



Configuring Power over Ethernet

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Prerequisites for PoE Power Management

The following prerequisites apply to the PoE Power Management feature:

- The minimum supervisor field-programmable gate array (FPGA) version that is required for the feature to work is 19082605. Use the **showplatform** command to verify the supervisor FPGA version. If the FPGA version is earlier than 19082605, and the user tries to configure the **power inline auto-shutdown** command, the following message is displayed:

```
This FPGA version does not support power inline auto shutdown feature.  
Please upgrade to FPGA from year 2019 and above.
```

To upgrade the supervisor FPGA, use the **upgrade hw-programmable cpld filename bootflash: R0** command in EXEC mode.

- Interfaces can have the **power inline port priority** command configured, but for the PoE Power Management feature to work, the **power inline auto-shutdown** command must be configured in global configuration mode.
- Disable the following commands before performing ISSU:
 - **power inline auto-shutdown**
 - **power inline port priority** (on all the configured interfaces)

Information About Power over Ethernet

The following sections provide information about Power over Ethernet (PoE), the supported protocols, and standards and power management.

PoE and PoE+ Ports

A PoE-capable switch port automatically supplies power to one of these connected devices if the switch senses that there is no power in the circuit:

- A Cisco prestandard powered device (such as a Cisco IP phone)
- An IEEE 802.3af-compliant powered device
- An IEEE 802.3at-compliant powered device
- An IEEE 802.3bt-compliant powered device

A powered device can receive redundant power when it is connected to a PoE switch port and to an AC power source. The device does not receive redundant power when it is only connected to the PoE port.

Supported Protocols and Standards

The device uses the following protocols and standards to support PoE:

- **Cisco Discovery Protocol (CDP) with power consumption:** The powered device notifies the device of the amount of power it is consuming. The device does not reply to the power-consumption messages. The device can only supply power to or remove power from the PoE port.
- **Cisco intelligent power management:** The powered device and the device negotiate through power-negotiation CDP messages for an agreed-upon power-consumption level. The negotiation allows a Cisco-powered device, which requires different power levels than its current allocation, to operate. The powered device first starts with its IEEE class power or 15.4 W (prestandard Cisco-powered device), and then negotiates power to operate at the appropriate power level. The device's consumption changes to the requested power mode only when it receives confirmation from the device.

High-power devices can operate in low-power mode on the device that do not support power-negotiation CDP.

Cisco intelligent power management is backward-compatible with CDP with power consumption; the device responds according to the CDP message that it receives. CDP is not supported on third party-powered devices. Therefore, the device uses the IEEE classification to determine the power usage of the device.

- **IEEE 802.3af:** The major features of this standard are powered-device discovery, power administration, disconnect detection, and optional powered-device power classification.
- **IEEE 802.3at:** The PoE+ standard increases the maximum power that can be drawn by a powered device from 15.4 W per port to 30 W per port.
- The **Cisco Universal Power Over Ethernet (UPOE)** feature provides the capability to source up to 60 W of power (2 x 30 W) over both signal and spare pairs of the RJ-45 Ethernet cable by using the Layer 2 power negotiation protocols such as CDP or LLDP. An LLDP and CDP request of 30 W and higher in the presence of the 4-wire Cisco proprietary spare-pair power type, length, and value descriptions (TLV) can provide power to the spare pair.

When enabled in IEEE 802.3bt mode, Cisco UPOE devices function as 802.3bt Type 3 devices, supporting up to Class 6 (see [Table 1: IEEE Power Classifications](#) in the document) on every port.



Note The following UPOE linecards are IEEE 802.3bt-complaint PSE Type 3 devices:

- C9400-LC-48U
- C9400-LC-48UX

- **IEEE 802.3bt:** This new standard led to the introduction of new power sourcing equipment (PSE) that supports not just new capabilities but also compatibility with previous standards. Cisco introduced its 90-watt-capable line card on the Cisco Catalyst 9400 Series Switches that are in complete compliance with the IEEE 802.3bt standard and also support Cisco UPOE.

This standard enables delivery of up to 90 W to a powered device over four pairs of Category 5e and above cables. It also introduces additional classes of PSEs and powered devices, class 5 to class 8, with PSE output power ranging between 45 W to 90 W, and the powered device input power ranging from 40 W to 71.3 W. This standard introduces new types of PSEs or powered devices, that is, Type 3(60 W) and Type 4 (90 W).

The IEEE 802.3bt standard enables support for Dual Signature Powered Devices, Single Signature Powered Devices, and Single Pair Powered Devices. It also supports power demotion to handle scenarios where Type 4 Powered Device is connected to a Type 3 PSE.

For more information, see the [Additional References for Power over Ethernet](#) section.

