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, on page 1
- Overview of FPD Image Upgrade Support, on page 1
- FPD upgrade service, on page 2

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 Downgrade of FPDs is not recommended.

Note FPD auto upgrade is not supported on this router.

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.
- 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

Method	Remarks
Manual Upgrade	Upgrade using CLI, force upgrade supported.
Auto Upgrade	Upgrade using install SMU activation or during image upgrade. User can enable/disable auto upgrade feature.

Important FPD auto upgrade is not supported on this router in releases before Cisco IOS XR Release 7.3.2.

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
                                                                          FPD Versions
                                                                          ==============
Location   Card type             HWver FPD device       ATR Status     Running   Programd
-------------------------------------------------------------------------------------------

0/0        NC55-18H18F           1.0   MIFPGA               NEED UPGD   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.

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. Interface module (IMs) and RSPs 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. However, the **force** option must be used cautiously and only to recover a component from a failed upgrade.

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)
```

How to Upgrade FPD Images

- Migrate the software to a later Cisco IOS XR software release.
- Swap IMs or RSPs from a system running a different Cisco IOS XR software release.
- Insert a new IM or RSP.

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.

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.

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.

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 IMs and RSPs are supported with your current Cisco IOS XR software release, which FPD image package you need for each IM or RSP, 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 a sample output from the **show fpd package** command:

```
sysadmin_vm:0_RP0# show fpd package
Fri Oct 16 07:20:50.021 UTC

================================ ============================================
                                        Field Programmable Device Package
                                 ============================================
                                              Req     SW      Min Req   Min Req
Card Type            FPD Description          Reload  Ver     SW Ver  Board Ver
================== ======================== ====== ======= ======== =========
--------------------------------------------------------------------------------
A900-IMA8CS1Z-CC     IMFPGA                    YES     1.96    1.96    0.0
```

A900-IMA8CS1Z-M	IMFPGA	YES	1.96	1.96	0.0
A900-IMA8Z	IMFPGA	YES	17.05	17.05	0.0
A900-IMA8Z-CC	IMFPGA	YES	17.05	17.05	0.0
A900-IMA8Z-L	IMFPGA	YES	1.45	1.45	0.0
A900-PWR1200-A	DCA-PriMCU(A)	NO	0.11	0.11	0.0
	DCA-SecMCU(A)	NO	1.04	1.04	0.0
A900-PWR1200-D	LIT-PriMCU(A)	NO	2.04	0.04	0.0
	LIT-SecMCU(A)	NO	1.23	1.23	0.0
A907-FAN-E	PSOC(A)	NO	1.65	1.65	0.0
	PSOC(A)	NO	1.66	1.66	0.4
N560-4-FAN-H	PSOC(A)	NO	177.02	177.02	0.0
N560-4-FAN-H-CC	PSOC(A)	NO	177.02	177.02	0.0
N560-4-PWR-FAN	PSOC(A)	NO	177.08	177.08	0.0
N560-4-PWR-FAN-CC	PSOC(A)	NO	177.08	177.08	0.0
N560-4-RSP4	ADM(A)	NO	1.06	1.06	0.0
	IOFPGA(A)	YES	0.64	0.64	0.0
	PRIMARY-BIOS(A)	YES	0.17	0.17	0.0
	SATA(A)	YES	2.10	2.10	0.0
N560-4-RSP4-CC	ADM(A)	NO	1.06	1.06	0.0
	IOFPGA(A)	YES	0.64	0.64	0.0
	PRIMARY-BIOS(A)	YES	0.17	0.17	0.0
	SATA(A)	YES	2.10	2.10	0.0
N560-4-RSP4E	ADM(A)	NO	1.06	1.06	0.0
	IOFPGA(A)	YES	0.64	0.64	0.0
	PRIMARY-BIOS(A)	YES	0.17	0.17	0.0
	SATA(A)	YES	2.10	2.10	0.0
N560-4-RSP4E-CC	ADM(A)	NO	1.06	1.06	0.0
	IOFPGA(A)	YES	0.64	0.64	0.0
	PRIMARY-BIOS(A)	YES	0.17	0.17	0.0
	SATA(A)	YES	2.10	2.10	0.0
N560-FAN-H	PSOC(A)	NO	2.02	2.02	0.0
N560-IMA-8Q/4L	IMFPGA	YES	1.08	1.08	0.0
N560-IMA1W	CFP2-D-DCO	NO	38.273	38.273	0.0
	CFP2-DE-DCO	NO	38.273	38.273	0.0
	CFP2-DET-DCO	NO	38.273	38.273	0.0
	CFP2-DETS-DCO	NO	38.273	38.273	0.0
	CFP2-DS-DCO	NO	38.273	38.273	0.0
	CFP2-DS100-DCO	NO	38.273	38.273	0.0
	IMFPGA	YES	1.24	1.24	0.0
N560-IMA2C-CC	IMFPGA	YES	5.04	5.04	0.0
N560-PWR1200-D-E	QCS-PriMCU(A)	NO	1.82	1.82	0.0
	QCS-SecMCU(A)	NO	1.84	1.84	0.0
N560-RSP4	ADM(A)	NO	1.06	1.06	0.0

```
                    IOFPGA(A)                 YES     0.64    0.64    0.0
                    PRIMARY-BIOS(A)           YES     0.17    0.17    0.0
                    SATA(A)                   YES     2.10    2.10    0.0
--------------------------------------------------------------------------------
N560-RSP4-E         ADM(A)                    NO      1.06    1.06    0.0
                    IOFPGA(A)                 YES     0.64    0.64    0.0
                    PRIMARY-BIOS(A)           YES     0.17    0.17    0.0
                    SATA(A)                   YES     2.10    2.10    0.0
--------------------------------------------------------------------------------
NCS560-IMA2C        IMFPGA                    YES     5.04    5.04    0.0
--------------------------------------------------------------------------------
NCS560-IMA2C-DD     IMFPGA                    YES     1.24    1.24    0.0
--------------------------------------------------------------------------------
NCS560-IMA2C-L      IMFPGA                    YES     1.24    1.24    0.0
```

upgrade hw-module fpd Command Output: Example

Use the **upgrade hw-module fpd** command to upgrade the FPD image. 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/RP0/CPU0:ios# upgrade hw-module location 0/RP0 fpd ADM
Wed Oct 28 07:46:49.805 UTC
upgrade command issued (use "show hw-module fpd" to check upgrade status)
RP/0/RP0/CPU0:ios#RP/0/RP0/CPU0:Oct 28 07:46:51.949 UTC: optics_driver[222]:
%PKT_INFRA-FM-2-FAULT_CRITICAL : ALARM_CRITICAL :OPTICS RX POWER LANE-0 LOW ALARM :CLEAR :
 Optics0/11/0/1:  Optics0/11/0/1
0/RP0/ADMIN0:Oct 28 07:46:54.154 UTC: fpdserv[4899]: %INFRA-FPD_Manager-1-UPGRADE_ALERT :
Upgrade for the following FPDs has been committed:
0/RP0/ADMIN0:Oct 28 07:46:54.154 UTC: fpdserv[4899]: %INFRA-FPD_Manager-1-UPGRADE_ALERT :
Location           FPD name             Force
0/RP0/ADMIN0:Oct 28 07:46:54.154 UTC: fpdserv[4899]: %INFRA-FPD_Manager-1-UPGRADE_ALERT :
================================================
0/RP0/ADMIN0:Oct 28 07:46:54.154 UTC: fpdserv[4899]: %INFRA-FPD_Manager-1-UPGRADE_ALERT :
0/RP0              ADM                  FALSE
0/RP0/ADMIN0:Oct 28 07:46:59.203 UTC: control_driver[3690]: %INFRA-FPD_Driver-6-UPGRADE_RESULT
 : Upgrade completes 20 percent for fpd ADM@location 0/RP0.
RP/0/RP0/CPU0:ios#0/RP0/ADMIN0:Oct 28 07:47:09.204 UTC: control_driver[3690]:
%INFRA-FPD_Driver-6-UPGRADE_RESULT : Upgrade completes 70 percent for fpd ADM@location
0/RP0.
0/RP0/ADMIN0:Oct 28 07:47:10.854 UTC: control_driver[3690]: %INFRA-FPD_Driver-1-UPGRADE_ALERT
 : FPD ADM@0/RP0 image programming completed with UPGRADE DONE state Info: [image 1.05 to
1.06 version]
0/RP0/ADMIN0:Oct 28 07:47:10.855 UTC: control_driver[3690]: %INFRA-FPD_Driver-1-UPGRADE_ALERT
 : FPD ADM @location 0/RP0 FPD upgraded and activated!
0/RP0/ADMIN0:Oct 28 07:47:10.857 UTC: shelf_mgr[3705]: %INFRA-SHELF_MGR-6-CARD_SW_OPERATIONAL
 : Card: 0/RP0 software state going to Operational
0/RP0/ADMIN0:Oct 28 07:47:10.857 UTC: shelf_mgr[3705]: %INFRA-SHELF_MGR-6-CARD_HW_OPERATIONAL
 : Card: 0/RP0 hardware state going to Operational
RP/0/RP0/CPU0:Oct 28 07:47:17.931 UTC: fpd-serv[393]: %INFRA-FPD_Manager-1-UPGRADE_ALERT :
  FPD Upgrade Completed(use "show hw-module fpd" to check upgrade status)
0/RP0/ADMIN0:Oct 28 07:47:19.155 UTC: fpdserv[4899]: %INFRA-FPD_Manager-1-UPGRADE_ALERT :
 FPD Upgrade Completed(use "show hw-module fpd" to check upgrade status)
RP/0/RP0/CPU0:ios#
```

