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September 2015 /// Volume 12 /// No. 09

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It's What You See

When you attend wireless communications conventions, as you may be doing this month with the Tower & Small Cell Summit and CTIA Super

Mobility 2015, you hardly ever hear people say that wireless service is maturing, do you? Maybe. But I mostly hear company leaders talk

about how the exponential growth in data traffic can't help but lead to the construction of more distributed antenna system (DAS) networks and small cells, the deployment of heterogeneous (cobble-together) networks and the use of alternative stopgap (LTE-Unlicensed) and new technologies (5G super-efficient, super-fast or converged fiber-wireless networks).

Reuters reporter Alina Selyukh referred to the wireless service as maturing in her story, "AT&T, DirecTV Complete Merger to Form Biggest Pay-TV Company." Her point may have been that AT&T Mobility has exploited handsets (the initial iPhone), network expansion (second to Verizon Wireless) and data service (unlimited, and then throttled, consumer access), and has found the need for a wider horizon.

A reason can be found to say that wireless service is maturing. Wireless device (formerly called handset) market penetration exceeds 100 percent in the United States. Gone are the hockey-stick graph lines for handset market penetration we used to see on projection screens used by CTIA

keynote speakers. In that sense, maybe wireless service is maturing.

The side that says wireless service is far from mature is the side that points to exponentially growing data traffic, composed mostly of video. That leads to more use of DAS and small cells, a business that doesn't fit a description of maturing, and continued development of towers for antennas, which carriers prefer to use when possible because using towers costs less than using DAS and small cells.

That brings us back to the Reuters story, which points out that the AT&T and DirecTV merger puts AT&T more firmly in video through broadcast carriage (cable and satellite) and whatever video the wireless service delivers (YouTube and multiple other forms of video streaming and downloading, plus a growing segment of video uploading).

Notwithstanding the FCC's proposed \$100 million fine for AT&T's throttled service, the company deserves credit for getting in front of consumers with handsets and the iPhone, DAS and small cells with its Antenna Solutions Group, and now video with its merger with DirecTV.

Towers? AT&T Mobility sold rights to 9,700 of its towers to Crown Castle International and gave management of other sites to Vertical Bridge. For AT&T, it's what you see that counts.



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Get Your Motor Running

I don't know exactly why my partner and I thought it would be a good idea to drive to Maiden Rock, Wisconsin, from AGL's regional conference in Denver, August



5, but we did. Going north, it was mile after mile of suburban sprawl to the Wyoming border.

As you would imagine, there was pretty good cell coverage, LTE on both carriers pretty much all the way. Crossing the line into Wyoming, we quickly found the lands of one bar, 3G and the cursed 1x. Taking a right on a two-lane road and heading north to Devils Tower, along Rt. 57 from Douglas, Wyoming, I saw something I had not seen in years — omni-directional cell sites. Nothing but mining, pipelines, train tracks and a few houses as far as the eye can see. This is the land of the dropped call, and the no bars.

It was funny to me to see fiber loops along the side of the road out there – and to have LTE coverage in the flat lands. Soon enough we were on the twisting roads to Devils Tower, and I had to say goodbye to all coverage for a few hours. Although it's a heavily traveled tourist corridor, the heavy forestation and a road following a river up a twisty canyon are too much of an RF challenge, even for the two largest carriers. Sitting in my hotel room in Hulett, Wyoming, which can only be described as a crossroads with a grocery store and a bar, I was pleasantly surprised to



have full LTE service, and 50 megabits per second (Mbps) from the free hotel Wi-Fi system.

We made the mistake of making this trek during the 75th annual Bike Week. Verizon was promoting the COWs they set up for the influx of more than 750,000 attendees; I had to see it! We took the back roads, and again alternated from 50 Mbps of LTE to nothing with the twist of a road. We eventually arrived at the Broken Spoke Saloon and Campground, and it was analogous to Mad Max meets Burning Man (without the environmental conscience). There was really great Verizon coverage and absolutely no AT&T coverage. AT&T, according to their press releases, also had a number of sites going COWs.