- **Cisco UPOE+:** Cisco UPOE+ combines the new IEEE 802.3bt standard and Cisco UPOE, which means Cisco UPOE+ switches are in complete compliance with the 802.3bt standard and also support all previous standards, such as 802.3af and IEEE 802.3at, as well as Cisco UPOE. This feature provides the capability to source up to 90 W on the IEEE 802.3bt-compliant Type 4 devices.

A Type 3 PSE can power up a Type 4 powered device through a power demotion to 60 W.

Cisco IOS XE Release 16.12.1 introduces C9400-LC-48H, an 802.3bt-compliant Type 4 device.

Cisco IOS XE Release 17.5.1 introduces C9400-LC-48HN, an 802.3bt-compliant Type 4 device.

Some legacy Cisco powered devices (such as 7910, 7940, 7960 IP phones and AP350 wireless access points) are incompatible with Type 4 Power Supply Equipments (PSEs), as defined in the IEEE 802.3bt standard. If connected, the PSE will report a Tstart or Imax fault with each periodic attempt at providing power to the powered device. For continued use of these legacy Cisco powered devices, connect them to Cisco PoE+ or UPOE PSEs.

Powered devices that do not meet the standard detection signature capacitance (such as CIVS-IPC-6000P) can be detected properly with PoE+ or Cisco UPOE devices running in UPOE mode, but may not be detected properly when running in 802.3bt mode.

Powered-Device Detection and Initial Power Allocation

The switch detects a Cisco prestandard or an IEEE-compliant powered device when the PoE-capable port is in the no-shutdown state, PoE is enabled (the default), and the connected device is not powered by an AC adaptor.

After device detection, the switch determines the device's power requirements based on its type:

- The initial power allocation is the maximum amount of power that a powered device requires. The switch initially allocates this amount of power when it detects and powers the powered device. Because the

switch receives CDP messages from the powered device, and because the powered device negotiates power levels with the switch through CDP power-negotiation messages, the initial power allocation might be adjusted.

- The switch classifies the detected IEEE device within a power consumption class. Based on the available power in the power budget, the switch determines if a port can be powered. The following table lists these levels.

Table 1: IEEE Power Classifications

Class	Maximum Power Level Required from the Device
0 (class status unknown)	15.4 W
1	4 W
2	7 W
3	15.4 W
4	30 W
5	45 W
6	60 W
7	75 W
8	90 W

The switch monitors and tracks requests for power and grants power only when it is available. The switch tracks the power budget (the amount of power available on the device for PoE). The switch also performs power-accounting calculations when a port is granted or denied power to keep the power budget up to date.

After power is applied to the port, the switch uses CDP to determine the *CDP-specific* power consumption requirement of the connected Cisco powered devices, which is the amount of power to allocate based on the CDP messages. The switch adjusts the power budget accordingly, through CDP or LLDP. Note that CDP does not apply to third-party PoE devices. The switch processes a request, and either grants or denies power. If the request is granted, the switch updates the power budget. If the request is denied, the switch ensures that the power to the port is turned off, and generates a syslog message. Powered devices can also negotiate with the switch for more power.

With PoE+, powered devices use IEEE 802.3at and LLDP power with medium-dependent interface (MDI) type, length, and value descriptions (TLVs) and power-via-MDI TLVs, for negotiating power up to 30 W. Cisco prestandard devices and Cisco IEEE powered devices can use CDP or the IEEE 802.3 at power-via-MDI power-negotiation mechanism to request power levels up to 30 W.



Note The CDP-specific power consumption requirement is referred to as the *actual* power consumption requirement in the Cisco Catalyst Switches software configuration guides and command references.

If the switch detects a fault caused by an undervoltage, overvoltage, overtemperature, oscillator fault, or short-circuit condition, it turns off power to the port, generates a syslog message, and updates the power budget.

Power Management Modes

The device supports these PoE modes:

- **auto**: The auto mode is the default setting. The device automatically detects if the connected device requires power. If the device discovers a powered device connected to the port, and if the device has enough power, it grants power, updates the power budget, and turns on power to the port on a first-come, first-served basis.

If the device has enough power for all the powered devices, they all come up. If enough power is available for all the powered devices connected to the device, power is turned on to all the devices. If enough PoE is not available, or if a device is disconnected and reconnected while other devices are waiting for power, it cannot be determined which devices are granted or are denied power.

If granting power would exceed the system power budget, the device denies power, ensures that power to the port is turned off, and generates a syslog message. After power is denied, the device periodically rechecks the power budget and continues to attempt to grant the request for power.

If a device that is being powered by the device is then connected to wall power, the device might continue to power the device. The device might continue to report that it is still powering the device irrespective of whether the device is being powered by the device or receiving power from an AC power source.

If a powered device is removed, the device automatically detects the disconnect and removes power from the port. You can connect a nonpowered device without damaging it.

