Enhanced Power over Ethernet: Easier Deployment and Improved Mobility

Introduction

As the network has become an integral part of the enterprise and small to medium-sized business, new applications have added new devices onto the network infrastructure. From IP telephony–based clients, first introduced in 2000, to new wireless access points based on the IEEE 802.11n standard, the requirement to provide ever-increasing levels of power to network end devices has grown dramatically. Cisco® was the first to develop the capability of providing power to the network end device when it enabled a means of providing power from an Ethernet switch port to its Cisco IP phone. From there, Cisco began work with numerous other vendors within the IEEE to create a standards-based means of providing power from an Ethernet switch port. This Power over Ethernet (PoE) capability has been ratified by the IEEE 802.3af committee and is now widely adopted.

Cisco is continuing to promote the evolution of technology innovation by delivering Cisco Enhanced PoE, another industry innovation. Cisco Enhanced PoE is Cisco's extension to the IEEE 802.3af standard that supplies greater amounts of power per port. By expanding its PoE support to deliver more than 15.4 watts (W) per port, Cisco offers greater flexibility and mobility to users while offering greater operational manageability to network managers.

Benefits of Cisco Enhanced PoE in the LAN Infrastructure

PoE is historically associated with two applications: IP telephony and 802.11 wireless networking. Since the completion and ratification of the IEEE 802.3af standard, the required power consumption for these devices has begun to extend beyond the level specified in the standard. In particular, the introduction of IEEE 802.11n wireless technology has promoted the need for delivery of PoE in excess of the 15.4W described in the original PoE standard. As a result, network infrastructure that supports only a maximum of 15.4W per port, as described in the IEEE 802.3af standard, must employ power injectors or other means of supplying the additional power, which not only increases the complexity of network installation and management, but also reduces its efficiency.

The Cisco Enhanced PoE infrastructure provides investment enhancement that can enable applications supporting higher-powered devices even before the IEEE 802.3at standard is ratified. Additional benefits from deploying Cisco Enhanced PoE today include:

- Simplicity and ease of deployment: In addition to providing the PoE benefit of network connectivity combined with power to a device over a single cable, Cisco Enhanced PoE allows a device that requires as much as 20W per port to be connected to the network using a single switch port. This reduces the amount of cabling and power facilities that must be installed and managed, as well as simplifies installation and management of powered devices.
- Mobility: Users can take advantage of the higher data rates, reliability, and predictability of coverage supported by wireless systems based on the IEEE 802.11n standard.

- Investment enhancement: Throughout the industry, new applications for powered devices requiring more than 15.4W per port are under consideration. Cisco Enhanced PoE could potentially provide support for these new applications such as video surveillance, remote video kiosks, and intelligent building management solutions.

What Is Cisco Enhanced PoE?

Cisco Enhanced PoE is Cisco's extension to the IEEE 802.3af standard that delivers between 15.4W per port and 20W per port. Cisco Enhanced PoE meets the needs of customers with an immediate requirement for PoE in excess of 15.4W per port. Cisco Enhanced PoE was designed for customers who want to install new PoE-enabled technologies that require greater than 15.4W per port to function at full capability, such as wireless technology based on the IEEE 802.11n standard.

To understand the innovation and roadmap of Cisco Enhanced PoE, it is helpful to review the capabilities of the current PoE (IEEE 802.3af) standard, as well as the goals of the upcoming PoE+ (IEEE 802.3at) standard.

PoE (IEEE 802.3af)

PoE is the ability of the LAN switching infrastructure to provide power over the Ethernet copper wire to an endpoint. This capability, sometimes also referred to as "inline power," was originally developed in 2000 by Cisco to support the emerging IP telephony solution. IP phones, like standard desktop private branch exchange (PBX)–supported phones, require 48 volts of power, which can be provided in one of two ways: by plugging the phone into a power outlet or by powering the phone over the network cable. The latter option was chosen because there was less chance of phone power failure. Cisco supports both its original proprietary technology for inline power and the IEEE 802.3af PoE on all Cisco Catalyst® LAN switches.

