

PoE Overview



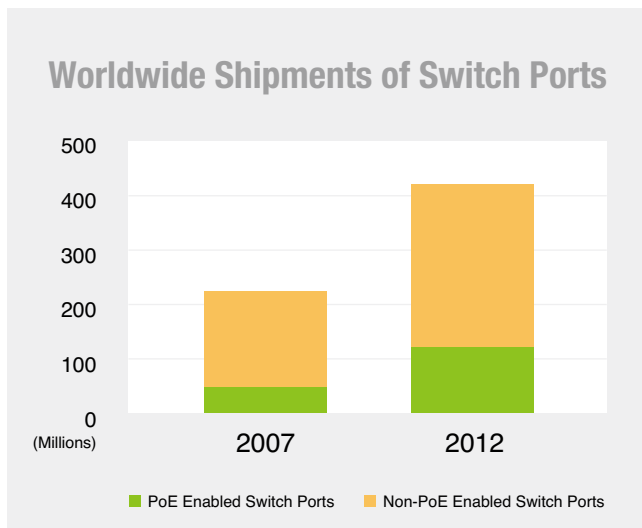
What is Power over Ethernet?

PoE is a technology that integrates data and power on standard Ethernet infrastructure, providing new options for power distribution. This allows IP telephones, wireless LAN access points, surveillance cameras and other embedded appliances to receive power as well as data over existing Cat.5 (or above) Ethernet cabling. Formally approved as an international standard, PoE is established as an economical, safe power distribution method and is already deployed in corporations throughout the world.

In simple terms, it uses the wires in standard Ethernet cabling to send power to the operating device. The device can then take its power from the Ethernet cable which means that a separate, local, power supply close to the device is not needed.

Growth in PoE Markets

According to VDC research, shipments of PoE-Enabled switch ports totaled approximately 47 million units in 2007. The research predicts that the growth rate for PoE switch ports will be almost double the rate of overall Ethernet port shipments to reach more than 130 million by 2012, which represents one quarter of all switch ports.



PoE Standard: IEEE 802.3af

The IEEE standard 802.3af describes the mechanism for Power over Ethernet. The standard provides the capability to deliver both power and data over standard Cat.5 (or above) Ethernet cabling.

The 802.3af specification provides 48 volts DC over two out of the four available pairs on a Cat.5 Ethernet cable with a maximum current of 350mA. After taking into account some power loss over the cable run, about 12.95W is available to the Powered Device.

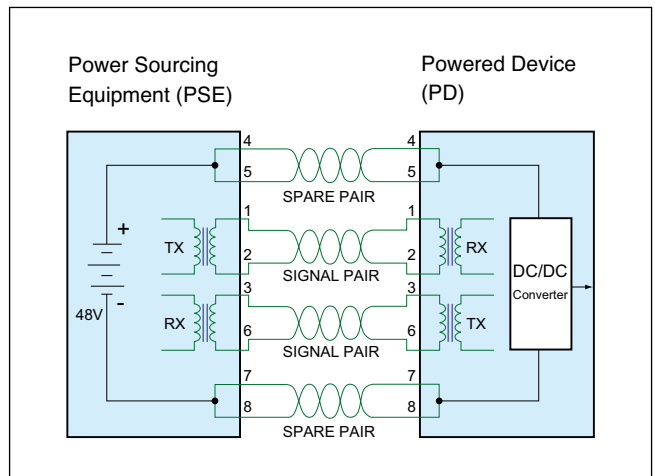
The standard also permits usage not only with 10BASE-T and 100BASE-TX, which only uses two of the four pairs in the cable, but also with 1000BASE-T (Gigabit Ethernet) which uses all four pairs for data transmission. This is possible by utilizing the Phantom Powering method.

How does it work?

A standard Cat.5 Ethernet cable has four twisted pairs, but only two of these are used for 10BASE-T and 100BASE-TX. The specification allows two options for using these cables for power:

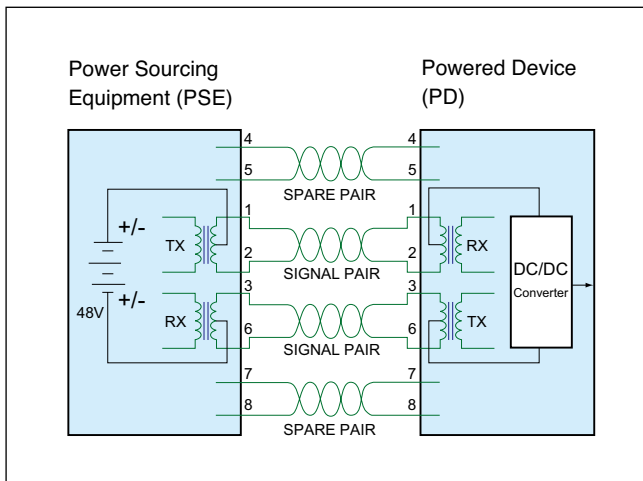
Power through the "spare pair"

The twisted pair on pins 4/5 is connected to form the positive electric power supply, while the pair on pins 7/8 is connected to form the negative supply. Each pair can accommodate either polarity.



