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Emerging Technology for Fiber

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Two Gray Beards

The cover features an image with Jake MacLeod and Jonathan Adelstein. The inside story is that Adelstein, president and CEO of PCIA – The Wireless Infrastructure Association, intended to shave his beard a few weeks ago. But when *AGL Magazine* scheduled the photo session, Adelstein delayed shaving. You see, MacLeod is president of Gray Beards Consulting — so, that's the jest: two gray beards. For the reason they're on the cover, see page 18.

Commission Support

Safety for tower workers received a boost from FCC Commisisoner Mignon Clyburn, who delivered a keynote address at the Wireless Infrastructure Show April 29 in Hollywood, Florida. Among other things, she said it may be necessary to rethink the safety provision in the contracts between wireless companies and service vendors. "All regulatory options should be on the table," she said.

Commissioner Michael O'Rielly, speaking there on April 28, lauded PCIA's effort to create an apprenticeship program promoting workplace safety and training.

Meanwhile, tower company executives spoke about employee safety during their time onstage at the convention. It is good to see worker safety receive attention at high levels, which may translate into more attention at the jobsite.

Good for Tower Developers

Congratulations are in order for law firm Wiley Rein, which obtained a favorable ruling in April that could be helpful to tower developers. Representing T-Mobile USA, Sprint Spectrum and T-Mobile Northeast, attorneys Joshua S. Turnere, Claire J. Evans and Caroline Rose Van Wie persuaded the U.S. Court of Appeals for the Third Circuit to affirm a lower court's favorable judgment in a wireless tower siting dispute.

The Zoning Board of Adjustment for Paramus, New Jersey, apparently wanted a distributed antenna system instead of a tower. A lower court found that a DAS would be more susceptible to outages, less flexible and designed to fill a coverage gap smaller than the one the tower was intended to cover. The Third Circuit said that carriers "do not bear the burden of proving that every potential alternative, no matter how speculative, is unavailable. The proper inquiry for an effective prohibition claim is whether a good faith effort has been made to identify and evaluate less intrusive alternatives."

The Third Circuit also rejected the zoning board's claim that the Communications Act amounted to unconstitutional commandeering of state government agencies. It said the Act is a valid congressional exercise of power.

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ABOVE GROUND LEVEL agl Magazine™

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FEATURES

POWER SYSTEMS AND BACKUP POWER

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YEAR OF THE CLIMBER

DEPARTMENTS

On the cover: Jake MacLeod, left, and Jonathan Adelstein. MacLeod is the newly named chairman of the PCIA Innovation & Technology Council. Adelstein is PCIA's president and CEO. The two are shown talking at the Diplomat Hotel & Spa in Hollywood, Florida, site of the 2015 Wireless Infrastructure Show, where the Council was launched. *See article on page 18.*

Photography by Don Bishop

Design by Courtney Duggan

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Bigger and Bigger

Where did all the towers go? Answer: to bigger companies!

We just learned that InSite Wireless Group purchased CTI Towers. InSite is a small (closer to medium-sized now) tower and distributed antenna system (DAS) company in Alexandria, Virginia. Through careful acquisitions and intelligent growth, including new technologies, this company is a star in our industry. The transaction takes Comcast out of a noncore business area; it makes sense.

As an old broadcaster, I'm a little surprised that iHeartRadio would let its tower portfolio go. Three hundred sixty-seven towers are going to be joining the Vertical Bridge portfolio shortly. It was an old rule that broadcasters would never give up operations of the transmitters or ownership of the towers; however, it looks as though we really are into a new phase of the broadcasting industry. We're all watching Vertical Bridge and what magic the company can make happen next, and the iHeartRadio assets will be in great hands.

It's fun to watch the carrier consolidation deals of many quarters ago now begin to result in merged networks. It takes considerable time to consolidate technologies, teams and users and their phones, so it is no surprise that AT&T took some time to integrate Leap Wireless's assets, and T-Mobile USA and MetroPCS. The fear of mass site count loss with news of any purchase or merger is the way the chicken-little industry pundits first declare the end of the industry. Of course, over time, we don't see much reduction in site count. All those customers come off of one technology and have to be moved to another. It means more antennas, more backhaul, more spectrum, etc.

We've talked about the AWS-3 auctions before; however, it looks as though Dish Network landed itself in hot water with the FCC. Whether Dish followed the rules to the T or not is not really the question anymore. Dish has shown how easy it is to structure a designated entity deal and save some serious cash at the spectrum checkout counter.

The good news is that the cash from the auction was substantial enough that it looks as though First Reponder Network Authority (FirstNet) will actually be able to build the network it's talked about needing for so long. And we are more than happy to provide tower space for FirstNet. For a fee.

I'm just back from PCIA, so we're a little out of sync for this issue to dig into all of the great things going on, but we certainly will be addressing the show in upcoming issues and in the newsletters.

Having read all the industry publications and news releases, I can see it appears there is more and more concern, real or dreamed up, about RF exposure. I'm still baffled at the lack of accurate information out there. I want the cell site next to the swing set on the schoolyard my kids play on. I want the coverage and the adequate signal strength.

We cover it in some detail in this issue; however, it excites me to see Jake MacLeod taking over the reins of a newly relaunched PCIA Innovation & Technology Council. I was a long-time member back in my days at Crown Castle International. I see such a great need for this group, and of course, Jake is perfectly situated to do the PCIA member companies proud. Perhaps we'll see if we can get some white papers back together. Perhaps on RF exposure.

Rich Biby, Publisher
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Mobile Network Virtualization is Real

By Iain Gillott

A couple of months ago, we had a detailed briefing from AT&T on the status of its ongoing project to virtualize its network. Given the size of AT&T's undertaking (it has a rather large network), you would be forgiven for thinking that AT&T had taken a few baby steps to date and had a decade or so to go before the network was rebuilt/redesigned using virtual principles. As we shall see, this is not the case — AT&T is making real progress.

The concept of network virtualization for the mobile networks has been around for a few years. Although numerous trials and proof-of-concepts have been conducted by operators around the world, showing solutions for the radio access network and Evolved Packet Core (EPC), the majority of commercial deployments to date have been for small segments of an operator's business or for mobile virtual network operators (MVNOs). Of course, given the potential benefits of re-architecting the mobile network using a virtualized approach, the vast majority of mobile operators have investigated the approach and are in the process of deployment. But few details have been made publicly available.

One of the biggest challenges with moving to a software-defined network (SDN)/network functions virtualization (NFV) architecture is shifting the employee mindset and skillset to that of a software company. AT&T noted this first in its briefing; the company is now thinking of itself as a software company, not a telco. Obviously, for those of us who have grown up with networks, class 5 switches, time-division multiplexing and the like, this is a big shift. Employee training has obviously had to change to accommodate this need.

> *"Operating expenses are falling, allowing the large operators to offer a lot more bandwidth for slightly more dollars while maintaining or growing revenue."*

Time and Planning

To put some scale on the task ahead of it, consider that AT&T, in addition to its regional data centers, has approximately 4,600 central offices or local data centers, depending on your nomenclature. Although these locations originally housed local switches (and were referred to as switching centers by some), their role has shifted in an era of soft switches, remote radio heads and locally cached content. Updating 4,600 of anything takes time and careful planning, especially when the revenue-generating network is still in full use.

AT&T is migrating its mobile packet core to a new architecture using standard off-the-shelf hardware; this is the main effort for 2015 and it affects a significant amount of AT&T's mobile traffic. To date, in line with the approach taken by other mobile operators, AT&T has used virtualized packet core

GUEST OPINION

solutions to support its MVNO and connected car businesses. This will change in 2015 as more of AT&T's core revenue-generating traffic shifts to a virtualized EPC.

Focus on the Backbone

In 2016, the focus of the virtualization project will shift to the backbone. The goal is that, by 2020, approximately 75 percent of AT&T's 150 network functions will be cloud-based and under NFV control. At the end of 2014, approximately 5 percent of the network functions were cloud-based.

AT&T expects much of the benefit from the SDN/NFV architecture to come from reduced operating expenses. Obviously, this step is critical to AT&T's remaining competitive moving forward because mobile revenue isn't likely to (some would say "certain not to") increase at the same pace as the demand for mobile bandwidth. The ability to get more out of the network at lower operating cost (and therefore at a lower effective cost per gigabyte delivered) is therefore paramount to AT&T being able to maintain and grow margins. AT&T's reduction in capital spending has been well publicized (and blamed for lower-than-expected results at the major infrastructure vendors in the final quarter of 2014) and it is interesting to note that in the briefing, the company said the shift to SDN was part of the reason for the drop.

So what does this all really mean? Simply that mobile networks are changing, and fast. The amount of dollars spent and where they are directed is shifting. Operating expenses are falling, allowing the large operators to offer a lot more bandwidth for slightly more dollars while maintaining or growing revenue. The ability to compete in 2019 and 2020 will not depend on the technical solutions delivered in a few years — the seeds of future competition are being sown now.

Iain Gillott is the founder and president of iGR and iGR Semiconductor Research. His email address is iain@iGR-inc.com.

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GUEST OPINION

The Super Bowl Brought the Best Teams Together, and That's Just the DAS Deployments

By J. Sharpe Smith

The Seattle Seahawks battled the New England Patriots in the 49th Super Bowl, or you could call it the "battle for data throughput."

There are two things John Spindler, director of product management for TE Connectivity, could count on as his company worked to ensure wireless service for fans, workers, media and NFL executives in the Phoenix area for the Super Bowl — wireless data processing would be measured in terabytes, and the systems would be more complex than ever.

At the University of Phoenix stadium, home of the NFL's Arizona Cardinals, TE deployed FlexWave Spectrum DAS to boost mobile coverage and capacity.

The Cardinals' stadium is sort of a home field for TE. It deployed a 33-sector distributed antenna system (DAS) network at the venue two years ago. The new system ups that number to 48 sectors and includes 96 main hubs, 49 expansion hubs and 225 remote antenna units to cover the stadium bowl, luxury boxes and service areas. The system supports various 700-, 800-, 850-, 1900- and 2100-MHz LTE, CDMA, EVDO and UMTS services.

Indoor antennas for cellular service.

Super Bowl Hosted Two DAS

This year's system was used by neutral-host provider Crown Castle International to serve the nation's big four carriers at the stadium. On the other hand, at last year's Super Bowl at Metlife Stadium, Verizon deployed a 44-sector TE Connectivity system, and AT&T deployed its own Commscope system, which used 63 RF sectors.

"In a way, a neutral-host provider makes things easier for the venue owner, who doesn't have to negotiate with multiple operators," Spindler said. "There are other efficiencies with a single system in terms of equipment placement and construction."

Verizon said last year's system carried 1.9 terabytes of data, and 50 percent of it used the AWS frequencies, while AT&T reported 624 gigabytes.

"That's a massive amount of traffic. Every year it amps up. Demand for capacity is not slowing down," Spindler said. "That is the most sectors in any system that I have been involved with."

High-profile Events

TE has experience providing DAS for large-venue, high-profile events, such as the Major League Baseball and National Hockey League all-star games, stretching all the way back to the Salt Lake City Winter Olympics in 2012.

"There is a certain amount of prestige to have your equipment chosen to support a major event, such as the Super Bowl," Spindler said. "It demands a lot of preparation

and attention to detail from the design standpoint to make sure you have a system that will perform to the requirements. We work closely with all the constituents. The carriers each have specific ideas on the capacity needs that are going to be required."

Super Bowl Transforms Stadium

The original design of the DAS at the Cardinal's stadium featured 850-MHz and 1900-MHz single-input, single-output (SISO) communications, 700-MHz multiple-input, multiple-output (MIMO) communications and AWS MIMO, and it served three operators. Along with additional sectors, the system made room for an additional carrier, Sprint, and its 800-MHz frequencies. It also increased the use of MIMO and used a double-starred design with a host that goes out to multiple expansion groups, which then go out to multiple remotes.

"We added roughly a third more sectors and went from SISO to MIMO at 1900 MHz, which is all about driving more capacity into the stadium," Spindler said.

For the stadium alone, there are three different headends. Two carriers share one headend, and the two other carriers each have their own headend.

An active integration panel.

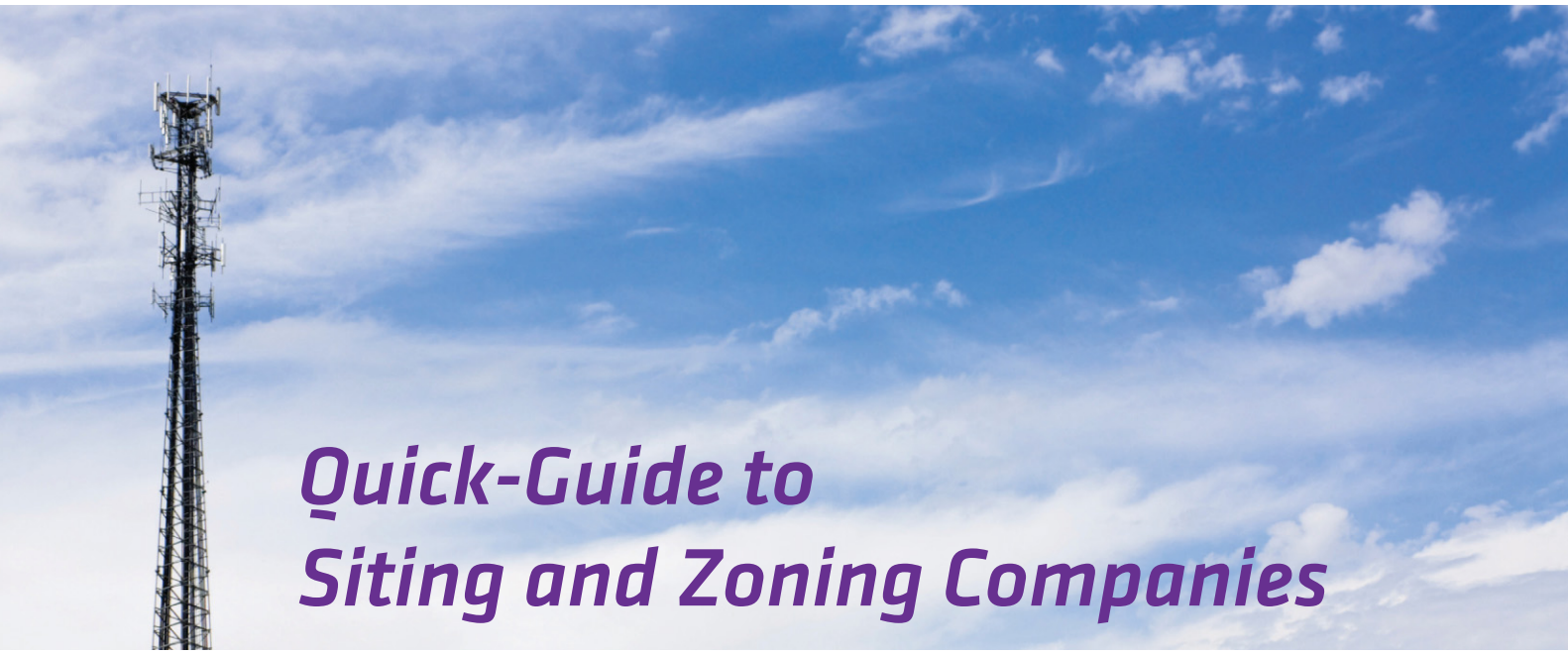
Beyond the Gridiron

Everyone knows the game is only part of the Super Bowl experience as parties fill every club, hotel and open-air venue. To provide blanket coverage, carriers spent years pumping up the LTE data capacity not only in Glendale, but also central Phoenix and Scottsdale, with new advancements such as LTE-Advanced and broadcast LTE.

A base station hotel 1.2 miles away feeds the University of Phoenix stadium, Gila River Arena and the Renaissance Phoenix Downtown Hotel, using a TE digital fiber link. In downtown Phoenix, TE's FlexWave Prism DAS was deployed at the Hyatt Regency Hotel, the headquarters for NFL executives, and at CityScape, an outdoor visitor center.

Elsewhere, TE's FlexWave Spectrum DAS with the common public radio interface (CPRI) digital interface unit was deployed at Talking Stick Resort Arena, formerly America West Arena and US Airways Center, which served as the media center. In addition, TE's host-to-host technology was deployed to link a base station hotel in downtown Phoenix with Talking Stick Resort Arena, the Hyatt Regency, Chase Field and the Phoenix Convention Center.

FlexWave digital host units.



Quick-Guide to Siting and Zoning Companies

As a supplement to *AGL Magazine's* January Buyers Guide, a list of siting and zoning companies offers more detail to help you choose a vendor for your next project. Where shown, logos and company descriptions were provided by and paid for by each company.

advantage engineers

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Isotrope
503 Main St.
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In the March issue's Quick-Guide to Test Equipment Companies, I typed a letter wrong and it made a big difference. It misidentified a vector network analyzer (VNA) as a VNI, causing confusion. In an effort to make up for the error, here is the listing once again with the correct product identification. *—Editor*

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And in the April issue's Quick-Guide to Tower Manufacturing Companies, another typing error on my part led to an incorrect listing for Larson Camouflage, misspelling Tom Feddersen's name and email address. Here is the correct listing. *—Editor*

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John Paleski
732.607.2828
subcom1@subcarrier.com
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Services: siting, zoning, estimating, consulting, development, turnkey system, site acquisition
Company description: Subcarrier Communications is a provider of telecommunications sites and services throughout the United States. The company's primary business is leasing antenna space on its multitenant towers and exclusively managed building rooftops.

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PCIA Launches Its Innovation & Technology Council

The new council will help focus the technical efforts of PCIA into work products that the association and its members can use with policymakers, and will help guide the growth of the wireless infrastructure industry.

By Richard P. Biby, P.E.

Wireless infrastructure industry executives who are joining the new PCIA Innovation & Technology Council to help to shape the wireless infrastructure industry's future gathered in Hollywood, Florida, on April 30 at the council's inaugural meeting. Membership is open to C-level and VP-level members of PCIA and the HetNet Forum who have a role in wireless technology.

"The U.S. wireless infrastructure industry is a model for the world," said Jonathan Adelstein, PCIA's president and CEO, in announcing the formation of the council. "Through the aggressive pursuit of policies that spurred investment and accelerated deployment, our members have deployed LTE faster and to more people than any other country in the world. Now, PCIA wants our members to be as well-informed as possible about the opportunities and challenges that accompany the next generation of wireless. We have established the Innovation & Technology Council to identify issues we can address to promote efficient and rapid wireless broadband deployment."

I spoke with Adelstein and with the new council's chairman, Jake MacLeod, who also is president of Gray Beards Consulting. What follows are their remarks, edited for length and style.

AGL Magazine: How will the council focus its efforts?

MacLeod: We're going to prioritize and deliver valuable information to our membership. There are many moving parts regarding 4G and 5G deployment, everything from proximity services to connected car to sensor networks to small cells. We will help everyone to come to a common understanding about the features and functionality and how that impacts the infrastructure of the network.

Adelstein: We want to look at the effects and potential benefits of wireless infrastructure deployments on Voice over LTE. We want to look at License-Assisted Access, LAA-LTE from unlicensed spectrum, network function virtualization (NFV) that's operated by networks, and carrier aggregation (CA) and its implications for wireless infrastructure. We want to look at machine-to-machine (M2M) transmission, which is where a lot of traffic is increasingly going. We want to look at connected cars and public safety. Many areas need the council's attention to sort out the implications for wireless infrastructure and make sure that our industry can deliver the products and bandwidth that are needed to meet the wireless data crunch.

