

# Manage Firmware Upgrades

This section describes managing firmware upgrade settings in IoT FND, and includes the following sections:

Use IoT FND to upgrade the firmware running on routers (CGR1000s, IR800s), AP800s and Cisco Resilient Mesh Endpoints (RMEs) such as meters and range extenders. IoT FND stores the firmware binaries in its database for later transfer to routers in a firmware group through an IoT FND and IoT-DM file transfer, and to RMEs using IoT FND.

Cisco provides the firmware bundles as a zip file. For Cisco IOS, software bundles include hypervisor, system image and IOx images (for example, Guest-OS, Host-OS).

Firmware system images are large (approximately 130 MB); kickstart images are approximately 30 MB. Every firmware bundle includes a manifest file with metadata about the images in the bundle. You can pause, stop, or resume the upload process.


- Router Firmware Updates, on page 1
- Working with Resilient Mesh Endpoint Firmware Images, on page 4
- AP800 Firmware Upgrade During Zero Touch Deployment, on page 12
- Configuring Firmware Group Settings, on page 14
- Firmware images, on page 19
- Push StackMode, on page 22
- Upgrading Firmware Image during Bootstrapping, on page 30
- Skipping Firmware Upgrades during PNP, on page 31


# Router Firmware Updates

IoT FND updates router firmware in two steps:

**Procedure**

**Step 1** Uploads the firmware image from IoT FND to the router. Firmware images upload to the flash:/managed/images directory on the router.

**Note**
In some cases the router might be in a Firmware Group. Refer to Configuring Firmware Group Settings, on page 14.

Because of their large size, firmware-image uploads to routers take approximately 30 minutes, depending on interface speeds

**Note**
If you set the property, collect-cellular-link-metrics, to 'true' in cgms.properties, then the following Cellular link quality metrics are collected for CGR1000, IR800 and IR1100, each time you initiate a firmware upload from IoT FND:

- RSRP: Reference Signal Received Power which is the power of the reference signal
- RSRQ: Reference Signal Received Quality or the quality of the reference signal which is the a ratio of RSSI to RSRP
- SINR: Signal-to-Noise Ratio which compares the strength of the signal to the background noise.
- RSSI: Received Signal Strength Indicator or the strength of the reference signal

Additionally, the following cgna profile is created on the CGR1240 and activated when the firmware upload is triggered.

```
cgna profile cg-nms-cellularlinkmetrics
add-command show cellular 3/1 all | format
flash:/managed/odm/cg-nms.odm
interval 5
url https://<FND IP address>:9121/cgna/ios/metrics
gzip
active
```

**Note**
On execution of the cgna profile above, the metrics data is persisted in the Metrics_History table in the database and can be collected by using the getMetricHistory NBAPI.

**Step 2** Installs the firmware on the device and reloads it.

During the firmware install the boot parameters on the routers are updated according to the new image file and the router is reloaded after enabling the *cg-nms-register* cgna profile.

**Note**
You must initiate the firmware installation process. IoT FND does not automatically start the upload after the image upload.

When a router contacts IoT FND for the first time to register and request tunnel provisioning, IoT FND rolls the router back to the default factory configuration (ps-start-config) before uploading and installing the new firmware image.

**Note**
This rollback requires a second reload to update the boot parameters in ps-start-config and apply the latest configuration. This second reload adds an additional 10–15 minutes to the installation and reloading operation.

# Upgrading Guest OS Images

Depending on CGR factory configuration, a Guest OS (GOS) may be present in the VM instance. You can install or upgrade Cisco IOS on the **CONFIG** > **FIRMWARE UPDATE** page (see Router Firmware Updates, on page 1). The GOS, hypervisor, and Cisco IOS all upgrade when you perform a Cisco IOS image bundle installation or update.

After any Cisco IOS install or upgrade, when IoT FND discovers a GOS, it checks if the initial communications setup is complete before it performs the required setup. The CGR must have a DHCP pool and GigabitEthernet 0/1 interface configured to provide an IP address and act as the gateway for the GOS. The new GOS image overwrites existing configurations. IoT FND has an internal backup and restore mechanism that ports existing apps to the upgraded Guest OS. See Monitoring a Guest OS for more information.

See Cisco 1000 Series Connected Grid Routers Configuration Guides for information on configuring the CGR.

**Note:** If IoT FND detects a non-Cisco OS installed on the VM, the firmware bundle will not upload and the Cisco reference GOS will not install.

# Upgrading WPAN Images

At the **CONFIG** > **FIRMWARE UPDATE** page, you can upload the independent WPAN images (IOS-WPAN-RF, IOS-WPAN-PLC, IOS-WPAN-OFDM, IOS-WPAN-IXM) to IoT FND using the Images sub-tab (left-hand side) and Upload Image button like other image upgrades. This process is known as a non-integrated WPAN firmware upgrade.

**Note:** The WPAN firmware image integrated with the IOS CGR image option is still supported.

Also, if only the WPAN firmware upgrade from the image bundled with IOS image is desired (for example, when the WPAN firmware upgrade option was not checked during IOS upgrade), the "Install from Router" option is also provided under respective WPAN image types (IOS-WPAN-RF or IOS-WPAN-PLC).

For detailed steps, go to Firmware images, on page 19.

# Changing Action Expiration Timer

You can use the cgnms_preferences.sh script to set or retrieve the action expiration timer value in the IoT FND database:

```
/opt/cgms
/bin/cgnms_preferences setCgrActionExpirationTimeout 50
```

Valid options are:

### Procedure

**Step 1** set <*pkg*>*actionExpirationTimeoutMins*<*value*>

where:

- <*pkg*> is the preference package (required for *set* and *get* operations).
- *actionExpirationTimeoutMins* is the preference key (required for *set* and *get* operations).
- <*value*> is the preferred value, in minutes (required for *set* and *setCgrActionExpirationTimeout* operations).

**Step 2** setCgrActionExpirationTimeout <value>

**Step 3** get <*pkg*>*actionExpirationTimeoutMins*

**Step 4** *getCgrActionExpirationTimeout*

### Example

In the following example, the action timer value is retrieved, set, the current value retrieved again, the value removed, and a null value retrieved:

```
[root@userID-lnx2 cgms]#./dist/cgms-1.x/bin/cgnms_preferences.sh
getCgrActionExpirationTimeout
```

```
2013-08-12 22:38:42,004:INFO:main:CgmsConnectionProvider: registered
the database url for CG-NMS: [jdbc:oracle:thin:@localhost:1522:cgms]
5
[root@userID-lnx2 cgms]#./dist/cgms-1.x/bin/cgnms_preferences.sh
setCgrActionExpirationTimeout 50
2013-08-12 22:38:51,907:INFO:main:CgmsConnectionProvider: registered
the database url for CG-NMS: [jdbc:oracle:thin:@localhost:1522:cgms]
Successfully set the preferences.
[root@userID-lnx2 cgms]#./dist/cgms-1.x/bin/cgnms_preferences.sh
getCgrActionExpirationTimeout
2013-08-12 22:38:58,591:INFO:main:CgmsConnectionProvider: registered
the database url for CG-NMS: [jdbc:oracle:thin:@localhost:1522:cgms]
50
[root@userID-lnx2 cgms]#./dist/cgms-1.x/bin/cgnms_preferences.sh
get com.cisco.cgms.elements.ciscocgr actionExpirationTimeoutMins
2013-08-12 22:39:12,921:INFO:main:CgmsConnectionProvider: registered
the database url for CG-NMS: [jdbc:oracle:thin:@localhost:1522:cgms]
50
[root@userID-lnx2 cgms]#./dist/cgms-1.x/bin/cgnms_preferences.sh
set com.cisco.cgms.elements.ciscocgr actionExpirationTimeoutMins 15
2013-08-12 22:39:23,594:INFO:main:CgmsConnectionProvider: registered
the database url for CG-NMS: [jdbc:oracle:thin:@localhost:1522:cgms]
Successfully set the preferences.
[root@userID-lnx2 cgms]#./dist/cgms-1.x/bin/cgnms_preferences.sh
get com.cisco.cgms.elements.ciscocgr actionExpirationTimeoutMins
2013-08-12 22:39:29,231:INFO:main:CgmsConnectionProvider: registered
the database url for CG-NMS: [jdbc:oracle:thin:@localhost:1522:cgms]
15
```

# Working with Resilient Mesh Endpoint Firmware Images

This section describes how to add Resilient Mesh Endpoint (RME) firmware images to IoT FND, and how to upload and install the images on routers.

## Overview

When you instruct IoT FND to upload a firmware image to the members of an RME firmware group or subnet, IoT FND pushes the image to the group members in the background and tracks the upload progress to ensure that the devices receive the image.

A Resilient Mesh Endpoint (RME) stores three firmware images:

- Uploaded image: Image most recently uploaded.
- Running image: Image that is currently operational.
- Backup image: It serves as a golden (fallback) image for the RME if there is an issue with the running image.



