



# Campus Software Image Management Using Cisco DNA Center Deployment Guide

## Prescriptive Deployment Guide

December, 2020

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## Introduction

### Audience

The audience for this document is network administrators who wish to automate the upgrade of a Catalyst 9000 series switch at a branch or campus using Cisco DNA Center software image management (SWIM) solution.

### About The Solution

Cisco DNA Center stores all the unique software images according to image type and version for the devices in your network. It allows to view, import, and delete software images and also push software images to the devices in your network. Software upgrade can also be scheduled for later date and time.

### About This Guide

This guide demonstrates the value of the Cisco DNA Center software image management (SWIM) solution using a specific combination of equipment, OS version, and configuration. You may apply this procedure to any Catalyst 9000 series switch but in this guide, we will only focus on Catalyst 9300 switch.

#### Reader tip

For more information on Cisco DNA Center supported devices please refer to the compatibility matrix information <https://www.cisco.com/c/en/us/support/cloud-systems-management/dna-center/products-device-support-tables-list.html>

### Use Cases

Standardize software images for your network devices with software image management (SWIM).

**Figure 1.**  
Implementation Flow



This document contains four major sections:

- The **Define** section presents a high-level overview of how software image management (SWIM) within Cisco DNA Center can help reduce device installation and upgrade times from hours to minutes.
- The **Design** section discusses the pre-requisites for setting up software image management (SWIM) in a network with Cisco DNA Center.
- The **Deploy** section of the guide shows how to standardize an image by marking as a golden image and go through the update image workflow to distribute and activate the golden image on a network device.
- The **Operate** section briefly discusses the known caveats of software image management (SWIM) in Cisco DNA Center.

## Define

### Solution overview

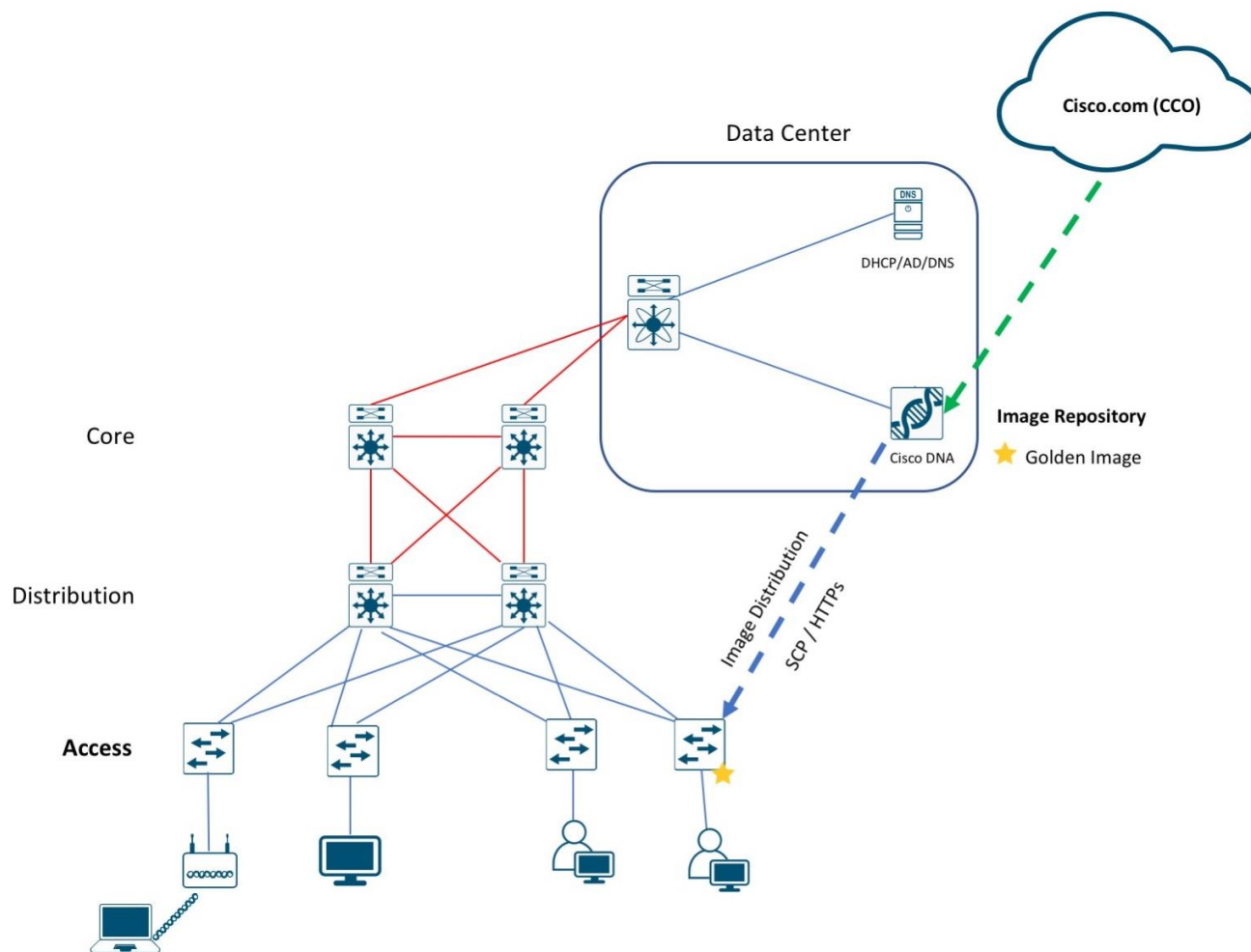
Cisco DNA Center can help with the non-fabric wired deployments in various different ways such as – network discovery, network inventory, return merchandise authorization, software image management (SWIM) etc.