Capital expenses are a huge

concern of the industry, and budgets are not unlimited. We have to consider the level of capex spending that is available and find how we can help ensure that it's deployed efficiently. We expect that thought leadership from the council will help drive capex in the right direction.

AGL Magazine: What makes network function virtualization (NFV) so important?

MacLeod: NFV allows the wireless carrier to segment a network function that supports a customer feature and virtualize it. At present, carriers use specific servers to provide their networks with specific functions. That method is capital-intensive. We've been able to determine ways to virtualize functions to pull them into the network on an as-needed basis, thereby conserving traffic on the fronthaul and backhaul networks. This action ultimately results in higher efficiency and less cost.

With NFV, the carrier can integrate the function with other capital equipment. Then, if and when a customer wants to use the feature, the network recognizes that the feature is in the customer's profile and that the customer is willing to pay to use it. The network then allows the customer to access the feature or function for the time frame involved. When the customer is done with it, the function reverts back to the network core, as opposed to remaining resident on distributed servers dedicated to that function. That is network function virtualization.

The use of NFV has a big effect on wireless infrastructure. You'll hear talk about fronthaul as opposed to backhaul. Fronthaul is the ability to deliver the virtualized function to the end-user with low latency and high reliability. Backhaul transports the traffic back to the core and out to the world. NFV requires the use of fiber-optic transmission or extremely high-capacity, high-speed microwave service.

AGL Magazine: The PCIA Innovation & Technology Council will draw upon ideas from its members. Where might it also look outside the council for ideas?

MacLeod: Among other opportunities, I would like to bring to the council an opportunity to interface with U.S. National Laboratories to expose the council membership to the applicable science that is being developed in the labs.

For example, two of the National Laboratories are focusing on nanomaterials. Imagine the impact if they developed a coating, for example? (And I'm just throwing this out as a blue sky example, I'm not saying that they have developed this.) What if they came out with a paint that reduced passive intermodulation (PIM) interference or a coating that could be sprayed onto antenna structures or onto the lenses of the antennas that would significantly reduce interference? Interference mitigation is a huge issue in our industry.

If we can come across a science of any kind that is being developed and if it could assist us even by a

PCIA Innovation & Technology Council

The council offers its members options to:

- Participate with their executive colleagues in semiannual face-to-face and virtual meetings to discuss critical industry issues
- Represent their companies' positions on a wide range of topics, particularly those related to 4G/5G technology deployment
- Collaborate with colleagues to develop and produce content (webinars, in-person events, white papers, research and fact sheets) tailored to ensure timely dissemination of key topics vital to the membership and the industry at large
- Participate in media opportunities such as press conferences, media education and press interviews

Source: PCIA

factor of 10 percent, it would bring a huge benefit to the industry monetarily and operationally. Those are the kinds of explorations that we're going to approach and see what the council's membership may want to do with them.

We'll also have outside speakers come into the council and provide their input. For example, network operators who would come in and say, "OK, here are the three things that keep me awake at night. How can you guys address these and help with them?" From the point of view of manufacturers and deployment specialists, those kinds of discussions are highly valuable and provide focus.

AGL Magazine: How will the council help the wireless infrastructure industry with legislative and regulatory matters?

Adelstein: In recognizing huge growth projections for data transmission, the wireless infrastructure industry plays a role as a technology champion and as an advocate for wireless on Capitol Hill, at the FCC, and among other regulatory agencies and at the state and local levels. Having the latest information about technological trends can help us to educate policymakers about issues that are critical to our industry.

We're seeing increasing focus from policymakers at all levels of government regarding the deployment of wireless infrastructure. This is because they recognize through their own personal experience how essential wireless data is to their lives and to the lives of people in their communities. Wireless infrastructure and the networks they support are expensive to deploy. Consumers want to receive these services as inexpensively as possible, hence we need to reduce the regulatory burden in order to meet the increasing consumer demand for wireless data. The PCIA Innovation & Technology Council will help us on many fronts, including advocacy.

MacLeod: Technology and policy go hand in hand. One of the only ways the leadership in the U.S. Congress obtains valid information is from industry representatives like PCIA. It's our duty to inform them about the potential effects of their decisions before they make them. They're open to listening to industry representatives who are well-informed and who have statistical information that they can use, from the FCC to state legislatures to the floor of the U.S. Senate or the House. The Innovation & Technology Council is a valuable entity within PCIA that coordinates well with the policy initiatives.

AGL Magazine: What do you anticipate as some of the tangible products to result from council activities?

MacLeod: Once we establish the council's priorities, we'll set up working groups with specific objectives and specific deliverables for review by the membership. YouTube might be used to offer videos of the council's debate regarding salient issues in the industry. Working groups may produce white papers that address specific developments, such as network function virtualization.

Each working group will have its finite deliverable. Once the deliverable is completed, the working group will be disbanded. I don't like working groups that just go on and on and on and eventually fade into the sunset. They're typically not as productive as a working group that has specific objectives and time-phased deliverables. We wish to make the most of the allocated resources.

Adelstein: The PCIA Innovation & Technology Council can function like a think tank for the industry, and we want to produce clear thought leadership in writing. The task force will inform the ideas to the PCIA staff, and our consultants will help translate that into white papers. As an industry consensus body, we are able to take the input, assimilate it, put it back out to the members of the council for their edits, and then have a document that the industry has really spent some time and effort to vet. We want to channel the efforts of our members into productive work products that they can use, that we can use with policymakers, and that will help to guide the direction of the wireless infrastructure industry.

The PCIA membership has some of the leading technical lights of the industry who have led the development of new technologies in wireless infrastructure. We are at the best place possible, an inflection point between 4G and 5G, at a time when PCIA has technical expertise among its members and the leadership of Jake MacLeod. This creates an environment conducive to a highly productive council.

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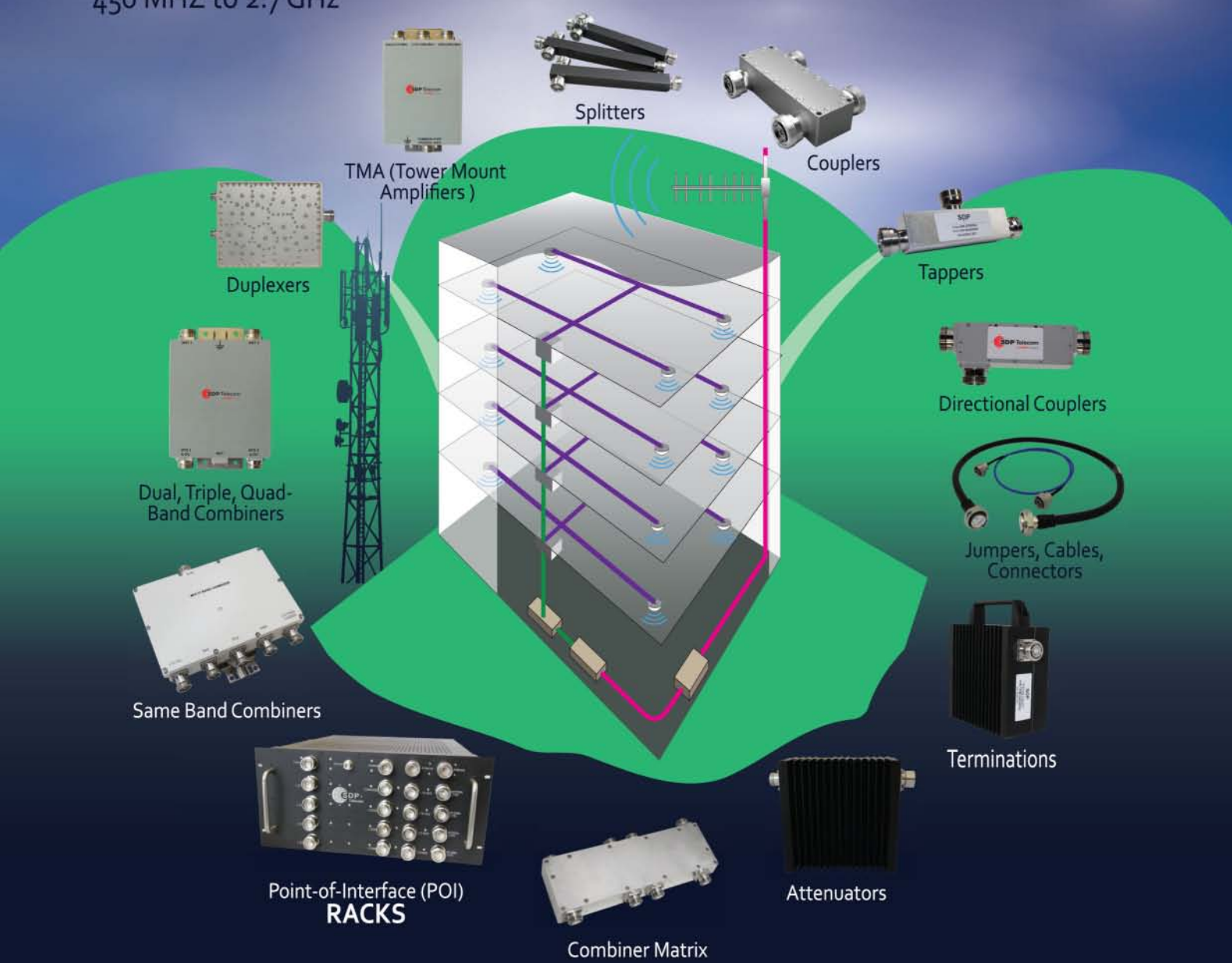

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Engineered to *Outperform*

Camouflaged Towers: Price Versus Cost

Wireless telecommunications carriers that work with manufacturers of high-quality concealment as a part of the antenna site development team can save vast amounts of time and money.

By Rienk Ayers

It was almost becoming a tradition. For the third year in a row I received a call regarding the exact same site.

The first year, we were asked to quote a pine tree tower in New England. Ours wasn't the low bid, so we didn't win the project.

The following year, we were asked to quote a set of replacement branches for the tree because a winter storm caused a large number of them to break off in a classic domino effect. Once again, the buyer decided to go with someone who was cheaper.

These are from the second set of branches described in the article text on this page. PVC becomes brittle over time – especially in the cold – and has no structural strength of its own. Without a formal structural layup, hand-applied fiberglass mat or roving also has no structual strength of its own.

The exact same thing happened the third year (see photo left), but now we were asked if we could offer a price break because the buyer had spent so much already. We declined, and we received an order for a set of branches anyway, and the site has been trouble-free going on six years.

This is a prime example of the disconnect between price and cost in the camouflaged tower industry. Three sets of branches, three mobilizations — all vain attempts to save a few percent up front. Unfortunately, this pennywise and dollar foolish mentality has become pervasive throughout the wireless telecommunications business, and especially in the concealment sector, though this hasn't always been the case.

Chameleon Engineering was one of the first companies to

Engineering and Testing

One of the biggest differences among manufacturers is the level of engineering and testing done — both wind tunnel testing and structural analysis.

Many companies don't test their products, and a number of branch manufacturers are no exception. The materials used to make the branches and the amount of foliage currently used makes a difference in effective wind pressure of the branch and thus on the mounting system and the tower itself. It also makes a huge difference in how long the branches and foliage last.

A dark secret of the concealment industry is that only a few manufacturers can prove that their branch mounts (receivers) meet code — most don't. This is why they show no calculations for branch mounts. Many let the customer assume that because the pole meets a structural capacity requirement that all of the other parts also do — when they actually don't. This is true with appurtenances from T-arm mounts to branch receivers. Caveat emptor.

introduce aesthetic realism with high-quality materials and systems, and it rapidly changed the industry. Our products were so well received, numerous jurisdictions established ordinances stating all concealment trees must be "Chameleon Engineering or equivalent." Soon, other manufacturers claimed their products were equivalent and less expensive, and not because they had better efficiency or lower margins, but instead it was because they offered cheaper products.

For a while, this tactic didn't gain much traction, but then the industry changed. With a race to the bottom in site development fees and a corresponding high turnover among personnel, the only thing that began to matter was price. Quality was no longer important. After all, by the time problems were discovered, those responsible were long gone. Cost was trumped by price, and value was replaced by expediency.

Because the wireless telecommunications carriers didn't care and jurisdictions didn't know better, concealment manufacturers started a cycle of doing whatever they could get away with to lower prices. The mantra of many became, "It's good enough." Some just copied what others were doing and assumed that proper testing must have been done by the other guy, and they hoped that the replicas also would pass muster. It was not a safe assumption.

In comparison, Chameleon takes quality seriously. If a branch is not resilient enough to avoid

This is about as cheap as bark can get – use a tile trowel to spread stucco on a pole.

When realism is important, this is the best bark available. It is molded from real trees and then applied to the tower (and with newer processes, it holds up as well as any other bark).

breaking when dropped from the truck, let alone from a manlift, how will it handle being subjected to sun, wind, rain, snow or ice for years? I enjoy it when customers visit our shop to see how our branches are made. They invariably step back when I throw my large mass at a branch, twisting it toward the ground like a steer wrestler, because they expect it to shatter and break. They are duly impressed when it simply returns to its normal position, impervious to such abuse. Similarly, we encourage customers to try pulling foliage out of our branches, and then compare it with other manufacturers' products. Foliage bonded into a solid branch is going to fare better than foliage glued to a hollow PVC tube, let alone foliage that is popped together or not glued at all.

With panels, we couldn't make the foam core system work to our satisfaction, and we weren't going to make uncontrolled and poorly finished hand layups or

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use inappropriate off-the-shelf materials. With our experience in aviation, we use military-aerospace materials and processes to make the strongest and lightest RF-friendly panels and radomes available. We are confident about our systems.

A good indicator of how a company feels about its products is to see how many close-up photos it's willing to show. Beauty shots from far away are one thing, but is a company willing to show details of its panels or branches? Will it reveal how they are made or what loads they can take? All products show wear sooner or later, but how do they compare? You can't fault a company for using fewer branches 10 years ago than would be common now. You can't expect a faux tree to grow replacement fake foliage. But how does the product hold up? And does the company have objective, empirical data to prove its claims?

What compromises in aesthetics, quality and durability has the industry made?

Regarding trees, bark molded from real trees gave way to hand-applied or troweled-on bark, and solid-cast branches lost ground to brittle plastic tubing. Manufacturers used fewer branches, shorter branches, smaller foliage or less foliage — anything to reduce the price. Some companies asserted that fiberglass wrapped around PVC tubing was adequate because when viewed from a sufficient distance, the looks didn't matter. Others claimed that even the fiberglass isn't necessary, and they simply coated PVC tubing with construction adhesive. These steps were driven by customers that really didn't want their product in the first place. The situation became so untenable that Chameleon nearly left the wireless industry.

Photosimulations

One aspect that exacerbated this problem was something that is supposed to help — photosimulations. Because concealment manufacturers are rarely involved in the beginning of the site development process,

Foliage used in PhotoSim

Actual foliage from the jobsite

Original foliage provided

Revised Foliage

Photosimulations: A Tale of Three Cities

• One jurisdiction was so concerned about how dense the foliage on a tree looked, it insisted on more and more branches. The photosimulation company obliged by twice cloning the original set of branches on the tree. The carrier then asked for competitive bids to match the photosim. However, most proposals were submitted with less than half of the branches shown on the photosim; thus, any manufacturer submitting a proposal that matched the simulation would lose. The jurisdiction was predictably unhappy with what the winning bidder provided and required the carrier to add more branches after the tree was installed, which made for an expensive on-site modification. The jurisdiction also increased restrictions on towers camouflaged as trees.

• Another city requested photosims for a tower disguised as a eucalyptus tree. The zoning consultant used a photo from another site instead of photos provided by the manufacturer of the tree. The photo submitted was based on a ficus tree style of leaf, and not the slender, drooping eucalyptus leaves at the site. Even though the foliage delivered best matched the locale, the city expressed frustration at what appeared to be bait-and-switch tactics and required the carrier to replace the foliage with something completely different (see photos at the left).

• The third city was not only concerned about the look of the tree, but also its longevity. For a large group of sites, not only did the city insist on seeing exact representations of what the trees would look like (several companies offer such 3-D services whereby even tree foliage can be accurately shown), it also insisted on longer warranties for color durability. We have processes to extend color durability that, although they increase the price, result in a lower cost over time because the branches don't need to be replaced as often. More importantly, months are saved by adequately taking care of the city's concerns sooner, rather than later.

developers show photosims of good-looking trees to jurisdictions, but these trees often are not what eventually is provided when the low-cost bidding process concludes, or the photosims' distant vantage points wouldn't adequately show what the tree would look like close up, and the planners felt misled once they saw a closer view of the product.

Eventually, jurisdictions started realizing that they were getting the short end of the fake stick. Yet with limited resources and little appropriate expertise, they still don't know what the best solution is. As trees became less realistic — not more — the jurisdictions scrambled for control, but loopholes abound, and the carriers don't seem to realize that they are the ones paying the price.

As with any industry, wireless carriers are more than willing to spend money on infrastructure that makes them more competitive or efficient, but concealment does nothing to directly enhance the bottom line — it is viewed simply as a necessary evil. To this day, most people on the front lines of site development don't stop to think about the ramifications of how cheap products might save a few bucks now, but cost so much more later.

Additionally, it seems as though senior management is too far removed from the tactical side to understand the strategic effect of this problem. But take a moment to think about it. When you realize how much revenue is missed for each day that a single site is not yet on-air, and how many months are now wasted in the approval process because of the pushback from jurisdictions over simple aesthetic or durability concerns, the snowballing cost to the industry is staggering. For example, if only two months were shaved off the approval process, at an average daily site revenue of $5,000 per day, a carrier could justify paying for quality and still net more than $250,000 per site. That figure doesn't include the additional savings for the carriers and their site development teams that come from spending two months' less time working on the site.

With some manufacturers, the use of solid-cast branches lost ground to brittle plastic tubing that breaks easily when there is little structural support.

And yet, for the sake of saving a few thousand dollars, front-line teams unintentionally end up poisoning the well in jurisdiction after jurisdiction, making the future more difficult for themselves and much more expensive for the carriers.

Hopefully, the industry will soon recognize that concealment is not the ugly stepchild of network expansion, but instead it is a critical partner in the rapid deployment of a large percentage of future sites. It would behoove carriers to pursue a course correction with regard to camouflage. By working with manufacturers of high-quality concealment as a part of the team, time and money can be saved — which will benefit the entire industry, along with the customers we serve.

A rustic western water tank has aerospace-grade panels, custom-formed to duplicate weathered wood and to match an old barn. Inset: A close-up of the grain detail in the fibergass-reinforced panel.

Rienk Ayers is general manager of Chameleon Engineering. His email address is rienk@chameleonengineering.com.

OPINION

New York Federal Court Rejects Town's Denial of Wireless Tower Site

A growing line of important precedents supports the federal goal of rapid and robust deployment of wireless services.

By Andrew Schriever

An underserved community of businesses and residences in East Fishkill, New York, will now have much needed mobile service thanks to a recent decision by the United States District Court for the Southern District of New York. The District Court, on Jan. 30, applied the Telecommunications Act of 1996 to strike down a denial by the Town of East Fishkill that blocked the development of Homeland Towers' proposed 150-foot monopole on a 16-acre wooded site — which site was selected in part because of the abundant natural vegetative screening that would greatly reduce any aesthetic impact. Co-plaintiff (and co-applicant before the town government) Verizon Wireless sought to install a wireless facility at the site to provide mobile data and voice services to the businesses, residences and approximately 35,000 people who travel through daily, including along local roads and the Taconic State Parkway where E911 access is especially critical. This case is distinctive for being one of the first to apply an October 2014 FCC Order interpreting the "Spectrum Act."