You can specify the maximum wattage that is allowed on the port. If the IEEE class maximum wattage of the powered device is greater than the configured maximum value, the device does not provide power to the port. If the device powers a powered device, but the powered device later requests, through CDP messages, more than the configured maximum value, the device removes power to the port. The power that was allocated to the powered device is reclaimed into the global power budget. If you do not specify a wattage, the device delivers the maximum value. Use the **auto** setting on any PoE port.

- **static**: The device preallocates power to the port (even when no powered device is connected) and guarantees that power will be available for the port. The device allocates the port-configured maximum wattage, and the amount is never adjusted through the IEEE class or by CDP messages from the powered device. Because power is preallocated, any powered device that uses less than or equal to the maximum wattage, is guaranteed to be powered when it is connected to the static port. The port no longer participates in the first-come, first-served model.

However, if the powered device's IEEE class is greater than the maximum wattage, the device does not supply power to it. If the device learns through CDP messages that the powered device is consuming more than the maximum wattage, the device shuts down the powered device.

If you do not specify a wattage, the device preallocates the maximum value. The device powers the port only if it discovers a powered device. Use the **static** setting on a high-priority interface.

- **never**: The device disables powered-device detection and never powers the PoE port even if an unpowered device is connected. Use this mode only when you want to make sure that power is never applied to a PoE-capable port, making the port a data-only port.

For most situations, the default configuration (**auto** mode) works well, providing plug-and-play operation. No further configuration is required. However, configure a PoE port for a higher priority, to make it data only, or to specify a maximum wattage to disallow high-power powered devices on a port.

Power Monitoring and Power Policing

When policing of the real-time power consumption is enabled, the device takes action when a powered device consumes more power than the maximum amount allocated, which is also referred to as the *cutoff-power value*.

When PoE is enabled, the device senses and monitors the real-time power consumption of the connected powered device. This is called *power monitoring* or *power sensing*. The device also polices the power usage with the *power policing* feature.

Power monitoring is backward-compatible with Cisco intelligent power management and CDP-based power consumption. It works with these features to ensure that the PoE port can supply power to a powered device.

The device senses the real-time power consumption of the connected device as follows:

1. The device monitors the real-time power consumption by individual ports.
2. The device records the power consumption, including peak power usage, and reports this information through the CISCO-POWER-ETHERNET-EXT-MIB.
3. If power policing is enabled, the device polices power usage by comparing the real-time power consumption with the maximum power allocated to the device. The maximum power consumption is also referred to as the *cutoff power* on a PoE port.

If the device uses more than the maximum power allocation on the port, the device can either turn off the power to the port, or can generate a syslog message while still providing power to the device based on the device configuration. By default, power-usage policing is disabled on all the PoE ports.

If error recovery from the PoE error-disabled state is enabled, the device automatically takes the PoE port out of the error-disabled state after the specified amount of time.

If error recovery is disabled, you can manually re-enable the PoE port by using the **shutdown** and **no shutdown** interface configuration commands.

4. If policing is disabled, the powered device can draw a maximum power based on what is allocated by the PSE. If the powered device consumes more than what is allocated, the port hits an I_{max} error and enters a fault condition.

Power Consumption Values

You can configure the initial power allocation and the maximum power allocation on a port. However, these values are the configured values that determine when the device should turn on or turn off power on the PoE port. The maximum power allocation is not the same as the actual power consumption of the powered device. The actual cutoff power value that the device uses for power policing is not equal to the configured power value.

When power policing is enabled, the device polices the power usage *at the switch port*, where the power consumption is greater than that by the device. When you manually set the maximum power allocation, you must consider the power loss over the cable from the switch port to the powered device. The cutoff power is the sum of the rated power consumption of the powered device and the worst-case power loss over the cable.

We recommend that you enable power policing when PoE is enabled on your device. For example, for a Class 1 device, if policing is disabled and you set the cutoff-power value by using the **power inline auto max 6300**

interface configuration command, the configured maximum power allocation on the PoE port is 6.3 W (6300 mW). The device provides power to the connected devices on the port if the device needs up to 6.3 W. If the CDP power-negotiated value or the IEEE classification value exceeds the configured cutoff value, the device does not provide power to the connected device. After the device turns on the power on the PoE port, the device does not police the real-time power consumption of the device, and the device can consume more power than the maximum allocated amount, which could adversely affect the device and the devices connected to the other PoE ports.

PoE Power Management

All ports are assigned a default PoE port priority based on the logical slot number of the linecard. Users can explicitly assign new priorities to the PoE ports by using the **power inline port priority** command in interface configuration mode. In a power shortage scenario, priority determines the order in which PoE ports will lose power. If the PoE Power Management feature is configured, PoE Ports with priority 7 (least priority) will shut down first and ports with priority 0 (highest priority) will shut down last, followed by line card shut down based on the autoLC shutdown priority. For more information, please refer the *Enabling Auto Line Card Shutdown* section of the *System Management Configuration Guide*

Ports in static mode have operational priority as 0, independent of the configured administration priority, so that during PoE load shedding, static ports shut down last. PoE ports are shut down before line cards are shut down.

