comnet™
Communication Networks

3 Corporate Drive
Danbury, CT 06810 • USA
T: 203.796.5300
F: 203.796.5303
www.comnet.net

March 13, 2012

ComNet Application Note

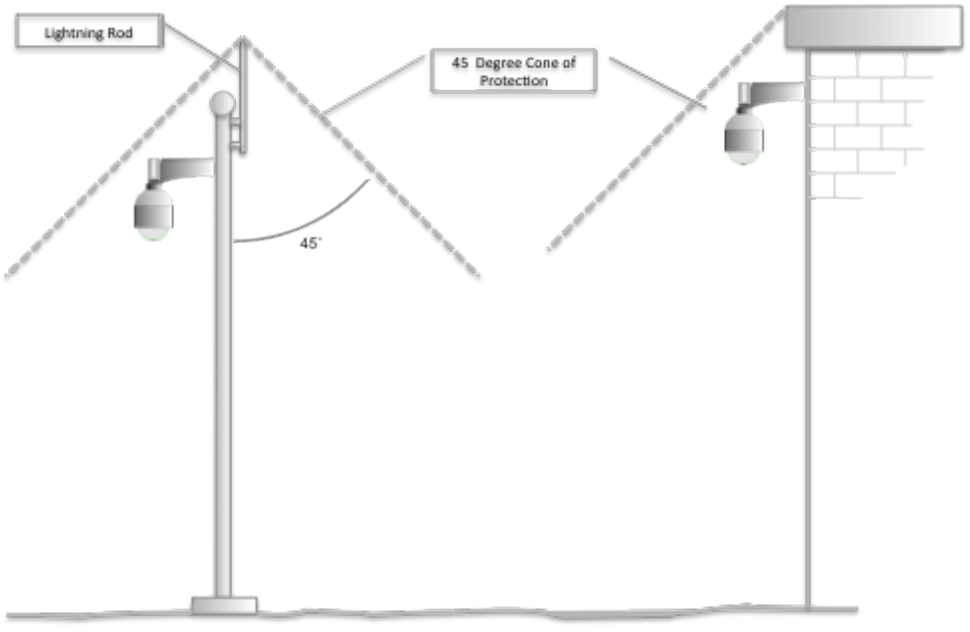
Protecting Copper Media Transmission Equipment from the Effects of Lightning and Other Voltage Transient Events

By Bruce M. Berman, V.P. of New Business Development

With the advent of long-distance transmission of Ethernet data through copper media, such as CAT-5E/6E wiring, unshielded telephone-grade twisted pair (UTP), and coaxial cable, it has become necessary to consider the protection of the field and head-end equipment from voltage transient events, including lightning and other high-voltage conditions. Stray voltage conditions should be considered as well. Although the ComNet CopperLine Ethernet-over-Copper transmission equipment includes multiple elements of voltage transient protection, to effectively protect not only itself but the equipment connected to it, the user, specifying engineer, or integrator should be aware of the need for proper installation practices to ensure the safety and reliability of the entire system.

