Power over Ethernet (PoE)

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Abstract

This White Paper provides an overview of Power over Ethernet (PoE) and details the PoE variations that are used in today's telecommunications networks.

Introduction

Power-over-Ethernet (PoE) is a technique that combines data and power onto a single Ethernet cable. The use of PoE compliant equipment eliminates the need to run 110/220 VAC power to remote network appliance devices in a wired LAN. In most cases the use of PoE can significantly decrease installation costs for remotely located devices. The use of PoE allows greater flexibility in the locating of network devices such as Wireless Access Points, Switches and IP Cameras.

A Brief History of PoE

The technique of combining data and power onto a single Ethernet cable has been around in one form or another since the early days of networking. The wireless community was one of the first to widely adopt this technique. In a replay of the video tape industry, many companies closely guarded the details of their "PoE" methods in the hope of garnering greater sales. As history has shown, a common standard will actually increase sales. The lack of a unified standard was hindering the growth of PoE capable equipment. Proprietary PoE equipment was costing customers more and in a bid to satisfy customer demands, major manufacturers called on the IEEE 802.3 Ethernet working group to develop a new standard which became 802.3af.

The 802.3af standard describes two types of devices, Power Sourcing Equipment (PSE) and Powered Devices (PD). The PSE provides the power to a PD. 802.3af compliant PSE also uses "smart" techniques so as to not supply power to non-PoE capable equipment thus possibly damaging them. Both the PSE and PD have power supplies and regulators isolated from ground to minimize any shock hazard or the introduction of ground loops that could impact data integrity.

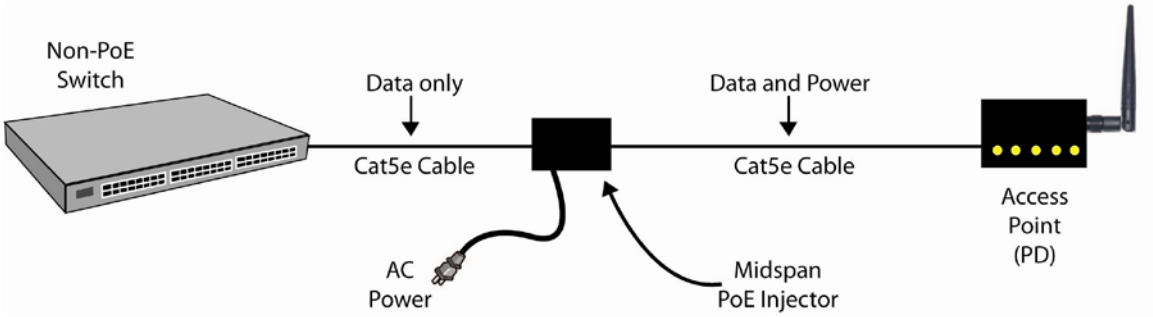
Consumers in most cases, now have a common standard to rely on. They can now buy equipment from multiple vendors that will "in general" interconnect without issues. There is enough flexibility in the 802.3af standard however that there is a small possibility that equipment from different vendors may not work. For example power polarity is not specified. In some cases a simple configuration change of the PSE will solve the problem. In others the only option may be to use a PoE Mid-Span or Injector that is known to work with the PD or network appliance. Another issue is the large amount of legacy PoE equipment that will only operate with specific devices from the same vendor.

PoE Details and Variations

The 802.3af PoE standard allows two different methods, Mode A or B to combine data and power onto the same cable supplying power to the remote network appliance or PD. To comply with 802.3af, a PD such as a wireless AP, downstream switch or IP camera will work on both Mode A or B. An 802.3af compliant PSE such as a network switch will use Mode A only. Some legacy switches from major network equipment suppliers can work in 802.3af compliant Mode A or a proprietary form of Mode B.

A product called a MidSpan or Injector is used to upgrade a non-PoE Switch to have PSE capability. A MidSpan or Injector uses Mode B to power the PD. See Diagram 1.

Dia. 1



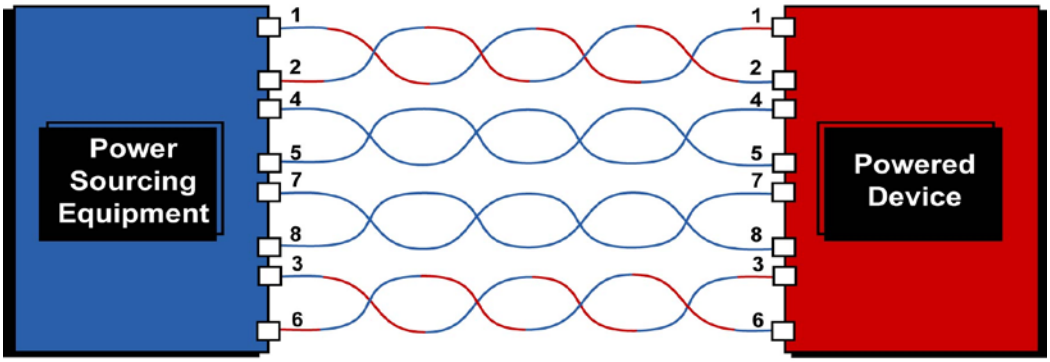
These devices can be fully compliant with 802.3af or be “Passive” and only offer power limiting. Passive MidSpans or Injectors offer lower cost as well as higher power capability and the ability to power non 802.3af compliant network appliances. In the wireless industry, to save cost or draw more power, it is common to use remote client devices that only work with passive PoE injectors.