**Note** You can initiate up to 3 firmware downloads simultaneously.

**Note** IR500s and other RME devices can coexist on a network; however, for firmware management they cannot belong to the same group.

**Note** RME devices can report BL/Boot Loader image types to IoT FND, but IoT FND cannot upload boot loader images to devices.

# Actions Supported and Information Displayed at the Firmware Management Pane

At the Firmware Management pane, you can filter the display by Subnet, PanID or Group when you are in the Devices tab.

For every image in the list, IoT FND displays the information as noted in the table:

***Table 1: Image Information Displayed by IoT FND***

| Item | Description |
|---|---|
| Image | Image name. |
| Uploaded | Specifies the number of devices that uploaded the image. Click the number to display a list of these devices. |
| Running | Specifies the number of devices running this image. Click the number to display a list of these devices. |
| Backup | Specifies the number of devices using this image as a backup. Click the number to display a list of these devices. |
| Boot Loader | Specifies the boot loader image version. |
| LMAC | Specifies the LMAC image version. |
| BBU | Specifies the BBU image version. |
| Status | Specifies the status of the upload process. |
| Scheduled Reload | Specifies the scheduled reload time. |

| Item | Description |
|---|---|
| Actions | Provides two actions:<br>• Schedule Install and Reload —Schedule the installation date and time of the loaded image and the reboot of the endpoint by selecting the Calendar icon.<br><br>• Set as Backup —Set the firmware backup image by selecting the clock icon with reverse arrow.<br><br>See Setting the Installation Schedule, on page 6 for complete steps. |

# Set a Firmware Backup Image

To set an image as a firmware image backup:

### Procedure

**Step 1** Click the Set as Backup button. (See the icon in the Actions summary in Table 1: Image Information Displayed by IoT FND, on page 5).

**Step 2** Click **Yes** to confirm backup.

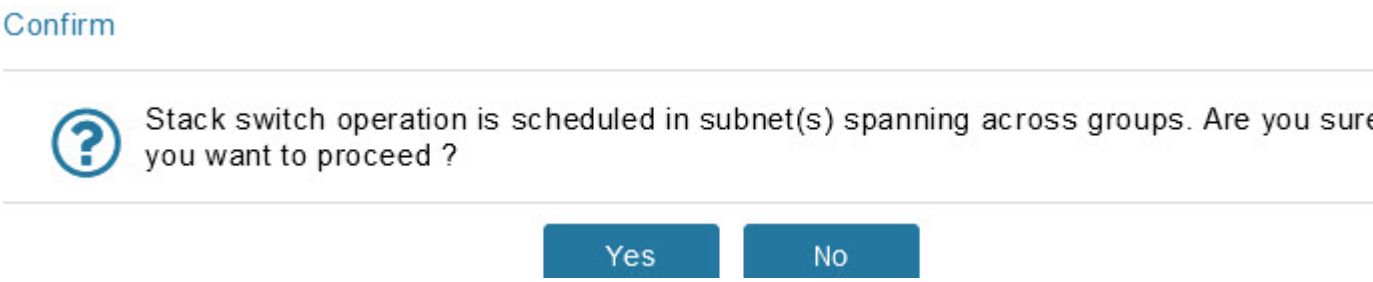
# Setting the Installation Schedule

To set the installation schedule for an image:

### Procedure

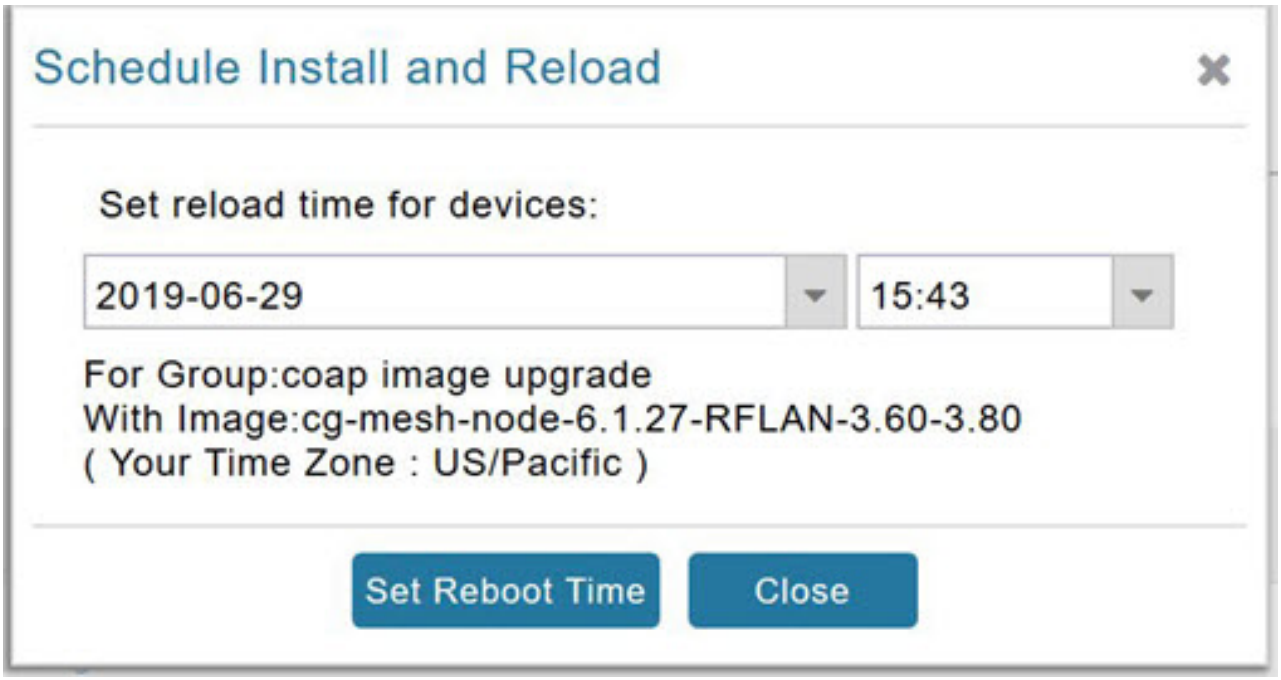
**Step 1** Click the **Schedule Install and Reload** button (Calendar icon). For more information, see Table 1: Image Information Displayed by IoT FND, on page 5.

The following message appears if you try to schedule a reload operation for the node that is scheduled for stack switch operation.




**Step 2** In the page that appears, specify the date and time for the installation of the image and rebooting of device.

***Figure 1: Schedule and Install and Reload Page***




**Step 3** Click the **Set Reboot Time** button.

# Firmware Update Transmission Settings

You can configure the Transmission Speed for pacing mesh firmware downloads at the Transmission Settings tab (See CONFIG > FIRMWARE UPDATE page).

**Procedure**

**Step 1** Select the Transmission Speed. Options are Slow (default), Medium, Fast or Custom.

The Slow setting is recommended as the initial setting. You can increase the Slow setting to Medium (or even Fast) if the following conditions exist:

- The slow setting does not cause any issues in the database and it is able to handle the workload presented without raising any alarms.
- There is a need to improve on the time taken to do the firmware download.

**Step 2** Configure the minimum number of nodes necessary to enable the Multicast firmware upload.

**Note**
For Custom Transmission Speed, you will have to specify Multicast Threshold, Unicast Delay and Minimum Multicast Delay values. Refer to the table below for the definitions of the terms on the **CONFIG** > **FIRMWARE UPDATE** > **Transmissions Settings** page.

