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

ABOVE GROUND LEVEL

agl

The official magazine for:
PCIA – The Wireless Infrastructure Association
SWAP – The State Wireless Association Program
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OUR 5 YEAR

JUNE/JULY 2009
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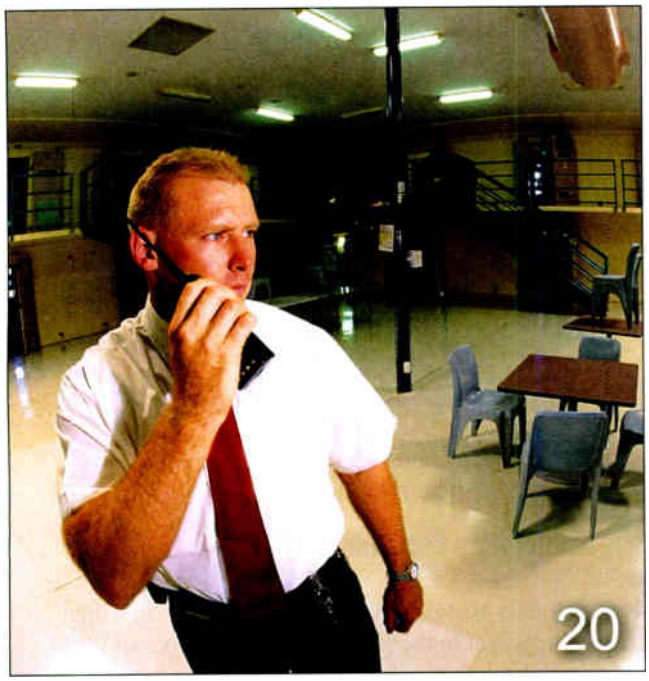
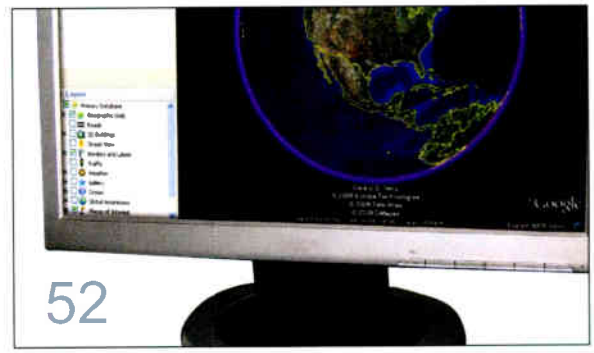


Features

Special Technology Review



on the cover

The Special Technology Review section includes in-depth and technical articles and articles that are not necessarily focused on the tower industry. Instead, they are more related to the technologies that carriers deploy. After all, the carriers' choice of technology is what drives the need for our industry. "We are the derivative of the technology," as Publisher Richard P. Biby, P.E., says.

Cover design by Scott Dolash.

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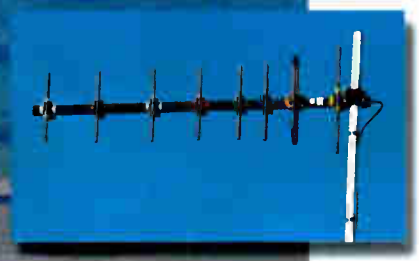

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On the Front Line

In May, thanks to a suggestion from our production artist, Scott Dolash, whose wife saw a sign in their neighborhood urging opposition to a proposed cell tower at a church and told him about it, I attended a city council meeting where the tower permit application was discussed and denied.

The council allowed all of the residents who wanted to speak to do so, and to speak for as long as they wanted, without interruption or any requests to hurry up, after the mayor first asked residents to be brief and not to repeat what others already might have said. In an hour's time, 11 residents spoke, with 10 opposing and one favoring the tower. The church's pastor also spoke in favor of the tower.

The carrier's attorney spoke for about an hour, interspersed with comments and questions from council members.

Council members discussed the matter among themselves and asked questions of city employees who were present. The council spent about three hours listening to everyone.

The council informed those present that the application had been denied three times by the planning commission, and the matter before the council was whether to override the planning commission's recommendation. The council also informed those present that the carrier already had brought suit in federal court to require the city to allow the tower placement.

The council took several votes. It voted whether to table the matter until the next meeting. It voted whether to send the matter back to the planning commission. Both motions failed.

By Don Bishop, Exec. Editor
dbishop@agl-mag.com

As an attorney for the carrier took notes, a resident directed his gaze at the city council and pledged $1,000 toward offsetting the city's cost in litigation involving the tower.

The council considered alternatives. Other locations. A shorter tower. A monopine. A council member cautioned that the Telecommunications Act of 1996 would, in his opinion, lead a judge to require the city to allow the tower after expensive litigation. A resident urged the council to take up the fight in court, despite the expense. He pledged $1,000 toward offsetting the cost and urged others to contribute. The vote to deny the application passed 8–4.

The meeting demonstrated what many already know, and that is that many carriers and some tower companies may be national in scope, but almost every tower siting decision is local. Officials may improve their chances for reelection by denying towers that judges may later order cities to accept. Facing neighbors across a room may not be easy. And chances for a tower placement are improved when fewer neighbors oppose it and more favor it.

If you don't already have a plan for generating neighborhood support, you may want to try some of Liz Walker's suggestions on page 30. agl

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Thank You, NY!

A big thank-you and congratulations to the New York State Wireless Association for a successful annual convention. As I write this, I just returned from the trip. Not only am I enthused, I remain impressed with all of the hard work and careful planning that the association's president, Doug Dimitroff, and all of the folks in New York put into this event, making it such a clear success.

In addition to the small, yet effective and useful exhibition floor, I attended several of the 12 educational sessions. PCIA President Mike Fitch delivered a lunchtime keynote speech. It was surprising to me to learn how much PCIA is tracking the broadband stimulus money. I'm just not sure we're going to see that much of it — more on that later.

Jim Young, chief operating officer of Crown Castle International's U.S. operations, delivered the evening dinner's keynote speech. Jim reflected on his 24 years in the industry. As an old-timer myself, I found it interesting, and I enjoyed reflecting on and reliving some of the history of how we got here. We were all laughing that the event was held at what would have to be the only "dry" Indian casino in North America. As we all know, there are ways around every rule and, of course, wireless folks would not survive two days without a frosty one. The dinners were "private," and the rules about alcoholic beverages did not apply. Yah!

Google will rule the Earth

With all of the stimulus money still being talked about and none of it yet awarded, one of the initial steps appears to be for someone to figure out how to conduct, and complete in some kind of timely manner, an inventory of current broadband coverage, available spectrum, existing collocatable vertical assets or a combination of the three.

As usual, steps never take place when they're expected to, or when they're most desired. Back in January, we thought the money would be freely flowing out of Washington by now. But the reality is that no one is sure how to even conduct the audit of where there is existing broadband service, an audit that would reveal where there is none and, thus, where to award money to build the *initial* broadband services called for in the stimulus bill.

Those folks at Google are worth watching with a carefully trained eye. They are up to something. Remember the rules for the 700 MHz auction — the most desirable band winner had to allow for open devices? We've not seen how that is going to shake out, but with folks at Google now requesting a national inventory of spectrum, and with what I've been watching them do with the television white spaces, you can bet there is a plan for the word "Google" to be on many more devices with an antenna.

I carry a G-1 (Google/Android phone) on the T-Mobile network, in addition to an iPhone. The G-1 is impressive. By the way, my wife carries a Verizon BlackBerry, as do most of my coworkers, and I've had a Sprint phone on my hip lately, too. In the D.C. market, we're anxious to get our hands on Cricket phones. That may have happened by the time you read this.

I've been watching the TV white space issues closely. I've even formed a little company to attempt to be the administrator of the spectrum. If you're curious, take a look at *www.wsdba.com* for some more info.

About this issue

I've long missed a magazine in the industry that I could really learn something from. The fine folks at the old *Mobile Radio Technology* did a great job of that, in my opinion. The same folks who deliver *AGL* to you every month once were a large part of the other publication's successful mission.

I'm a firm believer that we're missing educational resources that address the things they just don't teach you in school and that are not readily available in textbook form. IEEE journals are not what most of us practicing in the industry really need — that is, research. And our friends at most of the other wireless publications focus on reporting news of the industry (earnings reports, system deployments, new phones, etc.). So this issue is a bit bigger than usual, and a bit different in focus.

You'll find more in-depth and technical articles and articles that are not necessarily focused on the tower industry. They are more related to the technologies that carriers deploy. After all, the carriers' choice of technology is what drives the need for our industry. High frequency, lower power = more towers. Lower frequency = fewer towers. Higher power devices = fewer towers. Greater throughput = more towers. More spectrum, more throughput, higher frequency, greater power = ?

I'm a firm believer that we're missing educational resources that address the things they just don't teach you in school

You get the idea. We are the derivative of the technology. The technology is not chosen based on availability of towers. So, we'll begin to regularly take a look at technology that drives the siting industry, in addition to keeping up with all of the happenings of the industry directly. I'm pretty excited about this issue, and hope you enjoy reading it as much as we enjoyed putting it together. agl

By Rich Biby, Publisher
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Zoning Intervention: Grassroots Opportunities for Pro-siting Policies

–By Jackie McCarthy–

Often, the most effective engagement we as an industry association can make is at the municipal level. This effect is made all the more powerful by partnering our resources with local experts, from our State Wireless Association Program (SWAP) or otherwise, that have strong community ties and deep knowledge of the back story involved in any zoning issue. Recent examples illustrate the benefits of this partnership in encouraging local policies that enable wireless infrastructure development.

St. Augustine

In St. Augustine, Fla. (the oldest city in the nation, and a city especially focused on its aesthetic integrity), the city government's planning board considered a draconian ordinance that included provisions requiring public hearings for all facilities, and that required applicants to provide information that violated both federal and state statutory limits on municipal review. PCIA and the Florida Wireless Association (FWA) Regulatory Committee urged the planner, city attorney and planning board to consider the legal and policy problems with the proposed ordinance, and suggested alternative language that would more effectively balance the city's preservationist concerns with its need for increased wireless coverage and capacity. Through repeated engagements with these policy makers, the planning board adopted a more reasonable ordinance including a tiered review process that gives administrative advantage to facilities located on existing structures. FWA leadership provided critical in-person support for our advocacy positions, and their relationships with the city's representatives paved the way for a productive dialogue.

Rochester

In some cases municipalities initiate this collaboration, and both PCIA and SWAP are ready to capitalize on that opportunity. Recently, the City of Rochester, N.Y., invited the New York State Wireless Association (NYSWA) Regulatory Committee and PCIA to participate in an ordinance revision process. PCIA and NYSWA assembled a subcommittee of members most interested and involved with development in Rochester, and at press time they are engaged in a proactive effort to encourage ordinance revisions that provide for regulatory incentives to collocate and a reasonable process for development where collocation is not feasible.

Bedminster

Even when municipalities decline to adopt our suggested revisions to a problematic zoning ordinance, our engagement sets the record straight that our industry expressed concerns about the policy before it was enacted. One recent example of this comes from Bedminster, N.J. (a suburb with a tradition of restrictive policies toward wireless site development). PCIA and zoning experts from the New Jersey Wireless Association (NJWA), along with a broad contingent of carrier representatives, offered coordinated comments to express significant concerns about proposed wireless ordinance provisions that violate the federal Telecommunication Act of 1996 and New Jersey case law. The Bedminster Township Council declined to adopt all of our suggested revisions, but our written comments remain on the record as a strong example of industry concerns for any future challenges to the policies.

With our members and through our support of SWAP, PCIA coordinates engagement on a variety of local issues, from zoning ordinance revisions to wireless moratoria to the hiring of municipal consultants. As local governments look for ways to enhance revenue and streamline processes, we predict that local issues will continue to provide both significant challenges and excellent opportunities to advocate for a more balanced siting process. Please keep us posted on your experiences in this regard, and let us know if we can lend our voice to issues in your area. **agl**

Jackie McCarthy is director of government affairs at PCIA – The Wireless Infrastructure Association. Her email address is *jacqueline.mccarthy@pcia.com*.

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Illinois State Wireless Association

By Bob Stapleton

The Illinois State Wireless Association was founded in January 2007 with its initial meeting in March of that year. Our first quarterly meeting was held on the campus of the McDonald Corporation with 200 telecommunication professionals in attendance. Our speaker for that meeting was Alderman Edward Burke of the 14th ward of the City of Chicago. Burke is chairman of the Finance Committee of the Chicago City Council and is the council's dean. He had just published his new book *Last Watch*, the stories of all the Chicago Police officers killed in the line of duty since the beginning of the department.

Growth of wireless communications

As a former police officer, Burke talked about the growth of wireless communications within the police department from the turn of the century to the time of the Democratic Convention in 1968, and up to the present use of wireless real-time communications devices available to the officers of the day. It was a timely speech with the Cricket deployment just beginning and 4G in its initial stages. He talked about the ability of an officer to remotely control a wireless camera from his squad car to obtain a real-time view from a camera deployed in a high-crime area. He also spoke of the lack of field communications during the 1968 convention when the state of the art for field command was the use of World War II-type field radios.

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Charitable contributions

With that meeting, our organization started on the road to bringing independent contractors, vendor support companies, equipment makers and our carrier companies together under a common banner. With that meeting, we also made our first charitable contribution, which went to the Ronald McDonald house. That was just the beginning. Since that event, our organization has given more than $10,000 to Misericordia Home and other charitable groups. We also addressed a cause for one of our own. A year ago February, Mark Turkula of US Cellular was killed in a tragic accident. Mark left behind his wife and two beautiful children. The association, the industry and his friends stepped up, and in May we hosted a fundraiser for his family. We raised more than $64,000

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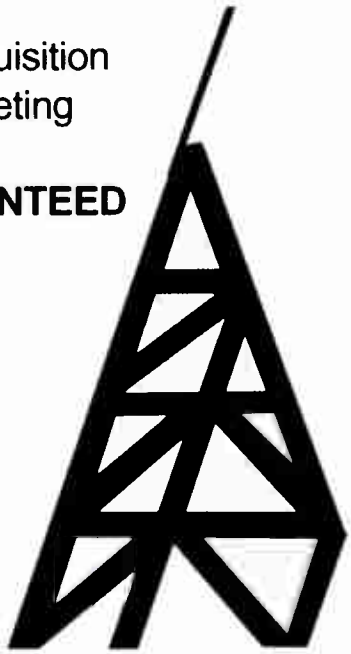

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for a tax-advantaged 529 investment plan to help to pay for higher education for his children. It was a group effort led by Jim Leahy of Black & Veatch with a great supporting cast.

First-quarter meeting

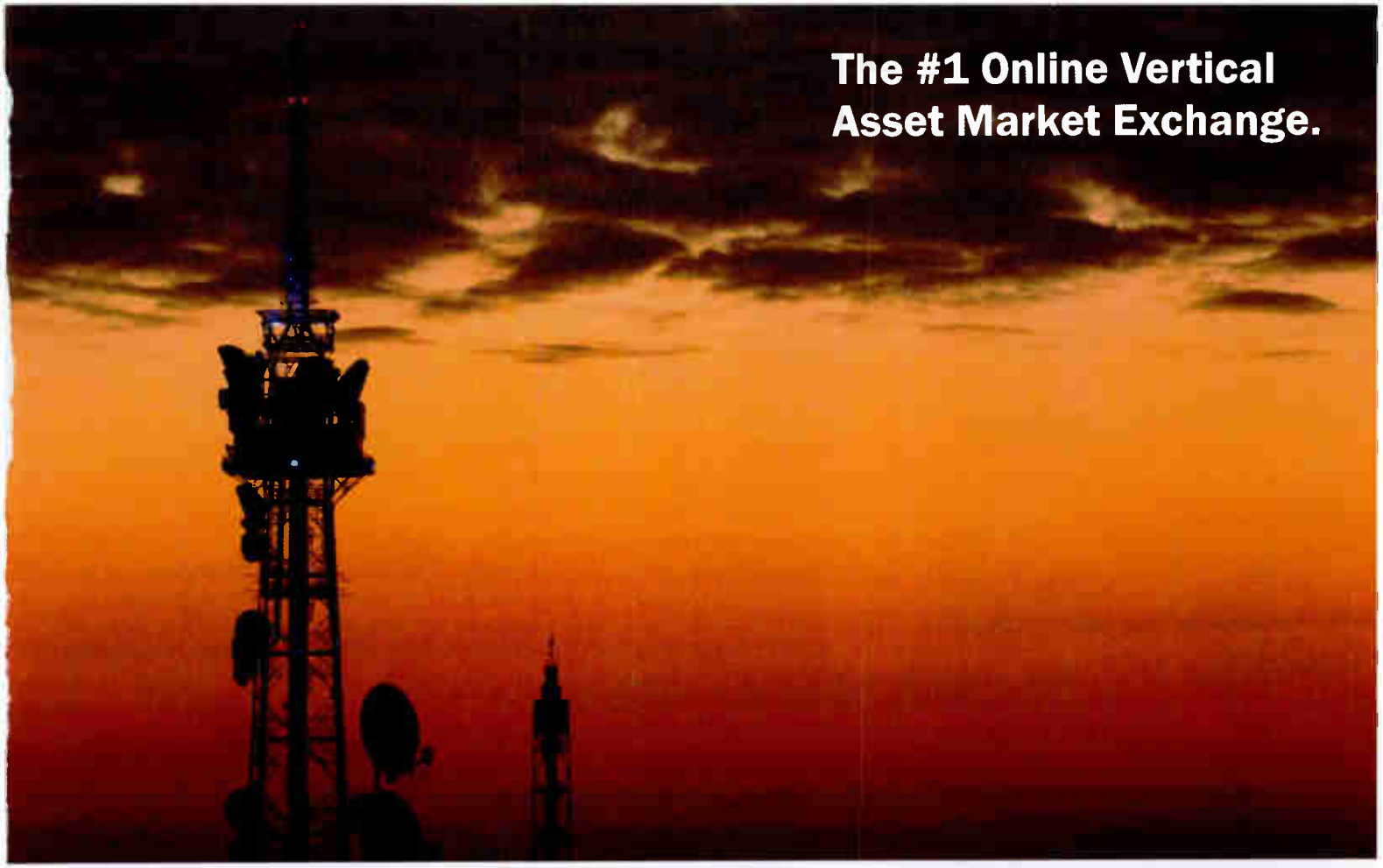
On March 25, this year, we conducted our first-quarter meeting. The event was called "State of the Industry," and more than 150 people attended. The speakers were Kurt Bagwell of SBA Communications, Steve Kingwell of American Tower and Pat Tant of Excell Communications and the State Wireless Association Program. Bagwell and Stingwell addressed questions relating to growth and the current business climate that is affecting our industry. Tant's remarks addressed issues relating to the State Wireless Association Program and how both the state associations and PCIA can help members grow their businesses, deal with regulatory issues and successfully work in today's business climate. Our members came away from the luncheon pleased with the answers they heard and with a sense that in the upcoming months there is hope.

Golf outing

On June 19, ILSWA will host its third annual golf outing. We are looking forward to another successful event. As with most of our events, an informal industry get-together is scheduled for the night before. For the past two years, more than 150 golfers at each event enjoyed the spirit of competition, and we had fun raising money for Misericordia. This past year our golfers had the opportunity to hear from Sheri Turkula, thanking everyone for their support of the fundraiser in her husband's name. They also heard from a parent of a child living at Misericordia. We heard about all the great things Misericordia is doing for its residents and how our contributions are put to work. As the president of this organization, I am grateful for the work done by our management team and volunteers in making these events successful and rewarding for our membership.

In the third quarter, we will host another meeting, possibly dealing with the zoning ordinances and building code of the City of Chicago. Our fourth-quarter plans are to host our second annual Texas hold 'em tournament. Last year, more than 100 people attended, with 75 guests playing in the tournament. It is the goal of our team to make our events timely, informative and interesting for our members. It is our objective to increase our carrier participation with such events. Carrier support and participation, as well as the ongoing support of our members and sponsors, are the keys to our continued growth.

The Illinois State Wireless Association is committed to educating its members, the industry it supports, the organizations it supports and the growth of wireless telecommunication. **agl**



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For Our First Responders,

In-building Public Safety DAS Is a Lifeline

By Bob Butchko

Although it is not widely known, in-building distributed antenna systems have two basic components. The first and more widely recognized is the commercial component, which brings full-bar cell-phone coverage or high-speed wireless Internet access to high-rise buildings. The second component consists of public safety radio systems (PSRS). These indoor distributed antenna systems provide guaranteed, 800 MHz, loud-and-clear first-responder communications in those same structures.

Since 9-11, the focus has been heightened on providing first responders with completely reliable radio communications during emergencies regardless of the location or situation. First responders who rely solely on 3-watt handheld radios often lose signals in difficult signal-propagation environments, such as building elevator lobbies, basements, garages or any areas where reception is weak or absent. The installation of a correctly engineered, designed and installed in-building public safety radio system resolves these issues.

Bill Gulbronson: 'The last thing any firefighter wants to hear is that loud "bonk" when your radio cannot get into the system. It's really frightening and can be life threatening.'

Last year, the historic Virginia community that includes Albemarle County, Charlottesville and the University of Virginia augmented its 800-MHz public safety radio system with in-building amplification for selected county, city and university buildings and facilities.

Updated radio system

The Emergency Communication Center's executive director, Tom Hanson, who represents this multijurisdictional public safety 9-1-1, police, fire and emergency medical service for that historic area explained, "While the recently updated ECC public safety radio system provides acceptable on-street coverage throughout the ECC service area, some buildings lack desired in-building coverage, and therefore require additional enhancement so first responders may have more reliable in-building radio communications. Unfortunately, regardless of how good the on-street coverage may be for your system, there will be factors (e.g., budget constraints, zoning, topography, etc.) that affect your in-building coverage, resulting in the need to augment coverage through additional amplification."

Bill Gulbronson, president and chief technology officer of Lord & Company Technologies, the systems integration company that designed and installed the in-building wireless communications systems for Charlottesville, commented, "Loud-and-clear radio communications during any emergency are indispensable. The last thing any firefighter wants to hear is that loud 'bonk' when your radio cannot get into the system. It's really frightening and can be life threatening. These in-building amplification systems are truly a first responder's lifeline."

More and more governmental entities around the nation are requiring these services to be provisioned and certified before new buildings can be occupied. In 2002, there were 11 U.S. jurisdictions with enacted or proposed signal-booster ordinances. Some sources now put that number close to 200, and it is multiplying each year.

Fire code template

The early-adopter municipalities broke ground for others to follow, and now there is nothing to stop cities and counties from making sure that public-safety officials have loud-and-clear communications anywhere inside of a building during an emergency. As an announcement issued in late 2008 said it would, the NFPA 1 Fire Code 2009 Edition offers a technically correct and legally sound in-building radio system regulation template for inclusion in local fire codes. The issuance of this template has been expected for some time, and the template should make it much easier to incorporate such regulation into local fire codes, accelerating an already rapid adoption in the United States. (See Annex O: In-Building Public Safety Radio Enhancement Systems.)

What first responders say

For first responders, in-building systems to enhance radio signals may

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make the difference between life and death. Police, fire and EMS personnel are frequently called upon to respond to emergencies inside buildings and are often the first to know that a building has poor radio reception.

"We have been pushing for these in-building radio systems for some time," said Mark Barrick, a fire inspector for Montgomery County, Md. "They will definitely save lives."

What real estate developers say

However, the reality is that in the commercial development and construction world, someone must pay for the design and installation of these systems. In most cases, that burden falls on the real estate developer.

