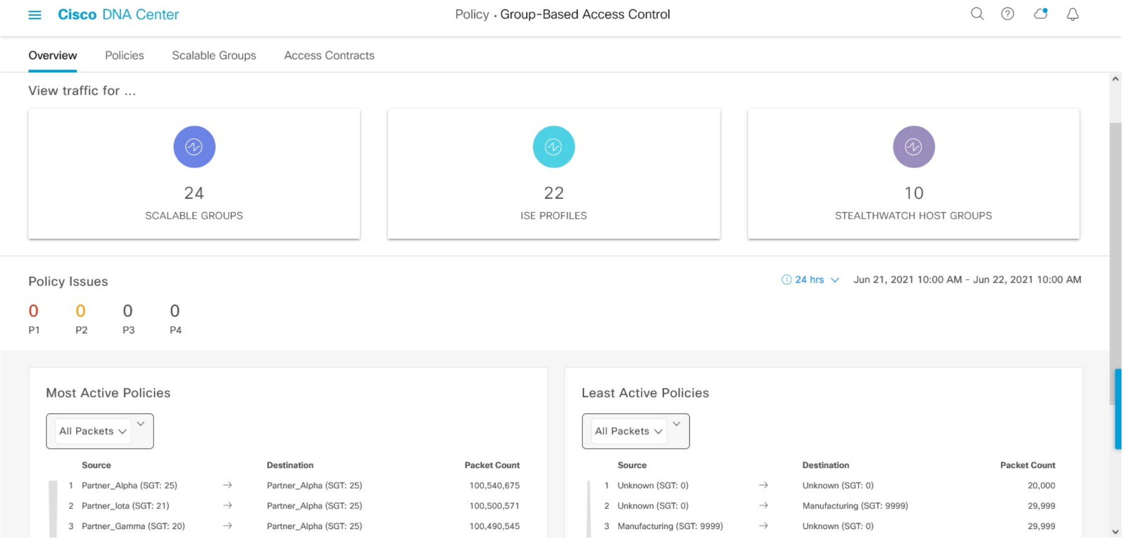
For information about configuring Cisco DNA Center for Cisco ISE, see the Cisco DNA Center Installation Guide.

For information about configuring Cisco ISE for Cisco DNA Center, see the Cisco Identity Services Engine Administrator Guide.

Group-Based Access Control Policy Dashboard

The Group-Based Access Control Policy dashboard provides you with a summary of network activity, policy-related issues, and traffic trends. Click the menu icon (☰) and choose **Policy** > **Group-Based Access Control** > **Overview** to view this dashboard.

Figure 41: Group-Based Access Control Policy Dashboard


Cisco DNA Center
Policy · Group-Based Access Control
Overview
Policies
Scalable Groups
Access Contracts
View traffic for ...
24
SCALABLE GROUPS
22
ISE PROFILES
10
STEALTHWATCH HOST GROUPS
Policy Issues
24 hrs
Jun 21, 2021 10:00 AM - Jun 22, 2021 10:00 AM
0
P1
0
P2
0
P3
0
P4
Most Active Policies
All Packets
Least Active Policies
All Packets

Most Active Policies

	Source		Destination	Packet Count
1	Partner_Alpha (SGT: 25)	→	Partner_Alpha (SGT: 25)	100,540,675
2	Partner_Iota (SGT: 21)	→	Partner_Alpha (SGT: 25)	100,500,571
3	Partner_Gamma (SGT: 20)	→	Partner_Alpha (SGT: 25)	100,490,545

Least Active Policies

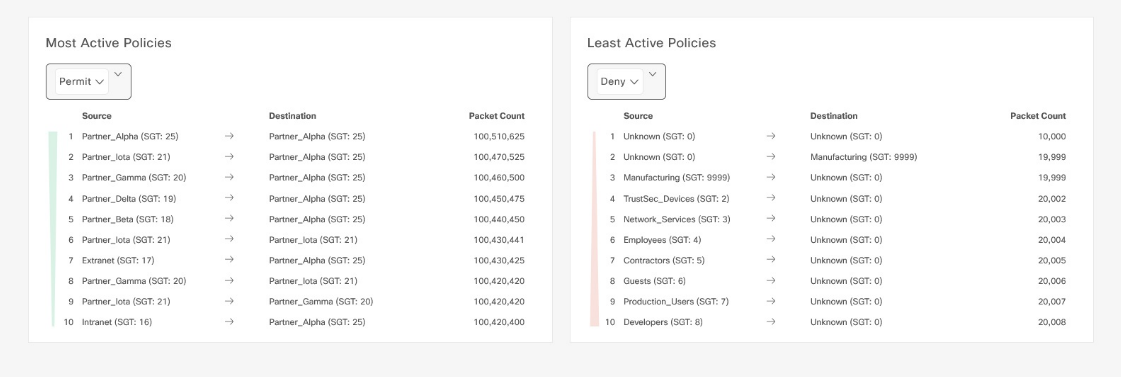
	Source		Destination	Packet Count
1	Unknown (SGT: 0)	→	Unknown (SGT: 0)	20,000
2	Unknown (SGT: 0)	→	Manufacturing (SGT: 9999)	29,999
3	Manufacturing (SGT: 9999)	→	Unknown (SGT: 0)	29,999

You can view the following details in this dashboard:

- **View Traffic**: You can view the traffic for scalable groups, Cisco ISE profiles, and stealthwatch host groups. You must install the Group-Based Policy Analytics package to view this data. Group-Based Policy Analytics provides you with insights to create group-based policies by visualizing communications between assets in order to assess the impact of introducing new access controls, and understand exactly which protocols you need to allow in the policies. Cisco Group-Based Policy Analytics aggregates information on groups of assets on your network, and their communication. For more information, see Cisco Group-Based Policy Analytics, on page 534.
- **View Policy-Related Issues**: It displays a count of policy-related issues. Click a counter to view the details. It opens the **Assurance Issues** dashboard in a new browser tab, where you can view the details.

  Note that this view of policy-related issues is for the currently selected time period. Use the time selector to adjust the time window, as needed.
- **View Most Active and Least Active Policies**: It provides the details about the most active and least active policies. By default, this view is based on the count of total number of packets seen in the network for each policy (for each source-to-destination group pairing). You can use the drop-down list to select only the permitted packets or dropped packets. You can use the dropped packets option to see which policies are enforcing policy-based drops most actively.

Figure 42: Most and Least Active Policy Dashlets



Most Active Policies

Permit

	Source		Destination	Packet Count
1	Partner_Alpha (SGT: 25)	→	Partner_Alpha (SGT: 25)	100,510,625
2	Partner_Iota (SGT: 21)	→	Partner_Alpha (SGT: 25)	100,470,525
3	Partner_Gamma (SGT: 20)	→	Partner_Alpha (SGT: 25)	100,460,500
4	Partner_Delta (SGT: 19)	→	Partner_Alpha (SGT: 25)	100,450,475
5	Partner_Beta (SGT: 18)	→	Partner_Alpha (SGT: 25)	100,440,450
6	Partner_Iota (SGT: 21)	→	Partner_Iota (SGT: 21)	100,430,441
7	Extranet (SGT: 17)	→	Partner_Alpha (SGT: 25)	100,430,425
8	Partner_Gamma (SGT: 20)	→	Partner_Iota (SGT: 21)	100,420,420
9	Partner_Iota (SGT: 21)	→	Partner_Gamma (SGT: 20)	100,420,420
10	Intranet (SGT: 16)	→	Partner_Alpha (SGT: 25)	100,420,400

Least Active Policies

Deny

	Source		Destination	Packet Count
1	Unknown (SGT: 0)	→	Unknown (SGT: 0)	10,000
2	Unknown (SGT: 0)	→	Manufacturing (SGT: 9999)	19,999
3	Manufacturing (SGT: 9999)	→	Unknown (SGT: 0)	19,999
4	TrustSec_Devices (SGT: 2)	→	Unknown (SGT: 0)	20,002
5	Network_Services (SGT: 3)	→	Unknown (SGT: 0)	20,003
6	Employees (SGT: 4)	→	Unknown (SGT: 0)	20,004
7	Contractors (SGT: 5)	→	Unknown (SGT: 0)	20,005
8	Guests (SGT: 6)	→	Unknown (SGT: 0)	20,006
9	Production_Users (SGT: 7)	→	Unknown (SGT: 0)	20,007
10	Developers (SGT: 8)	→	Unknown (SGT: 0)	20,008

Note that this view of policy activity is for the currently selected time period. Use the time selector to adjust the time window, as needed.

Group-Based Access Control Policies

The access control policies define which network traffic can pass from a source security group to a destination security group.

- **Security Group**: A classification category, to which you can assign users, network devices, or resources. Security groups are used in access control policies. You can associate security groups with virtual networks based on your organization's network configuration, access requirements, and restrictions.
- **Contract**: An access contract is a set of rules that controls the type of network traffic that is allowed to pass between the source and destination security groups. In other words, a contract is a traffic filter definition. Access contracts define the actions (permit or deny) performed when the traffic matches a network application, protocol, and port. The default action is to use the Catch All rule when no other rules match.
- **Group-Based Access Control Policies**: A group-based access control policy identifies a specific source and destination group pair and associates an access contract. The access contract specifies what types of traffic are permitted or denied between the source group and the destination group. These policies are unidirectional.

  Security groups and access contracts are the basic building blocks of access control policy. While creating the access control policy, you can use the security groups and contracts that you have created before or create new security groups and contracts while creating the policy. If you want to specify the network resources that can be accessed from a specific source group, you can create an access control policy with a single source and multiple destination groups. On the other hand, if you want to specify the source groups that are permitted to access a particular network resource, you can create an access control policy with a single destination and multiple source groups. For example, if you want to specify the network resources that can be accessed by the users associated with the "contractors" source security group, you can create an access control policy with a single source and multiple destination groups. If you want to specify the source groups that are permitted to access the "Finance Servers" destination security group, you can create an access control policy with single destination and multiple source groups.

  You can specify the default policy to use when no contract is specified for a source and destination security group combination. The default policy is **Permit**. You can change this policy to **Deny**,

Permit_IP_Log, or **Deny_IP_Log**, if necessary. You can set the default policy based on your network type, an open or closed network.

Note We recommend that you change the default policy from **Permit** to **Deny** only if you have created explicit policies to permit necessary network traffic for all your network infrastructure devices. Failure to do so can result in loss of network connectivity.

List View

Click the **List** icon at the top right of the **Group-Based Access Control** window to launch the **List** view.

- **Source View**: Displays a list of existing policies organized based on the source groups. You can expand each row to view the specific source-destination policy details.
- **Destination View**: Displays a list of existing policies organized based on the destination groups. You can expand each row to view the specific source-destination policy details.

To see which destination groups are available from a specific source group, use the **Source** view. To see which source groups are permitted to access a particular destination group, use the **Destination** view. For example, to see which destination groups are available to users who are part of the "Contractors" source security group, use the **Source** view. To see which source groups can access the "Finance servers" destination security group, use the **Destination** view.

You can also view the policy enforcement statistics data in the policies listing table. The total number of policy permits and denies are displayed for the selected time period.

The policy enforcement statistics are collected from the network devices that are provisioned for group-based policy and telemetry data language (TDL) subscription. These configurations are normally provisioned automatically for network devices that are part of a fabric. Manual configuration can be done for nonfabric network devices.

Note the following points while using the policy enforcement statistics data:

- Policy enforcement statistics data is available only when Group-Based Policy Analytics package is deployed.
- Telemetry subscription is added as part of base provisioning for both fabric and nonfabric network devices. TrustSec enforcement command is pushed when a new network device is added to Cisco DNA Center and assigned to a site.
- Software-Defined Access (SD-Access) adds TrustSec enforcement for the network devices that are added to a fabric. TrustSec telemetry data is collected only when this enforcement is enabled on a network device. If it is not enabled, the telemetry subscriptions used for policy monitoring are used to collect the TDL data for TrustSec.
- Cisco IOS XE 16.12 and later supports TDL streaming data.
- NETCONF must be enabled on the network devices.
- The following configuration must be added manually for the nonfabric network devices:

```
cts role-based enforcement vlan-list <VLAN of the endpoints>
```

- After upgrading, you might see the following message in the **Provision > Network Devices > Inventory** window:

  ```
  We detected IOS-XE devices in your network where new telemetry subscription for assurance
  data needs to be enabled and some of the existing subscription needs to be optimized
  for performance. Please note that you will have to enable netconf and configure the
  netconf port in the Inventory credentials for these devices. Also note that these devices
  will receive a new subscription for group based policy monitoring telemetry. Do you
  want to take an action to provision these subscriptions?
  ```

  Click **Apply Fix** to push the configuration to all network devices with site assigned.

Click **Deploy** to deploy the updated policies to the network devices. When you click **Deploy**, Cisco DNA Center requests Cisco ISE to send notifications about the policy changes to the network devices.

Matrix View

Click the **Grid** icon at the top right of the **Group-Based Access Control** window to launch the Matrix view. The Matrix view is a core policy view, which provides an overview of all policies for all security groups (whether explicit or default). You can use the Matrix view to view all source and destination policies and understand the overall policy structure. You can view, create, and update access control policies from the Matrix view.

The Matrix view contains two axes:

- Source Axis: The vertical axis lists all the source security groups.
- Destination Axis: The horizontal axis lists all the destination security groups.

Place the cursor on a cell to view the policy for a given source security group and a destination security group. The color of a cell is based on the policy that applies to that cell. The following colors indicate which policies are applied to each cell:

- **Permit**: Green
- **Deny**: Red
- **Custom**: Gold
- **Default**: Gray

Place the cursor on the **Permit**, **Deny**, **Custom**, or **Default** icon that is displayed at the top of the matrix to view the cells to which that policy is applied.

Click a cell to open the **Create Policy** or **Edit Policy** slide-in pane that allows you to create or edit the policies for the selected cell. The **Create Policy** slide-in pane shows the source and destination security groups as read-only fields. You can update the policy status and access contract.

You can create custom views of the policy matrix to focus only on the policies that you are interested. To do this, click the **View** drop-down list and choose **Create View**. While creating the custom view, you can specify the subset of security groups that you want to include in the custom view. You can save the custom views and edit them later, if required. Click the **View** drop-down list and choose **Manage Views** to create, edit, duplicate, or delete the custom views. The **Default View** shows all the source and destination security groups.

You can navigate through the matrix by dragging the matrix content area with the cursor or by using horizontal and vertical scroll bars. You can also use the mini-map to navigate through the matrix. The mini-map helps you to easily navigate through the matrix when the matrix size is large and it extends beyond the screen size.

You can move and place the mini-map anywhere on your screen. The mini-map provides the whole matrix view. The light gray portion in the mini-map represents the portion of the matrix that is currently displayed on your screen. You can drag that area to scroll through the matrix.

Note The mini-map is closed by default. Click the **Expand** icon to expand and view the mini-map.

The Matrix view highlights the cell and the corresponding row (source security group) and column (destination security group) when a cell is selected. The coordinates (source and destination security groups) of the selected cell are displayed near the matrix content area.

Click **Deploy** to deploy the updated policies on the network devices. When you click **Deploy**, Cisco DNA Center requests Cisco ISE to send notifications about the policy changes to the network devices.

You can use the **Filter** option to view a subset of the policy matrix, for a selected set of source and destination groups. You can create a filter to focus only on the policies that you are interested. To create the filter, select the source and destination groups that you want to include.

Cisco DNA Center integrates with Cisco ISE. Cisco ISE provides the runtime policy platform for providing policy download to the network devices on behalf of Cisco DNA Center. The TrustSec Workcenter user interface screens for Security Groups, Security Group Access Control Lists (SGACLs), and Egress Policy are displayed in Read-Only mode in Cisco ISE to prevent policy synchronization issues.

Policy Creation Overview

1. Define categorizations for your organization, or the portion of your organization that you plan to start with.
2. Create scalable groups for the categorizations that you identified.
3. Create access contracts for the types of network traffic you wish to control. There are predefined sample access contracts to Permit or Deny all traffic, and also some example contracts showing more specific traffic filtering. You can create additional, more granular access contracts based on specific application definitions.
4. Decide which categories of network users require access to particular network resources, such as application servers and connections to other networks.
5. Create access policies, associate a source group, a destination group, and an access contract, to define how traffic is allowed to flow from the source to the destination.

Create Scalable Groups

Before you begin

To perform the following task, you must be a Super Admin or Network Admin.

Step 1 Click the menu icon (≡) and choose **Policy** > **Group-Based Access Control** > **Scalable Groups**.

Step 2 Click **Create Scalable Group**.
The **Create Scalable Group** slide-in pane appears.

Step 3 In the **Create Scalable Group** slide-in pane, enter a name and description (optional) for the scalable group.

Note The following characters are supported for the **Name** field:

- alphanumeric characters
- underscore (_)

The scalable group name must start with an alphabetic character.

Cisco DNA Center generates the tag value. You can update this value, if necessary. An error message is displayed if the value that you specify is already used by an existing scalable group. The valid range is from 2 to 65519.

Step 4 Choose the **Virtual Networks** to be associated with this scalable group from the drop-down list. By default, the default virtual network (`DEFAULT_VN`) is selected.

Step 5 Check the **Propagate to ACI** check box if you want the scalable group to be propagated to Cisco Application Centric Infrastructure (ACI).

Step 6 Click **Save**.

The **Scalable Groups** window displays the scalable group name, tag value, assigned virtual networks, and associated policies. You can also view the sample scalable groups in this window. You can use or delete those scalable groups.

You can edit or delete the scalable groups from the **Scalable Groups** window. Click the **Scalable Group Name** link to view the details of a scalable group. Click **Edit** in the **View Scalable Group** window to update the scalable group details. When you click **Deploy**, Cisco DNA Center requests Cisco ISE to send notifications about the changes to the network devices.

Click the link in the **Policies** column of a scalable group to view the access control rules that use that scalable group and the policy to which it belongs. You cannot delete a scalable group if it is used in any access policy.

An orange triangle icon is displayed next to a scalable group if synchronization with Cisco ISE is not completed.

Cisco ISE supports packets coming from ACI to the TrustSec domain by synchronizing the Internal Endpoint Groups (IEPGs) and creating correlating read-only scalable groups in Cisco ISE. These scalable groups are displayed in the **Scalable Groups** window with the value `ACI` in the **Created In** column. You cannot edit or delete the scalable groups that are learned from ACI, but you can use them in the policies.

The **Associated Contracts** column shows the associated ACI-learned contracts for the scalable groups that are learned from ACI. Click the link displayed in the **Associated Contracts** column to view the details about the associated contracts.

When an IEPG is updated in ACI, the corresponding scalable group configuration is updated in Cisco ISE. A new EEPG is created in ACI, when a scalable group is created in Cisco ISE.

Note You cannot create a scalable group with the name "ANY" or tag value 0xFFFF/65535. Scalable Group ANY/65535 is a reserved internal scalable group that is used for the Cisco DNA Center default policy.

While synchronizing the scalable groups in Cisco DNA Center with Cisco ISE:

- If a scalable group is present in Cisco DNA Center and is not present in Cisco ISE, it is created in Cisco ISE.

- If a scalable group is present in Cisco ISE and is not present in Cisco DNA Center, it is created in Cisco DNA Center.
- If the scalable group name is same in both Cisco DNA Center and Cisco ISE, but the description and ACI data are different, Cisco DNA Center is updated with the data specified in Cisco ISE.
- If the scalable group name is same in Cisco DNA Center and Cisco ISE, but the tag values are different, a new scalable group with the tag value specified in Cisco ISE is created in Cisco DNA Center. The name of the existing scalable group in Cisco DNA Center is updated with the suffix `_DNAC`.
- If the tag value is same but the scalable group name is different, the scalable group name in Cisco DNA Center is updated with the name specified in Cisco ISE.

Create Access Contracts

An access contract is a set of rules that controls the type of network traffic that is allowed to pass between the source and destination scalable groups. Access contracts define the actions (permit or deny) performed when the traffic matches a network application, protocol, and port.

Note Security Group Access Control List (SGACL) in Cisco ISE is called `Access Contract` in Cisco DNA Center.

Before you begin

To perform the following task, you must be a Super Admin or Network Admin.

Step 1 Click the menu icon (≡) and choose **Policy** > **Group-Based Access Control** > **Access Contracts**.

Step 2 Click **Create Access Contract**.

Step 3 In the **Create Access Contract** slide-in pane, enter a name and description for the contract.

Step 4 Create the traffic filter rules:

- From the **Action** drop-down list, choose **Deny** or **Permit**.
- From the **Application** drop-down list, choose the application for which you want to apply that action. The port and protocol are automatically selected based on the application that you select.

  If you want to specify the transport protocol, source port, and destination port, choose the **Advanced** option from the **Application** drop-down list.

You can create multiple rules. To create multiple rules for a contract, click the **+** symbol and choose the settings for the **Action** and **Application** columns. The rules are checked in the order in which they are listed in the contract. Use the handle icon at the left end of a rule to drag and change the order of the rule.

You can enable or disable logging for any traffic filter rule (including the default action) by using the **Logging** toggle. Logging is disabled by default. When logging is enabled, the network device sends a syslog message when the traffic filter rule is hit. This might be helpful in troubleshooting and initial testing of a policy. However, we recommend that you use this option sparingly, because it might have a resource and performance impact on the network devices.

Step 5 From the **Default Action** drop-down list, choose **Deny** or **Permit**.

You can enable logging for the default action, if required.

Step 6 Click **Save**.

You can view, create, duplicate, update, and delete contracts from the **Access Contracts** listing window.

You can also view the sample contracts in the **Access Contracts** window. You can use or delete those sample contracts. However, you cannot delete the default contracts (Permit IP, Deny IP, Permit_IP_Log, and Deny_IP_Log).

Click the **Contract Name** link in the **Access Contracts** window to view the details of a contract. Click **Edit** in the **View Contract** window to edit the contract details.

An orange triangle icon is displayed next to a contract if synchronization with Cisco ISE is incomplete.

The contracts that are learned from ACI are displayed in the **Access Contracts** window with the value `ACI` in the **Created In** column. You cannot edit or delete the contracts that are learned from ACI, but you can use them in the policies while using the ACI-learned scalable groups. While creating or updating a policy from the Matrix view, if you select an ACI-learned scalable group as the destination group, the associated contracts are displayed in the **Preferred Contracts** tab. You can view all the contracts in the **All Contracts** tab.

You can view the number of rules used in each contract in the **Rules Count** column.

Click the link in the **Policies** column of a contract to view the policies that use that contract.

You cannot delete a contract if it is used in a policy. You must delete the contract from that policy before you delete the contract.

When you update the scalable groups, contracts, or policies, you must deploy the changes on the network devices. If you update the policies and do not deploy the updated policies, notifications about the policy changes are not sent to the network devices and the policies that are currently active in the network may not be consistent with the policy information displayed in Cisco DNA Center. To resolve this situation, you must deploy the updated policies on the network devices.

You can duplicate an existing contract and create a new contract by editing the required details. When you duplicate a contract, all information in the existing contract is copied and the copied contract has the existing contract name with the string `Copy` appended at the end.

You can use the **Filter** option to search for the contracts that you look for.

While synchronizing the access contracts in Cisco DNA Center with Cisco ISE:

- If a contract is present in Cisco DNA Center and is not present in Cisco ISE, it is created in Cisco ISE.
- If a contract is present in Cisco ISE and is not present in Cisco DNA Center, it is created in Cisco DNA Center.
- If the contract name is the same in Cisco DNA Center and Cisco ISE, but the description and traffic rule content are different, Cisco DNA Center is updated with the data specified in Cisco ISE.
- If the contract name and rule are the same, but the description is different, Cisco DNA Center is updated with the description specified in Cisco ISE.
- Text SGACL command lines in Cisco ISE are migrated as content that cannot be parsed. You can edit these contracts, but Cisco DNA Center does not parse them or check syntax. The changes that you make in Cisco DNA Center are reflected in Cisco ISE.

- If a policy has multiple SGACLs in Cisco ISE, those contracts are migrated as default policies in Cisco DNA Center.

Create Group-Based Access Control Policy

Scalable groups and access contracts are the basic building blocks of an access control policy. While creating an access control policy, you can use the scalable groups and contracts that you have created before, or create new scalable groups and contracts while creating the policy.

If you want to specify the network resources that can be accessed from a specific source group, you can create an access control policy with a single source and multiple destination groups. On the other hand, if you want to specify the source groups that are permitted to access a particular network resource, you can create an access control policy with a single destination and multiple source groups.

For example, if you want to specify the network resources that can be accessed by the users associated with the *Contractors* source scalable group, you can create an access control policy with a single source and multiple destination groups. If you want to specify the source groups that are permitted to access the *Finance Servers* destination scalable group, you can create an access control policy with a single destination and multiple source groups.

Group-based access control policies can also be created or updated based on the traffic flows for a given source and destination group pair.

To create a group-based access control policy, use the following procedure.

Step 1 From the **Policy List** or **Matrix** view, click **Create Policies**.

Step 2 To create an access control policy with a single source and multiple destination groups, click **Source to Destination(s)** and complete these steps:

a) Click the radio button next to the source scalable group that you want to select. If the scalable group that you need does not exist, click **Create Scalable Group** to create a new scalable group. For more information, see Create Scalable Groups, on page 528.

b) Click **Next**.

c) Choose the destination scalable groups to map to the selected source scalable group.

   You can view the scalable group details and edit the scalable groups, if necessary.

   If a policy already exists between the source and destination, an orange triangle icon is displayed near a scalable group.

d) Click **Next**.

e) Click the radio button next to the contract that you want to select. If the contract that you need does not exist, click **Create Contract** to create a new contract. For more information, see Create Access Contracts, on page 530.

   You can view and edit the contract details, if necessary.

   Note You can choose only one contract for a policy.

f) Click **Next**.

   The **Summary** window lists the policies that are created based on the selected scalable groups and contract.

g) Click **Save**.

Step 3 To create an access control policy with a single destination and multiple source groups, click **Destination to Source(s)** and complete the following steps:

a) Click the radio button next to the destination scalable group that you want to select. If the scalable group that you need does not exist, click **Create Scalable Group**.

b) Click **Next**.

c) Choose the source scalable groups to map to the selected destination scalable group.

You can view the scalable group details and edit the scalable groups, if necessary.

If a policy already exists between the source and destination, an orange triangle icon is displayed near a scalable group.

d) Click **Next**.

e) Click the radio button next to the contract that you want to select. If the contract that you need does not exist, click **Create Contract**.

You can view and edit the contract details, if necessary.

Note You can choose only one contract for a policy.

f) Click **Next**.

The **Summary** window lists the policies that are created based on the selected scalable groups and contract.

g) Click **Save**.

Note You can toggle between the **List** view and the **Drag and Drop** view using the **Toggle** button in the top-right corner of the scalable group listing area. The **Drag and Drop** view allows you to drag and drop the scalable groups to the **Source** and **Destination** fields while creating the access control policy. However, only the first 50 scalable groups are listed in the **Drag and Drop** view. You can use the **Drag and Drop** view if you have a smaller number of scalable groups (up to 50). If you have more than 50 scalable groups, use the **List** view to view them all.

To create or modify a group-based access control policy based on the traffic flows:

1. From the policy matrix view, click the cell for which you want to create or modify the group-based access control policy.

2. In the **Policy Details** slide-in pane, click **View Traffic Flows**.

   In the **View Traffic Flows** slide-in pane, you can see the rules for the selected contract or the default policy in the left pane. You can view the traffic flows that match any selected rule in the right pane.

3. Click **View Traffic** in the Default Action rule to see the list of flows that match that rule. While modifying an existing policy using access contracts with additional rules, you can use the **View Traffic** option for any rule to see the list of flows matching that rule.

4. For policies that are using the Default Action rule (with no explicitly selected access contract), you can select an access contract or create a new access contract to be used by that policy.

   For policies with access contract PERMIT or DENY, you can select an access contract or create a new access contract to be used by that policy.

   For policies with custom access contract, you can edit the selected access contract.

   While saving a newly created or edited contract, you have the following options:

  - Save the changes to the existing contract. Changes affect all policies that reference the contract.
  - Save the changes as a new contract. Changes are applied only to the current policy.
  - Save the changes as a new contract. Changes are not applied to any policy.

While synchronizing the policies in Cisco DNA Center with Cisco ISE:

- If a policy is present in Cisco DNA Center and is not present in Cisco ISE, it is created in Cisco ISE.
- If a policy is present in Cisco ISE and is not present in Cisco DNA Center, it is created in Cisco DNA Center.
- If a policy contract is different in Cisco ISE, Cisco DNA Center is updated with the contract specified in Cisco ISE.
- Policy mode information (Enabled, Disabled, or Monitor) is also imported from Cisco ISE.

Cisco ISE has an option to allow multiple SGACLs for a single policy (this option is not enabled by default in Cisco ISE). Cisco DNA Center does not support the use of multiple access contracts for a single policy. During policy synchronization, if a policy in Cisco ISE has multiple SGACLs, the Cisco DNA Center administrator is given the option to change that policy to have no contract selected (to use the default policy). The administrator can select a new or existing access contract for that policy after the policy synchronization is complete.

Cisco Group-Based Policy Analytics

Group-Based Policy Analytics enables you with insights, to create group-based policies by visualizing communications between assets, to assess the impact of introducing new access controls, and understand exactly which protocols you need to allow in the policies.

Cisco Group-Based Policy Analytics aggregates information on groups of assets on your network, and their communication to answer the following questions:

- Which groups are communicating with each other?
- What kind of communication is this?
- Which group does a given asset belong to?

Installation

You can purchase one of following types of licenses for Cisco DNA Center:

- Cisco DNA Essentials
- Cisco DNA Advantage
- Cisco DNA Premier

Cisco DNA Advantage and Cisco DNA Premier contain the Group-Based Policy Analytics package. This package consists of the following archives (.tar.gz files):

- Backend
- User Interface
- Summarizer Pipeline
- Aggregation definitions

Cisco Group-Based Policy Analytics is a part of Cisco DNA Center but, is not installed by default. Click the menu icon (≡) and choose **System** > **Software Updates** > **Installed Apps**. Scroll down to **Group-Based Policy Analytics** under **Policy Applications**. Click **Install** to install the application.

Hardware and Software Compatibility

Platform Support

Cisco Group-Based Policy Analytics is supported on the following hardware platforms:

- 44 cores, single node or three-node cluster
- 56 cores, single node or three-node cluster
- 112 cores, single node or three-node cluster

These platforms must meet the performance and scalability requirements mentioned here.

For details about the supported hardware, see Cisco UCS M4 appliances or Cisco UCS M5 appliances.

The following table lists the performance metrics that Cisco DNA Center and Cisco Group-Based Policy Analytics support on each of the core platforms. The NetFlow metrics were introduced by Cisco Group-Based Policy Analytics.

Note The following table lists the performance metrics for a standalone deployment. These values might vary based on the number of nodes in the cluster and the number of installed packages.

Table 47: Performance Metrics

Metric	44 cores, three nodes	56 cores	112 cores
Devices (NADs)	5000 1000 switches or 1000 routers or a combination of both; 4000 APs	8000 2000 switches or 2000 routers or a combination of both; 6000 APs	18,000 5000 switches or 5000 routers or a combination of both; 13,000 APs
Clients (endpoints)	25,000 20,000 wireless; 5,000 wired	40,000 30,000 wireless; 10,000 wired	100,000 60,000 wireless; 40,000 wired
NetFlows per sec	30,000	48,000	120,000

Device Support

You must enable NetFlow to use Cisco Group-Based Policy Analytics. The following table shows the various ways in which NetFlow can be enabled on different network devices.

Table 48: Device Support

Network Devices	Series	NetFlow Configurable in telemetry section of Network Settings in Cisco DNA Center UI (Flexible NetFlow or Application Visibility and Control Based NetFlow)	NetFlow Configurable using the template editor tool in the Cisco DNA Center UI (Flexible NetFlow or Application Visibility and Control Based NetFlow)	NetFlow Collection in Fabric Deployment	NetFlow Collection in Nonfabric Deployment
Routers	Cisco 1000 Series Integrated Services Routers (ISR1K)	Yes	Yes	Yes	Yes
	Cisco 4000 Series Integrated Services Routers (ISR4K)	Yes	Yes	Yes	Yes
	Cisco Cloud Services Router 1000v Series (CSR 1000v)	Yes	Yes	Yes	Yes
	Cisco 1000 Series Aggregation Services Routers (ASR1K)	Yes	Yes	Yes	Yes
Switches	Cisco Catalyst 9200 series	Yes	Yes	Yes	Yes
	Cisco Catalyst 9300 Series	Yes	Yes	Yes	Yes
	Cisco Catalyst 9400 Series	Yes	Yes	Yes	Yes
	Cisco Catalyst 9500 Series	No	Yes	Yes	Yes
	Cisco Catalyst 9600 Series	No	Yes	Yes	Yes
	Cisco Catalyst 2k series	No	Yes	NA	Yes
	Cisco Catalyst 3560 series	No	Yes	NA	Yes
	Cisco Catalyst 3650 series	No	Yes	Yes	Yes
	Cisco Catalyst 3850 series	No	Yes	Yes	Yes
	Cisco Catalyst 4k series	No	Yes	Yes	Yes
	Cisco Catalyst 6500 Series Switches	No	Yes	Yes	Yes
	Cisco Catalyst 6800 Series Switches	No	Yes	Yes	Yes

Network Devices	Series	NetFlow Configurable in telemetry section of Network Settings in Cisco DNA Center UI (Flexible NetFlow or Application Visibility and Control Based NetFlow)	NetFlow Configurable using the template editor tool in the Cisco DNA Center UI (Flexible NetFlow or Application Visibility and Control Based NetFlow)	NetFlow Collection in Fabric Deployment	NetFlow Collection in Nonfabric Deployment
Wireless Controllers	Cisco 3504 Wireless Controller (AireOS-Based)	Yes	Yes	No	Yes, only central switching SSID
	Cisco 5520 Wireless Controller (AireOS-Based)	Yes	Yes	No	Yes, only central switching SSID
	Cisco 8540 Wireless Controller (AireOS-Based)	Yes	Yes	No	Yes, only central switching SSID
	Cisco Catalyst 9800 based controller	Yes	Yes	Yes	Yes

Cisco ISE

Cisco ISE 2.4 Patch 7 and later, Cisco ISE 2.6 Patch 1 and later, and Cisco ISE 2.7 and later are supported.

Cisco Stealthwatch

Cisco Stealthwatch 7.x or later is supported.

Understand Connectors

Cisco Group-Based Policy Analytics gathers telemetry from the following sources, which are also known as connectors. You can configure the connectors either by following the Initial Configuration of Cisco Group-Based Policy Analytics, on page 538 workflow, or by choosing **Policy** > **Group-Based Access Control** > **Analytics** > **Configurations** > **Analytics Settings**.

Group Data Connectors

The group data connectors collect information about groups that assets are classified into. Cisco ISE and Cisco Stealthwatch are group data connectors.

- **Cisco ISE**

  Cisco ISE is a next-generation identity and access control policy platform that enables enterprises to enforce compliance, enhance infrastructure security, and streamline their service operations. Cisco ISE is installed on a virtual machine, a physical machine or a combination of both. Cisco ISE uses the Cisco Platform Exchange Grid (pxGrid) service as the publisher-subscriber module for sharing SessionDirectory, Scalable Groups, and other information. PxGrid uses a query interface and supports bulk download. Users on the network are authenticated, authorized, and accounted for, and a session directory is maintained. User events are published to the connectors that are subscribed to the SessionDirectory service. Other services like scalable group notifications can also be subscribed to.

User identity and device information obtained during authentication is used to classify the packets, as they enter the network. This packet classification is maintained by tagging packets when they enter the network so that they can be properly identified for applying security and other policy criteria along the data path. The tag, also called the Scalable Group Tag (SGT), allows Cisco ISE to enforce access control policies by enabling the network device to act upon the SGT to filter traffic.

In addition, Cisco ISE collects information about endpoints connected to your network, such as the type of device, OS, OS version, IP address and other attributes. These are called ISE profiles.

The Cisco ISE connector provides Cisco Group-Based Policy Analytics with SGT definitions and profiles from Cisco ISE.

- **Cisco Stealthwatch**

  Cisco Stealthwatch is a network-based anomaly detection system which provides advanced threat detection, accelerated threat response and network traffic security analysis. The Cisco Stealthwatch connector obtains the host groups that are configured on Cisco Stealthwatch. A host group is essentially a virtual container containing multiple host IP addresses or IP address ranges that have similar attributes, such as location, function, or topology.

Communication Connector

The communication connector helps gather information on traffic seen between groups, that could be leveraged in Group-Based Policy decisions. This is done using NetFlow from network devices managed by Cisco DNA Center. NetFlow is collected and aggregated natively by Cisco DNA Center.

Initial Configuration of Cisco Group-Based Policy Analytics

This workflow helps you configure the data connectors that are required to collect telemetry data related to network activity, and endpoints from specific sources such as Cisco ISE, Cisco Stealthwatch, and NetFlow. This task is useful when you are configuring the data connectors for the first time.

Before you begin

Cisco DNA Center must have Cisco Group-Based Policy Analytics installed.

Step 1 Click the menu icon (≡) and choose **Policy** > **Group-Based Access Control** > **Overview**. The **Create policies with more confidence** window appears.

Step 2 Click **Get Started**.
The **Configure your data connectors** window appears.

Step 3 Click **Let's Do It**.

The **Configure Group Data Connectors** window appears.

Note If the Cisco ISE version is earlier than the version required for running Cisco Group-Based Policy Analytics, an error message is displayed.

Step 4 Click **Configure** at the bottom of the connector that you want to configure.
A new window opens, redirecting you to the Cisco DNA Center **Settings** window, where you can configure the required connectors. You must configure the Cisco ISE connector. Configuring the Cisco Stealthwatch connector is optional.

Step 5 Close the **Settings** window. You will see a green dot next to the **Configure** option for the successfully configured connectors in the **Configure Group Data connectors** window.

Step 6 Click **Next**.

The **Configure Communication Connectors** window appears.

Step 7 Configure the communication connector (NetFlow) by using one of the following options:

- Provision NetFlow on the Cisco DNA Center device interface manually.
- Click **Template Editor** to configure NetFlow using the **Template Editor Tool** in Cisco DNA Center.
- Click **Telemetry in Network Settings** to configure NetFlow in the telemetry section of network settings.

Step 8 Click **Next**.
The **Summary** window displays the configuration details of the connectors.

Step 9 Click **Done** to start discovering your groups and endpoints.

Explore Groups and Endpoints

The following section provides information about the different ways to visualize traffic between different groups.

Multiple Groups to Multiple Groups

When you click the number that is displayed in the **Scalable Groups** box in the **Overview** window, the **Explore Scalable Groups** window is displayed. In this window, you can see a summary of all the group-to-group communication among Scalable Groups. By default, the time range for this view is the last available 24 hours of data. Note that this is different from the time range mentioned in the **Overview** window, where it is set to the last 14 days. The chart shows the top 25 source Scalable Groups and their corresponding interactions, starting with the source Scalable Group with the highest number of unique flows within the given time period and so on.

Click the icon to display the chart view, or to display the table view.

In the table view, if you click the **See destinations** link on a particular row, it opens a window showing all the destination Scalable Groups for the selected source Scalable Group, and the unique flow count for each destination Scalable Group.

Click a source group to view the **Single Group to Multiple Groups** window.

When you hover your cursor over a link, the link is highlighted and a tooltip shows the number of unique traffic flows. Clicking the link takes you to the **Single Group to Single Group** window.

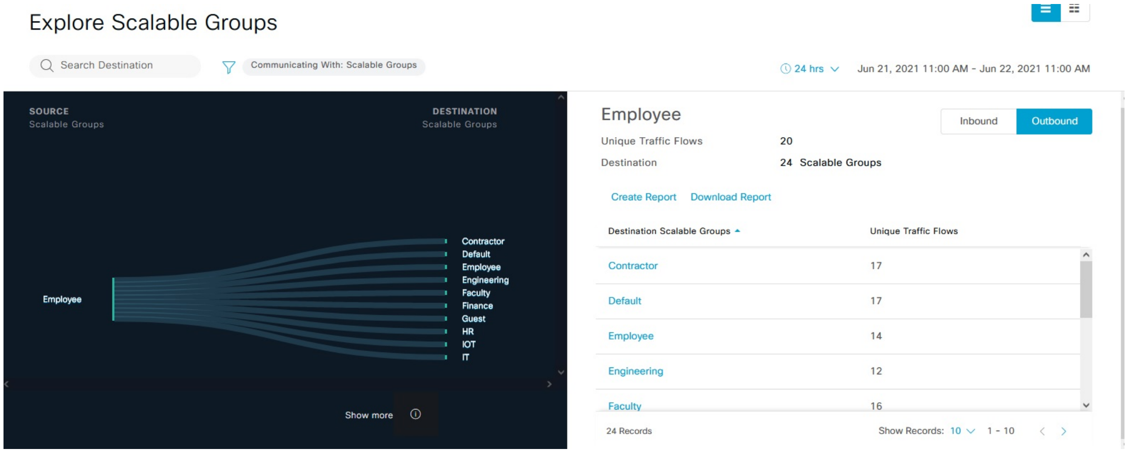
When you click the number displayed in the **ISE Profiles** box in the **Overview** window, the **Explore ISE Profiles** window is displayed. In this window, you can see a summary of all the communication from ISE Profiles as the source and Scalable Groups as the destination. In order to focus on group-based policy decisions, either the source or destination category must be Scalable Groups in this view.

When you click the number displayed in the **Stealthwatch Host Groups** box in the **Overview** window, the **Explore Stealthwatch Host Groups** window is displayed. In this window, you can see a summary of all the communication, with Stealthwatch Host Groups as the source and the Scalable Groups as the destination. In order to focus on group-based policy decisions, either the source or destination category must be Scalable Groups in this view.

Single Group to Multiple Groups

Single Group to Multiple Groups: Outbound

This window displays the activity between a single source group and multiple destination groups. The source or the destination or both must be a Scalable Group. By default, the time range for this view is the last available 24 hrs of data and the default number of links or records shown is 10.


Explore Scalable Groups
Search Destination
Communicating With: Scalable Groups
24 hrs
SOURCE
Scalable Groups
DESTINATION
Scalable Groups
Employee
Contractor
Default
Employee
Engineering
Faculty
Finance
Guest
HR
IOT
IT
Show more
Inbound
Outbound
Create Report
Download Report

Jun 21, 2021 11:00 AM - Jun 22, 2021 11:00 AM

Employee

Unique Traffic Flows: 20

Destination: 24 Scalable Groups

Destination Scalable Groups	Unique Traffic Flows
Contractor	17
Default	17
Employee	14
Engineering	12
Faculty	16

24 Records

Show Records: 10 1 - 10

Click the icon to display the chart view or to view the table view.

Outbound displays the connections initiated by the selected scalable group. **Inbound** displays the connections initiated by another group to this scalable group.

Click any column to sort in ascending or descending order.

