Managing Router Hardware

This chapter describes the concepts and tasks used to manage and configure the hardware components of a router running the Cisco IOS XR software.

This module contains the following topics:

MPA Reload

A Modular Port Adapter (MPA) is a hardware component used in networking equipment, such as routers and switches, to provide flexible and scalable port configurations.

A data path power-on timer is used during the power-on sequence of a network device to manage the initialization, stabilization, and diagnostic processes of the data path components. If an MPAcard doesn't come up within 20 minutes, the data path power-on timer expires, and the MPA goes for another reload to attempt recovery.

Note When a router enters an undefined state and disrupts the traffic due to the data path power-on timer expiry (timer associated with a data path has expired), reload the router using the **reload location** command.

RP Redundancy and Switchover

This section describes RP redundancy and switchover commands and issues.

Establishing RP Redundancy

Your router has two slots for RPs: RP0 and RP1 (see Figure 1: Redundant Set of RP Installed in Slots RP0 and RP1 in an Cisco 8608 8-Slot Centralized Chassis, on page 2 and Figure 2: Redundant Set of RP Installed in Slots RP0 and RP1 in an Cisco 8808 8-Slot Distributed Chassis, on page 3). RP0 is the slot on the left, facing the front of the chassis, and RP1 is the slot on right. These slots are configured for redundancy by default, and the redundancy cannot be eliminated. To establish RP redundancy, install RP into both slots.

Figure 1: Redundant Set of RP Installed in Slots RP0 and RP1 in an Cisco 8608 8-Slot Centralized Chassis

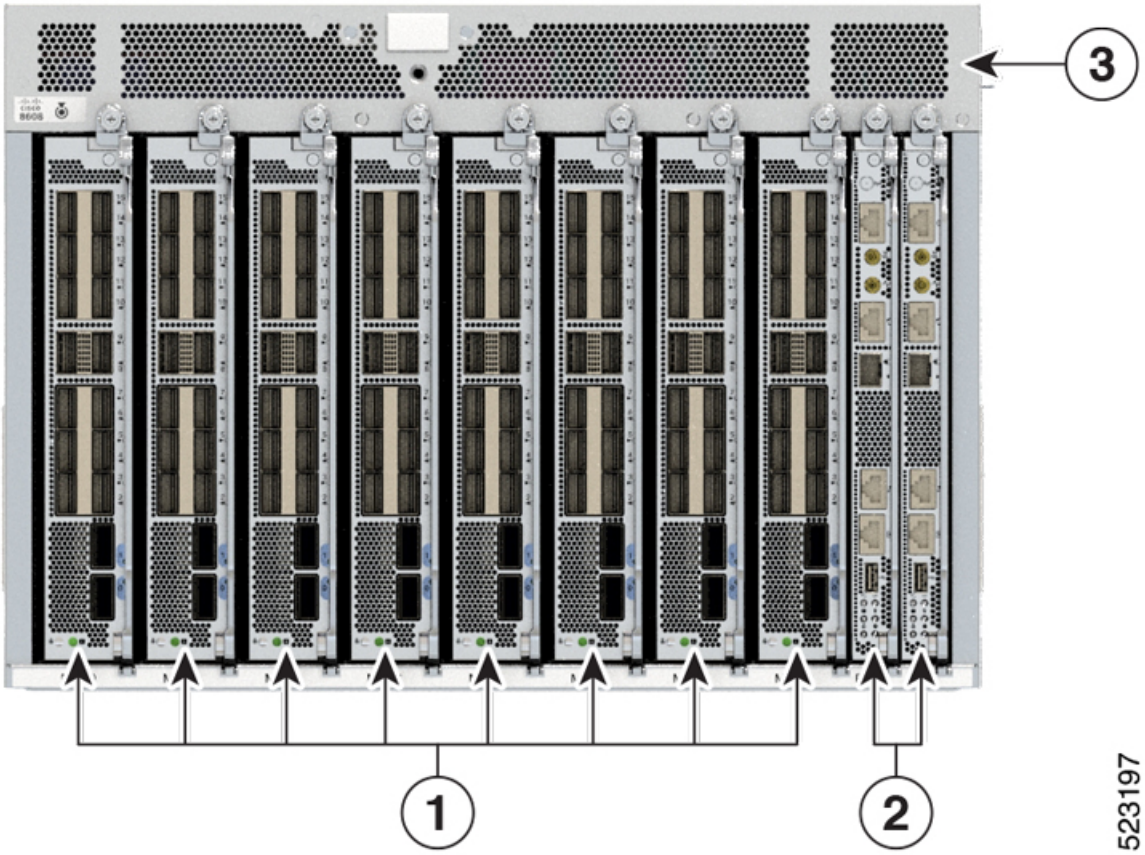
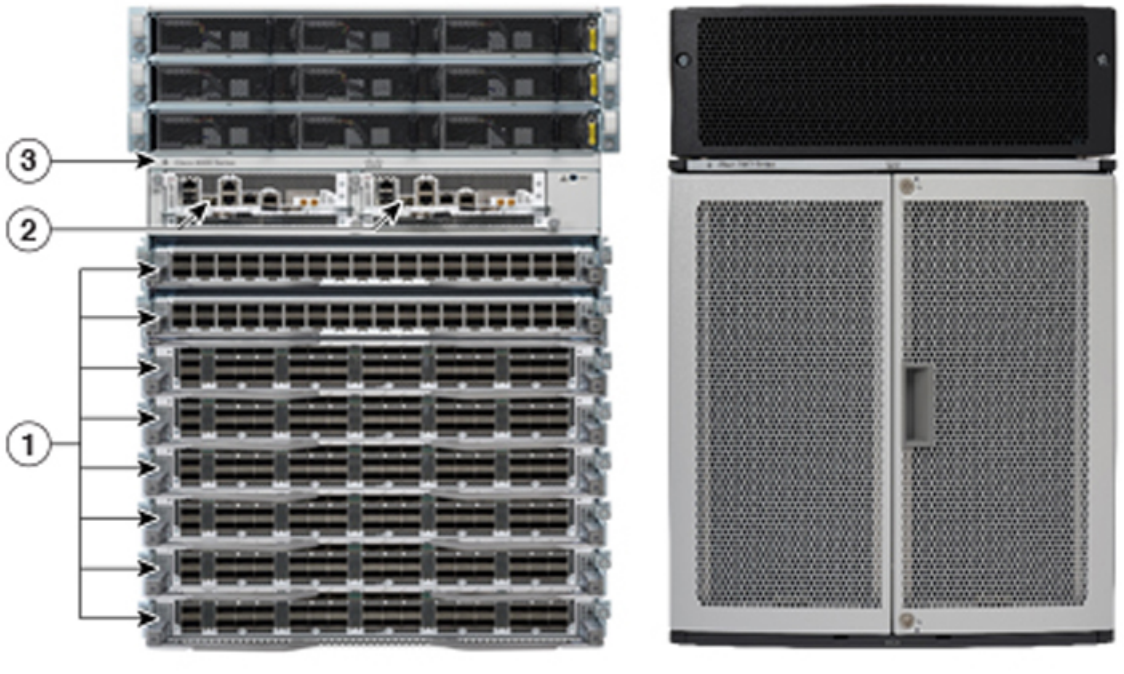


Figure 2: Redundant Set of RP Installed in Slots RP0 and RP1 in an Cisco 8808 8-Slot Distributed Chassis



1	Modular Port Adaptors (MPAs)
2	Route Processors (RPs)
3	Chassis

Determining the Active RP in a Redundant Pair

During system startup, one RP in each redundant pair becomes the active RP. You can tell which RP is the active RP in the following ways:

- The active RP can be identified by the green Active LED on the faceplate of the card. When the Active LED turns on, it indicates that the RP is active and when it turns off, it indicates that the RP is in standby.
- The slot of the active RP is indicated in the CLI prompt. For example:

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

  In this example, the prompt indicates that you are communicating with the active RP in slot RP1.

- Enter the **show redundancy** command in EXEC mode to display a summary of the active and standby RP status. For example:

```
RP/0/RP0/CPU0:router# show redundancy

  This node (0/RP0/CPU0) is in ACTIVE role
  Partner node (0/RP1/CPU0) is in STANDBY role
  Standby node in 0/RP1/CPU0 is ready
```

```
Reload and boot info
----------------------
RP reloaded Fri Apr  9 03:44:28 2004: 16 hours, 51 minutes ago
This node booted Fri Apr  9 06:19:05 2004: 14 hours, 16 minutes ago
Last switch-over Fri Apr  9 06:53:18 2004: 13 hours, 42 minutes ago
Standby node boot Fri Apr  9 06:54:25 2004: 13 hours, 41 minutes ago
Standby node last not ready Fri Apr  9 20:35:23 2004: 0 minutes ago
Standby node last ready Fri Apr  9 20:35:23 2004: 0 minutes ago
There have been 2 switch-overs since reload
```

Role of the Standby RP

The second RP to boot in a redundant pair automatically becomes the standby RP. While the active RP manages the system and communicates with the user interface, the standby RP maintains a complete backup of the software and configurations for all cards in the system. If the active RP fails or goes off line for any reason, the standby RP immediately takes control of the system.

Summary of Redundancy Commands

RP redundancy is enabled by default in the Cisco IOS XR software, but you can use the commands described in Table 1: RP Redundancy Commands, on page 4 to display the redundancy status of the cards or force a manual switchover.

Table 1: RP Redundancy Commands

Command	Description
show redundancy	Displays the redundancy status of the RP. This command also displays the boot and switch-over history for the RP.
redundancy switchover	Forces a manual switchover to the standby RP. This command works only if the standby RP is installed and in the “ready” state.
show platform	Displays the status for node, including the redundancy status of the RP cards. In EXEC mode, this command displays status for the nodes assigned to the SDR. In administration EXEC mode, this command displays status for all nodes in the system.

Automatic Switchover

Automatic switchover from the active RP to the standby RP occurs only if the active RP encounters a serious system error, such as the loss of a mandatory process or a hardware failure. When an automatic switchover occurs, the RPs respond as follows:

- If a standby RP is installed and “ready” for switchover, the standby RP becomes the active RP. The original active RP attempts to reboot.
- If the standby RP is not in “ready” state, then both RPs reboot. The first RP to boot successfully assumes the role of active RP.

RP Redundancy During RP Reload

The **reload** command causes the active RP to reload the Cisco IOS XR software. When an RP reload occurs, the RPs respond as follows:

- If a standby RP is installed and "ready" for switchover, the standby RP becomes the active RP. The original active RP reboots and becomes the standby RP.
- If the standby RP is not in the "ready" state, then both RPs reboot. The first RP to boot successfully assumes the role of active RP.

Manual Switchover

If a standby RP is installed and ready for switchover, you can force a manual switchover using the **redundancy switchover** command or reloading the active RP using the **reload** command.

Manual Switchover Using the Reload Command

You can force a manual switchover from the active RP to the standby RP by reloading the active RP using the **reload** command. As active RP reboots, the current standby RP becomes active RP, and rebooting RP switches to standby RP.

```
RP/0/RP0/CPU0:router# reload
RP/0/RP1/CPU0:router#
```

Manual Switchover Using the Redundancy Switchover Command

You can force a manual switchover from the active RP to the standby RP using the **redundancy switchover** command.