The system can sustain an instantaneous drop of 9000 watts. We recommend that you do not assign more than 6000 watts to one PoE priority. If more than 6000 watts is configured for a PoE priority level, a warning message is displayed, and if more than 9000 watts is configured for a PoE priority level, a critical message is displayed.

The following table lists the slot numbers of the linecards along with the default PoE port priority:

Table 2: Default PoE Port Priority

Slot Number	Cisco Catalyst C9404R Switches	Cisco Catalyst C9407R Switches	Cisco Catalyst C9410R Switches
1	0	0	0
2	Supervisor	1	1
3	Supervisor	Supervisor	2
4	1	Supervisor	3
5	—	2	Supervisor
6	—	3	Supervisor
7	—	4	4
8	—	—	5
9	—	—	6
10	—	—	7

Cisco Universal Power Over Ethernet

Cisco Universal Power Over Ethernet (Cisco UPOE) is a Cisco-proprietary technology that extends the IEEE 802.3 at PoE standard to provide the capability to source up to 60 W of power over standard Ethernet cabling infrastructure (Class D or better) by using the spare pair of an RJ-45 cable (wires 4,5,7,8) with the signal pair (wires 1,2,3,6). Power on the spare pair is enabled when the switch port and end device mutually identify themselves as Cisco UPOE-capable using CDP or LLDP and the end device's requests for power to be enabled on the spare pair. When the spare pair is powered, the end device can negotiate up to 60 W of power from the switch using CDP or LLDP.

If the end device supports detection and classification on both signal and spare pairs, but does not support the CDP or LLDP extensions required for Cisco UPOE, a 4-pair forced mode configuration automatically enables power on both signal and spare pairs from the switch port.

You can upgrade the Cisco UPOE devices (C9400-LC-48U and C9400-LC-48UX) to support 802.3bt standard as a Type 3 power-sourcing device. A device can support Cisco UPOE and 802.3bt Type 3 on the same port. Note that while an 802.3bt-compliant Type 3 device and a Cisco UPOE device offer 60 W, they operate differently. 802.3bt-compliant devices mutually identify the maximum power requirements during physical classification (see [Table 1: IEEE Power Classifications](#)). An 802.3bt-compliant Type 3 powered device cannot ask for more power over LLDP than what is requested over the physical layer, which means that an 802.3bt-compliant Class 4 powered device cannot ask for more than 30 W using CDP or LLDP. However, an 802.3bt-compliant Class 6 powered device requests 60 W from the physical layer immediately before the data link layer is established.

In essence, 802.3at devices support ALT-A (signal pair) 30 W. Cisco UPOE devices support up to 60 W through CDP or LLDP negotiation. 802.3bt-compliant Type 3 4-pair devices can support up to 60 W across Alt-A and Alt-B (both pairs of wires) directly from the physical classification. 802.3bt-compliant Cisco UPOE PSEs support a powered device as physically requested. In addition, Cisco UPOE PSEs continue to support UPOE-powered devices. When you upgrade a Cisco UPOE device to 802.3bt mode, there is no change in the behavior of the UPOE-powered devices that are connected to the upgraded PSE.

How to Configure PoE and UPOE

The following tasks describe how you can configure PoE and UPOE.

Configuring a Power Management Mode on a PoE Port



Note When you make PoE configuration changes, the port that are being configured drops power. Depending on the new configuration, the state of the other PoE ports and the state of the power budget, the port might not be powered up again. For example, port 1 is in the auto and on state, and you configure it for static mode. The device removes power from port 1, detects the powered device, and repowers the port. If port 1 is in the auto and on state, and you configure it with a maximum wattage of 10 W, the device removes power from the port and then redetects the powered device. The device repowers the port only if the powered device is a class 1, class 2, or a Cisco-only powered device.

Procedure

	Command or Action	Purpose
Step 1	enable Example: <pre>Device> enable</pre>	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	configure terminal Example: <pre>Device# configure terminal</pre>	Enters global configuration mode.
Step 3	interface <i>interface-id</i> Example: <pre>Device(config)# interface gigabitethernet2/0/1</pre>	Specifies the physical port to be configured, and enters interface configuration mode.
Step 4	power inline {auto [max <i>max-wattage</i>] never static [max <i>max-wattage</i>] consumption <i>milli-watts-consumption</i> } Example: <pre>Device(config-if)# power inline auto</pre>	Configures the PoE mode on the port. The following are the keywords: <ul style="list-style-type: none"> • auto: Enables detection of powered devices. If enough power is available, automatically allocates power to the PoE port after device detection. This is the default setting. • max <i>max-wattage</i>: Limits the power allowed on the port. The range for Cisco UPOE ports is 4000 to 60000 milliWatts (mW). If no value is specified, the maximum is allowed. • never: Disables device detection and power to the port. <p>Note If a port has a Cisco-powered device connected to it, do not use the power inline never command to configure the port. A false link-up can occur, placing the port in the error-disabled state.</p> <ul style="list-style-type: none"> • static: Enables detection of powered devices. Preallocate (reserve) power for a port before the device discovers the powered device. The device reserves power for this port even when no device is connected, and guarantees that power will be provided upon device detection.