What an eye-opening experience this week has been. It was similar to what was presented at the AGL regional conference and what I'm hearing about more and more. Urban areas are pretty well covered, with Verizon and Sprint overbuilding

with small, typically LTE-only sites. Rural areas are mostly stagnant, with some of the top four carriers continuing to build the occasional coverage site and a few raw land builds to improve capacity.

Sprint's recent reorganization was a welcome surprise, particularly when followed with some bold announcements about network upgrades. The announcements included a figure that caused speculation that as many as 70,000 additional small cell sites may be added. This will be in addition to some sweeping additional frequency bands to enable many sites to be more consistent across all the macrosites.

It looks like this wireless thing may be here to stay.

Rich Biby, Publisher
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Quick-Guide to Legal and Financial Companies

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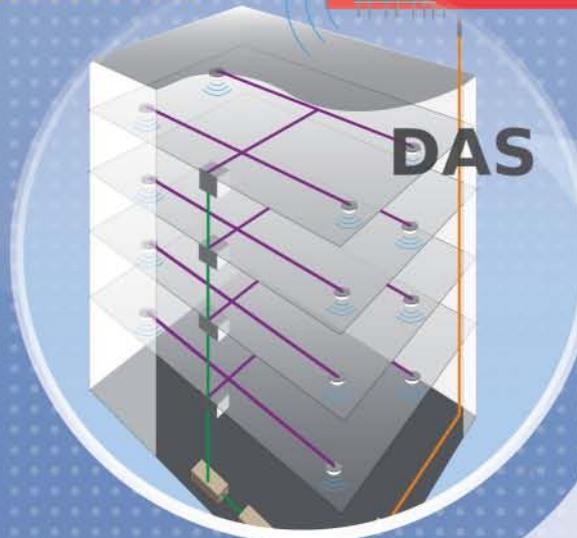
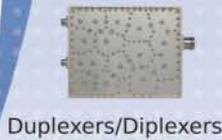
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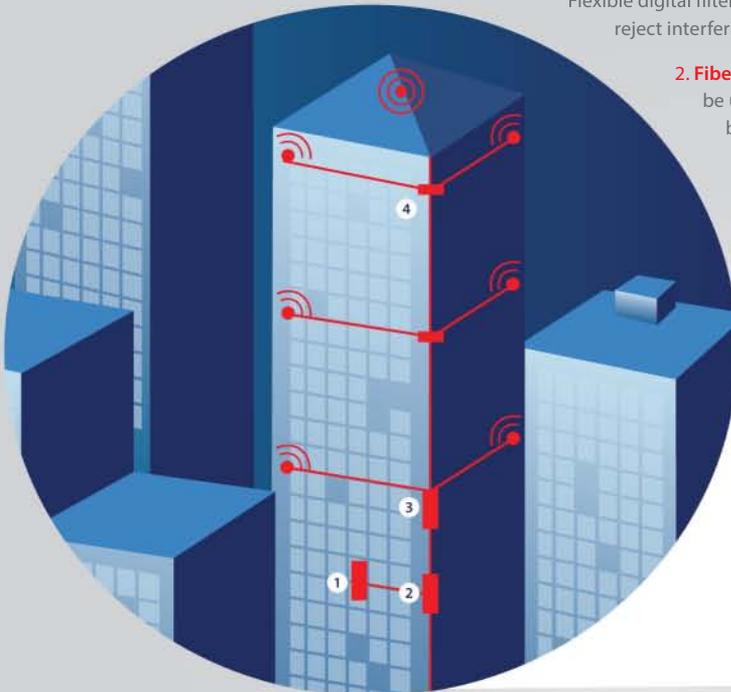
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Diagnosing and Repairing PIM Problems in DAS with an LTE Overlay

Using test equipment that calculates the distance from the instrument to a fault can save a great deal of time that might otherwise be wasted disassembling, inspecting and verifying each component in the system.