If a standby RP is installed and ready for switchover, the standby RP becomes the active RP. The original active RP becomes the standby RP. In the following example, partial output for a successful redundancy switchover operation is shown:

```
RP/0/RP0/CPU0:router# show redundancy

  This node (0/RP0/CPU0) is in ACTIVE role
  Partner node (0/RP1/CPU0) is in STANDBY role
  Standby node in 0/RP1/CPU0 is ready

  RP/0/RP0/CPU0:router# redundancy switchover
  Updating Commit Database.  Please wait...[OK]
  Proceed with switchover 0/RP0/CPU0 -> 0/RP1/CPU0? [confirm]
  Initiating switch-over.
  RP/0/RP0/CPU0:router#

  <Your 'TELNET' connection has terminated>
```

In the preceding example, the Telnet connection is lost when the previously active RP resets. To continue management of the router, you must connect to the newly activated RP as shown in the following example:

```
User Access Verification

  Username: xxxxx
```

```
  Password: xxxxx
  Last switch-over Sat Apr 15 12:26:47 2009: 1 minute ago

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

If the standby RP is not in “ready” state, the switchover operation is not allowed. In the following example, partial output for a failed redundancy switchover attempt is shown:

```
RP/0/RP0/CPU0:router# show redundancy

  Redundancy information for node 0/RP1/CPU0:
  ==========================================
  Node 0/RP0/CPU0 is in ACTIVE role
  Partner node (0/RP1/CPU0) is in UNKNOWN role

  Reload and boot info
  ----------------------
  RP reloaded Wed Mar 29 17:22:08 2009: 2 weeks, 2 days, 19 hours, 14 minutes ago
  Active node booted Sat Apr 15 12:27:58 2009: 8 minutes ago
  Last switch-over Sat Apr 15 12:35:42 2009: 1 minute ago
  There have been 4 switch-overs since reload

  RP/0/RP0/CPU0:router# redundancy switchover

  Switchover disallowed: Standby node is not ready.
```

Communicating with a Standby RP

The active RP automatically synchronizes all system software, settings, and configurations with the standby RP.

If you connect to the standby RP through the console port, you can view the status messages for the standby RP. The standby RP does not display a CLI prompt, so you cannot manage the standby card while it is in standby mode.

If you connect to the standby RP through the management Ethernet port, the prompt that appears is for the active RP, and you can manage the router the same as if you had connected through the management Ethernet port on the active RP.

NPU Power Optimization

Table 2: Feature History Table

Feature Name	Release Information	Description
NPU Power Optimization	Release 7.3.15	This feature lets you choose a predefined NPU power mode based on your network's individual requirements, and consequently reducing NPU power consumption. The **hw-module npu-power-profile** command is introduced for this feature.

Cisco 8000 series routers are powered by Cisco Silicon One Q200 and Q100 series processors. Cisco Silicon One processors offer high performance, flexible, and power-efficient routing silicon in the market.

NPU Power Optimization feature helps to reduce NPU power consumption by running a processor in a predefined mode. There are three NPU power modes—high, medium, and low. Based on your network traffic and power consumption requirements, you can choose to run the processor in any one of the three NPU power modes.

- High: The router will use the maximum amount of power, resulting in the best possible performance.
- Medium: The router power consumption and performance levels are both average.
- Low: The router operates with optimal energy efficiency while providing a modest level of performance.

Note We recommend that you work with your Cisco account representatives before implementing this feature in your network.

On a Q200-based Cisco 8200 series chassis, you can configure an NPU power mode on the entire router.

On a Q200-based Cisco 8800 series chassis, you can configure an NPU power mode only on fabric cards and line cards.

The following table lists the supported hardware, and their default NPU power mode:

Table 3: Supported Hardware and Default Modes

Supported Hardware	Default NPU Power Mode
Cisco 8200 32x400 GE 1RU fixed chassis (8201-32FH)	High
88-LC0-36FH without MACSec, based on Q200 Silicon Chip	Medium
88-LC0-36FH-M with MACSec, based on Q200 Silicon Chip	Medium
8808-FC0 Fabric Card, based on Q200 Silicon Chip	Low
8818-FC0 Fabric Card, based on Q200 Silicon Chip	Medium

Caution We recommend that you use the default NPU power mode on your router.

Limitations

The NPU power optimization is not supported on the Q100-based systems.

The NPU Power Profile mode is not supported on the following Q200-based line cards:

Table 4: Limitation on Hardware and Power Profile Modes

Hardware	Power Profile Mode
88-LC0-36FH-M	High
88-LC0-34H14FH	High

Configuring NPU Power Mode

Configuring NPU power mode on a fixed chassis:

The following example shows how to configure an NPU power mode on a fixed chassis:

```
RP/0/RP0/CPU0:ios(config)#hw-module npu-power-profile high
RP/0/RP0/CPU0:ios(config)#commit

RP/0/RP0/CPU0:ios(config)#reload
```

Note Note: Reload the chassis for the configurations changes to take effect.

Verifying NPU power mode configuration on a fixed chassis:

Use the **show controllers npu driver** command to verify the NPU power mode configuration:

```
RP/0/RP0/CPU0:ios#show controllers npu driver location 0/RP0/CPU0
Mon Aug 24 23:29:34.302 UTC
==========================================
NPU Driver Information
==========================================
Driver Version: 1
SDK Version: 1.32.0.1
Functional role: Active,     Rack: 8203, Type: lcc, Node: 0
Driver ready      : Yes
NPU first started : Mon Aug 24 23:07:41 2020
Fabric Mode:
NPU Power profile: High
Driver Scope: Node
Respawn count     : 1
Availablity masks :
        card: 0x1,     asic: 0x1,    exp asic: 0x1
...
```

Configuring NPU power mode on a modular chassis

The following example shows how to configure an NPU power mode on a fabric card and a line card:

```
RP/0/RP0/CPU0:ios(config)#hw-module npu-power-profile card-type FC high
RP/0/RP0/CPU0:ios(config)#hw-module npu-power-profile card-type LC low location 0/1/cpu0
RP/0/RP0/CPU0:ios(config)#commit
```

Note For the configurations to take effect, you must:

- Reload a line card if the configuration is applied on the line card.
- Reload a router if the configuration is applied on a fabric card.

Verifying the NPU power mode configuration on a modular chassis

Use the **show controllers npu driver location** command to verify the NPU power mode configuration:

```
RP/0/RP0/CPU0:ios#show controllers npu driver location 0/1/CPU0

Functional role: Active,     Rack: 8808, Type: lcc, Node: 0/RP0/CPU0
Driver ready      : Yes
NPU first started : Mon Apr 12 09:57:27 2021
Fabric Mode: FABRIC/8FC
NPU Power profile: High
Driver Scope: Rack
Respawn count     : 1
Availablity masks :
        card: 0xba,     asic: 0xcfcc,    exp asic: 0xcfcc
Weight distribution:
        Unicast: 80,      Multicast: 20
+-------------------------------------------------------------------+
| Process | Connection | Registration | Connection | DLL            |
| /Lib    | status     | status       | requests   | registration|
+-------------------------------------------------------------------+
| FSDB    | Active     | Active       |           1|  n/a        |
| FGID    | Active     | Active       |           1|  n/a        |
| AEL     | n/a        | n/a          |         n/a|  Yes        |
| SM      | n/a        | n/a          |         n/a|  Yes        |
+-------------------------------------------------------------------+

Asics :
HP - HotPlug event, PON - Power On reset
HR - Hard Reset,    WB  - Warm Boot
+-------------------------------------------------------------------------------------+
| Asic inst. | fap|HP|Slice|Asic|Admin|Oper | Asic state | Last |PON|HR |  FW  |
|   (R/S/A)    | id |  |state|type|state|state|            | init |(#)|(#)|  Rev |
+-------------------------------------------------------------------------------------+
| 0/FC1/2    | 202| 1| UP  |s123| UP  | UP  |NRML        |PON   |  1|  0|0x0000|
| 0/FC1/3    | 203| 1| UP  |s123| UP  | UP  |NRML        |PON   |  1|  0|0x0000|
| 0/FC3/6    | 206| 1| UP  |s123| UP  | UP  |NRML        |PON   |  1|  0|0x0000|
| 0/FC3/7    | 207| 1| UP  |s123| UP  | UP  |NRML        |PON   |  1|  0|0x0000|
| 0/FC4/8    | 208| 1| UP  |s123| UP  | UP  |NRML        |PON   |  1|  0|0x0000|
| 0/FC4/9    | 209| 1| UP  |s123| UP  | UP  |NRML        |PON   |  1|  0|0x0000|
| 0/FC5/10   | 210| 1| UP  |s123| UP  | UP  |NRML        |PON   |  1|  0|0x0000|
| 0/FC5/11   | 211| 1| UP  |s123| UP  | UP  |NRML        |PON   |  1|  0|0x0000|
| 0/FC7/14   | 214| 1| UP  |s123| UP  | UP  |NRML        |PON   |  1|  0|0x0000|
| 0/FC7/15   | 215| 1| UP  |s123| UP  | UP  |NRML        |PON   |  1|  0|0x0000|
+-------------------------------------------------------------------------------------+

SI Info :
+-------------------------------------------------------------------------------------------------+
|   Card  | Board      | SI Board | SI Param | Retimer SI    | Retimer SI    | Front Panel
   |
|         | HW Version | Version  | Version  | Board Version | Param Version | PHY
   |
+-------------------------------------------------------------------------------------------------+
```

```
|  FC1    |  0.22      |     1    |     6    |       NA      |       NA      |       NA
   |
|  FC3    |  0.21      |     1    |     6    |       NA      |       NA      |       NA
   |
|  FC4    |  0.21      |     1    |     6    |       NA      |       NA      |       NA
   |
|  FC5    |  0.21      |     1    |     6    |       NA      |       NA      |       NA
   |
|  FC7    |  0.21      |     1    |     6    |       NA      |       NA      |       NA
   |
+-------------------------------------------------------------------------------------------+
Functional role: Active,     Rack: 8808, Type: lcc, Node: 0/1/CPU0
Driver ready      : Yes
NPU first started : Mon Apr 12 09:58:10 2021
Fabric Mode: FABRIC/8FC
NPU Power profile: Low
Driver Scope: Node
Respawn count     : 1
Availablity masks :
        card: 0x1,     asic: 0x7,    exp asic: 0x7
Weight distribution:
        Unicast: 80,      Multicast: 20
+-----------------------------------------------------------------+
| Process | Connection | Registration | Connection | DLL          |
| /Lib    | status     | status       | requests   | registration|
+-----------------------------------------------------------------+
| FSDB    | Active     | Active       |           1|  n/a         |
| FGID    | Inactive   | Inactive     |           0|  n/a         |
| AEL     | n/a        | n/a          |         n/a|  Yes         |
| SM      | n/a        | n/a          |         n/a|  Yes         |
+-----------------------------------------------------------------+

Asics :
HP - HotPlug event, PON - Power On reset
HR - Hard Reset,    WB  - Warm Boot
+-------------------------------------------------------------------------------+
| Asic inst. | fap|HP|Slice|Asic|Admin|Oper | Asic state | Last |PON|HR |  FW  |
|   (R/S/A)  | id |  |state|type|state|state|            | init |(#)|(#)|  Rev |
+-------------------------------------------------------------------------------+
| 0/2/0      |   8| 1| UP  |npu | UP  | UP  |NRML        |PON   |  1|  0|0x0000|
| 0/2/1      |   9| 1| UP  |npu | UP  | UP  |NRML        |PON   |  1|  0|0x0000|
| 0/2/2      |  10| 1| UP  |npu | UP  | UP  |NRML        |PON   |  1|  0|0x0000|
+-------------------------------------------------------------------------------+

SI Info :
+-------------------------------------------------------------------------------------------+
|   Card  | Board      | SI Board | SI Param | Retimer SI    | Retimer SI    | Front Panel
   |
|         | HW Version | Version  | Version  | Board Version | Param Version | PHY
   |
+-------------------------------------------------------------------------------------------+
|  LC2    |  0.41      |     1    |     9    |       NA      |       NA      |  DEFAULT
   |
+-------------------------------------------------------------------------------------------+
```

Dynamic Power Management

Table 5: Feature History Table

Feature Name	Release Information	Description
Dynamic Power Management	Release 7.3.15	The Dynamic Power Management feature considers certain dynamic factors before allocating power to the fabric and line cards. This feature has the following benefits: • Reduces number of PSUs required by accurately representing the maximum power consumption • Improves PSU efficiency by providing more accurate power allocation This feature thus optimizes power allocation and avoids overprovisioning power to a router.
Dynamic Power Management	Release 7.3.2	Previously available for fabric and line cards, this feature that helps avoid excess power allocation by considering dynamic factors before allocating power to them is now available for optical modules. To view the power allocation on a per port basis, a new command "**show environment power allocated [details]**" is introduced.
Dynamic Power Management	Release 7.3.3	The Dynamic Power Management feature is now supported on the following Cisco 8100 and 8200 series routers: • Cisco 8201 • Cisco 8202 • Cisco 8201-32-FH • Cisco 8101-32-FH
Dynamic Power Management	Release 7.5.2	The Cisco 8202-32FH-M router will now consider dynamic factors, such as optical modules, NPU power profile, and MACsec mode to enable improved power allocation and utilization.

Prior to Cisco IOS XR Release 7.3.15, when Cisco 8000 series routers were powered on or reloaded, the power management feature reserved power to fabric cards and allocated maximum power to line cards. The

power management feature wouldn't consider dynamic factors, such as the type of fabric or line cards in the chassis, or whether a fabric or line card was present in a slot.

The Dynamic Power Management feature considers such dynamic factors before allocating power to the fabric and line cards.

This feature has the following benefits:

- Reduces number of PSUs required by accurately representing the maximum power consumption
- Improves PSU efficiency by providing more accurate power allocation

This feature thus optimizes power allocation and avoids overprovisioning power to a router.

This feature is supported on the following Cisco 8000 series routers:

- Cisco 8804, 8808, 8812, and 8818 routers
- Cisco 8201, 8202, 8201-32-FH, and 8202-32FH-M routers
- Cisco 8101-32-FH

By default, this feature is enabled on the router.

The Dynamic Power Management feature allocates the total power to a router and its fabric card or line card based on the following parameters:

- Number and type of fabric cards installed on the router
- Fabric cards operating modes (5FC or 8FC)
- Number and type of line cards installed on the router
- Combination of line card and fabric card types installed
- NPU power mode configured on a fabric card
- Number and type of optics installed (supported in Cisco IOS XR Software Release 7.3.2 and later)
- MACSec-enabled ports (supported from Cisco IOS XR Software Release 7.3.3 and later)

  For details, see *Dynamic Power Management for MACSec-Enabled Ports* section in the *Configuring MACSec* chapter in the *System Security Configuration Guide for Cisco 8000 Series Routers*.

On 8202-32FH-M router, the Dynamic Power Management feature allocates the total power to a router based on the following parameters:

- Optical modules installed.
- NPU power profile. To identify the mode on which the router is operating, use the `hw-module npu-power-profile` command.
- MACSec mode. By default, MACSec mode is disabled on 8202-32FH-M router.

Note We recommend you work with your Cisco account representatives to calculate power requirements for the Cisco 8000 series router.

Power Allocation to Empty Card Slot

This feature allocates a minimum required power for all empty LC or FC slots. This minimum power is required to boot the CPU and FPGAs immediately when a card is inserted. The feature doesn't control booting up the CPU and FPGAs. Also, the minimum power is required to detect the card type before the feature decides if there's enough power to power up the data path.

For example, the following **show environment power** command output displays various LC or FC card statuses, and also shows allocated and used power.

Note The allocated power capacity shown in the following **show** command output isn't standard capacity. The allocated power capacity varies depending on various other factors.