Click a group to view the **Single Group to Single Group** window with the corresponding destination as the selected group. The source group does not change.

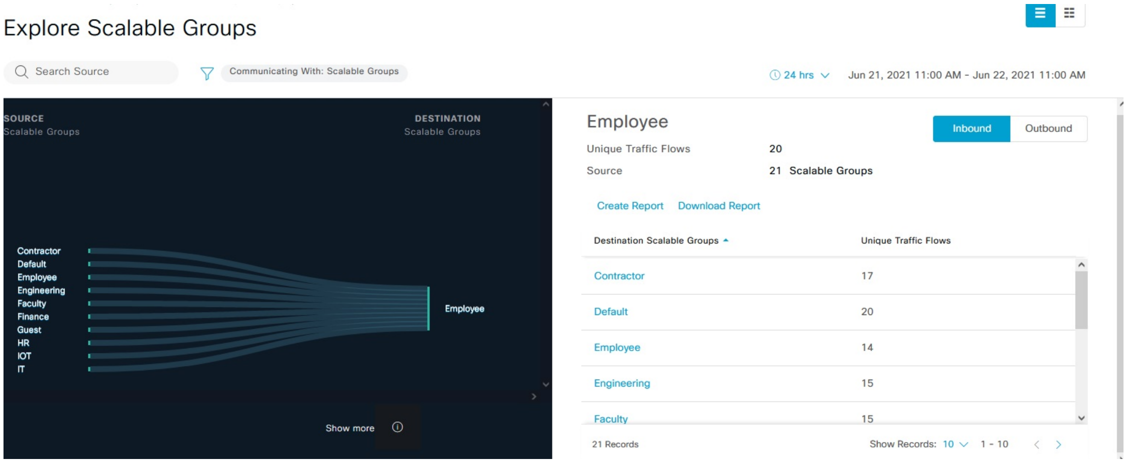
When you hover your cursor over a link, it is highlighted, and a tooltip shows the number of unique traffic flows. If you click this link, it takes you to the **Single Group to Single Group** window.

Click **Create Report** to generate a new report in CSV format with the information in this view. The **Reports** window opens, where you can see the generated report. This window also provides you access to previously generated reports and allows you to download the reports.

Click **Download Report** to view the generated reports. The **Reports** window opens, where you can click the *download* icon under the **Last Run** column to download a report.

Single Group to Multiple Groups: Inbound

If you click **Inbound**, it shows all the connections initiated by any group as the source and the selected Scalable Group as destination.


Explore Scalable Groups
Search Source
Communicating With: Scalable Groups
24 hrs
Jun 21, 2021 11:00 AM - Jun 22, 2021 11:00 AM
SOURCE
Scalable Groups
DESTINATION
Scalable Groups
Contractor
Default
Employee
Engineering
Faculty
Finance
Guest
HR
IOT
IT
Employee
Show more
Inbound
Outbound
Create Report
Download Report

Employee

Unique Traffic Flows 20

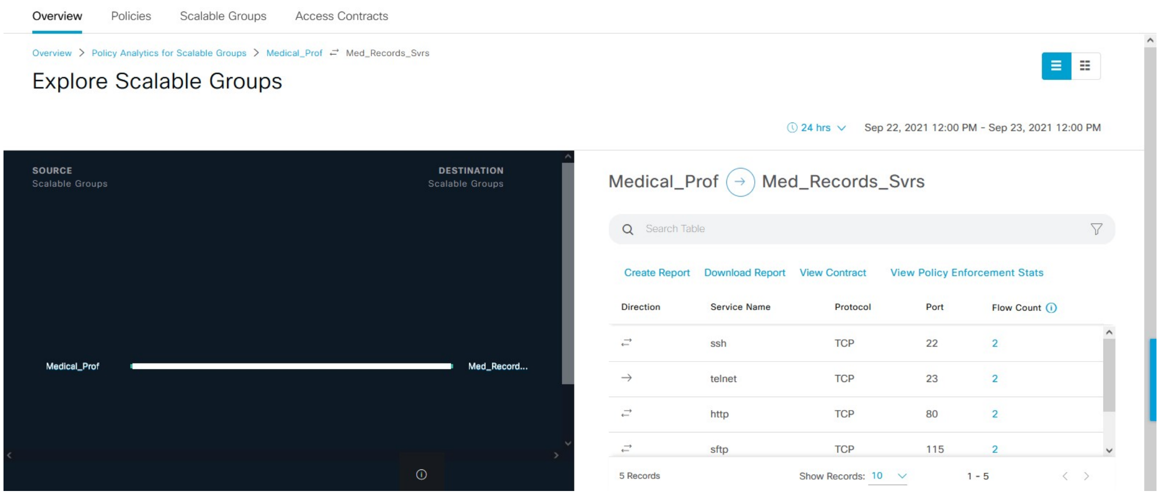
Source 21 Scalable Groups

Destination Scalable Groups	Unique Traffic Flows
Contractor	17
Default	20
Employee	14
Engineering	15
Faculty	15

21 Records Show Records: 10 1 - 10

Single Group to Single Group

This window shows the activity between a source group and a destination group. The source group or the destination group or both must be a scalable group. By default, the time range for this visual is the last available 24 hours of data and the default number of links or records shown is 10.

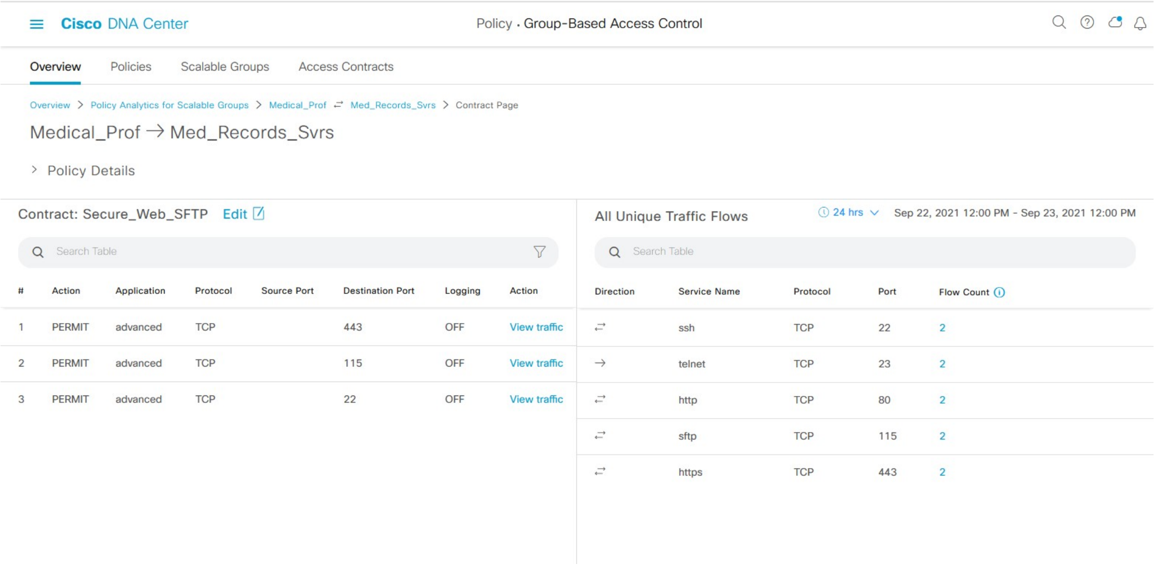

Overview
Policies
Scalable Groups
Access Contracts
Overview > Policy Analytics for Scalable Groups > Medical_Prof ⇄ Med_Records_Svrs
Explore Scalable Groups
24 hrs
Sep 22, 2021 12:00 PM - Sep 23, 2021 12:00 PM
SOURCE
Scalable Groups
DESTINATION
Scalable Groups
Medical_Prof
Med_Record...
Medical_Prof → Med_Records_Svrs
Search Table
Create Report
Download Report
View Contract
View Policy Enforcement Stats

Direction	Service Name	Protocol	Port	Flow Count
⇄	ssh	TCP	22	2
→	telnet	TCP	23	2
⇄	http	TCP	80	2
⇄	sftp	TCP	115	2

5 Records Show Records: 10 1 - 5

When you click the directional arrow displayed between the source and destination groups, the source and destination groups are interchanged in this view.

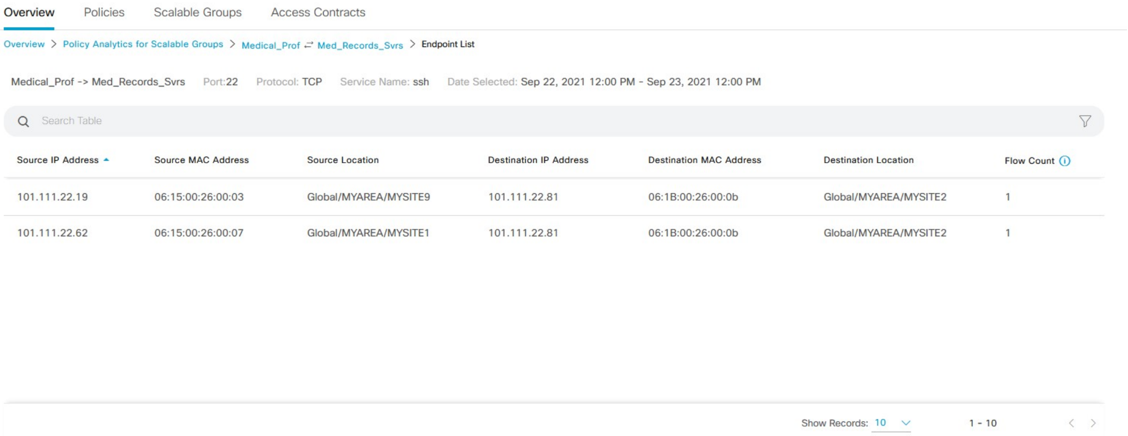
Click **View Contract** to view a side-by-side comparison of traffic flows with the access contract rules that are in effect for this source and destination group pair.


Cisco DNA Center
Policy · Group-Based Access Control
Overview
Policies
Scalable Groups
Access Contracts
Overview > Policy Analytics for Scalable Groups > Medical_Prof ⇄ Med_Records_Svrs > Contract Page
Medical_Prof → Med_Records_Svrs
> Policy Details
Contract: Secure_Web_SFTP
Edit
Search Table
All Unique Traffic Flows
24 hrs
Sep 22, 2021 12:00 PM - Sep 23, 2021 12:00 PM
Search Table

#	Action	Application	Protocol	Source Port	Destination Port	Logging	Action
1	PERMIT	advanced	TCP		443	OFF	View traffic
2	PERMIT	advanced	TCP		115	OFF	View traffic
3	PERMIT	advanced	TCP		22	OFF	View traffic

Direction	Service Name	Protocol	Port	Flow Count
⇄	ssh	TCP	22	2
→	telnet	TCP	23	2
⇄	http	TCP	80	2
⇄	sftp	TCP	115	2
⇄	https	TCP	443	2

The left pane in the **View Contract** window displays the rules for permitted and denied traffic between the source and destination groups. You can view the traffic flows that match any selected rule in the right pane. You can view the flow direction, service name, flow count, ports, and protocol details in the right pane. The **Flow Count** column displays the number of flows detected for that particular service, port, and protocol combination for the selected time period. You can click the flow count link to view the flow details for each endpoint.

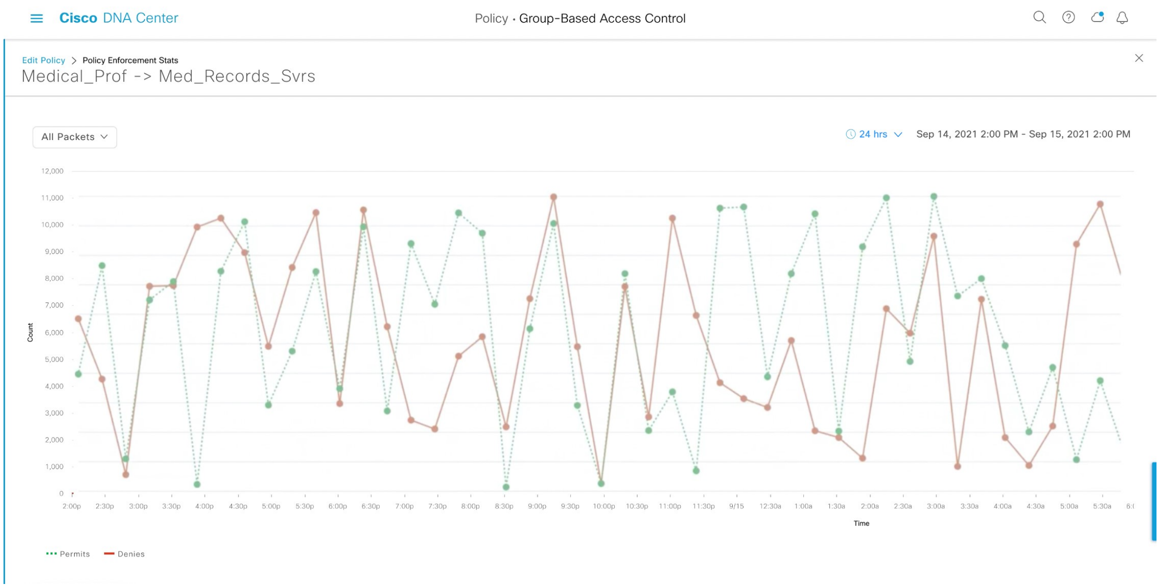

Overview
Policies
Scalable Groups
Access Contracts
Overview > Policy Analytics for Scalable Groups > Medical_Prof ⇄ Med_Records_Svrs > Endpoint List
Search Table
Show Records: 10
1 - 10

Medical_Prof -> Med_Records_Svrs   Port:22   Protocol: TCP   Service Name: ssh   Date Selected: Sep 22, 2021 12:00 PM - Sep 23, 2021 12:00 PM

Source IP Address	Source MAC Address	Source Location	Destination IP Address	Destination MAC Address	Destination Location	Flow Count
101.111.22.19	06:15:00:26:00:03	Global/MYAREA/MYSITE9	101.111.22.81	06:1B:00:26:00:0b	Global/MYAREA/MYSITE2	1
101.111.22.62	06:15:00:26:00:07	Global/MYAREA/MYSITE1	101.111.22.81	06:1B:00:26:00:0b	Global/MYAREA/MYSITE2	1

Note When you sort the **Traffic Flows** table based on the flow count, only 1000 records are displayed.

Click **View Policy Enforcement Stats** to view a time-series graph of permit and deny counts for any source and destination group pair. It provides per-policy enforcement statistics visibility. You can use the **All Packets** drop-down list to select only the permitted or dropped packets. Graph data points are displayed for each 15-minute data collection period. You can hover over any data point to view the number of permits and denies. You can click a data point or time period to view the contract and traffic flow details for the selected time period.


Cisco DNA Center
Policy · Group-Based Access Control
Edit Policy > Policy Enforcement Stats
Medical_Prof -> Med_Records_Svrs
All Packets
24 hrs
Sep 14, 2021 2:00 PM - Sep 15, 2021 2:00 PM
Count
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2:00p
2:30p
3:00p
3:30p
4:00p
4:30p
5:00p
5:30p
6:00p
6:30p
7:00p
7:30p
8:00p
8:30p
9:00p
9:30p
10:00p
10:30p
11:00p
11:30p
9/15
12:30a
1:00a
1:30a
2:00a
2:30a
3:00a
3:30a
4:00a
4:30a
5:00a
5:30a
Time
Permits
Denies

Note Note that the selected time period will be the hour that contains the 15-minute interval corresponding to the selected data point, because the flow data aggregation is done every 60 minutes.

The **Traffic Flows** table can also be accessed from the **Policy Details** slide-in pane while creating or editing a policy.

Click the icon to display the chart view or to display the table view.

You can set the date and time using the Date and Time Selector.

Click **Create Report** to generate a new report in CSV format with the information in this view. The **Reports** window opens, where you can see the generated report. This window also provides you access to previously generated reports and allows you to download the reports.

Click **Download Report** to view the generated reports. The **Reports** window opens, where you can click the *download* icon under the **Last Run** column to download a report.

Access Contracts

Access Contracts can now be created and modified directly in the Analytics workflow.

View Contract

To launch the **View Contract** window, from the **Explore Scalable Groups** window, click **View Contract**. The left pane in the **View Contract** window displays the rules for permitted and denied traffic between the source and destination groups. You can view the traffic flows that match any selected rule in the right pane.

This table can also be accessed from the **Policies** window. Click the menu icon (☰) and choose **Policy** > **Group-Based Access Control** > **Policies**.

From the policy matrix view, click the cell for which you want to create or modify contracts. In the **Policy Details** slide-in pane, click **View Traffic Flows**.

If there is currently no contract assigned between the source and destination groups, no data is displayed. You can use the **Change Contract** or **Create Access Contract** option to create or modify the contract.

Click **View traffic** in the **Action** column to see the list of flows that match that rule.

Create Access Contract

To launch the **Contract Content** window, from the **Policy Details** pane, click **Create Access Contract**. To create the traffic filter rules:

1. From the **Action** drop-down list, choose **Deny** or **Permit**.
2. From the **Application** drop-down list, choose the application for which you want to apply that action. The port and protocol are automatically selected based on the application that you select.

   If you want to specify the transport protocol, source port, and destination port, choose the **Advanced** option in the **Application** drop-down list.

You can create multiple rules. To create multiple rules for a contract, click the Plus icon and choose the settings for the **Action** and **Application** columns. The rules are checked in the order in which they are listed in the contract. Use the Handle icon at the left end of a rule to drag and change the order of the rule.

You can use the **Add to Contract** option within the **All Unique Traffic Flows** pane to add an entry to the contract.

While saving a newly created or edited contract, you have the following options:

- **Update current policy only**: A duplicate of the contract is created and applied to the current policy. Other policies that reference this contract are not affected.
- **Update contract for all referenced policies**: The contract is updated and applied to the current policy and other policies that reference this contract.
- **Create a new contract with no policies affected**: A duplicate of the contract is created but not applied to any policy.

Change Contract

To launch the **Change Contract** window, from the **Policy Details** pane, click **Change Contract**. All available contracts are displayed. You can select the required contract and click **Change** to add that contract to the policy.

Edit Contract

The **Edit** option is displayed only when a contract has already been added to the policy. If you want to edit the contract details, click **Edit** displayed after the name of the contract.

After updating the contract, click **Save**. The following options are available:

- **Update current policy only**: A duplicate of the contract is created and applied to the current policy. Other policies that reference this contract are not affected.
- **Update contract for all referenced policies**: The contract is updated and applied to the current policy and other policies that reference this contract.

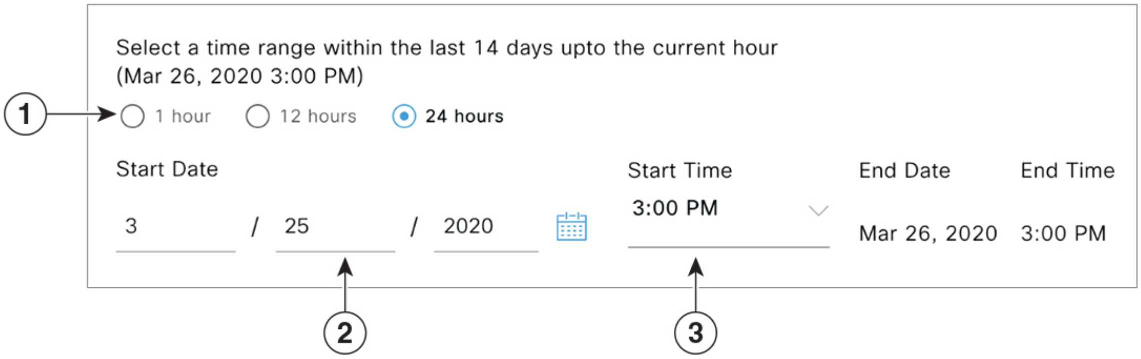
- **Create a new contract with no policies affected**: A duplicate of the contract is created but not applied to any policy.

After choosing the appropriate option, enter a name and description (if you select the first or third option), and then click **Confirm**.

Date and Time Selector

You can select the time period for which you want to see the connection summary. You can select a time range within the last 14 days up to the current hour.

Figure 43: Date and Time Selector



Select a time range within the last 14 days upto the current hour (Mar 26, 2020 3:00 PM)

○ 1 hour ○ 12 hours ● 24 hours

Start Date: 3 / 25 / 2020

Start Time: 3:00 PM

End Date: Mar 26, 2020

End Time: 3:00 PM

1. Select one of the options. The **End Time** will be adjusted automatically.
2. Specify the **Start Date** by entering the month, day, and year manually or by using the calendar icon.
3. Choose the **Start Time** from the drop-down menu.

Use Search

The **Overview** window has a **Search** field that can search across the data for scalable groups, ISE profiles, Stealthwatch host groups, IP addresses, or MAC addresses.

As you start entering the characters in the search field, an automatic search is performed for scalable groups, ISE profiles, and Stealthwatch host groups, and up to three results are displayed for each group type. For MAC addresses, the relevant characters are hexadecimal and colon.

Cisco Group-Based Policy Analytics supports both IPv4 and IPv6 addresses for endpoints. You can search and filter the endpoints using an IPv4 or IPv6 address.

- The following characters can be used to search and filter IPv4 addresses:
  - Numbers (0-9)
  - Dot (.)

  You can enter up to 15 characters in the filter field.

- The following characters can be used to search and filter IPv6 addresses:
  - Numbers (0-9)

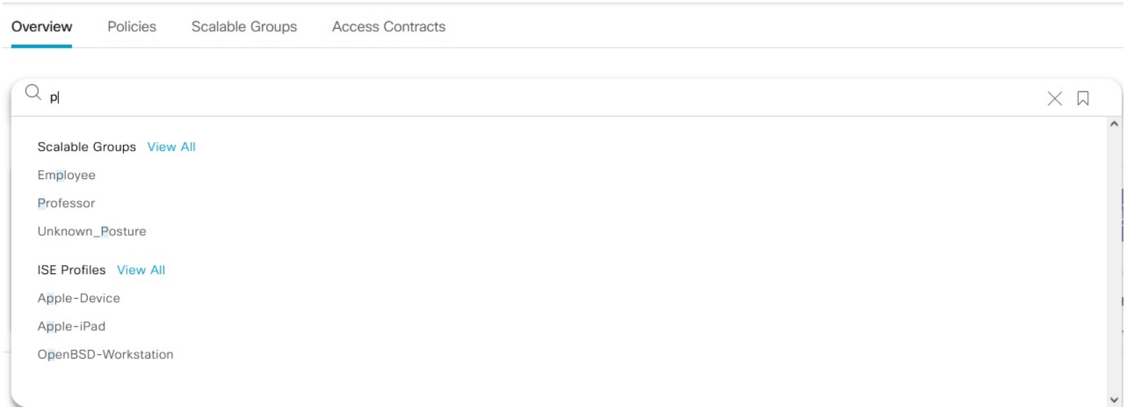
- Lowercase and uppercase alphabetic characters (a-f, A-F)
- Colon (:)

You can enter up to 39 characters in the filter field.

Note

- The **Search Results** window does not open until you click the **View All** link.
- A read-only user cannot search for an IP address or a MAC address. See Role-Based Access Control for more information.

Figure 44: Search Window


Overview
Policies
Scalable Groups
Access Contracts
pl
Scalable Groups View All
Employee
Professor
Unknown_Posture
ISE Profiles View All
Apple-Device
Apple-iPad
OpenBSD-Workstation

From the **Focus** drop-down list, choose the required option to change your search criteria.

The filter icon (▽) is used in advanced filtering, and is available only when you search for a MAC address or an IP address. When you click the ▽ icon, each column is provided with a search field on top of the column name.

For each column, you can enter up to three search criteria. When entering more than one criterion per column, you can specify an OR operation or an AND operation. The resultant query performs an AND operation across the columns.

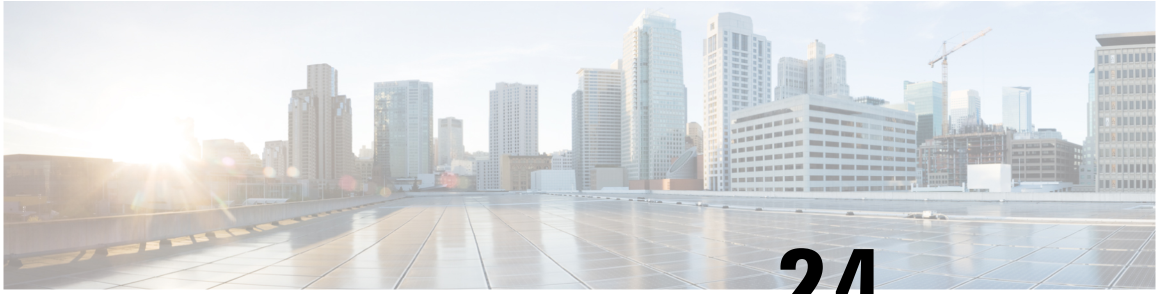
Click the 🔖 icon and use the **Save Current Search** option to save the current displayed search.

To delete a saved search, click the 🔖 icon. Hover your cursor over the name of the saved search and click the ✕ icon. Click **Yes** in the **Delete Saved Filter** dialog box to permanently delete the filter.

Role-Based Access Control

Cisco Group-Based Policy Analytics supports Role-Based Access Control. It differentiates between a read-write user and a read-only user. However, because Cisco Group-Based Policy Analytics is primarily based on visibility, which does not make any changes to the system, there are only a few limitations for a read-only user:

- A read-only user cannot save search queries.
- A read-only user cannot makes changes in the Initial Configuration of Cisco Group-Based Policy Analytics, on page 538 window.
- A read-only user cannot export data because exporting data is an HTTPS POST operation.
- A read-only user can only perform search by group and is restricted from other search functions as they involve HTTPS POST operations.



CHAPTER 24

Configure IP-Based Access Control Policies

- IP-Based Access Control Policies, on page 549
- Workflow to Configure an IP-Based Access Control Policy, on page 550
- Configure Global Network Servers, on page 550
- Create an IP Network Group, on page 551
- Edit or Delete an IP Network Group, on page 551
- Create an IP-Based Access Control Contract, on page 551
- Edit or Delete an IP-Based Access Control Contract, on page 552
- Create an IP-Based Access Control Policy, on page 552
- Edit or Delete an IP-Based Access Control Policy, on page 554
- Deploy an IP-Based Access Control Policy, on page 554

IP-Based Access Control Policies

An IP-based access control policy controls the traffic going into and coming out of a Cisco device in the same way that an Access Control List (ACL) does. As with an ACL, an IP-based access control policy contains lists of permit and deny conditions that are applied to traffic flows based on various criteria, including protocol type, source IP address, destination IP address, or destination port number.

IP-based access control policies can be used to filter traffic for various purposes, including security, monitoring, route selection, and network address translation.

An IP-based access control policy has two main components:

- **IP Network Groups**: IP network groups comprise IP subnets that share the same access control requirements. These groups can be defined only in Cisco DNA Center. An IP network group may have as few as one IP subnet in it.

- **Access Contract**: An access contract is a common building block that is used in both IP-based and group-based access control policies. It defines the rules that make up the access control policies. These rules specify the actions (permit or deny) performed when traffic matches a specific port or protocol and the implicit actions (permit or deny) performed when no other rules match.

Workflow to Configure an IP-Based Access Control Policy

Before you begin

- Cisco ISE is not mandatory if you are adding groups within the **Policy** > **IP Based Access Control** > **IP Network Groups** window while creating a new IP-based access control policy.
- Make sure that you have defined the following global network settings and provision the device:
  - Network servers, such as AAA, DHCP, and DNS servers: See Configure Global Network Servers, on page 173.
  - Device credentials, such as CLI, SNMP, HTTP, and HTTPS: See Global Device Credentials Overview, on page 173.
  - IP address pools: See Configure IP Address Pools, on page 182.
  - Wireless settings as SSIDs, wireless interfaces, and wireless radio frequency profiles: See Configure Global Wireless Settings, on page 188.
  - Provision devices.

Step 1 Create IP network groups.

For more information, see Create an IP Network Group, on page 551.

Step 2 Create an IP-based access control contract.

An IP-based access control contract defines a set of rules between the source and destination. These rules dictate the action (allow or deny) that network devices perform based on the traffic that matches the specified protocols or ports. For more information, see Create an IP-Based Access Control Contract, on page 551.

Step 3 Create an IP-based access control policy. The access control policy defines the access control contract that governs traffic between the source and destination IP network groups.

For more information, see Create an IP-Based Access Control Policy, on page 552.

Configure Global Network Servers

You can define global network servers that become the default for your entire network.

Note You can override global network settings on a site by defining site-specific settings.

Step 1 Click the menu icon (≡) and choose **Design** > **Network Settings** > **Network**.

Step 2 In the **DHCP Server** field, enter the IP address of a DHCP server.

Note You can click the plus icon and enter both IPv4 and IPv6 addresses.

You must define at least one DHCP server in order to create IP address pools.

Step 3 In the **DNS Server** field, enter the domain name of a DNS server.

Note You can click the plus icon and enter both IPv4 and IPv6 addresses.

You must define at least one DNS server in order to create IP address pools.

Step 4 Click **Save**.

Create an IP Network Group

Step 1 Click the menu icon (≡) and choose **Policy** > **IP Based Access Control** > **IP Network Groups**.

Step 2 Click **Add Groups**.

Step 3 In the **Name** field, enter a name for the IP network group.

Step 4 In the **Description** field, enter a word or phrase that describes the IP network group.

Step 5 In the **IP Address or IP/CIDR** field, enter the IP addresses that make up the IP network group.

Step 6 Click **Save**.

Edit or Delete an IP Network Group

Step 1 Click the menu icon (≡) and choose **Policy** > **IP Based Access Control** > **IP Network Groups**.

Step 2 In the **IP Network Groups** table, check the check box next to the group that you want to edit or delete.

Step 3 Do one of the following tasks:

- To make changes to the group, click **Edit**. For field definitions, see Create an IP Network Group, on page 551. Make the desired changes and click **Save**.
- To delete the group, click **Delete** and then click **Yes** to confirm.

Create an IP-Based Access Control Contract

Step 1 Click the menu icon (≡) and choose **Policy** > **IP Based Access Control** > **Access Contract**.

Step 2 Click **Add Contract**.

Step 3 Enter a name and description for the contract.

Step 4 From the **Implicit Action** drop-down list, choose either **Deny** or **Permit**.

Step 5 From the **Action** drop-down list in the table, choose either **Deny** or **Permit**.

Step 6 From the **Port/Protocol** drop-down list, choose a port or protocol.

a) If Cisco DNA Center does not have the port or protocol that you need, click **Add Port/Protocol** to create your own.
b) In the **Name** field, enter a name for the port or protocol.
c) From the **Protocol** drop-down list, choose **UDP**, **TDP**, or **TCP/UDP**.
d) In the **Port Range** field, enter the port range.
e) If you want Cisco DNA Center to configure the port or protocol as defined, and not report any conflicts, check the **Ignore Conflict** check box.
f) Click **Save**.

Step 7 (Optional) To include more rules in your contract, click **Add** and repeat Step 5 and Step 6.

Step 8 Click **Save**.

Edit or Delete an IP-Based Access Control Contract

If you edit a contract that is used in a policy, the policy's state changes to **MODIFIED** in the **IP Based Access Control Policies** window. A modified policy is considered to be stale because it is inconsistent with the policy that is deployed in the network. To resolve this situation, you need to redeploy the policy to the network.

Step 1 Click the menu icon (≡) and choose **Policy** > **IP Based Access Control** > **Access Contract**.

Step 2 Check the check box next to the contract that you want to edit or delete and do one of the following tasks:

- To make changes to the contract, click **Edit**, make the changes, and, click **Save**. For field definitions, see Create an IP-Based Access Control Contract, on page 551.

  Note If you make changes to a contract that is used in a policy, you need to deploy the modified policy by choosing **Policy** > **IP Based Access Control** > **IP Based Access Control Policies**, checking the check box next to the policy name, and clicking **Deploy**.

- To delete the contract, click **Delete**.

Create an IP-Based Access Control Policy

Create an IP-based access control policy to limit traffic between IP network groups.

- Multiple rules can be added to a single policy with different configurations.
- For a given combination of IP groups and contract classifiers, rules are created and pushed to the devices. This count cannot exceed 64 rules as Cisco WLC limits an ACL to have a maximum of 64 rules.
- If a custom contract or the IP group that is used in a **Deployed** policy is modified, the policy is flagged with status as **Modified**, indicating that it is Stale and requires a redeployment for the new configurations to be pushed to the device.

Step 1 Click the menu icon (≡) and choose **Policy** > **IP Based Access Control** > **IP Based Access Control Policies**.

Step 2 Click **Add Policy**.

Step 3 Complete the following fields:

Field	**Description**
Policy Name	Name of the policy.
Description	Word or phrase that identifies the policy.
SSID	Lists FlexConnect SSIDs and non-FlexConnect SSIDs that were created during the design of SSIDs. If the selected SSID is configured in a FlexConnect mode, then the access policy is configured in FlexConnect mode. Otherwise, it will be configured in a regular way. **Note** If an SSID is part of one policy, that SSID will not be available for another policy. A valid site-SSID combination is required for policy deployment. You will not be able to deploy a policy if the selected SSID is not provisioned under any devices.
Site Scope	Sites to which a policy is applied. If you configure a wired policy, the policy is applied to all wired devices in the site scope. Likewise, if you configure a wireless policy for a selected service set identifier (SSID), the policy is applied to all of the wireless devices with the SSID defined in the scope. For more information, see Site Scope, on page 558.
Source	Origin of the traffic that is affected by the contract. From the **Source** drop-down list, choose an IP network group. If the IP network that you want is not available, click **+Group** to create one.
Contract	Rules that govern the network interaction between the source and destination in an ACL. Click **Add Contract** to define the contract for the policy. In the dialog box, click the radio button next to the contract that you want to use. Alternatively, you can select the permit (permit all traffic) or deny (deny all traffic) contract.
Destination	Target of the traffic that is affected by the contract. Click the **Destination** drop-down list, choose an IP network group. If the IP network that you want is not available, click **+Create IP Network Group** to create one.
Direction	Configures the relationship of the traffic flow between the source and destination. To enable the contract for traffic flowing from the source to the destination, select **One-Way**. To enable the contract for traffic flowing in both directions (from the source to the destination and from the destination to the source), select **Bi-directional**.

Step 4 (Optional) To create an IP network group, click **Create IP Network Group**.

Step 5 (Optional) To add another rule, click the plus sign.

Note To delete a rule, click **x**.

Step 6 (Optional) To reorder the sequence of the rules, drag and drop a rule in the order you want.

Step 7 Click **Deploy**.

The success message `IP-Based Access Control Policy has been created and deployed successfully` is displayed. Depending on the SSID selected, either a FlexConnect policy or a standard policy is created with different levels of mapping information and deployed. The **Status** of the policy is shown as **DEPLOYED**. A wireless icon next to the **Policy Name** shows that the deployed access policy is a wireless policy.

Edit or Delete an IP-Based Access Control Policy

If you need to, you can change or delete an IP-based access control policy.

Note If you edit a policy, the policy's state changes to **MODIFIED** on the **IP Based Access Control Policies** window. A modified policy is considered to be stale because it is inconsistent with the policy that was deployed in the network. To resolve this situation, you need to redeploy the policy to the network.

Step 1 Click the menu icon (≡) and choose **Policy** > **IP Based Access Control** > **IP Based Access Control Policies**.

Step 2 Check the check box next to the policy that you want to edit or delete and do one of the following tasks:

- To make changes, click **Edit**. When you are done, click **Save**. For field definitions, see Create an IP-Based Access Control Policy, on page 552.
- To delete the policy, click **Delete**.

Step 3 If you make changes to the policy, deploy the modified policy by checking the check box next to the policy name and clicking **Deploy**.

Deploy an IP-Based Access Control Policy

If you make changes that affect a policy's configuration, you need to redeploy the policy to implement these changes.

Step 1 Click the menu icon (≡) and choose **Policy** > **IP Based Access Control** > **IP Based Access Control Policies**.

Step 2 Locate the policy that you want to deploy.

Step 3 Check the check box next to the policy.

Step 4 Click **Deploy**.
You are prompted to deploy your policy immediately or to schedule it for a later time.

Step 5 Do one of the following:

- To deploy the policy immediately, click the **Run Now** radio button and click **Apply**.
- To schedule the policy deployment for a later date and time, click the **Schedule Later** radio button and define the date and time of the deployment.

Note The site time zone setting is not supported for scheduling application policy deployments.

CHAPTER 25

Configure Application Policies

- Application Policies Overview, on page 557
- Manage Application Policies, on page 570
- Manage Queuing Profiles, on page 580
- Manage Application Policies for WAN Interfaces, on page 581

Application Policies Overview

Quality of Service (QoS) refers to the ability of a network to provide preferential or deferential service to selected network traffic. By configuring QoS, you can ensure that network traffic is handled in such a way that makes the most efficient use of network resources while still adhering to the objectives of the business, such as guaranteeing that voice quality meets enterprise standards, or ensuring a high Quality of Experience (QoE) for video.

You can configure QoS in your network using application policies in Cisco DNA Center. Application policies comprise these basic parameters:

- **Application Sets**: Sets of applications with similar network traffic needs. Each application set is assigned a business relevance group (business relevant, default, or business irrelevant) that defines the priority of its traffic. QoS parameters in each of the three groups are defined based on Cisco Validated Design (CVD). You can modify some of these parameters to more closely align with your objectives.
- **Site Scope**: Sites to which an application policy is applied. If you configure a wired policy, the policy is applied to all the wired devices in the site scope. Likewise, if you configure a wireless policy for a selected service set identifier (SSID), the policy is applied to all of the wireless devices with the SSID defined in the scope.

Cisco DNA Center takes all of these parameters and translates them into the proper device CLI commands. When you deploy the policy, Cisco DNA Center configures these commands on the devices defined in the site scope.

Note Cisco DNA Center configures QoS policies on devices based on the QoS feature set available on the device. For more information about a device’s QoS implementation, see the corresponding device's product documentation.

CVD-Based Settings in Application Policies

The default QoS trust and queuing settings in application policies are based on the Cisco Validated Design (CVD) for Enterprise Medianet Quality of Service Design. CVDs provide the foundation for systems design based on common use cases or current engineering system priorities. They incorporate a broad set of technologies, features, and applications to address customer needs. Each one has been comprehensively tested and documented by Cisco engineers to ensure faster, more reliable, and fully predictable deployment.

The latest validated designs relating to QoS are published in the Cisco Press book, *End-to-End QoS Network Design: Quality of Service for Rich-Media & Cloud Networks*, 2nd Edition, available at: http://www.ciscopress.com/store/end-to-end-qos-network-design-quality-of-service-for-9781587143694. For additional information, see the following Cisco documentation:

- Cisco Validated Designs
- Enterprise Medianet Quality of Service Design 4.0
- Medianet Campus QoS Design 4.0
- Medianet WAN Aggregation QoS Design 4.0

Site Scope

A site scope defines the sites to which an application policy is applied. When defining a policy, you configure whether a policy is for wired or wireless devices. You also configure a site scope. If you configure a wired policy, the policy is applied to all the wired devices in the site scope. Likewise, if you configure a wireless policy for a selected service set identifier (SSID), the policy is applied to all of the wireless devices in the site scope with the SSID defined in the scope.

This allows you to make tradeoffs as necessary to compensate for differences in the behaviors between wired and wireless network segments. For example, wireless networks typically have lower bandwidth, lower speed, and increased packet loss in comparison to wired networks. Individual wireless segments may exhibit further variation due to local conditions of RF interference, congestion, and other factors, such as the varying capabilities of network devices. The ability to apply per-segment policies to individual wireless segments enables the adjustment of traffic-handling rules to ensure that the highest-priority traffic is least affected by degradation of the wireless network.

Business-Relevance Groups

A business-relevance group classifies a given application set according to how relevant it is to your business and operations.

Business-relevance groups are Business Relevant, Default, and Business Irrelevant, and they essentially map to three types of traffic: high priority, neutral, and low priority.

- **Business Relevant**: (High-priority traffic) The applications in this group directly contribute to organizational objectives, and as such, may include a variety of applications, including voice, video, streaming, and collaborative multimedia applications, database applications, enterprise resource applications, email, file transfers, content distribution, and so on. Applications designated as business relevant are treated according to industry best-practice recommendations, as prescribed in Internet Engineering Task Force (IETF) RFC 4594.

- **Default**: (Neutral traffic) This group is intended for applications that may or may not be business relevant, for example, generic HTTP or HTTPS traffic may contribute to organizational objectives at times, while at other times, such traffic may not. You may not have insight into the purpose of some applications, for instance, legacy applications or even newly deployed applications. Therefore, the traffic flows for these applications should be treated with the Default Forwarding service, as described in IETF RFC 2747 and 4594.

- **Business Irrelevant**: (Low-priority traffic) This group is intended for applications that have been identified as having no contribution towards achieving organizational objectives. They are primarily consumer-oriented or entertainment-oriented or both in nature. We recommend that this type of traffic be treated as a *Scavenger* service, as described in IETF RFCs 3662 and 4594.

Applications are grouped into application sets and sorted into business-relevance groups. You can include an application set in a policy as-is, or you can modify it to meet the needs of your business objectives and your network configuration.

For example, YouTube is member of the consumer-media application set, which is business-irrelevant (by default), because most customers typically classify this application this way. However, this classification may not be the true for all companies, for example, some businesses may be using YouTube for training purposes. In such cases, an administrator can move the YouTube application into the streaming-video application set, which is business relevant by default.

Consumers and Producers

You can configure relationships between applications such that when traffic from one application is sent to another application (thus creating a specific a-to-b traffic flow), the traffic is handled in a specific way. The applications in this relationship are called *producers* and *consumers*, and are defined as follows:

- **Producer**: Sender of the application traffic. For example, in a client/server architecture, the application server is considered the producer because the traffic primarily flows in the server-to-client direction. In the case of a peer-to-peer application, the remote peer is considered the producer.

- **Consumer**: Receiver of the application traffic. The consumer may be a client end point in a client/server architecture or it may be the local device in a peer-to-peer application. Consumers may be endpoint devices, but may, at times, be specific users of such devices (typically identified by IP addresses or specific subnets). There may also be times when an application is the consumer of another application's traffic flows.

Setting up this relationship allows you to configure specific service levels for traffic that matches this scenario.

Marking, Queuing, and Dropping Treatments

Cisco DNA Center bases its marking, queuing, and dropping treatments on IETF RFC 4594 and the business relevance category that you have assigned to the application. Cisco DNA Center assigns all of the applications in the Default category to the Default Forwarding application class and all of the applications in the Irrelevant Business category to the Scavenger application class. For applications in the Relevant Business category, Cisco DNA Center assigns traffic classes to applications based on the type of application. The following table lists the application classes and their treatments.

