PoE Configuration Guide

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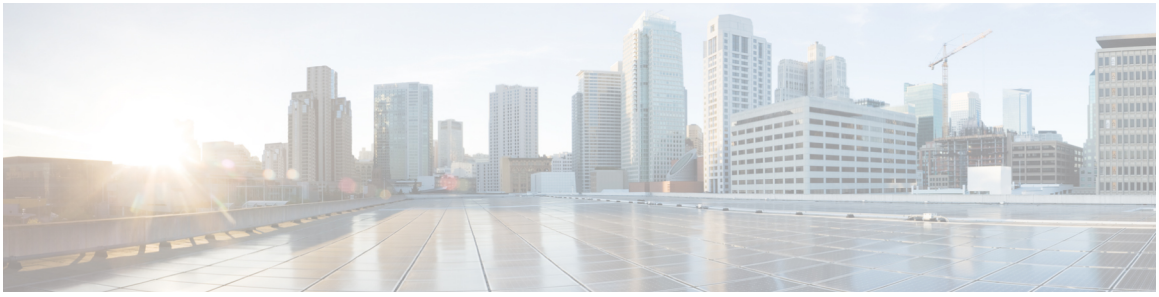

Read Me First

Only supported features are documented. To confirm or clarify all the supported features for a platform, go to Cisco Feature Navigator.

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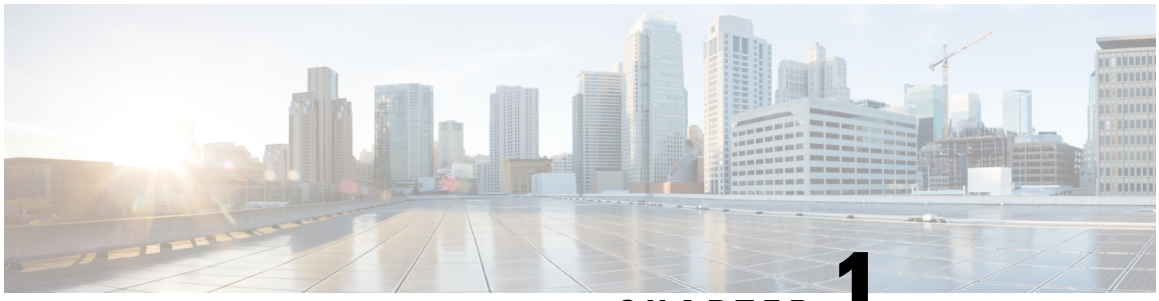

CHAPTER 1

PoE

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Feature History for PoE

This table provides release and platform support information for the features explained in this module.

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

Release	Feature Name and Description	Supported Platform
Cisco IOS XE 17.18.1	PoE: Power over Ethernet (PoE) is a technology that allows Ethernet cables to carry electrical power, along with data, to powered devices.	Cisco C9350 Series Smart Switches

PoE support on switch models

The following Cisco C9350 Series Smart Switches modules do not support PoE:

- C9350-24T
- C9350-48T
- C9350-48TX

Cisco UPOE in IEEE 802.3bt mode support on switch models

Only the following UPOE switches are IEEE 802.3bt-compliant Type 3 devices:

- C9350-24U
- C9350-48U
- C9350-48HX

Guidelines for PoE

General

- The initial allocation for Class 0, Class 3, and Class 4 powered devices is 15.4 W. When a device starts up and uses CDP or LLDP to send a request for more than 15.4 W, it can be allocated up to a maximum of 30 W.
- 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.
- You can connect a nonpowered device on a PoE port without damaging the device.
- The Cisco intelligent power management method is backward-compatible with the CDP with power consumption method which means that the device responds according to the CDP message that it receives.
- 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 and LEDs.
- By default, IEEE 802.3bt mode is enabled on the Cisco UPOE switch.

Auto mode

- If a specific wattage is not configured, the maximum value is configured by default.
- If the maximum power level allowed for an IEEE class exceeds the configured maximum wattage, the PoE switch does not provide power to the port.
- If a switch has multiple PoE ports and each PoE port has a powered device connected to it, then
  - If enough power is available for all PoE ports, then all PoE ports are changed to the Up state and LEDs are updated.
  - If all powered devices require power and enough power is available, then power is turned on for all devices.
  - If enough PoE is not available, and
    - all powered devices remain connected, then all powered devices do not receive power.
    - a powered device is disconnected and reconnected while other devices are waiting for power, it is not possible to determine which devices are granted or denied power.

- If a powered device requests additional power that exceeds the power budget, the device is denied power, power to the port is turned off, a syslog message is generated, and. LEDs are updated. The switch periodically rechecks the power budget and continues to attempt to grant the power request.
- If a powered device, that is receiving power from a PoE-capable switch, is also connected to a power source, the PoE-capable switch continues to power the device. The switch continues to report that it is providing power to the device irrespective of whether the device is actually getting power from the PoE-capable switch or the power source.
- If a powered device is removed from a PoE port, the PoE-capable switch detects the disconnect and removes power from the port.
- If the device supplies power to 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 global power budget reclaims the power that was allocated to the powered device.

Static mode

- If a specific wattage is not configured, the maximum value is configured by default.
- The PoE port is powered only if it discovers a powered device.
- The port is not part of the first-come, first-served model.
- The switch allocates the port-configured maximum wattage, and the power is not changed even if the powered device is assigned to an IEEE class or sends CDP messages.
- If the PoE switch learns through CDP messages that the powered device is consuming more than the maximum wattage, the switch shuts down the powered device.