Power through the “data pair”

Also known as phantom powering, the power is delivered along the data pairs on pins 1/2 and 3/6 to the device without disturbing data transfer. This method is applied in 1000BASE-T (Gigabit Ethernet) as all four pairs are used for data transmission.



The specification does not allow both sets of wires to be used to send power, 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.

An obvious requirement of the specification is to prevent damage to existing Ethernet equipment. A “discovery process” runs from the PSE which 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 the full 48V applied, but this is still current-limited to prevent damage to cables and equipment in fault conditions.

The PD 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 PD may indicate to the PSE its maximum power requirements. The following table shows the different PD classes and the PSE power output for each corresponding PD power range.

Class	Usage	Min. PSE Output	Power Available for PD
1	Default	15.4W	0.44W – 12.95W
2	Optional	4.0W	0.44W – 3.84W
3	Optional	7.0W	3.84W – 6.49W
4	Reserved for Future Use	Treat as Class 0	Reserved for Future Use

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

Why PoE?

As Ethernet becomes more common in server rooms and network backbones of most organizations, PoE becomes a much more attractive solution to deploy network devices without changing your existing infrastructure.

Cost Effective

Using one cable for both data and power to devices significantly reduce the power line installation cost for electrical wiring, conduits, and outlets throughout the buildings. It also reduces future maintenance costs, bringing cost elimination when using PoE technology for large installations.

Flexibility

PoE is standards based, so interoperability across vendors is guaranteed. This means that PoE can be used to provide maximum flexibility for device installation when it is difficult to provide a power source at hard to reach locations.

Also, even greater flexibility can be provided with the use of PoE Splitters, PoE technology can also be applied to devices weren’t designed for PoE.

Reliability

Using just one cable instead of separate cables for data and power improves overall network reliability and deployment flexibility.

Safety

PoE is a safe power solution. To avoid damaging devices or accidental contact, there are numerous safety procedures in the PoE specification which includes Over-current, Under-current and fault protection.

Advanced Management

Managed PoE switches provide network administrators with additional monitoring and control capabilities. Users can remotely enable and disable the power output from the switch to powered devices. This can be used to troubleshoot and reset devices by powering them on and off, or to schedule the times that power is provided to the devices to control when they will be turned on.

PoE (Power over Ethernet)

- ◆ PoE (Power over Ethernet)
 - PSE / PD
- ◆ Midspan
- ◆ Endspan

◆ PoE

- Take the un-used pins of CAT5 cable to carry DC power, so the CAT5 cable can carry both of DC power and data.
- The whole structure of PoE
 - ◆ PSE (Power-Source Equipment), it is power supply function and network management.
 - ◆ PD (Powered Device), it is the device which accepts the power supply.

PoE Midspan Solution

L2 Switch



Data



Mid-Span



Data

Power



44-57V, 350mA (Min 15.4W)
On spare pairs

PD



IEEE 802.3af

Max 12.95W

Endspan

PoE Switch



Data



Power



IP Terminal

Alternative A (Type A) is using the original data pairs of CAT-5 to carry power, and Alternative B (Type B) is using the spare pairs to carry power

Pin	Alternative A	Alternative B
1	Vport Negative	
2	Vport Negative	
3	Vport Positive	
4		Vport Positive
5		Vport Positive
6	Vport Positive	
7		Vport Negative
8		Vport Negative




