White Paper

Power over Ethernet in IP Based Security Applications

Convergence of Video, Data and Power

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Revision 003
Last modified – February 16th, 2005

What is Power over Ethernet?

Power over Ethernet (PoE) is a revolutionary technology that integrates data, voice and power over standard LAN infrastructure. It is the means to supply reliable, uninterrupted power to Internet Protocol (IP) telephones, wireless LAN access points, network cameras and other Ethernet devices, using existing, commonly used Category 3 (4 pairs) and Category 5 cable infrastructure.

Power over Ethernet technology saves time and cost of installing separate power cabling, AC outlets and wall warts, as well as eliminates the need for a dedicated UPS for individual devices.
The power delivered over the Ethernet infrastructure is automatically activated when a compatible terminal is identified, and blocked to legacy devices that are not compatible. This feature allows users to freely and safely mix legacy and PoE-compatible devices, on their network.

The PoE technology is to be designed in a way that does not degrade the network data communication performance or decrease the network reach.

There are two main implementations of Power over Ethernet:

The Endspan – PoE enabled Ethernet switch. Power is supplied directly from the data ports.

The Midspan – A patch-panel like device, residing between an ordinary Ethernet switch and the terminals, often referred to as a "Midspan". Power is added on the spare wires, with data uninterrupted.

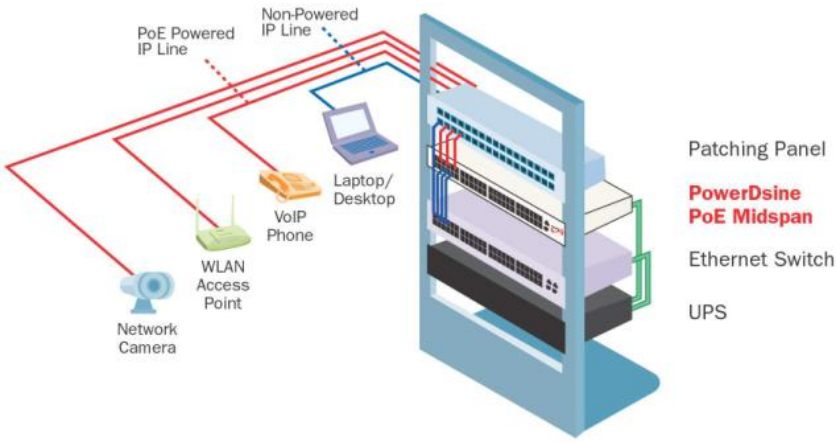

Figure 1: Architecture of Power over Ethernet Midspan in the Enterprise

The Revolution of Ethernet Based Security Systems

A closed circuit television system (CCTV) is a television system which operates on a closed loop basis, unlike the Television at home which is a public system available to anyone with a suitable receiver. CCTV images are only available to those connected to the closed loop.

The main function of the CCTV system is to allow surveillance and remote viewing, typically from several cameras, back to one location within the same building. Usually, it is part of an overall integrated package operated by security personnel that includes access control, alarms, intrusion detection and communications.

The typical surveillance system comprises four components: camera, video network, recorder, and monitor. Over the last 15 years, one by one, these four components have been digitized.

- **Digitization of the Camera**. Around 1990, digital cameras replaced analog tube cameras. These CCD cameras were *partly* digital, and still used analog connections of coax cable. Recording was still done to analog VCR tapes.

- **Digitization of the Recording.** Around 1996, the DVR's recording function become digital. No more changing tapes, recording quality was consistent and recorded event searches became much more efficient. The DVR was an analog-digital hybrid. It still had analog coax inputs and an analog output for the monitor.

- **Digitization of the Monitor**. The monitoring station was digitize through employing a PC. In the last few years, DVRs come equipped with a network or modem interface so that the recorded images can be monitored remotely, via monitoring software, using a standard PC.