PoE

Power over Ethernet (PoE) is a technology that allows Ethernet cables to carry electrical power, along with data, to powered devices. Power is supplied from the switch's power sourcing equipment (PSE) through the PoE-capable port and over the cable to the powered device.

If the powered device has mains power source (AC), the PoE-capable port provides redundant (backup) power. When the AC power becomes unavailable, a PoE-capable port detects and supplies power based on the power management mode.

Supported powered devices

PoE-capable switches can detect and supply power to devices that comply with universally adopted PoE standards and be IEEE standards-compliant. These device can be a Cisco device, such as a Cisco IP phone, or a third-party device. Third-party devices are classified based on the PoE standards they support. See Table for device classification based on PoE standards.

PoE classification

PoE technology is classified according to the IEEE standards that have evolved over the years.

Table shows the relationship between the PoE types, PoE standard, device types and the maximum power supported for each PoE classification.

Table 1: PoE classification based on standards

PoE types	PoE standard	Device type	Maximum power supported
PoE (standard PoE)	IEEE 802.3af	Type 1	15.4 W
PoE+	IEEE 802.3at	Type 2	30 W
PoE++	IEEE 802.3bt	Type 3	60 W
4PPoE	IEEE 802.3bt	Type 4	90 W
Cisco Universal Power Over Ethernet (UPOE)	Cisco-proprietary technology	Cisco devices	60 W

Cisco UPOE

The Cisco UPOE is a Cisco proprietary technology and an enhancement to PoE. It allows a PoE-capable switch to provide 60 W (2 x 30 W) of power over standard Ethernet cabling infrastructure (Class D or better) by using both pairs of an RJ-45 cable-signal pair (wires 1,2,3,6) and spare pair (wires 4,5,7,8), and managing the power using Cisco Discovery Protocol (CDP) or Link Layer Discovery Protocol (LLDP).

Power classification of a powered device

Power classification refers to how a PoE-capable switch determines the power consumption class of a detected device. The classification is done based on the IEEE standards.

Table shows the relationship between the power consumption class and the maximum power level in each class.

Table 2: Power classification of a powered device

Class	Maximum power level required from the device
0 (unknown class status)	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

PoE management modes

PoE management modes control how the PoE-capable switch provides power to connected devices. The PoE-capable switch supports these power management modes:

- auto:

  In this mode, the PoE-capable switch automatically detects if the powered device requires power and provides power based on the device's power requirement and the available power budget. This is the default setting.

  You can configure the auto mode and specify the maximum wattage that is allowed on the port. If you do not specify a wattage, the device preallocated the maximum value.

  This setting is ideal when you want to connect a plug-and-play device or where you want to restrict high-power devices on a port by specifying a maximum wattage.

- static:

  In this mode, the switch pre-allocated power to a port regardless of whether a powered device is connected. Any powered device that uses less than or equal to the maximum wattage receives power when connected to the static port.

  You can configure static mode and specify its maximum wattage.

  This setting can be used on a high-priority interface or where you want to restrict high-power powered devices on a port by specifying a maximum wattage.

- never:

  In this mode, the PoE-capable switch does not power the PoE port and disables powered-device detection. Use this setting on a port that serves only data and is not PoE-enabled.

Configure a power management mode on a PoE port

By default, the power management mode is set to auto. You need to perform this task to change the power management mode.

Before you begin

When you make PoE configuration changes to a port, the power to the port is dropped. The port is provided power again depending on the

- new configuration,
- the state of the other PoE ports, and
- the state of the power budget.

For example, port 1 is in the *auto* and *on* states.

When you change the mode to *static*, then the switch

- removes power from port 1
- detects the powered device, and

- repowers the port

When you change the mode to static and conigure it with a maximum wattage of 10 W, the the switch removes power from the port and then redetects the powered device. The switch provides power to the port only if the powered device is a class 1, class 2, or a Cisco-only powered device.

Procedure

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** *interface-id*

Example:

```
Device(config)# interface gigabitethernet1/0/4
```

Specifies the physical port to be configured and enters interface configuration mode.

Step 4 **power inline** {**auto** [**max** *max-wattage*] | **never**| **static** [**max** *max-wattage*] }

Example:

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

Configures the PoE mode on the port. The following are the keywords:

- **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** *max-wattage*: 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.

  Note
  Do not configure the **power inline never** command on a port connected to a powered device. A false link-up can occur that can change the port into an error-disabled state.

- **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.

  The device allocates power to a port configured in static mode before it allocates power to a port configured in auto mode.

Step 5 **end**

Example:

```
Device(config-if)# end
```

Returns to privileged EXEC mode.

Step 6 **show power inline** [*interface-id* | **module** *switch-number*]

Example:

```
Device# show power inline
```

Displays the PoE status for a device or a device stack, for the specified interface, or for a specified stack member.

The **module** *switch-number* keywords are supported only on stacking-capable devices.

Step 7 **copy running-config startup-config**

Example:

```
Device# copy running-config start-up config
```

(Optional) Saves your entries in the configuration file.

PoE, powered device, and switch

These sections provide information about the conditions required for a PoE capable switch to provide power, how the PoE-capable switch identify the power requirement of the powered device, and how PoE works on a standalone switch and a switch stack.

Conditions for a PoE-capable switch to provide power

A PoE-capable switch provides power when all of the following conditions are met:

- A Cisco pre-standard or an IEEE-compliant powered device on its PoE-capable port
- The PoE-capable port is in the no-shutdown state.
- PoE is enabled.

Note By default, PoE is enabled.

- The powered device is not powered by an AC adapter.