Table 49: Marking, Queuing, and Dropping Treatments

Business Relevance	Application Class	Per-Hop Behavior	Queuing and Dropping	Application Description
Relevant	VoIP[5]	Expedited Forwarding (EF)	Priority Queuing (PQ)	VoIP telephony (bearer-only) traffic; for example, Cisco IP phones.
	Broadcast Video	Class Selector (CS) 5	PQ	Broadcast TV, live events, video surveillance flows, and similar inelastic streaming media flows; for example, Cisco IP Video Surveillance and Cisco Enterprise TV. (Inelastic flows refer to flows that are highly drop sensitive and have no retransmission or flow-control capabilities or both.)
	Real-time Interactive	CS4	PQ	Inelastic high-definition interactive video applications and audio and video components of these applications; for example, Cisco TelePresence.
	Multimedia Conferencing	Assured Forwarding (AF) 41	Bandwidth (BW) Queue and Differentiated Services Code Point (DSCP) Weighted Random Early Detect (WRED)	Desktop software multimedia collaboration applications and audio and video components of these applications; for example, Cisco Jabber and Cisco Webex.
	Multimedia Streaming	AF31	BW Queue and DSCP WRED	Video-on-Demand (VoD) streaming video flows and desktop virtualization applications, such as Cisco Digital Media System.
	Network Control	CS6	BW Queue only[6]	Network control-plane traffic, which is required for reliable operation of the enterprise network, such as EIGRP, OSPF, BGP, HSRP, IKE, and so on.
	Signaling	CS3	BW Queue and DSCP	Control-plane traffic for the IP voice and video telephony infrastructure.
	Operations, Administration, and Management (OAM)	CS2	BW Queue and DSCP[7]	Network operations, administration, and management traffic, such as SSH, SNMP, syslog, and so on.
	Transactional Data (Low-Latency Data)	AF21	BW Queue and DSCP WRED	Interactive (foreground) data applications, such as enterprise resource planning (ERP), customer relationship management (CRM), and other database applications.
	Bulk Data (High-Throughput Data)	AF11	BW Queue and DSCP WRED	Noninteractive (background) data applications, such as email, file transfer protocol (FTP), and backup applications.

Business Relevance	Application Class	Per-Hop Behavior	Queuing and Dropping	Application Description
Default	Default Forwarding (Best Effort)	DF	Default Queue and RED	Default applications and applications assigned to the default business-relevant group. Because only a small number of applications are assigned to priority, guaranteed bandwidth, or even to differential service classes, the vast majority of applications continue to default to this best-effort service.
Irrelevant	Scavenger	CS1	Minimum BW Queue (Deferential) and DSCP	Nonbusiness related traffic flows and applications assigned to the business-irrelevant group, such as data or media applications that are entertainment-oriented. Examples include YouTube, Netflix, iTunes, and Xbox Live.

[5] VoIP signaling traffic is assigned to the Call Signaling class.
[6] WRED is not be enabled on this class because network control traffic should not be dropped.
[7] WRED is not enabled on this class because OAM traffic should not be dropped.

Service Provider Profiles

Service provider (SP) profiles define the class of service for a particular WAN provider. You can define 4-class, 5-class, 6-class, and 8-class models.

When application policies are deployed on the devices, each SP profile is assigned a certain service-level agreement (SLA) that maps each SP class to a DSCP value and a percentage of bandwidth allocation.

You can customize the DSCP values and the percentage of bandwidth allocation in a SP profile when configuring an application policy.

After you create the SP profile, you need to configure it on the WAN interfaces.

Table 50: Default SLA Attributes for SP Profiles with 4 Classes

Class Name	DSCP	Priority Class	SLA	
			Bandwidth (%)	Remaining Bandwidth (%)
Voice	EF	Yes	10	—
Class 1 Data	AF31	—	—	44
Class 2 Data	AF21	—	—	25
Default	0	—	—	31

Table 51: Default SLA Attributes for SP Profiles with 5 Classes

Class Name	DSCP	Priority Class	SLA	
			Bandwidth (%)	Remaining Bandwidth (%)
Voice	EF	Yes	10	—
Class 1 Data	AF31	—	—	44
Class 2 Data	AF21	—	—	25
Class 3 Data	AF11	—	—	1
Default	Best Effort	—	—	30

Table 52: Default SLA Attributes for SP Profiles with 6 Classes

Class Name	DSCP	Priority Class	SLA	
			Bandwidth (%)	Remaining Bandwidth (%)
Class 1 Data	AF31	—	—	10
Class 3 Data	AF11	—	—	1
Video	AF41	—	—	34
Voice	EF	Yes	10	—
Default	0	—	—	30
Class 2 Data	AF21	—	—	25

Table 53: Default SLA Attributes for SP Profiles with 8 Classes

Class Name	DSCP	Priority Class	SLA	
			Bandwidth (%)	Remaining Bandwidth (%)
Network-Control Management	CS6	—	—	5
Streaming Video	AF31	—	—	10
Call Signalling	CS3	—	—	4
Scavenger	CS1	—	—	1
Interactive Video	AF41	—	—	30
Voice	EF	Yes	10	—

Class Name	DSCP	Priority Class	SLA	
			Bandwidth (%)	Remaining Bandwidth (%)
Default	0	—	—	25
Critical Data	AF21	—	—	25

Queuing Profiles

Queuing profiles allow you to define an interface's bandwidth allocation based on the interface speed and the traffic class.

Note Queuing profiles do not apply to WAN-facing interfaces that are connected to a service provider profile.

The following interface speeds are supported:

- 100 Gbps
- 10/40 Gbps
- 1 Gbps
- 100 Mbps
- 10 Mbps
- 1 Mbps

If the speed of an interface falls between two interface speeds, Cisco DNA Center treats the interface at the lower interface speed.

Note Cisco DNA Center attempts to detect the operational speed of the interface in order to apply the correct policy. However, if a switch port is administratively down, Cisco DNA Center cannot detect the speed. In this case, Cisco DNA Center uses the interface's supported speed.

You define a queuing policy as part of an application policy. When you deploy the application policy, the devices in the sites that are selected in the site scope are configured with the assigned LAN queuing policy. If no LAN queuing policy is assigned, the application policy uses the default CVD queuing policy.

If you change the queuing policy in an application policy that has already been deployed, the policy becomes stale, and you need to redeploy the policy for the changes to be configured on the devices.

Note the following additional guidelines and limitations of queuing policies:

- You cannot delete a LAN queuing profile if it is used in a policy.
- If you update a queuing profile that is associated with a policy, the policy is marked as stale. You need to redeploy the policy to provision the latest changes.

- Traffic class queuing customization does not affect interfaces on Cisco service provider switches and routers. You should continue to configure these interfaces without using Cisco DNA Center.

Table 54: Default CVD LAN Queuing Policy

Traffic Class	Default Bandwidth (Total = 100%)[8]
Business Relevant Voice	10%
Business Relevant Broadcast Video	10%
Business Relevant Real-Time Interactive	13%
Business Relevant Multimedia Conferencing	10%
Business Relevant Multimedia Streaming	10%
Business Relevant Network control	3%
Business Relevant Signaling	2%
Business Relevant OAM	2%
Business Relevant Transactional Data	10%
Business Relevant Bulk Data	4%
Business Relevant Scavenger	1%
Business Relevant Best Effort	25%

[8] We recommend that the total bandwidth for Voice, Broadcast Video, and Real-Time Interactive traffic classes equals no more than 33%.

Processing Order for Devices with Limited Resources

Some network devices have a limited memory (called TCAM) for storing network ACLs and access control entries (ACEs). So, because ACLs and ACEs for applications are configured on these devices, the available TCAM space is used. When the TCAM space is depleted, QoS settings for additional applications cannot be configured on that device.

To ensure that QoS policies for the most important applications get configured on these devices, Cisco DNA Center allocates TCAM space in the following order:

1. **Rank**: Number assigned to custom and favorite applications, but not to existing, default NBAR applications. The lower the rank number, the higher the priority. For example, an application with rank 1 has a higher priority than an application with rank 2, and so on. Having no rank is the lowest priority.

Note

- Custom applications are assigned rank 1 by default.
- If we mark the NBAR application as favorite, the rank is set to 1000.

2. **Traffic Class**: Priority based on the following order: Signaling, Bulk Data, Network Control, Operations Administration Management (Ops Admin Mgmt), Transactional Data, Scavenger, Multimedia Streaming, Multimedia Conferencing, Real Time Interactive, Broadcast Video, and VoIP Telephony.
3. **Popularity**: Number (1–10) that is based on CVD criteria. The popularity number cannot be changed. An application with a popularity of 10 has a higher priority than an application with a popularity of 9, and so on.

Note

- Custom applications are assigned popularity 0.
- Default NBAR applications are assigned a popularity number (1–10) that is based on CVD criteria. When you mark an application as a favorite, this does not change the popularity number; only the rank is changed.

4. **Alphabetization**: If two or more applications have the same rank and popularity number, they are sorted alphabetically by the application's name, and assigned a priority accordingly.

For example, let us assume that you define a policy that has the following applications:

- Custom application, custom_realtime, which has been assigned rank 1 and popularity 10 by default.
- Custom application, custom_salesforce, which has been assigned rank 1 and popularity 10 by default.
- Application named corba-iiop, which is in the transactional data traffic class, and you have designated as a favorite, giving that application a ranking of 10,000 and popularity of 9 (based on CVD).
- Application named gss-http, which is in the Ops Admin Mgmt traffic class, and you have designated as a favorite, giving that application a ranking of 10,000 and popularity of 10 (based on CVD).
- All other, default NBAR applications, which have no rank, but will be processed according to their traffic class and default popularity (based on CVD).

According to the prioritization rules, the applications are configured on the device in this order:

Application Configuration Order	Reason
1. Custom application, custom_realtime	Custom applications are given highest priority. Given that the custom_salesforce and custom_realtime applications have the same rank and popularity, they are sorted alphabetically, custom_realtime before custom_salesforce.
2. Custom application, custom_salesforce	
3. Favorite application, gss-http	Because both of these applications have been designated as favorites, they have the same application ranking. So, Cisco DNA Center evaluates them according to their traffic class. Because gss-http is in the Ops Admin Mgmt traffic class, it is processed first, followed by the corba-iiop application, which is in the Transactional Data traffic class. Their popularity does not come into play because the processing order has been determined by their traffic class.
4. Favorite application, corba-iiop	

Application Configuration Order	Reason
5. All other, default NBAR applications	All other applications are next and are prioritized according to traffic class and then popularity, with the applications having the same popularity being alphabetized according to the application's name.

Policy Drafts

When you create a policy, you can save it as a draft without having to deploy it. Saving it as a draft allows you to open the policy later and make changes to it. You can also make changes to a deployed policy, and save it as a draft.

Note After you save or deploy a policy, you cannot change its name.

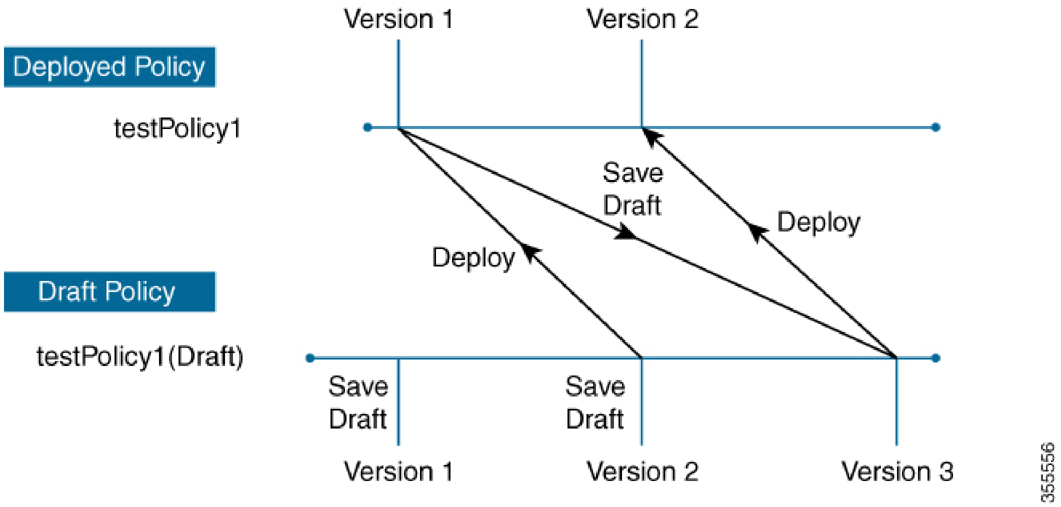
Draft policies and deployed policies are related to one another, but they have their own versioning.

When you save a policy as a draft, Cisco DNA Center appends the policy name with (Draft), and increments the version number. When you deploy a policy, Cisco DNA Center increments the version number of the deployed policy.

For example, as shown in the following figure, you create a policy named testPolicy1 and save it as a draft. The policy is saved as testPolicy1 (Draft), version number 1. You make a change to the draft and save it again. The policy has the same name, testPolicy1 (Draft), but its version number is incremented to 2.

You decide you like the policy, and you deploy it to the network. The policy is deployed with the name testPolicy1 and its version number is 1. You make a change to the deployed policy and save it as a draft. The draft policy, testPolicy1 (Draft), is incremented to version number 3. When you ultimately deploy that version, testPolicy1 is incremented to version 2.

Figure 45: Deployed Policy and Draft Policy Versioning



Any time you modify and save either a draft policy or a deployed policy, the draft policy version number is incremented. Similarly, any time you deploy either a draft policy or a modified deployed policy, the deployed policy version is incremented.

Just as with deployed policies, you can display the history of draft policies and roll them back to previous versions.

For more information about viewing the history of policy versions and rolling back to a previous version, see Policy Versioning, on page 567.

Policy Preview

Before you deploy a policy, you can generate the CLI that will be applied to a device.

The Preview operation generates the CLI commands for a policy, compares them with the CLI commands in the running configuration on the device, and returns only the remaining CLI commands that are required to configure the policy on the device.

After reviewing the preview output, you can deploy the policy to all of the devices in the scope, or you can continue to make changes to the policy.

Policy Precheck

When you create an application policy, you can verify if it will be supported on the devices in the site scope before you deploy it. The precheck function verifies if the device type, model, line cards, and software images support the application policy that you created. If any of these components are not supported, Cisco DNA Center reports a failure for the device. Cisco DNA Center also provides possible ways to correct the failures. If these remedies do not fix the failure, you can remove the device from the site scope.

If you deploy the application policy as-is, the policy will fail to deploy on the devices that reported a failure during the precheck process. To avoid the failure, you can remove the device from the site scope or update the device components to a level that the application policy supports. For a list of supported devices, see the Cisco DNA Center Compatibility Matrix.

Policy Scheduling

After you create or change a policy, you can deploy or redeploy the policy to the devices associated with it. You can deploy or redeploy a policy immediately or at a specific date and time, for example, on a weekend during off-peak hours. You can schedule a policy deployment for wired or wireless devices.

After you have scheduled a policy to be deployed, the policy and site scope are locked. You can view the policy, but you cannot edit it. If you change your mind about deploying the policy, you can cancel it.

Note When the scheduled event occurs, the policy is validated against the various policy components, for example, applications, application sets, and queuing profiles. If this validation fails, the policy changes are lost.

Policy Versioning

Policy versioning allows you to do the following tasks:

- Compare a previous version to the current (latest) one to see the differences.
- Display previous versions of a policy and select a version to reapply to the devices in a site scope.

Editing one version of a policy does not affect other versions of that policy or the components of the policy, such as the application sets that the policy manages. For example, deleting an application set from a policy does not delete the application set from Cisco DNA Center, other versions of that policy, or even other policies. Because policies and application sets exist independent of each other, it is possible to have a policy version that contains application sets that no longer exist. If you attempt to deploy or roll back to an older version of a policy that references an application set that no longer exists, an error occurs.

Note Policy versioning does not capture changes to applications (such as rank, port, and protocol), application set members, LAN queuing profiles, and sites.

Original Policy Restore

The first time that you deploy a policy to devices, Cisco DNA Center detaches the device's original Cisco Modular QoS CLI policy configurations, but leaves them on the device. Cisco DNA Center stores the device's original NBAR configurations in Cisco DNA Center. This allows you to restore the original Modular QoS CLI policies and NBAR configuration onto the devices later, if needed.

Note Because the Modular QoS CLI policies are not deleted from the device, if you remove these policies, you will not be able to restore them using the Cisco DNA Center original policy restore feature.

When you restore the original policy configuration onto a device, Cisco DNA Center removes the existing policy configuration that you deployed and reverts to the original configuration that was on the device.

Any Modular QoS CLI policy configurations that existed before you deployed application policies are reattached to the interfaces. However, queuing policies, such as multilayer switching (MLS) configurations, are not restored; instead, the devices retain the MLS configurations that were last applied through Cisco DNA Center.

After you restore the original policy configuration to the device, the policy that is stored in Cisco DNA Center is deleted.

Note the following additional guidelines and limitations for this feature:

- If the first attempt to deploy a policy to a device fails, Cisco DNA Center automatically attempts to restore the original policy configurations onto the devices.
- If a device is removed from an application policy after that policy has been applied to the device, the policy remains on the device. Cisco DNA Center does not automatically delete the policy or restore the QoS configuration on the device to its original (pre-Cisco DNA Center) configuration.

Stale Application Policies

An application policy can become stale if you change the configuration of something that is referenced in the policy. If an application policy becomes stale, you need to redeploy it for the changes to take affect.

An application policy can become stale for any of the following reasons:

- Change to applications referenced in an application set.
- Change to interfaces, such as SP Profile assignment, WAN subline rate, or WAN or LAN marking.
- Change to the queuing profile.
- New site added under a parent site in the policy.
- Device added to a site that is referenced by the policy.
- Devices moved between sites in the same policy.
- Change in interfaces exclusion/inclusion.
- Change in device Controller-Based Application Recognition (CBAR) status.

Application Policy Guidelines and Limitations

- Cisco DNA Center cannot learn multiple WLANs with the same SSID name on a wireless controller. At any point, Cisco DNA Center has only one entry for a WLAN with a unique name, although it is possible for the WLC to contain multiple entries with the same name and different WLAN profile names.

  You might have duplicate SSID names per WLC by design, or you might have inadvertently added a WLC with a duplicate SSID name using Cisco DNA Center. In either case, having duplicate SSID names per WLC is problematic for several features:

  - **Learn Config**: Cisco DNA Center learns only one randomly chosen SSID name per WLC and discards any remaining duplicate SSID names. (**Learn Config** is typically used in a brownfield scenario.)
  - **Application Policy**: When deploying an application policy, Cisco DNA Center randomly applies the policy to only one of the duplicate SSID names and not the others. In addition, policy restore, CLI preview, EasyQoS Fastlane, and PSK override features either fail or have unexpected outcomes.
  - **Multiscale Network**: In a multiscale network, multiple duplicate SSID names on multiple devices can cause issues. For example, one device has a WLAN configured as a nonfabric SSID, and a second device has the same WLAN, but it is configured as a fabric SSID. When you perform a **Learn Config**, only one SSID name is learned. The other SSID name from the other device is discarded. This behavior can cause conflicts, especially if the second device supports only fabric SSID names, but Cisco DNA Center is trying to perform operations on the device with nonfabric SSID names.
  - **IPACL Policy**: When deploying an IPACL policy, Cisco DNA Center randomly applies the policy to only one of the duplicate SSIDs. In addition, scenarios involving Flex Connect are also impacted.

- Cisco DNA Center does not recommend out-of-band (OOB) changes to device configurations. If you make OOB changes, the policy in Cisco DNA Center and the one configured on the device become inconsistent. The two policies remain inconsistent until you deploy the policy from Cisco DNA Center to the device again.
- The QoS trust functionality cannot be changed.
- Custom applications are not supported on the wireless controller. Therefore, custom applications are not selected while creating a wireless application policy.

- Make sure you delete the corresponding wireless application policy before deleting an SSID from design and reprovisioning the wireless controller.
- Wireless application for eWLC is not supported on SSID provisioned through learned configuration.
- Cisco DNA Center provides ACL-based Application Policy support for Cisco Catalyst IE 3300 Rugged Series switches and Cisco Catalyst IE 3400 Heavy Duty Series switches. You can deploy a maximum of eight port-based custom applications. However, there is no restriction for DSCP-based applications.

Note Cisco DNA Center does not support FlexConnect Local Switching mode for AireOS and eWLC platforms.

Manage Application Policies

The following sections provide information about how to manage application policies.

Prerequisites

To configure application policies, you must address the following requirements:

- Cisco DNA Center supports most Cisco LAN, WAN, and WLAN devices. To verify whether the devices and software versions in your network are supported, see the Cisco DNA Center Compatibility Matrix.
- Make sure that your Cisco network devices, such as the ISR-G2, ASR 1000, and Wireless LAN Controller, have the Application Visibility and Control (AVC) feature license installed. For information, see the *NBAR2 (Next Generation NBAR) Protocol Pack FAQ*.
- AVC support is available for switches running Cisco IOS-XE 16.9 only if auto-QoS is not configured on the switches. You must upgrade the switches with auto-QOS to Cisco IOS-XE 16.11 or later to get AVC support.
- For Cisco DNA Center to identify the WAN interfaces that need policies, you must specify the interface type (WAN), and optionally, its subline rate and service-provider Class-of-Service model. For more information, see Assign a Service Provider Profile to a WAN Interface, on page 582.
- Verify that the device roles that were assigned to devices during the discovery process are appropriate for your network. If necessary, change the device roles that are not appropriate. For more information, see Change the Device Role (Inventory), on page 96.

Create an Application Policy

This section provides information about how to create an application policy.

Before you begin

- Define your business objectives. For example, your business objective might be to improve user productivity by minimizing network response times or to identify and deprioritize nonbusiness applications. Based on these objectives, decide which business relevance category your applications fall into.
- Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

- Verify that the device roles that were assigned to devices during the discovery process are appropriate for your network. If necessary, change the device roles that are not appropriate. For more information, see Change the Device Role (Inventory), on page 96.
- Add devices to sites. For more information, see Add a Device to a Site, on page 90.
- If you plan to configure this policy with an SP profile for traffic that is destined for an SP, make sure that you have configured an SP profile. After creating the application policy, you can return to the SP profile and customize its SLA attributes and assign the SP profile to WAN interfaces. For more information, see Configure Service Provider Profiles, on page 187.

Step 1 Click the menu icon (≡) and choose **Policy** > **Application QoS** > **Application Policies**.

Step 2 Click **Add Policy**.

Step 3 In the **Application QoS Policy Name** field, enter a name for the policy.

Step 4 Click either the **Wired** or **Wireless** radio button.

Step 5 For wireless networks, select an SSID that is provisioned from the **SSID** drop-down list.

Step 6 Click **Site Scope** and check the check box next to the sites where you want to deploy the policy.

Note For policies of wired devices, you cannot select a site that is already assigned to another policy. For policies of wireless devices, you cannot select a site that is already assigned to another policy with the same SSID.

Step 7 For policies of wired devices, you can exclude devices or specific interfaces from being configured with the policy:

a) From the **Site Scope** pane, click ⚙ next to the site you are interested in.

   A list of devices in the selected scope is displayed.

b) Locate the device that you want to exclude and click the toggle button in the corresponding **Policy Exclusions** column.

c) To exclude specific interfaces, click **Exclude Interfaces**.

d) From the list of **Applicable Interfaces**, click the toggle button next to the interfaces that you want to exclude.

   By default, only the **Applicable Interfaces** are shown. You can choose **All** from the **Show** drop-down list to view all the interfaces.

e) Click **< Back to Devices in *Site-Name***.

f) Click **< Back to Site Scope**.

Step 8 For WAN devices, you can configure specific interfaces:

a) From the **Site Scope** pane, click ⚙ next to the desired site.

b) From the list of devices in the site, click **Configure** in the **SP Profile Settings** column next to the desired device.

   Note This option is only available for routers.

c) In the **WAN Interface** column, from the **Select Interface** drop-down list, choose an interface.

d) In the **Role** column, from the **Select Role** drop-down list, choose a role according to the type of interface you are configuring:

   - Physical interface: Choose **WAN**. This role is the only valid role for a physical interface.
   - Tunnel interface: Choose either **DMVPN Branch** or **DMVPN Hub**. If you choose **DMVPN Hub**, you can also define the bandwidth to its corresponding branches.

Note Make sure that the tunnel interfaces have been created on the devices before deploying these policy settings.

e) In the **Service Provider Profile** column, from the **Select Profile** drop-down list, choose an SP profile.
f) (Optional) If necessary, in the **Sub-Line Rate (Mbps)** column, enter the upstream bandwidth that the interface requires.
g) (Optional) To configure additional WAN interfaces, click **+** and repeat Step c through Step f.
h) Click **Save**.
i) Click **< Back to Site Scope**.

Step 9 From the **Site Scope** pane, click **OK**.

Step 10 (Optional) If the CVD queuing profile (CVD_QUEUING_PROFILE) does not meet your needs, create a custom queuing profile.

a) Click **Queuing Profiles**.
b) Select a queuing profile from the list in the left pane.
c) Click **Select**.

Step 11 (Optional) If this policy is for traffic that is destined for an SP, customize the SP profile SLA attributes:

a) Click **SP Profile**.
b) Choose an SP profile.
c) Customize the SLA attributes (**DSCP**, **SP Bandwidth %**, and **Queuing Bandwidth %**).

Step 12 (Optional) Configure the business relevance of the application sets used in your network.

Cisco DNA Center comes with application sets that are preconfigured into business-relevancy groups. You can keep this configuration or modify it by dragging and dropping an application set from one business-relevancy group to another.

Applications marked as a favorites are listed at the top of the application set. To change favorites, go to the Applications registry.

Step 13 (Optional) Customize applications by creating consumers and assigning them to applications, or by marking an application as bidirectional:

a) Expand the application group.
b) Click the gear icon ⚙ next to the desired application.
c) From the **Traffic Direction** area, click the **Unidirectional** or **Bi-directional** radio button.
d) To choose an existing consumer, from the **Consumer** drop-down list, choose the consumer that you want to configure. To create a new consumer, click **+ Add Consumer** and define the **Consumer Name**, **IP/Subnet**, **Protocol**, and **Port/Range**.
e) Click **OK**.

Step 14 Configure host tracking. Click the **Host Tracking** toggle button to turn host tracking on or off.

When deploying an application policy, Cisco DNA Center automatically applies ACL entries to the switches to which collaboration endpoints (such as Telepresence units or Cisco phones) are connected.

The ACE matches the voice and video traffic generated by the collaboration endpoint, ensuring that the voice and video traffic are correctly marked.

When host tracking is turned on, Cisco DNA Center tracks the connectivity of the collaboration endpoints within the site scope and to automatically reconfigure the ACL entries when the collaboration endpoints connect to the network or move from one interface to another.

When host tracking is turned off, Cisco DNA Center does not automatically deploy policies to the devices when a collaboration endpoint moves or connects to a new interface. Instead, you need to redeploy the policy for the ACLs to be configured correctly for the collaboration endpoints.

Step 15 (Optional) Preview the CLI commands that will be sent to devices. For more information, see Preview an Application Policy, on page 578.

Step 16 (Optional) Precheck the devices on which you plan to deploy the policy. For more information, see Precheck an Application Policy, on page 578.

Step 17 Do one of the following tasks:

- Save the policy as a draft by clicking **Save Draft**. For more information, see Policy Drafts, on page 566.
- Deploy the policy by clicking **Deploy**. You can deploy the policy now or schedule it for a later time.

  To deploy the policy now, click the **Now** radio button and click **Apply**.

  To schedule the policy deployment for a later date and time, click the **Later** radio button and define the date and time of the deployment. For more information, see Policy Scheduling, on page 567.

  Note Site time zone setting is not supported for scheduling application policy deployments.

View Application Policy Information

You can display various information about the application policies that you have created and deployed.

Before you begin

You must have at least one deployed application policy.

Step 1 Click the menu icon (≡) and choose **Policy** > **Application QoS** > **Application Policies**.

Step 2 Sort the policies by name, or filter them by name, status, or queuing profile.

Step 3 View the list of policies and the following information about each:

- **Policy Name**: Name of the policy.
- **Version**: Iteration of the policy. Each time a policy is deployed or saved as a draft, it is incremented by one version. For example, when you create a policy and deploy it, the policy is at version 1. If you change the policy and deploy it again, the version of the policy is incremented to version 2. For more information, see Policy Drafts, on page 566 and Policy Versioning, on page 567.
- **Policy Status**: State of the policy. If the policy applied on Cisco Catalyst 3850, Catalyst 4500, and Catalyst 9000 devices and is impacted by the port channel update (create/modify/delete), an alert is shown in the policy status.
- **Deployment Status**: State of the last deployment (per device). Presents a summary of the following
  - Devices that were successfully provisioned.
  - Devices that failed to be provisioned.
  - Devices that were not provisioned due to the deployment being terminated.

  Clicking the state of the last deployment displays the Policy Deployment window, which provides a filterable list of devices on which the policy is deployed. For each device, the following information is displayed:

  - Device details (name, site, type, role, and IP address)
  - Success deployment status. Clicking the gear icon next to the status launches the **Effective Marking Policy** window that shows the **Business Relevant** and **Business Irrelevant** applications and the traffic class queue in which they end up. For devices that have limited TCAM resources or an old NBAR protocol pack, only a subset of the applications that are included in the policy can be provisioned, and they are shown in the view.
  - Failure status shows the reason for the failure.

- **Scope**: Number of sites (not devices) that are assigned to the policy. For policies of wireless devices, the name of the SSID to which the policy applies is included.
- **LAN Queuing Profile**: Name of the LAN queuing profile that is assigned to the policy.

Edit an Application Policy

You can edit an application policy.

Before you begin

You must have created at least one policy.

Step 1 Click the menu icon (☰) and choose **Policy** > **Application QoS** > **Application Policies**.

Step 2 Use the **Filter** field to locate the policy that you want to edit.

Step 3 Click the radio button next to corresponding policy.

Step 4 From the **Actions** drop-down list, choose **Edit**.

Step 5 Make changes to the application policy, as needed.

Step 6 You can change the business relevance of an application by moving application set between business relevant, business irrelevant, and default groups.

For information about the application policy settings, see Create an Application Policy, on page 570.

Step 7 To update the queuing profile, click **Queuing Profiles**, and select a queuing profile from the list in the left pane.

Step 8 Click **Select**.

Step 9 Do one of the following tasks:

- Save the policy as a draft by clicking **Save Draft**. For more information, see Policy Drafts, on page 566.
- Deploy the policy by clicking **Deploy**. You can deploy the policy now or schedule it for a later time.

  To deploy the policy now, click the **Run Now** radio button and click **Apply**.

  To schedule policy deployment for a later date and time, click the **Schedule Later** radio button and define the date and time of the deployment. For more information, see Policy Scheduling, on page 567.

Note The site time zone setting is not supported for scheduling application policy deployments.

Save a Draft of an Application Policy

When creating, editing, or cloning a policy, you can save it as a draft so that you can continue to modify it later. You can also make changes to a deployed policy and save it as a draft.

Step 1 Click the menu icon (≡) and choose **Policy** > **Application QoS** > **Application Policies**.

Step 2 Create, edit, or clone a policy.

Step 3 Click **Save Draft**.

For more information, see Policy Drafts, on page 566.

Deploy an Application Policy

If you make changes that affect a policy's configuration, such as adding a new application or marking an application as a favorite, you must redeploy the policy to implement these changes.

Note Before deploying a policy, the Auto-QoS configuration is removed automatically from Cisco Catalyst 3650, Catalyst 3850, and Catalyst 9000 devices with Cisco IOS 16.x or later.

After creating custom applications, if CBAR is enabled for a device, the custom applications are configured automatically on the device. You must wait for the synchronization to the latest application registry to complete before deploying the application policy on the device. You can view the synchronization status in **Provision** > **Services** > **Service Catalog** > **Application Visibility**.

If CBAR is enabled for a device, while deploying the application policy, only the attribute sets and maps are configured on the device, because the custom applications are configured through CBAR.

Step 1 Click the menu icon (≡) and choose **Policy** > **Application QoS** > **Application Policies**.

Step 2 Use the **Filter** field to locate the policy that you want to deploy.

Step 3 Click the radio button next to the policy that you want to deploy.

Step 4 From the **Actions** drop-down list, choose **Deploy**.

a) If you redeploy the policy, you are prompted to take an appropriate action for the devices that were removed from the policy scope. Choose any one of the following actions:

- Delete policy from the devices (recommended)
- Remove devices from policy scope
- Remove devices from policy scope and restore devices to brownfield configuration

b) Click **Apply**.

Step 5 You are prompted to deploy your policy now, or schedule it for later. Do one of the following:

- To deploy the policy now, click the **Run Now** radio button and click **Apply**.
- To schedule policy deployment for a later date and time, click the **Schedule Later** radio button and define the date and time of the deployment.

Note The site time zone setting is not supported for scheduling application policy deployments.

Cancel a Policy Deployment

After you click **Deploy**, Cisco DNA Center begins to configure the policy on the devices in the site scope. If you realize that you made a mistake, you can cancel the policy deployment.

The policy configuration process is performed as a batch process, in that it configures 40 devices at a time. If you have 40 devices or fewer and you cancel a policy deployment, your devices might be configured anyway, because the deployment to the first batch of devices would have already taken place. However, if you have hundreds of devices, canceling the policy deployment can be useful when needed.

When you click **Abort**, Cisco DNA Center cancels the configuration process on devices whose configuration has not yet started, and changes the device status to **Policy Aborted**. Cisco DNA Center does not cancel the deployments that are in the process of being completed or have been completed. These devices retain the updated policy configuration and reflect the state of the policy configuration, whether it is Configuring, Successful, or Failed.

During a policy deployment, click **Abort** to cancel the policy configuration process.

Delete an Application Policy

You can delete an application policy if it is no longer needed.

Deleting policy deletes class maps, policy map, and association of policy map with wireless policy profile.

Step 1 Click the menu icon (≡) and choose **Policy** > **Application QoS** > **Application Policies**.

Step 2 Use the **Filter** field to locate the policy that you want to delete.

Step 3 Click the radio button next to the policy that you want to delete.

Step 4 From the **Actions** drop-down list, choose **Undeploy Policy**.

Step 5 In the **Undeploy Policy** window, click the **Delete policy from devices** radio button and click **Apply**.

Step 6 To confirm the deletion, click **OK**. Otherwise, click **Cancel**.

Step 7 When the deletion confirmation message appears, click **OK** again.

You can view the deletion status of the policies in the **Application QoS Policies** page. If the status shows deletion failed, do the following:

a) Click the failed state link under **Deployment Status** in the **Application QoS Policies** page.
b) In the **Undeployment Status** window, click **Retry** to delete the policy.

Clone an Application Policy

If an existing application policy has most of the settings that you want in a new policy, you can save time by cloning the existing policy, changing it, and then deploying it to a different scope.

Before you begin

You must have created at least one policy.

Step 1 Click the menu icon (≡) and choose **Policy** > **Application QoS** > **Application Policies**.

Step 2 Use the **Filter** field to locate the policy that you want to clone.

Step 3 Click the radio button next to the policy that you want to clone.

Step 4 From the **Actions** drop-down list, choose **Clone**.

Step 5 Configure the application policy, as needed. For information about the application policy settings, see Create an Application Policy, on page 570.

Step 6 Do one of the following tasks:

- Save the policy as a draft by clicking **Save Draft**. For more information, see Policy Drafts, on page 566.
- Deploy the policy by clicking **Deploy**. You can deploy the policy now or schedule it for a later time.

  To deploy the policy now, click the **Run Now** radio button and click **Apply**.

  To schedule the policy deployment for a later date and time, click the **Schedule Later** radio button and define the date and time of the deployment. For more information, see Policy Scheduling, on page 567.

  Note The site time zone setting is not supported for scheduling application policy deployments.

Restore an Application Policy

If you create or make changes to a policy and then decide that you want to start over, you can restore the original QoS configuration that was on the device before you configured it using Cisco DNA Center.

Step 1 Click the menu icon (≡) and choose **Policy** > **Application QoS** > **Application Policies**.

Step 2 Use the **Filter** field to locate the policy that you want to reset.

Step 3 Click the radio button next to the policy.

Step 4 From the **Actions** drop-down list, choose **Undeploy Policy**.

Step 5 In the **Undeploy Policy** window, click the **Restore devices to original configurations** radio button and click **Apply**.

Step 6 Click **OK** to confirm the change or **Cancel** to cancel it.

You can view the restoration status of the policies in the **Application QoS Policies** page. If the status shows restoration failed, do the following:

a) Click the failed state link under **Deployment Status** in the **Application QoS Policies** page.
b) In the **Undeployment Status** window, click **Retry** to restore the policy.

Reset the Default CVD Application Policy

The CVD configuration is the default configuration for applications. If you create or make changes to a policy and then decide that you want to start over, you can reset the applications to the CVD configuration. For more information about the CVD configuration, see Application Policies Overview, on page 557.

Step 1 Click the menu icon (≡) and choose **Policy** > **Application QoS** > **Application Policies**.

Step 2 Use the **Filter** field to locate the policy that you want to reset.

Step 3 Click the radio button next to the policy.

Step 4 From the **Actions** drop-down list, choose **Edit**.

Step 5 Click **Reset to Cisco Validated Design**.

Step 6 Click **OK** to confirm the change or **Cancel** to cancel it.

Step 7 Do one of the following tasks:

- To save a draft of the policy, click **Save Draft**.
- To deploy the policy, click **Deploy**.

Preview an Application Policy

Before you deploy a policy, you can generate the CLI that will be applied to a device and preview the configuration.

Step 1 Click the menu icon (≡) and choose **Policy** > **Application QoS** > **Application Policies**.

Step 2 Create or edit a policy, as described in Create an Application Policy, on page 570 or Edit an Application Policy, on page 574.

Step 3 Before deploying the policy, click **Preview**.

A list of the devices in the scope appears.

Step 4 Click **Generate** next to the device that you are interested in.

Cisco DNA Center generates the CLIs for the policy.

Step 5 Click **View** to view the CLIs or copy them to the clipboard.

Precheck an Application Policy

Before you deploy an application policy, you can check whether the devices in the site scope are supported. The precheck process includes validating a device's model, line cards, and software image.

Step 1 Click the menu icon (≡) and choose **Policy** > **Application QoS** > **Application Policies**.

Step 2 Create or edit a policy, as described in Create an Application Policy, on page 570 or Edit an Application Policy, on page 574.

Step 3 Click **Pre-check**.

Cisco DNA Center checks the devices and reports failures, if any, in the **Pre-Check Result** column. The **Errors** tab shows the devices that do not support this policy. The **Warnings** tab shows the restrictions or features that are not supported if you chose to deploy this policy in the device. You can still deploy the policy for the devices listed under **Warnings** tab. To resolve the failures, bring the devices into compliance with the specifications listed in the Cisco DNA Center Compatibility Matrix.

Display Application Policy History

You can display the version history of an application policy. The version history includes the series number (iteration) of the policy and the date and time on which the version was saved.

Step 1 Click the menu icon (≡) and choose **Policy** > **Application QoS** > **Application Policies**.

Step 2 Click the radio button next to the policy that interests you.

Step 3 From the **Actions** drop-down list, choose **History**.

Step 4 From the **Policy History** dialog box, you can do the following:

- To compare a version with the current version, click **Difference** next to the version that interests you.
- To roll back to a previous version of the policy, click **Rollback** next to the version that you want to roll back to.

Roll Back to a Previous Policy Version

If you change a policy configuration, and then realize that it is incorrect, or that is not having the desired affect in your network, you can revert to a policy that is up to five versions back.

Before you begin

You must have created at least two versions of the policy to roll back to a previous policy version.

Step 1 Click the menu icon (≡) and choose **Policy** > **Application QoS** > **Application Policies**.

Step 2 Click the radio button next to the policy that interests you.

Step 3 From the **Actions** drop-down list, choose **Show History**.

Previous versions of the selected policy are listed in descending order, with the newest version (highest number) at the top of the list and the oldest version (lowest number) at the bottom.

Step 4 (Optional) To view the differences between the selected version and the latest version of a policy, click **Difference** in the **View** column.

Step 5 When you determine the policy version that you want to roll back to, click **Rollback** for that policy version.

Note If the selected site scope changed between policy versions, rollback is not done on the current (latest) selected site. Only the policy content is rolled back.

Step 6 Click **Ok** to confirm the rollback procedure.

The rolled back version becomes the newest version.

Manage Queuing Profiles

The following sections provide details about the various tasks that you can perform to manage queuing profiles.

Create a Queuing Profile

Cisco DNA Center provides a default CVD queuing profile (CVD_QUEUING_PROFILE). If this queuing profile does not meet your needs, you can create a custom queuing profile.

Step 1 Click the menu icon (≡) and choose **Policy** > **Application QoS** > **Queuing Profiles**.

Step 2 Click **Add Profile**.

Step 3 In the **Profile Name** field, enter a name for the profile.

Step 4 Configure the bandwidth for each traffic class by using the slider, clicking the plus (+) or minus (-) sign, or entering a specific number in the field.

The number indicates the percentage of the total interface bandwidth that will be dedicated to the selected application class. Because the total bandwidth equals 100, adding bandwidth to one application class subtracts bandwidth from another application class.

An open lock icon indicates that you can edit the bandwidth for the application class. A closed lock indicates that you cannot edit it.

If you make a mistake, you can return to the CVD settings by clicking **Reset to Cisco Validated Design**.

The graph in the middle helps you visualize the amount of bandwidth that you are setting for each application class.

Step 5 (For advanced users) To customize the DSCP code points that Cisco DNA Center uses for each of the traffic classes, from the **Show** drop-down list, choose **DSCP Values** and configure the value for each application class by entering a specific number in the field.

To customize the DSCP code points required within an SP cloud, configure an SP profile.

Step 6 Click **Save**.

Edit or Delete a Queuing Profile

Step 1 Click the menu icon (≡) and choose **Policy** > **Application QoS** > **Queuing Profiles**.

Step 2 From the **Queuing Profile** pane, click the radio button next to the queuing profile that you want to edit or delete.

Step 3 Do one of the following tasks:

- To edit the profile, change the field values, except the profile name, and click **Save**. For information about the fields, see Create a Queuing Profile, on page 580.
- To delete the profile, click **Delete**.

  You cannot delete a queuing profile if it is referenced in an application policy.

Manage Application Policies for WAN Interfaces

The following sections provide details about the various tasks that you can perform to manage application profiles for WAN interfaces.

Customize Service Provider Profile SLA Attributes

If you do not want to use the default SLA attributes assigned to your SP profile by its class model, you can customize the SP profile SLA attributes to fit your requirements. For more information about the default SP profile SLA Attributes, see Service Provider Profiles, on page 561.

Before you begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery feature.

Step 1 Click the menu icon (☰) and choose **Policy** > **Application QoS** > **Application Policies**.

Step 2 Use the **Filter** field to locate the policy that you want to change.

Step 3 Select the radio button next to the policy.

