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**IEEE802.3af POWER OVER ETHERNET:
A RADICAL NEW TECHNOLOGY**

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THIS PAPER EXPLAINS THIS NEW TECHNOLOGY,
AND DISCUSSES THE IMPLICATIONS
FOR FUTURE APPLIANCES

What's all this Power Over Ethernet Stuff Anyway?

Power Over Ethernet technology allows IP telephones, wireless LAN Access Points and other appliances to receive power as well as data over existing LAN cabling, without needing to modify the existing Ethernet infrastructure.

It has just become an international standard, called IEEE802.3af, as an extension to the existing Ethernet standards. The freezing of the standard will allow an explosion of Power Over Ethernet devices and installations. Power Over Ethernet is likely to be ubiquitous in a few years, as the cost of adding the power supplies to the Ethernet switches is going to be small. Indeed, it offers the first truly international standard for power distribution.

Figure 1 shows a typical system. In the wiring cabinet existing Ethernet switch equipment is retained and a “midspan” power source injects power into the twisted pair LAN cables. At the other end of the cables the power is used to run phones, wireless access points, cameras and other appliances. An Uninterruptable Power Supply (UPS) can optionally support the installation in the case of power failures.

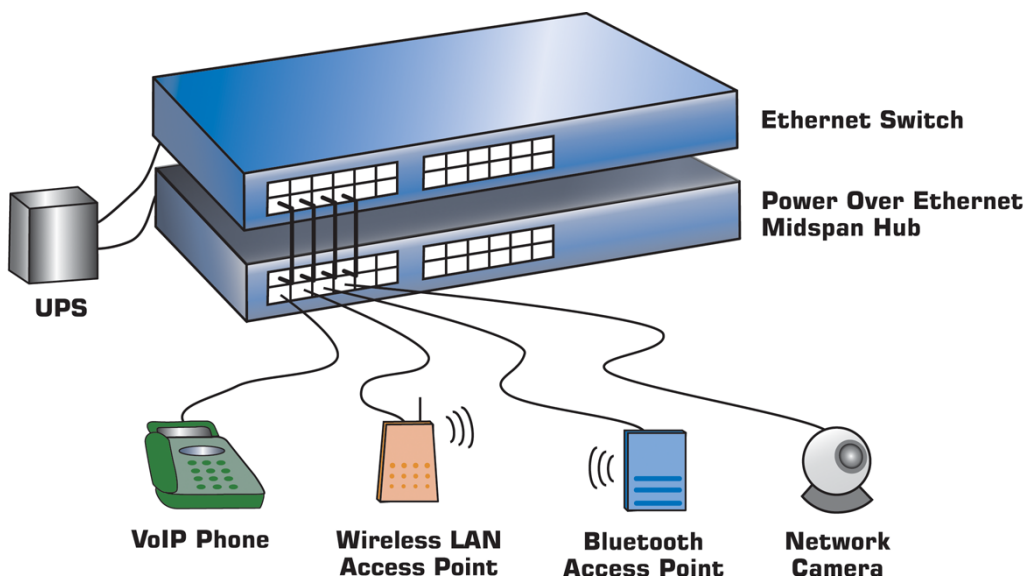


Figure 1 – A Typical Installation

The Motivation for Power over Ethernet

Almost all appliances require both data connectivity and a power supply. In a familiar example, telephones are powered from the telephone exchange through the same twisted pair that carries the voice. Now we can do the same thing with Ethernet devices.

So why bother? Here are some reasons:

- Only one set of wires to bring to your appliance – simplifies installation and saves space.
- There is no need to pay for an expensive electrician, or delay your installation to meet the electrician's schedule – saves time and money.
- The appliance can be easily moved, to wherever you can lay a LAN cable – minimal disruption to the workplace.
- Safer – no mains voltages anywhere.
- A UPS can guarantee power to the appliance even during mains power failure.
- As well as the data transfer to and from the appliance, you can use SNMP network management infrastructure to monitor and control the appliances.
- Appliances can be shut down or reset remotely – no need for a reset button or power switch.
- In wireless LAN systems it simplifies the RF survey task, as the access point can easily be moved and wired in.