How does the PoE-capable switch identify the power requirement of the powered device

Workflow

When a powered device is connected to a PoE-enabled port,

1. The PoE-capable switch performs a detection test to determine if the device is PoE-capable.
2. If the device is PoE-capable, the switch sends a classification signal (15.5 V to 20.5 V) to determine the device's power consumption class. The device responds with an electrical signature (measured in milliamps) that corresponds to its power classification.
3. Based on the detected power class, the switch checks its power budget and allocates the required power to the port. The switch then adjusts its power budget accordingly.

PoE on a standalone switch

In a standalone switch, the total power available for powered devices depends on the power supply configuration and the installed internal power supplies.

In a standalone switch, replacing the power supply can affect the available power for the powered device in the following ways:

- If the replacement power supply supports less power, the switch may not have enough power for all powered devices. In this case, the switch denies power to PoE ports, configured in auto mode, starting with the highest port numbers. If there is still insufficient power, the switch denies power to the PoE ports configured in static mode, starting with the lowest port numbers.
- If the replacement power supply supports more power than the previous one, the switch will have additional power available. In this case, the switch grants power to PoE ports configured in static mode, starting with the lowest port numbers. If there is still sufficient power, the switch grants power to the PoE ports configured in auto mode, starting with the highest port numbers.

PoE on a switch stack

PoE operates the same whether or not the switch is configured as a standalone or as a stack. The power budget is per switch and independent of the switch members in the stack. Election of a new active switch does not affect PoE operation. The active switch keeps track of the PoE status for all switch members and ports in the stack and includes the status in output displays.

A stacking-capable switch also supports StackPower, which allows the switch's power supplies to share the load across multiple systems in a stack when you connect the switch with power stack cables. You can manage the power supplies of up to four stack members as a single large power supply.

The stacking-capable switch also supports StackPower. StackPower allows the power supplies to share the load across the stack when you connect up to four switch members with power stack cables.

Power management protocols

Power management protocols determine how a PoE-capable switch manages power to a powered device. The supported power management protocols are

- CDP with power consumption: The powered device notifies the PoE-capable switch of its power consumption. The switch does not reply to the power consumption messages. The switch can only supply or remove power from the PoE port.

  CDP with power consumption is supported only on Cisco devices.

Note In this method, high-powered devices operate in low-power mode only.

- Cisco intelligent power management: The powered device and the PoE-capable switch use CDP or LLDP messages to negotiate an agreed-upon power-consumption level. The process allows a high-powered device to operate at its highest power mode.

  The powered device first boots up in low-power mode. It then negotiates for additional power to operate in high-power mode. The device switches to high-power mode only after receiving confirmation from the switch.

  Cisco intelligent power management is supported on the following devices:

  - Cisco devices with CDP or LLDP messages
  - third party devices with LLDP messages except in Cisco UPOE mode.

Power management with CDP messages

When a powered devices connects to a PoE port on a switch,

1. the device sends CDP messages to the switch, specifying its precise power consumption requirements.
2. the switch:
   - Receives the CDP messages and determines the exact power requirements of the powered device.
   - Adjusts the power allocation for the port accordingly, ensuring that the device gets exactly the amount of power it requires—no more, no less.
   - Updates the power budget. The switch subtracts the allocated power from its total available power budget, ensuring it can supply power to additional PoE devices without overloading.

Power management with LLDP messages

When a powered devices connects to a PoE port on a switch,

1. The switch uses LLDP messages to discover the device and its capabilities.
2. The powered device sends power-via-MDI TLVs via LLDP to request a specific amount of power (e.g., 25 W). The request includes a proprietary TLV that specifies the
   - Type: The type of power being requested (e.g., spare-pair power for 4-wire delivery).
   - Length: The length of the TLV message.
   - Value: The details of the power requirement (e.g., 30 W or higher).
3. The switch evaluates the request, adjusts its power allocation, and supplies the requested power.

4. If the PD's power requirements change, updated TLVs are sent, and the switch dynamically adjusts the power delivery.

Power management with Cisco UPOE

When a powered device connects to a Cisco UPOE-enabled switch,

- the switch detects the device and initiates power negotiation using either CDP or LLDP.
- If the device requires more than the standard PoE+ power limit (30 W), it sends an LLDP or CDP message specifying its power needs.
  - Upon receiving the message, the UPOE switch determines whether it can meet the power request. If sufficient power is available, the switch activates the spare pairs (in addition to the signal pairs) to deliver up to 60 W of power.
  - The switch begins supplying power over all four pairs of wires, enabling the powered device to operate in high-power mode.
- If the device does not support CDP or LLDP messages, but it supports detection and classification on both signal and spare pairs, you can configure a 4-pair forced mode. This mode automatically enables power on both signal and spare pairs from the switch port.

Enable power on signal and spare pairs

Perform this task if you want to enable power on both signal and spare pairs.

Before you begin

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

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** *interface-id*

Example:

```
Device(config)# interface gigabitethernet1/0/4
```

Specifies the physical port to be configured, and enters interface configuration mode.

Step 4 **power inline four-pair forced**

Example:

```
Device(config-if)# power inline four-pair forced
```

Enables power on both signal and spare pairs from a switch port.

Step 5 **end**

Example:

```
Device(config-if)# end
```

Exits interface configuration mode, and returns to privileged EXEC mode.

Power monitoring and power policing

Power monitoring, also known as power sensing, is the process in which a PoE-capable switch monitors the real-time power consumption of a powered device.

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

Power policing is the process that enables the switch to restrict power usage based on power monitoring. By default, power policing is disabled on all PoE ports.

