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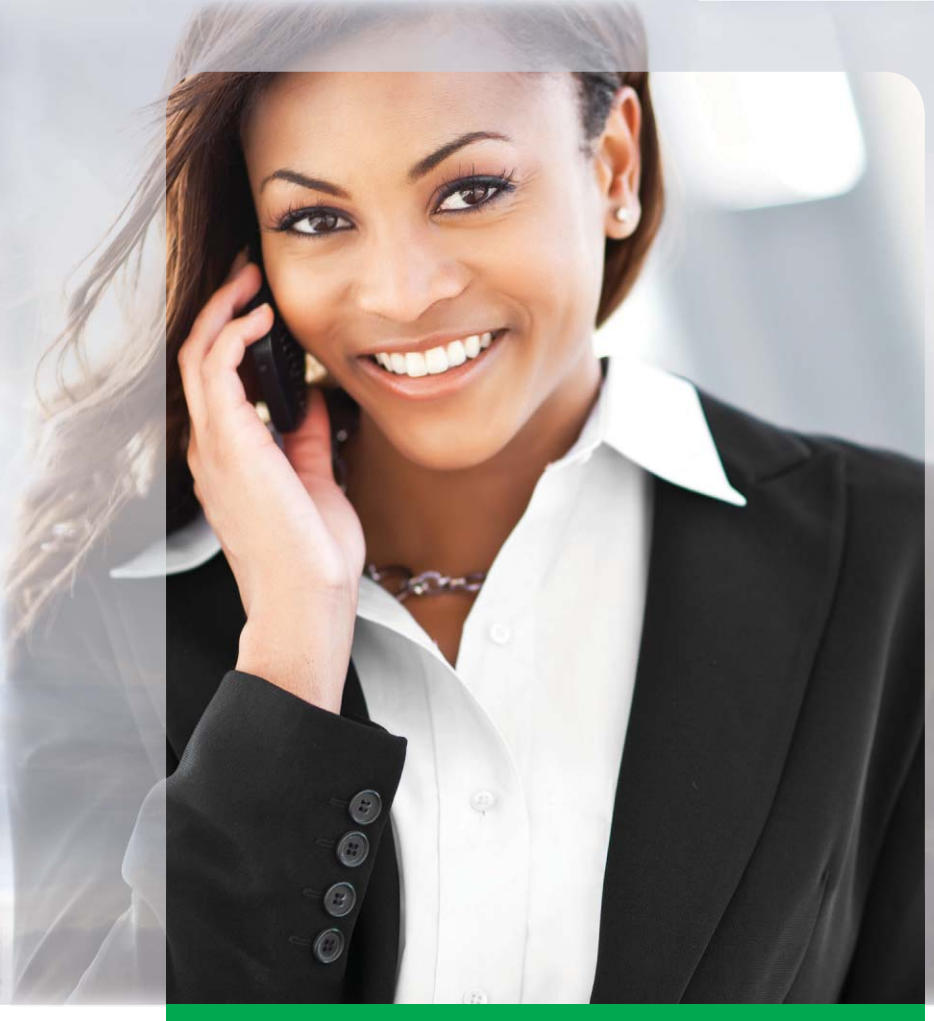


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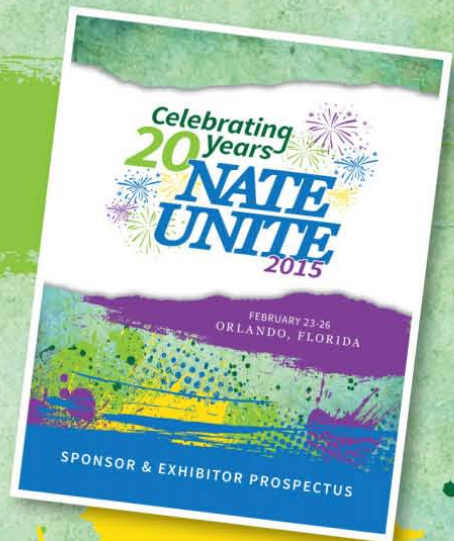
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# Not a Tower

When is a tower not a tower? When it is a surveillance device known as a Stingray, made by Harris and provided to federal, state and local law enforcement agencies.



The Stingray surveillance device intercepts communications from cellphones by simulating the reception of a handset's international mobile subscriber identity code,

just as a cell tower would. It forces a cellphone to register its location and identifying information with the police device and enables officers to track calls whenever the phone is on, an Associated Press report states.

The federal government goes to great lengths to keep information about the Stingray surveillance device secret as the press and others, such as the American Civil Liberties Union, seek to pry loose details about the extent of its use from law enforcement agencies. For example, in May, the U.S. Marshals Service seized Stingray records from the Sarasota, Florida, police department just before ACLU representatives would have arrived to view them under terms of a Florida public records request.

In June, a three-judge panel of the 11th U.S. Circuit Court of Appeals ruled that people have an expectation of privacy in their movements. It said cell-tower data falls within that expectation, and a showing of probable cause is necessary for police to obtain a search warrant for those records.

Also in June, telecommunications service provider Vodafone published its first law enforcement disclosure report to shed light on the extent to which governments secretly force it to disclose its customers' communications and data about those communications.

As the use of wireless communications grows, the role cell towers play in providing law enforcement agencies with details about users' activities grows with it — whether the tower is real or not.

## Carlson to Hall of Fame

Congratulations to William F. (Bill) Carlson, president of Tower Systems in Watertown, South Dakota, on his selection to be inducted into the Wireless History Foundation's Hall of Fame at the foundation's Sept. 9 dinner in Las Vegas. The National Association of Tower Erectors credits Carlson as its founder, stemming from Carlson bringing together an initial group of 65 tower contractors in 1995. NATE gave Carlson its Lifetime Service Award in February. To arrange to attend the Hall of Fame dinner, visit [www.wirelesshistoryfoundation.org](http://www.wirelesshistoryfoundation.org).

Sam Ginn, Jan Uddenfeldt and Robert G. Conway also will be inducted into the foundation's Hall of Fame.

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EDITORIAL COMMENT

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# Don't Build that Tower



In general, I'm a fan of towers. I own some, I rent space on others, and I admire them when driving. And I love a good concealed site. I bore my kids with stopping to look at interesting towers — just as my father did with me. Yes, I'm trying to create the next generation of nerds.

When I'm wearing my small-cell hat — in previous columns, I've mentioned my involvement with small cells — I find that I'm surprised by the number of calls I receive from people who want to oppose a new tower because small cells “eliminate the need for the tower.” Nothing could be further from the truth.

Macrosites are needed now and will always be needed. In mature networks, their role may be changing, but it remains the same for newer networks. Any network always starts its life by covering the largest area with the least number of sites; thus, you use tall towers. As networks undergo increasing use and higher user demand, yet the spectrum they use remains limited, the radiation centers selected on towers come down in height to allow greater frequency reuse. Coverage area per site is reduced, signal penetration into buildings and other areas harder to serve from high rad centers improves, and the network matures.

Small sites or microsites help fill in the nooks and crannies. With the possible exception of limited, defined areas, macrosites often serve the need quite well. Small sites complement

them nicely. And distributed antenna system (DAS) technology is evolving from the use of centralized base stations to the use of remote amplifiers feeding signals into backhaul to be carried to remote small base stations. It all works together, not at cross purposes. Different needs require different solutions and tools.

I actually have opposed a tower construction proposal. Sometimes a tower is an inappropriate solution for a need, an area or a community. Sometimes the tower design fails to match the need, aesthetically, technically or structurally. Meanwhile, some people are anti-anything. They're out there. If you've been in the industry more than a week, you've probably met some of them.

I'm on a multiyear exploration of small cells, and in part because of that experience, I don't subscribe to the notion that small cells are replacements for macrosites. Use the right tool for the job.

## AGL Conference

A word of thanks to everyone who attended the June AGL Conference in Washington. We had some absolutely wonderful speakers, and it was a great time. Special thanks to Jonathan Adelstein, president and CEO of PCIA – The Wireless Infrastructure Association, for attending and delivering a fantastic opening keynote. And our continued thanks to NATE, the National Association of Tower Erectors, which will be represented at every AGL Conference this year, and to Pat Cipov, NATE's chairwoman; Todd



Jonathan Adelstein, president and CEO of PCIA – The Wireless Infrastructure Association, gave the keynote speech at the June AGL Conference in Washington.

Schlekeway, NATE's executive director; John Paul Jones, a NATE board member; and David Anthony. NATE hosts a two-hour discussion, education and outreach event at each AGL Conference. I attended the NATE session at the June conference, and I was very impressed with their work.

## August Surprise

We have a little surprise I'm working up for the August issue. Let's just say: I'll be reaching new heights.



**Rich Biby, Publisher**  
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Wireless carriers use towers positioned behind a house in Cleveland, Tennessee. Photo by Don Bishop

# Cell Towers Must Battle NIMBYism with Better Tactics

By Al Maiorino

Don't assume support for your new cell tower. Run an aggressive campaign and identify vocal supporters to outnumber opponents in petitions, letters or crowds at public hearings.

TOWERS

Cell phone towers provide businesses and residents with an essential service: wireless communications access. New towers allow for expanded service areas, but because of concerns about visual aesthetics, effects on property values and possible negative health effects, among others, not every community welcomes a new tower. As a result, proposals for new towers

are often met with organized opposition from within the community, causing delays in tower construction or forcing companies to find alternate locations. Examples across the United States and Canada demonstrate how opponents can effectively organize campaigns to prevent the construction of new towers and, thus, reduce the opportunity to increase cell phone service in areas in need. However, there are

tactics that companies can employ to increase the likelihood for public support in order to successfully obtain the permits needed to construct these towers. Cell tower companies should be mindful that taking a proactive approach to gaining public support for a new tower is the best way to prevent costly project delays due to NIMBY or “not in my backyard” opposition.