#### Reader tip

This guide only covers software image management (SWIM). For day-zero onboarding of a switch with Plug and Play (PnP) and return merchandise authorization (RMA) refer to the following guide, [Network Device Onboarding for Cisco DNA Center Deployment Guide](#).

**Figure 2.**

Campus Topology highlighting Standardize software images for your network devices with SWIM.



Cisco DNA Center is designed for intent-based networking (IBN). The solution breaks the process in to Day 0 and Day N. The solution provides a unified approach to provision enterprise networks comprised of Cisco routers, switches, and wireless devices with a near zero touch deployment experience.

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Zero-touch device connectivity and Software Image Management (SWIM) features reduce device installation and upgrade times from hours to minutes and bring new remote offices online with plug-and-play ease from an off-the-shelf Cisco device. Software Image Management (SWIM) manages software upgrades and controls the consistency of image versions across your network.

## Design

Before you proceed you must make sure you already have Cisco DNA Center installed on your network.

### Reader tip

For more information on how to install Cisco DNA Center, refer to [Cisco DNA Center Installation resources](#) page.

Before performing an image upgrade, the following pre-requisites should be reviewed.

#### 1. Check the Minimum Software Releases Requirements on Devices

Cisco DNA Center requires the software releases on devices to meet the ones listed in **Minimum Supported Software Version** column of supported devices spreadsheet below:

<https://www.cisco.com/c/en/us/support/cloud-systems-management/dna-center/products-device-support-tables-list.html>

#### 2. Devices have CLI /SNMP or HTTPS/SCP credentials.

Network devices should be in managed state or the administrators have CLI/SNMP or HTTPS/SCP credentials for Cisco DNA Center to discover them and bring them in **managed state** before performing a Software Image upgrade. This requirement is only for Day N scenario.

#### 3. CCO Credentials

Though this is not a mandatory requirement for SWIM but its strongly recommended to add CCO credentials. Otherwise, certain features like ROMMON upgrade or suggested and latest image display list of images will not function. CCO Credentials is also required to download the KGV file for Integrity Verification of Software Images.

#### 4. 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 (KVG) file to ensure that the two values match.

## Process 1: Connect to Cisco and access software images

Cisco DNA Center must be connected to Cisco (CCO) to display and allow you to select Cisco-recommended software images for the devices that it manages.

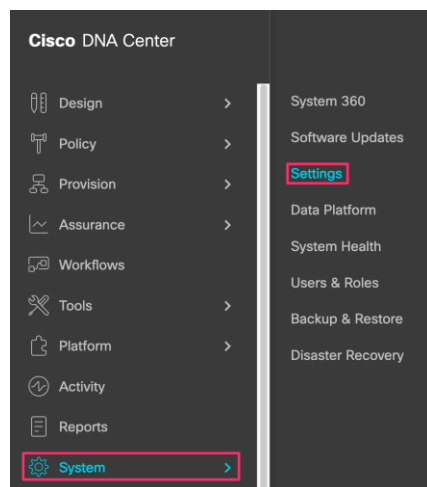
### Tech tip

As part of the Cisco DNA Center installation, you will be asked to complete a first-time setup wizard in which you will be required to provide Cisco Credentials before the Terms and Conditions must be accepted. For any reason the Cisco Credentials need to be reentered or changed please follow the instructions below.