	Command or Action	Purpose
		<ul style="list-style-type: none"> • consumption: Sets the PoE consumption (in mW) of the powered device connected to a specific interface. The power consumption can range from 4000 to 90000 mW. <p>To re-enable the automatic adjustment of consumption, either use the no keyword or specify 60000 mW.</p> <p>The device allocates power to a port configured in static mode before it allocates power to a port configured in auto mode.</p>
Step 5	end Example: Device(config-if)# end	Returns to privileged EXEC mode.
Step 6	show power inline [[interface-id] [detail]] Example: Device# show power inline	Displays the PoE status for a device , for the specified interface.
Step 7	copy running-config startup-config Example: Device# copy running-config startup-config	(Optional) Saves your entries in the configuration file.

Enabling Power on Signal and Spare Pairs



Note You do not have to perform this task if the line card on which the device is connected is in 802.3bt-compliance mode because the **power inline four-pair forced** command is redundant in the 802.3bt-compliance mode.

Do not perform this task if the end device cannot source inline power on the spare pair, or if the end device supports the CDP or LLDP extensions for Cisco UPOE.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: Device# configure terminal	Enters global configuration mode.

	Command or Action	Purpose
Step 2	interface <i>interface-id</i> Example: Device(config)# interface gigabitethernet2/0/1	Specifies the physical port to be configured, and enters interface configuration mode.
Step 3	power inline four-pair forced Example: Device(config-if)# power inline four-pair forced	(Optional) Enables power on both signal and spare pairs from a switch port. Note This step is not required if the linecard on which the device is connected is in 802.3bt compliance mode.
Step 4	end Example: Device(config-if)# end	Returns to privileged EXEC mode.

Configuring Power Policing

By default, the device monitors the real-time power consumption of connected powered devices. You can configure the device to police the power usage. By default, policing is disabled.

Procedure

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	interface <i>interface-id</i> Example: Device(config)# interface gigabitethernet2/0/1	Specifies the physical port to be configured, and enters interface configuration mode.
Step 4	power inline police [action {log errdisable}] Example: Device(config-if)# power inline police	Configures the device to take one of these actions if the real-time power consumption exceeds the maximum power allocation on the port:

	Command or Action	Purpose
		<ul style="list-style-type: none"> • power inline police: Shuts down the PoE port, turns off power to it, and puts it in the error-disabled state. <p>Note You can enable error detection for the PoE error-disabled cause by using the errdisable detect cause inline-power global configuration command. You can also enable the timer to recover from the PoE error-disabled state by using the errdisable recovery cause inline-power interval interval global configuration command.</p> <ul style="list-style-type: none"> • power inline police action errdisable: Turns off power to the port if the real-time power consumption exceeds the maximum power allocation on the port. • power inline police action log: Generates a syslog message while still providing power to the port. <p>If you do not enter the action log keywords, the default action shuts down the port and puts the port in the error-disabled state.</p>
Step 5	exit Example: Device(config-if)# exit	Returns to global configuration mode.
Step 6	Use one of the following: <ul style="list-style-type: none"> • errdisable detect cause inline-power • errdisable recovery cause inline-power • errdisable recovery interval interval Example: Device(config)# errdisable detect cause inline-power Device(config)# errdisable recovery cause inline-power Device(config)# errdisable recovery interval 100	(Optional) Enables error recovery from the PoE error-disabled state, and configures the PoE recovery mechanism variables. By default, the recovery interval is 300 seconds. interval interval: Specifies the time in seconds, to recover from the error-disabled state. The range is 30 to 86400.
Step 7	exit Example:	Returns to privileged EXEC mode.

	Command or Action	Purpose
	Device(config)# exit	
Step 8	Use one of the following: <ul style="list-style-type: none"> • show power inline police • show errdisable recovery Example: Device# show power inline police Device# show errdisable recovery	Displays the power-monitoring status, and verifies the error recovery settings.
Step 9	copy running-config startup-config Example: Device# copy running-config startup-config	(Optional) Saves your entries in the configuration file.

Configuring PoE Power Management

Before configuring the PoE port priority on an interface, the **power inline auto-shutdown** command must be enabled in global configuration mode. This command is disabled by default.

Procedure

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	power inline auto-shutdown Example: Device(config)# power inline auto-shutdown	Enables auto shutdown control on PoE ports.
Step 4	interface interface-id Example: Device(config)# interface gigabitethernet2/0/1	Specifies the physical port to be configured, and enters interface configuration mode.