Mike Kearny, a senior vice president at The JBG Companies, one of metro D.C.'s largest and most respected developers, put things in perspective. "As a commercial real estate developer, [I always make] safety a top priority," he said. "These new in-building public safety radio requirements are like the advent of sprinkler systems several decades ago. Distributed antenna systems are now another part of the life-safety infrastructure of any new commercial building. The JBG Companies are proud to do their part to ensure first responder communications in our projects."

What RF design engineers say

As the rapid adoption of in-building public safety radio systems moves toward standard practice, there will be a groundswell of companies that desire to go after these projects. As a word of caution, these systems are not a matter of mounting antennas and pulling cable. These systems must be carefully designed to provide the correct signal coverage throughout the entire building. They must never degrade or interfere with the emergency communications system as a whole, and they must create an optimal "interference-free" in-building RF environment. For example, the careful planning of antenna positions allows for a low-attenuation

(Continued on page 37)

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We Be Jammin'?

Whether the purpose is to quiet cell phones in a church, theater or business; in one's personal space; or in a detention facility, the use of cell phone jammers in the United States is illegal.

By William Sill

The marketing, sale, and use of jamming devices that prevent, degrade or interfere with radio communications regulated by the FCC in the United States are unlawful unless sold to, or used by, the federal government. Currently, two distinct types of jammers are available in violation of the law and pose a threat to public safety and the ability for wireless subscribers to make and sustain their calls. The first type is mobile jammers sold to individuals under the guise of empowering them to keep cellular callers' conversations from bothering them in public places. The other type is intended to prevent calls at fixed locations such as theaters, restaurants and prisons.

Model XP6000WB from Taipei, Taiwan-based Infostream Technologies jams 3G/GSM/CDMA/Wi-Fi/Bluetooth. It also jams wireless cameras and body bugs. Illegal for use in the United States, the jammer sells online for $259 plus shipping, with a car charger included.

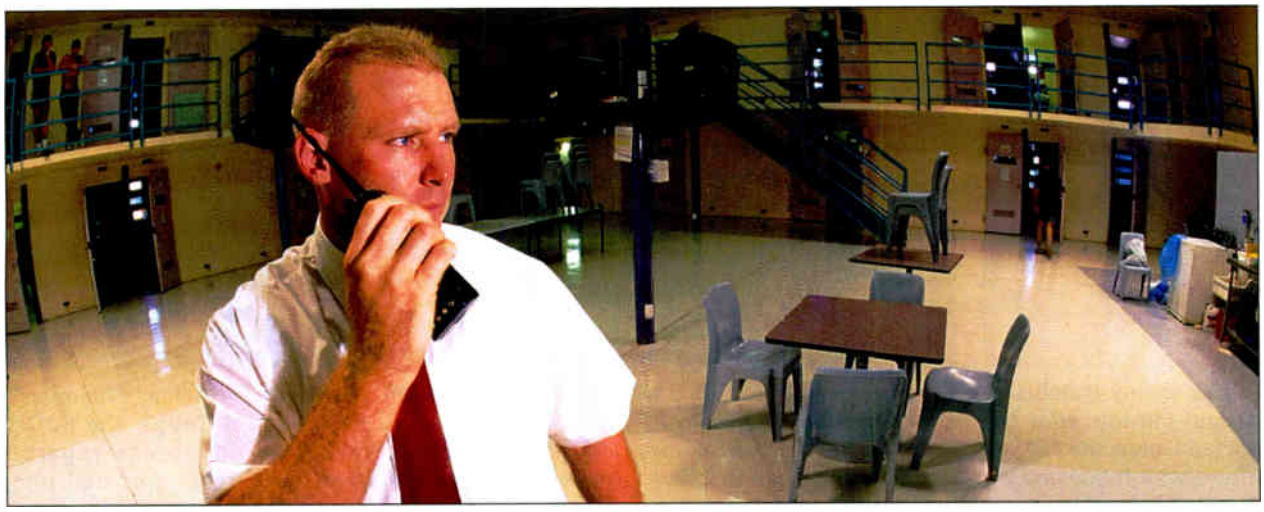
The ubiquitous use of jammers in the United States poses serious problems for public safety. A jammer is designed to flood the frequencies used by wireless devices with electromagnetic noise to impair communications within a range of 20 to 100 feet, depending on the size of the device. The widespread use of handheld jammers would lead to intermittent mobile dead zones in coverage that cannot be accounted for by network design. A wireless system could quickly have its hard-won reliability undermined, with the result that enhanced 9-1-1 distress calls and public emergency alerts could be dropped or never initiated. Public safety communications would similarly be jeopardized.

In addition to their immediate effect on wireless communications, jammers will exert a negative effect on wireless system reliability over the long term. Two of the cornerstones of the success of wireless in the United States have been first, the ability to provide reliable service, and second, the ability to provide service over an ever-increasing area. Jammers can destroy signal reliability instantly, and thereby undermine the confidence of subscribers in wireless technology. If consumer confidence were to erode over time, one would expect to see usage flatten or decrease with the concomitant flattening or decrease of carrier revenues. Although carriers would attempt to remedy the situation, the intermittent nature and mobility of jammers would frustrate these efforts.

The FCC, under the leadership of former Chairman Kevin Martin, appeared to be either insensitive to, or unconcerned by, the threat posed by jammers. During his tenure, the FCC showed a willingness to allow the limited use of jammers in state and local prisons notwithstanding the law. However, it appears that Acting Chairman Michael Copps may be reversing this disturbing trend. If true, this would be a welcome change, as lax enforcement sends the wrong message to sellers and users of jamming equipment to the detriment of the public, public safety and network operations.

Jammin' ain't legal

Section 333 of the Communications Act of 1934 states that "[n]o person shall willfully or maliciously interfere with or cause interference to any radio communications of any station licensed or authorized by or under this Act." The Act and the FCC's rules further provide that intentional radiating equipment not certified by the Commission cannot be sold, marketed or operated in the United States. Jammers, the FCC has found, are ineligible for certification because such equipment is clearly designed to interfere with radio communications in contravention of Section 333. The FCC has said that first-offense violations of the prohibition on the marketing, sale and use of jamming devices could result in fines of up to $11,000 a day for each violation and could subject the offender to criminal prosecution. A limited exception to the prohibition does exist to allow the



Boca Raton, Fla.-based GEO Group designs, builds, finances and manages corrections and detention facilities worldwide, such as the Reeves County Detention Complex in Pecos, Texas (lower photo, left) and the Rio Grande Detention Center in Laredo, Texas (lower photo, right). GEO Group has asked the FCC to permit state and local correctional authorities to use jamming devices at prisons and jails. Inmate possession of cell phones, while typically prohibited, according to GEO Group, is a widespread problem that "has impeded public safety, undermined law enforcement, [and] enabled inmates to conduct criminal activities while incarcerated and to intimidate members of the public, law enforcement and judicial personnel."

federal government to buy, and use, uncertified jamming equipment.

Easy to buy

If you are looking for a jammer, you need only visit the website of one of the many foreign businesses marketing such devices. An Internet search using the term "cellular jammers" resulted in 140,000 "hits" on Google. Many websites offering jammers are located outside the United States, particularly in the United Kingdom; however, they helpfully offer to ship jammers to America. (See *www.spymodex.com*, *www.globalgadgetuk.com*, and *www.thesignaljammer.com*.) An India-based business (*www.cell-phone-jammers.com*) states that it has "already shipped over 1,000 jammers to USA, UK and Europe in last six months to many satisfied customers." Other companies and individuals offer their jammin' wares on eBay.

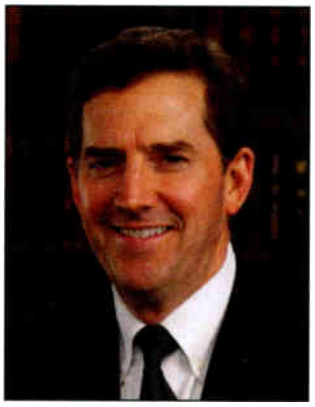
These websites extol the virtues of jammers, suggesting that jammers are being used to increase productivity in U.S. businesses and to discourage cheating at American universities. Others point out how much "fun" it is to disrupt the calls of those loud, pesky cell phone users:

"Well boys and girls of all ages, it's time to develop a god-complex with the ultimate tech toy: a cellular phone jammer.

"Some of you will be skeptical at first, but some of you will experience the same — dare we say it — nearly orgasmic feeling of being able to disconnect people from their cell phone calls on demand. We at autothing.com wished we could fly when we were ten years old, but we soon realized it was not humanly possible (thank goodness for the safety net!) This dream is for real however, as you really can teach people some phone manners without them knowing about it ..." *www.autothing.com/funthings/Tech%20Reviews/Cell%20Phone%20Jammer%20Review.htm*.

A British-based website, *www.phonejammer.com*, apparently continues to market jammers to the United States even though the FCC issued a citation against the company last September; this

Sen. Kay Bailey Hutchison (R-Texas) introduced a bill that would allow the FCC to grant waivers requested by state officials for the operation of jamming devices in correctional facilities.



Sen. Jim DeMint (R-S.C.) sent a representative to a CellAntenna jammer demonstration at a South Carolina state prison. He co-sponsored Sen. Kay Bailey Hutchison's related bill.

Under former Chairman Kevin J. Martin, the FCC looked favorably, or at least looked the other way, when it came to the use of cell phone jammers in correctional facilities.

Under Acting Chairman Michael Copps, the FCC did an about-face regarding the testing of cell phone jammers in prisons, turning down a request involving the District of Columbia jail.

suggests that further enforcement action is warranted.

FCC's shifting stance

Despite the serious public safety concerns, the FCC, under former Chairman Martin, softened the FCC's stance on the use of jammers in certain situations.

In the summer of 2007, CellAntenna and GEO Group filed petitions seeking authority to sell jamming equipment to discrete groups. Coral Springs, Fla.-based CellAntenna, which sells signal boosters and repeaters for indoor use and cell phone antennas for mobile and fixed locations,

sought a rule change to allow for the sale of jammers to state and local law enforcement agencies and emergency first responders, stating that the jammers were necessary to prevent terrorist attacks by disrupting the wireless detonation of remotely controlled explosive devices. Boca Raton, Fla.-based GEO Group, a private developer and manager of correctional facilities, asked the FCC to forbear from applying the existing prohibition to permit state and local correctional authorities to use jamming devices at prisons and jails. Inmate possession of cell phones, while typically prohibited, according to GEO Group, is a widespread problem that "has impeded public safety, undermined law enforcement, [and] enabled inmates to conduct criminal activities while incarcerated and to intimidate members of the public, law enforcement and judicial personnel."

Two trade associations, PCIA and CTIA, have publicly condemned the use of jammers. In November 2007, CTIA asked the FCC to affirm the prohibition on the sale and use of jammers except for those sold to, and used by, the federal government and to declare that violations will be prosecuted. PCIA's DAS Forum, in its November 2008 FCC filing, stated that "jammers pose significant interference problems for wireless infrastructure providers, including DAS network operators striving to deliver optimum carrier coverage in the network area."

Jammer demonstration conducted

CellAntenna moved aggressively to conduct field tests of its equipment. On Nov. 21, 2008 the company conducted a demonstration at a state prison in South Carolina. South Carolina prison authorities and CellAntenna have said that the demonstration showed that jamming equipment could be operated without causing interference to legal wireless operations as people could still make calls in a hallway outside of the room where the jammer was operated. The FCC did not attend the demonstration although it was invited. Pleas to the FCC and South Carolina Gov. Mark Sanford to prevent the demonstration went unanswered.

CellAntenna started planning tests in other locales, including Austin, Texas, and the District of Columbia. Prison authorities halted both tests. Texas prison officials canceled their test scheduled for Dec. 18, 2008, because they did not want to violate the law. In an ironic development, FCC spokesman Robert Kenny issued a statement *urging* Texas officials to move ahead with the test. In a follow-up statement, Mr. Kenny said, "My statement from earlier today was perfectly consistent with the way in which we responded to the test completed in a South Carolina prison last month. In fact, we chose not to act on a CTIA request asking us to stop the South Carolina test. Nor did we pursue any enforcement action in South Carolina, and see no reason to treat the testing of cell phone jammers in Texas prisons any differently."

Designed specifically for vehicle-mounted use, the Griffin jamming system from Enterprise Control Systems can be used to jam radio-controlled improvised explosive devices, for explosive ordinance disposal and RF communication jamming, The Griffin provides comprehensive, wide-frequency-range jamming, including 3G and wireless LAN, as a countermeasure to the increased incidence of terrorists using cell phone infrastructure to detonate remote-controlled bombs.

Jerry Strickland, a spokesman for the Texas attorney general, evidencing puzzlement, stated that "[o]nly in Washington can a federal agency encourage conduct it previously said was unauthorized." Similarly, CellAntenna's planned Jan. 8, 2009, demonstration at a Washington, D.C., jail was halted by the prison authorities in reaction to a writ of mandamus filed with the U.S. Court of Appeals for the District of Columbia Circuit seeking to halt the demonstration.

No precedential value

With the departure of Chairman Martin and the appointment Michael Copps as acting chairman, the FCC has performed an about face on the testing of jammers at prisons. On Feb. 18, 2009, the FCC's Wireless Telecommunications Bureau denied a request by CellAntenna for authority to test jamming equipment at a D.C. jail. The FCC said that it could not grant the request because the authority

sought violated the Act and the FCC's rules. The FCC further stated that the previous grant of authority on Jan. 2, under Chairman Martin's regime, "did not fully consider all relevant legal issues" and "therefore has no precedential value."

STA request

Seemingly undeterred, CellAntenna has stated that it will proceed with plans for additional demonstrations. "As a U.S. company, we're allowed to demonstrate technology," said Howard Melamed, CellAntenna CEO. On March 3, 2009, CellAntenna filed a request for special temporary authority with the FCC to conduct a 15-minute test on March 20, 2009, at the Pine Prairie Correctional Center in Louisiana. A private company pursuant to a federal government contract operates the prison. CellAntenna argued that the test should be allowed given the federal government use exception to the prohibition on jamming equipment.

The fallout from the CellAntenna's proposed and actual demonstrations has been felt as far away as Capitol Hill. Sen. Kay Bailey Hutchison (R-Texas) introduced legislation in January 2009 titled the "Safe Prisons Communications Act of 2009," S. 251. The bill proposes to amend Section 333 of the Act by allowing state officials to file waiver petitions with the FCC to operate wireless jamming devices in correctional facilities. The FCC would notify carriers of filed petitions and a publicly available database would be maintained containing information on petitions filed and their disposition. The bill requires the FCC to consider "whether the jammer would interfere with emergency or public safety communications outside the prison's walls" when determining whether to grant the request. Sen. Jim DeMint (R-S.C.), who had a representative attend the test in South Carolina, is a co-sponsor of the bill. As of the deadline for this article, the bill had only just been referred to the Senate Committee on Commerce, Science, and Transportation.

Jammers are illegal and dangerous. Given the serious public safety concerns over the widespread use of jamming devices, the FCC should make it clear through its actions and statements that the previous laissez-faire policy toward jammers is no longer the FCC's policy. Action should be taken to stop the sale of jammers anywhere on the Internet. If there is a valid public interest rationale for a limited use of nonmobile jamming systems, the issue should be considered by the FCC in the context of a rulemaking proceeding so that the concerns of the public, public safety groups and the industry can be carefully considered. agl

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UtiliSite Meeting Focuses on Collocation for Utilities

Conference speakers say wireless telecommunications antenna collocation on electric utility infrastructure could be a home run, but utilities must learn to play ball. Marketers, carriers, attorneys and utility representatives offer advice.

AGL Report

A strong revenue stream awaits in collocation of cellular antennas but only for utilities willing to work for it, speakers told the audience at the "Wireless Business Overview" session of the Utilities Wireless Collocation Summit 2009, conducted by the UtiliSite Council March 4–6 in San Diego, Calif. The session was one of 11 held at the confab, covering the issues surrounding collocating wireless antennas on utility infrastructure. Before an audience of nearly 60 at the three-day gathering, speakers addressed all aspects of collocation, from the business case to wireless technology advancements. Panelists also dealt with RF emission concerns and regulatory issues.

Demand for collocation

Mike Kampen, a principal with KGI Wireless, opened his presentation by asserting that any utility preparing a business case for collocation should be asking several questions, such as: Is it sustainable? What is demand going to look like now and into the future? Who are the potential clients?

"We are very bullish on the demand," Kampen said. "It is a great time to be in wireless. Even in the current economic environment, we are not seeing churn. We are not seeing folks turn in their wireless devices."

Kampen said the tower industry is expected to benefit from the ever-increasing number of subscribers, a number that has increased 9 percent year over year since 2005 with 22 million net new subscribers in 2007 and 16 million net new subscribers expected in data yet to be tabulated for 2008. And, he noted, similar growth is expected in the future.

"The wireless penetration rate is estimated to hit 94 percent by 2010. This should equal cell site growth to an estimated 249,000 in 2010. It all means more business opportunities," Kampen said.

Additional demand for tower collocations is expected from the deployment of next-generation 3G/4G wireless technologies and the build-out of the AWS and 700 MHz spectrum, according to Kampen.

Kampen also cited Clearwire, Leap Wireless, MetroPCS and Cox Communications as possible customers for collocation.

John Saboe, vice president for western region technical operations, Cricket Communications, noted that collocation benefits both carriers and utilities, providing the utility with revenue and increasing the coverage area for his company's customers.

"As one of the fastest-growing wireless carriers, our site portfolio will continue to expand, offering substantial revenue opportunities to motivated collocation partners," Saboe said. "Obviously there is a tremendous revenue stream here."

Total commitment is key

Saboe promised a "tremendous upside" for utilities that are willing to make the commitment to antenna collocations.

"Folks at certain utilities have really done a great job with collocation," he said. "It is because there is firm alignment between the executive business team and the frontline workers to make this a successful part of their business."

Therein lies the rub. Not every utility enjoys a top-to-bottom commitment to collocation, Saboe noted.

"It is still relatively difficult to do business with utilities," Saboe said. "Cricket generally avoids using utility locations due to costs, development timelines, site access and business complexity."

The problem, according to Saboe, is that although a business team at a utility might be all for collocation, the lower levels that really have to implement the collocation may not be as committed to the success of the project.

Saboe said Cricket Communications seeks partnerships with utilities that are similar to those it has with the major tower aggregators, which are cooperative in nature.

"Tower aggregators have dedicated customer support that we work with to solve these types of issues," Saboe said. "That is present in some utility providers but for the most part, we see a lot of folks that are not aligned on the opportunity."

Saboe noted that improvements could be made in some of the utility/carrier relationships in the areas of capital upgrade costs, tower locations and availability, timelines to construct,

lease terms and renewals, performance bonds, and maintenance — a situation that Saboe said could be remedied with a dedicated relationship manager.

"Dedicated relationship management and organizational alignment, if aggressively explored and addressed, would likely lead to quick resolution of other issues," Saboe said. "What I view as the business relationship manager's job is to make sure the business objectives of the utility are aligned with the folks who actually have to implement [the agreement]."

Jeff Frye, implementation director for the western region, ExteNet Systems, a distributed antenna system (DAS) provider, gave a detailed account of how utilities can modify their operations to become better collocation partners with DAS companies

From utility to utility and even within each utility, Frye explained, DAS providers enter a maze of different rules and regulations for collocation that slow down the deployment of pole attachments. "Greater consistency is key for utilities to better work with DAS providers," said Frye. "There are multiple departments and multiple cultures to navigate through to try to get everyone on board."

The first step is the attachment agreement. What does it take for a DAS provider to get a utility's approval to access their distribution poles, transmission poles, streetlights and duct work?

"Typically, in the utility world, we have to go through a separate different department and enter separate, individual agreements for each of these items we need to access," Frye said. "That is one of the things that slows us down and from getting to market."

Each utility has unique requirements — a different set of hoops for the DAS provider to jump through, if you will. There are different rules on what equipment — whether it is the antenna, radio cabinets or fiber — should be allowed on the pole. Some utilities will allow an antenna on the pole, but no radio cabinets. Some allow fiber to the pole but no equipment.

The other inconsistency is in fee structures. Some utilities charge by linear foot on the pole. Some charge per attachment. Some charge more for antennas and less for cabinets. If a joint pole association does not regulate it, then the fees vary across the board.

ExteNet ran into problems with a utility in San Diego concerning insurance. While attempting to gain access to the poles, the DAS provider was informed that it would need $500 million in insurance. "Even though everyone shook hands and agreed on this, [the insurance requirement] pretty much eliminates us from getting on the pole. That is a nonstarter for us," Frye said.

Inconsistencies also occur in planning and design of the system. The utility's people in the field sometimes

do not agree with the personnel who designed the equipment layout, which delays the project. The DAS provider then must facilitate the communication between the desk designer and the field personnel in order to resolve the issue, causing more delay.

"This is an area in which we are really struggling with utilities," Frye said. "Utilities don't seem to know whether they want to provide great service to the companies that attach to our poles."

Noting the irony, Frye said the biggest issue DAS providers have with utilities is securing power for the antennas. Although he prefers nonmetered, tariffed power, metered power flow is also acceptable.

"Some of the rates are reasonable and some are not. What stunts our growth is utilities that won't allow meters to be placed on their own poles. In those instances, we must go to a meter pedestal type of application, which triggers a whole new permit process to go through," Frye said.

Business opportunities

A number of solid business reasons make offering wireless collocation a good idea, according to speakers at the "Utility Collocation Business Opportunities" session. Reasons cited included incremental recurring and nonrecurring revenue streams, infrastructure enhancement and asset utilization, and the community benefits from nonproliferation of new towers.

The main reason to get into wireless collocation is the monthly recurring revenue stream. There is a lot of money in it, said Allan Bakalar, vice president and general manager, PT Access Networks.

"The way these leases are set up is with a five-year minimum initial term and four renewal options of five years," Bakalar said. "No sliding termination liability is permitted. Some do annual escalators and others do term-related escalators. It's nice to keep up with the cost of inflation." Modifications and optimizations will also increase the recurring revenue stream, he added, be it additional antennas or ground space for another generator.

Ranking with revenue in importance to a utility is being able to replace old, decrepit infrastructure on the carrier's dime. To attach their antennas, carriers may require the towers to be upgraded or replaced based on structural analyses (Rev. G) and, typically, the carriers will pay for these upgrades, Bakalar said.

Angela Castellano, manager, wireless division, SRP Telecom, agreed. "Another element that a utility may consider in contemplating this business is the inherent improvements you get in your core system," she said. "You have an opportunity to improve your system at the wireless carrier's expense."

In some cases, these towers are no longer being used by the utility. Collocation can lead to enhancements to

abandoned or underutilized infrastructure. "When you can convert otherwise useless assets into a revenue producer, that's always good," Castellano said.

Technology issues were addressed in the session "Backhaul: Yesterday, Today & Tomorrow," in which speakers discussed how the demand for IP capabilities will push migration from legacy backhaul network to new solutions that can handle the explosion of wireless data traffic.

Ron Mudry, CEO, Tower Cloud, talked about how the bandwidth explosions in cellular and Ethernet are transforming backhaul network requirements from no longer being just a T-1 business. These technological changes may spell backhaul market business opportunities for utilities, he said.

"A utility can become an end-to-end provider of backhaul service. More importantly, there is an opportunity to provide infrastructure and services to [existing third-party] backhaul providers. We need tower attachment leases. We want to come on to your towers. We need dark-fiber collocation services. A lot of you have affiliates that provide that," Mudry said.

