

ABOVE GROUND LEVEL

# agl Magazine

## CSI: TOWER SQUAD



SMALL CELL CAMOUFLAGE

SHELTERS, ENCLOSURES AND SECURITY

PUBLIC SAFETY COMMUNICATIONS

IN-BUILDING WIRELESS

MICROWAVE RADIO

HOW ANTENNA ACCURACY SAVES LIVES

YEAR OF THE CLIMBER

WHY TOBE D. WHEALE DIED

PCIA ON PREVENTION

CRIME SCENE DO NOT ENTER

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# This Land Is Your Land

Some antenna site developers have specialized in particular types of resources. Examples include railroad rights of way, school property, church property, rooftops, water tanks, electric utility substations and mountaintops.

Meanwhile, often enough it has been difficult to obtain permission to establish

commercial wireless communications sites on federal land. The notion of federal land conjures up images of federal land holdings in the West such as vast tracts of forests and grassland, not to mention national parks and monuments. And there's plenty of it, representing about a quarter of the land area of the United States. It's not where the largest percentage of wireless service customers use their devices, though.

What's mostly meant by federal land in the eyes of wireless communications site developers would be federal land in and adjacent to urban and suburban areas. This land would include post offices, law enforcement buildings, courts, federal office buildings, military bases, maintenance facilities, warehouses and distribution centers — many locations representing the same kind of real estate owned by the private sector.

Included in a bill introduced in the U.S. Senate on June 18 and dubbed the Wireless Innovation Act of 2015 is a provision to promote the deployment of wireless infrastructure on federally owned build-

ings and property by streamlining the process by creating a standard fee and master application to grant real property interests.

According to Sen. Marco Rubio (R-Fla.), one of the senators who introduced the bill, the Act promotes the deployment of wireless infrastructure on federally owned properties to increase wireless coverage and capacity “so Americans can access 21st-century technologies and so the infrastructure is there to support the Internet of Things.”

When the bill was introduced, PCIA President and CEO Jonathan Adelstein pointed out that in addition to helping the wireless infrastructure industry better serve its customers and meet the federal mandate of ubiquitous wireless broadband coverage, the bill will also help federal agencies by allowing work to scale with deployment demands, by supporting fee retention, and by providing an ombudsman to expedite stalled applications. He said these initiatives will provide agencies and the industry the certainty they need for new projects.

If the bill becomes law, and if infrastructure-related provisions of the bill work as intended, wireless site developers may find many new opportunities to please wireless carriers and their customers with coverage improvements.



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# Changes

We've been waiting for some changes in the wireless telecommunications industry, and they are arriving.

The AT&T purchase of DirecTV, a direct broadcast satellite service provider and broadcaster, is official. Although the purchase probably will be positive for AT&T, its effect on the antenna-siting business is most likely to be minimal.

A merger of T-Mobile USA and Dish Network would be another story. Should that merger move forward, it would be an interesting network to piece together. Spectrum holdings all over the radio-frequency chart would result in some large, highly different network deployments — antennas of all kinds, multiple carrier hardware platforms, for sure, and many new sites, along with replacements, upgrades and modifications.

The FCC is kind of ticked off at Dish Network. The company claimed \$3.3 billion in discounts when it bid in an RF spectrum auction this year, using two smaller companies in which it owns a controlling interest, Northstar Wireless and SNR Wireless, to place the bids. The FCC chairman appears to be blocking what are called designated entity (DE) discounts, which amount to bidding credits. There is some deep history of DE fights ending up in court and dragging out for entirely too long. Let's hope this one gets cleared up quickly. The wireless industry and the American public could use the wireless network alternatives that

the additional spectrum could provide.

Some impressive changes in the small cell world: Marc Ganzi caused everyone's heads to swivel as Digital Bridge acquired ExteNet from the current owners, and that list includes SBA Communications. The transaction is being presented as a recapitalization of the company's finances, but that sounds like a code word for acquisition (if you know the difference, please consider sending a letter to the editor).

Anyone who's been watching the industry knows Mr. Ganzi is always doing the next thing, before everyone else is, and dropping \$1 billion into ExteNet is going to result in profit for Marc and, you can bet, for his investors. I just wish Digital Bridge were a public company, so we could benefit from Marc's insight. To be serious, in my mind, this is a real change and puts small cell, vertical-market Wi-Fi folks into play. This comes on the heels of Crown Castle International's announcement of its acquisition of Sunesys for \$1 billion, which Crown views as a small cell play, rather than a fiber play. It's going to be interesting.

Zayo and other fiber companies seem to have figured out the magic of dark fiber for the carriers. Verizon Communications and Verizon Wireless, although sometimes behaving like schizophrenic twins, seem to be doing nicely selling between themselves while installing quantities of dark and light fiber. I'm betting that the Verizon Wireless network densification effort will pay off quickly as voice over LTE emerges.

Regretfully, I was unable to participate in the Wells Fargo Supply Chain Symposium July 23 in New York, run by the ever-present and insightful Jen-

nifer Fritzsche, managing director in the equity research department at Wells Fargo Securities, and her great team from Chicago. Key points from her newsletters, which correlate well with other sources, are that Verizon Wireless is still aggressively working on densification of its network with traditional macrosite adds, small cells and DAS, and that Crown's early footing in the small cell arena continues to pay off as it appears to be building more nodes than any other company.

As an RF engineer, I often look at things with the twist you would expect. To me, everything is an antenna problem, a propagation issue, a coverage gap or a throughput concern. Towers are merely the necessary evil that holds the antenna in the air at the point where it's needed. If everything were perfect, a wireless network wouldn't need towers — infinitely large antennas could be floated in the air in any desired location, for free.

Ah, but the engineer's dream is not grounded in reality. Nevertheless, we're always interested in talking with anyone who has knowledge and interest in the physical world of antenna-siting infrastructure. If you, a coworker or anyone else out there would be interested in sharing industry knowledge, we're always looking for the best sources of information, so please be in touch.



**Rich Biby, Publisher**

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## Quick-Guide to Shelter, Enclosure and Security Companies

As a supplement to *AGL Magazine's* January Buyers Guide, a list of shelter, enclosure and security 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.

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**Product:** air conditioning units  
**See ad on page 57**

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5600 Apollo Drive  
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**Product:** enclosures  
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**Product:** precast concrete foundations

**See ad on page 41**

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**Products:** shelters, enclosures, permanent



### Peabody Engineering

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William Rupert

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**See ad on page 43**

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gulletttawes@ventev.com

www.ventev.com/infra

**Product:** enclosures

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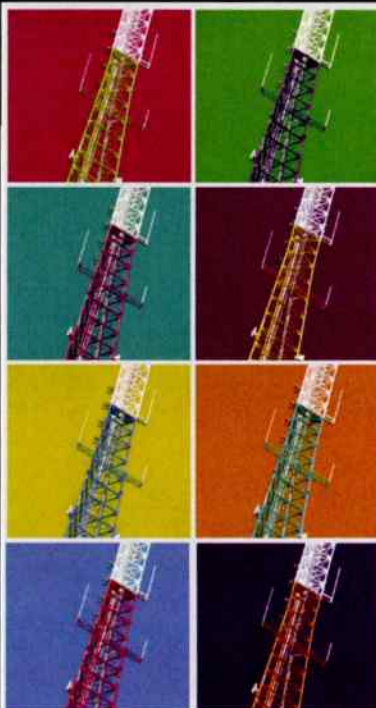
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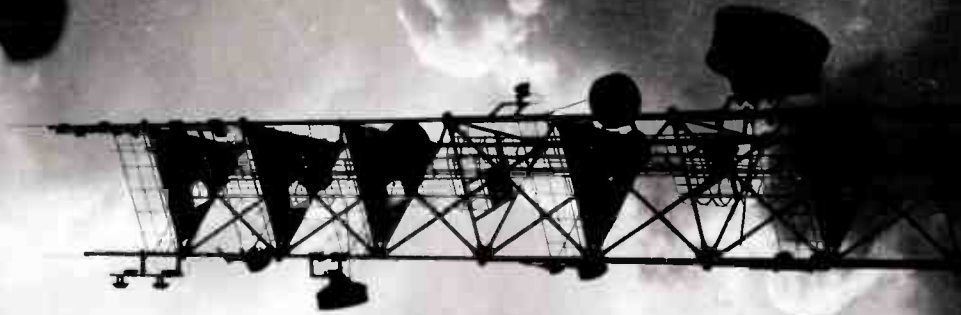
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# CSI: TOWER SQUAD



CRIME SCENE DO NOT CROSS CRIME SCENE DO NOT CROSS

First it was copper, and now at some cell sites, it's batteries. As thieves target more cell sites, the need for security increases. Among many alternatives are mechanatronic locks that offer security along with tracking options.

By Jim Fryer

**T**he stories of thefts at tower sites have been stacking up like cases of bootleg hooch on a Jersey-bound truck. It's gotten to the point that Hollywood might start looking at their TV show potential: *CSI – Telecom*, *Copper Cops*, *Tower Squad*, *Guy Wires* or *Site Detective*. The reality might not be as far fetched as you believe.

In the past year, some local jurisdictions have begun to dedicate units to site-related crimes, one being Baltimore County, Maryland, where a division of its police department, under the Scrap Metal Unit, focuses on tower properties. The BCPD slapped the cuffs on a perp in March for the theft of copper grounding plates from four sites valued at \$5,000 to \$10,000 per site.

The Harford County, Maryland, Sheriff's Department has also seen enough to warrant its attention. According to one detective, preferring to remain nameless, "The fact that these properties are mostly isolated, rural and relatively unguarded makes them a good target for thieves. We've been seeing a trend in increased frequency and organization of thefts along with property damage at these sites." Although there still is no hard body of statistics regarding this market, the

anecdotal evidence is growing along with the proliferation of new sites.

Copper has been the primary target for bad guys (and gals) over the years as prices for the metal shot up from a low in 2009 to record highs in 2011. Prices have cooled off considerably in the last few years, with copper losing its Metallic Flavor of the Month status among speculators and reaching a five-year low in June (see Figure 1).

A scrap metal dealer in New Jersey, Rockaway Recycling (which advertises "Top Prices for Your Scrap

Copper"), posted its most recent prices for the metal ranging from \$1 to \$2 per pound, depending on its configuration. Scrapregister.com skews it a little higher at up to \$2.80 per pound for high-grade copper.

Nonetheless, prices have slumped so much that CNBC's "Market Insider" column posted a story this past June titled: "Can't Get Worse for Copper, So Buy It."

Industry analyst Wade Sarver, owner of Wade4Wireless, stills sees a healthy appetite for the metal. "Copper theft happened all the

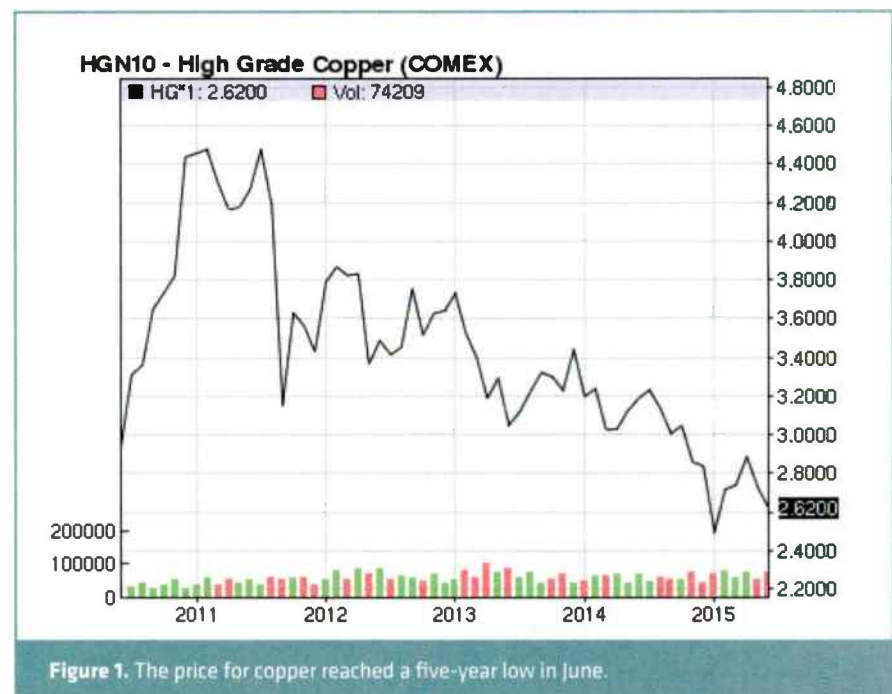


Figure 1. The price for copper reached a five-year low in June.

time,” he said. “One of the worst was when someone not only stole all the copper at our site in Rhode Island, but also ripped open all the cooling units and ripped out the coils to get more copper.”