```
Router# show environment power
Thu Apr 22 12:03:06.754 UTC
===============================================================================
CHASSIS LEVEL POWER INFO: 0
===============================================================================
   Total output power capacity (N + 1)             :    9600W +     6300W
   Total output power required                     :    9241W
   Total power input                               :    6146W
   Total power output                              :    5826W

===============================================================================
   Power       Supply         -------Input--------   -----Output---     Status
   Module      Type            Volts A/B   Amps A/B   Volts     Amps
===============================================================================
   0/PT0-PM0   PSU6.3KW-HV     245.5/245.7 5.1/5.0    54.7      43.1     OK
   0/PT0-PM1   PSU6.3KW-HV     0.0/245.2   0.0/7.4    54.3      31.7     OK
   0/PT0-PM2   PSU6.3KW-HV     0.0/246.9   0.0/7.5    54.1      32.3     OK

Total of Power Modules:       6146W/25.0A              5826W/107.1A

===============================================================================
   Location     Card Type               Power       Power        Status
                                        Allocated   Used
                                        Watts       Watts
===============================================================================
   0/RP0/CPU0   8800-RP                 95          69           ON
   0/RP1/CPU0   -                       95          -            RESERVED
   0/0/CPU0     88-LC0-36FH             796         430          ON
   0/1/CPU0     -                       102         -            RESERVED
   0/2/CPU0     88-LC0-36FH             796         430          ON
   0/3/CPU0     -                       102         -            RESERVED
   0/4/CPU0     -                       102         -            RESERVED
   0/5/CPU0     -                       102         -            RESERVED
   0/6/CPU0     -                       102         -            RESERVED
   0/7/CPU0     -                       102         -            RESERVED
   0/8/CPU0     -                       102         -            RESERVED
   0/9/CPU0     88-LC0-36FH             102         -            OFF
   0/10/CPU0    -                       102         -            RESERVED
   0/11/CPU0    -                       102         -            RESERVED
   0/FC0        -                       26          -            RESERVED
   0/FC1        -                       26          -            RESERVED
   0/FC2        -                       26          -            RESERVED
   0/FC3        8812-FC                 784         509          ON
   0/FC4        8812-FC                 784         503          ON
   0/FC5        8812-FC                 26          -            OFF
   0/FC6        8812-FC                 26          -            OFF
   0/FC7        8812-FC                 26          -            OFF
```

```
0/FT0        8812-FAN              1072        1000         ON
0/FT1        8812-FAN              1072        1012         ON
0/FT2        8812-FAN              1072        861          ON
0/FT3        8812-FAN              1072        1033         ON
```

This table describes the card slot statuses:

Table 6: Router Card Slot Status

Status	Description
RESERVED	When a slot is empty
OFF	When a card is inserted in a slot but power isn't allocated to the card
ON	When a card is allocated power and the card is in operational state

Low-Power Condition

When you insert an LC or FC in a card slot at the time when the router doesn't have enough power available to allocate to the new card, the dynamic power management feature doesn't provision power to the card. It raises the *ev_power_budget_not_ok* alarm, and gracefully shuts down the card.

In the following **show** command output, an FC inserted in the card slot location 0/FC6 is gracefully shut down due to lack of power:

```
Router# show shelfmgr history events location 0/FC6
Thu Apr 22 12:03:11.763 UTC
NODE NAME     : 0/FC6
CURRENT STATE : CARD_SHUT_POWERED_OFF
TIME STAMP    : Apr 20 2021 16:49:52
-------------------------------------------------------------------------------
DATE        TIME (UTC)  EVENT                    STATE
-------------------------------------------------------------------------------
Apr 20 2021 16:49:52    ev_powered_off           CARD_SHUT_POWERED_OFF
Apr 20 2021 16:49:52    ev_device_offline        STATE_NOT_CHANGED
Apr 20 2021 16:49:52    ev_unmapped_event        STATE_NOT_CHANGED
Apr 20 2021 16:49:48    transient_condition      CARD_SHUTDOWN
Apr 20 2021 16:49:48    ev_check_card_down_reaso CHECKING_DOWN_REASON
Apr 20 2021 16:49:48    ev_timer_expiry          CARD_SHUTDOWN_IN_PROGRESS
Apr 20 2021 16:48:46    ev_power_budget_not_ok   CARD_SHUTDOWN_IN_PROGRESS
Apr 20 2021 16:48:45    transient_condition      POWER_BUDGET_CHECK
Apr 20 2021 16:48:45    ev_fpd_upgrade_not_reqd  CARD_STATUS_CHECK_COMPLETE
Apr 20 2021 16:47:45    ev_card_status_check     CARD_STATUS_CHECK
Apr 20 2021 16:47:45    ev_card_info_rcvd        CARD_INFO_RCVD
Apr 20 2021 16:47:44    ev_device_online         DEVICE_ONLINE
Apr 20 2021 16:47:43    ev_timer_expiry          CARD_POWERED_ON
Apr 20 2021 16:47:33    ev_powered_on            CARD_POWERED_ON
Apr 20 2021 16:47:33    init                     CARD_DISCOVERED
-------------------------------------------------------------------------------
```

However, after an LC, FC, or chassis reload, the dynamic power management feature can't ensure that the same LCs, FCs, optics, or interfaces, which were operational earlier (before the reload), would become active again.

Note During a low-power condition, this feature doesn't borrow power from a redundant power supply.

Power Allocation to Optics

From Cisco IOS XR Release 7.3.2 onwards, power requirement for optics is also considered before allocating power to them.

To identify the power allocated for a particular interface, use the **show environment power allocated** [**details**] **location** *location* command.

When the optical modules are inserted, power is automatically allocated for that interface. If power has been allocated to the interface, then use the "**no shut**" command to enable the interface.

```
Router# show environment power allocated location 0/3/CPU0
Thu Oct  7 22:27:35.732 UTC
================================================================================
   Location    Components               Power
                                        Allocated
                                        Watts
================================================================================
  0/3/CPU0     Data-path                772
               OPTICS                   138
================================================================================
               Total                    910

Router# show environment power allocated details location 0/3/CPU0
Thu Oct  7 22:27:42.221 UTC
================================================================================
   Location    Components               Power
                                        Allocated
                                        Watts
================================================================================
  0/3/CPU0     Data-path                772
               0/3/0/0                  3
               0/3/0/1                  3
               0/3/0/2                  3
               0/3/0/3                  3
               0/3/0/4                  3
               0/3/0/5                  3
               0/3/0/6                  3
               0/3/0/7                  3
               0/3/0/8                  3
               0/3/0/9                  3
               0/3/0/10                 3
               0/3/0/11                 3
               0/3/0/12                 3
               0/3/0/13                 3
               0/3/0/14                 3
               0/3/0/15                 3
               0/3/0/16                 3
               0/3/0/17                 3
               0/3/0/18                 3
               0/3/0/19                 3
               0/3/0/20                 3
               0/3/0/21                 3
               0/3/0/22                 3
               0/3/0/23                 3
               0/3/0/24                 3
```

```
                0/3/0/25                3
                0/3/0/26                3
                0/3/0/27                3
                0/3/0/28                3
                0/3/0/29                3
                0/3/0/30                3
                0/3/0/31                3
                0/3/0/32                3
                0/3/0/33                3
                0/3/0/34                3
                0/3/0/35                3
                0/3/0/36                3
                0/3/0/37                3
                0/3/0/38                3
                0/3/0/39                3
                0/3/0/40                3
                0/3/0/41                3
                0/3/0/42                3
                0/3/0/43                3
                0/3/0/44                3
                0/3/0/46                3
==============================================================================
                Total                   910
```

When the power is not allocated to the interface, the following syslog error and alarms are displayed

```
!<--Syslog Error-->!
#LC/0/3/CPU0:Oct  7 22:46:48.114 UTC: optics_driver[165]: %PKT_INFRA-FM-3-FAULT_MAJOR :
ALARM_MAJOR :POWER ALLOCATION FAIL :DECLARE :0/3/CPU0:  Optics0/3/0/44
LC/0/3/CPU0:Oct  7 22:46:48.114 UTC: optics_driver[165]:
%L2-OPTICS-2-QSFP_POWER_ALLOCATION_FAILURE : Not enough power available to enable Optics
0/3/0/44

!<--Alarm-->!
Router#show alarms brief system active
Thu Oct  7 22:47:19.569 UTC

------------------------------------------------------------------------------------------
Active Alarms
------------------------------------------------------------------------------------------
Location        Severity     Group            Set Time                    Description



------------------------------------------------------------------------------------------
0/3/CPU0        Major        Software         10/07/2021 22:46:48 UTC     Optics0/3/0/44 -
 hw_optics:  Lack of available power to enable the optical module


0/3/CPU0        Major        Software         10/07/2021 22:47:06 UTC     Optics0/3/0/46 -
 hw_optics:  Lack of available power to enable the optical module
```

If power is not allocated to an interface and you attempt to enable that interface using the "**no shut**" command, the following syslog error is displayed:

```
LC/0/2/CPU0:Aug 30 18:01:14.930 UTC: eth_intf_ea[262]: %PLATFORM-VEEA-1-PORT_NOT_ENABLED :
 Power not allocated to enable the interface HundredGigE0_2_0_6.
```

Power Allocation to Fixed-Port Routers

The following **show environment power** command output displays power information for fixed-port routers and components.

```
Router# show environment power
Wed Feb 16 21:05:10.001 UTC
===============================================================================
CHASSIS LEVEL POWER INFO: 0
===============================================================================
   Total output power capacity (Group 0 + Group 1) :    1400W +     1400W
   Total output power required                     :    1033W
   Total power input                               :     390W
   Total power output                              :     255W

Power Group 0:
===============================================================================
   Power       Supply         ------Input----   ------Output---     Status
   Module      Type            Volts     Amps    Volts     Amps
===============================================================================
   0/PM0       PSU1.4KW-ACPE   244.5     0.8     12.0      11.1     OK

Total of Group 0:              195W/0.8A         133W/11.1A

Power Group 1:
===============================================================================
   Power       Supply         ------Input----   ------Output---     Status
   Module      Type            Volts     Amps    Volts     Amps
===============================================================================
   0/PM1       PSU1.4KW-ACPE   244.2     0.8     12.0      10.2     OK

Total of Group 1:              195W/0.8A         122W/10.2A

===============================================================================
   Location     Card Type               Power       Power        Status
                                        Allocated   Used
                                        Watts       Watts
===============================================================================
   0/RP0/CPU0   8201                    893         -            ON
   0/FT0        FAN-1RU-PE              28          -            ON
   0/FT1        FAN-1RU-PE              28          -            ON
   0/FT2        FAN-1RU-PE              28          -            ON
   0/FT3        FAN-1RU-PE              28          -            ON
   0/FT4        FAN-1RU-PE              28          -            ON
```

To identify the power allocated for a particular interface, use the **show environment power allocated** [**details**] **location** *location* command.

