AXIS COMMUNICATIONS

VIDEO PRODUCTS

WHITE PAPER

Accessories

# Power over Ethernet

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# 1 Introduction

Power over Ethernet (PoE) is a convenient and secure way to provide power to devices such as network cameras, IP telephones and wireless device points. By injecting power into the network cable, the requirement for local power at the location of a device is removed. And this is done without any degradation of network performance. There are a couple of clear benefits associated with the use of PoE:

- Reduced cabling, only one cable is required
- Easy installation for locations which are hard to reach, as no local power is needed
- No need for certified electricians
- A centrally provided power provides an easy way to add UPS functionality
- Improved security, no risk for power interruptions due to “borrowed” power outlets
- Lower system costs since new power outlets do not need to be installed

A PoE system contains of two basic components:

- Power Supply Equipment (PSE). This is a unit, which inject power into the network cable. There are two types of PSE available:
    - Midspan. This is a standalone injector which just adds power to a network cable. It is used when adding PoE functionality to an existing network. Normally available in 1, 6, 12 or 24-port versions.
    - Endspan. This refers to network switches that have built-in PoE functionality in addition to its switching functionality.

- Powered Device (PD). This is the device being powered via the network. It can either have built-in functionality for PoE, such as the AXIS 221 network camera, or use an external splitter such as the Power over LAN Active Splitter offered by Axis. The external splitter is a small unit that splits network and power into two separate functions/cables, and is used to provide PoE functionality to products without built-in support for PoE.

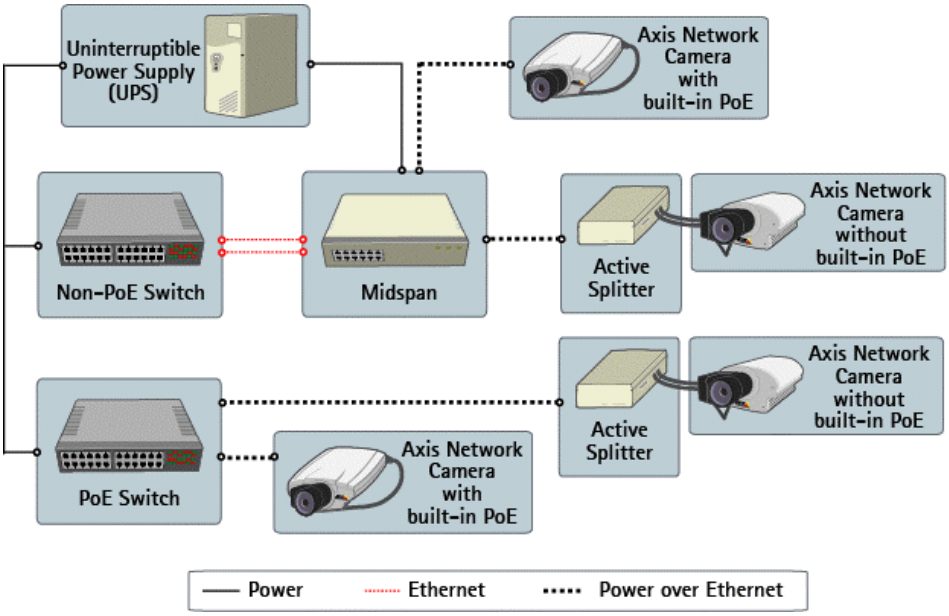


*Figure 1. Example of a PoE-based system*

# 2 How does it work

## 2.1 Basic description

All networked products have two things in common; they require a network connection and a power supply. Networking is normally achieved by providing network sockets at the location of the networked product connecting to the facilities network infrastructure. The power supply normally means using the nearest power socket without considering what other devices are connected to this group or knowing where the fuse for this group is located. If controlled power is needed, e.g using UPS, it normally means providing separate power cabling from one or two locations within the facility.

Using PoE combines these two functions into one cable, the network cable.

## 2.2 The standard

The functionality of PoE is defined in the IEEE 802.3af standard, and it describes the power requirements as well as detecting and removing devices.

The standard covers two different means to carry the power. The first one is built around using the spare wires (4,5,7 & 8) in a Cat 5 or 5e cable, while the other one uses the data wires (1,2,3 & 6) and so called Phantom feeding which means that power and data will share the same physical wires. The benefit of using Phantom feeding is that functionally is present when power is and the other way around, so a bad connection or damaged network wire will not cause the product to be powered up without being correctly networked which may be the case when different wires are used. The standard defines that all PDs must comply with both methods of providing power.

The standard provides 48VDC and a maximum of 15.4W per port. Due to expected cable losses, a PD may require no more than 12.95W

The operating distance for a PoE connection is the same as for a normal network connection using Cat 5 or 5e cabling, i.e. up to 100m (328 ft).

To improve the performance of a PSE, the unit will classify connected devices based on its power requirement. Classifying a PD is optional, if the device does not support this, it will automatically be classified as Class 0.