	Command or Action	Purpose
Step 5	power inline port priority <i>value</i> Example: Device(config-if)# power inline port priority 7	Configures PoE port priority on the specified interface.
Step 6	end Example: Device(config-if)# end	Returns to privileged EXEC mode.

Enable the 802.3bt Mode on Type 3 Cisco UPOE Modules

C9400-LC-48U and C9400-LC-48UX modules that support IEEE 802.3bt standard for Type 3 powered devices, are in 802.3at mode by default. You can enable 802.3bt mode on them using the **hw-module slot slot upoe-plus** command in global configuration mode. Note that the **hw-module slot slot upoe-plus** command power-cycles the module.

```
Device(config)# hw-module slot 4 upoe-plus
Performing oir to update poe fw on chassis 1 slot 4
Device#
*Mar 21 05:39:36.215: %IOSXE_OIR-6-REMSPA: SPA removed from subslot 4/0, interfaces disabled
```



Caution

The **hw-module switch upoe-plus** command performs an online insertion and removal (OIR) on the module and the module will be out of service for the duration of the OIR.

You can revert to 802.3at mode using the **no** form of the **no hw-module slot slot upoe-plus** command.



Note

C9400-LC-48H module is a Type 4 PSE that supports IEEE 802.3bt standard. C9400-LC-48H and C9400-LC-48HN is in 802.3bt mode by default. Therefore, the mode-conversion **hw-module slot slot upoe-plus** command is not supported on the C9400-LC-48H and C9400-LC-48HN modules.

Support for Noncompliant Powered Devices

You can allow a powered device, which is capable of drawing power on both pair sets, to draw more power than what is allowed on its physical layer, according to the IEEE Classification ([Table 1: IEEE Power Classifications](#)), using the **power inline auto** and **power inline static** commands.

The following example shows a Class 4 powered device configured to draw up to 40 W on the port it is connected to:

```
Device> enable
Device# configure terminal
Device(config)# interface gigabitEthernet1/0/14
Device(config-if)# power inline static 40000
Device(config-if)# end

Device# show power inline upoe gigabitEthernet 1/0/14
Codes: DS - Dual Signature device, SS - Single Signature device
```

SP - Single Pairset device

Interface	Admin State	Type	Oper-State Alt-A,B	Power (Watts)		Class Alt-A,B	Device Name
				Allocated	Utilized		
Gi1/0/14	static	SS	on,on	40.0	36.7	4	Ieee PD

Monitoring Power Status

Use the following **show** commands to monitor and verify the PoE configuration.

Table 3: show Commands for Power Status

Command	Purpose
show power inline police	Displays power-policing data.
show power inline <i>[[interface-id] [detail]]</i>	Displays PoE status for an interface on a switch.
show power inline consumption <i>interface-id</i>	Displays the PoE consumption for an interface.
show power inline upoe-plus <i>[interface-id] [module]</i>	Displays the PoE status for an interface that is enabled for 802.3bt-compliant mode.
show power inline priority <i>interface-id</i>	Displays the PoE states and priorities for an interface.
show power	Displays the available system power and the inline power of the interfaces. When power inline auto-shutdown is enabled, it also displays the total power allocation for each priority and shutdown threshold.

Examples

The following example displays the PoE status for an 802.3bt-enabled interface:

```
Device# show power inline upoe-plus gigabitEthernet 1/0/23
```

Codes: DS - Dual Signature device, SS - Single Signature device
SP - Single Pairset device

Interface	Admin State	Type	Oper-State Alt-A,B	Power (Watts)		Class Alt-A,B	Device Name
				Allocated	Utilized		
Gi1/0/4	auto	SP	on	4.0	3.8	1	Ieee PD
Gi1/0/15	auto	SS	on,on	60.0	10.5	6	Ieee PD
Gi1/0/23	auto	DS	on,on	45.4	26.9	3,4	Ieee PD

The following table describes the significant fields shown in the display.

Table 4: show power inline upoe-plus Field Descriptions

Field	Description
Type	Type of Powered Device: Single Pairset device (SP), Single Signature device (SS), Dual Signature device (DS).
Oper-State	The state of each pair on the port.
Power Allocated	Power allocated to the port.
Power Utilized	Power consumed by the powered device on the port.
Class Alt-A, B	Signal and Spare pair respectively
Device Name	Name of the powered device as advertised by CDP.

The **show power inline detail** command is enhanced to display 802.3bt-complaint device information such as the Operational Status of the device, IEEE Class of the device, Physical Assigned Class, Allocated Power, (Power) Measured at the port.

