



# Upgrading Field-Programmable Devices

In general terms, *field-programmable devices* (FPDs) are hardware devices implemented on router cards that support separate software upgrades. A *field-programmable gate array* (FPGA) is a type of programmable memory device that exists on most hardware components of the router. The term *FPD* has been introduced to collectively and generically describe any type of programmable hardware device on SIPs and shared port adapters (SPAs), including FPGAs. Cisco IOS XR software provides the Cisco FPD upgrade feature to manage the upgrade of FPD images on SIPs and SPAs.

This chapter describes the information that you must know to verify image versions and to perform an upgrade for SPA or SIP FPD images when incompatibilities arise.

For complete descriptions of the FPD commands listed in this module, refer to the upcoming sections. To locate documentation for other commands that might appear in the course of performing a configuration task, search online in *Cisco ASR 9000 Series Aggregation Services Router Commands Master List*.

**Table 1: Feature History for Upgrading FPD Software on Cisco IOS XR Software**

Release	Modification
Release 3.9.0	Support for FPD upgrades was introduced.
Release 5.3.2	Enhance FPD upgrade and downgrade behavior.
Release 6.3.1	Support for parallel FPD upgrade for power modules.

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# 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.

## 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.

Whenever an image is released that supports SIPs and SPAs, a companion SIP and SPA FPD image is bundled. Generally, the FPD image is not automatically upgraded. You must manually upgrade the FPD image running on the SPA or SIP when you upgrade the Cisco IOS XR software image.

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. An FPGA incompatibility on a SPA does not necessarily affect the running of the SPA interfaces; an FPD incompatibility on a SIP disables all interfaces for all SPAs in the SIP until the incompatibility is addressed.

Use the **show hw-module fpd** command to determine if an FPD upgrade is required. A value of 'Yes' in the Upg/Dng? (upgrade/downgrade) column indicates that an upgrade or downgrade is required.

The NCS 5500 supports upgrades for FPGA devices on its SIPs and SPAs. FPGA and ROMMON software upgrades are part of an FPD image package that corresponds to a Cisco IOS XR software image. SIPs and SPAs support manual upgrades for FPGA devices using the Cisco FPD upgrade feature that is further described in this chapter.



### 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).
- You must not reload any line card or the router before all FPD image upgrades are completed successfully.

## Automatic FPD Upgrade

The following conditions must be met for an Automatic FPD Upgrade to work on a system upgrade:

- FPD package installation envelope (PIE) must be installed on the router.

- FPD PIE must be activated together with the new Cisco IOS XR image.
- The **fpd auto-upgrade** command must be configured in the XR Configuration mode.

The following conditions must be met for an Automatic FPD Upgrade to work on a FRU Insertion or reload:

- The **fpd auto-upgrade** command must be configured in the XR Configuration mode.




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**Note** Although the FPD upgrade is performed during the install operation, there is no install commit performed. Therefore, once the FPD has been upgraded, if the image is rolled back to the original version, the FPD version is not downgraded to the previous version.

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**Note** A message is displayed when router modules cannot get upgraded during automatic FPD upgrade indicating that the FPGA is intentionally skipped during upgrade. To upgrade such FPGAs, you can use the CLI command with a particular location explicitly specified. For example, **upgrade hw-module fpd all location 0/3/1**.

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## Restrictions For Automatic FPD Upgrade

- Newly inserted or reloaded line cards do not reload automatically after a FPD image automatic upgrade, so you must reload the line card manually to use the new FPD image
- By default, the FPD image is not automatically upgraded. You must manually upgrade the FPD image running on the Field Replaceable Unit (FRU) when you upgrade the Cisco IOS XR software image. However, if you enable the **fpd auto-upgrade** command in XR Configuration mode, FPD images are automatically updated when:
  - Software upgrade is carried out.
  - Line cards are added to an existing router or reloaded.
- Automatic FPD Upgrade is not performed when:
  - A non-reload software maintenance upgrade (SMU) or PIE installation is performed, even where the FPD image version changes. Since a non-reload installation is, by definition, not supposed to reload the router, and an FPD upgrade requires a router reload, an Automatic FPD Upgrade is repressed.
- In all cases where the automatic FPD upgrade is not performed, you must perform a manual FPD upgrade using the **upgrade hw-module fpd** command.
- CFP2-DCO Optical modules do not support automatic-FPD upgrade.
- The TimingIC-A and TimingIC-B FPDs upgrades are excluded from the **fpd auto-upgrade** configuration and the user-executed **upgrade hw-module location all** command. The following ASR 9000 5th Generation ASR9000 Line Cards contain FPDs TimingIC-A and TimingIC-B:
  - A99-4HG-FLEX-SE
  - A99-4HG-FLEX-TR