In a comprehensive 72-page decision in the case captioned as *Orange County-Poughkeepsie Limited Partnership d/b/a Verizon Wireless and Homeland Towers, LLC v. Town of East Fishkill, et al.*, 13 Civ. 4791 (KMK) (S.D.H. Jan. 30, 2015), Federal Judge Kenneth M. Karas rejected the town government's efforts to come up with after-the-fact justifications for the denial, which justifications were, in any event, unsupported by the record. In declining to adopt the town's arguments, the court noted that it did not believe legal precedent would allow it to entertain post-hoc rationalizations that were not supported by language in the written denial or some other contemporaneous writing, relying on the United States Supreme Court's recent ruling in *T-Mobile South, LLC v. City of Roswell, Ga.*, 135 S. Ct. 808 (2015) and *MetroPCS N.Y. LLC v. City of Mount Vernon*, 739 F. Supp. 2d 409 (S.D.N.Y. 2010), the latter case also litigated by the law firm of Cuddy & Feder.

The case also presents one of the first instances in which a federal court applied a recent FCC order issued in October 2014, which was addressed to Section 6409(a) of the Middle Class Tax Relief and Job Creation Act of 2012 (a/k/a the Spectrum Act). That law was passed to overcome bureaucratic delays in wireless infrastructure deployment by requiring municipalities to approve applications for collocations and modifications that do not substantially change the physical dimensions of an existing wireless facility. The town argued that, although the tower was designed to collocate five carriers, none of the carriers would be able to locate below Verizon (which would be at the top) and that every carrier that came after could rely on Section 6409 to require the town to approve indefinite extensions of the height of the tower. In examining the implications of Section 6409 for the first time in

the context of a new tower application, the court rejected this argument, pointing out that under the FCC order, extensions are available once and municipalities still retain the ability to deny a Section 6409 application under certain conditions, so the town's concerns about mandatory indefinite tower height extensions were not established.

The court also overruled the town's argument that the plaintiffs had an obligation to demonstrate that future carriers would be technically able to collocate below the Verizon antennas. The court initially noted that the town's code contained no such requirement, so that inquiry was impermissible under state law and the Telecommunication Act's mandate that a denial be supported by substantial evidence. The court then observed that "a requirement that an applicant demonstrate a proposed tower could support the frequency needs of other providers may turn on technical and operational matters over which the FCC and the federal government have exclusive authority," quoting the case of *N.Y. SMSA Ltd. P'ship v. Town of Clarkstown*, 612 F.3d 97, 106 (2d Cir. 2010). The *Clarkstown* case (in which Cuddy & Feder served as co-plaintiffs' counsel) made clear that municipalities are federally preempted from imposing requirements on carriers and wireless siting applications that infringe on the FCC's and Congress' regulation of wireless technology. In this case, the town's arguments that it could require Homeland Towers and Verizon to demonstrate other carriers' technical requirements as part of its zoning review ran afoul of the federal preemption doctrine upheld in *Clarkstown*.

The *East Fishkill* decision otherwise reaffirmed and discussed at length several precedents where the wireless industry prevailed by proving that a denial was unsupported by substantial evidence and had the effect of prohibiting wireless services. Chief among the court's findings was the recognition that in establishing an effective prohibition claim, "the size of the gap is by no means determinative" and that a gap is significant (and therefore needs to be filled in furtherance of federal policy favoring rapid robust deployment) not only based on its size, but also based on the number of people adversely affected, which in this case would include local residents, businesses and visitors, as well as 35,000 daily travelers along this commuter route. The size of the gap that would affect people in the town as well as those travelers in this case spanned approximately 2 miles along the Taconic and 1.6 miles along State Route 82, and the court recognized that a finding of its significance is in line with other recent federal cases in which such distances were found to be significant, such as where gaps ranged from 0.6 miles to less than 2 miles. The decision also admonished the town for relying on "findings" that were unsupported by actual evidence, such as the zoning board chair's uncorroborated suggestion that the gap was only a quarter mile, and the town's decision to rely on a real estate broker's affidavit suggesting that property values would decline without offering supporting data, in contrast to the appraiser's affidavit submitted by the applicants, which concluded there would be no adverse property value effect, based on comparable real estate market data.

The *East Fishkill* decision contributes to a growing line of important precedents supporting the federal goals of rapid and robust deployment of wireless services, and it provides those seeking to provide the infrastructure for these services with another tool to help guide the municipal review process. The case also reaffirms the fundamental proposition that facts — not assertions — must drive the municipal review process, and where an application adheres to a town's code, or where an applicant demonstrates that a proposed facility fills a significant gap and constitutes the least intrusive means to fill that gap, federal policy will not allow municipal authorities to thwart appropriate wireless deployments.

Andrew Schriever served as lead litigation counsel in the East Fishkill case together with a team led by Cuddy & Feder's Telecommunication Department Chair and NYSWA President Christopher B. Fisher, and with Land Use Department Chair and NYSWA Regulatory Committee Chair Anthony B. Gioffre III, who prosecuted the municipal application with Anthony F. Morando. For copies of the decision or other inquiries about Cuddy & Feder's practice, please contact Fisher at 914.761.1300 or at telecommunications@cuddyfeder.com.

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Intellectual Property in the Telecommunications Structure Industry

The right patent or collection of patents may bring value to your business in multiple ways.

By Abdul Basit

As technology has become more prevalent in the way that we work, live, and especially, communicate, intellectual property has also become more important to organizations in how they protect their technological innovations and maintain market leadership. This is especially true in the communications industry, and, particularly, the wireless infrastructure industry.

Multiple wireless carriers apply for patents. Verizon Wireless, for example, was issued 668 patents in 2012. Other corporations associated with the wireless and broadcast industries have also received patents, such as Samsung with 4,654, Qualcomm with 2,182, and Research in Motion with 817 patents, according to a 2013 report by the Intellectual Property Owners Association based on an analysis of the U.S. Patent and Trademark Office's databases. Some of these companies' patents are for improvements to wireless infrastructure, such as tower technology, LTE technology and M2M technology. As such, companies of all sizes use patents to protect many different technological ideas.

In the wireless infrastructure industry, for example, the size, shape and metal composition used to fabricate a tower can be investigated for intellectual property protection. Electronic hardware components such as antenna devices and battery backup systems could be investigated for such protection. Software technologies used to control the operations and functions of a tower might also qualify for protection.

The following information will provide a brief introduction to how patents can be used as an asset, what is a patent, the process of obtaining a patent, and the types of technologies that could receive patent protection in the telecommunications sector.

Patent Use in Business

A patent holder can use a patent as an asset in a number of different ways. If the patent holder determines that others are making or using the patent, then the patent holder can negotiate a licensing fee to be paid by the patent infringer to the patent holder. A license allows an infringer to continue to make or use the invention with the patent holder's permission. Or, a patent holder can take the infringer to federal court and force the infringer to pay penalties and costs to the patent holder.

Patents can also be used as a company asset. For example, Google purchased Motorola's patent portfolio for $4 billion. Other organizations have created marketplaces, such as auctions, that allow for the selling and buying of intellectual property assets. Organizations can also use intellectual property as a strategic tool to work with investors and banks to obtain funding.

Patents can be used to alert competitors that you have the intellectual resources, including engineers, scientists and researchers to maintain technical and strategic leadership in your

technology segment. These factors are especially useful in one of the world's most competitive and technically advanced markets, telecommunications, where a strong intellectual property strategy can sometimes mean the difference between success and failure.

What Is a Patent?

Patent rights have existed since the founding of the United States and are based upon Article One, Section 8, Clause 8 of the United States Constitution. Patents were initially issued after approval by a commission that included several prominent members of the president's cabinet, and the patent commission at one time included Thomas Jefferson. As the demand for patents grew, the Patent Act of 1836 created the U.S. Patent Office for the purpose of examining patent applications and issuing patents.

According to the United States Patent and Trademark Office, a patent is a "property right given to an inventor to exclude others from making, using, offering for sale, or selling the invention throughout the United States or importing the invention into the United States." Patents do not provide a right to make or perform an invention, but rather the right to exclude others from making or performing the invention.

Patents can be obtained for a machine or apparatus, such as a wireless router, and for methods and systems to make or perform an invention, such as a method to determine quality of service or a method to process wireless communications. The evolution and the controversies of patent law have coincided with technology advancements in genetics and software, among other technology areas. According to a 2010 analysis by the U.S. Department of Commerce, intellectual property for American companies was worth $5.06 trillion and was directly responsible for 27 million jobs within the United States.

Telecom Infrastructure Patents

Some patents sought by telecommunications companies relate to tower technology. Besides those previously mentioned, patents relating to telecommunication infrastructure can be for equipment and processes to distribute communications, software to control one or more aspects of a wireless communication system, and a multitude of other ideas associated with the business of generating and distributing communications.

How to Obtain a Patent

The process of obtaining a patent starts with filing a patent application with the United States Patent and Trademark Office. The substantive portion of the patent application includes a written description of the invention, drawings and claims, which are used to create the boundaries of protection for the invention. Once the patent application is filed, it can take six to 18 months before an examiner begins the examination process.

During the examination process, the examiner will determine whether to issue the application as a patent or whether the application should be rejected because it does not meet the requirements of patentability. During the process, the applicant has the opportunity to respond to rejections.

The examination process has several possible outcomes. The examiner and the applicant can come to an agreement and the examiner can allow the application. The examiner can stand by the rejection. Or, the applicant can decide to abandon the application.

If the examiner stands by the rejection, the applicant can appeal the decision to the Patent Trial and Appeal Board (PTAB), an administrative body within the U.S. Patent and Trademark Office. Beyond the PTAB, the applicant has the option to further appeal the examiner's decision to the United States Court of Appeals for the Federal Circuit and even to the United States Supreme Court.

Conclusion

Since the first U.S. patent was issued in 1790, intellectual property has increasingly become a vital business strategy for many organizations. Patents not only protect inventions, they also can be used to influence stakeholders such as investors that your organization is on the cutting edge of innovation and has the human and financial resources to maintain a strategic and competitive edge against competitors. With constant technological changes in the telecommunications industry, this means that the value of intellectual property, particularly patents, should continue to grow in importance.

Abdul Basit is a patent attorney. His telephone number is 703.994.6839. *This article is for informational and educational purposes and does not constitute legal advice or legal opinions. The reader should not act or rely on any information contained in this article without first seeking the advice of an attorney.*

Using Emerging Technology to Reduce Fiber Deployment and Construction Costs

By Scot Bohaychyk

Increasing broadband demands are placing a substantial load on the cellular macronetwork. In some environments, particularly urban areas with high demands, the load is now critical. Market data suggests that the number of DAS (distributed antenna system) network implementations will grow rapidly. A unique property of a DAS is that the components are small and thus can be deployed in areas previously not available to system providers. An example of this is streetlight poles in metro areas. These locations typically could not support the load of a traditional cellular system. DAS networks are small enough to not overload the support structure and are more aesthetically appealing. With this smaller size comes a smaller broadcast footprint. This means that more sites are needed per square mile to give the coverage that is expected.

Because of the high-density environment where these DAS networks are most critically required, the dependence on traditional deployment and construction methods is simply too costly. Using emerging technology to reduce fiber deployment and construction costs will not only reduce the time (i.e., labor) required, but will also be less disruptive to the environment in which the DAS is being installed.

Instead of the 1-foot-wide to 2-foot-wide trench needed for a traditional inner duct, a microduct uses a microtrench an inch or two wide. The manhole need not be excavated for access, and no plating is needed for vehicular crossing.

The following case study illustrates the improvements these emerging technologies can deliver.

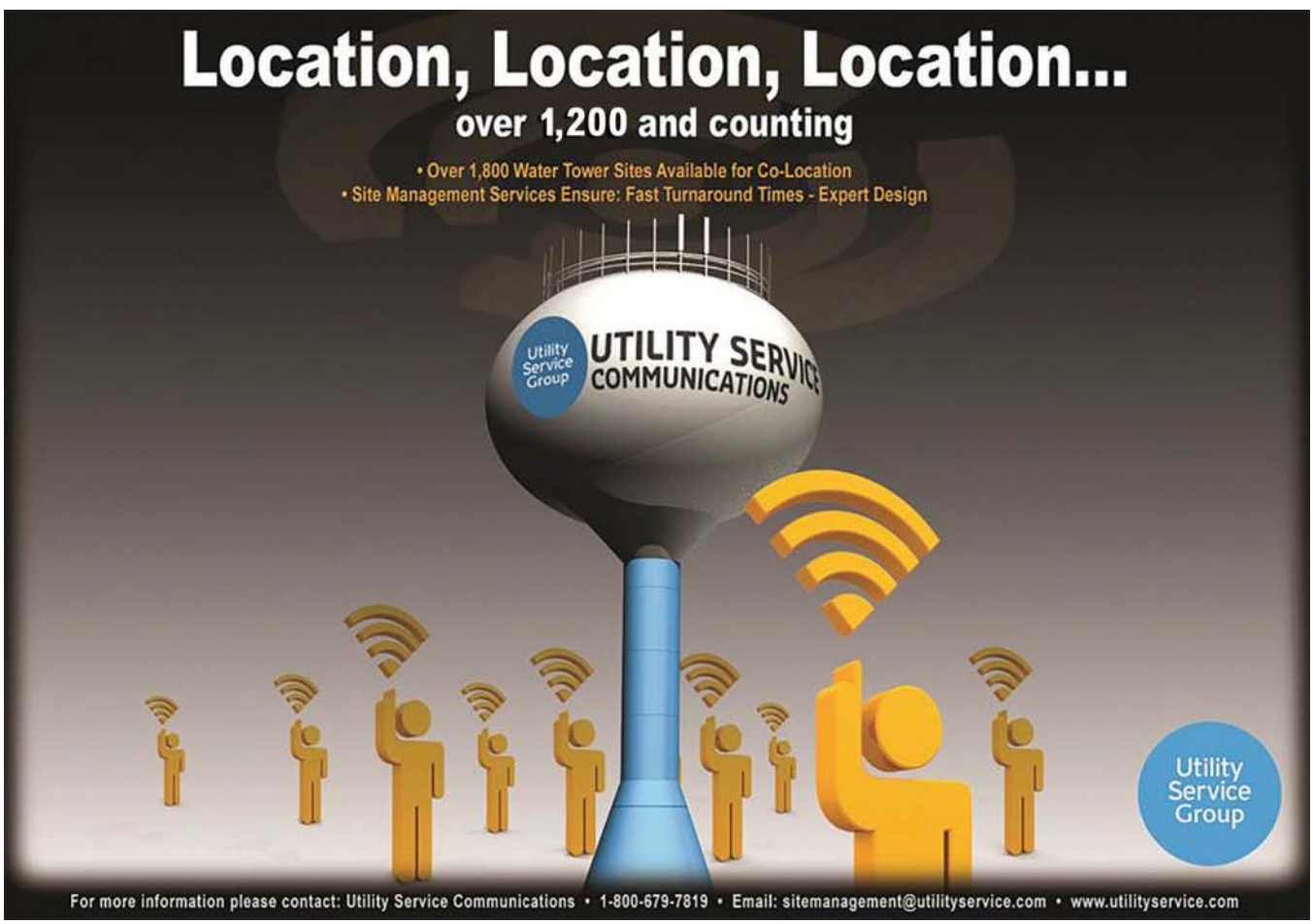
The Traditional Model

Because DAS sites are typically fiber-fed, they need to have access to the traditional fiber networks that are already constructed in the underground systems (manholes) in most cities.

Traditional installations would involve cutting two slots in the pavement or concrete far enough apart to facilitate the use of a backhoe or excavator bucket. The slots normally would be 1 foot to 2 feet apart because the smallest bucket for these machines is a foot or more wide. After the cuts are made, the material is removed by breaking it into small pieces and excavating it. This also requires using steel plating to enable traffic movement or closing the roadway altogether, the latter normally not being acceptable. After the trench is opened, the conduit can be constructed from the manhole to the streetlight pole. Once the conduit is in place, sand, crushed stone or some other premium aggregate is placed around and over the conduit. This aggregate is then compacted and typically covered with a layer of concrete. Finally, a topcoat of concrete or asphalt is laid to finish the trench. At this point the fiber can be pulled from the manhole to the DAS site.

Lower-cost Alternative

Using the same example but deploying microduct and microtrenching, you would quickly notice a significant difference: Microtrenching requires a much smaller trench to be cut from the manhole system to the streetlight pole (1 inch wide versus 1 foot wide) and boring into the manhole versus excavating around the manhole. Because the trench is so insignificant, no material is excavated. No steel plating or road closing are required. After the microtrench is open, the conduit is placed, restoral is applied to seal the pavement and the preconnectorized fiber is pushed or pulled to the desired location.



A lengthy saw-cut microtrench only needs traffic barriers during the saw cut and final microduct placement, whereas traditional inner duct installation requires a wider trench and traffic control barriers or both for the duration of the installation.

Cost Modeling

The costs for deployments are calculated using various methods across the United States. However, a generic example is one of costs per work action. Using the example given as a guide, you have the following:

1. Saw cuts (2) from manhole to DAS location
2. Break asphalt or concrete
3. Remove debris and excavate trench
4. Enter into manhole (excavation around and break into sidewall)
5. Plate open trench to accommodate vehicular or pedestrian traffic
6. Place structure in trench (1-inch to 2-inch inner duct or traditional conduit). Note: This requires a reel trailer and vehicle to transport and deploy.
7. Backfill and compact the trench
8. Install concrete cap
9. Apply final topcoat and restoral
10. Place fiber from manhole to DAS location
11. Use traffic control/barriers for the duration of installation
12. Splice and turn up the site

For the same scenario using microduct and microtrenching:

1. Saw cut (1) from manhole to DAS location
2. Enter into manhole (core drilling)
3. Place structure in trench (FieldShield microduct). Note: This requires a small reel stand to deploy.
4. Install restoral material, including topcoat, usually done in a single pass
5. Place preconnectorized fiber to DAS site and turn up the site
6. Use traffic control/barriers during saw cut and final placement

DAS in a Metropolitan Area

For a recent project, 33 DAS towers were erected. Nineteen sites were installed using traditional construction methods and 14 sites were installed using microtrenching. The length of installation varied from 50 feet to 600 feet, evenly divided between the installation types.

Installation using the traditional method required $707 of labor per linear foot and a total material cost per location of $5,210. Installation using microtrenching had a labor cost of $274 per linear foot and a material cost of $928.57 per location.

It should also be noted that because

of the added time needed for traditional construction methods, inspection costs, although not included in the numbers mentioned, were nearly double those of a microtrenching installation. Most microtrench installations were completed within a 12-hour window (7 p.m. to 7 a.m.), whereas traditional installations required two to three days to complete and also required an inspector to be on-site during that time.

An extra benefit of microtrenching is that because of the small size, there is no requirement to use extra vehicles to bring the material to the jobsite. Typical inner duct requires a large-diameter reel to hold it, thus requiring a reel trailer and a vehicle (and person) to bring it to the job site and to deploy it. Additionally, because the equipment required for traditional excavation is also large, a much larger worksite needs to be secured. The larger worksite is disruptive to both pedestrian and vehicular traffic and costs the contractor more because the contractor has to use larger vehicles and more of them for transportation and construction. The typical microduct deployment can be brought to the jobsite in two standard-size pickup trucks.