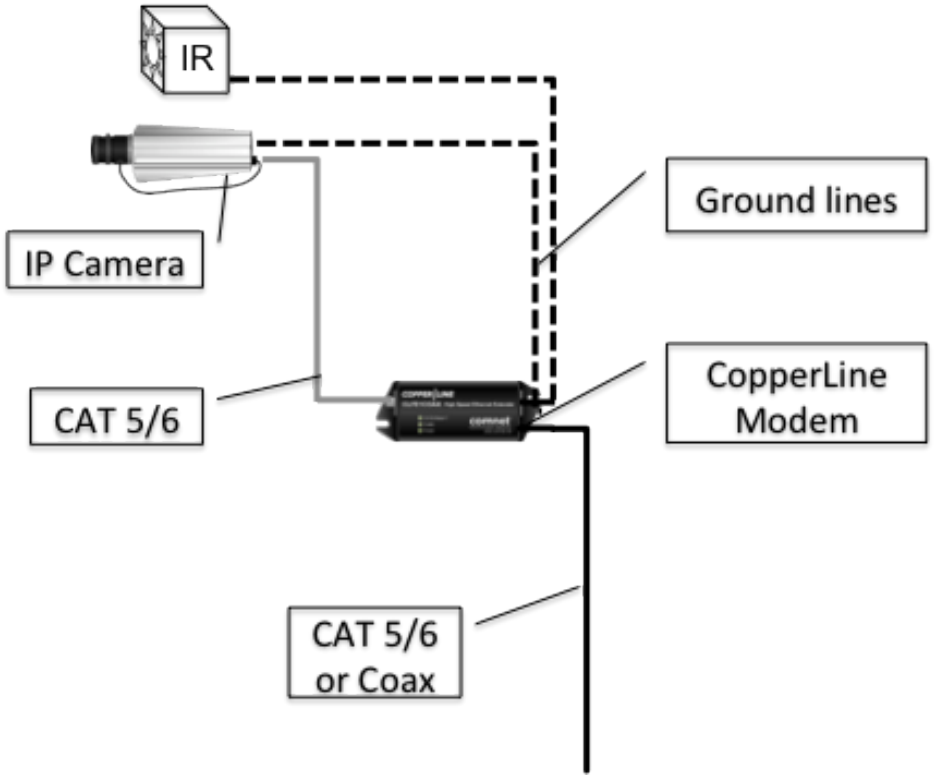
Field or Out-of-Door Equipment Installation & Protection

For the field or outdoor equipment, such as a CCTV camera, access control equipment, etc., the "45 degree cone of protection rule" should be rigorously observed. Ideally, the camera and housing should be located beneath an imaginary 45 degree angle drawn from the top of the supporting structure or building. If it is not practical or possible to do this, a properly grounded lightning rod must be installed in the near-field of the camera, so as to attract lightning or other static discharges away from the equipment. Otherwise, the risk of a near or direct hit to the camera becomes significant, and no existing technology can protect delicate electronic equipment from a direct lightning hit. As an example, unprotected parking-lot cameras installed on metallic support masts, or cameras mounted on metal-skinned buildings are particularly susceptible to lightning damage.



If the camera is mounted to a metallic structure, it becomes necessary to electrically and mechanically isolate the camera from the structure. This may be easily accomplished by the use of plastic or nylon screws, washers, and other non-metallic hardware, to effectively isolate the camera housing and its associated wiring away from the structure. The camera and all related equipment must electrically float relative to ground on the structure.

If there are grounding attachment points or connections (i.e. screws, nuts, etc.) on the camera, the camera housing, or any other equipment located in the field and related to the camera, they must be individually wired to the CopperLine modem ground connection with a minimum of 12 gauge solid conductor (not stranded) wire, **but do not connect any of this equipment to earth ground.** This single-point or star grounding practice is highly effective for protection against high-voltage transients and low-voltage ground loops, and can eliminate troublesome video hum bars that otherwise may occur.



This field installation approach offers the best means of protecting the equipment against damaging voltage transients, especially when compared to connecting it to the local ground, and will provide the highest level of protection, particularly in lightning-prone regions.

These practices should always be subject to regulatory safety requirements, such as the NEC, or your local electrical code.

In the event that an in-line voltage transient protection device is to be used for either the Ethernet transmission cabling or the camera power line, install the device immediately adjacent to the camera. Connect the protection device's ground to the BNC connector (or its shield) located on the camera, rather than the local ground; this will effectively bypass the transient to ground. It is also good practice to install an Ethernet-specific in-line transient protection unit where the copper runs from the cameras or any other field equipment terminate at the RJ-45 data port(s) on the CopperLine modem. An effective, inexpensive, and easy-to-install example is the ComNet CLESP Electrical Surge Protection unit; the CLESP simply plugs in between the CAT-5/6 cable and the mating RJ-45 port on the modem. The use of the CLESP is recommended where the copper transmission lines are deployed in or near particularly electrically noisy environments, as typically found near heavy electrical equipment or machinery, etc.

