LANPRO

PoE
Power Over Ethernet

Power over Ethernet (PoE)

Introduction

PoE is the acronym for "*Power Over Ethernet*": and is a technology that permits the transfer of electric energy simultaneously with data over the pairs used in a conventional Ethernet network cable and in this way there is no need for additional energy cables to power remote equipment like Switches, hubs, AP's IP cameras, etc.

The PoE technology was covered under the IEEE 802.3af standard which lets you to power remote equipment with up to 15.4W. In the year 2009 the standar was updated to the IEEE 802.3at (called as PoE+) augmenting the available power to up to 25.5W.

PoE requires at least Category 5 TP cables as a minimum to transmit full power; if less power is needed, Category 3 cables could be used.

Additional advantages for PoE

Besides the obvious advantage for PoE infrastructure deployment by saving on elimination of remote site local power it also has additional advantages:

✓ Facilitates power supervision and control of remote devices, resulting in a better power saving and management through all the facilities.

✓ Facilitates the installation of energy backup devices for critical systems like:

✓ IP telephony, security IP cameras, between others.

Similar Technologies

- USB: the Universal Serial Bus standard provides data and power but its design limi8ts the distance to short paths up to 5 meter length and less than 2.5 W that can power devices like Mouses, web cameras, microphones, etc.

- IEEE 1394 (FireWire): is similar to the USB but can provide higher power (45W) up to a 4.5 m distance.

- Power Line Communications: is a technology that uses the existing AC electric power wiring for data transmission.

- Passive PoE : there are proprietary ways of delivering power over data cables that are not standardized, and use a passive non intelligent power injector to deliver power through the pairs not used for data.

Power Limit

Category 5 data cable uses 24 AWG conductors which can deliver up to 360 mA @ 50 VDC as per the TIA standard. There are two pairs available for this purpose (Alternative A and B), this represents a maximum power that can be injected of: 50V x 360mA x 2 = 36W.

If you take in account maximum length path of 100 m as per the ANSI/TIA/EIA-568 standard for structured cabling, a loss of 4.4W is expected. This limits the power delivered to the **Remote Load** to a maximum of 31.6W.

The self heating of the cable also limits the number of cables in a bundle to 100 due to a maximum temperature of 45ºC. This limit can be surpassed if a higher category cable is used like the CAT 6, due to the lower resistance of the AWG 23 wires.

Power Network Topology

The PoE standard established two(2) topologies for the delivery of required power to remote devices. In both topologies there is a Power Sourcing Equipment called PSE and a Powered Device called PD respectively.

In the first topology, power is sourced by the PSE data equipment directly, and it is connected to the remote device called *Endspan* because it is at the end of the link.

In the second topology, power is sourced by an injector equipment called *Midspan* which is placed in a point between the data equipment and the endspan equipment at the remote site.

Power Network Topology

From the point of view of delivered power, there are two types of PSE equipment:

- **Type 1:** The PSE can deliver a maximum of 15.4W with a voltage range of 44 to 57 VDC, by using at least a CAT3 cable. This type of equipment permits the reuse of legacy infrastructure.

- **Type 2:** The PSE can deliver a maximum of 25.5W with a voltage range of 50 to 57 VDC, by using at least a CAT5 cable

Power Network Topology

The remote equipment (PD) is limited to a maximum consumption of 13 Watt if it is a Type 1 IEEE 802.3af device and 25.5 W if it is a type 2 IEEE 802.3at device over a range of 44 to 57 VDC.

When a PD is connected to a PSE, they begin a negotiation sequence in which the delivered power level is stablished in accord to the PD class.

There are two connection alternatives for the DC energy to flow:

- **Alternative A**: Power is delivered through the coupling data transformers center tap on pairs 1/2 and 3/6.

- **Alternative B**: Power is delivered through the pairs 4/5 and 7/8.

Power Network Topology

- **Alternative A:** power is delivered through the center taps of coupling transformers of pairs ½ and 3/6
- **Alternative B:** Power is delivered through pairs 4/5 and 7/8