Restoring the trench after placing the microduct often can be done in a single pass that includes placing restoral material and a topcoat of concrete or asphalt.

FieldShield optical fiber from Clearfield offers a single connectorized fiber, and with the use of a multifiber push-on (MPO) connector, it allows the microduct to deliver 12 fibers ready for use. The same sheath can provide one to 12 fibers, allowing the installer to tailor the installation without having to inventory multiple microducts.

Microduct Solutions Differ

Because the trench being cut for a microtrenching installation is so much smaller, turns and bends will be much tighter. Microduct and the optical fiber used with it must be able to withstand the pressure of being placed in these small trenches and still function.

Because they use a saw cut, installers make intersecting cuts 90 degrees apart at the location of a turn. Then, installers make a 45-degree diagonal cut between the two to allow for conduits to bend around a corner. What is left are two points along the corner that have somewhat sharp points left behind. This is a load point for the microduct, and in my experience in the industry, I have often witnessed a failure at these points. Although it isn't always apparent at initial installation, because microduct typically is placed in the roadbed, vehicle vibration and pressure can cause some microducts to collapse at these corners.

FieldShield, a microduct and pushable fiber solution from Clearfield, was designed and introduced to the market two years ago to address these varying limitations. Because Clearfield is expert in protecting optical fiber, FieldShield's performance requirements called for high crush ratings, allowing it to be immune to these pressures.

The crush rating is typically defined as SDR (standard dimensional ratio), and the lower the SDR number, the higher the crush rating. With typical inner ducts, a rating of 13.5 is considered standard. SDR 11 has been looked at as the heavy-duty duct. The FieldShield 10-millimeter outside diameter by 6-millimeter inside diameter product rates at an SDR of 5. But even with this rating, FieldShield retains a flexibility that allows it to be placed in the tight confines of a microtrench.

In a microtrenching application, it is critical to preconnectorize the optical fiber. Without the use of preconnectorized fiber, significant labor costs would be incurred to splice on a connector in the field, thereby negating the cost advantages gained through the microtrench solution. Because of the extremely small size of the microtrench, a connector specially designed for microtrenching must be used.

FieldShield optical fiber offers not only a single connectorized fiber, but with the use of a multifiber push-on (MPO) connector, FieldShield microduct can deliver 12 fibers ready for use. And because the same sheath can provide one to 12 fibers, the installer can tailor the installation without having to inventory multiple microducts.

Conclusion

Microduct and preconnectorized fiber solution coupled with microtrenching eliminates up to 60 percent of the work operations and costs in a typical installation.

- A single 1-inch cut is made from the manhole to the DAS site, and because the cut is quite narrow, no plating is required for vehicular crossing.
- Using a core drill to enter the manhole eliminates the need to excavate at the manhole to gain access.
- Restoral is usually accomplished in a single pass. No compaction or multilayering needed.
- Minimal traffic control is needed because vehicles can drive over the saw cut without danger of damage to the vehicle or trench.
- A minimal number of work vehicles is required. The need for a reel trailer for conduit is eliminated, and no large equipment is needed on-site, such as a backhoe or an excavator.

Scot Bohaychyk is product marketing manager for new markets at Clearfield. He has nearly 30 years in the telecommunications industry. His background includes serving in The White House Communications Agency, providing communications infrastructure support for President Ronald Reagan and his White House staff. His private sector experience includes outside plant field and engineering experience along with market development and sales work in the fields of blown and pushable fiber for long-haul fiber installations in the United States and overseas.

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Business Opportunities in Services, DAS, Wi-Fi and Small Cells

Steps leading up to small cell and DAS deployment, such as site surveys and capacity assessments, offer opportunities. Carriers are embracing Wi-Fi to offload network traffic from macrosites.

By Don Bishop

At the Tower & Small Cell Summit in Las Vegas in September, Jeff Lime, vice president of Ventev Wireless Infrastructure, a division of Tessco Technologies, spoke at a session about new opportunities in the tower business led by Jake McLeod, president of Gray Beards Consulting. Ventev Wireless Infractructure was created through the coming together of three brands: TerraWave (Wi-Fi enclosures, antennas and cable assemblies), Wireless Solutions (base station infrastructure, including site hardware and grounding) and Ventev (integrated power and outdoor enclosures). Lime has been with Ventev for seven years, developing products for the cellular and Wi-Fi industries.

What follows are Lime's remarks from the session, edited for length and style.

Small cells have arrived in the United States, although at present, greater use is being made of small cells in other countries. Many tower owners, RF engineers, integrators and contractors make a living in the macrocell site industry, but the macrocell site industry is changing. Small cell is a force enabling us to find new opportunities to bring the wireless communications signal closer to the user and increase wireless network capacity so wireless communication is no longer a coverage industry. Millions of small cells will be deployed worldwide, both indoors and outdoors.

Many other countries have no landline technology that resembles what we have in the United States. In those countries, it's cheaper to deploy cellular than to deploy landlines. Thus, they're a little bit further ahead than we are in the United States on cellular and wireless technology deployments.

Picocells and microcells are being deployed for enterprise applications. They complement distributed antenna system (DAS) networks and Wi-Fi access. Many of them are single-carrier; DAS is multicarrier. Indoor use of small cells is already happening and makes economic sense.

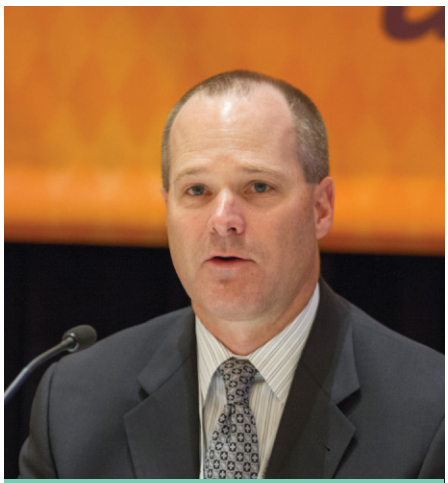
Using small cells outdoors is more challenging, in three ways.

First is the infrastructure. You have to have the infrastructure to put a small cell in. There are towers as short as 30 feet and even shorter, and then there's street furniture such as light poles, benches and bus stops, and rooftops and walls are also possible locations. There are many ways to mount small cells, so infrastructure is not likely to be the holdup.

The second challenge is power. How do you power a small cell? In many cases, the desired location lacks power. Considerations are whether the small cell needs AC power or DC power and whether it will be powered by solar or by PoE (Power over Ethernet), and whether a trench has to be opened to lay a power cable. Getting power to the location can be a large part of small cell capital expense.

The third challenge is backhaul, which is another large capex expense.

The challenge is not the small cell unit



Jeff Lime, vice president, Ventev Wireless Infrastructure, at the Tower & Small Cell Summit. *Photo by Don Bishop*

itself. Numbers indicate it is half as expensive to put in the same capacity using a small cell compared with a macrocell site. It's the other elements of small cell deployment, power and backhaul, that represent the capex challenge.

Steps leading up to small cell and DAS deployment continue to offer opportunities for doing business.

You'll still be doing a lot of site surveys and capacity assessments. Whether it's for a macrocell site, a small cell site or a DAS, a lot of upfront planning goes into deciding how much you want to put where. That's a big part of the industry now, and it will continue to be a big part of the industry as we deploy small cells and DAS into the smaller segments and smaller sites.

Growth

A billion mobile devices were shipped in 2013. By the end of 2013, there were more mobile devices than people on Earth. There's more data traffic now than there is voice traffic. And over the next three or four years, 7 billion more mobile devices will be shipped. Consumers served through the tower industry and through the rest of the wireless industry are demanding more and more bandwidth. It's no longer a coverage game; it's now a capacity game. And it's not just a capacity game at the macrocell site, it's a capacity game everywhere you have a mobile device.

At the World Congress in Barcelona, Spain, Cisco Systems set up a 1,000-Wi-Fi-access-point network. At one time during the convention, there were 100,000 simultaneous mobile connections on that network in a 7-square-mile area. A big part of our business is enabling Wi-Fi in high-density environments and enabling other types of connections through our antennas and enclosure business. I don't think of this as being in the tower industry anymore. We're in the wireless infrastructure industry that provides coverage, access and capacity. That capacity demand places pressure on macrocell sites, and relieving the pressure calls for the use of small cells. Small cell technology is coming into its own.

AT&T mentioned it plans to deploy 40,000 small cell sites in the United States during the next 12 months. Most of them will be indoors. What percentage of that market can we capture by doing the site planning, the site surveying, the permitting, the project management, the deployment and the turn up of that service? That's a big opportunity for all of us. The DAS business is exploding, and a lot of it is in-building DAS.

The Future

Carrier Wi-Fi is coming — not enterprise Wi-Fi, which we know and use today, but carrier Wi-Fi. It's not here yet, but it's coming. Carriers have embraced Wi-Fi as a technology for offloading traffic from macrosites. For a long time, the carriers didn't embrace Wi-Fi because it was a competing technology and took the revenue stream away from the cellular data. But what they're finding is that to deliver the user experience, to keep the users on their networks and to open up new revenue streams, Wi-Fi is the technology that they can deploy. A tier-one U.S. carrier is using Wi-Fi in stadiums to offload traffic, to deliver a better user experience. Thus, they capture revenue in different ways.

It's still early days, but another opportunity lies in location-based services. Most people are on an unlimited data plan, or they're on a high-number data plan. So they're already paying for their data minutes, whether the traffic goes over the cell network or it goes to the Wi-Fi network. The carriers are already capturing the money. Now, they need to make sure they deliver the best experience. If I'm on one network and I can't get Wi-Fi access but my wife is on another network and she's getting Wi-Fi, I might consider moving to her network.

Thus, carriers are now competing at the user experience level. Wi-Fi is the third leg of the stool in terms of new opportunities for us to think about in the wireless access business.

The next Tower & Small Cell Summit will be held Sept. 9–11 at the Sands Convention Center in Las Vegas. The Summit is collocated with Super Mobility Week, a convention owned by CTIA. The Summit is owned by UBM Tech. AGL Media Group provided programming for the 2014 Summit sessions as the conference's content partner.

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HEIGHT
113 FEET

TOWER TYPE
MONOPOLE

CELLULAR CARRIERS
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OWNER
VERIZON WIRELESS

YEAR CONSTRUCTED
2002

LOCATION
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NEVADA

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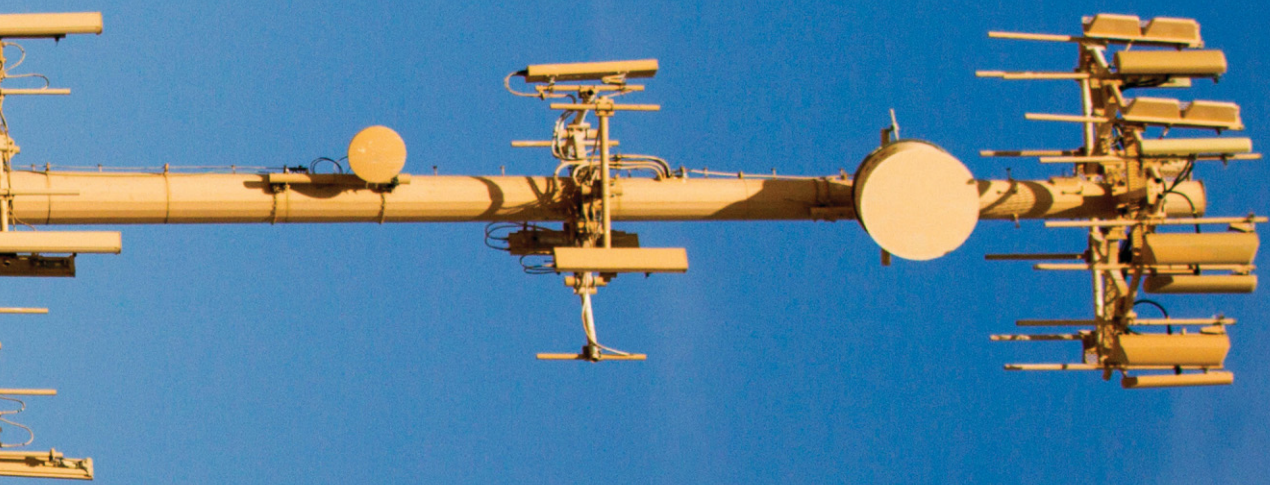

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ABOVE GROUND LEVEL

MAY 2015

AGL TOWER OF THE MONTH

Small Cells: Is There a Business Model That Works for Vendors and Carriers?

Until significant new revenue streams from services such as content, M2M, and connected cars become commonplace, carriers will need to focus on keeping small cell deployment and operating costs down.

By Greg Weiner

In the wake of growing data demand and their short-term plans to shift voice traffic to LTE, mobile network operators are actively investigating ways to densify their networks and achieve an acceptable level of indoor performance.

Consider the uptick in demand for data, a phenomenon that continues to defy even the loftiest predictions. An estimated 15 petabytes of new data are created every day (200 years of HDTV), according to 451 Research, which also says that 90 percent of today's digital data was created during the past two years. Cisco Systems says that in 2015, the gigabyte equivalent of all movies ever made will cross global IP networks every five minutes. Also according to 451 Research, 3 billion photos are uploaded to Facebook Web pages each month, and Facebook manages 25 terabytes of data per day.

Notably much, if not all, of this data will ultimately traverse wireless networks. In fact, Venture Beat News reported that in Facebook's third-quarter 2014 earnings announcement, the company revealed that it has more than 1.35 billion active users. Of those, 1.12 billion were mobile users, accounting for more than 703 million mobile active daily users.

Then there's the global adoption of 4G, which continues to increase significantly. GSMA Intelligence is forecasting that the number of global LTE connections will reach 2.5 billion by 2020, which will account for 27 percent of the worldwide population.

Small cell investment is focused on improving coverage (indoor and outdoor), increasing capacity to keep up with user demands, and driving more efficient spectrum use. But this network densification comes at a time of flattening or declining average revenue per user (ARPU), a looming price war and a relatively saturated marketplace where growth is coming from lower-value devices (e.g., tablets) and movement of customers among the Big 4 carriers. There simply isn't a significant amount of new revenue on the immediate horizon to support a massive network investment. As a result, if small cells in their various forms ultimately are to be deployed in the tens or hundreds of thousands, an aggressive cost structure must be achieved.

Carriers in the Marketplace

There are a number of dynamics in the marketplace that are influencing the rate of small cell adoption by the carriers. Like most new technologies, achieving economies of scale will help drive down unit costs for the equipment and associated services. Some of the relevant market conditions include early adopters, the evolution of the vendor-carrier relationship and standardization versus menu-driven pricing.

Early adopters: According to

telecom research firm Infonetics, mobile operators in developed countries (including Japan, South Korea, the United Kingdom and the United States) are the only ones today that are driving early adoption of small cells. As a result, small cells have not reached the critical mass required to drive costs to an attractive price point with an acceptable set of features and capabilities. Further, these early adopters bear the responsibility of working through the network design, deployment, integration, and management challenges associated with small cells. This steep learning curve and cost structure has delayed the ramp up considerably relative to previous aggressive forecasts, according to an Infonetics report.

The evolution of the vendor-carrier relationship: The infrastructure business model has not fully shaken out, with vendors taking a fairly conservative approach to the small cell market thus far. There are many traditional deployment services providers who are adapting their capabilities to deploy small cells in large volumes. However, the real estate side of the model has not yet matured into a sustainable steady state. Some traditional macro tower companies are sitting on the sidelines while others are willing to invest capital in small cell real estate (whether fiber or poles). There are other providers that have put the lion's share of the capital burden on the carrier while collecting ongoing fees for operations, maintenance and management of the underlying real estate. And there are still others that are offering a hybrid of the two approaches.

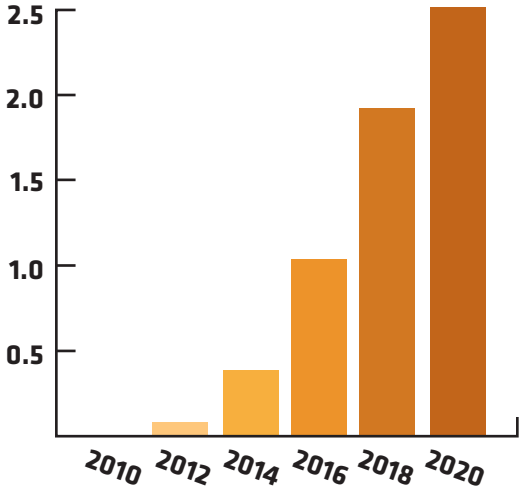
What has become clear, however, is that the traditional macro deployment approach will not work for small cells. The FCC has acknowledged as much with its recent order that will exempt certain small cells from environmental and historic preservation reviews, providing for a shot clock to expedite approvals. This action may be the push required to focus carriers on utility poles and other structures in the right of way. The consequence of this order is that deployment service providers could see a significant reduction in some of the higher-margin services associated with macrosite deployment. The deployments, however, are still complex with many node-specific challenges such as backhaul, power, site acquisition and maintenance.

Standardization versus menu-driven pricing: The industry has not yet achieved a level of standardization of small-cell sites where menu-driven pricing is a feasible option. Acquisition models are emerging in two forms: turnkey and a la carte.

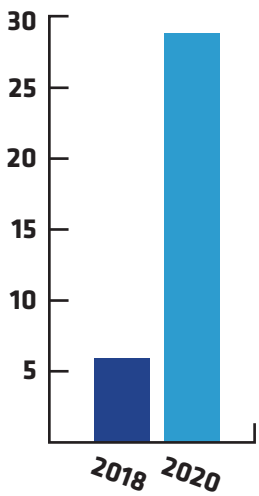
Turnkey models include the provision of deployment services (such as RF engineering, candidate identification, securing backhaul and power, performing make-ready work and equipment installation) as well as providing backhaul (either via new or existing fiber assets), ongoing operations and maintenance services, and assuming primary responsibilities for the underlying leases. These offerings allow a service provider to become a one-stop sourcing partner to wireless operators and to drive utilization of the space, power and transport assets over time. For carriers, advantages include offoading small-cell development projects at a time when demand — and 4G-related jockeying for competitive position — is at its peak.

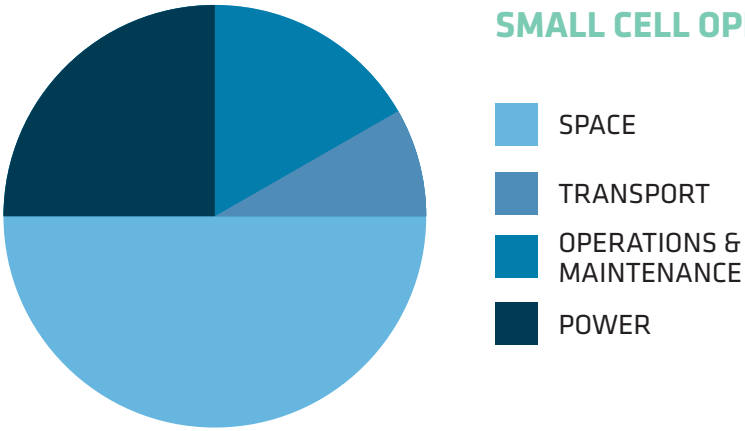
A la carte configurations typically saddle operators with more onerous project management, including the sourcing of multiple vendors across an increasing number of network points, with each point having more than one supplier (e.g., design, deployment, maintenance, power, lease management). Although a single vendor may provide the deployment services, this model contemplates separately procuring power and backhaul and usually entering into a lease relationship with a landlord. This results in more challenging management of scope and scale

GLOBAL LTE CONNECTIONS (BILLIONS)



PERCENTAGE OF TOTAL WORLDWIDE LTE CONNECTIONS





and less cost predictability, according to an ACM-Atlantic report, "2014 Small Cell Economics & Realities."