***Figure 2: CONFIG > FIRMWARE UPDATE***

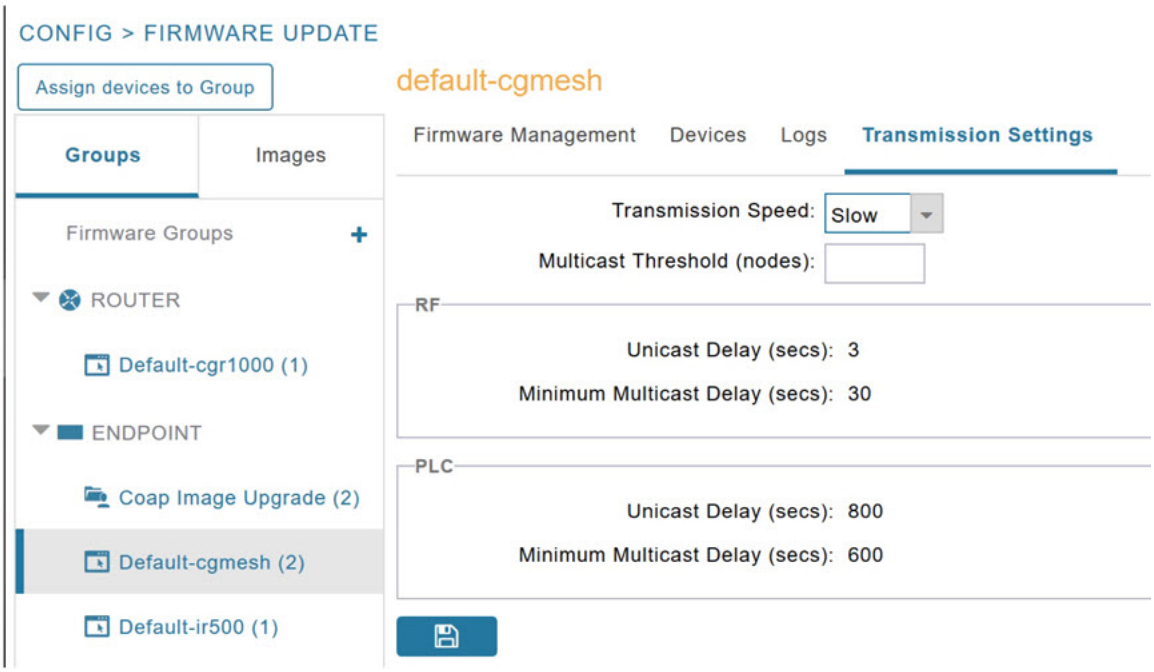



***Table 2: Definitions of variables seen on CONFIG > FIRMWARE UPDATE Transmissions Settings page***

| Item | Description |
|---|---|
| Minimum Multicast Delay (seconds) | Time between subsequent blocks when sending multi-cast messages/blocks/packets to a node. |
| Multicast Threshold (nodes) | Minimum number of nodes needed to ensure that a multicast transmission can happen in a subnet, if the number of elements requiring a specific image block is greater than or equal to the multicast-threshold value. |
| Transmission Speed | Options are Slow (default), Medium, Fast or Custom. |
| Unicast Delay (seconds) | Time between subsequent blocks when sending unicast messages, blocks or packets to a node. |

# Uploading a Firmware Image to a Resilient Mesh Endpoint (RME) Group

To upload a firmware image to mesh endpoint group members:

### Procedure

**Step 1** Choose **CONFIG** > **FIRMWARE UPDATE**.

**Step 2** Click the **Groups** tab (left-pane).

**Step 3** Select the Endpoint firmware group to update.

**Step 4** In the right panel, select Firmware Management and then click the Upload Image button. In the entry panel that appears, do the following:

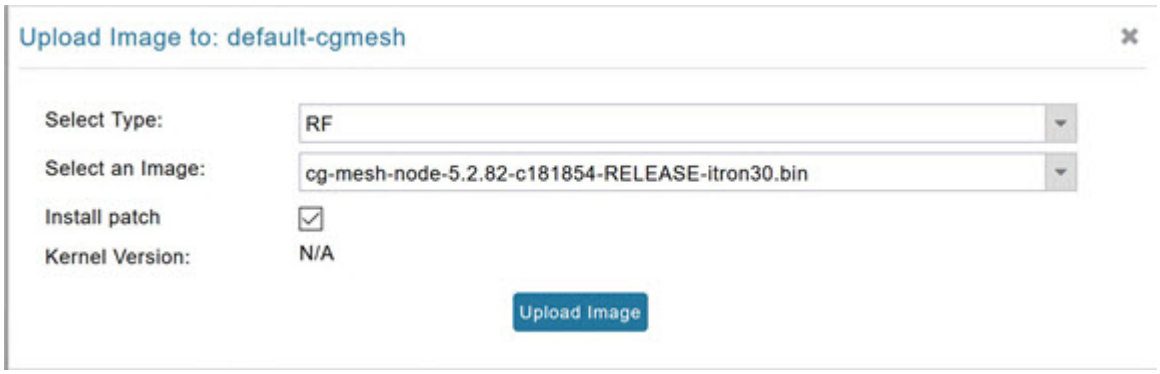
a) From the Select Type drop-down menu, choose the firmware type for your device.

b) From the Select an Image drop-down menu, choose the firmware bundle to upload.

c) Click **Upload Image**.

d) (Optional) Check the Install patch box, if you choose *to install only the patch* of the new image (For more information, see Figure 3: Check Install Patch Item to ONLY Install the Patch Rather than the Full Image, on page 9).

***Figure 3: Check Install Patch Item to ONLY Install the Patch Rather than the Full Image***




e) Click **OK**.

IoT FND adds the image to the list of images in the Firmware Management pane and starts the upload process in the background. A bar chart displays the upload progress (percentage complete). See Figure 4: Firmware Update - Percentage Complete (top-portion of screen), on page 10 and Figure 5: Firmware Update - Upload Summary (bottom-portion of screen), on page 10.

**Note**
Click the Sync Membership button to ensure that FND and the member endpoint firmware group information are the same.

*Figure 4: Firmware Update - Percentage Complete (top-portion of screen)*

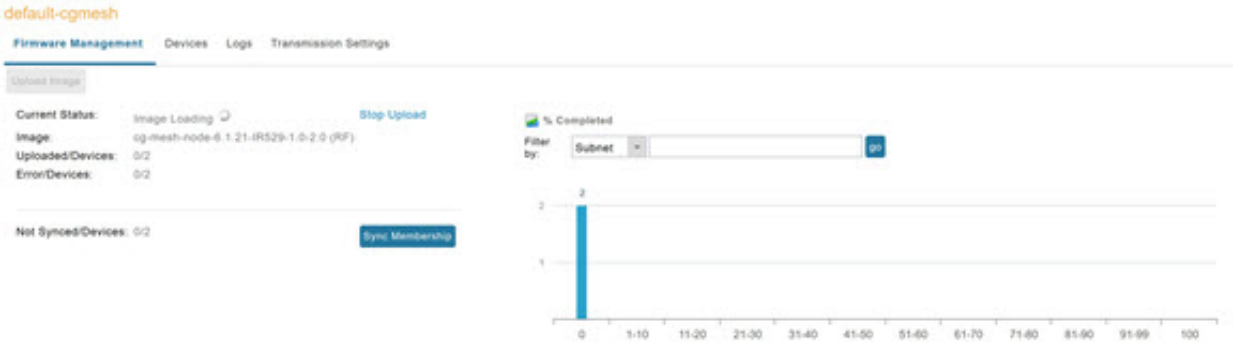



*Figure 5: Firmware Update - Upload Summary (bottom-portion of screen)*




# Uploading a Firmware Image to FND

To upload a firmware image to mesh endpoint group members:

### Procedure

**Step 1** Choose **CONFIG** > **FIRMWARE UPDATE**.

**Step 2** Select the **Images** tab (left-pane).

**Step 3** Select the Endpoint Image type (such as BBU, IOx-IR500 LMAC) to be uploaded.

**Step 4** Click on + (plus icon) next to the FIRMWARE IMAGES heading to browse the firmware from your local system.

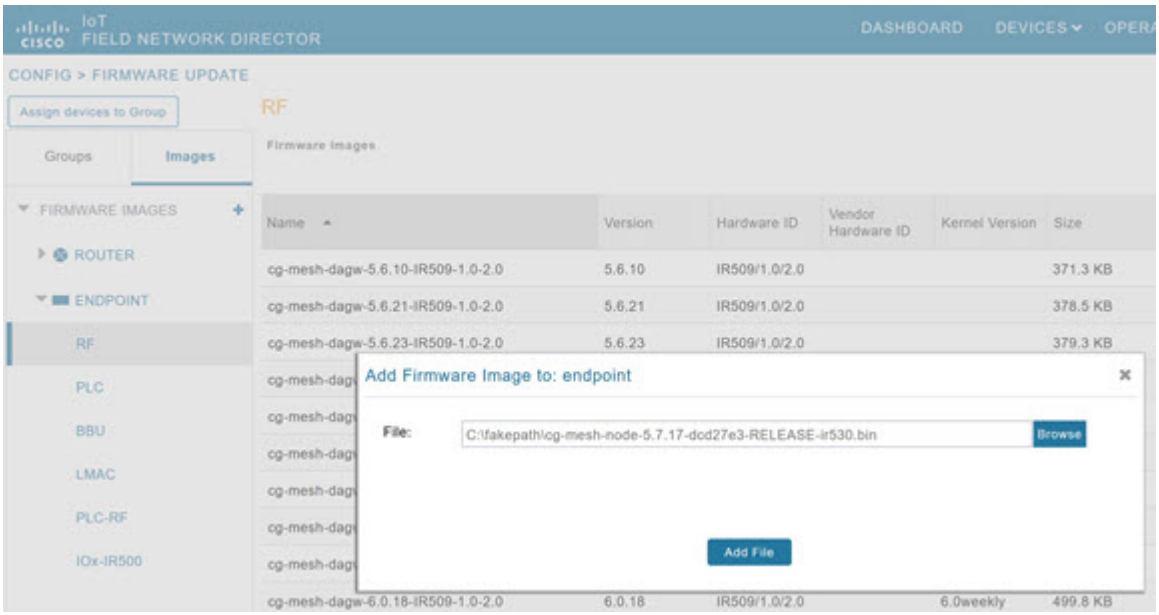
**Step 5** Browse and click on **Add file**.