Consider a scenario where a Class 5 Single Signature powered device sends a request through LLDP to lower the power allocated by PSE. Because of this, the power that is allocated drops to 30 W. The following is the output of the **show power inline detail** command in such a scenario:

```
Device# show power inline gigabitEthernet 1/0/29 detail
```

```
Interface: Gi1/0/29
Inline Power Mode: auto
Operational status (Alt-A,B): on,on
Device Detected: yes
Device Type: Ieee PD
Connection Check: SS
IEEE Class (Alt-A,B): 5
Physical Assigned Class (Alt-A,B): 5
Discovery mechanism used/configured: Ieee and Cisco
Police: off

Power Allocated
  Admin Value: 60.0
Power drawn from the source: 30.0
Power available to the device: 30.0
Allocated Power (Alt-A,B): 30.0

Actual consumption
Measured at the port(watts) (Alt-A,B): 10.5
Maximum Power drawn by the device since powered on: 10.5

Absent Counter: 0
Over Current Counter: 0
Short Current Counter: 0
Invalid Signature Counter: 0
Power Denied Counter: 0

Power Negotiation Used: IEEE 802.3bt LLDP
LLDP Power Negotiation  --Sent to PD--  --Rcvd from PD--
Power Type:              Type 2 PSE      Type 2 PD
Power Source:            Primary         PSE
Power Priority:           low             critical
PD 4PID:                  0              1
```



```

Requested Power(W):          25.5          25.5
Allocated Power(W):          25.5          40.0
Requested Power ModeA(W):    0.0           6.5
Allocated Power ModeA(W):    0.0          25.5
Requested Power ModeB(W):    0.0          13.0
Allocated Power ModeB(W):    0.0          25.5
PSE Powering Status:         4 pair SS PD   Ignore
PD Powering Status:          Ignore         SS PD
PSE Power Pair ext:           Both Alternatives Both Alternatives
DS Class Mode A ext:         SS PD          Class 2
DS Class Mode B ext:         SS PD          Class 4
SS Class ext:                 Class 4        Class 5
PSE Type ext:                 Type 3 PSE     Type 3 SS PD
PSE Max Avail Power:         51.0          51.2
PSE Auto Class Supp:         No            No
PD Auto Class Req:           No            No
PD Power Down Req:           No            No
PD Power Down Time(sec):     0             70

```

```

Four-Pair PoE Supported: Yes
Spare Pair Power Enabled: Yes
Four-Pair PD Architecture: Shared

```

The following example shows how a Dual-Signature powered device sends a request to lower the power allocated by the PSE:

```
Device# show power inline gigabitEthernet 1/0/23 detail
```

```

Interface: Gi1/0/23
Inline Power Mode: auto
Operational status (Alt-A,B): on,on
Device Detected: yes
Device Type: Ieee PD
Connection Check: DS
IEEE Class (Alt-A,B): 3,4
Physical Assigned Class (Alt-A,B): 3,4
Discovery mechanism used/configured: Ieee and Cisco
Police: off

Power Allocated
  Admin Value: 60.0
Power drawn from the source: 22.4
Power available to the device: 22.4
Allocated Power (Alt-A,B): 7.0,15.4
  Actual consumption
Measured at the port(watts) (Alt-A,B): 2.7,2.7
Maximum Power drawn by the device since powered on: 5.5
  Absent Counter: 0
Over Current Counter: 0
Short Current Counter: 0
Invalid Signature Counter: 0
Power Denied Counter: 0

Power Negotiation Used: IEEE 802.3bt LLDP
LLDP Power Negotiation    --Sent to PD--    --Rcvd from PD--
Power Type:                Type 2 PSE        Type 2 PD
Power Source:               Primary          PSE
Power Priority:              low              critical
PD 4PID:                    0                1
Requested Power(W):         19.9             0.0
Allocated Power(W):         19.9             0.0
Requested Power ModeA(W):   6.5              6.5
Allocated Power ModeA(W):   6.5             13.0
Requested Power ModeB(W):   13.0             13.0
Allocated Power ModeB(W):   13.0             25.5

```

```

PSE Powering Status:      4 pair DS PD      Ignore
PD Powering Status:      Ignore             2 pair DS PD
PSE Power Pair ext:      Both Alternatives  Both Alternatives
DS Class Mode A ext:     Class 2            Class 3
DS Class Mode B ext:     Class 3            Class 4
SS Class ext:            DS PD              Class 5
PSE Type ext:            Type 3 PSE         Type 3 SS PD
PSE Max Avail Power:     51.0              51.2
PSE Auto Class Supp:     No                No
PD Auto Class Req:       No                No
PD Power Down Req:       No                No
PD Power Down Time(sec): 0                 70

```

```

Four-Pair PoE Supported: Yes
Spare Pair Power Enabled: Yes
Four-Pair PD Architecture: Independent

```

The following is a sample output of the **show power inline priority** command when the port priority is not configured on an interface. The admin priority, as shown below will be n/a and the operational priority will be the default priority based on the line card slot.

```
Device# show power inline priority gigabitEthernet 1/0/1
```

```

Interface  Admin  Oper      Admin      Oper
           State State      Priority    Priority
-----
Gig1/0/1   auto   on        n/a        0