show platform Command Output: Example

Use the **show platform** command to verify that the IM is up and running.

```
RP/0/RP1/CPU0:router# show platform
Tue Oct 20 04:42:31.936 UTC
Node              Type                       State            Config state
```

```
--------------------------------------------------------------------------------
0/0/CPU0          A900-IMA8CS1Z-M            OPERATIONAL       NSHUT
0/1/CPU0          A900-IMA8CS1Z-M            OPERATIONAL       NSHUT
0/2/CPU0          A900-IMA8CS1Z-M            OPERATIONAL       NSHUT
0/4/CPU0          A900-IMA8Z-L               OPERATIONAL       NSHUT
0/5/CPU0          A900-IMA8Z-L               OPERATIONAL       NSHUT
0/7/CPU0          N560-IMA1W                 OPERATIONAL       NSHUT
0/9/CPU0          N560-IMA2C-DD              OPERATIONAL       NSHUT
0/10/CPU0         A900-IMA8Z                 OPERATIONAL       NSHUT
0/11/CPU0         A900-IMA8Z-L               OPERATIONAL       NSHUT
0/RP0/CPU0        N560-RSP4-E(Standby)       UNKNOWN           NSHUT
0/RP1/CPU0        N560-RSP4-E(Active)        IOS XR RUN        NSHUT
0/FT0/CPU0        N560-FAN-H                 OPERATIONAL       NSHUT
0/PM2/CPU0        A900-PWR1200-A             OPERATIONAL       NSHUT
```

Auto FPD Upgrade

Table 1: Feature History Table

Feature Name	Release Information	Feature Description
Auto FPD Upgrade	Release 7.3.2	This functionality enables automatic upgrade and reload for field-programmable devices (FPDs) whenever the Cisco IOS XR image has a newer FPD version. This functionality upgrades all route processors and line card FPDs simultaneously while displaying upgrade triggers on the console.

Effective Cisco IOS XR Release 7.3.2, you can enable automatic upgrade of FPD by using the "fpd auto-upgrade enable" command.

Note Automatic upgrade of FPD is not supported in Cisco IOS XR Release 7.4.1.

To automatically upgrade all FPDs, use:

```
RP/0/RP0/CPU0:IOS(config)#fpd auto-upgrade enable
```

To reload the interface modules following the fpd auto-upgrade, use:

```
RP/0/RP0/CPU0:IOS(config)#fpd auto-reload enable
```

Limitations and Usage Guidelines

Limitations

- FPD auto-upgrade should be enabled only in the XR VM and *not* in the System Admin VM.
- With auto-upgrade enabled, if any card is in RELOAD REQUIRED state, auto-upgrade is re-triggered during any SSO or FPD-serv process restart.
- When an interface module (IM) or route processor (RP) is in RELOAD REQUIRED state and auto-upgrade is enabled, FPD upgrades are triggered again.

- With auto-upgrade enabled, if line card is inserted, an auto-upgrade is triggered. During this phase optics alarms are generated. If auto-reload is not enabled, you must reload the line cards manually to clear these alarms.
- SATA allows you to upgrade or downgrade when an FPD version change is available. Therefore, when auto-upgrade is enabled, the system automatically downgrades if lower versions are available. This behavior is specific only to SATA FPDs.
- FPD auto-reload is applicable for line cards only. Line cards are automatically reloaded after the fpd auto-upgrade process is completed.
- You must disable auto-upgrade during XR ISSU; otherwise, the router goes into a state where redundancy cannot be achieved. In this case, standby RP must be reloaded to achieve redundancy.
-
- TimingICs do not support **auto fpd upgrade** on NCS5500 Series Routers as the TimingIC requires a card reload immediately after upgrade. For the same reason, the TimingICs are not upgraded if the user specifies **location all** in the **auto fpd upgrade** command. To upgrade a TimingIC FPD, specify the FPD name along with the card location. For example, **upgrade hw-module fpd TimngIC-A location 0/RP0/cpu0.**

Usage Guidelines—Online Insertion of Line Cards

When a line card with a lower FPD version is inserted, one of the following scenarios apply:

- If fpd auto-upgrade and auto-reload are enabled, and a new line card is inserted, the system upgrades the line card FPDs automatically with the latest FPDs and reloads the line cards.
- If fpd auto-upgrade and auto-reload are both disabled, no action is required.
- If fpd auto-upgrade is enabled and auto-reload is disabled, the following alarms are displayed on the console:

```
RP/0/RP1/CPU0:Jun 1 10:05:46.095 UTC: optics_driver[231]: %PKT_INFRA-FM-3-FAULT_MAJOR
: ALARM_MAJOR :OPTICS SUPPORTED_ERROR :DECLARE : Optics0/5/0/6: Optics0/5/0/6
RP/0/RP1/CPU0:Jun 1 10:05:46.096 UTC: optics_driver[231]: %PKT_INFRA-FM-2-FAULT_CRITICAL
 : ALARM_CRITICAL :OPTICS NOT SUPPORTED :DECLARE : Optics0/5/0/6: Optics0/5/0/6
```

  You must reload the line cards manually to clear these alarms

Usage Guidelines—Online Insertion of RPs

When fpd auto-upgrade is enabled and a new RP is inserted, the system upgrades the RP FPDs automatically with the latest FPDs.

Note RPs are not reloaded automatically. You must manually reload the RP or chassis for the latest FPD version to reflect.

Note Reload of active RPs and line cards impacts the network traffic.

```
RP/0/RP0/CPU0:IOS# admin
Mon Jun 28 17:00:39.340 UTC
```

```
sysadmin-vm:0_RP1# hw-module location 0/RP1 reload
Mon Jun  28 17:00:52.178 UTC+00:00
Reload hardware module ? [no,yes] yes
#result Card graceful reload request on 0/RP1 succeeded.
RP/0/RP0/CPU0:IOS#

RP/0/RP0/CPU0:ios# show hw-module fpd
Fri Jun  4 10:08:01.784 UTC

Auto-upgrade:Enabled
                                                                          FPD Versions
                                                                          ==============
Location   Card type              HWver FPD device       ATR Status    Running   Programd
-------------------------------------------------------------------------------------------
0/1        N560-IMA2C-DD          0.0   IMFPGA               CURRENT     1.27      1.27
0/3        N560-IMA2C             0.0   IMFPGA               CURRENT     5.01      5.01
0/5        A900-IMA8CS1Z-M        0.0   IMFPGA               CURRENT     1.98      1.98
0/RP0      N560-4-RSP4            0.0   ADM                  CURRENT     1.06      1.06
0/RP0      N560-4-RSP4            0.0   IOFPGA               CURRENT     0.64      0.64
0/RP0      N560-4-RSP4            0.0   PRIMARY-BIOS         CURRENT     0.18      0.18
0/RP0      N560-4-RSP4            0.0   SATA                 CURRENT     2.10      2.10
0/RP1      N560-4-RSP4            0.0   ADM                  CURRENT     1.06      1.06
0/RP1      N560-4-RSP4            0.0   IOFPGA               CURRENT     0.64      0.64
0/RP1      N560-4-RSP4            0.0   PRIMARY-BIOS         CURRENT     0.19      0.19
0/RP1      N560-4-RSP4            0.0   SATA                 CURRENT     2.10      2.10
0/FT0      N560-4-PWR-FAN         0.1   PSOC                 CURRENT   177.08    177.08
0/FT1      N560-4-FAN-H           0.1   PSOC                 CURRENT   177.02    177.02
0/FT2      N560-4-FAN-H           0.1   PSOC                 CURRENT   177.02    177.02
RP/0/RP0/CPU0:ios#
```

Table 2: Action Required on FPDs After Auto Upgrade

FPD	Action Required
IOFPGA	Manual reload required
ADM	Upgraded version available immediately
PRIMARY-BIOS	Manual reload required
SATA	Upgraded version available immediately
PSOC	Upgraded version available immediately
IMFPGA	Manual reload required, if auto-reload is not configured

Configuring Auto FPD During System Upgrade

In case of Software upgrade (without ISSU), configure the **fpd auto-upgrade enable** command. All the FPDs are automatically upgraded in the currently installed image (V1). After the upgrade, the router automatically reloads and comes up with the new image (V2) with the upgraded FPDs already running. No additional reloads are required.