Fred Francis, owner of Xenirad Broadcast Engineering in Huntington, West Virginia, has had his share of damage because of copper fever. “I had one site where all the copper in the building was stolen, including the phone wire and Ethernet cable,” he said. “The transmitter was even stolen — a new Nautel NX25 — as well as all the components in the antenna tuning unit.”

Francis fought back. “The best

thing I have found to thwart copper thieves is cold zinc galvanizing,” he said. “I have had several sites where copper was routinely stolen until it was galvanized. I have had air conditioner units destroyed in order to get 2 feet of copper tubing, and I have had transmitters destroyed in order to get a few dollars’ worth of copper. Since then, we have a security company monitoring the site.”

To the American Galvanizers Association, the term “cold galvanizing” is more of a marketing term than an actual process. Cold galvanizing, according to the AGA, is simply painting a piece of metal. Because the coating is zinc-rich

paint, it will not have the durability of hot-dip galvanizing in terms of abrasion resistance, cathodic protection and service life (or time to first maintenance). The AGA cautions that pure copper cannot be galvanized because there is no iron for the zinc to react with. Without a metallurgical reaction, a galvanized coating cannot develop. In short, it changes the color and masks the tell-tale shine, but it does not make the metal any less valuable.

Routing the copper wire through pipes is another method of concealment, although there is some debate over the conductivity of steel pipes. Running the wire through a PVC pipe filled with concrete is another suggested remedy to ruin a crook’s agenda.

Making it tougher to fence copper by working with local law enforcement and encouraging compliance stings on local scrapyards and recyclers is not only a way of catching criminals (albeit after the act), but also increasing the difficulty of making it profitable. Requiring scrap dealers to get an ID, license plate number and the signature of their customers before they hand over the cash, and making it clear that local law enforcement monitors those transactions, would serve to alter the business plan of any theft-based entrepreneurs.

Statistics are still blurry on how many thefts are inside jobs and how many are break-ins. Our Baltimore County police source says, “It’s about 50-50.”

“You can tell when it’s an inside job,” Sarver said. “Generally, they know what they can steal without setting off any alarms, whereas

### Scrap Metals Rockaway Recycling Buys - Price List Non-Ferrous (Last Modified: June 26, 2015, 11:27 am)

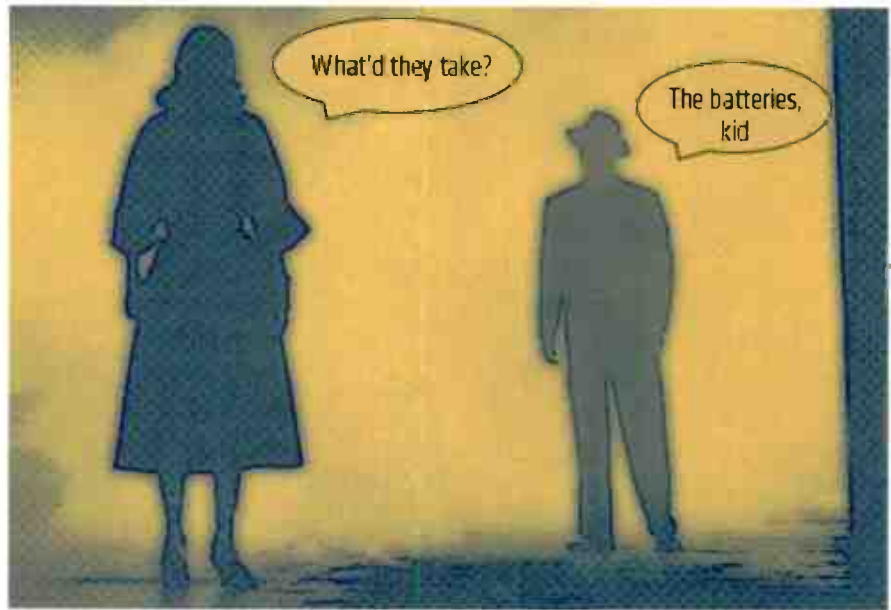
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some criminals just take whatever they can grab. It is pretty obvious. The only ones that get caught are generally when the tower has a camera at it. We had a site in Trenton where the thieves were caught on camera and they were recognized as the tower crew that was there just two weeks ago. They got arrested," he said.

Site manager Christine Teeter, owner of Rooftop Wireless, said one of her first suggested remedies to site owners is to install dummy cameras on a site, followed by real cameras if theft problems recur. "Anyone can request a site visit and say they're from a carrier, so we try to accompany them," she said.

Sarver doesn't see video surveillance as the final word in site security,



however. "The video usually catches them in the act, but they generally know how to cover up and hide from the video," he said.

Mike Hayden of LBA Group has a blunt but practical suggestion. "Many tower sites have a basic security problem that makes them

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Photos 1 and 2. Most U.S. sites are secured by a heavy chain and a pad lock.

attractive to thieves: They are relatively isolated," he said. Observed Hayden, philosophically: "If the thieves want the copper, they are going to get it. All you can do is minimize your risk." He suggests tower site owners and carriers take two actions to protect their investment: (1) Put razor wire atop the surrounding fence to discourage would-be thieves from scrambling over it; and (2) visit sites more frequently to increase the odds of interrupting thieves' planning.

However, thieves will be thieves, and morally bankrupt though they may be, they are quick to make market adjustments.

"Copper prices are down, the damn site manager made it harder to get at — what else ya' got?"

"Ah — batteries."

A recent report from AGL Media Group's J. Sharpe Smith ("Move Over Copper; Cell Tower Batteries Are the Hot Item Now") detailed a wide range of battery thefts from single-site boosts of four batteries valued at \$1,200 to a theft ring affecting 500 sites in several states

with battery values in the hundreds of thousands of dollars. One company, Acsys, has addressed the issue by creating a hardened cage that protects batteries by connecting individual monoblocs in groups of six or more. "That makes it too heavy and burdensome to lift from the site," said Michael Sothan, Acsys' vice president of business development. "The cage is locked with our mechatronic lock, which uses a code system to require verification before access is granted."

Technology is not only slow to come to the rescue when it comes to protecting a high-tech tower site, but also is practically medieval in its techniques. Most U.S. sites are still guarded by a heavy chain secured with a padlock. An informal survey, by this author, of 10 tower sites of varying size in the Philadelphia area confirmed the setup. Only half of the sites surveyed had razor wire around the perimeter fence (see Photos 1 and 2).

New products have come to market in response to the spike in the telecom crime wave.

Smart mechatronic keys and lock systems combined with a phone app are being introduced to the U.S. market by Acsys. The keys can be programmed to allow entry at specific times, specific sites or specific doors within the site. The system can be integrated with the ticketing systems used by telcos and their vendors to manage their operations and maintenance (O&M) to provide a complete picture of site access across their networks in real time. Although widely used in the African, Asian and South American markets, the system is new to the North American market. The system monitors when the gate is open and closed, so a job that was supposed to take three hours and only takes 30 minutes (and vice versa) can be called into question.

According to David Meganck, Acsys founder and chief operating officer, one of the significant features is the geolocation or geofencing solution. "This allows the system to be run automatically and only generate access codes if a user has reached a specific location defined by latitude and longitude," he said. "Our customers have dealt with a number of cases where a user gained access to a site and then left without closing it, allowing others to gain access and steal equipment. With the geofencing and code generating system (CGS), which has one true pairing (OTP) to grant an access code, the network operations center (NOC) has real-time feedback of where the user is and also can control when the user opens and locks a site. Moreover, we can verify that the



Photo 3. With a mechatronic lock, when the user arrives on site, verified by smartphone GPS, an access code is sent automatically that allows the key to open the lock to the site.

job was completed and that the gate was locked through our app, which includes a watermarked and

time-stamped photo feature. This simple tool provides an unprecedented level of knowledge about

what is going on at remote sites in real time that was simply not possible before." (See Photo 3.)

Mechatronic locks that combine mechanical locking systems with high-security electronics extend the operational possibilities of cylinder locks. They are especially useful where remote access is needed in remote locations by members of a group that can be defined.

*Jim Fryer owns Fryer Marketing & Media, a consulting firm serving the tower industry, and he represents Acsys, a company mentioned in this article. He is a board member of the Pennsylvania Wireless Association. He owns and manages Site Acquisition Specialist, LinkedIn's largest site acq group. His email address is jamesmfryer@hotmail.com.*

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# Adhesive-backed Films Offer Camouflage for Small Cells

By Steve King

**L**ook around. Chances are you're probably surrounded by people looking down at their smartphones or tablets. They're doing everything from working to watching video or playing games — or just updating their Facebook status. (Are you reading this article on a mobile device?)

To accommodate all this bandwidth, small cells will soon be popping up everywhere. Small cells fit just about anywhere because of their small size. However, they are typically placed less than 30 feet high, so it's harder to keep them out of sight.

If network densification is the key factor in the wireless evolution, how can we keep small cell infrastructure

from becoming an eyesore everywhere from St. Louis to Shanghai?

To make small cell equipment more aesthetically pleasing, a smarter approach to concealment and camouflage is necessary.

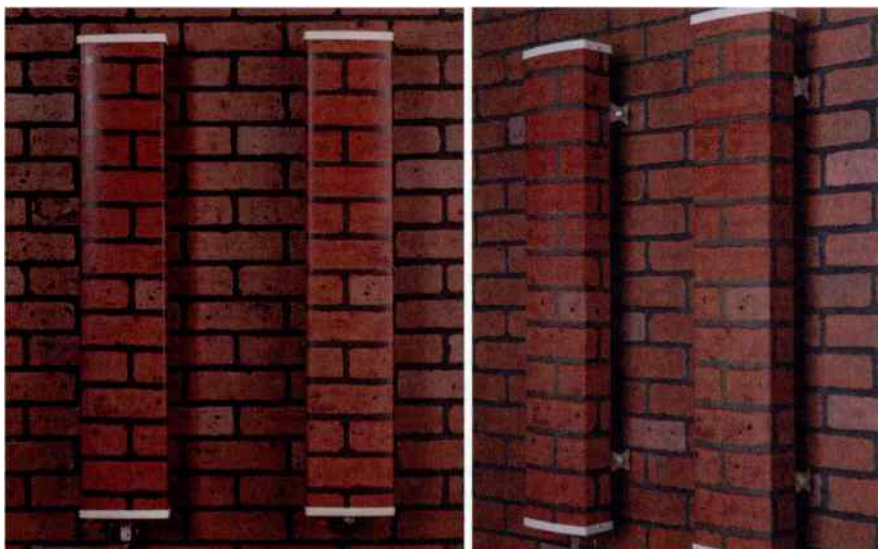
Because small cells come in various shapes, the right solution needs to be pliable. It also needs to be tough and weather resistant because small cells are frequently placed outdoors.

Some mobile service providers are finding success by simply wrapping small cells with the same materials used to wrap cars or buses. Companies such as 3M make adhesive-backed films that are UV resistant, durable for years, and easy to apply. What's more, they can be

printed on. So if a mobile service provider wants to place a small cell next to a brick wall, they can simply take a high-definition photo of the wall and have it printed on the film. Experienced installers can then apply the film to the cell.

The result can be a camouflaged match, and sometimes it can be so effective that it may only be seen if you know where to look. (Everyone is more interested in his or her smartphone screens anyway.) With solutions such as printable films, hiding in plain sight may be the solution mobile carriers need for aesthetically pleasing network densification.

*Steve King is an applications engineer with the 3M Communications Markets Division.*



A small cell next to a brick wall can practically disappear with printable, adhesive-backed films from 3M.



Wireless components can hide in plain sight with the same materials used to wrap cars and buses.

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World Radio History

# Demystifying Fire Codes for In-building Public Safety Communications

If the wireless industry does not get involved, codes, standards and ordinances are going to get modified and updated without your input.

By Alan Perdue

**I**t never ceases to amaze me how much confusion, ambiguity and uncertainty surround our fire codes for in-building public safety communications. Most of my colleagues in public safety are fully aware of the communications bottleneck they face when an incident calls for them to enter large buildings of various construction types. But many of them are unaware that there's a solution for that problem.

That knowledge gap is understandable though, especially considering how relatively new these codes are. Fire alarms and sprinkler systems have been around since the late 1800s, and the codes for those systems were some of the first fire codes adopted in this country.

The International Code Council (ICC) introduced in-building requirements for public safety communications into the International Fire Code (IFC) in 2009. And even

then, it only showed up in the appendix, which meant it was a recommendation available for adoption — not necessarily a requirement in the technical provisions of the code. Upon further modification, that language got moved to the technical provision of chapter five of the IFC in 2012. National Fire Protection Association (NFPA) requirements also followed similar timelines.

It's no wonder so much mystery surrounds these codes such as when and where they apply, how they are enforced and how often they change. So let me start at the beginning and explain how public safety officials, first responders, building owners and the communications industry can work together to solve this problem and enable wireless communication indoors for public safety and the public at large.

