POWER OVER ETHERNET WHITEPAPER

Introduction and Motivation

Power over Ethernet (PoE) is a revolutionary technology that extends the already ultra-broad functionality of Ethernet by supplying reliable DC power over the same Category 5/5e twisted-pair cable that currently carries Ethernet data. PoE, modeled after the technology used by the telecommunications industry to supply reliable power to telephones, enables lifeline quality power for IP telephones (VoIP) as well as many other low power Ethernet network devices like wireless access points (WAP) and security cameras as shown in Figure 1.

PoE, or IEEE standard reference 802.3af, began the standardization process in 1999 to address the need to ensure interoperability among a growing number of proprietary methods of distributing DC power to network devices. Now that the standard has been passed, the ubiquitous Ethernet RJ-45 plug and outlet make up the first universal worldwide power connectors. Consequently, PoE equipment vendors are designing standards-based products that leverage the numerous advantages offered by PoE. These products include security access systems, battery chargers, vending and gaming machines, electric guitars and even electronic shavers. Constantly emerging applications using PoE are limited only by the ingenuity of the product designers.

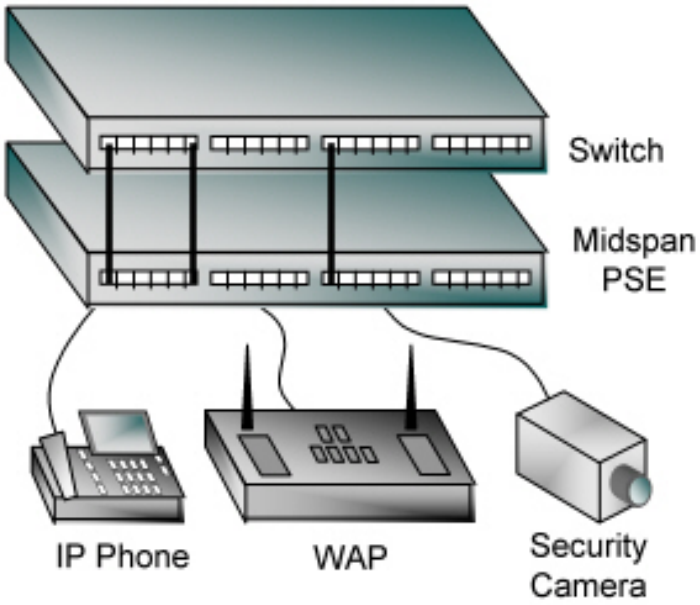


Figure 1. Typical PoE installation utilizing a powered patch panel midspan PSE to support common low power Ethernet devices.

Network equipment investments are expected to provide functionality that support current and future productivity enhancements. Deploying a PoE network today offers the following advantages that will also support tomorrow's innovations.

• *Lower cost*. PoE eliminates the need for running both data and power wires to each network device. WAPs and security cameras can be installed without the additional expense of contracting an electrician to install AC outlets where deployed. PoE also helps protect IT investments as it is forward and backward compatible with other Ethernet protocols. Furthermore, PoE devices that are Simple Network Management Protocol (SNMP) manageable can be remotely monitored and controlled to efficiently manage or troubleshoot power consumption and/or failures.
• *More flexible*. Network devices can be installed and re-located where performance is optimum and not

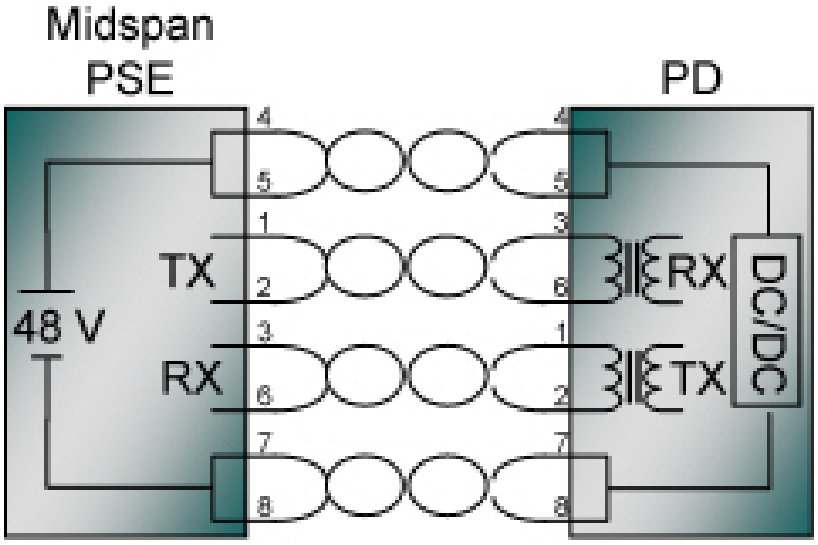
tethered to an existing AC outlet. This is especially important for devices like WAPs, which may be installed in hard to reach places like the ceiling in order to achieve the broadest coverage.
• *More reliable*. A SNMP manageable centralized power source enhances the protection against power overloads, outages, surges and spikes. When PoE is implemented, along with uninterruptible power supplies (UPSs) or battery backups, it allows enterprises to distribute power even when the AC electrical power is down. This enables them to replace conventional telephones with feature rich VoIP phones while retaining the lifeline reliability benefits.

Due to all of these advantages, it is not hard to understand why PoE is generating so much interest and excitement among IT vendors and consumers.