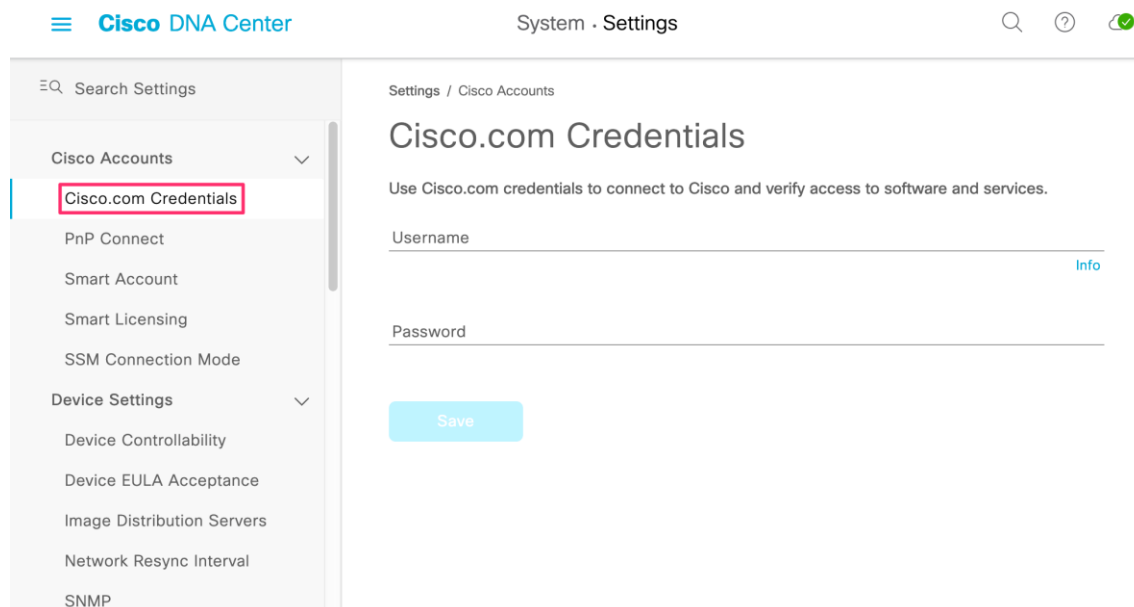
## Procedure 1. Verify Cisco Credentials

**Step 1.** Login to the **Cisco DNA Center**.

**Step 2.** Click the hamburger icon, then select **System > Settings**.



**Step 3.** In **System . Settings** select **Cisco.com Credentials** from left.



**Step 4.** Under **Cisco Credentials**, select **CCO**



System 360   Software Updates   **Settings**   Data Platform   Users   Backup & Restore

≡ Search

- AI Network Analytics
- Anonymize Data
- Authentication and Policy Servers
- Certificate
- Cisco Credentials**

## Cisco Credentials

Use credentials to connect to Cisco and verify access to software and services.

**CCO** | License | PnP Connect

Cisco.com Credentials

Username

**Step 5.** Enter the Cisco Connection Online (CCO) username and password.

System 360   Software Updates   **Settings**   Data Platform   Users   Backup & Restore

≡ Search

- AI Network Analytics
- Anonymize Data
- Authentication and Policy Servers
- Certificate
- Cisco Credentials**
- CMX Servers
- Debugging Logs

## Cisco Credentials

Use credentials to connect to Cisco and verify access to software and services.

CCO | License | PnP Connect

**Cisco.com Credentials**

Username

Password

### Tech tip

The credentials (user and password) entered must have SUPER-ADMIN-ROLE OR NETWORK-ADMIN-ROLE privileges.

**Step 6.** Select **Use Cisco.com user ID** and click **Apply**.

## Cisco Credentials

Use credentials to connect to Cisco and verify access to software and services.

CCO | [License](#) | [PnP Connect](#)

### Cisco.com Credentials

Username 

Password

\*\*\*\*\*



### Link your Smart Account

Your current Smart Account is **BU Production Test** 

☒ Use Cisco.com user ID

☐ Use different credentials

## Deploy

This section of the guide shows how to standardize an image by marking as a golden image and go through the update image workflow to distribute and activate the golden image on a network device (example: Catalyst 9300 Series Switch).

### Process 2: Upgrade Workflow

This process is used to import and upload the latest software images for a network device (example: Catalyst 9300 Series Switch) to the Cisco DNA Center software image repository.

