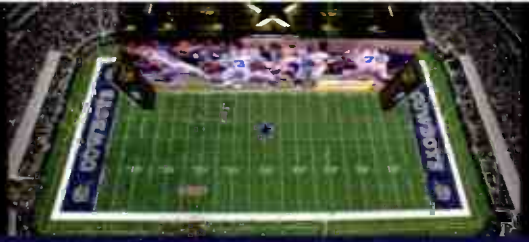
Backhaul
Spectrum
Sunsets



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Infrastructure, regulatory and financial information for the antenna-siting community

ABOVE GROUND LEVEL

agl

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May 2010

Lighting Systems & Technology

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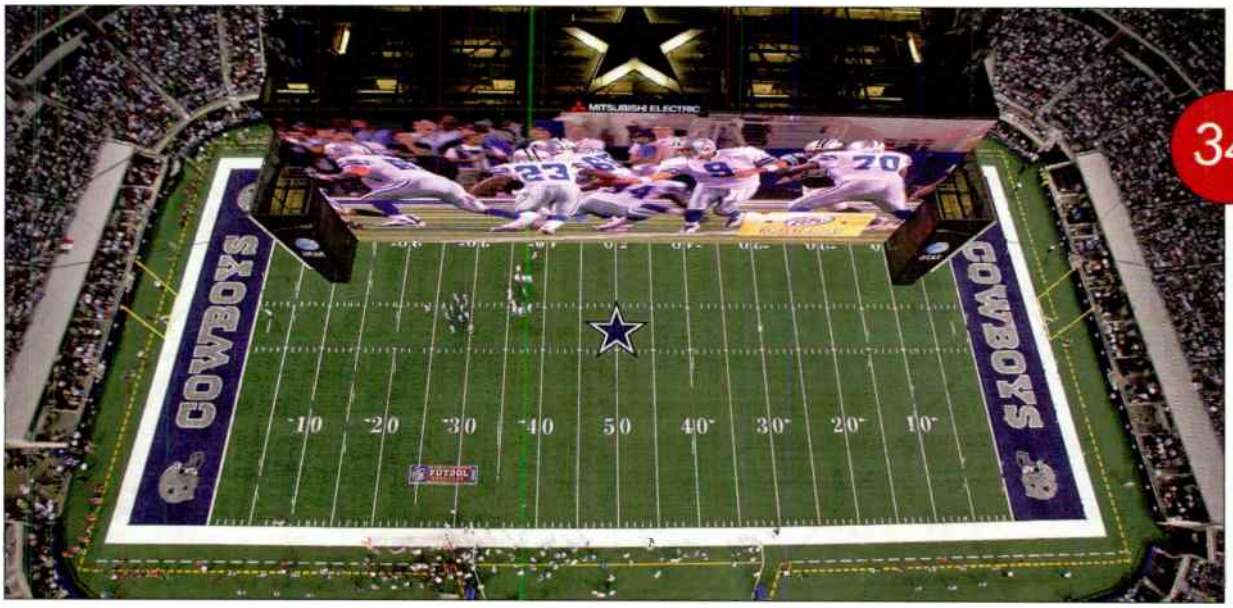

on the cover

Pictured on this month's cover is an aviation obstruction lighting system from Flash Technology. This dual-LED lighting solution features a single layer of LEDs supplying both red and white light, enhanced data monitoring capabilities, and ground-based power converter and controller.

For more information on lighting systems and monitoring, see our product showcase on page 44.

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Features

Departments

Full Signal

A documentary movie about the antenna-siting industry, *Full Signal*, may not tell the full story. It also may not be intended to tell the full story.

A first-time directorial effort by an experienced line producer for documentaries, Talal Jabari, the movie offers a look at wireless infrastructure that narration describes as "the world's largest biological experiment ever."

At two conferences *AGL* attended during the past month, attorneys involved in helping wireless telecommunications carriers and antenna site developers with public meetings and hearings associated with the process of obtaining local government permits for antenna collocation and new sites said that their clients should expect the movie to be cited by those who oppose the permits.

Screenings of the movie are limited, but you can watch the movie's trailer and teaser videos at the website *www.fullsignalmovie.com.*

A site acquisition attorney who viewed the movie said he saw no information presented except that which took the side against antenna placement. For a video that supports antenna placement, you'll need the California Wireless Association's film, *You Can't Have One Without the Other*. You can view it at *www.calwa.org*. agl

Don Bishop, Executive Editor
dbishop@agl-mag.com

Picture of the Month

David Saab, president of the Missouri/Kansas (MoKan) Wireless Association, stands in front of the exhibit area in the lobby of the Overland Park Convention Center in Overland Park, Kan. On April 12, the association conducted its inaugural trade show, attracting 200 attendees and 26 exhibitors. Saab said that all 11 of the event's available sponsorships, which ranged in price from $250 to $5,000, sold out. "If we are fortunate enough to have volunteers willing to help with a second trade show," Saab said, "we'll do it again next year."

Delaina Lenard, a member of the MoKan Wireless Association board of directors, was among the volunteers who spearheaded the inaugural trade show effort.

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Infrastructure, regulatory and financial information for the antenna-siting community

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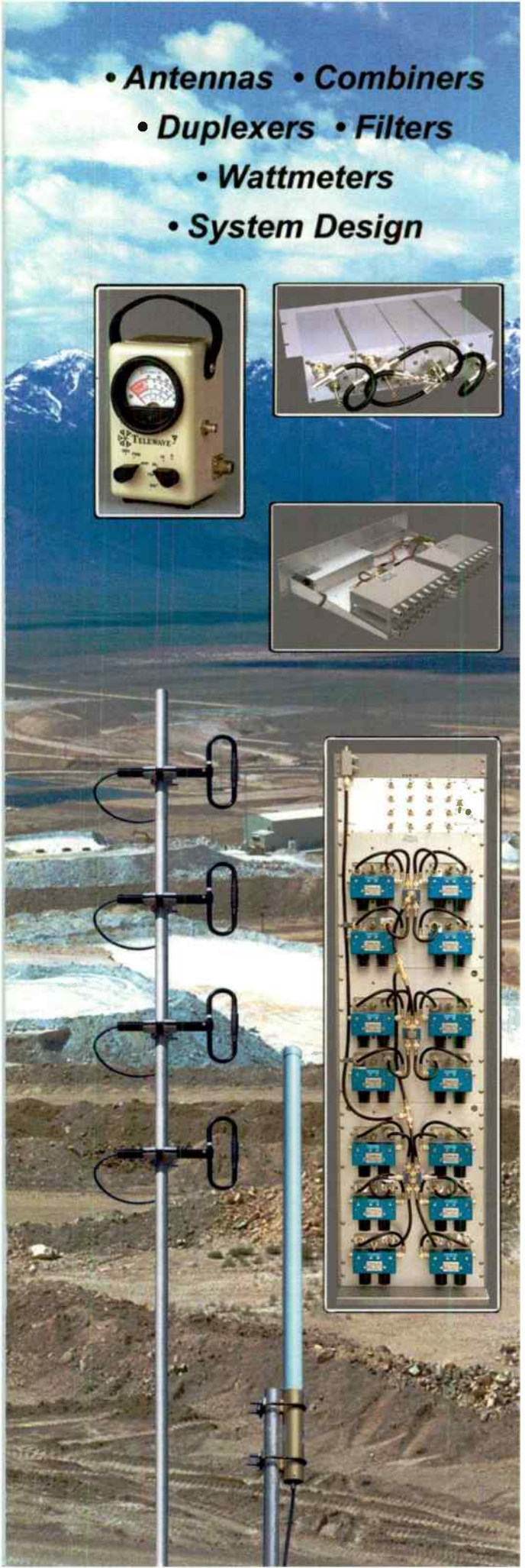

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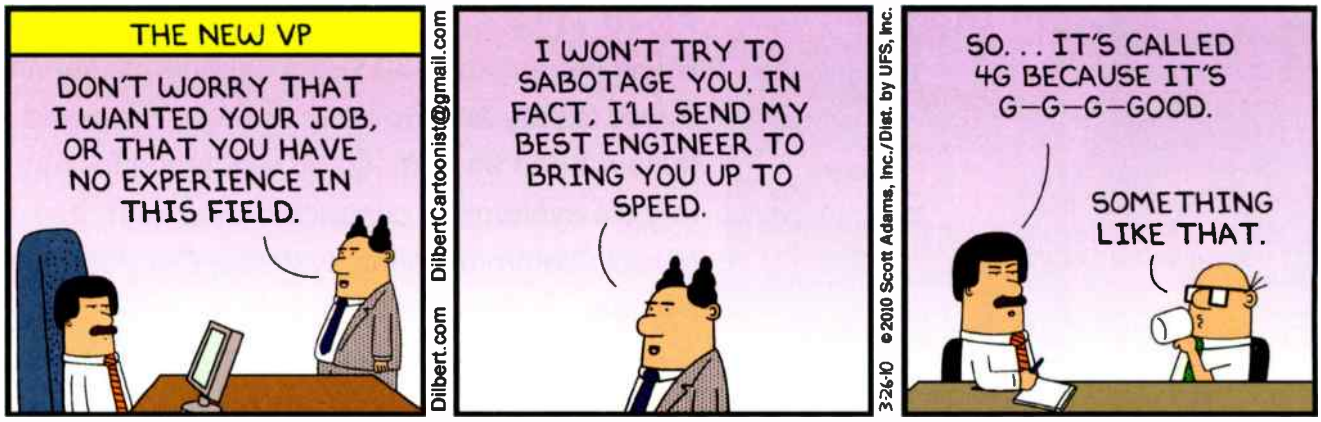

As much as I love going to all of the trade shows and as much as I enjoyed my time in purgatory — oh, I'm sorry, I mean Las Vegas — this year was a little upsetting. I turned 45 years old yesterday, and although my right knee hurts more than usual, I have to admit I have less and less of an idea of where this industry is going than I ever had. I'm not trying to shake your confidence in *AGL* however.

As I write this, I'm getting back from the Tower Technology Summit collocated with CTIA Wireless 2010. This year, the *AGL* staff and I had the pleasure of being responsible for the Summit programming material (that means we organized the speakers and decided or helped to decide what the sessions should be), and that means that I was up on the stage and had a microphone all to myself. It was a surprise to me to realize how much the industry has matured. So many years ago (I was about 17 years old in 1982), this industry seemed so foreign, different and unique. Few people had a basic understanding of what was happening or the physics behind how it happened. In 1983, the year I graduated from high school, I remember meeting so many people who would go on to do some amazing things in wireless: attorneys, managers, engineers, entrepreneurs and others.

Many fortunes have been made in wireless, and some have been lost, but there are more wins to come. My only doubt comes from not knowing exactly where some of the next wins will come from. Some things that seem like good bets may turn out not to be. For example, I'm surprised that a modern-day shared backhaul infrastructure provider could not be just cleaning up with the current demand for capacity. However, carrier concerns for quality and self-destination are overriding shorter-term financial incentives.

