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Technology

InscapeData The Leader in Wireless and IP Video Systems

Power Over Ethernet – Simplifying your PoE deployment

Introduction

Power over Ethernet (PoE) is an evolving technology designed to deliver power and data on an Ethernet cable at the same time. Modeling after telecommunication systems which supply power to telephones, PoE powers network devices without the need of an AC electrical outlet. By eliminating the power cord infrastructure, PoE technology simplifies wiring and deployment providing convenience and benefits to enterprise, commercial, industrial, and residential applications.

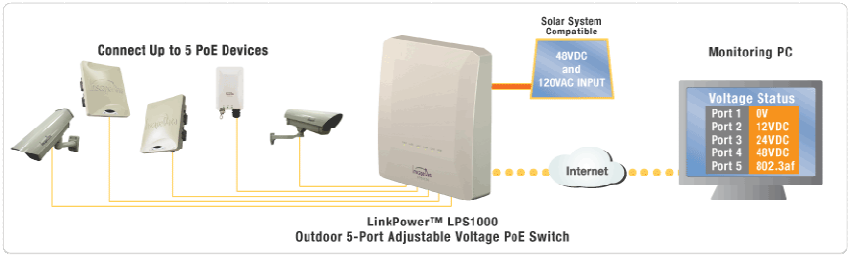

Figure 1. Example of LinkPower LPS1000 PoE Switch

History

Telecommunication systems utilized phantom power in powering telephone handsets. This was a very practical approach used by the telecom service providers in providing telephone service to homes and businesses. When local AC power outages occurred, phantom power kept phone system working, hence, the ability to continue to make phone calls. Phantom power is a method that provides DC electrical power through cables to operate the interfacing device containing active electronic circuitry. Like phantom power, PoE technology and devices had great success in the market place.

The demand for PoE technology began in the year 2000 with the introduction of IP telephony. Since IP telephone equipment requires power to operate, its deployment is simplified by combining power and data transfer in a single Ethernet cable. The technology soon was adopted by other IP based applications. With an increase in PoE usage and the need for a common PoE interface, the IEEE standard for PoE or 802.3af, was soon released. Today there are three basic types of Power-over-Ethernet (PoE) devices; one is what we often refer to as pre-standard or passive PoE, the IEEE 802.3af standard, and the proprietary active PoE.

Pre-standard PoE

These types of PoE devices deliver power over the spare pairs (pins 4, 5, 7 and 8) of a CAT3, CAT5, CAT5E or CAT6 type Ethernet network cable. It delivers the voltage across the spare pairs of an Ethernet cable. This pre-standard version of PoE is implemented in many different manufactured products. These chipsets are lower cost than 802.3af compliant chipsets which can result in lower product cost. Additionally, with pre-standard PoE, power may be easily applied to a powered device using DC voltage from multiple sources such as automobile batteries or solar solutions. Many PoE Vendors opt out of 802.3af due to the 13 watts maximum power specification, which is too low for higher demanding powered IP applications.

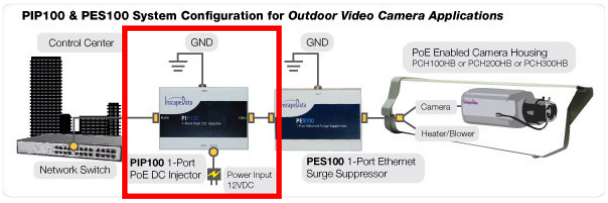

Figure 2. Example of a PIP100 Passive PoE Mid-span Injectors

The most commonly used Ethernet cable, CAT5e, uses 24 AWG copper conductors, which can safely carry 360 milliamp of current at 50 volts. The cable has eight conductors with only four conductors being used to provide power. Therefore, the maximum direct current power transmitted is 50 V × 0.360 A × 2 = 36 W. Considering the voltage drop of 3 volts of DC every 25 meters of cable length, at 100 meters, a powered device would only receive 31.6 watts of usable power.

Power planning and cable length is an important consideration when using passive PoE technology. Utilizing longer cables without accounting for the device's power requirements may cause intermittent operation and equipment malfunction.