By Ferdinand Gerhardes

Operators running 2G mobile phone networks have been able in many cases to avoid passive intermodulation (PIM) interference by carefully choosing which frequencies reside on the same feeder cable. Because of the narrow channel bandwidth and relatively wide duplex spacing, low-order IM products were less likely to fall in the operator's uplink band.

The situation changes dramatically, however, when LTE network technology is introduced to a base transceiver station. In an effort to satisfy demand for data and bandwidth, the industry has created a more crowded spectrum in which low-order (relatively strong) intermodulation products are more prone than before to interfere with receivers' frequencies.

The problem is particularly acute in 2G/3G distributed antenna system (DAS) networks with an LTE overlay — and this also happens to be a fast-growing part of the network as operators rush to meet the lucrative demand

for improved in-building coverage. If the operator overlays LTE capability on a 2G/3G DAS using a so-called same-band or in-band combiner, it is likely to generate PIM products. What can be done to ensure it does not impair cell coverage or data throughput rates?

Why PIM affects DAS installations

PIM is a growing problem in cellular networks, especially in indoor DAS, because of the aging of existing 2G

and 3G systems. The older a system, the more it tends to suffer from corrosion and other types of degradation that give rise to PIM. The widely used N connectors in DAS, for example, are prone to degradation. The difficulty of performing maintenance when collocating new carriers or when installing new equipment also tends to give rise to problems with PIM.

Many legacy DAS sites were commissioned before the development of

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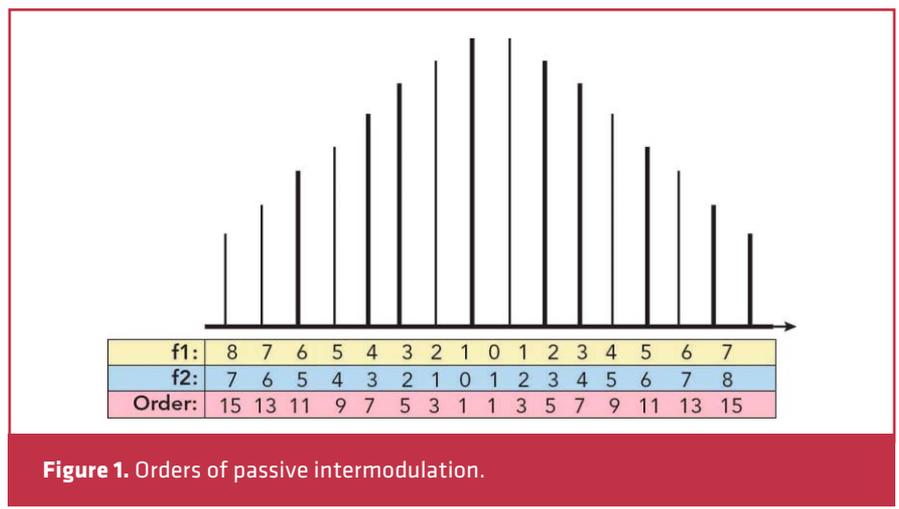


Figure 1. Orders of passive intermodulation.

LTE, which introduced multiple-input, multiple-output (MIMO) communications antenna technology. Thus, many existing DAS installations do not support MIMO or receiver diversity, nor does the existing cable support operation at frequencies up to 2600 MHz, as found in LTE systems. Overlaying LTE on old DAS therefore involves disturbance to existing passive components such as cables and connectors and the installation of additional new ones, creating a seedbed for the future growth of PIM products.

To understand why PIM is such a notable problem in DAS, it is important to know the way in which interference from PIM is caused. PIM is a form of intermodulation distortion that occurs in components normally thought of as linear, such as cables, connectors and

antennas. However, when subject to the high RF powers found in cellular systems, and in the presence of material nonlinearities, these devices can easily generate intermodulation signals at -80 dBm or higher. Because distortions are generated late in the signal path, they cannot be filtered out and may cause more harm than the stronger, but filtered, intermodulation products from active components.

