RAYCAP ARTICLE

5G Infrastructure & Climate Change

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Engineering Challenges to Upgrading Cell Sites With 5G Radios

The rollout of 5G services rides on the capabilities of new radios, operating at sub 6GHz band and even higher frequencies for mmWave signals.

The higher capacity equipment draws more power than previous generations of cellular radios. At the same time, their sensitive electronics are more at risk from power surges from lightning strikes, and other environmental concerns. Engineers need to examine and manage these impacts on existing and new cell sites.

Figure 1. Radios, antennas and other electronic equipment atop a cell tower.

Compensation for voltage drops

As equipment is added to a cell site, engineers must account for voltage drops that can compromise performance of equipment at the top of the structure. The challenge becomes tougher when adding high-power equipment.

Engineering cell sites to control voltage drops typically involves upgrading cables. Replacing cables is expensive – often prohibitively so. Meanwhile, existing racks might not be able to accommodate larger cables – the recourse then is to replace that equipment too.

Raycap has come up with a better solution. PowerPlus is an affordable system that can be installed at the DC plant output to increase the voltage at the base of a cellular site to overcomevoltage drops. This allows carriers to use their existing infrastructure cables and distribution equipment.

Each PowerPlus module is equipped with Strikesorb® surge protection, adding Class I protection at the unit. The PowerPlus units slot directly into standard 19-inch and 23-inch racks, but the product can also be customized depending upon customer requirements. This simple upgrade can save carriers and integrators tremendous cost and downtime.

Controlling for greater environmental extremes

Soaring heat, more severe winds, and greater incidence of lightning—all effects of climate change—are serious threats to wireless network infrastructure. Meanwhile the public's expectations for network reliability, low latency, and greater bandwidth keep growing, especially as people consume increasing amounts of streaming media.

New radios support more frequency bands and offer more capacity. However, densification is mandatory for high traffic areas and therefore many more cell sites are needed. Add in the adverse effects of climate change, and the combined result is that careful engineering is required to protect the investment in high-power high-capacity radios.

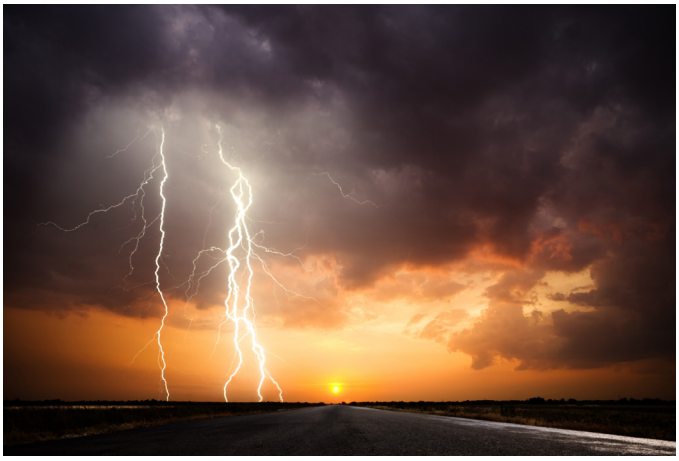

Figure 2. More lighting and more cell sites means a greater chance of network downtime due to lightning if sites are unprotected.

The deteriorating environment for 5G

In 2021, an early summer heatwave baked the western U.S. with temperatures above 100° for days on end. Meanwhile, the eastern seaboard experienced 21 hurricanes in 2021, while the historical annual average is just 14. Climate models suggest that heat waves and storms are going to keep getting worse in terms of frequency, intensity, and reach.[1]

Looking forward, lightning strikes are projected to become more prevalent with global warming, increasing 50 percent over this century. By most estimates, a severe storm might include a few thousand lightning strikes. The National Weather Service reports that in 2014 a massive storm that stretched across Texas, Louisiana, and Arkansas produced 17,000 strikes in just one hour.[2]

This all necessitates greater protections for wireless network systems that will entail performing careful thermal analyses of cells, assuring the mechanical strength of poles, and building in robust overvoltage protection (OVP) solutions.

Heat and small enclosures

5G cells, especially those with mmWave radios, require short signal distances, optimized lines of sight and more long-distance tower installations for the mid-band spectrum. That recommends attaching them directly to light poles, buildings and existing tower structures. But the public wants these cells to be inconspicuous. As a result, 5G radios get crammed into small, densely packed enclosures, making heat management a greater challenge. 5G radios operate at a higher power level and generate more heat naturally, therefore complicating retrofits of existing 4G cell sites.

Soaring temperatures exacerbate the problem, making it imperative to perform thorough thermal analyses of 5G sites to assure long-term viability.

Sometimes engineers can reposition equipment inside enclosures to improve air flow and lower operating temperatures, but sometimes such relatively simple measures are not enough. For example, Raycap performed thermal analysis on small cell integrated poles for Arlington County, VA, and concluded that consistent performance would require the addition of an active ventilation system to the final designs.

Small cell poles and higher-force winds

A warming atmosphere is generating more storms. They're more powerful, last longer, and travel farther inland, increasing the likelihood of more damage to wireless sites.

Major municipalities have regulations on pole wind shear strength that take into account the expected intensity of local storms. These regulations are likely to become increasingly stringent, pacing the growing severity of storms.

