

Power over Ethernet (PoE)

Advantages of PoE in Industrial Networking Applications

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June 2, 2014

White Paper

June 2014

The Ins and Outs of PoE

Today, Power over Ethernet (PoE) has become a hot term that is frequently referenced but not completely understood. There are a lot of different acronyms and subtle differences used in the PoE arena that can quickly confuse and frustrate even advanced users. Let's go over some of the more common differences such as multiple standards, varying power outputs and standard Ethernet restrictions as well as some more advanced management features available with respect to PoE. Despite all of the naming rules and subtle confusion, PoE has been widely adopted due to the challenges it has overcome and simplicity it has provided. PoE in its basic function is quite simple, plug in an Ethernet cord and it can receive both communication as well as power to the PoE capable device.

Power over Ethernet

A new technology, now referred to as PoE, was first developed in the year 2000 by Cisco to reduce noise issues in the emerging VoIP phone system. Power over Ethernet quickly took off; by the year 2003 the first PoE standardization was developed to create uniformity amongst all of the PoE device manufacturers. PoE is beneficial over standard Ethernet network communication because of the reduction in both the equipment needed and wired connections to the devices. Why run both an Ethernet wire and a power cord to a unit when one Ethernet wire can work?



PSE Switch

PoE Naming Rule

To start off, PoE is used as an all-encompassing term for all devices within the PoE market. When in actuality PoE can be split into two broad categories. The main unit is the Power Sourcing Equipment (PSE), This is the device that injects the power into and along the Ethernet cord. The PSE is typically a switch or power injector. The other units are end devices and are classified as the Powered Device (PD); these are the units that require power through the Ethernet cable to turn on. A good example would be an IP camera, VoIP phone or outdoor industrial wireless access point.



PD Camera

Standardization

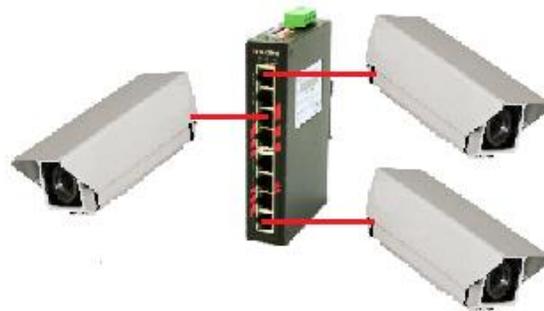
When looking to get either a PSE or a PD there are a couple important pieces of information to consider. First, there are two different standards of how the power is sent along the Ethernet wire. PoE mode A, which seems to include the majority of PoE devices, uses pins 1, 2, 3 and 6 to send power along the

White Paper

Ethernet cable. Whereas, mode B devices will use pins 4, 5, 7 and 8 for power transmission. Second, how much power is required? PoE PSE sourcing units have multiple different power output levels; mainly standard power and high power or what is referred to as PoE+ are used. The Institute of Electrical and Electronics Engineers (IEEE) has two different official categories for the different power outputs of a PSE device. The IEEE 802.3af standard states that devices will not output more than 15.4 Watts of power out of each port. The PoE+ or IEEE 802.3at standard allows each port to provide an output power of up to 30 Watts per port. Typically, if a manufacturer's PoE PSE switch supports IEEE 802.3at high power devices capable of up to 30 watts of power, the switch will also do power auto negotiation. This means that the high power PSE will detect how much power is required by the PD to operate and not provide excess power to a device that only requires 15 Watts or less.

Applications

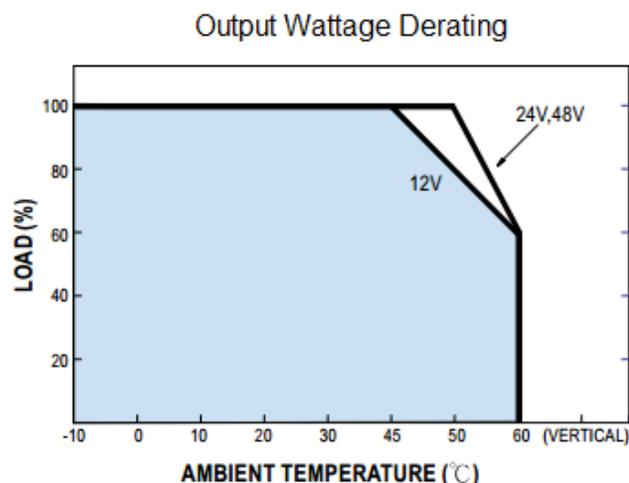
A great benefit and use of PoE units is when a power source is not available at the end location, such as the side or top of a building for a security camera or Wi-Fi access point. Another benefit of implementing PoE is when installing multiple devices at a location, such as surveillance cameras, a PoE switch and all of the cameras can all use a single power supply. This can reduce the installation cost because there will be a reduction in the amount of equipment as well as a reduction in the amount of power cables needed to be installed.



