Installing PoE for Outdoor Deployments

White Paper

September 2011

Introduction

This white paper addresses the challenges of installing powered devices in an outdoor environment, and explores different powering options. Further it provides industry standard best practices for installing Power over Ethernet (PoE) to these outdoor deployments of wireless applications and IP surveillance camera devices.

Dust, water, lightening, ultraviolet light; these weather conditions, sometimes extreme, all require an additional level of caution and protection when installing powered devices in an outdoor environment.

Powering Options for Outdoor Installations

Typical outdoor installations will often include network security cameras and wireless access points which may be powered through standard AC power, or over a standard Cat5 or better Ethernet cable using PoE technology.
Ethernet devices may be powered outdoors using AC power; though, they will require a special National Electrical Manufacturers Association (NEMA)-rated enclosure for the AC outlet. Additionally some devices will also have DC input, and therefore require an AC/DC splitter. Further, installation will require a licensed electrician.

Another option for powering data terminals that are installed into an outdoor environment is the deployment of PoE. A PoE solution will allow easy installation, flexible deployment and reliability while providing additional cost savings. This option will be explored further shortly, but first there should be an understanding of the environmental conditions that must be mitigated.

Considerations for Outdoor PoE Solutions

When installing a device in an outside environment, the following considerations must be made:
1) The level of dust and water protection needed
2) The level of enclosure protection defined by NEMA
3) UV protection requirements
4) Flame classification
5) The level of lightning protection necessary to protect the entire network
6) The temperature range of the environment where the devices will be installed
7) The data rates that the applications needs
8) The level of PoE the device will draw and the need for Standards compliance
9) Physical installation requirements (i.e. wall, pole, etc.)

Dust and Water Protection

The International Electrotechnical Commission IEC 60529 standard defines the requirements for outdoor deployment of electrical equipment. It defines an Ingress Protection Rating (or IP Code) that classifies and rates the degrees of protection for electrical devices, against the intrusion of solids and water in mechanical casings with enclosures. The first digit in an IP Code indicates the protection against solids, and the second digit the protection against water. Table 1 and Table 2 identify the first and second digit ratings. For example: an IP66 rated product is completely dust tight, and can be exposed to powerful jetting water (e.g. torrential rain) because six is the highest rating level, and the second digit six while not the highest rating, does protect against powerful jetting water.

Table 1 - Solid Protection (first digit)

Numeral	Characterization of Ingress Limit
0 or X	Not evaluated
1	≥50.0 mm diameter object
2	≥12.5 mm diameter object
3	≥2.5 mm diameter object
4	≥1.0 mm diameter object
5	Dust-protected
6	Dust-tight

Table 2 - Water Protection (second digit)

Numeral	Characterization of Ingress Limit
0 or X	Not evaluated
1	Dripping water: vertical
2	Dripping water: 15° tilt
3	Spraying water
4	Splashing water
5	Jetting water
6	Powerful jetting water
7	Temporary immersion
8	Continuous immersion

NEMA Enclosure Type

NEMA defines enclosure types, some of which are fit for outdoor applications. The table below from NEMA 250-2003 compares enclosures for outdoor nonhazardous applications:

Provides a Degree of Protection Against the Following Conditions	Type of Enclosure									
	3	3X	3R*	3RX*	3S	3SX	4	4X	6	6P
Access to hazardous parts	X	X	X	X	X	X	X	X	X	X
Ingress of water (Rain, snow, and sleet **)	X	X	X	X	X	X	X	X	X	X
Sleet ***	...	...	...	...	X	X	...	...	...	...
Ingress of solid foreign objects (Windblown dust, lint, fibers, and flyings)	X	X	...	...	X	X	X	X	X	X
Ingress of water (Hosedown)	...	...	...	...	...	...	X	X	X	X
Corrosive agents	...	X	...	X	...	X	...	X	...	X
Ingress of water (Occasional temporary submersion)	...	...	...	...	...	...	...	...	X	X
Ingress of water (Occasional prolonged submersion)	...	...	...	...	...	...	...	...	...	X

* These enclosures may be ventilated.
** External operating mechanisms are not required to be operable when the enclosure is ice covered.
*** External operating mechanisms are operable when the enclosure is ice covered.

As shown, NEMA 4X rating defines similar protection as the IP66 rating. For typical outdoor applications, where submersion is not a characteristic of installation, a NEMA 4X enclosure will be the optimal choice.

UV Protection

The IEC 60950-22 standard defines that non-metallic components of an outdoor enclosure shall be sufficiently resistant to degradation by ultra-violet (UV) radiation. The standard defines the minimum property retention limits after UV exposure to 70 percent retention. When choosing an outdoor rated device make sure the device is 60950-22 certified to ensure that the device was tested and approved for use in an outdoor environment.

Flame Classification

There are 12 flame classifications specified in UL 94 that are assigned to materials based on the results of small-scale flame tests. These classifications are used to distinguish a material's burning characteristics after test specimens have been exposed to a test flame under controlled laboratory conditions. The required flame classification for PoE outdoor devices is 5VB, so you will only want to select a device that was tested and approved to level 5VB.