Still, turnkey offerings will not be the only successful deployment model. Although the scale and complexity of small-cell deployments favors single vendor sourcing, some of the carriers want control of the build-out process and ongoing management of the network and underlying rights. Further, there are many factors that will prevent carriers from leveraging a turnkey model in certain locations, including price, footprint coverage and vendor capabilities.

Cost Component Considerations

In addition to the relatively immature small cell equipment and services space, carriers must focus efforts on achieving price points that support their business case. These are the primary cost drivers associated with a small cell deployment.

Power: Although it can add complexity, power itself is generally not a cost driver. In fact, recurring power charges will likely be less than $50 per month. That said, providers should be conscious of the need for commercial power when selecting sites because extending power to some locations can be costly. Additionally, carriers still need to work through whether backup power is required in all situations. Installing batteries and the associated cabinets introduces a new set of permitting, deployment and cost constraints.

Space: The costs associated with securing space can vary greatly for small cells, ranging from cheap regulated rates (e.g., <$10/month) to $200+/month when privately owned. When it comes to evaluating space many structures are available (e.g., lampposts, utility poles, buildings) and each have their tradeoffs. Key attributes to consider include suitable mounting heights, adequate structural capacity, the ability to locate cells where needed, the ability to lease in relatively large quantities, a low capital cost to install the cells (e.g., avoid pole replacements), a low ongoing rental expense, and whether power and backhaul options are available or close by.

Transport: Although dark fiber allows wireless carriers to maintain complete control over their service experience by increasing capacity on their own terms and on their own timeline, dark fiber back to the macro has proven to be an expensive option (i.e., $500 or more in monthly operating expense for the fiber and tens of thousands of dollars in capital expense for its construction). Lit transport options are also available; however, bandwidth and performance vary significantly depending on the choices available (e.g., fiber-based service, asymmetrical coax-based service, consumer vs. carrier grade). Carriers are well aware of the cost structures for lit service as it will typically parallel that which is available on their macrosites. Backhaul providers have not been quick to discount service simply because it is terminating at a small cell. LOS/NLOS microwave options exist as well, complete with relatively low capital expense and almost no operating expense. However, microwave isn't without its challenges when operating in a highly cluttered, close-to-the-ground environment.

Operations and maintenance: Although cost structure and scope of needs are largely undefined at the outset, it's helpful to include and allow for some level of monitoring and mobilization for diagnosis and repair (<$100/month/node). This is particularly important when extending the coverage footprint (versus enhancing capacity) as an outage has the same consequences as a macrosite outage, albeit on a smaller scale. Additionally, installing on utility poles — especially above the power space — can require specialized crews.

Electronics: This can vary widely depending on the technology solution selected and specific carrier configurations. Current offerings are primarily 3G or 4G and support only a single wireless carrier. Most major OEMs have multiple-technology and multi-carrier equipment on their road map.

Acquisition, construction and installation services: With elements that include leasing, permitting, construction and installation,

costs are running $20,000 to $40,000 per node with very focused efforts to reduce these numbers by 50 percent or more over time.

How to Drive Costs Down

Vertix Consulting believes that in order to drive meaningful volumes it is important to get operating expense down below $400 per month total and capital expense down to $20,000 or less. At current price points carriers will deploy in major problem areas and use these projects as a litmus test to analyze performance and to further evaluate cost structures. Vendors are salivating at the prospect of growing services revenue (or replacing slowing macro revenue growth) and have shown limited efforts to drive price points down significantly.

Some considerations involve identifying transport solutions that reduce operating expense and capital expense, including lower-cost copper options that meet performance requirements, LOS/NLOS microwave aggregation, and making use of existing outside plants. Another consideration involves looking at installation differently than macrosites, including dramatically reducing the scope of required services (e.g., surveys, title searches, drawings), evaluating performance requirements relative to macrosites (e.g., battery backup), and looking to the FCC to help streamline environmental and permitting processes (see sidebar).

Yet another consideration involves looking to vendors to come up with innovative business models.

Tower companies have invested large amounts of money in tower assets in exchange for an ongoing rent stream from carriers. Will vendors emerge to do the same for small cells in large volumes? How will they be valued? Can they make it attractive to carriers with shorter terms, less onerous restrictions and lower rents? We believe that vendors will emerge with these shared infrastructure models.

However, carriers need to be careful to avoid the long-term burdens (i.e., escalating costs, limited flexibility) that have historically accompanied the tower company relationships. Carriers also need to be cautious regarding the long-term viability of these providers.

FCC Rule Changes

On Oct. 17, 2014, the Federal Communications Commission met to consider rule changes that would expedite wireless infrastructure deployment and make it easier for wireless service providers to win regulatory approval from municipalities for these deployments. The new initiative singles out small cells and distributed antenna systems (DAS), noting their "minimal effects on the environment," an Oct. 7, 2014, story on the RCR Wireless News website reported.

"New distributed antenna system (DAS) networks and other small-cell systems use components that are a fraction of the size of traditional macrocells and can be installed — unobtrusively — on utility poles, buildings, and other existing structures," wrote Tom Wheeler, FCC Chairman in supporting faster deployment of DAS and small cells. "The draft order accounts for that change by crafting a far more efficient process for small deployments that do not trigger concerns about environmental protection or historic preservation." Wheeler wrote his comments in the FCC blog on Feb. 26, 2015.

The provisions, adopted in October and effective beginning February 9, 2015: include:

- Excluding small cells and certain other wireless facilities from environmental and historic preservation review, particularly for those deployments leveraging rooftops and utility poles in rights of way
- Defining certain terms of the Spectrum Act and rules for their implementation at the state and local level, including a new shot clock that requires that an application be addressed within 60 days or it is deemed granted
- Limiting when additional information can be requested regarding an application and clarifying when the shot clock begins and when it can be tolled

True equipment sharing never materialized at carrier macrosites. Are small cells a better candidate? Will OEMs produce equipment that can support multiple wireless carriers in a single enclosure with shared installation, backhaul and power? This would enable any number of vendor models where investors appreciate multi-tenant solutions with low turnover. We don't believe the OEMs are motivated to reduce the number of distinct devices that they sell without some external prodding and possibly substantial volume commitments.

Cable companies (multiple system operators, or MSOs) are another possible disruptor to the small cell model. They have access to space on a significant number of utility poles, can provide power (with backup) directly from their HFC plants, can provide fiber or coax-based backhaul, and have the field force required to maintain the assets. MSOs have been actively deploying Wi-Fi equipment in a similar fashion; however, there are strategic reasons that may prevent them from being too aggressive in the small cell space. Are they willing to give up premium strand space where people congregate? Would they rather work to monetize their Wi-Fi offering instead of enabling the MNOs to enhance wireless service? Are they comfortable leasing dark fiber? Will they approach the lower prices required for small cells and risk impacting their macro backhaul business? We believe that MSOs will continue to investigate if and how they want to play in the small cell space and feel that they may ultimately be forced to participate to prevent new entrants from overbuilding their networks and threatening existing and future revenue.

The OEMs have danced around a managed network model in the past but have never made any significant investments in such a strategy. Are small cells, along with a shift of network capabilities to the cloud, the catalysts that will stimulate such a strategy? OEMs have been reluctant to do anything viewed as competitive with their MNO customers. However, it presents an opportunity to ensure that their equipment is deployed over competitors. Further, OEMs generally feel like they have the technical capabilities to engineer, design, deploy and manage a network, as long as they don't have to handle the customer side of the business. Although this model may emerge over time, we do not believe it will happen in the short term.

The Optimal Business Model

Until significant new revenue streams such as content, M2M, and connected cars become commonplace, carriers will need to be focused on keeping small cell deployment and operating costs down. Without being able to justify deployments that concurrently rein in operating expense as well as capital expense, they will find it challenging to meet the lofty volume targets that have been published in recent years. By executing a disciplined approach to developing the strategy, pushing vendors to try different models, and shifting the internal mindset away from a macro mentality, MNOs will ultimately find the model that enables them to deploy small cells by the tens or hundreds of thousands.

Greg Weiner is a managing partner and cofounder of Vertix Consulting. He has more than 14 years of industry and consulting experience with an emphasis on sourcing, outsourcing and the telecom industry. Visit www.vertixconsulting.com.

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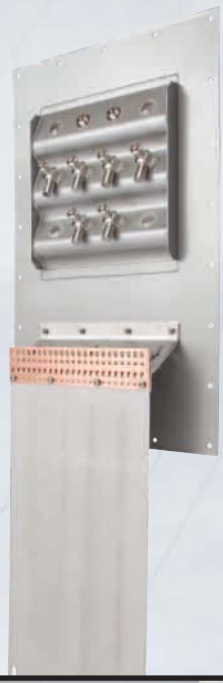

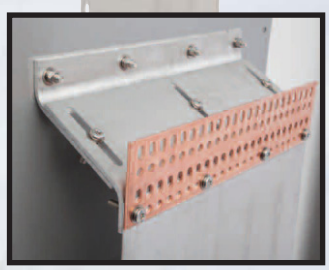

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KEEPING WIRELESS NETWORKS ALWAYS ON

Power system cabinets at a macrocell site.
Photo courtesy of Alpha Technologies

In an era of "always on" demand for wireless services, DC power plants and related backup systems that run the network are critically important. Engineered configurations of high-efficiency switching mode rectifiers, high-capacity batteries and standby generators keep the network humming even during utility power outages. Here's how.

By John Celentano

Telecom power engineers will tell you that consideration for powering wireless networks usually brings up the rear. Network power is the last piece of network equipment to be considered in any site build or upgrade.

This situation is understandable to some extent. Wireless network engineers invariably focus on the radio-frequency (RF) designs, including where to place the antennas to deliver the strongest signals to the most customers. Besides that, they expect the direct-current (DC) power system to work, without failure, in a multitude of environments, large and small, indoors and outdoors, and under all operating conditions, especially during utility alternating-current (AC) power outages.

To paraphrase the late Rodney Dangerfield, "The DC power guys don't get no respect!"

That's not really true, of course. It's just that telecom DC power is a unique field that generally is left to experts. Moreover, the DC power plant specifications depend upon the end equipment or application, referred to as the load, that is being powered. So until the load is defined, DC power equipment requirements cannot be determined.

DC Power System Configuration

Wireless networks rely on specialized power systems that convert utility AC power to DC power needed to operate switching centers, cell sites, distributed antenna system (DAS) headends and remotes, and backhaul equipment.

Figure 1 is a schematic diagram of a typical DC power system used in wireless networks.

The same basic configuration is used in large switching centers, at macrocell sites, with small cells

DC POWER PLANT CONFIGURATION

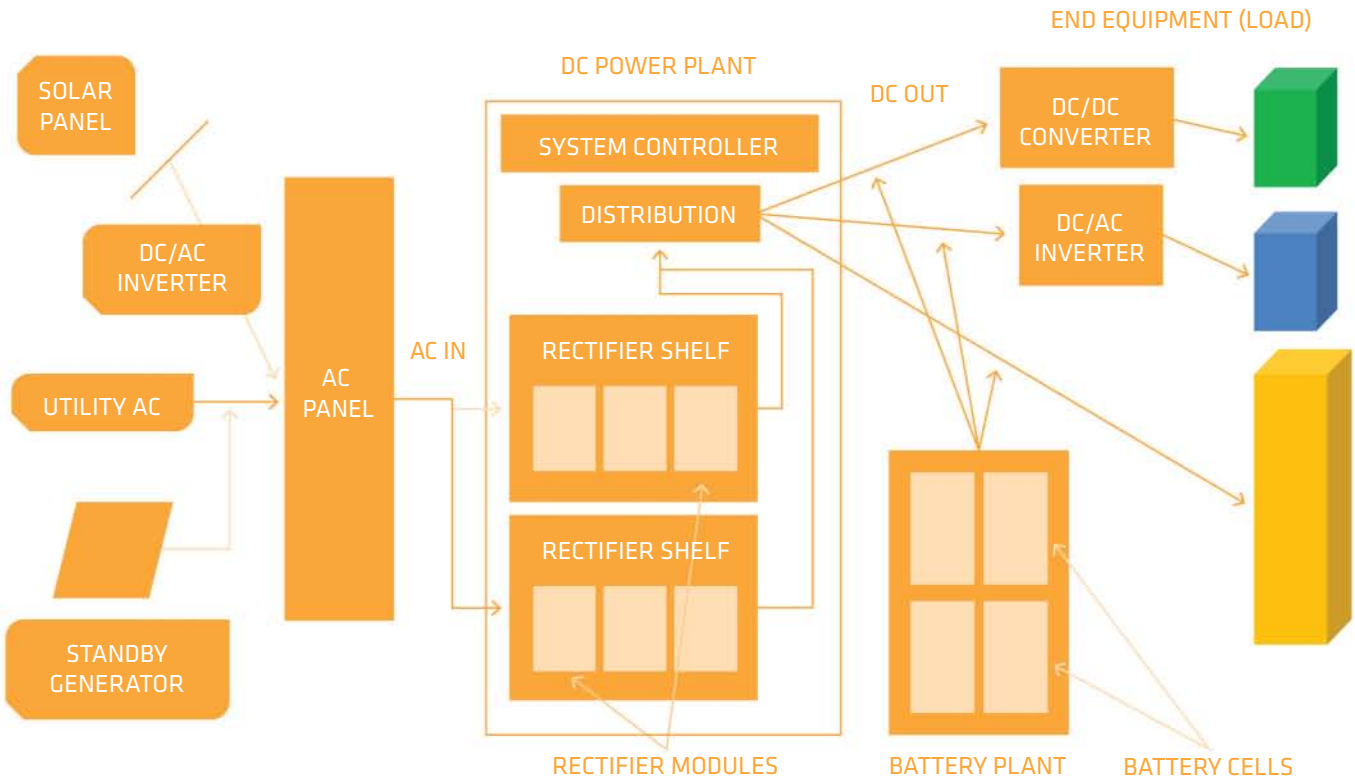

Figure 1. A schematic diagram of a typical DC power system used in wireless networks.

and in DAS installations. The variable is the quantity of power equipment needed to carry and back up the load. It is interesting to note that the same type of power equipment is used in wireline networks in a variety of applications.

Utility AC power is connected to the site power plant through an AC panel or AC entrance. The AC panel also serves as the connection point for alternate power sources such as a solar panel with a DC/AC inverter or backup power systems such as standby diesel generators that are used if the utility AC power is interrupted. Hydrogen fuel cells also are used as a DC power backup source.

From the AC panel, power is fed to the DC power plant and each rectifier shelf that houses a number of modular, plug-in AC/DC rectifiers that convert the incoming utility AC at 120 volts or 240 volts to commonly used DC levels of –48 VDC or +24 VDC.

Rectifiers are the heart of the power system in delivering the required DC power levels to the load. Units on the market today can range from 250 watts to 12,000 watts per module. Rectifier modules are available with multiple AC input and DC output options to provide the right solution depending on the application. Modular rectifiers are easy to handle, facilitating installation and maintenance and enabling flexible configurations, and they are cost-effective. They can be added incrementally to rectifier shelves to serve the specified load. They are designed for hot-swapping, which means that they can be plugged into or removed from a rectifier shelf without turning off the AC power.

The system controller monitors the rectifiers and overall system status and reports any alarms or abnormal conditions to the service provider's network operating center.

A distribution shelf or module is equipped with various fuses or circuit breakers for distributing DC power to different end equipment elements. In small installations, a separate power line runs from the fuse or circuit breaker to the specific equipment being powered. In large

installations such as a switching center with lots of equipment installed throughout a building, a DC bus runs from the power plant to one or more battery distribution fuse bays located close to the end equipment being served. Individual power circuits then are run from the battery distribution fuse bays to specific end equipment.

Batteries are installed in groups, also called strings. Several batteries are wired together in a series circuit forming a string providing DC power at –48 volts, +24 volts or other voltages. Usually, there are two or more strings of series-connected batteries. These strings of batteries are connected in a parallel circuit between the DC power plant and the various loads. This arrangement allows an individual string of batteries to be taken offline for service or replacement without compromising the availability of uninterruptible power. Under normal operation, batteries are trickle-charged at full capacity. When the incoming AC power is interrupted, the rectifiers shut off and the batteries discharge to carry the load from one hour to eight hours, depending on the load size and site location. When the utility AC is restored or a standby generator starts, the rectifiers deliver power to the load and recharge the batteries. Battery plants are sized according to the DC voltage levels (–48 VDC or +24 VDC), the size of the load and the duration of the backup time needed, often one hour to four hours in a small site and for as long as eight hours or more in a large installation. Battery plants can be sized for the expected full duration of an interruption or may be required only to provide power while a standby generator set or other emergency power supply is started.

Auxiliary power conversion equipment includes DC/DC converters that derive other DC levels such as +24 VDC from primary –48 VDC for other types of equipment at the site, or DC/AC inverters for AC-powered computing equipment used at the site.

DC Power Technology Trends

Rectifier technology has evolved since the 1980s when controlled ferroresonant designs that used big, bulky magnetic technology to convert AC to DC were state of the art. Today, the compact, lightweight switching-mode designs that rely on power semiconductors for the power conversion dominate the field. Controlled ferroresonant units, despite their size and weight, were stable and reliable and produced energy conversion efficiencies of 80 to 85 percent. Switching-mode units are lightweight and modular. With new advances in power semiconductors, switching mode units are achieving energy efficiencies of 92 to 96 percent or better.

Battery technology continues to evolve. Researchers are looking for ways to store more energy in smaller packages, thereby achieving longer reserve times yet with little or no maintenance. Batteries often used in battery rooms are the flooded or wet vented lead-acid (VLA) battery, the valve-regulated lead-acid (VRLA) or sealed battery, and the nickel-cadmium (NiCd) battery.

Lead-acid batteries are widely used in switching centers, in large and small cell sites, and in remote microwave site applications. VLAs have size and weight but are cost-effective for the amount of energy they store. VRLAs, either gel cell or absorbent glass mat versions, are more compact and easier to handle and maintain than VLAs. NiCd batteries have performance characteristics that are similar to VRLAs but require less maintenance, and they have proven to be reliable in remote sites, but they are more expensive.

Lithium ion (Li-ion) batteries are lightweight, high-density designs that nearly double the energy storage capacity of VRLA batteries. Li-ion batteries can work well in medium and small applications such as macrocells and small cells, although their performance is still being evaluated for larger installations.

Market Applications, Size and Trends

We estimate that the U.S. wireless carriers' 2014 capital expenditures for DC power systems were in the $800 million to $900 million range. This figure includes the DC power equipment (rectifiers, control panel, distribution), batteries and services (engineering and installation). The market will grow with the overall wireless network investment and represents 3 to 4 percent of the total wireless capital expenditures, depending on the size of the application.