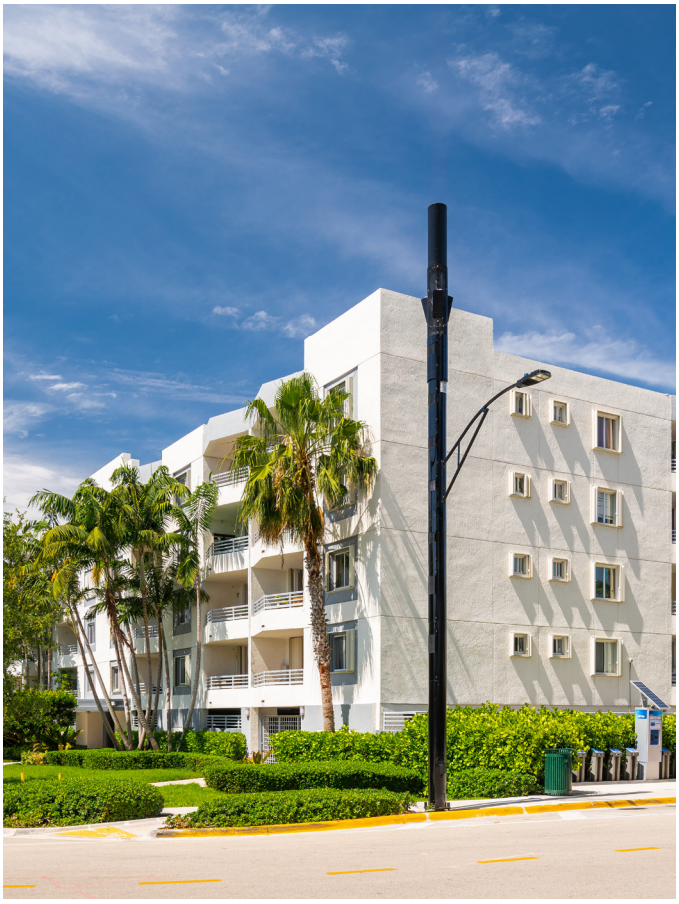

Figure 3. A small cell pole with 4G and 5G equipment installed in Miami Florida and customized to withstand windloads

Conforming to stricter regulations will require performing structural analyses to determine whether each pole will hold all its loads during high winds.

Customized small cell poles can be engineered to meet structural load requirements and other needs. For example, Raycap designed a streetlight pole for the country's Southeastern region able to withstand 170 mph maximum wind load requirements.[3] We adapted our standard integrated pole design to use a thicker walled pipe and more robust steel than necessary in other parts of the country.

5G cells and the increased incidence of lightning

More lightning means more strikes on cellular towers and building-mounted sites. While direct lightning strikes are dangerous in and of themselves, electronic systems are also affected by energy surges in adjacent conductors through magnetic induction, capacitive coupling, or direct galvanic connection.

[1] *https://www.science.org/doi/10.1126/science.1259100*
[2] *https:// https://www.weather.gov/otx/Lightning*
[3] *https:// www.raycap.com/wp-content/uploads/2021/01/Raycap-Case-Study_Miami-.pdf*

These surges are common and can travel through power mains to nearby equipment, causing significant damage if not adequately mitigated. Class I protection is required to fully protect radios and their associated electronics from the energy inherent in a lightning strike.

That's why cellular installations (towers, building-mounted, and pole-mounted) must include a fully considered lightning protection system (LPS) and external surge protection integrated into the power system for the site.

For example, Raycap's Strikesorb technology is a unique OVP solution that includes both Class I and Class II protection. Strikesorb products incorporate a distribution grade metal oxide varistor (MOV) to handle larger surges without affecting performance. The voltage level applied to the equipment during a surge event (let-through voltage) needs to be low and as close as possible to the nominal operating voltage level; Strikesorb has very low let-through voltage characteristics.

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 processes comply with all international safety standards. Raycap operates in the United States, Germany, Greece, Cyprus, Slovenia, and Romania.

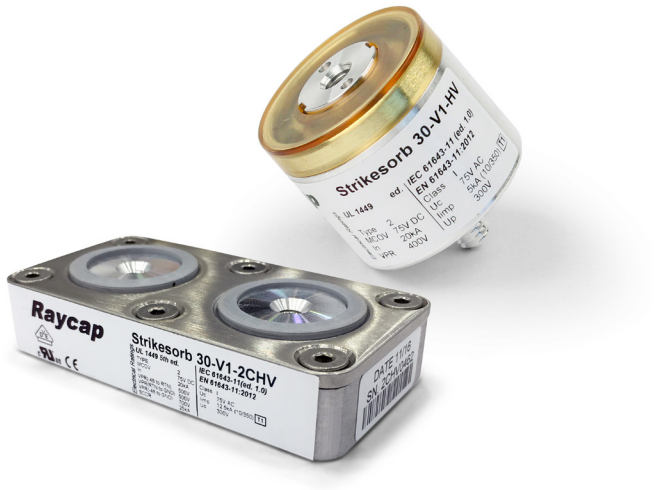

Figure 4. Two of the Strikesorb SPDs from Raycap

Summary

With the rollout of 5G service, more infrastructure is needed to support and protect new high frequency radios from the increased lightning, wind, and heat associated with climate change. Experienced professional design and engineering are required to ensure that wireless sites can operate reliably even under increasingly adverse environmental conditions. Innovations such as Raycap's Strikesorb technology and PowerPlus solution make it easier to protect and support high capacity equipment.

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