- **Digitization of the Video Network** To complete the CCTV digitization, the link from the camera to the DVR was digitized using IP Network cameras and video servers. Digital imaging, combined with networking, enables a whole new range of system-level functionality and cost efficiency.

Security systems are only useful if they can communicate and control the environment they secure. The video streaming from the CCTV system is meant to be watched and/or recorded, otherwise it is useless. Access control devices enable access to authorized personnel, while restricting others and must have a central personnel database. As such, the use of the readily available and cost effective Ethernet infrastructure was imminent.

Once end devices, such as a network camera or an access control terminal are up and connected to the Ethernet infrastructure, they still require power to run. It is here that Power over Ethernet has a role. Power over Ethernet technology enables Ethernet devices to be powered over the network-cabling infrastructure, thus avoiding the need for separate power and data cable infrastructure and costly AC outlets near cameras. This eliminates the need for licensed electricians from the installation team thereby cutting costs to the overall installation.

Network cameras are traditionally installed in open high places, such as corridor ceilings, airport or lecture halls, etc. The adding of power infrastructure was a costly and long affair, requiring dedicated electrician teams for pulling of power cables and conduits. These changes also needed to be recorded in building plans for safety approvals.

Once operating, each device was connected to a specific electrical branch, which if down, meant an appearance of unacceptable "holes" in the security coverage. By allowing the Network cameras to be installed where they are most effective and not where the AC sockets are, the actual number of cameras may also be reduced, further reducing the surveillance implementation costs.

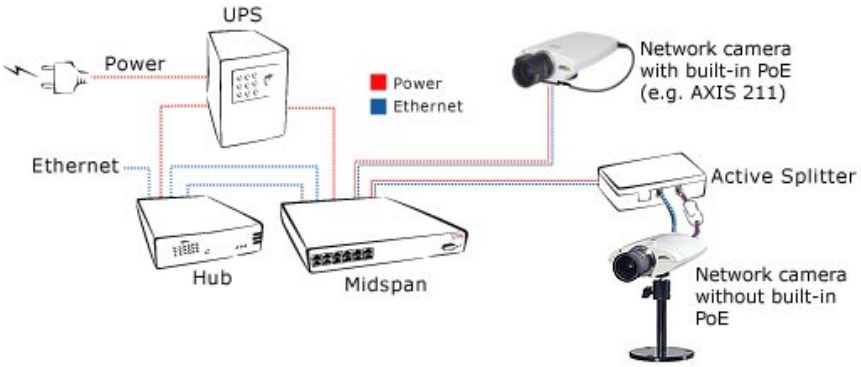

Figure 2: Architecture of Power over Ethernet in the Enterprise

There are additional key benefits for Power over Ethernet in the Security market:

- Simple Means for Resetting IP Cameras. IP Cameras, as complex devices, may need to be reset from time to time. A "dark" camera, once discovered to require a reset, forces the IT manager to locate the network camera, reach it, and then reset it. By using Power over Ethernet, resetting becomes a trivial matter, enabling reset via the camera's respective PoE port (instead of climbing up high ceiling installations).
- Easy Changes to Camera Positions as Needed. Altering a camera position, no longer requires a new AC installation. It is even possible to experiment the camera position to achieve ultimate coverage results.
- UPS Backup for the Security Network. By backing up of the Power over Ethernet Midspan in the communication room, the entire camera network can continue operation during a power outage. This is a real must for a high-end surveillance system. With PoE, the security system can be backed up with one single network.
- Assured Safety With Advanced Line Terminal Detection. Line detection is the technology, which enables safe installation without worrying about high voltage damages to laptops, desktops and other non-power ready devices, due to a misplaced connection.
  A faulty camera or an access control terminal can be detected and shut down preventing damage to expensive switches and patch panels in the Ethernet network. The line detection is one of the reasons the Power over LAN midspan is much more than an intelligent power source.