Utilities that take the plunge into the collocation will need to be fluent in the regulations and safety issues that come into play.

The "Legal/Regulatory Update" session touched on ways in which government regulation influence a utility's ability to deploy new towers, manage collocation arrangements and set rates for access to utility-owned infrastructure.

Kevin M. Cookler, an attorney with McDermott Will & Emery, said utilities must be aware of the opportunities the stimulus bill provides, how the FCC's Nationwide Programmatic Agreement (NPA) applies to antenna-siting activities, and the possible changes in pole-attachment rules.

Klaus Bender, director of RF engineering, Utilities Telecom Council, said utilities should respect the danger inherent in RF energy and obey FCC and OSHA regulations that govern RF emissions and exposure levels at cell sites and in the workplace. Failure to comply, he noted, can result in personal injury, fines and lawsuits.

Other topics included best practices, the carrier's business case, next-generation wireless technologies and collocation contracts. The audience included representatives of utilities, DAS providers and wireless carriers.

Karnel Thomas, vice president of member services at the Utilities Telecom Council, said some non-members who attended the conference joined the UtilitSite Council afterward. "The conference demonstrated the value of the organization," he said.

Sixty-two registrants attended this year's conference. Next year's conference is set for March 17–19 at the Westin Diplomat in Hollywood, Fla. agl

Top 11 Ways
to Prepare for a Neighborhood Meeting

By Liz Walker

One step short of a 12-step program, this plan for site acquisition professionals to follow in preparing for a neighborhood meeting will help to satisfy jurisdiction and community concerns to achieve approval for wireless telecommunications sites.

Photo: City of Austin, Texas

A neighborhood meeting may help to allay concerns of those who reside near a proposed antenna site before a planning commission, zoning board or city council meeting where protesters may be more difficult to satisfy.

As wireless network development continues its deployment into residential areas, the neighborhood meeting is more often than not a necessary step in the zoning approval process. So why does the mere mention of a neighborhood meeting requirement in a zoning process strike fear in the heart of even the most seasoned site acquisition consultants? The term itself is pretty innocuous. What could be more friendly, fun, and relaxing then a neighborhood meeting? It's kind of like a block party, right? Preparing for and managing the neighborhood meeting, sometimes referred to as the community meeting, can be a valuable asset for the site acquisition professional permitting the site. Here are some tips that will help you make the most of your neighborhood meeting and give you the best chance of success for the planning hearings to follow.

1. Start with your planning case manager. First, talk to your planner and find out as much as you can about the meeting process. Determine who from the planning department or neighborhood will attend, and clarify the roles expected to be played by your client, your planner and yourself. A key question is: Who will run the meeting? In some jurisdictions, the consultant will be expected to start the meeting, control the agenda, field questions and conclude the meeting. In other jurisdictions, the planning representative may handle these responsibilities. Either way, the meeting preparation will be the same, but it's important to understand the process so there is no confusion at the meeting that could hurt your credibility with community members. After all, it is likely that this is not the first neighborhood meeting the community members have attended. Ask the planner what tools she recommends that you bring with you. What is the community expecting to see? Ask about past meetings regarding other wireless sites in this neighborhood and the jurisdiction as a whole. Ask about other real estate developments that this neighborhood or jurisdiction might be upset about. Other groups previously organized may be upset about a nonrelated development. Neighbors may show up angry to your meeting because of a perceived lack of control with respect to other developments. Maybe they couldn't stop the giant box store from going in down the street, so they are not going to let you or your client off as easy.

It should go without saying that you must follow the jurisdiction's notice requirements and carefully document the fact that you met those requirements. In some cases, an objection based on your failure to conform to meeting notice requirements may not prohibit your application, but you could fail to meet projected build dates by having to re-file or re-process your application. Send notices to meet the date deadline with a few extra days in mind. Hold the meeting at an accessible location and a reasonable time. List a start and end time on your meeting notice. If you run out of time, you can always have a second meeting, which is sometimes required, and it will reflect positively on you in the eyes of the planning department. Transparency with respect to your application and your accessibility to answer questions and listen to concerns can only help you with your community and when you appear in front of the board, the commissioners or both.

2. Enlist the help of your neighborhood liaison. Some jurisdictions will require that you work with the neighborhood liaison. Contact that person as early as possible, for instance, at the time you identify a candidate site, and include the liaison in the process to the greatest extent possible. The liaison can be your ally at the meetings and at hearings. Reaching out to the liaison and listening to the liaison's concerns will help you later on. Use the liaison as the valuable resource that the liaison is. Be interested in the liaison's knowledge, and ask questions such as:

- Who generally participates in neighborhood meetings?
- Who are the key people, individuals or groups?
- How established is the neighbor hood?
- Have other wireless facilities been proposed? If so, what was the result?
- What do they anticipate will be the neighborhood concerns?
- What recommendations do they have regarding time and place of meeting?

Transparency again is the key, so keep the neighborhood liaison in the loop with regard to the site development process. Inviting the liaison to the site walks will help the liaison understand the site development process and challenges. Challenging sites often have a complicated history. Including the liaison in the site design walks will give you an opportunity to explain the site's history and the alternative sites that may have been ruled out. Inform your client that the liaison will be attending the walks. Introducing your liaison to the entire site acquisition team is a great way to educate the liaison about site development and our industry. Having the liaison meet your talented team will bolster your team's credibility and will foster relationships between the people who work in the wireless industry

Preparing for a neighborhood meeting

1. Start with your planning case manager.
2. Enlist the help of your neighborhood liaison.
3. Take your team, and don't go it alone.
4. Consider requesting a meeting facilitator.
5. Discuss site specifics and benefits, including emergency services.
6. Explain the status of the application and the expected time frame.
7. Discuss coverage.
8. Address health concerns.
9. Prepare to discuss concerns about property values.
10. Plan for what to do when things don't go well.
11. Follow up.

Photo by Don Bishop

Let the community know the benefits of wireless telecommunications services, including statistics on emergency calls made from cell phones.

can diffuse tension in the meeting. The facilitator will usually set the rules for the meeting and emphasize that all will be heard but that everyone must be treated with respect. If someone gets out of hand or makes a personal attack, the facilitator can help manage that person and neutralize the situation. People sometimes behave better when the expectations of respect are set by a third party. The facilitator may also be able to help you keep track of issues and concerns that arise.

Explain the E911 requirements and the accuracy and benefit of locating emergency callers. Provide current statistics on the staggering number of 911 calls made from cell phones.

5. Discuss site specifics and benefits, including emergency services. Your initial presentation at the meeting should be clear and concise. Introduce yourself by stating your name and qualifications. Then introduce your team and its members' respective roles, and introduce any jurisdiction representatives present. Identify your client. Identify the location of the site by referring to maps and overhead photos, if available. Discuss the specifics of the site design. Have photo simulations with you that are large enough for people to see from a distance or bring additional copies to pass around. Bring large copies of your zoning drawings mounted on foam core to use during your presentation.

Let your community know the benefits. Describe the new or improved services that will be provided as a result of the additional or improved coverage. If your client has marketing materials available, bring them to the meeting and refer to them at this point.

Explain the E911 requirements and the accuracy and benefit of locating emergency callers. Provide current statistics on the staggering number of 911 calls made from cell phones. Ask those attending the meeting to think about how this has changed emergency response services. Before the meeting, contact emergency responders in the area and have them attend, if possible, to advocate for the site on this basis.

Some neighbors may claim a site is not needed because your competitor already has a site, and their carriers' coverage is fine. Ask whether people deserve to have options in their choice of services. Discuss industry competition and how that can benefit consumers.

6. Explain the status of the application and the expected time frame. The notice requirements often do not give the neighbors much detail about the proposed site. They may also be concerned that they were notified at the end of the application process. Some jurisdictions require a meeting before the application is even filed. If this is the case, let the neighbors know this. They are often relieved to know that the application hasn't been submitted yet or is in the early stages of the process. Assure them that you will do what you can to keep them in the loop as far as the application goes so they can

feel a part of the process. Bring your own sign-up sheet to record names, addresses, phone numbers and email addresses.

7. Discuss coverage. Neighbors are often concerned that the site won't work or that the site isn't really needed. Assure them that no one wants to waste time or money to build a site that doesn't work. Ask your RF engineer to prepare coverage maps well in advance of the meeting. The maps should show: (1) existing coverage without the site, (2) a map showing the expected coverage from the site combined with the other sites in the area, and (3) a map showing just the expected coverage from the site. Know in advance whether these maps are computer-simulated coverage or prepared from actual drive-test data. It's a good idea to enlarge the maps and have them mounted to foam core. This looks professional and makes them easy to work with. Make sure you have reviewed the coverage maps and understand what they represent. The maps should be up-to-date. Don't use an old coverage map that may not show coverage from recently turned on sites. Know whether your site is to improve capacity or provide coverage to an area. Be able to provide information about your client's sites in the area as well as your competitors' sites.

Expect that health concerns will be raised in a community meeting, and refer to your experts, including your RF engineer, for a response.

8. Address health concerns. Health concerns as they relate to sites are under the purview of the FCC, and a local jurisdiction cannot use health as criteria for denying an application for a site, although they can confirm that carriers meet the FCC requirements. That said, expect that this issue will be raised in a community meeting, and refer to your experts, including your RF engineer, for a response. It is usually best to let the jurisdiction representative explain the jurisdiction's review responsibilities and limitations to the community. Know beforehand how your planner will address or explain the exclusivity of the FCC as it relates to such issues. Provide resources to your community for self-education on these issues, including credible websites that can explain the safety of wireless technology.

9. Prepare to discuss concerns about property values. If you know the issue of property values is going to come up, prepare for it. Your planner may know from past experience that this issue will be raised. Find out from your client if they have resources or studies in the area that can address this red herring. If you find out from the planner that a community member will be raising this issue, ask to

speak to this person before the meeting and do some probing on how they formed this opinion. Where has a property loss been documented or occurred before? What was the actual loss in value? Who arrived at those numbers? When was the evaluation conducted? Ask questions to find out the basis for that person's opinion. If you have contrary resources available, present them to the individual at this time. If not, your best bet is to probe to find out the basis of the opinion. Most often, you will discover that the individual is worried about aesthetics, which is an issue that can be resolved in the ultimate design of the site.

10. Plan for what to do when things don't go well. When the community members start raising their concerns, make sure you ask them to introduce themselves before they make comments or ask questions. Ask: "What was your name sir? Where do you live? What do you do here for a living? How long have you lived here?" Learn about them and thank them for participating in the process. Acknowledge the fact that they care about their community enough to come out in the evening to attend this meeting.

If you have an exceptionally angry community, do not lose your cool. This can be difficult, especially if you come under personal attack. Try to prevent this by listening to concerns, repeating them back to the person, and note the concerns on the white or chalk board if available — the goal here is to let the person know they are being heard. Ask follow-up questions: "Why do you say that? Where did you hear that? Tell me more about that." Nothing you say at this point is probably going to sway this person. If someone is being abusive, your best bet is to keep them talking for a while. They won't expect that type of a reaction, and a bully will eventually lose credibility. Don't be afraid to take a break if things get heated. Discuss the possibility of an angry crowd or unruly person with your planning case manager and team in advance of the meeting, and come up with a plan to manage the situation if this happens.

11. Follow up. Be sure to follow up on any promises made during the meeting to provide information or status updates regarding the site. The goal of the neighborhood meeting is to create transparency with respect to the land use process. It helps people recognize their interest and responsibility with regard to the look and feel of their community. For site acquisition professionals, the neighborhood meeting is an opportunity to educate the community about our technology and leave them with a positive impression of our wireless community. agl

Liz Walker is a real estate specialist with Technology Associates International Corporation, a technology consulting company. She works in the Rocky Mountain Region. Her email address is *liz.walker@taic.net*.

(Continued from page 18)

radio link, thus greatly reducing fading effects. Excellent radio links are achieved with low downlink and uplink transmit power.

These in-building DAS systems should be engineered and installed by specialists who are competent and experienced in wireless communication, specifically those who have installed public safety systems in a variety of challenging or mission-critical environments. A valid FCC license should be made available if testing is to be done on frequencies other than police, fire or emergency medical frequencies. Many municipalities also require a professional engineering seal to complete the compliance paperwork.

The challenge for CRE developers and government organizations is to find expert and experienced vendors that can design an in-building enterprise system to ensure that the building is not only first-responder ready to the letter and spirit of the regulations, but also able to create efficient designs with cost savings in mind.

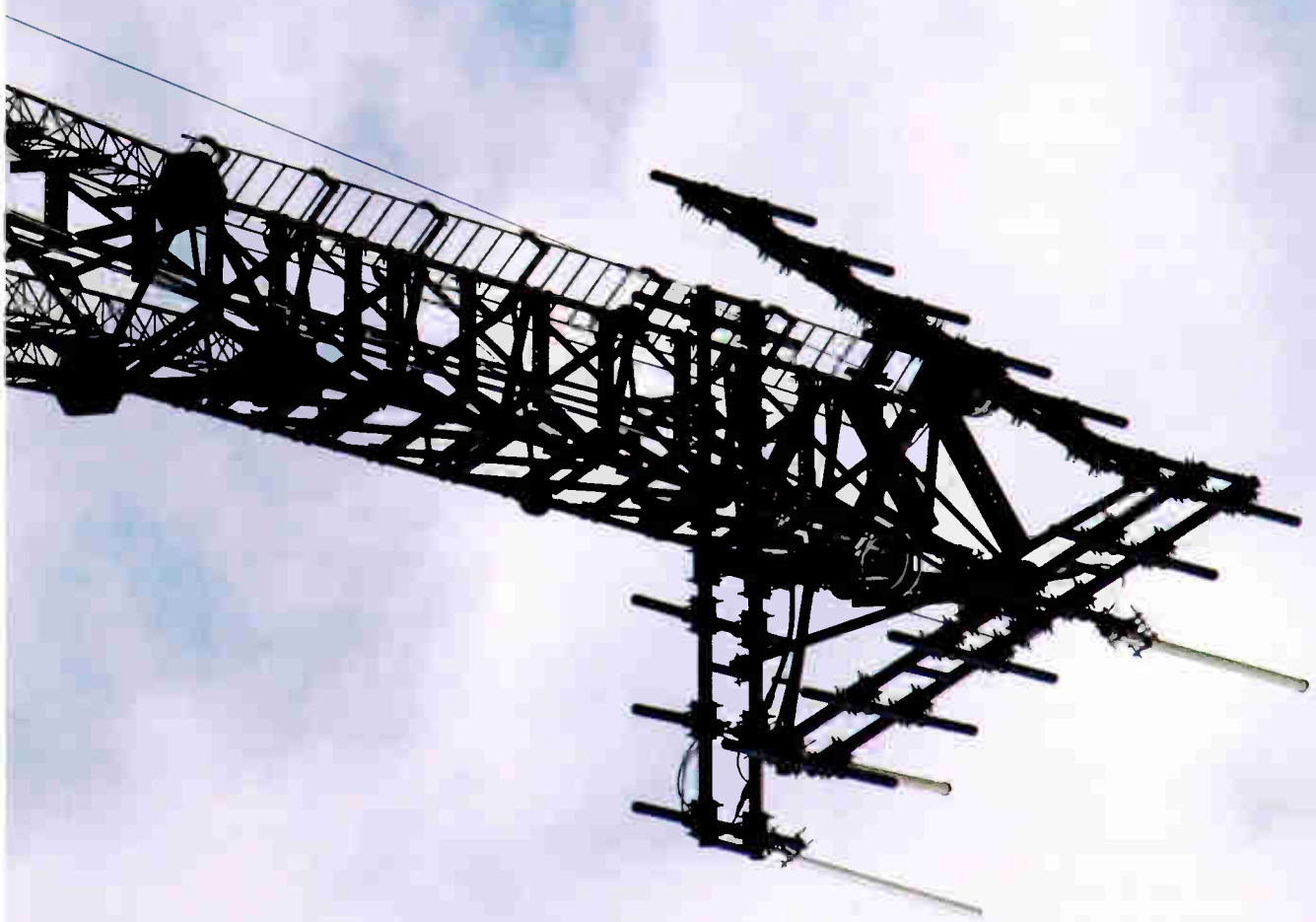
Emerging from a basement, a firefighter holds a portable two-way radio up in the air in an effort to establish a signal connection with the radio communications system. Photo source: Lord & Company Technologies.

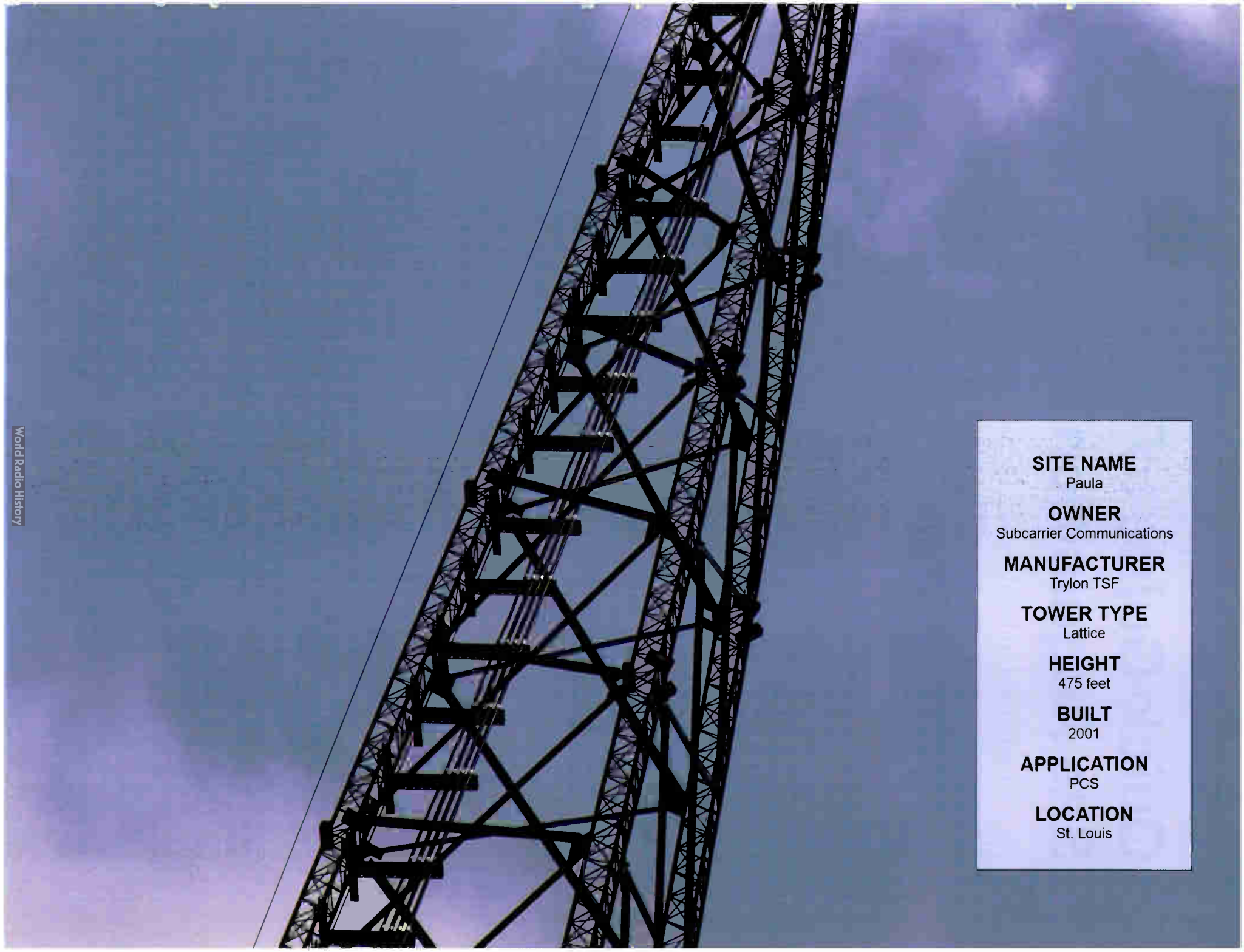
Want to know more about public safety radio systems and codes? Visit *www.apco911.org/services/bulletin.* **agl**

Bob Butchko is a partner and executive vice president of Lord & Company Technologies, a turnkey systems integration company that designs, installs, tests, certifies and maintains in-building wireless communications systems for public safety radio and commercial wireless. He is a public speaker and advocate for the in-building public safety regulations. See his IWCE 2009 presentation at *http://ecbiz43.inmotionhosting.com/~lordco5/news.htm*. His email address is *b.butchko@lordcotech.com*.

AGL TOWER OF THE MONTH

JUNE/JULY





SITE NAME
Paula

OWNER
Subcarrier Communications

MANUFACTURER
Trylon TSF

TOWER TYPE
Lattice

HEIGHT
475 feet

BUILT
2001

APPLICATION
PCS

LOCATION
St. Louis

Quick-Guide to Site Acquisition Companies

As a supplement to the January Buyers Guide issue, a list of site acquisition companies offers more detail to help you choose a vendor for your projects.

a berliner communications company

BCI Communications
97 Linden Ave.
Elmwood Park, NJ 07407
Sales Contact: Lorin A. Perow
perowl@bcisites.com
Phone: (201) 791-3200
Fax: (201) 794-8974
www.bcisites.com
Acquisition Services: Tower, Rooftop, DAS
Other: RF Propagation Studies, Site Selection, Title Service, Zoning/Permitting, Site Design, Site Prequalification, Environmental Assessments, Site Survey, Right-of-way Procurement, NEPA Checklist, Lease Acquisition, Land Acquisition, Geotechnical Analysis, Construction Planning, Tower Mapping, Site Security Evaluation, Grounding Design, Construction Management, Green Energy Technologies
Company description: BCI Communications is a nationwide, self-performing, full turnkey service vendor to the wireless community. With more than 14 years of experience, 20 locations across the United States and 375 employees, BCI designs, builds and installs cell sites and site equipment. In 2008, BCI launched two new groups: the Green Energy Group and the Cable Services Group.

Capital Telecom
1500 Mt. Kemble Ave., Ste. 203
Morristown, NJ 07960
Sales Contact: Bert Stern
bstern@capitaltelecomsites.com
Phone: (215) 803.4858
www.capitaltelecomsites.com
Acquisition Services: Tower
Site Selection
Lease Acquisition

CMX Telecommunications
3550 Buschwood Park Drive, Ste. 270
Tampa, FL 33618
Sales Contact: Martha Penton
mpenton@cmxengineering.com
Phone: (813) 781-6809
Fax: (813) 932-7383
www.cmxengineering.com
Acquisition Services: Tower, Rooftop, DAS
Other: RF Propagation Studies, Site Selection Title Service, Zoning/Permitting, Site Design, Site Prequalification, Environmental Assessments, Site Survey, Right-of-way Procurement, NEPA Checklist, Lease Acquisition, Land Acquisition, Grounding Design, Construction Management, Balloon Tests, Photo Sims, Project Management, Construction, Power, Telco Coordination, Site Audits, Post-construction Inspections, Bid Management, Geotechnical Analysis, Construction Planning

Faulk & Foster
1811 Auburn Ave.
Monroe, LA 71201
Sales Contact: Lee Burlison
lee.burlison@faulkandfoster.com
Phone: (318) 325-4666
Fax: (318) 807-2707
www.faulkandfoster.com
Acquisition Services: Tower, Rooftop, DAS
Other: Site Selection, Site Design, Site Survey, Lease Acquisition, Construction Planning, Zoning/Permitting, Title Service, Site Prequalification, Right-of-way Procurement, Land Acquisition, Construction Management, Lease Administration, Program Management
Company description: Faulk & Foster is a national provider of real estate consulting services specializing in:
- real estate acquisition
- leasing
- zoning
- permitting
- program management
- lease administration
- sublease management
- regulatory compliance
- construction management services
- property management

The company has been serving the real estate and communication industry since 1945. For additional information please contact Brooke Irby at brooke.irby@faulkandfoster.com or Lee Burlison at lee.burlison@faulkandfoster.com or (800) 779-0495.