How power monitoring and power policing works

Workflow

Power monitoring and power policing allow the switch to control the power consumption of a powered device. This is how power monitoring works:

1. The switch monitors the real-time power consumption of its individual ports.
2. The switch records the power consumption, including peak power usage. It reports this information through CISCO-POWER-ETHERNET-EXT-MIB.
3. If power policing is enabled, the switch polices power usage by comparing the real-time power consumption with the maximum power allocated to the powered device. This maximum power value is also known as the cutoff power.
    - If the powered device uses more than the cutoff power, the switch can either turn off the power to the port, or can generate a syslog message and update the LEDs . In this case, the port LED blinks amber, and the switch continues providing power to the powered device based on the device configuration.
    - If error recovery from the PoE error-disabled state is enabled, the switch 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 power policing is disabled, no action occurs when the powered device consumes more than the maximum power allocation on the PoE port, which could adversely affect the switch.

Power consumption values for power monitoring and power policing

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

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 switch.

For example, with a Class 1 switch, if policing is disabled and you set the cutoff-power value by using the **power inline auto max 6300** command, in interface configuration mode, the configured maximum power allocation on the PoE port is 6.3 W (6300 mW). The switch provides power to the powered devices on the port if the powered device needs up to 6.3 W. If the CDP power-negotiated value or the IEEE classification value exceeds the configured cutoff value, the switch does not provide power to the powered device. After the switch turns on power on the PoE port, it does not police the real-time power consumption of the powered device. As a result, the powered device can consume more power than the maximum allocated amount, which could adversely affect the switch and other powered devices connected to other PoE ports.

Configure power policing

You can perform this task to police the power usage.

By default, the device monitors the real-time power consumption of powered devices and policing is disabled.

Procedure

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** *interface-id*

Example:

```
Device(config)# interface gigabitethernet1/0/4
```

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:

- **power inline police**: Shuts down the PoE port, turns off power to it, and puts it in the error-disabled state.

  Note
  You can enable error detection for the PoE error-disabled state 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.

- **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.

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.

Step 5 **exit**

Example:

```
Device(config-if)# exit
```

Exits interface configuration mode, and returns to global configuration mode.

Step 6 Choose any one of the following commands:

- **errdisable detect cause inline-power**
- **errdisable recovery cause inline-power**
- **errdisable recovery interval** *interval*

Example:

```
Device(config)# errdisable detect cause inline-power
OR
Device(config)# errdisable recovery cause inline-power
OR
Device(config)# errdisable recovery interval 100
```

(Optional) Enables error recovery from the PoE error-disabled state, and configures the PoE recovery mechanism variables.

- **errdisable detect cause inline-power**: Enables the switch to detect errors related to PoE that would cause a port to enter an error-disabled state. When enabled, if a PoE-related issue occurs on a port such as a connected device attempts to draw more power than allocated or supported by the port, the switch will place that port into an err-disabled state.

- **errdisable recovery cause inline-power**: Enables the automatic recovery mechanism for ports that have been placed in an err-disabled state specifically due to an inline-power error. Without this command, an administrator would need to manually re-enable the port by issuing shutdown followed by no shutdown commands on the interface.
- **errdisable recovery interval** *interval*: Sets the time, in seconds, that the switch will wait before attempting to automatically re-enable a port that is in an err-disabled state.

  The *interval* range is 30 to 86400.

  By default, the recovery interval is 300 seconds.

Step 7 **exit**

Example:

```
Device(config)# exit
```

Returns to privileged EXEC mode.

Step 8 Choose any one of the following:

- **show power inline police**
- **show errdisable recovery**

Example:

```
Device# show power inline police
OR
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 start-up config
```

(Optional) Saves your entries in the configuration file.

Monitor power status

Command	Purpose
show env power switch [*switch-number*]	(Optional) Displays the status of the internal power supplies for each switch in the stack or for the specified switch. The range is 1 to 9, depending on the switch member numbers in the stack. These keywords are available only on stacking-capable switches.
show power inline [*interface-id* | module *switch_number*]	Displays PoE status for a switch or switch stack, for an interface, or for a specific switch in the stack.

Command	Purpose
show power inline police	Displays power-policing data.
show power inline upoe-plus *interface-id* **[module]**	Displays the PoE status for an interface that is enabled for 802.3bt-compliant mode.