Installing a Network Video System using Power over Ethernet

Network Video systems are being installed today in many different environments.
Most common among these:

- Transport terminals, Airports
- Large retail stores, Shopping malls, Casinos
- Law enforcement surveillance in public events
- Government and Security facilities CCTV
- Universities, Schools remote monitoring

There are differences in the requirements from the Surveillance system for each type of environment. For example, a Train Station installation, with a high camera count and the need for minimum maintenance, is very different from a warehouse installation, with difficult accessibility and the need for durability. This

paper focuses on the approach to optimize the IP Video network with Power over Ethernet. Fortunately, most Network devices installations, in most environments, share a very similar infrastructure design.

The Ethernet lines run from the network switch, sometimes through a patch panel, out of the communication room and connect to the digital cameras and analog to digital video gateways (See Figure 3). Adding Power over Ethernet enables the cameras to be powered through the same cabling infrastructure, providing the most cost effective solution.

When the switch is already installed, the simplest means to add Power over Ethernet is by adding a dedicated Power over Ethernet midspan.

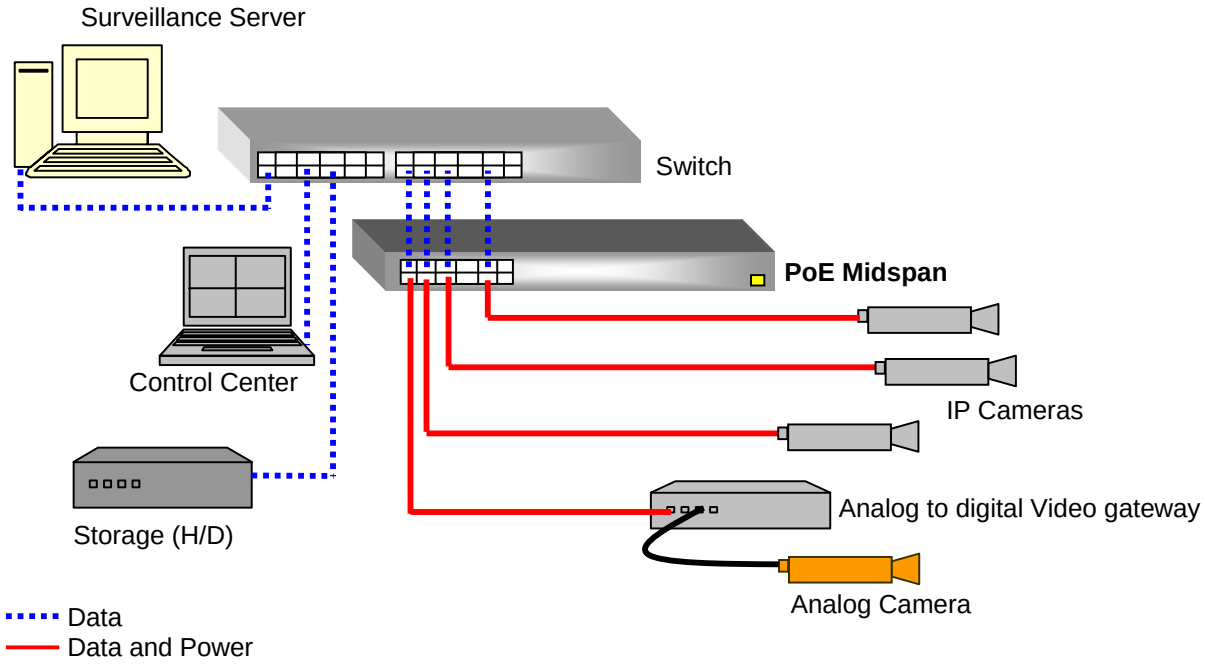

Figure 3: Installing Network Video system using Power over Ethernet Midspan

Installing a LAN Based Access Control Network Using Power over Ethernet

Access Control systems are being installed today in many different environments. Most common among these are:

- Transport terminals, Airports
- The Business Enterprise
- Government and Security facilities
- Universities, Schools

There are differences in the requirements from the Access Control system for each type of environment. For example, an airport installation, with the need for high security while maintaining a high rate of approved personnel changes, is very different from an enterprise installation, with the need for work hours recording. Usually, an installation of Access control devices has a similar design. The Ethernet lines run from the network switch, sometimes through a patch panel, out of the communications room and connect to the various Access Control terminals (See Figure 4). Adding Power over Ethernet enables the Access Control terminals to be powered through the same cabling infrastructure, providing the most cost effective solution.