#### Tech tip

When doing a major code update (example: 16.9.1 to 16.11.1) there is additional delay due to ROMMON code upgrade

**Table 1.** Software Images for the Catalyst 9300 Series Switches

Platform	Software Version	Software Image Name
Cisco Catalyst 9300 Switch	IOS XE Release 16.9.1 (Current)	Install Mode (16.9.1)
Cisco Catalyst 9300 Switch	IOS XE Release 16.9.3 (Upgrade image)	Install Mode (16.9.3)

The following procedures are required for this process:

- Standardize the image by marking a **Golden Image**.
- Distribute and activate the software image for the switch.

### Procedure 1. Standardize the image by marking a Golden Image

Images can be imported automatically through Cisco Connection Online (CCO) or manually uploaded. Cisco DNA Center perform the following.

- Image Compliance Check (Pre/Post)
- Automatically download of Software Maintenance Updates (SMU)
- Prompt to provision Image updates

For the purpose of this guide, we will use the latter.

Cisco DNA Center displays the suggested and latest image list for each of the discovered device families.

#### Tech tip

CCO credentials are required for Cisco DNA Center to fetch and display the suggested list of images automatically. To learn how, refer above to **Process 1 (Option 1)**.

Use the following steps to apply software updates of images and software maintenance updates (SMUs) to the devices, by importing the required images, marking images as golden, and applying images to devices.



## Option 1 - (AUTO) Recommended Software Image

It's highly recommended to mark a software image as golden from the list provided by Cisco-recommended images.

**Step 1.** Login to **Cisco DNA Center**.

**Step 2.** Go to **Design > Image Repository**




**Step 3.** Click to expand to view the full list available Cisco-recommended images.

Family	Image Name	Using Image	Version	Golden Image	Device Role
 Cisco Catalyst 9300 Switch	cat9k_iosxe.16.09.01.S...  Verified	0	16.9.1 Add On (N/A)		 ACCESS 
	Install Mode (16.9.1.0.70)	1	16.9.1 Add On (N/A)		

### Tech tip

For Cisco DNA Center to suggest Cisco recommended and latest images under image repository it requires CCO login as show above in *Process 1*.

**Step 4.** Mark the Cisco-recommended image as golden.

cat9k_iosxe.16.09.03.SPA...  Verified	0	16.9.3 Add On (N/A)		
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### Tech tip

After you mark the Cisco-recommended image as golden, Cisco DNA Center automatically downloads the image from cisco.com

### Tech tip

Also select non-LDPE software image and avoid selecting the Licensed Data Payload Encryption (**LDPE**) software version as it is a limited deployment export control version which limits IPSEC capabilities. An example of LDPE is cat9k\_iosxeldpe.X.X.X.SPA.bin, compared to non-LDPE cat9k\_iosxe.X.X.X.SPA.bin

## Option 2 - (Manually) Upload Software Image

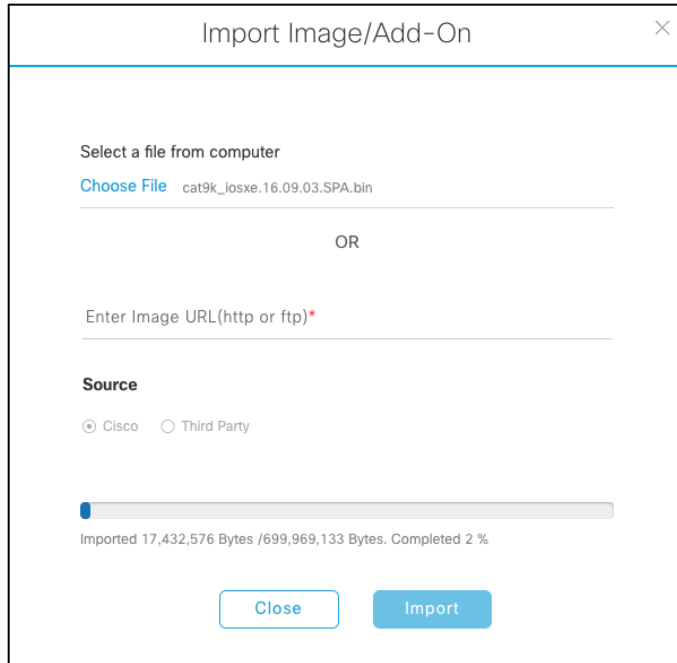
If the software image you would like to mark as golden is not available, you can upload the image manually.