Goodman Networks
6400 International Parkway, Ste. 1000
Plano, TX 75093
Sales Contact: Kathleen Willard
kathleen.willard@goodmannetworks.com
Phone: (415) 370-4511
www.goodmannetworks.com
Service Area: National
Acquisition Services: Tower, Rooftop, DAS
Other: RF Propagation Studies, Site Selection, Title Service, Zoning/Permitting, Site Design, Site Prequalification, Environmental Assessments, Site Survey, Right-of-way Procurement, NEPA Checklist, Lease Acquisition, Land Acquisition, Geotechnical Analysis, Construction Planning, Tower Mapping, Site Security Evaluation, Grounding Design, Construction Management

Lyle
3140 Gold Camp Drive, Ste. 30
Rancho Cordova, CA 95670
Sales Contact: Mani Kontokanis
mani@lyleco.com
Phone: (866) 434-5953
Fax: (916) 266-7001
www.lyleco.com
Acquisition Services: Tower, Rooftop
Other: Site Selection, Zoning/Permitting, Site Prequalification, Right-of-way Procurement, Lease Acquisition, Land Acquisition, Construction Planning, Construction Management

Mobile Relay Associates
15330 Vermont Ave.
Paramount, CA 90723
Sales Contact: Joyce Peters
joyce@mra-raycom.com
Phone: (323) 636-5202
Fax: (562) 408-1892
www.mra-raycom.com
Service Area: One or more cities/counties
Acquisition Services: Tower
Other: RF Propagation Studies, Site Selection, Site Design, Site Prequalification, Site Survey, Lease Acquisition, Tower Mapping, Site Security Evaluation

Powder River Development Services
2523 E. Garfield St., Ste. A
Laramie, WY 82070
Sales Contact: Chase Turner
chase.turner@powderriverdev.com
Phone: (307) 742-9416
Fax: (307) 742-6280
www.powderriverdev.com
Acquisition Services: Tower, Rooftop, DAS
Other: Site Selection, Zoning/Permitting, Site Prequalification, Site Survey, Right-of-way Procurement, Lease Acquisition, Land Acquisition, Construction Management

Rocky Mountain Telecom Solutions
P.O. Box 162
Spangle, WA 99031
Sales Contact: Jerry Newman
jnewman@rockymts.net
Phone: (509) 443-0479
Fax: (509) 443-6192
Acquisition Services: Tower, Rooftop
Zoning/Permitting, Environmental Assessments, Site Security Evaluation, Site Design, Site Survey, Lease Acquisition, Construction Planning, Right-of-way Procurement, Land Acquisition, Construction Management, Grounding Design, Project Management Services

SBA Network Services
5900 Broken Sound Parkway NW
Boca Raton, FL 33487
Sales Contact: Johnny Crawford
jcrawford@sbasite.com
Phone: (843) 324-9732
Fax: (561) 226-9368
www.sbasite.com
Acquisition Services: Tower, Rooftop, DAS
Other: RF Propagation Studies, Site Selection, Title Service, Zoning/Permitting, Site Design, Site Prequalification, Environmental Assessments, Site Survey, Right-of-way Procurement, NEPA Check List, Lease Acquisition, Land Acquisition, Geotechnical Analysis, Construction Planning, Tower Mapping, Site Security Evaluation, Grounding Design, Construction Management

Site ID
1060 First Ave., Ste. 400
King of Prussia, PA 19406
Sales Contact: Michael Shine
mshine@siteidinc.com
Phone: (610) 768-8039
Fax: (610) 337-9548
www.siteidinc.com
Acquisition Services: Tower, Rooftop
Other: Site Selection, Zoning/Permitting, Site Prequalification, Site Survey, Right-of-way Procurement, Construction Management, NEPA Checklist, Lease Acquisition, Land Acquisition, Tower Mapping, Site Security Evaluation, Tower Build-to-suit

Subcarrier Communications
139 White Oak Lane
Old Bridge, NJ 08857
Sales Contact: John Paleski
john@subcarrier.com
Phone: (732) 607-2828
Fax: (732) 607-1390
www.subcarrier.com
Acquisition Services: Tower, Rooftop
Other: RF Propagation Studies, Site Selection, Title Service, Zoning/Permitting, Site Design, Site Prequalification, Environmental Assessments, Site Survey, Lease Acquisition, Land Acquisition, Geotechnical Analysis, Construction Planning, Tower Mapping, Site Security Evaluation, Grounding Design, Construction Management, Tower Construction, Sweep Test, System Installation, Right-of-way Procurement, NEPA Checklist
Company description: Subcarrier Communications has been providing rooftop and tower site management for over 25 years, bringing together a team of professionals to offer comprehensive site acquisition, development, and long-term management services. We also provide building and tower owners with planning and design services, lease negotiations, installation, and maintenance of telecommunications sites.
See our advertisement on the back cover.

Tower Economics
700 Route 130 N. #204
Cinnaminson, NJ 08077
Sales Contact: Leonard B. Stevens
len@towereconomics.com
Phone: (856) 786-7200
Fax: (856) 786-7450
www.towereconomics.com
Acquisition Services: Tower, Rooftop, DAS
Other: Site Selection, Zoning/Permitting, Site Design, Site Survey, Right-of-way Procurement, Lease Acquisition, Land Acquisition, Geotechnical Analysis, Construction Planning, Tower Mapping, Grounding Design, Construction Management
See our advertisement on page 13.

Tower Maps
38659 Bolington Road
Lovettsville, VA 20180
Sales Contact: David Ward
info@towermaps.com
Phone: (540) 822-5092
Acquisition Services: Tower, Rooftop
Other:Tower Mapping

TowerSource
3214 Blackwood Place
Colorado Springs, CO 80921
Sales Contact: Mary Carlile
mary@towersource.com
Phone: (610) 284-9289
www.towersource.com
Acquisition Services: Tower, Rooftop, DAS
Other: Site Selection
Company description: TowerSource is an on line vertical asset market exchange firm, which offers customizable dedicated portals that serve as a clearinghouse providing listing, location, mapping, ownership details and data mining specific to vertical assets used in the telecommunications industry.
See our advertisement on page 15.

WFI
1840 Michael Faraday, Ste. 240
Reston, VA 20190
Sales Contact: David Porte
david.porte@wfinet.com
Phone: (703) 563-7127
Fax: (703) 563-7200
www.wfinet.com
Acquisition Services: Tower, Rooftop, DAS
Other: RF Propagation Studies Site Selection, Title Service, Zoning/Permitting, Site Design, Site Prequalification, Environmental Assessments, Site Survey, Right-of-way Procurement, NEPA Checklist, Lease Acquisition, Land Acquisition, Geotechnical Analysis, Construction Planning, Tower Mapping, Site Security Evaluation, Grounding Design, Construction Management, RF engineering, Microwave network design and installation, In-building and venue design and installation

PUBLIC SAFETY WIRELESS TRENDS

The trend toward greater public safety use of commercial wireless data systems is expected to continue. Agencies will, and are encouraged to, demand the grades of service needed to support their missions.

By Dan Hawkins

Public safety agencies have long relied on wireless data systems for vital communications needs. Police, fire and emergency medical service providers have used tone-encoded signaling and simple digital modulation schemes to transmit data throughout most of their 75-year history of using two-way radio. Strictly speaking, they have used constant-wave (CW) keying even longer than any voice-modulation mode, establishing digital data communications as first in time. Today, however, a renaissance is taking place both in the technologies used and in business needs being met.

Over the past several decades, private radio technologies dominated the U.S. public safety marketplace as agencies chose almost universally to build their own wireless data systems. Nearly all ran on 25-kilohertz-wide voice channels, resulting in very limited data rates. Systems running at 4800 bits per second (bps) or less were common. While some are still in existence today, those built within the past decade were most commonly running at 19.2 kbps. Given the long product and purchase lifecycles in the public safety market, it should come as no surprise that these systems are still widely in use, despite such low data rates — and over a shared medium, no less.

Today, the rush to broadband wireless services in commercial and consumer markets is apparent among public safety agencies. We increasingly see agencies shutting down their private radio systems and turning to commercial carriers in pursuit of data rates unattainable from traditional mobile data technologies or without an extensive, costly build-out of cellular-like infrastructure.

While a few notable jurisdictions here and there are building mesh networks and pushing the envelope with mobile use of IEEE 802.11 and 802.16 protocols, they are the newsworthy exceptions more than the rule. Few jurisdictions nationally have the population density and resultant tax base necessary to fund these expensive projects. More commonly, jurisdictions are jumping to commercial carriers as they see 3G cellular coverage expanding well beyond business corridors, routinely offering the promise of several-hundred-kilobit and even megabit-plus speeds to emergency response vehicles.

Public safety agencies such as fire departments have relied on wireless data systems for many years. Photo by Scott Dolash.

The allure of reduced capital expenditures influences the trend, but regulatory developments also have had an effect. "Refarming" of radio frequency spectrum below 512 MHz in the United States will bring spectrum-efficiency requirements of at least 19.2 kbps in 25-kilohertz-wide channels (4800 bps in 6.25 kilohertz of spectrum). While technology is readily available to meet and exceed this threshold, even if still relatively modestly, the supported data rates do not support modern application needs. Little new interest in these technologies is seen.

Agency-owned systems

Beyond sub-dialup speeds, wideband technologies targeting 50- to 150-kilohertz-wide channels once offered promise for agency-owned systems. Plans to use in the 700 MHz frequency band were dealt a serious blow in the latter half of 2007 when the Federal Communications Commission released long-awaited rules restructuring 700 MHz spectrum to be freed upon the transition to digital television.[1] The details of this restructuring are a story or two unto themselves.[2]

In short, the FCC consolidated the band to produce a 10-megahertz-wide segment primarily for public safety broadband data, making the wideband channels secondary. This spectrum was subsequently licensed to a nationwide entity named the Public Safety Broadband Licensee, or PSBL. The FCC defined a

future, innovative partnership between the PSBL and the auction winner of another 10 megahertz of spectrum referred to as the D Block. Public Safety Spectrum Trust, a newly created, nonprofit corporation formed for this opportunity, became the PSBL prior to the D Block auction in late 2007. FCC rules established that, upon the awarding of the D Block license and successful negotiation of a Network Sharing Agreement, the PSBL and auction winner could share spectrum in a unique public/private partnership.

Minimum bid not met

FCC Auction 73 for 700 MHz spectrum was conducted in early 2008. It did not generate a bid exceeding the $1.33 billion minimum established for the D Block. By contrast, other blocks of the band auctioned at the same time yielded nearly $19 billion, almost double the original projections. The failed auction was followed by months of finger-pointing and the growth of competing interests.

The D Block has not been reauctioned nor otherwise licensed. Consequently, there is no partner with whom the Public Safety Spectrum Trust can leverage the value of its 10 megahertz of spectrum. Its original vision of a partnership whereby access to the spectrum and a defined market would lead to the commercial development of a nationwide broadband wireless network suitable for public safety has been unrealized.

Through public statements, the Public Safety Spectrum Trust (PSST) remains committed to a public/private partnership. It has sought funding through federal economic stimulus programs to spur construction of the network and worked with the FCC to modify rules for a potential re-auction of the D Block.

Regional licenses

Much has occurred in the intervening year. Late last September, the FCC adopted a Third Further Notice of Proposed Rulemaking[3] that proposed altering auction rules to allow regional licensees if they would result in greater population coverage and auction proceeds. Final rules are expected to force through another auction a technology choice between LTE or WiMAX. However, this is up in the air, so to speak. A change of administration in Washington, D.C., resulted in the departure of Kevin Martin, who presided over the Commission during development of the partnership concept, and Derek Poarch, first chief of the FCC Public Safety and Homeland Security Bureau, who was the Commission's point man for public safety.

Outside of the Beltway, several large, local jurisdictions have been pushing Congress and the FCC to modify rules to allow them to build their own broadband systems in the frequency band. PSST officials have testified before Congress that funding available to these jurisdictions does not exist elsewhere, and only a national effort will serve to both meet needs and ensure interoperability.[4]

Time will tell how competition for this vital and valuable spectrum will play out, but it appears to be undisputed that nationwide, public safety agencies do not have the resources to build out their own broadband wireless systems. A counterargument is that given the resources, agencies would not compromise critical communications services by outsourcing them. Time is telling a different story, however, as more and more public safety agencies nationwide are moving systems from the slow, aging infrastructure that they own to commercial broadband services that they rent.

Own versus rent

Regulatory activities will invariably shape the own-versus-rent playing field for public safety broadband wireless, but decisions by most agencies will be made less on the availability of spectrum and the potential, future nationwide systems than on immediate economic and technical necessities. A nationwide or even regional system operated to public safety standards of availability, reliability and security would certainly be appealing over more commercial offerings, but the market is very margin-sensitive. How much of a premium agencies would pay is a key question.

About SEARCH

SEARCH, the National Consortium for Justice Information and Statistics, is a nonprofit organization of the states founded in 1969. Its staff members work under multiple federal grant programs providing technical assistance to recipients of information sharing and communications interoperability grants. This work allows staff the opportunity to observe, research and work with many types of communications and information systems across the country.

Growth and expansion of commercial broadband services in recent years leave today's public safety agencies comfortably in the mainstream with their moderate expectations being outpaced by the broader market. Trends toward the use of commercial services may slow as experience grows, though. For example, wireless carriers may not be as stable as public safety agencies expect them to be.[5]

A general economic downturn, declining tax revenues for public sector subscribers, and a brutal capital market will lead some broadband providers to decisions that ultimately tighten the coverage and quality of the service envelopes pushed by public safety. A contraction in that broader market will necessarily lead to less capacity growth, less coverage expansion, and perhaps slower effective data rates as margins tighten. Where economic self-interest may have led the agencies to commercial services, the realities involved with the use of a shared resource outside of their control will undoubtedly cause the pendulum to swing back in some cases.

In the end, practical considerations lead public safety agencies to their technology choices. SEARCH has published the chart shown in Figure 1 to help jurisdictions determine whether they should own or rent their own wireless data communications systems.[6] Two classes of agency-owned systems are examined

Wireless Data Communications Rent or Own Decision Factors

	Speed			Availability			Reliability		
	Rating	Pro	Con	Rating	Pro	Con	Rating	Pro	Con
Build Using Specialized Public Safety Technologies	–	No nosebleeds	Data speeds at 1% to 5% of alternatives; improved coding techniques and software yield little relative improvement	+	Coverage designed for agency requirements	Design, construction, and implementation of networks takes time	+	Stable, dependable technologies built for the rigors of public safety use	Capacity is very low relative to alternatives and difficult to increase significantly
Lease Commercial Services	+	The fastest wide-area alternatives are available soonest	Technoogy turnover brings new user equipment and installation costs	–	Existing networks means systems can be brought up more quickly	Coverage is designed for broader market needs; reduced coverage in rural and isolated urban areas	–	Highest capacity, typically, due to sharing with other users	Capacity is designed for broader market needs; reduced capacity in rural and isolated urban areas; ruggedized user equipment may be required at higher cost
Build Using Broadly Available Technologies	✔	Much faster than traditional, specialized public safety technologies	Turnover of consumer and industry technologies is faster than specialized technologies traditionally used by public safety	✔	Coverage designed for agency requirements	Design, construction, and implementtion of networks takes time; coverage is typically spotty compared to traditional networks; wide area coverage is expensive	✔	Capacity designed for agency requirements that can be increased relatively easily	High capacity to meet surge needs requires overbuilding; ruggedized user equipment may be required at higher cost

Figure 1. Rent or own alternatives and factors.

separately, based on whether they use specialized public safety or broadly available commercial technologies. Factors by approach are assigned a net positive (+) or negative (–) rating based on the balance of pros and cons. Factors rated with check marks are considered acceptable compromises.

This analysis suggests that agency-owned systems using broadly available (nonspecialized) technology is the compromise choice. However, cost appears to be the determining factor.

As an industry, public safety has a mixed history of use and adoption of new communications technologies. It foresaw trends toward digital voice radio and was in the vanguard pushing Project 25 (P25 or TIA/EIA-102) for its share of the private radio marketplace. Development of standards and adoption of the technology have been slower than expected, primarily due to long system lifecycles following sparse funding of new systems. Once promoted as offering an alternative to proprietary data protocols, P25's 9600 bps raw data rate and 4800 bps throughput numbers have discouraged its use for much more than over-the-air rekeying and reprogramming.

Generally speaking, public safety has lagged more than led the wireless data market. This trend is expected to continue as the need for mission-critical voice communications in the form of traditional push-to-talk radio continues to predominate. Agencies widely recognize the value of off-loading congested voice channels through the use of data systems for dispatch, standard information inquiries and status reporting. However, as long as they rely foremost on voice systems, there is an internal competition for resources. Shortening product lifecycles for voice radio systems will also inevitably reduce wireless data demand, particularly capital expenditures, because of the economic realities of limited budgets.

Our crystal ball has been known to fog up, but trends toward greater public safety use of commercial wireless data systems are expected to continue. Agencies will, and are encouraged to, demand the grades of service needed to support their missions. If a national broadband wireless network becomes available with such a standard offering, other carriers will respond in-kind to some extent, providing healthy competition.

Until standard metrics for evaluating what is today characterized mostly euphemistically as "public safety grade," cost will continue to be the biggest

– = Detracting Factors + = Attractive Factors ✔ = Acceptable Compromises

Security			Support			Costs		
Rating	Pro	Con	Rating	Pro	Con	Rating	Pro	Con
✔	Relatively obscure technologies lead to a bit more security	Staples of modern network security, such as Virtual Private Networks (VPNs) and advanced authentication, are difficult or impossible to use	–	Relative reliability of equipment leads to reduced suppor needs	Heavy reliance on vendors for information, even with internal support		Easily predictable initial costs; long product lifecycles	Limited market for the technology increases initial costs; ongoing maintenance costs can be high, mainly for vendor maintenance contracts, licenses, internal labor, and contracted services
✔	Broadband provides IP and other standards supporting modern network security measures	Common use and widely available information on technologies used increases vulnerabilities	+	Least amount of internal support required; broad usage means there is widely available community support	Lack of internal expertise and support leads to vendor dependence		Predictable costs that may be negotiated and contracted; lowest internal labor costs; other markets find wide-area commercial services cost-effective	Recurring costs, typically monthly; shortest lifecycles for user equipment; most rapid migration of technologies, adding to costs
✔	Broadband provides IP and other standards supporting modern network security measures	Widely available information on technologies used increases vulnerabilities	✔	Wide range of community support	Internal expertise requires continuous study; commercial user technologies are less rugged		Wide availability of technology reduces purchase, operations, and maintenance costs	Ongoing maintenance costs can be high, mainly for labor or services; relatively rapid equipment lifecycles

$ Cost factors vary by implementation. Initial and ongoing costs should be evaluated over comparable system lifecycles and assessed based on requirements met. Absolute dependence on any one or more requirements may lead to acceptance of higher costs.

Figure 1. (Continued)

determinant of where agencies go for broadband wireless data. **agi**

Dan Hawkins is a staff member of SEARCH, where he has worked for the past five years, following a 20-year career in local and state government and a short stint with Biby, Inc., doing RF modeling with geographic information systems. He is a life member of the Association of Public-Safety Communications Officials Int'l. He serves as the association's representative and user committee chair for Project MESA, an international partnership developing broadband wireless standards for public safety and disaster relief. His email address is *dan@search.org*.

Footnotes

1. FCC Second Report and Order on PS Docket 06-229. See *http://fjallfoss.fcc.gov/edocs_public/openAttachment.do?link=FCC-07-132A1.pdf*.
2. For further details, see "A Brave New World of Public Safety Broadband" *Public Safety IT*, September 2007 (*www.hendonpub.com/resources/articlearchive/details.aspx?ID=4186*) and "Defining a Broadband Wireless Future" *Public Safety IT*, November 2007 (*www.hendonpub.com/resources/articlearchive/details.aspx?ID=4264*), both by the author.
3. See *http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-285630A1.pdf*.
4. John Contestabile testimony before the U.S. House of Representatives Subcommittee on Emergency Communications, Preparedness and Response, September 16, 2008. See *www.psst.org/documents/PSSTContestabileTestimony091608.pdf*.
5. "Sprint Nextel: The Canary in Wireless's Coal Mine," *BusinessWeek*, February 20, 2009. See *http://tinyurl.com/aog2go*.
6. Dan M. Hawkins, *Law Enforcement Tech Guide for Communications Interoperability: A Guide for Interagency Communications Projects*, Washington, D.C.: U.S. Department of Justice Office of Community Oriented Policing Services, 2006.

WHAT SIMULCAST IS ... AND WHAT IT ISN'T

Our radio manager keeps referring to his magic 'simulcast system.' I wonder what he's talking about ...

By Ed O'Connor

In the IT world, you have unicast, anycast and multicast, but no simulcast. Simulcast is a contraction of the words *simul*taneous and broad*cast*. In many municipalities, simulcast offers a way to work within the FCC power limits and channel availability to cover a greater geographic area than a single transmitter can reach. Other municipalities employ simulcast technology to help signals penetrate structures by bombarding them with matched RF from multiple directions. Multiple identical transmitters are installed around the area, which could be a city or county, for example, and are set up so they perform as though they were one big transmitter.

Simulcast is a spectrally efficient technology used to cover wide geographies with a limited number of channels. Operationally, it is easy to use for dispatchers and field personnel; nevertheless, simulcast is technically demanding and moderately costly to implement.

When the strength of one simulcast transmitter is much higher than all the other transmitters on the same frequency, the receiver in field unit (mobile or portable) captures the transmitter with the higher power. When signals from two or more transmitters are received at about the same strength, the field receiver sums the audio signals. The area where signals from two or more transmitters are of roughly equal strength is referred to as the *noncapture area* or the *overlap zone*. For communications to be intelligible in the overlap zone, each transmitter's modulation and frequency must be identical.

Modulation

Making simulcast work seamlessly requires transmitters to be truly identical. That is usually accomplished by precisely adjusting modulation levels so the exact same audio frequency and amplitude creates the exact same transmitter modulation out over the air. Additionally, modulation for either trunking data or low-frequency tones to open up the radio receiver must be precisely matched.

Because the audio takes different length paths to each remote site, the path to each site must be precisely delayed so that the audio reaches the center of all overlaps at the same time. For simulcast to work, tolerances of 20 millionths of a second to 70 millionths of a second must be held for 9600 baud and analog audio, respectively. If the paths these signals are traveling do not have exactly the same frequency-response characteristics, the amplitude and group delay of each line must be equalized across the frequency band.

Frequency

For simulcast to work, each transmitter's carrier frequency must be exactly the same. If you have UHF transmitters (470 MHz range), the carriers must be within 0.5 hertz of one another. In the 1970s, when simulcast was first attempted, matched crystal oscillators were utilized. Since the 1990s, simulcast systems have used GPS receivers to provide ultra-accurate frequency and timing references.

