

PoE+ technology overview and benefits

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Introduction

This paper explores Power over Ethernet (PoE) and Power over Ethernet Plus (PoE+) as methods of supplying power to networked devices via Ethernet LAN cables. The Institute of Electrical and Electronics Engineers (IEEE) 802.3af, Power over Ethernet (PoE), standard specifies how power should be distributed over Ethernet LAN cables to networked devices. The IEEE 802.3af standard was approved in June 2003. The IEEE 802.3at draft standard, Power over Ethernet Plus (PoE+), specifies how higher power levels should be distributed over Ethernet LAN cables to networked devices. The IEEE 802.3at standard is expected to be ratified in 2009.

A brief overview of PoE and PoE+ and their differences are provided, in order to allow for a greater understanding of the capabilities and use models. Link Layer Discovery Protocol (LLDP) extensions for PoE+ are also discussed, which enable dynamic and granular control over power allocation.

PoE

The IEEE 802.3af-2003 standard specifies how power is distributed along with data on standard Ethernet LAN cables. The IEEE 802.3af standard eliminates the need to have separate Ethernet LAN cables for data and electrical outlets for power. Instead both data and power are distributed over the Ethernet cabling.

Power is injected on the Ethernet cabling along with data by Power Sourcing Equipment (PSE), like an Ethernet LAN switch or router. A Powered Device (PD), like a wireless access point or an IP Phone, receives power and data over the Ethernet cabling. The PSE employs a power classification method for detecting compatible PDs from non-compatible devices and will only provide the maximum power limit to compatible PDs, based on the PoE device class. The PSE continuously monitors the PDs and stops providing power when it is no longer requested or it detects an overload or short circuit condition on the port.

Examples of Powered Devices (PDs) are Voice over IP (VoIP) phones, IP Video Security cameras, Wireless Access Points (APs), card access readers, and other devices designed to operate by means of Power over Ethernet.

The benefits of PoE offer more reliable power, lower deployment costs, greater deployment flexibility, and simplified remote device management. For example,

deploying IP Video Security cameras on ceilings and building perimeters can be expensive, if separate Ethernet cabling and power outlets are both required. Significant cost savings come from eliminating the expense of an electrician to install electrical outlets and wiring in remote and hard to access locations, instead only installing Ethernet cabling. Additionally, simplified device management comes from being able to remotely monitor power usage and control the power to PDs via the Power Sourcing Equipment (i.e. Ethernet LAN switch). For example, if a PD needs to be power cycled to force a reboot, this can be done remotely by turning off the PoE power at the PSE.

It is also possible to use this remote management capability to establish "Power Saving" policies that automatically turn off unused devices after hours. This re-enables them based on policy, for significant energy savings (e.g. turn off IP-Phones on evenings/weekends, leaving only certain critical emergency-related phones enabled 24/7).

The IEEE 802.3af, Power over Ethernet (distinct from PoE+ outlined later), specification can provide up to 15.4 watts of power at the PSE. A PD under the IEEE 802.3af specification can use no more than 12.95 watts. The difference in maximum power levels provided by the PSE and available at the PD is in accounting for worst case power loss in the cabling between the PSE and PD, which can be influenced by cable length, quality, and other factors. This amount of wattage is sufficient to power the majority of current generation PoE Devices.

The IEEE 802.3af specification uses a physical layer power classification method at device startup, based on five PD classes, which specify the maximum power level output at the PSE:

- Class 0: 15.4 watts (default)
- Class 1: 4 watts
- Class 2: 7 watts
- Class 3: 15.4 watts
- Class 4: reserved for future use (e.g. PoE+)

The power classification method is used to provide information about the maximum power required by the PD during operation. The IEEE 802.3af physical layer classification is a static power allocation based on only 3 "coarse grain" bands that make efficient power management challenging.

PoE+

The success of PoE has prompted the development of a new IEEE specification, which allows for higher power levels to be delivered from Power Sourcing Equipment to Powered Devices. This new IEEE specification, now in draft form, is known as IEEE 802.3at or Power over Ethernet Plus (PoE+). The IEEE 802.3at specification is expected to be ratified in 2009.