Step 4 From the **Actions** drop-down list, choose **Edit**.

Step 5 Click **SP Profiles** and select an SP profile.

Step 6 You can modify the information in the following fields:

- **DSCP**: Differentiated Services Code Point (DSCP) value. Valid values are from 0 to 63.
  - Expedited Forwarding (EF)
  - Class Selector (CS): CS1, CS2, CS3, CS4, CS5, CS6
  - Assured Forwarding: AF11, AF21, AF41
  - Default Forwarding (DF)

  For more information about these DSCP values, see Marking, Queuing, and Dropping Treatments, on page 559.
- **SP Bandwidth %**: Percentage of bandwidth allocated to a specific class of service.
- **Queuing Bandwidth %**: Percentage of bandwidth allocated to each of the traffic classes. You can make one of the following changes:
  - To customize the queuing bandwidth, unlock the bandwidth settings by clicking the lock icon and adjust the bandwidth percentages.

- To calculate the queuing bandwidth automatically from the SP bandwidth, lock the queuing bandwidth settings by clicking the lock icon and then clicking **OK** to confirm. By default, Cisco DNA Center automatically distributes the queuing bandwidth percentage such that the sum of the queuing bandwidth for all of the traffic classes in an SP class aligns with the SP bandwidth percentage of that class.

Step 7 Click **OK**.

Assign a Service Provider Profile to a WAN Interface

If you have already created an application policy and now want to assign SP profiles to WAN interfaces, you can edit the policy and perform this configuration, including setting the subline rate on the interface, if needed.

Before you begin

If you have not created a policy, you can create a policy and assign SP profiles to WAN interfaces at the same time. For more information, see Create an Application Policy, on page 570.

Step 1 Click the menu icon (≡) and choose **Policy** > **Application QoS** > **Application Policies**.

Step 2 Use the **Filter** field to locate the policy that you want to edit.

Step 3 Click the radio button next to the policy.

Step 4 From the **Actions** drop-down list, choose **Edit**.

Step 5 From the **Site Scope** pane, click the gear icon next to the site you are interested in.

Step 6 Click **Configure** in the **SP Profile Settings** column for the device you are interested in.

Step 7 In the **WAN Interface** column, from the **Select Interface** drop-down list, choose an interface.

Step 8 In the **Role** column, from the **Select Role** drop-down list, choose a role according to the type of interface you are configuring:

- **Physical interface**: Choose **WAN**. This role is the only valid role for a physical interface.
- **Tunnel interface**: Choose either **DMVPN Branch** or **DMVPN Hub**. If you choose **DMVPN Hub**, you can also define the bandwidth to its corresponding branches.

  Note Make sure that the tunnel interfaces have been created on the devices before deploying these policy settings.

Step 9 In the **Service Provider Profile** column, click the **Select Profile** drop-down field and choose an SP profile.

Step 10 If necessary, in the **Sub-Line Rate (Mbps)** column, enter the upstream bandwidth that the interface requires.

Step 11 To configure additional WAN interfaces, click **+** and repeat Step 7 through Step 10.

Step 12 Click **Save**.

Step 13 Click **< Back to Site Scope**.

Step 14 Click **OK**.

Step 15 Click **Deploy**.

You are prompted to deploy your policy now or to schedule it for a later time.

Step 16 Do one of the following:

- To deploy the policy now, click the **Run Now** radio button and click **Apply**.
- To schedule policy deployment for a later date and time, click the **Schedule Later** radio button and define the date and time of the deployment.

Note The site time zone setting is not supported for scheduling application policy deployments.

CHAPTER 26

Configure Traffic-Copy Policies

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- Sources, Destinations, and Traffic Copy Destinations, on page 585
- Guidelines and Limitations of Traffic Copy Policy, on page 586
- Workflow to Configure a Traffic Copy Policy, on page 586
- Create a Traffic Copy Destination, on page 587
- Edit or Delete a Traffic Copy Destination, on page 587
- Create a Traffic Copy Contract, on page 587
- Edit or Delete a Traffic Copy Contract, on page 588
- Create a Traffic Copy Policy, on page 588
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Traffic Copy Policies

Using Cisco DNA Center, you can set up an Encapsulated Remote Switched Port Analyzer (ERSPAN) configuration such that the IP traffic flow between two entities is copied to a specified destination for monitoring or troubleshooting.

To configure ERSPAN using Cisco DNA Center, create a traffic copy policy that defines the source and destination of the traffic flow that you want to copy. You can also define a traffic copy contract that specifies the device and interface where the copy of the traffic is sent.

Note Because traffic copy policies can contain either scalable groups or IP network groups, throughout this guide, we use the term *groups* to refer to both scalable groups and IP network groups, unless specified otherwise.

Sources, Destinations, and Traffic Copy Destinations

Cisco DNA Center simplifies the process of monitoring traffic. You do not have to know the physical network topology. You only have to define a source and destination of the traffic flow and the traffic copy destination where you want the copied traffic to go.

- **Source**: One or more network device interfaces through which the traffic that you want to monitor flows. The interface might connect to endpoint devices, specific users of these devices, or applications. A source group comprises Ethernet, Fast Ethernet, Gigabit Ethernet, 10-Gigabit Ethernet, or port channel interfaces only.

- **Destination**: The IP subnet through which the traffic that you want to monitor flows. The IP subnet might connect to servers, remote peers, or applications.
- **Traffic Copy Destination**: Layer 2 or Layer 3 LAN interface on a device that receives, processes, and analyzes the ERSPAN data. The device is typically a packet capture or network analysis tool that receives a copy of the traffic flow for analysis.

Note At the destination, we recommend that you use a network analyzer, such as a Switch Probe device, or other Remote Monitoring (RMON) probe, to perform traffic analysis.

The interface type can be Ethernet, Fast Ethernet, Gigabit Ethernet, or 10-Gigabit Ethernet interfaces only. When configured as a destination, the interface can be used to receive only the copied traffic. The interface can no longer receive any other type of traffic and cannot forward any traffic except that required by the traffic copy feature. You can configure trunk interfaces as destinations. This configuration allows the interfaces to transmit encapsulated traffic.

Note There can be only one traffic copy destination per traffic copy contract.

Guidelines and Limitations of Traffic Copy Policy

The traffic copy policy feature has the following limitations:

- You can create up to 8 traffic copy policies, 16 copy contracts, and 16 copy destinations.
- The same interface cannot be used by more than one traffic copy destination.
- Cisco DNA Center does not show a status message to indicate that a traffic copy policy has been changed and is no longer consistent with the one that is deployed in the network. However, if you know that a traffic copy policy has changed since it was deployed, you can redeploy the policy.
- You cannot configure a management interface as a source group or traffic copy destination.

Workflow to Configure a Traffic Copy Policy

Before you begin

- To be monitored, a source scalable group that is used in a traffic copy policy needs to be statically mapped to the switches and their interfaces.
- A traffic copy policy destination group needs to be configured as an IP network group. For more information, see Create an IP Network Group, on page 551.

Step 1 Create a traffic copy destination.

This is the interface on the device where the traffic flow will be copied for further analysis. For information, see Create a Traffic Copy Destination, on page 587.

Step 2 Create a traffic copy contract.

The contract defines the copy destination. For information, see Create a Traffic Copy Contract, on page 587.

Step 3 Create a traffic copy policy.

The policy defines the source and destination of the traffic flow and the traffic copy contract that specifies the destination where the copied traffic is sent. For information, see Create a Traffic Copy Policy, on page 588.

Create a Traffic Copy Destination

Step 1 Click the menu icon (☰) and choose **Policy** > **Traffic Copy** > **Traffic Copy Destination**.

Step 2 Enter a name and description for the traffic copy destination.

Step 3 Select the device and one or more ports.

Step 4 Click **Save**.

Edit or Delete a Traffic Copy Destination

Step 1 Click the menu icon (☰) and choose **Policy** > **Traffic Copy** > **Traffic Copy Destination**.

Step 2 Check the check box next to the destination that you want to edit or delete.

Step 3 Do one of the following:

- To make changes, click **Edit**, make the necessary changes, and click **Save**.
- To delete the destination, click **Delete**.

Create a Traffic Copy Contract

Step 1 Click the menu icon (☰) and choose **Policy** > **Traffic Copy** > **Traffic Copy Contract**.

Step 2 Click **Add**.

Step 3 In the dialog box, enter a name and description for the contract.

Step 4 From the **Copy Destination** drop-down list, choose a copy destination.

Note You can have only one destination per traffic copy contract.

If no copy destinations are available for you to choose, you can create one. For more information, see Create a Traffic Copy Destination, on page 587.

Step 5 Click **Save**.

Edit or Delete a Traffic Copy Contract

Step 1 Click the menu icon (≡) and choose **Policy** > **Traffic Copy** > **Traffic Copy Contract**.

Step 2 Check the check box next to the contract that you want to edit or delete.

Step 3 Do one of the following:

- To make changes, click **Edit**, make the necessary changes, and click **Save**.
- To delete the contract, click **Delete**.

Create a Traffic Copy Policy

Step 1 Click the menu icon (≡) and choose **Policy** > **Traffic Copy** > **Traffic Copy Policies**.

Step 2 Click **Add Policy**.

Step 3 In the **Policy Name** field, enter a name.

Step 4 In the **Description** field, enter a word or a phrase that identifies the policy.

Step 5 In the **Contract** field, click **Add Contract**.

Step 6 Click the radio button next to the contract that you want to use and then click **Save**.

Step 7 Drag and drop groups from the **Available Groups** area to the **Source** area.

Step 8 Drag and drop groups from the **Available Groups** area to the **Destination** area.

Step 9 Click **Save**.

Edit or Delete a Traffic Copy Policy

Step 1 Click the menu icon (≡) and choose **Policy** > **Traffic Copy** > **Traffic Copy Policies**.

Step 2 Check the check box next to the policy that you want to edit or delete.

Step 3 Do one of the following:

- To make changes, click **Edit**, make the necessary changes, and click **Save**.
- To delete the policy, click **Delete**.

PART VII

Monitor and Troubleshoot Your Network

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CHAPTER 27

Cisco AI Endpoint Analytics

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Cisco AI Endpoint Analytics Overview

Visibility is the first step towards securing an endpoint. Cisco AI Endpoint Analytics is an endpoint visibility solution that helps you identify and profile endpoints and Internet of Things (IoT) devices. The Cisco AI Endpoint Analytics engine enables you to assign labels to endpoints, using the telemetry information received from the network from various sources.

The profiling labels that are available in Cisco AI Endpoint Analytics are endpoint type, hardware model, manufacturer, and operating system type. This is called multifactor classification.

Cisco AI Endpoint Analytics provides nuanced visibility and enforcement in your network with features like Trust Scores that allow you to identify and act upon potentially risky endpoints and devices. You can also manage potential risks by applying ANC policies through Cisco ISE, from the Cisco AI Endpoint Analytics GUI. You can monitor and work around the issue of random and changing MAC addresses from endpoints in Cisco AI Endpoint Anaytics and accurately identify endpoints through a unique attribute called the DUID instead of MAC addresses.

Cisco AI Endpoint Analytics helps you gather endpoint telemetry from different sources. The primary source is the Network-Based Application Recognition (NBAR) mechanism. The NBAR mechanism is embedded in Cisco Catalyst 9000 Series switches (access devices) and performs deep packet inspection (DPI). Cisco AI Endpoint Analytics can also receive telemetry from Cisco DNA Traffic Telemetry Appliances.

You can gather endpoint context information from various sources such as Cisco ISE, self-registration portals, and configuration management database (CMDB) software such as ServiceNow.

Cisco AI Endpoint Analytics allows data inflow from a wide range of network devices, expanding your ability to easily identify and profile endpoints with greater accuracy, and act upon any anomalies. You can aggregate varied endpoint information and use the data to profile endpoints in Cisco AI Endpoint Analytics. After endpoints are profiled, AI and machine learning algorithms can also be used to reduce the number of unknown endpoints by intuitively leveraging different methods.

Key Features of Cisco AI Endpoint Analytics

- **Cisco AI Endpoint Analytics dashboard**

  The Cisco AI Endpoint Analytics dashboard gives you a comprehensive view of the endpoints that are connected to your network. You can view the number of known, unknown, profiled, and unprofiled endpoints, endpoints with low Trust Scores, and endpoints that use random MAC addresses. The AI Proposals dashlet displays intelligent profiling suggestions to enhance endpoint profiling and management.

- **Trust Scores to flag potentially risky endpoints**

  Cisco AI Endpoint Analytics assigns Trust Scores to endpoints to allow you to easily monitor and act on potentially risky endpoints in your network. Behavioral anomalies are monitored and tracked, and a Trust Score is assigned based on the number and frequency of the anomalies tracked. See Trust Scores for Endpoints, on page 607.

- **Detect endpoints that use random MAC addresses**

  Cisco AI Endpoint Analytics enables you to handle the issue of random and changing MAC addresses by receiving from Cisco ISE a unique endpoint identifier called the DUID (also known as GUID in Cisco ISE). Cisco AI Endpoint Analytics then uses the DUID as the identifier for an endpoint, instead of its MAC address.

- **Reduce net unknowns with machine learning capabilities**

  Cisco AI Endpoint Analytics provides profiling suggestions based on learnings from endpoint groupings. You can use these suggestions to reduce the number of unknown or unprofiled endpoints in your network.

- **Manage endpoints with system and custom profiling rules**

  Use Cisco-provided system rules and custom rules of your design to reliably profile and manage the endpoints connected to your network.

- **Registration of endpoints through Cisco AI Endpoint Analytics**

  You can onboard and profile endpoints using Cisco AI Endpoint Analytics. The endpoint attribute data that is collected through this registration process is used to profile the endpoints.

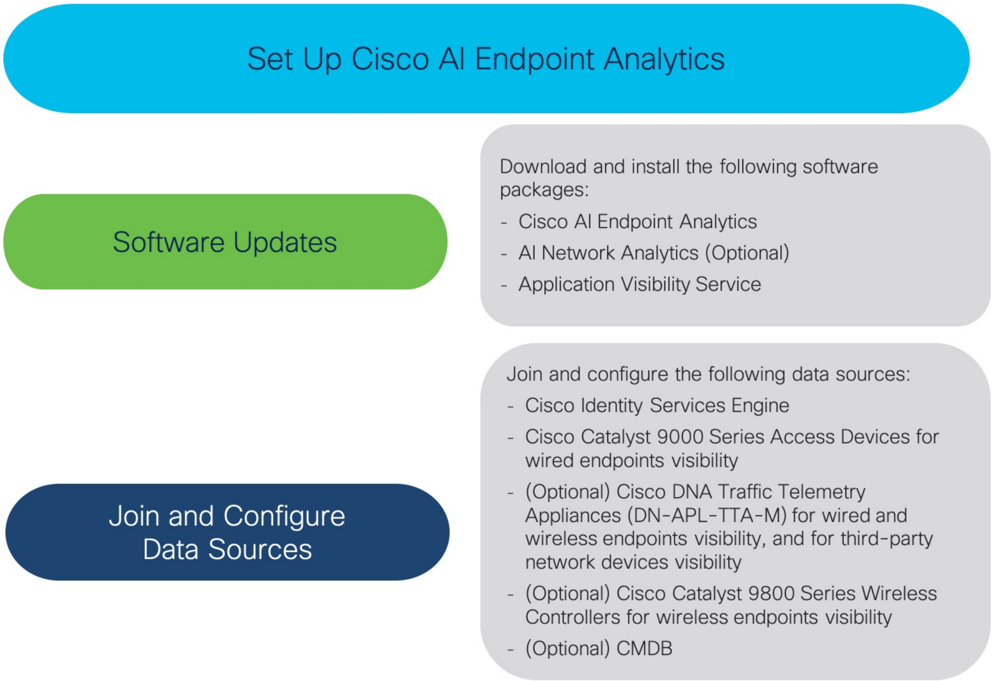
- **Registration of endpoints using external sources**

  You can connect some external sources of endpoint data, such as Configuration Management Databases (CMDB), to Cisco AI Endpoint Analytics. This allows you to easily register, manage, and profile endpoints in your network.

- **Purge endpoints after a defined period of inactivity**

  Define an Endpoint Purge Policy to remove from your network the endpoints that have been inactive for a defined time. You can define the period of inactivity after which an endpoint must be removed. You can also customize a purge policy to act on a particular set of endpoints based on a profiling attribute.

Set Up Cisco AI Endpoint Analytics in Cisco DNA Center


Set Up Cisco AI Endpoint Analytics
Software Updates
Join and Configure Data Sources

Download and install the following software packages:
- Cisco AI Endpoint Analytics
- AI Network Analytics (Optional)
- Application Visibility Service

Join and configure the following data sources:
- Cisco Identity Services Engine
- Cisco Catalyst 9000 Series Access Devices for wired endpoints visibility
- (Optional) Cisco DNA Traffic Telemetry Appliances (DN-APL-TTA-M) for wired and wireless endpoints visibility, and for third-party network devices visibility
- (Optional) Cisco Catalyst 9800 Series Wireless Controllers for wireless endpoints visibility
- (Optional) CMDB

Install Software Updates

Install software updates in Cisco DNA Center to use Cisco AI Endpoint Analytics, as described in the following procedure.

Step 1 Log in to Cisco DNA Center.

Step 2 Click the menu icon (☰) and choose **System** > **Software Updates**.

Step 3 In the **Updates** tab, check if **Cisco AI Endpoint Analytics**, **AI Network Analytics**, and **Application Visibility Service** are listed in the **Application Updates** section. If these application updates are visible, click the **Install All** button.

- Install the **Cisco AI Endpoint Analytics** update to access the endpoint profiling solution in your Cisco DNA Center.
- Install the **AI Network Analytics** update to use machine learning and AI capabilities to receive intelligent profiling suggestions.
- Install the **Application Visibility Service** update to use NBAR and Controller-Based Application Recognition (CBAR) techniques to inform endpoint profiling.

Step 4 If any of these updates are not listed in the **Updates** tab, click **Installed Apps** tab to check if the updates are already installed and are available for use. The **Installed Apps** tab also confirms if the software installation has been successful.

Connect and Enable Data Sources

Note The data sources that Cisco AI Endpoint Analytics uses may already be connected to your Cisco DNA Center. If the data sources are connected, see the following instructions to ensure that the data sources are available for use by Cisco AI Endpoint Analytics.

You must add Cisco ISE or Catalyst 9000 Series access devices to Cisco DNA Center for Cisco AI Endpoint Analytics to provide results.

1. **Connect Cisco ISE to Cisco DNA Center.**

   See the "Integrate Cisco ISE with Cisco DNA Center" section in "Complete First-Time Setup" in the *Cisco DNA Center Appliance Installation Guide*.

   The following Cisco ISE releases support Cisco AI Endpoint Analytics:

   - 2.4 Patch 11 and later
   - 2.6 Patch 5 and later
   - 2.7 Patch 1 and later
   - 3.0 and later releases

   In your Cisco ISE administration portal:

   a. Choose **Work Centers** > **Profiler** > **Settings**.

   b. In the **Endpoint Analytics Settings** area, check the following check boxes:

      - **Publish Endpoint Attributes to AI Endpoint Analytics**
      - **Consume Endpoint Profiles from AI Endpoint Analytics**

   After Cisco ISE authenticates endpoints through 802.1X or MAB authentication methods, the endpoint attributes collected are made available to Cisco AI Endpoint Analytics. Cisco ISE also shares telemetry data with Cisco AI Endpoint Analytics.

2. **Connect Cisco 9000 Series access devices to Cisco DNA Center for wired endpoints visibility.**

   See "Discover Your Network" in the *Cisco DNA Center User Guide*.

   To enable Cisco AI Endpoint Analytics features, upgrade your Cisco 9000 Series access devices to Cisco IOS-XE Release 17.6 or later.

   To enable CBAR for the required access devices, click the menu icon (☰) in Cisco DNA Center:

   a. Choose **Provision** > **Services** > **Application Visibility**.

   b. Select the Cisco Catalyst 9000 access device that you need data from. Check the check box next to the device name in the **Site Devices** section.

   c. Click **Enable CBAR**.

   d. Click **Yes** in the subsequent confirmation window

   e. In the **Enable CBAR** slide-in pane, check the check box next to the supported SSID type.

f. Click **Enable**.

3. **(Optional) Connect Cisco Catalyst 9800 Series Wireless Controllers to Cisco DNA Center for wireless endpoints visibility.**

   The following Cisco Catalyst 9800 Series Wireless Controller models are supported by Cisco AI Endpoint Analytics:

   - 9800-CL
   - 9800-40
   - 9800-80
   - 9800-L

   Cisco DNA Center Release 2.3.2 and later releases support FlexConnect in Cisco Catalyst 9800 Series Wireless Controllers with Cisco IOS XE Release 17.7.1 and later releases. SD-AVC version 6 is not supported.

   To configure and provision a Cisco Catalyst 9800 Series Wireless Controller in Cisco DNA Center, see Cisco Catalyst 9800 Series Wireless Controller Overview, on page 390.

4. **(Optional) Connect Cisco DNA Traffic Telemetry Appliances to Cisco DNA Center for wired and wireless endpoints visibility, and for third-party network device visibility.**

   Cisco DNA Traffic Telemetry Appliances (DN-APL-TTA-M) generate telemetry from mirrored network traffic for endpoint analytics. This appliance enables Network-Based Application Recognition (NBAR)-based protocol inspection and endpoint attribute extraction.

   To receive endpoint attributes collected through the telemetry appliance in Cisco AI Endpoint Analytics, you must integrate Cisco ISE with Cisco DNA Center.

   See Cisco DNA Traffic Telemetry Appliances for information on installing the appliances, connectivity configurations, and managing the appliances in Cisco DNA Center.

   Enable CBAR on Switched Port Analyzer (SPAN)-receiving ports of access switches connected to Cisco DNA Traffic Telemetry Appliances with the following command:

   ```
   ip nbar protocol-discovery
   ```

   Not all endpoints that are connected to the telemetry appliances are visible in Cisco AI Endpoint Analytics. Only endpoints that are also connected to Network Access Devices (NADs) which are managed in Cisco DNA Assurance, are visible in Cisco AI Endpoint Analytics.

5. **(Optional) Enable ServiceNow in Cisco DNA Center.**

   After connecting ServiceNow to Cisco DNA Center, click the menu icon in Cisco DNA Center and choose **Platform** > **Manage** > **Bundles**.

   If the **Status** of the bundle **Endpoint Attribute Retrieval with ITSM (ServiceNow)** is **New**, click **Enable** for the bundle.

6. **(Optional) Enable Cisco AI Analytics in Cisco DNA Center.**

   To receive suggestions about AI-based endpoint groupings, automated custom profiling rules, and endpoint labels, and to detect potentially spoofed devices in your network, you must enable the required settings in the **Cisco AI Analytics** window.

   You must install the AI Network Analytics software to receive these AI-based suggestions.

a. From the main menu of Cisco DNA Center, choose **System** > **Settings** > **External Services** > **Cisco AI Analytics**.

b. Click the toggle button for each of the following services that you want to enable:

    - **AI Endpoint Analytics**: AI Network Analytics leverages machine learning to drive intelligence in the network and enables you to effectively improve network performance and accelerate issue resolution. AI Network Analytics significantly reduces noise and false positives by analyzing network behavior and adapting to your network environment.

    - **Endpoint Smart Grouping**: Using AI and Machine Learning, Endpoint Smart Grouping reduces the number of unknown endpoints in your network by providing AI-based endpoint groupings, automated custom profiling rules, and crowdsourced endpoint labels.

    - **AI Spoofing Detection**: AI Spoofing Detection identifies spoofed endpoints based on behavioral models. Models are currently being built using collected flow information from devices. You can also enable data collection by Cisco by enabling the **Send data to help Cisco improve the model** toggle button, to help Cisco further enhance behavioral models.

Endpoint Telemetry Sources

Cisco AI Endpoint Analytics receives telemetry data in the following ways.

- **Deep Packet Inspection**

  Deep packet inspection is an advanced method of packet analysis that is carried out by Cisco Catalyst 9000 Series access devices. These access devices run NBAR, which inspects application traffic and performs protocol analysis to discover, identify, and profile endpoints with high fidelity.

  Deep packet inspection profiling is based on various attributes that are collected from endpoint traffic to the network. These attributes are collected across multiple protocols, from packet header layers 4 to 7.

- **Configuration Management Database Connection**

  Cisco AI Endpoint Analytics receives endpoint data from your Configuration Management Database Connection (CMDB) for greater accuracy in endpoint profiling. The connection with ServiceNow enables you to receive information from the CMDB to Cisco AI Endpoint Analytics.

- **Machine Learning Capabilities**

  Data collected for profiling is anonymized and sent to a Cisco cloud location that serves as a device data lake. Here, machine learning algorithms analyze the data available to create profiling rules that you can evaluate and apply, as needed. Smart profiling rules are suggested through Cisco AI Endpoint Analytics to help make endpoint profiling and management simpler and more efficient for you. Existing rules too are evaluated and improvement suggestions provided based on this continuous learning.

Cisco AI Endpoint Analytics Overview Window

Click the menu icon (≡) and choose **Policy** > **AI Endpoint Analytics**.

The **Overview** window displays the following dashlets:

- **Total Endpoints**

This dashlet displays the total number of endpoints in your network in two groups, **Fully Profiled** and **Missing Profiles**. Cisco AI Endpoint Analytics profiles endpoints based on four factors, Endpoint Type, OS Type, Hardware Model, and Hardware Manufacturer. If one or more of these factors are missing for an endpoint, it is profiled in the **Missing Profiles** group.

Click **Missing Profiles Labels** to view the number of endpoints in your network with missing profiles, categorized by profile label type. To check the endpoints with a specific missing profile label, click the number next to the profile label. The **Endpoint Inventory** tab is displayed with the corresponding list of endpoints.

- **AI Proposals**

  Cisco AI Endpoint Analytics uses smart grouping algorithms to group unknown endpoints in your network that have similar profiling data. If you have enabled AI Endpoint Analytics, you will receive the following types of rule proposals. These rule proposals are based on learnings from endpoint clusters:

  - New rules for profiling endpoints that may be similar.
  - Modification proposals for previously accepted rules.
  - Review of profiling rules that are no longer needed.

  For more details, see Cisco AI Rules or Smart Grouping, on page 627.

- **Trust Scores**

  The Trust Scores dashlet provides an overall view of the Trust Scores assigned to the endpoints in your network. See Trust Scores for Endpoints, on page 607.

- **Configuration**

  Click the **Configuration** link in the top-right corner of the Overview area to access the following configurations:

  - **Profile Rule Settings**: Schedule automatic updates for system profile rules. See Automatic System Rule Updates for Endpoint Profiling, on page 624.
  - **ISE Integration**: See Publish Authorization Attributes to Cisco ISE, on page 600.
  - **Trust Score Sources**: Click the toggle buttons to enable or disable Trust Score sources. You cannot disable the **Authentication Method** source. If an active Cisco ISE integration is configured, the authentication method used by the endpoint and its posture status will inform the Trust Score of an endpoint. You can enable or disable other sources of Trust Score data such as **AI Spoofing Detection** **Changed Profile Labels**, **NAT Mode Detection**, **Concurrent MAC Addresses**, and **Security Sensor**.

    See Trust Scores for Endpoints, on page 607.
  - **Endpoint Purge Policy**: See Endpoint Purge Policies, on page 601.
  - **Endpoint Subnet Inspection**: See Configure Endpoint Subnet Inspection, on page 602.

- **Endpoint MAC Randomization**

  The Endpoint MAC Randomization displays the number of static MAC addresses and random and changing MAC addresses in the network. See Trust Scores For Endpoints with Random and Changing MAC Addresses, on page 612.

Publish Authorization Attributes to Cisco ISE

Publish Cisco AI Endpoint Analytics profile data to Cisco ISE to authorize endpoint access to the network and for endpoint control. The attribute information that is shared by Cisco AI Endpoint Analytics is then easily accessible to a Cisco ISE administrator through the AI Endpoint Analytics dictionary. A Cisco ISE administrator can easily create authorization policies in Cisco ISE. The following attributes are shared with Cisco ISE:

1. The overall trust score and the score for each anomaly that is recorded.
2. CMDB attributes.
3. Multifactor profiling attributes—Hardware Manufacturer, Hardware Model, Operating System, and Endpoint Type.

If your Cisco DNA Center has an active integration with Cisco ISE Release 3.1 and later releases, and you want to publish authorization attributes to Cisco ISE, carry out the following tasks.

Enable Attribute Sharing in Cisco DNA Center

1. In the Cisco AI Endpoint Analytics **Overview** window, click **Configurations**.
2. Click **ISE Integration** from the left panel.
3. Click the **Enable Profile Publishing to ISE** toggle button to enable the feature.
4. Check the **Asset Topic Based Integration** or **Enhanced Authorization Integration** check boxes, or both, depending on which type of topic you want to use to publish attribute information to Cisco ISE.
5. Click **Save**.

Enable pxGrid Subscription in Cisco ISE

1. In the Cisco ISE GUI, click the menu icon and choose **Work Center** > **Profiler** > **Settings**.
2. If you are connected to Cisco ISE Release 3.1, in the **Endpoint Analytics Settings** area, check the following check boxes:
    - **Publish Endpoint Attributes to AI Endpoint Analytics**
    - **Consume Endpoint Profiles from AI Endpoint Analytics**

Verification

From the Cisco ISE main menu, choose **Administration** > **pxGrid Services** > **Diagnostics** > **WebSocket** > **Clients**. The newly created subscription containing `“com.cisco.ea.data.ise-<Cisco ISE node>”` is displayed in the **Subscription** column of the PSN nodes.

In the Cisco ISE **Policy** > **Policy Sets** window, a new dictionary that is named **Endpoint-Analytics** is visible in the Conditions Studio.

In the Cisco ISE **Context Visibility** > **Endpoints** window, click **MAC Address** for endpoint details. The attributes area of the details displays attributes that contain "EA-" prefixes for the attributes that are received from Cisco AI Endpoint Analytics.

Endpoint Purge Policies

Define an Endpoint Purge Policy to remove from your network the endpoints that have been inactive for a defined time. You can define the period of inactivity after which an endpoint must be removed. You can also customize a purge policy to act on a particular set of endpoints based on a profiling attribute. Purge policies are executed at 2 A.M. (server time) every day, and the endpoints that meet the defined purge requirements are removed from your network.

Registered endpoints and static endpoints that are imported into Cisco AI Endpoint Analytics are not affected by endpoint purge policies.

The Backup and Restore operation in your Cisco DNA Center and the endpoint purge activity cannot run simultaneously. If a Backup and Restore operation is in progress at 2 A.M., the purge activity is not initiated. If a Backup and Restore operation starts while an endpoint activity is in progress, the endpoint purge stops running, and the purge activity is left incomplete. The remaining endpoints are not acted on until the next purge is executed at 2 A.M. (server time) the next day.

To view, edit, or add endpoint purge policies, click the menu icon (≡) and choose **Policy** > **AI Endpoint Analytics** > **Configurations** > **Endpoint Purge Policy**. The following policies are available by default:

- **Default**
- **Random MAC Default**

You cannot edit these default policies. You can only enable or disable them.

Create a Purge Policy

Step 1 Click the menu icon (≡) and choose **Policy** > **AI Endpoint Analytics** > **Configurations** > **Endpoint Purge Policy**.

Step 2 Click **Add Endpoint Purge Policy**.

Step 3 In the **Add Endpoint Purge Policy** dialog box, click **Let's Do It** to start with the workflow.

Step 4 In the **Define Policy Details** window:

a. Enter a name for your policy in the **Rule Name** field.

b. From the **Select Status** drop-down list, choose **Enabled** or **Disabled**.

c. Define the time of inactivity after which an endpoint must be purged. Enter a value (in days) in the **Elapsed Greater than or Equal to** field. The accepted value range is from 5 to 180 days.

Step 5 Click **Next**.

Step 6 (Optional) In the **Define Additional Policy Conditions** window, choose the profiling attributes by which to filter the endpoints that are impacted by this purge policy. Check the check box next to the attribute you want to select and choose the required values in the drop-down lists displayed for the attribute.

Step 7 Click **Next**.

Step 8 The **Summary** window displays your Purge Policy configuration. Review the details that are displayed and click **Done** to create the policy.

What to do next

Audit Logs of Endpoint Purge Activities

After you enable an Endpoint Purge Policy and a purge activity is executed, you can view the audit logs of an endpoint purge activity:

1. Click the menu icon (≡) and choose **Activities** > **Audit Logs**.
2. Check the description fields of the audit logs to find the logs related to the execution of a purge policy.
3. Click the appropriate audit logs to view the details of the Purge Policy that was executed.

Configure Endpoint Subnet Inspection

In a deployment, devices at the access layer and devices above the access layer have different IP subnets. In the case of Cisco TTA devices, endpoint profiling accuracy is optimum when only southbound traffic is analyzed by Cisco AI Endpoint Analytics. To allow better endpoint profiling, configure specific IP subnets or subnet ranges that must be analyzed by Cisco AI Endpoint Analytics.

This configuration of filtered subnets is then shared with Cisco SD-AVC servers. The configuration is applied on Cisco TTA devices though Cisco SD-AVC servers.

Step 1 Click the menu icon (≡) and choose **Policy** > **AI Endpoint Analytics** > **Configurations** > **Endpoint Subnet Inspection**.

Step 2 Enter the required value in the **IP Subnet** field.

Step 3 Click **+** to add another IP subnet. You can add multiple subnets or subnet ranges in this window.

Endpoint Inventory

The endpoints that are connected to Cisco AI Endpoint Analytics through the data sources, in the **Endpoint Inventory** tab. The tab contains two views that you can choose from using the **Focus** drop-down list:

- **All Endpoints**: This is the default view for the Endpoint Inventory tab. This view displays the profiling information of all the connected endpoints.

  The **All Endpoints** view displays profiling information such as **Endpoint Type**, **OS Type**, **Is Random Mac**, **Trust Score**, and so on. To select the profiling information you want to view for the endpoints, click the vertical ellipsis icon at the top-right corner of the table. Choose one of the following sets of profiling information and click **Apply**:

  - **All**: All the profiling information that are available is displayed. You cannot edit this set.
  - **General**: This is a selection of profiling information that gives you a generic view of the endpoints. This is the set of columns displayed by default. You cannot edit this set.
  - **Detailed**: This is a selection of profiling information that provides a deeper view of the endpoints. You cannot edit this set.
  - **Custom**: This is the only set that you can edit. Check or uncheck the profiling information you want to view in the **Endpoint Inventory** window.

You can also filter the list endpoints displayed in the **All Endpoints** view by clicking the required **View Known Profiles** buttons. You can filter the list of endpoints by **Endpoint Type**, **Hardware Manufacturer**, **Hardware Model,** and **OS Type**.

- **Trust Score**: This view filters the endpoint inventory list to display only the endpoints with a Trust Score assigned to them.

  The **Trust Score** view displays columns for the various factors that inform the overall Trust Score of an endpoint. The Trust Score helps you identify the endpoints in which behavioral anomalies have been detected, so you can examine the details of the endpoint and take the necessary remediation actions. If you apply an ANC policy to an endpoint to manage its low Trust Score, the Trust Score view also displays the name of the ANC policy applied and when the policy was applied. See Trust Scores for Endpoints, on page 607.

You can easily filter a set of endpoints based on your requirement. You can register endpoints, and edit, delete, and profile registered endpoints. You can select single or multiple endpoints by checking the check box adjacent to the MAC addresses to filter and perform a particular action on the chosen endpoints from the **Actions** drop-down list.

To see the complete profiling details of an endpoint, click the **MAC Address** of the endpoint. A slide-in dialog box is displayed which contains user details, endpoint details, and attribute details of the endpoint.

In the **Details** tab, the following new fields are displayed in Cisco DNA Center Release 2.2.2 and later releases, with the details received from Cisco ISE:

- **Authentication Status**: This field displays **Started** when an endpoint is authenticated through Cisco ISE, and **Disconnected** when it is not.
- **Authorization Profile**: The authorization policies configured for an endpoint in Cisco ISE are displayed here.
- **Scalable Group Tag**: The Scalable Group Tags configured for an endpoint in Cisco ISE are displayed here.

For information on these attributes, see the Cisco ISE Administrator Guide for the Cisco ISE release that you use.

In Cisco DNA Center Release 2.2.2 and later releases, the **Trust Score** tab is available in the slide-in dialog box for endpoint details. This tab displays details of the various factors that inform trust score of an endpoint. See Trust Scores for Endpoints, on page 607.

In Cisco DNA Center Release 2.2.3 and later releases, the **Details** tab contains the **Previous MAC Addresses** area, which displays the MAC addresses that have been used by an endpoint which has the MAC Randomization feature enabled on it. See Trust Scores For Endpoints with Random and Changing MAC Addresses, on page 612.

Export Cisco AI Endpoint Analytics Data

To export a list of endpoints and their details from this window, click **Export**. If you apply any filters in the **Endpoint Inventory** window, only the filtered endpoints will be processed for export. To export the details of all the endpoints, ensure that no filters are applied when you click **Export.**

When you click **Export**, a new tab opens with the **Reports** window. The **Generated Reports** window contains a list of exports initiated, with the latest export request at the top of the list. A report generated from the Endpoint Inventory window contains **AI Endpoint Analytics** in its **Template Category** column. Report generation takes a few minutes. When a report is ready for download, the value in the **Last Run** column changes from **Not Initiated** to a timestamp with a download icon next to it. The timestamp refers to the time at which the export list was generated. Click the download icon to download a CSV file of the list of endpoints to your system.

You can also export Cisco AI Endpoint Analytics data from the **Reports** window, through the following steps:

Note You must run your first export of AI Endpoint Analytics data for endpoints from the **Endpoint Inventory** window. Then you can generate AI Endpoint Analytics reports directly from the **Reports** window.

1. Choose **Reports** from the main menu.
2. Click **Report Templates**, and choose **AI Endpoint Analytics** from the menu.
3. Click **Let's Do It** in the **Generate a New Report** dialog box.
4. In the **Select Report Template** window, the template **Endpoint Profiling** is applied by default. Click **Next**.
5. In the **Setup Report Scope** window, enter a value in the **Report Name** field. Define the filters that you want to apply to the list of endpoints to be exported from the **Endpoint Inventory** window. To export the details of all endpoints, do not choose any values in the **Scope** area. Click **Next**.
6. In the **Select File Type** window, the **Client Details** area allows you to review the chosen parameters. Edit the information to be exported by checking or unchecking the check boxes next to the relevant fields. Click **Next**.
7. In the **Schedule Report** window, click the radio button for **Run Now**, **Run Later (One-Time**, or **Run Recurring**. The **Run Later (One-Time** and **Run Recurring** options display scheduling fields to define the time of export. Click **Next**.
8. In the **Delivery and Notification** window, do not check the **Email Report** check box. Click **Next**.
9. In the **Summary** window, review all the configurations chosen in this workflow. To edit any configurations click the corresponding **Edit** option. Click **Next**.
10. The final window of the workflow informs you that your report is being generated. Click the **View Reports** link in this window for a list of generated reports. It takes a few minutes for the report to be generated and displayed in this window.

Filter Endpoints

Using the filter option, you can view and action upon a set of endpoints. These endpoints can you be filtered based their profiling data, primary profiling labels, known profiles, and health status.

In order to filter the endpoints, follow the below steps:

1. In the **Endpoint Inventory** window, click **Filter**.
2. Define the following filters by choosing a value from the corresponding drop-down list or clicking the radio button for the required value, as applicable:
    - **Mac Address**
    - **Trust Score**

- **Endpoint Type**
- **Hardware Model**
- **Hardware Manufacturer**
- **OS Type**
- **Registered**
- **Is Random Mac**

3. Click **Apply**.

You can also filter the profiled endpoints displayed by the four primary profiling labels. Click one or more of the labels in the **View Known Profiles** section.

The health status of endpoints is updated every five minutes.

Attribute Glossary

Attribute glossary is a list of all the profiling attributes available from Cisco ISE probe data.

In order to view all the profiling attributes, follow these steps:

1. In the **Endpoint Inventory** window, click the MAC address of an endpoint.
2. In the new area that is displayed on the right side, click **View Attribute Glossary**.

The **Attribute Glossary** window displays the following information for each attribute:

- **Key profiling attributes**
- **Description**
- **Associated Profile Labels**
- **Source**
- **Dictionary**
- **Discovery Method**

The glossary gives you a detailed view of all the profiling attributes. If a profiling attribute is frequently used to create a profile label, the label is listed in the **Associated Profile Labels** column.

You can also view the attribute glossary in the **Choose Attribute Condition** window while creating a logical condition for the rules. For more information, see Create a Custom Rule.

Register Endpoints

You can onboard and profile new endpoints by registering them in Cisco AI Endpoint Analytics. The profiling information of an endpoint is the source of truth for classification. You can also update new profile information for a registered endpoint using the **Register Endpoint** option.

Step 1 Choose **Actions** > **Register Endpoints**.

Step 2 Choose whether you want to register a single endpoint or multiple endpoints, by clicking the **Single** or **Bulk** radio button.

Option	Steps
Single	Enter the **MAC Address**, **Endpoint Type**, **Hardware Model** and **Hardware Manufacturer** for the endpoint.
Bulk	**a.** Download a .csv template by clicking the **Download .csv Template** option. **b.** In the downloaded .csv file, enter the following details for each endpoint you must register: MAC address, endpoint type, hardware model, and hardware manufacturer. Save this file. **c.** Upload the .csv file using the **Choose a File** option. You can register a maximum of 500 endpoints at a time using the **Bulk** option.

Step 3 Click **Next**.

Step 4 Review the endpoint details in the **Review Endpoint** window. You can also edit the endpoint details, if changes are required.

Note While registering an existing endpoint, the profile label changes of the endpoint are reflected in purple color and can be edited.

Step 5 Click **Next** to continue with the registration process.

Step 6 Click **Register**.

Edit Registered Endpoints

You can update the profiling information of registered endpoints from the **Endpoint Inventory** window.

Step 1 Check the check box adjacent to the MAC address of the endpoint that you want to edit.

Step 2 Click **Actions**.

Step 3 Click **Edit Endpoint**.

Step 4 Enter the **Endpoint Type**, **Hardware Model**, and **Hardware Manufacturer** details.

Step 5 Click **Save**.

Delete Registered Endpoints

If there are registered endpoints that are no a longer part of your network, you can delete them from Cisco AI Endpoint Analytics.

Step 1 Check the check box adjacent to the MAC address of the endpoints that you want to delete.

Step 2 Click **Actions**.

Step 3 Click **Delete Endpoint**.

The following message is displayed:

```
Do you really want to delete the selected endpoint(s)?
```

Step 4 Click **Yes** to permanently delete the endpoint from Cisco AI Endpoint Analytics.

Trust Scores for Endpoints

Cisco AI Endpoint Analytics assigns Trust Scores to endpoints to allow you to easily monitor and act on potentially risky endpoints in your network. Behavioral anomalies are monitored and tracked, and a Trust Score is assigned based on the number and frequency of the anomalies tracked.