I've been preaching for some time that there will be a much greater number of smaller sites, and that providers of site construction and maintenance should do well in the future. That remains my prediction. I thought it would have happened by now. One characteristic of people who are early predictors of technology changes is that those who predict what will happen are often frustrated by the slow rate of change and do not stick to ideas long enough to achieve the financial reward. Recently, I ran into a gentleman who has acquired fiber rights-of-way along railroad tracks to build and provide dark fiber. Initially, my response of "seen that — someone else did it, so why bother" quickly gave way to my excitement over what this group was doing differently. We'll feature this person and his company in upcoming *AGL* issues. I hope to show how a unique idea fits into our industry.

Speaking of our industry, it is nice to see tower companies begin to provide more services again. We're seeing the "We're just a real estate company" mantra changing into an acknowledgement that "Yeah, and we do a bunch of other stuff too." In the late '90s, we saw gravity in action as a serious force and we've all learned a lot. Let's hope the noncore business opportunities will be profitable and longer-lived this time out.

We're looking into DAS networks much more thoroughly than previously. If you have any unique knowledge or particular love of DAS, please be in touch. We're lining up a series of articles and are looking for different perspectives, experiences and backgrounds to dig into the technology. agl

I'm surprised that a modern-day shared backhaul infrastructure provider could not be just cleaning up with the current demand for capacity

By Rich Biby, Publisher
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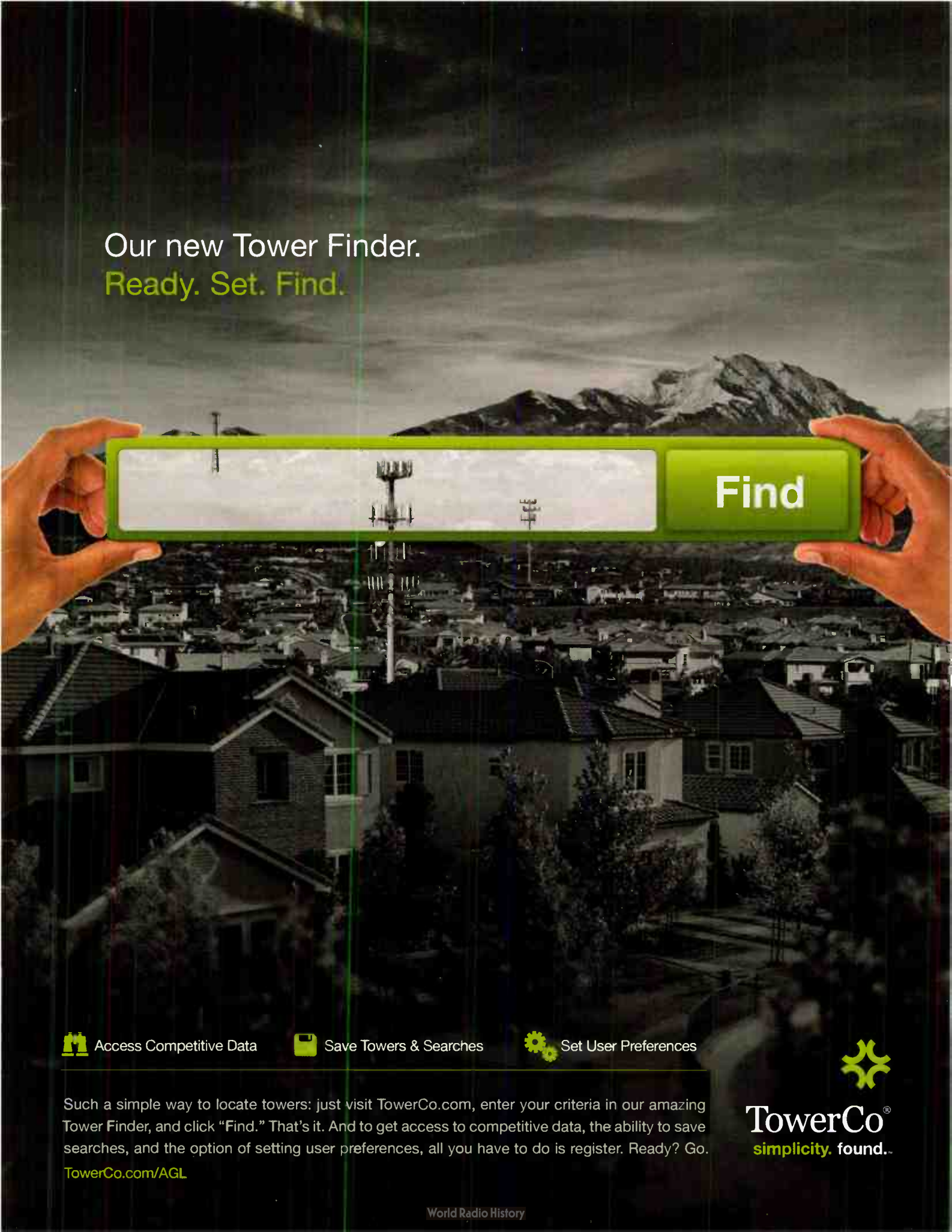

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As a supplement to January's 2010 Buyers Guide, here is a listing of engineering firms with additional information on the types of services they provide.

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Company Description
Civil – Environmental – Survey Group Inc. (CES) dba Novacom is a full-service firm providing turnkey services to the wireless industry across the southwestern United States. All services are provided in-house and under one roof. CES/Novacom is a licensed California general contractor as well as a certified small and minority business enterprise.

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Services
Structural
Company Description
Consulting structural engineers specializing in lattice towers, monopoles and rooftop installations for the wireless and broadcast industries. Expert services (to lawyers) on issues involving tower structures.

Protect Your Business Insurance During a Recession

By David Saul, AAI

As layoffs and foreclosures continue to be widespread, many properties have become vacant. The insurance risks and liabilities associated with owning vacant property can be extensive. To be sure that you, the owner of the vacant property, remain protected, it is important to know how a property insurance policy functions in the case of a vacancy. For added protection, one option is to purchase vacant-property insurance. In addition, there are preventive strategies for maintaining vacant properties to reduce risk and liability

Photography and photo illustration by Scott Dolash

Potential risks

There are a host of risks and concerns associated with owning vacant property. First of all, vacant buildings are an obvious target for theft, trespassing and vandalism. For example, due to the rising cost of copper, the last two years have shown an increase in the theft of copper pipes from vacant properties. In addition to any loss or property damage that may occur, owners need to keep in mind that they can be held liable for criminal activities or accidents that take place on the premises.

In addition, vacant properties are susceptible to undetected damage, such as fire, water damage, electrical explosions, wind or hail damage. Many incidents occur in vacant buildings due to small maintenance issues that go unattended, whereas someone in an occupied building would have recognized and handled the problem before it caused a larger loss.

In certain facilities, there may also be environmental hazards that the owner needs to consider. Diesel fuel and other pollutants should be removed or securely stored if they are present at vacant facilities. The property owner may be held liable for hazardous materials that contaminate groundwater or other nearby natural resources. Also, underground fuel tanks present serious challenges and thus should be frequently and carefully inspected by professionals.

Insuring vacant properties

Most insurance companies include a clause that the insured's insurance will expire if a building is left vacant for more than 30 or 60 days (depending on the policy). This leaves you, the property owner, financially vulnerable for all the risks previously noted. However, many insurance companies offer vacant-property insurance (also known as vacant-building insurance).

Because of the increased risks and liability associated with a vacant property, this type of insurance tends to cost much more, with prices ranging from one-and-a-half to five times the cost of a property insurance policy. It is important, though, to examine potential policies beyond their price, to ensure that the coverage is suitable to protect the property fully.

Other ways to mitigate risk

Beyond an insurance policy, there are some simple steps that owners of vacant property can take to limit their risk and liability.

- **Prevent vandalism:** Notify local authorities of vacated properties so they can watch for criminal behavior. Maintain an occupied appearance to

the property — mow the lawn, have mail forwarded or picked up regularly, and install light timers, a security system or both.

- **Limit liability:** Make sure the property is free from significant hazards (broken railings or steps, broken windows, etc) that could cause injuries to anyone on the property, including police officers, maintenance workers, firefighters and trespassers.
- **Avoid damage:** Performing regular maintenance on the property can decrease the odds of many damages occurring. Make sure the heating system and chimney are cleaned and inspected regularly. Have the plumbing system winterized to prevent pipes from freezing. Periodically inspect the roof, insulation, attic, basement, gutters and other areas of the property for any necessary repairs, mold, damage or other problems. Consider installing smoke detectors tied to a centrally monitored fire alarm system so the fire department will be notified in case of an alarm. Remove all excess material and combustibles from in and around the building.

Also, credit and funding problems can cause project cessation for contractors. Dried-up funding on a project can lead to costly delays, painful layoffs, shattered morale and other negative side effects.

Project managers, developers and general contractors must keep an open dialogue with their insurance agents to avoid costly contractual violations with respect to the cessation of work.

Many insurance policies are designed with warranties that provide a maximum coverage period for cessation. Violation could void the contract and leave the project exposed to non-coverage for losses such as theft, vandalism, fire and windstorm.

Many insurance companies issuing these policies will negotiate an extended cessation period in return for assurance that the property will be maintained and protected during downtime. The insurance company may require the submission of a formal maintenance plan and solicit periodic updates to ensure compliance.

If you are involved in a project that is in danger of experiencing a slow-down or cessation period, even if that period is brief; or if you have vacant property, give your insurance agent a call. Your agent can help determine what steps you must take to retain valuable insurance coverage. agl

David Saul is executive vice president of Atlantic Risk Management, Columbia, Md., and is an accredited risk advisor in insurance (AAI). His email address is: *dsaul@atlanticrisk.com*.

Multiple Sunsets at 18 GHz Reduce Backhaul Spectrum

Because of staggered regulatory sunset dates, a portion of the 18 GHz band is no longer available for fixed service microwave service often used for backhaul. Check to see whether your backhaul is affected.

By Jerry Armes, P.E.

Most people can relate to a beautiful sunset, and attractive tower photos are often taken in this light. But for a small number of microwave system operators in the 18 GHz band, other sunsets are rapidly approaching, and these are not quite so pretty.

Three subbands exist in and around 18 GHz where point-to-point microwave systems have sunset dates.

The crux of the issue is spelled out rather succinctly in the FCC Rules:

"Until June 8, 2010, stations operating in the band 18.58–18.8 GHz that were licensed or had applications pending before the Commission as of June 8, 2000, may continue those operations on a shared co-primary basis with other services under parts 21, 25, 74, and 78 of this chapter.

"Until June 8, 2010, stations operating in the band 18.8–19.3 GHz that were licensed or had applications pending before the Commission as of Sept. 18, 1998, may continue those operations on a shared co-primary basis with other services under parts 21, 25, 74, and 78 of this chapter.

"After November 19, 2012, stations operating in the band 18.3–18.58 GHz are not entitled to protection from fixed-satellite service operations and must not cause unacceptable interference to fixed-satellite service station operations." [47CFR101.47(r)]

The effect of these rules varies. For those who applied for or received a license in the 18-GHz band after Nov. 12, 2002, there should not be a conflict. For older facilities, the potential for conflict exists.

Micronet Communications has set up a Web page for access at no charge for anyone in the community to check for such conflicts, either by a call sign or an FCC Registration Number (FRN). The link at *www.micronetcom.com/Show18/index.aspx* will quickly identify, from the FCC database, which 18-GHz microwave facilities fall within those regions

where interference protections will be surrendered.