```
Router# show environment power allocated location 0/RP0/CPU0
Wed Feb 16 21:05:21.360 UTC
===============================================================================
   Location    Components              Power
                                       Allocated
                                       Watts
===============================================================================
  0/RP0/CPU0   Data-path               858
               OPTICS                  35
===============================================================================
               Total                   893


Router# show environment power allocated details location 0/RP0/CPU0
Wed Feb 16 21:05:36.142 UTC
===============================================================================
   Location    Components              Power
                                       Allocated
                                       Watts
===============================================================================
  0/RP0/CPU0   Data-path               858
```

```
                0/0/0/19                21
                0/0/0/18                14
================================================================================
                Total                   893
```

Disabling Dynamic Power Management

By default, the dynamic power management is enabled on a router. The following example shows how to disable dynamic power management:

```
RP/0/RP0/CPU0:ios(config)#power-mgmt action disable
RP/0/RP0/CPU0:ios(config)#commit
```

Caution After disabling the dynamic power management feature, you must manage the router power on your own. So, use this command with caution.

Note To reenable dynamic power management, use the **no power-mgmt action disable** command.

On-demand transfer of Redundant Power Modules to Power Reservation Pool

Table 7: Feature History Table

Feature Name	Release Information	Feature Description
On-demand transfer of Redundant Power Modules to Power Reservation Pool	Release 24.4.1	Introduced in this release on: Fixed Systems(8200, 8700); Modular Systems (8800 [LC ASIC: P100]) (select variants only*). *This feature is now supported on: • 8212-32FH-M • 8711-32FH-M • 88-LC1-12TH24FH-E

Feature Name	Release Information	Feature Description
On-demand transfer of Redundant Power Modules to Power Reservation Pool	Release 7.11.1	The Cisco 8800 Series Modular Routers now have a functionality that allows them to transfer their redundant Power Supply Units (PSUs) to the power reservation pool when there is inadequate power supply. This capability helps prevent the router from shutting down hardware components due to a lack of power in the reservation pool, which used to occur due to the router prioritizing redundancy over power availability in the power reservation pool. Consequently, the router now raises an alarm indicating redundancy loss when it transfers PSUs to the power reservation pool. This feature ensures that the router components reserve the necessary power, even when redundancy is enabled.

The Cisco 8000 Series Modular Routers offer redundancy while managing Power Supply Units (PSUs), providing continuous operation if there is PSU failure. By default, the router operates in N+1 redundancy, where N represents the number of PSUs allotted to the power reservation pool for powering the router components, and 1 indicates the backup PSU. You can use the **power-mgmt redundancy-num-pms** *number* command in XR Config mode mode to configure the PSU redundancy from N+1 to N+x, where x is the number of redundant PSUs required. The total number of functioning PSUs must be at least x more than the number of PSUs required to support the power demanded by all the components in the system for optimal router functionality. The range of values assigned to x is 0–11, where 0 implies no power redundancy. The router uses the redundant PSUs only when there is a PSU failure. But, if the power requirement of the router increases than the available power offered by PSUs, the router prioritizes maintaining PSU redundancy overpowering the components.

Starting from Cisco IOS XR Release 7.11.1, the Cisco 8800 Modular Routers prioritize powering the router components over preserving redundancy. The router transfers the redundant PSUs to a power reservation pool to power the router components on demand. The router utilizes the redundant PSUs to increase the power capacity in the power reservation pool rather than maintaining redundancy. For example, consider a scenario with 18900W (3 6300W PSUs) available power. Initially, the router reserves 12600W (using 2 PSUs) in the power reservation pool and retains 6300W (one PSU) as a backup to maintain N+1 redundancy. Suppose the router needs to reserve power for any components to power up and needs more power than is available in the reservation pool. In that case, the router uses the entire 18900W with all three PSUs to power the components by transferring the redundant PSU to the power reservation pool. The router then triggers a redundancy loss alarm with such an assignment. However, if any further actions result in reduced power consumption in the router, the system automatically restores redundancy and clears the redundancy lost alarm.

On redundancy loss, the router raises a **Critical** severity **Power Module redundancy lost** alarm. You can use the **show alarms brief** command to view the redundancy lost alarm.

Syslog messages for transforming redundant PSU into borrowable resource:

Syslog message created while redundancy loss (transforming redundant PSU to functional PSU):

```
RP/0/RP0/CPU0:Jul 24 11:49:01.316 UTC: envmon[214]: %PKT_INFRA-FM-3-FAULT_MAJOR : ALARM_MAJOR
 :Power Module redundancy lost :DECLARE :0:
```

Syslog message created while restoring redundancy:

```
RP/0/RP0/CPU0:Jul 24 11:49:11.375 UTC: envmon[214]: %PKT_INFRA-FM-3-FAULT_MAJOR : ALARM_MAJOR
 :Power Module redundancy lost :CLEAR :0:
```

You can also use the **show environment** view the redundancy status of the PSUs in the router.

The following section details the commands to verify the redundancy status in the router:

Router with N+1 redundancy:

```
Router:ios# show environment power
          ================================================================================

           CHASSIS LEVEL POWER INFO: 0
          ================================================================================

           Total output power capacity (N + 1)             :   12600W +     6300W
           Total output power required                     :   11545W
           Total power input                               :    3302W
           Total power output                              :    3004W

          ================================================================================

           Power       Supply         -------Input--------   -----Output---     Status
           Module      Type            Volts A/B   Amps A/B   Volts     Amps
          ================================================================================

           0/PT5-PM0   PSU6.3KW-HV     240.5/241.3 2.2/2.4    55.1      18.3     OK
           0/PT5-PM1   PSU6.3KW-HV     240.5/240.8 2.1/2.3    54.8      17.3     OK
           0/PT5-PM2   PSU6.3KW-HV     242.2/241.1 2.3/2.4    54.9      19.1     OK

           Total of Power Modules:       3302W/13.7A              3004W/54.7A

          ================================================================================

           Location     Card Type               Power       Power        Status
           Allocated   Used
           Watts       Watts
          ================================================================================

           0/RP0/CPU0   8800-RP                 105         78           ON
           0/RP1/CPU0   -                       105         -            RESERVED
           0/0/CPU0     8800-LC-36FH           1097        513          ON
           0/1/CPU0     -                      102         -            RESERVED
           0/2/CPU0     88-LC0-36FH            102         0            OFF
           0/3/CPU0     -                      102         -            RESERVED
           0/4/CPU0     -                      102         -            RESERVED
           0/5/CPU0     -                      102         -            RESERVED
           0/6/CPU0     -                      102         -            RESERVED
           0/7/CPU0     -                      102         -            RESERVED
           0/8/CPU0     -                      102         -            RESERVED
           0/9/CPU0     -                      102         -            RESERVED
           0/10/CPU0    -                      102         -            RESERVED
           0/11/CPU0    -                      102         -            RESERVED
           0/12/CPU0    -                      102         -            RESERVED
           0/13/CPU0    -                      102         -            RESERVED
           0/14/CPU0    -                      102         -            RESERVED
           0/15/CPU0    -                      102         -            RESERVED
           0/16/CPU0    -                      102         -            RESERVED
           0/17/CPU0    -                      102         -            RESERVED
```

```
0/FC0        -                      32          -           RESERVED
0/FC1        -                      32          -           RESERVED
0/FC2        8818-FC0               584         475         ON
0/FC3        -                      32          -           RESERVED
0/FC4        8818-FC0               584         472         ON
0/FC5        -                      32          -           RESERVED
0/FC6        -                      32          -           RESERVED
0/FC7        -                      32          -           RESERVED
0/FT0        8818-FAN               1786        237         ON
0/FT1        8818-FAN               1786        228         ON
0/FT2        8818-FAN               1786        234         ON
0/FT3        8818-FAN               1786        228         ON
```

Router with redundancy loss:

```
Router:ios# sh env power
          ===============================================================================

           CHASSIS LEVEL POWER INFO: 0
          ===============================================================================

           Total output power capacity (N + 1)             :   18900W +        0W
           Total output power required                     :   12689W
           Total power input                               :    3302W
           Total power output                              :    3004W

          ===============================================================================

           Power       Supply         -------Input--------   -----Output---     Status
           Module      Type            Volts A/B   Amps A/B   Volts     Amps
          ===============================================================================

           0/PT5-PM0   PSU6.3KW-HV     240.5/241.3 2.2/2.4    55.1      18.3     OK
           0/PT5-PM1   PSU6.3KW-HV     240.5/240.8 2.1/2.3    54.8      17.3     OK
           0/PT5-PM2   PSU6.3KW-HV     242.2/241.1 2.3/2.4    54.9      19.1     OK

           Total of Power Modules:       3302W/13.7A              3004W/54.7A

          ===============================================================================

           Location     Card Type              Power       Power        Status
           Allocated   Used
           Watts       Watts
          ===============================================================================

           0/RP0/CPU0   8800-RP                105         78           ON
           0/RP1/CPU0   -                      105         -            RESERVED
           0/0/CPU0     8800-LC-36FH           1097        513          ON
           0/1/CPU0     -                      102         -            RESERVED
           0/2/CPU0     88-LC0-36FH            916         510          ON
           0/3/CPU0     -                      102         -            RESERVED
           0/4/CPU0     -                      102         -            RESERVED
           0/5/CPU0     -                      102         -            RESERVED
           0/6/CPU0     -                      102         -            RESERVED
           0/7/CPU0     -                      102         -            RESERVED
           0/8/CPU0     -                      102         -            RESERVED
           0/9/CPU0     -                      102         -            RESERVED
           0/10/CPU0    -                      102         -            RESERVED
           0/11/CPU0    -                      102         -            RESERVED
           0/12/CPU0    -                      102         -            RESERVED
           0/13/CPU0    -                      102         -            RESERVED
           0/14/CPU0    -                      102         -            RESERVED
           0/15/CPU0    -                      102         -            RESERVED
           0/16/CPU0    -                      102         -            RESERVED
           0/17/CPU0    -                      102         -            RESERVED
```

```
            0/FC0       -                    32          -           RESERVED
            0/FC1       -                    32          -           RESERVED
            0/FC2       8818-FC0             749         475         ON
            0/FC3       -                    32          -           RESERVED
            0/FC4       8818-FC0             749         472         ON
            0/FC5       -                    32          -           RESERVED
            0/FC6       -                    32          -           RESERVED
            0/FC7       -                    32          -           RESERVED
            0/FT0       8818-FAN             1786        237         ON
            0/FT1       8818-FAN             1786        225         ON
            0/FT2       8818-FAN             1786        234         ON
            0/FT3       8818-FAN             1786        228         ON
Router:ios# sh alarms brief system active

------------------------------------------------------------------------------
            Active Alarms

------------------------------------------------------------------------------
            Location        Severity     Group           Set Time
Description


------------------------------------------------------------------------------
            0/RP0/CPU0      Critical     Software        10/27/2023 00:22:08 UTC
Redundancy Partner Not Present

            0               Major        Environ         10/27/2023 00:23:48 UTC    Power
 Module redundancy lost
            0/RP0/CPU0      Minor        Fabric          10/27/2023 00:22:39 UTC    Fabric
 Plane-0 status

            0/RP0/CPU0      Minor        Fabric          10/27/2023 00:22:39 UTC    Fabric
 Plane-1 status

            0/RP0/CPU0      Minor        Fabric          10/27/2023 00:22:39 UTC    Fabric
 Plane-3 status

            0/RP0/CPU0      Minor        Fabric          10/27/2023 00:22:39 UTC    Fabric
 Plane-5 status

            0/RP0/CPU0      Minor        Fabric          10/27/2023 00:22:39 UTC    Fabric
 Plane-6 status

            0/RP0/CPU0      Minor        Fabric          10/27/2023 00:22:39 UTC    Fabric
 Plane-7 status

            0/RP0/CPU0      Major        Software        10/27/2023 00:22:59 UTC
Communications Failure With Cisco Licensing Cloud

            0               Major        Environ         10/27/2023 00:23:48 UTC    Power
 Module redundancy lost
```

Power Redundancy Protection

Table 8: Feature History Table

Feature Name	Release Information	Feature Description
Power Redundancy Protection	Release 24.1.1	You can now prevent power module exhaustion or failure due to power redundancy issues in the power feeds with the help of alarms that warn that the total output power required by the router exceeds the total feed redundancy capacity. You can configure either single-fault protection or dual fault protection, depending on whether you want to trigger alarms during redundancy failures in the power supply feed, PSU redundancy, or both. The feature introduces these changes: **CLI:** • **power-mgmt feed-redundancy** • The `Total feed redundancy capacity` field is added to the **show environment** command.

The Cisco 8000 Series Modular Routers have two redundancy mechanisms to ensure the router continues functioning even during power supply failures:

- The PSU redundancy involves having extra power supplies that can take over if one fails, ensuring continuous operation.
- The power feed redundancy divides the input power into A and B feeds. When both feeds are functioning normally, they share the power load equally. However, if one of the feeds fails, the other feed scales up to its maximum capacity or the power supply unit (PSU) will operate with reduced input to ensure that the power supply to the router is uninterrupted.

These power redundancy options provide a high level of reliability and minimize the risk of network downtime due to power supply failures.

The routers now have power redundancy protection that triggers alarms for PSU and feed redundancy failures when the total output power required by the router exceeds its total feed redundancy capacity. You can configure the total feed redundancy capacity in two modes- single fault protection and dual fault protection.

The **single fault protection** mode monitors the router against a **power supply feed or PSU** redundancy failure. Meanwhile, the **dual fault protection** monitors the router against a **power supply feed and PSU** redundancy failure simultaneously. You can also customize the PSU single feed capacity in the router. Each

PSU has a default power range for the single feed; you can configure a value within the range to meet your specific infrastructure requirements.

The feed redundancy alarm is triggered when the total output power required exceeds the total feed redundancy capacity. The router's total feed capacity is determined by the least of two factors: feed redundancy capacity and PSU redundancy capacity. The PSU redundancy capacity is the number of power supply units minus the redundant ones (N) multiplied by a dual feed capacity. On the other hand, the feed redundancy capacity is the total number of PSUs multiplied by a single feed capacity. In single-fault protection, the PSU refers to the router's total number of power supply units (N+1). In dual-fault protection, the PSU refers to the number of power supply units minus the redundant ones (N).

For example, consider a router that has a total of 9 PSUs with a default N + 1 power redundancy configuration. The PSU feed capacity with dual feed is 4800 W and the single feed capacity value is set 3200 W, then the total feed redundancy capacity would be:

Power Redundancy Protection	Total Number of PSUs	PSU redundancy	Number of PSUs minus the redundant ones (N)	Dual Feed Capacity	Single Feed Capacity	Feed Redundancy Capacity	PSU Redundancy Capacity	Total Feed Redundancy Capacity
Single fault protection	9	N+1	8	4800 W	3200 W	28800 W	38400 W	28800 W
Dual fault protection	9	N+1	8	4800 W	3200 W	25600 W	38400 W	25600 W

Guidelines and Restrictions for Power Redundancy Protection

- By default, the router doesn’t enable Power Redundancy Protection.
- The Power Redundancy Protection feature doesn’t impact the power budgeting in the routers.
- For maximum power redundancy protection, use the dual fault protection.
- For total feed redundancy capacity calculations, the router considers only the PSUs with A and B inputs. Both A and B inputs must be within the operating range in healthy conditions. If either feed is unavailable, the router excludes such PSUs from the calculations.
- The router considers all PSUs, including redundant PSUs with two feeds (within the operating range in healthy condition) for feed redundancy capacity in single fault protection. However, the router excludes the redundant PSUs for feed redundancy capacity in dual fault protection. If the router has 8 PSUs and N+3 redundancy, single fault protection calculation considers all eight PSUs, whereas dual fault protection considers just 5 PSUs.

Configure Power Redundancy Protection

To configure the power redundancy protection mode and PSU single feed capacity, you can use the **power-mgmt feed-redundancy** command.

Single fault protection with PSU single feed capacity set to 2400 Watts

Configuration:

```
Router# config
Router(config)# power-mgmt feed-redundancy single-fault-protection capacity 2400
Router(config)# commit
```

Running Configuration:

```
Router# show run power
…
power-mgmt feed-redundancy single-fault-protection capacity 2400
…
```

Verification:

```
Router# show env power
================================================================================
CHASSIS LEVEL POWER INFO: 0
================================================================================
   Total output power capacity (N + 1)             :   28800W +     4800W
   Total output power required                     :    6679W >>>>> 1
   Total power input                               :    2394W
   Total power output                              :    2066W
   Total feed redundancy capacity (Single Fault)   :   16800W >>>>> 2
   //*The router triggers feed redundancy loss alarm when 1 > 2.**//
================================================================================
   Power       Supply         -------Input--------   -----Output---     Status
   Module      Type            Volts A/B   Amps A/B   Volts     Amps
================================================================================
   0/PT0-PM0   PSU4.8KW-DC100  62.8/62.7   2.6/2.5    55.2      5.3      OK
   0/PT0-PM1   PSU4.8KW-DC100  62.7/62.7   2.7/2.6    55.3      5.3      OK
   0/PT0-PM3   PSU4.8KW-DC100  61.0/62.7   2.6/2.5    55.2      4.8      OK
   0/PT1-PM0   PSU4.8KW-DC100  67.3/67.3   2.7/2.5    55.3      5.2      OK
   0/PT1-PM1   PSU4.8KW-DC100  67.3/67.2   2.8/2.7    55.3      5.7      OK
   0/PT1-PM2   PSU4.8KW-DC100  67.3/67.4   2.7/2.7    55.2      5.6      OK
   0/PT1-PM3   PSU4.8KW-DC100  67.3/67.3   2.6/2.5    55.3      5.5      OK

Total of Power Modules:       2394W/36.7A              2066W/37.4A
```

Dual fault protection with PSU single feed capacity set to 2400 Watts

Configuration:

```
Router# config
Router(config)# power-mgmt feed-redundancy dual-fault-protection capacity 2400
Router(config)# commit
```

Running Configuration:

```
Router# show run power
…
power-mgmt feed-redundancy dual-fault-protection capacity 2400
…
```

Verification:

```
Router# show env power
================================================================================
CHASSIS LEVEL POWER INFO: 0
================================================================================
   Total output power capacity (N + 1)             :   28800W +     4800W
   Total output power required                     :    6679W >>>>> 1
   Total power input                               :    2394W
   Total power output                              :    2066W
   Total feed redundancy capacity (Dual Fault)     :   14400W >>>>> 2
 //*The router triggers feed redundancy loss alarm when 1 > 2.**//
================================================================================
```

```
   Power       Supply         -------Input--------   -----Output---     Status
   Module      Type            Volts A/B   Amps A/B   Volts     Amps
==============================================================================
   0/PT0-PM0   PSU4.8KW-DC100  62.8/62.7   2.6/2.5    55.2      5.3      OK
   0/PT0-PM1   PSU4.8KW-DC100  62.7/62.7   2.7/2.6    55.3      5.3      OK
   0/PT0-PM3   PSU4.8KW-DC100  61.0/62.7   2.6/2.5    55.2      4.8      OK
   0/PT1-PM0   PSU4.8KW-DC100  67.3/67.3   2.7/2.5    55.3      5.2      OK
   0/PT1-PM1   PSU4.8KW-DC100  67.3/67.2   2.8/2.7    55.3      5.7      OK
   0/PT1-PM2   PSU4.8KW-DC100  67.3/67.4   2.7/2.7    55.2      5.6      OK
   0/PT1-PM3   PSU4.8KW-DC100  67.3/67.3   2.6/2.5    55.3      5.5      OK

Total of Power Modules:       2394W/36.7A              2066W/37.4A
```

Alarms for power redundancy loss

You can use the **show alarms brief** command to view the power redundancy alarm:

Note The router triggers the `Power Module redundancy feed mode lost` alarm only when **Total output power required** exceeds **Total feed redundancy capacity**.

```
Router# show alarms brief system active
------------------------------------------------------------------------------------------------------------------
Active Alarms
------------------------------------------------------------------------------------------------------------------
Location        Severity     Group           Set Time                    Description


------------------------------------------------------------------------------------------------------------------


0              Major        Environ        11/27/2023 12:55:08 UTC    Power Module redundancy
 feed mode lost
```

System Log messages for power redundancy loss

Syslog message created while power redundancy loss (total output power exceeds total feed redundancy capacity):