- A9K-8HG-FLEX-SE
- A9K-8HG-FLEX-TR
- A9K-20HG-FLEX-SE
- A9K-20HG-FLEX-TR

To upgrade TimingIC-A and TimingIC-B FPDs, see [Upgrade TimingIC-A and TimingIC-B FPDs](#), on page 9.

## Parallel Power Module Upgrade

Power modules can now be upgraded in parallel on Cisco 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.




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**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.

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To upgrade the power modules in parallel, use **upgrade hw-module location pm-all fpd 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.
- 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:

## Manual Power Module Upgrade

Manual Power modules FPD upgrades are supported on Cisco ASR 9000 Series Routers and should be performed in Admin mode only. This feature lets you perform FPD upgrades on individual Power Entry Modules (PEMs) rather than initiating a [Parallel Power Module Upgrade](#).

Only power modules that support FPD upgrades can be upgraded manually. This includes V3 AC-DC and V2 AC-DC power modules



- Note** Power module upgrades are time consuming and can't be implicitly upgraded or as a part of automatic FPD upgrades. These modules must be upgraded independent of the other fpga upgrades.

To determine which PEMs requires upgrade, use **show hw-module location all fpd**.

PEMs requiring upgrade are in **UPGD SKIP** status.

```
Router#show hw-module location all fpd
```

```
Auto-upgrade:Enabled
```

Location	Card type	HWver	FPD device	ATR Status	FPD Versions	
					Running	Programd
0/PT0	PWR-4.4KW-DC-V3	2.11	<b>PM0-DT-Pri0MCU</b>	UPGD SKIP	3.00	3.00
0/PT0	PWR-4.4KW-DC-V3	2.11	PM0-DT-Pri1MCU	UPGD SKIP	3.00	3.00
0/PT0	PWR-4.4KW-DC-V3	2.11	PM0-DT-Sec054vMCU	UPGD SKIP	3.00	3.00

```

0/PT0      PWR-4.4KW-DC-V3      2.11  PM0-DT-Sec154vMCU      UPGD SKIP  3.00      3.00
0/PT0      PWR-4.4KW-DC-V3      2.11  PM0-DT-Sec5vMCU       UPGD SKIP  3.00      3.00

```

To upgrade the power modules manually, use **[admin] upgrade hw-module location 0/PT<location> fpd <fpd\_device>**.

```

Router# admin
Router# upgrade hw-module location 0/PT0 fpd PM0-DT-Pri0MCU

```

## 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.

### Implementation Considerations

The following limitation must be considered while configuring automatic line card reload on FPD upgrade:

- In Cisco IOS XR 32-bit OS, FPDs that are part of MPAs are not auto upgraded neither on inserting them to a line card nor when the entire line card gets inserted into a chassis.
- In Cisco IOS XR 64-bit OS, FPDs that are part of MPAs are auto upgraded. But the MPA will not be auto reloaded.
- If the FPD upgrade fails on a line card then the automatic line card reload feature (if enabled) stops the LC from reloading.

### 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

```




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

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**Note To manually reload the line card on FPD upgrade**

During FPD upgrade process, ensure to use **hw-module location node-id reload** command in EXEC or administration EXEC mode at the end of the upgrade procedure. This cause the selected card(s) to perform a complete hardware reload, which is required for some FPDs.

## FPD upgrade service

The main tasks of the FPD upgrade service are:

- Check FPD image version to decide if a specific firmware image needs an upgrade or not.
- 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

Method	Remarks
Manual Upgrade	Upgrade using CLI, force upgrade supported.

## 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.

### Example