Note System reloads are part of the SU process, therefore you can disable the FPD auto reload functionality by using the **fpd auto-reload disable** command.

1. **Enable FPD auto-upgrade**

```
RP/0/RP0/CPU0:IOS#conf
RP/0/RP0/CPU0:IOS(config)#fpd auto-upgrade enable
RP/0/RP0/CPU0:IOS#commit
```

2. **Check for FPD Versions**

```
RP/0/RP0/CPU0:Router#show hw-module fpd
Mon Jun 28 21:41:19.187 UTC

Auto-upgrade:Enabled
                                                                          FPD Versions
                                                                          ==============
Location   Card type            HWver FPD device       ATR Status    Running   Programd

-------------------------------------------------------------------------------------
0/2        NCS4200-1T16G-PS      0.0   IMFPGA               CURRENT     1.98      1.98
0/3        A900-IMA8CS1Z-M       0.0   IMFPGA               CURRENT     1.95      1.95
0/4        A900-IMA8Z            0.0   IMFPGA               CURRENT    17.05     17.05
0/5        A900-IMA8Z-L          0.0   IMFPGA               CURRENT     1.48      1.48
0/8        NCS4200-1T16G-PS      0.0   IMFPGA               CURRENT     1.98      1.98
0/9       N560-IMA1W           66.32 CFP2-DS-DCO          CURRENT    38.27397  38.27397
0/9        N560-IMA1W            0.0   IMFPGA               CURRENT     1.28      1.28
0/15       NCS4200-1T16G-PS      0.0   IMFPGA               CURRENT     1.98      1.98
0/RP0      N560-RSP4             0.0   ADM                  CURRENT     1.06      1.06
0/RP0      N560-RSP4             0.0   IOFPGA               CURRENT     0.64      0.64
0/RP0      N560-RSP4             0.0   PRIMARY-BIOS         CURRENT     0.19      0.19
0/RP0      N560-RSP4             0.0   SATA                 CURRENT     1.30      1.30
0/RP1      N560-RSP4             0.0   ADM                  CURRENT     1.05      1.05
0/RP1      N560-RSP4             0.0   IOFPGA               CURRENT     0.64      0.64
0/RP1      N560-RSP4             0.0   PRIMARY-BIOS         CURRENT     0.19      0.19
0/RP1      N560-RSP4             0.0   SATA                 CURRENT     1.30      1.30
0/FT0      N560-FAN-H            1.0   PSOC                 CURRENT     2.02      2.02

RP/0/RP0/CPU0:Router#
```

3. **Check that Auto Upgrades are Triggered for FPDs with Newer Versions Available**

Note At this step, all RSP, IMs, and fan FPD upgrades are initiated and completed. All cards are upgraded *before* the router reloads.

```
RP/0/RP1/CPU0:UUT-RSP4# copy tftp://<ncs560-mini-x-7.3.2.iso> harddisk:/
RP/0/RP0/CPU0:IOS#install add source harddisk: ncs560-mini-x-7.3.2.iso
ncs560-mcast-2.0.0.0-r732.x86_64.rpm ncs560-mgbl-2.0.0.0-r732.x86_64.rpm
```

```
ncs560-mpls-1.0.0.0-r732.x86_64.rpm
RP/0/RP0/CPU0:IOS#install ncs560-mini-x-7.3.2 ncs560-mcast-2.0.0.0-r732.x86_64
ncs560-mgbl-2.0.0.0-r732.x86_64 ncs560-mpls-1.0.0.0-r732.x86_64
RP/0/RP0/CPU0:IOS#install commit

RP/0/RP0/CPU0:ROUTER# install activate ncs560-mini-x-7.3.2.28I
Mon Jun 28 21:30:17.673 UTC
2021-06-28 21:30:20 Install operation 31 started by root123:
  install activate pkg ncs560-mini-x-7.3.2.28I
2021-06-28 21:30:20 Package list:
2021-06-28 21:30:20     ncs560-mini-x-7.3.2.28I
RP/0/RP0/CPU0:Jun 28 21:32:41.204 UTC: sdr_instmgr[1213]: %PKT_INFRA-FM-6-FAULT_INFO :
INSTALL-IN-PROGRESS :DECLARE :0/RP0/CPU0: INSTALL_IN_PROGRESS Alarm : being DECLARED for
 the system
This install operation will reload the system, continue?
 [yes/no]:[yes] yes
2021-06-28 21:33:01 Install operation will continue in the background
 ...
RP/0/RP0/CPU0:ROUTER#RP/0/RP0/CPU0:Jun 28 21:41:40.910 UTC: fpd-serv[168]:
%PKT_INFRA-FM-3-FAULT_MAJOR : ALARM_MAJOR :FPD-NEED-UPGRADE :DECLARE :0/RP0:
RP/0/RP0/CPU0:Jun 28 21:41:41.159 UTC: fpd-serv[168]: %PKT_INFRA-FM-3-FAULT_MAJOR :
ALARM_MAJOR :FPD-NEED-UPGRADE :CLEAR :0/RP0:
0/RP0/ADMIN0:Jun 28 21:41:42.565 UTC: control_driver[3205]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD SATA@0/RP0 image programming completed with
UPGRADE DONE state Info: [SDD firmware upgraded from 1.30 to 2.10]
0/RP0/ADMIN0:Jun 28 21:41:42.566 UTC: control_driver[3205]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD SATA @location 0/RP0 FPD upgraded and activated!

0/RP0/ADMIN0:Jun 28 21:41:42.570 UTC: shelf_mgr[3220]:
%INFRA-SHELF_MGR-6-CARD_SW_OPERATIONAL : Card: 0/RP0 software state going to Operational

0/RP0/ADMIN0:Jun 28 21:41:42.570 UTC: shelf_mgr[3220]:
%INFRA-SHELF_MGR-6-CARD_HW_OPERATIONAL : Card: 0/RP0 hardware state going to Operational

RP/0/RP0/CPU0:Jun 28 21:41:42.486 UTC: fpd-serv[168]: %PKT_INFRA-FM-3-FAULT_MAJOR :
ALARM_MAJOR :FPD-NEED-UPGRADE :DECLARE :0/RP1:
0/RP1/ADMIN0:Jun 28 21:41:44.182 UTC: control_driver[3220]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD SATA@0/RP1 image programming completed with
UPGRADE DONE state Info: [SDD firmware upgraded from 1.30 to 2.10]
0/RP1/ADMIN0:Jun 28 21:41:44.182 UTC: control_driver[3220]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD SATA @location 0/RP1 FPD upgraded and activated!

0/RP1/ADMIN0:Jun 28 21:41:48.905 UTC: control_driver[3220]:
%INFRA-FPD_Driver-6-UPGRADE_RESULT : Upgrade completes 20 percent for fpd ADM@location
0/RP1.
0/RP1/ADMIN0:Jun 28 21:41:48.905 UTC: control_driver[3220]:
%INFRA-FPD_Driver-6-UPGRADE_RESULT : Upgrade completes 50 percent for fpd
PRIMARY-BIOS@location 0/RP1.
0/RP1/ADMIN0:Jun 28 21:42:10.160 UTC: control_driver[3220]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD PRIMARY-BIOS@0/RP1 image programming completed
with UPGRADE DONE state Info: [  Upgrade Complete ]
0/RP1/ADMIN0:Jun 28 21:42:10.161 UTC: control_driver[3220]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD PRIMARY-BIOS @location 0/RP1 upgrade completed.

0/RP1/ADMIN0:Jun 28 21:42:11.060 UTC: control_driver[3220]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD ADM@0/RP1 image programming completed with UPGRADE
 DONE state Info: [image 1.05 to 1.06 version]
0/RP1/ADMIN0:Jun 28 21:42:11.061 UTC: control_driver[3220]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD ADM @location 0/RP1 FPD upgraded and activated!

0/RP0/ADMIN0:Jun 28 21:42:11.062 UTC: shelf_mgr[3220]:
%INFRA-SHELF_MGR-6-CARD_SW_OPERATIONAL : Card: 0/RP1 software state going to Operational

0/RP0/ADMIN0:Jun 28 21:42:11.062 UTC: shelf_mgr[3220]:
%INFRA-SHELF_MGR-6-CARD_HW_OPERATIONAL : Card: 0/RP1 hardware state going to Operational
```

```
RP/0/RP0/CPU0:Jun 28 21:45:14.615 UTC: fpd_imfpga[121]: %INFRA-FPD_Driver-6-UPGRADE_RESULT
 : Upgrade completes 50 percent for fpd IMFPGA@location 0/5.
RP/0/RP0/CPU0:Jun 28 21:45:14.616 UTC: fpd_imfpga[121]: %INFRA-FPD_Driver-6-UPGRADE_RESULT
 : Upgrade completes 50 percent for fpd IMFPGA@location 0/3.
RP/0/RP0/CPU0:Jun 28 21:48:24.763 UTC: fpd_imfpga[121]: %INFRA-FPD_Driver-6-UPGRADE_RESULT
 : Upgrade completes 90 percent for fpd IMFPGA@location 0/5.

RP/0/RP0/CPU0:ROUTER#RP/0/RP0/CPU0:Jun 28 21:48:43.929 UTC: fpd_imfpga[121]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD IMFPGA@0/5 image programming completed with
UPGRADE DONE state Info: [DONE ]
RP/0/RP0/CPU0:Jun 28 21:48:43.940 UTC: fpd_imfpga[121]: %INFRA-FPD_Driver-1-UPGRADE_ALERT
 : FPD IMFPGA @location 0/5 upgrade completed.
0/RP0/ADMIN0:Jun 28 21:48:45.354 UTC: shelf_mgr[3220]:
%INFRA-SHELF_MGR-6-CARD_HW_OPERATIONAL : Card: 0/5 hardware state going to Operational

0/RP0/ADMIN0:Jun 28 21:48:45.354 UTC: shelf_mgr[3220]:
%INFRA-SHELF_MGR-6-CARD_SW_OPERATIONAL : Card: 0/RP0 software state going to Operational

0/RP0/ADMIN0:Jun 28 21:48:45.354 UTC: shelf_mgr[3220]:
%INFRA-SHELF_MGR-6-CARD_HW_OPERATIONAL : Card: 0/RP0 hardware state going to Operational
P/0/RP0/CPU0:Jun 28 21:50:21.630 UTC: fpd_imfpga[121]: %INFRA-FPD_Driver-1-UPGRADE_ALERT
 : FPD IMFPGA@0/3 image programming completed with UPGRADE DONE state Info: [DONE ]
RP/0/RP0/CPU0:Jun 28 21:50:21.642 UTC: fpd_imfpga[121]: %INFRA-FPD_Driver-1-UPGRADE_ALERT
 : FPD IMFPGA @location 0/3 upgrade completed.
0/RP0/ADMIN0:Jun 28 21:50:23.056 UTC: shelf_mgr[3220]:
%INFRA-SHELF_MGR-6-CARD_HW_OPERATIONAL : Card: 0/3 hardware state going to Operational

0/RP0/ADMIN0:Jun 28 21:50:23.056 UTC: shelf_mgr[3220]:
%INFRA-SHELF_MGR-6-CARD_SW_OPERATIONAL : Card: 0/RP0 software state going to Operational

0/RP0/ADMIN0:Jun 28 21:50:23.057 UTC: shelf_mgr[3220]:
%INFRA-SHELF_MGR-6-CARD_HW_OPERATIONAL : Card: 0/RP0 hardware state going to Operational
```