Example: Display PoE status

The following is a sample example of **show power inline upoe-plus** command.

```
Device# show power inline upoe-plus

Module   Available     Used     Remaining
          (Watts)     (Watts)    (Watts)
------   ---------   --------   ---------
3          1310.0      660.0       650.0
Codes: DS - Dual Signature device, SS - Single Signature device
       SP - Single Pairset device

Interface   Admin  Type Oper-State       Power(Watts)     Class   Device Name
            State       Alt-A,B       Allocated Utilized  Alt-A,B
----------- ------ ---- ------------- --------- --------- ------- -----------

Te3/0/1     auto   DS   on,on         60.0      6.8       3,3     Ieee PD
Te3/0/2     auto   DS   on,on         60.0      6.7       3,3     Ieee PD
Te3/0/3     auto   DS   on,on         60.0      6.8       3,3     Ieee PD
Te3/0/4     auto   DS   on,on         60.0      6.8       3,3     Ieee PD
Te3/0/5     auto   DS   on,on         60.0      6.8       3,3     Ieee PD
Te3/0/6     auto   DS   on,on         60.0      6.8       3,3     Ieee PD
Codes: DS - Dual Signature device, SS - Single Signature device
       SP - Single Pairset device

Interface   Admin  Type Oper-State       Power(Watts)     Class   Device Name
            State       Alt-A,B       Allocated Utilized  Alt-A,B
----------- ------ ---- ------------- --------- --------- ------- -----------

Te3/0/7     auto   DS   on,on         60.0      6.8       3,3     Ieee PD
Te3/0/8     auto   DS   on,on         60.0      6.8       3,3     Ieee PD
Te3/0/9     auto   n/a  off           0.0       0.0       n/a
Te3/0/10    auto   SS   on,off        30.0      5.4       4       Ieee PD
Te3/0/11    auto   SS   on,off        30.0      9.0       4       Ieee PD
Te3/0/12    auto   SS   on,off        30.0      9.7       4       Ieee PD
Te3/0/13    auto   n/a  off           0.0       0.0       n/a
Te3/0/14    auto   n/a  off           0.0       0.0       n/a
Te3/0/15    auto   n/a  off           0.0       0.0       n/a
Te3/0/16    auto   n/a  off           0.0       0.0       n/a
Te3/0/17    auto   n/a  off           0.0       0.0       n/a
Codes: DS - Dual Signature device, SS - Single Signature device
       SP - Single Pairset device

Interface   Admin  Type Oper-State       Power(Watts)     Class   Device Name
            State       Alt-A,B       Allocated Utilized  Alt-A,B
----------- ------ ---- ------------- --------- --------- ------- -----------

Te3/0/18    auto   n/a  off           0.0       0.0       n/a
Te3/0/19    auto   n/a  off           0.0       0.0       n/a
Te3/0/20    auto   n/a  off           0.0       0.0       n/a
Te3/0/21    auto   n/a  off           0.0       0.0       n/a
Te3/0/22    auto   SS   on,off        30.0      12.0      4       Ieee PD
```

```
Te3/0/23    auto   SS   on,off        30.0      12.3      4       Ieee PD
Te3/0/24    auto   SS   on,off        30.0      5.3       4       Ieee PD
--------- ------ ---------- ---------- ---------- ------------------- -----

Totals:            14   on          660.0    107.9
```

The following are descriptions of the fields that you see in the output of the **show power inline upoe-plus** command:

Table 3: Fields displayed in the output command

Field	Description
Type	Type of PD: 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, Spare-pair respectively
Device Name	Name of the Powered Device as advertised by CDP.

The following is a sample output of the **show power inline** command. This command displays 802.3bt-compliant 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.

```
Device# show power inline Te3/0/1 detail

 Interface: Te3/0/1
 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): 3,3
 Physical Assigned Class (Alt-A,B): 3,3
 Discovery mechanism used/configured: Ieee and Cisco
 Police: off

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

 Actual consumption
 Measured at the port(watts) (Alt-A,B): 3.4,3.3
 Maximum Power drawn by the device since powered on: 6.9

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

 Power Negotiation Used: None
 LLDP Power Negotiation       --Sent to PD--      --Rcvd from PD--
```

```
 Power Type:                  -                    -
 Power Source:                -                    -
 Power Priority:              -                    -
 Requested Power(W):          -                    -
 Allocated Power(W):          -                    -

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 police** command:

```
Device# show power inline police

 Module   Available     Used     Remaining
          (Watts)     (Watts)    (Watts)
------   ---------   --------   ---------
3          1310.0      660.0       650.0
Interface Admin  Oper       Admin      Oper       Cutoff Oper
          State  State      Police     Police     Power  Power
--------- ------ ---------- ---------- ---------- ------ -----
Te3/0/1   auto   on         none       n/a        n/a    6.8
Te3/0/2   auto   on         none       n/a        n/a    6.7
Te3/0/3   auto   on         none       n/a        n/a    6.9
Te3/0/4   auto   on         none       n/a        n/a    6.8
Te3/0/5   auto   on         none       n/a        n/a    6.8
Te3/0/6   auto   on         none       n/a        n/a    6.8
Te3/0/7   auto   on         none       n/a        n/a    6.8
Te3/0/8   auto   on         none       n/a        n/a    6.8
Te3/0/9   auto   off        none       n/a        n/a    n/a
Te3/0/10  auto   on         none       n/a        n/a    5.4
Te3/0/11  auto   on         none       n/a        n/a    8.9
Te3/0/12  auto   on         none       n/a        n/a    9.5
Te3/0/13  auto   off        none       n/a        n/a    n/a
Te3/0/14  auto   off        none       n/a        n/a    n/a
Te3/0/15  auto   off        none       n/a        n/a    n/a
Interface Admin  Oper       Admin      Oper       Cutoff Oper
          State  State      Police     Police     Power  Power
--------- ------ ---------- ---------- ---------- ------ -----
Te3/0/16  auto   off        none       n/a        n/a    n/a
Te3/0/17  auto   off        none       n/a        n/a    n/a
Te3/0/18  auto   off        none       n/a        n/a    n/a
Te3/0/19  auto   off        none       n/a        n/a    n/a
Te3/0/20  auto   off        none       n/a        n/a    n/a
Te3/0/21  auto   off        none       n/a        n/a    n/a
Te3/0/22  auto   on         none       n/a        n/a    12.0
Te3/0/23  auto   on         none       n/a        n/a    12.2
Te3/0/24  auto   on         none       n/a        n/a    5.3
--------- ------ ---------- ---------- ---------- ------ -----
Totals:                                                  107.6
```

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

