Raycap

What 5G Disaggregation Means for Cell Site Retrofits

It has become common practice to move 5G radio units next to antennas. RUs dissipate considerable heat, however. What does that mean for upgrading existing cell sites, and what does that mean for new installations? Thermal analysis provides the answers.

Part of the trend toward open systems in cellular networks involves the disaggregation of network equipment, allowing operators to choose the best hardware to match specific service features. It is feasible to separate the 5G radio from the other base station equipment and co-locate the 5G antennas and radio units (RU) in another area.

RUs dissipate considerable heat, and adding a 5G radio and antenna to an existing 4G antenna enclosure, or concealment can immediately throw off that site's thermal balance. This excessive heat can diminish the performance of electronic equipment at the site increase the risk of failure, and reduce expected lifetimes.

Another issue with 5G is that some of the spectrum used is less robust than those used for 3G and 4G. When putting 5G radios that operate at C-band or mmWave wavelengths in protected spaces – be it in an existing structure or an enclosure built specifically for the cell – the structural materials can often impede 5G signals.

With 5G, it is imperative to conduct sophisticated thermal analyses when designing and manufacturing those enclosures to accommodate the 5G radios and antennas. Real-life examples of upgrades to various existing cell sites with 5G equipment illustrates how those two key capabilities can help carriers improve their networks while being fiscally responsible.

Adding 5G to Existing Cells

Cellular antennas mount at different elevated levels on poles, buildings, or other structures, and their frequency bands differ. The equipment is often either protected or concealed (or both) by enclosures. Enclosures could be purpose-built cabinets, specially designed concealments, or existing structures.

Existing structures such as domes, cupolas, or spires are convenient places to hide cellular antennas, but it cannot be assumed that they will be hospitable to the adding 5G equipment. Illustrating this are two similar 5G equipment installations in existing concealment sites, one in Plymouth, Massachusetts, and the other in Alexandria, Virginia.

The Virginia Steeple

In Virginia, cellular equipment was already housed within a steeple atop a local church. The steeple was an enclosed space where the dissipated heat from the new 5G RUs would be trapped inside. The steeple would have to be vented somehow, but local regulatory authorities also required that any modification to the landmark building be architecturally consistent with the existing structures. Raycap's proposed solution was to entirely replace the steeple with a new custom-engineered version that included louvered panels.

The company provided a detailed thermal analysis of the site. In addition, Raycap's research verified that this approach would produce sufficient ventilation for the new equipment and additional RUs if the carrier ever needed to add capacity. The custom solution also satisfied local aesthetic requirements.