IoT FND can upload the following image types to ENDPOINT devices as shown in the table below:

*Table 3: Firmware Images for Endpoints*

| Image Type | Description |
|---|---|
| RF | For endpoints with RF radio only. |
| PLC | For endpoints with Power line communication (PLC) radio only. |
| BBU | For Battery back up (BBU) units. |
| LMAC | For Local MAC connected devices. |
| IOx-IR500 | For IR500 devices running Cisco IOx software. |

*Figure 6: Using IoT FND to Upload Images to an Endpoint*




# Modifying Display of Firmware Management Page

You can filter the Firmware Management page display by Subnet, PanId or Group in the Devices tab.

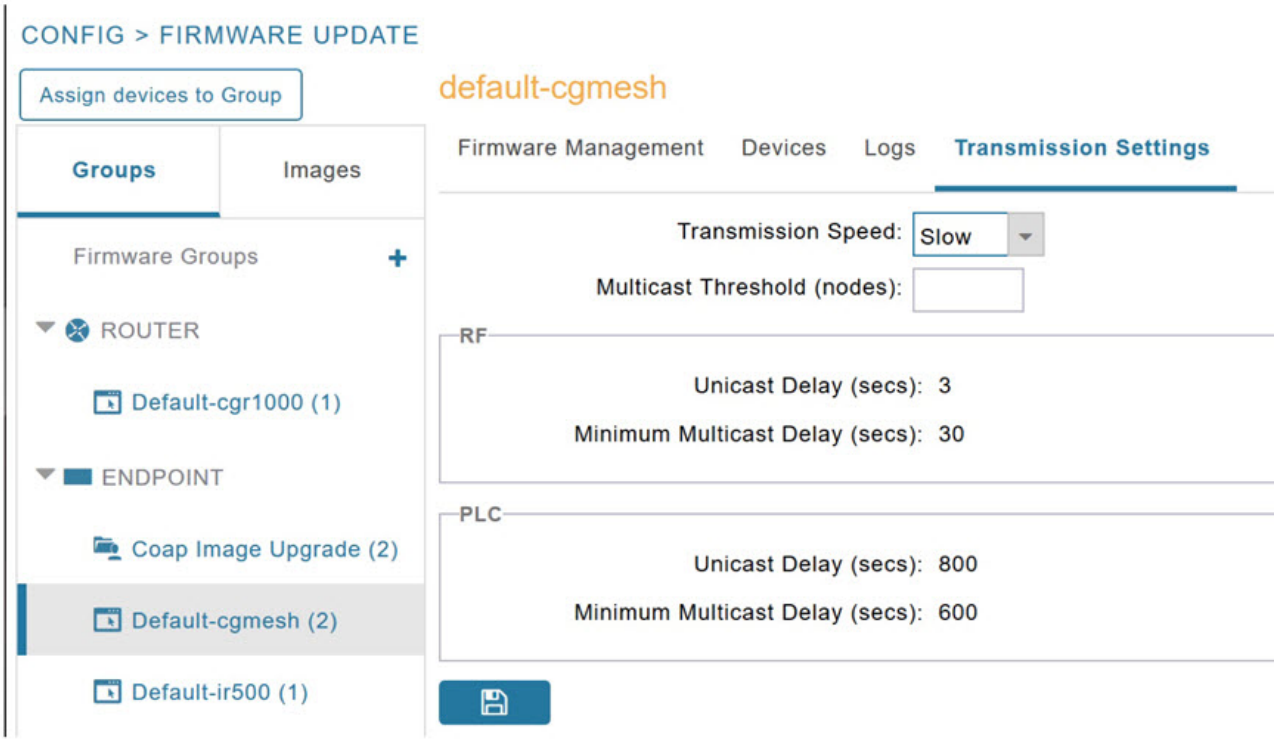
To modify the display of firmware management page:

### Procedure

**Step 1** Choose **CONFIG** > **FIRMWARE UPDATE**.

**Step 2** Click the **Sync Membership** button to ensure that the information for FND and the member endpoint firmware group is the same.

*Figure 7: CONFIG > FIRMWARE UPDATE*




# Viewing Mesh Device Firmware Image Upload Logs

To view the mesh device firmware image upload logs:

**Procedure**

**Step 1** Click the **Sync Membership** button to sync the group members in the same firmware group.

**Step 2** Click the **Devices** tab to view member's devices.

**Step 3** Click the **Logs** tab to view log files for the group.

For more information, refer to Figure 4: Firmware Update - Percentage Complete (top-portion of screen), on page 10 .

# AP800 Firmware Upgrade During Zero Touch Deployment

During the PnP bootstrapping, whenever an access point (AP) or router sends the firmware request, FND will need to make the choice as to whether Unified Firmware or Autonomous Firmware is updated on the AP to make it accessible to the Cisco Wireless LAN Controller (WLC) after a firmware upgrade.

**Note** Once you set up the DHCP server on a Cisco IOS router, WLC generally handles the software updates for the AP.

Allows you to set the desired firmware that will update an IR829 router during ZTD.

There are two possible firmware options:

- **Option 1**: Set the 'unified' version (k9w8: the factory-shipped version) as the desired firmware.
- **Option 2** : Set the autonomous firmware as the desired firmware version.

During the ZTD process, the firmware upgrade of an access point (AP) or embedded AP on an IR829 router will upgrade using the firmware version you define as the autonomous firmware.

To define the Autonomous Firmware for an IR829 router:

### Procedure

**Step 1** Choose **CONFIG** > **DEVICE CONFIGURATION**.

**Step 2** Select the desired router: Default-ir800 (left-pane).

**Step 3** Check the installed firmware version, BEFORE upload. if equal to the latest version, skip firmware upgrade.

**Step 4** Before you upload the software to the router, check the image and version:

- If the router image version is equal to the latest version, skip upgrade.
- If router image has the latest

**Step 5** Select Edit AP Configuration Template tab (right-pane).

**Step 6** Enter the following text in the right-pane:

```
ip dhcp pool embedded-ap-pool
network <router_ip> 255.255.255.0
dns-server <dns_ip>
default-router <router_ip>
option 43 hex f104.0a0a.0a0f (Note: Enter a single WLC IP
address(10.10.10.15) in hex format)
ip address <router_ip> 255.255.255.0
! {Note the symbol in this line is an exclamation point}
service-module wlan-ap 0 bootimage unified
```

**Step 7** Click disk icon (bottom of page) to save the commands in the configuration template.

# Image Diff Files for IR809 and IR829

To reduce the file size that transfers across network for IR809 and IR829, you can send a partial image:

- At the Upload Image page, select type: IOS-IR800.
- Check box for option: "install patch for IOS and hypervisor from this bundle."

# Gateway Firmware Updates

IC3000 Firmware Updates:

- At the **CONFIG** > **FIRMWARE UPDATE** page, you can add or delete the IC3000 firmware image.

**Note** Firmware image upload depends on interface speeds. You can set the timeout duration (in minutes) for firmware upload in cgms.properties file using "igma-idle-timeout" key. If you don't set this duration, then default timeout duration will be 15 minutes.

- At the **Images** tab page, expand the Gateway icon and click on IC3000 to see a list of available IC3000 images.

# Configuring Firmware Group Settings

This section describes how to add, delete, and configure firmware groups, and includes the following topics:

- Adding Firmware Groups, on page 15
- Assigning Devices to a Firmware Group, on page 16
- Renaming a Firmware Group, on page 18
- Deleting Firmware Groups, on page 19