Voting

Other than paging systems, which are usually one-way transmit systems, all simulcast systems are voted. Voting means that the receive audio (audio transmitted by mobiles and portables) from all the remote sites is brought back to a voter comparator shelf at the main site. The voter comparator continuously picks the best incoming audio, sends it to the dispatch consoles, and may send it back out to the transmitters so it will be repeated out over the air.

Site linking

Most simulcast systems are connected by digital microwave. To increase reliability, some are *looped*, a short way of saying *loop-protected systems*. Because of path availability

and cost considerations, other backbones are configured in a hub-and-spoke topology, sometimes with hot-standby radios. Telco T1 links, fiber networks and single-channel RF interconnection are all acceptable ways to link simulcast sites. Telco 4-wire phone circuits and analog microwave require special attention to detail and may periodically drift out of tolerance on their own. The packet-based, asynchronous nature of IP connectivity makes it difficult to maintain simulcast tolerances at this time.

OEM systems

Motorola has had four major generations of simulcast equipment. In the early 1980s, the company used Starplex/Starpoint analog microwave equipment and a prime optimization node computer to set delays. In the late 1980s, digital simulcast modules (DSM) were installed in Siemens T1 channel banks. By the mid-1990s, Motorola upgraded to GPS-aligned DSM-II modules that were installed in TeNSR Premisys (now Zhone) T1 channel banks. In recent digital P25 systems, Motorola optimizes delay in the base stations. The company typically uses a (number)(dot)(number) to describe the generation of simulcast hardware and software.

For simulcast to work, each transmitter's carrier frequency must be exactly the same.

Tyco Electronics' M/A-COM division (formerly known as GE) has fielded two generations of simulcast. In the 1980s and early 1990s, the company fielded "Modem" and "RS232" simulcast, which utilized WWVB receivers and special channel banks. For the past dozen years, the company has been installing GPS-based simulcast for its EDACS systems and is continuing to use GPS-based simulcast for its digital P25 systems.

Summary

Simulcast is a spectrally efficient technology used to cover wide geographic areas with a limited number of channels. Operationally, it is easy to use for dispatchers and field personnel; nevertheless, simulcast is technically demanding and moderately costly to implement. **agl**

During the past two decades, Ed O'Connor has provided equipment for more than 2,500 simulcast sites throughout the world. Technical application notes can be downloaded from *www.simulcastsolutions.com*.

COMPUTERIZED TOWER SUPPORT TOOLS

Software that predicts how obstructions could affect RF coverage from a site helps to avoid deficient antenna-mounting configurations. Additional software that predicts coverage for specific installations helps to sell antenna rental spaces.

By Arthur K. Peters, P.E.

Not too many years ago, nearly all towers were erected by companies whose staffs were expert in their particular areas of communications. Consultants may have helped to start projects until a company hired a chief engineer and expert technical staff. But, in most cases, sometimes with assistance from manufacturers, towers were sited and constructed under the direction of individuals trained in the communications arts. Fast forward to today. Many organizations responsible for wireless activities are under the direction of IT experts with little if any training or skills in things wireless. This transition appears to be a natural consequence of progress toward making everything digital.

Unfortunately, as the level of wireless expertise in a company diminishes, the need for such expertise does not necessarily diminish. Towers still must be carefully sited for the greatest efficiency, meaning the best coverage for their intended purposes. To be profitable, most towers must share their valuable real estate among two or more users, but not at the cost of reduced efficiency or coverage. This requires even greater attention to tower placement and to the management of shared tower resources.

For many years, our firm principally relied on two software programs to site towers and manage antennas on towers. I wrote the first program in the late 1970s and early 1980s using Technical Note 101 by Anita Longley and Phil Rice to evaluate signal levels in the presence of terrain. At the time, the U.S. Army Mapping Service had completed digitizing worldwide terrain at three-second intervals and released to the U.S. Geological Survey an unclassified version on 1/2-inch magnetic tapes. We acquired a full set of tapes that required an entire room of tape racks. These tools enabled a marvelous view of expected signal coverage never before attainable. We could test and verify various sites and optimize tower sites. Today, these steps can be performed in seconds. In the early days, each test required as much as several days. We named the program FieldStrengthCalc.

A cell tower sports a side-mounted radio communications antenna that might interact with the monopole, possibly affecting the antenna's RF coverage pattern adversely.

The second program I wrote, in the same period, could determine how an antenna's radiation pattern would be affected by nearby metallic objects. It was common knowledge that placing an antenna on the side of a tower distorted its radiation characteristics. Antenna manufacturers had physically measured the radiation characteristics of a few antennas side-mounted on small sections of tower. But, because of the infinite ways of making mountings, it was impossible to measure all potential distortions. Once, when a pattern diagram was required to settle an interference issue before the FCC, I traveled to the antenna manufacturer's plant to obtain the diagram. On a piece of

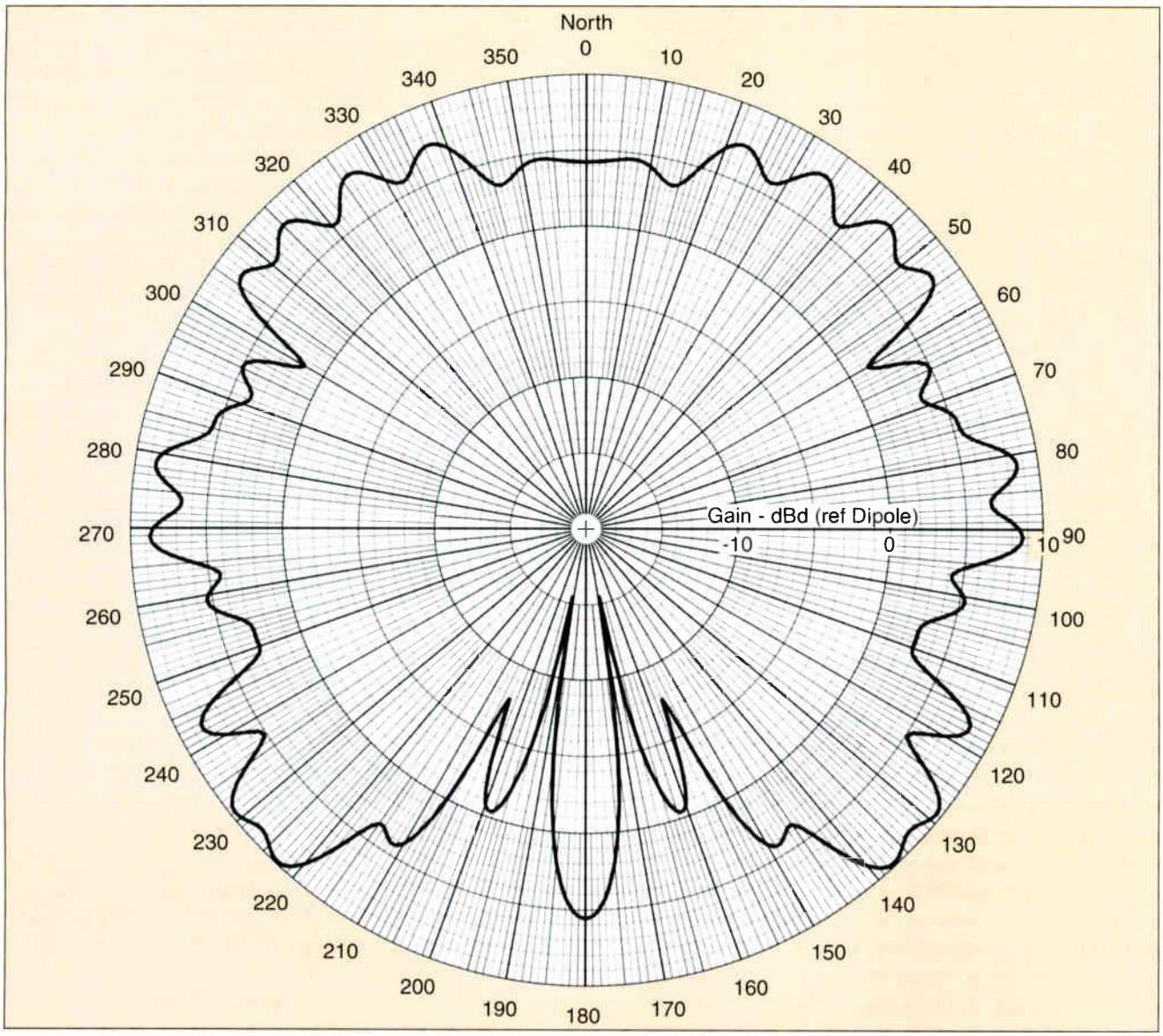


Figure 1. A computer-generated, predicted radiation pattern for an antenna mounted 2 feet from a leg on a tower with a 6-foot face shows nulls that adversely affected coverage.

polar graph paper, one of the engineers skillfully drew the pattern by hand using no data whatsoever, and stating that the pattern he drew was "pretty close."

The program I wrote, named Obspat, a contraction of the words *obstructed pattern*, was time-shared on our company's computer. Antenna manufacturers, consultants, other companies and individuals would dial into our computer and enter the details of their antenna-pattern problems. The program would compute the obstructed pattern and return, over the telephone, 360 pattern values that could be used in a pen plotter to trace the obstructed pattern. This time-share service was used extensively. Periodically, antenna manufacturers using the service physically verified patterns it produced. Chances are that if you requested a manufacturer's pattern during the 1980s and 1990s, the pattern was a product of Obspat software.

In the past several years, both programs were rewritten and modernized, and they have been released for Windows and Macintosh platforms. Both are much faster than ever. FieldStrengthCalc has gone from perhaps hours to minutes and Obspat from a minute to a second. Meanwhile, terrain data that once required a roomful of magnetic tapes that cost $50,000 for the United States alone now may be obtained on six DVDs for $1,000 with data for the entire world.

In today's uncertain economic times, any tool that can minimize costs or save expensive repairs quickly rises to the level of a necessity. This includes tower placements in less-than-optimal locations or having to send crews to reposition antennas that are not performing

as expected. The pattern-obstruction software answers antenna and radiation questions with a minimum of operator input. Obspat software may be operated by relatively nontechnical and highly technical people alike.

Ground investigation

Obspat software allows antenna issues to be investigated on the ground well before an antenna is mounted on a tower. It considers, if desired, tower structural members, mounting brackets, transmission lines, other antennas (as obstructions), guy wires and other metallic objects in or near an antenna's aperture (length).

For example, one case in which the pattern-obstruction software was used involved a mountaintop with a rugged, 200-foot-tall triangular lattice tower with 6-inch diameter legs and a 6-foot-wide face. A 6 dBd omnidirectional antenna operating at 800 MHz was attached at the 100-foot level. In those days, the standard mount placed an antenna about 2 feet from the tower leg. The antenna as mounted resulted in severe signal-strength degradation in some directions. A tower with such a wide face was thought to have little effect on a leg-mounted antenna's radiation pattern.

Computer-generated pattern

Figure 1 is the computer-generated, predicted radiation pattern of the problem, made with the pattern-obstruction software. It shows how wrong that thinking was. After experimenting with the antenna placement for a few minutes using the software, the customer was pleased to find that by simply mounting the antenna 10 feet out from the tower leg, a mounting position that is common knowledge today, the problem was solved. Figure 2 shows the resulting pattern. The time required to discover a solution was about 20 minutes. The cost of the fix was relatively high, considering the expense of sending a tower crew back to the mountain to revise the antenna mounting. The problem could have been avoided in the first place by verifying the anticipated result with the software.

Same-height mounting

Another example of the program's use involves mounting an antenna on a tower at the same height as other antennas. Each of the other antennas becomes a pattern-affecting obstacle to the new antenna. Using a directional antenna and adjusting the mounting distance and direction of the antenna are possible solutions that may easily be examined using the program. The pattern-obstruction software uses measured radiation patterns from all antenna manufacturers, so pattern distortions also account for effects on directional antennas. All Obspat patterns may be exported in a variety of file formats for use in field strength tools such as FieldStrengthCalc.

The pattern-obstruction software also may be used to synthesize or create custom patterns using obstacles, combinations of one or more off-the-shelf antennas, or both. Resulting patterns provide reduced radiation in certain directions to reduce interference or to meet service area constraints.

Sales advantage

As for field-strength-calculating software, why would a tower operator or company want or need such a tool? One reason comes to mind: *sales*. What if you could show the expected coverage at the customer's frequency, using his power output and antenna, or, what if you could explain why your tower would provide better, more competitive coverage than another tower using a coverage plot from both? Both scenarios could provide competitive advantages, particularly if you could provide that information for a cost of about one month's rent for one antenna.

If sales and competitive advantages are not enough incentive, how about acquiring an in-house troubleshooting capability? Problems caused by obstructed radiation patterns can be remedied using pattern-obstruction software. But that may be only a partial solution.

For example, suppose an antenna has inadequate range or dead coverage areas at its present location on a tower. Suppose that the pattern-obstruction software indicated that relocating an antenna to a different position on the tower would reduce the pattern distortions. This may require a change in antenna position, up or down. Are you aware that moving the antenna in either direction could worsen the problem? Perhaps moving it up would cause greater interference, and moving down would critically impair coverage.

Height versus interference

A field-strength tool can potentially provide answers before relocating and testing the new antenna position. Experience shows that moving an antenna to a greater height doesn't necessarily increase interference, nor will it necessarily increase the signal strength. Raising and lowering an antenna on a tower produces changes that are highly dependent on the characteristics of the coverage area.

One typically raises an antenna to overcome dead spots or areas of weaker signals. If the dead spots are caused by terrain obstructions, increasing the antenna height may provide little relief. Terrain obstructions can diminish signal levels by as much as 10 decibels and more. If by raising the antenna height the signal levels increase by 4 decibels, those dead areas may not experience signal-level improvements that provide good communications.

Similarly, lowering an antenna to reduce interference is also highly dependent on terrain and other factors. Depending on specific conditions, lowering an antenna may not provide the needed interference reduction. Frequently, the most effective way to reduce interference is to reduce the power toward the affected area.

Both conditions, weak signals and interference, may be tested using a field strength tool before actual changes are made. If the results of field-strength calculations are inconclusive, there is a good possibility that little change would result from actually changing an antenna's position.

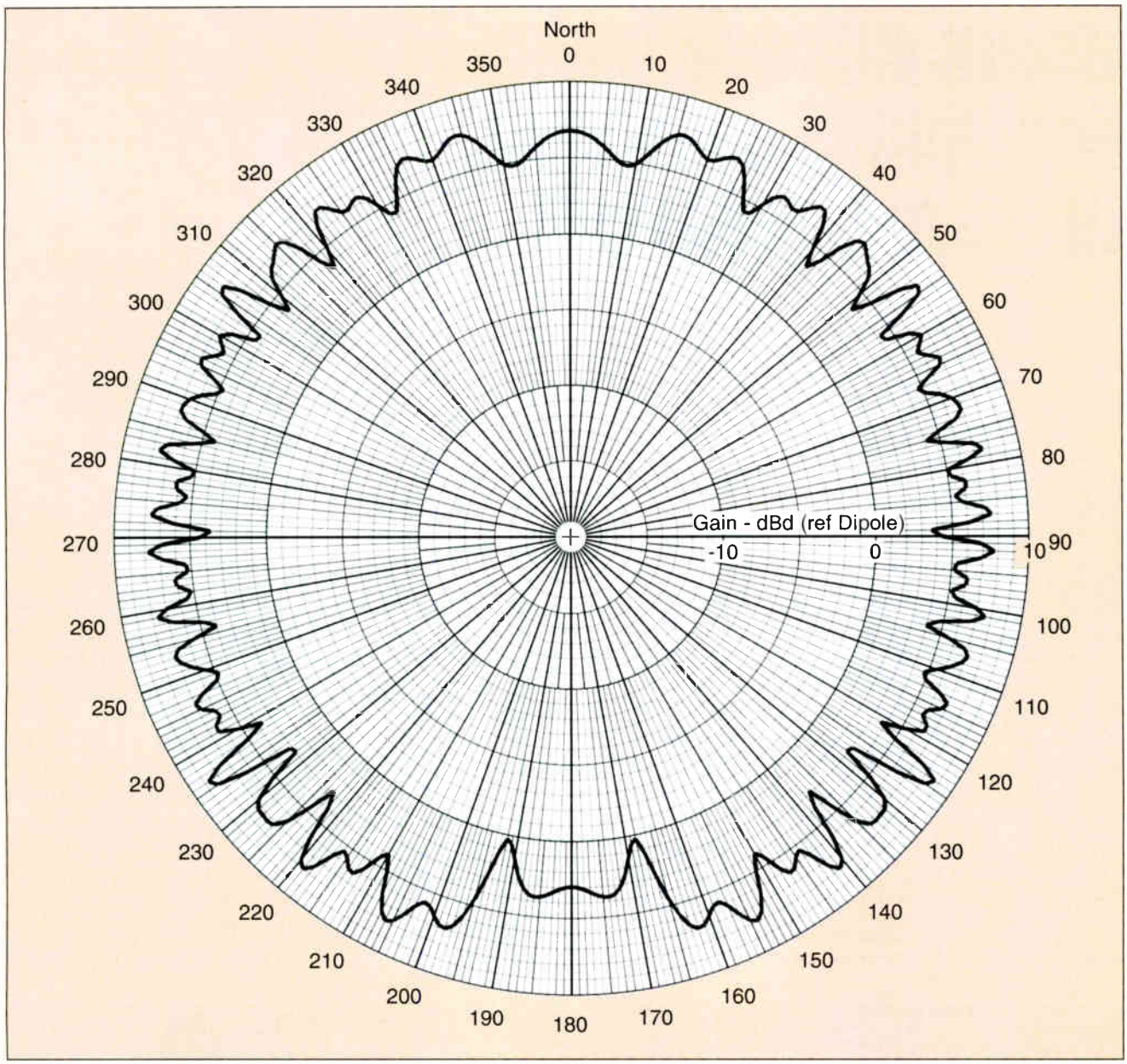


Figure 2. A predicted radiation pattern for the antenna from Figure 1 after the antenna mount was modified to move the antenna to a distance 10 feet from the tower leg shows more uniform coverage.

FieldStrengthCalc software requires minimum data entry. To keep costs low, the program does not provide internal map generation, instead providing overlay pictures that may be placed on a map. Because everyone has different map needs, it was decided to provide resources that enable coverage information to be placed on virtually any base map. To this end, four map projections may be applied to the most common map projections used worldwide. Data may be used equally on simple road maps or highly accurate topographic quadrangles, and even on scanned map images. The user controls colors, resolution, line thickness, dash patterns, contour fill, signal levels/colors and area size and other aspects of output picture files.

The field-strength-calculating software is supplied with an armful of tools and no optional extras. One terrain region, such as North America, is included with the program. Other regions are available for most of the rest of the world. Databases are included for U.S. county boundaries, interstate highways, international boundaries and major roads for the world including the world's islands. agl

Arthur K. Peters, P.E., is a life member of IEEE and a member of the Association of Federal Communications Consulting Engineers.

USING GOOGLE EARTH FOR RADIO COVERAGE, RF PATHS ANALYSIS

The ability to export a visual coverage plot from terrain analysis software allows the telecom engineer to provide important coverage information and integrate it with geographic information system software.

By Larry D. Ellis, P.E.

The power of the 3-D visual display graphics of Google Earth can now be used to examine radio coverage maps. With these same tools, one can also now visualize an entire microwave or SCADA path in 3-D to see where obstacles adversely affect or block the line of sight along the path. The engineering calculations are all performed within the Terrain Analysis Package (TAP) software, and then the details are imported into Google Earth software. The TAP software requires you to supply the geographic coordinates of the transmitter or repeater antenna location and all the other pertinent engineering details such as antenna pattern, frequency, power and height in order to calculate the received field strength at the desired receiving location. In this process, you select the desired propagation model and calculate the coverage.

The engineer can plot traditional coverage maps showing the received field strength over the desired region along with layers that include civil information such as roads and municipal boundaries. The coverage is displayed as a graphic, but it is actually stored in a geo-referenced database in the software. This coverage information can be exported to many third-party software applications. This allows the telecom engineer to provide important coverage information to be integrated into existing GIS software that contains a great deal of other information used by the company or agency. A newly released capability in the TAP software is to export the visual coverage plot from the TAP software directly into Google Earth. This will then allow

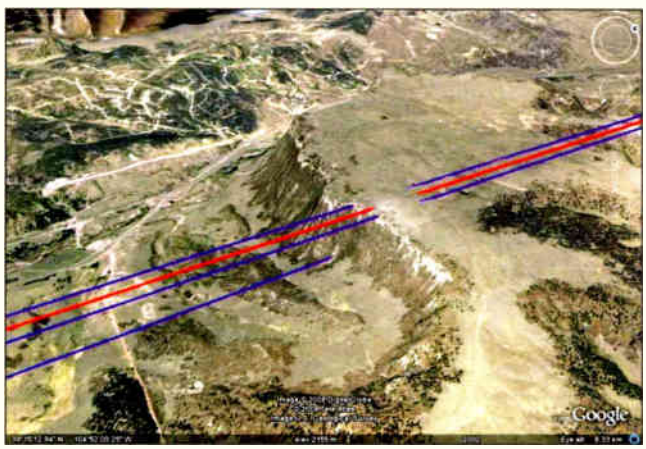


Figure 1. The line-of-sight (red) and the .5F1 (half of the first Fresnel zone) (blue) are blocked to the left and the right of the path as well as below the path (also blue).

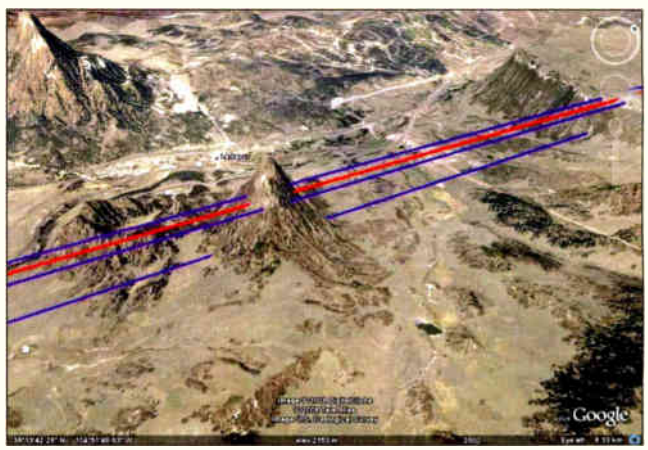


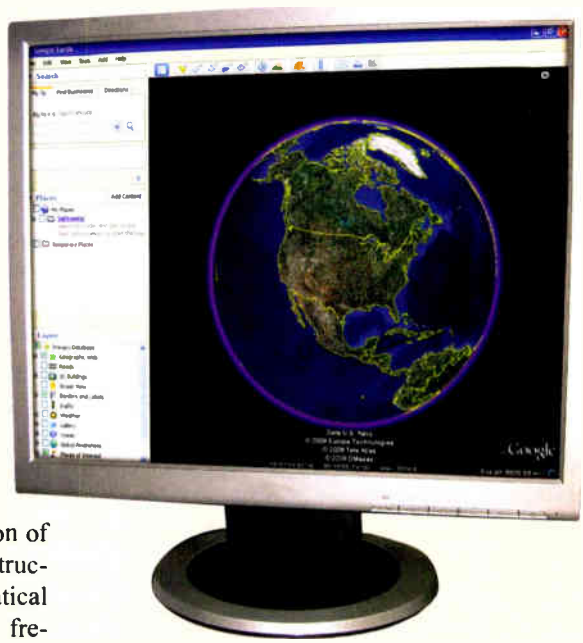
Figure 2. This region shows a cliff that blocks the radio signal for the receiving end of the line-of-sight path (red) between proposed transmitter and receiver locations, and also affects the Fresnel zones (blue).

the engineer to examine the coverage using the powerful satellite imagery that has become familiar thanks to Google Earth. Several examples are show in Figures 1, 2 and 3.