```

The following is a sample output of the **show power inline priority** command when the port priority is configured as 5. With this configuration, both the admin and the operational priority will change to 5.

```
Device(config)# show power inline priority gigabitEthernet 1/0/1
```

```
Device(config-if)# power inline port priority 5
```

```
Device# show power inline priority gigabitEthernet 1/0/1
```

```

Interface  Admin  Oper      Admin      Oper
           State State      Priority    Priority
-----
Gig1/0/1   auto   on        5          5

```

The following is a sample output of the **show power inline priority** command when you configure a priority on static ports. The operation priority will change to 0, as static ports have the highest priority and will be the last to shutdown.

```
Device(config)# interface gigabitEthernet 1/0/1
```

```
Device(config-if)# power inline static
```

```
Device # show power inline priority gigabitEthernet 1/0/1
```

```

Interface  Admin  Oper      Admin      Oper
           State State      Priority    Priority
-----
Gig1/0/1   static on        5          0

```

The following table describes the significant fields shown in the display:

Table 5: show power inline priority Field Descriptions

Field	Description
Admin State	Administration mode: auto , off , static .
Oper State	Operating mode: on , off , faulty , power-deny .

Field	Description
Admin Priority	Administration priority level: 0 to 7.
Oper Priority	Operating priority level: 0 to 7.
Power Per Priority(Watts)	Power allocated to the PoE port priorities.

The following is the sample output of the **show power** command:

```
Device #show power
Power Fan States
Supply Model No Type Capacity Status 1 2
-----
PS1 C9400-PWR-3200AC ac 3200 W active good good
PS2 C9400-PWR-3200AC ac 3200 W active good good
PS3 C9400-PWR-3200AC ac 3200 W active good good
PS4 C9400-PWR-3200AC ac 3200 W active good good
PS5 C9400-PWR-3200AC ac 3200 W active good good
PS6 C9400-PWR-3200AC ac 3200 W active good good
PS7 C9400-PWR-3200AC ac 3200 W active good good
PS8 C9400-PWR-3200AC ac 3200 W active good good

PS Current Configuration Mode : Combined
PS Current Operating State : Combined

Power supplies currently active : 8
Power supplies currently available : 8

Power Summary Maximum
(in Watts) Used Available
-----
System Power 2380 2380
Inline Power 4320 23220
-----
Total 6700 25600

PoE POE Shutdown
Priority Allocation(Watts) Threshold(Watts)
-----
Priority-0 90 2475
Priority-1 0 2475
Priority-2 0 2475
Priority-3 0 2475
Priority-4 4230 6705
Priority-5 0 6705
Priority-6 0 6705
Priority-7 0 6705
```

Additional References for Power over Ethernet

Related Documents

Related Topic	Document Title
For complete syntax and usage information pertaining to the commands used in this chapter.	See the "Interface and Hardware Commands" section in the <i>Command Reference Guide</i> .

Related Topic	Document Title
For complete information on IEEE 802.3bt standard	See Cisco UPOE+: The Catalyst for Expanded IT-OT Convergence

Feature History for Power over Ethernet

This table provides release and related information for features explained in this module.

These features are available on all releases subsequent to the one they were introduced in, unless noted otherwise.

Release	Feature	Feature Information
Cisco IOS XE Everest 16.6.1	Power over Ethernet (PoE)	Power over Ethernet (PoE) allows the LAN switching infrastructure to provide power to an endpoint, called a powered device, over a copper Ethernet cable. The following types of end points can be powered through PoE: <ul style="list-style-type: none"> • A Cisco prestandard powered device An IEEE 802.3af-compliant powered device An IEEE 802.3at-compliant powered device
Cisco IOS XE Gibraltar 16.11.1	Support for IEEE 802.3bt Type 3 PDs (up to 60 W)	The hw-module slot upoe-plus command was introduced to enable 802.3bt-compliant mode on the C9400-LC-48U, and C9400-LC-48UX line cards.
Cisco IOS XE Gibraltar 16.12.1	Support for IEEE 802.3bt Type 4 PDs (up to 90 W)	802.3bt-compliant Type 4 module, C9400-LC-48H was introduced.

Release	Feature	Feature Information
Cisco IOS XE Amsterdam 17.3.1	PoE Power Management	PoE Power Management allows port priority to be set on interfaces to determine which interface will shutdown first incase of a power outage.
Cisco IOS XE Bengaluru 17.5.1	Support for IEEE 802.3bt Type 4 PDs (up to 90 W)	802.3bt-compliant Type 4 module, C9400-LC-48HN was introduced.

Use Cisco Feature Navigator to find information about platform and software image support. To access Cisco Feature Navigator, go to <http://www.cisco.com/go/cfn>.