**Step 1.** Login to **Cisco DNA Center**.

**Step 2.** Go to **Design > Image Repository**

**Step 3.** Click **+Import**

**Step 4.** From the **Import Image/Add-On** dialog, choose a file location, and then click **Import**.



The dialog box titled "Import Image/Add-On" has a close button (X) in the top right corner. It contains two main sections for file selection:

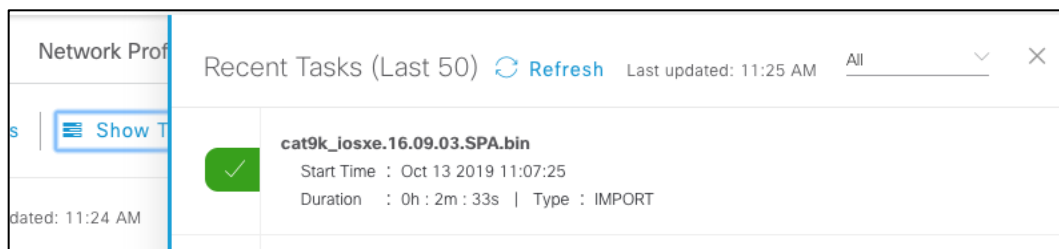
- Select a file from computer:** Includes a "Choose File" link and a text input field containing "cat9k\_iosxe.16.09.03.SPA.bin".
- OR**
- Enter Image URL(http or ftp)\*:** A text input field.

Below these is a **Source** section with two radio buttons: **Cisco** (selected) and **Third Party**.

A progress bar is shown with the text: "Imported 17,432,576 Bytes /699,969,133 Bytes. Completed 2 %".

At the bottom are two buttons: **Close** and **Import**.

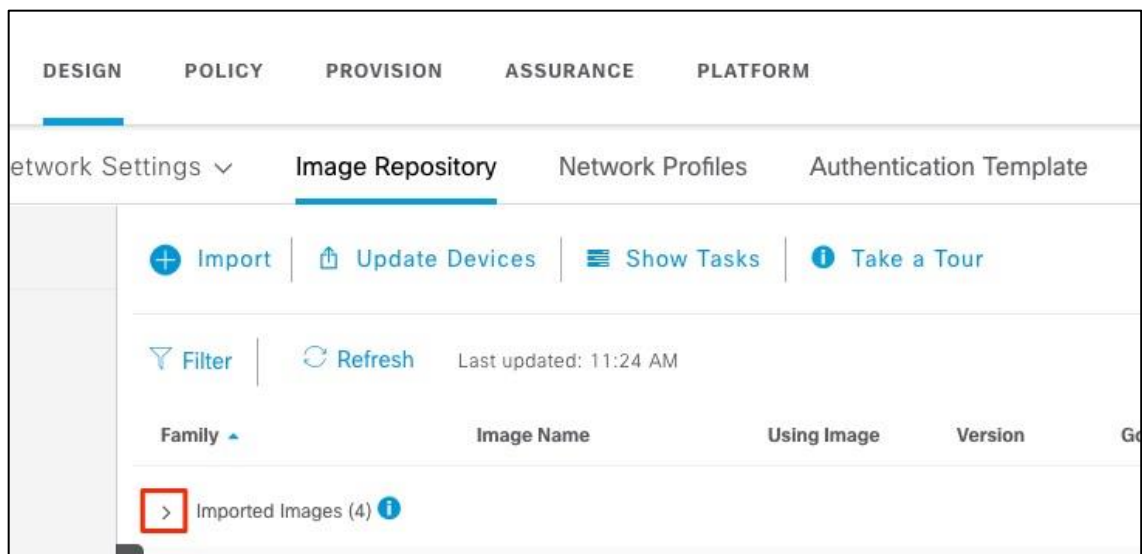
**Step 5.** Under **Image Repository**, click **Show Tasks** to verify if the import was successful.



The screenshot shows a "Recent Tasks (Last 50)" table with a "Refresh" button and a filter dropdown set to "All". A "Show Tasks" button is highlighted in the left sidebar. The table contains one task entry:

Task ID	Status	Image Name	Start Time	Duration	Type
cat9k_iosxe.16.09.03.SPA.bin	Success (Green Checkmark)	cat9k_iosxe.16.09.03.SPA.bin	Oct 13 2019 11:07:25	0h : 2m : 33s	IMPORT