When you identify an area where predicted coverage is particularly poor, these tools will allow the engineer to determine the source of the signal degradation. The engineer can then seek alternative solutions that will increase the received signal level at those locations where the field strength is too low for reliable communications. Being able to zoom down close to the surface and see the actual photographic image of what is present on the surface makes it possible to pinpoint precisely what the signal level is at the location of anything visible on the Google Earth image.

Paths can extend either from the repeater site to a location of particular interest, from a land-mobile system or from a point-to-point or point-to-multipoint radio link. The use of this path integration with Google Earth can help the engineer to study the entire length of a problematic path.

The traditional analysis of a radio path relies heavily upon a predictive modeling developed by the French physicist, Augustine-Jean Fresnel. His RF modeling technique defined an invisible envelope of transmitted energy that surrounds the line of sight between the transmitting antenna (repeater) and the receiving antenna of the fixed or mobile unit. This energy envelope can be pictured to resemble a long, skinny, three-dimensional balloon, the length of which is the length of the path between the two antennas. This balloon is not round like a ball, but long and thin, much like what clowns use at parties when they make objects out of such balloons. The radius of the Fresnel zone envelope is largest at the center and decreases to zero at both ends of the path. The lower the frequency, the larger the radius is at the midpoint of the path. When any topography or significant man-made obstruction penetrates this invisible envelope of energy, the result is a reduction of the received signal level at the end of the path. The level of attenuation of the received signal due to these obstructions can be predicted by mathematical analysis of the path geometry, the frequency, and the location and heights of the obstructions. Such degradations are frequency sensitive with the higher frequencies suffering decreased signal levels. At VHF frequencies, reliable, but degraded, signal levels can be used even with an obstructed path as long as the received signal level is sufficient. However, at UHF and higher frequencies, these obstructions within the Fresnel zone can become quite problematic, rendering the link unusable for either digital or analog use.



Simplified 2-D model

Up to now, radio path analysis relied upon a simplified two-dimensional model using profile graphs. If the entire portion of the Fresnel Zone (typically 0.5 of the first Fresnel zone) to

Figure 3. These graphics represent a close-up view of the received signal levels on both sides of Hampden Ave. in the Denver, Colo., area. Note the lower elevations off to the right (red) where the signal level is reduced below what is present in the residential areas that are higher in elevation (green).

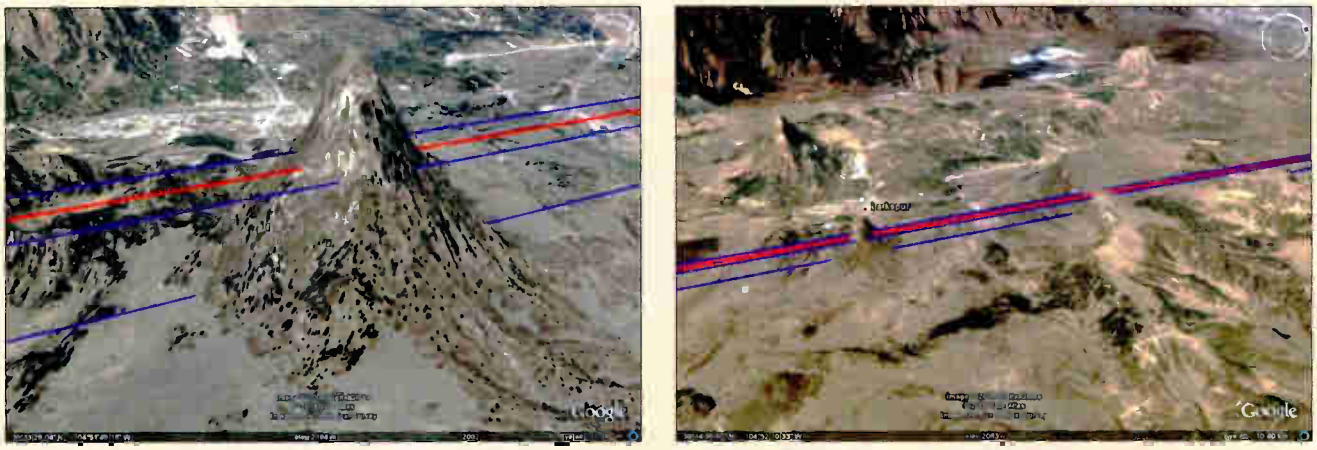


Figure 4. These two views of proposed radio signal paths indicate that the terrain is severely blocking the reception on this path. Software allows the designer to know in advance if these problems will be present and to make design adjustments to eliminate or minimize these types of problems.

be protected were above the elevation of the ground and obstructions, the receiver would receive the maximum possible signal. Slight encroachments into the Fresnel zone produced slight reduction in the received signal level.

SoftWright has now developed a method of graphically modeling in 3-D not only the portion of the Fresnel zone that lies below the line-of-sight, as has been common practice in the past, but also on both sides of the path being investigated. Additional Fresnel zone losses created on these horizontal directions along both sides of the paths are just as destructive as they are directly under the line-of-sight path. Up until now, obstructions due to terrain along

these horizontal paths would have gone undetected. No mathematical calculations are made with the examination of these side Fresnel zones, because there are no known studies of these types of paths that could be incorporated into the software to quantify these additional losses. Nevertheless, their destructive effect is quite real.

RF path modeling tool

Using this newly designed RF path modeling tool integrated with Google Earth, the engineer can visually examine the areas that will cause the signal degradation from all angles. The link system designer can actually fly the length of the path and instantly identify the locations where the degradation starts to occur. Several examples of graphics demonstrating these discoveries are included in Figures 1, 2 and 4. Only when the engineer knows precisely where these obstructed locations are can the engineer proceed with logical solutions to seek to eliminate these problems. Once these problems become known, the conventional treatment for these obstructions is to shift your path location and antenna heights to decrease the effect of these obstructions. Sometimes a change to a more desirable frequency can help as well. With this knowledge, the engineer can look for alternative solutions to increase the received signal level, should the engineer consider the level of losses unacceptable. If the link is only in the design phase, gaining this information prior to construction can eliminate a great deal of grief should the equipment otherwise be installed without this assessment.

Terrain blocking

Figure 4 indicates that the terrain is severely blocking the reception on this path. The TAP software allows the designer to know in advance if these problems will be present and to make design adjustments to eliminate or minimize these types of problems. If your existing radio system is known to have problematic locations, an analysis of the coverage or your link paths will reveal why these problems exist so that your system reliability can be improved.

The Terrain Analysis Package software is used to perform evaluation of existing or proposed radio transmitter sites, radio coverage predictions, intermodulation studies and radio site administration for conventional two-way radio, TV and FM broadcasting, MMDS, ICS, SCADA, WiMAX, cellular, paging, air-to-ground and ship-to-shore radio system design. **agl**

Larry Ellis, P.E., is president of SoftWright, Aurora, Colo. For more information, visit *www.softwright.com*. Photo illustration by Scott Dolash.

LOADING UP THE TOWER: THE TREND TOWARD RADIO HEADS

Distributed base stations with remote radio head capability bring benefits in cost, performance and efficiency. They're vital to the delivery of next-generation wireless services. Remote radio heads on the tower are coming. Are you ready?

By David Porte

If you haven't been approached about remote radio heads on your tower or rooftop yet, chances are you will be soon. Remote radio heads (RRHs) are a fundamental part of today's state-of-the-art base station architecture, and they bring benefits in cost, performance and efficiency on the road to 4G.

To successfully compete in the new data-centric world of iPhones, data USB sticks and on-demand content, network operators are beginning to adopt next-generation wireless technologies such as WiMAX and LTE (long-term evolution). To deliver on their promises, both technologies are going to require the most efficient radio architecture in the form of RRHs and their component parts.

WiMAX continues to gain momentum, with one industry analyst firm projecting 76 million fixed and mobile WiMAX subscribers by 2011. It's the first 4G technology to claim more than 400 commercial deployments worldwide. A valuable alternative to WiMAX, LTE has been adopted by several of the larger carriers and also represents the next generation for mobile networks such as GSM, WCDMA/HSPA and CDMA. A number of U.S. operators are already deploying WiMAX, and most other operators have announced LTE trials in 2009 and 2010. RRH technology is vital to the efficient delivery of these advanced wireless services, as evidenced by most 4G equipment vendors showcasing their RRHs at the major wireless shows.

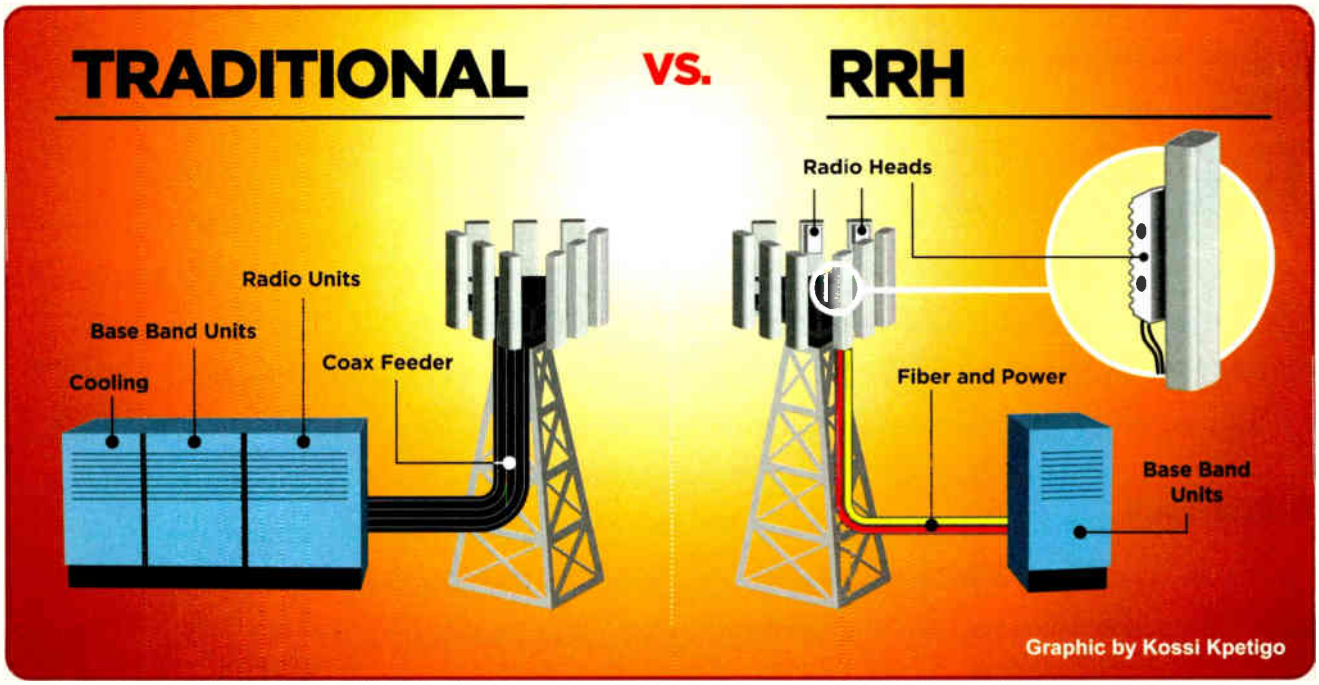
The remote radio head shown on the facing page is the device mounted to the left of the support mast. On the right of the mast is the antenna. Used by Clearwire for its WiMAX network, the RHH serves customers in the Portland, Ore., area. Photo by Clearwire.

In light of these new technologies, it's time to rethink the effect that tower-mounted electronics have on the typical cell site. The old base station/thick coax/antenna array model isn't going to cut it in a 3G and 4G world. Tower-mounted radio systems help to obtain coverage and capacity where it's needed, allowing carriers to maximize their investments not only in existing deployments, but also, as technology evolves, to effectively reducing site capital expense and operating expense.

The technology

Remote radio heads are part of a split base station architecture and are designed to enable lower capital and operating expenditures, reduce typical power requirements (they're greener), and add flexibility to network configurations. In an RRH configuration, radio-related functions are contained in a unit mounted as close to the antenna as possible and are linked to a main indoor unit that contains the control and baseband signal processing. The long coax cable runs required by systems with the radios mounted in the shelter and the transmit/receive losses associated with them, are replaced with a digital optical fiber data interface and power.

In a conventional base station, thick, expensive, heavy coaxial cables run up the tower to the antenna. These long cable runs not only impair transmission power, but also reduce signal quality. The base station makes up for the transmit cable losses by using high-output power amplifiers, driving up both the purchasing and operating cost of the base station and necessitating extensive and expensive cooling. To fix the receive loss problem, many operators install tower-mounted amplifiers (TMAs) near their antennas, designed to boost the returning signal, amplifying it along the coax run from the antenna to the base station racked in the shelter. Radio heads, because their amplifiers and receivers are next to the antenna, don't have to make up for cable losses, so they can use much smaller amplifiers on the downlink and they don't need TMAs on the uplink. By using lower-power electronics, operators gain the increased power efficiency and lower power costs necessary to achieve the same coverage footprint. The lighter, more flexible fiber-optic cable is also cheaper to purchase and easier to install than coaxial cables. While the typical



Traditional base transceiver station equipment occupies more space than their counterpart baseband units in a remote radio head configuration because a portion of the electronics moves to positions behind the antennas.

RRH is larger than a TTA/TMA, the radio heads themselves are designed to be installed in a simple fashion because of their low weight and size.

Because the natural elements cool the power-hungry electronics mounted next to the antenna, the space and cooling required in the typical shelter are reduced by as much as 75 percent. Renting and licensing for large base stations and antenna sites on roofs in buildings or on towers means increased costs for network operators. The RRH system allows base stations, which usually have a large footprint, to be installed at a distance from the radio heads, simplifying the acquisition of new antenna sites. The operator has more flexibility and can better optimize network coverage. For example, rather than site the base station in a heavy shelter on the roof of a building, an operator can site the baseband side of the base station in a nearby equipment room and place the radio heads next to the antennas on the roof.

The core value of radio heads comes from their improved RF performance and simplified siting. New, higher-power RRH units can now support a wide range of operator demands ranging from broader coverage to meeting increasing capacity requirements. RRH units also support newer technologies more readily, such as MIMO and smarter antennas. RRHs that connect via lossless fiber links dramatically reduce site acquisition costs and offer faster, more scalable deployment.

Nik Hatzis, vice president of base station systems for Powerwave Technologies, outlined the following primary drivers for RRHs versus traditional base transceiver station (BTS) solutions. "RRH eliminates the brick-and-mortar shelter or cabinet, eliminating heating, cooling and power needs on the ground," Hatzis said. "Deploying RRH technology offers flexibility in placement, whether on tower tops, rooftops or the sides of buildings, allowing operators to better address capacity gaps. And RRHs eliminate feeder lines, replacing heavy, expensive coax cables with lighter, less-expensive and more-efficient fiber optics. It's like putting the whole base station on top."

As for the future of RRHs, Hatzis is adamant: "RRH is the only thing that will support 4G in the United States and Europe."

The growing popularity of RRH technology is evident with all the major carriers right now as they vie for increasing shares of the next-generation technology pie. John Storch, vice president of network deployment at Clearwire, a national operator using RRHs in its advanced mobile WiMAX networks, cited several benefits. "Clearwire's smaller RRH provides us with a compelling competitive advantage," he said. "Its smaller scale, decreased power needs and the ability to site on utility or telephone poles allow us to deploy our markets more efficiently and cost-effectively than traditional carriers."

RRH represents a much greener technology, using two to three times less power than traditional equipment, noted Storch, therefore minimizing the environmental impact of wireless systems.

Structural considerations

RRH systems' smaller size eases compliance with Rev. G standards regarding steel antenna towers' capacity and engineering. Under FCC rules, a radio head can weigh no more than 44 pounds, and typically measures 18 inches high by 12 inches wide by 8 inches thick.

One large tower operator reported that an RRH customer is using smaller, lighter antennas, and that, combined

with the use of fiber-optic cable in place of heavy coax, the installation of RRHs decreased weight and stress on the tower overall. Structural engineers are more concerned with wind and ice loading. Companies requiring larger antennas because of different frequency requirements, however, need to carefully consider issues of weight.

Understanding these engineering differences is vital, and most of the larger tower companies have experience analyzing structural issues regarding weight, wind and radial ice in colder environments. "Understanding the structural and loading issues, and remote radio heads' impact on physical tower space is key," said Chris Nichol, director of operations at American Tower.

Advantages of Remote Radio Heads

Improved Radio Performance	Reduced Site Construction Costs	Reduced Operational Costs
• less feeder loss	• simplified, cheaper site construction	• reduced power consumption
• high receiver sensitivity without TMA	• optical fibers easier and cheaper to deploy than RF coax feeder	• less cooling requirements
• low noise	• faster and cheaper upgrade of existing 2G sites	• smaller footprint, less site rental possible
• high downlink power available	• smaller and cheaper enclosures	
• more flexibility for optimum antenna positioning		
Radio Performance	CAPEX	OPEX

Easy installation

Because of their lower weight and smaller size, RRHs are designed to be installed quickly and easily. This simplifies site acquisition, while allowing the network operator greater flexibility in optimizing coverage and eliminating possible interference.

The relatively new, active technology involved with remote radio heads may translate into less time between failures, requiring more tower climbs and the increased potential for interference by climbers with other tenants' equipment. One large tower operator noted, however, that it is indemnified by the owners of the equipment and that, to date, there have been no incidents of climbers interfering with other tenants' equipment on shared towers.

Reliability issues aside, having active electronics at the top of the tower will require more tower climbs, said Nichol. But this potential drawback is balanced by the advantages brought by eliminating the large ground space demands and simplified site acquisition, he explained. To prepare for the possibility of more tower climbs, owners need to ensure that their tower is easily accessible and verify that all climbers are approved and capable.

The issue that many traditional carriers grapple with is a lack of experience and resources to manage electronics at the top of the tower, said Eric Woodruff, executive vice president of site development for WFI. With a lack of data on failure rates, field operations teams are still developing their maintenance and repair model for RRHs. "With RRHs, a field tech can no longer deploy to a site and repair or replace electronics on the ground," he said. "Instead, technicians may need to use bucket trucks and tower climbers — neither of which are typically among carrier-owned resources."

The need for a new model of operations may result in resistance from tier-1 carriers to RRHs, or it may accelerate the network services outsourcing model, said Woodruff, with a third party providing the resources required for tower-top maintenance and repairs. "A model of outsourced management may develop that is similar to WFI's current microwave network maintenance business where the maintenance partner is dispatched to deal with any remote electronics issues," said Woodruff.

Get ready

What should site operators do to prepare for RRHs? Now's the time for tower owners and operators to get up to speed on the technology and what it means, structurally and capacity-wise, for their particular towers.

This new technology's ability to decrease the runs of traditional coax cable may well extend the capacity of many existing towers without costly upgrades. This is especially true in regions such as Southern California, where towers are shorter and slimmer because of more stringent zoning requirements, and where some jurisdictions see upgrades as an opportunity to add onerous conditions to existing towers. "The ability to expand tower capacity without a physical upgrade is a positive from both a cost and timing perspective," said Woodruff.

Rethink your tower's capacity with respect to RRHs and determine how best to lease your tower space to accommodate them in a cost-effective manner for the operator. "Tower owners are still being paid to load up the tower," noted a spokesman for a large 4G operator, "so understanding what RRHs mean for your tower in terms of space and capacity is important."

Finally, provide good access to your tower and work only with approved climbers.

The wireless industry is moving to RRH architecture — in fact, it has already arrived. And tower sites are ideal for providing the extensive coverage that will be required. Reduced RF power requirements, better signal transfer through the use of cheaper, more efficient fiber-optic cable, simplified siting and reduced costs — the advantages are clear. Tower operators who position themselves to accommodate RRHs will win more contracts and increase their revenue. It's a win-win situation for everyone. agl

David Porte is president and CEO of WFI, a wireless network services firm with headquarters in Reston, Va.

SOFTWARE DEFINED RADIOS HELP AGENCIES COMMUNICATE

SDR technology holds significant promise for addressing critical issues in public safety communications, including interoperability, performance enhancement, and life-cycle cost reduction.

By Joseph Heaps

During Hurricane Katrina in August 2005, winds and floods knocked out virtually every form of communication: landline service, cellular phone service, the Internet, and radio transmission. Even when radio equipment did work, law enforcement officials and emergency crews were unable to communicate with one another because their radio systems were incompatible. This caused confusion and delay and made it nearly impossible for officials to coordinate missions.

During emergency situations — whether a natural disaster like Katrina, large transportation accident, or terrorist attack — public safety officials from different agencies (in some cases, different counties and states) must be able to effectively communicate with each other. If they cannot share information quickly, critical time will be wasted and lives could be lost. Unfortunately, police officers, firefighters, and emergency medical personnel cannot always depend on wireless radio communications during natural disasters, major accidents, or criminal activities because their radio systems are often incompatible.

New technology is emerging that will enable public safety officials to exchange information seamlessly: experts call it "interoperability." One of the most promising of these technologies is software defined radio (SDR) systems.

SDR is a type of radio that uses software to control a radio's operating parameters and protocols, allowing the radio to be updated and reconfigured, thus minimizing the need to change existing hardware. SDR can overcome the challenges of incompatible communications systems by allowing radios to be easily updated with new functions, protocols, and standards. Most police radios today cannot be easily reconfigured to implement new capabilities, and as a result, incorporating new communications technology into an agency's operations can take decades. SDR technology has the potential to break that cycle by helping to ensure that the investment a department makes today does not lock it into limited solutions for many years. SDR enables new technology to be introduced without replacing the whole system and allows interoperability to be maintained without having to move all users to the new technology at the same time.

The good news is that some elements of SDR technology exist in most public safety radios manufactured today; the bad news is that the full potential of SDR for public safety communications is yet to be realized. Before this can happen, significant technical, operational, and regulatory concerns must be addressed. The National Institute of Justice (NIJ)—through partnerships and research grants—is working to help resolve these issues and accelerate the progress of SDR technology so that public safety officials can communicate effectively with each other and save lives.

Independent purchasing

Traditionally, local police departments and other public safety organizations make independent purchasing decisions for mobile communications devices. With more than 50,000 independent organizations making these decisions—based primarily on local factors—it is not surprising that the field is filled with incompatible communications systems. Further complicating matters, Federal agencies do not generally use the same frequency bands as State and local agencies, making it difficult to coordinate during a major incident.

Significant strides have been made in linking incompatible radio systems to improve first responders' ability to communicate. For example, current technology allows the transmission on one radio system to be rebroadcast on one or more systems. Such rebroadcasts, however, have limitations. Transmitting on a separate channel for every connected radio system is an inefficient use of scarce frequency resources. Channels may also be incorrectly or inadvertently linked, causing communication problems.

Where does SDR come in?