The power equipment spend in several thousand mobile switching offices in the United States has decreased because most of these sites are built out. Most power-related activity is for modernization and upgrades of existing power plants. These are large power plants with capacities of up to 10,000 amperes at -48 VDC,

A power plant in a mobile switching office.
Photo courtesy of Alpha Technologies

typically with an eight-hour battery reserve and standby diesel generators.

Some 350,000 cell sites (not towers) in the United States use medium-size power plants ranging from 600 amperes to 1,200 amperes at +24 VDC and –48 VDC, installed either in huts or outdoor cabinets at the base of the tower. Four-hour battery reserves are common. These sites often do not have a permanent standby generator but can accommodate a portable unit when backup power is needed. The growth of macrocells has slowed as 4G LTE build outs near completion. All new cell site installations use a –48 VDC power system.

Small is big. Thousands of small cells are proliferating at a rapid pace as the carriers look for ways to extend network coverage and capacity into indoor and outdoor spaces where macrocells cannot reach. Powering small cells is a challenge. Small cells consume 400 watts to 600 watts of power that must be supplied in unusual locations, with or without battery backup.

Wireless capacity and coverage are being achieved with indoor DAS (iDAS) and outdoor DAS (oDAS) deployments. Both iDAS and oDAS involve enough headend electronics to require a small –48 VDC power plant, and distributed remote units that connect to the antennas need their own power supply that can range from 60 watts to 80 watts, and up to 300 watts. New current-limiting devices on the market allow for transmitting DC power over copper-wire pairs from the headend power plant to each remote device, thereby eliminating the need for a remote power supply.

A small cell radio node.
Photo courtesy of SpiderCloud Wireless

It Just Has to Work

The reliance on reliable and sustainable operation of the wireless network is growing dramatically. People and businesses increasingly depend on wireless communications and expect their wireless devices to work. Citizens and first responders alike need to be able to communicate in times of natural disasters and unseen threats. Certainly, the recent experience of natural disasters such as hurricanes and superstorms that knocked out utility AC power places major dependency on the DC power plants at cell sites and switching centers to keep operating on batteries or other backup power systems.

DC power systems are critically important because lives and livelihoods can depend on getting a wireless call through. In the end, it just has to work.

John Celentano is an independent marketing consultant with more than 25 years in telecom. He has worked in telecom power systems engineering and product management and has advised large power equipment manufacturers on telecom power market trends and key marketing strategies.

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HOW THE WIRELESS WORLD CAN REDUCE OPERATING EXPENSES WITH SMART ENERGY SOLUTIONS

Comprehensive solutions give telecom companies a capability for monitoring and maintenance, and they can include responsibility for the grid power, on-site renewable power generation and all of the energy infrastructure.

By Phil Herman and Jason Scharfspitz

For wireless carriers, energy and operating costs have always been a challenge. Electricity can account for up to 15 percent of total cellular network operating costs in mature markets. In developing markets, power costs can climb as high as 50 percent of total operating costs because of unreliable grid supply and a reliance on generators powered by diesel, which is subject to fuel theft.

In both mature and developing markets, power consumption — and energy costs — are expected to rise with the staggering increase in mobile device use. Meanwhile, the telecommunications industry faces consistent challenges brought about by Mother Nature and power grid instability. Both can interrupt electrical service to wireless towers, traditionally forcing operators to turn to some combination of lead-acid batteries and diesel generation to keep mobile users connected.

However, there is a new class of backup power solutions that use remotely monitored and controlled smart energy infrastructure. These assets reduce energy and operating costs and increase efficiency and reliability. Under the right conditions, they can even replace existing energy sources, including the need for on-site fuel, and provide stored or generated energy when the towers are operating normally to further enhance operational savings.

Working Together

Lower costs and increased efficiency sound great, but what's the deal behind this new wave of smart energy solutions transforming the industry?

New outsourced solutions provide comprehensive management and control of wireless site energy infrastructure, providing true enterprise energy management. This capability uses remote and site-installed hardware, and it uses software that communicates with the on-site assets (battery, generator, HVAC) and intelligently operates them to reduce electricity consumption, optimize useful life and increase reliability. Understanding the performance of each component from afar minimizes the number of site visits, thus reducing the number of truck rolls for both preventive maintenance and fault fixes.

Lithium-ion batteries are also an important part of the solution. They can be managed precisely and recharged quickly, and they occupy a smaller physical footprint than lead-acid alternatives. In some instances, lithium-ion batteries can replace the need for generators in both on- and off-grid sites, and they can be charged with solar power.

This type of enterprise energy management has set off a buzz in the telecommunications industry. The industry shift from traditional, static power infrastructure designed only to provide standby support in case of a grid outage, to the integration and management of smart energy assets provides carriers and operators the opportunity to effectively address and achieve the lowest possible total ownership cost for their networks. This, combined with new energy-as-a-service models, allows telecom carriers to transition from heavy capital-expense spending to more predictable and affordable operating expense models. What's more, the solution gives the industry a remote management capability, so operators can see what's happening at the tower even when traditional energy sources fail. In fact, with satellite connectivity, operators can continue to monitor the state of the sites when the network is down, providing new tools to better manage disaster recovery, including automated Federal Communications Commission reporting.

This is the Panasonic Eco Solutions Green Tower comprehensive energy solution for cellular tower and Wi-Fi hotspot sites on display at the Mobile World Congress conducted in March in Barcelona, Spain. The product combines Panasonic's lithium-ion and solar technology expertise with PowerOasis' energy management platform.

Reaping the Benefits

The new wave of comprehensive solutions provides telecom companies a sense of security. They offer monitoring and maintenance, and they can include responsibility for the grid power, on-site renewable power generation and all of the energy infrastructure. In addition to direct energy and operating cost savings, the new systems offer an opportunity to generate additional savings (cost avoidance) through smart grid energy arbitrage, or load shifting, together with revenue generation through participation in energy markets via defined load management or ancillary markets. Predictive algorithms are used to manage assets to maintain agreed service levels with excess production or storage dispatched to further reduce total ownership cost.

In addition, the economics of these solutions can be justified by the performance enhancements and operational savings achieved, providing the operators with net-net cost reductions without the need to invest capital. The intent is to save the operators from 10 to 20 percent on energy and operating costs annually. These new models are changing the way wireless carriers spend on energy, taking something that's historically a capital expenditure and turning it into an operating expense with year-to-year predictability.

Putting It into Practice

So who can make use of this opportunity? Applications include on-grid, off-grid and weak-grid solutions for cellular towers and other radio frequency transmission sites.

It appears that these smart-energy solutions will evolve in North America first; however, the challenges they address are experienced by virtually all competitive carriers globally, and it is expected the solutions eventually will be deployed internationally.

Phil Herman is chief energy engineer of Panasonic Enterprise Solutions, and Jason Scharfspitz is vice president of mergers, acquisitions, strategy and structured finance at Panasonic Enterprise Solutions. Visit www.panasonic.com/greentowersolution.

> *"Applications include on-grid, off-grid and weak-grid solutions for cellular towers and other radio frequency transmission sites."*

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CHALLENGES AND APPROACHES FOR POWERING DISTRIBUTED ANTENNA SYSTEMS AND SMALL CELLS

A distributed antenna system headend power system and batteries. *Photo courtesy of GE Critical Power*

Power and reach limitations can be overcome by using multiple circuits and appropriate combiner circuitry to power larger loads at extended distances, without jeopardizing safety or reliability.

By Paul Smith

Wireless data capacity can quickly reach its limits at large stadiums, on college campuses or in hospital settings with many wireless users in a highly concentrated geographical area. Given the limitations of traditional macrocell towers and Wi-Fi at these facilities, wireless engineers and designers are adopting a host of small cell and distributed antenna system (DAS) solutions. These systems rely on a network of smaller communications nodes across a defined area to fill in the gaps in wireless coverage and to add capacity to existing high-user, high-traffic areas.

Both small cell systems (including picocells, metrocells and microcells) and DAS offer advantages and disadvantages depending on a number of factors. The choice of technology depends on the setting, existing wire and cabling infrastructure, service provider needs and power availability.

When it comes to choosing small cell and DAS solutions, part of the evaluation is the power and requisite power backup requirements for these various options. Most small cell options, for example, generally rely on individual AC power supplies near each communications node. In this scenario, power protection is provided by either AC or DC uninterruptible power supply (UPS) units at each location. This approach does require higher power equipment and installation costs for the combined locations and ongoing maintenance and battery backup replacement costs. Yet these considerations need to be weighed against the advantages of lower up-front costs, reduced infrastructure requirements and faster deployment.

Furthermore, in large venue or stadium settings, most small cell, public site deployments are designed to handle anywhere from 20 to 30 users (for picocells and metrocells)

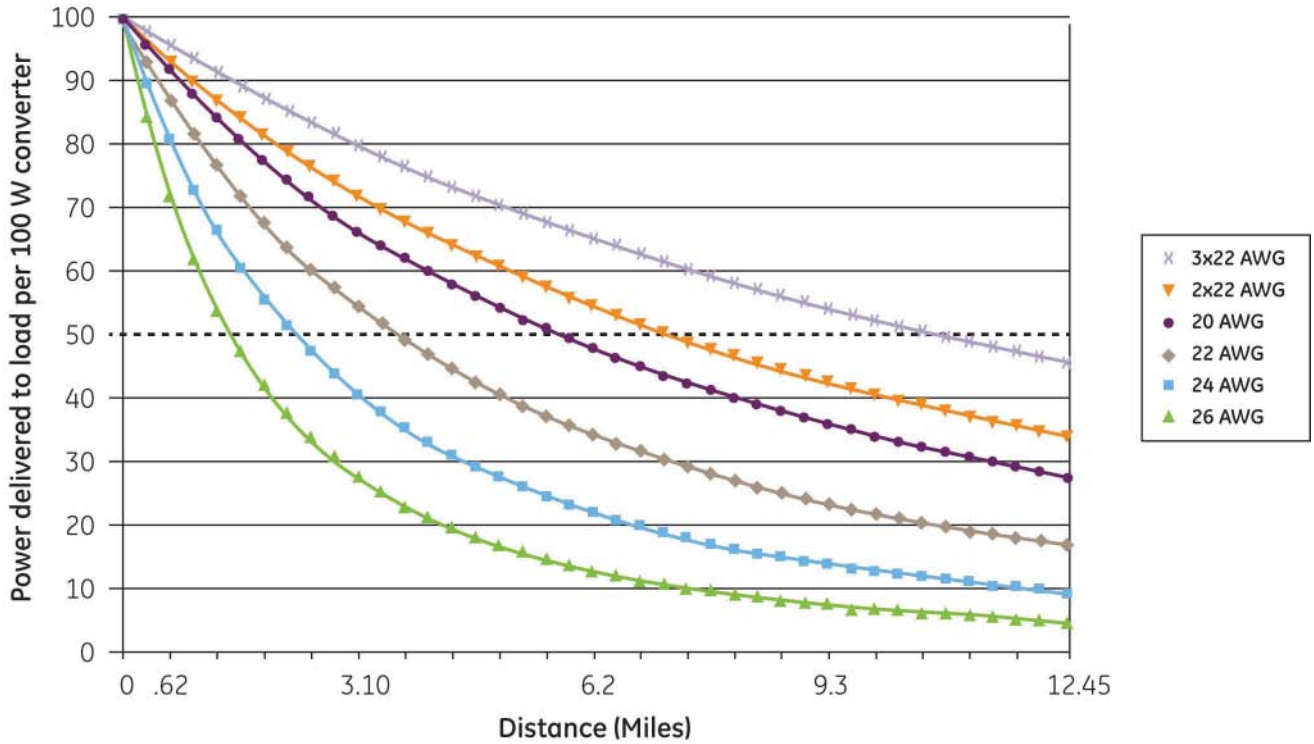

Figure 1. Reach calculations for different wire gauges – power delivered to load *per converter circuit*.

up to 200 users (in a microcell application) and have coverage areas of tens to hundreds of square feet. Given the need to manage cell traffic for thousands of fans in a stadium or for college students on campus, a DAS, which can handle as many as 1,800 users per system, is the preferred method for many large venues or facilities. Distributed antenna systems have larger coverage areas on the order of thousands of feet and, as the name implies, rely on more centralized approaches to power supply and power protection.

Power Challenges

Users expect wireless systems to be available at all times. Loss of utility power does not excuse loss of service, so backup power is essential. Providing backup power via UPS modules to large numbers of small cells and DAS remotes is expensive both from infrastructure and maintenance standpoints. Being able to supply uninterruptible power from a central location significantly reduces maintenance costs, with just a slight increase in infrastructure cost to deliver power to the required locations.

Transmitting DC power to small cells or DAS remotes from a central location requires using copper wires that incur resistance losses that increase with distance. Use of a higher voltage allows longer reach for modest amounts of power. Fortunately, most small cells do not require large amounts of power.

High-voltage Approaches

The high-voltage approach uses a power-limiting DC/DC converter to generate ±190 volts, limited to <100 watts per circuit and feeding small-gauge wire circuits for remote loads. The reach of a single circuit is dependent upon the wire gauge selected and the power required by the load, as shown in Figure 1.

At the remote end of the circuit, a down converter is used to return the ±190 volts to the voltage required by the load equipment, typically 48 volts or 12 volts.

The outputs of the down converters may be fed in parallel to enable load power in excess of the 100-watt limit per circuit or to increase the reach at lower power levels.

Low-voltage Approaches

Power delivery to remote equipment at low voltage DC, typically 48 volts, can be achieved using National Electric Code (NEC) safety practices designated Secondary or Class 2.

Secondary circuits are not limited in power allowed in

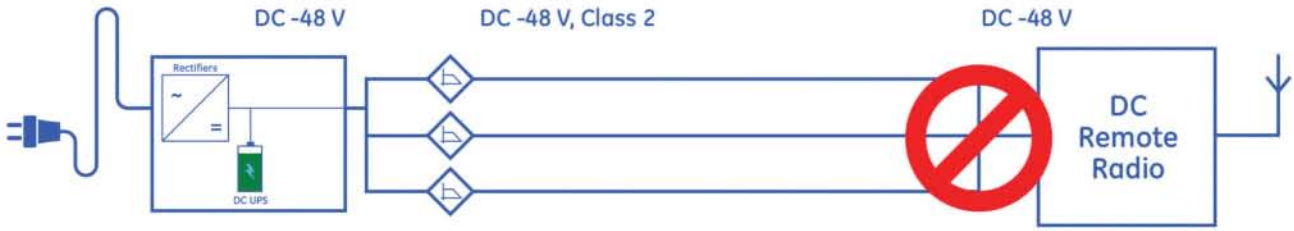

Figure 2. Class 2 power delivery circuits cannot be directly paralleled.

each circuit, but circuits must be installed in a protective conduit for fire and safety reasons. Secondary circuits can carry higher currents and reach longer distances, but they are more expensive, both in material costs and installation.

Class 2 circuits are required to be limited to 100 watts of DC power per circuit for fire and safety purposes, but can be installed without a protective conduit, significantly reducing material and installation costs. Each circuit requires a protective device, typically an active current limiter, which can limit total power to 100 watts per circuit.

For loads requiring less than 70 watts, the 100-watt power-limited circuit can have sufficient reach. The power limitation can become restrictive when longer reaches are required or when higher power loads are used.

Multiple circuits cannot be directly paralleled to provide additional power or reach (see Figure 2) because this would negate the Class 2 safety features by allowing larger potential fault currents.

Multiple circuits may be run in parallel, however, if a combiner circuit is used to isolate fault currents from parallel circuits (see Figure 3). This can significantly increase the load power that can be supplied or increase the reach of the combined circuits.

Reach is also limited by the need to make allowances for the discharged voltage of the batteries used to provide backup power. Reach must be calculated based on the end-of-discharge voltage of the battery. Typically, this would be 42 volts for a nominally 48-volt battery. Use of a boost converter that maintains the line voltage at a constant 58 volts can more than double the effective reach of a Class 2 circuit (see Figure 4).

For Class 2 circuits, it can be seen from Figure 5 that a load of 50 watts can be located about 1,300 feet from the source without the use of the voltage booster, whereas the same load could be located at a distance of 4,400 feet with the voltage booster. Not having to install the cable in a protective conduit is estimated to save around $8 per foot, totaling more than $10,000 for a 1,300-foot cable run.

For larger loads, Class 2 circuits can still be used, but a combiner is required at each load to allow safe paralleling of circuits. Calculations are straightforward: a 100-watt load would require two circuits at 1,300 feet. The combiner used to parallel circuits can be used with or without the boost converter that extends reach.

An additional safety violation can be posed by a current-limiting circuit that has user-replaceable current-limit elements such as fuses. A fuse that could be replaced by an incorrectly rated part can pose an inadvertent safety or fire hazard.

Conclusion

Providing uninterruptible power to a proliferation of

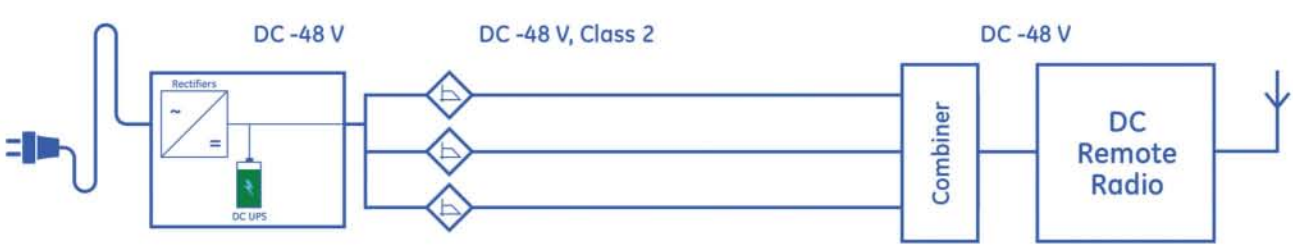

Figure 3. Class 2 power delivery circuits paralleled using a combiner.

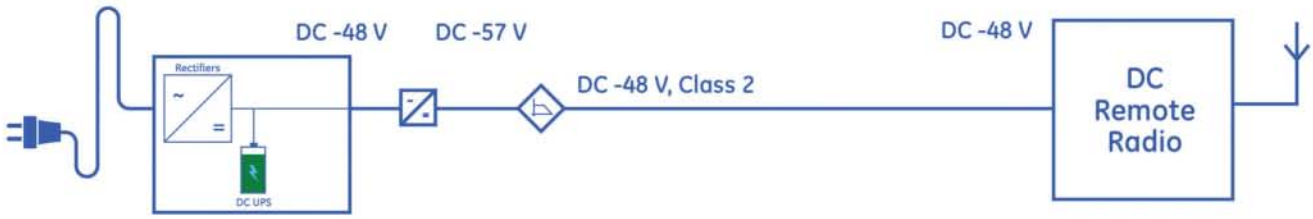

Figure 4. Voltage booster and current limiter used to implement Class 2 power delivery circuits.

small loads requires many UPS units or the ability to transmit DC power over significant distances from a centralized location. The use of NEC Class 2 circuits is a cost-effective way to transmit power over long cables while minimizing the installation cost by avoiding conduit.

The architecture typically used by DAS and small cell systems, with a centrally located data processing site, lends itself well to this power architecture. In most cases, the remote equipment requires a fiber-optic cable connection for data communications, so installation can be further simplified by the use of a hybrid fiber cable, which contains multiple fibers along with copper conductors used to carry the power. Installation of a single, hybrid cable, without the need for conduit, is all that is required for these cases. This type of installation offers low cost, high reliability and low maintenance.