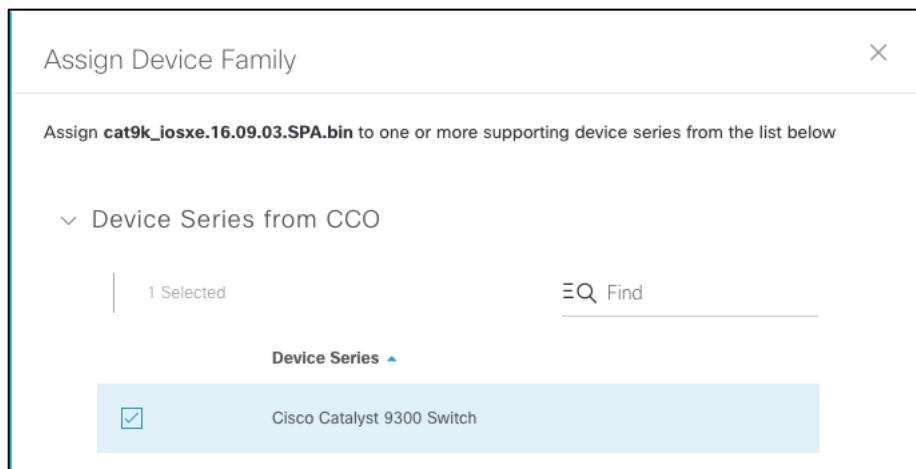
**Step 6.** Under **Image Repository**, click **Imported Images** to expand the list of all the imported images that are pending to be assigned to a device family.













**Step 7.** Click on **Assign** next to the image name need to be assigned.






**Step 8.** The slide out panel will show the list of device series from CCO based on the selected image. Check the box next to the Device Series and click **Assign**.



**Step 9.** Go to the assigned **Device Family** and click the expand icon and verify the image imported is available to mark as golden.

Family	Image Name	Using Image	Version	Golden Image	Device Role
<div>  Cisco Catalyst 9300 Switch </div>	cat9k_iosxe.16.09.01.S...  Verified	0	16.9.1 Add On (N/A)		 <div>ACCESS </div>
	Install Mode (16.9.1.0.70)	1	16.9.1 Add On (N/A)		
	cat9k_iosxe.16.09.03.S...  Verified	0	16.9.3 Add On (N/A)		

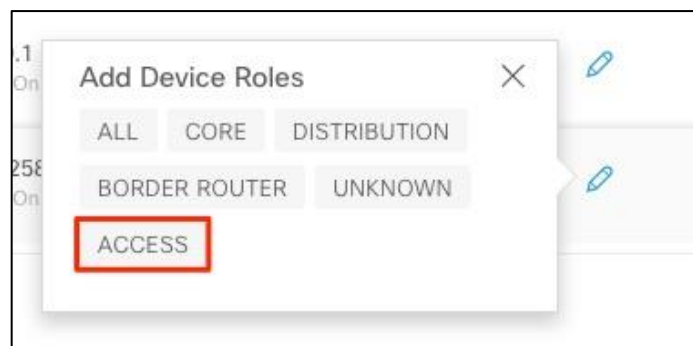
**Step 10.** Mark the manually uploaded image as golden.

cat9k_iosxe.16.09.03.SPA...  Verified	0	16.9.3 Add On (N/A)		
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**Step 11.** (Optional) Click the pencil icon and select the appropriate role, to mark a **Golden Image** for specific device role.

Family	Image Name	Using Image	Version	Golden Image	Device Role
<div>  Cisco Catalyst 9300 Switch </div>	cat9k_iosxe.16.09.01.S...  Verified	0	16.9.1 Add On (N/A)		 <div>ACCESS </div>
	Install Mode (16.9.1.0.70)	1	16.9.1 Add On (N/A)		
	cat9k_iosxe.16.09.03.S...  Verified	0	16.9.3 Add On (N/A)		

**Step 12.** (Optional) Select **ACCESS** tag.



**Step 13.** Verify image is **marked as golden** and **ACCESS** tag is selected.

Family	Image Name	Using Image	Version	Golden Image	Device Role
> Cisco Catalyst 9300 Switch	cat9k_iosxe.16.09.03.S... Verified	0	16.9.3 Add On (N/A)	☆	<a href="#">ACCESS</a> ☆

## Procedure 2. Provision and activate the software image

Now that the image is in repository, it can be distributed and activated on the network devices. It's recommended to run the activation at a specified date and time to comply with existing network change windows.

Before pushing a software image to a device, Cisco DNA Center runs a compliance check of devices in inventory compared to the images marked golden. Devices out of compliance with the golden image are marked as **Need Update** in inventory. If you have not designated a golden image for the device type, then the device's image cannot be updated.