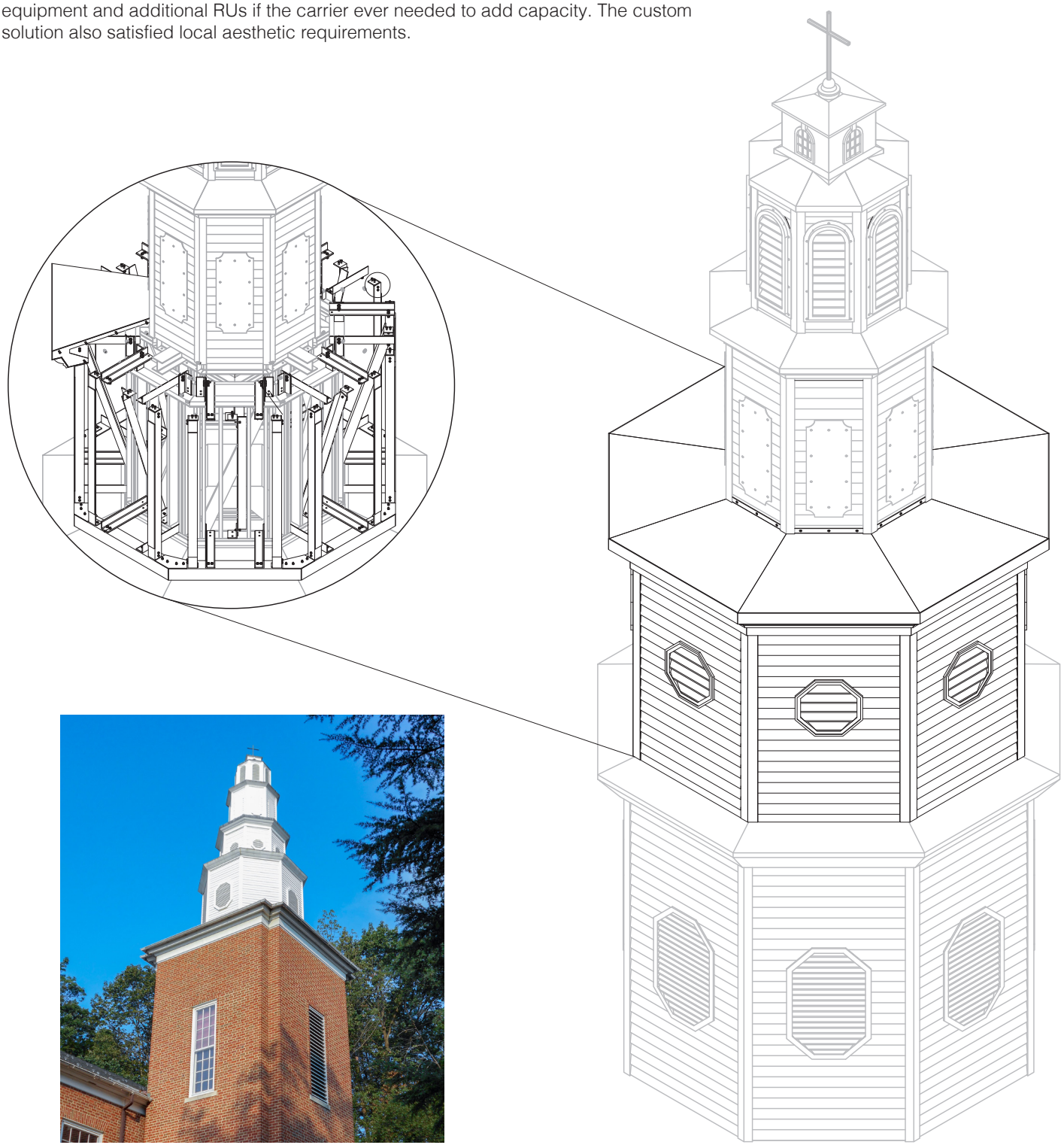

Figure 1: Virginia Steeple rebuilt to accommodate 5G equipment heat displacement.

The Massachusetts Cupola

The case in Massachusetts involved adding 5G equipment into an existing cell site within the cupola of a landmark building where wireless antennas were aimed out of the cupola windows. In this case, the build-up of heat was a lesser issue. Of more significant concern was that the windows in the cupola would impede 5G signals.

Raycap's proposal was to design new windows using specially engineered material that would offer minimal or no interference to the 5G equipment. The analysis of how much heat the equipment could tolerate in different scenarios determined that the approach was sound. The new window design also complied with local restrictions on the aesthetic appearance of the cupola.

Figure 2: Massachusetts Cupola concealing 5G equipment.