```
Device# show power inline priority

Interface  Admin  Oper       Admin
           State  State      Priority
---------- ------ ---------- ----------
Te3/0/1    auto   on         low
Te3/0/2    auto   on         low
Te3/0/3    auto   on         low
Te3/0/4    auto   on         low
Te3/0/5    auto   on         low
Te3/0/6    auto   on         low
Te3/0/7    auto   on         low
```

```
Te3/0/8    auto   on         low
Te3/0/9    auto   off        low
Te3/0/10   auto   on         high
Te3/0/11   auto   on         high
Te3/0/12   auto   on         high
Te3/0/13   auto   off        high
Te3/0/14   auto   off        high
Te3/0/15   auto   off        high
Te3/0/16   auto   off        high
Te3/0/17   auto   off        low
Te3/0/18   auto   off        low
Te3/0/19   auto   off        low
Te3/0/20   auto   off        high
Te3/0/21   auto   off        high
Te3/0/22   auto   on         high
Te3/0/23   auto   on         high
Te3/0/24   auto   on         high
```

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

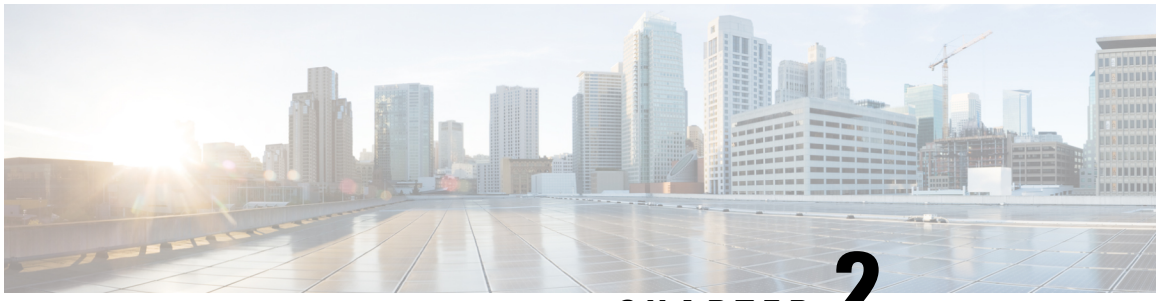
```
Device# show power inline meter

Module   Available     Used     Remaining
          (Watts)     (Watts)    (Watts)
------   ---------   --------   ---------
1          1625.0       85.6      1539.4
Interface    Meter Update             Three Hours Metered    Metered Energy in MilliWattSec
 (15min Buckets)
             Time                       Value (MilliWattSec)

----------   ----------------------   --------------------
-------------------------------------------------------------------------------------------------------------
Tw1/0/1      2024-06-25 20:59:28 UTC                      0   0-0-0-0-0-0-0-0-0-0-0-0
Tw1/0/2      2024-06-25 20:59:28 UTC                      0   0-0-0-0-0-0-0-0-0-0-0-0
Tw1/0/3      2024-06-25 20:59:28 UTC                      0   0-0-0-0-0-0-0-0-0-0-0-0
Tw1/0/4      2024-06-25 20:59:28 UTC                      0   0-0-0-0-0-0-0-0-0-0-0-0
Tw1/0/5      2024-06-25 20:59:28 UTC               29439712
2373112-2460600-2460600-2460600-2460600-2460600-2460600-2460600-2460600-2460600-2460600-2460600
Tw1/0/6      2024-06-25 20:59:28 UTC               29166857
2355512-2440250-2439315-2443385-2430515-2443000-2438380-2436620-2435080-2427600-2433650-2443550
Interface    Meter Update             Three Hours Metered    Metered Energy in MilliWattSec
 (15min Buckets)
             Time                       Value (MilliWattSec)

----------   ----------------------   --------------------
-------------------------------------------------------------------------------------------------------------
Tw1/0/7      2024-06-25 20:59:28 UTC                      0   0-0-0-0-0-0-0-0-0-0-0-0
Tw1/0/8      2024-06-25 20:59:28 UTC                      0   0-0-0-0-0-0-0-0-0-0-0-0
Tw1/0/9      2024-06-25 20:59:28 UTC                      0   0-0-0-0-0-0-0-0-0-0-0-0
Tw1/0/10     2024-06-25 20:59:28 UTC                      0   0-0-0-0-0-0-0-0-0-0-0-0
Tw1/0/11     2024-06-25 20:59:28 UTC               29375104
2367904-2455200-2455200-2455200-2455200-2455200-2455200-2455200-2455200-2455200-2455200-2455200
Tw1/0/12     2024-06-25 20:59:28 UTC                      0   0-0-0-0-0-0-0-0-0-0-0-0
Tw1/0/13     2024-06-25 20:59:28 UTC                      0   0-0-0-0-0-0-0-0-0-0-0-0
Tw1/0/14     2024-06-25 20:59:28 UTC                      0   0-0-0-0-0-0-0-0-0-0-0-0
Tw1/0/15     2024-06-25 20:59:28 UTC               89776174
7238706-7499648-7504958-7500310-7502066-7509576-7499730-7508690-7501684-7504556-7505350-7500900
Tw1/0/16     2024-06-25 20:59:28 UTC                      0   0-0-0-0-0-0-0-0-0-0-0-0
Interface    Meter Update             Three Hours Metered    Metered Energy in MilliWattSec
 (15min Buckets)
             Time                       Value (MilliWattSec)

