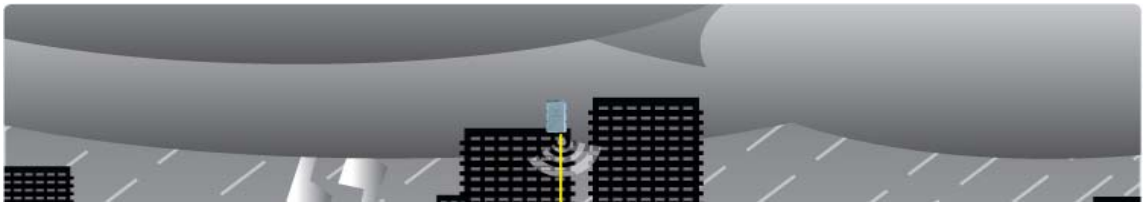
Outdoor Risk and Equipment Protection

The proper use of surge suppressors, lightening arrestors, and weatherproof enclosures are critical protection measures for all outdoor wireless and IP video devices. Inscape Data Corporation offers a complete line of cost effective Power over Ethernet (PoE), Surge Suppressors, Lightening Arrestors, weather proof products (IP67/68). Many outdoor products such as wireless broadband radios to IP digital video cameras are often times surged unprotected. Outdoor Ethernet based equipment suffering surge related damages add up to significant maintenance and camera replacement cost, due in part, to premature equipment mortality from water damage, lightning and/or electrical surges. While it is difficult to quantify lightning losses or water damage, industry experts estimate many millions of dollars worth of damages and losses occur each year. Safeguarding your outdoor Ethernet based equipment with proper surge protection devices and by following industry standard grounding practice, will help to ensure years of trouble free operation. Inscape Data encourages you to review and learn the outdoor surge protection, grounding techniques, and weather proof compliance, so your investment and equipment will be properly protected over the life time of the installation.

Lightning

Lightning, the most dangerous and most frequently encountered weather hazard experienced each year is one of the most common causes to outdoor digital surveillance equipment. Cloud to ground lightning can destroy digital equipment by direct or indirect ways. There is no direct lightning strike protection of equipment but only diversion through lightning rods and insurance claims. Direct lightning strikes incinerate equipment in contact beyond repairable means and the aftermath resembles that of a charred barbeque platter. Direct strike to equipment is preventable and is more obvious to detect than indirect lightning strikes.



Indirect lightning strikes are common when the lightning current branch off to obstacles as it traverse its way to earth ground while destroying everything on its

way. Common obstacles are antennas, power lines, telephone lines, water tower, tree, water, pipes, or aquifers to name a few. Unprotected digital equipments in contact with the lightning surge are sure to be in danger and have very low probability of survival. It only takes micro-seconds after a surge to damage unprotected digital equipment.

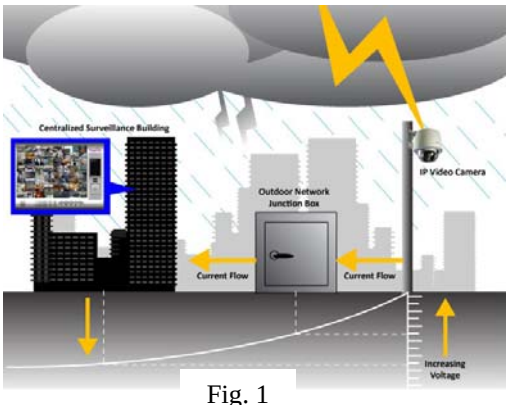


Fig. 1

Let's take a look at an example: Consider lightning strike to a nearby street light, see Figure 1. The voltage or electric potential is raised to hundreds of kilo-Volts. In other words, the light pole becomes a charged battery with hundreds of kilovolts of electricity. This electricity dissipates into its surrounding over time and raises the voltage levels of everything it is in contact with. Unprotected outdoor digital equipment installed onto poles or into cabinets is now charged with thousands of volts of electricity. The damaging factor is not necessarily attributed to the highly charged digital equipment but the condition the equipment is connected to another device through a communication interface with less electric potential or charged voltage. Since electric flow only occurs when there is an electric potential difference, the outdoor digital device then discharges these hundreds of kilovolts through the communication cable to the connected device. If the connected device has low voltage surge tolerance, it will not survive the electric current transfer. The voltage surge may still be strong and now ready to find its next victim. Voltage surges can travel miles before it subsides.

Risk Analysis

A site Engineer responsible for the design of outdoor digital equipment deployment needs to consider the following two major risks to the installed components:

1. Surge onto equipment contact points
2. Elevated Ground Potential

For instance, if we consider an outdoor IP camera installed on a pole with intermediary electronics housed in a cabinet nearby, we can observe both risks are present. Moving the electronic cabinet onto the pole may alleviate the "Elevated Ground Potential Risk", but "Surge onto equipment contact points" are still present. In all cases, surge protection must be installed and is the key to address risk #1.