First, I'd like to set some baseline definitions for codes, standards

and ordinances. These terms are not the same; although they are often used interchangeably, they work together to accomplish our common goal of reliable indoor communications. Basically, codes are what you have to do, standards tell you how to accomplish that, and an ordinance provides the legal path for getting those functions into place (see Figure 1).

ICC and NFPA publish model codes and standards for in-building wireless communications. They're the glue that holds everything together, but there are differences between what is published by the ICC and the NFPA, so it's important to be aware of what's adopted via ordinance in each respective jurisdiction. Public agencies can also combine requirements from these codes and standards to create their own code, so it's imperative that stakeholders understand what is required in each jurisdiction.

## What's the Difference?



### Codes:

A set of laws or regulations available for adoption.



### Standards:

A level of quality achievement that is considered acceptable or desirable.



### Ordinances:

A law set forth by a governmental authority (i.e., City Council, County Commission).

**Figure 1.** Basically, codes are what you have to do, standards tell you how to accomplish that, and an ordinance provides the legal path for getting those functions into place

## Need and Opportunity

It is apparent that there exists a need and opportunity to both streamline and simplify this process for all stakeholders. Our goal at the Safer Buildings Coalition is to identify what is really needed in the in-building arena and determine how to get those standards into all the model documents for jurisdictions to adopt via ordinance. This will

deliver more consistency for everyone involved — code adoption to integrator, manufacturer, public safety, fire, emergency medical personnel and law enforcement — and responding to an incident.

These model codes from the ICC and NFPA are typically updated on a three-year cycle, and the frequency of change for local codes can vary depending on the political climate of the community, although they rarely go longer than six years before modifications are adopted. The person or entity most often responsible for enforcing these codes is referred to as the authority having jurisdiction (AHJ). Some cities may empower their fire code official to enforce these codes while other communities might delegate the responsibility to the building official (see Figure 2).

## Jurisdictions

Many of the jurisdictions that we encounter have adopted or are in the process of adopting the 2009 or 2012 edition of the IFC or NFPA 1 as their base code. So it's quite common for a jurisdiction to be one to three years behind the current model codes. For example, the 2015 edition of the IFC is available for adoption now, but it takes time for the model code to get promulgated and then it must work through the local or state adoption process. There's usually a lag in the process from codification to local adoption.

One of the critical components of the code development process is that nothing proprietary can be required, and that should help alleviate any concern original

equipment manufacturers (OEMs) might have about competitive threats in this space. Codes must be performance-based and generic enough to allow any wireless equipment manufacturer or solution provider to be in compliance. It's critical that we identify performance-based codes that accomplish our goal, because prescriptive codes mired down in specific components of the system can become outdated in the blink of an eye. We need to support rules that are fair, repeatable and realistic for every stakeholder so long as they meet the needs of both the public and public safety responders. It's precisely because we don't always know what's coming next from the technology world that our systems need to be plug and play, not rip and replace.

Ultimately, it's about what public safety needs, not what we want. Just because we can get a requirement into the model code doesn't mean we should. If these rules are too stringent for local adoption, we fail to solve the problem. We have to be realistic because, even though we'd love to have the Cadillac system, we understand we can get by with less 99 percent of the time. Success manifests in a balance that supports the needs of everyone without diminishing the importance of our objective.

## Coalition Mission

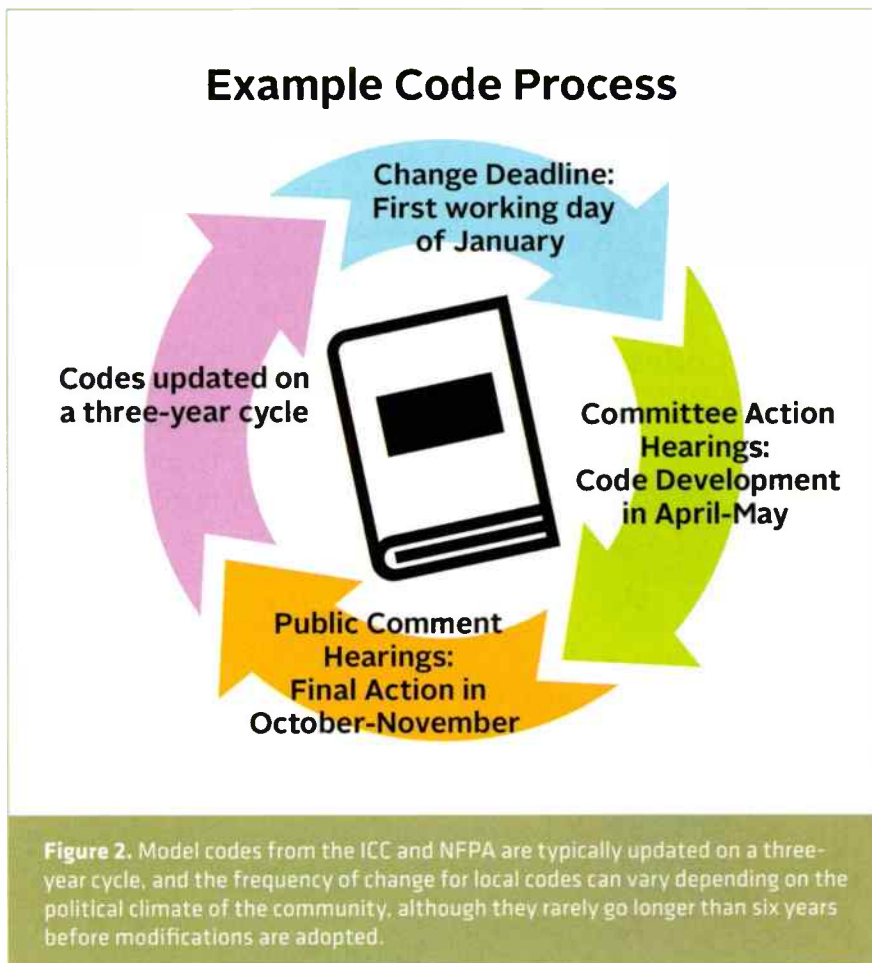
Our mission at the Safer Buildings Coalition is threefold. We want the public to be able to call 911 in the event of an emergency. We want facility managers and public safety

officials to be able to distribute emergency notifications such as text messages to individuals inside a building or campus during an incident. And we want to enable communications among public safety officials and emergency responders during an event.

Unfortunately, this vision is not yet a universal reality. For example, many universities have an active-shooter plan that involves notifying the occupants of their campus, their students, teachers and visitors via text message. The problem is, if you or I or our children are in a building that doesn't have coverage inside, that plan will fail because we're not going to get notified during an event.

Simply put, the public must be able to call for help and receive updates and information about an event, and public safety officials must be able to talk to one another without disruption. In order to achieve that, we've set out some primary goals at the Safer Buildings Coalition: bring all stakeholders together during the code development process to help facilitate the changes and improvements that are necessary; drive awareness among the public and public safety community through education; and ensure greater quality assurance of our performance goals during the integration and installation process.

If building owners are going to take on this responsibility and the costs associated with that, they need to have more confidence that the people they're hiring are doing things correctly. Building owners



can't afford not to have wireless coverage in their buildings. The public's expectation of always-on connectivity has never been stronger, and it's imperative that people be able to communicate regardless of where they are.

### 80 Percent of Traffic

For the majority of people, 80 percent of cellular traffic occurs indoors, and when most people are faced with an emergency today, they reach for their mobile device (not a landline) to call 911. When first responders arrive to deal with that situation, they need to be able to communicate as well. Any communications breakdown

or disruption during an emergency can have significant adverse effects on the outcome. Our job is to educate and convince all stakeholders, including building owners, of the value-added benefit of supplying in-building communications to their clients, tenants and other occupants, particularly during a time of need.

I'm confident that things are moving in the right direction and believe our best chance to accomplish our collective goals will come from all of us working together. If we don't get all the stakeholders involved and invested in the process, the results are going to be all over the place, which will show up



as in-building projects with extra unnecessary costs caused by having to re-do installations, adding overlooked requirements or the AHJs denying a certificate of occupancy.

### Code Development

If the wireless industry does not get involved, these codes, standards and ordinances are going to get modified and updated without your input. Can you live with the results of that? In-building communications code development is going to occur with public safety at the table, the question for the wireless industry is: Do you want to help shape the rules of engagement that you will be required to comply with? I encourage everyone in the industry to support the work of the Safer Buildings Coalition to ensure that your ideas are considered and heard.

I grew up on a farm on a dirt road, and I learned very early on as a youngster going down that dirt road that you have two choices. You can either make the dust or eat the dust. It's about being out front, engaged and charting your own course.

All of us at the Safer Buildings Coalition are committed to making our codes and standards as streamlined as possible to accomplish our broader goal. Regardless of the role you play or the interests you bring to the table, we believe you should be aware of the in-building communications requirements today and going forward. The collective experiences we gain are also being used to refine and improve these codes through various code-development

processes. Join us and make sure your voices are heard.

*Alan Perdue, a credentialed chief fire officer and fire marshal with 34 years in the fire service, is executive director of the Safer Buildings Coalition, a not-*

*for-profit industry organization that seeks to make buildings safer through wireless technology. He serves in leadership roles within the International Association of Fire Chiefs and other groups. His email address is alan.perdue@saferbuildings.org.*

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# Microwave Radio for Wireless Public Safety Networks

Ultrahigh-capacity packet microwave radio offers advantages for public safety wireless networks that are called upon to evolve their broadband data capabilities to the level of current 4G LTE networks and beyond.

By Bernard Prkic

**W**ireless public safety networks are in a flux, driven by emerging user requirements and expectations, such as bidirectional video streaming and real-time uploading and downloading of high-resolution pictures. These new, high-data-rate requirements are beyond the capabilities of the legacy — mostly time-division, multiple-access-based — data backhaul architectures that support the majority of today's wireless public safety networks.

At the same time, traditional values of public safety networks must be upheld. If remote and sparsely populated areas are to gain service, then service latency has to remain low and service availability needs to be high. In addition, the networks have to be both resilient against attacks or natural disasters and meet the highest standards in terms of network integrity and data confidentiality.

The following information explains why the third generation of

rugged, all-outdoor, ultrahigh-capacity packet microwave radios can be the ideal backhaul engine for wireless public safety networks.

## Public Safety Networks

Microwave radio technology has found its way into public safety networks, providing data backhaul services for wireless applications such as TETRA, which is Terrestrial

Trunked Radio, a professional mobile radio and two-way transceiver specification designed with government agencies and emergency services in mind.

Rapid deployment capability and an acceptable total cost of ownership are clearly important attributes for any backhaul technology supporting a wireless public safety network. But more is needed,

## Important Attributes for Microwave Radio Backhaul

- Rapid deployment capability
- Acceptable total cost of ownership
- High service availability on the order of 99.995 to 99.999 percent
- Low link latency: 0.1 milliseconds to 1 millisecond per link
- High link bandwidth: up to 200 megabits per second per wireless base station site
- Support for frequency and phase synchronization in cases where a time-division duplex or 4.5 G-based technology is used for the radio access
- Network resilience, no single point of failure in any vital part of the network
- A high degree of network integrity and data confidentiality

especially for next-generation broadband wireless public safety networks. Additional important requirements that are desired by microwave radio backhaul include high service availability on the order of 99.995 to 99.999 percent, low link latency of 0.1 milliseconds to 1 millisecond per link and a high link bandwidth up to 200 megabits per second per wireless base station site. Other important requirements are support for frequency and phase synchronization in cases where a time-division duplex (TDD) or 4.5 G-based technology is used for the radio access, network resilience such that there is no single point of failure in any vital part of the network, and there is a high degree of network integrity and data confidentiality.

### Wireless Networks in Flux

Public safety teams have been equipped with digital photo and video cameras and portable or vehicle-based data terminals for remote database access and for command and control purposes. There is a latent need for public safety applications to support live high-definition video streaming and instantaneous uploading of photos and film. Unfortunately, wireless access and backhaul technologies deployed in most of today's wireless public safety networks are still based upon time-division multiplexing (TDM) technologies developed more than 15 years ago, and are therefore incapable of providing a veritable broadband service. Examples of TDM technologies in use are plesiochronous digital hierarchy (PDH) and synchronous digital

hierarchy (SDH)/synchronous optical networking (SONET).

In some markets, this discrepancy between user needs and network capabilities is being addressed by a hybrid network model. The key voice service and narrowband messaging services are kept on the private, dependable and full-coverage wireless public safety network. Meanwhile, broadband data capability is provided by third-party public land mobile broadband networks.