----------   ----------------------   --------------------
-------------------------------------------------------------------------------------------------------------
```



CHAPTER 2

Perpetual PoE and Fast PoE

- Feature History for Perpetual PoE and Fast PoE , on page 21
- Support of Perpetual PoE and Fast PoE on a switch, on page 22
- Perpetual PoE, on page 22
- Fast PoE, on page 22
- How fast PoE works, on page 22
- Guidelines to configure perpetual PoE and fast PoE, on page 23
- Configure perpetual PoE and fast PoE, on page 23
- Example: Configure perpetual PoE, on page 24

Feature History for Perpetual PoE and Fast PoE

This table provides release and platform support information for the features explained in this module.

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

Release	Feature Name and Description	Supported Platform
Cisco IOS XE 17.18.1	Perpetual PoE: Perpetual PoE, also known as Persistent PoE, is an enhancement to the PoE technology that allows a switch to provide uninterrupted power to connected powered devices during a switch reload or reboot. Fast PoE: Fast PoE is another enhancement to PoE technology that focuses on reducing the time powered devices require to receive power from a switch after a power cycle.	Cisco C9350 Series Smart Switches

Support of Perpetual PoE and Fast PoE on a switch

Perpetual PoE and Fast PoE is supported only on the following modules of the Cisco C9350 Series Smart Switches:

- C9350-24P
- C9350-48P
- C9350-24U
- C9350-48U
- C9350-48HX

Perpetual PoE

Perpetual PoE, also known as Persistent PoE, is an enhancement to the PoE technology that allows a switch to provide uninterrupted power to connected powered devices during a switch reload or reboot. In traditional PoE implementations, powered devices lose power during a switch reload. This occurs because the switch's power sourcing equipment (PSE) temporarily shuts down. This interruption can cause downtime for devices and interrupt services.

Fast PoE

Fast PoE is another enhancement to PoE technology that focuses on reducing the time powered devices require to receive power from a switch after a power cycle. Unlike traditional PoE, which requires the switch to fully boot up before it can initialize and provide power to connected devices, Fast PoE reduces this delay.

How fast PoE works

Workflow

When Fast PoE is configured on a port, the switch records the port configuration.

After the switch recovers from a power failure or while the main power (AC) to the switch is being restored, the switch identifies the Fast PoE and provides power to the port,

1. within 15 to 20 seconds after the power is established,
2. without waiting for the IOS to finish booting, and
3. even before the switch forwards network traffic.

Guidelines to configure perpetual PoE and fast PoE

- You must configure Perpetual PoE or Fast PoE before physically connecting any endpoint.
- After all configurations are completed, it is advised to do a manual shut and no-shut of the ports.
- During an M3 or PSE firmware upgrade, power to the ports is interrupted. The switch backs up power configurations and reloads them after the IOS software restarts.
- During an MCU firmware upgrade, power to the ports is interrupted. After the upgrade, ports restore power immediately.
- When switches are power-stacked, perpetual PoE and Fast PoE may not function as expected because of a power budget shortage.
- If the powered device does not support LLDP, configure it with either static or 2-event to provide the required power as specified for the device.
- For devices that have negotiated a custom power level using LLDP, after the switch recovers from a power outage, Fast PoE restores power based only on initial detection of the powered device and its power classification. LLDP-based power negotiation requires Cisco IOS to be fully operational to exchange LLDP packets and communicate power requirements. Fast PoE quickly applies power using the initial detection and power classification to minimize downtime. The custom LLDP-negotiated power settings are re-established only once the IOS and LLDP exchange are operational again.

Configure perpetual PoE and fast PoE

Perform this task to configure Perpetual PoE and Fast PoE.

Before you begin

Configure the **perpetual-poe-ha** command before connecting the powered device, or manually shut or unshut the port after configuring **poe-ha** command.

Procedure

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** *interface-id*

Example:

```
Device(config)# interface gigabitethernet1/0/4
```

Specifies the physical port to be configured, and enters interface configuration mode.

Step 4 **power inline port perpetual-poe-ha**

Example:

```
Device(config-if)# power inline port perpetual-poe-ha
```

Configures perpetual PoE. When you configure perpetual PoE on a port connected to a powered device, the powered device remains powered on during reload.

Step 5 **power inline port poe-ha**

Example:

```
Device(config-if)# power inline port poe-ha
```

Configures Fast PoE. When you configure Fast PoE, if the switch is power cycled, PD device power inline port poe-ha into a power source without waiting for IOS to boot up.

Step 6 **end**

Example:

```
Device(config-if)# end
```

Returns to privileged EXEC mode.

Example: Configure perpetual PoE

This example shows how you can configure perpetual PoE on a switch:

```
Device> enable
Device# configure terminal
Device(config)# interface gigabitethernet2/0/1
Device(config-if)# power inline port perpetual-poe-ha
Device(config-if)# end
```

This example shows how you can configure fast PoE on the switch:

```
Device> enable
Device# configure terminal
Device(config)# interface gigabitethernet2/0/1
Device(config-if)# power inline port perpetual-poe-ha
Device(config-if)# power inline port poe-ha
Device(config-if)# end
```

This example shows what happens if you configure fast PoE before configuring perpetual PoE:

```
Device> enable
Device# configure terminal
Device(config)# interface gigabitethernet2/0/1
Device(config-if)# power inline port poe-ha
Interface Gi2/0/1:INFO: Please execute "power inline port perpetual-poe-ha"
configuration command when "power inline port poe-ha" is configured on
the interface to enable fast poe
```

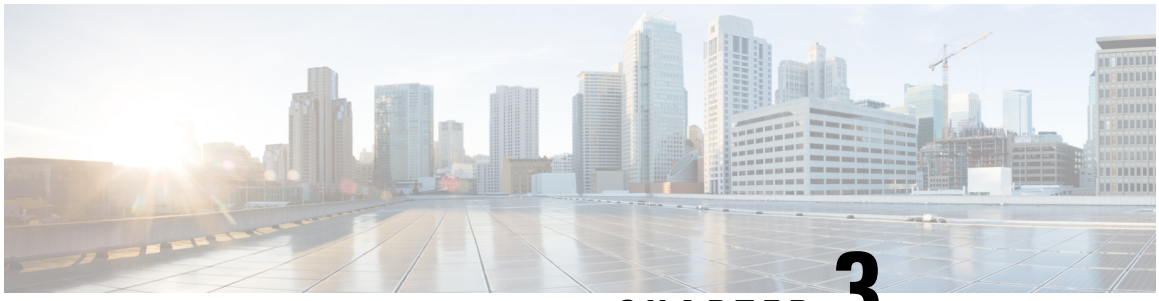
```
Device(config-if)#
Device(config-if)# power inline port perpetual-poe-ha
Device(config-if)# end
```

This example shows what happens when you disable perpetual PoE without disabling fast PoE on the interface:

```
Device> enable
Device# configure terminal
Device(config)# interface gigabitethernet2/0/1
Device(config-if)# power inline port poe-ha
Interface Gi2/0/1:INFO: Please execute "power inline port perpetual-poe-ha"
configuration command when "power inline port poe-ha" is configured on
the interface to enable fast poe

Device(config-if)#
Device(config-if)# power inline port perpetual-poe-ha
Device(config-if)# no power inline port poe-ha
Device(config-if)# power inline port poe-ha
Device(config-if)# no power inline port perpetual-poe-ha
Interface Gi2/0/1:INFO: Please execute "no power inline port poe-ha"
configuration command, as fast poe has no effect without "power inline
port perpetual-poe-ha" configuration on the interface

Device(config-if)#
Device(config-if)# end
```



CHAPTER 3

Persistent PoE with 2-event enabled and Fast PoE

- Feature History for Persistent PoE with 2-event enabled and Fast PoE, on page 27
- Support of persistent PoE with 2-event enabled and fast PoE on switch, on page 27
- Persistent PoE with 2-event enabled and fast PoE, on page 28
- How persistent PoE with 2-event enabled and fast PoE works, on page 28
- Guidelines to configure persistent PoE with 2-event enabled and fast PoE, on page 28
- Configure persistent PoE with 2-event enabled and fast PoE, on page 29
- Example: Configure 2-Event classification, on page 29

Feature History for Persistent PoE with 2-event enabled and Fast PoE

This table provides release and platform support information for the features explained in this module.

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

Release	Feature Name and Description	Supported Platform
Cisco IOS XE 17.18.1	Persistent PoE with 2-event enabled and Fast PoE: 2-event classification is a method that allows the switch's PSE to signal its ability to provide higher power (up to 30W) to a powered device.	Cisco C9350 Series Smart Switches

Support of persistent PoE with 2-event enabled and fast PoE on switch

Persistent PoE with 2-event enabled and Fast PoE is supported only on the following modules of the Cisco C9350 Series Smart Switches:

- C9350-24P
- C9350-48P
- C9350-24U
- C9350-48U
- C9350-48HX

Persistent PoE with 2-event enabled and fast PoE

2-event classification is a method that allows the switch's power sourcing equipment (PSE) to signal its ability to provide higher power (up to 30W) to a powered device. With 2-event classification, when a class 4 powered device is detected, Cisco IOS allocates 30W of power without requiring CDP (Cisco Discovery Protocol) or LLDP (Link Layer Discovery Protocol) negotiation. This means that even before the network link becomes operational, the Class 4 powered device can receive 30W of power.

How persistent PoE with 2-event enabled and fast PoE works

Workflow

The following process details how persistent PoE with 2-event enabled and Fast PoE works:

1. The PSE detects the presence of a powered device by applying a small voltage (usually between 2.7V and 10.1V) on the Ethernet cable and measuring the resistance to determine that a powered device is connected.
2. The PSE sends a low voltage (usually between 15.5V and 20.5V) on the Ethernet cable, and the powered device responds with a specific current signature that indicates its power class, for example class 0, 1, 2, 3, or 4 and so on. This is known as the first event.
3. The PSE repeats the classification voltage a second time. This is known as the second event.
4. Based on the power class identification, the PSE applies full operating voltage (44V to 57V, typically around 48V) and begins delivering power to the powered device.

Guidelines to configure persistent PoE with 2-event enabled and fast PoE

- Configuration of 2-event classification has to be done before physically connecting any endpoint.
- Power to the ports is interrupted in case of microcontroller unit firmware upgrade and ports will be restored immediately after the upgrade.
- Once 2-event is enabled on a port, manually shut and no-shut the port or reconnect the powered device to start the detection.

Configure persistent PoE with 2-event enabled and fast PoE

Perform this task to configure Persistent PoE with 2-event enabled and Fast PoE to enable a PSE to higher power to a powered device.

Procedure

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** *interface-id*

Example:

```
Device(config)# interface gigabitethernet1/0/4
```

Specifies the physical port to be configured, and enters interface configuration mode.

Step 4 **power inline port 2-event**

Example:

```
Device(config-if)# power inline port 2-event
```

Enables 2-event classification on the port of the switch.

Step 5 **end**

Example:

```
Device(config-if)# end
```

Returns to privileged EXEC mode.

Example: Configure 2-Event classification

This example shows how you can configure 2-event classification:

```
Device> enable
Device# configure terminal
Device(config)# interface gigabitethernet2/0/1
```

```
Device(config-if)# power inline port 2-event
Device(config-if)# end
```