Power over Ethernet

Power over Ethernet

Power over Ethernet (PoE) is a technique for delivering DC power to devices over copper Ethernet cabling, eliminating the need for separate power supplies and outlets. Using PoE can improve flexible options for placing Ethernet end devices, and reduce the time and expense of installing electrical cabling.

PoE is supported on three Cisco Catalyst IE9300 Rugged Series Switch models beginning in the Cisco IOS XE Dublin 17.12.x release. For details of PoE support, see PoE Support for Cisco Catalyst IE9300 Rugged Series Switches in this guide.

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:

- An IEEE standard powered device, such as a new Cisco IP phone.

- An IEEE 802.3af-compliant powered device, which can receive up to 15.4 W of DC power

- An IEEE 802.3at-compliant powered device, which can receive up to 30 W of DC power

- An IEEE 802.3bt-compliant powered device, which can receive up to 90 W of DC power

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.

Types of PoE

There are two types of PoE: PoE+, and Universal Power over Ethernet Plus (UPoE+). PoE+ delivers 30 W to a port while UPoE+ delivers 90 W to a port. However, both PoE+ and UPoE+ support lower wattages.

PoE Support for Cisco Catalyst IE9300 Rugged Series Switches

The following table provides information about which Cisco Catalyst IE9300 Rugged Series Switches are supported for PoE and the supported ports and wattage.

Switch Model	Supported Ports	PoE Budget
IE9320 10 GE PoE switches (IE-9320-24P4X-A and IE-9320-24P4X-E)	24 ports of up to 30W PoE output on all downlink ports	720 W
IE9320 10 G mGig 4PPoE switch (IE-9320-16P8U4X-A and IE-9320-16P8U4X-E)	• 16 Ports of up to 30 W PoE output on all GE downlink ports • 8 ports of up to 90 W PoE output target on all 2.5 GE downlink ports	720 W
IE9320 GE PoE switches (IE-9320-24P4S-A and IE-9320-24P4S-E)	24 ports of up to 30 W PoE output on all downlink ports	385 W

The switches support the following PoE features in the Cisco IOS XE Dublin 17.12.x release:

- **PoE power policing:** When power policing is enabled, the device polices power usage by comparing the real-time power consumption with the maximum power allocated to the device.

  For more information, see the section Power Monitoring and Power Policing.

- **Perpetual PoE:** Perpetual PoE provides uninterrupted power to a connected powered device even when the power sourcing equipment switch is booting.

  For more information, see the section Configuring Perpetual PoE and Fast POE.

- **Fast PoE:** Fast PoE enables the quick start of PoE power after a system power loss and recovery. If Fast PoE is enabled, status of PoE ports is stored in flash so that if there is a power loss and recovery, ports can be powered on as quickly as possible.

  For more information, see the section Configure Perpetual PoE and Fast PoE in this guide.

- **Load shedding:** Load shedding is the process in which the system shuts down PoE devices when a power supply fails. The switch first shuts down low-priority devices. If the switch still lacks enough power, it shuts down high-priority devices in descending order of port number. You can configure port priority using the CLI. Load shedding is enabled by default.

  For more information, see Load Shedding and Configure Port Priority in this guide.

Powered-Device Detection and Initial Power Allocation

The switch detects 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 adapter.

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.

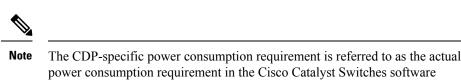| Power Consumption Class	Maximum Power Level Required from Device
0 (class status unknown)	15.4 W
1	4 W
2	7 W
3	15.4 W
4	30 W
5	45 W
6	60 W
7	75 W
8	90 W

The following list shows the power consumption class and maxim power level required for the switches:

- IE9320 10 GE PoE switches (IE-9320-24P4X-A and IE-9320-24P4X-E): Support power consumption classes 1 through 4 (4 W to 30 W).

- IE9320 10 G mGig 4PPoE switches (IE-9320-16P8U4X-A and IE-9320-16P8U4X-E):

  - 16 GE downlink ports support power consumption classes 1 through 4 (4 W to 30 W).