Although this hybrid solution may appeal to the instincts of the procurement community, it has serious shortcomings and can therefore only be regarded as a mediocre stopgap solution. The main reason is that public wireless networks have not been engineered — mostly because of competitive cost pressures — to be as resilient and secure as dedicated, public-safety wireless networks.

Examples of weaknesses of public broadband networks that render them to be a suboptimal choice for public safety applications include a lack of battery backup systems or the use of a short-term battery backup, the existence of single points of failure almost everywhere in the access part of the network, and the use of frequency bands that are generally higher than the bands used by wireless public safety networks and therefore provide less in-building coverage. Sites used by public broadband wireless networks are more readily accessible and therefore are more easily compromised or sabotaged than the secure sites purpose-built for a public wireless safety network.

In case of calamities, public broad-

band networks — ironically especially those parts located in the disaster area — will tend to overload or will be forced offline because of a power outage or structural damage to sites or the backhaul network. Avoiding this problem has historically been one of the key rationales behind pouring significant amounts of money into dedicated, purpose-built wireless public safety networks.

Public broadband networks use a mix of owned infrastructure and leased infrastructure for data backhauling. Data security and confidentiality are therefore not warranted. And the public broadband network is more exposed to the Internet and therefore is more prone to malicious intrusion and attack than a largely stand-alone public safety network.

There's a genuine need to evolve the broadband data capabilities of public wireless safety networks to the level of current 4G LTE networks and beyond. In order to support such an evolution, microwave backhaul has to evolve too.

### The Ideal Backhaul Engine

The third generation of rugged, all-outdoor, ultrahigh-capacity packet microwave radio is the ideal backhaul engine for next-generation broadband wireless public safety networks.

First, all payload generated by a broadband wireless network is by default packet-based. There's no need for circuit emulation or deployment of hybrid systems. High-capacity Gigabit Ethernet (GE) or even 10 Gigabit Ethernet (10GE) interfaces substitute a large number of narrowband, legacy PDH and SDH/SONET interfaces.

Traffic Type	Throughput w/o BAC	Throughput w/BAC
Web traffic (Top 100 sites, HTTP and HTTPS)	242.5 Mbps	622.6 Mbps
XLS and email traffic mix	242.5 Mbps	606 Mbps
MP4 video traffic	242.5 Mbps	355 Mbps
Mixed traffic (Web, video and ftp)	242.5 Mbps	505 Mbps

**Table 1.** An example of how throughput in a 28-megahertz-wide channel can be increased by applying bulk compression.

Second, no shelters at all are needed for backhaul equipment. Third-generation packet microwave radios are rugged, all-outdoor systems with four GE interfaces, plus a potent multigigabit Ethernet switch (14+ Gbps) in a single, integrated system. It dispenses of traditional split-mount system indoor units and cell-site routers, freeing up space and budgets.

Third, they provide high baseline spectral efficiency, in the order of 8 bps/Hz using 2048 QAM or 4096 QAM modulation. Spectral efficiency can be doubled to 16 bps/Hz by deploying 2x2 line-of-sight (LoS) MIMO (multiple-input, multiple-output) communications or 2+0 cross-polarization interference cancellation (XPIC). MIMO communication is a radio frequency scheme where multiple transmitters and receivers (with a minimum of two) are used at each end of a link to increase the link spectral efficiency of a single (polarization) radio channel by up to 100 percent, or to increase link budget by up to 9 dB (in a 2x2 MIMO case). XPIC is a radio frequency interference cancellation scheme enabling the use of a single radio channel in two

spatially orthogonal polarizations in order to double link throughput and, in a way, spectral efficiency.

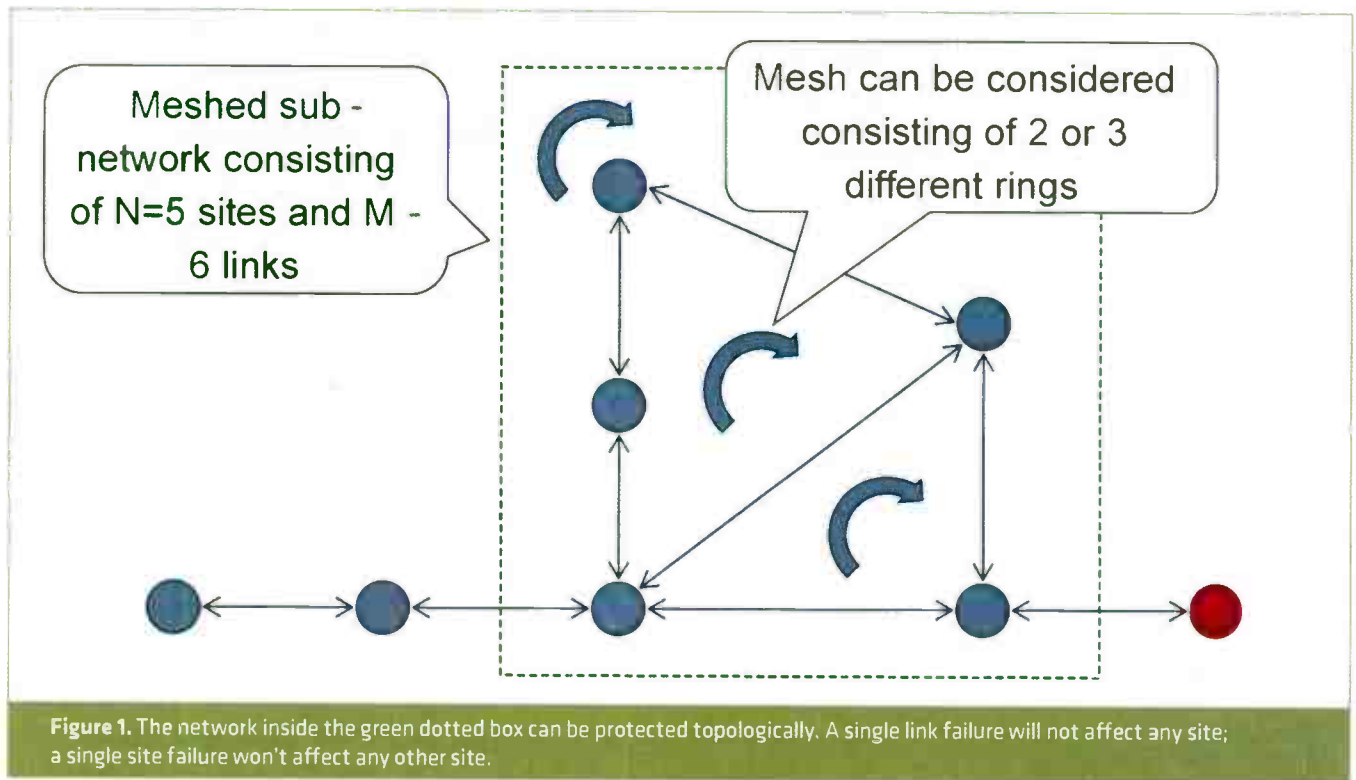
Beyond that, there's the possibility of boosting spectral efficiency to >32 bps/Hz by deploying wireless bulk data compression. Spectral efficiency reduces operational expenditure by paring down channel size and spectrum lease cost or provides for additional traffic capability. Table 1 shows an example of increased throughput in a 28-megahertz-wide channel that results from bulk compression.

Ultrahigh-capacity packet microwave radios support a large channel size. It helps to use large channels where high throughputs are required for trunking purposes. Third-generation all-outdoor packet microwave radios support 100 (ANSI) and 112 (ETSI) megahertz-wide channels. In case even more capacity is required, multicarrier microwave radio variants are available as a cost-effective alternative to discrete 2+0 and 4x4 MIMO configurations.

**Topological redundancy:** Full support for equipment and topological redundancy leads to link

availability in excess of 99.999 percent and to network resiliency on the macro level. Equipment redundancy means that every link can be configured with no single point of equipment failure. Topological redundancy is implemented by building a network topology that can maintain connectivity between key network points A and B through different physical data paths. If one path is cut, one or more alternative paths exist. Third-generation all-outdoor microwave radio equipment supports this through the implementation of redundancy protocols like Rapid Spanning Tree Protocol (RSTP) and Multiple Spanning against multiple simultaneous failures yet relatively slowly — (200 to 2,000 milliseconds) or G.8031 (Ethernet Linear Protection) and G.8032 (Ethernet Ring Protection) — while protecting against a single failure yet very fast (<50 milliseconds). Figure 1 shows a network topology that mitigates the risk of the failure of a single link or site.

**Low latency:** Microwave radio links featuring high spectral efficiency and capacity provide for lower link



latency than less-efficient, slower links. Third-generation all-outdoor packet microwave systems can have latencies as low as 0.1 milliseconds. Mobile broadband system-inherent latency is on the order of 10 to 15 milliseconds one way, end to end, and the contribution of third-generation microwave systems to the overall latency is limited. Full system performance is warranted when using such microwave links for backhaul.

**Comprehensive synchronization support:** Third-generation all-outdoor packet microwave systems support frequency synchronization through Synchronous Ethernet and frequency and phase synchronization. This is achieved by treating IEEE1588v2 synchronization packets with the highest priority in their queueing system and minimizing jitter by means of packet cut-through for highest-priority packets. In

addition, phase synchronization accuracy is improved by means of a Transparent Clock, an algorithm compensating for microwave link-induced jitter and latency. Phase synchronization is required for synchronizing TDD-based wireless access technologies and for advanced 4.5G features requiring phase lock of the wireless air interface across the entire network.

**Strong support of network integrity and data confidentiality:** Third-generation all-outdoor packet microwave systems support SNMPv3 for full encryption of the management plane for the microwave system. They also support centralized remote access dial-in user service (RADIUS) and terminal access controller access-control system plus (TACACS+) user authentication. On top of this, all of the payload transiting the air interface can be AES256 encrypted.

## Conclusion

Wireless public safety networks are evolving toward supporting mobile broadband services, while maintaining the high service availability and data security standards of today's voice-centric networks.

Third-generation rugged, all-outdoor, ultrahigh-capacity packet microwave radio is ideally suited as the main backhaul engine for a broadband wireless public safety network because of its modest total cost of ownership and excellent technical attributes tailored toward supporting 4G and 4.5G wireless access networks.

*An electrical engineer with studies in applied physics, Bernard Prkic is a product line manager at DragonWave. He previously worked in sales, product management, strategy and sales support roles with Nokia Siemens Networks, Nokia Networks and Siemens.*

# Building on the FCC's Wireless Enhanced 911 Ruling to Save Even More Lives

Improving antenna position data capture is one of the solutions to improving E911 network location-based determinations.

By John Vetter

**T**he Federal Communications Commission's recent unanimous ruling in favor of increased horizontal-axis location accuracy requirements for wireless Enhanced 911 (E911) systems is a great first step toward improving emergency response times. The agency should also be praised for providing guidance to develop and implement vertical-axis solutions and requirements. These actions will protect our citizens better, allowing first responders to react quicker and more efficiently to mobile phone calls, which is extremely important given that 75 percent of these emergency calls are made using wireless devices. Although the ruling is significant, further measures are needed to operate even more efficiently and save additional lives.

FCC rules for E911 require that confidence and uncertainty data be provided to the public safety answering points (PSAPs). Commercial

Mobile Radio Service (CMRS) providers or wireless carriers must file their conformance verification procedures with the FCC, and the agency recommends periodic conformance testing.

Location solutions are split into two classes. Network location, which relies entirely on CMRS provider infrastructure to determine location,

*“Recorded location errors of 30 to 50 meters are common for tower antennas. Target location errors tend to be approximately twice the tower antenna location error.”*

can include received signal strength indication (RSSI), observed time difference of arrival (downlink OT-DOA), angle of arrival (AoA), multipath fingerprinting and combinations of these techniques. Handset location is dependent upon

location information provided by, or cooperative analysis with, the user device. It can include techniques based on Global Positioning System (GPS) coordinates, Assisted Global Positioning System (A-GPS), enhanced observed time difference (E-OTD), enhanced forward link triangulation (E-FLT, CDMA-only) or a combination of them.

Although market penetration of smartphones increases handset location use, the continued presence of older GSM and CDMA devices requires that network location techniques be available. It is estimated that 75 percent of the mobile phones in the United States still use legacy technologies (as of Q2 2014), which do not offer GPS, Wi-Fi, or Bluetooth. Additionally, smartphones with handset location capability cannot provide location data if a GPS lock cannot be obtained because of signal blocking and signal scattering situations, both of which are quite

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possible in dense urban areas.

All of this means network location is still often needed to service E911 calls. The problem is that network location techniques rely on accurate placement and alignment of provider infrastructure, and that, unfortunately, is not always the case.

Recorded location errors of 30 to 50 meters are common for tower antennas. Target location errors tend to be approximately twice the tower antenna location error. When the emergency call is made by someone capable of interacting with first responders, an error of up to 100 meters may result in an extended time-to-contact. If the call is made from a person unable to respond (e.g., a caller who loses consciousness after dialing 911), 100-meter inaccuracy may be significant.

