Power-over-Ethernet and Power-over-HDBaseT for Wireless LAN Deployment

White Paper

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Introduction

Since the invention of Power over LAN™ in 1998 by Microsemi, Power-over-Ethernet (PoE) has been employed by enterprises worldwide to deploy IP telephony, WLAN infrastructure, network security cameras and other technologies where reliability and flexibility of installation are important parameters. PoE dramatically reduces the CAPEX in existing installations where a non-PoE switch has already been deployed or in those where the devices are located in hard-to-reach locations. Turning power into smart power, PoE also allows OPEX reduction through powering devices down in pre-scheduled times, and through remote device scheduling.

The virtually universal presence of Wi-Fi connectivity in smartphones, tablets, laptops and even desktop computers has driven enterprises, municipalities and service providers to deploy WLAN access points for both indoor and outdoor, in the effort to provide ubiquitous WLAN coverage.

This whitepaper provides a brief overview of the existing PoE and Power-over-HDBaseT (PoH) standards, and how PoE and PoH can be used to deploy WLAN infrastructure.

Power-over-Ethernet: Technology and Standards

PoE Technology

PoE is, generally speaking, a technology that allows sending power and data over the same Category 5 (or better) cables, at a range of up to 100 meters (m) (333feet). It includes a compatible device detection mechanism, which means only those will be powered. The operating voltage for energy transmission is always under 60 volts (V), power is always under 100 watts (W), and the power source is protected against short circuits. With that, PoE is safe for people and for equipment. PoE's major advantages over using a local AC power adaptor are:

a) The powered device (PD) can be located anywhere in a radius of 100m from the power source equipment (PSE)
b) Range can be easily extended by using a POE extender
c) The PD can be remotely reset, without the need to access it physically (with a managed PSE)
d) All the PDs connected to a single PSE can be backed up with a single uninterrupted power supply (UPS), instead of having a UPS per device
e) The RJ45 connector is universal, the same in every country
f) PoE PD devices can be shutdown remotely for extended periods of time (with a managed PSE)

The PoE Standards

The original PoE standard, IEEE802.3af-2003, defined the method of delivering safe power to devices consuming up to 12.95W. In September 2009, the IEEE802.3 working group finalized IEEE802.3at-2009 specification, which defined delivering up to 25.5W to PDs over two-pairs, and allowed the delivery of up to 51W to a device over a single Category 5 or better cable (without clearly specifying how). The IEEE802.3bt task force is working to clearly define the delivery of power above 25.5W over four-pairs.

Power over HDBaseT

HDBaseT is a standard created by the HDBaseT Alliance that includes 5Play™, enabling up to 8 Gbit/s of uncompressed video and audio, 100BaseT Ethernet, control signals and power to all share the same cable, across distances up to 100m using standard RJ-45 connectors. Geared towards connecting audio and video equipment, HDBaseT addressed the need for delivering even more power, as TV's will often take over 51W.

PoH, ratified in September 2011, extends PoE's capabilities to deliver up to 95W over CAT5e and better cables. The HDBaseT Alliance has chosen the Microsemi four-pairs detection methodology to insert power while enabling lower cost and higher energy efficiency at lower power levels.

Midspans vs. Switches

There are two ways to deploy high-power PoE technology: by upgrading the network switch, or by installing midspans in the existing networking infrastructure. PoE-capable switches offer the advantage of an integrated solution that requires only one cable for the network connection. However, this isn't necessarily the best choice. Unless shortcomings of existing data network infrastructure requires replacement of the switch to provide increased capacity or performance, and is required for low-power levels, idspans are the superior choice for PoE deployment. They deliver a combination of simplified deployment, management and maintenance, with superior flexibility, reliability, security and energy efficiency. By decoupling the power and data portions of the network infrastructure, midspans simplify network expansion and upgrades, and provide more flexibility for low-port count incremental upgrades to the power infrastructure.

WLAN Infrastructure Deployment with PoE and PoH

Most of the WLAN infrastructure (outside of residential gateways and home routers) can benefit from PoE or PoH technology. The sections below enumerate different configurations.