What most often is neglected for outdoor deployments are surge protection at all ends of every circuit on a site, not only the equipment power port. The Ethernet port, one of the most sensitive digital ports for digital electronics, is not very

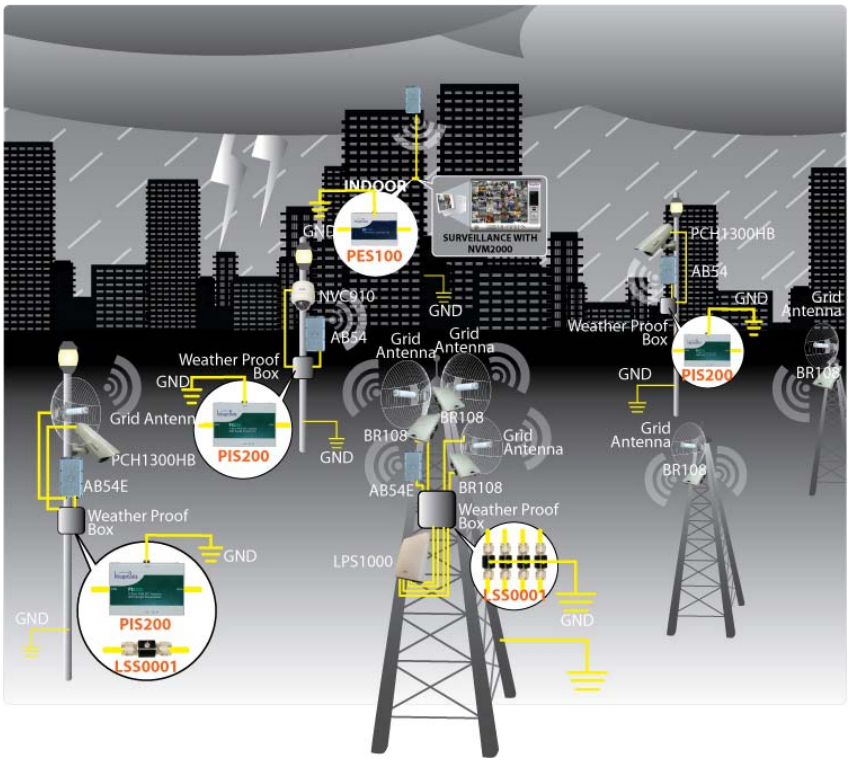
tolerant of voltage surges and is easily damaged. Other ports to consider for outdoor wireless IP based Video surveillance system are antenna, alarm, sensor ports, PTZ, and hybrid camera's coaxial video ports.

It is important to address ground potential of interconnected equipment. Ground potential is essentially equipments electric potential referenced to ground. For example, if the outdoor IP cameras are installed onto a light pole, then the outdoor IP camera is referenced to the light pole's ground potential. If the outdoor IP camera is installed inside a utility cabinet sitting on the ground, then the IP camera is referenced to the utility cabinet's ground potential. The key to successfully avoid surge related problems is to keep all interconnected equipment at the same ground potential. In other words, when electrical surges are present on the equipment, it raises the potential of equipment all at once and dissipates it over time harmoniously. Damages are likely to occur only if interconnected equipment is at different ground potential. This is key to addressing Risk #2.

Solution to Outdoor Risk

Once we understand the potential risk to outdoor equipments, we can understand the measures taken to minimize equipment mortality rate.

There are many surge protection devices in the market. Most of us are aware of surge protected power strips which protects our sensitive home electronics equipment. Consumer surge protection devices differ from industrial surge protection device in the level of surge protection it provides. Industrial surge protection devices are more sensitive and operate at much higher surge capacity than consumer surge protection equipment. It is not recommended to use consumer surge protection for use with commercial or industrial application.



A surge protection device is a junction equipment device with a built-in voltage sensitive switch. It increases and decreases impedance based on engineered voltage threshold. If the voltage sensed is higher than the surge protection device is rated, it decreases impedance and provides an alternative path for the excess voltage to dissipate into. It provides a safe conductive path for the excess voltage to travel and diverting it away from the sensitive digital electronics components or system. The following photos are industrial surge protection devices for Ethernet and Antenna Ports from Inscape Data Corporation.


One may wonder why ground wires are shown as one of the four photos above. The ground wire is the most important component of a commercial surge protection device. It provides a conductive path for the harmful voltage to the Earth's ground. Using a surge protection device without attaching the ground wire properly renders the surge protection device's effectiveness to none. Always properly ground your outdoor digital equipment at all times. Skipping this step may lead to serious consequences and many hundreds or thousands dollar of maintenance and service calls.