Table 1 - RJ-45 PoE Pinout

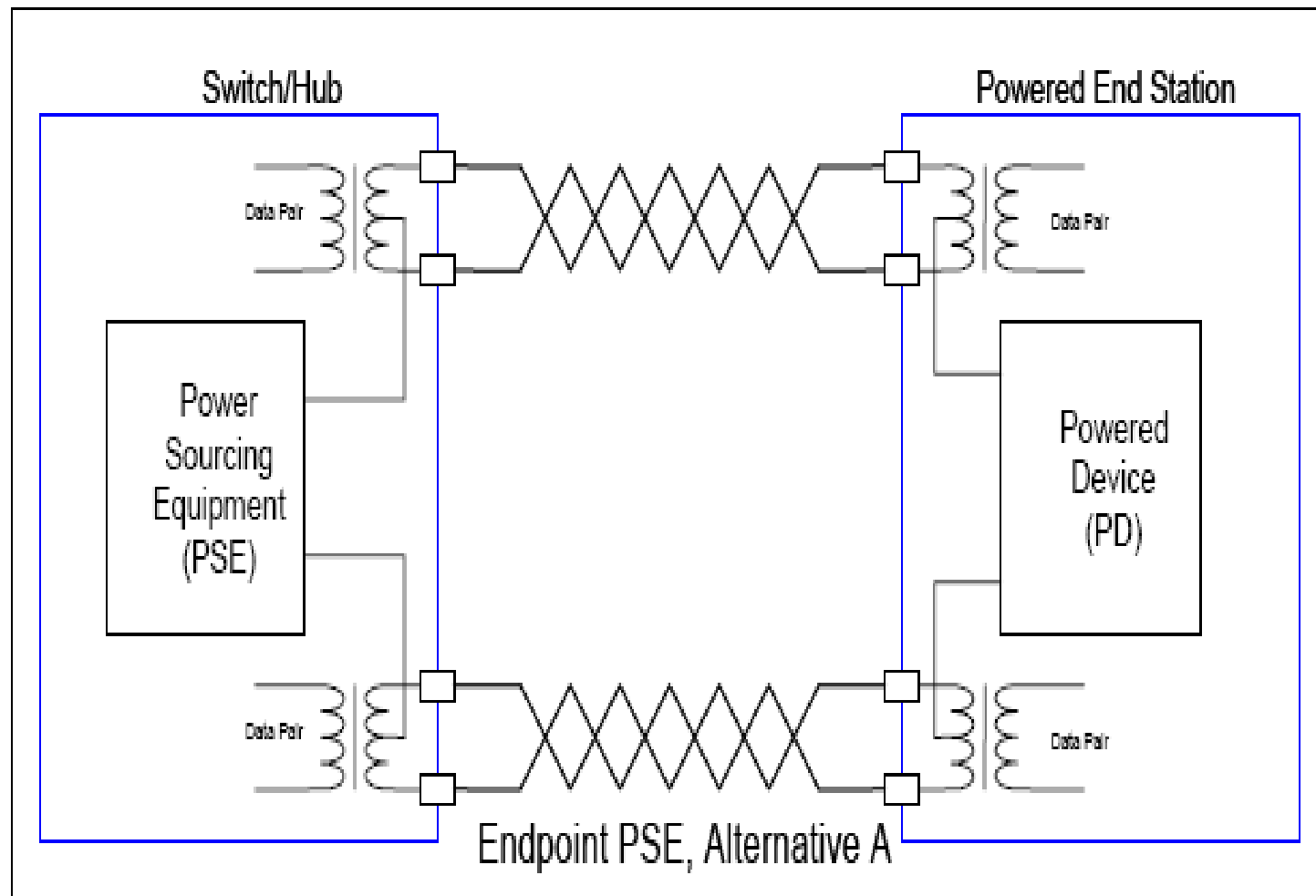


Figure 2 – PoE feeding using Alternative A (Data/Signal pairs)

