

Verify Differences between PoE 802.3AT/802.3BT on Catalyst 9000

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Introduction

This document describes the difference between PoE standards 802.3at and 803.bt.

Prerequisites

Requirements

Cisco recommends that you have knowledge of these topics:

- PoE (Power Over Ethernet)

Components Used

The information in this document is based on these software and hardware versions:

- Catalyst 9000 family and Line cards that supports PoE.
- Cisco IOS-XE®

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

Background Information

Terminology

- IEEE - Institute of Electrical and Electronics Engineers
- PoE - Power over Ethernet
- PoE+ - PoE+ standard increases maximum power that can be drawn by a powered device from 15.4 to 30W per port

- UPoE - Universal PoE. Cisco proprietary technology that extends the IEEE 802.3 PoE standard to provide the capability to source up to 60W of power over per port.
- CDP - Cisco Discovery Protocol, used to negotiate power between Cisco devices.
- LLDP - Link Layer Discovery Protocol used to negotiate power between Cisco and non Cisco devices

A PoE-capable switch port can provide power to one of the connected devices if the device senses that there is no power on the circuit. For this, three different standards were created in order to accomplish different tasks:

- An IEEE 802.3af-compliant powered device
- An IEEE 802.3at-compliant powered device
- An IEEE 802.3bt-compliant powered device

In 1999, IEEE standardized PoE to establish interoperability in a wide range of connected powered devices and power provider equipment. The first standards 802.3af specifies that the power must be able to be provided by either spare pairs (pins 4 and 5 or pins 7 and or data pairs (pins 1 and 2 or pins 3 and 6). Then, In 2009, IEEE 802.3at (PoE+ or Type 2) was created, It allows us to increase power to 30W. Finally, in 2011 a new Cisco proprietary standard came up that allows us to use all four twisted pairs, the IEEE 802.3bt standard defines 4PPoE Type 3 (UPOE) and let us provide up to 60W. Later on, in 2018 this standard allows us to increase the maximum power to 90W from the power source known as 4PPoE Type 4 (UPOE+).

To summarize:

	PoE	PoE+	UPoE	UPoE+
IEEE standard	802.3af	802.3at	Cisco proprietary (802.3bt based)	802.3bt
Type Designation	Type 1	Type 2	Type 3	Type 4
Maximum power per interface	15.4W	30W	60W	90W
Number of twisted pairs used	2	2	4	4

The next section is focused on the 802.3at (Poe+) and 802.3bt (UPoe+) mode.

PoE switch models

- Catalyst 9000 switches and line cards with P in their product ID support PoE+ on a group of ports or all ports. For example, C9200L-48P-4G, C9200-24P, C9300-48P, C9400-LC-48P and so on.
- Catalyst 9000 switches and line cards with U in their product ID support UPoE on a group of ports or all ports. For example, C9300-24U, C9400-LC-48UX, and so on.
- Catalyst 9000 switches and line cards with H in their product ID support UPoE+ on a group of ports or all ports. For example, C9300-48H, C9400-LC-48H and so on.

Note: PoE capability alone does not guarantee PoE assignment. The next section describes when CDP or LLDP is needed to negotiate the proper power.

This table describes the devices that support PoE+, UPOE and UPOE+:

	9200	9300	9400
Do not support PoE	C9200-24T C9200-48T C9200CX-12T	C9300-24T C9300-48T C9300-24S C9300-48S C9300L-24T C9300L-48T C9300X-48TX C9300X-12Y C9300X-24Y C9300-24S C9300-48S C9300LM-48T	C9400-LC-48T C9400-LC-48XS C9400-LC-48XS C9400-LC-24XS C9400-LC-24S C9400-LC-48S
Support PoE+	C9200-24P C9200-24PB C9200-24PXG C9200-48P C9200-48PL C9200-48PB C9200-48PXG C9200CX-12P C9200CX-8P	C9300-24P C9300-48P C9300L-24P C9300L-48P	C9400-LC-48P
Support UPoE	C9200CX-8UXG	C9300-24U C9300-48U C9300-24UX C9300-48UXM C9300-48UN C9300-24UB C9300-24UXB C9300-48UB C9300L-24UXG C9300L-48UXG C9300LM-48UX C9300LM-48U C9300LM-24U C9300-24U C9300-48U C9300-24UX C9300-48UXM C9300-48UN	C9400-LC-48UX C9400-LC-48U

		C9300-24UB C9300-24UXB C9300-48UB C9300L-24UXG C9300L-48UXG C9300LM-48UX C9300LM-48U C9300LM-24U	
Support UPoE+		C9300X-48HX C9300X-48HXN C9300X-24HX C9300-24H C9300-48H	C9400-LC-48HX C9400-LC-48HN C9400-LC-48H

Note: The Cisco Catalyst 9300 UPOE switches that support IEEE 802.3bt standard for Type 3 powered devices are in 802.3at mode, by default.

Note: The Cisco Catalyst 9300 UPOE+ switches that support IEEE 802.3bt standard for Type 4 powered devices are in 802.3bt mode, by default.