The effect of connecting any electrical device to earth ground at the edge of the network is analogous to sitting in a car and it having it struck by lightning. In the event this were to happen, you and everything in the vehicle float at the same high voltage, but no path to ground exists, by virtue of the car's non-conductive, insulating rubber tires. As such, no

voltage can flow, and you are electrically isolated and protected from electrocution. However, if you were to open the car door and put your bare foot on the ground during the lightning strike, you have completed a conductive path between the strike and ground, with obvious (and probably unfortunate) consequences. As should be apparent at this point, do not connect any of the field equipment directly to earth ground under any circumstance.

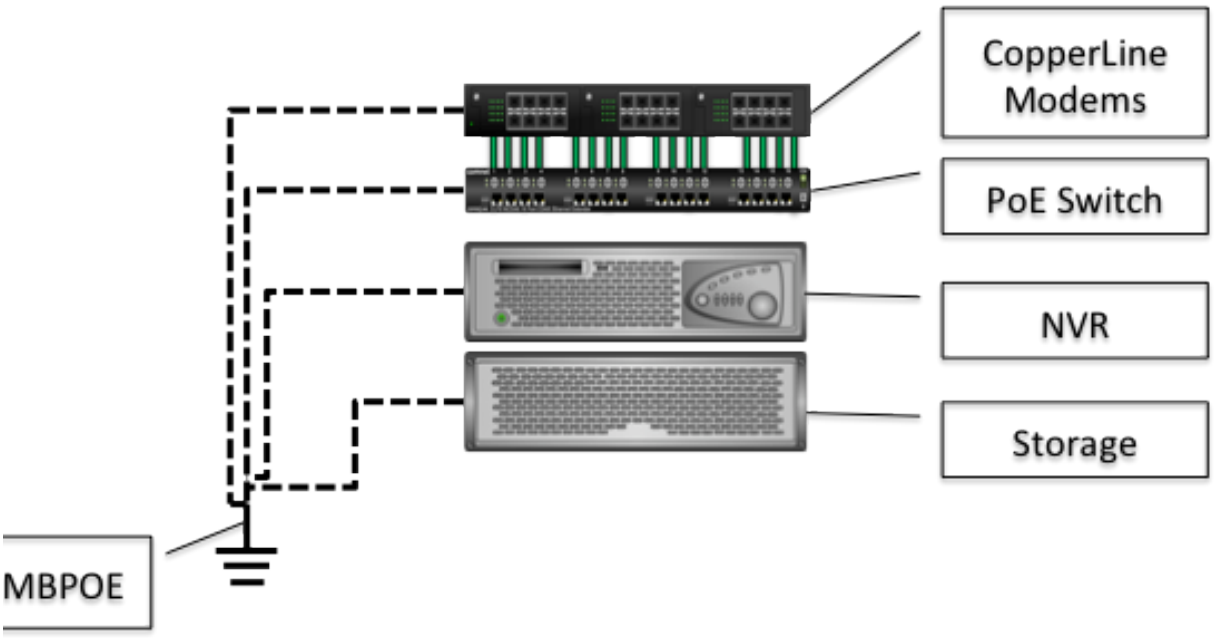
Interior or Indoor Equipment Installation & Protection

Do not mount cameras located within the interior of the building directly to T-bar ceilings, as these ceilings can carry stray voltages that could also damage the equipment. Stray voltage differentials as small as 0.25 volts can create issues with the quality of the video, such as the presence of hum bars and other anomalies.

Head-End or Central Control Room Equipment Installation & Protection

For equipment located at the head-end or control room location, all copper media transmission and other equipment related to the installation must share one common ground at the electrical Main Building Point of Entry (MBPOE), which serves as the single-point ground. Note that the MBPOE is normally installed by the electrical contractor, and should exist in any properly installed-to-code building electrical distribution system. Never use a ground rod installed by the telephone or cable company for this purpose. Always use the MBPOE ground whenever possible, or have a qualified electrician or electrical contractor install one for the safety and protection of the installation. The importance of this is to ensure that the cameras, recording equipment, and any other equipment comprising the system and network are all sitting at the same electrical potential relative to ground.

.



In conclusion, the implementation of these simple and basic practices as described in this paper will significantly enhance the overall reliability of the customer's installation from the effects of lightning and other potentially damaging electrical events, and with minimal cost impact. They may also be found useful in the elimination or reduction of hum bars or other interference to the video.