802.3af Standards A and B

PINS on Switch	T568A Color	T568B Color	10/100 DC on Spares (mode B)	10/100 Mixed DC & Data (mode A)	1000 (1 Gigabit) DC & Bi-Data (mode B)	1000 (1 Gigabit) DC & Bi-Data (mode A)
Pin 1	white/green stripe	white/orange stripe	Rx +	Rx + DC +	TxRx A +	TxRx A + DC +
Pin 2	green solid	orange solid	Rx –	Rx – DC +	TxRx A –	TxRx A – DC +
Pin 3	white/orange stripe	white/green stripe	Tx +	Tx + DC –	TxRx B +	TxRx B + DC –
Pin 4	blue solid	blue solid	DC +	unused	TxRx C + DC +	TxRx C +
Pin 5	white/blue stripe	white/blue stripe	DC +	unused	TxRx C – DC +	TxRx C –
Pin 6	orange solid	green solid	Tx –	Tx – DC –	TxRx B –	TxRx B – DC –
Pin 7	white/brown stripe	white/brown stripe	DC –	unused	TxRx D + DC –	TxRx D +
Pin 8	brown solid	brown solid	DC –	unused	TxRx D – DC –	TxRx D –

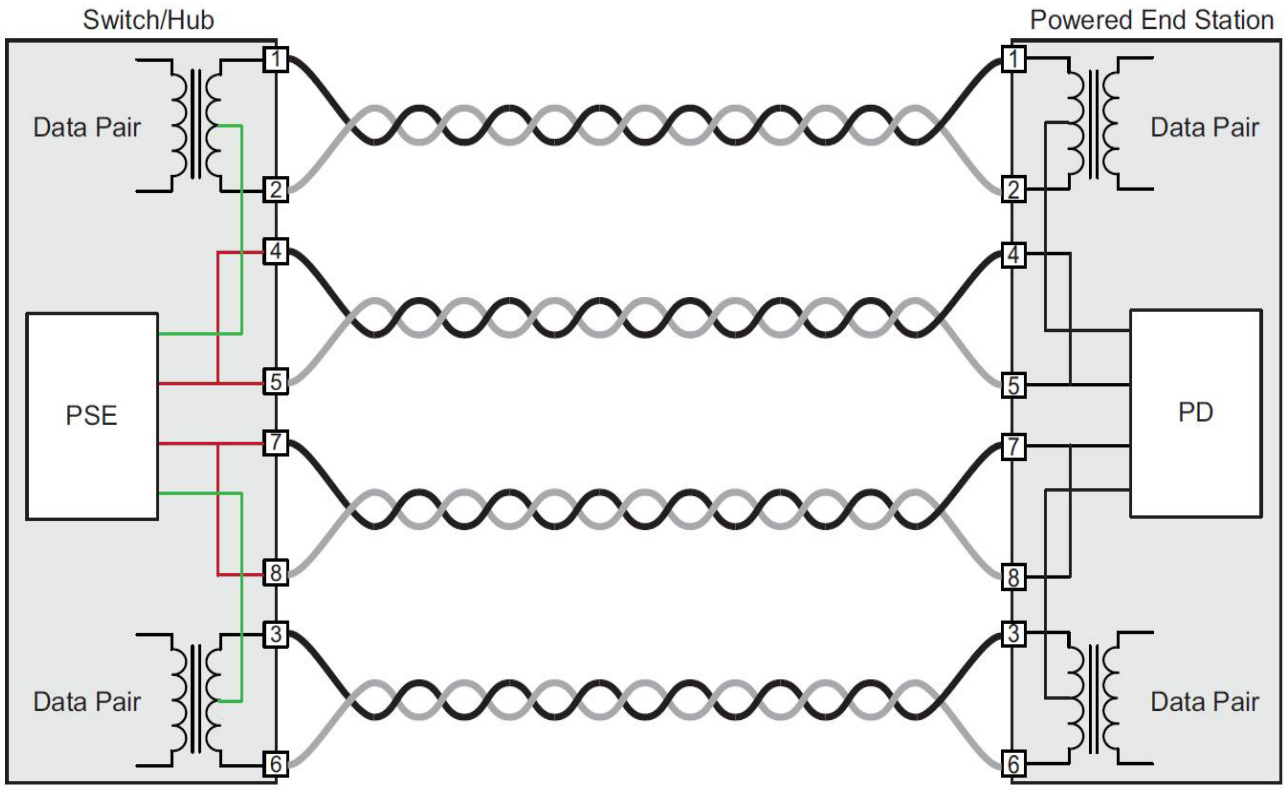
Power delivery schemes

There are four(4) power delivery schemes, each with two(2) alternative methods of power injection(A shown in green color, and Alternative B, shown in red color.:

- Endspan type PSE, with support for 10/100 Mbps networks.
- Endspan type PSE, with support for 10/100/1000 Mbps networks.
- Midspan type PSE, with support for 10/100 Mbps networks.
- Midspan type PSE, with support for 10/100/1000 Mbps networks.

