



## Predownloading an Image to an Access Point

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## Information About Predownloading an Image to an Access Point

To minimize network outages, download an upgrade image to an access point from the device without resetting the access point or losing network connectivity. Previously, you could download an upgrade image to the device and reset it, causing the access point to go into discovery mode. After the access point discovered the controller with the new image, the access point would download the new image, reset it, go into discovery mode, and rejoin the device.

You can now download the upgrade image to the controller. When the controller is up with the upgrade image, the AP joins the controller and moves to Registered state, because the AP image has been predownloaded to the AP.

## Restrictions for Predownloading an Image to an Access Point

The following are the restrictions for predownloading an image to an access point:

- The maximum number of concurrent predownloads are limited to 100 per wncd instance (25 for 9800-L) in the controller. However, the predownloads are triggered in sets of 16 per wncd instance at the start, and is repeated every 60 seconds.
- Access points with 16-MB total available memory may not have enough free memory to download an upgrade image and may automatically delete crash information files, radio files, and backup images, if any, to free up space. However, this limitation does not affect the predownload process because the predownload image replaces backup image, if any, on the access point.

- All of the primary, secondary, and tertiary controllers should run the same images. Otherwise, the feature will not be effective.
- At the time of reset, you must make sure that all of the access points have downloaded the image.
- An access point can store only 2 software images.
- The Cisco Wave 1 APs may download the image twice while moving from Cisco AireOS Release 8.3 to Cisco IOS XE Gibraltar 16.10.1. This increases the AP downtime during migration.
- The **show ap image** command displays cumulative statistics regarding the AP images in the controller. We recommend that you clear the statistics using the **clear ap predownload statistics** command, before using the show ap image command, to ensure that correct data is displayed.
- Cisco Catalyst 9800-CL Wireless Controller supports only self-signed certificates and does not support Cisco certificates. When you move the access points between Cisco Catalyst 9800-CL Wireless Controllers, and if the AP join failure occurs on the Cisco Catalyst 9800-CL controller, execute the **capwap ap erase all** command to remove the hash string stored on the APs.
- During AP image pre-download, the WNCPU may rise to 99 percent, which is normal and doesn't cause a crash or client or AP disconnect problems.

## Predownloading an Image to Access Points (CLI)

### Before you begin

There are some prerequisites that you must keep in mind while predownloading an image to an access point:

- Predownloading can be done only when the device is booted in the install mode.



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**Note** Predownload of the AP image is based on the AP model rather than the image type. Predownload is allowed only when the model exists in the new capability XML file. Also, with appropriate modification of the capability XML, the controller can override the existing AP image for a particular model.

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- You can copy the new image either from the TFTP server, flash image, or USB.
- If the latest upgrade image is already present in the AP, predownload will not be triggered. Check whether the primary and backup image versions are the same as the upgrade image, using the **show ap image** command.
- The **show ap image** command displays cumulative statistics regarding the AP images in the controller. We recommend that you clear the statistics using the **clear ap predownload statistics** command, before using the **show ap image** command, to ensure that correct data is displayed.
- AP continues to be in predownloading state, if AP flaps post SSO during AP predownload. We recommend that you issue the **ap image predownload abort** command and then the **clear ap predownload stats** command only then the predownload can be initiated again.

**Procedure**

	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	<p><b>install add file bootflash:</b><i>file-name</i></p> <p><b>Example:</b></p> <pre>Device# install add file bootflash:image.bin</pre>	The controller software image is added to the flash and expanded.
<b>Step 2</b>	<p><b>ap image predownload</b> or <b>ap name</b> <i>ap-name</i> <b>image predownload</b></p> <p><b>Example:</b></p> <pre>Device# ap image predownload Device# ap name ap1 image predownload</pre>	Downloads the new image to all the access points or a specific access point connected to the device.
<b>Step 3</b>	<p><b>show ap image</b></p> <p><b>Example:</b></p> <pre>Device# show ap image</pre>	Verifies the access point's predownload status. This command initially displays the status as Predownloading and then moves to Completed, when download is complete.
<b>Step 4</b>	<p><b>show ap name</b> <i>ap-name</i> <b>image</b></p> <p><b>Example:</b></p> <pre>Device# show ap name ap1 image</pre>	Provides image details of a particular AP.
<b>Step 5</b>	<p><b>ap image swap</b> or <b>ap name</b> <i>ap-name</i> <b>image swap</b> or <b>ap image swap completed</b></p> <p><b>Example:</b></p> <pre>Device# ap image swap</pre>	Swaps the images of the APs that have completed predownload.  <b>Note</b> You can swap the AP images using <b>ap image swap</b> command even without pre-downloading a new image to the AP and there are no restrictions or prerequisites to swap the image.
<b>Step 6</b>	<p><b>install activate</b></p> <p><b>Example:</b></p> <pre>Device# install activate</pre>	Runs compatibility checks, installs the package, and updates the package status details.  For a restartable package, the command triggers the appropriate post-install scripts to restart the necessary processes, and for non-restartable packages it triggers a reload.  <b>Note</b> This step reloads the complete controller stack (both primary and secondary controllers, if HA is used).
<b>Step 7</b>	<p><b>install commit</b></p> <p><b>Example:</b></p> <pre>Device# install commit</pre>	Commits the activation changes to be persistent across reloads.  The commit can be done after activation while the system is up, or after the first reload. If the