What if my license is subject to a sunset date? You have a number of options. One is to move to another section of the 18-GHz band where satellite facilities are not present. Another is to switch bands. If you find yourself in this situation, contact your frequency coordinator as quickly as possible to explore the alternatives available to you.

Who pays for the transition? In the event a satellite services company formally requests that a current microwave user move before the deadline dates indicated on the Micronet website, transition costs will be paid by the satellite services company. This holds true until the sunset date for that band. Otherwise, the cost will be borne by the microwave licensee. After the sunset dates, the satellite services operators are no longer obligated.

Why is this happening? Spectrum management is a process that attempts to apply the frequency spectrum in a way that would bring about the most public benefit. For the commercial markets in the United States, this process falls to the FCC.

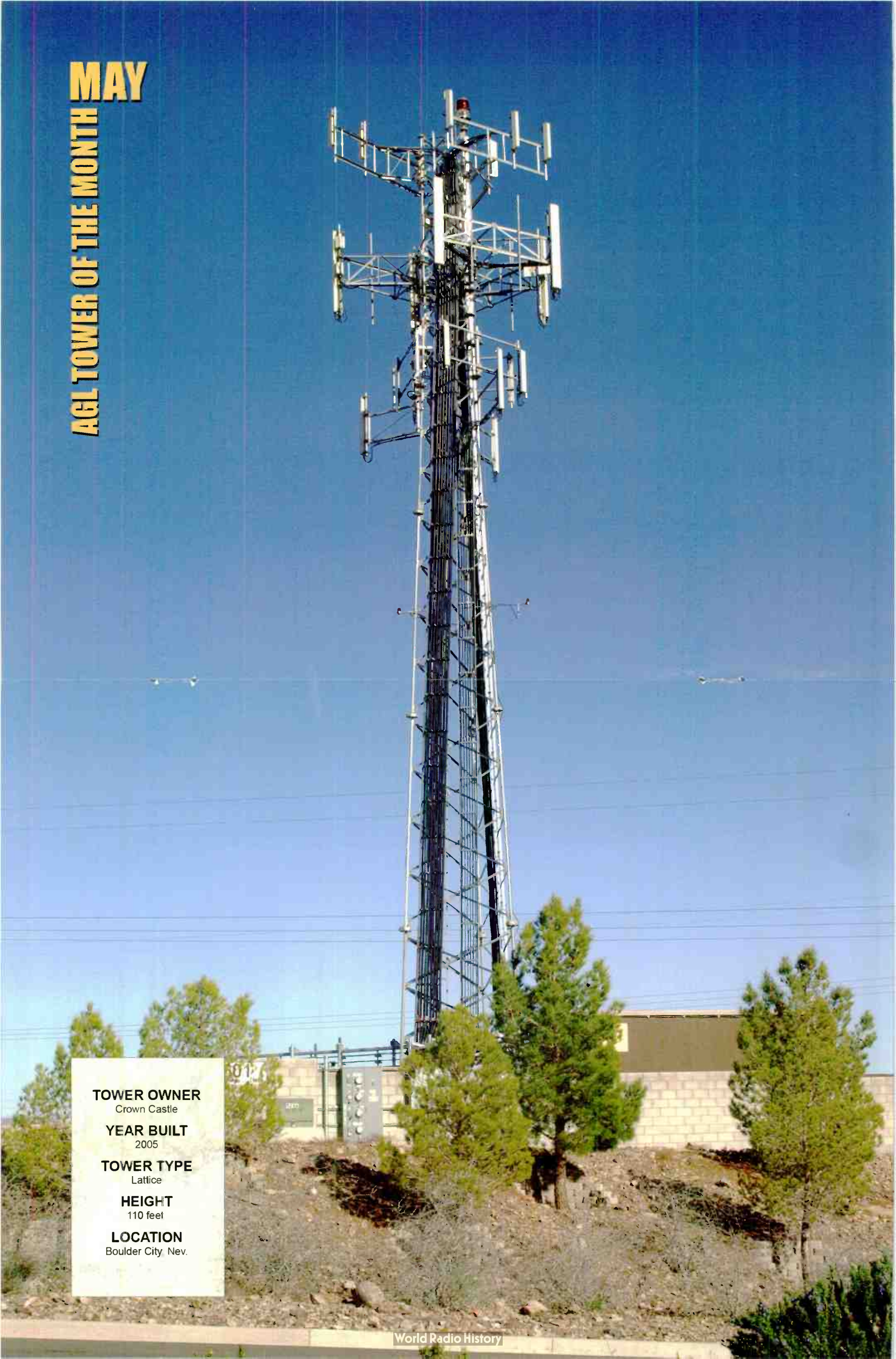
Starting in the 1980s, satellite operators began offering direct-to-the-home video services, originally in the C and Ku bands. As this market grew, it became apparent that new spectrum and new technologies should be considered as vehicles for providing these popular services. In 1992, the World Administrative Radio Conference (WARC) allocated spectrum for Ka-band satellite use in delivering broadcast satellite services (BSSs).

The term Ka band generally applies to downlink frequencies in the 17.7–20.2 GHz band and uplink frequencies at 27.5–30.0 GHz.

In 2000, with the *18 GHz Report and Order*, the FCC accepted in part the recommendations of the WARC and implemented the domestic allocations for BSS and other applications of Ka-band satellite technology, while also making sure that the fixed service

AGL TOWER OF THE MONTH

MAY



TOWER OWNER
Crown Castle

YEAR BUILT
2005

TOWER TYPE
Lattice

HEIGHT
110 feet

LOCATION
Boulder City, Nev.

Cable Networks Set to Break the Backhaul Bottleneck

Cable's estimated $100 million share of the total cellular backhaul market is expected to grow exponentially as traditional providers of TV, digital telephone and high-speed Internet expand backhaul services.

By J. Sharpe Smith

Cable companies have long set their sights beyond merely bringing programming to the televisions of America. Cable transports massive amounts of voice and data for commercial as well as residential customers.

In the last decade, cable operators grew their infrastructures to become ubiquitous in metro areas, sinking $130 billion into upgrading the industry's hybrid fiber/coax plant and offering deeper and deeper fiber penetration, according to Alan Breznick, senior analyst, Heavy Reading.

"Typically, cable companies have deployed multicount fiber deep into the system," said John Dahlquist, vice president of marketing, Aurora Networks, a company providing optical network transport solutions to cable operators.

The Commercial Services Gateway (CSG440) by Arris provides Fast (nominal 100 Mbps) and Gigabit (nominal 1 Gbps) Ethernet demarcation gateways with T1/E1 circuit emulation services connectivity over Ethernet/IP Fiber networks.

"Each fiber is like a multi-lane highway. When you have a piece of fiber in place you have a very broad pipe, so capacity [for wireless communications] in the cable industry is not an issue."

Cable's embedded fiber-optic systems are just the answer to break up the backhaul bottlenecks caused by the tsunami of 3G and 4G data. These networks today are gearing up to meet backhaul needs as they make the transition from voice-centric circuit-switched traffic to packet-switch data.

"When cable operators saw the explosion going on in mobile services, it woke up everyone in the industry. They can provide those backhaul services, too," Dahlquist said. "When a third of the wireless operating costs go to backhaul, it is only natural for the cellular carriers to look to the cable operators for lower rates."

The cable backhaul evolution

A big plus of the cable infrastructure is its ability to leverage the parts of the network that are in close proximity to a vast number of cell towers. As cell site development moved beyond the major thoroughfares into business districts and residential areas, cable operators were simultaneously upgrading their fiber networks in many of the same locales.

However, in the past, cable operators could not justify the aggressive marketing and service support that would be required to attack a niche market such as cellular backhaul, according to Shridhar Kulkarni, Aurora Networks product manager for access network solutions. Today's emerging need for high-speed backhaul is now playing to cable's strength — embedded, fiber-based, gigabit Ethernet-carrying networks. New network access products are marrying cellular to cable broadband networks.

"Previously, backhaul capacity expansion requirements were tied to a need for T1 or E1 lines," Kulkarni said. "Cable's presumed ability to leverage a ubiquitous fiber presence to deliver backhaul services cost effectively has been encumbered by the absence of cable-optimized transport platforms that could meet the rigorous performance requirements set by mobile operators."

Cable operators are moving forward with agreements to provide fiber to the facilities so the carriers can get the bandwidth they need, according to Chirag Trivedi, vice president of professional services at Arris Group, a company that specializes in the design and engineering of broadband networks.

(point-to-point microwave) market also had room to grow. See "Redesignation of the 17.7–19.7 GHz Frequency Band, Blanket Licensing of Satellite Earth Stations in the 17.7–20.2 and 27.5–30.0 GHz Frequency Bands, and the Allocation of Additional Spectrum in the 17.3–17.8 GHz and 24.75–25.25 GHz Frequency Bands for Broadcast Satellite-Service Use, *Report and Order*, 15 FCC Rcd 13430 (2000)."

Dedicated microwave band

Specifically, the 17.7–18.3 GHz band was allocated to the fixed service on a primary basis, meaning that other services in that band could not interfere with the microwave users. Effectively, this was a dedicated microwave band. Similarly, the band from 18.58–18.8 GHz was allocated to the geostationary fixed satellite systems service on a primary basis.

The 18.3–18.58 GHz band was allocated on a co-primary basis between the fixed service and the geostationary fixed satellite service, setting the stage for an environment where the microwave and satellite communities could coexist using frequency coordination to make sure that new facilities of neither service degraded the other. Considering that the Ka-band satellite operators were dealing with a new and largely untried technology at that time, this made a lot of sense from the perspective of the FCC.

This allowed the microwave community to use the band, considering that some time would pass before the Ka-band satellite community would have substantial numbers of terminals in place.

Yet another group of mobile satellite systems (MSSs), those that operate in inclined (nongeostationary) orbits, also needed spectrum allocations. The 19.3–19.7 GHz band was allocated on a co-primary basis between these inclined-orbit mobile satellite systems and the fixed service, using comparable logic.

The Commission decided to permit terrestrial fixed stations already operating in spectrum designated for exclusive satellite use to continue to operate on a co-primary basis for 10 years. This was subject to the overriding right of satellite providers to require terrestrial fixed stations to relocate. During this 10-year period, existing terrestrial fixed stations could be compelled to relocate in accordance with the procedures specified in the *Report and Order*.

If a terrestrial fixed station were required to relocate within 10 years of the effective date of the *Report and Order*, a satellite service provider would be required to pay for the relocation to comparable facilities. At the end of the 10-year period, existing terrestrial fixed stations would be allowed to continue to operate on a noninterference basis. In the case of 19.26–19.30 GHz, the co-primary status of existing terrestrial fixed stations, as well as their entitlement to relocation costs by MSS service providers, was made permanent.

In this same *Report and Order*, the FCC acknowledged that the number of very small aperture terminals at Ka-band would number in the thousands, and it authorized blanket licensing in those bands not subject to sharing. The agency also indicated a willingness to accept applications for blanket licensing in shared bands.