Power and reach limitations can be overcome by using multiple circuits and appropriate combiner circuitry to power larger loads at extended distances, without jeopardizing safety or reliability. For more information about solving power reach issues with diverse DAS solutions, take a look at our "Going the Distance with DAS" white paper at *http://apps.geindustrial.com/publibrary/checkout/DET-810?TNR=White%20Papers|DET-810|generic*.

Paul Smith, technical marketing manager at GE's Critical Power business, works with telecommunications and data center customers to build and sustain massive communications, network and data capacity with reliable and energy-efficient power. Visit www.gecriticalpower.com.

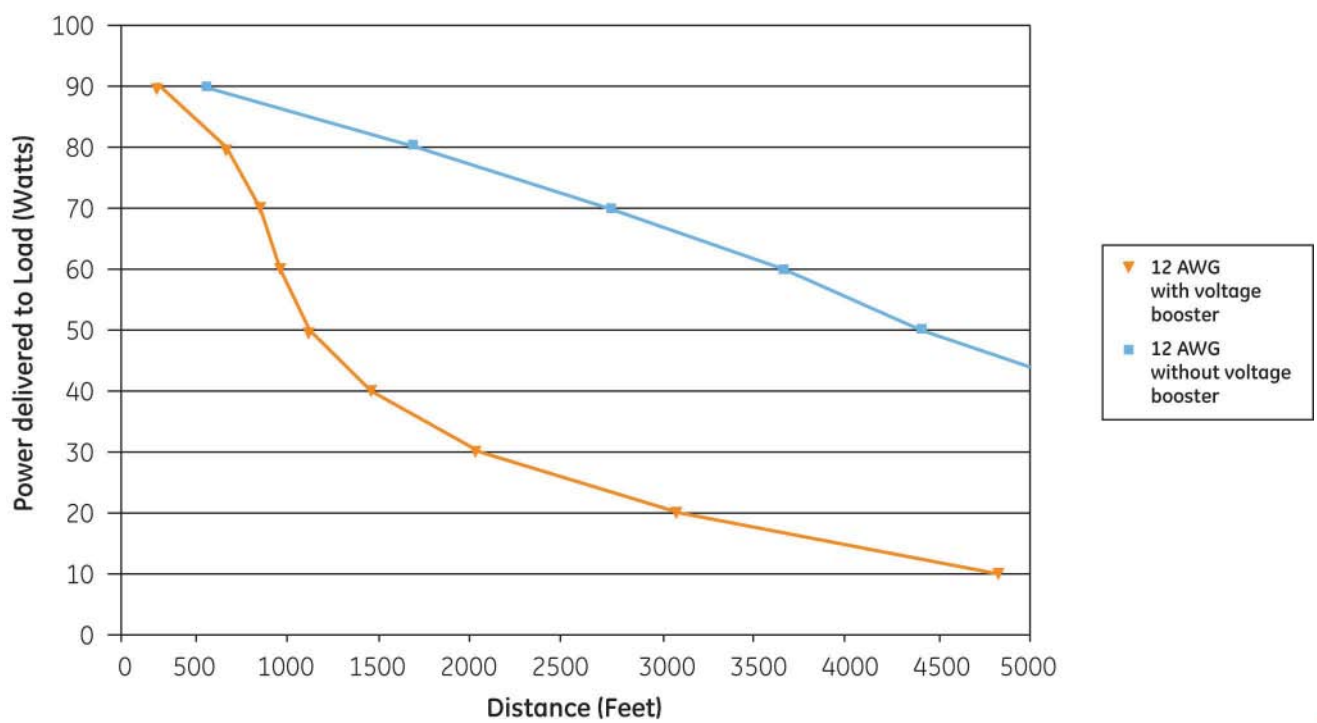

Figure 5. Reach of a Class 2 circuit, with and without voltage booster.

Tower Family FOUNDATION

Providing Support by Standing Together

"The Nevada Wireless Association supports the efforts of the Tower Family Foundation and has made them a recipient in our annual charity golf tournament. Best of luck to the Foundation as you continue to grow and help those in need!"

Chris Wener
Nevada Wireless Association President

"As a climber with 17 years of experience, I've seen firsthand the hurt and the pain caused by the loss of a fallen friend and fellow tower climber. I am grateful and humbled to know there is an organization that has resources to assist tower climbers and their families during times of need."

John Gates
Tower Climber from ATS

"I want to thank everyone involved for making this happen! Synergy Concepts will be donating to the Tower Family Foundation and encourages other companies in the industry to donate as well."

Russ Chittenden
Vice President of Synergy Concepts, Inc.

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www.towerfamilyfoundation.org

YEAR OF THE CLIMBER

By Don Bishop

Accidents that cause towers to collapse may result in someone being injured, and sometimes fatally. Sometimes ice, high wind or a combination of the two cause towers to fall when no one is near. In March, a 24-year-old man apparently fell asleep while driving on Highway 8 on Harrison Ferry Mountain in Tennessee. His vehicle left the road, went down an embankment, traveled 175 feet through a field and struck a guy wire anchor. The damage caused a 300-foot tower owned by DTC Communications to collapse. The driver was not injured, and no one else was around.

Verizon Wireless and SI Wireless (MobileNation) had antennas on the tower for GSM, UMTS and LTE coverage, along with microwave antennas for backhaul. The falling tower cut electrical transmission lines and fiber-optic cable, knocking out power and wireline telephone, data and video service to the area. The property damage was substantial, yet to have an accident cause a tower collapse with no one injured is rare indeed.

Ask the Safety Experts: The Quiet Installers

The real experts in safety for tower workers are the introverted installers who sit quietly in an open discussion, and they are the ones we need to hear from the most.

By Richard R. Bell

I was 16 years old when I climbed and painted my first tower. I was paid 25 cents per foot as a subcontractor to paint five Windcharger towers in Oklahoma City for KTOK-AM. Four of the towers were 220 feet tall, and the center one was 450 feet tall. The contractor I was working for was Boots Griffith, a local tower hand who worked for Liberty Tower. Boots' brother Earl owned Liberty Tower and occasionally contracted with his hands to do maintenance around the city. Liberty probably charged the owner $1 per foot to provide the materials and labor to do the job, then subbed it out to Boots for 50 cents a foot, who subbed it out to his nephew Artie and myself to provide the labor while Boots spent the week at home. Does all this start to sound familiar?

This was 57 years ago, and this type of subcontracting is an ongoing practice to this day. One would expect that with the emergence of the Occupational Safety and Health Administration, the National Association of Tower Erectors, new labor laws, stricter insurance requirements and the litany of workplace regulations enacted during the past 57 years that things would have changed by now.

Nature of Tower Workers

Boots was one of seven brothers, all of whom became iron workers and tower hands. These brothers, along with other field construction hands at Liberty Tower, were a brash, physical bunch who drank too much, smoked, chewed, cussed frequently and never failed to notice an attractive woman. They had limited education and were culturally unrefined. Yet, in spite of these characteristics, they were never unemployed. The work they did was dangerous, and even though they often fought among themselves, the mutual respect they shared for one another was the bond that is still commonplace with tower hands today. These men were not suited for work in an office or a production line. They did the job they loved doing, and they enjoyed the freedom and independence of knowing that if they were subjected to the demands of an abusive foreman, they could quit their jobs and return to work the next day on another crew, doing the same jobs for the same rate of pay.

Today's Training

The tower workers' job responsibility has changed dramatically over the years. Fifty years ago, the central focus of a system was structural, such as standing the tower up. The antennas and lines were the simple part of the job, except for heavy TV antenna picks and CATV installations. CATV had numerous, bulky

antennas that often mounted on 10-foot booms similar to cellular, and there were separate lines for each antenna, plus there were amplifiers to install and the antennas had to be orientated to a specific target. The cellular industry today makes the CATV work look simple, and the technical responsibility of the tower hand is increased exponentially. Today, the training is focused almost entirely on equipment, climbing techniques, rescue and the technical aspect of a project while overlooking what I see from a safety point of view as most important — construction and installation. Common sense tells us that if the workers are good at construction and know how to avoid accidents, there will be very little need for rescue.

Much to the dismay of industry leaders, this industry has to have towers — and the breed of people who put towers up is the same as it was 57 years ago. The industry has even changed the name of the people who build towers from iron workers or tower hands to tower technicians, because the word "technician" is associated with education. Fifty-seven years ago, in a raising gang erecting towers, the maximum level of education was a high school diploma, and seldom was there ever a hand who attended college. In tower crews today, the maximum level of education is usually a high school diploma and rarely is there a hand with any college education.

Burden for Safety

The Wireless Industry Safety Task Force was created by "top safety executives representing wireless carriers, tower owners, original equipment manufacturers, turnkey and construction management firms, and small contractors." And what this gang of regulators accomplished was to place 100 percent of the burden for project safety on the shoulders of the small contractors. Also, responsibility for certain mandatory equipment requirements, rescue training and competency training was placed on the small contractors who were the weakest voice in the regulatory crowd.

Refocus

If the Wireless Industry Safety Task Force sincerely wanted to make this industry safer, they would refocus their attention away from the tower hands and onto the owners, the engineering firms and the tower manufacturers. Many of the towers currently supporting our American communication infrastructure are as bad as I have ever seen in 57 years. I'm referring to 36-inch face towers with four or more carriers, with all three faces fully covered with transmission lines, some stacked two deep. The climbing facility consists of step-bolts running up one leg with guywires and antenna mounts obstructing the climbing path, and many of these towers don't even have horizontal members to climb or stand on. Monopoles with step-bolts are even worse. Tower hands need to be provided with a safe workplace, and this is a responsibility failure that cannot be placed on the tower hands or small contractors.

The military uses an organizational strategy in planning missions in which it separates participants into three categories: the brains, then the eyes, and then the muscle. The brains are the strategists who plan the mission. The eyes are the forward observers and organizers. The muscle are the soldiers who physically perform the mission. Practically all participants in the mission began their careers in the lowest category, the muscle, and worked their way up the ladder with some reaching the top position of brains. In order for the brains to be effective as strategists, they have to have detailed knowledge of the difficulties that the muscle will have to overcome to be successful.

Brains, Eyes and Muscle

In our industry, the tower owners are the brains, the people responsible for locating the towers and estimating how many carriers they will need to support in the future. The brains need to adopt a minimum tower standard that not only meets the current structural requirements, but also provides the workers with a safe workplace. The standard should include requirements such as an inside climbing ladder instead of step-bolts; horizontal members in their guyed towers, at least on 48-inch centers; an open space between lines on the outside of the tower for a climber to put a foot on while climbing; a platform at antenna levels with a hand rail to support the antennas; and all-weather site access for emergencies. The brains need to work with the engineers in plan-

ning and developing construction requirements for new projects and tower modifications.

The eyes of the operation are the project managers, the inspectors and the general contractors responsible for policing and assuring the owner that the installation meets the owner's standards.

The muscle is the small contractor that meets the qualifications of the owner's standards and that provides the tower hands to complete the project safely and on time.

The Warriors 4 Wireless program probably has a better chance of providing good construction people than the other programs, simply because the military personality shares similarities with the tower hand. The work is dangerous no matter how safe you make the workplace or even if the workers are wearing smart lanyards. There is always risk associated with working at height. It's the physical, adventuresome, free spirits in the industry who make the jobs go, and I believe that these personality types will prove to be the tower technicians of the future. They're the same type of people, once described as the "Cowboys of the Sky" in the '20s and '30s, who fought to make their occupation safe. Without this aggressive type of personality being involved in tower construction, it will take a very long time to get a tower installed.

Real Experts

With all due respect to the people who truly take this subject seriously, I wish your ideas about more and better equipment or more training would resolve the problem. Will Rogers once made the statement, "The greatest fool is the educated man that tries to be expert in a field he is not educated in." I believe he is right. The real experts in this case are the introverted installers who sit quietly in an open discussion, and they are the ones we need to hear from the most. It might be better to use a questionnaire with multiple-choice questions to obtain their opinions. Some tower workers don't do well with writing. Many will speak out when they are among coworkers.

Richard R. Bell is president of Bell Tower.

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Industry Standards, Stop-work Authority Can Improve Tower Safety

Important steps include job hazard assessments and planning the work. Technology can also play a major role. We don't need to reinvent the wheel to make jobsites safer and more productive for everyone.

By John H. Johnson

Safety and fall prevention have new primacy in the wireless infrastructure business. Falls are a leading cause of death in the industry, but they are preventable. How can we turn this around? We can educate, enforce and work collaboratively as contractors, owners, clients and regulators to do the right thing.

Black & Veatch has been working with National Association of Tower Erectors members for more than a year to help solve the problem. We asked the group's board of directors, "What are we going to do as an industry?" We can do all that we can with our programs, procedures and training, and Black & Veatch and its subsidiary companies do many good things. But a lack of consistency clouds the industry on this crucial issue. NATE has been instrumental in carrying the torch for industry improvements and is in the forefront demonstrating its commitment to safety and health.

So how do you achieve consistency? A key step is setting a standard the industry can live by.

An American National Standards Institute committee is preparing these guidelines. But standardization is not only about how you train people. It involves skills training that correlates with safety training. We, along with other contractors, have focused on safety training. Workers receive competent climber, RF awareness, first aid, CPR and rescue training. But we realized that the safety training didn't validate that they knew how to do their jobs.

To fix that, we devised a new training program that can serve as a model consistent with other activities. In particular, the leading indicators show that the lifting equipment that's being used, the cat heads and hoists that lift infrastructure up the towers and put it in place, are not always being used correctly. These seemingly simple tools have complexities, and workers frequently don't know how to use them — how to rig, and how to determine load weights and sling angles, for example.

Standards developers with the Occupational Safety and Health Administration (OSHA) are reaching out to the industry, and Black & Veatch is one of several contractors offering assistance. In February 2015, OSHA representatives visited several Black & Veatch telecommunications job sites to witness work activities, learn about common hazards and interact with construction workers. The effort assisted OSHA in developing standards that will address the unique hazards associated with the telecommunications industry. This is a prime example of how employers, employees and regulators can work in a collaborative effort to address industry concerns.

Drones

Technology can also play a huge role. Drones can help keep people on the

ground. Drones won't hang the antennas, turn the wrenches or pull the cables, but a drone can go up and help plan the work to validate what exactly is on that tower so that a climber climbs once — not multiple times. This technology should be explored and used.

Stop Work Authority

When conditions are unsafe, tower climbers must have the authority to stop the work without fear of discipline or losing their jobs. Several employers give their workers authority to stop when things aren't right, including weather conditions. They have the authority to stop or at least come down and adjust the work plan.

When a tower climber stops work because of conditions that create doubt and is subsequently disciplined for that decision, how can such a reaction be considered to be effective? Changing this behavior will be a cultural shift that will take time and effort. Everybody having the ability to stop work and everybody planning their work is the standard this industry needs to adopt.

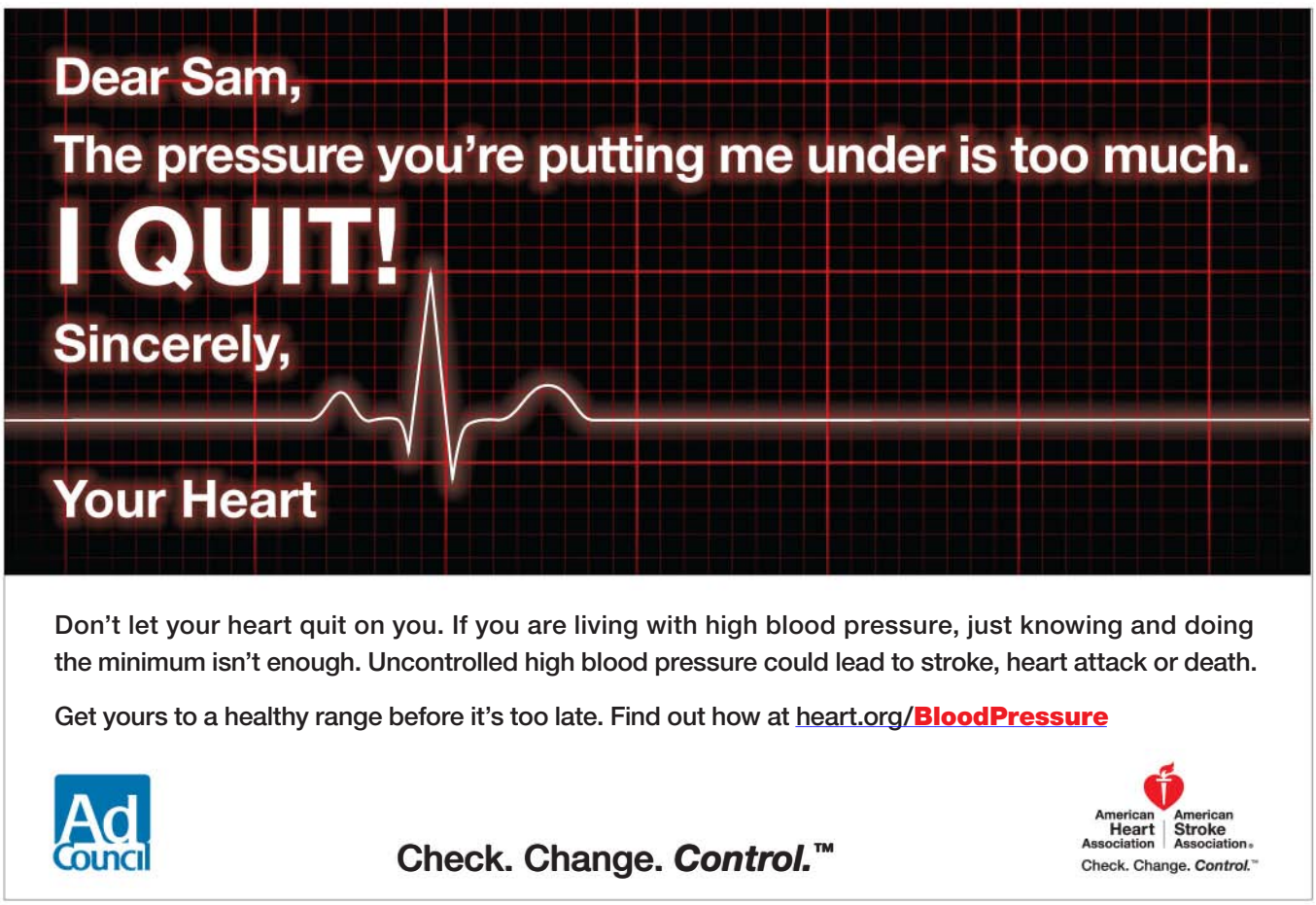
Standards

In October 2013, a representative of a carrier stood up at the Telecommunications Industry Safety Summit and said, "You tell me what I need to do, and we'll do it." We need to have one set of standards that applies to this industry. It must be an evolving set of standards, but one that is adopted by individual organizations and by the industry. Then we must hold true to them.

Carriers, their flow-downs and their contractors will say, "If you're going to do this work, you need to follow these standards, period." That's what we're waiting on. Many things have been brewing during the past several years, and momentum has been building to start this important work. It's time, and we don't need to reinvent the wheel to make jobsites safer and more productive for everyone.

There are things we can do now. We all care about safety, and if we adopt standards, our industry will see significant changes not only in fatality rates but also in accident rates in general.

John H. Johnson is vice president and director of environmental safety, health and security at Black & Veatch, an engineering, procurement and construction company serving clients in the wireless infrastructure industry.