The specification for PoE calls for two devices: the power source equipment (PSE) and the powered device. The Cisco Catalyst switch, when populated with PoE-capable line cards, functions as the PSE and provides power to the end device, which is the powered device. The powered device can be one of many different devices, including the IP phone or wireless access point. Other powered devices are introduced and covered later in this document.

The standard also supports another mode of operation. Because today many existing switches still in service do not support 802.3af or any type of inline power, the powered devices must support midspan PSE. This device sits between the LAN switch and the powered device, inserting power on the Ethernet cable to the powered device. A technical difference between the two mechanisms should be noted: If the Cisco Catalyst switch is the PSE device, the power is transmitted over the same pairs (pins 1, 2 and 3, 6) of the Ethernet cable used to transmit data (this capability is sometimes referred to as "phantom power"). If a midspan PSE, such as the Cisco Catalyst Inline Power Patch Panel, is used, then the power is delivered on the unused pairs (pins 4, 5 and 7, 8).

The 802.3af standard also provides for five power classes to which a device might belong. The PSE vendor does not have to implement all these classes and can choose to support the maximum of 15.4W. This might require the facilities manager to invest significantly more resources in providing PoE if a vendor chooses not to use power management. It should also be remembered that even though a powered device might support IEEE 802.3af-2003 power classification, the PSE might not, and 15.4W delivery is the common denominator.

Cisco supports the capabilities described in the 802.3af standards as well as its own prestandard implementation of PoE. Cisco's prestandard PoE implementation includes support for Cisco Intelligent Power Management (IPM). Cisco IPM, which is described later in this paper, provides better efficiency in the use of power in the Cisco Catalyst switch relative to other potential PSEs. Cisco IPM is just one early example of Cisco's continuing innovation in PoE.

PoE+ (IEEE 802.3at)

The introduction of network devices that require more than 15.4W has compelled the IEEE to develop a new PoE standard that can deliver even more power than defined in the IEEE 802.3af standard. This new standard, IEEE 802.3at, is designed to deliver at least 30W per port of inline power.

Transmitting more than 15.4W of power per port poses some significant challenges. One such challenge lies in the physical characteristics of copper cabling, which can overheat or get damaged when transmitting power above certain thresholds. The IEEE is exploring different means of transmitting higher levels of power subject to these limitations.

Another challenge is backward compatibility with the IEEE 802.3af standard. This interoperability could be crucial to the successful adoption of 802.3at. Therefore, the IEEE is working to make sure that 802.3at-compliant PSEs are able to interoperate with 802.3af powered devices and the reverse. As a result of these and other implementation challenges, the IEEE 802.3at standard is not expected to be finalized until 2009. When it is ratified, Cisco, a proponent of and major contributor to the development of the standard, will support the IEEE 802.3at standard.

The WS-X4648-RJ45V+E linecard on the Catalyst 4500 Series switch is ready to support the IEEE 802.3at(PoE+) standard with a software-only upgrade expected to be announced with standard ratification in 2009.

Cisco Enhanced PoE

To support new and emerging technology, many of Cisco's customers have an immediate requirement for PoE in excess of 15.4W per port. For example, Cisco has introduced a new wireless access point compliant with the IEEE 802.11n draft 2.0 standard. This wireless access point, the Cisco Aironet® 1250 Series Access Point, supports two radios, which use MIMO and other new technologies to increase the throughput, reliability, and predictability of the wireless network. However, to function at full capability, the Cisco Aironet 1250 requires 18.5W of PoE.

Powering the Cisco Aironet 1250, with its 18.5W power requirement, from a switch that supports only the IEEE 802.3af standard decreases network efficiency, because network managers must either add more equipment and cable to provide the additional power needed or resort to utilizing only one radio in the Cisco Aironet 1250. Although the Cisco Aironet 1250 could easily receive full power from an IEEE 802.3at-compliant PSE, that standard has not yet been ratified.