## 2.3 Connecting a device

Connecting a 48V supply to network devices such as laptops would probably do permanent damage to the unit, so a PSE does not apply power to a port until the connected device has been detected and verified as a PoE enabled device. This is all done automatically upon connecting a cable to the port.

The PSE does this using a technology called Resistive Power Discovery, which means that the unit sends out two different short low voltage discovery signals (between 2.7V and 10.1V), with at least 2 ms in-between, to the PD.

Once this detection is done, and the device is verified as PoE enabled, the unit will try to verify the classification of the PD. A PoE device is classified in one of 4 different classes, depending on the power consumption of the unit. This helps the PSE to optimize its performance.

| Class | Power Requirement | Comment |
|---|---|---|
| 0 | 0.44 – 12.95W | Default class |
| 1 | 0.44 – 3.84W | Optional |
| 2 | 3.84 – 6.49W | Optional |
| 3 | 6.49 – 12.95W | Optional |
| 4 | For future use | For future use |

*Table 1. Available PoE classifications*

Once the device has been verified and classified, the unit will provide full power to the port.

It is worth noting that most multi-port PSEs are not capable of providing full power to all ports simultaneously. It has a certain "power budget" that it will distribute to the ports, depending on the need of the PD's. If the power required by all connected PDs exceeds what the unit can provide, the unit will start to disconnect devices one by one, until power requirements are below the unit's maximum capacity.

## 2.4 Disconnecting a device

Just as with the connection of a device to a PSE, the removal of the device is a controlled action. The PSE will constantly monitor the device and if it is removed, the unit will disconnect the power within 300-400ms. This is done to avoid new items, installed right after the removal of a device, from being damaged.

# 3 Installing IP-surveillance using PoE

As image quality and frame rate from network cameras and video servers have now surpassed the performance of analog cameras, and high speed networks are commonly available at reasonable cost, IP-surveillance systems based on streaming digital video over Ethernet are now replacing the functionality of analog systems. And with the capability to power up devices using the same network cable, there are additional benefits and the installation is more cost efficient.

Today, IP Surveillance systems are being installed in many different environments, some of the more common once are:

- Education
- Retail
- Transportation (such as airports terminals)
- Government (such as prisons)
- Banking and Finance

There are differences in the requirements for the Surveillance system from each type of environment. A train station installation is very different from a warehouse installation, and this has little in common with a prison installation. Fortunately, most network device installations share a similar infrastructure design.

Ethernet cables run from the network switch, through a patch panel, out of the communication room and terminate in network sockets located throughout the facility. Devices such as a network camera, IP telephones, print servers and computers are then connected to these sockets using a short connection cable (See Figure 2). Adding PoE enables all PoE-ready devices such as network cameras, to be powered through the same cabling infrastructure, providing the most cost effective and secure solution.

If the switch is already installed, the simplest means to add PoE is by adding a dedicated midspan. In new installations, the most convenient and cost effective solution would be to add a switch with built-in PoE functionality, a so-called endspan or PoE-enabled network switcher, which are available from manufacturers such as Cisco, 3Com, HP and Netgear. Smaller SoHo oriented switches with PoE functionality have become more freely available.

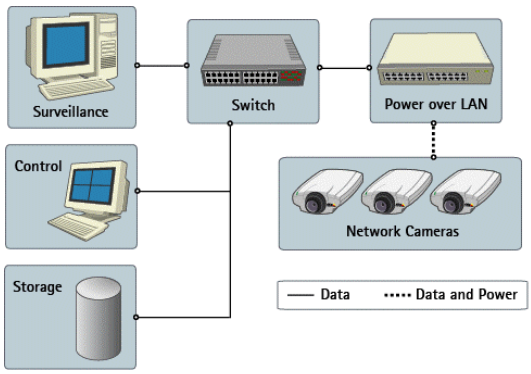


*Figure 2: Network Video system Architecture Using Power over Ethernet*

## 3.1 Added values using Power over Ethernet

Some of the key benefits for PoE within the Security market are:

**Easy to change camera position**
Altering a camera position no longer requires installation of a new power outlet. It is possible to easily experiment with different camera positions to achieve ultimate coverage results.

**UPS backup for the security network**
By using UPS backup for the PSE/network switch in the server room, the entire camera network can continue operation during a power outage.

**Add secure intrusion functionality**
If the network cameras alarm input is connected to an alarm device such as a door sensor or intrusion detector, the fact that the camera is powered from a central location, most likely with a UPS back-up, provides the user with not only video, but also intrusion detection and other alarm functions over the same monitored and centrally powered network.

## 3.2 Limitations with PoE

PoE presents many benefits, but comes with some limitations that are important to be aware or.

*Outdoor installations*
When installing cameras in outdoor environment, the camera must normally be protected against the environment by having a protective housing. This housing is normally equipped with either a heater to remove condensation from the front glass of the housing or a fan to circulate air inside the housing to avoid overheating. And both these devices require power, which cannot be provided by the PSE. But PoE may power the camera itself, as long as the additional heater/fan is powered locally. The benefit of this is that the camera is powered from a controlled central location, and may be monitored. The camera would not be affected by a local power failure.