Improper tower antenna placement results in unfavorable hyperbolic geometries, especially in sparse suburban or rural areas where tower antennas are distant and located along similar azimuths as observed from the handset. A location error of 15 to 30 meters could result in a handset location error of more than 500 meters. A hiker who falls into a ravine or someone in a car driven down an embankment who makes an emergency call may not be easily found, resulting in additional first responders and longer response time.

Because OTDOA is limited, E911 deployment may require additional techniques, such as AoA. When used with OTDOA, AoA can reduce

uncertainty and decrease response time to contact. AoA + OTDOA systems require installing specialized antenna arrays. Commonly referred to as triangulation, stand-alone AoA requires at least three tower antenna sites, and AoA + OTDOA requires at least two tower antenna sites and works best with three or more.

Target location inaccuracy caused by incorrect tower antenna location data for OTDOA systems, inaccurate azimuthal alignment for AoA systems or both have consequences beyond failing to meet FCC E911 mandates. A Columbia University

“Target location inaccuracy caused by incorrect tower antenna location data for OTDOA systems, inaccurate azimuthal alignment for AoA systems or both have consequences beyond failing to meet FCC E911 mandates.”

study found that, on average, a one-minute reduction in emergency medical service (EMS) response time equals a 17 percent decrease in the likelihood of 90-day mortality, the medical standard for measuring effectiveness of treatment or intervention. Approximately 25 million people call for an ambulance each year. Using rough but reasonable assumptions, it can be estimated that improved location accuracy that reduces EMS response time by one minute can save over 10,000 lives annually and have a societal benefit of more than \$92 billion.

Using proper alignment tools that can measure and record latitude and longitude to within 30 centimeters can improve response time and save more lives. When used to align the azimuth of a sectored cellular antenna,  $\pm 0.3$  degrees RMS can be provided. The appropriate tools can ensure proper azimuth alignment and record more accurate antenna location data for PSAP and RF databases. Benefits include fewer periodic adjustments and less likelihood of costly and time-consuming system troubleshooting and retesting.

Providing PSAPs with a highly accurate database of tower antenna locations is critical to meeting FCC E911 mandates. Accurate azimuthal alignment of antennas is also essential for system performance. Improving antenna position data capture is one of the solutions to improving E911 network-location-based determinations. Achieving these success metrics will create

a system that better serves an increasingly mobile community with accuracy and lowered public safety response times.

*John Vetter is vice president of business development at Sunsight Instruments. He has more than 20 years of experience in RF engineering wireless network design, deployment and post network performance and optimization. See also “E911 Location Accuracy” by David Witkowski, president of the Wireless Communications Alliance, available at <http://sunsight.com/index.php/e911-white-paper-request/view/form>.*



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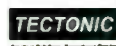
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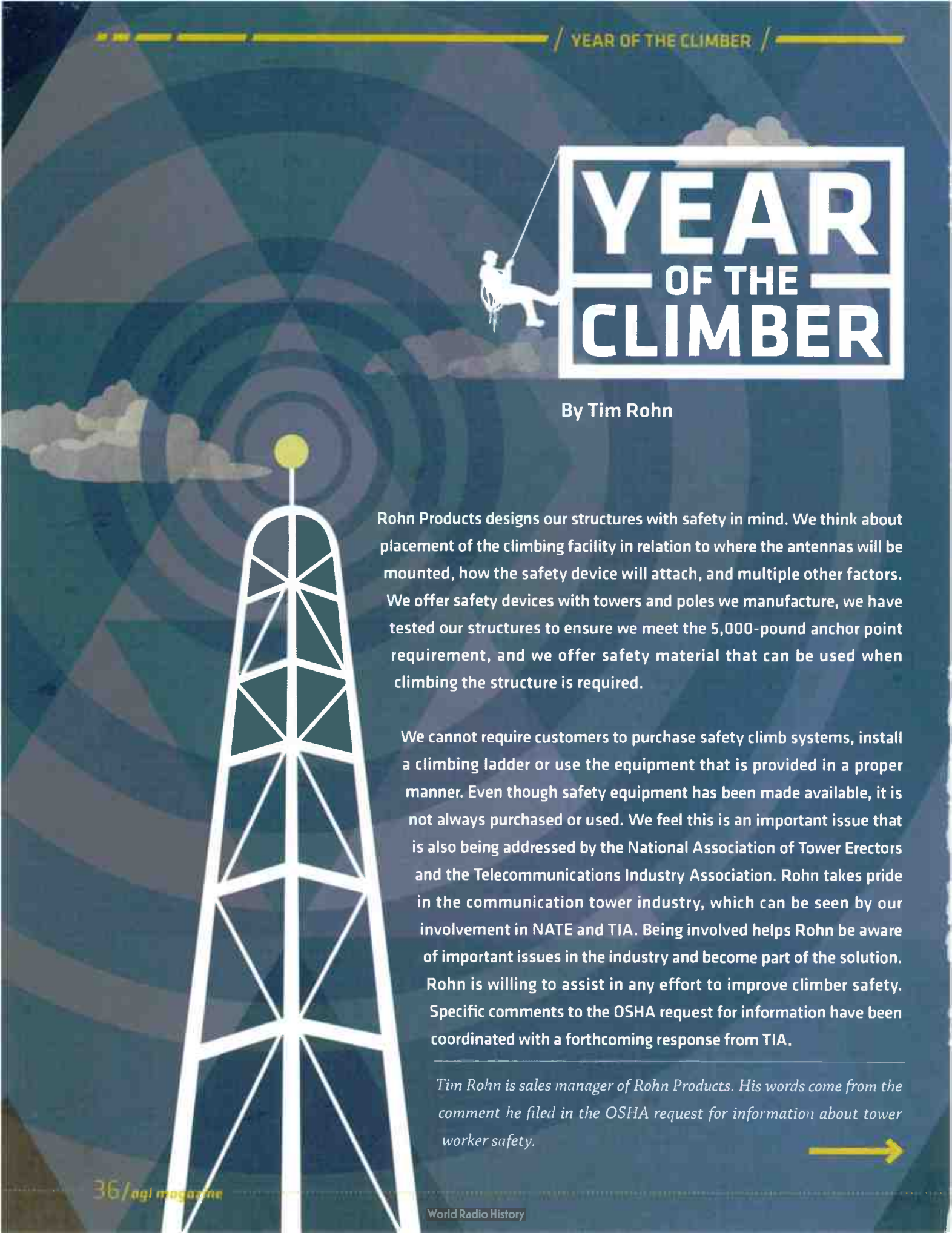
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A stylized illustration of a climber on a rope, positioned in the upper right quadrant. The climber is a white silhouette against a background of concentric circles in shades of blue and green. To the left, a white lattice tower structure is visible, topped with a yellow circle. The overall background is a dark blue with a pattern of concentric circles.

# YEAR OF THE CLIMBER


By Tim Rohn

Rohn Products designs our structures with safety in mind. We think about placement of the climbing facility in relation to where the antennas will be mounted, how the safety device will attach, and multiple other factors. We offer safety devices with towers and poles we manufacture, we have tested our structures to ensure we meet the 5,000-pound anchor point requirement, and we offer safety material that can be used when climbing the structure is required.

We cannot require customers to purchase safety climb systems, install a climbing ladder or use the equipment that is provided in a proper manner. Even though safety equipment has been made available, it is not always purchased or used. We feel this is an important issue that is also being addressed by the National Association of Tower Erectors and the Telecommunications Industry Association. Rohn takes pride in the communication tower industry, which can be seen by our involvement in NATE and TIA. Being involved helps Rohn be aware of important issues in the industry and become part of the solution. Rohn is willing to assist in any effort to improve climber safety. Specific comments to the OSHA request for information have been coordinated with a forthcoming response from TIA.

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*Tim Rohn is sales manager of Rohn Products. His words come from the comment he filed in the OSHA request for information about tower worker safety.*



# The OSHA Files – Why Tobe D. Wheale Died

The crew had been on-site nearly two weeks without incident, dismantling a 240-foot self-supporting tower. On June 6, 2005, Tobe D. Wheale climbed a gin pole, which in its movement came to an abrupt stop, throwing him from the tower.

By Dr. Bridgette Hester

**T**he first installment of “The OSHA Files” appeared in the April issue. The following information explores what happened to Tobe D. Wheale in the summer of 2005 that led to his death from a fall from a telecommunications tower. If there is one question I am asked repeatedly, it is: “What really happened on that fatality? All we know is what the media said.” This series responds to that question.

My intentions are for these installments to be informative and to provide details about what exactly transpired in fatality cases. I hope they will encourage crews and companies to review how they operate and ask questions about what they can do to make their workplace safer.

Much of the information comes from the file OSHA sent me in response to a Freedom of Information Act request. OSHA redacted some of the file contents. Other

information (such as surviving family) was obtained with a search I conducted. The following are my words unless indicated by the citation (OSHA, 2005).

## Summary of Events

According to the OSHA report, the company had been on site for approximately two weeks. The purpose of the work on the site was to dismantle a 240-foot self-supporting microwave tower at Lincoln Center that was not being used. There was a typical crew of four or five technicians on site to dismantle the tower. According to the report, “Three employees typically climbed the tower and unbolted the various legs, K sections and other components. The parts were then lowered to the ground by way of a gin pole that was jumped down as the work progressed. The other crew members worked on the ground running the hoist, processing materials and performing other support activities.”

As would be expected, all the employees “should be using 100% fall protection by way of a harness, lanyards, positioning lanyards, rope grabs and small slings.” (OSHA, 2005)

## The Incident

OSHA performed a comprehensive investigation of Wheale’s death. According to this report (OSHA, 2005), the crew had been on this project approximately two weeks without any prior incident.

“The OSHA investigation found that at the time of the accident, employee Tobe Wheale was not protected from falling from the tower. The employee was ascending the gin pole in order to rig a K section for removal. As he climbed the gin pole, approximately 130 feet above the ground, the gin pole moved from its position and slid along the south face of the tower. The pole came to an abrupt stop when the overhaul ball of the load line contacted the rooster head. Mr. Wheale was thrown from

**The OSHA Files**

Tobe D. Wheale: June 6, 2005

**Pertinent Information:**

<b>Inspection Number:</b>	308567205
<b>Date of Incident:</b>	June 6, 2005, 11:02 a.m.
<b>Location:</b>	Lincoln, Illinois
<b>Gender:</b>	Male
<b>Age:</b>	43
<b>Family:</b>	The author was unable to find information on whether Wheale had children, but was able to locate one possible relative. Wheale served in the U.S. Army from 1979 to 1981 and achieved the rank of corporal.
<b>Cause of Death:</b>	"Fall/Other" (OSHA, 2005)
<b>Toxicology:</b>	Negative
<b>Training:</b>	Yes
<b>Time on Job:</b>	Not noted in file
<b>Free Climbing Reported?</b>	No
<b>Company Years in Business:</b>	Established in 2000 (according to website)
<b>Total Number Employees:</b>	Redacted from OSHA report
<b>Reported to OSHA:</b>	June 6, 2005
<b>Others Injured:</b>	N/A
<b>Height of Tower:</b>	240 feet
<b>Height at Fall:</b>	Approximately 120 feet
<b>Tower:</b>	Self-supporting, being dismantled
<b>Tower Condition:</b>	According to narrative, there were no deficiencies noted
<b>Operation:</b>	"Employees were dismantling communication tower " (OSHA, 2005)
<b>Case Closed:</b>	Aug. 2, 2005

**Citation:**

29 CFR 1926.105(a) – Serious – "Safety nets were not provided when workplaces were more than 25 feet above the ground or water surface, or other surface(s) where the use of ladders, scaffolds, catch platforms, temporary floors, safety lines, or safety belts was impractical.

On or about June 6, 2005, an employee performing demolition operations on a communication tower was climbing a gin pole, approximately 130 feet above the ground, and the appropriate fall protection was not utilized." Proposed Penalty: \$1,500

**TOTAL FINES PROPOSED:** \$1,500

**TOTAL FINES PAID:** \$750

*The citation was reclassified as "other" and reduced to \$750 as a result of an informal settlement hearing.*

the tower as a result of the abrupt stop.” (OSHA, 2005)

### Investigator Comments

According to the investigator’s conclusions, Wheale “was not protected from falling from the tower. Tobe had been wearing a full body harness, one six-foot shock-absorbing lanyard with a pelican hook (the shock absorber was not deployed), a tool belt and a positioning lanyard. The employee was not equipped with a rope grab, nor was a rope grab on the safety rope” (OSHA, 2005).

Additionally, the investigator reported that Wheale had been climbing “approximately 15 feet above the connection point of the safety rope on the gin pole” and only had “one pelican hook and no rope or rope grab [and] was unable to utilize fall protection during the rigging operation.”