Let's look at the Inscape Data AirGoggle NVC300 Fixed Dome IP Video Camera as a planning example. The NVC300 PoE power requirement is 8.4 watts and minimal voltage of 7 VDC. If using a 12VDC passive PoE injector with 50 meters of CAT5e cable, the camera would receive 8.4 watts of power at 6VDC. This would be marginally below the minimum voltage requirement of 7VDC for the NVC300 IP video camera. This calculation used the 3 VDC voltage drop for every 25 meters of cable used. A more ideal passive PoE injector voltage would be 18 VDC at 50 meters of cable length or 24 VDC at 100 meters. If planned well, passive PoE technology provides very reliable, cost effective, and flexible power implementation for powering PoE enabled devices.

Although not defined, pre-standard PoE equipment also utilizes similar nomenclature for standard PoE technology powered devices and power sourcing equipment.

Standard PoE (802.3af)

The IEEE 802.3af standard compliance PoE technology is based on the concept of active power delivery with feedback loop. In order for the 802.3af technology to work properly, the standard must be implemented in the powered sourcing equipment (PSE) and the powered device (PD).

Power Sourcing Equipment (PSE) is equipment that supplies power to a powered device. A PoE capable switch is the most common example of PSE. Acting as a power transmitter, the PSE has three main job functions:

- Detection of PD and determination of the PD's power level
- Deliverance of power to the PD according to the power level negotiated
- Monitor and stoppage of power delivery to the PD

There are two types of PSE defined in this standard, the endspan and the midspan. An endspan PSE is a PoE capable port that carries both data and power on the link, while a midspan PSE stands between a common Ethernet port and a PD to help inject power. Midspan offers a solution when adding PoE to an existing network infrastructure without changing its original configuration.

Powered Device (PD) is a device that receives power from PSE. More and more networks today have attachments such as IP phones, wireless LAN access points, and IP cameras all designed as PDs. Due to the different power requirements needed by various PDs, IEEE802.3af defines an option to classify PDs into classes according to their power consumptions. Following the process of classification, a PD informs the PSE of its power range so the PSE can apply more efficient power. Table 1 details the class and the corresponding power levels delivered from PSE and received by PD.

Class	Usage	Maximum Power level
0	Default	0.44 to 12.94
1	Optional	0.44 to 3.84
2	Optional	3.84 to 6.49
3	Optional	6.49 to 12.95
4	Reserved	PSE classify as Class 0

Table 1. PD Power Classification

There are two different modes included in the 802.3af standard. Mode A is to apply the power over the same data pairs (pins 1,2,3 and 6) as the data that is being transported. This is true of both 10/100 and 1000BASE-T networks. Mode A is sometimes referred to as phantom power. Mode B allows the power to be carried over the unused pairs (pins 4, 5, 7 and 8). However, a pre-standard PSE or injector using power over the unused pairs may not operate with an 802.3af PD due to various power negotiations occurring between the PSE and PD, such as detection and classification.

