RAYCAP ARTICLE

Why Internal Surge Protection Fails to Protect Sensitive 5G Infrastructure

Lightning induced surges can prove too much for internal protection devices

The Importance Of Keeping 5g Services Online At All Times

With the ability to carry data at much higher speeds than previous generations of wireless telecommunications infrastructure, 5G is now being used by a host of new applications including consumer services such as video streaming apps and real-time business-oriented applications like industrial IoT. One appeal of 5G as a communications medium is the promise of low latency (delay) connections, but this means that any interruption to service is a real problem for users, not to mention a potentially critical threat to mission-critical applications.

While the manufacturers of 5G radio equipment usually include a level of surge protection built into the remote radio head (RRH), this is not always sufficient to guarantee continued operation in the event of a high voltage surge such as a lightning strike. To prevent service interruptions, it is highly recommended to protect transmission equipment by installing external overvoltage protection systems at the top and bottom of macro towers, and at small cell sites.

Climate Change Is Increasing The Severity Of Storms And The Incidence Of Lightning Strikes

Lightning activity has increased considerably in recent years and the latest climate change models show that this trend will continue, with a possible increase in the number of strikes up by 50% by the end of the century. While midwest and southern states such as Arkansas and Florida show the highest levels of electrical storm activity, other geographical areas including the western U.S. states are increasingly at risk. Indeed, during a recent storm in California, more than 15,000 lightning strikes were registered over the course of 24-hours.

5g Radio Internal Protection Does Not Provide Enough Protection From Lightning Surge Damage

Apart from the obvious destructive potential of a direct hit, the energy in a lightning bolt can indirectly cause damage by creating large voltage and current spikes on the power mains. If adequate surge protection is not installed on the AC mains, these can cause damage to other electronic systems.

Neither is it safe to assume that equipment installed on walls or rooftops adjacent to taller buildings is safe (Figure 1) since lightning does not always strike the highest structures. The magnetic field radiating from a strike on a nearby building can induce a large overvoltage in the wiring of the building on which rooftop telecommunication equipment is located. When lightning strikes happen, radios are the most common mode of failure because the internal protection provided in most remote radiohead units (RRU) is only tested to test class II and will not withstand test class I exposure. For these reasons, modern cellular infrastructure (from the macro tower to the small cell) all require sufficient protection to prevent interruptions to normal operation from happening.

Figure 1. Lightning striking lower structures.

External protection with an LPS is needed, based on IEC 61643

The IEC 61643 standard classifies SPDs by the test class for the electrical environment they are intended to operate within. A Lightning Protection System (LPS) is usually the first stage in the type of protection scheme used for elevated structures such as telecommunication towers (Figure 2).

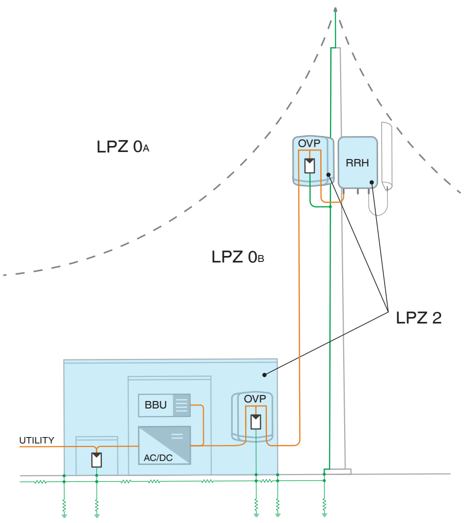

Figure 2. Lightning protection zones for a 5G site.

The LPS is intended to capture the electrical energy in a lightning strike (with a Franklin rod) and discharge it to a controlled location from where the current is then safely diverted via a lightning down-conductor, to a low impedance grounding mechanism. Using an LPS lowers the risk from direct lightning strikes (thereby reducing the exposure level from LPZ0 to LPZ1). However, the sensitive RRHs are still exposed to potential damage. The exposure level of the LPZ in which the RRH is located must be further reduced from LPZ1 to LPZ2. This can be done through the appropriate choice of additional SPDs which reduce the magnitude of any overvoltage which occurs to a level which the equipment can safely withstand.

Choose SPDs For Class I Exposure And Low Let-Through Voltage

Engineers must consider the operational characteristics of the equipment being protected when choosing the type of SPD to be installed at a cellular site. A Class I SPD is one which has been tested to withstand “a direct or partial direct lightning discharge”. This means that the SPD has been tested to withstand the discharge energy typically encountered by structures located in exposed areas. Class II SPDs are normally installed in structures such as small cell streetlights, where only induced currents are likely.

Raycap’s Strikesorb® technology (Figure 3) incorporates the properties of both Class I and Class II devices in a single solution which can survive lightning currents (rated at up to 25kA 10/350) while keeping let-through (residual) voltage levels close to 100V.

Figure 3. Strikesorb surge protection by Raycap.

The technology has been custom designed to provide the required I_{imp} and U_p ratings necessary to protect t he type of sensitive electronic equipment typically found at cell sites.

About Raycap

Raycap is an international manufacturer and technology leader with decades of experience providing innovative infrastructure solutions for customers in the telecom, energy, defense, transportation, and other industrial markets. Its solutions protect mission-critical applications and ensure the best possible system availability. The company's product portfolio includes lightning and surge protection technologies, structured cabling and connectivity solutions, power management systems, custom enclosures, cabinets, and wireless network concealments. Since its founding in 1987, the company has experienced continuous growth. Its engineering expertise, test laboratories, and multiple manufacturing facilities guarantee quality, reliability, and innovation. Product design, testing, and approval pro-cesses comply with all international safety standards. Raycap operates in the United States, Germany, Greece, Cyprus, Slovenia, and Romania.

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