In December 2013, in Westport,

Massachusetts, New Cingular Wireless CPS introduced a proposal for a new cell tower to provide residents and businesses with increased cellular coverage. The tower, slated at 150 feet, would allow the placement of three cellular providers' antennas to reduce the need for additional towers in the future. However, by January, residents in nearby neighborhoods began organizing an opposition campaign focused on the visual effect of the tower, increased construction traffic and perceived negative property value effects. Because of the tower's height, the project would need approval from the Westport zoning board, but pressure from opponents has already pushed developers to begin to consider other locations. Despite the fact that opponents acknowledged their currently poor cell phone service in the area, they remain more concerned with the ultimate defeat of the proposed tower in their community.

The efforts of even just one vocal opponent can have costly effects on cell tower construction. Opponents of cell towers often draw upon their own personal resources to prevent new towers from being built in their communities. In November 2013, in Abbotsford, British Columbia, one resident presented the results of her own personally funded survey to the city council, claiming 79 percent of residents were in opposition to its construction. Conversely, city staff reported that in a comment card response format, 59 percent of residents were actually in favor of the new cell tower. Despite reassurance from the developer, who has addressed community concerns, opposition

## Campaign Elements

- Announce your proposal wisely
- Meet with identified supporters
- Build grassroots support
- Keep an updated database

continues to stall the construction process for this cell tower.

### Strategy for Support

Companies need to look at their strategy for building public support to counter the NIMBY effect because the likelihood for a smooth entitlement process for their cell tower projects is at risk. Cellular providers in particular run the risk of losing customers because of poor service from an inadequate number of towers in the area. According to Pricewaterhouse Coopers in 2012, customers switch service providers every 48 months, indicating that consumers are quick to take their business elsewhere because of inadequate service.

Having been in the business of running public affairs campaigns to build public support for controversial projects for nearly 20 years, I can tell you that the key piece of the puzzle missed by companies in their public outreach strategy is the campaign-style approach the opponents seem to do so well.

Too often, cell tower companies do not offer an aggressive public affairs campaign when they announce a project, often letting crucial time pass between when the proposal is announced and when public outreach begins. Opponents use this time to build opposition and sway residents against these projects. By running a

political-style campaign, you can reach all residents, identify the supporters and harness them into action for your project. Here are some crucial tactics that cell tower companies should consider in their outreach efforts:

#### **Announce your proposal wisely.**

When announcing a project, have a few pieces of direct mail ready to hit all households in the host community to explain the benefits of the project. Follow this up with newspaper, Web ads and using phone banks to further identify supporters. The advantage of phone banks is that, unlike with a random sample poll, each household receives a short, persuasive call to identify particular residents as supporters and to determine their willingness to assist the campaign by writing a letter or attending a hearing. Have an open house to answer residents' questions and recruit supporters. All of this should be done in the first few weeks after announcing a project to prevent the opposition from solidifying and taking over the entire project narrative. Too often, companies lose precious time between announcing a project and disseminating information to the community.

#### **Meet with identified supporters.**

Once a database of supporters has been built from the mailers, ads and phone calls, the developer should meet with them so that their support is acknowledged as critical to campaign

/ FEATURES /

efforts as well as to inform them of their potential as a grassroots force that can begin to write letters to public officials and the newspapers, and that they should attend key public hearings to speak out. Rarely will a supporter write a letter on behalf of a project or attend and speak at a public hearing

if you have not had this face-to-face contact with them previously.

**Build grassroots support.** In addition to reaching out to residents, stakeholders and well-known members of the community, along with businesses, associations and other civic groups should also be met with

to attempt to bring them on board for support.

**Keep an updated database.** As you begin to identify supporters of your project, that information should be maintained in a database to refer to throughout the entitlement process. Coding your supporters by local legislative districts can also help if you need to target a particular local legislator who may be wavering in support, especially in the specific project area where a cell tower is proposed.

The key goal of these types of campaigns is to never allow the opponents an opportunity to seize the moment because of inaction by the developing company. It's not enough to simply announce a new cell tower and assume that everyone will be on board to support it. By running an aggressive campaign and identifying supporters, you have taken a key step in ensuring approval. Engaging the identified members of a community who support your project is the next step, and one that will allow vocal supporters to outnumber opponents. Strategies include petitions, letters and crowds at public hearings.

In 2014 and beyond, expect NIMBY opposition to cell towers. Meeting this challenge with proven grassroots techniques will be critical to making 2014 a success for new cell tower construction.

*Al Maiorino is president of the Public Strategy Group, which was founded in 1995. The firm has developed and managed multiple corporate public affairs campaigns in a variety of industries such as gaming, cable television, retail development, auto racing, energy and residential projects in 20 states and three countries. Visit [www.publicstrategygroup.com](http://www.publicstrategygroup.com).*

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# Ajit Pai Says the FCC Has More Steps to Take to Speed Wireless Infrastructure Deployment

State governments have a role, but Commissioner Ajit Pai sees the need for more federal pre-emption as the FCC contemplates how to facilitate more rapid wireless network construction.

By Don Bishop

**O**n May 20, 2014, FCC Commissioner Ajit Pai spoke to an audience at the Wireless Infrastructure Show in Orlando, Florida. The following are his remarks, edited for length and style.

Many people seem to treat infrastructure as an afterthought to radio-frequency spectrum. Some seem to forget that towers, antennas, backhaul and other infrastructure are essential. It doesn't matter how much spectrum we make available, consumers won't have wireless service if operators can't deploy wireless infrastructure in a timely manner.

Deploying more infrastructure is important because we're on the leading edge of a data tsunami. By 2018, U.S. mobile data traffic will increase nearly

eight-fold, with outsized growth in mobile video in particular. Video is expected to account for nearly 70 percent of all mobile traffic by 2018. By the end of this year, there will be more connected mobile devices than people on this planet.

Consumers will use the airwaves almost as seamlessly as they breathe the air. Entrepreneurs are conceiving an Internet of Things made up of connected watches, appliances and clothes.

## Carrier Upgrades

Speeds and capacities have to increase significantly, and that's where infrastructure comes in. Carriers are upgrading their networks to support the latest 4G technologies. They're looking to add capacity by densifying their networks and deploying small-scale

technologies, including microcells, picocells and distributed antenna system (DAS) networks.

Wireless infrastructure also drives job creation and economic growth. Researchers estimate that over the next four years, industry will invest up to \$36 billion each year in mobile broadband if we put the right regulatory framework in place. These investments will generate up to 1.3 million new jobs and increase our nation's GDP by \$1.2 trillion.

## State and Local Rules

What's holding us back? Byzantine state and local rules often make it impossible to make even minor modifications to wireless facilities.

In some cases, municipalities are applying a one-size-fits-all review process. That means you have to jump through the same hoops whether you're looking to swap out a 3G antenna for a 4G one or constructing an entirely new 200-foot-tall tower. Permitting processes may drag on for years. Municipalities charge exorbitant fees that deter necessary

*Providers are looking for ways to squeeze more capacity out of existing spectrum. By using more and smaller antennas at lower power, these solutions can improve coverage and enable us to reuse scarce spectrum.*

upgrades and modifications.

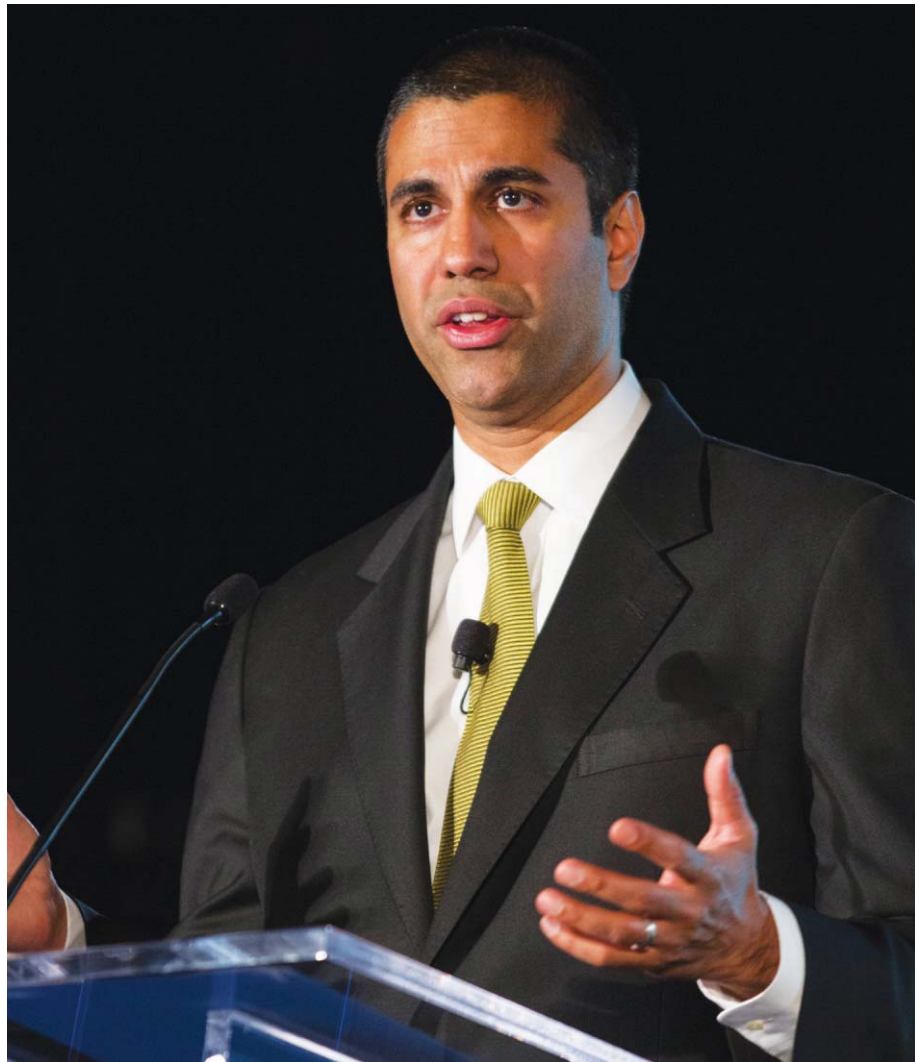
Every consumer wants fast, dependable wireless services where he or she lives, works and plays. But getting those services to work requires local infrastructure. This isn't like nuclear power, where you can supply energy whether you put a plant 1 mile or 100 miles away. For wireless networks to work, infrastructure has to be near the consumer, whether it's a big tower or a small cell. Ultimately, NIMBYism leads to more dropped calls, less capacity and less redundancy in cases of emergency.