4. Check the RP FPD Versions and FPD Status

When the router is operational after the reload, all the RP, IMs, and fan FPDs are upgraded to the latest FPD versions.

```
sysadmin-vm:0_RP1# show hw-module fpd
Mon Jun 28 21:51:20.187 UTC

Auto-upgrade:Enabled
                                                                          FPD Versions
                                                                          ==============
Location   Card type            HWver FPD device       ATR Status    Running   Programd

-----------------------------------------------------------------------------------------
0/2        NCS4200-1T16G-PS      0.0   IMFPGA              CURRENT     1.98      1.98

0/3        A900-IMA8CS1Z-M       0.0   IMFPGA              CURRENT     1.98      1.98

0/4        A900-IMA8Z            0.0   IMFPGA              CURRENT    17.05     17.05

0/5        A900-IMA8Z-L          0.0   IMFPGA              CURRENT     1.49      1.49

0/8        NCS4200-1T16G-PS      0.0   IMFPGA              CURRENT     1.98      1.98

0/9       N560-IMA1W           66.32 CFP2-DS-DCO         CURRENT    38.27397  38.27397

0/9        N560-IMA1W            0.0   IMFPGA              CURRENT     1.28      1.28

0/15       NCS4200-1T16G-PS      0.0   IMFPGA              CURRENT     1.98      1.98
```

```
0/RP0      N560-RSP4             0.0   ADM                CURRENT     1.06       1.06
0/RP0      N560-RSP4             0.0   IOFPGA             CURRENT     0.64       0.64
0/RP0      N560-RSP4             0.0   PRIMARY-BIOS       CURRENT     0.19       0.19
0/RP0      N560-RSP4             0.0   SATA               CURRENT     2.10       2.10
0/RP1      N560-RSP4             0.0   ADM                CURRENT     1.05       1.05
0/RP1      N560-RSP4             0.0   IOFPGA             CURRENT     0.64       0.64
0/RP1      N560-RSP4             0.0   PRIMARY-BIOS       CURRENT     0.19       0.96
0/RP1      N560-RSP4             0.0   SATA               CURRENT     2.10       2.10
0/FT0      N560-FAN-H            1.0   PSOC               CURRENT     2.02       2.02
RP/0/RP0/CPU0:ROUTER#
```

Configuring Auto FPD During ISSU

ISSU occurs in two phases—in the System Admin VM and then in the XR VM.

In the System Admin VM mode, first execute the **fpd auto-upgrade enable** command. This configuration causes the FPDs on the route processor (RP) to automatically upgrade to the latest versions.

In the XR VM mode, you *must* disable the FPD auto upgrade. This is because IM FPGA upgrades are not automatically triggered as part of ISSU.

Note Less than 50ms traffic loss is expected during ISSU.

Note During both Admin and XR ISSU, always disable the auto reload functionality by using the **fpd auto-reload disable** command.

1. **Enable FPD auto-upgrade in XR VM**

```
RP/0/RP0/CPU0:IOS#conf
RP/0/RP0/CPU0:IOS(config)#fpd auto-upgrade enable
RP/0/RP0/CPU0:IOS#commit
```

2. **Disable FPD auto-reload in XR VM**

```
RP/0/RP0/CPU0:IOS#conf
RP/0/RP0/CPU0:IOS(config)#fpd auto-reload disable
RP/0/RP0/CPU0:IOS#commit
```

3. **Check for FPD Versions**

```
RP/0/RP0/CPU0:iso#show hw-module fpd
Sun Aug  1 19:36:13.869 UTC

Auto-upgrade:Enabled

                                                                    FPD Versions
                                                                   ==============
Location   Card type            HWver FPD device      ATR Status    Running   Programd
```

```
--------------------------------------------------------------------------------
0/11       NCS4200-8T-PS          0.0   IMFPGA              CURRENT    17.05     17.05
0/RP0      NCS4216-RSP-800        0.0   ADM                 CURRENT     1.06      1.06
0/RP0      NCS4216-RSP-800        0.0   IOFPGA              CURRENT     0.78      0.78
0/RP0      NCS4216-RSP-800        0.0   PRIMARY-BIOS        CURRENT     0.21      0.21
0/RP0      NCS4216-RSP-800        0.0   SATA                CURRENT     2.20      2.20
0/RP1      NCS4216-RSP-800        0.0   ADM                 CURRENT     1.06      1.06
0/RP1      NCS4216-RSP-800        0.0   IOFPGA              CURRENT     0.78      0.78
0/RP1      NCS4216-RSP-800        0.0   PRIMARY-BIOS        CURRENT     0.21      0.21
0/RP1      NCS4216-RSP-800        0.0   SATA                CURRENT     2.20      2.20
0/FT0      NCS4216-F2B-FAN        1.0   PSOC                CURRENT     2.02      2.02
0/PM0      A900-PWR1200-A         0.1   DCA-PriMCU          CURRENT     0.13      0.13
0/PM0      A900-PWR1200-A         0.1   DCA-SecMCU          CURRENT     2.03      2.03
0/PM1      A900-PWR1200-A         0.1   DCA-PriMCU          CURRENT     0.13      0.13
0/PM1      A900-PWR1200-A         0.1   DCA-SecMCU          CURRENT     2.03      2.03
RP/0/RP0/CPU0:iso#
```