Surge/Lightening Protection

Telcordia's GR-1089 ensure telecommunications equipment contained the Electromagnetic Compatibility (EMC) and electrical safety criteria necessary to perform safely and reliably. GR-1089 includes guidelines for outdoor deployment; specifically surge protection requirements, which ensure the equipment can survive electromagnetic (EMC) surges such as those transmitted through lightning strikes.

Having dedicated surge protection in the PoE source ensures that when lightning strikes either the Ethernet cable or close to the Ethernet cable surges will be suppressed and will not reach the indoor units, potentially causing damage to expensive electronics equipment connected to the network through Ethernet cables.

It is wise to select a device that meets surge protection as specified in GR-1089-Core Criteria B:
± 1000V/100A @10/1000 [µS] Waveform
± 2500V/500A @2/10 [µS] Waveform
± 1000V/25A @10/360 [µS] Waveform

Network Availability

The applications most often implemented in an outdoor environment, such as IP security cameras, require high availability and ultimate reliability. Using a PoE solution provides a simple way to centrally back up the power source by deploying a UPS close to the AC power source. The combination of PoE and UPS will ensure continuous operation of the WLAN AP or the IP camera even in cases of network power shut downs.

Temperature range

It is very important to verify that all the devices that will be installed in an outdoor environment can operate in the associated temperature ranges typical to the installation location. One of the most important points is the start up temperature of the devices in extreme low temperatures; it is wise to choose devices that support -40C/-40F as the minimum operating temperature. On the high end of the range, supporting 131°/ +55C and even +149°/65C is also recommended.

Note that some vendors may place an indoor PoE device in an IP66 enclosure and present it as outdoor PoE solution. Be aware that this solution will most likely not meet the temperature ranges needed.

Data Rates

While some applications may currently only require 10/100Mbps data transfer rates, it is highly recommended to choose a PoE solution that supports 10/100/100Mbps. This is primarily because the PoE device becomes part of the infrastructure, and will deliver a more future-proof network—avoiding the need for a physical replacement of the entire unit in the future when higher data rates are needed.

PoE Power Levels and Standards

As explained in the "Introduction to PoE" section above, the IEEE 802.3at-2009 is the latest PoE standard, and compliance will ensure interoperability with the Outdoor PoE devices, safe and reliable installation, and protection in case of a fault in the Powered Device (PD) and in cases where a non-PoE device is connected to the PoE unit. Be aware that choosing a non-standard PoE solution may cause damage to non-PoE devices such as laptops, which will be connected to the output RJ45 connector of the non-standard PoE unit. It is recommended to choose an IEEE 802.3at-2009 PSE PoE solution to ensure safe and future-proof installation.

Physical Installation Requirements

A very important aspect of the outdoor installation is the type of mechanical installation required—whether it will be mounted on a wall or be a pole installation. Make sure the PoE unit comes with a mounting kit that can support required installation parameters, as it will be best to avoid choosing a PoE solution from one vendor and the mounting kit from a different vendor. Having a complete solution from a single vendor will guarantee optimal installation and security of the installation during extreme weather conditions, especially during high wind conditions.

PoE 101

PoE is technology that allows the delivery of data and power over Category 5 or better cables. The latest standard, IEEE802.3at-2009, specifies the delivery of up to 25.5W to powered devices, and allows the delivery of up to 51W when all the wires in Category 5 cable are employed.

The IEEE802.3at-2009 standard defines two types of devices: Power Sourcing Equipment (PSE), which sends power, and Powered Device (PD), which receives power. PSE’s can be either embedded into an Ethernet Switch, which then becomes a PoE Switch, or can be independent of the Ethernet Switch, and in that case are called midspans. Midspans allow the addition of PoE to a network without the need to replace the Ethernet Switch. Either of these options may be used to safely deliver PoE power to the device, though use of a PoE Switch will require addition of a dedicated lightening protection unit.

PoE deployment environments

IEEE802.3at-2009 defines two deployment environments in section 33.4.1:

Environment A: when both PSE and PD are located indoors, inside the same building. In this environment, there has to be electrical isolation between the PoE circuitry and the data circuitry inside a PSE. Multi-port PSE’s can all share the same ground isolation. Environment A is therefore an indoor PSE –indoor PD environment (a.k.a. indoor/indoor).

Environment B: when the PSE and PD are not located in the same building. In this environment there needs to be electrical isolation between PoE and data, as well as between every port in a multi-port PSE. This isolation between ports requirement de facto determines a completely separate power supply per port, which makes multi-port PSE's for outdoor PD deployment impractical. Environment B is therefore an indoor PSE-outdoor PD (a.k.a. indoor/outdoor) or outdoor PSE-outdoor PD (a.k.a. outdoor/outdoor) environment.

This means only single-port PSE's should normally be used when PD's are deployed outdoors.
In summary, the PD-PSE environment cans one of the following three options:
1) PoE Source is indoor, PD is indoor
2) PoE Source is indoor, PD is outdoor
3) PoE Source is outdoor, PD is outdoor

The next section will discuss the requirements for option 3, as this is the most challenging environment where both the PD and PSE are installed outdoors.