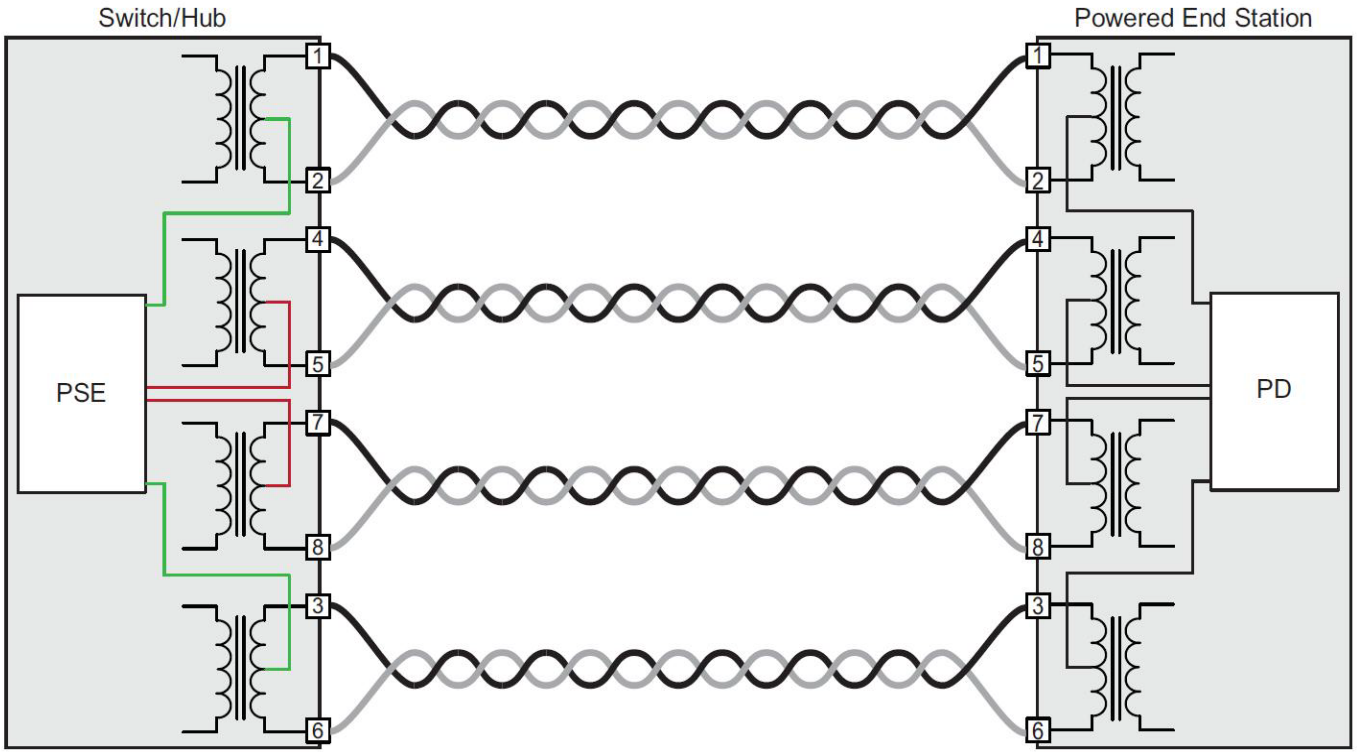
Power delivery schemes

Endspan type PSE, with support for 10/100 Mbps networks.