Thankfully, Congress has already given the FCC powerful tools to create a more balanced regulatory framework. Almost a year and a half ago, I outlined a comprehensive plan that uses our authority to remove barriers to infrastructure deployment. I'd like to quickly discuss that plan and update you on where things stand.

### Easier Deployment

First, I proposed we make it easier to deploy small cells and DAS. This is becoming more vital every day. Densification and heterogeneous networks are becoming the new norm. Providers are looking for ways to squeeze more capacity out of existing spectrum. By using more and smaller antennas at lower power, these solutions can improve coverage and enable us to reuse scarce spectrum.

Our rules need to keep pace with this technological trend. Many were written with large macrosites in mind. They don't make sense when applied to minor facility changes. Nor should they apply to small cell deployments that carriers use to cover targeted indoor or localized outdoor areas,



FCC Commissioner Ajit Pai: "The FCC should modernize its rules and exempt DAS from environmental processing requirements, except for those involving RF emissions." Photo by Don Bishop

such as office buildings, stadiums and local parks.

The FCC should modernize its rules and exempt DAS from environmental processing requirements, except for those involving RF emissions. Our rules let us do this if a technology is "deemed to have no significant effect on the quality of the human environment." Given their size and appearance, DAS nodes meet this standard.

The FCC should update its historic

preservation regulations, which impose yet another layer of process, to account for DAS and small cell technologies. These systems are barely visible, and they hardly affect the surrounding environment. As a result, I don't think that most DAS networks or small cells should be subject to review under Section 106 of the National Historic Preservation Act. In order to take this step, we will need to renegotiate Nationwide Programmatic Agreements with

Consumers deserve certainty that local rules or efforts to update those rules will not stand in the way of better service. At a minimum, the FCC should make it clear that a moratorium is not a loophole that localities can sneak through to avoid the limits of section 332(c)(7).

state historic preservation officers, the Advisory Council on Historic Preservation, and tribes.

**Local Moratoriums**

Second, I proposed to make clear that local moratoriums on the approval of new wireless infrastructure violate Section 332(c)(7) of the Communications Act. In that section, Congress recognized the important role that state and local governments play in approving requests to construct or modify wireless facilities. But Congress also imposed important limits on that authority and specifically required that state and local governments act on all such requests within a reasonable period. And now some cities are trying to evade those limits by adopting moratoriums on the approval of new wireless infrastructure.

Here's how it happens: Somebody files an application with a local government for a new wireless facility. Then, a few people in the community complain. Rather than deal with the issue, the local government calls an indefinite time-out until it can decide how to address issues raised by the application.

I proposed that the FCC make clear that such delays are contrary to Section 332. Local governments, of course, need to review and revise existing laws every now and then to account for changed circumstances. But consumers deserve certainty that local rules or efforts to update those rules will not stand in the way of better service. At a minimum, the FCC should make it clear that a moratorium is not a loophole that localities can sneak through to avoid the limits of section 332(c)(7).

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### Shot Clock

Third, I called on the FCC to build on its wireless facilities shot clock to further reduce delays and ease the construction of new networks.

The FCC unanimously adopted the shot clock a few years ago. It gives local zoning authorities 90 days to act on collocation requests and 150 days for all other requests. The FCC took this step after hearing that 760 applications had been pending with states and municipalities for more than a year and that more than 180 had been pending for at least three years.

### Litigation Remedy

But there's still a problem. If a city doesn't process your application within the 90- or 150-day time frames, your only remedy is to file a lawsuit. In other words, the solution to municipal delay is litigation.

To solve this problem, the FCC needs to bring down the gavel if a local

government does not act on a wireless facilities application by the end of our shot clock deadlines. We should borrow an idea that the agency used when it reformed video franchising back in 2006. We should deem an application granted if a local government doesn't act on it by the end of the shot clock. This would maximize the incentive for local governments to rule on applications. And it would let companies stop litigating over infrastructure and start deploying it.

### DAS Networks

Similarly, we should clarify that our shot clock applies to DAS. Believe it or not, some have suggested it doesn't, even though neither Section 332 nor our shot clock rules make any distinction between DAS and other wireless technologies. Given their size and importance, DAS networks should raise fewer state and local concerns than traditional wireless

infrastructure, not more.

That was the plan: streamline the treatment of DAS and small cells, curb local moratoria and improve our shot-clock rules with a deemed-granted remedy that applies to all wireless technologies.

Less than a year after I outlined my plan, the FCC sought public input on these and other ideas for promoting the deployment of wireless infrastructure. The time for submitting comments ended two months ago, which means the time for deciding is here.

We should bring the same urgency to this task that has animated our recent push to make additional spectrum available for mobile broadband. The time has come to put the FCC on its own shot clock. The Commission should commit to adopting rules within the next six months.

### Clarify Section 6409(a)

Meanwhile, let's also clarify that

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Section 6409(a) of the Spectrum Act means what it says. The law says that a state or local government may not deny, and shall approve, any eligible facilities request for a modification of an existing wireless tower or base station that does not substantially change the physical dimensions. By pre-empting state and local roadblocks to deployment, Congress sought to promote small cells and hetnets. And yet, I've heard reports that some localities are nevertheless dragging their heels and subjecting qualifying deployments to discretionary review.

Denying eligible requests is not an option. Establishing a deemed-granted remedy with a relatively short fuse — say, 30 days — should be effective

at keeping everyone on track.

**Objective Standards**

Just as important, we need to set objective standards for when requests involving Section 6409 won't substantially change the physical dimensions of existing wireless towers or base stations. The Commission already has a head start on this project with our nationwide agreements on the collocation of wireless antennas and implementation of the National Historic Preservation Act review process. Outlining those standards soon will head off the inevitable disputes that are sure to arise — and it would be a sad irony if Commission inaction emboldened state and local

governments to do nothing as well.

None of what I've said means that states don't have a place at the table. The federal government might get most of the attention, but states are also helping to speed the deployment of next-generation wireless networks. Just this year, six states have enacted legislation to streamline broadband deployment. For example, the Georgia legislature passed the Mobile Broadband Infrastructure Leads to Development Act, which is expected to expand mobile broadband in the Peach State by setting predictable timelines and eliminating costly delays in the siting of wireless facilities. These are great models for other legislatures to follow, and I hope they do.

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# RF Awareness: How to Identify and Mitigate Risks

Personal protection monitors help to safeguard tower workers from possible RF emission-related injuries. The minimum safe distance from an antenna may be farther than you believe.

By Jim Acree

Since the late 1940s, the heating effect of microwave radiation has been well known. It was, in fact, discovered by an engineer who had a candy bar that melted in his pocket while he worked on a radar set.

The general public has been concerned about the potential health risks of RF radiation for some time, but according to the World Health Organization, the only health effect from RF fields identified in scientific reviews has been related to an increase in body temperature ( $> 1^{\circ}\text{C}$ ) from exposure at a very high field intensity. Because the strength of RF fields is greatest at the source and it diminishes quickly with distance, it is the workers closest to the source who must keep a close eye on their level of RF exposure.

## OSHA Taking Notice

In November 2013, the U.S. Occupational Safety and Health Administration sent a letter to the communications tower industry concerning the tower fatalities — 14 in all — that occurred in just a few months. Although the deaths were related to falls, OSHA is sharply increasing investigations into safety and compliance issues across the board and is requesting that its com-

pliance officers track a wide range of potential safety hazards. The following questions come directly from the letter: “Was ambient RF present? Were employees wearing any measuring or warning devices to protect against ambient RF?”

James G. Maddeux, director of OSHA’s Directorate of Construction, sent the letter to OSHA regional administrators.

The increasing focus on RF exposure stems from an increased awareness of the health effects involved. RF radiation, although not cumulative in nature, still causes physical damage because the human body acts as an antenna, absorbing the energy. The rate of absorption depends on the height of the person near a transmitting device versus the frequency or wavelength emitted. The person’s position as it orients to the transmis-

sion field is also significant. Polarization refers to the direction that the electromagnetic waves are traveling out from the source.

## Are You at Risk?

The RF threat is present anywhere an antenna is present, including antennas mounted on buildings and rooftops. The following employers should all consider their teams at risk for high levels of RF exposure:

- Telecommunications service employees, including cell tower workers and related contractors
- Any municipality with code inspectors who go near antennas
- Roofers, HVAC workers, construction workers and related contractors
- Fire department and EMT workers who might need to deliver emergency services near an antenna

*The rate of absorption depends on the height of the person near a transmitting device versus the frequency or wavelength emitted. The person’s position as it orients to the transmission field is also significant. Polarization refers to the direction that the electromagnetic waves are traveling out from the source.*

## Mitigating RF Radiation Risk

What levels constitute a serious risk? The National Council on Radiation Protection and Measurements (NCRP), the Institute of Electrical and Electronics Engineers (IEEE) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP) recommend an exposure less than 4 watts per kilogram for the whole body. In the case of cellular and PCS cell site transmitters, the FCC's RF exposure guidelines recommend a maximum permissible exposure level to the general public of approximately 580 microwatts per square centimeter. To provide context, the effective radiated power (ERP) of the majority of cellular or PCS cell sites in urban and suburban areas is 100 watts per channel or less. An ERP of 100 watts corresponds with an actual radiated power of 5 watts to 10 watts, depending on the type of antenna used. In urban areas, cell sites commonly emit an ERP of 10 watts per channel or less, according to "Human Exposure to Radio Frequency Fields: Guidelines For Cellular and PCS Sites," published by the FCC.