Indoor Enterprise or Public Space Wi-Fi Hotspots

WLAN access points are normally deployed at high, hard to reach locations, for coverage reasons. Typically, their power consumption is between 10W, for 2x2 MIMO 802.11n access points, to 50W for higher range, higher bandwidth 3x3 or 4x4x MIMO 802.11ac Wave 2 WLAN access points, which may include an embedded 3G, LTE or LTE-A small cell. These WLAN access points are normally connected to the network through 1000BaseT (Ethernet over copper). In the cases where an enterprise WLAN access point needs to provide 100Mbit/s bandwidth to more than 10 users at once, a 2.5Gbit/s link such as NBase-T or 10GBaseT uplink can be used.
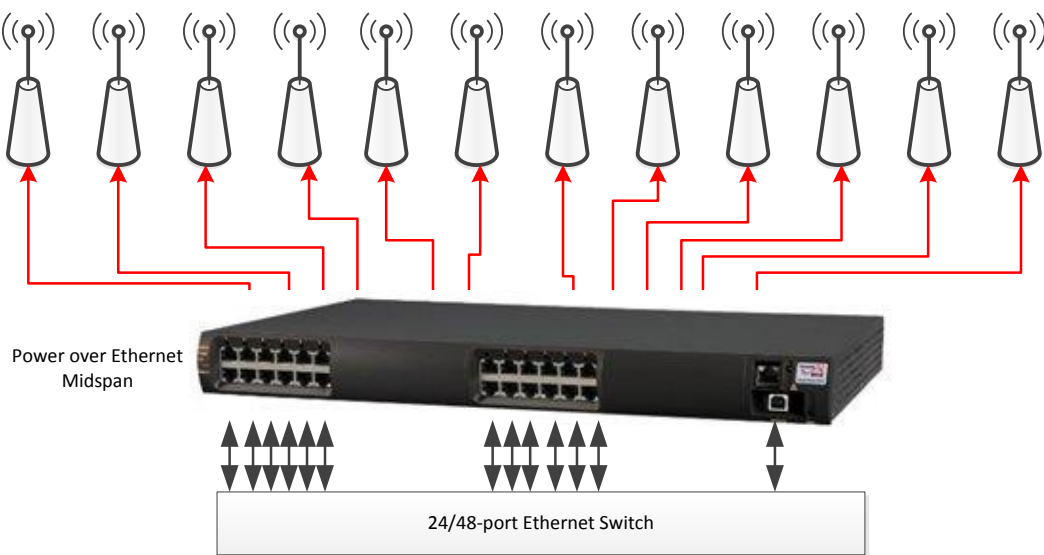
Figure 1 Indoor WLAN Deployment with PoE

PoE based deployment allows convenient location and simple installation using the Ethernet infrastructure for both data and power transmission. Managed PoE also allows remote power management including power monitoring, remote reset and shutdown at pre-defined schedule to allow power savings and optimization of power usage. In the cases where management is desirable, the capability to support IPv6 and SNMPv3 are present. The fact that a single PoE midspan or switch is to be utilized to PDs that provide contractual service to customers makes it desirable to have support for redundant power supplies.

Deployment of networking equipment owned by carriers in locations which are not owned by them makes it extremely important to consider the question of network demarcation and deployment. In public spaces, such as shopping centers, retailers in many cases already have older WLAN access points connected to PoE switches. The deployment of newer, carrier-grade WLAN hotspots at the same location adds venue-wide Wi-Fi coverage, with possible customer location and personalized advertising, however it may require a drastically higher amount of power consumption leading to the question: can it be done with the PoE switch? The existing PoE switches would in most cases support 15.4W only, and in some cases 30W. Replacing the switch is complex, as the switch is owned and maintained by the IT manager responsible for the location. So the ideal solution is a midspan, which can be added to the network without disruption or reconfiguration of existing switches.

PoE as Part of the Infrastructure

An additional advantage of PoE midspans is granularity/separation; midspans are available in 1, 4, 6, 12 and 24 port configurations, and can be:

a) Paired with a switch with a larger number of ports
b) Shared between two switches

This means that PoE is only purchased when really needed, and the PoE refresh cycle is de-coupled from the Ethernet switch refresh cycle. With a limited lifetime warranty of 16 years for Microsemi's managed indoor midspans, this means completely skipping a refresh cycle. Effectively, PoE becomes part of the cabling infrastructure.

Extending the POE Range

The PD can be located anywhere in a radius of 100m from the PSE. However it is possible that some of the access points would be located further away from the PoE switch or the midspan. A cost-effective way to extend the Ethernet network reach beyond 100m is to use a PoE extender. Such PoE extender solutions deliver both data and power to network devices such as WLAN access points and network cameras up to a distance of 200m while complying with IEEE PoE and data standards. PoE extender such as Microsemi's PD-PoE xtender supports 10/100/1000Mbps data rates and delivers 802.3at power levels, up to 25.5W. The PoE extender does not require local power and is powered via the PoE input and can be cascaded to reach up to 500m range.

Energy Efficiency and PoE

Deploying PoE only when needed is also more energy efficient. If PoE switches with PoE on every port are deployed and not fully populated, the PoE power supplies inside the switches will have a lot of idle capacity, which means higher power losses from the moment the PoE switch is installed. PoE midspans allow installing PoE only to the devices that need to be powered, minimizing standby power losses.

Microsemi's PD-55xx, PD-95xx and PD-96xx series include a Microsemi-exclusive technology, EEPoE™ (Energy Efficient PoE), which further reduces power dissipation by utilizing all the copper available in a CAT5 (or a better cable) to deliver power to IEEE802.3at 25.5W (or below) devices. With EEPoE, power dissipation on the cable is cut by up to 2.25W per port, compared to other Microsemi PoE midspans.