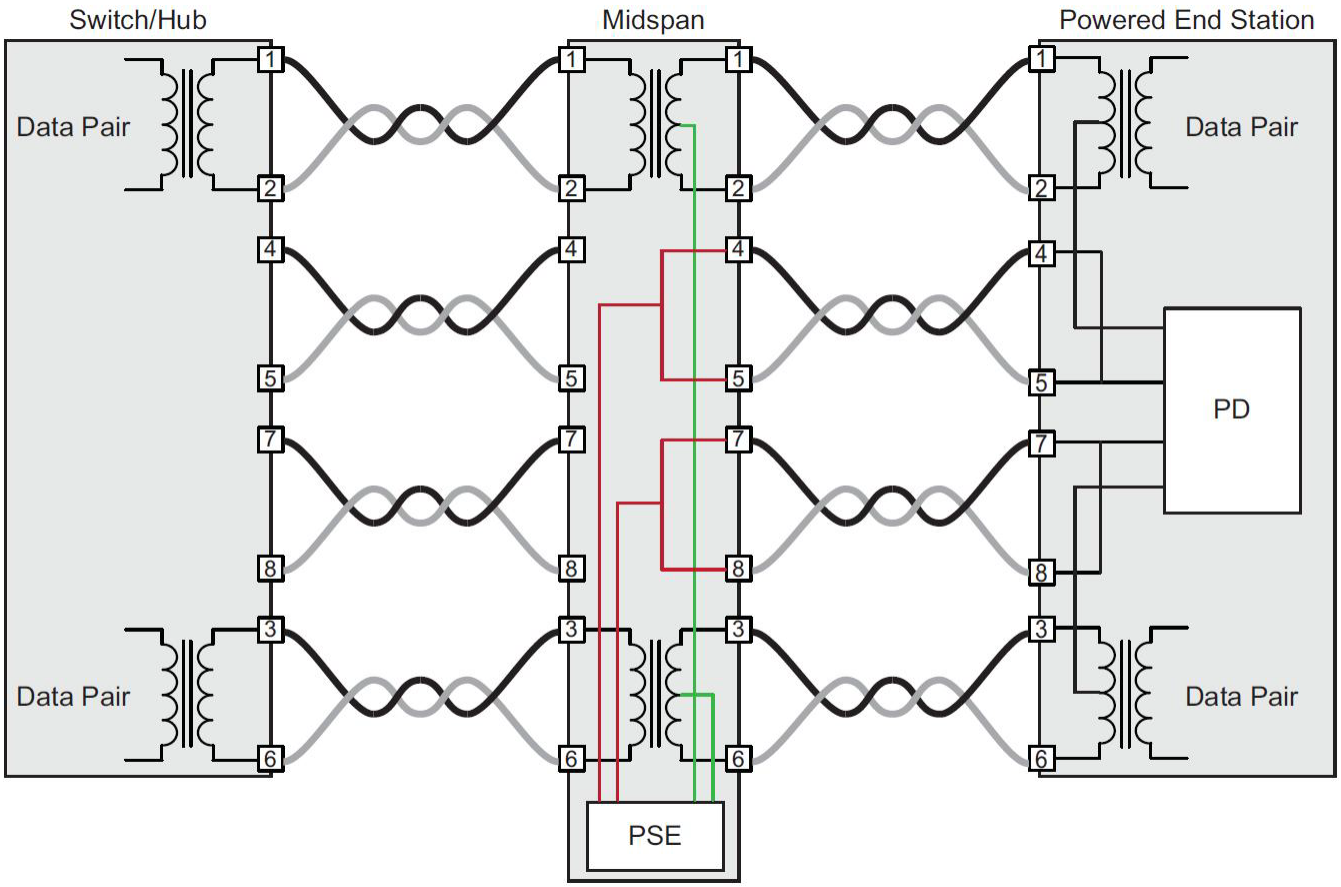
Power delivery schemes

Endspan type PSE, with support for 10/100/1000 Mbps networks.