Although OSHA prefers engineered solutions to mitigate the risk of RF, an engineered solution is not always feasible. That's why personal protection monitors (PPMs) are essential to safeguard employees against the real dangers of RF radiation. A PPM is an RF measuring device designed to be carried by anyone near antennas. It constantly scans for electromagnetic waves and alerts users whenever the acceptable limits are exceeded. Even though OSHA has not yet mandated the use of PPM devices to monitor employee exposure, all major tele-



A worker wears an RF monitor on his shoulder.

communications carriers now require these technologies as part of their safety and compliance plans.

### Best RF Monitors

For a PPM to be effective, it must align with the polarization of the RF field it is detecting. If the PPM you're wearing does not align with the polarization of the RF field being emitted, proper detection capability falls short. It is believed that the best protection from RF comes through PPM units with both the highest sensitivity and the greatest range of detection possible that can be worn

comfortably by the user. That's why PPM from Microwave Vision Group (MVG) use isotropic (tri-axial) probes to measure all three polarizations of the RF field for the user, versus single-axis units that measure only one polarization at a time. When only one polarization is measured, a user pointing the device in the wrong direction could get a misleading measurement. That's why measurement of all three polarizations is essential.

MVG designs its devices with an overload capacity of more than 5,000 percent. This is to prevent monitors from burning up in high RF environ-

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*The strength of RF fields is greatest at the source and it diminishes quickly with distance. It is the workers closest to the source who must keep a close eye on their level of RF exposure.*

ments, and it's also useful for incidental passage through high RF zones.

The MVG portable dosimeters, EME Guard and EME Guard XS, continuously measure RF fields and alert the user when preset thresholds are exceeded. These thresholds can be set to meet user requirements in advance. EME Guard is designed as a unit to protect an entire team. Easily worn on a belt clip, in an outside pocket or in a harness, the device features three independent alarms with warnings that can be triggered as soon as the exposure level reaches 25 percent, 50 percent, 75 percent and 100 percent of the chosen reference threshold. Another useful feature is that RF measurement data can be tracked for monitoring purposes after

a project is complete.

EME Guard's smaller sibling, EME Guard XS, is designed as a unit that can be worn by each member of a team individually. Exposure limits are preset at the factory, but they can be customized upon request. RF levels are indicated by an LED color scale. Audio and visual alarms are triggered when RF exceeds the reference level. A more basic unit such as this is highly effective at distributing protection to anyone who may be at risk while still factoring in budget considerations.

PPMs should be worn at all times, even if the antenna is thought to be powered down. The minimum safe distance from an antenna may also be farther than you believe. "Not only should it be required to wear a PPM monitor in the air, it should also be



The EME Guard, an RF monitor made by Microwave Vision.

required on the ground," said Wade Sarver, a 25-year wireless veteran with Alcatel-Lucent. "I once brought a spectrum analyzer out to a tower site and discovered that there is plenty of RF radiation at ground level. The minute you open up a fence and go inside, you should be wearing a PPM."

*Jim Acree is an RF engineer with MVG. For more information, visit [www.microwavevision.com/rfsafety](http://www.microwavevision.com/rfsafety).*

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**TOWER OWNER**  
FRONTIER RADIO

**TOWER TYPE**  
MONOPOLE

**HEIGHT**  
80 FEET,  
EXTENDABLE TO 100 FEET

**TOWER MANUFACTURER**  
ROHN

**YEAR CONSTRUCTED**  
2008

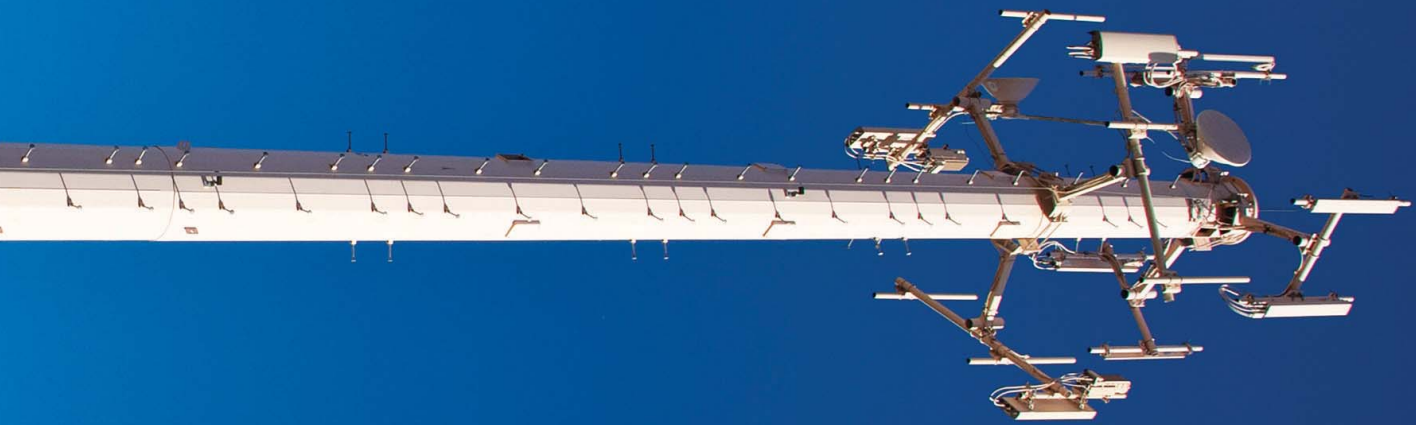
**CARRIERS**  
T-MOBILE/METROPCS  
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**LOCATION**  
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# How Small Cells Affect Office and Commercial Building Leasing

A return to tradition will revolutionize the nature of indoor small cell leasing as wireless communications network operators deploy small cells to help increase network densification.

By Lynn Whitcher

In the early days of macro site leasing, lease agreements consisted of just one page of pre-printed text. Landlord modifications were rare and, when needed, were simply handwritten into the margins. Fast forward decades later and the contrast could not be more dramatic. The typical carrier lease now starts with 12 to 20 pages. Landlord form agreements are longer, often extending to 30 pages or more. And that's without exhibits. Specialized lease consultants and real estate counsel spend hours on marathon negotiation calls parsing the complexities of general versus gross negligence indemnities, automatic late payment penalties versus an opportunity to cure, landlord relocation rights, limitations of liability and insurance requirements. It can

take years to finalize a contentious lease for a new site. Landlords have become emboldened to assert a wide range of extraordinary demands, including, for example, one municipality that asked a carrier to install a basketball court as a condition for allowing a cell tower at a park.

## Feverish Demand

The consumption of bandwidth is at an all-time high, and there appears to be no end in sight to the feverish demand for constant connectivity, according to the "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2012-2017." The carriers cannot afford to dedicate valuable time, resources or monies to the continued accommodation of lease agreements uniquely crafted to

the whims and variations of macrosite landlords nationwide. In order to meet the immediate need for additional network infrastructure, efficient and cost-effective deployment is critical, especially in the highly competitive wireless provider market. Fortunately, industry leasing is experiencing yet another radical change: the return of the no-change template lease, albeit in the limited context of in-building small cells.

Operators are looking to small cells to help increase coverage densification. Small Cell Forum Chairman Gordon Mansfield, speaking about this year's small cell deployment, said Verizon Wireless, Sprint and T Mobile USA have stated "in some shape or form that they're currently in trials and planning to move into mainstream deployments." Mansfield also is AT&T's associate vice president of small cells. AT&T is in the middle of a three-year endeavor to deploy tens of thousands of small cells in commercial and mixed-use buildings. As part of this wireless industry push, building owners lucky enough to hold property in areas selected for small cell development will have a windfall opportunity to

## Lease Essentials

- Identification of parties and property
- Lease term
- Access
- Removal requirements
- Default protocols
- Carrier termination rights
- Description of the proposed system

bring dedicated wireless service to building tenants and visitors, free of charge, courtesy of the carrier. Finally, reliable cell coverage indoors! The catch — landlord attorneys sitting in high-rise office buildings may be enjoying the benefits of indoor small cell coverage without expending billable hours negotiating the underlying leases.

What can a landlord expect to see in these form agreements? There will be a few provisions dedicated to the essentials: identification of the parties and property, the lease term, access, removal requirements, default protocols, carrier termination rights and a description of the proposed system. In light of the limited coverage area of a small cell antenna and the plug-and-play system architecture, providers will want the flexibility to reconfigure antenna placement to respond to changes in the tenant mix and usage over the life of the lease. The agreements will not provide for rent payments. Overall, cost containment and speed to market will be essential building blocks of the carrier's small cell portfolio. Carriers will enjoy an expedited siting process with few, if any, zoning and regulatory requirements, and the expectation will be that the lease process will be equally as efficient.