That is why Cisco developed Cisco Enhanced PoE, Cisco's extension to the IEEE 802.3af standard that delivers as much as 20W per port of inline power for devices that support Cisco Discovery Protocol (CDP). Cisco Enhanced PoE is offered on Catalyst 3750-E and Catalyst 3560-E switches starting in February 2008 with Cisco IOS® Software Release 12.2(44)SE. The Catalyst 6500 Series10/100/100 PoE linecards support Enhanced PoE with 12.2(33)SXH2 or later and the Catalyst 4500 E-Series support Enhanced PoE with 12.2(44)SG or later. When, for example the Cisco Aironet 1250 is connected to a Catalyst switch supporting Cisco Enhanced PoE, the access point can use Cisco Discovery Protocol to request a power level from the switch that is higher than the 15.4 Watts described in the IEEE 802.3af standard. After the Catalyst switch receives the

Cisco Discovery Protocol message for higher power, it will grant the increased wattage to the Cisco Aironet 1250.

Cisco Enhanced PoE is by no means a replacement for or in competition with the IEEE 802.3at (PoE+) standard. It is simply a means of delivering PoE in excess of 15.4W per port to those customers who must immediately implement technologies requiring it and cannot wait for the 802.3at standard to be finalized.

Cisco Leadership in PoE

Cisco was the first to innovate PoE, and the company has been promoting the evolution of technology to standardization by delivering IEEE 802.3af-compliant PoE solutions to the entire Cisco Catalyst switch portfolio. Cisco continues its innovation in PoE by delivering Cisco Enhanced PoE. As of February 2008, Cisco Enhanced PoE is available in the Cisco Catalyst 3750-E and 3560-E Series Switches. Cisco Enhanced Power over Ethernet will be supported in a range of switches across the entire Catalyst switching portfolio, including the Catalyst 6500 Series and the Catalyst 4500 E-Series by mid-CY 2008.

Cisco IPM

Cisco Catalyst switches supporting Cisco Enhanced PoE also further extend these capabilities with Cisco IPM. Cisco IPM enables scalable, intelligent management of power delivery for all PoE ports in the switch, including Cisco Enhanced PoE ports. It enables the granular control of power delivery to each PoE port, allowing for power reservation, more granular power allocation, power oversubscription management, and power prioritization, thereby extending the manageability of PoE deployments by minimizing wall-power requirements and maximizing power utilization on a per-port basis.

To address the requirement to provide PoE cost effectively and efficiently, Cisco IPM provides a mechanism for the powered devices and the PSEs to negotiate their respective capabilities to deliver precisely the amount of power required. Many, if not most, powered devices do not require the full 15.4W that the IEEE 802.3af standard requires. Cisco IPM uses the Cisco Discovery Protocol to discover and negotiate the amount of power needed by the Cisco IP phones and Cisco wireless access points. By default, Cisco Catalyst switches provide 7W of power to a powered device, unless the powered device “asks” the PSE for more power through Cisco IPM using the Cisco Discovery Protocol. This enables the facilities manager to be more conservative in power planning for the wiring closet where the PSE is installed.

Cisco IPM uses the Cisco Discovery Protocol for extended device manageability and more granular per-port power management. Additional support for Cisco Discovery Protocol maintains backward compatibility with installed Cisco devices and provides deeper granular control for PoE delivery. This enables network and facility managers to preallocate power and provide managed power oversubscription to allow for deployment of a higher number of devices that require lower power in a standby state. Additionally, specific ports that need to maintain power can be reserved if the switch power system becomes oversubscribed, helping ensure that a critical end device (a badge reader, for example) receives consistent power.

Conclusion

Cisco is continuing its innovations in PoE, offering more power, greater flexibility, and increased mobility to users with Cisco Enhanced PoE. This enables support for new services and applications, delivers maximum investment enhancement, and enables organizations to make the most of their network infrastructure today and into the future.

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV
Amsterdam, The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at www.cisco.com/go/offices.

Printed in USA C11-453743-01 09/08