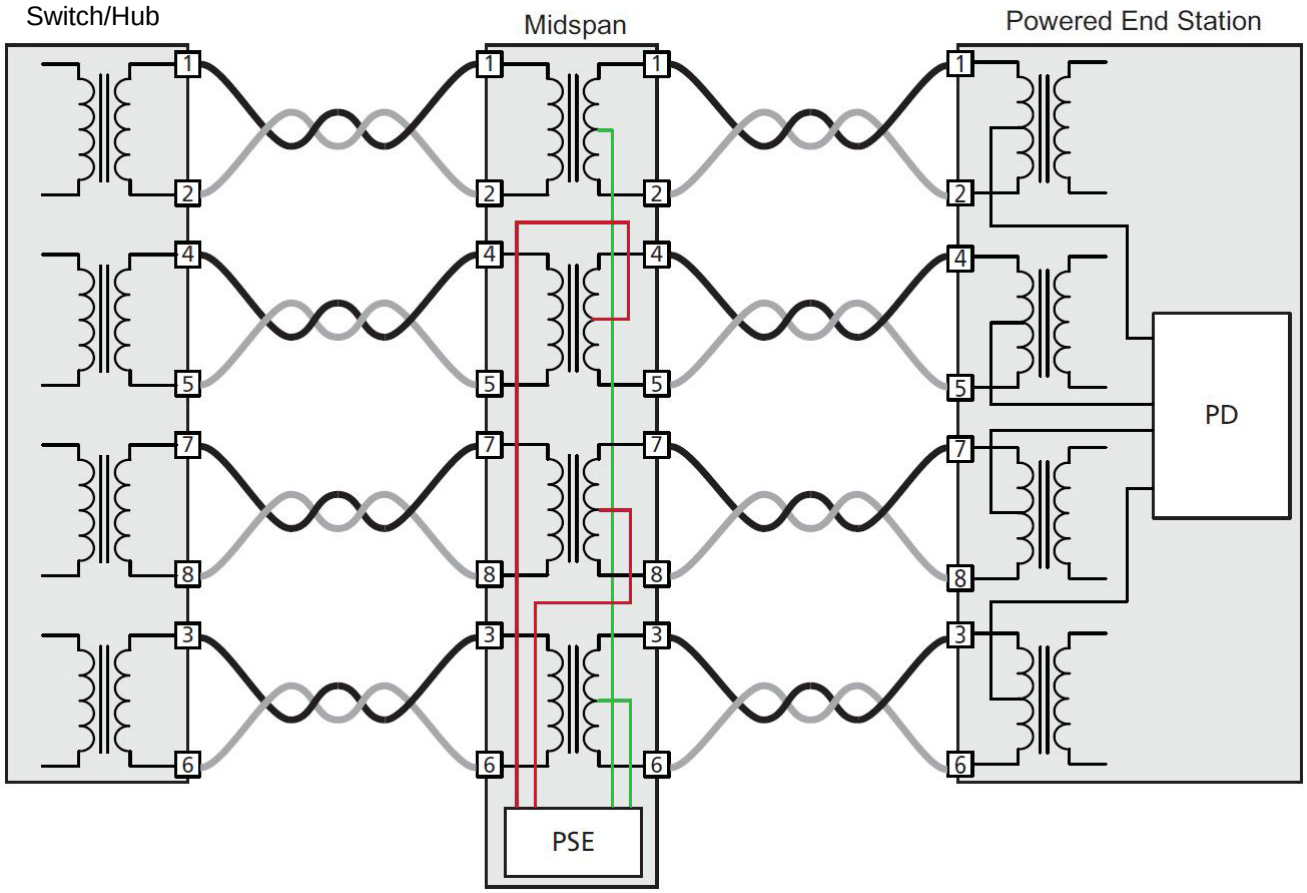
Power delivery schemes

Midspan type PSE, with support for 10/100 Mbps networks



Power delivery schemes

Midspan type PSE, with support for 10/100/1000 Mbps networks.



Power Administration

Once the link connects the PSE determines the PD power classification, it makes it via two mechanisms:

1. Via the PHY Layer: this mechanism uses the link cable and the PD electrical characteristics to determine the class.

Class	Maximum available power available
Class 0	13.0W
Class 1	3.84W
Class 2	6.49W
Class 3	13.0W
Class 4	25.5W

Power Administration

2. Classification via the Data Link Layer: Once the Data Link is established, the PSE and the PD talk using the *Media Endpoint Discovery* protocol which is an extension of the Link Layer Discovery Protocol) LLDP-MED. This method of classification has a finer resolution for the PD classification and enables a dynamic adjustment of the power level demanded during the PD operation.

Summary Table

Characteristics	802.3af (802.3at Type 1)	802.3at Type 2
Available power at the PD	12.95W	25.5W
Maximum power delivered by the PSE	15.4W	30.0W
PSE Voltage range	44-57VDC	50-57VDC
PD voltage range	37-57VDC	42.5-57VDC
Maximum Current	350mA	600mA
Maximum cable resistance	20 Ohm	12.5 Ohm
Power administration	3 Level negotiation	4 Level negotiation
Operating Modes	Alternative A (Endspan), Alternative B (Midspan)	Alternative A, Alternative B
Minumum category of Data Cabling	Cat3	Cat5

LanPro LP-SGW2404FP PoE Switch

The **LP-SGW2404FP** has been designed for Department and Work Groups and provides “wire speed” performance and a complete set of Layer 2 management functions. It provides also a variety of service characteristics and powerful multiple functions with high security.

This switch has 24 copper ports that support the IEEE 802.3af and IEEE 802.3at standards for PoE, and acts a a PSE for those equipment compatible with those standards up to a 320 W capacity. This Switch has a powerful GUI for a practical management of power.

LanPro LP-SGW2404FP PoE Switch

- Total power can be configured from 1W to 320 W.
- The Switch has two modes for inhibiting the delivery of power to a port when it arrives to the limit:
    1. Just by inhibiting the port or
    2. Disconnecting the lowest priority port.
- The initial negotiation voltage level can be set to: High, Middle, Low, etc.
- Power can bi limited from 1W to 30W 0.1W steps
- It is possible to define ranges of time for the application of power in each port.

Conclusion

The PoE technology has gained popularity as an effective media to power a large variety of devices distributed in the work space of a structured cabling network, like: IP cameras, IP Phones, Access Points, etc., with the resulting reduction of costs in the infrastructure of power distribution.

The first version of the PoE standard limited the PD power to 12.95 W, and the last one , the IEEE 802.3at has augmented it to 25.5 W, widening the variety of remote equipment to be included.

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