When the switch is already installed, the simplest means to add Power over Ethernet is by adding a dedicated Power over Ethernet midspan.

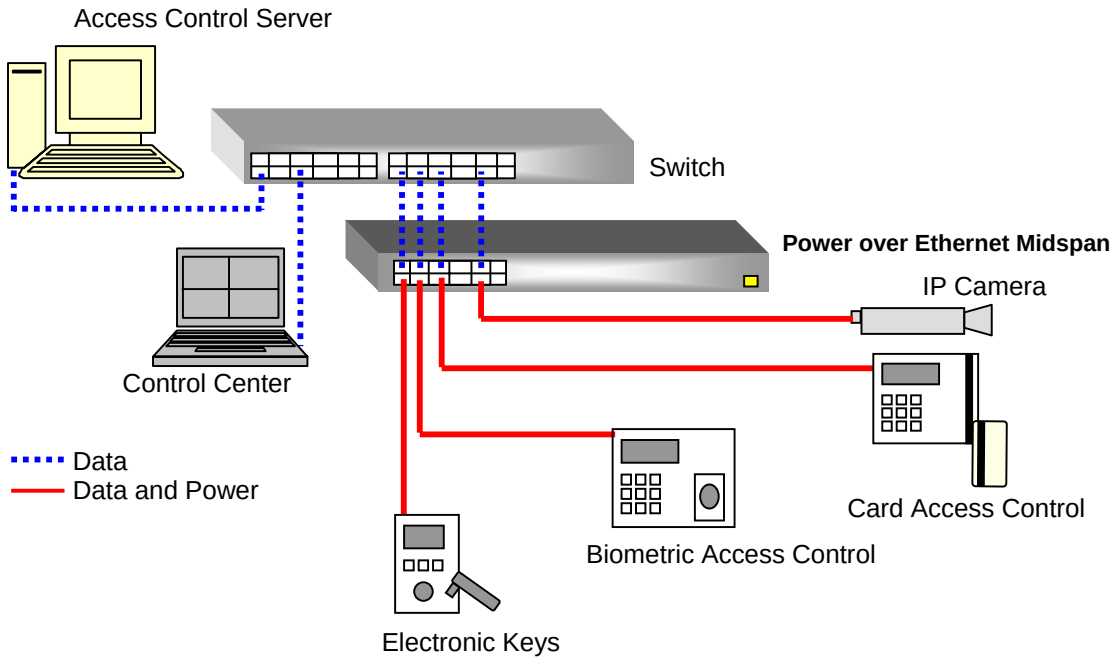

Figure 4: LAN Based Access Control Architecture Using Power over Ethernet

How to Select the Appropriate Power over Ethernet Midspan

Once installed, the cameras' Ethernet cabling is pulled to the communications rooms, where the switches (and Power over LAN midspans) are installed.
The port density of cameras that reach a specific communications room depends on the following parameters:

- Ethernet cable maximum length, which is 100 m (330 ft)
- Number of cameras needed, per size of the site.
- The geographic stretch of the facility.

Typically surveillance systems converge to:

1. A high-density site – **9 to 16 cameras** and more terminals pulled to the Communications room.
2. Smaller or spread installations – **3 to 4** cameras pulled to the Communications room.
3. Remote sites and single camera installations – **1 to 2** cameras pulled to the Communications room.

