Upgrading Field-Programmable Device

An FPD is a field programmable logic device which contains non-volatile, re-programmable memory to define its internal wiring and functionality. The contents of this non-volatile memory are called the FPD image or FPD firmware. Over the lifespan of an FPD, FPD firmware images may need upgrades for bug fixes or functionality improvements. These upgrades are performed in the field with minimum system impact.

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- Overview of FPD Image Upgrade Support, on page 1
- FPD upgrade service, on page 3
- How to Upgrade FPD Images, on page 5
- Configuration Examples for FPD Image Upgrade, on page 6
- Troubleshooting Problems with FPD Image Upgrades, on page 8

Prerequisites for FPD Image Upgrades

You must install the FPD pie before you install the SMUs or Service Packs. If you install the SMU or Service Packs before the FPD pie, the FPDs on the line card may not upgrade. In such cases, you must remove the SMUs and Service Packs and reload the router.

Overview of FPD Image Upgrade Support

An FPD image is used to upgrade the software on an FPD.

FPD versions must be compatible with the Cisco IOS XR software that is running on the router; if an incompatibility exists between an FPD version and the Cisco IOS XR software, the device with the FPGA may not operate properly until the incompatibility is resolved.

Note

It is mandatory to upgrade all the required FPDs before doing a reload when you are upgrading FPDs on line cards. This is because, partial FPD component upgrades might result in booting errors (in some cases).
Parallel Power Module Upgrade

Power modules can now be upgraded in parallel on Cisco NCS 5500 Series Routers. This feature lets you perform FPD upgrades on multiple power modules simultaneously. The newer power modules (V3) take more time to upgrade separately than their previous counterparts, which increases the total time taken to upgrade a full chassis to an unacceptable limit.

Parallel upgrade process reduces the overall time required to upgrade a full chassis with many power modules. Only power modules that support FPD upgrades can be upgraded in parallel. This includes V3 AC-DC and V2 AC-DC power modules.

Note

- Power module upgrades are time consuming and cannot be implicitly upgraded or as a part of automatic FPD upgrades. These modules must be upgraded independent of the other fpga upgrades.
- Currently, this feature is not supported on Cisco IOS XR 64 Bit.
- V1 power modules do not support FPD upgrades and cannot be upgraded.
- V3 power modules must have both power feeds connected before upgrading them.

To upgrade the power modules in parallel, use `upgrade hw-module fpd fpga location pm-all` or `upgrade hw-module fpd all location pm-all` command in Admin mode.

To force a power module upgrade, use `upgrade hw-module fpd all force location pm-all` command in Admin mode.

Pre-requisites to perform Parallel Upgrade

- Ensure that all power connections to the power supply are energized. To verify the power supply details, use `show environment power-supply` command in Admin mode.

For more information on these commands, see `Hardware Redundancy and Node Administration Commands` chapter in `System Management Command Reference for Cisco NCS 5500 Series Routers, IOS XR Release 6.3.x`.

- Ensure power available to the power supply is equal to the rated power. For example, 6KW power module must have a 6KW power feed. If the power feed to the power supply is less, the excess power calculation will be incorrect and the chassis may run out of power during an upgrade and suffer a sudden shutdown.

- Ensure sufficient or excess power is available in the chassis before you start the upgrade process.
- Do not add or remove any component (Line cards, RPs, power connections) from the chassis during an upgrade. This may cause power failure in the system due to sudden change in power in the system.

Note

- The system upgrades the power modules in random order.
- The number of modules that can be upgraded simultaneously depends on the excess power available to the chassis.

- Ensure you initiate the parallel upgrade process only when all the pre-requisites are satisfied because the upgrade process cannot be aborted in between.
Performing Parallel Power Module Upgrade

To initiate a parallel upgrade process and upgrade all the power modules in the chassis simultaneously, use `pm-all` keyword in the `upgrade hw-module fpd` command in Admin mode.

Example

The following section illustrates parallel power module upgrade implementation:

Verification

Use `show hw-module fpd` command to verify the upgrade:

Automatic Line Card Reload on FPD Upgrade

This feature automatically reloads a newly inserted line card (LC) after a successful FPD upgrade. The current auto FPD upgrade process does not reload the line card automatically, the user had to manually reload the LC. To enable this feature on Cisco IOS XR 32 bit operating system, use the `fpd auto-reload` command and use `fpd auto-reload enable` command in Cisco IOS XR 64 bit OS.