```
RP/0/RP0/CPU0:Dec 15 10:24:29.489 UTC: envmon [123]: %PKT_INFRA-FM-3-FAULT_MAJOR : ALARM_MAJOR
 :Power Feed redundancy lost :DECLARE :0
```

Ability to Set Maximum Power Limit for the Router

Table 9: Feature History Table

Feature Name	Release Information	Feature Description
Ability to Set Maximum Power Limit for the Router	Release 24.4.1	Introduced in this release on: Fixed Systems(8200, 8700); Modular Systems (8800 [LC ASIC: P100]) (select variants only*). *This feature is now supported on: • 8212-32FH-M • 8711-32FH-M • 88-LC1-12TH24FH-E
Ability to Set Maximum Power Limit for the Router	Release 7.11.1	We are introducing functionality to set the maximum power limit for a router to improve power management and distribution in the PSUs. It prevents a router from using more than the configured power and also gives the ability to limit the reservation pool regardless of how many power supplies are present. In the previous releases, the ability to prevent a router from using more than a configured amount of power was unavailable. This feature introduces the following change: **CLI** • **power-mgmt configured-power-capacity**

In the earlier releases, there was no mechanism to limit the power a router consumed. Routers could draw more than the infrastructure could handle. Over power consumption could result in system brownout.

With the Cisco IOS XR Software Release 7.11.1, you can allocate system power based on max power capacity configuration. This prevents the router from allocating more power than the infrastructure can handle. It also gives you the ability to limit power to a router according to your infrastructure requirements. The max power capacity parameter doesn't allow power consumed by the hardware to cross the configured amount.

The criteria to set maximum power limit is that the value must be set between the current allocated power and the available maximum power at time of configuration.

This feature is not applicable for fixed routers.

A new command **power-mgmt configured-power-capacity** has been introduced with this feature.

A new alarm **PKT_INFRA-FM-3-FAULT_MAJOR : ALARM_MAJOR :Power reservation exceeds configured power** is introduced to be raised when the max power capacity is crossed.

Note This alarm is extremely rare and is raised only when the power reservation exceeds configured power. This can only happen when hardware is inserted, it is granted power without a request, such as a fan tray.

Configuring the Compatibility Mode for Various NPU Types

Table 10: Feature History Table

Feature Name	Release Information	Description
Optimizing NPU Mode Compatibility for Route Processor Upgrades	Release 24.1.1	When installing Route Processor (RP) cards from different NPU modes or NPU families, the system prioritizes newer generations over older generations. Upgrading to a newer RP, like the 8800-RP2, maintains performance by allowing the use of the Q200 NPU mode without needing to revert to Q100 NPU mode. You can switch to a different NPU mode by using the **hw-module profile npu-compatibility** command.
Configure Compatibility Mode for Q100 and Q200-based Line Cards	Release 7.7.1	You can now configure the compatibility behavior of line cards to operate in Q100 mode (default behavior) or in Q200 mode when you have a mix of Q100-based line cards and Q200-based line cards that are installed in a router. In earlier releases, in a mixed mode combination, where multiple generations of line cards were installed on a distributed chassis, the behavior was to make the second-generation line cards interoperate with the first-generation line cards. However, this led the NPUs to set lower resource limits for the newer generation line cards to ensure backward compatibility. Also, the router didn't fully utilize the improved scale, higher capacity, and feature-rich capabilities of the newer generation line cards. This compatibility feature now enables you to select if you want the line cards to operate in Q100 or Q200 NPU mode. The **hw-module profile npu-compatibility** command is introduced for this feature.

In earlier releases, if you install a mix of Q100-based line cards and Q200-based line cards, the Q200-based line cards operate in a scaled-down (Q100) mode by default.

The compatibility feature, applicable to Cisco 8800 Series modular/distributed chassis, now allows you to choose if you want line cards to operate in Q100 (default behavior), Q200, or P100 mode. In Q200 mode, the router boots only the Q200-based line cards and gracefully shuts down the Q100-based line cards.

For example, if a router has a Q100 NPU-based line card and you try to add a line card from the Q200 NPU-based line card, the Q200 NPU line card operates in a scaled down mode to be able to work with the older generation-Q100 line cards. With the new implementation, you can choose if you want the router to work in the Q100 mode or shutdown the Q100-based linecards, and use the Q200 NPU-based line cards in the Q200 mode.

FAQs About the Compatibility Modes for Various NPU Types

- **Can the line cards still be used in scaled down mode, like in the previous scenario?**

  Yes, you can still switch to the previous implementation, if you may, to the scaled down mode.

- **What all ASICs can participate in the compatibility mode implementation?**

  P100, Q200, Q100.

- **Is there any default ASIC set by the system?**

  The ASIC default is based on the Fabric Cards (FCs) and route processor cards used in a distributed chassis. However, you can choose to change the ASIC mode to Q200, Q100, or P100.

- **Do I need to reboot the router after implementing a new NPU mode?**

  Yes, reboot the router for the new NPU mode to take effect.

- **What defines an NPU mode?**

  NPU mode is determined by the Route Processor (RP) and the Fabric Card (FC). During the router's boot-up process, it initially identifies the RP and the FC, setting the corresponding NPU mode regardless of the line cards present in the router.

Usage Guidelines and Limitations

The following guidelines and limitations apply when you configure the line cards from different ASIC families:

- By default, a mix of Q100 and Q200 line cards results in the Q200 line cards operating in Q100 (scaled-down) mode. Configuring Q100 mode results in the same (default) behavior. Similarly, a mix of P100 and Q200 line cards results in the Q200 line cards operating in P100 (scaled-down) mode. Configuring P100 mode results in the same (default) behavior.
- To be able to use the improved scale, higher capacity, and feature-rich capabilities of the Q200-based line cards, use the **`hw-module profile npu-compatibility`** command and set it to operate in the Q200 mode. Else, the Q200-based line cards scale down to the Q100 mode, which is the default behavior. The same behavior applies to the P100-based line cards.
- Reboot the router for the compatibility mode to take effect. If the system detects a noncompatible line card, it shuts down that line card. For example, in Q200 mode, the router boots only the Q200-based line cards and gracefully shuts down the Q100-based line cards.
- The **`hw-module profile npu-compatibility`** command isn't configurable on the Cisco 8200 Series fixed router and Cisco 8608 router.

- For 8800-RP, the default NPU mode is Q100. For 8800-RP2, the default NPU mode is Q200.
- For the various fabric card types available, the following scenarios may be applicable:
  - 8800-RP Route Processor Card - if the router boots up with an 8800-RP route processor card without any fabric card, then the default mode is set to Q100.
  - 8800-RP2 Route Processor Card - if the router boots up with a 8800-RP2 route processor card without any fabric card, then the router sets the default mode to P100. If you insert a Q200 fabric card, then router reload is required.
  - Swapping Fabric Cards - if the router initially boots with Q200 fabric cards and you later replace them with F100 fabric cards, a router reload is necessary.

This table lists the Q100, Q200, and P100-based line cards that support the compatibility mode:

ASIC Family	Line Card
Q100-based line cards	8800-LC-48H
	8800-LC-36FH
Q200-based line cards	88-LC0-34H14FH
	88-LC0-36FH
	88-LC0-36FH-M
P100-based line cards	88-LC1-36EH
	88-LC1-12TH24FH-E
	88-LC1-52Y8H-EM

Route Processor Card Behavior with NPUs

A newer generation Route Processor (RP) card takes precedence over an older generation RP card when installed from different NPU modes. The precedence followed by the system is: P100 > Q200 > Q100.

If you have Q200-based line cards and an older generation RP card (8800-RP) installed on your router, the router boots with Q100 ASIC mode for the line cards. However, you can change the ASIC mode from Q100 to Q200 by using the **hw-module profile npu-compatibility** command. Setting the ASIC mode to a newer generation ASIC allows you to utilize their improved scale, higher capacity, and feature-rich capabilities when you replace your RPs with a newer generation RP.

For instance, if your router is equipped with an 8800-RP route processor card set to ASIC mode as Q200, upgrading to an 8800-RP2 RP card won't require changing the ASIC mode from Q100 to Q200.

Line Card Behavior with NPUs

The following table explains how the various line cards take precendence when installed from different ASIC families. The precedence followed by the system is: P100 > Q200 > Q100, where the newer generation line cards take precedence over an older generation line card.

NPU Family of Installed Line Cards	Compatibility Mode Configured?	Compatibility Mode	Router Behavior during Bootup for the Line Cards
Q200 and Q100	N	Default (Q100)	Q200 line cards boot up and operate in Q100 mode, Q100 up.
	Y	Q200	Q200 line cards boot up, Q100 line cards shut down.
	Y	Q100	All line cards boot up, Q200 line cards operate in Q100 mode.
Q200 and Q200	N	Default (Q100)	Both the Q200 line cards boot up and operate in Q100 mode.
	Y	Q200	Both the Q200 line cards boot up
Q100 and P100	N	Default (Q100)	P100 line cards boot up and operate in Q100 mode, Q100 up.
	Y	P100	P100 line cards boot up, Q100 line cards shut down.

Supported Compatibility Modes on Fabric Cards, RP Cards, and Line Cards

The following table provides details on the fabric cards (FCs), supported route processors (RPs), compatible ASIC families, supported line cards, and the ability to configure the **hw-module profile npu-compatibility** command on those line cards within a router:

Router	Route Processor	Fabric Card	Supported ASIC families to co-exist	Supported Line Cards	Configure NPU Compatibility?
Cisco 8812 Cisco 8818	8800-RP	8812-FC 8818-FC	Q100, Q200	8800-LC-48H 8800-LC-36FH 88-LC0-34H14FH 88-LC0-36FH 88-LC0-36FH-M	Yes
		8818-FC0	Q100, Q200	8800-LC-48H 8800-LC-36FH 88-LC0-34H14FH 88-LC0-36FH 88-LC0-36FH-M	Yes
	8800-RP2	8818-FC0	Q200	8800-LC-48H 8800-LC-36FH 88-LC0-34H14FH 88-LC0-36FH 88-LC0-36FH-M	Yes
	8800-RP2-S	8818-FC0	Q200	88-LC0-36FH 88-LC0-36FH-M 88-LC0-34H14FH	Yes

Router	Route Processor	Fabric Card	Supported ASIC families to co-exist	Supported Line Cards	Configure NPU Compatibility?
Cisco 8804 Cisco 8808	8800-RP	8808-FC	Q100, Q200	8800-LC-48H 8800-LC-36FH 88-LC0-34H14FH 88-LC0-36FH 88-LC0-36FH-M	Yes
		8804-FC0 8808-FC0	Q100, Q200	8800-LC-48H 8800-LC-36FH 88-LC0-34H14FH 88-LC0-36FH 88-LC0-36FH-M	Yes
	8800-RP2	8804-FC0 8808-FC0	Q200	8800-LC-48H 8800-LC-36FH 88-LC0-34H14FH 88-LC0-36FH 88-LC0-36FH-M	Yes
		8804-FC1 8808-FC1	Q200, P100	88-LC0-34H14FH 88-LC0-36FH 88-LC0-36FH-M 88-LC1-36EH	Yes
		8804-FC1 8808-FC1	P100	88-LC1-36EH 88-LC1-12TH24FH-E 88-LC1-52Y8H-EM	Yes
	8800-RP2-S	8808-FC0 8804-FC0	Q200 Default mode is Q200	88-LC0-36FH 88-LC0-36FH-M 88-LC0-34H14FH	Yes
		8808-FC1	P100 Default mode is P100	88-LC1-36EH 88-LC1-12TH24FH-E 88-LC1-52Y8H-EM Q200-based ASIC line cards	Yes
		8804-FC1			Yes

Router	Route Processor	Fabric Card	Supported ASIC families to co-exist	Supported Line Cards	Configure NPU Compatibility?
			P100 Default mode is P100	88-LC1-36EH 88-LC1-12TH24FH-E 88-LC1-52Y8H-EM Q200-based ASIC line cards	

Note Q100-based ASIC is not supported with 8800-RP2-S.

These are details of the compatibility mode for 8800-RP2 card with various fabric cards, line cards, and the supported default mode:

Table 11: 8800-RP Compatibility with Fabric Cards, Line Cards, and Supported Default Mode

Fabric Card	Fabric Card ASIC	Default ASIC	Supported Line Cards	Configure NPU Compatibility?
8808-FC 8812-FC 8818-FC	Q100	Q100	Q100-based and Q200-based	Yes You can configure the NPU mode to Q200 if you have only Q200-based line cards installed on your chassis.
8804-FC0 8808-FC0 8818-FC0	Q200	Q100	Q100-based and Q200-based	Yes You can configure the NPU mode to Q200 if you have only Q200-based line cards installed on your chassis.
8808-FC1	F100	NA	NA	NA
8804-FC1	F100	NA	NA	NA

These are details of the compatibility mode for 8800-RP2 card with various fabric cards, line cards, and the supported default mode:

Table 12: 8800-RP2 Compatibility with Fabric Cards, Line Cards, and Supported Default Mode

Fabric Card	Fabric Card ASIC	RP(8800-RP2)	Default ASIC	Supported Line Cards	Configure NPU Compatibility?
8808-FC 8812-FC 8818-FC	Q100	Not Supported	NA	NA	NA
8812-FC0	Q200	Supported	Q200	Q200-based	NA
8808-FC1	F100	Supported	P100	P100-based	Yes You can configure the NPU mode to Q200 if you have both Q200-based an P100-based line cards installed on your chassis.

These are details of the compatibility mode for 8800-RP2-S card with various fabric cards, line cards, and the supported default mode:

Table 13: 8800-RP2-S Compatibility with Fabric Cards, Line Cards, and Supported Default Mode

Fabric Card	Line Card	Default Mode
8804-FC0 8808-FC0 8818-FC0	Q200-based ASIC line cards	Q200
8808-FC1	88-LC1-36EH 88-LC1-12TH24FH-E 88-LC1-52Y8H-EM Q200-based ASIC line cards	P100
8804-FC1	88-LC1-36EH 88-LC1-12TH24FH-E 88-LC1-52Y8H-EM Q200-based ASIC line cards	P100

Compatibility Matrix for Route Processor Cards

The following table outlines the behavior of the various RP cards when installed on the router and explains their compatibility:

Table 14: Compatibility Between Various RP cards Installed on Router

Active RP	Standby RP	Compatibility Yes/No	Behaviour
8800-RP2-S	8800-RP2-S	Yes	NA
8800-RP2-S	8800-RP2	No	8800-RP2 shutsdown
8800-RP2-S	8800-RP	No	8800-RP shutsdown
8800-RP2	8800-RP2-S	No	8800-RP2-S shutsdown
8800-RP	8800-RP2-S	No	8800-RP2-S shutsdown

Configuring NPU compatibility for Line Cards

To configure a router for handling line cards of different NPU-based line cards, use the **hw-module profile npu-compatibility** command. To go back to the default mode, use the **no** form of this command.

The following are the options available in command and their descriptions:

npu-compatibility	Allows you to make a router compatible with a NPU family.
mode-name	Allows you to set the mode, such as Q100, Q200, or P100.

The following is a configuration example:

```
Router:ios(config)#hw-module profile npu-compatibility q200
Tue Dec 7 15:06:53.697 UTC
Chassis mode will be activated after a manual reload of chassis/all line cards
Router:ios(config)#commit
Tue Dec 7 15:06:54.646 UTC
LC/0/1/CPU0:Dec 7 15:06:54.796 UTC: npu_drvr292:
%FABRIC-NPU_DRVR-3-HW_MODULE_PROFILE_NPU_COMPATIBILITY_CHASSIS_CFG_CHANGED : Please reload
chassis for the configuration to take effect
end
Router:ios(config)#end
Router:ios#
```

Running Configuration

```
RP/0/RP0/CPU0:ios# show ver
Mon Jun 27 19:25:52.947 UTC
Cisco IOS XR Software, Version 7.7.1.27I LNT
Copyright (c) 2013-2022 by Cisco Systems, Inc.

Build Information:
 Built By     : ingunawa
 Built On     : Wed Jun 01 23:50:09 UTC 2022
 Build Host   : iox-ucs-060
 Workspace    : /auto/iox-ucs-060-san1/prod/7.7.1.27I.SIT_IMAGE/8000/ws
 Version      : 7.7.1.27I
 Label        : 7.7.1.27I

cisco 8000 (VXR)
cisco 8808 (VXR) processor with 32GB of memory
ios uptime is 3 minutes
```

```
Cisco 8808 8-slot Chassis

RP/0/RP0/CPU0:ios#

RP/0/RP0/CPU0:ios# conf
Mon Jun 27 19:24:40.621 UTCRP/0/RP0/CPU0:ios(config)#hw-module profile npu-compatibility ?
  P100  Use P100 for Chassis mode
  Q100  Use Q100 for Chassis mode
  Q200  Use Q200 for Chassis mode
```

Verification

```
RP/0/RP0/CPU0:ios# show hw-module profile npu-compatibility matrix
Wed Nov 17 02:00:28.652 UTC
Node              Card Type                NPU Type
-----------------------------------------------------
0/0/CPU0          88-LC0-36FH              Q200
0/1/CPU0          88-LC1-36EH              P100
0/2/CPU0          88-LC1-36EH              P100
0/3/CPU0          88-LC1-36EH              P100

            Compatibility       Compatibility       Compatibility       Compatibility
  Compatibility       Compatibility       Compatibility
NPU Type   Mode Q100            Mode Q200            Mode G100            Mode P100
     Mode A100            Mode K100            Mode F100
-------------------------------------------------------------------------
Q100        Compatible          Not Compatible      Not Compatible      Not Compatible
  Not Compatible      Not Compatible      Not Compatible
Q200        Compatible          Compatible          Not Compatible      Not Compatible
  Not Compatible      Not Compatible      Not Compatible
G100        Not Compatible      Compatible          Compatible          Not Compatible
  Not Compatible      Not Compatible      Not Compatible
P100        Not Compatible      Not Compatible      Not Compatible      Not Compatible
  Not Compatible      Not Compatible      Not Compatible
A100        Not Compatible      Not Compatible      Not Compatible      Not Compatible
  Not Compatible      Not Compatible      Not Compatible
K100        Not Compatible      Not Compatible      Not Compatible      Not Compatible
  Not Compatible      Not Compatible      Not Compatible
F100        Not Compatible      Not Compatible      Not Compatible      Not Compatible
  Not Compatible      Not Compatible      Not Compatible
Default mode : P100
RP/0/RP0/CPU0:ios#
```

Storage Media Sanitization

Table 15: Feature History Table

Feature Name	Release Information	Feature Description
Storage Media Sanitization	Release 7.3.4	To comply with NIST SP 800-88 guidelines for Media Sanitization, it is important that your organization ensures that no easily reconstructible data is stored in the router and associated devices after it has left the control of your organization or is no longer protected by confidentiality categorization. With this feature, you can erase and overwrite any sensitive data, configuration, or keys present in the route processor or line card, ensuring media sanitization and preventing unauthorized data retrieval.

When you identify an RP or line card for RMA, or you require to ship it outside your organization, a service personnel may not be available on-site to remove the card immediately. However, you can reset your RP or line card to erase customer-sensitive data and let the RP or line card remain in the slot.

Guidelines and restrictions for factory reset functionality

These guidelines and restrictions apply to factory reset functionality on routers:

- You cannot initiate factory reset if the entire system is down or if no active RP is booted to IOS XR OS.
- We recommend using **factory-reset** without performing **commit replace** for securely removing the files in the misc/config folder.
- The RP or line card shuts down automatically if the factory reset takes more than 30 minutes, you can perform the factory reset again. The console displays this log message during automatic shutdown:

```
[ TIME ] Timed out starting Power-Off.
[ !!  ] Forcibly powering off as result of failure.
```

- If your router has dual RPs, and to perform the factory reset on both the RPs, first reset the standby RP from the active RP. After the reset is complete, you can then reset the active RP.
- The factory reset operation does not completely wipe out the data on the hard disk of the active RP because the disaster recovery partitioning is not removed.

Perform factory reset on a router

Factory reset functionality supports these scenarios:

- Reload option: resets the router and reboots it
- Shutdown option: resets the router and shuts it down
- Location option: applies the reset operation to specific locations such as individual line card (LC) or route processor (RP)

Use the **factory-reset** command for erasing these folders of RP or LC :

- /misc/disk1
- /misc/scratch
- /var/log
- /misc/config

Before you begin

- Device must be operational and booted to IOS XR OS to initiate factory reset.
- Ensure that there is no immediate requirement for the router after the operation, as it involves complete data removal and shutdown.
- Take a backup of the router data as a precautionary measure.

Procedure

Step 1 Initiate factory reset process on the router CLI.

- Reload option:

```
Router#factory-reset reload location 0/RP1/CPU0
Tue Mar 11 11:18:43.222 UTC
Performing factory-reset may affect the stability of the system. Re-imaging maybe required to
recover. Continue?
[confirm]
```

- Shutdown option:

```
Router#factory-reset shutdown location 0/RP1/CPU0
Tue Mar 11 11:18:43.222 UTC
Performing factory-reset may affect the stability of the system. Re-imaging maybe required to
recover. Continue?
[confirm]
```

The factory reset command with the **location** *location-id* option erases customer-sensitive data in the specified location.

Step 2 Check the system logs to confirm that the factory reset process is completed.

Example:

The logs are displayed on the console port of the node where the reset is performed.

Step 3 Verify that the factory reset process is completed.

Example:

This example shows how to verify the factory reset process that is performed with the **shutdown** option:

```
Router#show shelfmgr history events location 0/RP1/CPU0
Tue Mar 15 01:45:56.402 UTC
NODE NAME     : 0/RP1/CPU0
CURRENT STATE : CARD_SHUT_POWERED_OFF
TIME STAMP    : Mar 15 2022 01:44:47
------------------------------------------------------------------------------
DATE        TIME (UTC)  EVENT                     STATE
------------------------------------------------------------------------------
Mar 15 2022 01:44:47    ev_powered_off            CARD_SHUT_POWERED_OFF
Mar 15 2022 01:44:47    transient_condition       CARD_SHUTDOWN
Mar 15 2022 01:44:47    ev_check_card_down_reaso CHECKING_DOWN_REASON
Mar 15 2022 01:44:47    ev_os_halted              OS_HALTED
Mar 15 2022 01:44:43    ev_factory_reset_done     FACTORY_RESET_DONE
Mar 15 2022 01:33:16    ev_factory_reset_started FACTORY_RESET_IN_PROGRESS
Mar 15 2022 01:33:11    ev_os_halting             OS_HALT_IN_PROGRESS
Mar 15 2022 01:33:10    ev_xr_shut                START_OS_HALT
Mar 15 2022 01:33:09    ev_ack_ok                 STATE_NOT_CHANGED
Mar 15 2022 01:33:09    ev_graceful_shut          CARD_SHUTDOWN_IN_PROGRESS
Mar 15 2022 00:55:31    ev_xr_ready               XR_RUN
```

This example shows how to verify the factory reset process that is performed with the **reload** option:

```
Router#show shelfmgr history events location 0/RP0/CPU0
Tue Mar 15 01:45:56.402 UTC
NODE NAME     : 0/RP0/CPU0
CURRENT STATE : CARD_SHUT_POWERED_OFF
TIME STAMP    : Mar 15 2022 01:44:47
------------------------------------------------------------------------------
DATE        TIME (UTC)  EVENT                     STATE
------------------------------------------------------------------------------
Jun 29 2022 13:48:34    ev_xr_ready               XR_RUN
Jun 29 2022 13:48:10    ev_card_info_rcvd         CARD_INFO_RCVD
Jun 29 2022 13:47:52    ev_xr_init                XR_INITIALIZING
Jun 29 2022 13:47:44    ev_kernel_booting         STATE_NOT_CHANGED
Jun 29 2022 13:47:14    ev_kernel_booting         KERNEL_BOOTING
Jun 29 2022 13:46:53    ev_unmapped_event         STATE_NOT_CHANGED
Jun 29 2022 13:46:53    ev_bios_started           BIOS_STARTED
Jun 29 2022 13:46:51    ev_bios_ready             BIOS_READY
Jun 29 2022 13:46:10    ev_unmapped_event         STATE_NOT_CHANGED
Jun 29 2022 13:46:10    ev_powered_on             CARD_POWERED_ON
Jun 29 2022 13:46:05    ev_card_reset_done        CARD_RESET
Jun 29 2022 13:46:05    transient_condition       CARD_RESETTING
Jun 29 2022 13:46:05    ev_check_card_down_reaso CHECKING_DOWN_REASON
Jun 29 2022 13:46:05    ev_os_halted              OS_HALTED
Jun 29 2022 13:45:50    ev_factory_reset_done     FACTORY_RESET_DONE
Jun 29 2022 13:34:09    ev_factory_reset_started FACTORY_RESET_IN_PROGRESS
Jun 29 2022 13:33:59    ev_os_halting             OS_HALT_IN_PROGRESS
Jun 29 2022 13:33:58    ev_xr_shut                START_OS_HALT
Jun 29 2022 13:33:56    ev_graceful_reload        CARD_SHUTDOWN_IN_PROGRESS
Jun 29 2022 09:18:43    ev_xr_ready               XR_RUN
Jun 29 2022 09:17:37    ev_card_info_rcvd         CARD_INFO_RCVD
Jun 29 2022 09:17:32    ev_powered_on             CARD_POWERED_ON
Jun 29 2022 09:17:31    init                      CARD_DISCOVERED
```

Excluding Sensitive Information in Show Running Configurations Output

Table 16: Feature History Table

Feature Name	Release Information	Feature Description
Excluding Sensitive Information in Show Running Configurations Command Output	Release 7.5.4	You can now exclude sensitive information such as strings, usernames, passwords, comments, or IP addresses within the **show running-configuration** command output by enabling sanitization on the nonvolatile generation (NVGEN) process. With this feature, you can achieve better data protection to prevent cybersecurity risks compared to regular router algorithms. This feature introduces the **nvgen default-sanitize** command.

The **show running configuration** command uses the nonvolatile generation (NVGEN) process in IOS-XR software to collect configuration information from every system component and construct a running configuration file to create its output. However, this file may contain sensitive information, including usernames, passwords, and IP addresses, which could pose a security threat when obfuscation algorithms in the router are weak compared to modern cryptographic standards.

In this feature, you can mask the following types of sensitive information in the show running configurations:

- Strings
- Usernames
- Passwords
- Comments
- IP Addresses

On enabling the sanitization in show running configurations, the NVGEN process replaces the corresponding information with **<removed>** string. For example, if you enable sanitization for IP Addresses, the show running configuration includes the **<removed>** string in place of all the IP Addresses in the output.

Sanitizing Strings

Configuration

```
Router# config
Router:(config)# nvgen default-sanitize strings
Router:(config)# commit
```

Running Configuration

```
Router# show run nvgen
nvgen
 default-sanitize strings
!
```

Verification

```
Router# show run int Hu0/2/0/4
interface HundredGigE0/2/0/4
 ! This is comment 1
 description <removed>
 !
```

Sanitizing Usernames

Configuration

```
Router# config
Router:(config)# nvgen default-sanitize usernames
Router:(config)# commit
```

Running Configuration

```
Router# show run nvgen
nvgen
 default-sanitize usernames
!
```

Verification

```
Router# show run username test
username <removed>
 group root-lr
 password 7 172864HJWBJHBCWH
!
```

Sanitizing Passwords

Configuration

```
Router# config
Router:(config)# nvgen default-sanitize passwords
Router:(config)# commit
```

Running Configuration

```
Router# show run nvgen
nvgen
 default-sanitize passwords
!
```

Verification

```
Router# show run username test
username test
 group root-lr
 password 7 <removed>
!
```

Sanitizing Comments

Configuration

```
Router# config
Router:(config)# nvgen default-sanitize comments
Router:(config)# commit
```

Running Configuration

```
Router# show run nvgen
nvgen
 default-sanitize comments
!
```

Verification

```
Router# show run int Hu0/2/0/4
interface HundredGigE0/2/0/4
 ! <comments removed>
 description This is bundle member
 !
```

Sanitizing IP Addresses

Configuration

```
Router# config
Router:(config)# nvgen default-sanitize ipaddrs
Router:(config)# commit
```

Verification

```
Router# show run int Hu0/2/0/4
interface HundredGigE0/2/0/4
 ! This is comment 1
 description This is bundle member
  ipv4 address <removed> <removed>
!
```

Fabric Link Management for Uncorrectable Errors

Table 17: Feature History Table

Feature Name	Release Information	Feature Description
Fabric Link Management for Uncorrectable Errors	Release 24.2.11	You can now run your fabric links error-free using the forward error correction (FEC) technique. The feature allows you to determine the link quality by monitoring the noisy fabric links during and post bring-up. This feature introduces the **hw-module fabric-fec-monitor disable** command.

Forward error correction (FEC) is a method for obtaining error control in data transmission in which the transmitter sends redundant data and the receiver recognizes only the portion of the data that contains no

apparent errors. When FEC is used in data transmissions, the receiver can detect and correct a limited number of errors.

The Cisco IOS XR router will not bring the link to the data plane if the link is noisy at inception (during bring up). If the link becomes noisy post bring up, fabric link will be re-set and re-tuned. If this event continues for five times with in an hour then fabric link will be shutdown permanently. Post link up, polling interval for link error is 10 minutes.

Fabric link management feature uses FEC as the criteria to determine if a link is good. The router receives a notification for every bad FEC on each fabric port. FEC can correct up to 15 bits beyond which the error is considered as uncorrectable error. This feature allows you to make fabric links run error-free.

Note In Cisco IOS XR Release 24.2.11, this feature is enabled only for Q200 based line cards and Fabric cards.

FEC bin index

FEC bin index indicates the number of bit errors.

For example, FEC bin index of a good link is {12642341946,0,0,0,0,0,0,0,0,0,0,0,0,0,0,} and for a bad link it is {221568554,532162,414888,101277,144171,3317,61681,4065,741,1977586,138,62,17,6,1,}.

If the FEC bin index more or equal to ten non-zero bits (bin >= 10 non-zero) before the link is up, then the FEC will show the link as bad FEC. When the link is up and the FEC bin index more or equal to 13 non-zero bits (bin >= 13 non-zero), the FEC will show the link as bad FEC.

Link States for a Noisy Fabric Link

When there is a noisy fabric link, any one of the following link states can be possible:

- Link does not come up at all.
- Link comes up, but fluctuates.
- Link comes up, but generates uncorrectable errors.

The network traffic flow is not impacted if the link never comes up and there will be packet drops observed for the other two states of the link mentioned above.

Monitor FEC Fabric Links

For every FEC report, the router performs the following process to monitor the fabric links:

1. If the fabric link is faulty before the link is up, the router will retune and checks again for the FEC improvement.
2. If the link quality does not improve after retuning, the router displays the syslog message after tuning for 100 times and will not bring the link to the data plane.
3. Post link up, when the fabric link becomes noisy, the router will collect a snapshot and retune after the first failure.
4. From second failure to fifth failure, the MAC port will be stopped and re-activated (retune will be done as part of this process).
5. If the fabric link fails for the sixth time within an hour, the router will permanently shut down the link.

Verify the FEC Links

Verify the FEC link information using **show controllers npu link-info** command.