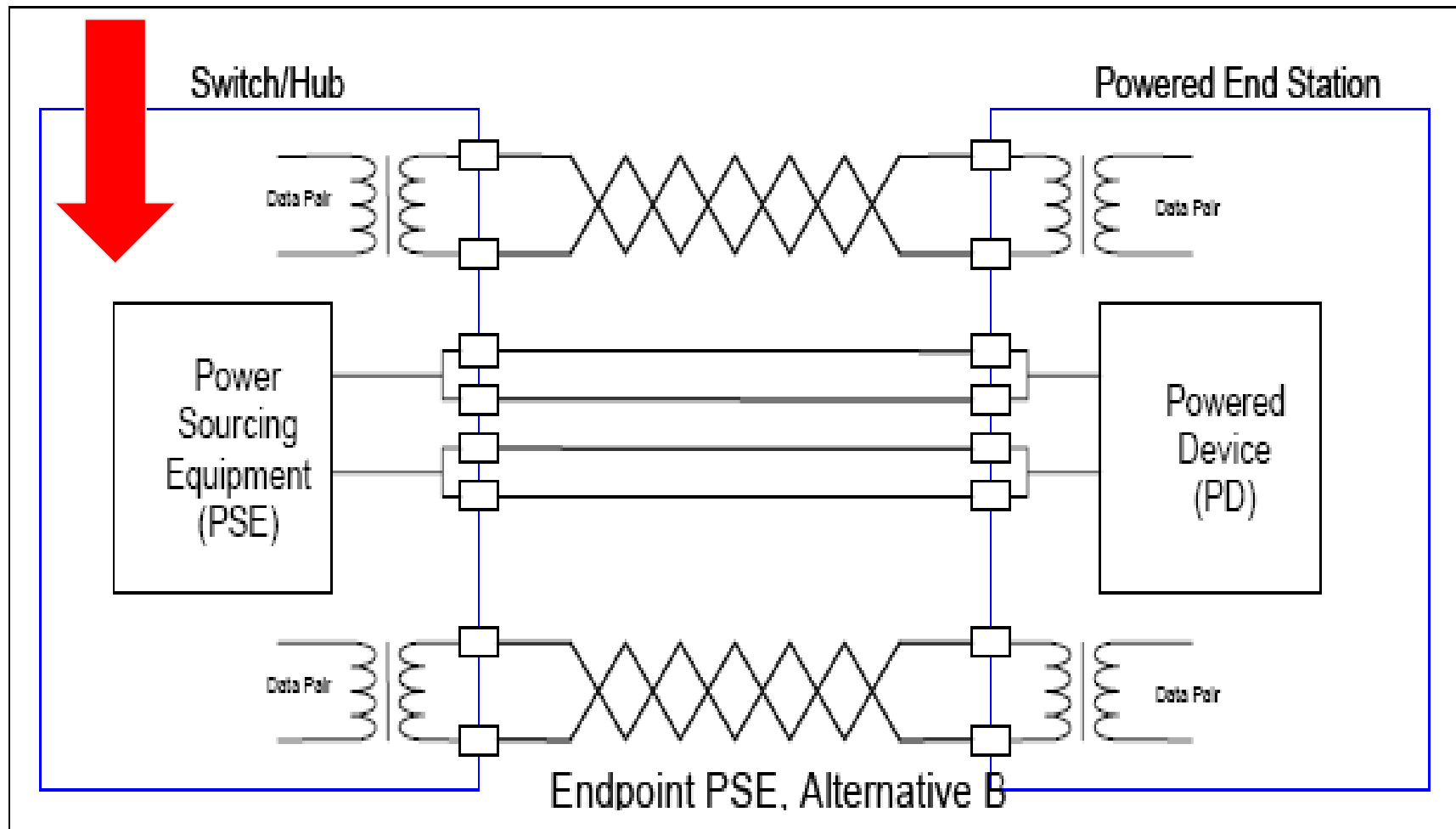


Figure 3 - PoE feeding using Alternative B (Spare pairs)

The Spec. of IEEE 802.3af

- ◆ IT is standard for PoE
- ◆ Power: 44~57VDC/15.4W carried on CAT 5 cable.
- ◆ Power Source Equipment, PSE
 - 2 types: Midspan and Endspan
 - Midspan is to accept the data from some network device and apply its own power, finally both of data and power are the output to PD, Powered Device.
 - Endspan has built-in PoE function, its output is also both of data and power.

PoE Detection

- ◆ To make sure the supply of DC power is safe for devices, before PSE supplies power, it will execute the procedure to detect if the connected PD is PoE supported.
- ◆ First, PSE will search for the special component, resistor of $25K\Omega$, if it can be found, it means the PD is PoE supported, otherwise, it is traditional NIC device.
- ◆ Only make sure the connected PD is PoE supported, PSE will start to supply power, it can avoid damaging traditional devices

Classification for PD

- ◆ After PSE detect PD, it will classify BD by different classes. Its purpose is to know the maximum power which will be allocated on the PD. According to 802.3af, there are 4 classes.
- ◆ (Class 0)
 - It is not yet defined, the maximum power for the port should be 15.4W from PSE.
 - Now, since the majority of PDs are not yet supporting classification, it is considered to be Class 0.
 - Any loss on transmitting on cables should be considered too.

Class	PD Current - Classification Period [mA]	PD Power - Operation Period [W]	Note
0	0 - 4	0.44 -12.95	Default
1	9 - 12	0.44 -3.84	Optional
2	17 - 20	3.84 -6.49	Optional
3	26 - 30	6.49 -12.95	Optional
4	36 - 44	Future use	Future use

Table 3 - PD Classification values