The logistics to address surge for outdoor equipment's contact points and elevated ground potential are relatively easy but a very important item on an

installer's checklist. Taking the time to plan and address outdoor risks will lower maintenance cost and increase longevity of outdoor equipments. The next few sections address common outdoor risk associated with each particular application.

CCTV

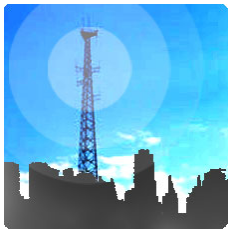
Surge onto equipment contact points maybe addressed by using port specific surge arrestors and protectors. In the CCTV world, the minimum recommendation is to add surge protection devices to the following ports:

- 24VAC Power Line
- Coaxial Video Cable Line
- RS485 PTZ Line
- Audio Line

IP Video
The big advantage of IP video cameras compared to analog CCTV system is the decrease in the number of concurrent cable interfaces to and from the video camera. IP video systems typically use a single network cable to digitally transmit multiple video, audio, and telemetry information. The minimum recommendation is to add surge protection devices to the following ports:

- 12VDC or 24VAC Power Line
- Ethernet Port or RJ45 Line
- Power over Ethernet Line

Wireless Data Communication
In the Wireless Data Communication world, the minimum recommendation is the following:



- Antenna Ports
- Power over Ethernet Line
- Equipment Power Line

Ethernet Cables
Special mention about the type of Ethernet cables to use for outdoor deployment is crucial. The Ethernet cable should be CAT5 or CAT5e, outdoor rated, and shielded. The designation for these types of cables is the following: sFTP, FTP, or STP. The use of unshielded twisted pair (UTP) cable and/or unshielded RJ-45 jack outdoor is not recommended because of the increased electromagnetic noise level for outdoor deployments. Using shielded CAT5 cable without shielded RJ-45 jack at the PoE side may cause more problems then not using it. The Cat V shield if ungrounded, acts as a magnet for static surges present in the environment. Since the charges do not discharge properly through the conductive RJ45 jack, it couples with the internal data or power lines of the PoE cable. The coupling of high voltages present on the data cables will damage the equipment directly interfacing it.

Since every component of outdoor digital equipment is crucial to the system as a whole, damage to one component may heavily cripple the effectiveness of the whole system. Always use outdoor rated Ethernet cables for outdoor installations.

Grounding

The criteria of success to address ground potential difference are placement location and effective grounding. When possible, place interconnected equipment on the same mounting location referenced to the same ground potential. Doing so simplifies installation efforts. If the interconnecting equipment must reside at different location, one may address the grounding issues

through careful planning. The key is common potential ground reference. How does one achieve this? By understanding and properly ground all equipment to a common ground reference, the Earth Ground.

One may use the best and strongest surge protection device in the industry, but without proper grounding, the surge protection devices will not work optimally and in most cases will not work at all. The following are proper grounding points from the United States National Electric Code (NEC) Sections 810-15s and 810-21 to be nearest accessible location to the following:

- The building / structure grounding electrode
- The grounded interior metal water piping system
- The power service external enclosure
- The metallic power service raceway
- The service equipment enclosure
- The ground electrode or 8 foot ground rod

A detail list of the NEC code on grounding is in the appendix of this article. Please reference to it for more details. It is highly recommended to follow the national electrical code for grounding to achieve the highest level of protection for your outdoor equipment.

More Tips

Here are more tips to increase the effectiveness of your grounding scheme and surge related items and to fight against lightning surges and minimize equipment damage.

- When in doubt regarding grounding, drive your own rod and bond it to the house ground.
- Keep cable runs as straight as possible.
- Use a minimum of 16 AWG copper clad steel wire to ground the Antenna Mast and outdoor wireless system to the nearest common earth ground point.
- Always run the outdoor PoE cable inside of the mounting pole when possible. The mounting pole, if metal, will add insulation and pass the surge to ground.
- Use PoE cable and RJ-45 jack that is rated for the following:
    - Outdoor or direct burial
    - Shielded (FTP, sFTP, STP)
- Test for conductivity of the grounding system to ensure the installation is solid and electrically capable of grounding any ambient surge or static.

Other Factors to Consider

Surges from natural occurrences happen more frequently during certain seasons than others. Using industrial rated surge protection from Inscape Data Corporation ensures your equipment will be protected against outdoor surges all year round. There are few key items the Inscape Data Corporation's surge protection device cannot address are:

- ESD Damage Caused by Not Grounding Yourself During Installation
- ESD Damage Caused by Dragging Cat 5 Cables Across Carpet
- Direct Lightning Strikes to Outdoor Equipment
- Damage Caused by Not Grounding Your Equipment and Surge Protection Device

Transient surges are everywhere and closest to you without your notice. Always ground yourself and clear yourself of harmful static electricity before handling your equipment. One may plan to install the best surge protection the industry has to offer but prematurely damage the device through means of ESD.