Cisco DNA Center also performs pre-checks on the device, such as checking the health of the CPU, disk space, and the route summary etc. After it pushes a software image to a device, Cisco DNA Center repeats these checks to ensure that the state of the network remains unchanged.

The following are the steps for distributing software images to the Catalyst 9300 switch or any network device in the inventory.

**Step 1.** From the main Cisco DNA Center dashboard navigate to **Provision > Devices**

**Step 2.** Click the devices focus which is set to **Inventory** by default and select **Software Images**.



**Step 3.** From the list of devices, locate the switch (example: AD1-9300.cisco.local)

DEVICES (21)

FOCUS: Software Images

Global

Take a Tour

DEVICE TYPE

All

Routers

Switches

APs

WLCs

REACHABILITY

All

Reachable

Unreachable

Filter

Add Device

Tag Device

Actions

Last updated: 1:33

	Device Name	IP Address	Device Family	Site	Reachability	Software Image	Image Version
	AD1-9300.cisco.local	10.4.79.10	Switches and Hubs	.../Building 23	Reachable	CAT9K[16.9.1.0.70] Needs Update	16.9.1



#### Step 4. Click Needs Update

DEVICES (21) Global Take a Tour

FOCUS: **Software Images** ▾

DEVICE TYPE: **All** | Routers | Switches | APs | WLCs | REACHABILITY: **All** | Reachable | Unreachable

Filter | + Add Device | Tag Device | Actions ▾ ⓘ | Last updated: 1:33

<input type="checkbox"/>	Device Name ▾	IP Address	Device Family	Site	Reachability	Software Image	Image Version
<input type="checkbox"/>	AD1-9300.cisco.local ⓘ	10.4.79.10	Switches and Hubs	.../Building 23	🟢 Reachable	CAT9K[16.9.1.0.70] <b>Needs Update</b>	16.9.1

#### Tech tip

If incorrect Golden Image is shown even after refreshing the page or running recheck the devices table, the image that is not set as Golden Image anymore will need to be deleted from the image repository and then only the **Need Update** option will be available.

#### Step 5. Under Image Update Readiness Check, verify the correct Golden Image is shown.

DEVICES (21) Global Take a Tour

FOCUS: **Software Images** ▾

DEVICE TYPE: **All** | Routers | Switches | APs | WLCs | REACHABILITY: **All** | Reachable | Unreachable

Filter | + Add Device | Tag Device | Actions ▾ ⓘ | Last updated: 1:33

<input type="checkbox"/>	Device Name ▾	IP Address
<input type="checkbox"/>	AD1-9300.cisco.local ⓘ	10.4.79.10
<input type="checkbox"/>	AD3-3850.cisco.local ⓘ	10.4.95.5

### Image Update Readiness Check

Running Image : CAT9K[16.9.1.0.70]

**Golden Image : cat9k\_iosxe.16.09.03.SPA.bin**

Reboot Required: Yes

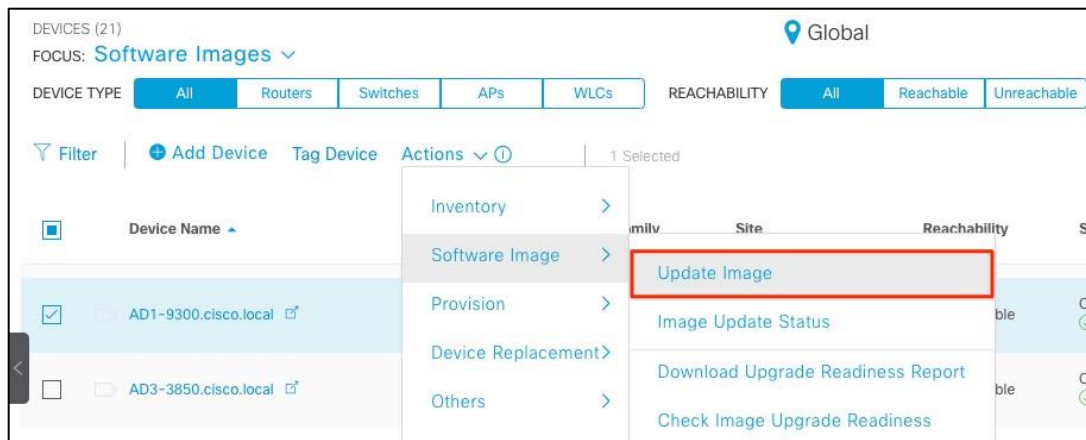
Export Recheck

Check Type	Description	Status ⓘ	Last Checked
Startup config check	Startup configuration exist for this device	🟢	Sun Oct 13 2019 1:31:18 PM
Config register check	Config-register verified successfully	🟢	Sun Oct 13 2019 1:31:18 PM

#### Tech tip

Ensure that the Status column of all the checks shows either a green icon indicating success, or a yellow icon indicating a warning. If any of the checks shows a red icon indicating failure, the image on the platform cannot be upgraded. If necessary, correct any issues on the switch which resulted in a red icon indicating failure. Click the Recheck button in the upper right corner to re-run the readiness assessment.