Mode A

802.3af PoE Mode A combine’s power onto the same wires as the data signal using a technique called Phantom Powering. Phantom Powering is a common technique used in the Telco industry for Telephones and the audio industry for microphones.

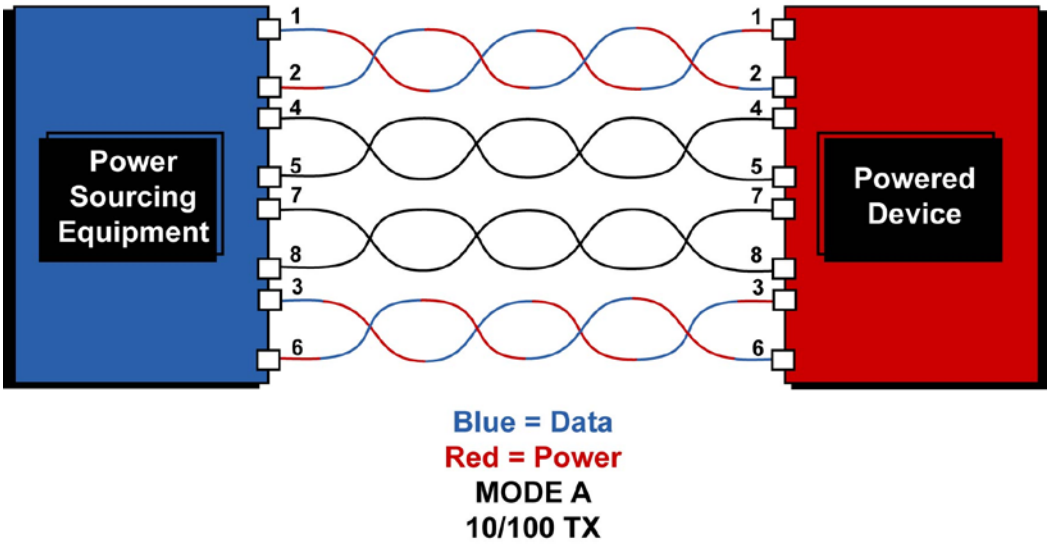
For 10/100/1000BaseT, data pairs 1/2 and 3/6 carry DC power as well as data. Pairs 4/5 and 7/8 are used for data only. See diagram 2.

Dia.2



In the case of 10/100BaseT Mode A, spare pairs 4/5 and 7/8 are unused See Diagram 3.

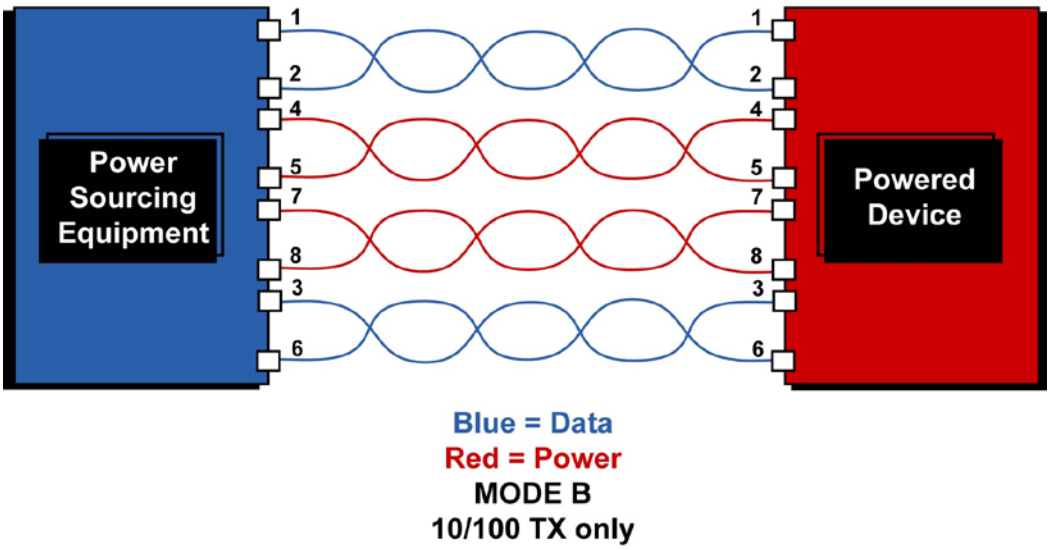
Dia.3



Mode B

802.3af PoE Mode B uses the Ethernet spare pairs 4/5 and 7/8 to carry power. Pairs 1/2 and 3/6 are left untouched and carry data for 10/100BaseT. Mode B is unusable for 1000BaseT. See diagram 4.

Dia. 4



Conclusion

PoE is perfect for remote locations where traditional AC power is not available. PoE is being used in many of today's wired and wireless connectivity applications saving both time and money. Many communication devices are now being designed with PoE interfaces such as wireless Access Points, Ethernet Switches, IP phones and sensors used in industrial and process networks.

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