**Note** Upload operations only begin when you click the **Resume** button.

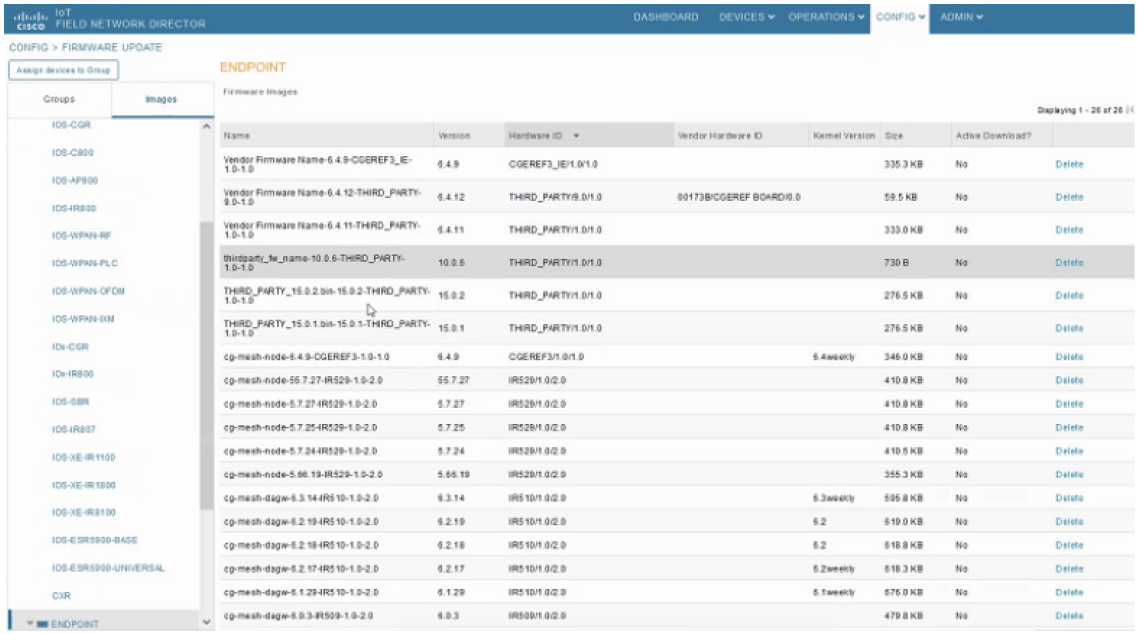
When you add routers or RMEs to IoT FND, the application sorts the devices into the corresponding default firmware group: default-<*router*> or default-cgmesh. Use these groups to upload and install firmware images on member devices. Add firmware groups to manage custom sets of devices. You can assign devices to firmware groups manually or in bulk. Before deleting a firmware group, you must move all devices in the group to another group. You cannot delete non-empty groups.

When creating firmware groups note the guidelines:

- CGRs, IR800s can coexist on a network; however, for firmware management, they cannot belong to the same firmware group.
- IR500s and other RMEs devices can coexist on a network; however, for firmware management, they cannot belong to the same group.

The Groups tab on the **CONFIG** > **FIRMWARE UPDATE** page displays various device metrics.

*Figure 8: CONFIG > FIRMWARE UPDATE*




**Tip** At the Firmware Update page, click the Error/Devices link (not shown) in the **Firmware Update** page to apply a filter.

Click **Clear Filter** to revert to an unfiltered view of the selected device group.

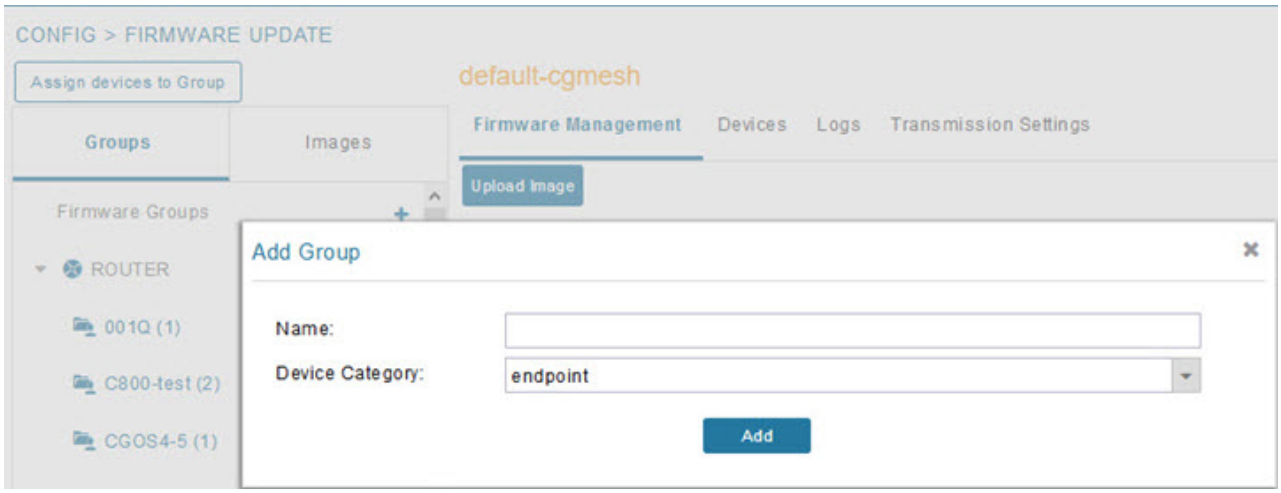
# Adding Firmware Groups

To add a firmware group:

### Procedure

**Step 1** Choose **CONFIG** > **FIRMWARE UPDATE**.

**Step 2** Click the **Groups** tab.




**Step 3** In the Groups pane, select one of the following:

- Default-cgr1000
- Default-ir500
- Default-ir800
- Default-cgmesh

**Step 4** Click + next to Firmware Groups heading in the Groups pane to Add Group.

**Step 5** In the **Add Group** dialog box, enter the name of the firmware group. Device Category options depend on the device type you select in Step 3.

**Step 6** Click **Add**.

The new group label appears under the corresponding device type in the Firmware Groups pane.

**Note**
To assign devices to the new group, see Assigning Devices to a Firmware Group, on page 16.

# Assigning Devices to a Firmware Group

This section explains moving devices to another firmware group in bulk or manually.

## Moving Devices to Another Group In Bulk

To move devices from one group to another in bulk:

**Procedure**

**Step 1** Create a CSV or XML file listing devices that you want to move using the format shown in the following examples:

| ***DeviceType/EID* for CGRs:** | ***EID* only for mesh endpoints:** | ***EID* only for IR800s** |
|---|---|---|
| eid<br>CGR1120/k9+JS1<br>CGR1120/k9+JS2<br>CGR1120/k9+JS3 | eid<br>00078108003c1e07<br>00078108003C210b | eid<br>ir800 |
| ***EID* only for ISR 800s:** | ***EID* only for IR500s:** | ***EID* only for IC3000** |
| eid<br>C819HGW-S-A-K9+FTX174685V0<br>C819HGW-S-A-K9+FTX174686V0<br>C819HGW-S-A-K9+FTX174687V0 | eid<br>da1<br>da2<br>da3 | eidIC3000+FOC2219Y47Z |

**Note**
Each file can only list one device type.

**Step 2** Choose **CONFIG** > **FIRMWARE UPDATE**.

**Step 3** Click the **Groups** tab.

**Step 4** Click the **Assign devices to Firmware Group** button (found above the Groups tab).

**Step 5** In the window that appears, click **Browse** and locate the device list CSV or XML file.

**Step 6** From the **Group** drop-down menu, choose the destination group.

**Step 7** Click **Assign to Group**.

**Note**
IoT FND moves the devices listed in the file from their current group to the destination group.

**Step 8** Click **Close**.

## Moving Devices to Another Group Manually

To manually move devices to a group:

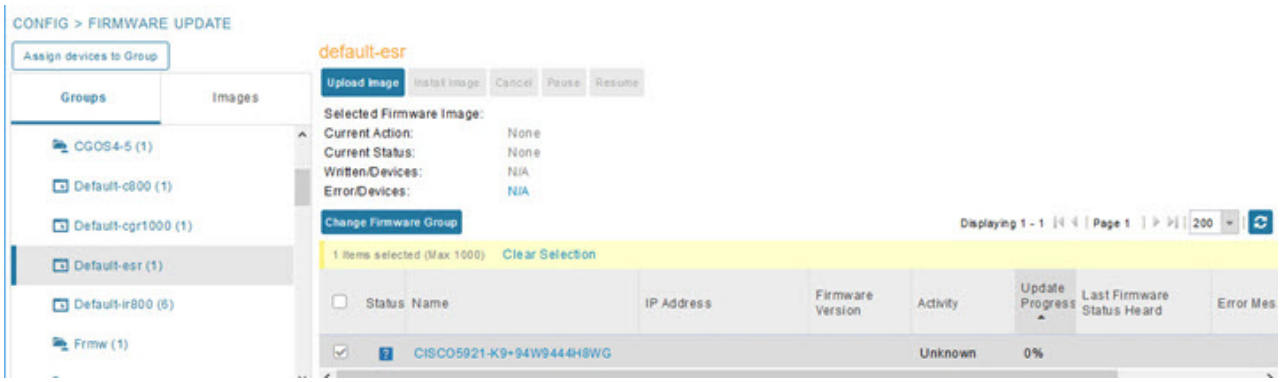
### Procedure

**Step 1** Choose **CONFIG** > **FIRMWARE UPDATE**.

**Step 2** Click the **Groups** tab.

**Step 3** In the Firmware Groups pane, select the desired firmware group based on device type.

**Note**
If this is an ENDPOINT firmware group, click the **Devices** tab above the main pane.




**Step 4** Check the check boxes of the devices that you want to move.

**Step 5** Click **Change Firmware Group** to open a pop up window.

**Step 6** From the **Firmware Group** drop-down menu, choose the firmware group to which you want to move the devices or enter a new group name.

**Step 7** Click **Change Firmware Group**.

**Step 8** Click **Close**.

# Renaming a Firmware Group

In the **Firmware Update** page, there are two firmware groups available, namely user-created groups and default groups of router, endpoint, or gateway. IoT FND allows you to rename the user-created firmware groups only. You cannot rename the default firmware groups.