#### Step 6. Under the Actions drop-down menu, select Software Image > Update Image.



**Step 7.** Go through the 3-steps **Update Image** workflow.

1. **Distribute:** Select **Now or Later (recommended for production devices)** and click **Next**.

The screenshot shows the 'Update Image' workflow step 1: Distribute. The 'When' dropdown is set to 'Now'.

2. **Activate:** Check **Schedule Activation after Distribution is completed** and click **Next**.

The screenshot shows the 'Update Image' workflow step 2: Activate. The 'Schedule Activation after Distribution is completed' checkbox is checked.

3. **Confirm:** Review the summary and click **Confirm**.

The screenshot shows the 'Update Image' workflow step 3: Confirm. The summary shows the distribution and activation details.

A notification is displayed stating the image update initiated.

Image update initiated. Please check Update Status for updated results

#### Tech tip

If you have scheduled the distribution and activation for a future date and/or time you can view the upcoming scheduled task.

**Step 8.** Verify the under the **Software Image** column, **Need Update** changed to **In Progress**.

<input type="checkbox"/>	Device Name	IP Address	Device Family	Site	Reachability	Software Image	Image Version
<input type="checkbox"/>	AD1-9300.cisco.local	10.4.79.10	Switches and Hubs	.../Building 23/Floor 1	Reachable	CAT9K[16.9.1.0.70] In Progress	

**Step 9.** Monitor the **Update Status** of the device.

#### Tech tip

During this process the device will reboot and become **Unreachable** for a while (15-30mins).

a. **Update Status** changes to **Distribution in Progress**

Software Image	Image Version	Update Status	Provision Status
CAT9K[16.9.1] In Progress	16.9.1	Distribution In Progress	Not Provisioned

b. **Update Status** changes to **Activation in Progress**

Software Image	Image Version	Update Status	Provision Status
CAT9K[16.9.1.0.70] In Progress	16.9.1	Activation In Progress	Not Provisioned

c. **Update Status** changes to **Activation Success**

Software Image	Image Version	Update Status
cat9k_iosxe.16.09.03.SPA	16.9.3	Activation Success

Verify the software image of the switch (example: AD1-9300.cisco.local) is now updated to the golden image (example: 16.9.3).

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## Operate

### Known Caveats

- In Cisco DNA Center, it is mandatory to mark image as Golden for device family for upgrade at global or site levels. Golden image is essentially equivalent to the certified software image by Enterprise IT, which will be used to standardize the image for all relevant devices of this device family in customer network environment.
- Golden image can be defined not only on a per device family, but also on device role. In general, you may only have one golden image per device family and for that, use ALL tag to apply in the device role.
- Configuring a time zone within IOS XE devices via the **clock time zone** IOS CLI command may cause a warning to appear within the Image Upgrade Readiness Check panel, indicating the time is significantly different between your device and Cisco DNA Center. You may be able to clear this warning by removing the **clock time zone** command from the device, resyncing the device within inventory, and clicking on the Recheck button to run the readiness assessment again. This will cause the time format of the device be displayed in UTC time, rather than the local time zone.
- During the SWIM upgrade of the network switch, DNAC does not modify the boot variable like the packages.conf filename or its location in bootflash. It takes the original file and modify the contents only to complete the upgrade after the device reboot.

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## Appendix A— Hardware and software used for validation

**Table 2.** Hardware and software

Functional area	Product	Software version
Controller (PnP Server)	Cisco DNA Center	2.1.2.3
Device to Onboard (PnP Agent)	Catalyst 9300 Switch Series	16.9.03

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## Appendix B—Glossary

**Cisco DNA** Cisco Digital Network Architecture

**Cisco PnP** Cisco Plug and Play

**SWIM** Software Image Management

**SSL** Secure Sockets Layer

**VLAN** Virtual Local Area Network

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## Feedback

For comments and suggestions about this guide and related guides, join the discussion on [Cisco Community](#).