If a building owner is unwilling to accept the carrier's small cell lease proposal, the operator will simply approach the owner of the building next door or across the street. After all, the service provider is primarily looking to offload traffic from the macrosite and may not particularly care if this happens in one building or the next. On the other hand, a landlord who passes up the opportunity of



A landlord who passes up the opportunity of a free small cell system may spend the next 20 years explaining to disappointed prospective and existing tenants that the building does not, in fact, have the latest tenant amenity of dedicated, reliable indoor connectivity.

a free small cell system may spend the next 20 years explaining to disappointed prospective and existing tenants that the building does not, in fact, have the latest tenant amenity of dedicated, reliable indoor connectivity. These tenants are the very same consumers with both a mobile phone and tablet, and a habit of binge watching video content that drove the carriers to install small cells in the first place. Ultimately, this property owner may end up spending tens or hundreds of thousands of its own dollars installing an in-building wireless system just to remain relevant in the equally competitive commercial real estate market. This welcome change in carrier negotiation leverage

will mean that for once in a very long time, landlords and carriers can again focus on one simple issue: Should there be a carrier-installed system at the property or not?

Thus, although it is the innovation and creativity of small cell technology that will change the wireless industry by bringing long-awaited coverage to basements, elevators and offices, it is a return to tradition that will revolutionize the nature of indoor small cell leasing.

*Lynn Whitcher is the associate general counsel of Md7 in San Diego. She also serves as secretary of the Women's Wireless Leadership Forum. Her email address is [lwhitcher@md7.com](mailto:lwhitcher@md7.com).*

# Safety is a Process, It Isn't Piecemeal

Safety counts in the field, not the classroom. Experienced climbers could play a more important role through mentoring. Responsibility and a safety culture have much to do with protecting workers.

By Dr. Bridgette Hester

As of April 3, the tower industry has lost six climbers: Chad Weller, Ronaldo E. Smith, T.J. Richards, Kyle Kirkpatrick, Martin Powers and Seth Garner. We also lost Michael Garrett, a firefighter, during the attempt to rescue Richards and Kirkpatrick. We are not off to a good start to 2014. We are averaging one climber death every 15 days.

Having attended the National Association of Tower Erectors conference in February and having read and viewed the speech delivered there by video by Dr. David Michaels, who heads the Occupational Safety and Health Administration as an assistant secretary of labor, I felt motivated to write about NATE's new 100 percent tie-off initiative and OSHA's renewed interest in the tower industry's fatality rate. Several people contacted me for my thoughts on the matter. I became a widow myself when a tower my husband was working on collapsed, fatally injuring him, and I represent families who have lost loved ones because of fatal injuries on tower jobsites.

No one is happy with the rising fatality rate. No one wants men and women to die in the execution of their jobs. Although various organizations play different roles within

the tower industry, all of us support any initiative that works toward saving lives. Furthermore, everyone in the industry wants a zero fatality rate. I regret to say I don't believe that will come to pass. Accidents happen in any industry, and the telecommunications industry is no exception.

What's needed is an overhaul of the industry's culture. Far too many variables affect safety. You cannot simply take one variable and treat it as though it is independent of the others.

Earlier this year, Michaels sent a letter from OSHA to the industry that read, in part, "During inspections, OSHA will be paying particular attention to contract oversight issues, and will obtain contracts in order to identify not only the company performing work on the tower, but the tower owner, carrier, and other responsible parties in the contracting chain."

My immediate thought was, "And this hasn't been a priority before, and you haven't been vigilant about this before because ...?"

**Training:** I hear far too many stories from climbers about their training or the lack thereof. Climber safety and rescue certification teaches how to climb safely. Period. There are still months, even years, of learning before you become a real tower hand, yet green hands are being thrown into the field with no experience and are expected to perform work they don't know how to do. Several climbers told me they have been climbing for months, and their employer hasn't yet sent them to basic certification training.

The training culture in the industry has to be addressed in its totality to achieve a tangible change. If you don't change the training, its execution or the paradigm under which it operates,

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## Hubble Foundation Research

The Hubble Foundation is conducting academic research on climbers' perceptions of their fall risk. To participate in the study, send an email to Dr. Bridgette Hester at [bridgette@hubblefoundation.org](mailto:bridgette@hubblefoundation.org) to receive

a consent form and a link to the online survey tool. Participants must be at least 18 years old and either currently active climbers in the industry (40 hours a week) or active climbers in the past five years.

people will continue to die at the unthinkable rate we have witnessed so far.

**Mentoring:** A natural extension of training is mentoring. When I say mentoring, I do not mean bashing, hazing or abusing new climbers. I realize there is a period of “tough love,” “initiation,” or “earning your place” on a new crew, and given the culture of the industry, that is understandable to a degree. However, I am talking about mentoring. I hear of a few cases in which a seasoned climber invests himself or herself in a new climber to pass along knowledge, information and wisdom. As a climber or business owner, you cannot expect to turn out high-quality workers if you don’t invest in them.

In this industry, turnover is high. Consequently, I understand there are reservations about seasoned hands or employers investing in a new climber. However, if you want a safe crew, you need to invest in the newcomers you are training in the field. Climbers depend on one another too much not to take the time.

**Subcontracting:** Moving from training and mentoring, we need to address the particulars of what’s expected in the field and the common use of subcontracting.

Because of the increasing amount of work available, subcontracting makes perfect sense from a business standpoint. A carrier hires a turf contractor, turf hires sub A, which hires sub B, which hires sub C. I don’t believe it’s unreasonable to assume that sub A doesn’t know sub C’s safety policies or how it trains crews in the field. Does sub B know the safety policies at sub C? Or at the turf company?

*In this industry, turnover is high. Consequently, I understand there are reservations about seasoned hands or employers investing in a new climber. However, if you want a safe crew, you need to invest in the newcomers you are training in the field. Climbers depend on one another too much not to take the time.*

Probably not. If they are aware of each other’s safety policies, how involved are they in making sure that the policies are followed?

Even with the renewed vigor for holding companies and individuals accountable, determining where the accountability lies seems to be the ongoing problem. Holding people and companies accountable for an accident or fatality, which should happen, doesn’t appear to happen often in this industry. Carriers expect turf vendors to be accountable, the turf vendors expect the subs to be accountable, and the employers of the subcontractors expect employees to be held accountable. Given those expectations, is it so unreasonable for families of those injured or killed to expect the same accountability from everyone involved?

Once the initiatives and the task force determine ways to address the fatality problem, my question then would be: Who is going to be held accountable, and what are you going to do about it? I’m interested to see the second half of the equation and the answer to that question.

**Carriers:** I have heard the argument far too often that carriers are too insulated. I tend to agree. It is understandable that carrier companies can’t be held responsible for every

nuance. There needs to be personal accountability from the climber and from the crewmembers on the ground. However, if a carrier company issues job orders, it needs to be held accountable all the way down the line. For example, if I contract work to build my office building and that contractor subs my work out to two more companies, and company C is now building my office, I have a moral, ethical and fiduciary responsibility to make sure the job on my building is executed correctly and safely. If during the construction or after its completion, something collapses, and contractors, employees or someone on the street is killed, it is my responsibility — maybe not entirely, but at least in part. I ultimately allowed company C to do the work on my building. If I didn’t follow up to make sure that company C knew what it was doing and that it was doing it safely, that’s on me. It’s called being responsible.

**Personal climber responsibility:** Ultimately, the climber and the foreman are responsible for their own safety. If it’s not safe, don’t climb. If the structure isn’t sound, don’t climb. Say no. Although this is good in theory, often climbers believe they can’t speak up for fear of losing their jobs or, more foolishly, because they want to be able say they got the job done.

*The industry's just-in-time (JIT) hiring probably has resulted in more safety incidents than any other determinant factor. JIT hiring is defined as programming personnel hiring to match workloads, and this process does nothing to develop safety culture. In fact, it does nothing to develop company culture.*

This is an issue in any industry when the majority of the workforce is made up of alpha personalities. In the case of ego, the foreman should not allow it, and the company owner should back up the foreman in his decision. Does it always happen? No. Should it? Yes.

The climber and foreman responsibility cycles back around to the first point I mentioned: training.

### Changing the Safety Culture

How do we change the safety culture? Although change will take time, there are a few ways to lead the industry in a more productive direction. Some industry professionals may suggest that I am ill informed, that I do not understand the complexity or the costs involved, or that change simply isn't feasible. Nevertheless, from a research perspective, an investment in comprehensive and structured training is not only smart, it's cost-effective.

**Uniformity:** Creating a training system based on proficiency is crucial. Internal and external training sources must teach the same subject matter, but not necessarily in the same way. Adult learners are not taught in the same way that children are taught, so there will be some variation in the method of delivery. Nonetheless, the subject matter should be taught to

the same level of proficiency. Proficiencies must be at the 80 percent level or higher. Safety must be at 100 percent proficiency. In addition, all evaluations must be objective.

Demanding such a system will enable employers, trainers and other industry professionals to specifically define tasks, conditions under which they are performed, and the standard to which they should be performed. Accidents and fatalities can be reduced, but it requires the employers, employees, and the industry as a whole to develop a plan and to follow the plan to mitigate safety issues through uniform proficiency standards that apply to everyone.

**Structured and measurable OJT:** On-the-job training plays an integral part in training within the telecommunications industry. OTJ training is one of the most important and effective ways to train a worker, thus the structure of the OJT should reflect this importance, and currently it does not. Success in restructuring the OJT paradigm lies in a measurable system of skill level: apprentice, journeyman and master. In such a system, workers are held accountable for their knowledge and proficiency and the practical

application of their knowledge. Furthermore, such a system would codify the practical knowledge learned and would identify the skills and the skill level required to perform specified tasks safely and properly.

### Pre-hire screening and testing:

If you are going to train people, invest in them. Invest in them monetarily and invest in them personally, and treat them with respect. People not only learn, but they are more likely to apply what they have learned when they feel appreciated. Part of investing in them also requires the companies to invest in themselves. There are methods to use to screen employees' personal characteristics and professional capabilities for their suitability for the job, but such a system is not utilized.

Behavioral and cognitive testing prior to hire is relatively inexpensive, especially when compared with the costs to be paid in connection with an accident or fatality. Behavioral screening before hire is also a concept the industry should embrace because employees repeat behaviors. Employers already observe climber behavior daily to see that they test their equipment and report anomalies.