Configuring Automatic Line Card Reload on FPD Upgrade

The auto-reload feature works only if auto-upgrade feature is also configured on the router. The following sample shows how to configure auto-reload feature for Cisco IOS XR 32-bit OS:

```
RP/0/RSP0/CPU0:ios(config)#admin
RP/0/RSP0/CPU0:ios(admin-config)#fpd auto-upgrade
RP/0/RSP0/CPU0:ios(admin-config)#fpd auto-reload
RP/0/RSP0/CPU0:ios(admin-config)#commit
```

The auto-reload feature is only supported on line cards.

The following sample shows how to configure auto-reload feature for Cisco IOS XR 64-bit OS:

```
RP/0/RSP1/CPU0:ios# config
RP/0/RSP1/CPU0:ios(config)#fpd auto-upgrade enable
RP/0/RSP1/CPU0:ios(config)#fpd auto-reload enable
RP/0/RSP1/CPU0:ios(config)#commit
```

Note

During the FPD upgrade process, the linecard may display IOS XR RUN state before triggering auto-reload.

FPD upgrade service

The main tasks of the FPD upgrade service are:

- FPD image version checking to decide if a specific firmware image needs an upgrade or not.
- Automatic FPD Image Upgrade (if enabled).
- Manual FPD Image Upgrade using the `upgrade hw-module fpd` command.
- Invoke the appropriate device driver with a name of the new image to load.
An FPD image package is used to upgrade FPD images. The **install activate** command is used to place the FPD binary files into the expected location on the boot devices.

**Supported Upgrade Methods**

<table>
<thead>
<tr>
<th>Method</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Upgrade</td>
<td>Upgrade using CLI, force upgrade supported.</td>
</tr>
<tr>
<td>Auto Upgrade</td>
<td>Upgrade using install SMU activation or during image upgrade. User can enable/disable auto upgrade feature.</td>
</tr>
</tbody>
</table>

**Determining Upgrade Requirement**

Use the **show hw-module fpd** command to determine if an FPD upgrade is required. Check for NEED UPGD in the Status column.

Use the **show fpd package** command to find out which FPGAs are supported with your current software release and minimum hardware requirements for each module.

**Automatic FPD upgrade**

Use the **fpd auto-upgrade enable** command to enable the auto upgrade feature.

The FPD images are upgraded as part of the install activation of the new image. The FPDs are upgraded before the router is reloaded.

During an FPD auto-upgrade, the installed FPD rpm package includes an FPD image with a new version of software that is different than the version of the image running on the hardware. Once the FPDs have been upgraded, even if the base image is rolled backed to the older version, the FPD will not be downgraded to its previous version.

When a reload package is installed with new FPD images, the FPD images are upgraded before the router gets reloaded. This feature is controlled through an fpd auto-upgrade configuration option. The auto-upgrade feature does not address the following:

- FPD Upgrade during initial boot
- FPD Upgrade during new card insertion

**Manual FPD upgrade**

Manual FPD upgrade is performed using the **upgrade hw-module fpd** command. All cards or all of FPGA in a card can be upgraded. If reload is required to activate FPD, the upgrade should be complete. All line-cards, fabric cards and RP cards cannot be reloaded during the process of the FPD upgrade.

FPD upgrade is transaction-based:

- Each fpd upgrade cli execution is one transaction
- Only one transaction is allowed at any given time
- One transaction may include one or many FPD upgrade(s)
The **force** option can be used to forcibly upgrade the FPD (regardless of whether it is required or not). It triggers all FPDs to be upgraded or downgraded. The force option can also be used to downgrade or upgrade the FPGAs even after the version check.

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**Note**  
In some cases, FPDs can have primary and backup images.

### How to Upgrade FPD Images

You must determine if an FPD image upgrade is needed using the `show hw-module fpd` command and perform the upgrade, if needed, under the following circumstances:

- You migrate the software to a later Cisco IOS XR software release.
- You swap SPAs or SIPs from a system running a different Cisco IOS XR software release.
- You insert a new SPA or SIP.