Furthermore, Wheale had “received training from the company, and supervision was at the site for the duration of the shift. The foreman for the crew was running the hoist truck and was in plain view of the employee as he performed his duties. No visual obstacles were present, and the foreman was in a position to observe the climbing practices of the employee.” (OSHA, 2005) “The CSHO viewed employees on the tower utilizing 100% fall protection during the return visit, and the hazard was considered corrected during inspection.”(OSHA, 2005)

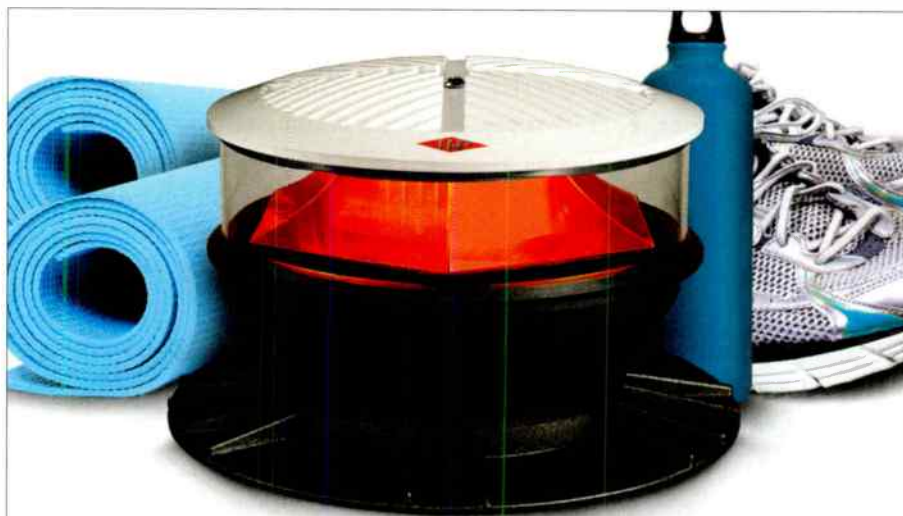
### Author’s Commentary

Given what is stated in the investigation file, one can reasonably conclude that because Wheale did not have two shock-absorbing lanyards, nor

was he protected by a safety line and rope grab, he therefore was not properly equipped to follow 100 percent tie-off. In addition, because I am an advocate and not a climber, I generally seek the advice of climbers I have come to know and trust and climbers that have stellar reputations. I also

seek advice from active and retired OSHA employees familiar with the inroads on the inspection report to help me decipher the information.

From my understanding, climbing the gin pole was an acceptable work practice if the pole was properly secured in place. Gin poles can be climbed in



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order to light them, to make adjustments or to grease the rooster head. Although some small gin poles are not to be climbed, it is permissible to climb most of them. Riding the gin pole, however, is not permissible.

As one of my advisers and I read the OSHA file, we noted that the OSHA compliance officer commented that Wheale had been climbing “approximately 15 feet above the connection point of the safety rope on the gin pole.” This struck us as unclear. Why would a safety rope be on the gin pole? It is possible that the compliance officer, not knowing why the rope was there, might have assumed it was a safety rope and may not have asked. It is more likely that the rope was a tag line, because a tag line would be connected with a gin pole. It would hang there until the workers rigged a tower piece to lower, and then the tag line would be attached to the load to hold it out from the tower while it was being lowered. If this

was in fact the way things were arranged, Wheale would have had a method for being compliant.

Much of the file was redacted, and no witness statements were available to use to gather more information. Whether work practices involved a lack of or the insufficient use of safety equipment is something that only that company and its employees know. The OSHA investigator did note that, during his time on the site after the accident, he “viewed employees on the tower utilizing 100 percent fall protection during the return visit.” (OSHA, 2005)

OSHA fined the employer an initial penalty of \$1,500 and reduced it to \$750 after an informal settlement hearing. Also of consequence was the investigator’s rating of the employer’s safety and health program. The report revealed that the employer had an inadequate rating inadequate rating for its safety and health program. This would include, but not necessarily be limited to, the comprehensiveness of the employer’s safety and

health program, safety training, communicating the program to employees and enforcing the program.

### Research Notations

As a researcher, I have to define events operationally for consistency in analyzing data. For instance, in defining free climbing, most people may say free climbing occurs when a climber is ascending or descending a tower without the use of lanyards, safety climbs or other approved methods of reaching the position where the climber will work. However, for purposes of my research, one of my advisers and I define free climbing as:

- Ascending or descending a tower without the use of lanyards, safety climbs or another approved method of reaching the position where the climber will work (climbing disconnected from the structure).
- Moving laterally on the tower while performing the functions of the job without being 100 percent tied off.
- Riding or climbing the gin pole, winch line, capstan or load would be considered to be free climbing because the climber would not be properly following the OSHA 100 percent tie-off policy, and there is no secondary lifeline or fall arrest in use. (Reardon, 2014)

Although the OSHA report does not use the term free climbing, according to my definition, for research purposes I would classify Wheale’s activity as free climbing because of what the OSHA report implies. The investigator referred to Wheale being knocked off the pole as it stopped while tipping: “The pole came to an abrupt stop when the overhaul ball of the load line contacted the rooster head. Mr. Wheale was thrown from the



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tower as a result of the abrupt stop” (OSHA, 2005). I know that new measures state that climbing on the gin pole in this way now is permissible in some circumstances, but that is a different issue for another article. Coding for research allows me to code data several ways for the purpose of analysis. For the purpose of Wheale’s case, multiple causes will be coded as failure to tie off 100 percent, free climbing, and improper supervision, with the primary cause being failure to tie off 100 percent.

### OSHA Reduction Notations

Not all OSHA reports read the same, and not all investigators are as meticulous as the one who investigated Wheale’s case. Furthermore, not all OSHA reports are redacted in the same way. I found reduction percentages that are used when determining fine reductions. Although the scores for this particular company were redacted (I could not see their scores), the scale does allow for percentages being knocked off fines. Factors include company size, good faith and history.

### Company Size

- 60 percent** 1–25 employees
- 40 percent** 26–100 employees
- 20 percent** 101–250 employees
- 0 percent** 251 or more employees

### Good Faith

- 25 percent** Written S & H program with only incidental deficiencies
- 15 percent** Documentable and effective S & H program with more than incidental deficiencies
- 0 percent** No safety and health program or where a willful violation is found

### History

**10 percent:** No serious, willful or repeated violations in the last three years

To some degree, I can abide a reduction in penalties for a company that does everything within its power to do the right thing, train their people correctly, provide a comprehensive work-

place safety plan and perform random drug testing. When an employer does what it is supposed to do and the fatality is a result of an action of a climber, I can abide a reduction, but not a cancellation of a fine.

If you do everything you can as an employer, and yet your employee chooses to act in an unsafe manner, you



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should still be fined, at least minimally. The reason is because your employees are a direct reflection of you, the work you do and the quality of services you provide. Maybe a fine and a recorded citation would make some employers be a little choosier about who they hire and retain and a little more aware of

what takes place on their work sites. Why employers and OSHA do not use negative reinforcement more effectively boggles my mind. Regardless of how one feels fine reductions, taking company size, good faith and history into consideration as mitigating factors is required by the OSHA Act of 1970.

In Wheale's case, to reduce the fine by 50 percent probably meant OSHA took a 10 percent reduction for the company history and a 40 percent reduction for the company size. I don't believe there would have been a reduction for good faith, based on what the report said about inadequacy of the company's health and safety plan, but the reason for the reduction is redacted, so this is speculation on my part. The company had no OSHA listing since 2002, supporting history as a mitigating factor, and its apparent size allows its size to be a mitigating factor.

### Conclusion

Every OSHA report is different, and circumstances for every fatality are different. Some deaths may have some things in common, but to understand what happened in each case, it is important to read each file. I hope companies and crews use "The OSHA Files" articles in conjunction with a copy of the OSHA report to dissect different scenarios as a learning tool to identify what happened in each case and what they might do differently if a similar situation presented itself.

Author J. Valor wrote, "Events had been set in motion whose echo would be heard a thousand and more generations from now." I pray the echo this industry hears a thousand generations from now is that we honored our fallen by learning from our past.

*Bridgette Hester, Ph.D., is a family and workplace strategist. She is the founder and president of the Hubble Foundation, which is dedicated to promoting the safety of tower workers, site crews and all workers at heights. Her email address is [bridgette@hubblefoundation.org](mailto:bridgette@hubblefoundation.org).*



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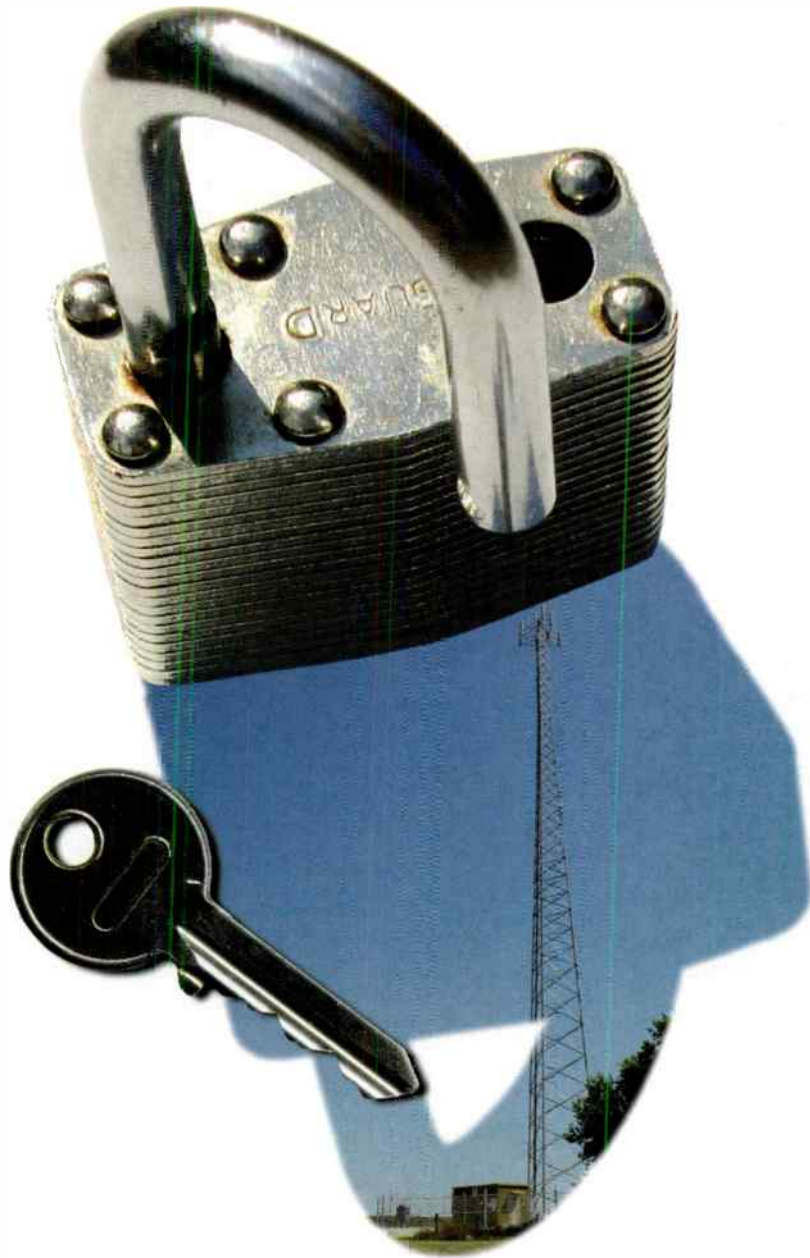
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## PCIA Sends OSHA Details About Preventing Injuries and Fatalities Among Tower Workers

OSHA continues to focus on tower worker safety with an inquiry that could lead to a fresh round of regulation, enforcement or both.

By AGL Magazine staff

**E**arlier this year, the Occupational Safety and Health Administration issued a request for information (RFI) about communications tower safety. PCIA – The Wireless Infrastructure Association is among respondents. PCIA is a membership organization representing companies that build, design, own and manage telecommunications facilities throughout the world. Its more than 200 members include carriers, infrastructure providers and professional services firms.

“Safety of all workers is of paramount importance to the wireless industry,” Jonathan Adelstein, PCIA president and CEO, said. “The answer to improving safety is adherence to today’s existing regulations and evolving standards, coupled with increased education and improved training and apprenticeships. PCIA is committed to enhancing workplace safety and looks forward to working with a diverse group of

stakeholders to address the issue and advocate for improvement.”

What follows are PCIA’s comments in the proceeding, edited for length and style.