```
Router: #show hw - module fpd
```

```
Wed Dec 14 07:08:08.424 UTC
```

```
Auto-upgrade:Disabled
```

Location	Card type	HWver	FPD device	ATR Status	FPD Versions	
					Running	Programd
0/0	NC55-18H18F	1.0	MIFPGA	<b>NEED UPGD</b>	7.01	7.01
0/0	NC55-18H18F	1.0	Bootloader	CURRENT	1.14	1.14
0/0	NC55-18H18F	1.0	IOFPGA	CURRENT	0.07	0.07
0/0	NC55-18H18F	1.0	SATA-M600-MCT	CURRENT	0.23	0.23

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 back 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 FPGA in a card can be upgraded. If reload is required to activate FPD, the upgrade should be complete. 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 upgrades

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.



### Note

- Sometimes, FPDs can have primary and backup images.
- Force FPD upgrade with **upgrade hw-module location all fpd all force** command affects forwarding over BVI interface. You must reload involved locations to recover.
- The use of the **force** option when performing an FPD upgrade is not recommended except under explicit direction from Cisco engineering or TAC for a one-time purpose only.
- FPD upgrade should be performed in Admin mode only.
- A new FPD upgrade should be issued only when previous FPD upgrades have been completed on the same FPD with the following syslog message:

```
RP/0/RP0/CPU0:May 10 10:11:44.414 UTC: fpd-serv[205]: %INFRA-FPD_Manager-1-UPGRADE_ALERT
: FPD Upgrade Completed (use "show hw-module fpd" to check upgrade status)
```



## Upgrade TimingIC-A and TimingIC-B FPDs

Perform the following steps to upgrade timing IC-A and Timing IC-B FPDs:

- Upgrade Timing IC-A FPD.

```
Router#upgrade hw-module location 0/[slot-number] fpd TimingIC-A
```

- Upgrade TimingIC-B FPD.

```
Router#upgrade hw-module location 0/[slot-number] fpd TimingIC-B
```

- Run the new XR using the **install commit** command, if you're performing this manual FPD upgrade.

```
Router(admin)#install commit
```

If you don't perform the install commit of the new XR, the LC reinstalls itself with this new XR again which could take 30 minutes.

- Reload the 5th Generation ASR9000 Line Card.

```
Router#admin
sysadmin-vm:0_RP0#hw-module location 0/[slot-number] reload
```

## YANG Data Model for Field Programmable Device

Table 2: Feature History Table

Feature Name	Release Information	Description
Unified Model for FPD: Cisco-IOS-XR-um-fpd-cfg	Release 7.7.1	We have introduced the Cisco-IOS-XR-um-fpd-cfg unified model to enable or disable the automatic reload and automatic upgrade of Field Programmable Devices.  You can access this unified model from the <a href="#">Github</a> repository.

YANG is a data modeling language that helps to create configurations, retrieve operational data and execute actions. The router acts on the data definition when these operations are requested using NETCONF RPCs. The data model handles the following types of requirements on the routers for FPD:

Operational Data	Native Data Model	CLI Commands
<b>Auto Upgrade:</b> Enabling or disabling of automatic upgrade of FPD.	Cisco-IOS-XR-fpd-infra-cfg.yang	<ul style="list-style-type: none"> <li>• <b>fpd auto-upgrade enable</b></li> <li>• <b>fpd auto-upgrade disable</b></li> </ul>
<b>Auto Reload:</b> Enabling or disabling of automatic reload of FPD.	Cisco-IOS-XR-fpd-infra-cfg.yang	<ul style="list-style-type: none"> <li>• <b>fpd auto-reload enable</b></li> <li>• <b>fpd auto-reload disable</b></li> </ul>

You can access the data models from the [Github](#) repository. To learn more about the data models and put them to use, see the *Programmability Configuration Guide for Cisco ASR 9000 Series Routers*.

## 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:

- Migrate the software to a later Cisco IOS XR software release.
- Swap line cards from a system running a different Cisco IOS XR software release.
- Insert a new line card.

In the event of an FPD incompatibility with your card, you might receive the following error message:

```
LC/0/0/CPU0:Jul 5 03:00:18.929 UTC: optics_driver[220]: %L2-OPTICS-3-BAD_FPGA_IMAGE :
Detected bad MI FPGA image programmed in MI FPGA SPI flash in 0/0/CPU0 location: Failed to
validate meta data CRC
LC/0/0/CPU0:Jul 5 03:00:19.019 UTC: optics_driver[220]: %L2-OPTICS-3-BACKUP_FPGA_LOADED :
Detected Backup FPGA image running on 0/0/CPU0 - primary image corrupted (@0x8c = 0x44)
RP/0/RP0/CPU0:Jul 5 03:00:48.987 UTC: fpd-serv[301]: %PKT_INFRA-FM-3-FAULT_MAJOR : ALARM_MAJOR
: FPD-NEED-UPGRADE :DECLARE :0/0:
```

Upgrades to the Cisco IOS XR software might result in an FPD incompatibility. Ensure that you perform the FPD upgrade procedure and resolve all incompatibilities, for the cards to function properly.




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

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### 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 reload the card, you can use the **hw-module location <location> reload** command in Admin mode, during the 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.

## Procedure

	Command or Action	Purpose
<b>Step 1</b>	<p><b>show hw-module fpd location</b> {all   node-id}</p> <p><b>Example:</b></p> <pre>RP/0/RSP0/CPU0:router# show hw-module fpd location all  or  RP/0/RSP0/CPU0:router# show hw-module fpd location 0/4/cpu0</pre>	<p>Displays the current FPD image versions for the specified card or all cards installed in the router. Use this command to determine if you must upgrade the FPD image on your card.</p>
<b>Step 2</b>	<p><b>admin</b></p> <p><b>Example:</b></p> <pre>RP/0/RSP0/CPU0:router# admin</pre>	<p>Enters administration EXEC mode.</p>
<b>Step 3</b>	<p>(Optional) <b>show fpd package</b></p> <p><b>Example:</b></p> <pre>RP/0/RSP0/CPU0:router(admin)# show fpd package</pre>	<p>Displays which cards are supported with your current Cisco IOS XR software release, which FPD image you need for each card, and what the minimum hardware requirements are for the various modules. (A minimum hardware requirement version of 0.0 indicates that all hardware can support this FPD image version.)</p> <p>If there are multiple FPD images for your card, use this command to determine which FPD image to use if you want to upgrade only a specific FPD type.</p>
<b>Step 4</b>	<p><b>upgrade hw-module fpd</b> {all   fpga-type} [force] location [all   node-id]</p> <p><b>Example:</b></p> <pre>RP/0/RSP0/CPU0:router(admin)# upgrade hw-module fpd all location 0/3/1 . . . Successfully upgraded 1 FPD for SPA-2XOC48POS/RPR  on location 0/3/1  RP/0/RP0/CPU0:V3_DC_MT(admin)# upgrade hw-module fpd all location all RP/0/RP0/CPU0:May 14 22:06:38.715 : upgrade_fpd_cli[65878]: %PLATFORM-UPGRADE_FPD-6-STATUS_UPG_LOC_ALL_OPT : pm fpga1 instance 14 on location 0/RP0/CPU0 was intentionally skipped during upgrade using location all option</pre>	<p>Upgrades all the current FPD images that must be upgraded on the specified card with new images.</p> <p>Before continuing to the next step, wait for confirmation that the FPD upgrade has successfully completed. Status messages, similar to these, are displayed to the screen until the FPD upgrade is completed:</p> <pre>FPD upgrade started. FPD upgrade in progress.. FPD upgrade in progress.. FPD upgrade sent to location xxxx FPD upgrade sent to location yyyy FPD upgrade in progress.. FPD upgrade finished for location xxx FPD upgrade in progress.. FPD upgrade finished for location yyyy FPD upgrade completed.</pre> <p>The “FPD upgrade in progress.” message is printed every minute. These logs are information logs, and as such, are displayed if the <b>logging console informational</b> command is configured.</p>

	Command or Action	Purpose
		<p>If Ctrl-C is pressed while the FPD upgrade is in progress, the following warning message is displayed:</p> <pre> FPD upgrade in progress on some hardware, aborting now is not recommended as it might cause HW programming failure and result in RMA of the hardware. Do you want to continue? [Confirm(y/n)] </pre> <p>If you confirm that you want to abort the FPD upgrade procedure, this message is displayed:</p> <pre> FPD upgrade process has been aborted, please check the status of the hardware and reissue the upgrade command if required. </pre> <p><b>Note</b></p> <ul style="list-style-type: none"> <li>• If your card supports multiple FPD images, you can use the <b>show fpd package</b> admin command to determine what specific image to upgrade in the <b>upgrade hw-module fpd</b> command.</li> <li>• A message is displayed when router modules cannot get upgraded during upgrade with <b>location all</b> option indicating that the FPGA is intentionally skipped during upgrade. To upgrade such FPGAs, you can use the CLI command with a particular location explicitly specified. For example, <b>upgrade hw-module fpd all location 0/3/1</b>.</li> <li>• It is recommended to upgrade all FPGAs on a given node using the <b>upgrade hw-module fpd all location {all   node-id}</b> command. Do not upgrade the FPGA on a node using the <b>upgrade hw-module fpd &lt;individual-fpd&gt; location {all   node-id}</b> as it may cause errors in booting the card.</li> </ul>
<b>Step 5</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>sysadmin-vm:0_RP0# exit</pre>	
<b>Step 6</b>	<p><b>hw-module location { node-id   all } reload</b></p>	<p>Use the <b>hw-module location reload</b> command to reload a line card.</p> <pre>sysadmin-vm:0_RP0# hw-module location 0/3 reload</pre>
<b>Step 7</b>	<p><b>exit</b></p>	

	Command or Action	Purpose
Step 8	<code>show hw-module fpd</code>	Verifies that the FPD image on the card has been successfully upgraded by displaying the status of all FPDs in the system.

## Configuration Examples for FPD Image Upgrade

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

### show hw-module fpd Command Output: Example

Use the `show hw-module fpd` to display the current version of FPD images on the SPAs, SIPs and other cards installed on your router.

This command can be used to identify information about FPDs on any card. If you enter the location of a line card that is not a SPA, the output displays information about any programmable devices on that line card.

The following example shows how to display FPD compatibility for all modules in the router:

```
RP/0/RSP0/CPU0:router# ios#show hw-module fpd
Tue Jan 22 13:56:55.082 UTC
```

Location	Card type	HWver	FPD device	ATR Status	FPD Versions	
					Running	Programd
0/RP0	NCS-55A2-MOD-S	0.3	MB-MIFPGA	CURRENT	0.19	0.19
0/RP0	NCS-55A2-MOD-S	0.3	Bootloader	CURRENT	1.10	1.10
0/RP0	NCS-55A2-MOD-S	0.3	CPU-IOFPGA	CURRENT	1.18	1.18
0/RP0	NCS-55A2-MOD-S	0.3	MB-IOFPGA	CURRENT	0.18	0.18
0/PM0	NC55-1200W-ACFW	1.0	LIT-PrimCU-ACFW	NEED UPGD	2.08	2.08
0/PM1	NC55-1200W-ACFW	1.0	LIT-PrimCU-ACFW	NEED UPGD	2.08	2.08

```
RP/0/RP0/CPU0:ios#.
```



**Note** After Release 5.3.x, Upg/Dng? will display Yes only for upgrade.

The following example shows the FPD for which upgrade will be skipped.

```
RP/0/RP0/CPU0:router# show hw-module fpd location all
```

```
===== Existing Field Programmable Devices =====
=====
```

Location	Card Type	HW			Inst	Current SW Version	Upg/Dng?
		Version	Type	Subtype			
0/SM1/SP	140G-4-S1S2S3	0.1	1c	rommonA	0	2.08	Yes
			1c	rommon	0	2.08	Yes
			1c	fpqal	0	6.04^	No

## show hw-module fpd Command Output: Example

```

-----
lc fpga2 0 4.01 No
-----
NOTES:
1. ^ One or more FPD will be intentionally skipped from upgrade using CLI with option "all"
   or during "Auto fpd".
   It can be upgraded only using the "admin> upgrade hw-module fpd <fpd> location <loc>"
   CLI with exact location.