PIM shows up as a set of unwanted signals created by mixing two or more strong RF signals in a nonlinear device, such as a loose or corroded connector, or nearby rust. Typically, the third-order product is the strongest and causes the most harm, followed by the fifth- and seventh-order products (see Figure 1).

Cellular operators will normally

configure their own receive bands so that their own third-order products do not fall into them. When multiple operators and multiple bands are hosted together in one DAS, however, the risk of interference from others' third-order products increases dramatically. It is also highly likely that energy from other external transmissions will mix within the nonlinear transmission line, causing many smaller PIM events of lower amplitude to mix repeatedly, resulting in a wideband raised noise floor that usually spans all operators' licensed spectra. Once this raised noise floor crosses into the receive band, it has a marked interference effect on the BTS receiver.

What's more, antennas and radios designed to handle LTE use so-called higher modulation schemes, such as

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64-QAM (quadrature amplitude modulation), which is inherently more sensitive to noise and interference than other modulation schemes such as quadrature phase-shift keying (QPSK). Because 64-QAM can only function well with very clean signals and minimal interference, LTE signals are more sensitive to PIM than are 2G and 3G signals.

This has led to a tightening of the standards applied to PIM tests. A standard pass level for GSM-based PIM is around -97 dBm (140 dBc); this is not difficult to achieve during installation. With LTE overlays, however, wireless service providers are advised in many instances to reduce the PIM pass level to ensure the system exceeds the specified receiver sensitivity level, which is usually around -107 dBm (150 dBc).

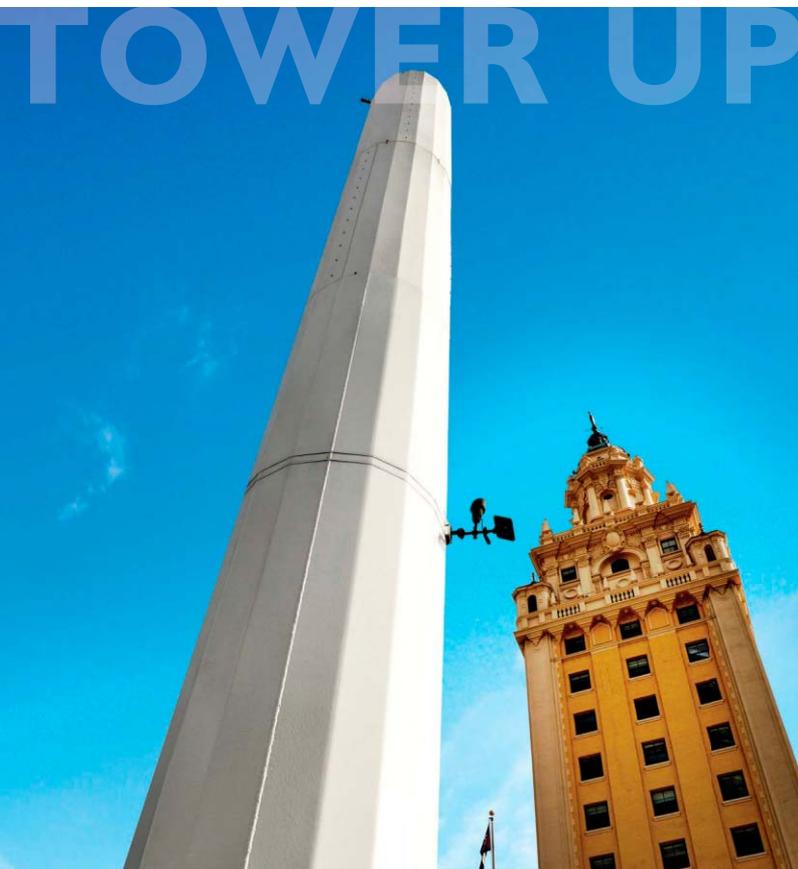
Troubleshoot PIM problems

Because this very low level will often be exceeded when overlaying LTE on an existing 2G/3G DAS, many network technicians will be required to address the issue of PIM in a complex antenna setup. When setting out to repair a PIM problem, it is helpful to have a plan. Experience has shown that the following sequence is effective:

- 1. Identify** — Discover whether there is a PIM problem by evaluating NMC statistics.
- 2. Quantify** — Measure how much interference the PIM products are causing in the frequency bands under investigation. Is it serious enough to be worth fixing?
- 3. Locate** — Find the root cause(s) of the PIM products.

The sheer existence of a PIM problem can often be discovered without recourse to a dedicated PIM tester. For instance, in 3G systems an examination of the received total wideband power (RTWP) graph over time will often show a marked increase when an LTE system is overlaid on an existing DAS. Likewise, a rise in the average uplink (UL) interference in a 2G system after the addition of an LTE transceiver will suggest a problem with PIM, especially if it can be correlated with a rise in the number of dropped calls.

The RTWP and idle traffic-channel UL interference data are system parameters that can be extracted from the network management system or operation and maintenance center of a 2G or 3G system. These



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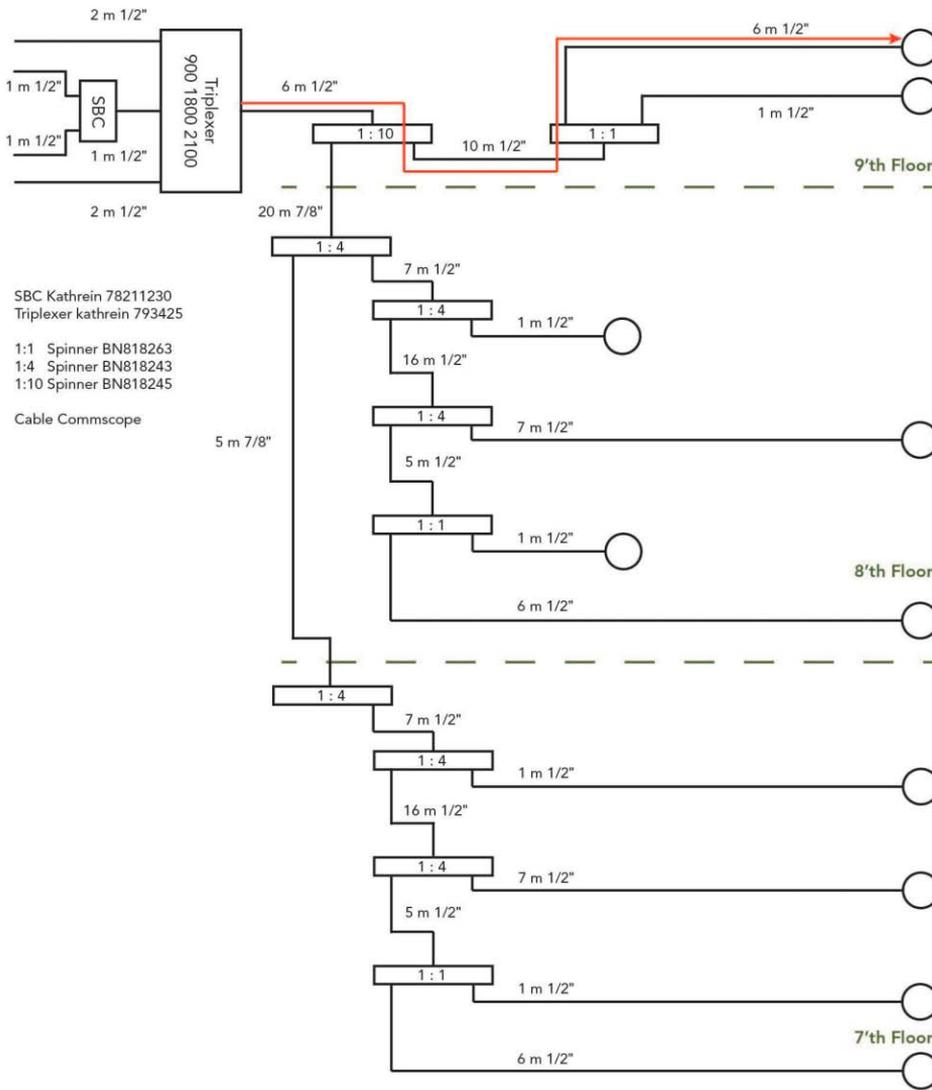