Benefits of PoE for Outdoor Installations

Ease of Deployment

PoE eliminates the time-consuming installation of AC outlets, especially in outdoor environment. PoE enables the use of a single Ethernet cable to provide both data and power to the outdoor device, reducing installation time and eliminating the need for professional electrician to install AC outlets.

Cost Efficient

PoE reduces cost associated with the outdoor AC outlet installation. In addition, use of an outdoor rated PoE midspan enables remote control over the power provided to the device to allow more control of power usage.

Flexibility

The physical location of the WLAN AP or the IP camera is usually dictated by the field conditions and line of site that are optimal for the application. In most cases an AC outlet is not available in these locations and often cannot be installed in those locations, however, PoE provides the flexibility to install a WLAN AP or IP Camera in any location and just connect it to the data and power source via a standard Ethernet cable.

Safe

PoE offers safe 50V DC power levels. The DC power is provided only after a valid PoE device is connected and is automatically disconnected in case of short circuit or overload.

Summary

Given the different challenges in outdoor powered device installations; withstanding dust, direct water exposure, humidity, ice-action, electrical surges and electromagnetic interference in general, users should have a broad understanding of the different standards that apply to outdoor installations of PoE equipment.

Being able to understand what different ratings mean may be the difference between having an installation that works for decades, or an installation that works intermittently or fails completely when exposed to the outdoor environment.

Users are encouraged to research their options thoroughly before selecting a powering solution for powered device installations in an outdoor environment.

Glossary of Terms

IEEE802.3af-2003 – Original Power over Ethernet (PoE) standard from July 2003. Allowed sending 15.4W of DC power with voltages between 44VDC and 57VDC and a maximum ongoing current of 350mA from the Power Sourcing Equipment (PSE) to the Powered Device (PD). Required Category 3 or better structured cabling, with worst-case resistance of 20ohms over 100m. 12.95W at a voltage range of 37VDC to 57VDC are available to the powered device, with the remaining15.4W-12.95W=2.45W being potentially dissipated on the cable.

IEEE802.3at-2009 – Latest IEEE802.3 PoE standard, also known as PoE+ or PoE plus, allows delivery of up to 30W or 60W over a single Category 5 or better cable, depending on the number of pairs utilized to deliver power. IEEE802.3at-2009 powered devices can consume up to 12.95W (type 1), 25.5W (type 2) or 51W (two collocated Type 2 interfaces)**.**

PoE (Power over Ethernet) – Nomenclature of the multiple technologies that allow delivery of power over Category 3 or better cables along with Ethernet data. Normally refers to the IEEE802.3af-2003 and IEEE802.3at-2009 standards, but can also refer to pre-standard equipment such as PowerDinse's Power over LAN™ and Cisco's Inline Power, EPoE or UPoE.

PD (Powered Device) – Device powered by a PSE and thus consumes energy. Examples include wireless access points, IP Phones, and IP cameras. Many powered devices have an auxiliary power connector for an optional, external, power supply. Depending on the PD design, some, none, or all power can be supplied from the auxiliary port, with the auxiliary port sometimes acting as backup power in case of PoE supplied power failure.

PSE (Power Sourcing Equipment) – Device that provides power on the Ethernet cable.

Midspan – Intelligent power injectors that stand between a non-PoE Ethernet switch and the powered device, injecting power without affecting the data.

WLAN AP (Wireless Local Area Network Access Point) – Base station for the wireless network. Transmit and receive radio frequencies for wireless enabled devices to communicate with.

UV (Ultraviolet Light) – This light wave can cause damaging burnt radiation, which is why Microsemi's PD-9001GO is UV protected to survive UV intensive environments.

NEMA - Defines standards for various grades of electrical enclosures typically used in industrial applications. Each is rated to protect against designated environmental conditions. The PD-9001GO has the NEMA 4X rating, which defines similar protection as the IP66 rating. For typical outdoor applications, where submersion is not a characteristic of installation, a NEMA 4X enclosure will be the optimal choice.

For more information, please contact Microsemi at sales.support@microsemi.com

Microsemi Corporate Headquarters
One Enterprise, Aliso Viejo, CA 92656 USA
Within the USA: +1 (800) 713-4113
Outside the USA: +1 (949) 380-6100
Sales: +1 (949) 380-6136
Fax: +1 (949) 215-4996
email: sales.support@microsemi.com
www.microsemi.com

Microsemi Corporation (Nasdaq: MSCC) offers a comprehensive portfolio of semiconductor and system solutions for communications, defense & security, aerospace and industrial markets. Products include high-performance and radiation-hardened analog mixed-signal integrated circuits, FPGAs, SoCs and ASICs; power management products; timing and synchronization devices and precise time solutions, setting the world's standard for time; voice processing devices; RF solutions; discrete components; security technologies and scalable anti-tamper products; Power-over-Ethernet ICs and midspans; as well as custom design capabilities and services. Microsemi is headquartered in Aliso Viejo, Calif., and has approximately 3,400 employees globally. Learn more at www.microsemi.com.