To choose the sources that must be included in the calculation of Trust Scores, from the Cisco AI Endpoint Analytics **Overview** window, choose **Configuration** > **Enable Trust Sources**. Click the toggle button for each of the sources you want to enable.

Cisco AI Endpoint Analytics generates historical Trust Scores based on the following factors:

- The history of anomalies associated with an endpoint—how many anomalies have been detected for this endpoint?
- The severity of each anomaly detected for the endpoint.

In Cisco DNA Center Release 2.2.3 and later releases, the overall Trust Score calculation for an endpoint factors in the following anomalies and scores are displayed for each anomaly that is detected (if the corresponding source is enabled):

- **AI Spoofing Detection**

  Cisco AI Endpoint Analytics analyzes NetFlow telemetry data, and network probe data from Cisco ISE and SD-AVC devices, to detect spoofed endpoints. For more information on how to configure NetFlow Collector servers, see Configure Syslog, SNMP Traps, NetFlow Collector Servers, and Wired Client Data Collection Using Telemetry, on page 23. In Cisco DNA Center Release 2.3.2 and later releases, probe and NetFlow data from Cisco DNA Traffic Telemetry Appliances (DN-APL-TTA-M) is also analyzed. Configure inbound span of traffic toward your Cisco DNA Traffic Telemetry Appliances so the endpoint traffic data is then available to Cisco AI Endpoint Analytics for spoofing detection.

  Each endpoint type has a behavior model that is developed using machine learning algorithms. Based on the data received for an endpoint, if an endpoint's behavior is unexpected of its endpoint type profile, the endpoint is assigned a low Trust Score in the AI Spoofing Detection area. The applications and server ports that are used by an endpoint are analyzed in this spoofing detection process. For example, if an endpoint profiled as a printer uses a video calling application, it is identified as a spoofed endpoint and assigned a Trust Score.

  AI Spoofing Detection currently covers the following device types:

  - IP Phones
  - Printers
  - Cameras

    - Building automation devices with the following hardware model attributes:
        - Automated-Logic-Device
        - Honeywell-Device
        - Johnson-Controls-Device
        - Rockwell-Automation-Device
        - Schneider-Electric-Device
        - Siemens-Automation-Device
        - Siemens-Building-Device
        - Trane-Device

- **Changed Profile Labels**

  When a device joins a network, and then through periodic probing while the device is active, the profiling data for an endpoint is continuously monitored and updated. Certain changes in the profiling data that is received from an endpoint are flagged as anomalies in Cisco AI Endpoint Analytics. For example, if an endpoint was first profiled as a Linux device and is then profiled as a macOS device, this is flagged as a high-severity anomaly. A score is assigned in the Changed Profile Label column for the endpoint and the endpoint's overall Trust Score is also updated to reflect this change.

  However, if there is a change in the version of macOS and the endpoint appears to have downgraded from a later release to an earlier release, such a change is flagged as a lower priority anomaly and the corresponding scores are updated accordingly.

- **NAT Mode Detection**

  If you have a NAT-enabled router in your network, an endpoint that is connected to a NAT router is recognized by the IP or MAC addresses of the router instead of the IP or MAC addresses of the specific endpoint. Information on NAT-enabled routers is collected from the Cisco Catalyst 9000 Series devices they are connected to.

- **Concurrent MAC Addresses**

  Identify the endpoints that share the same MAC addresses and are connected to Cisco Catalyst 9000 Series devices. The endpoints with shared MAC addresses are assigned a Concurrent MAC Address score, and you can easily identify these endpoints and examine their details.

- **Security Sensor**

  The Security Sensor source is available from Cisco DNA Center Release 2.3.2. You can install active probes on specific Cisco Catalyst 9000 Series switches, and configure Cisco AI Endpoint Analytics to scan endpoints for open ports that are not expected to be open, for credential vulnerabilities or both.

The Trust Score of an endpoint is also informed by the following events that are collected from Cisco ISE. Every endpoint that authenticates through Cisco ISE receives an initial Trust Score based on the following events:

- **Authentication Method**
- **Posture**

Note For the Trust Score sources that receive data from Cisco Catalyst 9000 Series devices, you must enable CBAR on the devices and upgrade the devices to Cisco IOS-XE Release 17.6 or later.

The Trust Score that is displayed in the **Endpoint Inventory** window is the overall trust score that takes the history and severity of anomalies for an endpoint. Click the **MAC Address** to view the details of the causes for the Trust Score that is assigned to an endpoint. This means that if a low-level anomaly was detected for an endpoint, and this is the only instance of an anomaly, the overall Trust Score for the endpoint would be a 9, even if the actual Trust Score for with the anomalous event is a 7.

If multiple low-level anomalies are detected, the overall Trust Score would further decrease to account for the number of anomalies.

The trust scores assigned range from 1 through 10, and are categorized as follows:

Trust Score Category	Range	Threat Level of Endpoint
Low	1–3	High
Medium	4–6	Moderate
High	7–10	Low

You can then apply Adaptive Network Control (ANC) policies from Cisco ISE to enforce appropriate remediation actions on the endpoints. See section “Adaptive Network Control” in Chapter “Cisco ISE Admin Guide: Maintain and Monitor” of the *Cisco ISE Administrator Guide*.

The ANC policies are defined in Cisco ISE and allow you to apply remediation actions on chosen endpoints. You can apply ANC policies to quarantine, shut down, or port bounce an endpoint, or force endpoint reauthentication. When you apply an ANC policy to an endpoint with an undesirable Trust Score in Cisco AI Endpoint Analytics, a Change of Authorization (CoA) is sent to the endpoint from Cisco ISE.

An endpoint is identified by its MAC address. Cisco ISE sends the CoA to the endpoints that hold an active session for the identified MAC address at the time of the ANC application. Any endpoint with the same MAC address that does not have an active session in Cisco ISE at the time matches the ANC policy when a new session starts or when it must reauthenticate at the end of the configured reauthentication timer.

To verify which endpoint is being acted upon by the ANC policy, log in to your Cisco ISE administration portal. From the main menu, choose **Operations** > **RADIUS** > **Live Sessions**. Enter the MAC address of the spoofed endpoint in the **Endpoint ID** column, to filter the endpoints that share the same MAC address and currently have live sessions in Cisco ISE. These are the endpoints that will be affected by the ANC policy.

To view a historic log of the RADIUS sessions in Cisco ISE, from the main menu, choose **Operations** > **Reports** > **Reports** > **Endpoints and Users** > **RADIUS Authentications**.

To view or modify ANC policy application on endpoints in Cisco ISE, from the main menu, choose **Context Visibility** > **Endpoints**. Check the check box next to the MAC address of an endpoint and click the options that are displayed at the top of the list, as required.

Prerequisites

Prerequisites for receiving Trust Scores for endpoints:

- Cisco DNA Center is upgraded to Release 2.2.2 or later.

- Cisco ISE is connected to your on-premise Cisco DNA Center.
- Network access devices are managed by both Cisco DNA Assurance and Cisco ISE.

Note The endpoint spoofing detection feature supports a maximum of 500 network access devices with NetFlow export flows, as Cisco DNA Assurance supports only 500 NetFlow exporters.

- Endpoints connected to network access devices are authenticated through Cisco ISE.
- Enable the required sources for Trust Score calculation in the Trust Score Sources window (**Policy** > **AI Endpoint Analytics** > **Configurations** > **Trust Score Sources**).

Changed Profile Labels

Cisco AI Endpoint Analytics collects data from multiple probes from different sources continually to derive accurate profile labels for endpoints. Cisco AI Endpoint Analytics collects the following data from the following sources:

From Cisco ISE:

- RADIUS probes.
- User details from Directory.
- VPN details like AnyConnect availability.
- Optionally, other data if port forwarding is configured. For example, DHCP details.

From switches:

- Device connection messages. For example, DHCP and NetBIOS messages.
- Deep packet inspection
- Switch telemetry

Cisco AI Endpoint Analytics creates system rules based on the information received from these sources. When a device joins a network, and then through periodic probing while the device is active, the profiling data for an endpoint is continuously monitored and updated.

Certain changes in the profiling data received from the endpoint are flagged as anomalies in Cisco AI Endpoint Analytics. For example, if an endpoint was first profiled as a Linux device and is then profiled as a macOS device, this is flagged as a high-severity anomaly. A score is assigned in the Changed Profile Label column for the endpoint and the endpoint's overall Trust Score is also updated to reflect this change.

However, if there is a change in the sub-version of macOS and the endpoint appears to have downgraded from a later release to an earlier release, such a change is flagged as a lower priority anomaly and the corresponding scores are updated accordingly.

In the **Endpoint Inventory** window, click the MAC Address of an endpoint with a **Changed Profile Label** score to view the profiling data changes recorded. The old and new profiles for the endpoints are displayed here. If the profiling changes are not of concern for any reason, or if you think the profiling change detected is erroneous, reset the score by clicking the corresponding button in the **Changed Profile Label** area of the endpoint's details.

You can also disable Changed Profile Label detection for a specific endpoint by clicking the toggle button in the **Changed Profile Label** area of the endpoint's details.

Data regarding this anomaly is sent to Cisco ISE if the affected endpoint is connected to Cisco ISE. The data is available as an Endpoint Analytics dictionary attribute that a Cisco ISE administrator can easily use to define policies.

Changed Profile Label detection is not available for the endpoints that have Custom Rules applied to them.

NAT Mode Detection

Network Address Translation (NAT) allows private IP internetworks that use nonregistered IP addresses to connect to the Internet. NAT can be configured to advertise to the outside world only one address for the entire network. If you have a NAT-enabled router in your network, an endpoint connected to a NAT router is recognized by the IP or MAC addresses of the router instead of the IP or MAC addresses of the specific endpoint. Information on NAT-enabled routers is collected from the Cisco Catalyst 9000 Series devices they are connected to.

NAT detection is included in Trust Score calculation as a device acting as a NAC-enabled router could allow unauthorized endpoints to connect to your network. For the endpoints that are assigned a NAT Mode Detection score, in the **Endpoint Inventory** tab, click the MAC Address to view the details of the endpoint in a slide-in window. If you are certain that the identity of the endpoint corresponds to a NAT-enabled router in your network:

1. Click **NAT Mode Detection** in the Trust Score tab of the details slide-in window.
2. Click the toggle button to disable NAT Detection for this specific endpoint.

Endpoints With Concurrent MAC Addresses Connected to Cisco Catalyst 9000 Series Devices

Identify the endpoints that share the same MAC addresses and are connected to Cisco Catalyst 9000 Series devices. The issue of endpoints with concurrent MAC addresses occurs in wired environments and in hybrid environments that contain wired and wireless deployments. In a wireless environment, concurrent MAC addresses do not occur as only one endpoint with a specific MAC address is allowed to access the network at any time.

Cisco AI Endpoint Analytics allows you to identify the endpoints with concurrent MAC addresses by assigning a Concurrent MAC Address score to the endpoints. To detect endpoints with shared MAC addresses in your network, you must enable CBAR in the connected Cisco Catalyst 9000 Series devices.

When devices with the same MAC Address connect to a Cisco Catalyst 9000 Series device, the endpoints are recognized as concurrent endpoints and a low score is assigned to the MAC Address. Endpoints with concurrent MAC addresses may be connected to:

- The same Cisco Catalyst 9000 Series device from different VLANs
- Different Cisco Catalyst 9000 Series devices

Table 55: Environments In Which The Concurrent MAC Address Issue Occurs

Deployment 1	Deployment 2	Can Concurrent MAC Addresses Occur In The Network?	Concurrent MAC Addresses Detection Support in This Environment
Wired	Wired	Yes	Yes
Wired	Wireless	Yes	Yes
Wireless	Wired	Yes	Yes
Wireless	Wireless	No	No

In Cisco DNA Center Release 2.2.3 and later releases, the **Trust Scores** view of the **Endpoint Inventory** tab contains the **Concurrent MAC Address** column. Shared MAC addresses are detected as an anomaly and a low score is assigned in the **Concurrent MAC Address** column. Click the MAC Address to view a slide-in window with the details of the MAC Address. Click **Concurrent MAC Address** and the field expands to display information regarding the various sources of the MAC address.

In the **Concurrent MAC Address** area, the **Network Device Name** column displays the name of the Cisco Catalyst 9000 Series device to which an endpoint is connected. The **Interface** and **VLAN** columns display the corresponding values to help you identify how the endpoint is connected to the network.

Initial Trust Score Assessment using Posture and Authentication Values from Cisco ISE

When an endpoint authenticates through Cisco ISE, a Trust Score is immediately assigned to the endpoint based on its authentication and posture details. Authentication Method score is assigned by default and you cannot disable or act upon this score. You can choose to enable or disable Posture-based scores, either at a global level from the **Configurations** window, or for a particular endpoint in the **Endpoint Inventory** tab. The Trust Score that is assigned based on the Authentication Method and Posture values becomes the initial Trust Score for the endpoint.

Any other anomalous behaviors detected for this endpoint would then impact this initial Trust Score and drive it lower based on the severity and number of the anomalies.

The **Authentication Method** score, displayed in the details of an endpoint in the **Endpoint Inventory** tab, is based on the perceived security level of the authentication method used. For example, WebAuth Over HTTPS, certificate-based authentication, and authentication using secure tunnels receive high Trust Scores.

The **Posture** score is based on whether or not the connect endpoint is posture compliant.

If an endpoint's Trust Score consists of only the Authentication Method score, the **Reset Trust Score** button is inactive. When a Trust Score source other than the Authentication Method displays a score, you can use the reset option.

Trust Scores For Endpoints with Random and Changing MAC Addresses

As a privacy measure, mobile devices increasingly use random and changing MAC addresses for each SSID that they connect to. Some desktop operating systems offer users the ability to randomize MAC addresses at regular intervals as well. This means that an endpoint presents different MAC addresses every time they connect to a different SSID.

Cisco AI Endpoint Analytics enables you to handle the issue of random and changing MAC addresses by receiving from Cisco ISE a unique endpoint identifier called the DUID (also known as GUID in Cisco ISE). Cisco AI Endpoint Analytics then uses the DUID as the identifier for an endpoint, instead of its MAC address. For more information how GUIDs are assigned in Cisco ISE, see Cisco ISE Administration Guide, Release 3.1.

The Endpoint MAC Randomization dashlet in the Cisco AI Endpoint Analytics **Overview** window displays a graphical representation of how many endpoints in your network are using random and changing MAC addresses.

For the endpoints that are connected to Cisco ISE and have DUID information available, this information is displayed in Cisco AI Endpoint Analytics as well. The following columns display the required information in the **Endpoint Inventory** window in Cisco AI Endpoint Analytics:

- **DUID**: The DUID value for the endpoint.
- **Previous MAC Addresses**: The random and changing MAC addresses with which the endpoint previously connected to the network.

Using the DUID value, Cisco AI Endpoint Analytics is now able to reliably identify an endpoint and track the various MAC addresses that the endpoint has previously used. This means that the Trust Score for an endpoint with random and changing MAC addresses still has high fidelity. The Trust Score of the endpoint from a previous MAC addresses is carried forward to the current MAC address that the endpoint is presenting and continues to be impacted by the probe data received for the same endpoint.

If a device has the **Private Address** setting enabled, the **Is MAC Random** column for this device displays the value **Yes**. This device is then recognized as a random and changing MAC address. However, whether or not a DUID value is available for this device depends on whether or not the endpoint was authenticated through Cisco ISE and if a GUID was generated for this endpoint in Cisco ISE.

Sensor Scans to Check for Open Ports and Credential Vulnerabilities

Install an active probes container to gain more information about the endpoints in your network. When you enable security sensor scans, the Trust Score that is assigned to an endpoint takes into account any anomalies in open ports and endpoint login credentials.

The sensor scan feature is supported by the following switches:

- Cisco Catalyst 9300 Series switches
- Cisco Catalyst 9400 Series switches

Note Cisco Catalyst 9800 Series switches do not support the sensor scan feature.

Cisco AI Endpoint Analytics uses the Application Hosting capability that is available on the switches to enable scans for open ports and weak credentials.

Enable and Monitor Sensor Scans

Before you begin

- Connection to Cisco ISE Release 3.1 or later releases, if you want to enforce endpoint policies based on the scan results.
- Connection to Cisco Catalyst 9200, 9300, or 9400 Series devices
- Ensure that the switches are upgraded to Cisco IOS XE Release 17.7.1 or later releases.

Step 1 Log in to your Cisco DNA Center.

Step 2 From the main menu, choose **Policy** > **AI Endpoint Analytics**.

Step 3 In the **Overview** window that is displayed, click **Configurations**.

Step 4 From the left pane, choose **Trust Score Sources**.

Step 5 In the **Security Sensor** area, the prerequisites for using the sensor scans feature to identify open ports and weak endpoint credentials are displayed. Click the corresponding links in this area to carry out the following tasks:

a. Verify the supported Cisco DNA Center and Cisco IOS-XE releases from the release notes for Cisco Catalyst 9000 Series devices. Download the security sensor container from software.cisco.com for the relevant Cisco Catalyst 9000 Series device. A .tar file downloads to your system.

b. Install App Hosting in your Cisco DNA Center. See Application Hosting, on page 497 for instructions.

c. Upload the .tar file in your Cisco DNA Center App Hosting window. The link to the App Hosting window is displayed in the **Security Sensor** area.

d. Install and enable the .tar file in each Cisco Catalyst 9000 Series device that you want to enable sensor scans on.

In your Cisco DNA Center App Hosting window, check that the **App Hosting Status** is active for least one of the Cisco Catalyst 9000 Series devices on which you enabled the .tar file.

Step 6 After the active probes container is installed and enabled as explained in the previous step, in the **Security Sensor** area, you can configure Trust Score settings in Cisco AI Endpoint Analytics to scan for open ports and weak credentials on endpoints that are connected to Cisco ISE and the Cisco Catalyst devices on which the active probes application is enabled.

- Click the **Open Port Scan** toggle button to enable Cisco AI Endpoint Analytics to proactively run port scans to detect and close possible vulnerabilities on defined endpoints on the network.
- Click the **Credential Vulnerability Scan** toggle button to enable Cisco AI Endpoint Analytics to proactively detect when endpoints on your network are using weak credentials in order to prevent malicious activity.

Step 7 (Optional) If you choose to enable scanning for open ports, you can define the scan by clicking **Scan Configuration** in the **Open Port Scan** area.

a) In the **Scan Configuration** window, in the **Defined Scans** tab, click the **Define Scan** button.

b) A dialog box is displayed that allows you to define the scope of a port scan:

  - To scan each endpoint at the time of endpoint enrollment, choose the **On enrollment, scan all endpoints** radio button.
  - To define the scope of the open port scan by subnet, profiling attributes, and more, choose the **Create a Custom Scan** radio button.

In both types of port scan, you define a list of unauthorized ports to specify the ports that must always be closed. This list allows Cisco AI Endpoint Analytics to recognize anomalous port activity on an endpoint and assign it a low trust score. For both port scan types, the minimum frequency of scan that you can configure is 12 hours.

c) In the **Scan Configuration** window, in the **Open Ports List** tab, specify the type and range of ports, or individual ports, that must be scanned.
d) In the **Scan Configuration** window, in the **Unauthorized Ports** tab, define by port number and port type, the ports that are unauthorized in your network. If Cisco AI Endpoint Analytics detects these ports as active, the endpoint is given a low trust score for the anomaly of an active unauthorized port.

Step 8 (Optional) If you choose to enable the detection of weak credentials, you can define the scan by clicking **Scan Configuration** in the **Credential Vulnerability Scan** area. SSH and TELNET protocols are supported by this feature.

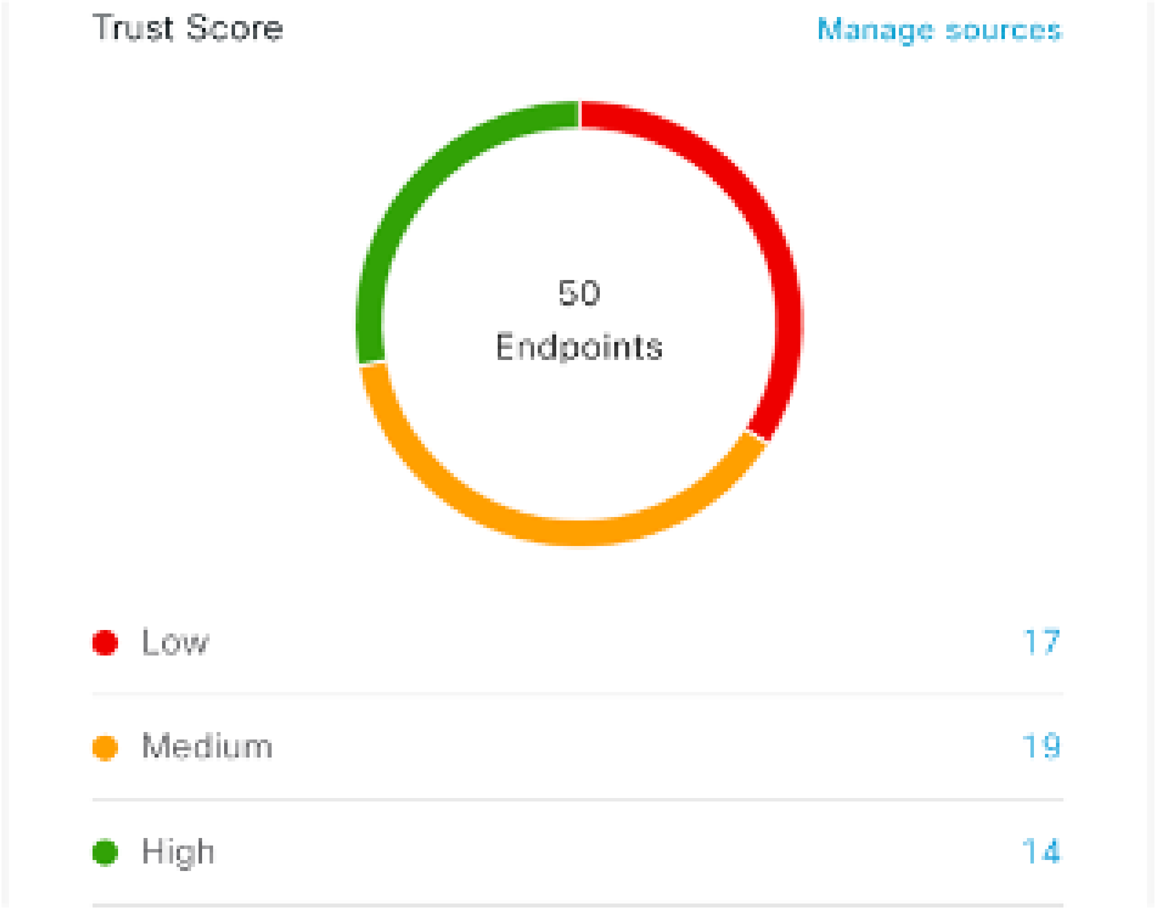
a) In the **Credential Vulnerability Scan** window, in the **Scan** tab, define a list of credentials that you want to identify as weak credentials. Define lists of usernames and passwords that are considered vulnerable according to your enterprise requirements.
b) In the **Credentials** tab, a default list of more than 3500 weak credentials is available by default. You can use this default list to create a credential vulnerability scan. To add a new list of vulnerable credentials, click **Create New List**.

The minimum frequency of credential vulnerability scan that you can configure is 12 hours.

Step 9 For the scans that you enable in the **Security Sensor**, the relevant endpoints are scanned and if anomalies are detected in open ports or credential checks, the Trust Score for these endpoints is adjusted accordingly. In the **Endpoint Inventory** tab, where applicable, the **Trust Score** tab for an endpoint displays the list of unauthorized ports that are open on the endpoint, or weak usernames, or both.

View and Manage Trust Scores for Endpoints

Figure 46: Trust Score Dashlet in Cisco AI Endpoint Analytics Overview Tab



After Cisco DNA Center is upgraded and necessary Trust Score sources are enabled, the Cisco AI Endpoint Analytics **Overview** tab (main menu > **Policy** > **AI Endpoint Analytics**) displays the **Trust Scores** dashlet. This dashlet contains the following information:

- The total number of endpoints that have been assigned a Trust Score.
- A donut chart and a list of the number of endpoints with low, medium, and high trust scores.

To view the details of endpoints in a trust score category, click its endpoint count in the **Trust Scores** dashlet. The **Trust Score** view of the **Endpoint Inventory** tab is displayed with the appropriate filters applied.

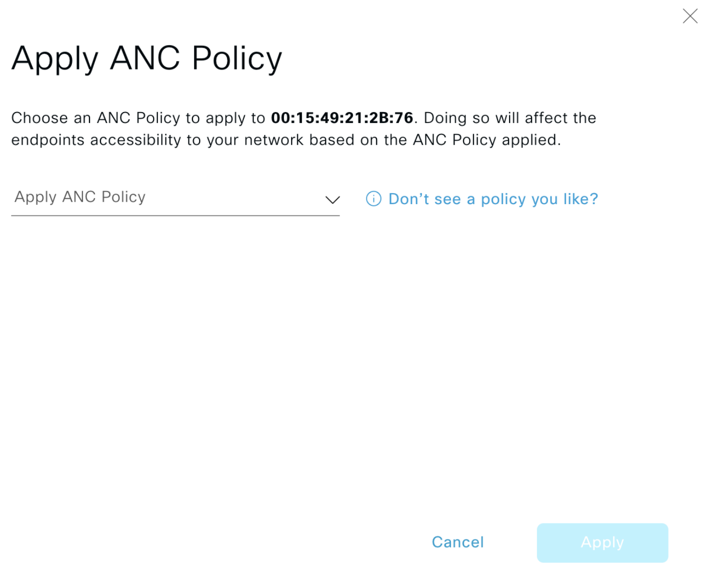
In the **Endpoint Inventory** tab, you can view endpoints with Trust Scores in two ways:

- Click the **Focus:** drop-down list and choose **Trust Score** to see all the endpoints with Trust Scores assigned.

- Click **View endpoints in Trust Score View** from the caution message that is displayed, to see endpoints with Low and Medium scores.

You can perform the following actions on endpoints with Trust Scores:

- **Apply an ANC Policy**

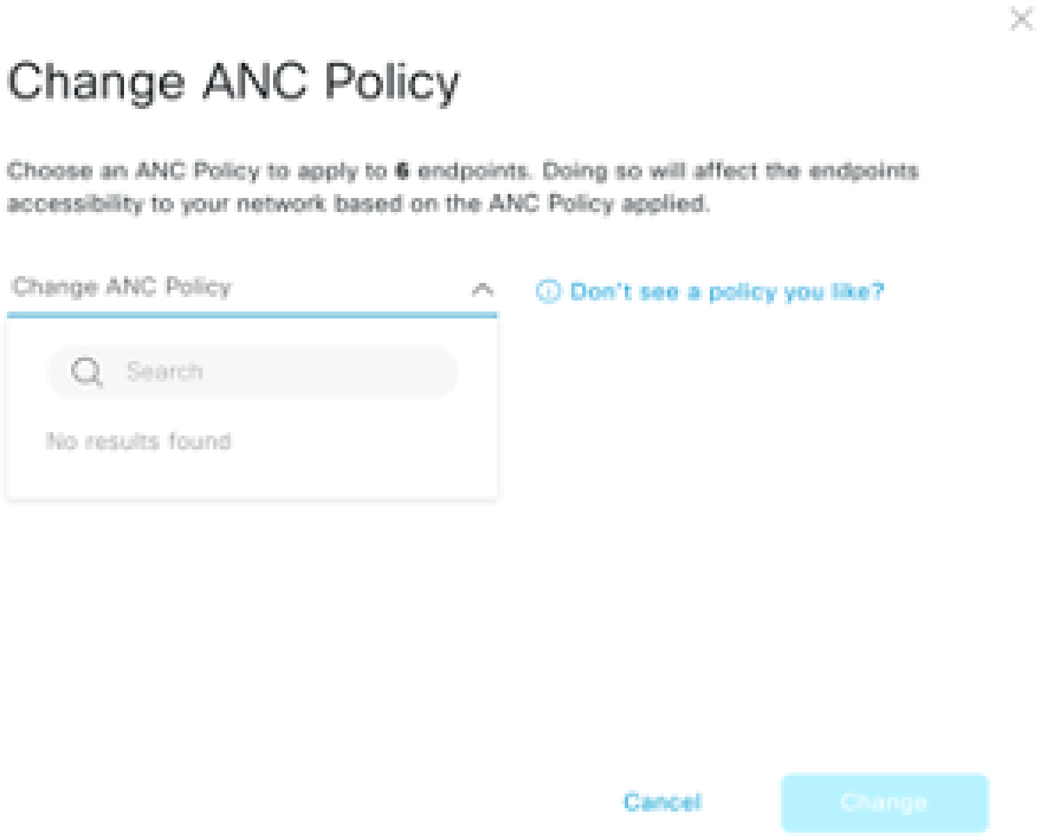


Apply ANC Policy

Choose an ANC Policy to apply to **00:15:49:21:2B:76**. Doing so will affect the endpoints accessibility to your network based on the ANC Policy applied.

Click the **Apply ANC Policy** button to choose an ANC policy to be applied to an endpoint. The endpoint's access to the network is modified accordingly. ANC policies are imported from Cisco ISE and displayed in the drop-down list in the pop-up window displayed.

- **Replace an ANC Policy**



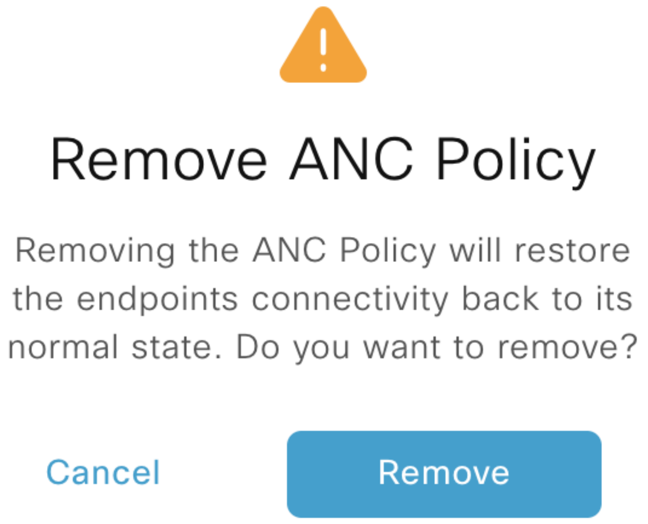
Change ANC Policy

Choose an ANC Policy to apply to **6** endpoints. Doing so will affect the endpoints accessibility to your network based on the ANC Policy applied.

Change ANC Policy
Don't see a policy you like?
Search
No results found
Cancel
Change

Click **Change ANC Policy** button to replace an existing ANC policy of an endpoint with another ANC policy. From the pop-up window displayed, choose the new policy to be applied from the **Change ANC Policy** drop-down list.

- **Remove an ANC Policy**

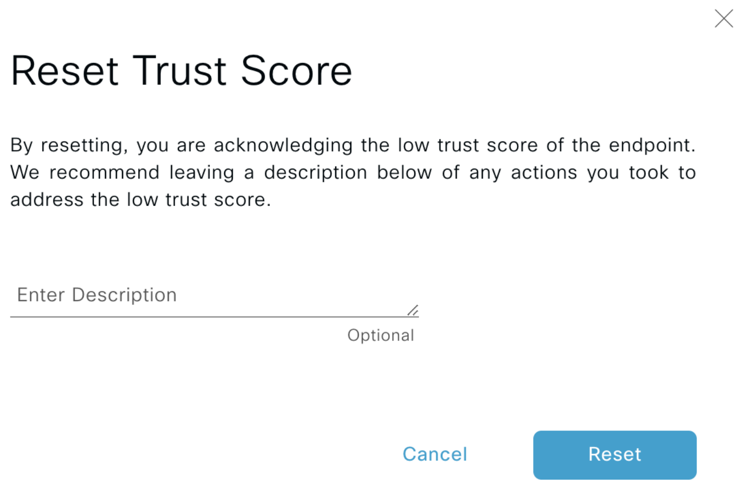

Remove ANC Policy

Removing the ANC Policy will restore the endpoints connectivity back to its normal state. Do you want to remove?

Click the **Remove ANC Policy** button to remove an applied ANC policy from an endpoint. In the pop-up window displayed, click **Remove**. This removes the remediation policy that was applied to the endpoint, and allows the endpoint to connect to the network normally.

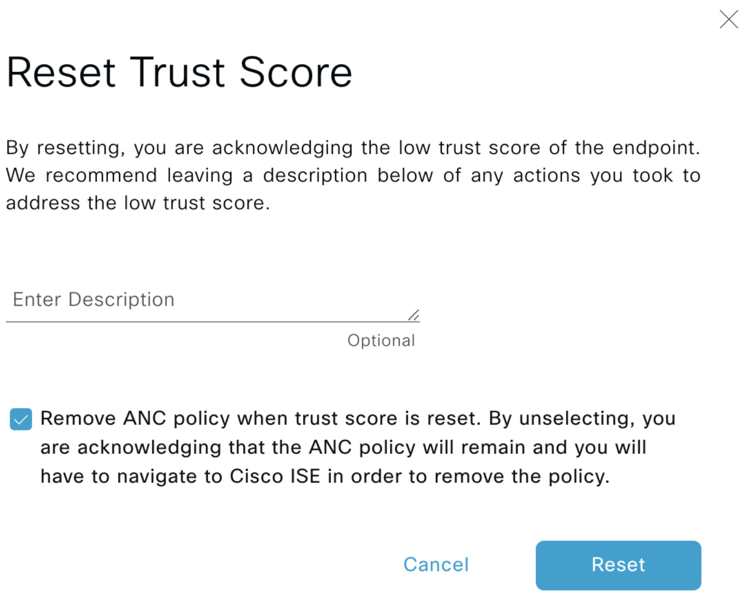
- **Reset Trust Score**

Figure 47: Reset Trust Score for an Endpoint Without an ANC Policy


Reset Trust Score

By resetting, you are acknowledging the low trust score of the endpoint. We recommend leaving a description below of any actions you took to address the low trust score.

Figure 48: Reset Trust Score for an Endpoint with an ANC Policy



Reset Trust Score

By resetting, you are acknowledging the low trust score of the endpoint. We recommend leaving a description below of any actions you took to address the low trust score.

Enter Description

Optional

☑ Remove ANC policy when trust score is reset. By unselecting, you are acknowledging that the ANC policy will remain and you will have to navigate to Cisco ISE in order to remove the policy.

Click **Reset Trust Score** button to remove an endpoint from the Trust Score inventory. In the pop-up window displayed, click **Reset**.

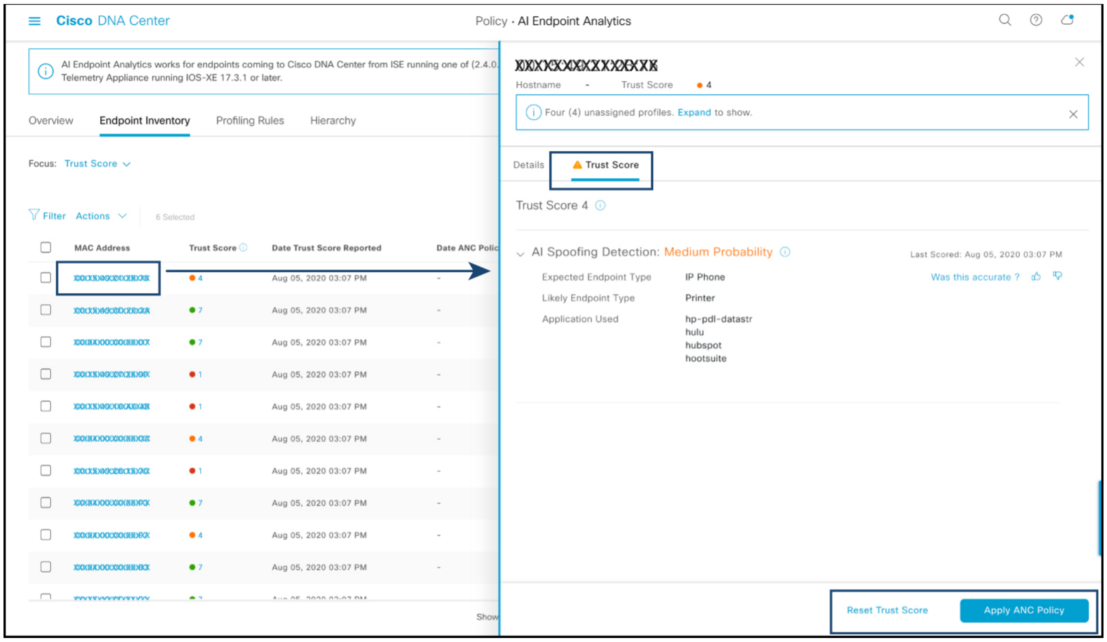
If you choose this option for an endpoint after applying an ANC policy, you will not see this endpoint in the Trust Score inventory again. In this case, to modify the ANC policy for such an endpoint, you must remove the policy from Cisco ISE instead.

If you reset the score for an endpoint without applying an ANC policy, you may see the endpoint in the Trust Score inventory again with the next automatic refresh of Trust Score data.

The buttons for each of the actions are displayed in two locations in the **Endpoint Inventory** tab. The actions can be performed a single endpoint, or on multiple endpoints.

- **Manage Trust Score for Single Endpoint**

Figure 49: Trust Score Options for an Endpoint Without an ANC Policy


Cisco DNA Center
Policy · AI Endpoint Analytics
Overview
Endpoint Inventory
Profiling Rules
Hierarchy
Focus: Trust Score
Filter
Actions
MAC Address
Trust Score
Date Trust Score Reported
Date ANC Polic
Details
Trust Score
Reset Trust Score
Apply ANC Policy

AI Endpoint Analytics works for endpoints coming to Cisco DNA Center from ISE running one of (2.4.0... Telemetry Appliance running IOS-XE 17.3.1 or later.

Hostname - Trust Score 4

Four (4) unassigned profiles. Expand to show.

Trust Score 4

AI Spoofing Detection: Medium Probability

Last Scored: Aug 05, 2020 03:07 PM

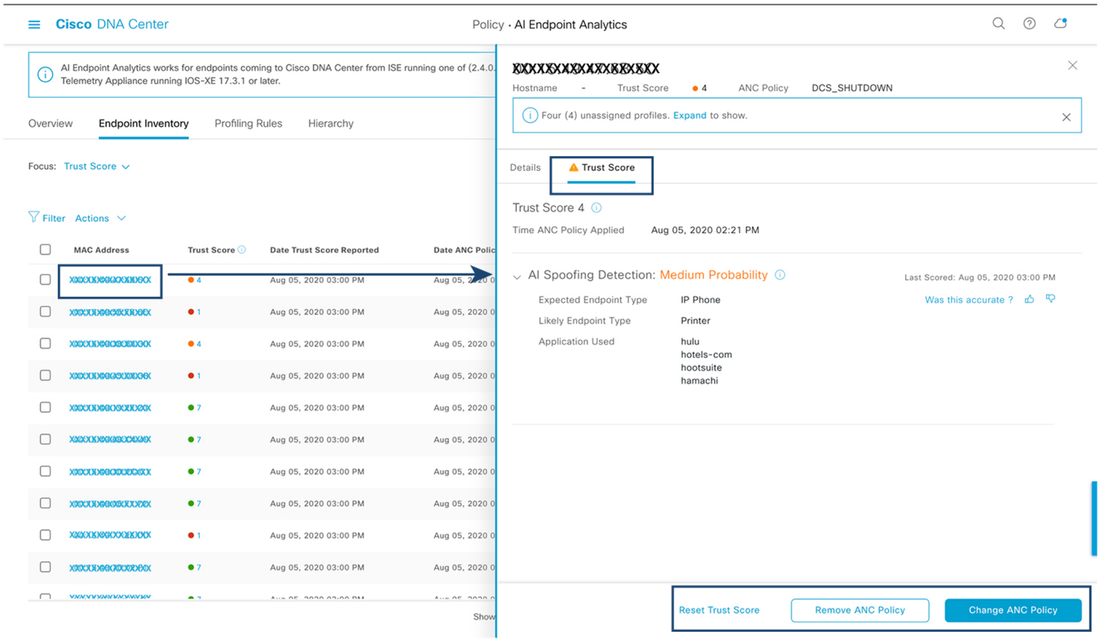
Was this accurate ?

Expected Endpoint Type: IP Phone

Likely Endpoint Type: Printer

Application Used: hp-pdl-datastr, hulu, hubspot, hootsuite

Figure 50: Trust Score Options for an Endpoint with an ANC Policy


Cisco DNA Center
Policy · AI Endpoint Analytics
Overview
Endpoint Inventory
Profiling Rules
Hierarchy
Focus: Trust Score
Filter
Actions
MAC Address
Trust Score
Date Trust Score Reported
Date ANC Polic
Details
Trust Score
Reset Trust Score
Remove ANC Policy
Change ANC Policy

AI Endpoint Analytics works for endpoints coming to Cisco DNA Center from ISE running one of (2.4.0... Telemetry Appliance running IOS-XE 17.3.1 or later.

Hostname - Trust Score 4 ANC Policy DCS_SHUTDOWN

Four (4) unassigned profiles. Expand to show.

Trust Score 4

Time ANC Policy Applied: Aug 05, 2020 02:21 PM

AI Spoofing Detection: Medium Probability

Last Scored: Aug 05, 2020 03:00 PM

Was this accurate ?

Expected Endpoint Type: IP Phone

Likely Endpoint Type: Printer

Application Used: hulu, hotels-com, hootsuite, hamachi

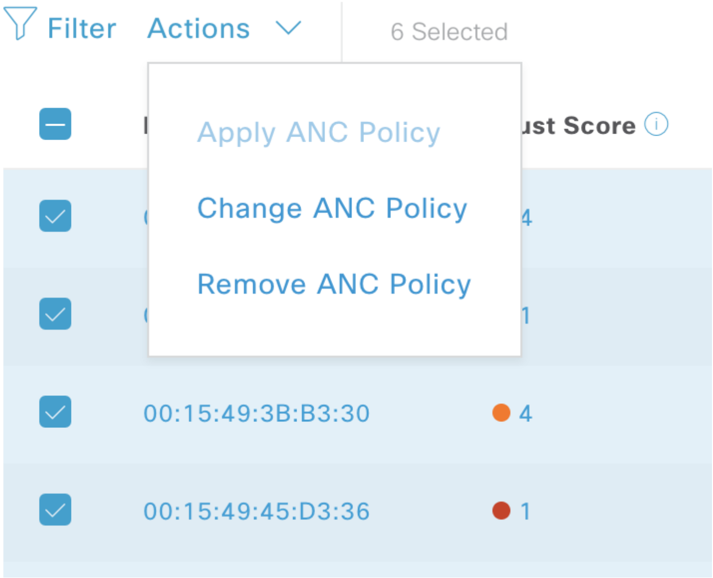
From the list of endpoints with a Trust Score, click the MAC Address of the endpoint you want to manage. In the endpoints details pane that is displayed, click the **Trust Score** tab.