PowerDsine® Power over LAN midspans, fitting the digital networking market, offer 1,6 12 and 24 port units. These units fit exactly the above port densities needs.
In order to optimize the distribution of Power over LAN midspans, the following guidelines should be followed:

1. Concentrating Camera or Access Control Terminals to Optimize the Installation

Rather than attempting to install the shortest cabling, try to pull Network Camera cabling to a single communications room rather than distributing a small number of camera ports in every communications room. This will enable a selection of a Power over LAN midspan with a higher port density and save rack space and installation costs.

See the example, presented in Figure 4.

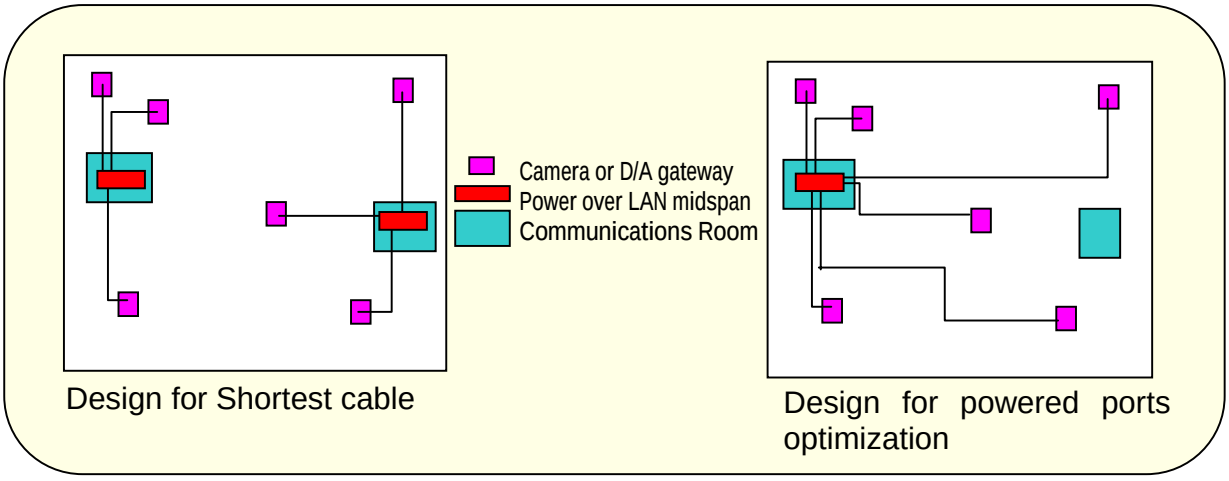

Figure 5: Concentrating of Camera Powered Ports to Optimize the Installation

2. Selecting the Appropriate Power over LAN midspans

Once the number of Cameras, or Access Control terminals, per communications room has been estimated, the following table is applied in order to select the appropriate Power over LAN products:

Camera Port Density	Power over LAN midspan to use	Recommendations
1-2	1-port	
3-4	6-port	Save 2 ports for expansion
9	12-port	Save 2 ports for expansion
16	24/48-Port and additional units following the same guidelines.	

3. Room for Expansion

In a similar fashion to Ethernet ports, 1 to 2 spare ports should be available for future growth, in case the Surveillance network requires an additional camera to cover a new spot.

Power over Ethernet Installation Tips

The following are some tips, based upon PowerDsine multi-site experience:

- **Power all possible cameras using Power over Etherent.** It may be tempting to use some AC outlets that are available, apparently to save some installation costs. This has the following implications:
  - Power over Ethernet midspans provide a simple convenient means to reset cameras, which are hidden or hard to reach.
  - 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.
  - Maintaining UPS capability. This creates a back up capability of the entire digital camera network (by backing up the Power over Ethernet midspan).
- **Install all midspans in communications rooms.** To minimize tampering with the units and enable central management. 6-port, 12-port and 24-port units should preferably be rack mounted. 1-port midspans can be placed on top of equipment, or wall mounted.
- **Use color-coding** for powered camera cabling, to indicate that these cables are not to be touched by maintenance personnel.
- **Use the per-port LED indications** on the Power over Ethernet midspans, to verify the state of the powered devices:
  - Green (Power Active) LED indicates that power is being provided. This is a good way to know that a camera is connected correctly.
  - Orange (Power not Active) LED indicates that a non-powered device is connected to this port or that the camera may be malfunctioning (or tampered with). This may also indicate that an installation error has occurred. The uniqueness of the PowerDsine Power over Ethernet midspan is that this is a completely safe state, though it is recommended to check the cause.