RP/0/RSP1/CPU0:router# show hw-module fpd location all

Mon Jun 29 05:38:50.332 PST

===== Existing Field Programmable Devices =====
Location      Card Type      HW Version  Type  Subtype  Inst  Current SW Upg/
=====
0/RSP0/CPU0   A9K-RSP-4G     4.8        lc   fpga3    0     1.13      No
              lc   fpga1    0     1.5       No
              lc   fpga2    0     1.14      No
              lc   cbc      0     1.2       No
              lc   fpga4    0     1.6       No
              lc   rommon   0     1.0       No
-----
0/RSP0/CPU0   ASR-9010-FAN   1.0        lc   cbc      1     4.0       No
-----
0/RSP0/CPU0   ASR-9010-FAN   1.0        lc   cbc      2     4.0       No
-----
0/1/CPU0      A9K-40GE-B     1.0        lc   fpga1    0     0.38      No
              lc   fpga2    0     0.8       No
              lc   cbc      0     2.2       No
              lc   cpld1    0     0.15      No
              lc   rommon   0     1.0       No
-----
0/1/CPU0      A9K-40GE-B     1.0        lc   fpga1    1     0.38      No
-----
0/4/CPU0      A9K-8T/4-B     1.0        lc   fpga1    0     0.38      No
              lc   fpga2    0     0.10      No
              lc   cbc      0     2.2       No
              lc   cpld2    0     0.7       No
              lc   cpld1    0     0.15      No
              lc   cpld3    0     0.3       No
              lc   rommon   0     1.0       No
              lc   fpga3    0     14.42     No
-----
0/4/CPU0      A9K-8T/4-B     1.0        lc   fpga1    1     0.38      No
-----
0/6/CPU0      A9K-4T-B       1.0        lc   fpga1    0     0.38      No
              lc   fpga2    0     0.10      No
              lc   cbc      0     2.2       No
              lc   cpld2    0     0.7       No
              lc   cpld1    0     0.15      No
              lc   cpld3    0     0.3       No
              lc   rommon   0     1.0       No
              lc   fpga3    0     14.42     No
-----
0/6/CPU0      A9K-4T-B       1.0        lc   fpga1    1     0.38      No
-----

```

The following example shows how to display FPD compatibility for a specific module in the router:

Table 3: show hw-module fpd Field Descriptions

Field	Description
Location	Location of the module in the <i>rack/slot/module</i> notation.
Card Type	Module part number.
HW Version	Hardware model version for the module.
Type	Hardware type. Can be one of the following types: <ul style="list-style-type: none"> <li>• spa—Shared port adapter</li> <li>• lc—Line card</li> </ul>
Subtype	FPD type. Can be one of the following types: <ul style="list-style-type: none"> <li>• fabldr—Fabric downloader</li> <li>• fpga1—Field-programmable gate array</li> <li>• fpga2—Field-programmable gate array 2</li> <li>• fpga3—Field-programmable gate array 3</li> <li>• fpga4—Field-programmable gate array 4</li> <li>• fpga5—Field-programmable gate array 5</li> <li>• rommonA—Read-only memory monitor A</li> <li>• rommon—Read-only memory monitor B</li> </ul>
Inst	FPD instance. The FPD instance uniquely identifies an FPD and is used by the FPD process to register an FPD.
Current SW Version	Currently running FPD image version.
Upg/Dng?	Specifies whether an FPD upgrade or downgrade is required. A downgrade is required in rare cases when the version of the FPD image has a higher major revision than the version of the FPD image in the current Cisco IOS XR software package.

## show fpd package Command Output: Example

Use the **show fpd package** command in administration EXECAdmin EXEC mode mode to find out which line cards are supported with your current Cisco IOS XR software release, which FPD image package you need for each line card, 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.



**Note** The FPD name used in the FPD Description column of the output of the `show fpd package` command displays `QDD_instance_port-number`. For example, depending on the instance and the port number, the FPD names for the QDD-400G-ZR-S and QDD-400G-ZRP-S modules will be `QDD_0_3`, `QDD_1_0`, and so on.



**Note** In case of Cisco ASR 9903 routers, the output of the `show fpd package` command displays `QDD_bay_port-number`. For example, depending on the bay and the port number, the FPD names for the QDD-400G-ZR-S and QDD-400G-ZRP-S modules will be `QDD_0_3`, `QDD_0_4`, and so on.

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