SDR technology is increasingly finding its way into public safety products. Some of today's radios use SDR

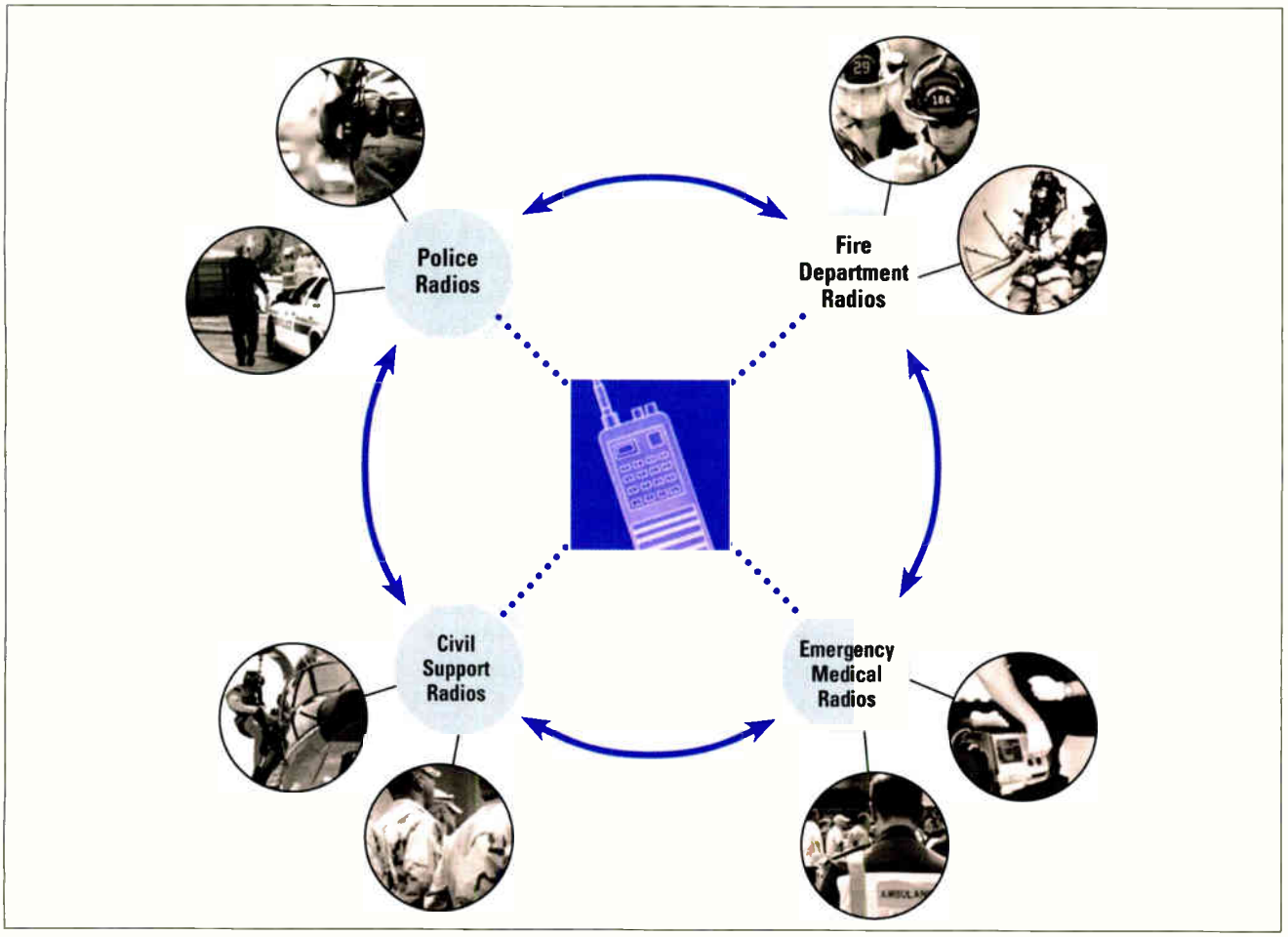


Figure 1. Software defined radio connects public safety officials with one another.

technology to support multiple "protocols," which are the operating rules for communication transmissions. Yet the real future promise of SDR technology is to implement radios that operate:

- On multiple frequency bands
- Using multiple services, such as two-way radio, cellular, and wireless data

Multifrequency band radios could include software that controls operating parameters, such as frequency, and allows the radio to be reconfigured, as needed, as one of the three main frequency bands used by public safety officials: (1) very high frequency, or VHF; (2) ultra-high frequency, or UHF; or (3) 800 megahertz (MHz). This approach has been implemented in military radios but has yet to be incorporated in radios used by public safety personnel. The intent in the public safety arena is to allow users to eventually communicate with systems operating on frequency bands other than their normal "home" systems—for example, a radio could be developed that includes both an 800-MHz capability used by a city police force and a VHF capability used by sheriffs' departments in the surrounding counties.

Software could also be developed to further support interoperability by enabling the user to communicate with other responders using both voice and data—such as Wi-Fi and commercial cellular capabilities—and to configure the device to the system needed at a particular moment. These abilities would allow, for example, responders who are called to a scene outside of their coverage area to participate fully in the emergency response. (See Figure 1)

Saving taxpayer dollars

Although the major benefit of SDR technology for public safety is increased interoperability—and how that translates into saving lives—other benefits include potential cost savings over the life of the radio equipment. SDR would allow police departments to easily:

- Upgrade individual pieces of equipment with new features and new communications protocols.
- Upgrade an entire communications system.
- Add new frequencies as they become available.

With respect to upgrading an entire communications system, SDR basestations could communicate via old and new devices until all equipment is upgraded, or equipment could be configured as needed during transition periods.

Reprogramming transmitted over the air from the basestation to radios would reduce the labor and coordination of physically reprogramming radios.

Another significant benefit of SDR is the enhancement of cognitive capabilities. A cognitive radio, for example, can sense its environment and adjust its operating parameters accordingly. Although it does not need to be an SDR, the capability to rapidly adjust operating parameters in real time can be implemented very effectively through software.

Equipment, security challenges

To make SDR technology useful and affordable for law enforcement and other public safety organizations, some key issues must be addressed:

- *Equipment* — Antennas and front-end processing continue to present challenges. Efficient antennas that can simultaneously handle VHF, UHF, and 800-MHz frequencies remain too large for portable use. In addition, development must work toward accommodating different frequency bands. As the frequency range of bands increases, the physics of the antenna present greater design challenges. For example, extending the range to low-band VHF is particularly difficult. Also, although solutions exist for increasing a radio's processing, memory, and power, they add weight and reduce the time that a battery remains charged, neither of which is acceptable to public safety agencies. Therefore, additional innovative processing approaches are needed.
- *Security* — Although SDRs are not inherently insecure, the potential impact of viruses or other malicious code is much greater with highly reconfigurable radios, particularly as over-the-air reprogramming occurs. The development of effective security measures will be essential in the deployment of SDR technologies.
- *Standards* — The U.S. Department of Defense has developed SDR standards for all new military radios under the Joint Tactical Radio System. Whether these standards (designed to meet military requirements) are suitable for public safety communications remains an open question.
- *Understanding the pros and cons* — Cost-benefit analyses are needed so that vendors and public safety organizations have a better understanding of appropriate price points for SDR. For example, how much extra is reasonable for the purchase of a multiband radio? Can vendors produce equipment at that price point? And it is crucial that such a cost-benefit analysis of SDR consider not only the unit-cost level but, more importantly, the life cycle or advantages of SDR over time.

Advancing SDR technology

To help address these issues and advance SDR technology for public safety officials, NIJ has implemented a multifaceted strategy.

In 2002, NIJ began to work with the Software Defined Radio Forum, an international consortium of organizations that promote the development and application of public safety radios. Within the SDR Forum, the Public Safety Special Interest Group — chaired since its creation by an NIJ grantee from the National Law Enforcement and Corrections Technology Center–Northeast (NLECTC–NE) — is working on two major initiatives:

- Developing a cost model that will allow vendors and users to identify critical price points for SDR and to perform cost-benefit analyses.
- Identifying opportunities for cognitive technology to improve responders' ability to communicate.

NIJ supports IEEE P1900, a committee that is developing standards for advanced radio concepts and cognitive radio technology.

The Institute is also funding two research and development projects at the Virginia Polytechnic Institute and State University. In the first project, Charles Bostian, Ph.D., and his colleagues are conducting research on cognitive radio for public safety applications. They have developed a prototype radio that is aware of its environment and can identify available frequencies and communicate on them. In the second project, Steve Ellingson, Ph.D., is developing a low-cost prototype multiband radio that will operate in the most common law enforcement radio bands. The architecture of this radio will become "open source" — that is, available to anyone or any company at no cost.

Finally, NIJ is funding three major projects to evaluate SDR technologies in the field:

- Building a prototype software defined, multiband conventional emergency radio that complies with the current standard for public safety radio communications (University of Texas–Dallas).
- Placing multiband military radios in a police department on an experimental basis to evaluate operational issues (NLECTC–NE).
- Developing ergonomically appropriate SDR technology for the public safety community (University of Notre Dame).

For more information on this work, visit NIJ's Communication Technology Web page (*www.ojp.usdoj.gov/nij/topics/technology/communication/welcome.htm*) or contact NLECTC–NE at 888-338-0584.

SDR technology holds significant promise for addressing critical issues in public safety communications, including interoperability, performance enhancement, and life-cycle cost reduction. More work remains to be done, however, and operational limitations and issues regarding security and standards need to be addressed. As SDR technology evolves, police officers will be able to respond more effectively to emergency situations and save lives. **agl**

Joseph Heaps manages the communications technology (CommTech) portfolio at the National Institute of Justice. He has an extensive background in communications technology, including work in the private sector and at the Federal Communications Commission, where he served as a U.S. delegate to two World Radiocommunication Conferences (in 1997 and 2000).

PIEDMONT REGIONAL VoIP CROSSES STATE LINES

Five jurisdictions participated in a project to extend radio coverage using the Internet to bridge gaps in their communications systems. Communicating across state and county lines, the Piedmont project helps officers apprehend suspects.

By Philip Bulman

To officers in the Danville (Va.) Police Department, sometimes it seemed like suspects knew a little too much geography.

When being pursued, suspects would head straight for the state line, and in just a few minutes, speed into North Carolina. Because of incompatible radio systems, Danville officers unfortunately had no way to communicate directly with their colleagues across the border, complicating efforts to arrest the suspects.

To fix the problem and help improve public safety, the City of Danville teamed up with surrounding law enforcement agencies — the Caswell County Sheriff's Office in North Carolina, the North Carolina State Highway Patrol, the Pittsylvania County Sheriff's Office in Virginia and the Virginia State Police — to use Internet technology to bridge the gaps in their communications systems.

Each of the five jurisdictions participating in what became known as the "Piedmont Regional Voice over IP Pilot Project" was able to keep existing radio systems, avoiding costly replacements. The new communications link was provided by "Voice over Internet Protocol" (VoIP) systems, which convert voice signals into digital form, allowing them to travel over the Internet or private networks that use Internet technology before they are converted back to ordinary voice signals at the receiving end.

The National Institute of Justice (NIJ) provided technology support to the public safety agencies, and two vendors donated equipment and services. Field tests show great improvement over previous conditions for participating officials. As Danville Chief of Police Philip Broadfoot said, "The technology works well. It's clear. It's effective. It's easy to use."

Communication barriers

Police departments in the United States started using radios in the 1930s. Historically, they did not coordinate radio purchases with surrounding jurisdictions. Indeed, some agencies went out of their way to ensure that they used different frequencies as a courtesy to nearby police departments. They did not want to create radio interference problems for neighboring public safety agencies. In recent decades, neighboring police departments have started moving toward increased cooperation in radio communications.

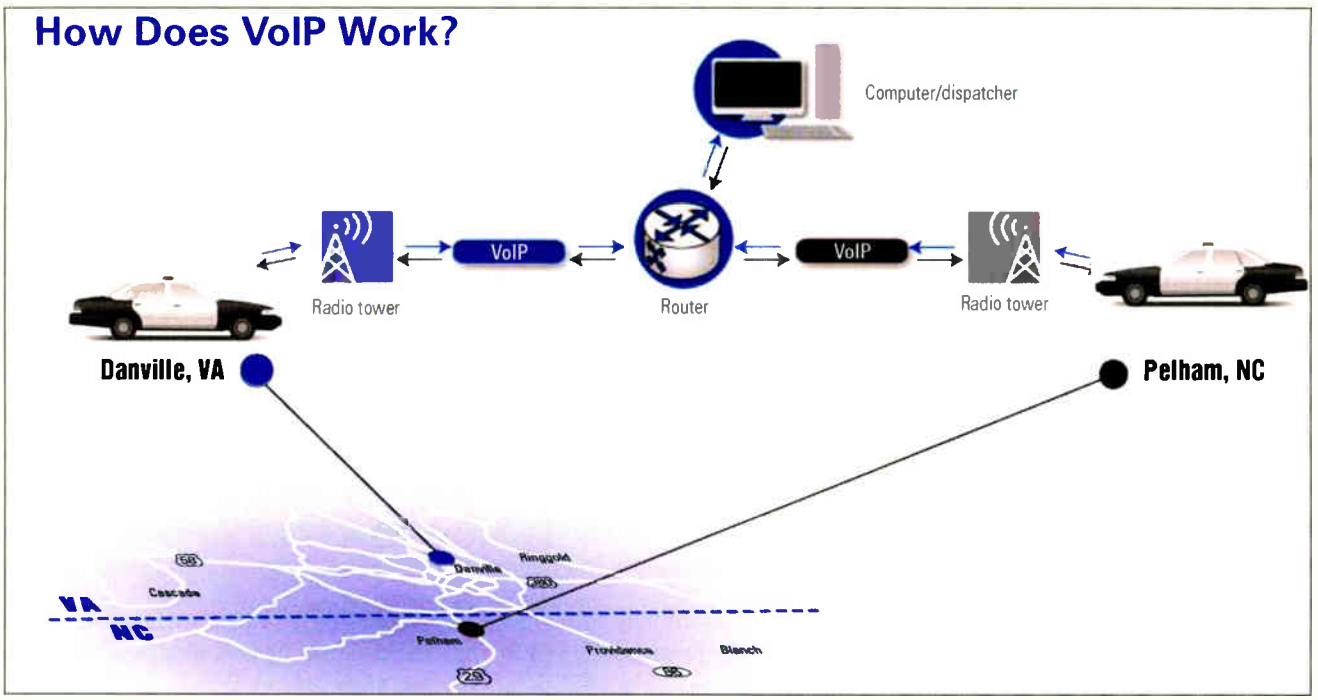
In recent decades, neighboring police departments have started moving toward increased cooperation in radio communications.

Budgets also play a role in radio operations. According to Broadfoot, a wide disparity exists in the equipment used. Police departments use everything from state-of-the-art equipment to off-the-shelf hardware bought from a local electronics store.

Like the other agencies participating in the pilot project, the Danville police already had solid voice radio systems on their side of the state line. Patrol officers were frustrated, however, by their inability to talk to another officer who, although across the state line, was only a short distance away.

Take, for instance, when a suspect crossed into North Carolina's Caswell County. Danville police officers could communicate with neither the Caswell County Sheriff's Office nor the North Carolina State Highway Patrol (NCSHP). "If we needed to talk with them, it had to be by telephone," Broadfoot explained.

A Danville patrol officer would have to radio the Danville dispatcher, who would then pick up the telephone and call another dispatcher, who in turn would relay the information by radio. This arrangement delayed communications and increased the risk that



Voice over Internet Protocol (VoIP) converts voice signals to a digital format, which allows the signals to travel over the Internet or private networks that use Internet technology. At the receiving end, they are converted back to ordinary voice signals. The technology allows both voice and data to travel on the same networks. In the Piedmont VoIP Pilot Project, a message can be sent from a radio by an officer from any of the participating agencies and reach another agency by way of VoIP.

important information might be garbled as it changed hands so many times.

To help overcome these barriers, Cisco Systems, Inc., a supplier of Internet networking equipment, worked with the participating law enforcement agencies to set up a VoIP system that connected the various police departments' existing land mobile radio networks to an interoperable Internet protocol network. The system allows communication using computers or standard radio equipment.

The new system also includes a dedicated connection between police dispatch centers. Dispatch personnel can now communicate directly with one another, and they can add more radio resources to the network as needed, using standard "patch" procedures with which they are already familiar.

Although officers on both sides of the Virginia-North Carolina border wanted to work toward better communications among their agencies, they were protective of their radio operations because of security concerns. No police department wants to risk having its emergency communications system crash because of an unforeseen technical problem. According to Broadfoot, participants in the pilot project were initially wary.

Leap of faith

To protect the integrity of their 9-1-1 centers, for example, many law enforcement agencies put strict limitations on access to their communications systems, and they are leery of companies with which they do not normally do business. This pilot project forged communications links by using equipment that had not previously been used in a law enforcement setting.

"That took a big leap of faith for these folks," Broadfoot said.

Also, with five agencies using radios from different vendors, it appeared to some that linking the systems would be difficult. "It becomes quite a project to convince people that it can be done," Broadfoot noted. Luckily, he added, law enforcement agencies are accustomed to working together: "When you look at the chiefs and sheriffs, they're saying, 'We're all in this for public safety.'"

Jeff Frazier, director of the Internet Business Solutions Group at Cisco Systems, said that one thing company officials underestimated was the difficulty of simply getting radio experts on board in a project that involved blending newer technologies with the radio networks that police departments have come to rely on and trust.

"We're bringing network technology into a radio world," Frazier said. "The people in the radio world see that as a big threat."

As everyone came to see this as an opportunity to take part in an innovative project, however, even the usual rivalries between private-sector companies decreased.

"I thought it was great," Frazier said. "We have multiple organizations

communicating in ways they never thought possible."

Allan Sadowski, the information technology manager for NCSHP, said one of the challenges involved in any interoperability project that combines radio systems with network Internet protocol systems is the different backgrounds of the technical people involved.

"The radio shops don't understand Internet protocol," Sadowski explained. Similarly, people who have worked extensively with telephone or Internet networks sometimes have little knowledge of radio. "They speak different languages," he said.

Sadowski recommends getting all technical people involved at the early stages of an interoperability project to help prevent misunderstandings and ensure that everyone is working well together.

Protecting the network

Yet even when the technical people are working together, they might run into a roadblock caused by strict network security policies designed to protect police communications systems. For example, to avoid computer viruses, hacking and other threats, NCSHP's private network is insulated from normal Internet traffic. Initially, it seemed impossible for the agency to keep its strict policy in place and still participate in the VoIP system. However, engineers created a break within the network that converted digital signals to analog voice signals and then sent them a short distance before reconverting them to digital signals. This process protected the private network from digital threats, such as intrusions by hackers and viruses, allowing NCSHP to take part in the project without violating its security policies.

Padowski said patrol officers are pleased with the results of the project because now they can communicate across the state line when they need to. "They can talk to dispatchers immediately," he said. "With a few mouse clicks, officers are talking to officers. They love it."

Michael Welch, sheriff of Caswell County, said that the project has led to significant improvements, giving officers an option that many citizens thought they already had. "A lot of people didn't understand that we didn't have that ability to talk car-to-car," he said.

Morale booster

Officers have been pleased because it gives them more options and the possibility of getting more help in a variety of situations, Welch said. "It has been a real morale booster," he added.

Jim Davis, director of emergency management and communications in Pittsylvania County, said that although the project seemed a bit daunting at first, the county communications team found it easy to do, once they got started. Davis noted that the ability to add more communications links as needed is impressive. "I think it's going to be a great tool — and not just for law enforcement," he said.

Indeed, the project has already moved beyond law enforcement to a broader public safety setting, as the jurisdictions have added fire and emergency medical services to the network. The project is a step toward giving law enforcement agencies an alternative, assured communications network when other systems are not working.

Joseph Heaps, deputy chief of NIJ's Information and Sensors Technologies Division and program manager for the project, said this pilot has been valuable both because the technology works and because other public safety agencies can learn what obstacles they may face in similar efforts.

"Integrating commercial off-the-shelf equipment can improve interoperability among radio systems, but the process is not as straightforward as the vendors may lead you to believe," Heaps said. "Budgets for planning and additional customization may be required. But if the proper planning is done in advance, these solutions can offer cost-effective options for linking radio systems together and improving public safety communications." **agl**

Philip Bulman is a writer and editor at the National Institute of Justice. He has 25 years of experience as a journalist and writer specializing in science policy, scientific research and technology development.

WHAT FLAT PANELS LACK WHEN IT COMES TO PERFORMANCE

Technical comparisons of flat-panel and microwave-dish antennas reveal substantial differences in forward gain and side lobes. Also, the diminishing returns of increasing array size with flat panels can be traced to the substrate commonly used.

By Andy Singer

My subject probably is obvious from the title. Many original equipment manufacturers (OEMs) of 802.11 and 802.16-type radios have been promoting flat-panel antennas for use with their radios. The following information is intended to demonstrate that performance of these flat-panel antennas at microwave frequencies is poor. The gain and patterns of flat-panel antennas are inferior to parabolic-dish antennas at microwave frequencies.

Unlicensed radios

The market for unlicensed radios grew during the past decade and became large because of the relatively low cost of these solutions and the lack of a licensing requirement. However, because of the unlicensed nature of these radios for bands such as 5 GHz, it is critical that the antenna provides as much gain as possible in the desired direction along with superior side-lobe performance to minimize the probability of transmitting or receiving interference from other users in the area in directions off of boresight. As the spectrum continues to get more crowded with users, it becomes even more important to preserve spectrum by using antennas with the best possible pattern performance.

Over the last couple of years, I have noticed OEMs for 802.11 and 802.16 radios using flat panels more frequently. If you ask them why, they will state that it is because of the flat-panel antenna's low profile and excellent performance. I have been either designing or marketing antennas since I graduated from engineering school in 1986, and the claims of good performance relative to parabolic-dish antennas just did not make sense to me. At Radio Waves, we decided to purchase a couple of brand-X flat-panel antenna arrays that many OEMs use and perform a side-by-side comparison of our SP2-5.2 2-foot parabolic dish and the 2-foot flat-panel antenna. We wanted documented data showing foot-for-foot which type of antenna has better performance.

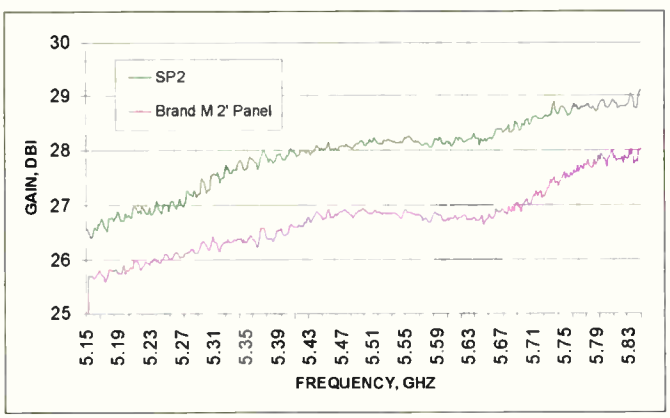


Figure 1. The gain of a microwave dish is compared with the gain of a flat panel, revealing about 1.5 decibels of higher gain in favor of the dish.