Installing Devices Using the Active Splitter

There are end terminals, such as cameras or Video servers, which operate on 12V and require the use of an “active splitter”. This is a small device that accepts 48V Power over Ethernet and converts the power into 12V. It also splits the power and data into two cables, an Ethernet data cable and a power cord.
The Active splitter is installed near the camera or video server, but its 1m long cables enable the box to be wall mounted or hidden in a Dome or above a decorating ceiling.
The following diagram describes a typical installation.

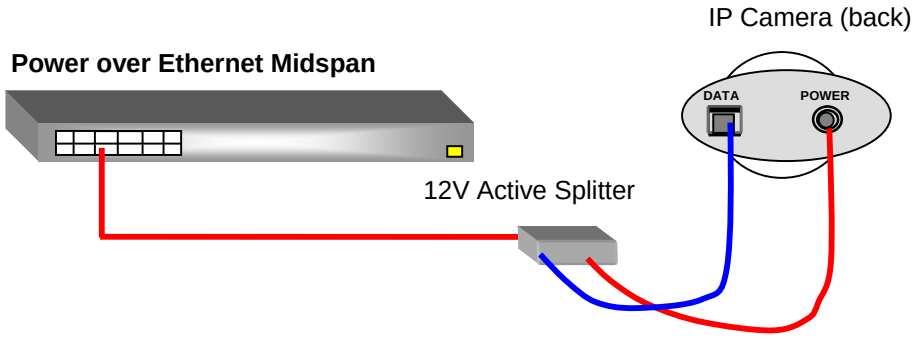

Figure 6: Detailed PoE installation of Non-PoE IP Camera

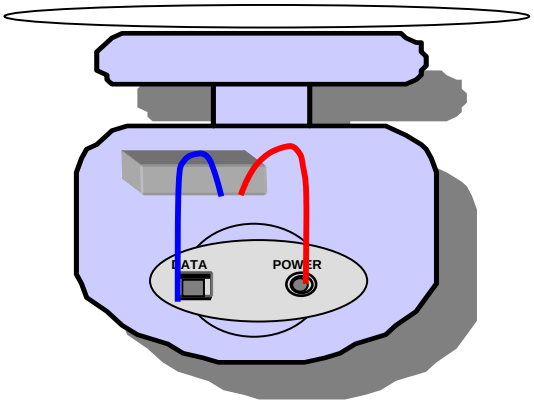

Figure 7: Using the PoE Active Splitter in a Dome

PowerDsine Power over Ethernet Midspan Family

PowerDsine family of Power over Ethernet midspan devices, with millions of ports already deployed in the market, provide the most field-proven reliable solution.

PowerDsine provides a full line of Power over Ethernet midspan devices, from 1 to 48-port devices intended mainly for Voice over IP applications, wireless LAN access points and network cameras.

PowerDsine Power over Ethernet midspans which best suit Network cameras installations are the 1, 6 and 12-port midspan units, however, when installed with IP Phones and other PoE network terminals, higher density PoE Midspans (24 port or 48 port) may be required.