Outdoor Wi-Fi Hotspots

Outdoor Wi-Fi Hotspots are located in places without easy access to electricity, and have the added disadvantage of requiring IP66 or IP67 weather protection, which means that minimizing the number of input ports is critical. Once more, PoE can be used to deliver power, either:

a) From a fiber backhaul gateway with PoE capabilities
b) Through the utilization of an outdoor midspan

c) Using a single port midspan located indoors, at under 100m from the Wi-Fi hotspot
d) Using an outdoor rated PoE hub (connecting and powering IP camera + Wi-Fi mesh hotspot)
e) A managed PoE switch, which would connect between the multiple outdoor PoE devices such as IP camera + Wi-Fi hotspot + backhaul
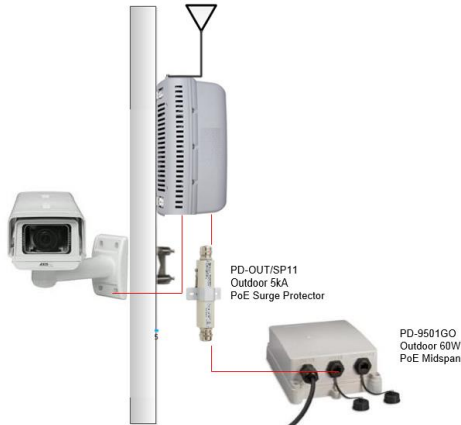

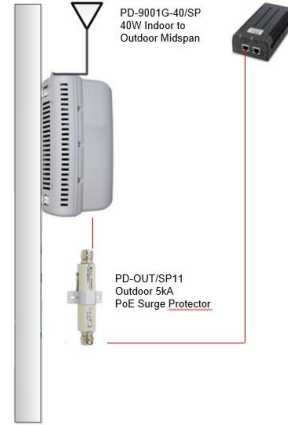**Figure 2 deploying a power forwarding Wi-Fi hotpsot+ IP camera with an outdoor midspan**
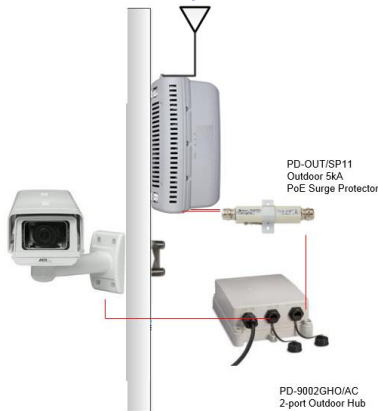

Figure 3 Indoor to outdoor Wi-Fi hotspot deployment

Figure 4 Wi-Fi hotspot + IP cameradeployment with PoE hub

Figure 5 Wi-Fi mesh hotspot with IP camera deployment with managed PoE switch

In outdoor installations it is critical to ensure that a proper surge/lightning protection device is placed close to the device being powered, to protect the device. This is especially important in case there is a long cable run between the outdoor PoE PSE (typically internally protected) and the PD.

Outdoor WLAN access points can also be connected to an indoor communications room, in which case the lightning protection needs to be installed close to the building Ethernet outlet, and the indoor PoE power source employed should be a single port device. According to IEEE802.3-2012 Clause 3.3.4.1.1 Electrical Isolation Environments, multiport PSE devices cannot be used to power devices placed in two different buildings. This is to protect one device from the other, in case a device is not connected to surge protection, and to protect indoor devices from surges that come from outdoor.

With outdoor deployments, it is also important to consider heating and cooling requirements, which typically increase power consumption potentially up to 70W, which is in the PoH range but not in the PoE range.

Microsemi PoE Systems

Microsemi has an extensive Gigabit PoE system product portfolio including:

a) Single port midspans delivering 15.4W to 95W, for indoor-to-indoor, indoor-to-outdoor and outdoor-to-outdoor deployment
b) Two-port PoE hubs with 30W per port for outdoor deployment
c) Three-port PoE managed switches with 30W per port for outdoor deployment
d) Four-port unmanaged PoE midspans with up to 30W per port
e) Six-port, 12-port and 24-ports managed PoE midspans with up to 95W per port, redundant power supplies, mutual midspan backup and EEPoE
f) Outdoor lightning protection for device for Ethernet solutions
g) Single port POE extenders delivering up to 25.5W and can be cascaded to reach up to 500m

Microsemi PD Certification Program

Microsemi offers a free-of-charge certification program to its partners, in which partners are certified to interoperate with Its PoE midspans and switches. Approved devices are placed at the PoE PD certification list at http://www.microsemi.com/products/poe-systems/poe-compatible-devices.

Summary

Power-over-Ethernet and Power–over-HDBaseT can greatly ease the deployment and maintenance of indoor and outdoor WLAN access points and hotspots. Microsemi has a complete PoE/PoH product portfolio, allowing the usage of data infrastructures to deliver power as well as data in indoor and outdoor environments. Microsemi also offers an innovative high reliability outdoor lightning protection device for Ethernet solutions to increase the resiliency of indoor infrastructures connected to outdoor devices.

Microsemi's PoE midspans can make the addition of PoE seamless, without the need to replace existing Ethernet switch infrastructure, and by separating large power supplies from sensitive Ethernet equipment.

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