	Command or Action	Purpose
		package is activated but not committed, it remains active after the first reload, but not after the second reload.

## Predownloading an Image to Access Points (GUI)

### Procedure

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- Step 1** Choose **Administration** > **Software Management** and click the **Software Upgrade** tab.  
Note that you must be in the Install Mode to continue with the following steps.
- Step 2** Select the **Transport Type, File System and File Path** of your choice to from receive the file.
- Step 3** Select the **AP Image Predownload** check box.  
If you already have an inactive image file on your device, a dialog box prompts you to remove the unused image and proceed with the latest image download.
- Step 4** Click **Download & Install**.  
This initiates the upgrade process and you can view and verify the predownload progress in the **Status** dialog box. You can also check the progress log by clicking on **Show Logs** icon.
- Step 5** Click the **Save Configuration & Activate** button after the predownload operation is successful.
- Step 6** Click **Yes** to confirm the activate operation.  
This operation runs compatibility checks, installs the package, and updates the package status details. The device reloads after a successful activation. If there are uncommitted files, you are prompted to remove those.
- Step 7** Click the **Commit** button to complete the upgrade process.
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## Predownloading an Image to Access Points (YANG)

YANG can be used with NETCONF and RESTCONF to provide the desired solution of automated and programmable network operations.

The following RPC is used for Predownloading an Image to an Access Point:

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="101">
  <set-rad-predownload-all
xmlns="http://cisco.com/ns/yang/Cisco-IOS-XE-wireless-access-point-cmd-rpc">
    <uuid>12312341231234</uuid>
  </set-rad-predownload-all>
</rpc>
```

For more information on the YANG models, see the Cisco IOS XE Programmability Configuration Guide and YANG Data Models on Github at <https://github.com/YangModels/yang/tree/master/vendor/cisco/xe>.

You can contact the Developer Support Community for NETCONF/YANG features using the following link:

<https://developer.cisco.com/>

## Monitoring the Access Point Predownload Process

This section describes the commands that you can use to monitor the access point predownload process.

While downloading an access point predownload image, enter the **show ap image** command to verify the predownload progress on the corresponding access point:

```
Device# show ap image
Total number of APs : 1
```

```
Number of APs
  Initiated           : 1
  Predownloading      : 1
  Completed predownloading : 0
  Not Supported        : 0
  Failed to Predownload : 0
```

AP Name	Primary Image	Backup Image	Predownload Status
Predownload Ver...	Next Retry Time	Retry Count	
AP1 10.0.1.67	10.0.1.66	10.0.1.66	Predownloading
	NA	0	

```
Device# show ap image
Total number of APs : 1
```

```
Number of APs
  Initiated           : 1
  Predownloading      : 0
  Completed predownloading : 1
  Not Supported        : 0
  Failed to Predownload : 0
```

AP Name	Primary Image	Backup Image	Predownload Status
Predownload Ver...	Next Retry Time	Retry Count	
AP1 10.0.1.67	10.0.1.66	10.0.1.67	Complete
	NA	0	

Use the following command to view the image details of a particular AP:

```
Device# show ap name APe4aa.5dd1.99b0 image
```

```
AP Name : APe4aa.5dd1.99b0
Primary Image : 16.6.230.46
Backup Image : 3.0.51.0
Predownload Status : None
Predownload Version : 000.000.000.000
Next Retry Time : N/A
Retry Count : 0
```

## Information About AP Image Download Time Enhancement (OEAP or Teleworker Only)

The wireless controller and the access point (AP) communicate with each other using CAPWAP. The CAPWAP has two channels, namely control and data. The control channel is used to send configuration messages, download images and client keys, or the context to the AP. The control channel has a single window in the current implementation. A single window means that every message that is sent from the controller has to be acknowledged by the AP. The next control packet is not transmitted till the earlier one is acknowledged by the AP.

The AP Image Download Time Enhancement feature adds support to multiple sliding windows for control packets going from controller to AP. The sliding window can be set to N (static) instead of a single window. The request queue size is decided based on the maximum window size the AP supports.

**Table 1: Recommended Window Size**

Link Bandwidth <sup>1</sup>	Less than 200 ms RTT	Greater than 200 ms RTT
More than 20 Mbps	10	15
Between 5 and 20 Mbps	10	15
Between 1 and 5 Mbps	5	10
Less than 1 Mbps	3	5

<sup>1</sup> The window size recommendation provided in the table is for packet loss of less than one percent (< 1%). If the network supporting the CAPWAP link has packet loss of more than one percent (> 1%), use a smaller value for window size. For good links with round-trip time (RTT) of about 100ms and packet drops of less than half a percent (< 0.5%), use a window size of up to 20 for better performance.



### Note

- The window size can be changed only during the AP join process.
- All image upgrades should be in the **install** mode for faster upgrade. Image upgrade should be done from the **one-shot** command to include OEAP predownload.
- Configure the window size only for AP profiles that are exclusively used for Teleworker or Office Extend Access Points (OEAP).
- An AP reload is not required after disabling this feature.
- This feature is supported only on the OEAP profiles.
- GUI does not support AP predownload. Therefore, the AP downloads after disjoining the controller during CAPWAP join phase. This causes a long disruption in the network as the Image download for AP can take upto one hour.



**Important** If you downgrade the software to Cisco IOS XE Gibraltar 16.12.4 or earlier from Cisco IOS XE Amsterdam 17.3.1, you should reset the CAPWAP multi window to a single window prior to the downgrade. Failure to do so necessitates a manual AP recovery.

**High-Level Workflow of AP Image Download Time Enhancement**

1. Select an existing AP join profile or create a new one.
2. Set the CAPWAP window size.
3. Associate the AP join profile to an existing site tag or new one.
4. Apply the site tag to the AP using: Static, Filter, Location, AP, or Default mapping method.

## Configuring AP Image Download Time Enhancement (GUI)

**Procedure**

- Step 1** Choose **Configuration > Tags & Profiles > AP Join > CAPWAP > Advanced**.
- Step 2** In the **CAPWAP Window Size** field, enter the unit of measurement of the window.
- Step 3** Click **Save & Apply to Device**.

## Configuring AP Image Download Time Enhancement (CLI)

**Procedure**

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters the global configuration mode.
<b>Step 2</b>	<b>ap-profile <i>ap-profile</i></b>  <b>Example:</b> Device(config)# ap profile capwap_multiwindow	Configures an AP profile.
<b>Step 3</b>	<b>capwap window size <i>window-size</i></b>  <b>Example:</b>	Configures the AP CAPWAP control packet transmit queue size.

	Command or Action	Purpose
	Device(config-ap-profile)# capwap window size 20	<p><b>Note</b> Configure the window size only for AP profiles that are exclusively used for teleworker or OEAP.</p> <p>Be aware that any change in window size may impact other APs.</p>
<b>Step 4</b>	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Device(config-ap-profile)# end</pre>	Returns to privileged EXEC mode.

## Verifying AP Image Download Time Enhancement Configuration

To view the CAPWAP window size present in an AP profile, use the following command:

```
Device# show ap profile name default-ap-profile detailed | in wind
Capwap window size : 10
```

To view the CAPWAP status and modes, use the following command:

```
Device# show capwap client rcb

OperationState           : UP
Name                     : AP4001.7A39.2D5A
MwarHwVer                : 0.0.0.0
Location                 : default location
ApMode                   : Remote Bridge
ApSubMode                : Not Configured
CAPWAP Path MTU          : 1485
Software Initiated Reload Reason : Reload command
CAPWAP Sliding Window
Active Window Size       : 10
Last Request Send To Application : 184
Expected Seq Num         : 185
Received Seq Num         : 184
Request Packet Count     : 42424
Out Of Range Packets Count : 0
Window Moved Packets Count : 0
In Range Packets Count   : 960
Expected Packets Count   : 41464
```

To view the AP configuration details, including the CAPWAP window size, use the following command:

```
Device# show ap config general | in Wind

Capwap Active Window Size : 5
Capwap Active Window Size : 10
Capwap Active Window Size : 1
```