The gain testing was straightforward. We placed two antennas on the antenna range and measured gain across the unlicensed 5-GHz band from 5.15 GHz to 5.85 GHz against a standard to determine each antenna's gain. The SP2-5.2 parabolic dish exhibited about 1.5 decibels higher gain than the flat-panel antenna. (See Figure 1). The reason the parabolic-dish antenna has higher gain is because at microwave frequencies, the parabolic dish is inherently a more efficient design. By efficiency, we mean more of the power that is fed into the antenna is radiated than with the

flat-panel antenna. The flat-panel array is etched on a printed circuit (PC) board substrate, and each of the many elements of the flat panel array must be fed with a transmission line etched on the PC board. The use of many transmission lines results in a large amount of distributed losses. Even if the manufacturer selects a decent-quality material for the PC board substrate, there are significant distributed losses as the RF energy travels through the PC board. Thus, the parabolic dish is more efficient and, in this case, the difference was about 1.5 decibels higher gain for the SP2-5.2 dish antenna than the equivalent-sized flat-panel antenna.

Testing at 5 GHz

Another point to keep in mind is that testing was done at 5 GHz. If you were to use a flat-panel antenna at higher microwave frequencies, the losses in the PC board substrate would only worsen and the gain loss relative to a parabolic dish would worsen. For instance, with a 2-foot panel at 18 GHz, these losses would be on the order of several decibels. Up until a couple of years ago, at least one OEM radio manufacturer sold a 1-foot flat-panel antenna for use with its licensed 38-GHz radios. We managed to acquire one of these 38-GHz flat-panel antennas, and its measured gain was below its advertised gain. This 38-GHz flat panel is, perhaps not surprisingly, not offered for sale any more. Methods exist to overcome these losses, such as using active devices on the array itself, but their complexity makes them cost-prohibitive for commercial applications. Using such methods would require a panel antenna to be priced in an order of magnitude higher, at about $1,000 per unit.

Another way to view this issue of distributed losses with flat-panel antenna PC-board arrays is that as the number of elements in the array increases, the corresponding increase in gain is less as the size of the array increases. Let me repeat that. As the number of elements in the array increases, the gain increase becomes smaller. This is what is known as a diminishing-return curve. The graphic representation of the diminishing-return curve would show array size on a horizontal axis and gain as the vertical axis. Depending on the specific substrate selected for the PC board material, after an array of about 16 x 16 elements is placed upon it, the transmission line losses become so high that the antenna's gain actually flattens and then decreases as more elements are added. That is why you don't see large flat-panel arrays available at microwave frequencies. As noted before, the flat-panel antennas simply do not have anywhere near the efficiency of a parabolic dish. Not only does this become increasingly evident at higher frequencies, it becomes increasingly evident as the size of the antenna increases.

Next, we measured patterns of the two antennas and graphed them in rectangular coordinates. A copy of the pattern measurements can be seen in Figure 2. The radiation pattern of the SP2-5.2 is substantially better than the brand-X flat-panel antenna. The first side lobe of the parabolic dish is actually a whopping 15 decibels lower than with the flat panel antenna. The rest of the side lobes, on average, are about 10 decibels lower with the parabolic dish. Because the side lobes are so dramatically better with the parabolic dish, it would be far superior to a flat panel in avoiding interference and preserving spectrum in today's crowded bands.

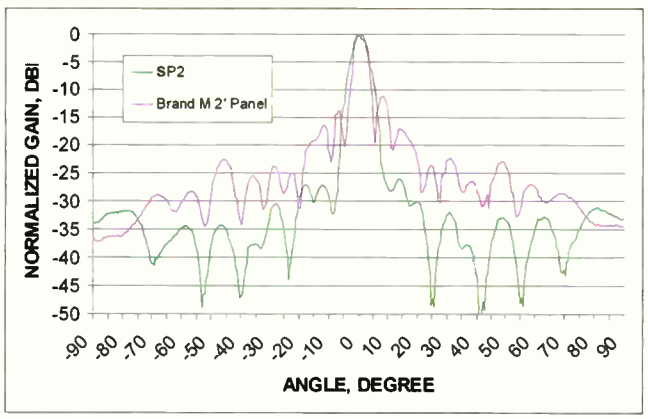


Figure 2. The radiation pattern of a microwave dish is compared with the pattern of a flat panel, revealing higher unwanted side lobes with the panel antenna.

Low profile

This leads to the next question, why do radio OEMs use flat panel antennas? The choice is not made based on performance because both the gain and the patterns are inferior to those of a parabolic-dish antenna of the same size. At Radio Waves, we manufacture flat-panel antennas to use where a low-profile look is required, but we are open with customers about the fact that flat-panel antenna performance is not as good as a dish antenna. In some cases, I am sure the OEM recommends the flat-panel antennas because of the need for a low-profile antenna even at the risk of lower performance, but in many cases users require the best possible link performance and best possible protection from interference, yet the flat panel cannot provide them. The reason seems apparent; in many cases, OEMs promote the use of a flat panel simply as a matter of profit. The producer of these flat panels used by the OEMs builds them with low-cost materials and labor in India or China and then sells them to the OEMs in volume for a very low price. The OEM can then mark the antenna up to a much higher price and make an excellent margin on the flat-panel antenna sale.

If you are looking for the best gain and pattern to optimize network performance and protect your link from interference, a parabolic dish will always provide better performance than the same size flat-panel antenna. **agl**

Andy Singer is president of Radio Waves. His email address is *andy_singer@radiowavesinc.com*.

Why Are Cell Site Leases Changing?

Answers to the top 10 most frequently asked questions shed light on the reason behind lease renegotiations.

By Tom Leddo

Most people don't like change. It often makes them wary or uneasy as they contemplate what comes next. For the most part, wariness of change is merely a fear of the unknown — like being in the dark. In our conversations with tens of thousands of landlords about the changes being made to their cell site leases, we have often explained that in the telecommunications industry where continually advancing technology is central to its operations, change is not only a reality, it's also a necessity.

Over the years, my colleague, Danny Ulibarri, and I have identified landlords' top 10 most frequently asked questions about why their leases are changing. Take a look and see if any of these questions have been on your mind — and if our insights as wireless tenant representatives help illuminate the issues.

1. Why would the carrier want to mess with the tallest site in town? As telecommunications technology evolves, so does the definition of "the best site in town." As I mentioned in a previous *AGL* article, contrary to popular belief, the Empire State Building does not offer the best coverage in Manhattan. One high site can't handle the millions of calls made each day in New York, nor can it accommodate the bandwidth needed to run voice communication, video, email, music, photo storage and more. In other words, taller is no longer better. Today's network relies on a greater number of low-elevation sites to accommodate the growing number of users and the bigger bandwidth requirements necessary to meet technology demands.

2. Why should I compromise my rent when I have the best site in town? Landlords often think that their site is more valuable because it is in a high-traffic area, or it's the tallest, or it's centrally located. As noted earlier, advances in technology are redefining what makes a good site. But further, as cell sites come closer to the ground and closer to each other, carriers are less particular about their location. This flexibility combined with an increasing ability to use nontypical cell sites (such as lightpoles) creates a competitive environment that drives cell site rents down. The landlord who once had "the best site in town" must now acknowledge that carriers have many viable options to choose from.

3. I'm happy with the way my lease is. Why does it have to change? The industry itself is changing the way it does business, in particular in its efforts to control operating expenses. There is a "perfect storm" of market dynamics compelling tenants to take immediate action: (1) subscriber saturation, (2) decreased revenue per subscriber, and (3) increased cost per user thanks to escalating operating costs and ongoing investment in network infrastructure to accommodate increasingly high-tech services. Escalating expenses have become a number-one priority for all carriers. Cell site rents are one of the largest expenses, so it's no surprise that carriers have focused on potential savings initiatives in this area. What's more, their scrutiny has revealed certain inequities in what they pay for space versus what more traditional tenants pay. For example, what a carrier pays for a 250-square-foot rooftop space usually exceeds what an interior tenant is paying for a more premium space that includes building amenities and services. Regarding tower leases, the inequity arises when the carrier rents space on a quarter acre of land and pays a monthly fee that is equal to what it would cost to purchase an entire acre outright. A good deal is only good when it works for both parties. In this case, tenants are looking to attain a better level of cost efficiency and equity in their cell site leases.

4. Why won't you pay me as much as the other carriers on my tower? It is actually this mindset that helped create the problem carriers are facing. Compelled to expand their networks, tenants once paid higher rents in a market where speed to market and coverage were a priority. While tenants traditionally competed with each other for the best sites, the market dynamic is beginning to shift, and now landlords

are competing with each other to keep their tenants. What today's tenants are competing for is operating efficiency. Escalating costs and decreasing revenues have resulted in well-publicized mergers and acquisitions, so carriers are more motivated than ever to right-size rents. Tenants are reviewing their networks and reevaluating how well the lease agreements meet their economic and technological initiatives. As tenant representatives, our company alone has personally contacted upward of 20,000 landlords on behalf of the carriers, which is only about 10 percent of the market. It's just a matter of time before you get a call from every carrier wanting to reassess their leases.

5. Why aren't I making what the guy down the street is making? This is a conversation about average rent versus market rent, which I addressed in great detail in the December 2008 *AGL*. For years, it has been said that the going rate for a cell site lease is roughly $1,500 to $1,800 for space on a tower or rooftop and $500 to $600 for ground space to build a tower, give or take whether it's a rural or urban location. But this dollar amount represents the "average rent" that tenants were willing to pay in yesterday's market, where speed and coverage were paramount. Today, carriers are pursing real market rates for cell site leases, which is not what another tenant paid down the street — it's what the competing potential landlord across the street will accept. Cell site leasing has become a competitive marketplace, and you have to decide if holding fast to your price is worth the possibility of losing your rent entirely to the guy next door.

6. Why should I deal with this when my local carrier representative said not to worry? Carriers are big companies with regional and national expectations and initiatives. The national executive charged with maintaining operating efficiency isn't necessarily in communication with your regional representative. Local reps keep the wheels turning while critical assessments made at the corporate level dictate new direction. It's through this high-level direction that companies like ours are often tasked to contact landlords on behalf of carriers to discuss potential changes to the network in a particular region. If you receive a call from a tenant representative, be sure they are authorized by the carrier to discuss your lease. Our company readily puts doubtful landlords in touch with our corporate contact to confirm the validity of the carrier's intentions.

7. Why would the carrier want to change the lease when they just renewed it? While headquarters is strategizing its forward-planning objectives and considering the fate of tens of thousands of sites, local managers are conducting business as usual in their corners of the world. The fact is, because of the carrier's large cell site portfolio, a monthly report is automatically generated to prompt lease renewals, independent of what changes may be brewing at the corporate office. A directive from corporate overrides any auto renewals initiated by the regional office.

8. Why would the carrier be renegotiating my lease — it's fairly new? Given the increased competition and today's economic environment, tenants are changing leadership, strategies, and operating plans. Every decision (even if just recently made) is being reevaluated. Additionally, mergers and consolidation create redundancy and realignment. New technology has necessitated different requirements of cell sites that may mean more, less or changing locations. In short, the industry is in constant flux and carriers must be responsive to it — even if it means re-doing. It can be a very fickle business. When it comes to cell sites, these days there's no Mr. Right. There's just Mr. Right Now.

9. Why do we need to change my agreement when the carrier was just here performing maintenance on the site? Carriers have made a multi-billion-dollar investment in their respective networks. In fact, according to CTIA – the Wireless Association, wireless companies have invested almost $190 billion in capital since the introduction of the national regulatory framework, not including tens of billions paid to the U.S. Treasury for spectrum — the bandwidth necessary to accommodate the advanced technology of services the market demands. It takes constant vigilance to keep up with consumer demand for more and more services. For example, about 56 percent of mobile devices are already capable of browsing the Web. Several carriers are now spending billions to build the new 3G and 4G networks that accommodate these services. The point is that whatever tomorrow's plan may be for the network, it has to work today. Carriers are going to protect their investment in each cell site until the minute it is terminated. As mentioned earlier, the regional office is charged with keeping their corner of the network up to speed until corporate determines which sites provide the most viable, long-term, lower-cost alternatives.

10. I have a 30-year lease! Actually, a typical lease is written for a five-year term with up to five renewals, totaling 30 years. Tenants may opt not to renew at each term. But more importantly, many landlords don't realize that the typical lease includes clauses that enable the tenant to exercise their option to terminate with as little as 90, 60 or even 30 days notice. While the typical tenant prefers to remain for a full 30 years or more, the lease may not be flexible enough to meet the ever-evolving cell site requirements. An equally important aspect of the carrier's initiative to update leases is to upgrade the lease language to provide operational flexibility for the long term. agl

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American Products designs and manufactures Thermal-Fort shelters and outdoor enclosures for applications in the telecommunications and wireless industries. Each shelter and outdoor enclosure is built to GR-487 specifications and meets strict NEMA 3 and NEMA 4 standards for protection from weather and water. Thermal-Fort shelters can be customized to accommodate the end use and are suitable for wireless broadband, backhaul networks and various other telecommunications applications.
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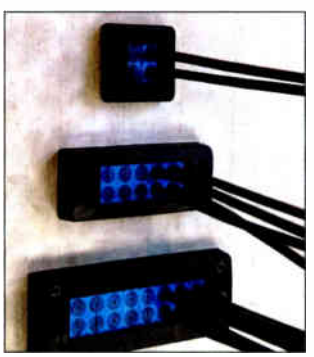
GFRC Shelters manufactures steel-frame concrete buildings for the telecommunications, energy and industrial markets. The shelters are built around a structural steel frame designed for strength and ruggedness. The outer walls of the building are glass-fiber-reinforced concrete architectural panels attached to the steel frame with bonding rods embedded in the GFRC panel. The panels "float" away from the steel frame, allowing them to expand and contract, eliminating a common source of cracking.
www.gfrc.com



EzEntry seals from **Roxtec International** simplify cable sealing into tower equipment enclosures. The UL/NEMA- and IP-approved seals for cabinets and enclosures allow installers to seal several preterminated cables of different sizes in a single opening. The seals protect equipment from water, gas, smoke, dust and vibrations.
www.roxtec.com

Purcell Systems' remote-access outdoor equipment cabinet model RAC24 is designed for small-scale network-equipment deployments. The unit is pole and wall mountable and features 5RU of equipment space, several thermal options and rear access to the installed equipment.
www.purcellsystems.net

Made from environmentally sound, noncorrosive fiberglass, equipment shelters by **Dupont Buildings** are designed to be economically priced and provide the maximum protection for installed equipment. The shelters meet or exceed applicable codes and requirements. Dupont Buildings designs, engineers and custom-builds the shelters to meet each customer's needs. The shelters meet zoning and engineering requirements, using multiple options for outer finishes, including standard stone flake finish, brick siding, rib-walled panel, block cast and T-111 siding.
www.dupontbuilding.com

Wall-mount air conditioners from **Bard Manufacturing** for telecommunication shelters feature 1- to 6-ton cooling capacity, left or right service access, economizer ventilation options and specific telecom control module options. Single-stage equipment is available up to 9.5 EER efficiencies, and double-stage equipment up to 15.2 IPLV is also offered for even greater efficiencies.
www.bardhvac.com

Enviro Buildings specializes in the design and manufacture of customized buildings for applications including lightweight communication shelters, outdoor buildings, cabinets and retrofits. Standard, lightweight pre-assembled shelters offer reduced transportation and crane costs for standard site locations such as rooftop and remote locales.
www.envirobuildings.com

Concrete shelters resistant to intrusion, ballistics and fire are available from **CellXion**. Featuring standard exposed-aggregate walls, the shelters provide a durable, maintenance-free aesthetic appearance and are available in alternate finishes that meet the requirements of local building ordinances.
www.cellxion.com

Enclosure cooling products from **Ice Qube** are designed to reduce wireless shelter temperatures even when the power is out. They may serve as an answer to the proposed FCC eight-hour backup rule. This 48-volt DC package remains on standby until either a line voltage cut off or a high internal preset temp triggers the unit into operation.
www.iceqube.com

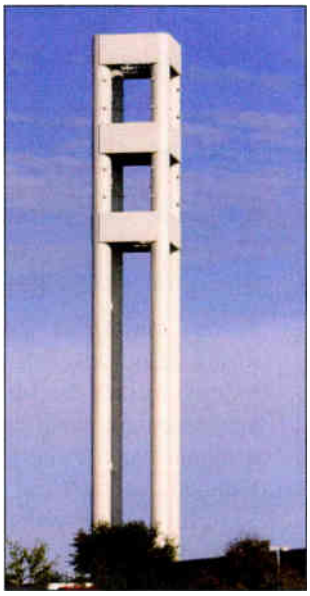
Monolithic precast concrete shelters from **CSI Shelter Technologies** suit utility, industrial, public, communications and municipal use. The shelters are designed to be low maintenance, weatherproof, vandal- and bullet-resistant, and are seismic rated with slate P.E. stamping.
www.sheltech.com

Shelters with cantilevered floors from **Fibrebond** allow for mounting a generator and other equipment outside the structure. Generators are drop-shipped to Fibrebond's facilities where they are mounted on the shelter and shipped to the cell cite as one piece.
www.fibrebond.com

The ecoCooling product line from **Dantherm Air Handling** combines a heat exchanger and an air conditioner to reduce operating costs and carbon dioxide emissions. The solution operates in different modes depending on the ambient temperature and internal air temperature. The unit reduces electricity costs and reduces downtime. The unit improves reliability.
www.dantherm-air-handling.us

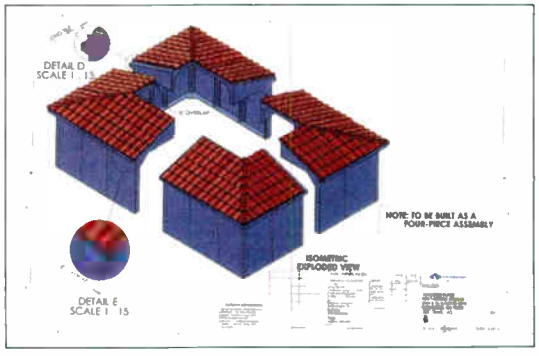
RFTransparent conceal height systems from **Solar Communications International** blend seamlessly into any environment from natural park space to shopping malls and from busy urban settings to residential neighborhoods and places of worship. Designs include monotrees, water tanks, church towers, clock towers and light standards. All RFTransparent height systems have a universal top hat that accommodates cellular or PCS antenna arrays, supports full horizontal diversity or polarization diversity antennas, and meets TIA/EIA-222 wind load requirements.
www.rftransparent.com

Atlantic Concealment has engineered, developed and designed the WavePortal series, which consists of antenna and equipment shelter enclosures fabricated from microwave RF-friendly composite materials. The WavePortal series addresses the issue of aesthetics, plus compliance with architectural standards and zoning ordinances. Atlantic Concealment uses high-performance composite materials that the company says have been proven in severe environments as well as in a wide array of microwave frequencies (1 to 40 GHz).
www.atlantic-concealment.com



FWT has developed aesthetically pleasing products that can be customized for a hidden communication site. Ways to disguise antennas include the Tree-Cell, flagpoles, bell towers, towers with cladding, and multileg concealment structures. Increased coax capacity is achieved with multileg designs capable of supporting as many as six carriers. They can be painted any color, and they comply with most zoning restrictions. Internal platforms feature grating and handrails to make antenna installation easy and safe. The RF-transparent panels disguise multiple levels of antennas and are available blank or printed with company or school logos.
www.fwtinc.com

Larson Camouflage manufactures concealment components such as pine branches, palm fronds, screening and paneling. The firm consults site developers on each project to ensure that it is accurately designed, coordinated, fabricated and installed. Although pine and palm trees are used extensively in the industry, Larson also fabricates artificial cacti and an array of architecturally concealed sites. The company has developed cabinet enclosures that look like boulders.
www.utilitycamo.com

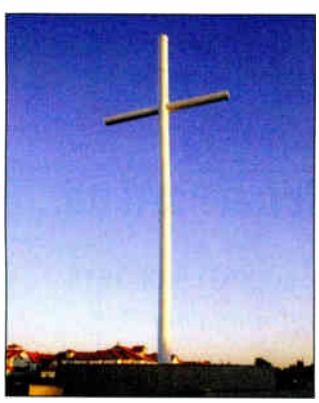


Peabody Engineering makes RF-transparent concealment for antenna cell sites. The concealment products are custom-made in durable, molded fiberscreen or polyscreen RF-transparent materials. Using computer-aided-design software, Peabody custom-molds the panels to the exact size, texture and look required for each site. The panels can be made to match the architectural surroundings of the antenna site, including split-face brick, stucco, Spanish tiles, wooden shingles or plain cement walls.
www.peabodyconcealment.com

Engineered Endeavors has introduced ClearPath Technologies, which encompasses both of its antenna concealment lines: ClearPath disguised structures and ClearPath rooftop solutions. The company's custom-designed solutions are intended to blend easily into residential, recreational and upscale retail areas. The disguised-structures line includes pine-tree poles, palm-tree poles and AMS system poles.
www.engend.com

Hi-Tech Composites Structures offers parapet walls, rooftop structures, radomes, flagpoles, cupolas and church steeple reproductions. Other features and textures available include faux brick, stonework faces, clock towers, wood or metal siding, reproductions and aged surfaces.
www.hitechcomposites.com

The Holbek Group custom-designs and builds site-specific monopines. The tree branches are custom designed for maximum concealment and are made from nonconductive and UV-light-resistant materials. They are designed for strength, durability, range of branch length and realism. Pictured is a monopine that stands in the Lake George region of New York's Adirondack Park known as Pilot Knob.
www.environmentalintegration.com



Sabre Towers and Poles designs and manufactures concealment products. Slimline poles can blend with the existing landscape. They can be disguised as lightpoles, stadium lights, flagpoles and cross poles. They feature internal bolted connections and hide all antennas inside the structure. Available in heights that meet customer specifications, Sabre's slimline poles can be painted in a variety of colors. All of the concealment products are designed to meet or exceed any municipality's wind load requirements.
www.sabretowersandpoles.com

Chameleon Engineering offers pole-based and custom-concealment solutions, which come in a variety of styles: pine, palm and broadleaf trees; flagpoles; rooftop panels; building-mounted antennas; windmills; water towers; crosses; steeples; and rockscapes. Chameleon uses solid-resin-cast branches with embedded fiberglass rods for structural strength.
www.chameleonengineering.com

Valmont Industries' portable base poles are designed for temporary and semi-permanent installations, permanent site solutions where conventional foundations may be impractical, or helping to simplify zoning and permitting processes for fast site deployment. The base and monopole can typically be erected in a single day. The concealment design features a bolt pattern that accepts a 24- or 30-inch-diameter pole, the ability to support a 130-foot structure with three to five carriers, ease of assembly and quick deployment and installation on blacktop or gravel.
www.valmont.com

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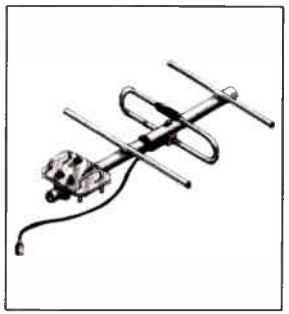

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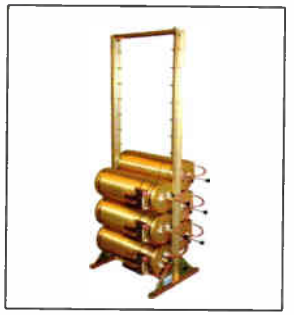

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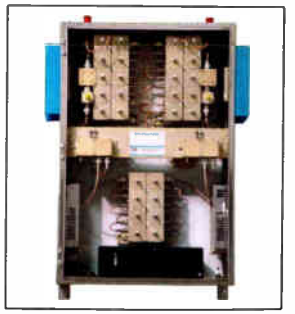

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