PowerDsine 6006/6012/6024 Power over Ethernet Midspan

- 6, 12, 24 port products
- Compact 1U, 19" rack mounted
- Metal casing
- Remote Management - option
- IEEE 802.3af compliant
- Support standard and pre-standard end terminals, including Cisco pre-standard terminals
- DC input – option
- Maximum power available: 200W, therefore, the 6/12-port Midspans offer full power for all ports
- Highly advanced power management for the 24-port midspan

PowerDsine 3006/3012 Power over Ethernet Midspan

- 6, 12 port products
- Compact design, half 19" size (rack mounting is an option using special mounting brackets)
- IEEE 802.3af compliant
- Support standard and pre-standard end terminals, including Cisco pre-standard terminals
- Cost effective PoE Midspan products
- Total available power: 100W, therefore, the 3006 offer full power per port.

PowerDsine 3001 1-Port Power over Ethernet Midspan

- 1-port Power over Ethernet Midspan
- Full 802.3af compliance
- Support standard and pre-standard end terminals, including Cisco pre-standard terminals
- Safe Detection algorithm
- 2 LED Status indications
- Wall mountable or free standing
- Interconnect construction for scalability

PowerDsine PD-AS-401/12 12V Active Splitter

- 12V Active Splitter
- Provides 12V, 1A max
- Splits power and data
- 1m long pigtails
- Power connector fits popular cameras

PowerDsine 6548 Power over Ethernet Midspan

New

- 48 port Midspan
- Uniquely Compact 1U, 19" rack mounted
- Metal casing
- Remote Management - option
- IEEE 802.3af compliant
- Support standard and pre-standard end terminals, including Cisco pre-standard terminals
- DC input – option
- Maximum power available: 400W
- Highly advanced power management

PowerDsine 8006/8012 High Power over Ethernet Midspan

New

- 6/12 port High Power Midspan
- Power per port: 39W (Double the standard 802.3af power)
- Support 802.3af as well as pre standard and Cisco terminals
- Compact 1U, 19" rack mounted
- Metal casing
- Remote Management - option
- Maximum power available: 200W
- Highly advanced power management

Remote Management of Power over Ethernet midspans

A unique option of PowerDsine's Power over Ethernet midspans is the remote management. PowerDsine's management offers both web management as well as SNMP MIB based. This feature allows for remote control of the Power over Ethernet midspan technology and the gathering of essential telemetry, collected by the units. The remote management enables central control of multi building installations enabling an immediate alert and response to a change in the well being of the essential security system in the field. This cannot be done with other traditional power supplies and transformers that are utilized in the security market. Here are few of the remote management features:

- **On/Off control for resetting units.** The on/off control enables IT managers to remotely reset a "dark" or non-responding camera, which would not respond otherwise. This important feature prevents the need to go to far-away communications rooms in a spread installation.
- **Security power-off shut down of the network.** Some times it may be necessary to quickly halt an entire access control network in the facility. A single command will stop all power remotely to the network, locking all entrances.

- **Telemetry of cameras state.** A maintenance and security dream: the remote management feature will alert to a change in the status of the camera, fall in power consumption, disappearance, etc. to identify discontinuities in the Security network coverage.
- **Telemetry of power consumption.** Collects power consumption information, to decide the appropriate UPS for your network, saving cost of needless UPS power. Get information on real status of power consumption.