Although, the user will need to keep in mind the power budget for the power supply that will be used. For example, if connecting three IEEE 802.3af cameras (15 Watts per camera) to a PSE switch, the output wattage of the power supply will need to be able to supply 45 Watts of power for the cameras plus the additional wattage required to power the switch.

Environment

There is a wide variety of products to choose from when preparing for a project. An additional consideration needs to be made regarding the temperature of the environment the application will be used. In extreme environment conditions, industrial grade equipment is essential and extended temperature range equipment can prove beneficial. This is especially true when selecting PSE switches or a power supply. Proper selection



White Paper

of industrial grade equipment is particularly important when using PSE units for PoE applications. A PSE unit will receive additional thermal activity over non PSE devices, because it will be generating additional heat through the power it is generating and providing to the PDs that are connected to it. Additionally, power supplies have an optimal operating temperature range. In hot environments the power supply will be affected by an operational output derating curve, where the total output wattage of the unit will be reduced by a percentage depending on the ambient temperature of the environment. The ambient temperature can have a significant effect on the power budget that is being calculated for a specific application. An example of an output derating curve is displayed above showing that at the extreme end the total power supplied by a power supply can be reduced by as much as 60% depending on the environment. Due to the drop off in available power in hot environments, a higher wattage unit might be required to provide adequate power.

Management

Managed switches are capable of providing users with a multitude of advanced features that can improve the management capabilities, performance, security and resilience of a network. The capabilities that a managed switch provides have been proven time and time again why the managed switch is the workhorse of the network. All the standard features a managed switch can provide end users with to enhance network performance are still relevant when using and implementing PoE devices. In fact, PoE switches with management capabilities provide even more function features that can be critical in providing optimum network performance.

IGMP

Management features such as Internet Group Management Protocol (IGMP) are very efficient in handling multicast traffic, such as PoE security camera monitoring, within a network. A typical unmanaged switch tries to send the camera data to all of the devices connected to it, creating unneeded broadcast traffic. Whereas a managed switch capable of IGMP with snooping is able to build a Group Destination Address (GDA) table. The GDA table determines the most effective pathways to all of the devices on the network and thus will only send the data to the units that require the data. The improved flow of data to only devices that require the information reduces the amount of network traffic and improves bandwidth availability.

In the example below, two controlled tests were performed on the same network which consisted of two computers, a managed PSE switch and two PD IP cameras. Packet analyzing software was used to view the amount of data that was transmitted in a 10 second time frame. The left table shows the results of running the test without the IGMP management feature enabled. The right table shows the results of the same test being performed but this time with IGMP enabled.