Dedicated satellite band

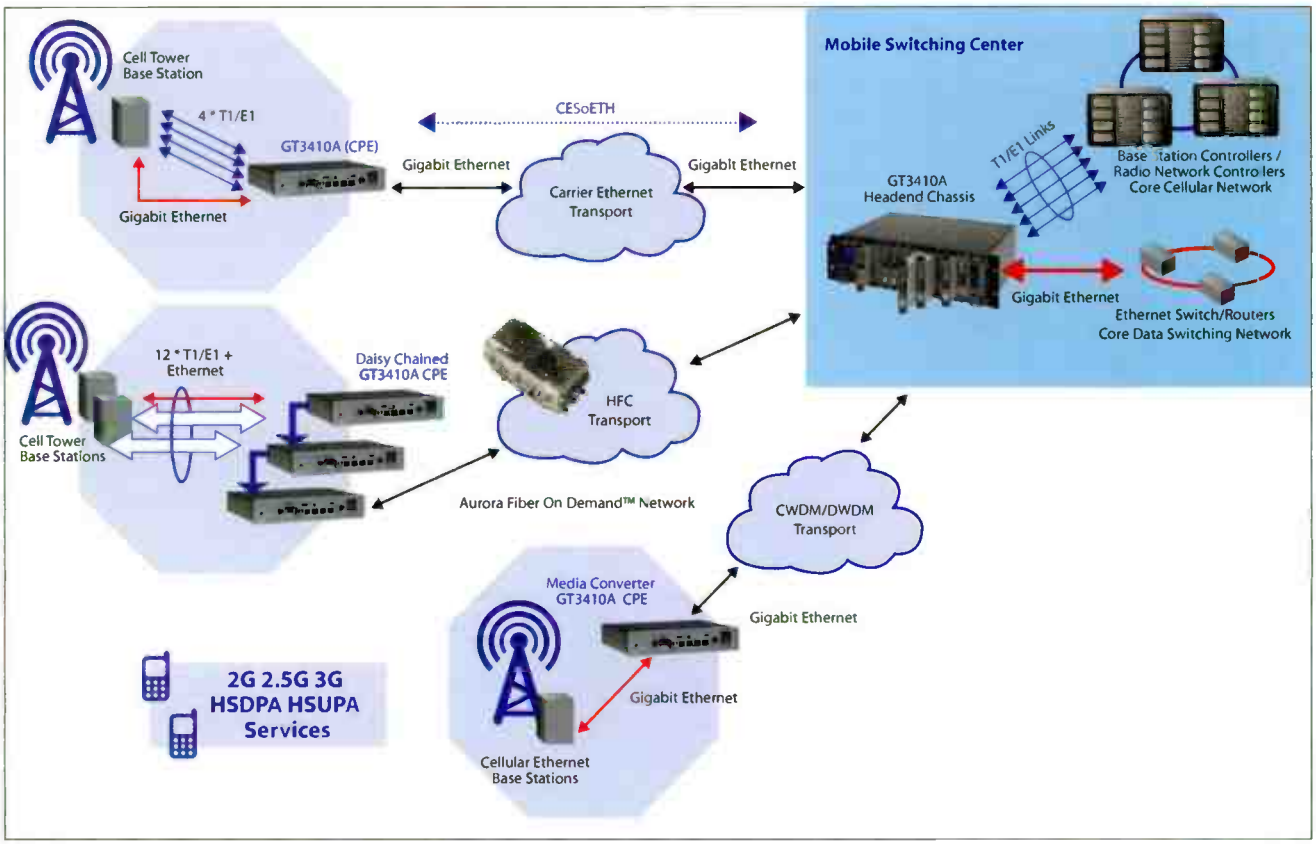
In 2002, partly in response to a petition for reconsideration by Hughes Electronics, the FCC made the frequency allocation from 18.3–18.58 GHz a dedicated band for satellite communications in order to allow effective blanket licensing. But as before, the terrestrial community was given a 10-year window before transitioning out of the band. See "Second Order on Reconsideration, In the Matter of Redesignation of the 17.7–19.7 GHz Frequency Band, Blanket Licensing of Satellite Earth Stations in the 17.7–20.2 GHz and 27.5–30.0 GHz Frequency Bands, and the Allocation of Additional Spectrum in the 17.3–17.8 GHz and 24.75–25.25 GHz Frequency Bands for Broadcast Satellite-Service Use, FCC 02-317, IB Docket No. 98-172, RM-9005, RM-9118, Released November 26, 2002."

The end result of this process is a set of staggered sunset dates, each reflecting a 10-year window starting from the last modification of the frequency allocation.

Summary

At the end of the day, a small portion of the 18-GHz band is no longer available to the fixed service. But there is a positive effect. Most people like a good movie, and when that movie is being delivered to the home via the DirecTV service, for example, in the 18.3–18.8 GHz band, the movie is unlikely to be affected by that 18-GHz microwave path that happens to cross directly above your house. See "Comments In Support of Petitions for Reconsideration, In the matter of Unlicensed Operation in the TV Broadcast Bands, ET Docket No. 04-186, Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz band, ET Docket No. 02-380, filed by DIRECTV, Filed 4January2010 with the FCC." agl

Jerry Armes, P.E., is a business development consulting engineer with Micronet. His email address is *jarmes@micronetcom.com*.



Aurora Networks' GT3410A platform supports a variety of cell tower backhaul configurations. When used with a variety of customer premise equipment devices, the GT3410A platform can transport cell tower communications between a tower and a mobile switching station via Gigabit Ethernet transport, a cable operator's hybrid fiber coaxial plant, and coarse wavelength division multiplexing and dense wavelength division multiplexing Ethernet conduits.

"MSOs (multisystem cable operators) are putting a very heavy emphasis on building out to cell sites. In their commercial services divisions, that is the low-hanging fruit. That is priority number one in a lot of companies," Trivedi said. "The big play for cable operators is to provide service to all the carriers that are collocated at the site, not just a single one."

The initial hurdle for each cable operator will be obtaining access and

Chirag Trivedi, vice president of professional services at Arris Group, which specializes in designing and engineering broadband networks: 'MSOs (multisystem cable operators) are putting a very heavy emphasis on building out to cell sites.'

John Dahlquist, vice president of marketing, Aurora Networks, a company providing optical network transport solutions to cable operators: 'Typically, cable companies have deployed multicount fiber deep into the system. Each fiber is like a multilane highway. When you have a piece of fiber in place you have a very broad pipe, so capacity [for wireless communications] in the cable industry is not an issue.'

right of entry to each wireless facility, he added.

Providing backhaul will be a new venture for many cable operators, but Cox Business, the commercial services division of Cox Communications, has been providing the service for more than a decade, albeit on a limited basis, usually to sites where there were chronic connectivity problems and more reliable transport was needed. But that involvement is already increasing. Cox currently has fiber facilities built out to more than 2,000 towers in its footprint. Cox Communications also is known as Cox Cable, and it is a part of Cox Enterprises, a privately held company that owns cable TV, digital telephone and high-speed Internet systems; radio and TV stations; newspapers; direct mail advertising services; and websites.

"With cellular operators building out to the same areas as our networks, we are in a good position to leverage those existing assets to extend our fiber from the nearest node to backhaul the cell site," said Jay Clark, senior manager, carrier product and sales operations, Cox Business.

Leasing fiber

If a cellular carrier leases fiber from a cable operator, it can avoid the costs of laying its own fiber to reach its sites. It will not only be cost-effective for cellular carriers, however; it will also have a tremendous upside for the cable operator, according to Clark.

The upside for the MSO of backhaul is healthy growth. In 2010, Cox Business' wholesale services, which include backhaul, will account for $100 million in revenues. In a couple of years, Cox expects backhaul to dominate the revenue of the wholesale division.

"We view backhaul as one of the growth pillars of our plans for the next couple of years," said Clark. "Overall, we think other cable operators are just as interested as we are in providing backhaul because they have the same synergies that we do. The industry is excited about it."

Not only do the cable network nodes have to be in close proximity to cell sites, but also specialized access technology is necessary for the cable network to become a conduit for the wireless signals. The challenge that optical transport equipment providers face is easing cellular carriers from voice-centric time division multiplex protocol traffic to packet data.

At a cable technology exhibition last October, Aurora Networks debuted new components and technology for its fiber-based platform for backhauling signals from cell sites. Aurora Networks' GT3410A T1/E1 access module provides Ethernet-based circuit emulation that enables the delivery of time-division multiplex (TDM) traffic over a fiber-optic network. When installed in base station controllers or at the cable headend, multiple GT3410A modules provide support for as many as 80 T1 ports.

"There is a lot of fiber already in place, but so far cable operators have not had cable-centric solutions to go after the cellular backhaul marketplace," Kulkarni said.

In order to develop a way for the cable system to carry the cellular signals, Aurora Networks combined Ethernet-over-cable transport technology with standards set by the Metro Ethernet Form (MEF) for the wireless industry. The T1/E1 circuit emulation had to meet MEF-8 and MEF-18 specifications, which set tolerance levels for jitter, wander, frame loss and packet delay metrics.

Backhaul opportunity

"It's a matter of the cable market recognizing the real opportunity of cell tower backhaul but also having the hardware and software developed to support it," Dahlquist said. Aurora Networks has plans to conduct cellular backhaul product trials with several mid-sized operators this year.

Juniper Networks, which has had products in the backhaul space for several years, released its first cell site router, the BX7000 multi-access gateway, in April 2008. It aggregates TDM, asynchronous transfer mode (ATM) and IP/Ethernet traffic at the cell site. Circuit traffic is then converted into circuit emulation pseudowire for transport over a packet-switch network.

"We have customers in the cable space who have been in trials with us testing our product," said Seshadri Sathyanarayan, product marketing manager, Juniper Networks. "There is a lot of interest among the major cable operators to act as the backhaul service provider to cellular carriers. The deployments began in 2009 and will continue on in the coming years."

The Commercial Services Gateway (CSG440) by Arris provides Fast (nominal 100 Mbps) and Gigabit (nominal 1 Gbps) Ethernet demarcation gateways with T1/E1 circuit emulation services connectivity over Ethernet/IP Fiber networks. Arris' portfolio of optical transport equipment migrates the cellular carriers from TDM to Metro Ethernet to passive optical network (PON) systems allowing the carrier to take advantage of the speed and efficiency of the fiber network.

"TDM is going away. Everything is becoming Ethernet-based, be it gigabit PON or Ethernet PON or Metro Optical Ethernet. Some MSOs are making cellular a separate commercial network and others are mixing it in with other bandwidth networks," said Trivedi.

Conclusion

In the future, according to Trivedi, cell sites are just going to become more and more bandwidth hungry. As cellular networks become saturated with data apps, MSOs will need to upgrade these facilities quickly with greater bandwidth, he added. Additionally, it will be critical for MSOs to monitor data traffic to ensure service is not denied on any cell site.

"As these cell towers go from 5 megabits to 50 megabits and then to 500 megabits, the numbers will boggle my mind," said Trivedi. "Will the backbone handle that traffic when video streaming applications become prevalent on cell phones?"

One thing is for certain. A growing number of cable operators will join wholesale fiber-optic services, such as Level 3 Communications, Qwest Communications and Verizon Partner Solutions, in transporting the growing magnitude of wireless data. And cable's estimated $100 million share of the total cellular backhaul market will grow exponentially, according to Light Reading.