Here, **Expected Endpoint Type** and **Likely Endpoint Type** values are displayed. The **Applications Used** field lists the applications that are used by the endpoint, that are unusual for the expected endpoint type.

This pane includes buttons to start the workflows of accepting and removing ANC policies, and to reset the Trust Score. Click the button for the intended task.

Alternatively, you can check the check box for an individual endpoint on the **Endpoint Inventory** window, click **Actions**, and choose the required option from the drop-down list.

- **Manage Trust Score for Multiple Endpoints**



In the **Endpoint Inventory** tab, check the check boxes for all the endpoints you must perform a specific action on. Click **Actions** and choose the required action from the drop-down list.

Profiling Rules

Profiling rules in Cisco AI Endpoint Analytics enable you to group endpoints with a combination of common attributes. These attributes allow endpoint identification by Endpoint Type, OS Type, Hardware model, and Hardware Manufacturer. The profiling rules help you administer and manage many endpoints with ease.

Cisco AI Endpoints Analytics receives profiling data from network devices through DPI, media protocols, medical industry protocols, and more. Profiling data from Cisco ISE is communicated through pxGrid. These profiling attributes are then available in the device dictionary for authoring profile rules.

You can view the profiling rules in the **Profiling Rules** tab of Cisco AI Endpoints Analytics. In the table that is displayed under this tab, click a **Rule Name** entry to view the assigned profiles and attributes used.

The profiling rules that are used to profile the endpoints in Cisco AI Endpoint Analytics are:

- System Rules
- Custom Rules
- Cisco AI Rules

Rule Prioritization

The profiling rules in Cisco AI Endpoint Analytics have an order of priority. Profiling rule execution follows this rule priority to profile endpoints with high fidelity.

As user inputs are primary in Cisco AI Endpoint Analytics, the priority of the profiling rules is as follows:

- Administrator-created static profiles, for example, profiles added using the **Register Endpoints** option.
- Administrator-created custom rules.
- Cisco-provided system rules that are available by default.
- Auto-generated rules through the machine learning-enabled Smart Grouping workflow.

To view the set rule priority, click **Rule Prioritization** in the **Profiling Rules** window.

A registered endpoint can be profiled by multiple Cisco AI Endpoint Analytics rules for different profiling labels. The following table shows the design of profiling rules for two endpoints.

Endpoint 1	Endpoint 2
Hardware Model profiled by System Rule	Hardware Model profiled by System Rule
OS Type profiled by Cisco AI Rule	Hardware Model profiled by Custom Rule
Hardware Manufacturer profiled by Custom Rule	Hardware Model profiled by Cisco AI Rule

For Endpoint 2, rule priority results in the precedence of the custom rule over the others. The Hardware Model label for Endpoint 2 is profiled by the custom rule.

For Endpoint 1, different rules define different profile labels, and each label is profiled accordingly.

Filter Profiling Rules

Step 1 In the **Profiling Rules** window, click **Filter**.

Step 2 Enter a name in the **Rule Name** field.

Step 3 Select values for endpoint attributes from the corresponding drop-down lists, to filter for a set of endpoints.

Step 4 Click **Apply**.

View Updated Profiling Rules

Step 1 Go to the **Endpoint Inventory** window.

Step 2 Click the check box adjacent to the MAC Address of the endpoint to view the profiling details of the endpoint.

Step 3 Click the information icon next to profile labels, and click the rule name to view the assigned profile and attributes details.

System Rules

Cisco AI Endpoint Analytics provides predefined rules called System rules for profiling endpoints. When Cisco AI Endpoint Analytics is deployed, it provides day zero visibility into endpoints without any need to configure specific rules.

Newly onboarded endpoints are profiled using system rules by default.

Network devices are managed in Cisco DNA Center in the **Provision** > **Network Devices** > **Inventory** window.

These network devices are profiled by the system rules and are not visible in the Cisco AI Endpoint Analytics **Endpoint Inventory** window. However, you can view the endpoints profiled by custom rules because the custom rules are created with network device as **Device Type**.

Automatic System Rule Updates for Endpoint Profiling

The system rules that are used for endpoint profiling in Cisco AI Endpoint Analytics are regularly updated to enhance profiling accuracy. Schedule automatic updates to receive updates in endpoint profiling system rules from Cisco. Your Cisco DNA Center receives updates at the configured time, and the changes are applied in Cisco AI Endpoint Analytics. In the **Profiling Rules** window (**Policy** > **AI Endpoint Analytics** > **Profiling Rules**), review the details of the changes in endpoint profiles, and accept or decline the system rule update.

If an endpoint's hardware model value changes due to an accepted system rule update, when you view the endpoint's details in the **Endpoint Inventory** tab, the **Hardware Model** field contains the name of the system rule update.

Before you begin

Configure and enable NBAR Cloud. See Configure the NBAR Cloud Connector, on page 494.

To check the status of NBAR Cloud, choose **Policy** > **AI Endpoint Analytics** > **Overview**, and click **Configuration**.

Step 1 From the main menu, choose **System** > **Settings** > **Cisco Accounts** > **Profile Rule Settings**.

The **Enabled** toggle button in the **Schedule Automatic Updates** area is set to active by default.

Step 2 Click the buttons for the days of the week on which you want to schedule updates. You can choose multiple days. Then, use the **Time Slot** text fields to select the time for the update. It takes 30 minutes for the updates to be received by Cisco DNA Center. The second time slot area is not editable and displays the time when the scheduled update is expected to complete.

Step 3 When your Cisco DNA Center receives a system rule update, a notification is displayed in the **Profiling Rules** window (**Policy** > **AI Endpoint Analytics** > **Profiling Rules**). The following notification is displayed when you click **Expand** in the dialog box:

You are updated to the latest version *Name of Latest Version* and a recent Cisco profiling rule has changed the profiles of some endpoints. Review Update.

Click **Review Update**

Step 4 The **Endpoint Profile Update Review** dialog box is displayed. The dialog box contains information on the current stable update applied, the latest update received, and more. It also contains the following sections that you can click to view the related endpoint profile updates:

a. **Major Updates**: Lists the endpoints whose profiles have had major changes, such as a Windows endpoint that is now recorded as a Linux endpoint.

b. **Minor Updates**: Lists the endpoints whose profiles have had minor changes, such as an updated version of Windows OS.

c. **Newly Profiled**: Lists the endpoints that were unprofiled previously and have now been assigned profile information.

Step 5 After you review the endpoint profile changes, to accept the profile update, click **Mark As Approved Version** in the **Endpoint Profile Update Review** dialog box. If you do not agree with the endpoint profile changes, click **Rollback**.

When you choose rollback, you must choose if you want to roll back to the last running version, or the last approved version, by clicking the corresponding option.

You can also perform the accept and rollback actions from the **AI Endpoint Analytics** > **Overview** > **Configuration** window.

Step 6 Click **X** to close the dialog box.

Custom Rules

In addition to the system rules, you can also create custom rules for profiling endpoints using a combination of endpoint attributes. Custom rules precede all the other endpoint profiling rules in Cisco AI Endpoint Analytics.

Logic and Conditions for Profiling Rules

You can create custom profiling rules in the **Endpoint Inventory** window. To create a custom profiling rule, you must create a logical condition based on endpoint attributes and values. These attributes are collected from network probe data and are different from the classification attributes available in the **Attribute Glossary** window.

A value is a user input that uniquely identifies the group of endpoints. The attributes and values create a regular expression with the help of the following operators.

Operators	Description
Contains	Attribute has the selected value.
Equals	Attribute is strictly mapped to the selected value.
Matches	Attribute should match the regular expression pattern of the selected value.
Starts With	Attribute should start with the selected value.

Note Contains, Equals, and Starts With are case-sensitive operators. For case-insensitive values, use the Matches operator.

These conditions can be further combined with the help of logic (**AND** and **OR**) to create a nested rule.

Create and Edit a Logical Condition

Follow the below instruction to create a logical condition.

Step 1 In the **Choose Attribute Conditions** window, check the check box adjacent to the **Attribute** that you want to update.

Step 2 Choose a option from the **Operator** drop-down lists.

Step 3 Enter the value in the **Value** field.

Step 4 Click **Next**.

Step 5 In the **Add Logic to Conditions** window that is displayed, drag and drop the **AND** logic or the **OR** logic between the conditions in order to create a logical sequence of conditions for a custom rule.

Note You can also add or edit an attribute condition in the **Add Logical Conditions** window using the vertical ellipsis next to a condition.

Step 6 Click **Next**.

Create a Custom Rule

Step 1 In the **Endpoint Inventory** window, check the check box adjacent to the MAC address of the endpoints that you want to profile.

Step 2 Click **Actions** and select **Profile with Custom Rules**.

Step 3 In the **Name Rule and Type** window that is displayed, in the **Rule Name** field, enter a name for the rule, and from the **Profile Label** drop-down list, choose a label.

Depending on what you choose from the **Profile Label** drop-down list, a corresponding field, whose name is dynamically updated, is displayed. For example, if you choose **Endpoint Type**, the **Endpoint Type** field appears.

Step 4 Enter a value in the new field that is displayed. As you start entering information, matching options are displayed. If an option matches your requirements, select the same. Otherwise, enter the complete type name.

Step 5 Click **Next**.

Step 6 In the **Choose Attribute Conditions** window that is displayed, create a logical condition.

For more information, see Logic and Conditions for Profiling Rules

Step 7 In the **Review Rule** window, review the list of endpoints that are going to be profiled with this custom rule.

Step 8 Click **Next**.

Step 9 Click **Profile**.

Edit a Custom Rule

Step 1 In the **Profiling Rules** window, check the check box adjacent to the admin rule you want to edit.

Step 2 Click **Actions** and select **Edit**.

Step 3 In the **Edit** window that is displayed, in the **Rule Name** field, enter a name for the rule, and select or enter the profile details based on the **Profile Label** selected during the rule creation.

Step 4 In the **Logic and Conditions** section, click on the vertical ellipsis and select **Edit** to update the logic and conditions for profiling rules. For more information, see Logic and Conditions for Profiling Rules.

Step 5 Click **Next**.

Step 6 Click **Apply**.

After the existing rule is updated with new profiling details, the endpoints profiled with this rule are updated with new profiling details.

Delete a Custom Rule

Step 1 In the **Profiling Rules** window, check the check box next to the rule that you want to delete.

Step 2 Click **Actions** and choose **Delete**.

The following message is displayed:

```
Do you really want to delete the selected Rule(s)?
```

Step 3 Click **Yes** to permanently delete the rule from Cisco AI Endpoint Analytics.

After the custom rule is deleted, the endpoints profiled with this rule are updated with system rules.

Export and Import Custom Profiling Rules Across Deployments Using APIs

Cisco DNA Center contains Cisco AI Endpoint Analytics APIs through which you can import, export, edit, and delete custom profiling rules.

To enable the Cisco AI Endpoint Analytics API bundle:

1. Click the menu icon (≡) and choose **Platform** > **Manage** > **Bundles**.
2. Find the bundle named **AI Endpoint Analytics** and click **Enable**.
3. The value in the **Status** column changes from **Disabled** to **Active**, and the list of APIs is displayed. You can also view the expected request and response payloads for each API.
4. After you enable the API bundle, the Cisco AI Endpoint Analytics APIs are added to the Cisco DNA Center Developer Toolkit. You can then access the APIs from the **Developer Toolkit** window (**Platform** > **Developer Toolkit**).

From both the **Bundles** and **Developer Toolkit** windows, you can:

- Generate code preview to view the API code that you can use in a different tool to run the API.
- Click **Try It** to run the API from the Cisco DNA Center GUI. You will receive a JSON response that you can copy and paste into a text editor of your choice to continue working with.

Cisco AI Rules or Smart Grouping

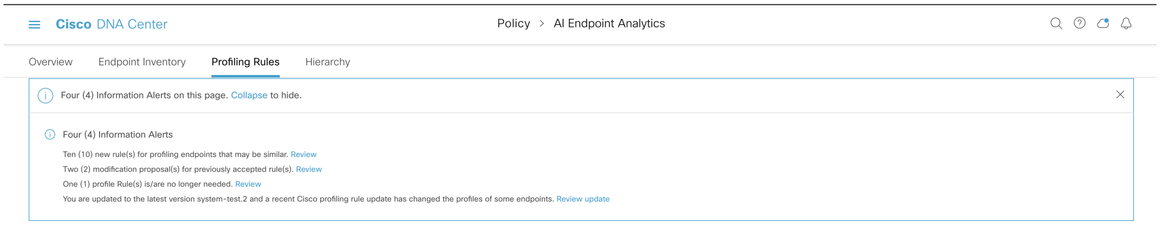
The Cisco AI Endpoint Analytics' AI algorithm analyzes data about endpoint profiling labels and groups across deployments and provides you with smart profiling rules suggestions.

The **AI Proposal** dashlet in the Cisco AI Endpoint Analytics **Overview** tab displays the following rule suggestions based on the learnings from endpoint clusters:

- New profiling rules for unprofiled or unlabeled endpoints in your network. For more information, see New Profiling Suggestions for Similar Endpoints in Your Network, on page 628
- Modification suggestions for existing profiling rules in your network that are based on the endpoint profiling data changes that AI algorithm has learned across deployments. For more information, see Smart Modification Suggestions for Your Endpoint Profiling Rules, on page 630.
- Deletion suggestions for profiling rule that contain an incorrect label that are based on the endpoint profiling data changes that AI algorithm has learned across deployments. When you accept a deletion rule, the incorrect profiling label is removed from the impacted endpoints. The profiling type value for the endpoints is then either empty or returns to a previously assigned label. For more information, see Smart Suggestions to Delete Profiling Rules, on page 632.

You can also initiate the workflows to review and apply proposals for changes to endpoint profiling rules from the **Profiling Rules** tab of Cisco AI Endpoint Analytics. The **Profiling Rules** displays a dialog box with information alerts. In the information alert dialog box, click **Expand** to view the available proposals for changes to endpoint profiling rules. Click **Review** next to the information alert that you want to examine to initiate the corresponding workflow.

Figure 51: Information Alerts in the Profiling Rules Tab



Four (4) Information Alerts on this page. Collapse to hide.

Four (4) Information Alerts

Ten (10) new rule(s) for profiling endpoints that may be similar. Review

Two (2) modification proposal(s) for previously accepted rule(s). Review

One (1) profile Rule(s) is/are no longer needed. Review

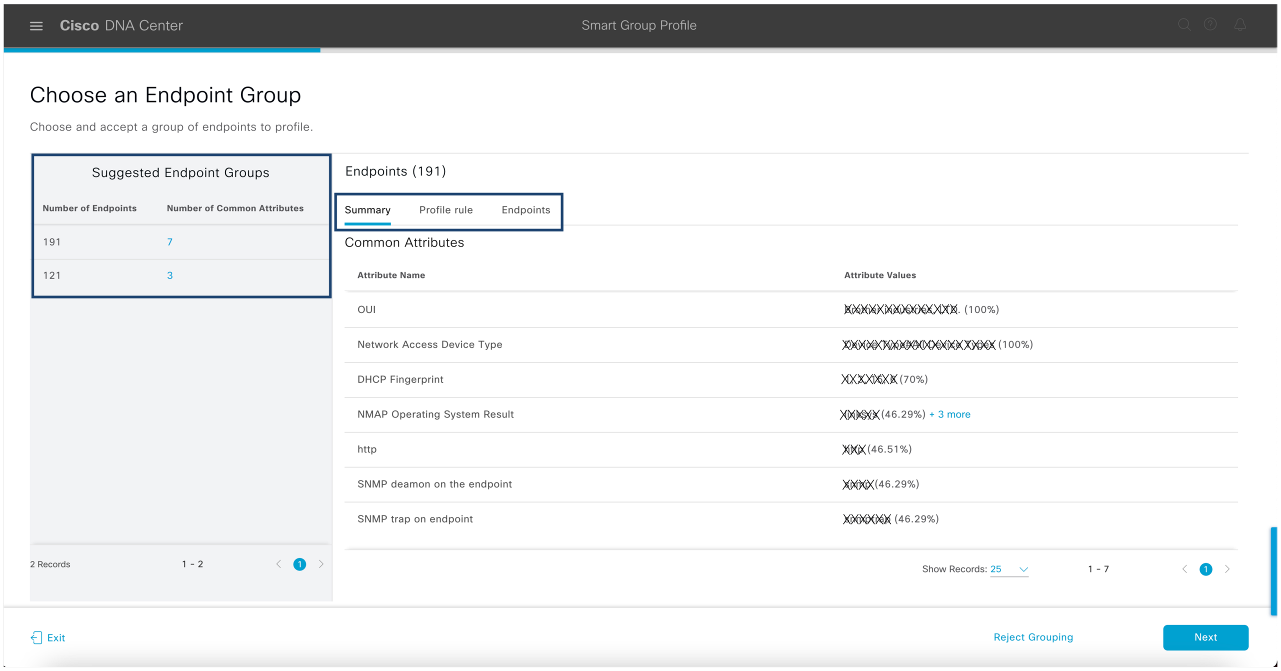
You are updated to the latest version system-test.2 and a recent Cisco profiling rule update has changed the profiles of some endpoints. Review update

New Profiling Suggestions for Similar Endpoints in Your Network

Step 1 In the **AI Proposals** dashlet, click the **Review** button next to **New rule(s) for profiling endpoints that many be similar**. The **Smart Group Profile** workflow is launched.

Step 2 The **Choose an Endpoint Group** window that is displayed contains a list of new profiling rules suggestions in the left pane. Click an entry in the list to view the details of the profiling rule in the right pane.

Figure 52: The Choose an Endpoint Group Window of the Smart Group Profile Workflow



Choose an Endpoint Group

Choose and accept a group of endpoints to profile.

Suggested Endpoint Groups

Number of Endpoints	Number of Common Attributes
191	7
121	3

2 Records 1 - 2

Endpoints (191)

Common Attributes

Attribute Name	Attribute Values
OUI	[redacted]. (100%)
Network Access Device Type	[redacted] (100%)
DHCP Fingerprint	[redacted] (70%)
NMAP Operating System Result	[redacted] (46.29%) + 3 more
http	[redacted] (46.51%)
SNMP deamon on the endpoint	[redacted] (46.29%)
SNMP trap on endpoint	[redacted] (46.29%)

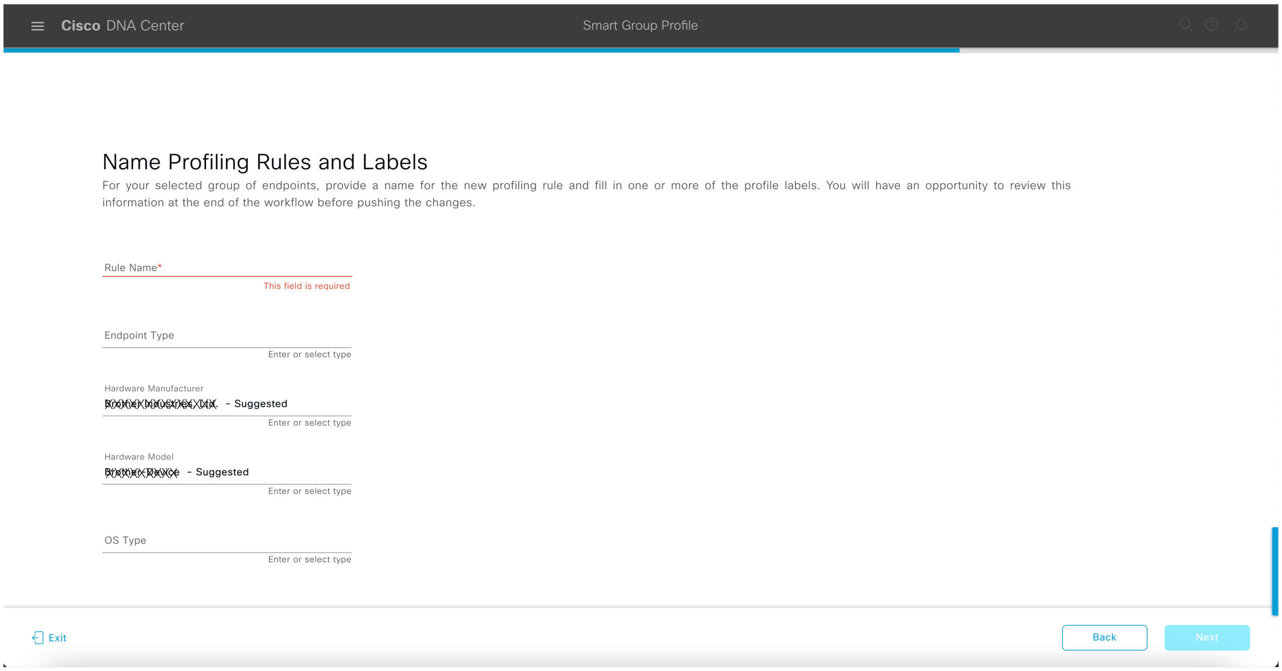
Show Records: 25 1 - 7

The right pane contains the **Summary**, **Profile Rule**, and **Endpoints** tabs that provide a quick view of the details of the profiling rule that is suggested.

Step 3 Click **Next** to create the suggested profiling rule.

Step 4 In the **Name Profiling Rules and Labels** window that is displayed, in the **Rule Name** field, enter a name for the rule.

Figure 53: The Name Profiling Rules and Labels Window of the Smart Group Profile Workflow



Name Profiling Rules and Labels

For your selected group of endpoints, provide a name for the new profiling rule and fill in one or more of the profile labels. You will have an opportunity to review this information at the end of the workflow before pushing the changes.

Rule Name*
This field is required

Endpoint Type
Enter or select type

Hardware Manufacturer
[redacted]. - Suggested
Enter or select type

Hardware Model
[redacted] - Suggested
Enter or select type

OS Type
Enter or select type

Step 5 In one or more of the following fields, enter the required values. You must enter a value in at least of the fields to proceed to the next step.

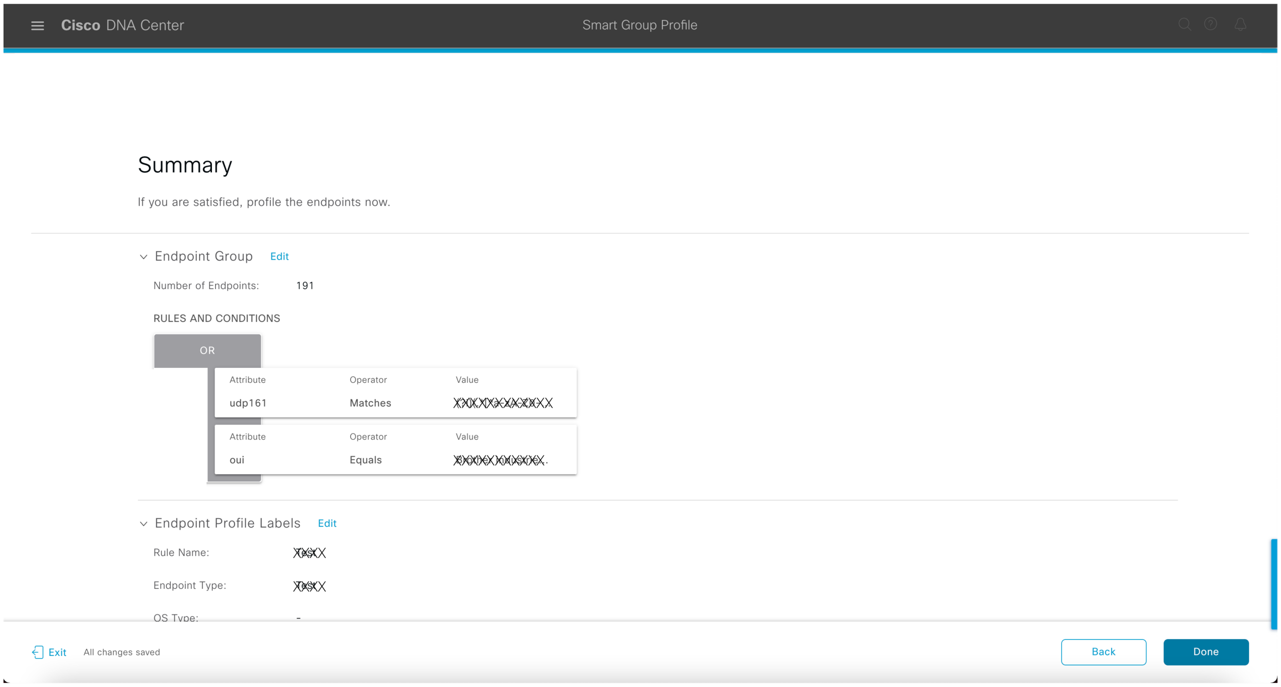
- **Endpoint Type**
- **Hardware Manufacturer**
- **Hardware Model**
- **OS Type**

If the AI algorithm identifies a profiling label for the endpoints, the label is displayed as a suggestion in the corresponding field. You can choose to proceed with the suggested label or select a different label.

Step 6 Click **Next** to continue.

Step 7 In the **Summary** window that is displayed, review the details of your profiling rule. To edit any details, click the **Edit** option that is displayed in the corresponding area of the window.

Figure 54: The Summary Window of the Smart Group Profile Workflow



Summary

If you are satisfied, profile the endpoints now.

Endpoint Group Edit

Number of Endpoints: 191

RULES AND CONDITIONS

OR

Attribute	Operator	Value
udp161	Matches	[redacted]
oui	Equals	[redacted]

Endpoint Profile Labels Edit

Rule Name: [redacted]

Endpoint Type: [redacted]

OS Type: -

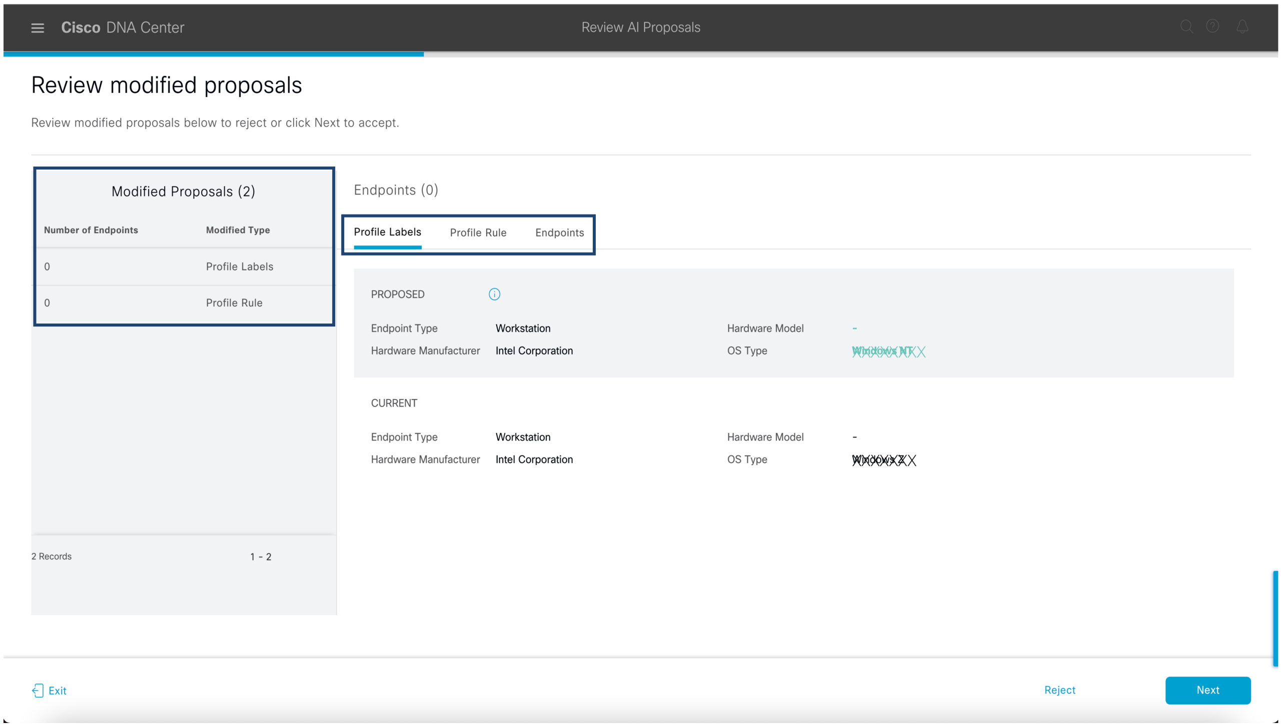
Step 8 To create the profiling rule, click **Done**.

Smart Modification Suggestions for Your Endpoint Profiling Rules

Step 1 In the **AI Proposals** dashlet, click the **Review** button next to **Modification proposal(s) for previously accepted rule(s)**. The **Smart Group Profile** workflow is launched.

Step 2 The **Review modified proposals** window that is displayed contains a list of modification proposals for existing profiling rules. Click an entry in the list to view the details of the modification suggestion in the right pane.

Figure 55: The Review Modified Proposals Window of the Review AI Proposals Workflow



Review modified proposals

Review modified proposals below to reject or click Next to accept.

Modified Proposals (2)

Number of Endpoints	Modified Type
0	Profile Labels
0	Profile Rule

2 Records 1 - 2

Endpoints (0)

Profile Labels | Profile Rule | Endpoints

PROPOSED

Endpoint Type: Workstation
Hardware Manufacturer: Intel Corporation
Hardware Model: -
OS Type: [redacted]

CURRENT

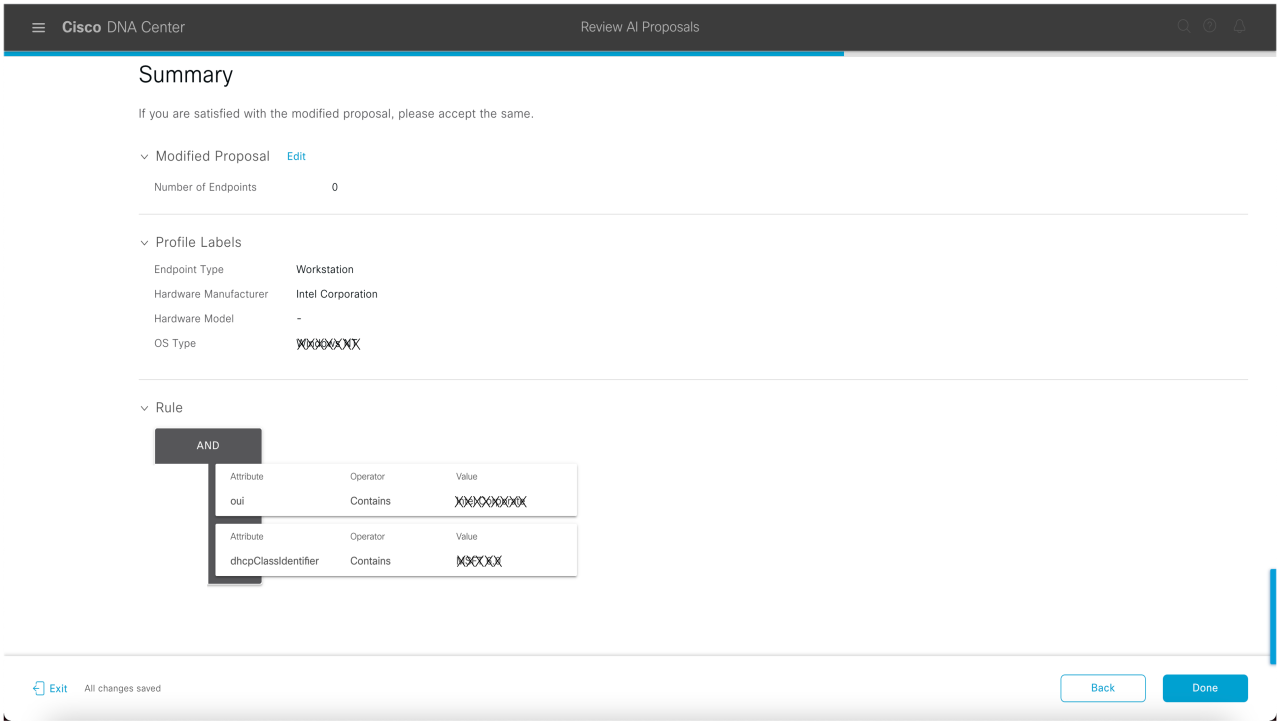
Endpoint Type: Workstation
Hardware Manufacturer: Intel Corporation
Hardware Model: -
OS Type: [redacted]

The right pane contains the **Profile Labels**, **Profile Rule**, and **Endpoints** tabs that provide a quick view of the details of the modified profiling rule that is suggested.

Step 3 Click **Next** to update the profiling rule as suggested.

Step 4 In the **Summary** window that is displayed, review the details of the profiling rule.

Figure 56: The Summary Window of the Review AI Proposals Workflow



Summary

If you are satisfied with the modified proposal, please accept the same.

Modified Proposal Edit

Number of Endpoints 0

Profile Labels

Endpoint Type	Workstation
Hardware Manufacturer	Intel Corporation
Hardware Model	-
OS Type	[redacted]

Rule

AND

Attribute	Operator	Value
oui	Contains	[redacted]
dhcpClassIdentifier	Contains	[redacted]

Step 5 To update the profiling rule, click **Done**.

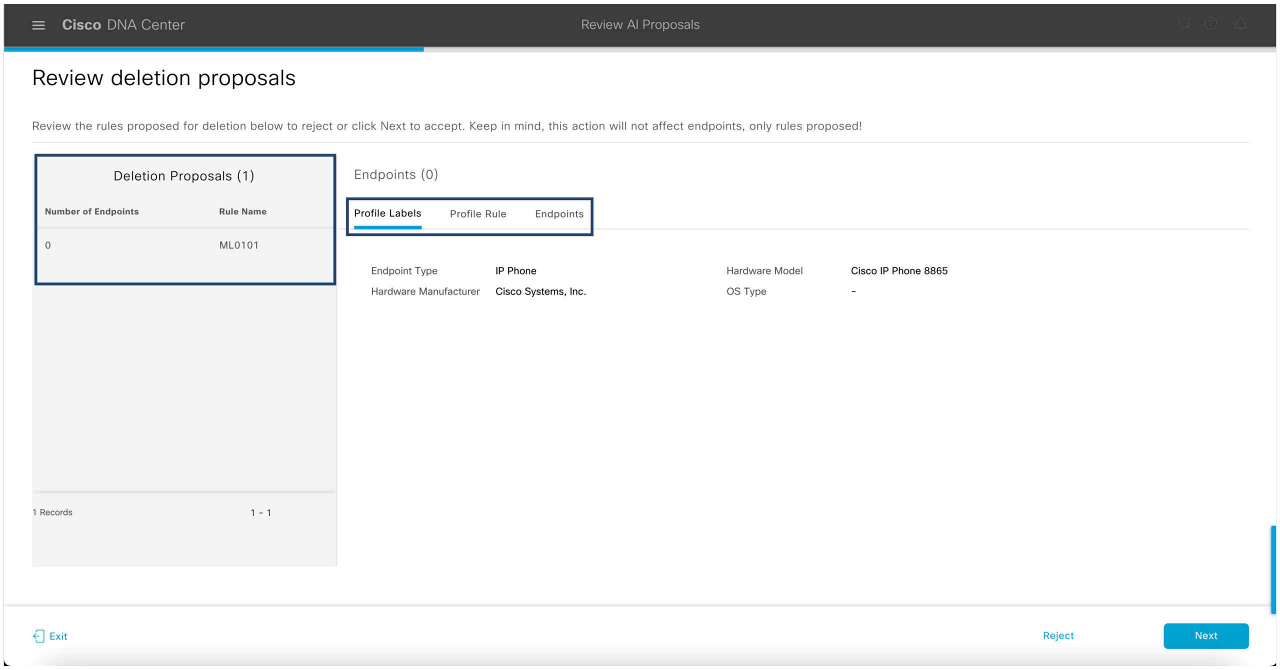
Smart Suggestions to Delete Profiling Rules

Step 1 In the **AI Proposals** dashlet, click the **Review** button next to **Profiling Rules(s) is/are no longer needed**.

The **Review AI Proposals** workflow is launched.

Step 2 The **Review deletion proposals** window that is displayed contains a list of deletion proposals for existing profiling rules. Click an entry in the list to view the details of the deletion suggestion in the right pane.

Figure 57: The Review Deletion Proposals Window of the Review AI Proposals Workflow


Cisco DNA Center
Review AI Proposals
Profile Labels
Profile Rule
Endpoints
Exit
Reject
Next

Review deletion proposals

Review the rules proposed for deletion below to reject or click Next to accept. Keep in mind, this action will not affect endpoints, only rules proposed!

Deletion Proposals (1)

Number of Endpoints	Rule Name
0	ML0101

1 Records 1 - 1

Endpoints (0)

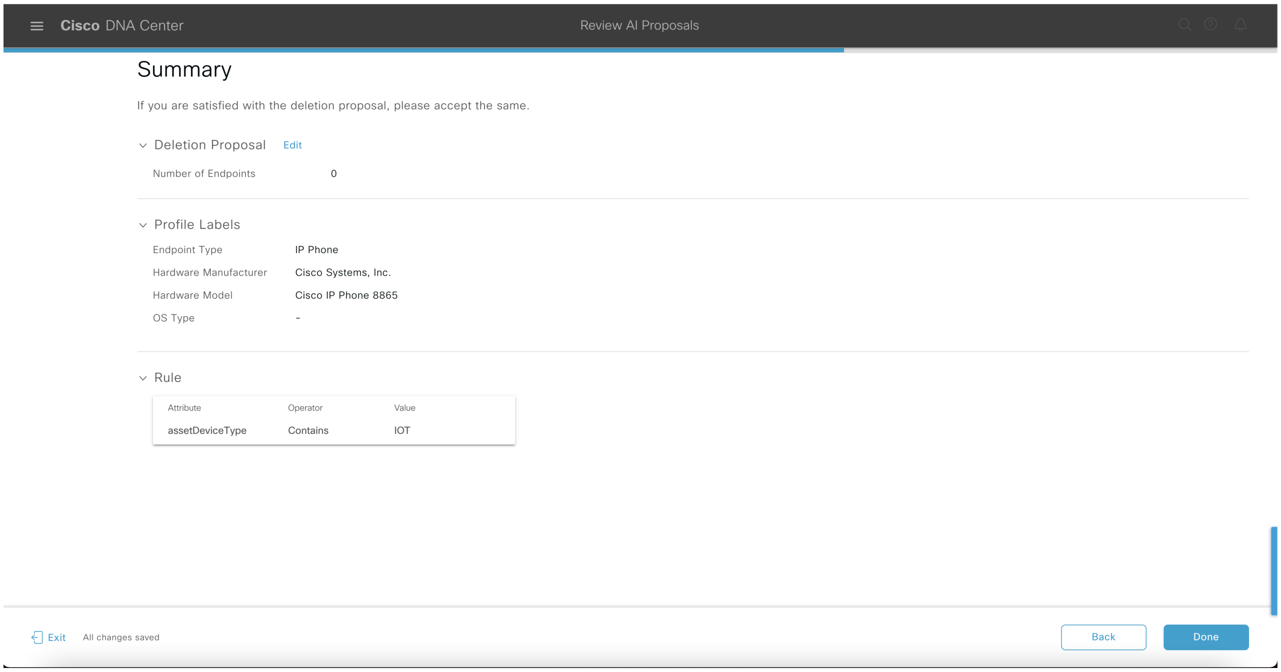
Endpoint Type	IP Phone	Hardware Model	Cisco IP Phone 8865
Hardware Manufacturer	Cisco Systems, Inc.	OS Type	-

The right pane contains the **Profile Labels**, **Profile Rule**, and **Endpoints** tabs that provide a quick view of the details of the modified profiling rule that is suggested.

Step 3 Click **Next** to update the profiling rule as suggested.

Step 4 In the **Summary** window that is displayed, review the details of the profiling rule.

Figure 58: The Summary Window of the Review AI Proposals Workflow


Cisco DNA Center
Review AI Proposals
Edit
Exit
All changes saved
Back
Done

Summary

If you are satisfied with the deletion proposal, please accept the same.

Deletion Proposal

Number of Endpoints 0

Profile Labels

Endpoint Type	IP Phone
Hardware Manufacturer	Cisco Systems, Inc.
Hardware Model	Cisco IP Phone 8865
OS Type	-

Rule

Attribute	Operator	Value
assetDeviceType	Contains	IOT

Step 5 Click **Done** to accept the deletion proposal.

Import Profiling Rules

You can migrate your custom profiling rules and Cisco AI rules by importing the .json files.

Step 1 In the **Profiling Rule** window, click **Actions**

Step 2 Choose **Import Profiling Rules**.

Step 3 Click **Choose a file** and browse to the .json file in your system.

Step 4 Click **Ok**.

Export Profiling Rules

You can export and back up custom rules and Cisco AI profiling rules from Cisco AI Endpoint Analytics. The **Export Profiling Rules** option exports all the available custom rules and Cisco AI profiling rules. You cannot selectively export rules.

Step 1 In the **Profiling Rules** window, click **Actions**.

Step 2 Choose **Export Profiling Rules**.

Step 3 Click **Yes** to export all the custom and ML profiling rules. Click **No** to exit.

Note You can import the same file again into Cisco AI Endpoint Analytics.

Hierarchy

Cisco AI Endpoint Analytics hierarchy helps you create logical groupings of endpoints, based on the endpoint types. Creating categories and subcategories for the endpoints focuses on endpoint visibility and simplifies the authorization process.

You can create categories from the **All Endpoints** default parent category. The category details such as total number of endpoints, endpoint types, and subcategories are listed within individual boxes in the **Hierarchy** window.

You can create, edit, and delete the categories to reorder the hierarchy.

Create Category and Subcategory

Step 1 In the **Hierarchy** window, click the horizontal ellipsis of the parent category.

Step 2 Click **Create Category**.

Step 3 Enter a category name.

Step 4 Click **Enter**.

What to do next

After you create a category, you can drag and drop endpoint types from the **Endpoint Type** window, or edit the category to add endpoints to it.

Edit a Category or Subcategory

Step 1 In the **Hierarchy** window, click on the horizontal ellipsis of the category.

Step 2 Click **Edit**.

Step 3 In the **Edit** window that is displayed, enter the **Category Name**.

Step 4 Enter the **Parent Category** from the drop-down menu, if you want to reassign the category.

Step 5 Click the **Endpoint Type** tab.

Step 6 Click **Actions** and select **Add Endpoint Type**.

Step 7 Choose the endpoint type from the **Search Dropdown** list.

Step 8 Click **Save**.

What to do next

In the Endpoint Type window, you can filter the endpoint types as **All**, **Available**, and **Assigned**.

Delete Endpoint Types from Category

Step 1 In the **Hierarchy** window, click the horizontal ellipsis of the category that you want to delete.

Step 2 Click **Edit**.

Step 3 In the **Edit** window, click the **Endpoint Type** tab.

