Cutting Power Consumption with Energy-Efficient Power over Ethernet (EEPoE) Technology

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Overview

Power over Ethernet (PoE) system efficiency is impacted across the entire length of the power chain, from power conversion at the output of the PoE power sourcing equipment (PSE), through power delivery to the powered device (PD), and on through conversion back to the various required voltages. To improve PoE system efficiency, power losses must be minimized across the entire length of the power chain, including the power supply, the power sourcing equipment and PDs (including their underlying PoE integrated circuits), and the channel (including cable, patch panel and connectors).

Microsemi's EEPoE technology takes a multi-pronged approach to reducing power losses throughout these power chain elements. The technology enables use of a more efficient power supply, and it builds power efficiency into the PSEs and PDs as well as the ICs inside them, while also leveraging four-pair powering to reduce power losses on the cables.

Improving Power Supply Efficiency

Microsemi's EEPoE technology enables PSEs to deliver highly responsive and agile power management, especially in high-power applications. These capabilities are critical for implementing a distributed power architecture with dynamic power allocation, which significantly improves efficiency by enabling the use of smaller and less expensive power supplies. Most high-power IEEE802.3at applications don't require full power on any single port. Further complicating the power management and allocation picture, many IEEE802.3at PSEs must power both higher- and lower-power PDs. The solution is to replace large power supplies with a smaller, more economical internal default supply that can be augmented with external supplies when needed. Smaller supplies also have lower heat dissipation and associated cooling costs.

One of the most efficient platforms for smart, distributed power management is the midspan. Installed between the existing switch and PDs, Microsemi's EEPoE midspans enable networks to be upgraded to PoE without any infrastructure changes. Unlike PoE switches, midspans also can monitor actual per-port power consumption, including that which is consumed by class 0 PDs (which would otherwise receive full power). It is not necessary to know PD power classifications or determine how to allocate power per port or across the network, so overall system power efficiency can be significantly improved.

Consider a typical 1U 24-port midspan with a total of 24 x 15.4 W (370 W) of power to manage. Since the network PDs might only need half this amount at any given moment, the midspan only requires a 200 W internal supply to support real-time demand. External power supplies are then employed as needed.

The midspans' ability to dynamically allocate power also eliminates the need for network administrators to rely on worst-case power budgets that account for a full 25.5 W per PD of power loss. Supporting actual, rather than worst-case budgets also eliminates cable power losses, as will be explained later.

EEPoE midspans further reduce energy requirements since they are installed outside the switching closet, which diminishes heat concentration as compared to PoE switches. Finally, EEPoE midspans enable remote management capabilities that further improve system efficiency. IT administrators can monitor each PD's power consumption and actively reduce its operational time as desired, which can reduce power usage by 70 percent.

IC advances have also improved energy efficiency for IP phones and cameras, WLAN access points and other PDs. Microsemi's EEPoE family of PD front-end ICs reduce the size, cost and complexity of next-generation energy-efficient PDs. They feature a 25KΩ input signature resistor disconnection that eliminates up to 0.13W of constant power dissipation, and a 0.6Ω worst-case isolating switch that reduces power dissipation up to 40 percent compared to alternative solutions. They also feature a low-power mode that cuts standby power losses by 80 percent.

One of the most important features of Microsemi's EEPoE PSE managers and PD front-end ICs is their ability to support four-pair powering, which minimizes cable losses. This is the third key contributor to improved overall network system power efficiency.

Reducing Cable Losses

Cable losses can be reduced by delivering power over all four pairs of Ethernet cable, rather than two. This important capability was specified in the latest high-power PoE standards. It enables a 600mA (rather than 1.2A) current level to be maintained while delivering high power. This cuts cable power losses by more than 50 percent while reducing costs almost 15 percent as compared to 2-pair solutions.

Four-pair powering enables PDs to have two power interfaces and receive up to 51 W of power over all four pairs of Ethernet cable (see Fig. 2). In addition to increasing power delivery and reducing cable power losses, four-pair powering also reduces cable resistance, which translates into extended reach.
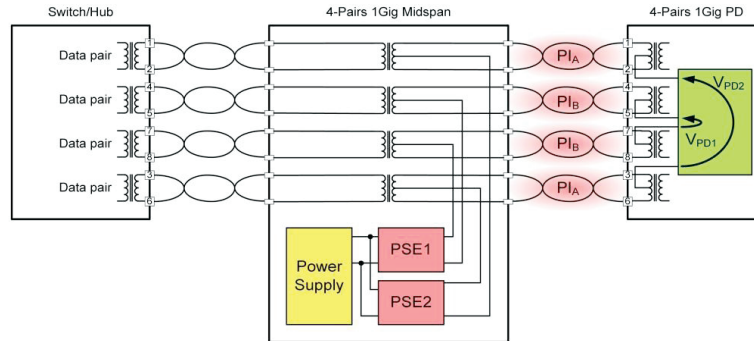

Figure 2: Four-pair powering

Cable losses can be further reduced by leveraging midspans' previously mentioned ability to allocate power dynamically. By eliminating the need for network administrators to rely on worst-case power budgets, EEPoE midspans can eliminate 4.5 W of cable loss.

EEPoE vs. EEE

EEPoE should not be confused with Energy Efficient Ethernet (EEE), which is specified in IEEE802.3az-2010. The goal of the IEEE802.3az specification is to significantly reduce the power consumption of Ethernet ports by taking advantage of the fact that typical server/client Ethernet links are idle most of the time, with only occasional traffic bursts. The specification defines a low-power idle (LPI) signaling protocol for both sides of the physical link, and enables rapid adjustments of power saving modes of the connected devices including powering down transmitting and receiving functions during periods of low or no utilization, and powering them up again when they need to transmit data.

The Ethernet Alliance has anticipated that LPI implemented with state-of-the-art Ethernet PHY technology could save up to 1 W per Ethernet link. However, EEE does not address cases where PoE is deployed. In these implementations, the majority of power losses occur in the PoE delivery subsystem rather than the data portion of the network. For instance, a typical 48-port Ethernet switch has a 50W to 80W power supply allocated for the traditional Ethernet Switch and Transceiver IC, and a 370W to 740W power supply allocated solely for PoE. This is a factor of around 8-to-1, which means that even minor gains in PoE efficiency may greatly improve the overall efficiency of an Ethernet switch. The Ethernet Alliance has estimated that total savings from the combination of EEE with EEPoE approaches 3.13W per link.

EEPoE requires no changes on the PD side, and can be implemented simply by upgrading the switch or midspan. The technology can therefore reduce power dissipation for delivering PoE not only to new PDs, but also to the huge installed base of more than 100 million powered devices already installed worldwide. Additionally, the power-savings advantages of EEPoE increase as more PDs are added to the network, whereas EEE savings only occur during standby operation. For even greater savings, network administrators can deploy EEPoE midspans. Since midspans are a layer 1 data pass-through device, they intrinsically support systems in which the switch supports EEE. This, combined with per-port power management and the ability to use smaller supplies, makes EEPoE midspans the most efficient powering option for today's networks.

Conclusion

PoE midspans increase energy efficiency in the enterprise and data center while improving the economics of wireless network deployment across a growing range of market applications. Microsemi's EEPoE technology offers the most energy-efficient way to deploy PoE and intelligently manage network power consumption by improving power supply efficiencies, reducing loss over the cable and managing power outputs.

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