Although cognitive testing for prospective employees, like IQ testing, is illegal, tests that measure skill and knowledge typically correlate to high cognitive functioning, hence skill and knowledge test results provide a good indication of general intelligence. Two valuable tests that employers can utilize as tools to evaluate an employee's ability and judgment are

*From a research perspective, an investment in comprehensive and structured training is not only smart, it's cost-effective.*

the Employee Reliability Inventory and the Situational Judgment Test. Both are easy to administer, reliable and valid.

Opponents may argue that screening is too expensive or not feasible, but the cost of pre-screening employees and matching job skills, personality, reliability and past employment experience will far outweigh the human cost in the event of a catastrophe. Effective planning equates with reduced risk — this is Risk Management 101.

The industry's just-in-time (JIT) hiring probably has resulted in more safety incidents than any other determinant factor. JIT hiring is defined as programming personnel

*Behavioral screening before hire is also a concept the industry should embrace because employees repeat behaviors. Employers already observe climber behavior daily to see that they test their equipment and report anomalies.*

hiring to match workloads, and this process does nothing to develop safety culture. In fact, it does nothing to develop company culture.

Changing the safety culture in this industry is a marathon, not a sprint. No matter how well intentioned any of us may be, it is important to remember that education and awareness, unless manifested and applied in the field, will be a fruitless effort.

*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). A contribution to this article was made by Dr. Michael Landa.*

## Keep on track for RF safety



Policy on human exposure  
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# Strengthening Tower Guy Wire Grounding Systems

By Ray Hildebrand and Bill Whitmer, P.E.

Use a method that electric utilities have used for decades to ground cables and adapt it for grounding guy wires that help to support telecommunications towers.

**G**uyed towers offer many advantages over traditional, self-supported towers. Maintaining the tower ground system isn't one of them, especially in locations prone to strong or gusty winds. Wind causes tower and guy wire vibration, which has a tendency over time to loosen guy wire ground clamps or snap ground conductors. Unchecked, guy wire ground conductors are left dangling and disconnected or clamps fall to the ground. This leaves guys insufficiently grounded and vulnerable to damage from lightning.

Regular inspections and maintenance of all tower systems is necessary. They support critical communications functions, and poor maintenance can cause safety concerns, liability problems or communications downtime. Maintenance crews must continually inspect guy wires and periodically tighten, reattach or replace clamps or conductors as needed (see Photos 1 and 2). However, maintenance and repair of guy wire grounding systems can be minimized if these systems are designed and built to withstand their environment. Standard cable clamps and ground wires that meet

electrical grounding and bonding requirements may lack the structural strength to withstand persistent, strong or gusty winds (see Photo 3).

## Standard Guy Wire Grounding

Grounding guy wires is necessary despite the fact that they are already physically attached to the ground. Grounding them prevents lightning discharge current from flowing through the guy turnbuckles, which can deform threads, damage foundations or structurally weaken load-bearing components. The standard method is to attach an approved

bimetal clamp to each guy at a point above the turnbuckle and drop a conductor to a ground rod in the earth. This effectively diverts lightning energy traveling down a guy wire to ground and away from the turnbuckle. The bimetal clamp is a device specifically made to join the galvanized steel guy wire to the copper ground conductor. Without it, galvanic corrosion can occur on the connections between dissimilar metals, and galvanic corrosion would structurally weaken the guy wires over time. To further prevent corrosion within this clamped connection, it normally is

LIGHTNING PROTECTION

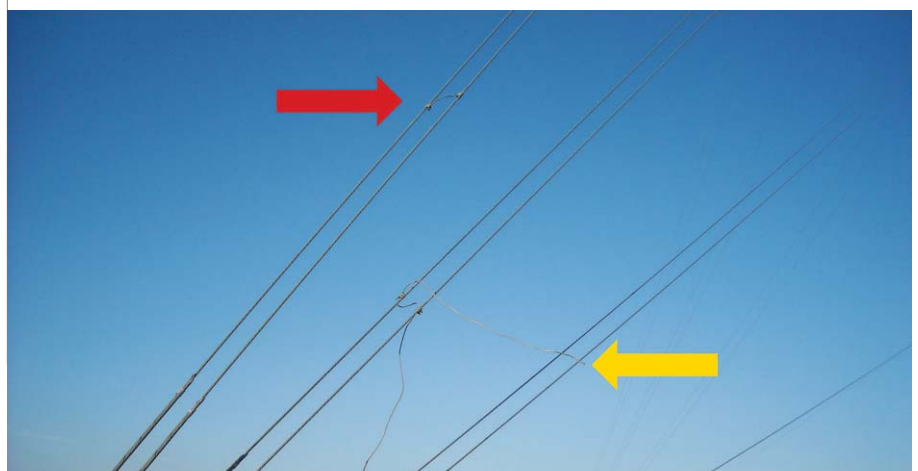


Photo 1. Given the distance above the ground, a bucket truck is probably needed to help with the repair of these guy wire grounding clamps and cables.



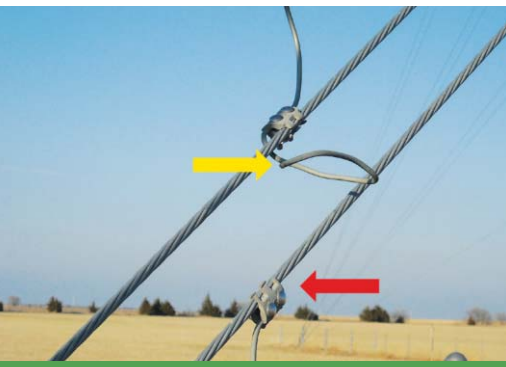


Photo 2. An example of a failed ground wire clamp. The dangling ground wire (yellow arrow) should attach to clamp (red arrow).

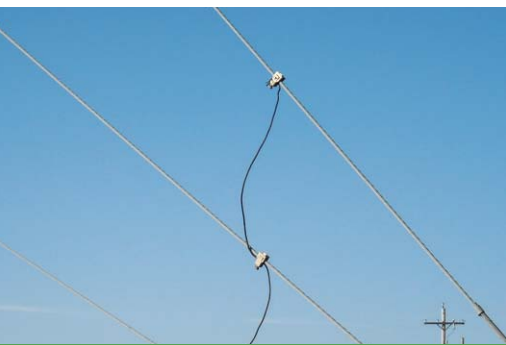


Photo 3. An example of a standard clamp and ground wire that may lack the structural strength to withstand persistent, strong or gusty winds.

coated with a listed conductive anti-oxidant compound. The exothermic welds commonly used for grounding connections cannot be used on guy wires because the heat used in the process will structurally weaken them.

Although this grounding method is fine, electrically, and from a corrosion standpoint, it has two structural weaknesses. First, bimetal clamps are hand-tightened and therefore lack the holding strength to withstand continual guy wire vibration. Second, when subjected to vibration and movement, copper wire becomes brittle and will snap.

### Improved Guy Wire Grounding

An extremely strong method of attaching one cable to another has been used by electrical utilities for decades. This method employs a powder-actuated tool, such as the TE Connectivity Ampact tool, to quickly attach two cables by a means superior to hand-tightened bolts. In this

method, a controlled mini-explosion drives a wedge into a C-shaped holder (see Photo 4), which makes a bond between the cables that is so strong it requires a similar process in reverse to free the cables from the bond. In our experience, this bond cannot be undone by typical tower guy wire ground clamps.

The Motorola R56 “Standards and Guidelines for Communication Sites” states that a #2 AWG or larger, bare, solid, tinned copper conductor should be used as the ground conductor for the guy wires. Larger wire sizes will withstand guy wire vibration better. Using a galvanized steel ground conductor (the same material as the guy wires) offers many advantages.

- Steel has a much higher mechanical strength than copper. It will survive wind vibration stresses much longer than copper.

- There is no risk of galvanic corrosion in using a galvanized steel ground

## General Grounding Do's and Don'ts

DO consider the use of static dissipation arrays for lightning prevention.

DO ask tower manufacturers to build cad weld flanges at the tower base for attachment of ground connections.

DO fence the guy anchors to protect the guys and the grounding connections.

DO inspect tower grounds regularly but especially before lightning season.

DO consult Motorola R56 and the National Electrical Code (NEC) for guidance on grounding and bonding.

DON'T run ground rods through or near concrete foundations.

DON'T use bolted connections when more permanent connection methods are available.

DON'T use sharp bends in ground conductors, but take as direct a route as possible to earth.

DON'T tie dissimilar metals directly together.

conductor to galvanized steel guy wire.

- During new construction, galvanized steel guy wire will be readily available (order approximately 30 meters of excess to use for the guy wire ground conductors).
- The galvanized steel ground conductor can be exothermically welded to a galvanized steel ground rod. Motorola R56 recommends using a galvanized steel ground rod at this location to prevent galvanic corrosion between the guy anchor steel and the ground rod. If copper ground rods are preferred here because of corrosive soils or other reasons, a bi-metal clamp and conversion to a copper conductor can be made above ground in a manner such that it will not be subject to vibration stress.

The only disadvantage in using galvanized steel ground conductors is that a galvanized steel cable with a diameter from 3/8-inch to 1/2-inch will offer more than 10 times the electrical resistance of a #2 AWG copper conductor. However, given the minimal length, this increase in resistance will not jeopardize the guy wires or turnbuckles that they are meant to protect.