The Current State of the Standard

The IEEE began the standardization process in 1999. Early players were 3Com, Intel, PowerDsine, Nortel, Mitel and National Semiconductor. They recognised that there was a need to supply power over Ethernet cables, and a number of proprietary implementations, but the lack of a standard was holding back the market.

The IEEE standardization process involved experts from many companies, and the specification benefits from this, as the issues were examined from many different perspectives. In addition, the draft specification was put to IEEE members for their approval in a ballot, at which stage any other objections could be raised and reconciled.

The IEEE802.3af standardization process is now complete. It was formally approved by the IEEE Standards Board on 12 June, 2003.

Many products are available that claimed compliance with the standard before it was formally in existence. Since the draft specification was changing over the months prior to June 2003, and some last minute changes were made to the spec, it is possible that some products on the market don't actually comply with the final standard. You will have to form your own view on products that claimed compliance to a non-existent standard, and treat them with some caution. In general, products designed reasonably recently are likely to be reasonably compliant with the final standard.

How Power is Transferred Through the Cable

A standard CAT5 Ethernet cable has four twisted pairs, but only two of these are used for 10BASE-T and 100BASE-T. The specification allows two options for using these cables for power:

- **The spare pairs are used.** Figure 2 shows the pair on pins 4 and 5 connected together and forming the positive supply, and the pair on pins 7 and 8 connected and forming the negative supply. (In fact, a late change to the spec allows either polarity to be used).
- **The data pairs are used.** Since Ethernet pairs are transformer coupled at each end, it is possible to apply DC power to the center tap of the isolation transformer without upsetting the data transfer. In this mode of operation the pair on pins 3 and 6 and the pair on pins 1 and 2 can be of either polarity. This is shown in Figure 3.