As cellular networks become saturated with data apps, MSOs will need to upgrade these facilities quickly with greater bandwidth

During cable giant Comcast's third-quarter earnings call, Steve Burke, the company's chief operating officer, sized up the opportunity this way: "As we expand our network to these businesses, we are also looking at cellular tower backhaul as another nice complementary commercial business that can further leverage our network, and we size this opportunity at roughly $1 billion a year for Comcast at a certain point in the future." agl

Ensuring FCC Compliance: The Value of a Well-run NOC

The value of improved air safety aside, the biggest single financial effect of a well-run national operations center (NOC) in the telecommunications industry is the ability to receive a waiver from having to do quarterly lighting inspections (QLI waiver).

By Brian Beck, Robert M. Smith and Mitch Bateman

With more than 275 million wireless phone subscribers in the United States who demand more services and features each day, wireless carriers grow their networks to keep customers satisfied. More than 245,000 telecommunications towers are devoted to the task of keeping wireless service available 24 hours a day. There were only 96,000 telecommunications towers a mere 10 years ago.

The Communications Act of 1934 gave the Federal Communications Commission authority to require the painting or illumination of antenna towers when it determines that such towers may constitute a hazard to air navigation. 47 U.S.C. § 303(q).

Over the years, the FCC reorganized rules applicable to radio station licensees and modified the rules to allow visual observations, the observation of an automatic indicator or the use of an automatic alarm system designed to detect antenna lighting system failures. Licensees were required to make observations of lights at least once every 24 hours either visually or by automatic indicator, and inspect such automatic indicators and alarm systems at least once every three months to confirm that automatic control devices and alarm systems were functioning properly.

Initially, tower watchers were employed to check the operation of obstruction lighting. As the number of towers grew, the use of tower watchers became impractical. The complexity and challenge of complying with the FCC requirements becomes increasingly apparent when the tower owner or operator has multiple sites.

A tower watcher might serve as a temporary solution, but it makes sense that the telecommunications tower, wind power generation and electric utility industries use new technology for monitoring to run a compliant, cost-effective operation.

In the 1960s, new technology emerged to take the place of the tower watchers. One predominant early monitoring system used a fuse-based meter design. This fuse-based meter design permitted only one-way contact between the monitoring system and the tower-lighting equipment, which usually was checked once every 24 hours. This system also suffered from the fact that it was possible for a bulb to be extinguished without the fuse being tripped, and thus without a NOTAM-worthy alarm being generated. (NOTAM stands for Notice to Airmen, a notice sent by the FAA to alert pilots to unmarked aviation hazards.)

Subsequent advances in technology offered dry-contact systems. Although this approach offered improvement over the fused-based approach, it still contained deficiencies that might prevent a tower owner from realizing that a light was no longer working.

The latest monitoring technology uses

Flash Technology's national operations center

advanced machine-to-machine (M2M) solutions that report real-time alarms and 24-hour status updates to a national or network operations center (NOC). This technology allows tower owners and NOCs to see more than an on/off indicator. This solution gives system data and diagnostic information about the lighting systems, and such information helps tower owners focus on their core business without the worries of lighting compliance. Reporting alarms within minutes of an outage is impossible with tower watchers and without an around-the-clock operations center. In the telecommunications industry, the NOC's core goals are to ensure air safety and lighting compliance and to save their customers money. A NOC's attendants are specifically trained on rules and regulations to ensure compliance.

Acting on data

It is easy to get lost in all the rules, guidelines and regulations, so let's define the FAA/FCC documents involved in marking and lighting obstructions.

The *Code of Federal Regulations* (CFR) is the administrative law, general and permanent rules and regulations published in the Federal Register by the executive departments and agencies of the federal government of the United States. Related matters are grouped together. For example, Title 47 Telecommunications Part 17 deals with the construction, marking and lighting of antenna structures and Title 14 Aeronautics and Space Part 77 deals with objects affecting navigable airspace.

The *Advisory Circular* (AC) system became effective in 1962. It provides a single, uniform, agency-wide system that the FAA uses to deliver advisory material to FAA customers, industry, the aviation community and the public. The AC system provides guidance such as methods, procedures and practices acceptable to the administrator for complying with regulations and grant requirements. The ACs that affect marking and lighting obstructions are:

- **AC 70/7460-1K:** FAA standards for marking and lighting structures

for aviation safety

- **AC 150/5345-43F:** Specification for obstruction lighting equipment
- **AC 150/5345-53C:** Airport Lighting Certification Program
- **AC 150/5345-53C Appendix 3 Addendum:** Certified equipment and manufacturers list

What to report and when

The FCC's Code of Federal Regulations (CFR) Title 47 Part 17.48 covers what to report and when. It can be summarized as follows: The extinguishment or improper functioning of any top steady burning light or any flashing light, regardless of its position, not corrected within 30 minutes shall be reported immediately to the FAA for a Notice to Airmen (NOTAM) to be issued. This means that if any top or mid-tier flashing lights are out, missing flashes, the wrong intensity or give incorrect flashes per minute, the issue must be reported to the FAA.

The FCC is the enforcer of the CFR. If a violation is found, the FCC will issue a Notice of Violation (NOV). An NOV doesn't mean the tower owner is guilty; it means the FCC has serious concerns about the stated issue. The affected tower owner is responsible for explaining the violation in a timely manner. Subsequently, the FCC may issue a Notice of Apparent Liability (NAL) or a Forfeiture Order, which are fines that could be thousands of dollars. The FCC also has the capability to shut down sites, cancel operating licenses and prosecute if regulations aren't followed.

As of Aug. 1, 1991, those fines start at $8,000 for private radio, $20,000 for broadcasters and $80,000 for common carriers. Depending on the severity and history of occurrences (even for a recent licensee), these amounts can rise dramatically.

In the United States, during the past 10 years, about 150,000 additional telecommunications towers have been built, as have about 23,000 wind turbines. As the telecommunications and wind power generation industries grow to meet the public need, following FCC regulations is even more imperative to maintain air safety. When incidents occur, the average settlement cost can be millions of dollars. A company's risk can be greatly reduced by using a well-run NOC (see table of FCC regulations).

FCC regulations and how an effective NOC keeps you compliant

CFR Title 47	NOC Feature?	How a NOC helps to maintain compliance
17.21 Paint and lighting, when required	YES ✓	NOC can verify FCC data against actual lighting installed and notify customer of any discrepancies.
17.47 Inspection of antenna structure lights and control equipment	YES ✓	NOC will automatically check status at least every 24 hours and create reminders about inspection due dates.
17.48 Notification of extinguishment or improper functioning of lights	YES ✓	NOC will report all light outages/malfunctions to FAA within minutes of a NOTAM-worthy event.
17.49 Recording of antenna structure light inspections in the owner record	YES ✓	NOC keeps record of all events, alarms, repairs and inspections.
17.51 Time when lights should be exhibited	YES ✓	NOC monitors that the correct lights are on and functioning at the correct time, 24/7/365.

Managing the repairs, monitoring, reporting, documentation and compliance for multiple sites can become overwhelming. When it does, using a NOC makes sense. Not only does the NOC help to maintain air safety, it also can save customers time and money. By using innovative M2M technology, a NOC watches over vital processes to ensure the performance is optimized. An effective NOC monitors, collects, analyzes and delivers critical information to key personnel, enabling them to make sound, data-driven decisions that improve profitability.

Let's take as an example the hypothetical Reliable Tower Company, which owns 8,000 towers. If Reliable attempts to comply with the FCC statute using only its internal resources, then in a given year, Reliable is likely to have to receive, process and act upon about 105,000 telephone calls from contractors and others; receive, process and manage about 375,000 electronic messages; and issue 80,000 service tickets. Imagine the investment required of Reliable in terms of people, equipment, space and training to accomplish that, to say nothing of acquiring the knowledge needed to do so.

For a portfolio of 8,000 towers, who keeps track of the nature, type and age of equipment at each site? Who knows when the standby generator was last serviced? Who keeps track of the service crew's activity logs?

If Reliable chooses instead to outsource these tasks to a well run NOC, the company can focus more attention and resources on meeting the growing customer need for more cellular services, thereby generating more revenue

A NOC is a solution from systems integration, equipment specification, design and communications to a Web-based platform and data analytics. Crucial data can be simultaneously routed to the NOC and the tower owner's team. Armed with this information, tower owners can reduce truck rolls, determine the type and age of equipment on a site, diagnose

failures and be more prepared with the correct parts. Most NOCs provide an online customer portal, which provides live status of assets, tickets and history available anywhere and at any time to improve processes and services.

The biggest single financial effect of a well-run NOC in the telecommunications industry is the ability to receive a waiver from having to do quarterly lighting inspections (QLI waiver).

In 2007, the FCC began granting the lighting inspection waiver for companies that used advanced data diagnostic monitoring systems with an experienced NOC. The FCC granted the waiver based on the fact that the robust monitoring capabilities, real-time alarm systems and trained NOC personnel are so reliable that they render quarterly inspections unnecessary. The issuance of the waiver was done in hopes that other tower owners would be encouraged to invest in state-of-the-art technologies so that they, too, would become capable of continuous, real-time monitoring of their lighting systems and control devices.

In 2009, the FCC granted an expedited waiver process that allowed tower owners using the Eagle platform offered by Flash Technology to submit minimal paperwork to be granted the waiver.

As the telecommunications and wind power generation industries grow to meet the public need, following FCC regulations is even more imperative to maintain air safety.

When a QLI waiver has been granted, the cost savings to the customer can be quite significant. Consider the hypothetical Reliable Tower Company. Without a waiver, its portfolio of 8,000 towers requires four on-site lighting inspections annually, for a total of 32,000 visits. Let's assume the cost of a truck roll to a site visit is $500. Reliable spends $16 million annually to inspect the lights on its portfolio of towers. However, with a waiver from the FCC to perform only one lighting inspection per year, Reliable's inspection costs would drop by 75 percent (one visit per site instead of four). In this example, Reliable could save as much as $12 million a year.

Using a well-run NOC makes good business sense for several reasons, including overall improvement to air safety; reductions in the investments needed for infrastructure, people and training; substantial reduction in the risk exposure to FCC fines for noncompliance; and significantly reduced operational costs. agi

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A Game-changer for In-building Wireless

When the National Fire Protection Association included language describing in-building public safety radio communications signal enhancement in its fire code, it made it easier for municipalities to require such enhancements.

By J. Sharpe Smith

The era of local regulation for in-building wireless systems is just shy of two decades old. During this time, if a municipality wanted to require new buildings to have first-responder, in-building wireless capability, it would have had to write its own code. The first jurisdiction to do so was Burbank, Calif., in 1991. Since then, more than 300 local ordinances have been written and enacted.

Last year, local regulation received a shot in the arm when the National Fire Protection Association (NFPA) codified in-building public safety signal enhancement, thus making it easier than ever for municipalities to write their own ordinances by adopting facets of the set of regulations known as *NFPA 1 Fire Code 2009 Edition* Annex O, "In-Building Public Safety Radio Enhancement Systems."

"We have had a tremendous breakthrough with these regulations being integrated into national fire codes," Bob Butchko, executive vice president, Lord and Company Technologies, told an audience at the 2009 PCIA Wireless Infrastructure Show. "We expect a significant rise in municipalities that demand first responders be able to use their radios within buildings. This is clearly a new driver for in-building wireless."