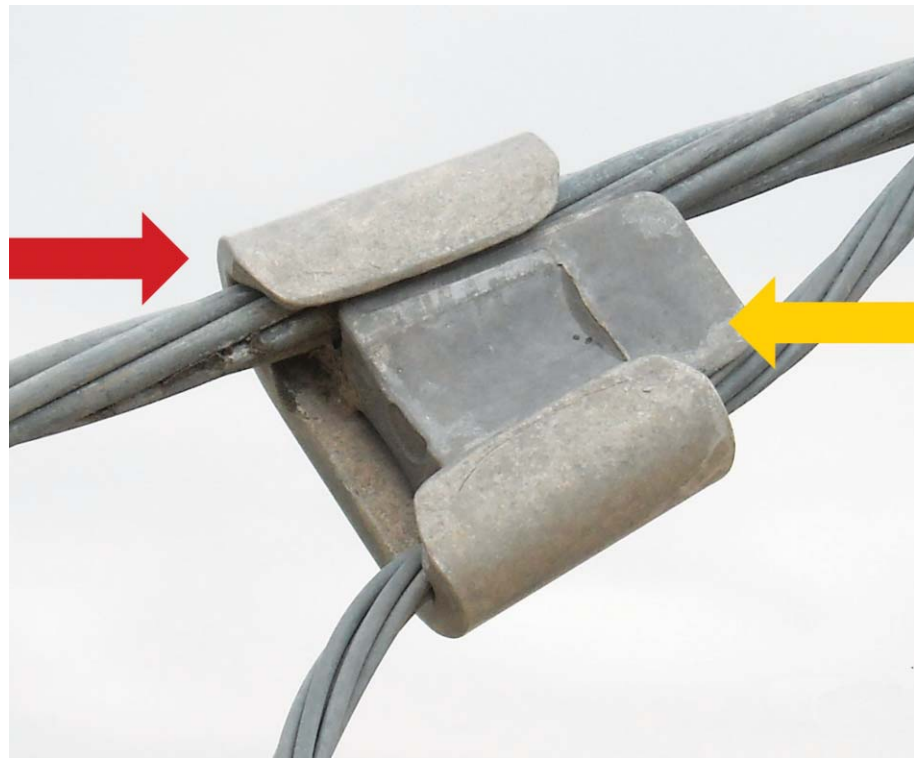


Photo 4. A powder-actuated cable clamp with its C-shaped cable holder (red arrow) and powder-actuated wedge (yellow arrow).

#### Resources

- Motorola, "Standards and Guidelines for Communications Sites," R56, 2005
- National Fire Protection Association, "NFPA 70 National Electrical Code," 2011

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# How an Electrode System Improves Grounding Results

Proper grounding is the key to protecting your employees, your facility and your equipment. A low-resistance grounding electrode system can save you money on transient voltage surge suppression equipment.

By Roy Whitten

The primary purpose of a tower is to provide a structure necessary to hold the antennas for your wireless communications. It is designed to hold appropriate weight in spite of expected and unexpected wind and other environmental stresses. The tower is typically a metal structure taller than most in the surrounding area, and as a result it can be the most likely candidate for being struck by lightning. It is usually made of 3/16-inch-thick or thicker steel, and it can withstand the energy generated by a direct lightning strike.

It is a common saying that electrical current travels the lowest-impedance path. But this is not entirely true. The majority of the current travels the lowest-impedance path, and proportional amounts of the residual current travel all other parallel paths. When struck, the tower not only acts as the conductor on which the fault current travels to earth, but also acts as a direct path that a portion of the same destructive fault current uses to enter your facility.

Without proper design and installation of a low-resistance grounding system and associated protective devices, the tower and RF conductors

will allow sufficient amounts of the strike current to reach and destroy your equipment. With proper planning, a lightning strike can be dealt with through the grounding and surge protection installed on your service panel, RF cables, data lines and phone lines. The capabilities and effectiveness of these devices determine the extent of damage your equipment and facility incurs. One main contributor to the effectiveness of these devices is the effectiveness of your facility's

grounding electrode system.

The foundation of all site protection is the grounding electrode system (see Figure 1). A low-impedance grounding electrode system is used by all transient voltage surge suppression (TVSS) and lightning-protection systems as a path through which harmful electrical voltages and currents are dissipated into earth.

The measurement of the earth's ability to absorb fault current is commonly referred to as soil resistivity,

GROUNDING

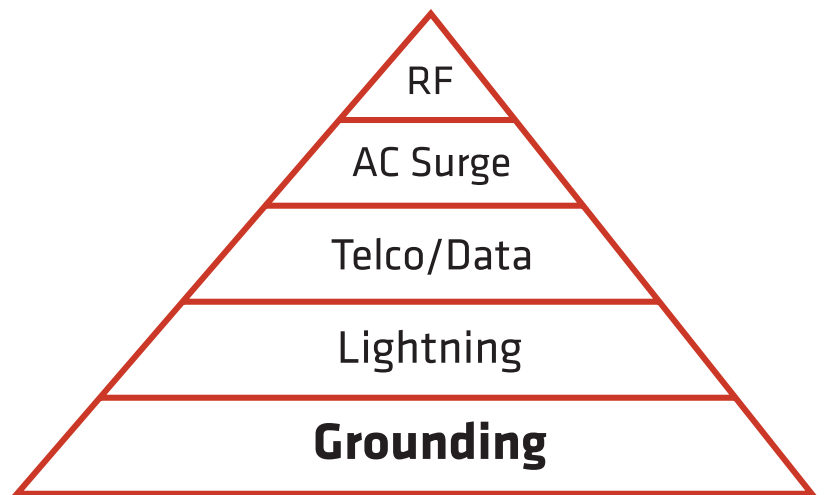


Figure 1. The foundation of all site protection is the grounding electrode system. A low-impedance grounding electrode system is used by all transient voltage surge suppression (TVSS) and lightning protection systems as a path through which harmful electrical voltages and currents are dissipated into earth.

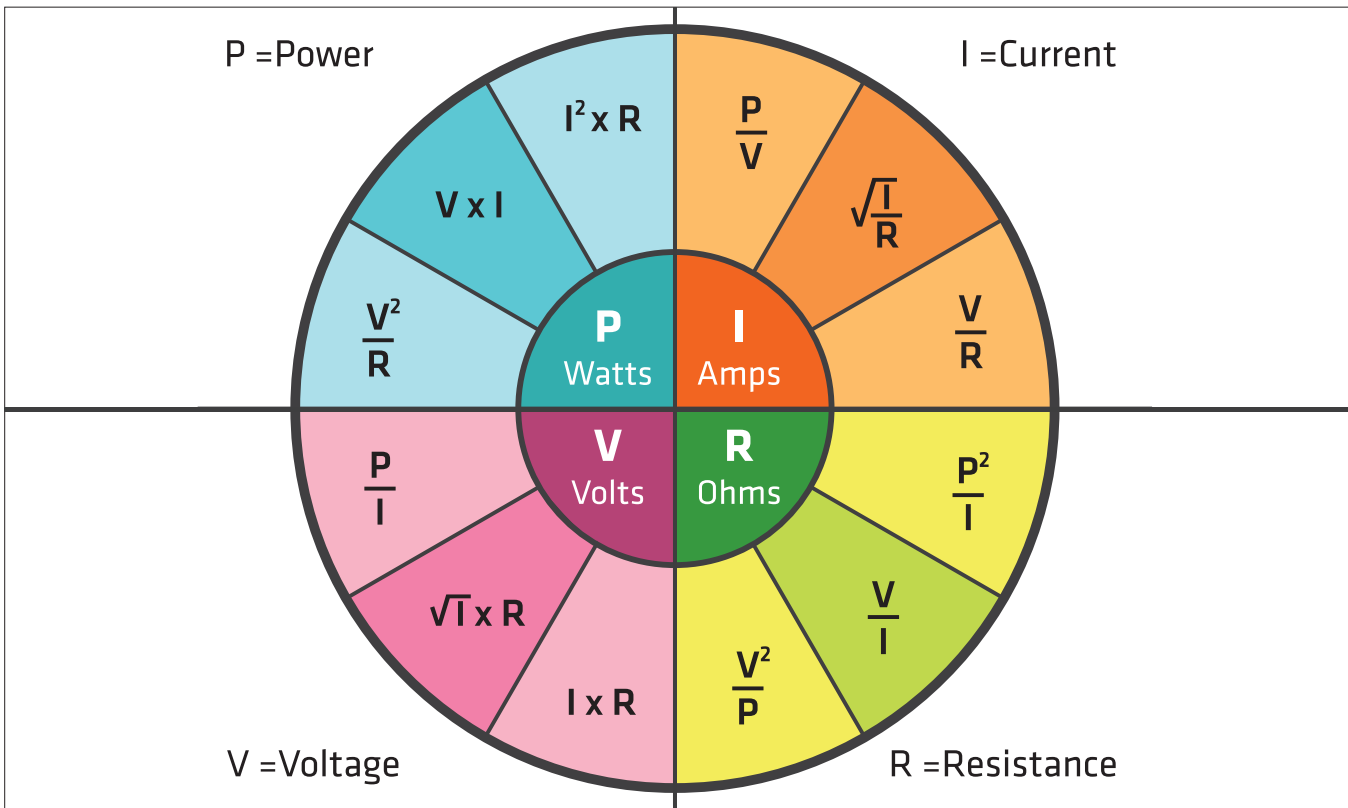


Figure 2. As current flows through your grounding electrode system into the soil, the voltage potential within the soil rises proportionally to the resistance to earth of the grounding electrode system. This voltage potential can be calculated by using an electrical theory known as Ohm's Law, where V = voltage potential, I = amount of current, and R = resistance to earth.

and this is the one most important variable to be considered when designing a grounding electrode system. Soil resistivity depends on three main variables: moisture content, electrolytes in that moisture, and temperature. Not only do these variables differ from site to site, they differ from one soil depth to another. The effectiveness of a grounding electrode system is directly proportional to the soil resistivity and is known as resistance to earth. The National Electric Code (NEC) specifies that a rod, pipe or plate electrode on all buildings with an electrical service must have a resistance to earth value of 25 ohms or less, or a second electrode must be installed. Installing a second electrode may result in an extremely high resistance to earth

value that nevertheless meets code. Many equipment manufacturers in the wireless market require a ground resistance as low as 5 ohms. The NEC, written by the National Fire Protection Association, is concerned with protecting your employees and your structure, not the equipment housed within the structure. You need to ensure you have a low-resistance-to-earth grounding electrode system to protect not only your workers and

your building, but also your equipment. As current flows through your grounding electrode system into the soil, the voltage potential within the soil rises proportionally to the resistance to earth of the grounding electrode system. This voltage potential can be calculated by using an electrical theory known as Ohm's Law, where V = voltage potential, I = amount of current, and R = resistance to earth (see Figure 2).