The driving force behind PoE+ is the higher power required from a new generation of network attached devices. These new devices, such as, multiple radio IEEE 802.11n wireless access points, Pan-Tilt-Zoom (PTZ) security cameras, thin clients, door locks, touch screen displays, and video phones frequently require more than the 12.95 watts available with IEEE 802.3af.

The IEEE 802.3at draft, Power over Ethernet Plus specification can provide up to 30 watts of power at the PSE. A PD under the IEEE 802.3at draft specification can draw up to 25.5 watts of power, which is sufficient to power a new generation of higher powered PDs.

Rather than using the limited physical layer power classification, the IEEE 802.3at draft specification mandates that all Powered Devices also support a more flexible Layer 2 power classification method based on Link Layer Discovery Protocol (LLDP). The use of LLDP for power classification provides "fine grain" PoE power allocation of 0.1 watt granularity, along with the ability to dynamically reallocate power, for improved power allocation and management between the PSE and PD.

The IEEE 802.3at scope is to be backward compatible with the IEEE 802.3af specification. This means that Powered Devices complying with the IEEE 802.3af specification will be compatible with the IEEE 802.3at draft compliant Power Sourcing Equipment. Of course, Powered Devices that support the upcoming IEEE 802.3at draft specification will be optimized to operate with IEEE 802.3at draft Power Sourcing Equipment to support advanced and dynamic power management. PSEs that only support the IEEE 802.3af specification will interoperate with IEEE 802.3at draft compliant PDs, as long as the PD can operate within the 12.95 watts of power (e.g. in a lower power mode, with potentially reduced capabilities).

Distinguishing PoE from PoE+

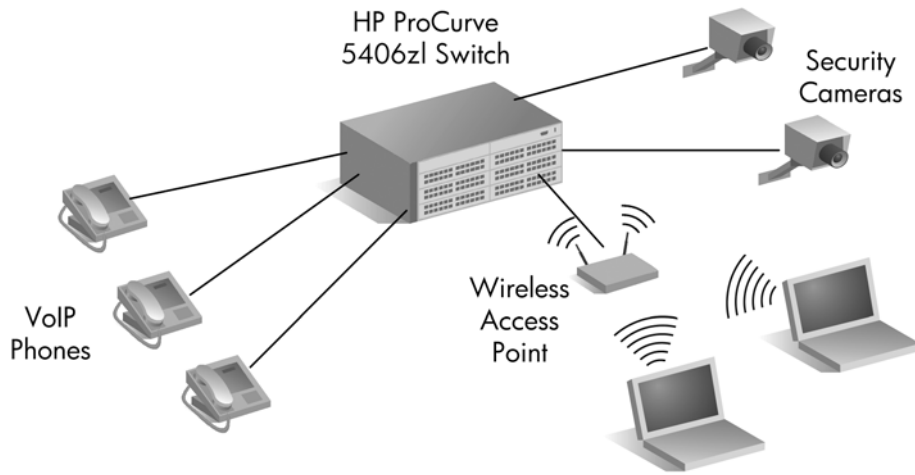
There are three main physical layer differences between the IEEE 802.3af (PoE) specification and the IEEE 802.3at (PoE+) draft specification from the point of providing power.

1. The IEEE 802.3af specification provides for a voltage range from a minimum of 44 volts to a maximum of 57 volts DC provided by the Power Sourcing Equipment. The IEEE 802.3at draft specification increases the minimum voltage to 50 volts DC provided by the Power Sourcing Equipment. This results in higher voltage that enables more wattage provided by the Power Sourcing Equipment (a maximum of 30 watts for PoE+ compared to 15.4 watts for PoE).
2. The IEEE 802.3af specification supports the usage of Category 3 (CAT3) Ethernet LAN cables or higher (i.e. CAT4 thru CAT6A). The IEEE 802.3at draft specification requires the usage of Category 5e (CAT5e) Ethernet LAN cables or higher (i.e. CAT6 or CAT6A). The usage of higher category Ethernet LAN cables reduce the cable resistance, thus allowing more power or wattage to be provided from the PSE to the PD, when comparing PoE+ to PoE.
3. The IEEE 802.3af specification provides a current range with a minimum of 10 mA to a maximum of 350 mA. The IEEE 802.3at draft specification provides for a current range from a minimum of 10 mA to a maximum of 600 mA. The increased current level leads to higher power or wattage to be provided from the PSE to the PD when comparing PoE to PoE+.