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OSHA Seeks Comment on Better Protections for Communications Tower Workers

Demand for cell towers leads to dramatic increases in worker fatalities.

By Don Bishop

The Occupational Safety and Health Administration is asking the public for information about worker safety hazards in communications tower construction and maintenance activities. Public input will assist the agency in determining what measures are needed to prevent worker injuries and fatalities.

In the past 30 years, the increased demand for wireless and broadcast communications has spurred dramatic growth in communications tower construction and maintenance. In order to erect or maintain communications towers, employees regularly climb anywhere from 100 to 2,000 feet. Communications tower workers face the risk of falls from great heights, structural collapses, electrical hazards, and hazards associated with inclement weather. OSHA recorded 13 communications tower worker deaths in 2013 — the deadliest year for these workers since 2006. In 2014, 12 workers were killed, which was double the number of deaths in 2011 and six times the total number in 2012.

"We understand the importance of this industry, but workers' lives should not be sacrificed for a better cell phone signal," said **Dr. David Michaels**, assistant secretary for occupational safety and health. "OSHA is inviting the public to tell us what we can do to better protect these workers."

OSHA is requesting information from tower workers, wireless carriers, engineering and construction management firms, tower owners, and tower construction and maintenance companies about the causes of employee injuries and fatalities, and to share best practices used by workers and employers in the industry to address these hazards.

The deadline for submitting comments is June 15. Interested parties may submit comments and additional materials electronically at *www.regulations.gov*, the Federal eRulemaking Portal. Comments may also be mailed or faxed. See the Federal Register notice at *http://federalregister.gov/a/2015-08633* for details.

Under the Occupational Safety and Health Act of 1970, employers are responsible for providing safe and healthful workplaces for their employees. OSHA's role is to ensure these conditions for America's working men and women by setting and enforcing standards, and providing training, education and assistance. For more information, visit *www.osha.gov*.

Responding to OSHA's announcement about its inquiry, **Todd Schlekeway**, executive director of the National Association of Tower Erectors, said, "NATE encourages our members and other wireless industry stakeholders to review the OSHA request for information on communications tower safety and participate in the public comment process. The association plans to formally submit public comments by addressing some of the specific questions outlined in the RFI as well as highlighting the ongoing initiatives that private industry is working on to raise the bar on worker safety and quality."

Jocko Vermillion, vice president of Safety Controls Technology, formerly an OSHA compliance and safety officer for 10 years who served as the agency's national tower expert and prior to that, for nine years as vice president and safety director for Summit Tower Services, said he recommends that OSHA reinstate the partnership it used to have with NATE.

"The partnership lowered the death rate significantly," Vermillion said. "OSHA is in a mode where it doesn't want partnerships, but partnerships work. I would like to see OSHA support NATE more, along with the National Wireless Safety Alliance."

Vermillion said the NWSA effort mirrors the 2010 crane standard and puts everyone on the same page. "They'll be issued a card, and all the training will be uniform for the tower technicians," he said. "Years ago, when we did the North Carolina standard, we hoped the federal government would adopt it. I would like to see OSHA do something like that. I was a member of a committee of OSHA's Advisory Council on Occupational Safety and Health that was formed to recommend tower standards for OSHA. We worked on it for a year and a half, and nothing came of it."

Vermillion said OSHA has three hurdles to overcome on its way to improving tower worker safety.

"First, OSHA doesn't have good standards," he said.

"Second, they don't have compliance officers who are trained to find hazards on tower sites."

"Third, they don't force the area offices to use all of the resources available to take a deep look at the multi-employer citation policy, or as I say, to go up the food chain."

"If OSHA were to put those things in place, they could stop people from hiring less-than-substandard contractors," Vermillion said. "In all my years of investigating accidents in the tower industry, I found that NATE members rarely were involved. Safety doesn't result from training and equipment alone. For example, in a case where a tower contractor was hired, the owner himself said he didn't know what the TIA 1019 standard for installation, alteration and maintenance of antenna supporting structures and antennas was. The controlling contractor that hired the contractor put a requirement to adhere to the standard in their contracts but didn't ensure that the contractor followed through. There is no question that this tower contractor provided the cheaper bid. It's about the almighty dollar. Until OSHA puts something in place that can mold people's thoughts on safety, they don't have a chance of winning."

John Paul "JP" Jones, president of Tower & Turbine Technologies, vice president of training at Safety LMSystems, and a member of NATE's board of directors, said, "I am truly grateful for OSHA's effort to bring focus on our industry. These actions are big steps in the right direction. We all have to work together to solve this issue once and for all. In OSHA's lap lies the responsibility to properly train their compliance officers in our industry's best practices. In my opinion, any fall protection violation should carry an automatic serious-level fine and the company should be placed on probation with ties all the way to the president and CEO of the company.

"With the development of the National Wireless Safety Alliance and TIRAP programs, employers are going to have to operate on a level playing field with true commitments to training and certification levels. No more worthless train-the-trainer cards taught by clueless instructors."

Edwin G. Foulke Jr., an attorney with Fisher & Phillips and a former head of OSHA as assistant secretary of labor for occupational safety and health from 2006 to 2008, said the questions OSHA is asking in its inquiry indicate the agency might be looking to establish that tower erectors and the contractors they hire somehow have a joint employer kind of relationship and, therefore, both parties could be cited for violations created by the contractor.

"On the training, OSHA says there's a need for industrywide training and certification," Foulke said. "That goes to what NATE is trying to do. I'm not sure the people who are answering this may understand."

Foulke said that it is important that companies respond to the OSHA inquiry, although he said he worries that some information OSHA requests may end up raising more questions than answers.

Sources: OSHA press release, prepared statements from NATE, PCIA and SafetyLMS, and interviews with Jocko Vermillion and Edwin G. Foulke Jr.

Summertime, and the Living is Not Easy: Tips to Limit Liability for Summertime Hazards

In addition to addressing hazards, employers must also take into consideration potential recordkeeping and first-aid issues that are seemingly unrelated to the workplace.

By Mark A. Lies II and Kerry M. Mohan

After a brutal winter for many of us, a long-deserved summer season lies ahead. Unfortunately, employers cannot just kick back and relax during the summer. Rather, they have to be as diligent as ever to address and abate countless potential hazards, including heat illness, insects and animals, and emergencies. In addressing these hazards, employers must also take into consideration potential recordkeeping and first-aid issues that are seemingly unrelated to the workplace.

Heat-related Illness

Every summer, numerous employees are overcome by heat-related illness and, unfortunately, some of them die. These deaths have garnered OSHA's attention, which, over the past several years, has made a concerted effort to address heat-related illness and issue General Duty Clause citations based on apparent failures to protect employees from heat-related hazards.

In fact, OSHA has a Web page entirely dedicated to heat-related illnesses, and it maintains a nationwide map and chronology of apparent heat-related deaths dating back to 2008. See *www.osha.gov/SLTC/heatillness/map.html*.

To protect employees from heat-related illness, OSHA requires employers to:

- Monitor on a daily basis the weather conditions to determine when hot and humid weather is occurring to determine whether the heat index enters the ranges where there is a serious health hazard
- Provide water, as well as liquids which replace electrolytes, to employees and ensure that employees remain hydrated during the day
- Mandate work/rest regiments that may vary depending on the heat and humidity conditions
- Acclimatize new or employees returning from an absence before returning them to full-time work
- Provide first aid to employees suffering from heat-related illness
- Train their employees on the signs and symptoms of heat-related illnesses and first aid, including additional training for supervisors to identify employees who are evidencing signs and symptoms of heat illness. This training should be documented.
- Thus, to prevent heat illness, employers should identify potential heat-related hazards, develop heat illness prevention programs and provide training to all employees who may be exposed to heat-related illnesses.

Insect and Animal Bites

With summer also comes potential exposure to insect and domestic or wild animals. From mosquitos to bees to spiders to ticks to dogs to birds, employers with employees working outdoors must be aware that any of these creatures can lead to allergic reactions,

painful or even deadly illnesses, or serious injuries due to insect or animal bites. For instance, the Chikungunya disease, which just recently migrated to the United States, is just one of the countless mosquito-borne diseases employees may contract. Thus, employers must be aware of these potential hazards their employees may face when they work in outdoor conditions, develop plans to address these hazards and provide training (including first aid training) on how to address these hazards. Documentation of the plans and training is critical.

Emergency Action Plans

Under OSHA's Emergency Action Plan regulation, 29 CFR 1910.38, employers are required to develop emergency action plans. Employer emergency plans must include:

- Emergency escape procedures
- Emergency escape route assignments
- Procedures to be followed by employees who must remain in the facility to operate critical equipment before they evacuate
- Rescue and medical duties for those employees who are required to perform them
- Means of reporting the emergency or a fire
- The identity of persons (title, name) or departments who employees can contact to obtain further information

During summers, each region in our country has its own unique weather hazards, ranging from thunderstorms to tornados, floods, hurricanes and fires. In each of these situations, employers must be prepared to address these emergencies and have written action plans in place to address these emergencies. Further, employers must train their employees on these emergency action plans so they are aware of what to do in the event of an emergency.

Recordkeeping Considerations

In addition to the issues identified thus far, employers must remember to consider OSHA's recordkeeping regulations, particularly relating to recordability, when it comes to heat-related illness, insect-borne diseases and animal injuries, as it does with any other injury or illness. For instance, when an employee working outside receives a bad sunburn and is give a prescription-strength ointment or medication or has days away from work or restricted activity, that incident must be recorded on the OSHA 300 Log. Further, when an employee receives an insect bite and receives medical treatment, that incident must be recorded on the OSHA 300 Log.

First Aid Considerations

OSHA also requires adequate first aid assistance to provide emergency medical assistance to employees suffering from heat illness and other injuries. OSHA mandates that this first aid either be provided by the employer or is reasonably available from third-party responders (e.g., EMTs and the fire department), typically within three to five minutes after the emergency occurs, although there can be circumstances in which this period is extended. See 29 CFR 1910.151(b); 29 CFR 1926.50(d)(1). Thus, employers should evaluate their potential hazards and ensure that employees at their work sites are provided appropriate first aid to address those hazards. For example, if employees are working at a remote job site where third-party emergency responders are not reasonably available typically in three to five minutes, the employer has primary responsibility for first aid and cannot rely on the outside responders.

Recommendations

To avoid potential liability for these summertime hazards, an employer should consider the following actions:

- Hazard identification — identify potential summertime hazards, such as job functions and environmental conditions. Employees should be consulted in this process.
- Hazard correction — correct, or reduce the identified hazards, if possible.
- Employee training to encompass:
  - description of various types of summertime hazards
  - information on how heat-related illness, allergic reactions, insect-borne diseases, or other summertime injuries and illnesses occur, including:
    - environmental conditions
    - working conditions
    - individual employees' health conditions or work practices, such as failure to consume adequate water, wear adequate personal protective equipment or remove PPE during breaks
  - how to recognize the common signs and symptoms of heat-related illness, allergic reactions or other summertime injuries and illnesses
  - duty to promptly report to a supervisor if the employee or

co-employee is experiencing the signs and symptoms of heat-related illness, insect-borne diseases or other summertime injuries and illnesses and to obtain assistance
  - o documentation of the training
  - o training must be provided in a language that the employee can understand
- Supervisor training
  - o Train supervisors to recognize the signs and symptoms of heat-related illness, allergic reactions or other summertime injuries and illnesses and how to respond
  - o Explain employer's program and how to implement it
- First aid — adequately train and provide readily available first aid services, using either in-house or outside third-party providers
- Emergency action plans — adequately develop and train employees on emergency action plans for emergencies that are reasonably anticipated to occur in your geographic area
- Recordkeeping — maintain the OSHA 300 Log in the event the injury or illness is recordable

Conclusion

If an employer undertakes these actions, it will minimize its potential liability as it relates to summertime hazards.

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www.trojanbattery.com

Rack-mount Power Supply

The **DuraComm** RLP-BBSCLVD-MU series of 2RU heavy-duty rack-mount DC power supplies with battery backup, smart charging, built-in monitoring and control and low-voltage battery disconnect includes a user-friendly integrated remote monitor and a control unit. The control unit provides a Web interface to monitor the operation of the RLP power supply, charger, temperature and AC line voltage. I/O pins provide additional alarms and controls for the site power system. The RLP series power supplies are available in 12-volt, 24-volt and 48-volt floating-ground configurations.

www.duracom.com

Hydrogen Fuel Cell Power Supplies

ReliOn is **Plug Power's** suite of stationary hydrogen fuel cells for backup, grid supplement and off-grid power for telecommunications, railroads, utilities and government. The units provide scalable, clean, cost-effective performance while offering flexibility in addressing the space and runtime constraints of customer locations, with both indoor shelter and outdoor cabinet options. Unlike traditional generator or battery power technologies, which can be unpredictable and maintenance-heavy, the systems are designed to deliver reliable power over a wide range of operating environments. Built with a modular design, the systems offer solutions for power requirements scaling from 50 watts up to 20 kilowatts or even higher, offering more than 190 possible configurations.

www.plugpower.com

DC Power System

Newmar's Sentinel high-reliability 48-volt DC power system provides primary and backup power along with system monitoring at communications sites. The integrated system features redundant rectifiers, distribution breakers, backup batteries with a low-voltage disconnect and interactive Web-based monitoring that reports alarm conditions via email, providing real-time operating information and data logging.

www.newmartelecom.com

PRODUCT SHOWCASE

Smart Energy Solution

A lithium-ion hybrid power system from **Panasonic Eco Solutions** provides energy for cellular tower and Wi-Fi hotspot sites. The Green Tower system combines Panasonic's lithium-ion battery and solar technology with **PowerOasis**' telecommunications energy management platform. The technology targets cellular towers operating on legacy infrastructure and demonstrates how they can be retrofitted with solar energy generation and advanced energy storage equipment. Green Tower offers the tower operator the benefits of energy efficiency, reduced operating costs and enhanced reliability. The system is designed for a range of telecommunications sites having loads that range from 50 watts to 3 kilowatts, and it is easily deployed in off-grid, unreliable grid or on-grid locations to provide primary or backup power.

www.panasonic.com

UPS for DAS

Heterogeneous networks are the primary tool in wireless carriers' efforts to augment bandwidth capacity and overcome spectrum limitations. **Alpha Technologies**, a supplier of power and battery systems for macrocells, with +24-volt and –48-volt rectifiers and converters, offers an NEBS-certified, environmentally hardened UPS for outdoor distributed antenna systems. The system combines rugged UPS and batteries in carrier-grade enclosures for use in the outdoor environment. For indoor DAS and Small Cell applications, the company has pioneered a 48-volt line powering technique that enables service providers to use safe and low-cost Class 2 circuits to power remote devices from a centralized location.

www.alpha.ca/das

Fuel Cell Power System

The Freedom Power Nacelle from **Altergy Systems** puts its fuel cell power system into a small, lightweight packaging that dramatically decreases system footprint and volume by 47 percent and reduces the price by 26 percent while providing numerous mounting options. The clean and green system eliminates batteries, battery maintenance, battery replacements, generators and other operational costs and environmental considerations while providing long backup power runtimes and ensuring continuous communications capability. The system is available in 1-kilowatt, 2.5-kilowatt and 5-kilowatt variants and features low initial capital cost, low maintenance and operating costs, a low total cost of ownership, a long runtime solution and convertibility to unlimited runtime via the Altergy Freedom Fuel service.

www.altergy.com

AC/DC Sine Wave Inverter with Ethernet option

The Sine Wave series 1,500-watt pure AC/DC sine wave inverters from **Innovative Circuit Technology** are optimized for site installations with dual 2RU 19-inch rack mounting and Ethernet management available. In addition to high efficiency, low idle current draw and an extremely compact size, the inverters offer such optional features as TCP/IP Ethernet interface, static AC transfer switch for backup operation and dual-rack mount kit. All connectors are on the rear of the unit, close to where the wiring connections are. The inverter can be ordered with or without dual front AC accessory outlets. The Ethernet option allows the user to monitor battery voltage, output voltage, output power and alarms. The inverter outputs can be turned on or off remotely, which is useful when an AC-powered server or network switch needs to be rebooted at a remote communications site. ICT Sine Wave series can be ordered for 12-volt, 24-volt or 48-volt DC input.

www.ict-power.com

Power Inverter/Charger

The EVO inverter/charger from **Samlex America** charges banks of batteries and converts DC current into usable AC power. The inverter/charger can accept input from the grid, a generator or a solar charge controller to charge the batteries. It automatically switches among power sources as they become available, ensuring the batteries are charging efficiently and AC loads are being powered without delay. The inverter/charger works best as a power solution for vehicles or remote locations where grid is not available. It also provides backup power in areas prone to blackouts or during emergencies. The product detects fault conditions and prevents product damage and uses five different temperature sensors to activate two-speed controlled cooling fans. Four models are available, one charging up to 4,000 watts.

www.samlexamerica.com

Energy-saving Power Supplies

Phoenix Contact has added 10 new devices to the UNO power supply family, a range of low-cost but high-quality power supplies. Compared with off-the-shelf products, UNO power supplies offer excellent energy savings, achieved through low idling losses of below 0.3 watts and operating at up to 90 percent efficiency. These 10 new power supplies cover output voltages from 5 volts DC to 48 volts DC, and are available in 25-, 30-, 40-, 55-, 60-, 90- and 100-watt versions. They measure 90 millimeters high by 84 millimeters deep and come in three widths: 22.5 millimeters, 35 millimeters and 55 millimeters, making them suitable for shallow cabinets. Additionally, the UNO Power family offers the highest power density per volume in its class. Outdoor use is possible thanks to a wide temperature range of –25 degrees Celsius to +70 degrees Celsius. Phoenix Contact USA backs the entire line of UNO power supplies with a five-year warranty.

www.phoenixcontact.com

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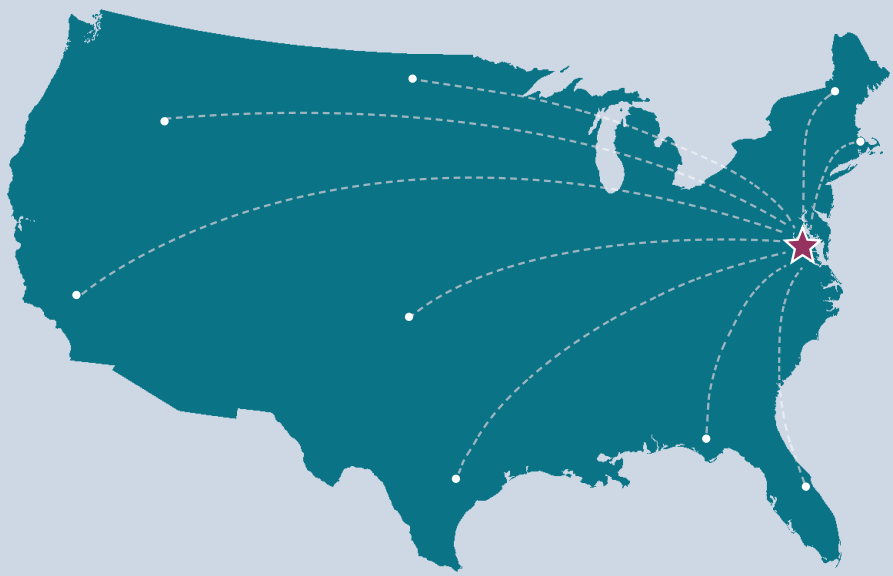

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