4. Perform sysadmin ISSU Upgrade

Check that FPD upgrades are triggered as part of ISSU:

```
RP/0/RP0/CPU0:IOS#admin
sysadmin-vm:0_RP0# install extract ncs560-mini-x-7.3.2
Mon Aug  2  04:54:17.250 UTC+00:00
result Mon Aug  2 04:54:18 2021 Install operation 1 (install extract) started by user
 'cafyauto' will continue asynchronously.
sysadmin-vm:0_RP0# 0/RP0/ADMIN0:Aug  2 04:58:47.990 UTC: inst_mgr[4350]:
%INFRA-INSTMGR-2-OPERATION_SUCCESS : Install operation 1 completed successfully
Mon Aug  2 04:58:47 2021 Install operation 1 completed successfully.
sysadmin-vm:0_RP0# install activate issu  host-7.3.2 ncs560-sysadmin-7.3.2
Mon Aug  2  05:26:31.442 UTC+00:00
op-initiated true
operation-id 2
result start-success
id 2
sysadmin-vm:0_RP0# 2021-08-02 05:26:31 Admin install operation 2 started
sysadmin-vm:0_RP0# 2021-08-02 05:26:31 install activate issu host-7.3.2
ncs560-sysadmin-7.3.2
sysadmin-vm:0_RP0# 2021-08-02 05:26:35 Install operation 2 started: ISSU prepare
install activate issu host-7.3.2 ncs560-sysadmin-7.3.2
sysadmin-vm:0_RP0# 0/RP0/ADMIN0:Aug  2 05:30:22.441 UTC: inst_mgr[4350]:
%INFRA-INSTMGR-2-OPERATION_SUCCESS : Install operation 2 completed successfully
2021-08-02 05:30:22 Install operation 2 completed successfully
sysadmin-vm:0_RP0# 2021-08-02 05:30:23 Admin install operation 3 started
sysadmin-vm:0_RP0# 2021-08-02 05:30:23 install activate issu host-7.3.2
ncs560-sysadmin-7.3.2
sysadmin-vm:0_RP0# 2021-08-02 05:30:25 Install operation 3 started: ISSU activate
install activate issu host-7.3.2 ncs560-sysadmin-7.3.2
sysadmin-vm:0_RP0#
sysadmin-vm:0_RP0# 2021-08-02 05:31:10 Admin VM of node 0/RP1 will now reload as part
 of ISSU operation 3
```

```
0/RP0/ADMIN0:Aug  2 05:31:17.314 UTC: shelf_mgr[3212]: %INFRA-SHELF_MGR-4-VM_RELOAD :
 Reloading VM on 0/RP1
0/RP0/ADMIN0:Aug  2 05:32:12.842 UTC: shelf_mgr[3212]:
%INFRA-SHELF_MGR-6-CARD_SW_OPERATIONAL : Card: 0/RP1 software state going to Operational

RP/0/RP0/CPU0:Aug  2 05:33:05.763 UTC: fpd-serv[419]: %PKT_INFRA-FM-3-FAULT_MAJOR :
ALARM_MAJOR :FPD-NEED-UPGRADE :DECLARE :0/RP1:

sysadmin-vm:0_RP0# 2021-08-02 05:33:28 Admin VM of node 0/RP0 will now reload as part
 of ISSU operation 3
RP/0/RP0/CPU0:Aug  2 05:35:44.331 UTC: fpd-serv[419]: %PKT_INFRA-FM-3-FAULT_MAJOR :
ALARM_MAJOR :FPD-NEED-UPGRADE :DECLARE :0/RP0:
0/RP1/ADMIN0:Aug  2 05:36:01.213 UTC: inst_mgr[6351]: %INFRA-INSTMGR-2-OPERATION_SUCCESS
 : Install operation 3 completed successfully
0/RP0/ADMIN0:Aug  2 05:36:29.242 UTC: control_driver[3920]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : Auto fpd triggered for FPD SATA upgrade @ location
 0/RP0 please wait until all fpd upgrades are done
0/RP0/ADMIN0:Aug  2 05:36:29.545 UTC: control_driver[3920]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD SATA@0/RP0 image programming completed with
UPGRADE DONE state Info: [SDD firmware upgraded from 1.30 to 2.10]
0/RP0/ADMIN0:Aug  2 05:36:29.545 UTC: control_driver[3920]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD SATA @location 0/RP0 FPD upgraded and activated!

0/RP1/ADMIN0:Aug  2 05:36:29.557 UTC: shelf_mgr[4032]:
%INFRA-SHELF_MGR-6-CARD_SW_OPERATIONAL : Card: 0/RP0 software state going to Operational

0/RP1/ADMIN0:Aug  2 05:36:29.557 UTC: shelf_mgr[4032]:
%INFRA-SHELF_MGR-6-CARD_HW_OPERATIONAL : Card: 0/RP0 hardware state going to Operational

0/RP1/ADMIN0:Aug  2 05:36:29.667 UTC: control_driver[4015]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : Auto fpd triggered for FPD SATA upgrade @ location
 0/RP1 please wait until all fpd upgrades are done
0/RP1/ADMIN0:Aug  2 05:36:29.981 UTC: control_driver[4015]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD SATA@0/RP1 image programming completed with
UPGRADE DONE state Info: [SDD firmware upgraded from 1.30 to 2.10]
0/RP1/ADMIN0:Aug  2 05:36:29.981 UTC: control_driver[4015]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD SATA @location 0/RP1 FPD upgraded and activated!

0/RP1/ADMIN0:Aug  2 05:36:29.987 UTC: shelf_mgr[4032]:
%INFRA-SHELF_MGR-6-CARD_SW_OPERATIONAL : Card: 0/RP1 software state going to Operational

0/RP1/ADMIN0:Aug  2 05:36:29.987 UTC: shelf_mgr[4032]:
%INFRA-SHELF_MGR-6-CARD_HW_OPERATIONAL : Card: 0/RP1 hardware state going to Operational

0/RP1/ADMIN0:Aug  2 05:36:30.059 UTC: control_driver[4015]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : Auto fpd triggered for FPD PRIMARY-BIOS upgrade @
 location 0/RP1 please wait until all fpd upgrades are done
0/RP0/ADMIN0:Aug  2 05:36:31.704 UTC: control_driver[3920]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : Auto fpd triggered for FPD PRIMARY-BIOS upgrade @
 location 0/RP0 please wait until all fpd upgrades are done
0/RP1/ADMIN0:Aug  2 05:36:35.977 UTC: control_driver[4015]:
%INFRA-FPD_Driver-6-UPGRADE_RESULT : Upgrade completes 50 percent for fpd
PRIMARY-BIOS@location 0/RP1.
0/RP0/ADMIN0:Aug  2 05:36:36.706 UTC: control_driver[3920]:
%INFRA-FPD_Driver-6-UPGRADE_RESULT : Upgrade completes 50 percent for fpd
PRIMARY-BIOS@location 0/RP0.
0/RP1/ADMIN0:Aug  2 05:36:55.985 UTC: control_driver[4015]:
%INFRA-FPD_Driver-6-UPGRADE_RESULT : Upgrade completes 100 percent for fpd
PRIMARY-BIOS@location 0/RP1.
0/RP1/ADMIN0:Aug  2 05:36:56.012 UTC: control_driver[4015]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD PRIMARY-BIOS@0/RP1 image programming completed
 with UPGRADE DONE state Info: [  Upgrade Complete ]
0/RP1/ADMIN0:Aug  2 05:36:56.012 UTC: control_driver[4015]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD PRIMARY-BIOS @location 0/RP1 upgrade completed.
```

```
0/RP1/ADMIN0:Aug  2 05:36:56.018 UTC: shelf_mgr[4032]:
%INFRA-SHELF_MGR-6-CARD_SW_OPERATIONAL : Card: 0/RP1 software state going to Operational

0/RP1/ADMIN0:Aug  2 05:36:56.018 UTC: shelf_mgr[4032]:
%INFRA-SHELF_MGR-6-CARD_HW_OPERATIONAL : Card: 0/RP1 hardware state going to Operational

0/RP0/ADMIN0:Aug  2 05:36:56.582 UTC: control_driver[3920]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD PRIMARY-BIOS@0/RP0 image programming completed
 with UPGRADE DONE state Info: [  Upgrade Complete ]
0/RP0/ADMIN0:Aug  2 05:36:56.869 UTC: control_driver[3920]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD PRIMARY-BIOS @location 0/RP0 upgrade completed.

0/RP1/ADMIN0:Aug  2 05:36:56.871 UTC: shelf_mgr[4032]:
%INFRA-SHELF_MGR-6-CARD_SW_OPERATIONAL : Card: 0/RP0 software state going to Operational

0/RP1/ADMIN0:Aug  2 05:36:56.872 UTC: shelf_mgr[4032]:
%INFRA-SHELF_MGR-6-CARD_HW_OPERATIONAL : Card: 0/RP0 hardware state going to Operational

RP/0/RP0/CPU0:IOS#admin
Mon Aug  2 05:49:27.392 UTC

cafyauto connected from 192.0.0.4 using ssh on sysadmin-vm:0_RP1
sysadmin-vm:0_RP1# install commit
Mon Aug  2  05:49:40.694 UTC+00:00
result Mon Aug  2 05:49:41 2021 Install operation 4 (install commit) started by user
'cafyauto' will continue asynchronously.
sysadmin-vm:0_RP1# Mon Aug  2 05:49:44 2021 Install operation 4 completed successfully.
sysadmin-vm:0_RP1# 0/RP1/ADMIN0:Aug  2 05:49:44.733 UTC: inst_mgr[6351]:
%INFRA-INSTMGR-2-OPERATION_SUCCESS : Install operation 4 completed successfully
0/RP1/ADMIN0:Aug  2 05:49:46.936 UTC: inst_mgr[6351]: %PKT_INFRA-FM-6-FAULT_INFO :
INSTALL-IN-PROGRESS :CLEAR :0/RP1: Calvados INSTALL_IN_PROGRESS Alarm : being CLEARED
 for the system
sysadmin-vm:0_RP1#
```