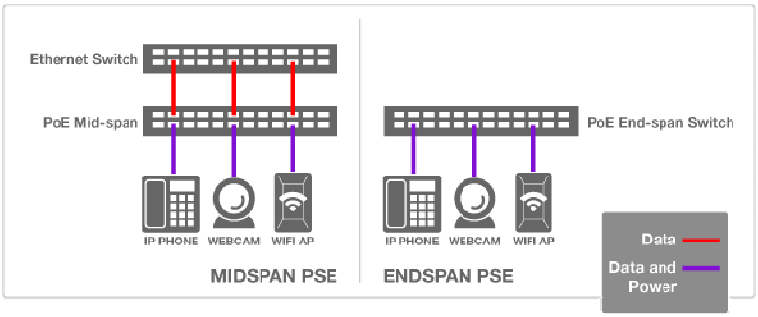

Figure 3. Comparison of Midspan PSE and Endspan PSE

The introduction of network devices that require more than 15.4W such as notebooks, video phones, PTZ IP cameras, and WiMax base stations, has compelled the IEEE 802.3 workgroup to develop a new PoE standard that can deliver even more power than defined in the IEEE 802.3af standard. This new standard, IEEE 802.3at, derived in 2004, was designed to deliver at least 30W per port of inline power. Transmitting more than 15.4W of power per port poses significant challenges. One such challenge lies in the physical characteristics of copper cabling, which can overheat or become damaged when transmitting power above certain thresholds. The IEEE workgroup is exploring different means of transmitting higher levels of power subject to these limitations. Another challenge is backward compatibility with the IEEE 802.3af standard. This interoperability could be crucial to the successful adoption of 802.3at. Therefore, the IEEE is working to make sure that 802.3at-compliant PSEs are able to interoperate with 802.3af powered devices and vice-versa. As a result of these and other implementation challenges, the IEEE 802.3at standard is not expected to be finalized any time soon.

Proprietary Active PoE

PoE products utilizing proprietary active PoE technology are vendor specific and usually not interoperable between vendors. Since the install base for proprietary Active PoE is small, products based on this technology are usually very costly. The following sections omit the discussion of proprietary Active PoE technology and focuses on pre-standard and standard PoE technologies.

PoE Architecture

PoE eliminates time, cost and effort required to install separate 110/220 Volts Alternating Current (VAC) power to the remote PD. Using the power derived from the Ethernet connection eliminates the need for a localized battery back-up, preventing any data loss or security breaches. All PD devices can be protected by a single centralized UPS.

There are two methods of interfacing power to the Ethernet cable. First, a mid-span powered hub is connected in cascade with the Ethernet switch (refer to Figure 4A). Second, the end-span (end-point) power module is fully integrated in the Ethernet switch delivering power without the need for additional components (refer to Figure 4B).

Examples of mid-span PSE equipment are Inscape Data Corporation's PIP100 1-port PoE injector and PIS200 2-port PoE injector with surge suppression built-in. The LinkPower LPS1000 5-port adjustable voltage PoE switch is an all-in-one end-span PSE type of equipment. Inscape Data Corporation's SB54 all-weather dual band access point / bridge and NVC series IP video camera are examples of PD devices.

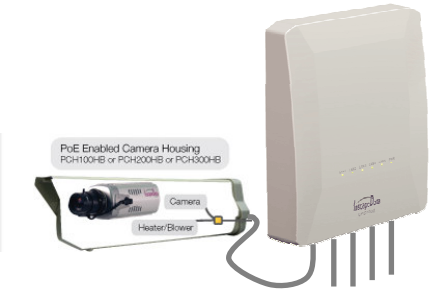

Figure 4A LPS1000 End-span PSE

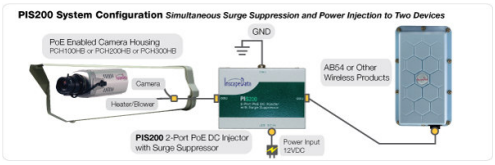

Figure 4B PIS200 two-port Mid-span PSE

Depending on which PoE technology is used, there may be a need for end-span, mid-span, or both systems in an application. End-span approach is preferred to reduce system component count. With the introduction of Inscape Data's Link Power LPS1000 end-span adjustable voltage PoE switch, pre-standard PoE support, 802.3af, remote port restart, Ethernet port surge suppression, and all weather enclosure are all inclusive to simplify each PDs' powering needs. The differences between the Inscape Data LPS1000 and currently common alternatives are highlighted in Figure 5.

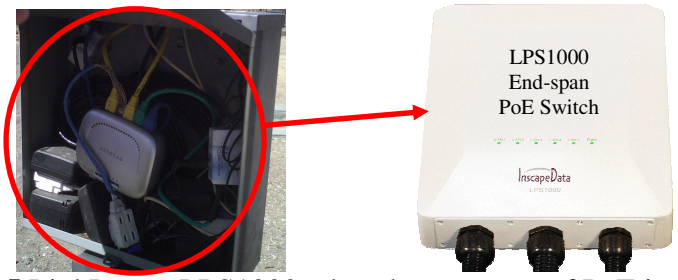

Figure 5 LinkPower LPS1000 takes the mess out of PoE installations

Applications

PoE offers great cost savings and flexibility in deploying equipment. Applications currently utilizing PoE technology range from, but not limited to, the following:

- IP Telephones
- Printers
- Wireless Peripherals
- Field Transducers and Sensors
- WiFi Access Points
- 802.11 Fixed Wireless Base Station
- Fixed Wireless Customer Premises Equipment
- Wimax Base Stations
- Bluetooth Access Points
- IP Surveillance Cameras
- Data Collection, Time and Attendance Control
- HVAC and Lighting Controls
- Badge/Card Readers
- RFID

Benefits of PoE

The benefits provided by PoE technology are more than just simplifying the wiring. Benefits also include:

Cost Savings
Cost savings in the time of deployment and costs associated allows for deployment without traditional high voltage electrical circuits, eliminating the creation and maintenance of power infrastructures such as cords, outlets, and conduits. Cost savings associated with the need to subcontract expensive high voltage electricians is also eliminated.

Easy to Install
PoE requires one set of wires to the PD. Vendors and users both benefit from this simplified installation concept.

Deployment Flexibility
Since PoE PDs may be deployed up to hundreds of feet away from AC outlets, the location flexibility of PDs simplifies cabling layout and power restrictions. Systems like IP cameras and wireless access points can be located in more secured locations to avoid intentional tampering.

Reliability
PoE architecture allows centralized power management by managing the PSE to an uninterruptable power supply (UPS) system. By attaching a battery backup system to the PSE, the PD is guaranteed power even when there is a main power failure.

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Outdoor PoE Challenges

Outdoor PoE applications pose new challenges for outdoor PSE systems. With increasing demand for cost effective IP devices, many new PDs are now operating both indoors and outdoors. IP video camera systems used to monitor the inside of buildings are now finding their way onto street lights and utility poles for public safety and traffic monitoring. The core challenges of powering outdoor PDs are:

- Inclement Weather Conditions
- Transient Voltage Surges
- Extreme Temperature Ranges
- AC Power Source Location
- Power Reliability
- Diverse PD voltage types
- PD Lock-Up

Inscape Data Corporation, the leader in wireless and IP video systems' introduction of the LinkPower LPS1000 Adjustable Voltage Outdoor PoE Switch based on Inscape Data's patent-pending proprietary technology tackles the challenges of outdoor PoE applications. The LPS1000 is a unique and powerful outdoor five-port Ethernet Switch with an adjustable voltage feature. Based on our patent-pending technology, the LPS1000 offers four discrete voltage levels, which covers a wide range of outdoor network and security application opportunities and significantly reduces the complexity of outdoor network installation, integration and ongoing network maintenance. The LPS1000 boasts the following features:

Features	**Description**
Remote Management	Remotely configure and manage each independent powered network port of the LPS1000 via web browser
All Weather Enclosure	IP67 enclosure rating and water tight connectors based on patent pending technology
Independent Port Voltage Adjustment	Adjustable DC Voltage with PoE voltage of 12VDC, 24VDC, 48VDC, and IEEE 802.3af compatible
Voltage and Power LED display	Bright LED indicators show operational power levels at each network port
5-Port PoE Switch	Connect up to 5 different PoE devices or uplink switch at 10/100 mbps speeds with Auto-MDX cross over feature.
Flexible Mounting Options	Easy to install brackets allow for wall or mast mounting of the LPS1000

Summary

Power over Ethernet is an emerging technology that will change the way both network and non-network devices are used. With the rapid increasing deployment of PoE enabled PDs, residential, retail, enterprise, and industrial users will all benefit from the cost savings as well as the simplicity, reliability, and flexibility. Outdoor PoE PSE and PD face diverse challenges of diverse power systems and extreme operating environments. By providing flexible PD voltage support and remote restart capability, Inscape Data Corporation's LinkPower LPS1000 overcomes practical deployment problems in outdoor environments and brings a new concept to outdoor PoE switching. The adjustable voltage, remote reset, individual port monitor, and much more, makes the LinkPower LPS1000 the industry's only adjustable power outdoor PoE Switch.