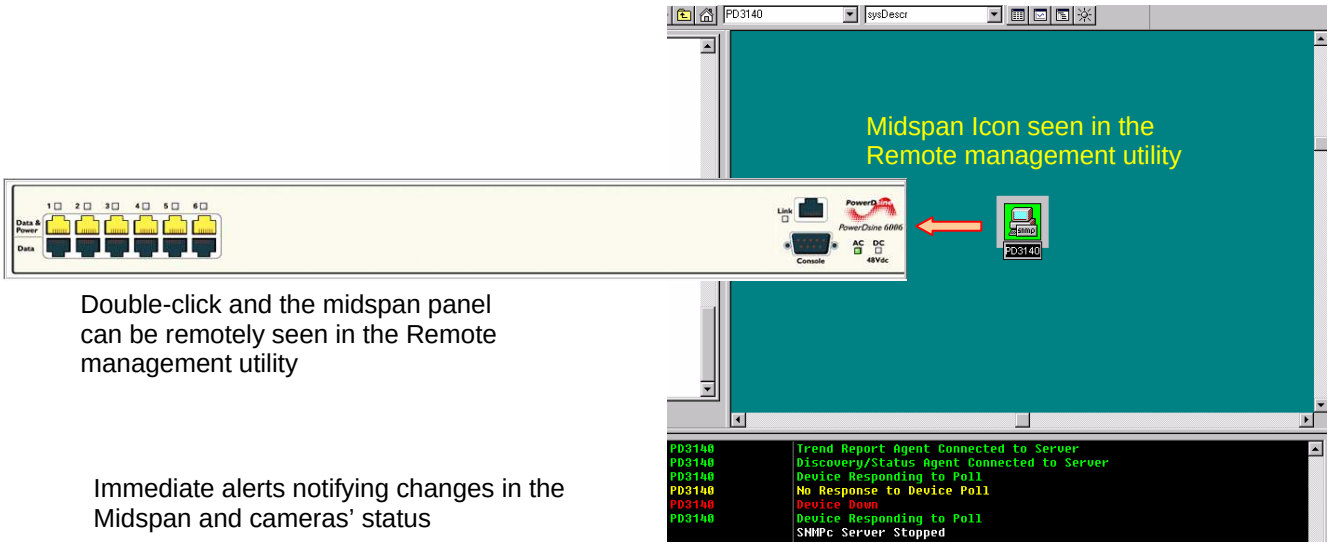

Figure 8: SNMP Management Screen

Comparison on Power over Ethernet vs. other Security Powering Solutions

		
Specification	PoE Midspans	Other Security Power Solutions
Cost for Install Cost for 4 ports	$59 to 99 per port installed, (depending on the need for a splitter at $49) $236 to $396 for 4 ports	$20/ Port xtra Cable = $20 xtra Labor = $75 avg per port Total = $125/port for a 4 port system $500
Ease of Installation	Plug and Play, splitter may be required at Camera end	Extra wiring is needed
Scalability	Scalability is possible, use what you need	In a rack system 8, 16 and 32 channels available
Features	PoE Detection Auto resets on shorts	No Detection, Auto resetting using PTC
Standards	802.3af compliant, Tested at UNH, independent Labs	Non PoE, separate Cables needed to run power
Compatibility	PoE circuit is tested with over 160 PoE Powered Devices	No formal certification program
Performance in Data Networks	Tested to ensure no data loss when connected to 100m CAT5 UTP cable	No formal testing
Network Management	Available with SNMP Models Allows Resetting, Remote service features allows for increased revenue in service contracts	None, service contracts will require sending a technician for routine resets.

Conclusion

This paper serves as a guide for the optimization of a LAN based security network with Power over Ethernet. Using the information provided here will assure the installer, user, or IT manager an easier mean to set-up and maintain a LAN based security network. Installation becomes simpler, more reliable and outright cheaper.

PowerDsine Power over Ethernet Midspans family for the security market provides security and IT managers the simplest, safest, most cost-effective solution for installing the network. The advanced features of the Power over Ethernet midspans also vastly simplify the on-going maintenance of the security network, enabling reliable, continuous operation with minimum downtime. The paper discussed the means to maximize the Power over Ethernet midspans benefits.

The remote management capabilities enable remote control of the Power over Ethernet midspan products and the gathering of essential telemetry, collected by the units. Central control of a multi-building installation for an immediate alert and response to a change in the status of a camera, or other powered devices.

The advanced detection mechanism, as well as the full IEEE 802.3af compliance today, guarantees the PowerDsine Midspan interoperability with many powered devices.

For more information on the PowerDsine Power over Ethernet Midspan products and our additional 802.3af compliant products, as well as the IEEE 802.3af standard for DTE Power via MDI: www.powerdsine.com

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