5. Check the FPD Versions

6. Disable FPD auto-upgrade in XR VM

```
RP/0/RP1/CPU0:PP-Router#conf
RP/0/RP1/CPU0:PP-Router(config)#fpd auto-upgrade disable
RP/0/RP1/CPU0:PP-Router(config)#commit
```

7. Perform ISSU Upgrade in XR VM

```
RP/0/RP0/CPU0:IOS#install extract ncs560-mini-x-7.3.2
Mon Aug  2 05:55:19.880 UTC
2021-08-02 05:55:22 Install operation 100 started by cafyauto:
  install extract ncs560-mini-x-7.3.2
2021-08-02 05:55:22 Package list:
2021-08-02 05:55:22     ncs560-mini-x-7.3.2
2021-08-02 05:55:23 Install operation will continue in the background
RP/0/RP0/CPU0:IOS#2021-08-02 05:59:42 Install operation 100 finished successfully
RP/0/RP0/CPU0:Aug  2 05:59:42.840 UTC: sdr_instmgr[1213]:
%INSTALL-INSTMGR-2-OPERATION_SUCCESS : Install operation 100 finished successfully
RP/0/RP0/CPU0:IOS#install activate issu  ncs560-xr-7.3.2
Mon Aug  2 06:02:06.097 UTC
2021-08-02 06:02:08 Install operation 101 started by cafyauto:
  install activate issu ncs560-xr-7.3.2
2021-08-02 06:02:08 Package list:
2021-08-02 06:02:08     ncs560-xr-7.3.2
This install operation will start the issu, continue?
 [yes/no]:[yes] yes
2021-08-02 06:04:03 Install operation will continue in the background
RP/0/RP0/CPU0:IOS#RP/0/RP0/CPU0:Aug  2 06:04:11.315 UTC: issudir[342]:
```

```
%PKT_INFRA-FM-6-FAULT_INFO : ISSU-IN-PROGRESS :DECLARE :0/RP0/CPU0: ISSU_IN_PROGRESS
Alarm : being DECLARED for the system
…
RP/0/RP0/CPU0:IOS# RP/0/RP1/CPU0:Aug  2 06:18:13.640 UTC: imfpga[345]: Change ISSU
Node State from [Secondary] to [Primary]
RP/0/RP1/CPU0:Aug  2 06:18:13.659 UTC: tmgctrl[444]: ISSU Node Role Change Notification
 [Primary]
RP/0/RP1/CPU0:Aug  2 06:18:13.725 UTC: issudir[139]:
%INSTALL-ISSU_INFRA-1-OPERATION_ISSU_RUN_DONE : ISSU Run has completed for install
operation '101'. Issue the command "install activate issu cleanup" to continue the
operation.
RP/0/RP1/CPU0:Aug  2 06:18:13.729 UTC: issudir[139]: %PKT_INFRA-FM-6-FAULT_INFO :
ISSU-IN-PROGRESS :DECLARE :0/RP1/CPU0:
RP/0/RP1/CPU0:Aug  2 06:19:13.695 UTC: fpd-serv[216]: %PKT_INFRA-FM-3-FAULT_MAJOR :
ALARM_MAJOR :FPD-NEED-UPGRADE :DECLARE :0/3:
RP/0/RP1/CPU0:Aug  2 06:19:13.695 UTC: fpd-serv[216]: %PKT_INFRA-FM-3-FAULT_MAJOR :
ALARM_MAJOR :FPD-NEED-UPGRADE :DECLARE :0/7:
RP/0/RP1/CPU0:Aug  2 06:19:53.982 UTC: fpd-serv[216]: %PKT_INFRA-FM-3-FAULT_MAJOR :
ALARM_MAJOR :FPD-NEED-UPGRADE :DECLARE :0/1:
RP/0/RP1/CPU0:Aug  2 06:19:13.764 UTC: imfpga[343]: ISSU Phase Change Notification
[Phase Cleanup]
RP/0/RP1/CPU0:Aug  2 06:19:19.442 UTC: tmgctrl[444]: ISSU Phase Change Notification
[Phase Completed], Becoming Timing Primary now
RP/0/RP1/CPU0:Aug  2 06:19:19.452 UTC: sdr_instmgr[1213]: %PKT_INFRA-FM-6-FAULT_INFO
: INSTALL-IN-PROGRESS :DECLARE :0/RP1/CPU0: INSTALL_IN_PROGRESS Alarm : being DECLARED
 for the system
RP/0/RP1/CPU0:Aug  2 06:19:19.519 UTC: issudir[139]: %PKT_INFRA-FM-6-FAULT_INFO :
ISSU-IN-PROGRESS :CLEAR :0/RP1/CPU0:
RP/0/RP1/CPU0:Aug  2 06:19:19.538 UTC: tmgctrl[444]: ISSU Phase Change Notification
[Phase Completed] Processing done
RP/0/RP1/CPU0:Aug  2 06:19:20.480 UTC: sdr_instmgr[1213]:
%INSTALL-INSTMGR-2-OPERATION_SUCCESS : Install operation 101 finished successfully

RP/0/RP1/CPU0:IOS# install commit
Mon Aug  2 06:44:07.572 UTC
2021-08-02 06:44:10 Install operation 103 started by root123:
  install commit
2021-08-02  06:44:11 Install operation will continue in the background
RP/0/RP1/CPU0:ISO#0/RP1/ADMIN0:Aug  2 06:44:20.839 UTC: inst_mgr[6353]:
%PKT_INFRA-FM-6-FAULT_INFO : INSTALL-IN-PROGRESS :CLEAR :0/RP1: Calvados
INSTALL_IN_PROGRESS Alarm : being CLEARED for the system
RP/0/RP1/CPU0:Aug  2 16:44:20.579 UTC: sdr_instmgr[1213]: %PKT_INFRA-FM-6-FAULT_INFO
: INSTALL-IN-PROGRESS :CLEAR :0/RP1/CPU0: INSTALL_IN_PROGRESS Alarm : being CLEARED
for the system
2021-08-02 06:44:23 Install operation 103 finished successfully
RP/0/RP1/CPU0:Aug  2 06:44:23.201 UTC: sdr_instmgr[1213]:
%INSTALL-INSTMGR-2-OPERATION_SUCCESS : Install operation 103 finished successfully
sysadmin-vm:0_RP1# show version
Mon Aug  2  07:24:58.414 UTC+00:00
Cisco IOS XR Admin Software, Version 7.3.2
Copyright (c) 2013-2021 by Cisco Systems, Inc.

Build Information:
 Built By     : ingunawa
 Built On     : Thu Jul 29 01:27:41 PDT 2021
 Build Host   : iox-ucs-003
 Workspace    : /auto/iox-ucs-003-san2/prod/7.3.2.DT_IMAGE/ncs560/ws
 Version      : 7.3.2
 Location     : /opt/cisco/calvados/packages/
 Label        : 7.3.2
System uptime is 1 hour, 53 minutes

sysadmin-vm:0_RP1# exit
Mon Aug  2  07:25:02.260 UTC+00:00
```

```
RP/0/RP1/CPU0:IOS#show version
Mon Aug  2 07:25:04.063 UTC
Cisco IOS XR Software, Version 7.3.2
Copyright (c) 2013-2021 by Cisco Systems, Inc.

Build Information:
 Built By     : ingunawa
 Built On     : Thu Jul 29 03:34:42 PDT 2021
 Built Host   : iox-ucs-003
 Workspace    : /auto/iox-ucs-003-san2/prod/7.3.2.DT_IMAGE/ncs560/ws
 Version      : 7.3.2
 Location     : /opt/cisco/XR/packages/
 Label        : 7.3.2

cisco NCS-560 () processor
System uptime is 1 hour 13 minutes

RP/0/RP1/CPU0:IOS #
```