PCIA has made workforce safety a top priority. PCIA has engaged with

“Existing industry standards play an important role in helping to ensure that safety features and systems are built-in to towers at the design phase.”

the Department of Labor (DoL) and the Telecommunications Industry Registered Apprenticeship Program (TIRAP), an effort launched two years ago by PCIA and wireless infrastructure companies, in conjunction with DoL and the Federal Communications Commission (FCC). PCIA also

supports Warriors 4 Wireless (W4W), a nonprofit formed to bridge the gap between the demand for trained and deployable wireless technicians and the thousands of qualified servicemen and women eager to transfer the skills they have learned in the military to civilian careers.

Additionally, PCIA has established a public-private partnership with Virginia State University (VSU) to help it develop and implement a curriculum to train workers to deploy wireless technology safely and efficiently. This partnership was enabled by a Trade Adjustment Assistance Community College and Career Training Grant awarded to VSU in fall 2014 by DoL.

There is a need for quality training of technicians by the telecommunications industry. Driving this need is a nationwide increase in demand for the wireless infrastructure necessary to meet users’ requirements for wireless data on smartphones, tablets, laptops and other devices. This

demand has led to a telecommunications industry that continues to grow and requires a skilled workforce and the additional equipment and materials necessary to accommodate network connections throughout the United States. This deployment must be carried out in a safe and efficient manner that will afford quality installations. Working with our industry partners and member companies, PCIA helps put into place the resources for these workers to be safe.

### Apprenticeship Program

TIRAP is a venture created by telecommunications companies, industry associations and DoL that develops DoL-credentialed apprenticeship programs available to qualified employers for the training and career development of the telecommunications workforce.

TIRAP's mission is to partner with stakeholders to promote safety, enhance quality, and enable education and advancement opportunities in the telecommunications workforce

“Standards developed by the Telecommunications Industry Association (TIA), including TIA-222-G, TIA-1019-A, and others, remain the industry standard for tower design, modification, and maintenance.”

that will meet network infrastructure build out needs. In addition, TIRAP works to build consensus in the industry, allowing for a common vernacular. TIRAP also has multiple

committees formed to address various worker-related industry issues, including a safety committee led by an experienced climber and safety instructor. PCIA's president and CEO is a member of the TIRAP board of directors.

### Warriors 4 Wireless

W4W offers education and training opportunities for veterans by leveraging the training and experience they have already gained through their military service. Many of the skill sets veterans return with are nearly identical to wireless deployment, maintenance, and technical support positions.

Safety is a key focus of the W4W curriculum. PCIA is a supporter of the work of W4W and PCIA's president and CEO is a member of its board of directors.

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- Basic electrical/grounding
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- First aid/CPR/AED
- Weatherproofing and connectors
- Basic LTE installation

### Virginia State University

In the fall of 2014, DoL awarded a grant that will help VSU expand one of America's first programs to train and qualify military veterans and displaced textile workers for careers in the fast-growing wireless sector. VSU and PCIA have been working together for many months to ensure VSU's certificate program is state of the art and poised to receive the support it needs.

The first course is scheduled to launch in fall 2015 at the VSU campus.

### Tower Design and Maintenance

Existing industry standards play an important role in helping to ensure that safety features and systems are built-in to towers at the design phase. Moreover, continuing to properly maintain and routinely

inspect a tower in accordance with industry standards helps to ensure the tower's safety design elements remain in good working order throughout its life.

Towers should be designed and modified in accordance with proper, prevailing industry standards. Standards developed by the Telecommunications Industry Association (TIA), including TIA-222-G, TIA-1019-A, and others, remain the industry standard for tower design, modification, and maintenance. TIA is accredited by the American Na-

*“The telecommunications industry continues to make significant progress to ensure the safety of tower climbers through the development of educational and training initiatives and through the improvement of tower design and maintenance.”*

tional Standards Institute (ANSI) to develop these standards. TIA's Engineering Committee TR-14, consisting of a broad representation of industry engineering experts, is charged with developing structural standards for communications and small wind turbine support structures. The TIA-222 standard has been integrated into or incorporated by reference in local building codes throughout the United States. This allows building officials to use these standards to help ensure that

towers are properly constructed. All parties participating in the construction or modification of a tower should understand the importance of these standards, including contractors, technicians, engineers, building officials and others. To assist in this effort, TIA's Engineering Committee TR-14 has created an interactive frequently asked questions website that allows users to submit questions about the standard. It is our understanding that TIA is working on the next revision of the 222 standard, Revision H, to be released in 2016, and is seeking input from industry stakeholders on how to improve upon the provisions of Revision G.

PCIA also understands that Engineering Committee TR-14 has requested and is excited to have input from OSHA on the upcoming Revision H. Input from a proceeding such as this can help Engineering Committee TR-14 refine and improve its well-established construction standards.

Each time antennas are added to a tower, a rigorous structural analysis is performed to determine whether the tower has capacity to hold the additional equipment. If the tower requires modification, the engineer will provide the modification design. The contractor performing the modification is responsible for the means and methods used to safely complete the job in accordance with the engineered specifications. Professional engineers are responsible for review of a contractor's rigging plan when

required by the TIA-1019-A standard. Proper application of the standard can help prevent structural failure. It is important that this existing standard be used by stakeholders when rigging or temporary bracing during modification to ensure stability during certain wind speeds and other conditions.

### Routine Maintenance

In addition to initial design requirements that take safety into account, infrastructure owners routinely inspect and maintain the towers in accordance with industry standards. Any entity that modifies a tower must ensure that critical

safety elements remain intact and operable and provide documentation of the post-modification inspection (PMI). When necessary, any entity that modifies a tower should allow for safe alternative means to access the tower and apertures and ensure that work is performed in a quality manner to allow future workers safe access.

### Specialized Equipment

PCIA cautions against the use of additional expensive, cumbersome mechanical fixes that may add complexity and increase maintenance responsibilities with few, if any, benefits. The RFI specifically asks about

“ One possible technological advancement that will help reduce climber risk is the use of unmanned aerial systems, commonly referred to as drones, for tower inspections. ”

the use of elevators for lifting personnel or materials as well as booms or davits to hoist materials. PCIA



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supports continuous investigation of technology or equipment that helps limit climber risk.

Some of these proffered solutions, however, are already being used in many tall broadcast towers to address climber fatigue; they are not commonly found in towers under 750 feet for the following reasons. First, an elevator or davit would add extra load to the tower and could require additional structural modification to ensure stability; many existing towers would be ineligible for the addition of this equipment because of possible overloading of structures that were not designed to host this equipment or cannot be further modified. Second, it would require a new piece of

machinery left attached to the top of the tower, exposed to elements such as heavy wind, ice, rain and snow. Adding this equipment to a tower

*“ The dissemination of information is vital to the goal of reducing risk to workers. Anonymous reporting of on-site activities regarding noncompliant employers should be encouraged by OSHA. ”*

would introduce more components requiring additional inspection and maintenance by on-site technicians

and would add extra inspection and rigging time prior to work beginning. Third, this equipment may be of limited functionality to work at lower elevations. Finally, this extra equipment would be impractical, providing limited added benefit while requiring significant extra factors in the form of construction, installation, site hardening, technician learning curve and maintenance. In fact, the additional inspections may actually increase risk due to the increased number of tower climbs that would be required for maintenance and inspection.

One possible technological advancement that will help reduce climber risk is the use of unmanned

## Survivability



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If you are building a new tower you must comply with the National Environmental Policy Act (NEPA) and the FCC National Programmatic Agreement (NPA) for Impacts to Historic Resources. In many cases, modifications to existing towers must also comply with the NPA.

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aerial systems (UASs), commonly referred to as drones, for tower inspections. At present, several U.S. infrastructure industry stakeholders and startups have debuted or are in the design stages of using UASs for wireless tower inspections. In Europe, T-Mobile announced a partnership with drone maker Aerialtronics to inspect antenna masts. UASs can use aerial photography to perform PMIs, check the activity status of bird nests and inspect tower conditions. More advanced UASs may also be able to perform advanced analysis, such as inspecting RF signal strength. UASs can perform these tasks quickly and efficiently, often supplanting the need for a person to climb the tower. In this way, advanced UAS technology can help eliminate certain climbs and help ensure climbs are performed in the safest possible environment.

### Fall Protection Anchor Points

Most structures provide natural anchorage points as indicated in TIA-222, Annex I. If the structure does not provide a convenient anchorage point, however, there are readily available, commercially engineered products to help in this regard. Currently, TIA gives design and minimum placement guidance on anchorage points but does not mandate placement on new structures. Mandating anchorage placement on new structures should be carefully considered because the anchorage points may not be located in the area where work will need to be completed, forcing workers to rely on commercially available anchorage points anyway. Another consideration is

that once an anchorage point is permanent, there won't be a way to tell if the anchorage point was ever used for rigging. If an anchorage point is used for rigging, it may not be subsequently used as an anchor point for personal protective equipment (PPE). An unsuspecting person may inadvertently tie off to an anchorage point that has become deformed or

where a weld may be potentially cracked through misuse from rigging. Consequently, the use of engineered anchorage points could actually result in increased worker risk.

### Climbing Mechanics

PCIA recognizes that safety is of utmost concern and is addressing tower climbing safety issues through

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formal and on-the-job training and adherence to existing regulations and standards. PCIA is currently communicating to the industry the need for a competent person on each site for the scope of work (SOW) to be performed. It is critical for the worker to have the proper training and accountability to ensure a safe, quality work environment.

As mentioned before, the telecommunications industry continues to make significant progress to ensure the safety of tower climbers through the development of educational and training initiatives and through the improvement of tower design and maintenance. With this increased level of engagement, the industry has been implementing standard practices consistent with OSHA requirements, TIA standards and industry-backed best practices.

For example, it is standard practice for tower owners and operators to require that all individuals who climb their towers receive appropriate training in tower climbing. OSHA recognition of commercial climbing training programs could ensure consistency in training standards. In addition, climbers should receive training on such safety issues as proper rigging in accordance with TIA-1019-A and any other applicable standards, which are crucial to the safe performance of work at the tower site. Appropriate training of all employees regarding rigging and the use of competent personnel to choose correct anchor points and inspect rigging gear as already required under OSHA regulation

continues to help prevent employee incidents and damage to towers and equipment. PCIA encourages the use of a documented rigging plan where necessary, and we have found that companies conduct regular inspections of all parts of the rigging to help ensure safe use.

In addition to rigging training, the majority of employers in the industry conduct training to ensure that their employees understand the limitations and safe operations of the

*“Notice of contractors that have past violations would help to ensure the entire market is moving forward together and will encourage corrective behavior.”*

equipment they use. They also ensure that equipment is properly maintained for employee use and that all equipment malfunctions are noted and corrected.

PCIA supports industry efforts geared toward implementing tower climbing safety standards and best practices. For example, PCIA has advocated for the inspection of any PPE used in fall protection plans, including the safety climb, prior to every use in accordance with OSHA and manufacturer requirements. Industry has been responsive to heightened safety measures and continues to encourage familiarity and training on climbing equipment and common

risks to safety while climbing.

One such risk is overexposure to radio-frequency (RF) radiation. Industry members train their employees who climb towers to mitigate RF exposure risks, and some companies include devices that monitor RF levels in a climber's PPE. Companies that have implemented RF safety programs have noted the programs help ensure that employees and third parties are adequately aware of RF levels and are protected while performing work on or near cell sites. RF safety can be adequately maintained through employee training programs, personal RF monitor use and the cooperation of broadcasters to power down transmitting antennas when necessary.

Effective tower climber safety training should also include hazard identification, prevention and abatement, in which companies train climbers on various hazards — including falling objects, environmental hazards and fatigue — and the proper documentation of specific hazards both before and as encountered during a climb.

### Safety Measures

The industry has shown a commitment to continuous improvement of safety measures.

Where the industry has recognized that some former climbing practices posed a greater degree of risk than safer alternatives, the industry has implemented those alternatives. For instance, an increasingly common approach to ensure climbers maintain 100 percent tie-off



is by use of vertical lifelines, horizontal lifelines or both. The lifelines can often be positioned to cover the entire work area including the center of the face of the tower. Use of such apparatus has the added advantages of: 1) allowing hands-free operation with 100 percent tie-off compliance, 2) allowing flexibility in installation to reduce the number of transitions between individual tie-off points, 3) providing ease of transition from fixed fall-protection systems, 4) ensuring that all fall-arrestor systems in use by their crew are compatible with the lifeline, and 5) giving the responsible party control of

the lifeline including locations, inspections, training, use and life span.

Continued training and reinforcement of RF and tower equipment installation training would help to

*“ Continued training and reinforcement of RF and tower equipment installation training would help ensure proper initial installations and enhanced carrier network performance, thereby reducing the need for climbing to correct faulty installations. ”*

ensure proper initial installations and enhanced carrier network performance, thereby reducing the need for climbing to correct faulty installations. PCIA's members review federal and industry standards on a regular basis and are exploring innovative ways to safely inspect towers and make necessary adjustments. As discussed, members have identified UAS as a way to minimize the number of tower climbs, and therefore reduce the number of climbing accidents.