Step 4 Check the check box adjacent to the endpoint type that you want to delete.

Step 5 Click **Actions** and choose **Remove From Category**.

The following message displays:

```
Are you sure you want to delete this category?
```

Step 6 Click **Yes** to delete the endpoint from the category. Click **No** to exit.

Reassign Endpoint Types from Category

Step 1 In the **Hierarchy** window, click the horizontal ellipsis of the category.

Step 2 Click **Edit**.

Step 3 In the **Edit** window, click the **Endpoint Type** tab.

Step 4 Check the check box adjacent to the endpoint type that you want to reassign.

Step 5 Click **Actions** and choose **Re-assign to existing category** or **Re-assign to a new category**.

Option	Steps
Re-assign to existing category	**a.** In the **Reassign** window, choose an existing category from the **Category** drop down list. **b.** Click **Save**.
Re-assign to a new category	**a.** In the **Reassign** window, choose **New Category** from the **Category** drop down list. **b.** Choose a parent category from the **Parent Category** drop down list. **c.** Enter the category name in the **New Category** field. **d.** Click **Save**

Delete a Category

Before you begin

Before you delete a parent category, check its subcategories. You can reassign the subcategories to another existing category or to a new category. Otherwise, all the subcategories are deleted along with the parent category. You can also reassign the subcategories while you are deleting a category.

Step 1 In the **Hierarchy** window, click the horizontal ellipsis of the category.

Step 2 Click **Delete**.

If you are deleting a category that has subcategories assigned to it, the **Reassign Relationships** dialog box is displayed. Choose one of the following options:

Option	Condition	Steps
Reassign to an existing category	Reassign the subcategories to an existing category.	**a.** Select a category from the **Category** drop-down list. **b.** Click **Reassign**. The parent category is deleted and its subcategories will be reassigned to the selected category.

Option	Condition	Steps
Reassign to a new category	Reassign the subcategories to an existing category.	**a.** Select a category from the **Parent Category** drop-down list. **b.** Enter the category name in the **New Category** field. **c.** Click **Reassign**. The parent category is deleted and its subcategories are reassigned to the new category.
Remove from category	Delete the subcategories along with the parent category.	Click **Reassign**. The parent category and its subcategories are deleted.

CHAPTER 28

Troubleshoot Network Devices Using Network Reasoner

- Network Reasoner Overview, on page 639
- Validate Cisco SD-Access Migration Using the MRE Workflow, on page 639
- Troubleshoot High CPU Utilization, on page 641
- Troubleshoot a Power Supply Failure, on page 642
- Troubleshoot a Downed Interface, on page 643
- Troubleshoot Network Connectivity, on page 644
- Troubleshoot IP Connectivity of a Device, on page 645
- Scan the Network for Bugs, on page 645
- Scan Cisco DNA Center for Bugs, on page 648

Network Reasoner Overview

The Network Reasoner tool allows you to troubleshoot various issues on your network quickly. Click the menu icon (≡) and choose **Tools** > **Network Reasoner** to launch the Network Reasoner Dashboard. The Network Reasoner dashboard hosts separate workflows using which you can proactively troubleshoot the network issues. The dashboard provides a brief description about the workflows, the number of affected devices in the last 24 hours, and impact of running a workflow on a network.

Note You must install the Machine Reasoning package to view the Network Reasoner feature under the **Tools** menu. For more information, see the *Cisco DNA Center Administrator Guide*.

Validate Cisco SD-Access Migration Using the MRE Workflow

The following MRE workflows assist in planning your migration to Cisco SD-Access:

- SDA Hardware Readiness Check
- SDA Software Readiness Check
- Redundant Link Check

- L3 Access Check
- MTU Link Check
- SDA Health Check
- SDA Scale Limits Check

Step 1 Click the menu icon (≡) and choose **Tools** > **Network Reasoner**.

Step 2 In the **Network Reasoner** dashboard, click the following workflows as required:

Workflow	Description	Action
SDA Hardware Readiness Check	Checks whether the hardware is ready for Cisco SD-Access migration.	**a.** Click **SDA Hardware Readiness Check**. **b.** Click **Run Machine Reasoning**.
SDA Software Readiness Check	Checks whether the software is ready for Cisco SD-Access migration.	**a.** Click **SDA Software Readiness Check**. **b.** Click **Run Machine Reasoning**.
Redundant Link Check	Checks whether any redundant uplinks are present in your device and if there are ways to increase availability by configuring redundant uplinks on the access switches.	**a.** Click **Redundant Link Check**. **b.** Select an appropriate device. **c.** Click **Troubleshoot**.
L3 Access Check	Checks whether your network has access switches that are running Layer 3 routing protocols to move to Cisco SD-Access with minimal design changes.	**a.** Click **L3 Access Check**. **b.** Select an appropriate device. **c.** Click **Troubleshoot**.
MTU Link Check	Checks whether the links between the main network devices and the access, core, and other switches are configured with the correct MTU.	**a.** Click **MTU Link Check**. **b.** Select an appropriate device. **c.** Click **Troubleshoot**.
SDA Health Check: Fabric Count	Checks the health of the Cisco DNA Center cluster to determine whether it is reaching any scale limit thresholds due to managing fabrics.	**a.** Click **Fabric Count**. **b.** Click **Run Machine Reasoning**.
SDA Health Check: SDA Scale Limits Check	Checks whether the number of client endpoints, network devices, and configured fabrics in Cisco DNA Center are within the published SDA limits.	**a.** Click **SDA Scale Limits Check**. **b.** Click **Run Machine Reasoning**.

Workflow	Description	Action
SDA Health Check: Client Count	Checks the health of the Cisco DNA Center cluster to determine whether it is reaching any scale limit thresholds due to managing clients.	**a.** Click **Client Count**. **b.** Click **Run Machine Reasoning**.
SDA Health Check: Device Count	Checks the health of the Cisco DNA Center cluster to determine whether it is reaching any scale limit thresholds due to managing network devices.	**a.** Click **Device Count**. **b.** Click **Run Machine Reasoning**.

Troubleshoot High CPU Utilization

CPU utilization troubleshooting support is available only for the following network devices with software version 16.9.3 and later:

- Cisco Catalyst 9400 Series Switches
- Cisco Catalyst 9300 Series Switches
- Cisco Catalyst 3850 Series Switches
- Cisco Catalyst 3650 Series Switches

Before you begin

- Install the Machine Reasoning package. For more information, see Download and Install Packages and Updates in the Cisco DNA Center Administrator Guide.
- Create a user role with write permissions for Machine Reasoning under the **System** function. For more information, see Configure Role-Based Access Control in the Cisco DNA Center Administrator Guide.

Step 1 Click the menu icon (≡) and choose **Tools** > **Network Reasoner**.

Step 2 Click the **CPU Utilization** tab.

The **CPU Utilization** window displays the filtered list of devices with high CPU utilization in the past 24 hours.

Click **All** to see the list of all devices from the inventory, and you can choose any device to run the workflow.

Step 3 Choose the device that you want to troubleshoot.

Click **Filter** and enter the devices by entering **Tag**, **Device Name**, **IP Address**, **Device Type**, **Site**, or **Reachability**.

Step 4 Click **Troubleshoot**.

Step 5 In the **Reasoner Input** window, enter the **CPU Utilization Threshold** percentage that you want to check against.

Step 6 Click **Run Machine Reasoning**.

Note The following processes, if observed, are considered for detailed analysis:

- **MATM Process Group**: MATM RP Shim, NGWC Learning, and VMATM Callback
- **IOSXE Process Group**: IP Input, ARP Input, IOSXE-RP Punt Se, SISF Main Thread, DAI Packet, and ARP Snoop

In the **CPU Utilization** window, you can see the **Root Cause Analysis** of the high CPU utilization for the chosen device.

The **Reasoning Activity** tab shows the various parameters that are checked as part of the troubleshooting process.

Step 7 (Optional) Click **Stop** to stop the ongoing reasoning activity.

Step 8 Click the **Conclusion** tab to see the processes that consume more CPU and the utilization percentage.

Step 9 Click **View Relevant Activities** for each process to view the **Activity Details** in the right pane.

Step 10 (Optional) Click **Run Again** to rerun the troubleshooting process for the same device.

Note The Machine Reasoning Engine (MRE) implements a system-terminate algorithm that detects and terminates network reasoner workflows when thresholds exceed a specified level, or when no events are received from the timeout request for inactivity.

Troubleshoot a Power Supply Failure

Power supply troubleshooting workflow support is available only for the following network devices with software version 16.6.1 and later:

- Cisco Catalyst 3650 Series Switches
- Cisco Catalyst 3850 Series Switches
- Cisco Catalyst 9300 Series Switches
- Cisco Catalyst 9400 Series Switches
- Cisco Catalyst 9500 Series Switches

Before you begin

- Install the Machine Reasoning package. For more information, see Download and Install Packages and Updates in the Cisco DNA Center Administrator Guide.
- Create a user role with write permissions for Machine Reasoning under the **System** function. For more information, see Configure Role-Based Access Control in the Cisco DNA Center Administrator Guide.

Step 1 Click the menu icon (≡) and choose **Tools** > **Network Reasoner**.

Step 2 Click the **Power Supply** tab.

The **Power Supply** window displays the filtered list of devices with power supply failures in the past 24 hours.

Click **All** to see the list of all devices in the inventory. You can choose any device to run the workflow.

Step 3 Choose the device that you want to troubleshoot.

Click **Filter** and filter the devices by entering **Tag**, **Device Name**, **IP Address**, **Device Type**, **Site**, or **Reachability**.

Step 4 Click **Troubleshoot**.

In the **Power Supply** window, you can see the **Root Cause Analysis** of the power supply failure for the chosen device.

The **Reasoning Activity** tab shows the various parameters that are checked as part of the troubleshooting process.

Step 5 (Optional) Click **Stop** to stop the ongoing reasoning activity.

Step 6 Click the **Conclusion** tab to see the **Stack Identifier**, **Product ID**, **Serial Number**, and **Status** of the power supply for the chosen device and the suggested action.

Step 7 Click **View Relevant Activities** for each stack identifier to view the **Activity Details** in the right pane.

Step 8 (Optional) Click **Run Again** to rerun the troubleshooting process for the same device.

Note The MRE implements a system-terminate algorithm that detects and terminates network reasoner workflows when thresholds exceed a specified level, or when no events are received from the timeout request for inactivity.

Troubleshoot a Downed Interface

Interface down troubleshooting workflow support is available only for the following network devices with software version 16.9.3, and later:

- Cisco Catalyst 3650 Series Switches
- Cisco Catalyst 3850 Series Switches
- Cisco Catalyst 9300 Series Switches
- Cisco Catalyst 9400 Series Switches
- Cisco Catalyst 9500 Series Switches

Before you begin

- Install the Machine Reasoning package. For more information, see Download and Install Packages and Updates in the Cisco DNA Center Administrator Guide.
- Create a user role with write permissions for Machine Reasoning under the **System** function. For more information, see Configure Role-Based Access Control in the Cisco DNA Center Administrator Guide.

Step 1 Click the menu icon (≡) and choose **Tools** > **Network Reasoner**.

Step 2 Click the **Interface Down** tab.

The **Interface Down** window displays the filtered list of devices with an interface that went down in the past 24 hours.

Click **All** to see the list of all devices from the inventory, and you can choose any device to run the workflow.

Step 3 Choose the device that you want to troubleshoot.

Click **Filter** and enter the devices by entering **Tag**, **Device Name**, **IP Address**, **Device Type**, **Site**, or **Reachability**.

Step 4 Click **Troubleshoot**.

Step 5 In the **Reasoner Input** window, enter the interface name that you suspect has issues.

Step 6 Click **Run Machine Reasoning**.

In the **Interface Down** window, you can see the **Root Cause Analysis** of the downed interface for the chosen device.

The **Reasoning Activity** tab shows the various parameters that are checked as part of the troubleshooting process.

Step 7 (Optional) Click **Stop** to stop the ongoing reasoning activity.

Step 8 Click the **Conclusion** tab to see the potential root causes for the interface down issue and the suggested action.

Step 9 Click **View Relevant Activities** for each root cause analysis to view the **Activity Details** in the right pane.

Step 10 (Optional) Click **Run Again** to rerun the troubleshooting process for the same device.

Note The MRE implements a system-terminate algorithm that detects and terminates network reasoner workflows when thresholds exceed a specified level, or when no events are received from the timeout request for inactivity.

Troubleshoot Network Connectivity

Only the following network devices running Cisco IOS-XE software version 16.9.3 or later support the network connectivity troubleshooting:

- Cisco Catalyst 9200 Series Switches
- Cisco Catalyst 9300 Series Switches
- Cisco Catalyst 9400 Series Switches
- Cisco Catalyst 9500 Series Switches
- Cisco Catalyst 9600 Series Switches

Use the following procedure to check the reachability of an end point from a device using IP address:

Before you begin

- Install the Machine Reasoning package. For more information, see Download and Install Packages and Updates in the Cisco DNA Center Administrator Guide.
- Create a user role with write permissions for Machine Reasoning under the **System** function. For more information, see Configure Role-Based Access Control in the Cisco DNA Center Administrator Guide.

Step 1 Click the menu icon (≡) and choose **Tools** > **Network Reasoner**.

Step 2 Click the **Network Connectivity** tab.

Step 3 You can view the device table with details, such as **Device Name**, **IP Address**, **Device Type**, **Site**, **Reachability**, **Role**, and **Platform**.

Step 4 Select a device and click **Troubleshoot**.

Step 5 In the **Destination IP address** field of the **Reasoner Inputs** window, enter a valid IP address and click **Run Machine Reasoning**.

Note Provide the Virtual Routing and Forwarding (VRF) name, if applicable.

Step 6 In the **Root Cause Analysis** window, under **Reasoning Activity**, you can view various workflows that are validated as a part of the troubleshooting process.

Step 7 In the **Conclusions** tab, you can view the status of the validation check and the suggested action.

Troubleshoot IP Connectivity of a Device

As ping is a simple command, IP connectivity troubleshooting support is available for all the network devices.

Before you begin

- Install the Machine Reasoning package. For more information, see Download and Install Packages and Updates in the Cisco DNA Center Administrator Guide.
- Create a user role with write permissions for Machine Reasoning under the **System** function. For more information, see Configure Role-Based Access Control in the Cisco DNA Center Administrator Guide.

Step 1 Click the menu icon (≡) and choose **Tools** > **Network Reasoner**.

Step 2 In the **Network Reasoner** dashboard, click **Ping Device**.

Step 3 In the **Devices** window, choose a device and click **Troubleshoot**.

Step 4 In the **Reasoner Inputs** window, enter **Target IP Address** and click **Run Machine Reasoning**.

Step 5 Click **View Details** to view the ping status.

Scan the Network for Bugs

The Cisco DNA Center network bug identifier tool allows you to scan the network for a selected set of defects or bugs that have been identified previously and are known to Cisco.

The Cisco DNA Center network bug identifier helps in identifying specific patterns in the device configuration or in the operational data of the device and matches them with known defects based on those patterns. This tool provides both bug-focused and device-focused views.

Cisco DNA Center collects network device configuration and operational data by running CLI commands on network devices, and then sends the information to the CX Cloud to be processed for exposure to potential security advisories or bugs. Cisco DNA Center invokes the following CLI commands for the network bug identifier tool:

- **show buffers summary**
- **show cef interfaces**
- **show clock**
- **show crypto eli all**
- **show crypto isakmp sa detail**
- **show eigrp service-family ipv4 neighbors**
- **show environment all**
- **show interfaces counters error**
- **show interfaces summary**
- **show inventory**
- **show ip interface brief**
- **show ip nat translations verbose**
- **show ip nbar protocol-discovery**
- **show ip nbar resources flow**
- **show ip nhrp**
- **show ip nhrp summary**
- **show ip route**
- **show ip ssh**
- **show ip vrf**
- **show logging**
- **show performance monitor cache detail**
- **show platform software route-map fp active map**
- **show pnp profile**
- **show redundancy**
- **show redundancy application group**
- **show running-config all**
- **show scp status**
- **show stackwise-virtual**
- **show startup-config**
- **show terminal**

- **show version**

The following procedure explains how to identify bugs using the network bug identifier tool.

Before you begin

- Install the Cisco DNA Center core package. For more information, see Download and Install Packages and Updates in the *Cisco DNA Center Administrator Guide*.
- Install the Machine Reasoning package. For more information, see Download and Install Packages and Updates in the *Cisco DNA Center Administrator Guide*.

Step 1 Click the menu icon (≡) and choose **Tools** > **Network Reasoner**.

Step 2 Select **Network Bug Identifier**.

Step 3 Click **Scan Network**.

Step 4 In the **Scan Network** window, do one of the following:

- To scan your system for bugs immediately, click the **Now** radio button and click **Submit**.
- To schedule the scan for a later date and time, click the **Later** radio button and specify the date and time.

The dashboard progress indicator shows the list of devices scanned in batches of 10. When the scan is done, the **Network Bug Identifier** window appears.

Step 5 Use the top pane to view information about the results of the scan, rescan the network, and change scan settings, as follows:

Item	Description
Bug Summary	Number of **Catastrophic**, **Severe**, and **Moderate** bugs in your network.
Affected Devices	Number of the following device types that were scanned: • **Routers** • **Switches and Hubs**
Scan Mode	Method used to perform the scan: • **Essential**: Scan performed using the Cisco Network Reasoner Engine (NRE). • **CX Cloud**: Scan performed using the CX Cloud.
Re-scan Network	Click this button to scan your network again.
Settings	Click the **Settings** icon to do the following: • Enable or disable weekly scans. • Enable or disable the CX Cloud to scan your network.

Step 6 Click the **Bugs on Devices** tab to view the following details:

- **Bug ID**
- **Name**
- **Affected Devices**
- **Severity**
- **Affected Versions**
- **Workaround**

Click any hyperlinked value to display more information about it.

Step 7 Click the **Devices** tab to view the following details:

- **Device Name**
- **Image Version**
- **IP Address**
- **Device Type**
- **Bugs**
- **Scan Status**
- **Scan Mode**
- **Site**
- **Reachability**

Click any hyperlinked value to display more information about it.

Step 8 From the **Devices** tab, click **Tag Device** to create, edit, or delete tags on the devices.

Scan Cisco DNA Center for Bugs

The **System Bug Identifier** tool provides an option to identify bugs in the Cisco DNA Center. The following procedure explains how to enable the **System Bug Identifier** tool:

Before you begin

- Install the Cisco DNA Center core package. For more information, see Download and Install Packages and Updates in the *Cisco DNA Center Administrator Guide*.
- Install the Machine Reasoning package. For more information, see Download and Install Packages and Updates in the *Cisco DNA Center Administrator Guide*.

Step 1 Click the menu icon (≡) and choose **Tools** > **Network Reasoner**.

Step 2 Select **System Bug Identifier**.

Step 3 Click **Scan System**.

Step 4 In the **Scan System** window, do any of the following:

a. To scan your system for bugs immediately, click the **Now** radio button and click **Submit**

b. To schedule the scan for a later date and time, click the **Later** radio button and specify date and time.

Step 5 The **System Bug Identifier** window shows the **BUG SUMMARY** and the **Bugs Identified on Your System** table.

You can view the following details in the **Bugs Identified on Your System** table:

- **Bug ID**
- **Name**
- **Severity**
- **First identified**
- **Last identified**
- **Identified frequency**
- **Workaround**
- **Affected Versions**

Step 6 Click the **Bug ID**.
The **Bug Details** dialog box displays the details of the bug.

Step 7 Click the arrow next to **Bug ID** to go to the **Bug Search Tools** window, which shows more details about the bugs.

CHAPTER 29

Identify Network Security Advisories

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Security Advisories Overview

The Cisco Product Security Incident Response Team (PSIRT) responds to Cisco product security incidents, regulates the Security Vulnerability Policy, and recommends Cisco Security Advisories and Alerts.

The Security Advisories tool uses these recommended advisories, scans the inventory within Cisco DNA Center, and finds the devices with known vulnerabilities.

Prerequisites

To use the Security Advisories tool, you must install the Machine Reasoning package. See *Download and Install Packages and Updates* in the Cisco DNA Center Administrator Guide.

If you log in to Cisco DNA Center as an Observer, you cannot view the **Security Advisories** tool in the home page.

View Security Advisories

Step 1 Click the menu icon (≡) and choose **Tools** > **Security Advisories**.

Step 2 If you are launching the **Security Advisories** window for the first time, click **Scan Network**.

Cisco DNA Center uses the knowledge base to identify security issues and improve automated analysis. We recommend that you update the knowledge base on a regular basis to view the latest security advisories.

a) Click the menu icon (≡) and choose **System** > **Settings** > **Machine Reasoning Engine**.
b) Either click **Import** or click **Download Latest** to download the latest available knowledge base. After the download, click **Import**.
c) Click the **AUTO UPDATE** toggle button to subscribe to automatic updates.

Step 3 The **ADVISORIES** area displays the distribution percentage of impact on the network, such as **Critical**, **High**, **Medium**, **Low**, **Informational**, or **Unknown**.

Step 4 Scans are performed on the devices based on the licenses associated against each device. In the **SCAN CRITERIA** area, you must follow the following order to match advisories against your devices:

- **Software Version**: Scans are performed on devices based on the software version with **Cisco DNA Essentials** license.
- **Custom**: Scans are performed on devices based on the software version and the custom configuration entered for an advisory (if any) against the device running configuration with **Cisco DNA Advantage** license.
- **Advanced**: Scans are performed on devices based on the software version, configuration, and operations data on devices with **Cisco CX Cloud Success Track** entitlements.

The license entitlements are not enforced in trial period and all devices are scanned at the **Advanced** level.

Note

- The security advisories dashboard shows security advisories published by Cisco that may affect devices on your network based on the software image currently installed. A further analysis of the configuration, platform details, or other criteria is required to determine if a vulnerability is actually present.
- Security advisories scanning is only available for routers and switches that are running the minimum supported software version. For more information, see the Cisco DNA Center Compatibility Matrix.
- The security advisories displayed are subject to the Cisco Security Vulnerability Policy.

The following table describes the information that is available.

Column	Description
Advisory ID	ID of the security advisories found in the network. Click the ID to go to the respective advisory web page.
Advisory title	Name of the security vulnerability advisory applicable to the network devices.
CVSS score	Score evaluated based on the Common Vulnerability Scoring System (CVSS) model.
Impact	Impact of the vulnerability on the network.
CVE	Common Vulnerabilities and Exposures (CVE) identifier for the vulnerability.

Column	Description
Devices	The number of devices impacted by the vulnerability. Click the number to view the devices that may be vulnerable based on this specific advisory, and upgrade the devices as needed.
Match Type	Indicates whether the vulnerability was detected based on the **Image Version** match or the **Configuration** match.
Known since (days)	The number of days since the vulnerability was discovered.
Last updated	The date when the advisory was last updated.

Step 5 In the **Advisories** table click **All** tab to list all the advisories.

Step 6 In the **Advisories** table click **Affecting Devices** tab to view the advisories based on affecting devices.

The **Devices** table list the devices based on **Device Name**, **Device Family**, **Device Series**, **IP Address**, **Advisories**, **Advisories (Suppressed)**, **Platform**, **Image Version**, **Scan Status**, **Scan Criteria**, **Site**, and **Reachability**.

Step 7 Click the **Devices** tab to view the number of advisories applicable to each device.

a) Click the number of advisories to view all that match the device.

b) Click the topology icon in the top-right corner to view the device topology. You can click a device in the topology to view all advisories that match the device.

A lock icon next to the device indicates that there are one or more advisories applicable to the device.

The **Fixed Version** column shows the version in which the advisories are fixed. You can remove the advisory on your device by upgrading to the version mentioned in this column.

Step 8 Click **Re-scan Network** to run the scan the network again.

To re-scan the network to identify security advisories based on automated config scan, see Rescan the Network to Identify Security Advisories, on page 655.

Schedule a Security Advisories Scan

Step 1 Click the menu icon (≡) and choose **Tools** > **Security Advisories**.

Step 2 Click **Scan Network**.

The **Scan Network** window appears.

Step 3 To scan the security advisories immediately, click the **Now** radio button and click **Start**.

Step 4 To schedule the scan for a later date and time, click the **Later** radio button and specify the date and time.

Step 5 Use the **Time Zone** drop-down list to schedule the scan according to a specific time zone.

Step 6 Choose the recurrence option: **None** (the default), **Daily**, or **Weekly**.

Step 7 In the **Run at Interval** field, enter the number of days or weeks for the recurrence of the scan.

Step 8 (Optional) Check the **Set Schedule End** check box to schedule an end date and number of occurrences.

a) To schedule a scan end date, click the **End Date** radio button and define the date and time.
b) To define the number of scan occurrences, click the **End After** radio button.

Step 9 Click **Schedule**.

Step 10 Click the menu icon (≡) and choose **Activities** > **Tasks** and confirm the schedule and recurrence of the scan.

Note In Cisco DNA Center releases earlier than 2.1.1.x, you have the ability to opt in or out of telemetry that Cisco collects. When you opt in, we collect your cisco.com ID, system telemetry, feature usage telemetry, network device inventory, and license entitlement. Telemetry is not application or feature specific; the disclosure of telemetry is for all of Cisco DNA Center. In Cisco DNA Center 2.1.1.x and later, telemetry collection is mandatory. The telemetry is designed to help the development of features that you use. See the *Cisco DNA Center Data Sheet* for a more expansive list of data that we collect.

When a security advisory scan runs, the following telemetry data is collected:

- Whether automatic update of knowledge packages has been set up.
- Whether recurring scanning and recurring reports have been set up.
- The number of reports that have been run.
- The number of devices with a security advisory match based on software version and configuration.
- The number of thumbs up/thumbs down votes, per scan.
- The manual configurations entered as a search, and the associated advisory.
- The number of advisory matches by software version and configuration, including product family.
- The number of devices based on other categories (zero advisories, unknown, and unsupported).
- The number of successful, failed, and terminated scans.
- The average scan time.

Enable the Try Cisco CX Cloud Success Track to Identify Security Advisories

Before you begin

- You must enter the correct URL and port in your firewall for Cisco DNA Center to reach the CX Cloud.
- You must enable the Cisco CX Cloud service. For more information, see **Update the Machine Reasoning Knowledge Base** in the *Cisco DNA Center Administrator Guide*.

Step 1 Click the menu icon (≡) and choose **Tools** > **Security Advisories** > **Advisories**.

Step 2 When you launch the **Security Advisories** window for the first time, click **Scan Network** to trigger an automated scan based on software version for all supported devices in the inventory.

Step 3 In the banner at the top of the **Security Advisories** window, click the **Try Cisco CX Cloud Success Track** link to enable a 60-day trial of the CX license.

Note For security advisories, the CX license level is Success Track 1.

Step 4 In the **Success Tracks** confirmation window, click **OK** to accept the end-user license agreement.

At the top of **Security Advisories** window, a banner shows the validity of the CX license trial period.

CLI Commands Invoked for Security Advisories

Cisco DNA Center collects network device configuration and operational data by running CLI commands on network devices, and then sends the information to the CX Cloud to be processed for exposure to potential security advisories or bugs. Cisco DNA Center invokes the following CLI commands for security advisories:

- **show inventory**
- **show running-config**
- **show version**

Rescan the Network to Identify Security Advisories

The following procedure describes how to rescan the network to identify security advisories based on automated configuration scan.

Before you begin

You must enable the Cisco CX Cloud service. For more information, see **Update the Machine Reasoning Knowledge Base** in the *Cisco DNA Center Administrator Guide*.

Step 1 Click the menu icon (≡) and choose **Tools** > **Security Advisories** > **Advisories**.

Step 2 Click **Re-Scan Network** to start the network scan again.

Step 3 To rescan the security advisories immediately, click the **Now** radio button and click **Start**.

Step 4 To schedule the rescan for a later date and time, click the **Later** radio button and specify the details. For information, see Schedule a Security Advisories Scan, on page 653.

In the **Device** table, the **Advisories** column is updated with the number of advisories.

- The Cisco DNA Center network rescan sends the running config of devices along with other details, such as platform details and the CX Cloud software version. The information is processed and sent back to Cisco DNA Center. The Machine Reasoning Engine (MRE) running on Cisco DNA Center maps the advisories against the devices provided by the Cisco CX Cloud.

- If Cisco DNA Center cannot determine the correct license level for a given device, the security advisory scan falls back to scan by software version.

Hide and Unhide Devices from an Advisory

Step 1 Click the menu icon (≡) and choose **Tools** > **Security Advisories**.

Step 2 If you are launching the **Security Advisories** page for the first time, click **Scan Network**.

Step 3 In the **Scan Network** window, choose **Now**, and then click **Start**.

Step 4 To hide the devices from an advisory, do the following:

a) From the **Focus** drop-down list, choose **Advisories**.
b) In the **Devices** column, click the devices count that corresponds to the advisory for which you want to hide the devices.

   The **Active** tab shows the number of devices for which these advisories are issued.

c) Choose the devices that you want to hide and click **Suppress Device**.

   The hidden devices can be viewed in the **Suppressed** tab.

d) Close the advisory window and view the change in the device count for this advisory.

Step 5 To restore the devices to an advisory, do the following:

a) From the **Focus** drop-down list, choose **Advisories**.
b) In the **Devices** column, click the devices count that corresponds to the advisory for which you want to unhide the devices.
c) Click the **Suppressed** tab to view the hidden devices.
d) Choose the devices that you want to unhide and click **Mark as Active**.

   The restored devices can be viewed in the **Active** tab.

e) Close the advisory window and view the change in the device count for this advisory.

Hide and Unhide Advisories from a Device

Step 1 Click the menu icon (≡) and choose **Tools** > **Security Advisories**.

Step 2 If you are launching the **Security Advisories** page for the first time, click **Scan Network**.

Step 3 In the **Scan Network** window, choose **Now**, and then click **Start**.

Step 4 To hide the advisories for a device, do the following:

a) From the **Focus** drop-down list, choose **Devices**.
b) In the **Advisories** column, click the advisories count that corresponds to device for which you want to hide the advisories.

   The **Active** tab shows the number of advisories issued for this device.

c) Choose the advisories that you want to hide and click **Suppress Advisory**.

The hidden advisories can be viewed in the **Suppressed** tab.

d) Close the device window and view the change in the advisory count for this device.

Step 5 To restore the advisories for a device, do the following:

a) From the **Focus** drop-down list, choose **Devices**.
b) In the **Advisories** column, click the advisories count that corresponds to the device for which you want to unhide the advisories.
c) Click the **Suppressed** tab to view the hidden advisories.
d) Choose the advisories that you want to unhide and click **Mark as Active**.

The restored advisories can be viewed in the **Active** tab.

e) Close the device window and view the change in the advisories count for this device.

Add Notification for a New Security Advisory KB

A security advisory Knowledge Bundle (KB) uses a Machine Reasoning Engine (MRE) to scan the network. You can configure Cisco DNA Center to notify you when a new security advisory Knowledge Bundle (KB) is available. After you enable notifications, Cisco DNA Center displays a visual notification and actionable alert whenever a new security advisory KB is available.

The following procedure explains how to add notifications for a new security advisory knowledge bundles:

Before you begin

- You must install the Cisco DNA Center core package. See Download and Install Packages and Updates in the *Cisco DNA Center Administrator Guide*.
- You must install the Machine Reasoning (MRE) package. See Download and Install Packages and Updates in the *Cisco DNA Center Administrator Guide*.
- The following containers must be present in your system:
  - cnsr-reasoner
  - cloud connectivity/download

Step 1 Click the notification icon in the top-right corner of the Cisco DNA Center GUI. From the drop-down menu, select the gear icon to view the notification preferences.

Step 2 In the **My Profile and Settings** window, enable the security advisory notification by choosing the **Security Advisories** option.

Step 3 Click **Save**.

Step 4 In the **Machine Reasoning Engine** window, click the **Download Latest** link to download the latest knowledge bundle.

Step 5 Review and update the Knowledge Base settings.

Step 6 In the **Security Advisory Settings** section, choose the recurrence option: **None** (default), **Daily**, or **Weekly**.

Step 7 Choose **Notification Center** > **Go to Security Advisories** to view the Security Advisories tool window directly.

Step 8 Rescan the network with the newly downloaded security advisories. For more information, see Schedule a Security Advisories Scan, on page 653.

View Security Advisories in the Inventory

The Cisco DNA Center security focus view lists the security advisories for your devices, based on the data retrieved from the previous security scan. The device data that you retrieve from the **Security Advisories** tool is displayed in the **Inventory** window.

Use the following procedure to view the security advisories:

Before you begin

- You must install the Cisco DNA Center core package. See Download and Install Packages and Updates in the *Cisco DNA Center Administrator Guide*.
- You must install the Machine Reasoning package. See Download and Install Packages and Updates in the *Cisco DNA Center Administrator Guide*.

Step 1 Click the menu icon (≡) and choose **Tools** > **Security Advisories**.

Step 2 Click **Scan Network**.

Step 3 To scan the security advisories immediately, click the **Now** radio button and click **Start**.

Step 4 Click the menu icon (≡) and choose **Provision** > **Network Devices** > **Inventory**.

Step 5 From the **FOCUS: Inventory** drop-down menu, choose **Security**.
The **Advisories** column is displayed in the **Inventory** table.

Step 6 In the **Device Details** window, select a device and view the advisories data.

Step 7 Click **Manage All** to navigate to the **Security Advisories** tool.

Add a Match Pattern

Step 1 Click the menu icon (≡) and choose **Tools** > **Security Advisories**.

Step 2 If you are launching the **Security Advisories** page for the first time, click **Scan Network**.

Step 3 In the **Scan Network** window, choose **Now**, and then click **Start**.

Step 4 Choose an advisory and in the **Match Type** column, click **Add match pattern**.

Step 5 In the **Add Configuration Match Pattern** window, enter the condition to match with devices in the **CONDITIONS** text box.

Step 6 Click **Save**.

The match pattern is added to the advisory.

Step 7 Click **Scan Network** to check the number of devices that match with the match pattern.

Define AND/OR for the Match Pattern

Step 1 Click the menu icon (≡) and choose **Tools** > **Security Advisories**.

Step 2 If you are launching the **Security Advisories** page for the first time, click **Scan Network**.

Step 3 In the **Scan Network** window, choose **Now**, and then click **Start**.

Step 4 Choose an advisory and in the **Match Type** column, click **Add match pattern**.

Step 5 In the **Add Configuration Match Pattern** window, do the following:

a) In the **CONDITIONS** text box, enter a condition and then click the **Add** icon.
b) From the drop-down list, choose **AND** or **OR** and then enter the next condition.
c) If you want to delete a condition, click the **Remove** icon.
d) Click **Save**.
The match pattern is added to the advisory.

Step 6 Click **Scan Network** to check the number of devices that match the match pattern.

Edit the Match Pattern

Step 1 Click the menu icon (≡) and choose **Tools** > **Security Advisories**.

Step 2 If you are launching the **Security Advisories** page for the first time, click **Scan Network**.

Step 3 In the **Scan Network** window, choose **Now**, and then click **Start**.

Step 4 Choose an advisory that already has a match pattern and in the **Match Type** column, click **Edit match pattern**.

Step 5 In the **Edit Configuration Match Pattern** window, enter the condition to match with devices in the **CONDITIONS** text box.

Step 6 Click **Save**.

The match pattern is changed.

Step 7 Click **Scan Network** to check the number of devices that match the match pattern.

Delete the Match Pattern

Step 1 Click the menu icon (≡) and choose **Tools** > **Security Advisories**.

Step 2 If you are launching the **Security Advisories** page for the first time, click **Scan Network**.

Step 3 In the **Scan Network** window, choose **Now**, and then click **Start**.

Step 4 Choose an advisory that already has a match pattern and in the **Match Type** column, click **Edit match pattern**.

Step 5 In the **Edit Configuration Match Pattern** window, click **Delete**.

The match pattern is deleted.

PART VIII

Assure Your Network

- Cisco DNA Assurance, on page 663

CHAPTER 30

Cisco DNA Assurance

- Overview of Cisco DNA Assurance, on page 663

Overview of Cisco DNA Assurance

Cisco DNA Assurance is an application that is available from Cisco DNA Center.

For details about the Assurance application, including *how to monitor and troubleshoot network health, client health, and application health, and enable NetFlow collection*, see the Cisco DNA Assurance User Guide.

PART IX

Manage Cisco DNA Center

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CHAPTER 31

Build and Deploy Workflows

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AP Refresh Workflow

The AP Refresh feature allows you to replace older AP models with newer AP models, using the Access Point Refresh workflow. You can use the following procedure to replace old APs with new ones in Cisco DNA Center.

For device compatibility information, see the *Cisco DNA Center Compatibility Matrix*.

Before you begin

- The old AP must be provisioned and in Unreachable state.
- The new AP must be connected to a Cisco Wireless Controller and available in the Cisco DNA Center Inventory, in Reachable state.
- The old and new APs must be associated with the same wireless controller.

Step 1 Click the menu icon (≡) and choose **Workflows** > **Access Point Refresh**.

A library of available workflows is displayed. These workflows guide you step by step through a particular task.

Step 2 Click **Let's Do it**.

To skip this window in the future, check **Don't show this to me again**.

Step 3 In the **Get Started** window, enter a unique task name for the workflow and click **Next**.

Step 4 In the **Select Network Sites** window, navigate to the floor where you want to refresh the AP and click **Next**.

The right pane shows the selected building, floor, and the total number of APs provisioned on that floor.

You can replace the APs that are already in Provisioned state.

Step 5 In the **Select Access Points** window, check the check box next to the device name that you want to replace, and click **Next**.

Step 6 In the **Select procedure for providing New Access Points** window, select a method through which you want to provide new AP details: **Add New Access Point detail via CSV file** or **Add New Access Point detail via GUI**.

- Click the **Add New Access Point detail via CSV file** radio button to upload a comma-separated value (CSV) file that contains the new device name and serial number.
    - To do this, click the **Download Selected Devices List** template and add the device name and serial number of the new AP. The downloaded CSV template file contains the old AP details. After adding the device name and serial number of the new AP, you can either import the CSV file or drag and drop the CSV file into the drag-and-drop area.
    - To import the CSV file, click **Choose file** and browse to the location of the CSV file, and click **Open**.

      Cisco DNA Center performs a validation check. If the uploaded CSV file does not meet the requirement, an error message appears. Click **View Details** to get more details about the error message.

- To add the new AP details using the GUI, click the **Add New Access Point detail via GUI** radio button and click **Next**.

  The **Assign New Access Points** window appears, where you can assign a new AP for each old AP.

    - The **Old Devices** area shows details such as the IP address of the old AP, old AP name, site details, platform, and AP series information. Under the **New Devices** area, provide details about the new device.
    - From the **Choose Serial Number** drop-down list, choose the serial number of the new AP.

      If the new AP is already associated with the wireless controller and is available in the Inventory, the serial number of that AP is displayed as **Managed** in the **Choose Serial Number** drop-down list.

      If the new AP has contacted Cisco DNA Center through PnP, the serial number of that AP is displayed as **Unclaimed** in the **Choose Serial Number** drop-down list.

      If the serial number of the new AP is not available in the Inventory, the **Serial Number** drop-down list does not contain the serial number. To add a new serial number that is not present in the Inventory, from the **Choose Serial Number** drop-down list, enter the serial number and click **+**.

      Note Cisco DNA Center performs a validation check and displays errors, if any. You must fix those errors before proceeding.

      You must resolve the following dependencies before provisioning new APs:

        - Device EULA acceptance by providing cisco.com credentials.
        - Update the Cisco Wireless Controller software image version. This validation does not stop you from proceeding with the AP refresh.
        - AP Connected SwitchPort: This validation message does not stop you from proceeding with the AP refresh.

Step 7 Click **Next**.

The configuration that is copied from the old AP to the new AP is displayed in the **Configuration Copied from Old Access Point to New** window.

Step 8 Click **Next**.

Step 9 In the **Submit Access Point Refresh Task** window, click **Provision** to start the AP refresh task.

Step 10 In the **Track Replacement Status** window, monitor the AP replacement status.

- Click **View Details** to get more information about the AP replacement status.
  - If the AP replacement succeeds, the **Replacement Status** window shows the **Replacement Status** as **REPLACED**.
  - If the AP replacement fails, the **Replacement Status** shows as **Error**.
  - To delete the replacement entry, under the **Actions** column, click the three blue dots and click **Delete**. In the **Warning** dialog box, click **Yes**.
  - Click **Export** to download the provisioning summary to a CSV file that you can save locally.
  - Click **Download Report** to download the provisioning status report.

Note If the new AP is not yet discovered in the Inventory and the corresponding AP refresh entry is waiting for the new device to be connected, or if the PnP claim process is in progress, you must resynchronize the Cisco Wireless Controller.

Step 11 Click **Next** to view the summary details.

Step 12 After successful replacement, an AP refresh event is generated in Cisco DNA Assurance for the old and new AP.

You can view the AP refresh event under **Event Viewer** in the **AP View 360** window.

The new APs are automatically updated on the respective floor maps in the **Network Hierarchy** window.

Configure User-Defined Network Workflow

The following sections provide information about configuring the Cisco User-Defined Network service using workflows in Cisco DNA Center.

Overview of User-Defined Network Service

Home, consumer, and IoT devices on the network, such as printers, speakers, Apple TV, Google Chromecast, ring doorbells, smart bulbs, and so on, depend on the Simple Service Discovery Protocols (SSDP) such as Apple Bonjour, multicast DNS (mDNS), and Universal Plug and Play (UPnP) to provide the easy discovery and usage of devices.

The Cisco User-Defined Network service provides secure and remote onboarding of client devices in shared environments such as dormitory rooms, residence halls, class rooms, and auditoriums. With the User-Defined Network service, users can securely use SSDPs such as Apple Bonjour, mDNS protocols such as AirPlay, AirPrint, Screen Mirroring, Print, or UPnP protocol to interact and share with only their registered device in the shared environment.

The User-Defined Network service provides the following solution:

- Easy and secure onboarding of client devices.
- Automatic segmentation of client devices that belong to a particular user.
- Ability to invite other users to share their devices.

Prerequisites for Configuring the User-Defined Network Service

Before configuring the Cisco User-Defined Network service, the following prerequisites must be completed:

- Confirm that APs have joined the Cisco Wireless Controller.
- Discover Cisco Wireless Controllers and APs in your network using the **Discovery** functionality so that the discovered devices are listed in the **Inventory** window.
- Map the AAA server client endpoint with Cisco Identity Services Engine.
- Add the authentication tokens to Cisco DNA Center.
- Create nonfabric enterprise SSIDs or guest wireless SSIDs with any security, and map them to the network profile.
- Provision SSIDs.

Configure the User-Defined Network Service

This procedure shows how to configure the Cisco User-Defined Network service from the **Workflows** > **Configure Cisco User Defined Network** window. Alternatively, you can configure the Cisco User-Defined Network service from the **Provision** > **Services** > **Cisco User Defined Network** window.

Step 1 Click the menu icon (≡) and choose **Workflows** > **Configure Cisco User Defined Network**.