To rename a firmware group:

### Procedure

**Step 1** Choose **CONFIG** > **FIRMWARE UPDATE**.

**Step 2** Click the **Groups** tab.

**Step 3** In the Firmware Groups pane, select the firmware group to rename.

**Step 4** Move the cursor over the firmware group and click the **Edit Group Name** pencil icon.




**Note**
Starting with IoT FND, you can only rename the user-created firmware groups and you cannot rename the default firmware groups. The pencil icon does not appear for the default firmware groups.

**Step 5** In the **Rename Group** window, enter the new name and then click **OK**.

**Note**
When you enter an invalid character entry (such as, @, #, !, or +) within the Rename Group field, IoT FND displays a red alert icon, highlights the field in red, and disables the **OK** button.

## Deleting Firmware Groups



**Note** Before deleting a firmware group, you must move all devices in the group to another group. You cannot delete non-empty groups.

To delete a firmware group:

**Procedure**

**Step 1** Choose **CONFIG** > **FIRMWARE UPDATE**.
**Step 2** Click the **Groups** tab.
**Step 3** In the Firmware Groups pane, select a firmware group to display a list of all possible firmware images for that group in the right pane.
**Step 4** Check the box next to the firmware group that you want to delete.
**Step 5** Click Clear Selection that appears above the entry (yellow bar).
**Step 6** To confirm deletion, click **Yes**.
**Step 7** Click **OK**.

# Firmware images

Firmware images in Cisco IoT FND are software files that you use to update and enhance the firmware of managed Cisco IoT devices.

A router group in Cisco IoT FND is a collection of routers that you can organize together to simplify managing, monitoring, and configuring tasks across multiple routers simultaneously.

***Table 4: Feature history***

## Add firmware images

Import the firmware file into the Cisco IoT FND database so it can be managed and later deployed to Cisco IoT routers.

Here are the steps to add firmware images to Cisco IoT FND:

### Procedure

**Step 1** In the Cisco IoT FND menubar, choose **CONFIG** > **Firmware Update**.

**Step 2** Click the **Images** tab.

**Step 3** Select **ROUTER** or **ENDPOINT** or **GATEWAY** and then select a device group. For example, IOS-XE-IR1100.

**Step 4** Click the **+** icon adjacent to **FIRMWARE IMAGES**.

**Step 5** Click **Browse** to locate the firmware image. Select the image, then click **Add File**.
The image appears in the **Firmware Images** list.

### What to do next

Upload firmware images

# Upload firmware images

This task guides you to upload firmware images to a router group, Cisco IoT FND pushes the image to the router group in the background and tracks the upload progress to ensure that the devices receive the firmware image.

Here are the steps to upgrade firmware on a router group:

### Before you begin

- Firmware image upload and installation require the following free disk space:
  - For bundle boot mode: 20 MB + uploaded file size
  - For install boot mode: 800 MB + uploaded file size
- If any devices in the router group encounter errors during firmware upload, Cisco IoT FND prevents firmware installation and you can see an error message indicating the presence of errored devices. For errored or cancelled devices, move them to a separate install group and repeat the upload and installation process.
- If you cancel the firmware upload for some devices, firmware installation proceeds only on devices that successfully completed the upload. For errored or cancelled devices, move them to a separate install group and repeat the upload and installation process.

### Procedure

**Step 1** In the Cisco IoT FND menubar, choose **CONFIG** > **Firmware Update**.

**Step 2** Click the **Groups** tab.

**Step 3** Select the router group that you want to upgrade.

**Step 4** Click **Upload Image**.

**Step 5** The **Select Type:** drop-down list is auto-selected based on the selected router group.

**Step 6** Select an image from the **Select an Image** drop-down list.

**Step 7** Click **Upload Image Now** to initiate the firmware upgrade process instantly.

**Note**
Use the **Cancel** or **Pause** buttons to either cancel or pause the firmware image upload.

### What to do next

Install firmware images.

# Install firmware images

Use this task to install a firmware image to a router group after you upload a firmware image to Cisco IoT FND.

### Before you begin

- If you cancel the firmware upload for some devices, firmware installation proceeds only on devices that successfully completed the upload. For errored or cancelled devices, move them to a separate install group and repeat the upload and installation process.

### Procedure

**Step 1** In the Cisco IoT FND menubar, choose **CONFIG** > **Firmware Update**.

**Step 2** Click the **Groups** tab.

**Step 3** In the **Groups** tab, select the router group for which you want to install the firmware.

**Step 4** Click **Install Image**.

**Step 5** In the **Install Image to:** dialog box, select **Install Image Now** to install the image instantly.

**Step 6** Use the **Cancel** or **Pause** buttons to cancel or pause the firmware installation.

**Note**

- If you restart Cisco IoT FND during the image installation process, it automatically resumes any firmware installations that were in progress before going offline.
- The firmware installation operation can time out on some routers. During installation, a job scheduler runs every two hours to terminate any firmware install jobs that are stuck at 35% progress. You can adjust the scheduler's default interval by setting the "firmware-install-timeout-schedule-cron-hour" key in the cgms.properties file to any value greater than 0 and less than 24. This scheduler applies only to jobs stalled at the 35% mark.
- When a firmware install or image upload operation for routers takes too long, it can cause other jobs in the queue to wait longer. You can set the timeout duration for stuck firmware jobs using the `router-firmware-upload-timeout-minutes` and `router-firmware-install-timeout-minutes` keys in the cgms.properties file; the default is 8 hours (480 minutes).

### What to do next

View the firmware images

# View firmware images

Use the following instructions to view the firmware images on Cisco IoT FND:

### Procedure

**Step 1** From the Cisco IoT FND menubar, choose **CONFIG** > **FIRMWARE UPDATE**.

**Step 2** Click the **Images** tab.

**Step 3** Select a ROUTER or an ENDPOINT to display all firmware images for those devices in the Cisco IoT FND database. You can view a list of firware images associated with the particular device type. You can view details such as name, version, hardware ID, vendor hardware ID, size, active download etc.

**Step 4** Click **Delete** to delete a particular firmware image.

# Push StackMode

Starting from Cisco IoT FND Release 4.8.1, Cisco IoT FND supports multiple mesh networking modes for IoT deployments. You must be an admin or you should have firmware upgrade permission to perform the switch from CR-Mesh to Wi-SUN stack mode. Switching from CR-Mesh to Wi-Sun mode changes the underlying radio protocol used by devices in the network. CG-Mesh is Cisco mesh technology, while Wi-Sun leverages the IEEE 802.15.4g standard with Wi-SUN profiles for interoperability within a broader ecosystem. During the switching process, a single or multiple PAN nodes are grouped and scheduled for switching devices from CG-Mesh to Wi-SUN stack. Wi-SUN stack supports both unicast and multicast transmissions. For more information see, Mesh protocol modes.

### Supported Platforms

Cisco IoT FND supports the following platforms for switching devices from CG-Mesh to Wi-SUN stack:

- ITRON30
- CR-Mesh
- Cisco 500 Series WPAN Industrial Routers

***Table 5: Feature History***

| Feature Name | Release Information | Description |
|---|---|---|
| Support For Wi-SUN Stack Switch | Cisco IoT FND Release 4.8.1 | Switch devices from CR-Mesh to Wi-SUN StackMode. |

# Prerequisites

Here are the prequisites for switching to Wi-SUN mode from CR-Mesh mode using Cisco IoT FND:

- Ensure that the following supported devices are running the minimum required versions
  - Cisco CGR: Cisco IOS Release 15.9(3)M1 and later releases.
  - Cisco IR8140: Cisco IOS-XE 17.x and later releases.
- Once you are done with switching of the devices from CR-Mesh to Wi-SUN stack mode, ensure to update the WPAN OFDM/FSK stack mode to Wi-SUN stack. If the WPAN OFDM/FSK is not updated, the node can't join back the network and will move to **Down** state in Cisco IoT FND.

# Switch from CR-Mesh to Wi-SUN StackMode

You can push your devices to Wi-SUN mode from CR-Mesh mode by scheduling the task at your convenience.

## Configure Push StackMode

Here are the instructions to push devices to Wi-SUN stack mode:

**Procedure**

**Step 1** From the Cisco IoT FND menubar, choose **CONFIG** > **Firmware Update**.

**Step 2** Click the **Groups** tab in the left pane.

**Step 3** Select the default or user-defined firmware group from the **ENDPOINT**.

**Step 4** Check the **PAN ID** check box in the **StackMode Switch** table.

**Step 5** Click **Push StackMode** to set your device mode to Wi-SUN stack mode.

**Step 6** A confirmation dialog-box appears, click **Yes**. If you see a stack mode failure message, retry pushing to StackMode.