```
show fpd package
Tue Jan 22 13:56:00.212 UTC

=====
                          Field Programmable Device Package
=====
Card Type                FPD Description                Req   SW   Min Req  Min Req
                          Reload  Ver   SW Ver  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
                          MPAFPGA                       YES    0.53  0.53    0.0
                          WDM-DE-1HL_DCO_2             NO    38.518 38.518  0.1
                          WDM-DS-1HL_DCO_2             NO    38.268 38.268  0.1
-----
NC55-MPA-2TH-HX-S        -WDM-D-1HL_DCO_0             NO    38.518 38.518  0.1
                          -WDM-D-1HL_DCO_1             NO    38.518 38.518  0.1
                          MPAFPGA                       YES    0.53  0.53    0.0
                          WDM-DE-1HL_DCO_0             NO    38.518 38.518  0.1
                          WDM-DE-1HL_DCO_1             NO    38.518 38.518  0.1
                          WDM-DS-1HL_DCO_0             NO    38.268 38.268  0.1
                          WDM-DS-1HL_DCO_1             NO    38.268 38.268  0.1
-----
NC55-MPA-2TH-S           -WDM-D-1HL_DCO_0             NO    38.518 38.518  0.1
                          -WDM-D-1HL_DCO_1             NO    38.518 38.518  0.1
                          MPAFPGA                       YES    0.53  0.53    0.0
                          WDM-DE-1HL_DCO_0             NO    38.518 38.518  0.1
                          WDM-DE-1HL_DCO_1             NO    38.518 38.518  0.1
                          WDM-DS-1HL_DCO_0             NO    38.268 38.268  0.1
                          WDM-DS-1HL_DCO_1             NO    38.268 38.268  0.1
-----
NC55-MPA-4H-HD-S         MPAFPGA                        YES    0.53  0.53    0.0
-----
NC55-MPA-4H-HX-S         MPAFPGA                        YES    0.53  0.53    0.0
-----
NC55-MPA-4H-S            MPAFPGA                        YES    0.53  0.53    0.0
-----
```



```

-----
NCS55A2-MOD-SE-H-S  Bootloader (A)      YES      1.11    1.11    0.0
                    CPU-IOFPGA (A)     YES      1.18    1.18    0.1
                    MB-IOFPGA (A)     YES      0.18    0.18    0.1
                    MB-MIFPGA        YES      0.19    0.19    0.0
                    SATA (A)         NO       5.00    5.00    0.0
-----
NCS-55A2-MOD-HD-S   Bootloader (A)      YES      1.11    1.11    0.0
                    CPU-IOFPGA (A)     YES      1.18    1.18    0.1
                    MB-IOFPGA (A)     YES      0.18    0.18    0.1
                    MB-MIFPGA        YES      0.19    0.19    0.0
                    SATA (A)         NO       5.00    5.00    0.0
-----
NCS-55A2-MOD-HX-S   Bootloader (A)      YES      1.11    1.11    0.0
                    CPU-IOFPGA (A)     YES      1.18    1.18    0.1
                    MB-IOFPGA (A)     YES      0.18    0.18    0.1
                    MB-MIFPGA        YES      0.19    0.19    0.0
                    SATA (A)         NO       5.00    5.00    0.0
-----
NCS-55A2-MOD-S      Bootloader (A)      YES      1.11    1.11    0.0
                    CPU-IOFPGA (A)     YES      1.18    1.18    0.1
                    MB-IOFPGA (A)     YES      0.18    0.18    0.1
                    MB-MIFPGA        YES      0.19    0.19    0.0
                    SATA (A)         NO       5.00    5.00    0.0
-----
NCS-55A2-MOD-SE-S   Bootloader (A)      YES      1.11    1.11    0.0
                    CPU-IOFPGA (A)     YES      1.18    1.18    0.1
                    MB-IOFPGA (A)     YES      0.18    0.18    0.1
                    MB-MIFPGA        YES      0.19    0.19    0.0
                    SATA (A)         NO       5.00    5.00    0.0
                    STATSFPGA        YES      0.01    0.01    0.0

```

This table describes the significant fields shown in the display:

**Table 4: show fpd package Field Descriptions**

Field	Description
Card Type	Module part number.
FPD Description	Description of all FPD images available for the line card.
Type	Hardware type. Possible types can be: <ul style="list-style-type: none"> <li>• spa—Shared port adapter</li> <li>• lc—Line card</li> </ul>
Subtype	FPD subtype. These values are used in the <b>upgrade hw-module fpd</b> command to indicate a specific FPD image type to upgrade.
SW Version	FPD software version recommended for the associated module running the current Cisco IOS XR software.
Min Req SW Vers	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.

Field	Description
Min Req HW Vers	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.



**Note** In the **show fpd package** command output, the “subtype” column shows the FPDs that correspond with each line card image. To upgrade a specific FPD with the **upgrade hw-module fpd** command, replace the *fpga-type* argument with the appropriate FPD from the “subtype” column, as shown in the following example:

```
RP/0/RSP0/CPU0:router(admin)# upgrade hw-module fpd fpga2 location 0/3/1 reload
```

## upgrade hw-module fpd Command Output: Example

Use the **upgrade hw-module fpd** command to upgrade the FPD image on a line card. The upgrade can be executed for all FPDs or for specific FPDs that need an upgrade. To upgrade all FPDs, use **upgrade hw-module fpd all location all** command. To upgrade a specific FPD image type, use the FPD subtype value in the **upgrade hw-module fpd** command.

```
RP/0/RSP0/CPU0:router# admin
RP/0/RSP0/CPU0:router(admin)# upgrade hw-module fpd fpga location 0/1/cpu0

Mon Jan 12 05:44:37.611 PST

% RELOAD REMINDER: - The upgrade operation of the target module will not interrupt its
normal
operation. However, for the changes to take effect, the target module
will need to be manually reloaded after the upgrade operation. This can
be accomplished with the use of "hw-module <target> reload" command.
- If automatic reload operation is desired after the upgrade, please use
the "reload" option at the end of the upgrade command.
- The output of "show hw-module fpd location" command will not display
correct version information after the upgrade if the target module is
not reloaded.
Continue? [confirm] y

Starting the upgrade/download of following FPD:

=====
Location      Type Subtype Upg/Dng   Current   Upg/Dng
            Type Subtype Upg/Dng   Version   Version
=====
0/1/CPU0     lc  fpga   upg      0.40      0.40
-----

LC/0/1/CPU0:Jan 12 05:44:43.700 : lc_fpd_upgrade[192]: %PLATFORM-UPGRADE_FPD-6-START :
Starting to upgrade fpga subtype image from 0.4 to 0.4 for for this card on location
0/1/CPU0
LC/0/1/CPU0:Jan 12 05:44:42.990 : fabricq_mgr[152]: EES:Internal clock detect IDLE
period(-106461) more than threshold(1200000)
LC/0/1/CPU0:Jan 12 05:44:42.990 : ingressq[179]: EES:Internal clock detect IDLE
period(-106461) more than threshold(1200000)
LC/0/1/CPU0:Jan 12 05:45:09.240 : fabricq_mgr[152]: EES:Internal clock detect IDLE
```

```

period(-105945) more than threshold(1200000)
LC/0/1/CPU0:Jan 12 05:45:09.241 : ingressq[179]: EES:Internal clock detect IDLE
period(-105944) more than threshold(1200000)
SP/0/1/SP:Jan 12 05:45:16.020 : upgrade_daemon[280]: ...programming...
SP/0/1/SP:Jan 12 05:45:16.034 : upgrade_daemon[280]: ...it will take a while...
SP/0/1/SP:Jan 12 05:45:16.053 : upgrade_daemon[280]: ...it will take a while...
SP/0/1/SP:Jan 12 05:47:42.967 : upgrade_daemon[280]: ...programming...
SP/0/1/SP:Jan 12 05:47:42.981 : upgrade_daemon[280]: ...it will take a while...

% SLC/0/1/CPU0:Jan 12 05:48:08.737 : lc_fpd_upgrade[192]: %PLATFORM-UPGRADE_FPD-6-PASSED :

Successfully upgrade fpga subtype image for for this card on location 0/1/CPU0

```

## show platform Command Output: Example

Use the **show platform** command to verify that the line card 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 Global Configuration mode to administratively shutdown the SPA. After the SPA is shut down, you can use the **upgrade hw-module fpd** command in administration EXEC mode:

```
RP/0/RSP0/CPU0:router# admin
```

```
RP/0/RSP0/CPU0:router(admin)# upgrade hw-module fpd fpga location 0/3/0
```

## 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.

To recover a SIP from the failed state because of a corrupted FPD image, you must turn off the automatic reset of the SIP card. Use the **hw-module reset auto disable** command in administration configuration mode, as shown in the following example:

```
RP/0/RSP0/CPU0:router(admin-config)# hw-module reset auto disable location 0/1/4
```