These three main physical layer differences between PoE and PoE+ are what allow for the higher wattage necessary to power the new generation of PDs.

Link Layer Discovery Protocol Media Endpoint Devices (LLDP-MED)

The IEEE 802.1AB standard, Link Layer Discovery Protocol (LLDP) was designed to provide a multi-vendor solution for the discovery of network devices and accurate physical topology of how these devices are connected to one another. LLDP allows network devices to advertise to other network devices on the same LAN segment their basic configuration and device capabilities.



The IEEE 802.1AB standard was extended by the Telecommunications Industry Association (TIA) to fill the need that multi-vendor VoIP deployments are required. The TIA created the ANSI/TIA-1057, Link Layer Discovery Protocol Media Endpoint Devices (LLDP-MED), standard which allows for Media Endpoint Devices, such as VoIP phones, to exchange basic and advanced configuration information, including Power over Ethernet management.

The ANSI/TIA-1057 standard and the IEEE 802.3at draft standard provide for the following advanced PoE management capabilities:

- Fine grain PoE power allocation (0.1 watt granularity)
- Power priority of the PD being supplied power
- Backup power conservation to extend UPS battery life during disasters

The IEEE 802.3at draft standard provides for the following additional PoE capabilities:

- Ongoing dynamic re-negotiation (e.g. need more power for video call)

PoE Use Models

The Use Models for Power over Ethernet devices are dependant on which Powered Devices are deployed. The use model for Voice over IP (VoIP) phones, IP Video Security cameras, Wireless Access Points (APs), thin clients, touch screen displays, and card access readers provide different solutions to business problems. The following are examples of a few use models.

Powering IP phones via PoE/PoE+ provides an improved use model for powering the IP phones connected directly to electrical outlets. Using an Uninterruptible Power Supply (UPS) to provide backup power to the PSE provides a power backup strategy in the case of power outages to insure uninterrupted IP telephony services.

Security cameras provide surveillance in parking lots, entrances and other sensitive locations at a number of Universities and Business. IP Video security cameras allow for the security video feeds to be easily distributed to any number of different locations for monitoring or recording. With legacy analog security solutions, it is costly and difficult to monitor and record them in multiple locations concurrently.

Summary

Products designed to the IEEE 802.3af (PoE) standard and IEEE 802.3at (PoE+) draft standard provide the benefits of more reliable power, lower deployment costs, greater deployment flexibility, and simplified remote power monitoring and device management. Products that support the upcoming IEEE 802.3at draft will be able to support higher power levels, along with more advanced and dynamic power management capabilities.

HP ProCurve Networking actively participates in the definition of these and other standards. HP ProCurve Networking offers a full line of 10/100Base-TX PoE, 10/100/1000Base-T PoE and 10/100/1000Base-T PoE+ Ethernet switch products.

Glossary of Terms

IEEE: Institute of Electrical and Electronics Engineers a non-profit, professional organization for the advancement of technology.

IEEE 802.3af -2003: Governing standard for Power over Ethernet (PoE).

IEEE 802.3at Draft 4.0: Draft of governing standard for Power over Ethernet Plus (PoE+)

PoE – Power over Ethernet: A means of supplying power to networked devices using standard Ethernet cabling.

PoE+ – Power over Ethernet Plus: A means of supplying power to networked devices using standard Ethernet cabling and enhanced capabilities (greater power, LLDP-MED).

PD – Powered Device: Any networked device that receives power from its Ethernet cable

PSE – Power Sourcing Equipment: A switch or other network device that can supply power to PDs.

TIA: Telecommunications Industry Association is the leading trade association representing the global information and communications technology (ICT) industries.

VoIP: Voice over Internet Protocol: voice communications over the internet

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4AA2-4857ENW, March 2009