**Step 7** Based on the status of the push stack mode process, the following states are displayed for the selected PAN ID in the **StackMode Switch** table:

| Field | Description |
|---|---|
| Stack Operation Type | Displays the following states for the Push StackMode operation:<br>• **StackMode Push Initiated**: Displays initiation of the stack mode operation.<br>• **StackMode Push Completed**: Displays the completion of the stack mode operation.<br>• **No operation** when no operation is initiated. |
| Stack Operation Status | Displays the overall success and failure status of the devices for the selected PAN during the StackMode operation. |
| Job Status | Displays the following statuses: |

| Field | Description |
|---|---|
| | • In-progress<br>• Success<br>• Aborted |

Your device modes are set to Wi-SUN stack mode.

## Schedule Push StackMode Time

Here are steps to configure Push StackMode Time:

### Procedure

**Step 1** From Cisco IoT FND menubar, choose **CONFIG** > **Firmware Update**.

**Step 2** From the **StackMode Switch** table, check the **PAN ID** check box.

**Note**
You can select only the PAN ID that has successfully completed the push StackMode configuration.

**Step 3** Click **Push StackMode Time**.

A **Confirm** dialog box appears to schedule the switching initiation process for moving CR-Mesh devices to Wi-SUN stack.

Based on the status of the StackMode time process, the following states are displayed for the selected PAN ID in the **StackMode Switch** table.

***Table 6: PAN ID Status***

| Field | Description |
|---|---|
| **Stack Operation Type** | Displays the following states for the Push StackMode operation:<br>• **StackMode Switch Time Push Initiated** : Displays initiation of the stack mode schedule operation.<br>• **StackMode Switch Time Completed**: Displays the completion of the stack mode schedule operation. |
| **Stack Operation Status** | Displays the overall success and failure status of the devices for the selected PAN during the StackMode operation. |

| Field | Description |
|---|---|
| **Job Status** | Displays the following statuses:<br>• In-progress<br>• Success<br>• Aborted |

**Note**

- If you abort an in-progress Push StackMode Time job, the job stops immediately and retains all progress completed before the abort. To complete Push StackMode Time for the remaining devices, run Push StackMode Time again to restart the workflow.
- When you run Push StackMode Time again for an aborted or unsuccessful workflow, Cisco IoT FND sends requests only to the pending devices. It ignores devices that successfully received the Push StackMode Time request during the previous run.
- When you perform Push StackMode Time more than once on a workflow, the timestamp on devices in the same PAN might vary depending on the time configured in each run. We recommend that you push the same timestamp each time. If different timestamps are configured across devices in the same PAN, the devices switch to Wi-SUN mode according to their configured time, which might prevent some nodes from rejoining the network.
- If you want to reschedule the Push StackMode Time and set the same for all devices in the same PAN ID, we recommend that you cancel Push StackMode and run Push StackMode and Time as a fresh workflow.

**Step 4** Select the time and date in the **Schedule Switch Wi-SUN Stack** dialog box and click **Schedule** .

**Note**
Ensure that the scheduled time is not more than 49 days from the current date.

**Note**
If the scheduled time is in the past, an error message appears.

**Step 5** Click **Yes** to confirm the stack switching operation.

On confirming the stack switching process, the stack operation type gets updated to **Stack Switch Time Push Initiated** state for the selected PAN ID.

**Step 6** Click **OK** in the **Success** dialog box.

On successful completion of the stack switch process, the stack operation type column in the table gets updated to **Stack Switch Time Push Completed** state for the selected PAN ID.

**Note**
We recommend that you wait until all the devices in the selected PAN get switched to Wi-SUN stack, as there is a possibility of some devices failing to switch in the scheduled time. However, the failed devices automatically switch to Wi-SUN StackMode after a one-day time period.

If you don't schedule Push Stack Mode Time after you Push StackMode, the endpoint devices switch to Wi-SUN mode after 24 hours.

**Note**

If you want to reschedule the stack time for some reason, then you have to cancel the current stack switch operation, push the StackMode again, and reinitiate the scheduling stack switch process.

## Cancel Wi-SUN Stack Switch Operation

Here are the steps to cancel Wi-SUN stack switch operation:

### Before you begin

- Starting from Cisco IoT FND Release 5.1.2, use the cancel switch operation during any stage of the Push StackMode workflow.
- Cancel switch operation cancels the scheduled Push StackMode workflow as well.

### Procedure

**Step 1** From the Cisco IoT FND menubar, Choose **CONFIG** > **Firmware Update**.

**Step 2** In the **Firmware Management** page, check the **PAN ID** check box for which you have completed either configuration or scheduling operation.

**Step 3** Click **Cancel StackMode**.

Based on the status of the StackMode cancellation process, the following states are displayed for the selected PAN ID in the **StackMode Switch** table.

*Table 7: PAN ID Status*

| Field | Description |
|---|---|
| **Stack Operation Type** | Displays the following states for the Push StackMode operation:<br>• **StackMode Cancel Initiated:** Displays the intitiation of cancelling the StackMode operation.<br>• **StackMode Cancel Completed**: Displays the completion of cancelling the StackMode Operation. |
| **Stack Operation Status** | Displays the overall success and failure status of the devices for the selected PAN during the StackMode operation. |
| **Job Status** | Displays the following statuses:<br>• In-progress<br>• Success<br>• Aborted |

**Step 4** Click **Yes** to cancel the stack switch operation.

A **Success** dialog box appears to indicate the successful cancellation of the Wi-SUN stack switch operation.

## Validate Push StackMode

In the **StackMode Push Initiated** state, the devices in the selected PAN ID are validated based on the following parameters:

- Firmware version
- StackMode configuration

***Table 8: Push StackMode Validation***

| Scenarios | System Validation | User Action |
|---|---|---|
| Firmware version 6.2 MR. | Checks if the devices in the selected PAN ID are running firmware version 6.2 MR.<br>• If the firmware version is lower than 6.2 MR, then an error message appears.<br>**Note** for more information on the devices that are running a lower version go to the **Devices** tab. | • You must upgrade the devices to firmware version 6.2 MR or later versions.<br>• After upgrading the devices, you must again push new StackMode for the selected PAN ID. |
| | • If the firmware version is greater than 6.2 MR, then the devices are already in Wi-SUN stack. | |
| StackMode configuration. | Checks if all devices in the selected PAN ID received the StackMode configuration.<br>• Some devices in the selected PAN ID fail to receive the configuration. | • Push StackMode again for the selected PAN ID.<br>or<br>• Remove the devices that are in Down state from FND and again push StackMode for the remaining devices in the PAN ID. |
| | • If all the devices in the selected PAN ID received the StackMode configuration, then you can schedule the devices for stack switch operation initiation. | You can schedule the devices for Wi-SUN stack switch only on successful completion of pushing StackMode configuration to all devices in the selected PAN. |

**Note** On successful completion of the validation, the stack operation state for the selected PAN ID changes to **Stack Mode Push Completed**.

# View StackMode information

From the **Devices** tab, you can view the StackMode status and StackMode time of each device for the following processes:

- Pushing Devices to Wi-SUN StackMode
- Scheduling Devices for Wi-SUN Stack Switch
- Canceling Wi-SUN Stack Switch Operation

### Procedure

**Step 1** From the Cisco IoT FND menubar, choose **CONFIG** > **FIRMWARE UPDATE** > **Groups** tab.

**Step 2** Select the default or user-defined firmware group from the **ENDPOINT**.

**Step 3** Select the **PAN ID** from the StackMode Switch table.

**Step 4** Click the **Devices** tab.

The **Stack Change Status** column displays the following states:

***Table 9: Device State***

| Device State | Description |
|---|---|
| Not Started | Indicates the supported devices that are not initiated for Wi-SUN stack switch. |
| Not Applicable | Indicates the devices that are not supported for Wi-SUN stack switch. |
| Configuring StackMode | Indicates the devices that are pushed for StackMode operation. |
| Configured Stackmode | Indicates the devices that are successfully configured with StackMode. |
| Scheduling Stackmode time | Indicates the devices that are scheduled for StackMode switch. |
| Success | Indicates the devices that are successfully switched from CG-Mesh to Wi-SUN stack. |
| Canceling stackmode switch | Indicates the devices that are scheduled for canceling StackMode switch. |

| Device State | Description |
|---|---|
| Cancelled stackmode switch | Indicates the devices that are successfully cancelled from switching to Wi-SUN stack. |

**Filtering Options**

a) Click **Show Filter**. The page displays three drop-down lists.
b) Select the search option from the first drop-down list. For example, if you select Status from the first drop-down list, the available list of states appears in the third drop-down list.
c) Select the required option in the third drop-down list and click +.

   Your selection is displayed in the text box above the drop-down lists.

d) Click the search icon.

   The table displays information based on the search criteria set by you.

# View logs for Wi-SUN stack switch

To view logs for Wi-SUN stack switch:

**Procedure**

**Step 1** From the Cisco IoT FND menubar, choose **CONFIG** > **Firmware Update**.
**Step 2** Select the firmware group from the **ENDPOINT** in the left pane.
**Step 3** In the **Firmware Management** page, select the **PAN ID** for which you want to see the logs.
**Step 4** Click the **Logs** tab.