#### Existing Regulation

Safety of all workers is of paramount importance, but the answer to improving the

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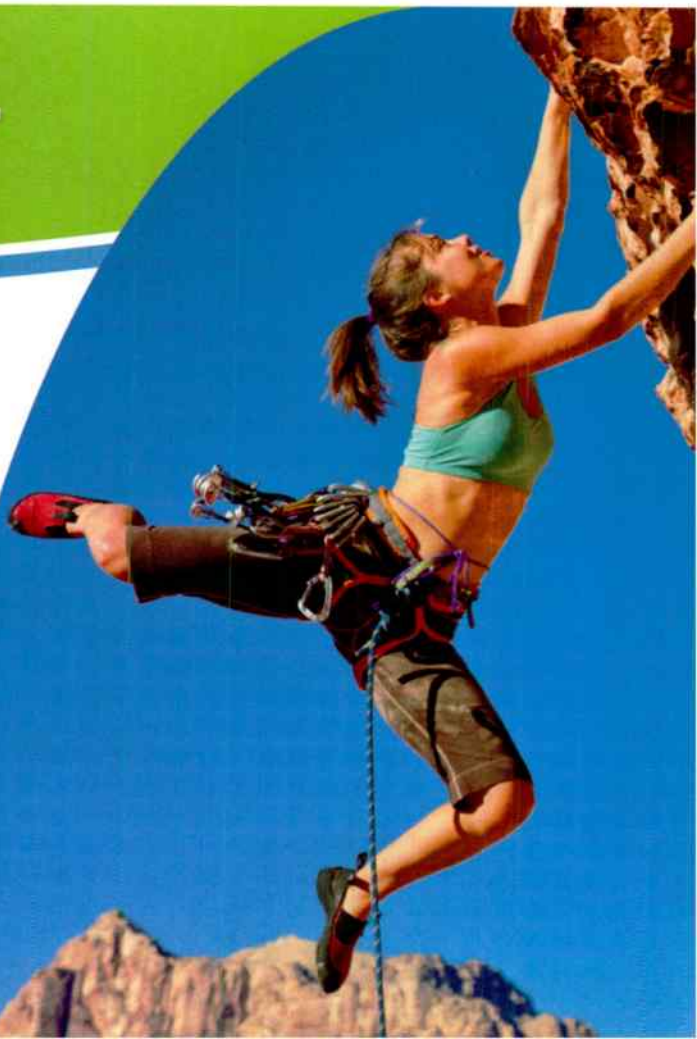
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safety record is not additional regulation. Adherence to, and accountability for, existing regulations and observance of the evolving industry standards, coupled with increased educational outreach, is the best way to promote safe worksites and reduce opportunities for injury. Industry standards are regularly examined and input is provided from all sectors of the industry and the workforce, including regulatory bodies such as OSHA. Every construction site, like every communications tower, is unique. Standards development accounts for these variables today. Recently, the

formation of TIRAP and the support of this body from OSHA, DoL and the FCC has provided new tools for disseminating existing stan-

*“ PCIA's members review federal and industry standards on a regular basis and are exploring innovative ways to safely inspect and make necessary adjustments on towers. ”*

dards previously discussed and a new public-private forum for the continual review and evolution of

these standards. Moreover, it is critically important to have a common vernacular in the industry and clearly define the responsibilities required to perform the various and ever-changing SOWs.

The industry is already governed under several key standards, including OSHA CPL 02-01-056, ANSI Z359, OSHA 1910, OSHA 1926, TIA-222, TIA-1019-A and ANSI A10.48, among others. The promulgation of new regulations may result in duplication, confusion or conflict with existing standards. Further, as noted, new public-private partnerships have formed to provide greater opportunity for review and dissemination of

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standards throughout the telecommunications and construction industries.

### Focus on Training and Education

PCIA welcomes additional support in disseminating existing standards. Enhanced employee training is often required regarding the applicable OSHA and TIA standards with respect to rigging — OSHA standards at 29 C.F.R § 1926.251 require the inspection of all rigging equipment prior to use, and TIA-1019-A “Standard for Installation, Alteration and Maintenance of Antenna Supporting Structures and Antennas” was developed with the goal of

“ It is critically important to have a common vernacular in the industry and clearly define the responsibilities required to perform the various and ever-changing SOWs. ”

improving tower construction safety and preventing construction accidents and structure collapses.

PCIA believes that more care can be taken to ensure that contractors fully understand their rigging

responsibilities (such as creating a rigging plan) and the hazards that can result from improper rigging such as not having the proper factors of safety, overloading the load/tag lines, limited knowledge of proper rigging signals, bent/failed structural members and distributing the load properly. The rigging standards as dictated in TIA-1019-A (Class I, II, III, IV)

limit potential rigging hazards by requiring a competent person to be on site who understands completely the SOW. Currently, the industry is working to educate engineers in their areas of responsibility with regard to these standards. Support in this

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endeavor is critical and has the ability to provide immediate results. For instance, as a result of OSHA's use of TIA-1019-A with respect to citations, there has been a renewed interest in the standard.

Existing radio-frequency standards govern worker exposure. The existing OSHA standard at 29 C.F.R. § 1910.268(p) (3) requires the following: "When an employee works in an area where the electromagnetic radiation exceeds the radiation protection guide, the employer shall institute measures that insure that the employee's exposure is not greater than that permitted by the radiation guide. Such measures shall include, but not be limited to those of an

administrative or engineering nature or those involving personal protective equipment." The FCC further regulates employee exposure

**“Enhanced employee training is often required regarding the applicable OSHA and TIA standards with respect to rigging.”**

to electromagnetic radiation under its regulations at 47 C.F.R. § 1.1310 and guidelines (Office of Engineering and Technology [OET] Bulletin

65). Through employee training programs, personal RF monitor usage and the cooperation of broadcasters to power down transmitting antennas when necessary, RF safety is adequately covered.

### Additional Steps

The dissemination of information is vital to the goal of reducing risk to workers. Anonymous reporting of on-site activities regarding noncompliant employers should be encouraged by OSHA. Notice of those contractors that have past violations would help to ensure the entire market is moving forward together and will encourage corrective behavior.

PCIA applauds OSHA's participation and ongoing dialog with the

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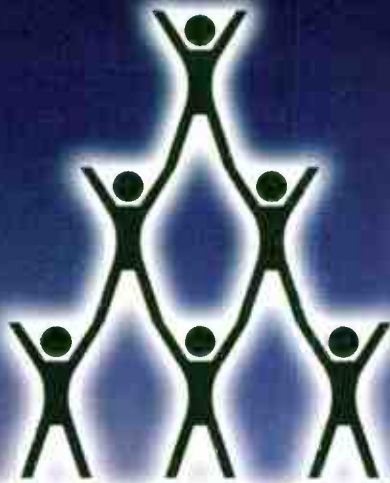
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## Providing Support by Standing Together

"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*

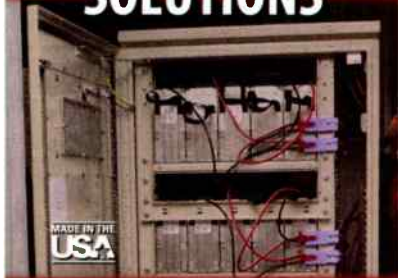
"I want to thank everyone involved for making this happen! Synergy Concepts will be donating to the Tower Family Foundation and encourages other companies in the industry to donate as well."

*Russ Chittenden*

*Vice President of Synergy Concepts, Inc.*

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“ Notice of those contractors that have past violations would help to ensure the entire market is moving forward together and will encourage corrective behavior. ”

TIRAP board, and we similarly encourage OSHA to contribute to the work of the Engineering Committee TR14. We also hope to work with the National Institute for Occupational Safety and Health (NIOSH) on documents that could be used to help further inform and support the industry

in applying the existing standards.

The numerous industry initiatives to help train the workforce of today for the networks of tomorrow, coupled with better understanding of existing regulations and industry standards, will help improve workplace safety in our growing industry.



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# Product Showcase – Shelters, Enclosures and Security



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[www.peabodyconcealment.com](http://www.peabodyconcealment.com)



## Composite Pad

The new composite pad (CPAD) from **Charles Industries** replaces poured-in-place or precast concrete pads. The CPAD enables carriers to more rapidly deploy networks by eliminating days of project work for poured-in-place concrete pads, as well as the heavy equipment requirements and safety concerns of handling and transporting precast concrete pads. The composite CPAD provides a rigid platform for mounting enclosures that house equipment and batteries. The CPAD uses open space on

the bottom side of the pad as additional workspace, helping route RF cables and providing fiber-slack storage. Advanced composite materials used to make the pads are intended to meet chemical-resistance, flammability, brushfire, UV-exposure, impact-resistance and water-absorption requirements of ANSI/SCTE-77.

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Photo 1.



Photo 2.

## Prefabricated ROW Communications Shelters

**Oldcastle Precast** right of way shelters (see Photo 1) are constructed to customer specifications and shipped assembled with lights, outlets, air conditioners, heaters, generators, transfer panels, ventilation systems, cable ladder and grounding systems. In addition, site preparation, excavation,



foundation construction and installation of the new precast modular building are provided. Oldcastle Precast turnkey right of way communication shelters (see Photo 2) are installed within existing railroad rights of ways for national communications companies that provide communications and data services to residences and businesses.

[www.oldcastleprecast.com](http://www.oldcastleprecast.com)



### Telecom Shelter Cooling Unit

The Dual-TEC DC voltage-free thermoelectric cooler from **Bard** offers rugged durability, dependability and smart innovations for equipment shelters. Features include a self-identifying unit, sleek and flexible programmable logic control, a Web link and a handheld diagnostic tool called the TEC-Eye. The unit is available in sizes from 3 tons to 5 tons with efficiencies of 10+ EER. Online and on-site training and certification are available.

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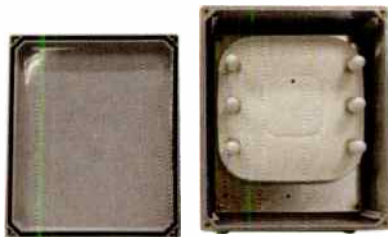
### Equipment Shelters

**American Products'** Thermal Fort lightweight equipment shelters are designed to protect sensitive equipment from the harshest environments. Constructed of heavy-gauge galvanized steel and powder-coated,



the shelter exceeds GR487 salt-spray requirements. The all-metal construction is intended to provide years of maintenance-free service. The lightweight design makes the shelters easy to deploy — suitable to install in remote locations and on building rooftops. Available in five standard sizes from 6-feet-by-6-feet to 9-feet-by-15-feet, the shelter can handle applications requiring anywhere from one to 12 standard 19-inch/23-inch equipment racks or up to 500 rack units of rack space. Custom sizes, configurations and colors can be designed to meet specific applications. Some of the shelters are stocked for immediate shipment.

[www.amprod.us](http://www.amprod.us)



### Under-the-seat Wi-Fi Enclosure

The TerraWave under-the-seat Wi-Fi enclosure from **Ventev** is designed for open stadiums with no roof and for venues with high ceilings. These applications can be particularly challenging to Wi-Fi network administrators

because installation of top-down high-gain antennas and access points may not be practical or even possible. The product provides bottom-up connectivity to the network for several rows of users. Powerful, small, form-factor Bantam antennas connect to the access point and are housed inside a NEMA 4X-rated compact watertight enclosure to ensure capacity and improve the Wi-Fi experience. A flange installation kit allows mounting the enclosure onto a concrete or metal surface while also raising the enclosure off the surface to allow for water runoff. The enclosure is compatible with Cisco 2600/2700/3500/3600/3700 access points.

[www.terrawave.com](http://www.terrawave.com)



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[www.kennerchainwall.com](http://www.kennerchainwall.com)

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## Enclosures

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enclosures protect equipment from lightning, electromagnetic interference, radio frequency interference and other threats to mission-critical communications. The Micro Radio Site provides highly mobile protection for communications equipment in nearly any setting where there is a need for radio access. The enclosure does not require excavation or a foundation, eliminating the need for geotechnical, environmental impact and archeological studies. Since the product launched, Pepro has used its customers' deployment data and building standards to incorporate several design improvements. The new design includes an upgraded cabinet to make the unit lighter and more streamlined, a redesigned base to provide a robust anchoring system for the most extreme conditions, and more rugged axles and wheels to make the unit more road-worthy on secondary roads, improving its performance for remote, temporary and environmentally sensitive applications.

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[www.airxccl.com](http://www.airxccl.com)



### Shelters for Ground Placement and Rooftops

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[www.vfpinc.com](http://www.vfpinc.com)



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