In the event that there is an FPD incompatibility with your card, you may receive an error message. If you upgrade to a newer version of the Cisco IOS XR software and there is an FPD incompatibility, you receive the following message:

```
LC/0/1/CPU0:Dec 23 16:33:47.945 : spa_192_jacket_v2[203]: %PLATFORM-UPGRADE_FPD-4-DOWN_REV : spa fpga2 instance 0 is down-rev (V0.6), upgrade to (V1.0). Use the "upgrade hw-module fpd" CLI in admin mode.
```

If the FPD image on the card is newer than what is required by the currently running Cisco IOS XR software image on the router, you receive the following error message:

```
LC/0/1/CPU0:Dec 23 16:33:47.955 : spa_192_jacket_v2[203]: %PLATFORM-UPGRADE_FPD-4-UP_REV : spa fpga instance 1 is severely up-rev (V2.1), downgrade to (V1.6). Use the "upgrade hw-module fpd" CLI in admin mode.
```

You should perform the FPD upgrade procedure if you receive such messages. Cards may not function properly if FPD incompatibilities are not resolved.

---

**Note**  
The use of the **force** option when performing a FPD upgrade is not recommended except under explicit direction from Cisco engineering or TAC.

### Before you begin

- The FPD upgrade procedure is performed while the card is online. At the end of the procedure the card must be reloaded before the FPD upgrade is complete. To automatically reload the card, you can use the `hw-module reload` command during your next maintenance window. The upgrade procedure is not complete until the card is reloaded.

- During the FPD upgrade, you **must not** do the following:
  - Reload, perform an online insertion and removal (OIR) of a line card (LC), or power down the chassis. Doing so may cause the node to enter an unusable state.
  - Press Ctrl-C if the console appears to hang without any output. Doing so may abort the upgrade.
• If you are not sure whether a card requires an FPD upgrade, you can install the card and use the `show hw-module fpd` command to determine if the FPD image on the card is compatible with the currently running Cisco IOS XR software release.

## Configuration Examples for FPD Image Upgrade

The following examples indicates the use of commands associated with the FPD image upgrade procedure.

### show fpd package Command Output: Example

Use the `show fpd package` command in System Admin EXEC mode to find out which SPAs and SIPs are supported with your current Cisco IOS XR software release, which FPD image package you need for each SPA or SIP, and what the minimum hardware requirements are for each module. If multiple FPD images are available for your card, they are listed as Subtype fpga2, fpga3, and so on.

#### Note

The FPD name used in the FPD Description column of the output of the `show fpd package` command includes the last ten characters of DCO-PID. Depending on the slot and port numbers, the FPD name is appended with DCO_0, DCO_1, or DCO_2. For example, the FPD names for CFP2-WDM-D-1HL in port 0 and port 1 are `-WDM-D-1HL_DCO_0` and `-WDM-D-1HL_DCO_1` respectively.

The following example shows sample output from the `show fpd package` command:

```bash
crout@crout:~$ show fpd package
  Tue Jan 22 13:56:00.212 UTC

  Field Programmable Device Package
  ------------------------------------------

  **Card Type** | **FPD Description** | **Req SW Ver** | **Min Req SW Ver** | **Reload Ver** | **Min Req Board Ver** |
 -----------------|---------------------|---------------|-------------------|---------------|----------------------|
  NC55-1200W-ACFW | LIT-PriMCU-ACFW(A)  | NO            | 2.09              | 2.09          | 0.0                  |
  NC55-900W-ACFW-I| LIT-PriMCU-ACFW-I(A)| NO            | 1.04              | 1.04          | 0.0                  |
  NC55-900W-DCFW-I| LIT-PriMCU-DCFW-I(A)| NO            | 2.260             | 2.260         | 0.0                  |
  NC55-930W-DCFW-C| LIT-PriMCU-DCFW-C(A)| NO            | 2.259             | 2.259         | 0.0                  |
  NC55-MPA-12T-S  | MPAFPGA             | YES           | 0.27              | 0.27          | 0.0                  |
  NC55-MPA-1TH2H-S| -WDM-D-1HL_DCO_2    | NO            | 38.518            | 38.518        | 0.1                  |
  NC55-MPA-2TH-HX-S| -WDM-D-1HL_DCO_0   | NO            | 38.518            | 38.518        | 0.1                  |
```