Butchko said the need for emergency communications has highlighted the lack of in-building infrastructure for wireless. One of the highest-profile

Mark Barrick, a firefighter and fire inspector with the Montgomery County (Md.) Fire & Rescue Service, said in-building radio systems are long overdue and will save lives.

communications issues that arose from the terrorist attacks of Sept. 11, 2001, was the lack of interoperability among the agencies that responded to the event. But equally important was the reliability of the communications systems for coordinating public safety personnel inside the Twin Towers.

"That tragedy created a demand that caused the blossoming of in-building public safety radio systems," Butchko said. "The last thing that a firefighter wants to hear is a 'bonk' when he is trying to tell his commanding officer that he cannot get out of a burning building. When the radio can't find a signal, he is trapped with no way to call for help."

To avoid this scenario, the NFPA fire code requires general areas to have 90 percent floor-area radio coverage. In critical areas, such as stairwells and other areas of egress, the emergency command center and the fire pump room, the radio system must cover 99 percent of the floor area. The code requires minimum inbound and outbound signal strength to be –95 dBm (decibels referenced to a milliwatt). The local authority, however, has the power to set its own minimum signal strength.

Cowboys Stadium, the latest high-tech National Football League venue, is fully wired for in-building cellular and public safety communications. Photo: James Smith.

In the event that the required radio coverage level cannot be supported

from outside networks, the building must deploy a signal enhancement system, such as a radiating cable system to a distributed antenna system (DAS) with FCC-certified signal boosters, according to the NFPA.

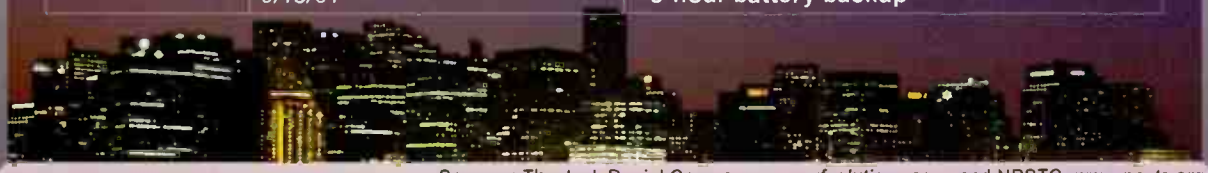
"The goal is for first responders to not have to fear that they will not be able to use their radios," Butchko said. "I have worked with fire chiefs and fire inspectors all around the country, and everyone tells me that the ability to use those handheld radios in that building will save lives."

The effect of the NFPA codes

There are a number of facets that the NFPA leaves up to the locality. The NFPA doesn't define the size of a building that must have public safety signal enhancement. The code also leaves it up to the authority having jurisdiction to determine what frequencies the system will enhance to ensure emergency responders' communications systems will work in the building.

The enhanced public safety signal system, however, is required to be able to

JURISDICTION	ORDINANCE REFERENCE	KEY PROVISIONS
Boston Massachusetts	Fire Dept. In-Building Radio Spec. *5/21/01*	• Min. signal –95 dBm, 95% of each floor • UHF band
Broward County Florida	Ord. 99-22 *5/25/99*	• No interference to public safety comms • Add'l facilities at no cost to county
Burbank California	Ord. 3265, Sec 7- 616.1 *Effective 9/21/91*	• Min. signal –107 dBm, 85% of each floor • 90% reliability factor • UHF band
Folsom California	City Code, Chapter 14.18	• Min. signal –95 dBm, 90% of each floor • 100% reliability factor • 800 MHz band • 12-hour battery backup
Grapevine Texas	Ord. No. 109.2	• Min. signal –107 dBm, 95 % of each floor • 800 MHz band • Adjacent band filtering • 8-hour battery backup
Roseville California		• Min. signal –95 dBm, 90% of each floor • 100% reliability factor • 800 MHz band • Adjacent band filtering • 12-hour battery backup
St. Petersburg Florida	Draft under development	• Min. signal –100 dBm, 95 % of each floor; –95 dBm in stairwells and below grade • 90% reliability • 800 MHz now • 700 MHz band by 1/2/2012 • 12-hour battery backup
Scottsdale Arizona	Section E, 810-90	• Min. signal –107 dBm, 85% of each floor • 90% reliability factor • 800 MHz and VHF bands • 2-hour battery backup
Tempe Arizona	Ord. 2001.25, Chapter 9 Section 9-21 to 9-32 *9/13/01*	• Min. signal –107 dBm analog; –93 dBm digital, 85% each floor • 8-hour battery backup



Sources: The Jack Daniel Company, *www.rfsolutions.com*; and NPSTC, *www.npstc.org*.

Table 1. A sample of local ordinances and codes involving in-building communications for public safety.

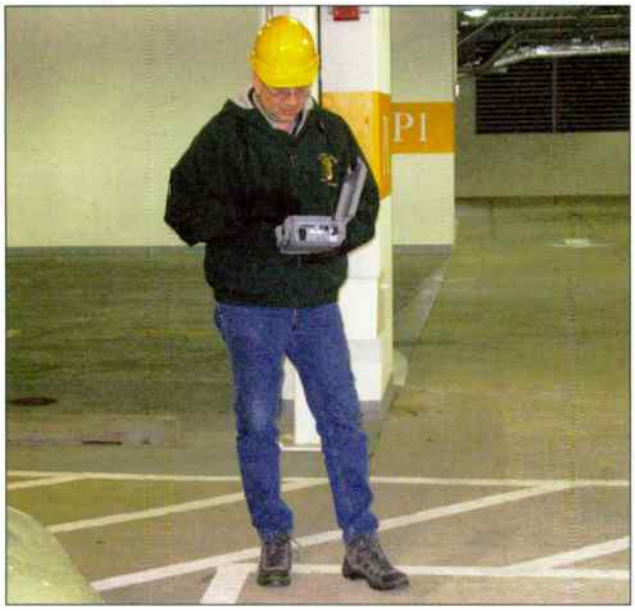
handle all public safety radio frequencies assigned to the jurisdiction and be capable of using any modulation technology. The local authority must be provided a list of all inbound and outbound frequency pairs from the public safety agencies for distribution to system designers. Isolation must be maintained between a donor antenna and all inside antennas, and it must be a minimum of 15 decibels above the signal booster gain.

Prior to installation, all plans for an in-building signal enhancement system would be required for submittal to the local jurisdiction. After acceptance testing, a renewable permit would be issued to the building owner. The code also covers monitoring, enclosures, battery backup, testing and maintenance.

Two intelligent optical network (ION) remote units installed in a box on the catwalk in Cowboys Stadium support the antennas that spread wireless signals throughout the upper concourse. Photo: Andrew Corporation.

Optional or obligatory?

At first blush, the in-building wireless codes in *NFPA 1 Fire Code 2009 Edition* might seem insignificant. They are, after all, just a few pages of a large volume of rules concerning sprinkler systems, exit signs and ramps — everything to do with fire safety. Additionally, all codes are implemented at the discretion of local authorities. Virtually every building in America incorporates codes developed by the NFPA to reduce the risk of fire. Municipalities will use this



Eric Parker, a radio technician with the Alexandria (Va.) Police Department, measures 800 MHz signal strength in a newly constructed high-rise building.

Half-inch coaxial cable feeds a typical indoor DAS antenna mounted in an underground parking garage to deliver wireless services where signals otherwise could be too weak.

national code as their guide for writing local codes.

Jack Daniel, a specialist in public safety in-building RF coverage, told *AGL* that the mere existence of an NFPA code has tremendous gravitas to influence the behaviors of building owners and municipalities.

"For people who have been struggling for years to get a code written, this NFPA code is a godsend," Daniel said. "What I did not anticipate when this code came out was that inspectors and enforcers of codes would tell the municipalities to buy the new hardware, even though they don't yet have a local code in place."

With public safety equipment built to last 10 to 20 years, Daniel noted, buying equipment or building a structure that is going to need massive adjustments to fit the newly adopted codes would make little sense.

The city of Irvine, Calif., which permitted about 250 high-rise buildings last year, is one of the most aggressive municipalities, according to Daniel, in part because of a countywide wireless in-building code, which is voluntary like the NFPA code.

"We met with their inspectors and technicians and said, 'This is what the future looks like,' and suggested that they start building to it now," Daniel said. "So, they are planning on applying the NFPA code even though it is not mandatory."

Another facet that will work in the favor of public safety signal enhancement is insurance rates. Whether it is sprinkler systems, fire alarms or smoke detectors, insurance companies smile on those who make their buildings safer.

"Now that public safety signal enhancement is codified by the NFPA, people who are compliant may see a reduction in their city fire assessment and lower insurance rates for their business," Daniel said. "Three years ago, owners of a building in Washington, D.C., deployed an in-building wireless system and received a reduction in their insurance rates because of the increase in security for their tenants."

Fire codes and in-building cellular

An increase in public safety-related in-building radio infrastructure may positively affect the deployment of in-building cellular systems because of the similarity in technologies. Andrew Wireless Solutions' Node A platform, for example, is protocol agnostic and can support multiband/multi-operator applications for public safety and cellular carriers alike.

"The NFPA code is the Trojan Horse that cellular DAS systems can ride in on. Once a building is required to deploy a public safety network, the incremental costs of adding cellular coverage become less. The building owner may as well think about commercial coverage needs," Matt Melester, senior vice president and general manager of Andrew's Wireless Innovations Group, told *AGL*.

As another example of in-building cellular and public safety communications, Lord and Company Technologies designed and installed a wireless system in the steam tunnels beneath the U.S. Capitol Complex in Washington, D.C., which supports cellular and public safety telecommunications. The extensive communications system features Heliax and Radiax cables coursing through two miles of tunnels, 60 feet below the surface in 160-degree Fahrenheit temperatures.

"In these large in-building, in-tunnel or in-ship environments, such as the $40 million deal to put cell phone coverage in the tunnels of the New York subway, there is also some significant portion used by public safety radios," Butchko said.

The building code in Arlington, Texas, required the Dallas Cowboys to provide public safety radio coverage as a condition for receiving an occupancy permit for the team's new stadium last year. Because team officials knew all the wireless carriers would want coverage in the facility and didn't want separate systems, they put in one system that would serve all the carriers and public safety. The decision was made to deploy Andrew Solutions' Node A platform and an intelligent optical network, fiber-based, distributed antenna system.

"It is a matter of enforcement. A building owner won't know that its facility doesn't meet code unless someone enforces it," Melester said. "When you have to go to the city for an occupancy certificate, that is when the code will be enforced."

Conclusion

Wireless public safety signal enhancement requirements for public buildings seem inevitable, but it will probably not be a smooth road ahead. Daniel noted that the NFPA code is retroactive, which "scares the heck out of the building owners." The codes add extra expense to building new facilities and eventually to maintaining existing structures, but building owners are starting to view this as a cost of doing business, and it can be marketed to their clients.

Butchko remembered when fire-suppression systems were made part of building codes.

"When the fire code changed and required them in buildings, everyone complained that it would add cost and some lobbied against it," Butchko said. "Now, for a long time, fire suppression systems have just become another part of building infrastructure. The same thing will happen with public safety radio."