Step 2 Click **Let's Do It**.

The **Let's start with configuring the Service** screen appears. You must generate an authentication token using the Cisco DNA Center Cloud portal so that Cisco DNA Center connects with Cisco DNA Center Cloud.

Step 3 Click **Configure Cloud Service**.

The **Cisco DNA Center Cloud** application opens in a new tab.

Step 4 Log in to **Cisco DNA Center Cloud** using your cisco.com account ID and password.

- Click the **Authentication Token** tab in the left menu.

  The **Authentication Token** window appears.

- In the **Authentication Token** window, click **Generate New Token**.

  The authentication token is generated.

- Click **Copy Token** to copy the authentication token.

Step 5 Navigate back to the **Let's start with configuring the Service** screen in Cisco DNA Center.

Step 6 Click **Next** to validate the copied authentication token.

Step 7 In the **Authentication Token** text box, paste the authentication token that you generated and copied in **Cisco DNA Center Cloud**, and click **Connect**.

If the token is validated successfully, a message saying `Connection validated, click Next to proceed` appears.

If the token validation fails, click **Retry**, re-enter the authentication token, and click **Connect**.

Step 8 Click **Next** to select the sites where you want to enable the Cisco User-Defined Network service.

- From the **Select Sites** drop-down list, choose the sites.
- Check the **Disable User Defined Network Service** check box to disable the workflow for all the enabled sites.

Step 9 Click **Next** to select the SSIDs for the sites you selected.

The provisioned nonfabric SSIDs are displayed for all the sites selected in the previous step.

- From the **SSID(s)** drop-down list, choose the SSIDs where the User-Defined Network service will be enabled.
- To limit the unicast traffic for the selected SSID, turn on **Unicast Traffic Containment**.
- Click **Apply Individually** to apply the unicast traffic containment for a specific site.
- Click **Apply to all** to apply the unicast traffic containment for all sites.

Step 10 Click **Next**.

Step 11 Select whether you want to provision the Cisco User-Defined Network service on your network now or schedule it for a later time.

- To provision the service on your network now, click the **Now** radio button and click **Next**.
- To provision the service on your network for a later time, click the **Later** radio button, define the date and time, and click **Next**.

The **Configuration Summary** screen appears.

Step 12 Review the following details and click **Edit** in any of the sections if you want to make a change.

- **Authentication Token**
- **Selected Sites & SSIDs**
- **Scheduling**

Step 13 Click **Configure**.

In the next screen, a check mark is shown next to each step as it is completed.

Step 14 Click **View Provisioning Status**.

Enable Application Hosting on Switches

The following procedure shows how to enable docker applications such as ThousandEyes Enterprise Agent and iPerf in selected switches at a specific site.

Before you begin

- Complete the prerequisites. For more information, see Prerequisites for Application Hosting, on page 498.
- Add the application to Cisco DNA Center. For more information, see Add an Application, on page 499.
- Check the readiness of the switch to host the application. For more information, see View Device Readiness to Host an Application, on page 499.

Step 1 Click the menu icon (≡) and choose **Provision** > **Services** > **App Hosting for Switches**.

Step 2 Choose the application and click **Install** at the bottom of the window.

Alternatively, you can also launch the workflow by choosing **Workflows** > **Enable Apps on Switches** > **Let's Do it**.

The workflow is launched.

Note At the top of the workflow window, place your cursor on the blue progress bar and switch back to the previous step listed.

Step 3 In the **Select Site** window, navigate to the building where you want to enable the application.

Step 4 Click **Next**.

Step 5 In the **Select App** window, click on the application you want to select.

Step 6 Click **Next**.

Note You can access the **+ New App** link to add an application that is not present in Cisco DNA Center.

Step 7 In the **Select Switches** window, check the check box next to the device name for which you want to enable the application.

Note You can import or export devices in bulk by providing the details in the specified template in the **Select Switches** dialog box.

Step 8 Click **Next**.

Step 9 Complete the following settings in the **Configuration App** window:

- **App Networking**
  - **Device Network**: From the **Select Network** drop-down list, choose a VLAN to configure the application.
  - **App IP address**: From the **Address Type** drop-down list, choose **Static** or **Dynamic**. If you choose **Static**, click the thumbnail icon and enter the **IP Address**, **Gateway**, **Prefix/Mask**, and **DNS** for the application.
- **Resource Allocation**: Check the **Allocate resources as asked by the app** or the **Allocate all resources available on the device** check box.
- **Custom Settings**: (Applicable only for Cisco package applications) Enter the configuration details for the attributes that are specified by the application.

- **App Data**: Browse and upload the application-specific files. To identify the required application-specific files, see the relevant application document.
- **Docker Runtime Options**: Enter the docker runtime options required by the application.

Step 10 In the **Summary** window, review the details before installing the application on the selected switches.

Step 11 Click **Next**.

The **Provisioning Task** window displays the task name that tracks the deployment of the application on the switches.

Step 12 Review the automatically generated task name and click **Provision**.

Step 13 In the **Track Provisioning Status** window, you can track the progress of the deployment.

Step 14 Click **View Details** to view the provisioning status of the individual devices and failures, if any.

Step 15 Click **Next**.

The application is enabled successfully.

The summary of the task result and the success/failure counts are displayed.

Step 16 Click **Manage App**, where you can manage the lifecycle operations of the application to perform Day N tasks.

Enable IoT Services Workflow

The following sections provide information about enabling IoT technologies such as Bluetooth, Zigbee, and ESL on Cisco Catalyst 9100 Series Access Points using **Workflows** in Cisco DNA Center.

Enable IoT Services on Cisco Catalyst 9100 Series Access Points

This procedure shows how to enable IoT technologies such as Bluetooth, Zigbee, and ESL on selected Catalyst 9100 Series Access Points.

Step 1 Click the menu icon (≡) and choose **Workflows**.

A library of available workflows is displayed. These workflows guide you step-by-step through a particular task.

Step 2 Click **Enable IOT Services**.

Step 3 Click **Let's Do it** to start the installation workflow.

Step 4 In the **Select Site** window, navigate to the floor where you want to enable the IoT service.

Step 5 Click **Next**.

Step 6 In the **Select the Application** window, select the SES-imagotag ESL Connector application to enable IoT in your network, and click **Next**.

Note To add an application that is not present in the Cisco DNA Center, see Add an Application.

The **Select Access Points** window shows all the APs available on the particular floor.

Step 7 In the **Select Access Points** window, check the check box adjacent to the **Device Name** where you want to install the IoT connector application.

Step 8 Click **Next**.

Step 9 In the **Summary** window, review the details before installing the application on the selected APs, and click **Next**.

The **Provisioning Task** window, which displays the task name created to track deployment of any application on APs, is displayed.

Step 10 Review the auto-generated task name and click **Provision**.

Step 11 In the **Track Provisioning Status** window, you can track the progress of the deployment.

Step 12 Click **View Details** to view the provisioning status.

Step 13 Click **Next**.

The **Done! Task Completed** window appears.

Step 14 Click **Manage IoT Application** to perform Day N tasks.

Manage IoT Applications

This procedure shows how to manage IoT applications.

Before you begin

You must have enabled IoT services on Cisco Catalyst 9000 Series Access Points.

Step 1 After enabling IoT services, click **Manage IoT Application** in the **Done! Task Completed** window.

Step 2 Check the check box next to the **Hostname** and perform the following tasks:

- To start the application, from the **Actions** drop-down list, choose **Start App**.
- To stop the application, from the **Actions** drop-down list, choose **Stop App**.
- To edit the application configuration, from the **Actions** drop-down list, choose **Edit App Config**.
- To upgrade the application, from the **Actions** drop-down list, choose **Upgrade App**.
- To uninstall the application from the selected AP, from the **Actions** drop-down list, choose **Uninstall App**.

Step 3 Click the AP name to view the following details:

- **AP Name**
- **AP Status**
- **IP Address**
- **Health**

Step 4 Click **Tech Support logs** to collect Application Hosting logs.

AP Configuration in Cisco DNA Center

The Configure Access Points workflow allows you to configure and deploy AP-level and radio-level parameters in Cisco DNA Center.

You can configure the following AP-level parameters:

- AP location
- AP admin status
- AP mode
- AP LED status
- AP failover priority
- High availability

You can configure the following radio-level parameters:

- Radio admin status
- Radio power settings
- Radio channel settings

Configure AP Workflow

This procedure shows how to configure AP and radio parameters in Cisco DNA Center.

Before you begin

Make sure that the AP is assigned to a site.

Step 1 In the Cisco DNA Center GUI, click the menu icon (≡) and choose **Workflows** > **Configure Access Points**.

Step 2 Click **Let's Do it**.

To skip this window in the future, check the **Don't show this to me again** check box.

The **Get Started** window appears.

Step 3 In the **Task Name** field, enter a unique name for the workflow, and click **Next**.

Step 4 In the **Select Site from the hierarchy** window, navigate to the site where you want to apply AP-related configurations.

The right pane shows the selected floor and the number of APs available on that floor.

Step 5 Click **Next**.

The **Select Access Points** window lists all the APs available in the selected site.

Step 6 In the **Select Access Points** window, check the check boxes of the APs to edit the AP name in bulk.

Step 7 Click **Next**.

The **Modify AP Name** window shows the list of APs selected in the previous window.

Step 8 In the **Modify AP Name** window, enter a new name for the APs using one of the following methods:

- **Create a New Naming Convention**: Click this radio button, enter a name based on your convention, and click **Apply Pattern**. The **Access Points** table shows the new AP names based on the naming pattern you entered.
- **Upload a CSV file**: Click this radio button, download the sample CSV template file, and add your AP names to it. Then, upload the CSV file either by dragging and dropping it into the drop area or by clicking **Choose a file** and browsing to select it.

Step 9 Click **Next**.

Step 10 In the **Configure AP Parameters** window, configure the following AP parameters:

- **Location**: Check this check box and enter the location details.
- **Admin Status**: To disable the admin status, check this check box and click **Disable**.
- **AP LED Status**: To disable the APs LED status, check this check box and click **Disable**.
- **AP Mode**: Check this check box and choose the AP mode from the **Select AP Mode** drop-down list. Valid modes are **Local/Flex**, **Monitor**, **Bridge**, and **Flex+Bridge**.
- **AP Failover Priority**: Check this check box and, from the **AP Failover Priority** drop-down list, choose the failover priority for APs. Valid options are:
  - **Low**: Assigns the AP to level 1 priority, which is the lowest priority level. This is the default value.
  - **Medium**: Assigns the AP to level 2 priority.
  - **High**: Assigns the AP to level 3 priority.
  - **Critical**: Assigns the AP to level 4 priority, which is the highest priority level.
- **Controller Configuration**: Check this check box and configure the primary, secondary, and tertiary controller name and IP address for the AP.

Step 11 Click **Next**.

Step 12 In the **Configure 802.11 a/n/ac/ax Parameters** window, configure the following 802.11 a/n/ac/ax parameters:

- Check the **Admin Status** check box and click the **Disable** button to disable the admin status.
- Check the **Power Assignment** check box, click the **Custom** button, and choose a custom power value from the **Select Custom Power** drop-down list.
- Check the **Channel Assignment** check box, click the **Custom** button, and choose a custom channel number from the **Select Custom Channel** drop-down list.
- Check the **Channel Width** check box and choose one of the channel bandwidth options from the **Select Channel Width** drop-down list:
  - **20 MHz**
  - **40 MHz**
  - **80 MHz**
  - **160 MHz**

- Check the **Antenna Name** check box and choose an antenna name from the **Select Antenna Name** drop-down list. If you choose **Other** as the Antenna name, enter the **Antenna Gain** value in the **Antenna Gain (for Antenna-Other)** field. Enter a number to specify an external antenna's ability to direct or focus radio energy over a region. High-gain antennas have a more focused radiation pattern in a specific direction. The Antenna Gain value is from 0 to 40.
- Check the **Azimuth** check box and enter a value for azimuth orientation, in degrees. The azimuth is the angle of the antenna measured relative to the x-axis. The azimuth range is from 0 to 360.
- Check the **Elevation** check box and enter a value for elevation orientation, in degrees. The elevation orientation range is from 0 to 90.

Step 13 Click **Next**.

Step 14 In the **Configure 802.11 b/g/n Parameters** window, configure the following 802.11 b/g/n parameters:

- Check the **Admin Status** check box and click the **Disable** button to disable the admin status.
- Check the **Power Assignment** check box and click the **Custom** button and choose custom power from the **Select Custom Power** drop-down list.
- Check the **Channel Assignment** check box, click the **Custom** button, and choose custom channel number from the **Select Custom Channel** drop-down list.
- Check the **Antenna Name** check box and choose the antenna name from the **Select Antenna Name** drop-down list.
- If you select **Other** as the Antenna name, enter the antenna gain value in the **Antenna Gain (for Antenna-Other)** field. Enter a number to specify an external antenna's ability to direct or focus radio energy over a region of space. High-gain antennas have a more focused radiation pattern in a specific direction. The antenna gain value is from 0 to 40.
- Check the **Azimuth** check box and enter a value for azimuth orientation in degrees. The azimuth is the angle of the antenna measured relative to the x-axis. The azimuth range is from 0 to 360.
- Check the **Elevation** check box and enter a value for elevation orientation in degrees. The elevation orientation range is from 0 to 90.

Step 15 Click **Next** to view the summary details. In the **Summary** window, review the following AP configuration details, and click **Edit** in any of the sections to make a change.

- Select Site from the hierarchy
- Select Access Points
- Modify AP Name
- Select AP Parameters
- Select 802.11 a/n/ac/ax Parameters
- Select 802.11 b/g/n/ax Parameters

Step 16 Click **Next**.

Step 17 To provision now, click the **Now** radio button and click **Next**. To provision at a later time, click the **Later** radio button, define the date and time, and click **Next**.

Step 18 In the **Track Provision Status** window, view the **AP Configuration Provision** status.

Learn Device Configurations from Brownfield Devices

Cisco DNA Center allows you to learn the configurations from brownfield devices such as Cisco Wireless Controllers and save the configurations at the global level. *Brownfield* refers to devices that belong to existing sites with pre-existing infrastructure.

The following procedure describes how to learn device configurations from brownfield devices in Cisco DNA Center.

Step 1 Click the menu icon (≡) and choose **Workflows**.

A library of available workflows is displayed. These workflows guide you step by step through a particular task.

Step 2 Click the **Learn Device Configuration** workflow.

Step 3 Click **Let's Do it**.

To skip this window in the future, check **Don't show this to me again**.

The **Select WLC to Learn Configuration** window appears.

Step 4 From the device name column, select a wireless controller device whose configurations have not been learned by Cisco DNA Center.

Step 5 Click **Next**.

Step 6 In the **Learned Network Configurations** window, review the network settings. The network servers that appear in this window are saved at the global level.

Step 7 **System Settings**: Shows all the AAA servers that are available on the device. Enter the password in the **Shared Secret** field for the AAA servers, because the passwords are encrypted and Cisco DNA Center cannot learn passwords.

Step 8 To save a AAA server as a Cisco ISE server, click the **Cisco ISE Server** toggle button and then enter the **Username**, **Password**, and **FQDN** details.

Note If the Cisco ISE server is already present in Cisco DNA Center, you cannot save a AAA server as a Cisco ISE server.

After configuring the AAA server as a Cisco ISE server, the certificate from the Cisco ISE server is automatically accepted to establish trust.

a) **AAA Server**: Shows the network servers configured in Cisco DNA Center. These network servers are prepopulated.

You can customize **Network** or **Client/Endpoint** for the AAA server. The servers and protocols are chosen by default.

From the drop-down list, choose **IP Address (Primary)** and **IP Address (Secondary)**. These servers are saved at the global level.

b) **DHCP Server**: Shows all the DHCP servers available on the device.

c) **NTP Server**: Shows all the NTP servers available on the device.

Step 9 Click **Next**.

The **Learned Wireless Configuration** window appears.

Step 10 Review the wireless configuration. The wireless configurations that appear in this window are saved at the global level.

Supported: Shows all the supported **SSIDs**, **RF Profiles**, **Interfaces**, and **Interface Groups**.

- To ignore an SSID, RF profile, interface, or interface group, select it and click **Ignore Config** in the corresponding table.
- To relearn an ignored SSID, RF profile, interface, or interface group, select it and click **Relearn Config** in the corresponding table.

Unsupported: Shows all the unsupported **SSIDs**, **RF Profiles**, **Interfaces**, and **Interface Groups**. You can address these unsupported or unknown configurations and use CLI templates.

Note: Attributes that are associated with multiple profiles can cause conflicts. However, you can resolve the conflicts in the next step.

Step 11 Click **Next**.

The **Resolve Multiple WLAN Profile Conflict** window appears.

Step 12 Review and resolve the conflicts that appear in the **Resolve Multiple WLAN Profile Conflict** window.

The SSIDs that are saved at the global level and learned with multiple WLAN profiles are listed.

Assign a WLAN profile from SSID to global and another profile to a particular site to resolve the conflict.

Step 13 To assign a WLAN profile to a site, click **Assign Site** in the corresponding SSID row.

Step 14 In the **Assign Site** window, choose a site and click **Save**.

Note Only the sites that do not have any wireless configurations or profiles that are associated to them can be overwritten. If there is no fresh site, exit from the current workflow, create a new site, and then restart the workflow.

Step 15 Click **Next**.

The **Resolve Configuration Conflicts** window appears.

Step 16 Review and resolve the conflicts displayed in the **Resolve Configuration Conflicts** window.

Configurations learned from the device and the configurations saved at the global level are shown.

Choose a configuration set to resolve the conflict:

- **Use DNAC Configuration**: To save configurations at the global level.
- **Use Device Configuration**: To learn configurations from the device.

  Selecting device configuration overwrites the configurations saved at the global level.
- **Use Custom Configuration**: To customize the configurations by choosing the required **Wireless Interface**.

Step 17 Click **Next**.

Step 18 In the **Model Configs Learned** window, review the model configuration.

The model configurations are a set of model-based, discoverable, and customizable configuration capabilities that can be deployed on network devices. Model configurations can be deployed on various hardware platforms and software types. Cisco DNA Center discovers and learns model configs from device-specific configurations such as CLI. The learned model configs are saved in designs that can be attached to network profiles.

Expand and review the following wireless model config design types:

- Advanced SSID Configuration
- CleanAir Configuration
- Dot11ax Configuration
- Flex Configuration
- Multicast Configuration

If you want to ignore any configuration from each model configuration design type, select the configuration in the corresponding table and click **Ignore Config**. To relearn the ignored configuration, select the ignored configuration and click **Relearn Config**.

Step 19 (Optional) Click the menu icon (≡) and choose **Tools** > **Model Config Editor** if you want to modify the learned model config designs.

Step 20 Click **Next**.

The **CLI Templates Learned** window appears.

Step 21 In the **CLI Templates Learned** window, review the CLI templates and use these templates to address the unknown or unsupported configurations.

- All the ignored WLAN configs are chosen by default. Click **Ignore Template** to restrict the template from addressing the configs. Click **Relearn Template** to address the configs.
- All the unknown or unsupported configs are chosen by default. Click **Ignore Template** to restrict the template from addressing the configs. Click **Relearn Template** to address the configs.

Step 22 (Optional) To edit the CLI template, choose **Tools** > **Template Editor**.

Step 23 Click **Next**.

The **Network Profiles** window appears.

Step 24 Review the network profiles in the **Network Profiles** window.

Based on the configurations learned, Cisco DNA Center creates the network profiles. You can either use these network profiles or create new ones.

Note SSIDs are learned and grouped when creating network profiles.

Step 25 To create a new network profile, click **Create New Profile**.

Step 26 In the **New Profile** window, enter a name for the network profile in the **Network Profile Name** field, choose SSIDs in the **SSIDs** table, and click **Save**.

Step 27 For each network profile, do the following:

- To assign a site to a network profile, click **Assign Site**. In the **Assign Site** window, choose a site and click **Save**.

  Click **Sites Assigned** to view the sites assigned to this profile.
- To attach a template to a network profile, click **Assign Template**. In the **Assign Template** window, choose templates from the **Select Templates** drop-down list for each brownfield device and click **Save**.

  Click **View Templates** to view the templates assigned to the profile.
- To ignore a network profile, click **Ignore Profile** and click **Continue**.

If a profile is marked as ignored, all the profile attributes of that profile are removed. This cannot be undone by relearning the profile. To relearn an ignored profile, click **Relearn Profile**.

- To add a site tag to a network profile, click **Add** in the **Site Tag** table. In the **Add Site Tag** window, choose a site tag from the **Select Site Tag** drop-down list, choose a site from the hierarchy, and click **Save**.

Step 28 Click **Save**.

The **Network Profile - Model Configurations** window appears.

Step 29 Add the model configurations learned by Cisco DNA Center to the network profiles.

a) Expand each network profile and click **Add**.

b) In the **Add Model Configs to Network Profile** window, do the following:

   1. Expand the model config design that you want to add.
   2. Choose the design.

      For **Advanced SSID Configuration**, for each design, choose SSIDs from the drop-down list in the **Applicable SSID** column.

   3. Click **Apply**.

c) To delete a model config added to the network profile, choose the model config and click **Delete**.

Step 30 Click **Next**.

The **Summary** window displays all the configurations learned from the device.

Step 31 To make any changes, click **Edit**. To make any changes to previous steps, click **Back**.

Step 32 Click **Save**.

All these network configurations are saved at the global level.

Step 33 Click the menu icon (≡) and choose **Design** > **Network Settings**.

- In the **Network** tab, you can view all the network configurations learned from devices.
- In the **Wireless** tab, you can view all the wireless configurations learned from devices.

The learned configurations are pushed to the devices when the devices are provisioned.

Replace Device Workflow

The workflow guides you step by step to replace a faulty device.

Note You can also replace a faulty device from the **Inventory** window. For more details, see Replace a Faulty Device, on page 105.

Before you begin

- The software image version of the faulty device must be imported in the image repository before marking the device for replacement.
- The faulty device must be in an unreachable state.
- The faulty device must be assigned to a user-defined site, if the replacement device onboards Cisco DNA Center through Plug and Play (PnP).
- The replacement device must not be in a provisioning state while triggering the RMA workflow.

Step 1 Click the menu icon (≡) and choose **Workflows** > **Replace Device**.

Step 2 Click **Let's Do it**.

To skip this window in the future, check the **Don't show this to me again** check box.

Step 3 In the **Get started** window, enter a unique **Task Name** for your workflow and click **Next**.

Step 4 In the **Choose Device Type** window, choose the type of faulty device that you want to replace and click **Next**.

Step 5 In the **Choose Site** window, choose the site in which you have the faulty device and click **Next**.

Step 6 In the **Choose Faulty Device** window, choose one faulty device that you want to replace and click **Next**.

Step 7 In the **Choose Faulty Device** window, if you don't find the faulty device, do the following:

a) Click **Add Faulty Device**.
b) Choose the faulty device and click **Next**.
c) In the **Mark for Replacement** window, click **Mark**.
d) Click **Next**.

Step 8 In the **Choose Replacement Device** window, choose a replacement device from the **Unclaimed** tab or **Managed** tab.

The **Unclaimed** tab shows the devices that are onboarded through PnP. The **Managed** tab shows the devices that are onboarded either through Inventory or the Discovery process.

Step 9 (Optional) If the replacement device is not yet onboarded, do the following:

a) In the **Choose Replacement Device** window, click **Add Device**.
b) In the **Add New Device** window, enter the **Serial Number** of the device and click **Add New Device**.

Or

a) In the **Choose Replacement Device** window, click **Sync with Smart Account**.
b) In the **Sync with Smart Account** window, click **Sync**.

Step 10 Click **Next**.

Step 11 In the **Schedule Replacement** window, click **Now** to start device replacement immediately or click **Later** to schedule device replacement at a specific time.

If the replacement device is not yet onboarded, the **Now** option is disabled. Click **Later** to schedule the device replacement at a specific time.

Step 12 Click **Review** to the view the chosen device type, faulty device details, and replacement device details.

Step 13 Click **Next** to view the details in the **Summary** window.

Step 14 In the **Summary** window, do the following:

a) (Optional) Click **Edit** if you want to change the device type, faulty device, and replacement device chosen in the previous steps.
b) (Optional) Under **Replacement Device**, click **View** to view the configuration of the replacement device.
c) Click **Replace**.

Step 15 Click **Monitor Replacement Status** to go to the **Mark for Replacement** view in the **Provision** window.

Step 16 Click **Replace Status** for the replacement device to view the status of the RMA workflow progress, as follows:

- Claim the PnP replacement device.
- Distribute and activate the software image to the replacement device.
- Deploy licenses.
- Provision VLAN configurations.
- Provision startup configurations.
- Reload the replacement device.
- Check for reachability of the replacement device.
- Deploy SNMPv3 credentials to the replacement device.
- Synchronize the replacement device.
- Remove the faulty device from CSSM.
- Add the replacement device to CSSM.
- Revoke and create the PKI certificate.
- Update Cisco ISE.
- Delete the faulty device.

After the workflow is completed, the **Replace Status** is updated to **Replaced**.

Step 17 If an error message appears, click the error link. Click **Retry** to retrigger the workflow with the same set of faulty and replacement devices.

Note The main inventory window displays the details of the new replacement device that has replaced the faulty device.

Step 18 (Optional) You can exit the workflow at any stage and resume it later. The Exit option is shown at the bottom left corner in all the windows. To exit the workflow and resume it later, do the following:

a) Click **Exit**.

The **Exiting Workflow** confirmation window appears.

b) Click **Exit** in the confirmation window.

A workflow **In Progress** card with the task name is created.

c) To resume the work flow from where you left, click the **In Progress** card.

- If a device has **In progress** card and you try to replace the same device from **Inventory** > **Marked for Replacement** window, a confirmation message with the serial number and task name of **In progress** card appears. Click **Yes** to resume the work-flow or **Cancel** to start a new workflow.

- If you click the **In progress** card for a device that is unmarked for replacement, a **Warning message** appears. Click **Yes** and choose a different faulty device to start a new workflow. If you click **Cancel** the workflow will be cancelled.

Create a Remote Support Authorization

The following procedure describes how to create a create a remote support authorization.

Note The Cisco DNA Center remote support authorization is supported with only LM Console version 0.40.5.

Step 1 Click the menu icon (≡) and choose **Workflows** > **Create a Remote Support Authorization**.

Step 2 Click **Let's Do it**.

Note To skip this screen in the future, check **Don't show this to me again**.

The **Set up the Authorization** window appears.

Step 3 In the **Cisco Specialist Email Address** field, enter the email address of the Cisco specialist.

Step 4 In the **Existing SR Number(s)** field, enter one or more SR numbers separated by a comma.

Step 5 In the **Access Justification** field, enter the access justification and click **Next**.

Step 6 In the **Schedule the Access** window, click **Now** to allow the Cisco specialist to access Cisco DNA Center immediately, or click **Later** to schedule the access for a later date and time.

Step 7 Click **Next**.

Step 8 In the **Access Permission Agreement** window, check **I agree** and click **Next**.

Note You can revoke the authorization at any time before the access.

Step 9 In the **Summary** window, review the details. To make changes, do the following:

- Click **Edit** to make changes in the **Set Up the Authorization** window.
- Click **Edit** to make changes in the **Schedule the Access** window.

Step 10 Click **Create**.

The **Done! Authorization is created** window appears.

Step 11 Click **View All Authorization** to navigate to the **Remote Support Authorization** window. For more information, see View the Remote Support Authorization Dashboard.

Create an Event Notification

Cisco DNA Center event notification allows you to associate multiple channels inside one notification that delivers the details of selected events that occur at multiple points.

Step 1 Click the menu icon (≡) and choose **Workflows** > **Create a New Notification**.

Step 2 In the **Create a New Notification window**, click **Let’s Do it**.

Note To skip this screen in the future, check the **Don't show this to me again** check box.

Step 3 In the **Select Channels** window, choose the notification channels.

The supported channels are **REST**, **PAGERDUTY**, **SNMP**, **SYSLOG**, **WEBEX**, **EMAIL**, and custom channels.

Step 4 Click **Next**.

Step 5 In the **Select Site and Events** window, from the **Select a site** drop-down list, choose a specific site for which you want to be notified for the selected events.

Note You can choose multiple sites at a time.

Step 6 Click either the plus icon next to an event, or click **Add All** to add all the events to the respective notification.

Step 7 To remove an event from the notification, click either the cross icon next to the event that you want to remove, or click **Remove All** to remove all the event from the event list.

Note

- When you choose a notification channel, a table in the **Select Site and Events** window lists the number of events supported by the chosen notification channel.
- When you choose more than one notification channel, a table in the **Select Site and Events** window lists the number of supported events that are common in the chosen notification channels.

Step 8 Click **Next**.

Step 9 In the **Configure Notification** window, configure the following values:

a. If you choose an **EMAIL** notification channel, configure the following in the **Email Settings** window:

  1. Click the link to access the Email GUI window and configure a new email server.

Note

- Notification type can be set for either **REST** API endpoint (webhook), **PAGERDUTY**, **SNMP**, **SYSLOG**, **WEBEX**, and **EMAIL**. If you choose **EMAIL**, but have not yet configured the email settings, you are prompted to access the GUI window where you can perform this task. Email settings are configured in the **Email** tab.

  (Optional) To access the **Email** tab, click the menu icon (≡) and choose **System** > **Settings** > **External Services**.

  Expand **External Services**, choose **Destinations**, and click the **Email** tab.

- Up to 20 email addresses per endpoint can be configured to receive email notifications. To add multiple email addresses, you need to add each email address separately and press **Enter** (on your keyboard) after each addition. Cisco DNA Center validates the email addresses and notifies you if the syntax is incorrect.

- If you need to configure more than 20 email addresses per endpoint, you can use a group email alias.

- When using email destinations for event subscriptions, the emails that are sent show events with a UTC timestamp.

2. Click either **Select Existing Instance** to use the existing email instance or **Create New Instance** to create a new email instance.
3. If you click **Select Existing Instance**, from the **Select Instance** drop-down list, choose an email instance.
4. Enter the email addresses in the **From** and **To** fields and a subject for the **Subject** header in the email.

b. If you choose a **SYSLOG** notification, configure the following values in the **Syslog Settings** window:

1. Click the link to access the Syslog GUI window and configure a new syslog endpoint (syslog server hostname and port number).

   Note Notification type can be set for either **REST** API endpoint (webhook), **PAGERDUTY**, **SNMP**, **SYSLOG**, **WEBEX**, and **EMAIL**. If you choose **SYSLOG**, but have not yet configured the syslog server settings, you are prompted to access the GUI window where you can perform this task. Syslog server settings are configured in the **Syslog** tab.

   (Optional) To access the **Syslog** tab, click the menu icon (≡) and choose **System** > **Settings** > **External Services**.

   Expand **External Services**, choose **Destinations**, and click the **Syslog** tab.

2. In the **Protocol** field, enter either TCP or UDP.
3. In the **Port** field, enter the port number of the syslog server.
4. In the **Hostname/IP** field, enter the hostname or IP address of the syslog server.
5. From the **Select Instance** drop-down list, choose the syslog instance.

c. If you choose a **REST** notification, configure the following values in the **REST Settings** window:

- Click the link to access the REST Webhook GUI window and configure a new webhook endpoint.

Note Notification type can be set for either **REST** API endpoint (webhook), **PAGERDUTY**, **SNMP**, **SYSLOG**, **WEBEX**, and **EMAIL**. If you select **REST**, but have not yet configured the webhook settings, you are prompted to access the GUI window where you can perform this task. Webhook settings are configured in the **Webhook** tab.

(Optional) To access the **Webhook** tab, choose **System** > **Settings** > **External Services**.

Expand **External Services**, choose **Destinations**, and click the **Webhook** tab.

- From the **Webhook Instance** drop-down list, choose a notification endpoint and URL.
- In the **URL** field, enter the URL address of the REST API endpoint that the event will be sent to.

  Trust certificate: Whether a trust certificate is required for REST API endpoint notification.

  Method: Either the PUT or POST method.
- **Basic**: Authentication where the client sends HTTP requests with the word *Basic* in the authorization header, followed by a space and a base64-encoded string username:password. If you choose **Basic** in the GUI, the **Headers** field is automatically populated with the **Authorization** value.
- **Token**: Authentication where users are authenticated using a security token provided by the server. If you choose **Token**, the **Headers** field is automatically populated with the **X-Auth-Token** value.
- **No Authentication**: No authentication needed.
- **Headers**: The **Header Name** and **Header Value**.

  Note The **Headers** fields may be automatically populated depending on your Authentication selection.

d. If you choose **SNMP** notification channel, configure the following values in the **SNMP Settings** window:

1. Click the link to access the SNMP GUI window and configure a new SNMP endpoint.

   Note Notification type can be set for either **REST** API endpoint (webhook), **PAGERDUTY**, **SNMP**, **SYSLOG**, **WEBEX**, and **EMAIL**. If you select **SNMP**, but have not yet configured the SNMP settings, you are prompted to access the GUI window where you can perform this task. SNMP settings are configured in the **SNMP** tab.

   (Optional) To access the **SNMP** tab, click the menu icon (☰) and choose **System** > **Settings** > **External Services**.

   Expand **External Services**, choose **Destinations**, and click the **SNMP** tab.

   The SNMP trap notification is only available for a system hardware event. When the health state of hardware components changes, a system hardware event triggers notifications to subscribers. Hardware components monitored for changes include CPU, memory, disk, NIC, fan, power supply, and RAID controller.

2. From the **SNMP Instance** drop-down list, choose the notification endpoint.
3. **Create a new endpoint**: Enter a new endpoint name and description.
4. In the **Hostname/IP Address** field, enter the hostname or IP address for the SNMP trap receiver (server).
5. In the **Port** field, enter the port number for the SNMP trap receiver (server).

e. If you choose **PAGERDUTY** notification channel, configure the following in the **PAGERDUTY settings** window:

1. In the **SERVICE CONFIGURATION** area, click either **Select Existing Instance** to use the existing PagerDuty instance or **Create New Instance** to create a new PagerDuty instance.
2. From the **Select Instance** drop-down list, choose a PagerDuty instance.
3. In the **PagerDuty Events API URL** field, enter a PagerDuty event API URL.
4. In the **PagerDuty Integration Key** field, enter a PagerDuty integration key.

f. If you choose **WEBEX** notification channel, configure the following values in the **WEBEX Settings** window:

1. From the **Select Instance** drop-down list, choose a Webex instance.
2. In the **Webex URL** field, enter the Webex URL.
3. In the **Webex Room ID** field, enter the Webex room ID.
4. In the **Webex Bot Access Token** field, enter the Webex bot access token.

Step 10 Click **Save**.

The **Name and Description** window appears.

Step 11 In the **Name** field, enter a unique name for the notification.

Step 12 In the **Description** box, enter a description of the notification.

Step 13 In the **Summary** window, review the configured details.

Step 14 Click **Finish**.

The **Done! Your new notification is complete** window appears.

CHAPTER 32

Troubleshoot Cisco DNA Center Using Data Platform

- About Data Platform, on page 689
- Troubleshoot Using the Analytics Ops Center, on page 690
- View or Update Collector Configuration Information, on page 691
- View Data Retention Settings, on page 692
- View Pipeline Status, on page 693

About Data Platform

Data Platform provides tools that can help you monitor and troubleshoot Cisco DNA Center applications. **Data Platform** displays synthesized data from various inputs to help you identify patterns, trends, and problem areas in your network. For example, if something goes wrong in your network, you can quickly get answers to questions such as whether a pipeline is in an error state and what is the real-time traffic flow in a particular area. The main areas of Data Platform are:

- **Analytics Ops Center**: Provides a graphical representation of how data is streamed through collectors and pipelines and provides Grafana dashboards, which can help you identify patterns, trends, and problem areas in your network. See Troubleshoot Using the Analytics Ops Center, on page 690.

- **Collectors**: Collects a variety of network telemetry and contextual data in real time. As data is ingested, Cisco DNA Center correlates and analysis the data. You can view the status of collectors and quickly identify any problem areas. See View or Update Collector Configuration Information, on page 691.

- **Store Settings**: Allows you to view how long data is stored for an application. See View Data Retention Settings, on page 692.

- **Pipelines**: Allows Cisco DNA Center applications to process streaming data. A data pipeline encapsulates an entire series of computations that accepts input data from external sources, transforms that data to provide useful intelligence, and produces output data. You can view the status of pipelines and quickly identify any problem areas. See View Pipeline Status, on page 693.

Troubleshoot Using the Analytics Ops Center

The Analytics Ops Center provides a graphical representation of how data is streamed through collectors and pipelines, and provides Grafana dashboards, which can help you identify patterns, trends, and problem areas in your network, such as:

- Missing data in Assurance.
- An inaccurate health score.
- Devices that appear as monitored under Inventory but unmonitored under Assurance.

Step 1 Click the menu icon (≡) and choose **System** > **Data Platform**.

Step 2 Click **Analytics Ops Center**.
A list of applications is displayed.

Step 3 Click the application name for which you want to view metrics; for example, **Assurance**.

A graphical representation of all existing collectors and pipelines in the application appears. CPU or throughput values corresponding to each pipeline are also provided.

The current health status of each component is indicated by its color:

- Red: error
- Yellow: warning
- Gray: normal operation

Step 4 To view historical data of pipelines, click **Timeline & Events**.

A timeline bar providing data for the time interval appears. You can also:

- Move the timeline slider to view data for a specific time.
- Hover your cursor over an event in the timeline bar to display additional details or a group of events that occurred at the same time.
- Click an event to display the Analytics Ops Center visualization at that particular time.

Step 5 To view additional details to help you troubleshoot an issue and determine the cause of an error or warning, click a collector name.

A slide-in pane appears with the following tabs:

- **Metrics**: Provides a selection of available metrics gathered during the last 30 minutes. It displays summary information indicating the component status, start and stop time, and error exceptions. You can also choose a different time interval.
- **Grafana**: Displays a dashboard associated with the respective component for deeper debugging.

Step 6 To view whether data is flowing through a specific pipeline, click a pipeline stream.

A slide-in pane appears with graphs. The graphs display whether the application is receiving data from the underlying pipelines. The graph information is based on the time interval you select from the drop-down list in the slide-in pane. Options are **Last 30 Min**, **Last Hour**, **Last 2 Hours**, and **Last 6 Hours**. The default is **Last 30 Min**.

Step 7 If a pipeline is not flowing at normal levels, hover your cursor over the stream to display the lag metrics.

Step 8 To view detailed information for a specific pipeline, click a pipeline name.

The appropriate *Pipeline* page displays with the following tabs:

Note Make sure to click the **Exceptions** tab to determine if any exceptions occurred in the pipeline. Under normal working conditions, this tab displays **null**.

- **Metrics**: Displays metrics, updated every 30 minutes in a graph.
- **Summary**: Displays summary information such as stats, run-time, and manifest.
- **Exceptions**: Displays any exceptions that occurred on the pipeline.
- **Stages**: Displays the pipeline stages.

Step 9 To change the metrics displayed on the Analytics Ops Center page, click **Key Metrics**, select up to two metrics, and then click **Apply**.

By default, Cisco DNA Center displays CPU and Throughput metrics.

Step 10 To view metrics for a particular flow, do the following:

a) Click **View Flow Details**.
b) Select three connected components (collector, pipeline, and store) by clicking the tilde (~) on the component's top-left corner.
c) Click **View Flow**.
Cisco DNA Center displays the metrics associated with that specific flow.

View or Update Collector Configuration Information

Collectors collect a variety of network telemetry and contextual data in real time. As data is ingested, Cisco DNA Center correlates and analyzes the data. You can view the status of collectors and quickly identify any problem areas.

Step 1 Click the menu icon (≡) and choose **System** > **Data Platform**.

Step 2 Click **Collectors**. The colored dot next to each collector indicates its overall status.

Step 3 To view additional details, click a collector name.

The appropriate *Collector* page appears. By default, Cisco DNA Center displays the **Configurations** tab which displays the list of current configurations.

Step 4 To view, update, or delete a configuration, click a specific configuration name.

Step 5 To add a new configuration, click **+ Add** in the **Configurations** tab.

A slide-in pane appears.

Step 6 In the slide-in pane, enter the required information for the configuration.

Step 7 (Optional) You can anonymize its data for some collectors such as **WIRELESSCOLLECTOR**, by checking the **Anonymize** check box.

Note When you check the **Anonymize** check box, the host name and user ID in the **Client Health** window is scrambled with one-way hash that cannot be decrypted.

Important If you want to anonymize your data, make sure that you check the **Anonymize** check box before you discover devices with the **Discovery** tool. If you anonymize the data after you discovered devices, the new data coming into the system is anonymized but the existing data will not be anonymized.

Step 8 Click **Save Configuration**.

Step 9 To view configured instances, click the **Instances** tab.

Step 10 To view summary information and metrics, choose an instance from the list.

Step 11 (Optional) If Cisco DNA Center integrates with Cisco Connected Mobile Experience (CMX), you have the option of anonymizing data on the CMX side. Do the following:

a) Using an SSH client, log in to Cisco CMX as the cmxadmin CLI user.
b) Change to the root user.
c) Go to `/opt/cmx/etc/node.conf` and under `[location]`, add **`user_options`**. For example:

```
[location]
…
user_options=-Dhideusername=true
```

d) On the Cisco CMX CLI, enter the following commands:

```
cmxctl agent restart
cmxctl location restart
```

View Data Retention Settings

You can view how long data is stored for an application.

Step 1 Click the menu icon (≡) and choose **System** > **Data Platform**.

Step 2 Click **Store Settings**.

Step 3 To view a list of historical purge jobs that have completed, click **Data Purge Schedule**.

The **HISTORY** table lists the name of the purge job, the result, time, and other data. You can sort, filter, and export data in the table.

Step 4 To view the current data retention and purge settings, click **Data Retention & Purge Configuration**. The following is displayed:

- **Document Store**: Settings for all time-based data, such as the maximum size and the low and high watermark threshold.

- **Metric Graph Store**: Settings for all time-based graphical data, such as the maximum size and the low and high watermark threshold.

View Pipeline Status

Data pipelines allow Cisco DNA Center applications to process streaming data. A data pipeline encapsulates an entire series of computations that accepts input data from external sources, transforms that data to provide useful intelligence, and produces output data. You can view the status of pipelines and quickly identify any problem areas.

Step 1 Click the menu icon (☰) and choose **System** > **Data Platform**.

Step 2 Click **Pipelines**.

Step 3 To view whether the application is receiving data from the underlying pipelines, click a pipeline name.

The appropriate *Pipeline* page displays with the following tabs:

Note Make sure to click the **Exceptions** tab to determine if any exceptions have occurred in the pipeline. Under normal working conditions, this tab displays **null**.

- **Metrics**: Displays metrics, updated every 30 minutes in a graph.
- **Summary**: Displays summary information such as stats, run-time, and manifest.
- **Exceptions**: Displays any exceptions that have occurred on the pipeline.
- **Stages**: Displays the pipeline stages.