Final Note

Industrial surge protection devices installed on all lines to the equipments interface and cabinet will greatly minimize 99% of outdoor weather related surge damages and provide the following key benefits:

- Protect equipments and investments
- Increase the life time of equipments
- Lower the probability of service call or operation failure

Outdoor surge protection is one of many consideration to keep your outdoor digital equipment operational for many years to come. Using outdoor IP or Nema rated equipment is also an important factor in choosing your outdoor equipment. Please contact an Inscape Data product expert for more information on outdoor wireless broadband radio and IP camera surge protection. A copy of this article with Appendix can be found on our website in the support section at www.inscapedata.com

APPENDIX

U.S.A. NATIONAL ELECTRICAL CODE (NEC)

810-20 AND 81-021

810-20. Antenna Discharge Units — Receiving Stations

(a) Where Required. Each conductor of a lead-in from an outdoor antenna shall be provided with a listed antenna discharge unit.

Exception: Where the lead-in conductors are enclosed in a continuous metallic shield that is either permanently and effectively grounded or is protected by an antenna discharge unit.

(b) Location. Antenna discharge units shall be located outside the building or inside the building between the point of entrance of the lead-in and the radio set or transformers, and as near as practicable to the entrance of the conductors to the building. The antenna discharge unit shall not be located near combustible material or in a hazardous (classified) location as defined in Article 500. A lightning arrester is not required if the lead-in conductors are enclosed in a continuous metal shield, such as rigid or intermediate metal conduit, electrical metallic tubing, or any metal raceway or metal-shielded cable that is effectively grounded. A lightning discharge will take the path of lower impedance and jump from the lead-in conductors to the metal raceway or shield rather than take the path through the antenna coil of the receiver.

(c) Grounding. The antenna discharge unit shall be grounded in accordance with Section 810-21. *810-21. Grounding Conductors — Receiving Stations*

Grounding conductors shall comply with (a) through (j).

(a) Material. The grounding conductor shall be of copper, aluminum, copper-clad steel, bronze, or similar corrosion-resistant material. Aluminum or copper-clad aluminum grounding conductors shall not be used where in direct contact with masonry or the earth or where subject to corrosive conditions. Where used outside, aluminum or copper-clad aluminum shall not be installed within 18 in. (457 mm) of the earth.

(b) Insulation. Insulation on grounding conductors shall not be required.

(c) Supports. The grounding conductors shall be securely fastened in place and shall be permitted to be directly attached to the surface wired over without the use of insulating supports.

Exception: Where proper support cannot be provided, the size of the grounding conductors shall be increased proportionately.

(d) Mechanical Protection. The grounding conductor shall be protected where exposed to physical damage, or the size of the grounding conductors shall be increased proportionately to compensate for the lack of protection. Where the grounding conductor is run in a metal raceway, both ends of the raceway shall be bonded to the grounding conductor or to the same terminal or electrode to which the grounding conductor is connected.

(e) Run in Straight Line. The grounding conductor for an antenna mast or antenna discharge unit shall be run in as straight a line as practicable from the mast or discharge unit to the grounding electrode.

(f) Electrode. The grounding conductor shall be connected as follows:
1. To the nearest accessible location on the following:
a. The building or structure grounding electrode system as covered in Section 250-50
b. The grounded interior metal water piping system as covered in Section 250-104(a)
c. The power service accessible means external to enclosures as covered in Section 250-92(b)
d. The metallic power service raceway
e. The service equipment enclosure, or
f. The grounding electrode conductor or the grounding electrode conductor metal enclosures; or If the building or structure served has no grounding means, as described in (f)(1), to any one of the individual electrodes described in Section 250-50; or If the building or structure served has no grounding means, as described in (f)(1) or (f)(2), to an effectively grounded metal structure or to any of the individual electrodes described in Section 250-52.
(g) Inside or Outside Building. The grounding conductor shall be permitted to be run either inside or outside the building.
(h) Size. The grounding conductor shall not be smaller than No. 10 copper, No. 8 aluminum, or No. 17 copper-clad steel or bronze.
(i) Common Ground. A single grounding conductor shall be permitted for both protective and operating purposes.
(j) Bonding of Electrodes. A bonding jumper not smaller than No. 6 copper or equivalent shall be connected between the radio and television equipment grounding electrode and the power grounding electrode system at the building or structure served where separate electrodes are used.