In the **Logs** page, you can view the events that are recorded for the selected PAN ID.

# View Audit Trail for Wi-SUN stack switch

To view audit trail for Wi-SUN stack switch :

**Procedure**

**Step 1** From the Cisco IoT FND menubar, choose **ADMIN** > **System Management** > **Audit Trail**.
**Step 2** In the Audit Trail page, click the **Date/Time** drop-down arrow to filter the audit trail based on the date and time.

You can view the audit trail of the stack operations that were performed on the selected PAN ID.

# Upgrading Firmware Image during Bootstrapping

During bootstrapping, you can enter a different image if the installed image at manufacturing is inappropriate. This is supported for IR1800 and IR8100 devices from the versions 17.13.01 and above. Plug and Play (PnP) must be supported on these devices.

**Note** Ensure that IR8100 device has the network-essentials license to register the device to IoT FND.

PnP Device Information service retrieves current firmware version on the device and the PnP ImageInstall service performs the image installation. The CGNA ‘image-retrieve' service transfers the image file from IoT FND to router.

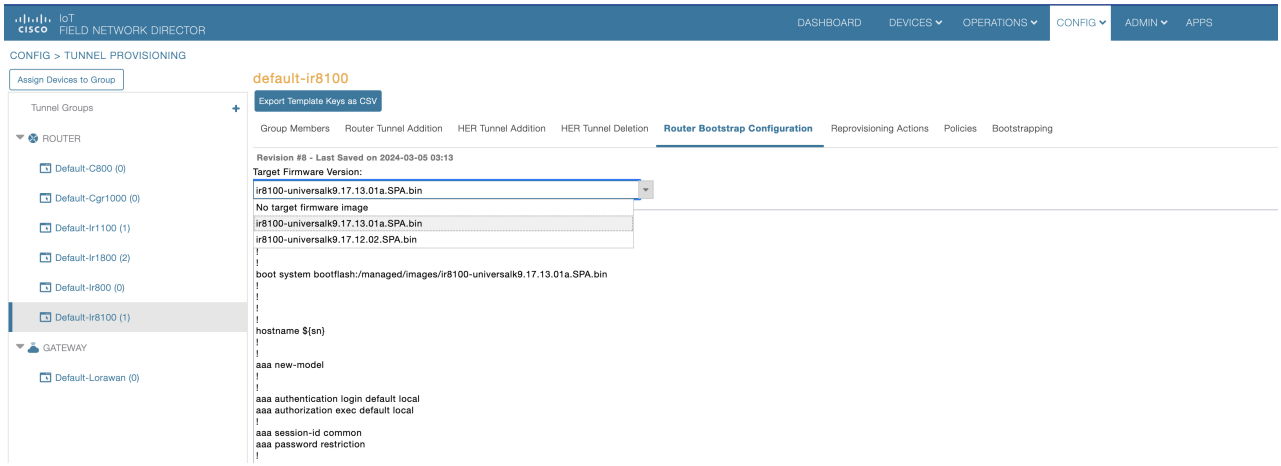
### Procedure

**Step 1** Set the firmware-update-bootstrap property in cgms.properties to ‘true’.

**Step 2** On the Tunnel Provisioning Page, navigate to **CONFIG** > **TUNNEL PROVISIONING** > **ROUTER BOOTSTRAP CONFIGURATION**.

**Step 3** Select the device group in the left pane, choose the Target Firmware Version from the drop down that lists the images in IoT FND, and click **Save**.

The PnP workflow configures the device to load the new image upon the next reload by executing the boot system command. The configuration changes are saved on the device. The PnP reload happens and sends a message to the PnP server after which an event is generated denoting image installation.




**Note**
The PnP workflow supports device upgrade only if the target image version is higher than the running (current) image version.

If the target image runs the same or lower version, then the device upgrade is skipped during the PnP workflow.

During PNP, you also have the option to skip the firmware upgrade and proceed with PNP if the source operating system on these devices is found to be unreliable. Enter the image versions as comma separated values in

**pnp-skip-update-ios-xe-fw-versions** property in cgms.properties file. This property is applicable for all IR1100, IR1800, and IR8100 devices. For more information, see Skipping Firmware Upgrades during PNP, on page 31.

# Skipping Firmware Upgrades during PNP

During Zero Touch Deployment (ZTD), certain scenarios may arise where Plug-and-Play (PNP) devices come bundled with software that exhibits instability or issues. If the source operating system (OS) on these devices is found to be unreliable, it can potentially disrupt the entire registration process. In such instances, during the PNP process, you can skip the firmware upgrade step while allowing PNP to proceed seamlessly. However, you can upgrade the firmware once the PNP process is complete.

To perform a PNP with firmware upgrade skip:

### Procedure

**Step 1** Set the image versions in pnp-skip-update-ir1100-fw-versions property in cgms.properties file.

**Note**
The pnp-skip-update-ir1100-fw-versions property is applicable for IOS-XE routers only.

**Step 2** Set the image versions in pnp-skip-update-ios-xe-fw-versions property in cgms.properties file.

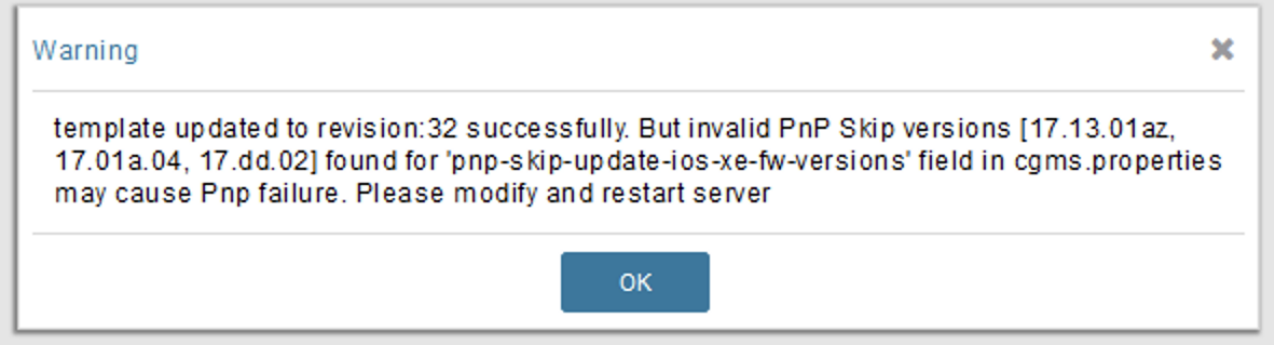
**Note**
The pnp-skip-update-ios-xe-fw-versions property is applicable for IOS-XE routers only.

**Step 3** Choose **CONFIG** > **Tunnel Provisioning**. Select the router group for which you intend to execute the PNP process.

**Step 4** Click **Router Bootstrap Configuration** tab.

**Step 5** Under Target Firmware Version, specify the image version you want to skip and click **Save**.

The template is saved. However upon performing PNP, during router bootstrap configuration, a warning popup appears if any invalid entry is found. In that case, modify the field and restart server.



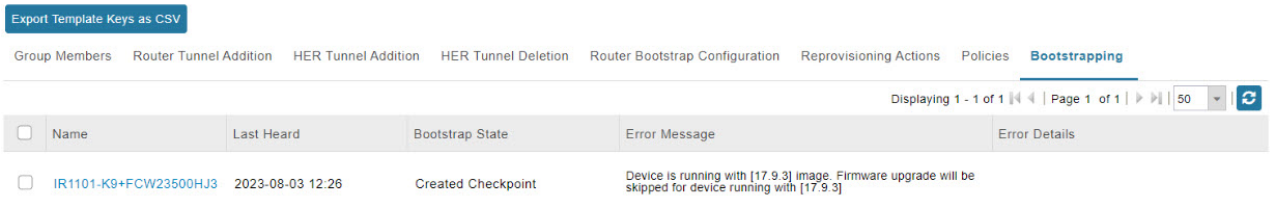

If firmware install is skipped during PnP process, the log details are stored in server.log file. The sample INFO log is shown below:

```
Aug 03 2023 19:24:26.854 +0000: %IOTFND-6-UNSPECIFIED:
 %[ch=WorkResponseHandler][eid=IR1101-K9+FCW23500HJ3][ip=1.1.1.121]
```

```
[sev=INFO][tid=tunnelProvJetty-67]: Retrieved device image version
[17.9.3] is present in PnP firmware image skip list. Firmware image update
 during PnP process will be skipped.
```

**Note**
In order to upgrade the device with the latest firmware version, skip entering the current image version in cgms.properties and proceed with PNP.

**Step 6** Navigate to the Bootstrapping tab where the Error Message field is updated though the PNP progresses as is.




The Bootstrapping tab shows the status of the PNP under the Bootstrap State field.