*PTZ-cameras*
A dome camera or one with Pan-Tilt-Zoom functionality will require additional power for the motors and the power specification for most cameras with PTZ-functionality is above what can be provided by PoE. There are non-standard PoE-systems, capable of providing higher power, but these are manufacturer specific. Work is ongoing to provide a new standard for up to 30W, but this is not yet finalized.

*Wireless cameras*
Due to the nature of these cameras, they have to be powered locally. But there are several access points on the market with embedded PD functionality. This makes it easier to install the access point where one can receive the best signal coverage, without having to consider availability of power. So PoE also has benefits for wireless network cameras.

*Use of additional add-on products*
Some network cameras have the ability to power third party devices with limited power through separate connectors on the camera. This functionality is only available if the cameras is powered using the supplied power supply, and not when being powered using PoE. In some cases, the camera may consume more power that its actual classification allows, which may cause the midspan/endspan to turn of the port due to “power overload”.

*Limited length*
Just as with a normal network cable, the maximum distance from the switch/midspan to the device is 100m (328 feet). Systems may operate over longer distances, but functionality and performance cannot be guaranteed.

## 3.3 Design considerations

Using PoE is straightforward. Normal network design considerations also apply to IP-surveillance systems, but there is also the need for network sockets at "odd" locations, such as in the ceiling and other areas not normally networked. In most cases, the natural location for a camera would be fairly high up in a corner, either on the wall or directly in the ceiling, as this normally provides the best images over the scene to be monitored and, at the same time, also reduces the ability to cover the camera, realign it to face the ceiling or even steal it. Also network cables and network sockets should preferably be concealed or located out-of-reach to avoid disconnection/manipulation.

**Spare capacity**
When designing a PoE-based IP-surveillance system one should, as with all systems, design it so that a spare capacity of at least 15-20% is available for expansion. Populating all ports on a PSE from the start, would limit the ability to quickly add a camera, or to swap ports when troubleshooting. Leaving at least one or 2 ports unpopulated on PSEs would provide the required flexibility.

As most PSEs cannot provide full power on all ports simultaneously, it is also important to ensure that the maximum power capacity of the PSE is not exceeded.

**Don't take short-cuts**
It may be tempting to use some AC outlets that are available, to save some equipment costs, but this has the following implications:

- The "vacuum cleaner" effect – cleaning personnel unplugging cameras, to use an existing AC outlet, as they are easy to find, creating coverage breaks in the security.
- "Where's the fuse?" – locating the correct fuse to a power outlet in a larger building may take some time, and using the normal power supply is always a risk, as one can never know what other devices may be connected, such as powerful work tools etc.
- Maintaining UPS capability. This creates a back up capability of the entire IP-surveillance system by backing up the PoE midspan or endspan.

**Install in a secure environment**
Install all midspans and endspans in locked and secure communications rooms. To minimize tampering with the units, they should preferably be rack mounted.

**Use colour cabling**
Use a consistent colour coding for powered camera cabling, especially within patch panels, to indicate that these cables are not to be touched, being part of the security system and including power.

# 4 Glossary

The following words are normally used in conjunction with PoE

**802.3af** Definition of the standard for Power over Ethernet – IEEE 802.3af

**PoE** Power over Ethernet

**PoL** Power over LAN, commonly used name for non IEEE 802.3af compatible Power over Local Area Networks.

**PSE** Power Sourcing Equipment. Equipment providing power to devices. May be a dedicated standalone power injector or integrated into a network switch.

**PD** Powered Device. Equipment being powered via the network, such as network cameras, IP telephones and wireless access points.

**Endspan** Another name for a switch with integrated PSE functionality.

**Midspan** Separate PSE device, supplying power in networks with existing switchers.

**UPS** Uninterruptible Power Supply. A unit providing backup power supply for equipment when there is a power failure. By using built-in batteries, the unit will provide power to mission critical devices for a “limited” time.

# 5 Conclusion

This white paper has explained the value of and the technology behind PoE. Whether you decide to install a new network using PoE-ready switches, or you prefer to continue using an existing infrastructure adding PoE functionality in the form of midspans, you will still make an investment in well established and standardized technology available from all leading manufactures of network products. This will provide you with a good foundation for your security system.

PoE for the security market provides security managers the simplest, safest and most cost-effective solution for networking and powering network cameras in a secure and controlled way. The advanced features of PoE also vastly simplify the on-going maintenance of the security network, enabling reliable, continuous operation with minimum downtime.

# 6 About Axis

Axis increases the value of network solutions. The company is an innovative market leader in network video and print servers. Axis products and solutions are focused on applications such as security surveillance, remote monitoring and document management. The products are based on in-house developed chip technology, which is also sold to third parties.

Axis was founded in 1984 and is listed on the O-list (Attract-40) of Stockholmsbörsen (XSSE:AXIS). Axis operates globally with offices in 16 countries and in cooperation with distributors, system integrators and OEM partners in 70 countries. Markets outside Sweden account for more than 95 % of sales.

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