That day cannot come soon enough for Melester. "We have seen the impact of the NFPA code in new construction builds of a certain size in Las Vegas and its casinos, where public safety is a driver in new hotels," he said. "We've seen a lot more interest. Have we seen it translate to a lot of sales? Not yet. I live for the day when every building wants to put in a multi-operator wireless system. The NFPA codes are driving us in that direction." agl

Designing and Testing Low-resistance Grounding

A properly designed, low-resistance grounding system plays a major role in obtaining and maintaining a well-protected, efficient facility. Use traditional methods or an enhanced system with electrolytic electrodes with carbon backfill.

By Harshul Gupta

We all have become dependent on electronics for our everyday lives. These same sensitive devices are vulnerable to hazards created by poor grounding. As any power quality expert would attest, poor grounding is second only to improper wiring as the leading cause of equipment malfunction.

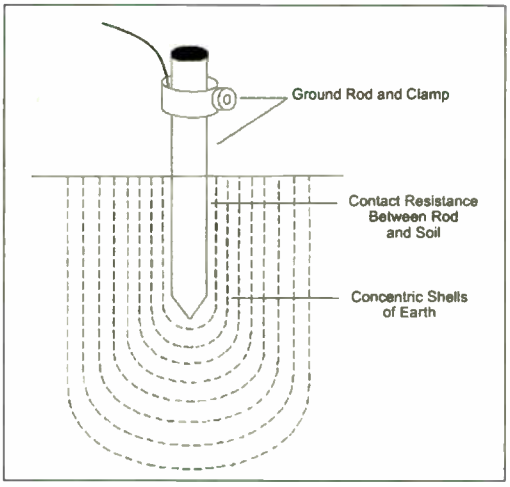


Figure 1. How an earth electrode provides a connection path from the equipment to the earth.

Standards for equipment performance mandate installing and maintaining a reliable, low-resistance earth ground. These standards often cannot be met and certainly cannot be assured for the long term by traditional grounding methods, which call for minimum requirements. Much of this equipment operates on 5 volts or less and is often subjected to higher steady-state transients.

A properly designed, low-resistance system can ensure the operation of critical equipment that often creates its own hazards, such as harmonics and transients. An additional benefit is enhanced personnel safety.

Earth grounding

The definition of a ground electrode is "a conductor or group of conductors in intimate contact with the earth for the purpose of providing a connection with the soil." This definition does not refer to an actual ohm resistance value of the electrode. The resistance value is determined by the resistivity of soil with which these electrodes are in contact.

The earth electrode is that connection path from the equipment to the earth (see Figure 1). The resistance of the electrode, measured in ohms, determines how quickly and at what potential the energy is equalized. Hence, grounding is necessary to maintain an object's potential equal to that of the earth.

As in the case of ground water, the current must pass through the soil to the assumed earth potential of 0 ohms. When an object is grounded, it is then forced to assume the same potential as the earth. If the potential of the grounded object is higher or lower, current will pass through the grounding connection until the potential of the object and earth are the same.

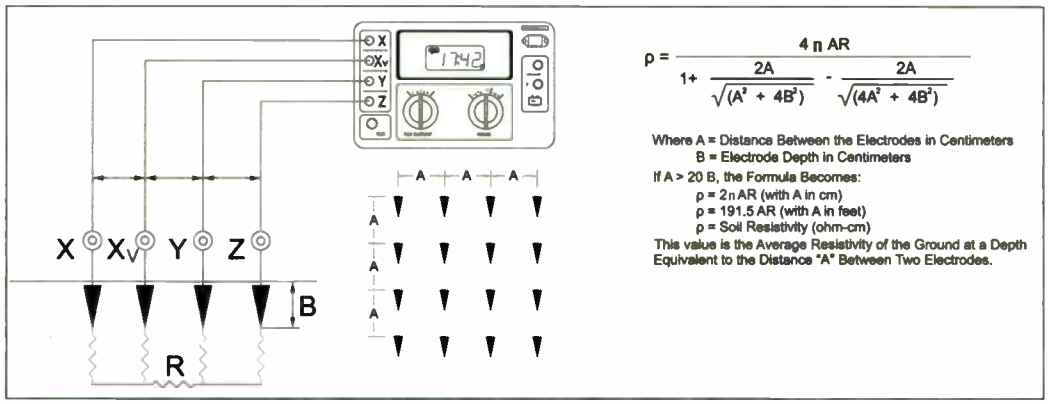


Figure 2. A four-point ground meter can be used to determine the conductivity of soil. The test requires the user to place four equally spaced auxiliary probes into the earth to determine the actual soil resistance, usually in ohms per centimeter.

Soil resistivity

The soil is the dynamic conductor for steady-state, natural and man-made fault currents. Most soils naturally contain varying amounts of electrolytes that conduct electricity. As a result, the addition of moisture will enhance or reduce the conductive properties. In general, however, the greater the moisture content in soil, the lower

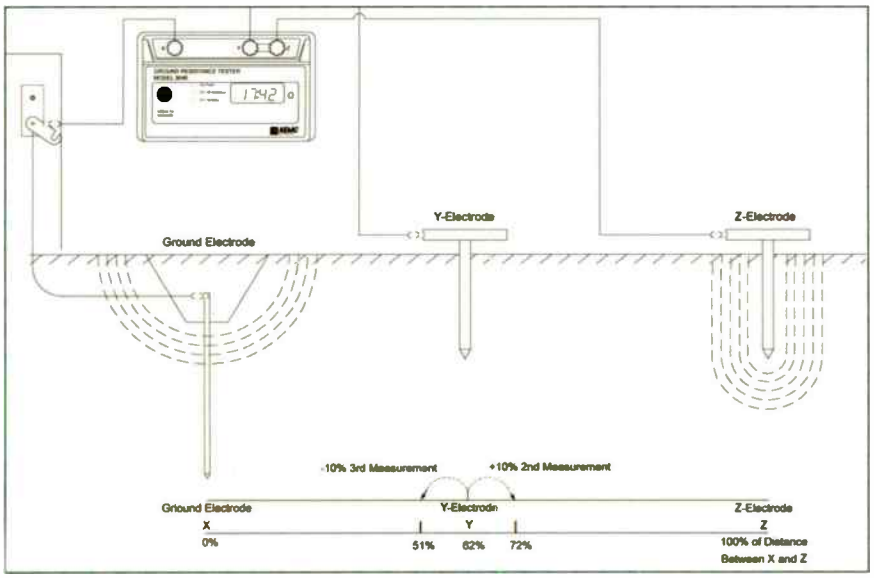


Figure 3. Once a ground system has been designed and installed, the verification process begins. This requires the use of a three-point, fall-of-potential, ground-resistance method.

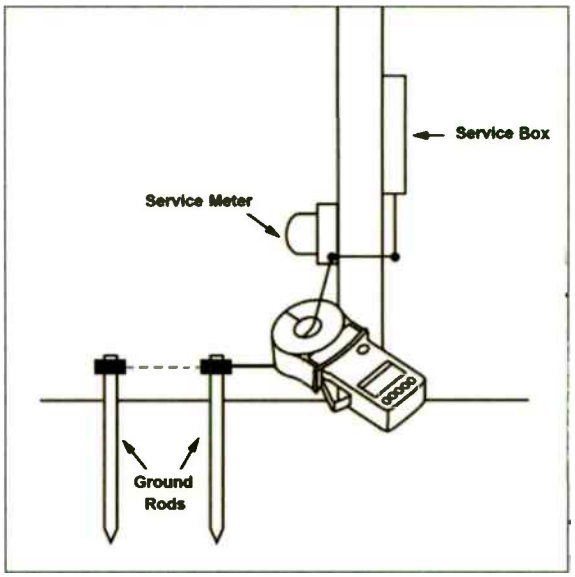


Figure 4. If ground system testing is conducted after utility power is connected, a clamp-on ground-resistance tester can be used.

the resistivity.

Temperature, like moisture, can have a significant effect on resistivity. Soil resistivity varies with temperature, especially when reaching 32 degrees Fahrenheit (the moisture in the soil freezes and the resistivity increases by almost three times its unfrozen value). This can have a detrimental effect on your clay- or cement-based backfill materials that rely on water as their primary conductor. A carbon-based backfill material will have the advantage of being an all-weather, year-round, low-resistance conductor.

Soil resistivity measurements

To determine the conductivity of the soil, a four-point ground meter is used (see Figure 2). This test requires the user to place four equally spaced auxiliary probes into the earth to determine the actual soil resistance, traditionally in ohms per centimeter. This test must take place around the entire area to determine the soil value at all locations. This test is done at different spacing, 5 to 40 feet, to determine the resistance value at various depths. This knowledge will aid in the design and implementation of the ground system necessary to meet the particular site requirements. Soil values can range from 500 ohms/cm with large amounts of electrolytes to more than 1 million ohms/cm in sandy, dry soil.

Post-installation testing

Once a ground system has been designed and installed, the verification process begins. This requires the use of a three-point, fall-of-potential, ground-resistance method (see Figure 3). This test involves the use of two auxiliary probes placed in the ground in a straight line. The lengths of the conductors from the instrument to these probes are determined by the size of the facility under test. This is traditionally five times the diagonal distance of the grounding system. The test must also be performed before tying into any other ground source. The reason for this is to verify that your system has the designed ground resistance value without influence from outside sources.

If the test is performed after the power is connected, the clamp-on ground-resistance tester can be used (see Figure 4). This involves clamping onto the power neutral between the utility transformer and the site ground. The user Service Box must be aware that a 0.7-ohm reading indicates a continuity loop and not ground resistance.

Low-resistance grounding system design

The design process for a grounding system begins with a site and power survey of the installation area (see Figure 5). The power survey includes bonding and grounding methods of present electrical power, telecommunications, standby power distribution, uninterrupted power, and many other systems that operate in the facility. A site survey must also include soil-resistivity analysis at several depths, relevant site plans, topography analysis and a boring core sample, if available. The site survey will show if any physical barriers such as rock, high-resistivity-mode soil or power lines will affect the earth-ground resistance in the installation area. Once this information is obtained, an effective design can be initiated.

A properly designed, low-resistance grounding system will play a major role in obtaining and maintaining a well-protected and efficient facility.