*Without proper design and installation of a low-resistance grounding system and associated protective devices, the tower and RF conductors will allow sufficient amounts of the strike current to reach and destroy your equipment.*

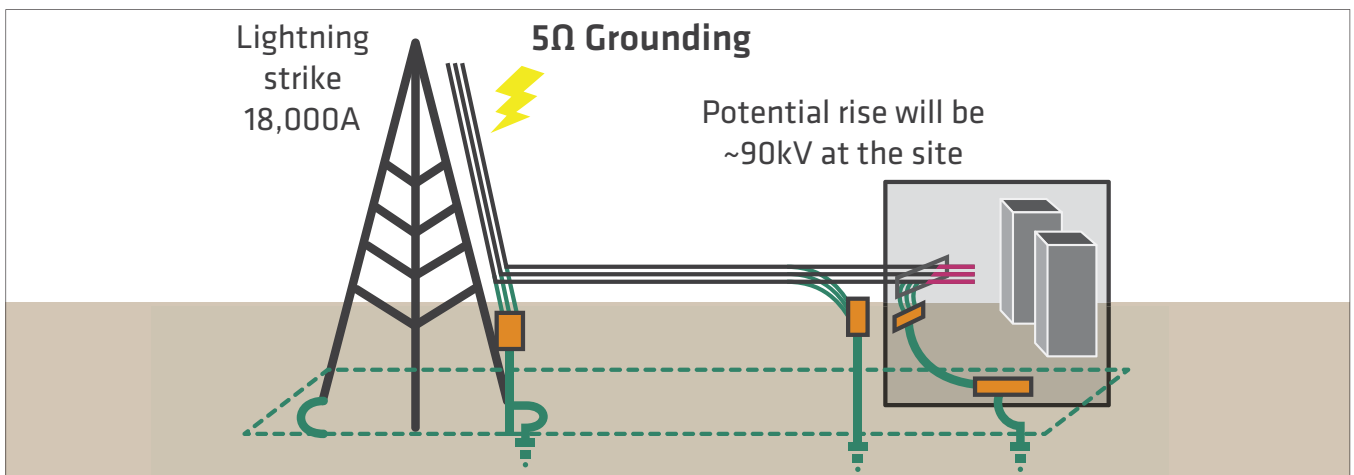
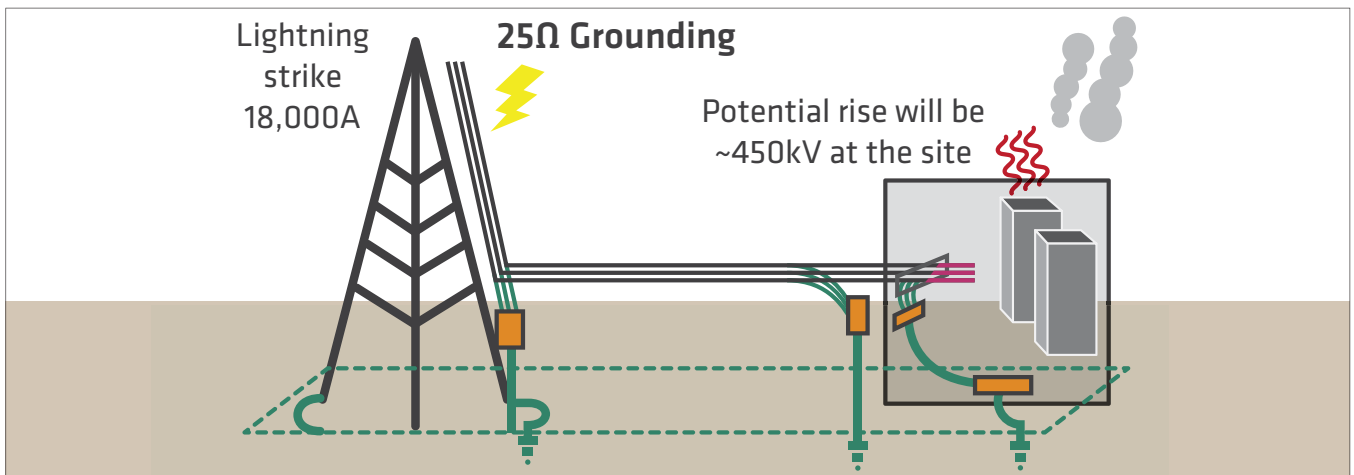


Figure 3. When a tower is protected by a 25-ohm grounding electrode system, an 18,000-amp strike, which is small for a lightning strike, will result in a 450,000-volt potential. This requires a transient voltage surge suppression (TVSS) capable of handling a 450,000-volt potential. In comparison, with a 5-ohm grounding system, the voltage potential for the same lightning strike is reduced to 90,000 volts, the tower and equipment can be protected with less-expensive TVSS for a more manageable and cost-effective result.

GROUNDING

The two examples in Figure 3 illustrate how a low-resistance ground creates a lower-voltage potential rise and minimizes the chances of equipment damage. This reduction in ground potential rise also reduces the cost when purchasing TVSS technology to protect your equipment from impending lightning strikes and other electrical faults.

When a tower is protected by a 25-ohm grounding electrode system, an 18,000-amp strike, which is small for a lightning strike, will result in a

450,000-volt potential. This requires a transient voltage surge suppression (TVSS) capable of handling a 450,000-volt potential. In comparison, with a 5-ohm grounding system, the voltage potential for the same lightning strike is reduced to 90,000 volts, the tower and equipment can be protected with less-expensive TVSS for a more manageable and cost-effective result.

To obtain the appropriate performance from your grounding electrode system, you have to have information about several aspects. You need soil

resistivity measurements that indicate the conditions along the surface and at multiple depths. A multilayered soil model can be produced that provides guidance on how the grounding system should be installed to obtain desired results using, for example, more rods, deeper rods, and radials. You need to know the equipment requirements that dictate the required resistance-to-earth target. You need to know the dimensions of the plot of land available for your grounding system. And if a tower and a communications

facility already are in place, you need a test of the existing grounding system to determine its performance.

Once the data is gathered, you can design the grounding system. The formula for IEEE for a single rod is:

$$R = \frac{\rho}{2\pi L} \left( \ln \frac{4L}{a} - 1 \right)$$

Where R is resistance, (lowercase Greek letter rho) is resistivity, L is the length of the rod and a is the radius of the rod.

To achieve a practical design, it is best to use a computer program created for the complex math in a multilayer soil model as opposed using the IEEE formula that assumes uniform soil. There are engineering

firms that can provide this service. It is usually cost-effective to solicit the services of one of these firms and have the most economically feasible grounding electrode system designed.

In the long run, a proper design puts the right amount of copper in the ground in the right configuration for the performance required. A full site-protection system takes into account the lightning protection, electrical protection TVSS on all incoming utilities and, as a foundation, the grounding electrode system. In a new site, it is easier and more cost-effective to do things right the first time as opposed to coming back and redoing them later.

In addition, on existing sites, it becomes even more challenging

because once a grounding system is installed, it is buried and in many cases no longer testable. To take partial readings and back-calculate what should be installed is, in many cases, the best that you can do. Creating a supplemental grounding electrode system and connecting it to an existing system guarantees that the combined grounding electrode system will be minimally as good as the design for the supplemental system and will be improved by the performance of the installed system, whatever remains of it that hasn't corroded away.

Roy Whitten is senior applications engineer and education specialist at Lyncole Grounding Solutions. His email address is [rwhitten@lyncole.com](mailto:rwhitten@lyncole.com).

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



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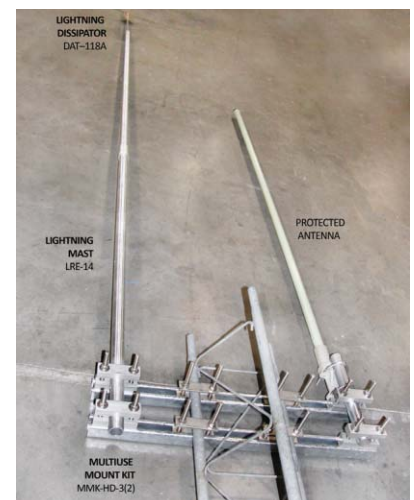
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### VARISTOR-BASED LIGHTNING ARRESTERS

The VAL-MS-T1/T2 lightning arresters from **Phoenix Contact** offer a higher

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



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protection while being extraordinarily portable. The series includes models from 14 feet to 38 feet high. The units can be set up by two men in less than an hour. The kits provide protection for communication systems and portable satellite systems. They provide options for lightning protection in mission-critical situations where transportation, setup and redeployment are challenging, yet the protection of assets is paramount.

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



**GROUNDING SYSTEMS**

Alltec offers lightning protection, surge suppression and grounding products to ensure that vital facilities remain functional in severe conditions. The grounding products are designed to protect telecommunication and broadcasting facilities and activities that are vulnerable to electrical noise, lightning-induced surges and transients caused by switching components.

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



**LIGHTNING ARRESTORS**

The QWS600 SurgeGuard series of quarterwave stub lightning arrestors is available from NexTek. The arrestors come with Type N connectors in male-to-female or female-to-female

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



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