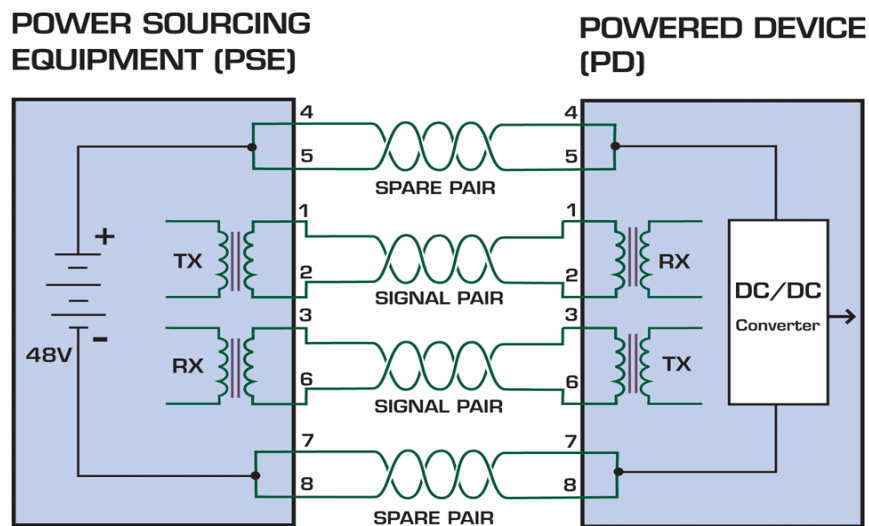


Figure 2 – Power Through the Cable on the Spare Pairs

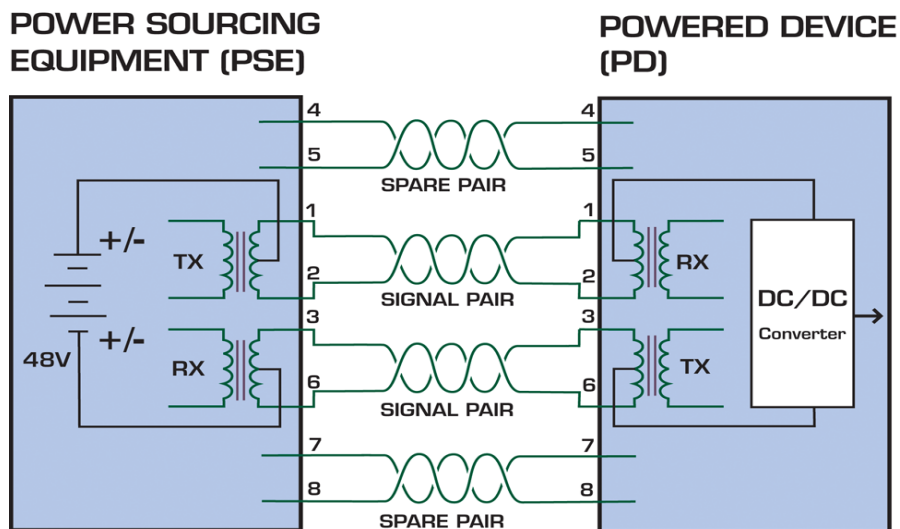


Figure 3 – Power Through the Cable on the Data Pairs

The spec does not allow both sets of wires to be used – a choice must be made. The Power Sourcing Equipment (PSE) applies power to either set of wires. The Powered Device (PD) must be able to accept power from both options.

In Figure 1, the Midspan Hub is the Power Sourcing Equipment, and the VoIP Phone, Wireless Access Points, and Network Camera are the Powered Devices. Newer Ethernet Switches include the PSE function internally, so the Midspan Hub is not required.

The voltage is nominally 48V, and about 13W of power is available at the Powered Device. An isolated DC-DC converter transforms the 48V to a lower voltage more suitable for the electronics in the Powered Device, while maintaining 1500V of isolation for safety reasons.

An obvious requirement of the spec is to prevent damage to existing Ethernet equipment. A “discovery process”, run from the Power Sourcing Equipment (PSE), examines the Ethernet cables, looking for devices that comply with the specification. It does this by applying a small current-limited voltage to the cable and checks for the presence of a 25k ohm resistor in the remote device. Only if the resistor is present is the full 48V applied, but this is still current-limited to prevent damage to cables and equipment in fault conditions.

The Powered Device must continue to draw a minimum current. If it does not (for example, when the device is unplugged) then the PSE removes the power and the discovery process begins again.

As an optional extension to the discovery process, a Powered Device may indicate to the Power Sourcing Equipment its maximum power requirements.

The Power Sourcing Equipment may optionally provide a level of system management, using, for example, the Simple Network Management Protocol (SNMP). This allows for management of actions such as devices to be powered off at night, or remotely reset.

Some Possible Uses of the Technology

Already manufacturers have products on the market. Many of these are described in the Products section of the www.PowerOverEthernet.com website. There is no shortage of the Power Sourcing Equipment Midspan Hubs, so you can start playing with the technology now. The big market players are using it for these applications:

- VoIP (Voice over Internet Protocol) Telephones.
- IEEE802.3af Wireless LAN Access Points
- Bluetooth Access Points.
- Web Cameras.

But Power Over Ethernet will enable many more appliances. Here's a list – but you can imagine many others!

- Smart signs/web signs.
- Vending machines.
- Gaming machines.
- Audio and video juke boxes.
- Retail point of information systems.
- EPOS systems.
- Building access control systems.
- Time and attendance systems.
- Battery chargers for mobile phones and PDAs.
- Electronic musical instruments.

Examples Of Power Over Ethernet Products



Figure 4 - Pingtel xpressa IP Telephone



Figure 5 - Sony Corp. SNC-VL10N IP Security Camera



Figure 6 - PowerDsine adapted this Power over Ethernet Shaver!

What To Do Next?

There is no doubt that this new technology is going to transform the way electrical equipment is powered. Why not become an “early adopter“ yourself, and start using IEEE802.3af Power Over Ethernet?

To get more information on Power Over Ethernet, visit www.PowerOverEthernet.com. This website dedicated to 802.3af technology is a portal for Power Over Ethernet news, articles, events information and links. The site has a detailed Power Over Ethernet products section, including all the latest product news, and extensive sortable databases. The site encourages manufacturers to enter their product details into these databases using online submit forms.