Benefits of a well-designed system

A properly designed, low-resistance

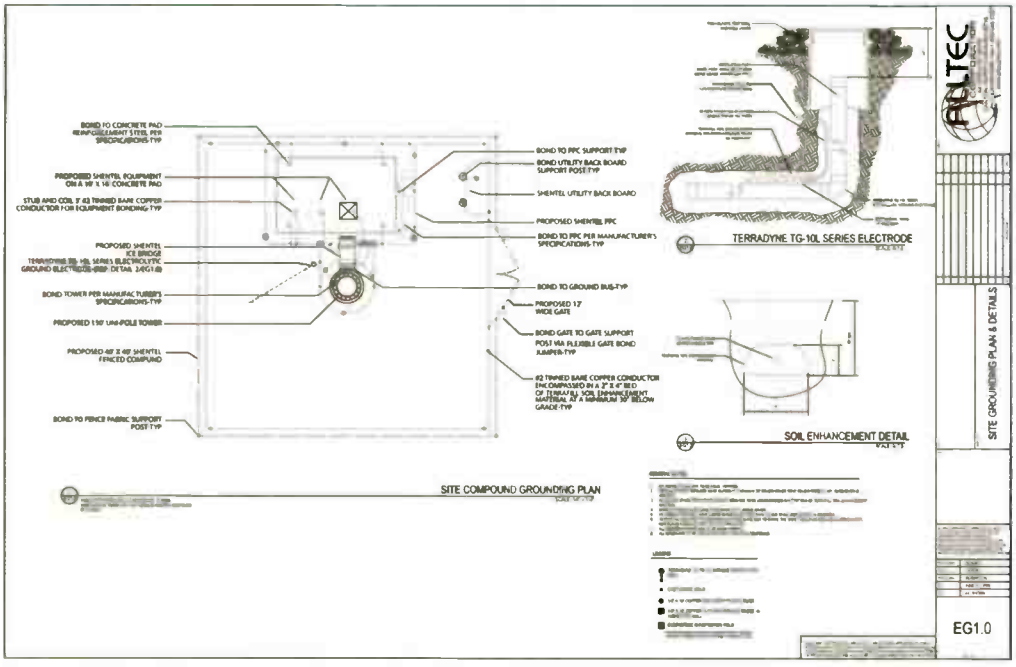


Figure 5. The design process for a grounding system begins with a site and power survey of the installation area.

grounding system will play a major role in obtaining and maintaining a well-protected and efficient facility. High-tech equipment is highly sensitive, and business downtime is often irreplaceable. In the fast-paced, competitive business world, availability is everything. To stay at the forefront of hard-line business competition, companies must be entirely reliable. The ground system is an integral part of the site and should be as highly regarded as all the other equipment-critical components. This may be achieved with traditional methods or an enhanced system with electrolytic electrodes with carbon backfill. agl

Harshul Gupta is vice president of engineering at Alltec Corporation. He is an electrical engineer with extensive knowledge in the design and testing of grounding systems for commercial and industrial facilities. Visit *www.allteccorp.com*.

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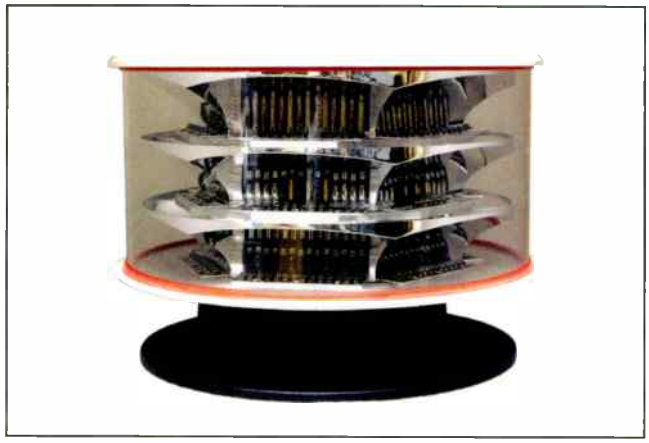
Site Monitoring, Alarm and Control

Davicom's MAC (monitoring, alarm and control) solutions allow broadcasters and telecom operators to remotely monitor and control transmitter sites and unattended studios, reducing operating costs and downtime. The systems provide immediate access to real-time site information, such as transmitter status, RF power, antenna VSWR, audio/video levels, mains power presence, temperature, tower lighting, fire alarm and building security status.
www.davicom.com

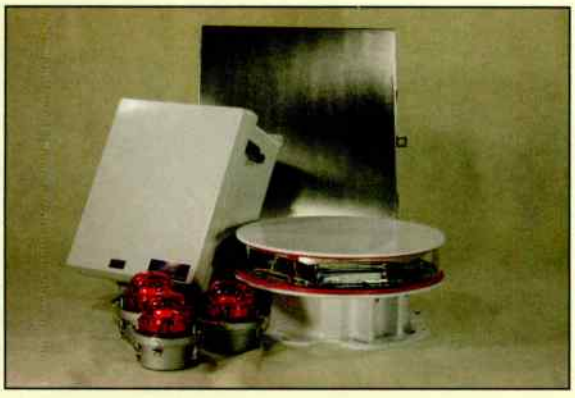


All-LED Beacon

The RVA LS7-D/E-LED from **RVA Lighting & Masts** is an all-LED beacon that comes in two models: FAA Type D (L-865 white 20,000-candela day/white 2,000-candela night) or FAA Type E (L-865 white 20,000-candela day/L-864 red 2,000-candela night). Operating on 120 volts, power consumption is 100 watts for white day-mode, white night-mode is 10 watts and red night-mode is 35 watts.
www.rvalightingandmasts.com

LED Tower Lighting

The Go Green line of obstruction lighting products from **Specialty Tower Lighting** (STL) allows tower owners and operators to realize monetary savings because LED lights use up to 95 percent less power than traditional incandescent lighting. Savings are also achieved in the area of maintenance — lamp life is 50 times longer than incandescent lights, which reduces maintenance costs. STL manufactures several energy-saving lights, many of which are direct replacements for existing incandescent lights.
www.specialtytowerlighting.com



Flash Dual Red/White Strobe

Dialight offers an FAA-certified all-LED L-864/L-865 flashing dual (white/red) strobe that is ETL-certified to the FAA requirements and compliant with the International Civil Aviation Organization and Directorate General of Civil Aviation standards. The unit features a small flash head and lightning protection tested up to 2 million volts/10,000 amps.
www.dialight.com

Remote Tower Site Monitoring

Hark Systems has introduced the HLM8-2, the first in a series of remote tower site monitoring equipment. It features eight inputs (contact closure or open collector), built-in power supply, smart battery charger and low-battery disconnect, which ensures fewer visits to the site over a simple battery issue. Local RS-232/RS-485 ports enable technicians to connect a laptop for diagnostic work or future expansion. Using Hark's monitoring equipment allows the site owner to apply for an FCC waiver eliminating quarterly site inspections.
www.harksystems.com

Triple Beacon Red/White LED Controller

The DLC-403 triple beacon red/white LED controller from **International Tower Lighting** controls and monitors three dual red/white LED beacons and two levels of up to five LED side lights. Alarm contacts (Form-C) are provided for three white beacons, three red beacons, two levels of Type L-810 LED side lights, power failure, backup and photocell alarms.
www.itl-llc.com

Dual-Hub Single-Obstruction

International Tower Lighting's MKR-ILED-0DH dual-hub single-obstruction light uses LED technology and Fresnel optics to provide a reliable low-power tower lighting solution. The unit features a lightweight rugged plastic design, stainless-steel latches and hardware, 3/4-inch conduit entrance, side and bottom hubs; modular replaceable power supply, and a power supply that operates from 100 volts AC to 240 volts AC, 50/60 hertz.
www.itl-llc.com

Tower Lighting Control

The CPS series tower lighting controller from **Xcel Tower Controls** can handle all tower sizes, even towers requiring as many as eight beacons. A CPS controller provides alarm outputs through standard Form-C dry-contact relays. The CPS line provides circuit breaker inspection and reset from the face of the panel. Other features include: individual beacon control, field switchability for incandescent or LED-style fixtures and circuit breaker reset on front panel.
www.xcel.com

White and Red, Medium-intensity LED Obstacle Lights

TWR Lighting/Orga Aviation has introduced a product line that incorporates advanced optical engineering and LED technology to minimize the visual impact of the lights on the surrounding environment and reduce power consumption. The optical design gathers the light produced by the LEDs and focuses it into the required beam profile.
www.twrlighting.com

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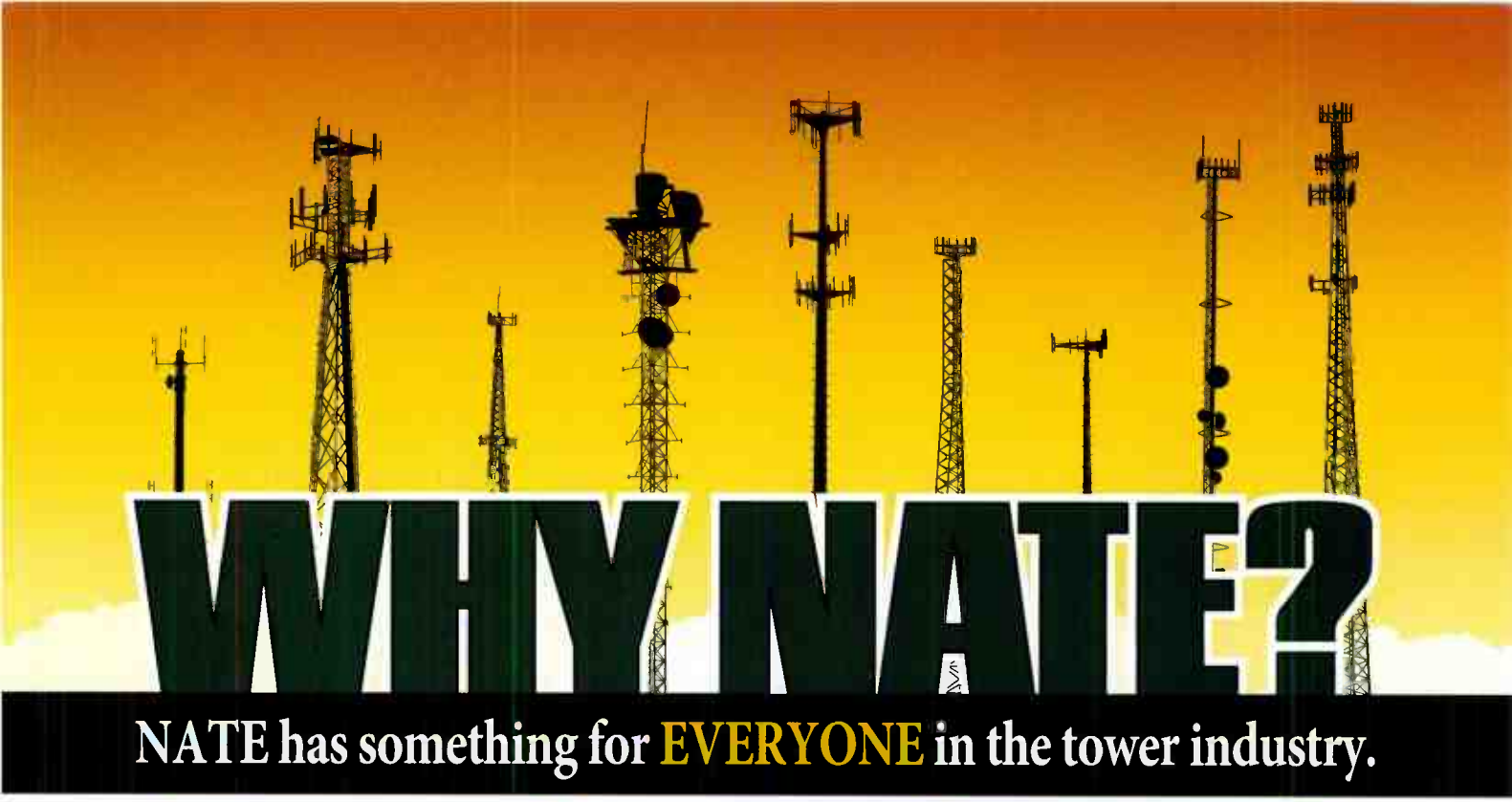

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