A switch classifies an IEEE compliant PoE device under a power consumption class and provides power as soon as the power device is detected.

Class	Maximum Power Level Required from the Device
0 (class stat	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

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 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 the maximum of 30 W.
- The switch is standby until a PoE devices requests for power and grants power only when it is available. Then the switch verifies the power availability (the total amount of power available on the device for PoE) and performs a calculation when a port is provided or denied of power in order to keep the budget up to date. As soon as the device provides power, either CDP or LLDP is involved to negotiate the total amount of power that can be granted:

If CDP is involved during the negotiation to determine the 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 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 LLDP, powered devices use media dependent interface (MDI) type, length, and value descriptions (TLVs), Power-via-MDI TLVs, for negotiation power up to 30 W. Cisco pre-standard devices and Cisco IEEE powered devices can use CDP or the IEEE 802.3at power-via-MDI power negotiation mechanism to request power levels up to 30 W.

- If no CDP/LLDP is supported on the PoE device, the command **power inline port 2-event** can be used in order to request for more than 15.4 W:

```
<#root>
```

```
Switch(config)#
```

```
interface Te1/0/1
```

```
Switch(config-if)#
```

```
power inline port 2-event
```

IEEE 802.3bt

- When IEEE 802.3bt mode is used, Cisco UPOE devices function as 802.3bt Type 3 or Type 4 devices, and support up to Class 6 and class 8 respectively (refer the IEEE Power Classification table in the document) on every port.

- This is the procedure this standard states in order to allocate power:

1. After device detection, the switch determines the device power requirements based on its type.

2. 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.

3. If the switch receives CDP messages from the powered device and as the powered device negotiates power levels with the switch through CDP power-negotiation messages, the initial power allocation can be adjusted. However, this is not needed as initially the switch allocates the maximum amount of power required, based on its class.

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.

- UPOE Devices are configured to use 802.3at mode, by default. To change the PoE standard to 803.bt mode, the command **hw-module switch switch_noupoe-plus** command can be used in the global configuration mode. A reload is needed:

```
<#root>
Device#
conf t
Device(config)#
hw-module switch 1

upoe-plus

!!!WARNING!!!This configuration will power cycle the switch to make it effective. Would you like to con
y
```

You can revert to 802.3at mode with the no form of the command: **no hw-module switch switch_noupoe-plus**. This command applies to both Type 3 and 4 802.3bt standards.

Verification

These showcommands can be used to monitor and verify PoE configuration:

Commands	Purpose
show platform	Displays the PID of the switch to verify if 803.bt is supported
show power inline gix/y/z detail	Displays the power details (Power mode, IEEE Class, Device type, Power negotiation and Four-Pair/Spare Pair support)

```
show power inline upoe-  
plus
```

```
Displays the PoE status for an interface that is enabled for 802.3bt or 802.3at  
compliant mode.
```

```
<#root>
```

```
Device#
```

```
show platform
```

```
Switch Ports   Model      Serial No.  MAC address  Hw Ver.  Sw Ver.  
-----  
1             41  C9300-24UX FJB2318A04T 7802.b107.bf00  V02     17.03.05  
Switch/Stack Mac Address : 7802.b107.bf00 - Local Mac Address  
! Output omitted for brevity
```

```
<#root>
```

```
Device
```

```
# show power inline Te1/0/24 detail
```

```
Interface: Te1/0/24  
Inline Power Mode: auto  
Operational status: on  
Device Detected: yes  
Device Type: Cisco IP Phone 7940
```

```
IEEE Class: n/a
```

```
<-- Type of class  
Police: off
```

```
Power Allocated  
Admin Value: 60.0  
Power drawn from the source: 6.3  
Power available to the device: 6.3
```

```
Actual consumption  
Measured at the port: 1.9  
Maximum Power drawn by the device since powered on: 1.9
```

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

```
Power Negotiation Used: CDP
```

```
<-- Protocol used to negotiate power  
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

<-- Four pair copper support

Spare Pair Power Enabled: No

<-- Spair pair enabled

Four-Pair PD Architecture: N/A

<#root>

Device#

show power inline upoe-plus

Module Available Used Remaining
(Watts) (Watts) (Watts)

1 595.0 0.0 595.0

Device IEEE Mode - AT

<-- PoE standard used in the device

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

Tel1/0/1 auto n/a off 0.0 0.0 n/a

Tel1/0/2 auto n/a off 0.0 0.0 n/a

Related Information

- [Technical Support & Documentation - Cisco Systems](#)
- [What Is Power over Ethernet \(PoE\)?](#)
- [Cisco Catalyst 9400 Series Switch Line Cards Data Sheet](#)
- [Cisco Catalyst 9200 Series Switches Data Sheet](#)
- [Cisco Catalyst 9300 Series Switches Data Sheet](#)
- [Cisco Catalyst 9400 Series Switch Data Sheet](#)
- [Interface and Hardware Components Configuration Guide \(Catalyst 9300 Switches\)](#)
- [Interface and Hardware Components Configuration Guide \(Catalyst 9400 Switches\)](#)