  - 8 2.5 GE downlink ports support power consumption classes 1 through 8 (4 W to 90 W).

- IE9320 GE PoE switches (IE-9320-24P4S-A and IE-9320-24P4S-E): Support power consumption classes 1 through 4 (4 W to 30 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. 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, generates a syslog message, and updates the LEDs. Powered devices can also negotiate with the switch for more power.

With PoE+, powered devices use IEEE 802.3bt 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 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 and LEDs.

Power Management Modes

PoE has the following power-management 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, and updates the LEDs. For LED information, see the hardware installation guide.

  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 exceeds the system's power budget, the device denies power, ensures that power to the port is turned off, generates a syslog message, and updates the LEDs. 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 or LLDP 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.

- **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, no action occurs when the powered device consumes more than the maximum power allocation on the PoE port, which could adversely affect the device.

   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 Imax 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.

Monitoring Power Status

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

Table 1: show Commands for Power Status

Command	Purpose
show power inline police	Displays power-policing data.

Load Shedding

If a power supply fails, the Cisco Catalyst IE9300 Rugged Series Switch shuts down PoE devices, based on port priority. This process—called load shedding—is enabled by default.

With load shedding, all low-priority powered devices are shut down. If the PoE power budget is sufficient, the system reconnects the devices, starting with the lowest-numbered ports. If the budget is insufficient, the system shuts down any high-priority ports in descending order of the port numbers. It does so until power consumption returns to normal.

By default, all powered devices are low priority, but you can configure high priority ports using the CLI. However, you must change priority before the port has been powered on. If the port is powered on, you must switch it off, change priority, and then switch the port back on.

If the power is restored or a new power supply is added, the switch powers on the devices on a first-come-first-serve basis.

See the section Configure Port Priority for more information.

Configuring PoE+ and UPoE+

This section provides instructions for configuring PoE+ and UPoE+ on Cisco Catalyst IE9300 Rugged Series Switches.

Configure a Power Management Mode on a PoE Port

Note When you make PoE configuration changes, the port that is 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, or class 2.

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** *interface-id* **Example:** `Device(config)# `**`interface gigabitethernet2/0/1`**	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. If no value is specified, the maximum is allowed. • **never**: Disables device detection and power to the port. • **static**: Enables detection of powered devices. Preallocate (reserve) power for a port before the device

	Command or Action	**Purpose**
		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	**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.

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

	Command or Action	Purpose
		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. • **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	Use one of the following:
	
	    • **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:** `Device(config)# exit`	Returns to privileged EXEC mode.

Step 8	Use one of the following:
	
	    • **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.

	Command or Action	Purpose
Step 9	**copy running-config startup-config** **Example:** Device# **copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

Configure Port Priority

By default, all the ports on the switch are low-priority. Low-priority ports are the first to be shut down under load-shedding, the process in which the switch shuts down ports when the power budget is low or a power supply goes out.

However, you can configure ports to be high-priority. You may want to do so for ports assigned to critical powered devices. A port configured as static is treated as high priority for load-shedding. You also can configure a high-priority port to a low-priority port.

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Note   The system treats any port configured as static as high-priority.

Complete the command in this section to configure port priority.

Before you begin

Make sure that the port that you want to configure is turned off.

Procedure

	Command or Action	Purpose
Step 1	**power inline port {low	high}** **Example:** Device# power inline port priority high	Configures the priority level of the port.

Feature History: PoE

The following table prIE-9320-16P8U4X-Eovides release and related 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	Feature Information
Cisco IOS XE Dublin 17.12.x	Power over Ethernet (PoE)	PoE is a technique for delivering DC power to devices over copper Ethenet cabling, eliminating the need for separate power supplies and outlets. You can configure PoE on the following Cisco Catalyst IE9300 Rugged Series Switch models: • IE-9320-24P4X-A and IE-9320-24P4X-E • IE-9320-16P8U4X-A and IE-9320-16P8U4X-E • IE-9320-24P4S-A and IE-9320-24P4S-E