8. Check the IMFPGA FPD Versions

Note IMFPGA FPDs are not upgraded as part of ISSU, as auto-upgrade is disabled. Based on your network design, you must enable and upgrade the IM FPDs as well as reload the IMs at a time when it has the least impact on traffic.

```
RP/0/RP1/CPU0:IOS#show hw-module fpd
Mon Aug  2 06:38:52.253 UTC

Auto-upgrade:Disabled
                                                                          FPD Versions
                                                                        ==============
Location   Card type            HWver FPD device      ATR Status    Running   Programd

--------------------------------------------------------------------------------------
0/1        NCS4200-1T16G-PS      0.0   IMFPGA              NEED UPGD   1.95      1.95

0/3        NCS4200-1T16G-PS      0.0   IMFPGA              NEED UPGD   1.95      1.95

0/4        A900-IMA8Z            0.0   IMFPGA              CURRENT    17.05     17.05

0/7        N560-IMA2C            0.0   IMFPGA              NEED UPGD   4.96      4.96

0/9        A900-IMA8Z            0.0   IMFPGA              CURRENT    17.05     17.05

0/RP0      N560-RSP4-E           0.0   ADM                 CURRENT     1.06      1.06

0/RP0      N560-RSP4-E           0.0   IOFPGA              CURRENT     0.67      0.67

0/RP0      N560-RSP4-E           0.0   PRIMARY-BIOS        RLOAD REQ   0.16      0.19

0/RP0      N560-RSP4-E           0.0   SATA                CURRENT     2.10      2.10

0/RP1      N560-RSP4-E           0.0   ADM                 CURRENT     1.06      1.06

0/RP1      N560-RSP4-E           0.0   IOFPGA              CURRENT     0.67      0.67

0/RP1      N560-RSP4-E           0.0   PRIMARY-BIOS        RLOAD REQ   0.16      0.19

0/RP1      N560-RSP4-E           0.0   SATA                CURRENT     2.10      2.10
```

```
0/FT0      N560-FAN-H            1.0   PSOC                 CURRENT     2.02       2.02

RP/0/RP1/CPU0:IOS#
```

9. Verify Standby is Node and NSR ready

```
RP/0/RP1/CPU0:IOS#show redundancy
Mon Aug  2 06:39:44.953 UTC
Redundancy information for node 0/RP1/CPU0:
==========================================
Node 0/RP1/CPU0 is in ACTIVE role
Partner node (0/RP0/CPU0) is in STANDBY role
Standby node in 0/RP0/CPU0 is ready
Standby node in 0/RP0/CPU0 is NSR-ready

Reload and boot info
----------------------
RP reloaded Mon Aug  2 06:11:55 2021: 27 minutes ago
Active node booted Mon Aug  2 06:11:55 2021: 27 minutes ago
Standby node boot Mon Aug  2 06:20:02 2021: 19 minutes ago
Standby node last went not ready Mon Aug  2 06:22:46 2021: 16 minutes ago
Standby node last went ready Mon Aug  2 06:26:47 2021: 12 minutes ago
Standby node last went not NSR-ready Mon Aug  2 06:15:01 2021: 24 minutes ago
Standby node last went NSR-ready Mon Aug  2 06:24:52 2021: 14 minutes ago
There have been 0 switch-overs since reload

Active node reload "CARD_SHUTDOWN"
Standby node reload "CARD_SHUTDOWN "

RP/0/RP1/CPU0:IOS#
```

10. IM FPD auto-upgrade: After ISSU

a. Configure the **fpd auto-upgrade enable** command to auto upgrade FPDs for all IMs

Note After ISSU is complete for RPs, configure FPD auto upgrade and FPD auto reload.

Note FPD auto reload affects network traffic. Ensure you schedule the reload of IMs at a time when it has the least impact on traffic.

Note Do not exit configure exclusive mode until all IM FPGA upgrades are automatically completed. Use a separate VTY session to monitor and check status.

```
RP/0/RP1/CPU0:IOS# configure exclusive
Mon Aug  2 06:45:11.297 UTC
RP/0/RP1/CPU0:IOS(config)# fpd auto-upgrade enable
RP/0/RP0/CPU0:IOS(config)# fpd auto-reload enable
RP/0/RP0/CPU0:IOS# commit
```

Note During this step, all IMs that need FPD upgrades, are upgraded simultaneously. IMs are reloaded automatically for the versions to reflect.

b. Exit **configure exclusive** mode when IMFPGA upgrades are completed on all IMs.

```
RP/0/RP1/CPU0:ROUTER#RP/0/RP1/CPU0:Jun 29 06:44:28.808 UTC: fpd_imfpga[430]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : Auto fpd triggered for FPD IMFPGA upgrade @
location 0/5/CPU0 please wait until all fpd upgrades are done
RP/0/RP1/CPU0:Jun 29 06:45:25.105 UTC: fpd-serv[125]: %PKT_INFRA-FM-3-FAULT_MAJOR
: ALARM_MAJOR :FPD-NEED-UPGRADE :DECLARE :0/5:
RP/0/RP1/CPU0:Jun 29 06:48:02.020 UTC: fpd_imfpga[430]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD IMFPGA@0/5 image programming completed with
 UPGRADE DONE state Info: [DONE ]
RP/0/RP1/CPU0:Jun 29 06:48:02.032 UTC: fpd_imfpga[430]:
%INFRA-FPD_Driver-1-UPGRADE_ALERT : FPD IMFPGA @location 0/5 upgrade completed.
0/RP1/ADMIN0:Jun 29 06:48:02.473 UTC: shelf_mgr[3695]:
%INFRA-SHELF_MGR-6-CARD_HW_OPERATIONAL : Card: 0/5 hardware state going to
Operational
0/RP1/ADMIN0:Jun 29 06:48:02.473 UTC: shelf_mgr[3695]:
%INFRA-SHELF_MGR-6-CARD_SW_OPERATIONAL : Card: 0/RP1 software state going to
Operational
0/RP1/ADMIN0:Jun 29 06:48:02.474 UTC: shelf_mgr[3695]:
%INFRA-SHELF_MGR-6-CARD_HW_OPERATIONAL : Card: 0/RP1 hardware state going to
Operational
RP/0/RP1/CPU0:Jun 29 06:48:08.741 UTC: fpd-serv[125]:
%INFRA-FPD_SERVER-1-UPGRADE_ALERT : fpd auto-reload configured on this box.  Going
 to reload node 0/5/CPU0 to activate newly upgraded FPD(s).
0/RP1/ADMIN0:Jun 29 06:48:19.182 UTC: shelf_mgr[3695]: %INFRA-SHELF_MGR-4-CARD_RELOAD
 : Reloading card 0/5
0/RP1/ADMIN0:Jun 29 06:48:19.186 UTC: shelf_mgr[3695]: %INFRA-SHELF_MGR-6-HW_EVENT
 : Rcvd HW event HW_EVENT_RESET, event_reason_str '' for card 0/5
0/RP1/ADMIN0:Jun 29 06:48:21.581 UTC: shelf_mgr[3695]: %INFRA-SHELF_MGR-6-HW_EVENT
 : Rcvd HW event HW_EVENT_POWERED_OFF, event_reason_str 'reset requested by user'
for card 0/5
RP/0/RP1/CPU0:Jun 29 06:48:58.746 UTC: fpd-serv[125]: %PKT_INFRA-FM-3-FAULT_MAJOR
: ALARM_MAJOR :FPD-NEED-UPGRADE :CLEAR :0/5:
0/RP1/ADMIN0:Jun 29 06:49:52.266 UTC: shelf_mgr[3695]: %INFRA-SHELF_MGR-6-HW_EVENT
 : Rcvd HW event HW_EVENT_POWERED_OFF, event_reason_str '' for card 0/5
0/RP1/ADMIN0:Jun 29 06:49:57.586 UTC: shelf_mgr[3695]: %INFRA-SHELF_MGR-6-HW_EVENT
 : Rcvd HW event HW_EVENT_POWERED_ON, event_reason_str '' for card 0/5
0/RP1/ADMIN0:Jun 29 06:50:23.999 UTC: shelf_mgr[3695]: %INFRA-SHELF_MGR-6-HW_EVENT
 : Rcvd HW event HW_EVENT_OK, event_reason_str '' for card 0/5
0/RP1/ADMIN0:Jun 29 06:50:23.999 UTC: shelf_mgr[3695]:
%INFRA-SHELF_MGR-6-CARD_HW_OPERATIONAL : Card: 0/5 hardware state going to
Operational
```