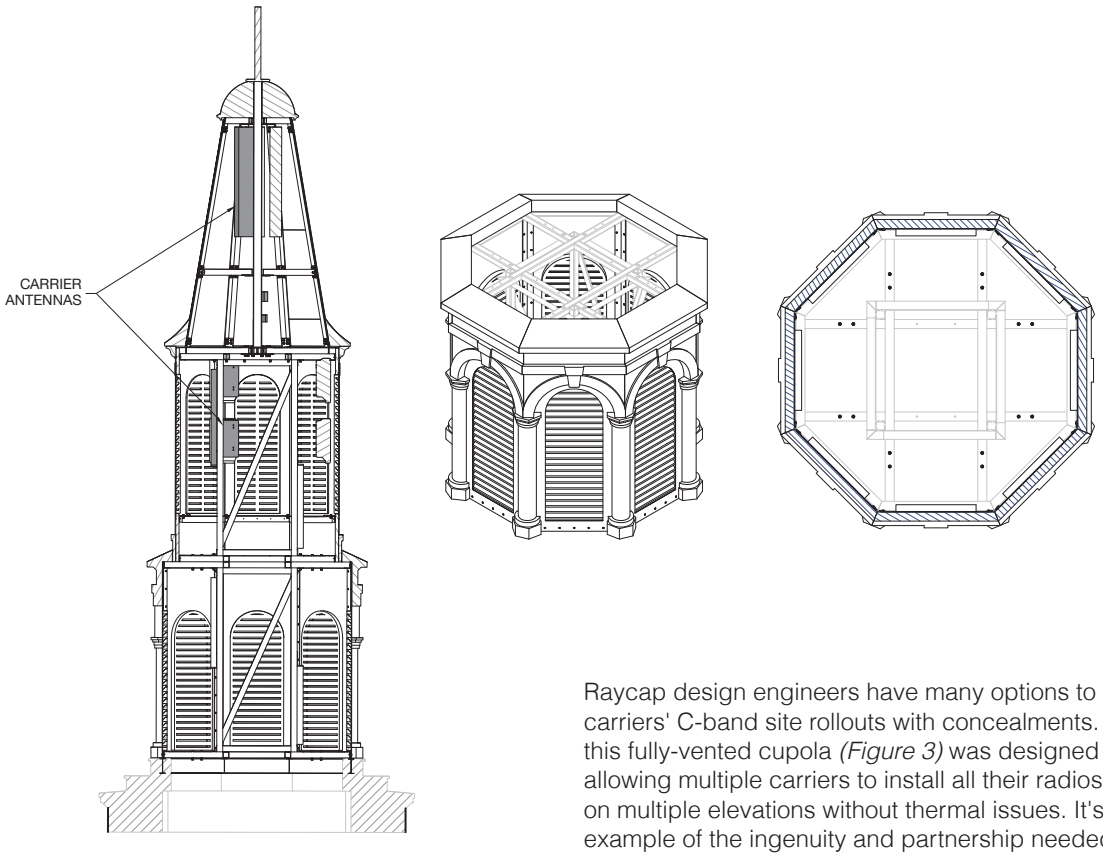

Figure 3: Cupola drawing showing multiple carrier antennas.

Raycap design engineers have many options to support carriers' C-band site rollouts with concealments. For example, this fully-vented cupola *(Figure 3)* was designed for co-location, allowing multiple carriers to install all their radios and antennas on multiple elevations without thermal issues. It's a great example of the ingenuity and partnership needed to enable the cellular connectivity that customers need.

Informed Decision-Making

A detailed thermal analysis can ensure that a proposed solution is likely to work well and indicate when not to proceed. An example of a no-go decision involved a major wireless carrier that wanted to add 5G radios to an existing cell in the downtown area of a major East Coast city.

Like the cases in Massachusetts and Virginia, this cell was installed inside the spire of a landmark building where ventilation was inadequate. Once again, the proposed solution would have to be architecturally appropriate.

In this instance, it was possible to custom-manufacture a replacement spire with ventilated panels that had the appearance of the weathered copper that would have to be replaced. The thermal analysis demonstrated that this solution would work for an initial retrofit but any addition of capacity might stress the heat energy budget for the space.

When given this data, the carrier determined that installing new 5G cell sites nearby was a more cost-effective option. The decision was much easier to make once armed with the work by Raycap's engineering teams that included detailed plans – including costs – for the proposed replacement structure.

New Installation Challenges

In another case, when one of the top US carriers needed a significant wireless service expansion in a highly trafficked public space in another major East Coast city, a partner brought Raycap in to assist with the concealment design. The project involved setting up enough sites to provide adequate spatial coverage and sufficient capacity to support large urban crowds.

This project involved the installation of new sites that would include a mix of 4G (LTE) and 5G. The 5G coverage would consist of both mmWave and C-band. The site contains a one-story structure built near a much taller wall with a marble facade. The wall area just above this structure's roof was a convenient spot to mount the new wireless equipment.

Because there was a requirement to screen the equipment from view, Raycap engineered a screen wall concealment made from specially engineered 5G-friendly material painted to match the marble. A thermal analysis again determined that no additional cooling measures would be required.

5G concealment technology

Municipalities, large and small, frequently request new small cells be hidden or concealed. Concealment technologies include screens and pole toppers that are matched to the surroundings to blend in seamlessly.

With 3G and 4G technologies, installers could often screen off equipment placed on top or mounted to the sides of buildings, and thermal management was less of an issue. However, with 5G technology, it is always advised to conduct a thorough thermal analysis to determine whether additional passive or active cooling is needed.

The spectrum a carrier is using will determine the type of concealment material used. For example, some 5G cells don't need simple concealment – they need concealment technology purposefully engineered to work with 5G wavelengths, in which case Raycap's InvisiWave® technology will need to be deployed.

Summary

There's nothing new about managing thermal budgets nor anything unique about remediating potential problems. Some combination of vents, fans, and active cooling will always be the solution. What's new is that with heat-dissipating 5G radios and antennas now co-located with earlier-generation cellular equipment, the problem isn't just the noonday sun or the occasional heatwave; it's a built-in 24/7 issue.

The increased potential to exceed heat budgets makes it imperative to perform tests and analyze all potential scenarios. Meeting the needs of both 5G retrofits and new 5G installations requires the ability to provide custom mounts, enclosures, and concealment technologies At its US-based manufacturing locations, Raycap can engineer custom structures and develop custom mounts, brackets, concealments, or cabinets to support any network infrastructure equipment needs.

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.

Contact Raycap if you need technical assistance about how to protect against surge or overvoltage damage, or if you have questions about your applications.

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