Upgrading Field-Programmable Device
This table describes the significant fields shown in the display:

Table 1: show fpd package Field Descriptions

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Card Type</td>
<td>Module part number.</td>
</tr>
<tr>
<td>FPD Description</td>
<td>Description of all FPD images available for the SPA.</td>
</tr>
<tr>
<td>Type</td>
<td>Hardware type. Possible types can be:</td>
</tr>
<tr>
<td></td>
<td>• spa—Shared port adapter</td>
</tr>
<tr>
<td></td>
<td>• lc—Line card</td>
</tr>
</tbody>
</table>

show fpd package Command Output: Example
FPD subtype. These values are used in the `upgrade hw-module fpd` command to indicate a specific FPD image type to upgrade.

FPD software version recommended for the associated module running the current Cisco IOS XR software.

Minimum required FPD image software version to operate the card. Version 0.0 indicates that a minimum required image was not programmed into the card.

Minimum required hardware version for the associated FPD image. A minimum hardware requirement of version 0.0 indicates that all hardware can support this FPD image version.

**upgrade hw-module fpd Command Output: Example**

Use the `upgrade hw-module fpd` command to upgrade the FPD image on a SPA, SIP or line card.

**show platform Command Output: Example**

Use the `show platform` command to verify that the SPA is up and running.

**Troubleshooting Problems with FPD Image Upgrades**

This section contains information to help troubleshoot problems that can occur during the upgrade process.

**Power Failure or Removal of a SPA During an FPD Image Upgrade**

If the FPD upgrade operation is interrupted by a power failure or the removal of the SPA, it could corrupt the FPD image. This corruption of the FPD image file makes the SPA unusable by the router and the system displays the following messages when it tries to power up the SPA. When it cannot successfully power up the SPA, it places it in the failed state, as shown in the following example:

```
LC/0/3/CPU0:Feb 4 08:23:16.672: spa_192_jacket[188]: %L2-SPA-5-OIR_INSERTED: SPA discovered in bay 0
LC/0/3/CPU0:Feb 4 08:23:23.349 : spa_192_jacket[188]: %L2-SPA-5-OIR_ERROR: SPA (0): An error occurred (0x1002), error recovery action: reset SPA
LC/0/3/CPU0:Feb 4 08:23:26.431 : spa_192_jacket[188]: %L2-SPA-5-OIR_INSERTED: SPA discovered in bay 0
LC/0/3/CPU0:Feb 4 08:23:32.593 : spa_192_jacket[188]: %L2-SPA-5-OIR_ERROR: SPA (0): Too many retries, error recovery stopped
LC/0/3/CPU0:Feb 4 08:23:32.593 : spa_192_jacket[188]: %L2-SPA-5-OIR_ERROR: SPA (0): An error occurred (0x1002), error recovery action: hold SPA in reset
```

When a SPA is in the failed state, it may not register itself with the FPD upgrade mechanism. In this case, you do not see the SPA listed when you use the `show hw-module fpd` command. To verify the state of a SPA, use the `show hw-module subslot error` command and the `show hw-module subslot status` command.
Performing a SPA FPD Recovery Upgrade

To recover a SPA from the failed state because of a corrupted FPD image, you must manually shut down the SPA. Use the `hw-module subslot subslot-id shutdown` command in XR Config mode to administratively shutdown the SPA. After the SPA is shut down, you can use the `upgrade hw-module fpd` command in mode:

Performing a SIP FPD Recovery Upgrade

If a SIP upgrade fails for whatever reason, do not reload the SIP. Try to perform the upgrade procedure again. You can perform the upgrade procedure multiple times, as long as you do not reload the SIP. The FPD upgrade procedure takes several minutes to complete; do not interrupt the procedure. If you reload the SIP when the FPD image is corrupted, the SIP malfunctions and you must contact Cisco technical support for assistance.

To recover a SIP from the failed state because of a corrupted FPD image, you must contact Cisco technical support.
Performing a SIP FPD Recovery Upgrade