11. Break Reload Actions in Multiple Steps to Avoid Traffic Loss

a. Reload Standby RP

In the following example, RP1 is the active and RP0 is the standby route processor. After the standby RP reloads and boots up, the RP FPDs come to node ready and NSR ready state.

Note It is expected behavior to see different versions of the RPs in System Admin VM and XR VM.

```
RP/0/RP1/CPU0:IOS# admin
Mon Aug  2 07:34:26.615 UTC
Last login: Mon Aug  2 07:20:24 2021 from 192.0.4.4

cafyauto connected from 192.0.4.4 using ssh on sysadmin-vm:0_RP1
sysadmin-vm:0_RP1# hw-module location 0/RP0 reload
Mon Aug  2  07:34:47.432 UTC+00:00
Reload hardware module ? [no,yes] yes
0/RP1/ADMIN0:Aug  2 07:34:48.728 UTC: shelf_mgr[4032]: %INFRA-SHELF_MGR-6-USER_ACTION
```

```
 : User cafyauto(192.0.4.4) requested CLI action 'graceful card reload' for location
 0/RP0
result Card graceful reload request on 0/RP0 succeeded.
0/RP1/ADMIN0:Aug  2 07:35:01.151 UTC: shelf_mgr[4032]: %INFRA-SHELF_MGR-4-CARD_RELOAD
 : Reloading card 0/RP0
RP/0/RP1/CPU0:Aug  2 07:35:01.263 UTC: fpd-serv[216]: %PKT_INFRA-FM-3-FAULT_MAJOR
: ALARM_MAJOR :FPD-NEED-UPGRADE :CLEAR :0/RP0:
RP/0/RP1/CPU0:IOS#show hw-module fpd

Auto-upgrade:Enabled
                                                                        FPD Versions


==============
Location   Card type             HWver FPD device       ATR Status    Running
Programd
-----------------------------------------------------------------------------------
0/1        NCS4200-1T16G-PS      0.0   IMFPGA               CURRENT     1.102
1.10
0/3        NCS4200-1T16G-PS      0.0   IMFPGA               RLOAD REQ   1.95
1.10
0/4        A900-IMA8Z            0.0   IMFPGA               CURRENT    17.05
17.05
0/7        N560-IMA2C            0.0   IMFPGA               RLOAD REQ   4.96
5.01
0/9        A900-IMA8Z            0.0   IMFPGA               CURRENT    17.05
17.05
0/RP0      N560-RSP4-E           0.0   ADM                  CURRENT     1.06
1.06
0/RP0      N560-RSP4-E           0.0   IOFPGA               CURRENT     0.67
0.67
0/RP0      N560-RSP4-E           0.0   PRIMARY-BIOS         CURRENT     0.19
0.19
0/RP0      N560-RSP4-E           0.0   SATA                 CURRENT     2.10
2.10
0/RP1      N560-RSP4-E           0.0   ADM                  CURRENT     1.06
1.06
0/RP1      N560-RSP4-E           0.0   IOFPGA               CURRENT     0.67
0.67
0/RP1      N560-RSP4-E           0.0   PRIMARY-BIOS         RLOAD REQ   0.16
0.19
0/RP1      N560-RSP4-E           0.0   SATA                 CURRENT     2.10
2.10
0/FT0      N560-FAN-H            1.0   PSOC                 CURRENT     2.02
2.02
RP/0/RP1/CPU0:IOS#
```

b. Redundancy Switchover—Swap to the Updated RP as Active RP

After the standby RP is reloaded and booted up, perform the redundancy switchover to this RP with upgraded FPD, as active RP.

Note Follow Step 11a to upgrade and reload the new standby RP.

```
RP/0/RP1/CPU0:IOS#redundancy switchover
Mon Jun 28 17:16:44.914 UTC
Proceed with switchover 0/RP0/CPU0 -> 0/RP1/CPU0? [confirm]

RP/0/RP1/CPU0:Jun 28 17:16:46.157 UTC: rmf_svr[234]: %HA-REDCON-4-FAILOVER_REQUESTED
 : failover has been requested by operator, waiting to initiate
Initiating switch-over.
```

c.

Note You can either perform steps 11a and 11b, *or* you can perform step 11c.

Reload the Router to Reflect the Latest FPD Versions

Note Reloading the router impacts network traffic.

```
RP/0/RP1/CPU0:IOS#admin
Wed Sep  8 06:10:48.761 UTC
Last login: Wed Sep  8 06:05:30 2021 from 192.0.4.6

root connected from 192.0.4.6 using ssh on sysadmin-vm:0_RP1
sysadmin-vm:0_RP1# hw-module location all reload
Wed Sep  8  06:10:56.203 UTC+00:00
Reloading the module will be traffic impacting if not properly drained. Continue
to Reload hardware module ? [no,yes] yes
result Card graceful reload request on all acknowledged.
sysadmin-vm:0_RP1#
```

Automatic FPD Upgrade for PSU

During the installation and Power Supply Unit (PSU) insertion process, the Field-Programmable Devices (FPD) associated with the PSUs are automatically upgraded.

Note The PSUs are upgraded sequentially, hence the PSU FPD upgrades take longer. You can choose to exclude PSUs from the auto upgrade flow. This restricts the PSUs from being upgraded either upon insertion, or during system upgrade.

To exclude the PSU FPDs from auto upgrading, use the following CLI:

fpd auto-upgrade exclude pm

```
RP/0/RSP0/CPU0:router# show running-config fpd auto-upgrade
Wed Mar 30 20:52:55.079 UTC
fpd auto-upgrade enable
fpd auto-upgrade exclude pm
```

Note When you upgrade from an earlier unsupported version to a version that supports Automatic FPD upgrade for PSU, the PSU upgrade might happen on bootup.

Upgrade Failure

On failure of an FPD upgrade, you get a warning with the following syslog message:

```
LC/0/5/CPU0:Jun 27 05:02:25.742 UTC: optics_driver[216]: %INFRA-FPD_Driver-1-UPGRADE_ALERT
 : FPD MIFPGA@0/5 image programming completed with UPGD FAIL state Info: [Image verification
 failed at offset 0x5c8, flash value = 0x0, image value = 0x40, image size = 4194304]
```

```
LC/0/5/CPU0:Jun 27 05:02:26.570 UTC: optics_driver[216]: %INFRA-FPD_Driver-1-UPGRADE_ALERT
 : FPD MIFPGA@0/5 image programming completed with UPGD FAIL state Info: [Image verification
 failed at offset 0x1e, flash value = 0x56, image value = 0xff, image size = 4194304]
```

When you use the **show hw-module fpd**command, the status column displays **UPGD FAIL** to indicate failure of the FPD upgrade.

Note

- Do not reload the line card with a failed FPD upgrade image.
- Upgrade failed FPDs will be fixed with a manual upgrade.
- Contact Cisco TAC or your account representative if the FPD upgrade failure is not repaired.