How PoE Works

There are two basic components in a IEEE 802.3af compliant PoE network: a device that supplies power, known as the Power Sourcing Equipment (PSE) and a device that receives and utilizes the power, known as the Powered Device (PD). Upon connection of any network device to a PSE, the PSE must first determine or "discover" if the device is a PD or not. This ensures that existing Ethernet equipment, that may not be PoE compliant, is not forwarded power and possibly damaged. The PSE does this by applying two small current-limited voltage signals across the cable and checks for the presence of a characteristic resistance; power is provided only if this specified resistance is detected. As an optional extension to the discovery process, a PD may also classify how much power it will require from the PSE. This feature supports the PSE by helping it supply power in an efficient way.

After the PSE has discovered a PD, it will supply 48 V and a maximum current of 350 mA. Accounting for



the voltage drop due to the cable losses, a minimum of about 13 W is available to the PD. This is enough power for numerous applications including VoIP telephones, WAPs, security cameras and building access systems. IEEE 802.3af is not targeted to support desktop computers, servers or printers. Once the PSE begins to provide power, it continuously monitors the PD current draw. Once the PD current consumption drops below a minimum value, for example when the device is unplugged, the PSE discontinues supplying power and the discovery process begins again.

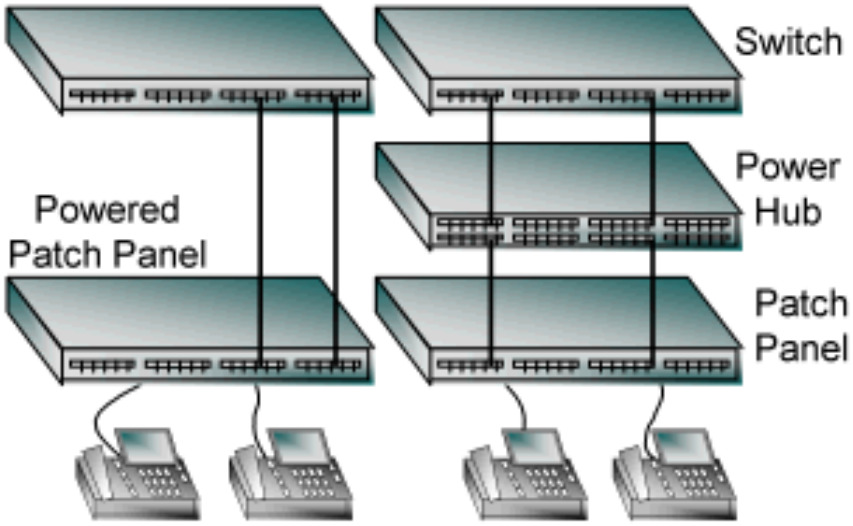
The standard defines two different types of PSEs: endspan and midspan. An endspan PSE integrates the power sourcing functionality with a network switch. Endspans available today look and function exactly the same as any other Ethernet switch, except they can provide PoE in addition to routing data. Since Ethernet data pairs use transformers coupled at each end of the link, DC power can easily be added to the center tap of the transformer without disrupting the data. In this mode of operation, an

endspan injects both power and data on pin-pairs 3 and 6 and pin-pairs 1 and 2.

A midspan PSE fits in between the switch and the PD. It supplies power over the unused cable pin-pairs 4 and 5 and pin-pairs 7 and 8; data is routed through the midspan device without modification as shown in Figure 2. These devices are usually mounted adjacent to the Ethernet switch in an equipment rack. It is important to note that although the PSE must use the pin-pairs assigned to an endspan or midspan, not both, the PD must have the capability to accept power from both an endspan or a midspan.

Figure 2. A midspan PSE supplies power on the unused wire pairs and is typically a stand-alone device.

Midspan devices offer the advantage of retaining the current investment in a switch that does not support PoE. Furthermore, since midspans are less expensive than endspans, midspans are the more cost-effective way of adding PoE on a port by port basis to an existing network. A single midspan may be used to support multiple switches with connections to PDs that require PoE.



Currently, there are two different types of midspan devices: a power hub and a powered patch panel. A power hub has two RJ-45 outlets for each PoE port, an input and output, both of which are located on the front. A patch cord connects the switch port to the input of the hub and an additional patch cord connects the matching hub output to a patch panel and subsequently the PD. The other type of midspan, a powered patch panel, combines the functionality of a midspan device with a conventional patch panel.

By using a powered patch panel midspan, such as the *PANDUIT® DPoE™ Power Patch Panel*, the switch connects directly to the PD through the panel. A RJ-45 patch cord connects the switch to the front of the patch panel while the PD is connected to the back of the panel on the matching punchdown terminal. Power is added to the unused data pin-pairs within the patch panel. Using this simplified approach requires fewer ports, fewer patch cords and less rack space compared to power hub midspans as shown in Figure 3.

Figure 3. Comparison of implementation configurations for the two types of midspan PSEs: powered patch panel (left) verses power hub.

Conclusion

PoE is a rapidly emerging technology that is enabling the efficient deployment of reliable VoIP and wireless networking tools to increase the efficiency of communication across the enterprise. Furthermore, since PoE has significant cost savings, flexibility and reliability advantages over traditional AC power, it reduces the overall cost of network ownership. Although both endspan and midspan devices deliver PoE, the *PANDUIT® DPoE™ Power Patch Panel* midspan PSE offers the most efficient Solution to upgrade the network with PoE enabled applications.