```
router#show controllers npu link-info rx 254 255 fsm instance 0 location 0/2/CPU0 detail
Sat Jan 13 00:39:49.448 UTC

Node ID: 0/2/CPU0
Link ID: 0/2/0/254    255      Oper State: DOWN   0/FC1/2/158
Event                       State                 Timestamp
+-------------------------------------------------------------------------------------+
LINK_UP_INTR                UP                    Sat Jan 13 00:18:44 2018
BAD_FEC_BELOW_THR           PORT_ACTIVATE_DELAYED Sat Jan 13 00:19:16 2018
LINK_MON                    FAB_PORT_CREATED      Sat Jan 13 00:19:17 2018
LINK_MON                    ACTIVATED             Sat Jan 13 00:19:19 2018
LINK_UP_INTR                MAC_UP                Sat Jan 13 00:19:24 2018
LINK_UP_INTR                PEER_DISCOVERY        Sat Jan 13 00:19:24 2018
LINK_UP_INTR                PEER_DETECTED         Sat Jan 13 00:19:24 2018
LINK_UP_INTR                TOPOLOGY_CHECK        Sat Jan 13 00:19:24 2018
LINK_UP_INTR                SYNC_WAIT             Sat Jan 13 00:19:24 2018
LINK_UP_INTR                KEEPALIVE_START       Sat Jan 13 00:19:24 2018
LINK_UP_INTR                CHECK_REACH           Sat Jan 13 00:19:24 2018
LINK_UP_INTR                UP                    Sat Jan 13 00:19:24 2018
BAD_FEC                     UP                    Sat Jan 13 00:20:16 2018
DIS_PERM_SHUT               MAC_UP                Sat Jan 13 00:20:16 2018
DIS_PERM_SHUT               STOPPED               Sat Jan 13 00:20:16 2018
+-------------------------------------------------------------------------------------+
```

This table describes the significant fields shown in the above example.

Table 18: show controllers npu link-info Field Descriptions

Field	Description
BAD_FEC_BELOW_THR	There are FEC failures, but the number of failures has not exceeded the predefined threshold (in this case, 5 per hour). The router retunes and checks for FEC improvement.
BAD_FEC	This part of the log entry indicates that FEC detected failures, and the number of these failures surpassed a predefined threshold. As a result, the decision was made to permanently shut down the affected interface or port as a protective measure.
DIS_PERM_SHUT	The link or port has been intentionally disabled and is in a shutdown state after FEC fails for the threshold limit (After fifth failure).

System Log messages

The router displays the following syslog messages after retuning:

- If the link is noisy at inception (during bring up), the router displays the following syslog message after tuning for 100 times:

```
LC/0/2/CPU0:Jan 13 00:56:03.939 UTC: npu_drvr[128]:
%FABRIC-NPU_DRVR-3-NPU_CPA_GEN_ERR_INFO : Link 0/254 has tuned 100 times and failed to
 come up. FEC bin is filled to 11
```

- If the link is noisy post bring up, the router permanently shuts down the link and displays the following syslog message:

```
LC/0/2/CPU0:Jan 13 00:20:16.251 UTC: npu_drvr[128]:
%FABRIC-NPU_DRVR-3-NPU_CPA_GEN_ERR_INFO : FEC check failures on link 0/254. FEC bin is
 filled to 14
```

Disable Fabric Link Management for Uncorrectable Errors

Fabric link management for uncorrectable errors is enabled by default. To disable this feature, use the **hw-module fabric-fec-monitor disable** command in XR Config mode mode.

The following example shows how to disable the fabric FEC monitor:

```
RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:router(config)# hw-module fabric-fec-monitor disable
RP/0/RP0/CPU0:router(config)# commit
```

Fault recovery handling

Table 19: Feature History Table

Feature Name	Release Information	Feature Description
Fault recovery handling	Release 24.2.11	You can now configure the number of fault recovery attempts by a line card, fabric card or a route processor before it permanently shuts down, thus preventing a faulty card from entering into a cycle of automatic recovery. This feature introduces the following change: **CLI**: • **hw-module fault-recovery** **YANG DATA Model**: • New XPaths for Cisco-IOS-XR-hw-module-cfg.yang (see Github, YANG Data Models Navigator)

In the previous releases, if a line card, fabric card or a route processor experienced a fault, they used to trigger fault recovery and reboot themselves to be operational. Fault recovery mechanism was time based as the fault recovery count used to reset to zero if the card remained operational for more than hour. After the fault recovery count exceeded five, then the faulty card was shut down. As power related faults triggered were not frequent, and fault recovery count used to reset to zero, the card never entered the shut down mode. As a result the card always attempted for fault recovery.

With the Cisco IOS XR Software Release 24.2.11, we have introduced the **hw-module fault-recovery** command with which you can set the number of times a fault recovery can take place before permanently shutting down a faulty card.

Note This configuration is not applicable for BMC instance

How to Configure the Fault Recovery Attempts

Configuration Examples

The configuration example shows how to configure the fault recovery attempts on the fabric card FC0.

```
Router#configure
Router (config)#hw-module fault-recovery location 0/FC0 count 1
Router(config)#commit
```

Verification

Use **show running-config formal | include hw-module** command to display the number of times a card can initiate recovery attempts before shutting down .

```
Router#show running-config formal | include hw-module
Building configuration...
hw-module fault-recovery location 0/FC0 count 1
```

The following system logs are generated when the number of fault recovery attempts on the card exceeds the configured count:

```
RP/0/RP0/CPU0:Dec 4 15:44:22.950 PST: shelfmgr[121]:
%PLATFORM-SHELFMGR-2-FAULT_ACTION_CARD_SHUTDOWN : Forced shutdown requested for card 0/FC0.
 Reason Fault retry attempts exceeded configured count(1)
```

```
RP/0/RP0/CPU0:Dec 4 15:44:25.247 PST: shelfmgr[121]: %PLATFORM-SHELFMGR-4-CARD_SHUTDOWN :
Shutting down 0/FC0: Fault retry attempts exceeded configured count(1)
```

Use the **show reboot history** command to get the reason of card shutting down. In the following example, it shows that the card was shut down due to **Fault retry attempts exceeded configured count(1)**.

```
RP/0/RP0/CPU0:ios#show reboot history location 0/FC0 detail
Mon Dec  4 15:44:55.827 PST
------------------------------------------------------------------------------
No   Attribute       Value
------------------------------------------------------------------------------
1    Time (PST)      Dec 04 2023 15:44:22
     Cause Code      0x0800000d
     Cause String    REBOOT_CAUSE_FM
     Graceful Reload No
     Kdump Requested No
     Reason          Fault retry attempts exceeded configured count(1)
```

Use the **show platform** command to see the current state of the card that was shut down because of Fault recovery handling feature.

```
RP/0/RP0/CPU0:ios#show platform
Mon Oct 2 21:08:03.383 UTC

Node              Type                      State                     Config state
```

```
------------------------------------------------------------------------------
0/RP0/CPU0         8800-RP(Active)          IOS XR RUN                NSHUT
0/RP0/BMC0         8800-RP                  OPERATIONAL                NSHUT
0/RP1/CPU0         8800-RP(Standby)         IOS XR RUN                NSHUT
0/RP1/BMC0         8800-RP                  OPERATIONAL                  NSHUT
0/3/CPU0           8800-LC-48H              IOS XR RUN                NSHUT
0/FC0              8812-FC                  SHUT DOWN                 NSHUT
0/FC3              8812-FC                  OPERATIONAL               NSHUT
0/FT0              SF-D-12-FAN              OPERATIONAL               NSHUT
0/FT1              SF-D-12-FAN              OPERATIONAL               NSHUT
0/FT2              SF-D-12-FAN              OPERATIONAL               NSHUT
0/FT3              SF-D-12-FAN              OPERATIONAL               NSHUT
0/PT0              FAM7000-ACHV-TRAY        OPERATIONAL               NSHUT
0/PT1              FAM7000-ACHV-TRAY        OPERATIONAL               NSHUT
0/PT2              FAM7000-ACHV-TRAY        OPERATIONAL               NSHUT
Router#
```

Periodic syslog messages for shutdowns due to fault-recovery failures

Table 20: Feature History Table

Feature Name	Release Information	Feature Description
Periodic syslog messages for shutdowns due to fault-recovery failures	Release 24.4.1	Introduced in this release on: Centralized Systems (8600); Modular Systems (8800 [LC ASIC: Q100, Q200, P100]) Cisco IOS XR Software now generates a syslog message immediately to indicate its shutdown state after a Line Card (LC), Fabric Card (FC), or Route Processor (RP) shuts down due to fault-recovery failure. This syslog message is repeated every 60 minutes to keep you informed of the shutdown status. This enhancement helps in identifying and troubleshooting shutdown LC, FC, or RP components.

A periodic shutdown syslog message is a log message generated by the router when

- the LC, FC, or RP experiences a fault,
- the Cisco IOS XR software triggers the fault recovery cycle, attempting to reboot the LC, FC, or RP to restore operational status, and

- if the LC, FC, or RP fails to become operational after this recovery attempt, the Cisco IOS XR software proceeds to shut down the affected component and generates a shutdown syslog message immediately following the shutdown.

By default, the Cisco IOS XR software performs the fault recovery cycle five times before shutting down the LC, FC, or RP. If the fault recovery handling count is configured, the Cisco IOS XR software shuts down the LC, FC, or RP after the expiry of the fault recovery count. For more information, see Fault recovery handling, on page 46.

Before Release 24.4.1, the Cisco IOS XR software generates a shutdown syslog message only once immediately after the LC, FC, or RP shut down to notify you of the shutdown.

From Release 24.4.1 onwards, the Cisco IOS XR software generates the following shutdown syslog message immediately after the LC, FC, or RP shuts down and repeats the shutdown syslog message every 60 minutes to notify you of the shutdown until you manually shut down the LC, FC, or RP using the **hw-module shutdown location** or **reload location** commands.

```
Router: Dec 4 15:44:22.950 PST: shelfmgr[121]: %PLATFORM-SHELFMGR-2-FAULT_ACTION_CARD_SHUTDOWN
 : Forced shutdown requested for card 0/FC0. Reason Fault retry attempts exceeded configured
 count(1)
Router:Dec 4 15:44:25.247 PST: shelfmgr[121]: %PLATFORM-SHELFMGR-4-CARD_SHUTDOWN : Shutting
 down 0/FC0: Fault retry attempts exceeded configured count(1)
```

Limitations and restrictions for periodic shutdown syslog messages

When you manually shut down a specific node using the **shutdown location** command in XR EXEC mode or the **hw-module shutdown location** command in XR Config mode, the Cisco IOS XR software doesn't generate the shutdown syslog messages.

Machine check error notifications

Table 21: Feature History Table

Feature Name	Release Information	Feature Description
Machine check error notifications	Release 24.4.1	Introduced in this release on: Fixed Systems (8200, 8700); Centralized Systems (8600); Modular Systems (8800 [LC ASIC: Q100, Q200, P100]) You can now identify and resolve MCE-related issues quickly and easily because Cisco IOS XR Software displays a syslog notification for MCE errors, eliminating the need to manually check for them in the MCE log file.

Machine Check Errors (MCE) in routers occur when the system's processors detect hardware errors.

Various hardware failures, such as issues with memory, CPUs, power, or other critical components, can cause these errors.

When a MCE occurs, the router logs a System Error Message (SEM) in `/var/log/mcelog.log` and may restart the affected Line Card (LC), Route Processor (RP), or the entire router as a corrective action.

Before Release 24.4.1, you must manually check the MCE error logs in the location `/var/log/mcelog.log` or on the syslog server to determine whether the router reboot was due to a MCE or another issue.

From Release 24.4.1 onwards, the Cisco IOS XR Software logs the error in the MCE log file and notifies you by displaying a syslog message.

This is an example of an MCE that the router displays:

```
RP/0/RP0/CPU0:Oct 28 22:37:44.293 UTC: shelfmgr[377]: %PLATFORM-CPA_INTF_SHELFMGR-3-CPU_MCERR
 : CPU Machine Check Error condition reported for node0_RP0_CPU0: corrected DIMM memory
error count exceeded threshold: 10 in 24h . Reported at 2024-10-28 22:37:44.00000 UTC
```

Syslog message information

The syslog message displays the following information about the error:

- **Error title** - CPA_INTF_SHELFMGR-3-CPU_MCERR
- **Error description** - CPU Machine Check Error
- **Error location** - RP/0/RP0/CPU0
- **Error type** - DIMM memory error
- **Error time** - 2024-10-28 22:37:44.00000 UTC

Error detail and recommended action

- **Cisco feature navigator error messages tool** - Provides detailed error information and recommended actions. For more information, see Viewing error details in the cisco feature navigator error messages tool, on page 51.
- **MCE log file** - Stores all past errors in the MCE log file located at `/var/log/mcelog.log`. You can determine if the current error has occurred in the past using the MCE log file and troubleshoot accordingly. For more information, see Viewing error details in the MCE log file, on page 51

MCE Major Errors in a Router

These are some of the MCE major errors that occurs in a router:

- **Card power zone error**: Displays under voltage or over voltage failure condition on the Line Card (LC) or Fabric Card (FC). During such an error, the system will attempt to recover by power-cycling the LC or FC.
- **Single Event Upset (SEU) error**: Displays corrected and uncorrected SEU events that can happen in FPGA devices.
- **Central Processing Unit (CPU) error**: Displays all CPU errors.

If these errors occur in a router, you can see the occurrence of these errors using the **show alarms** command. For more information, see Monitoring Alarms and Implementing Alarm Log Correlation section in the *System Monitoring Configuration Guide for Cisco 8000 Series Routers*.

Limitations and restrictions for MCE major errors

From Release 24.2.11, **show alarm** command output includes only the power zone errors.

Viewing error details in the cisco feature navigator error messages tool

Perform these steps to see error details in the cisco feature navigator error messages tool:

Procedure

Step 1 Login to Cisco Feature Navigator Error Messages Tool.
The cisco feature navigator error messages tool provides these search options:

- **Release** - Displays error details based on specific Cisco IOS XR Release.
- **Error** - Displays the error details based on the provided error title.
- **Compare** - Displays the error details by comparing different Cisco IOS XR Releases.

Step 2 Click on **Error** option.

Step 3 Enter the error title, for example, CPA_INTF_SHELFMGR-3-CPU_MCERR.

Step 4 Click **Submit** to view the error details.

The error details contain these sections:

- Error
- Severity
- Limit
- Format
- Explanation
- Recommended action

For more information about error details sections and Cisco Feature Navigator Error Messages Tool, see Cisco IOS XR System Error Message Reference Guide.

Viewing error details in the MCE log file

Perform these steps to see error details in the MCE log file:

Procedure

Step 1 Navigate to MCE log file located at `/var/log/mcelog.log`.

Step 2 Open mcelog.log file to view the error details.