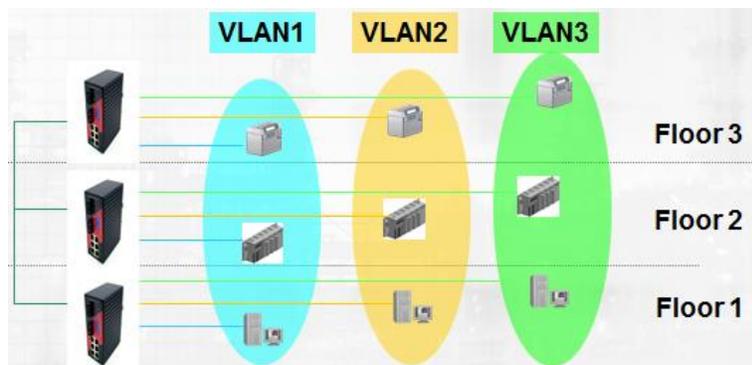
White Paper

Time	Source	Destination	Time	Source	Destination		
8562	16.246256	192.168.1.112	239.192.0.20	48	12.012485	192.168.10.119	192.168.10.2
8563	16.246826	192.168.1.112	239.192.0.20	49	12.013360	192.168.10.2	192.168.10.119
8564	16.247291	192.168.1.112	239.192.0.20	50	12.213648	192.168.10.119	192.168.10.2
8565	16.247921	192.168.1.112	239.192.0.20	51	12.923640	192.168.10.119	192.168.10.2
8566	16.248390	192.168.1.112	239.192.0.20	52	12.925776	192.168.10.2	192.168.10.119
8567	16.248980	192.168.1.112	239.192.0.20	53	13.118956	192.168.10.119	192.168.10.2
8568	16.249474	192.168.1.112	239.192.0.20	54	13.119824	192.168.10.2	192.168.10.119
8569	16.249993	192.168.1.112	239.192.0.20	55	13.320111	192.168.10.119	192.168.10.2
8570	16.250505	192.168.1.112	239.192.0.20	56	13.547048	192.168.1.119	255.255.255.255
8571	16.250964	192.168.1.112	239.192.0.20	57	15.130791	192.168.10.119	192.168.10.2
8572	16.278116	192.168.1.112	239.192.0.20	58	15.133010	192.168.10.2	192.168.10.119
8573	16.278425	192.168.1.112	239.192.0.20	59	15.145724	Dell_a4:50:34	Broadcast
8574	16.278645	192.168.1.112	239.192.0.20	60	15.331825	192.168.10.119	192.168.10.2
8575	16.279610	192.168.1.112	239.192.0.20	61	15.332775	192.168.10.2	192.168.10.119
8576	16.279946	192.168.1.111	239.192.1.111	62	15.533009	192.168.10.119	192.168.10.2

From the results, there was a drastic amount of traffic reduction from 8500 packets when no management features were used down to 62 packets when IGMP management was enabled for the same 10 second time period. The benefits from implementing IGMP on managed switches only increases as a network size becomes larger.

VLAN

Management features such as VLANs are used to create separate segments within the main network. By preventing access from one VLAN group to another, it is possible to keep different departments such as accounting, customer service and product development on the same main network without being able to access the others departments files. A flexible feature of VLAN implementation is that the devices can be located anywhere on the network and be connected to any VLAN within the network. There are no physical restrictions of units being too close to one another to be on the same VLAN as shown to the right.



Another useful VLAN application would be a PoE Wi-Fi unit that allows guests visiting an office to get an internet connection. For security reasons it would not be wise to allow guests to go through the main network to access the internet; although a private guest VLAN could be implemented to allow connectivity and ensure network security.

Managed PoE Features

Managed PoE switches also include some additional features that can provide information specifically for PoE devices. Within the management features, a user is capable of setting and viewing the exact power being supplied to each port as well as setting power priority levels. A very useful feature is the ability of the user to cycle power to specific ports. PoE power cycling can be done either manually

White Paper

through the web console or automatically with an auto-ping tool. The auto-ping tool can be used to periodically ping an IP address associated to one of the ports of the managed switch. If there is not a response from the IP address after a certain number of attempts, then the managed switch will cycle power to the port. Being able to cycle the power to a specific port can be used to re-establish communication to a device that might have become unresponsive in a remote or hard to reach location.

Conclusion

In summary, the major points that require attention when using PoE devices are: What mode of wiring (Mode A or B) is used for the power being sent along the Ethernet cable, what standard PD is being used (IEEE 802.3af or 802.3at), and how much wattage does the power supply need to provide? Knowing and avoiding the causes of potential issues can save time and money. Being able to offer advanced management features that provide key solutions will demonstrate knowledge and increase reputation. Due to the cost saving benefits from utilizing PoE devices, and an increased organization with a reduction in the amount of wiring and devices used in the facility, PoE applications will only be increasing in quantity due to its ability to provide easier flexibility during installation, maintenance and facility expansion.

About Antaira Technologies, LLC

Antaira Technologies is a leading developer and supplier of Industrial Device Networking and Industrial Communication products. Antaira's turnkey Industrial Network Connectivity Solutions include Industrial Ethernet Switches, Industrial Ethernet Media Converters, Industrial Wireless 802.11, Industrial Serial Communications, and Industrial Embedded Computing and provide reliable communication amongst the specialized devices and protocols in various industrial applications.