Figure 2: Schematic of a DAS feeder run.

parameters, however, cannot identify the exact fault in the DAS, and so on-site troubleshooting is necessary to locate the source of the PIM or other fault.

Once establishing that there is a problem with PIM, the engineer can begin to fix it. Damaged connectors, cables, duplexers, circulators and antennas may all contain nonlinear components. Also, it is wise to isolate the antenna itself to see whether the PIM is inside the system or beyond the antenna.



Figure 3. The Anritsu MW82119A PIM Master can precisely locate sources of PIM interference with its eDTP capability.

FEATURES

The usual process is to first eliminate the closest source of PIM and work outward from there toward the antenna. Once the antenna is disconnected and the feeder line under test is terminated with a low residual PIM load, it often becomes clear that larger PIM sources are hiding smaller ones further down the line. The methodical repetition of the PIM-fixing process throughout the entire length of the feeder line will ensure that every source of PIM is eliminated.

With the feeder line to the antenna now clear of PIM, the engineer may reconnect the antenna. A repeat of the measurements will show whether the site is operating properly or whether there are additional PIM problems beyond the antenna.

PIM Measurements in a DAS

As an illustration of the process, Figure 2 shows measurements from a real DAS installed inside a nine-story building. The system is approximately six years old and was originally designed to operate 2G and 3G systems. All of the cellular infrastructure was installed on the

top (ninth) floor. Testing was required to establish the effect of overlaying a 10-megahertz LTE 1800 service on the same system.

The original triplexer was retained, but a new 1800-MHz port was connected to the same-band combiner to carry GSM 1800 and LTE 1800 signals in parallel on the same feeder run.

The test plan called for the nine floors to be tested in turn, in order to isolate potential problems at each floor. In other words, floor 9 was measured by terminating port 1 of the 1:10 taper. Then, floor 8 was measured by terminating port 2 of the 1:10 taper and terminating in parallel port 1 of the 1:4 taper on floor 8, and so on. Following this procedure, it was possible to locate the floor on which each PIM problem occurred.

To precisely locate the sources of PIM on each floor, the test engineer would then need to disconnect the floor feeder runs and terminate each free splitter port with a low-PIM load. The test parameters are shown in Table 1.

As an example, the test results for the cable run marked in red in Figure 2 are summarized in Table 2.

It is obvious that this feeder line has some PIM problems. The root cause for the observed problem was bad workmanship at the feeder end, where the indoor antenna jumper cable was connected.

Finally, having located PIM at the level of a single floor, the

700 MHz (U)	3,6 m
700 MHz (L)	2,8 m
800 MHz	3,4 m
850 MHz	3,3 m
900 MHz	3,1 m
1800 MHz	1,2 m
1900 MHz	1,7 m
1900/2100 MHz	1,5 m
2100 MHz	1,7 m
2600 MHz	3,3 m

Table 3. eDTP resolution v. model type.

Tone 1	Tone 2	Third-Order Intermodulation Product	PIM threshold
1805,0 MHz	1880,0 MHz	1730,0 MHz	-107 dBm

Table 1. Test parameters for the LTE 1800 installation.

Test Location	Test Power	Return Loss	Average PIM	Peak PIM	Result
Top of Cabinet	+43 dBm	-24 dBm	-86 dBm	-82 dBm	Fail

Table 2. Test results for the cable run marked in red in Figure 2.

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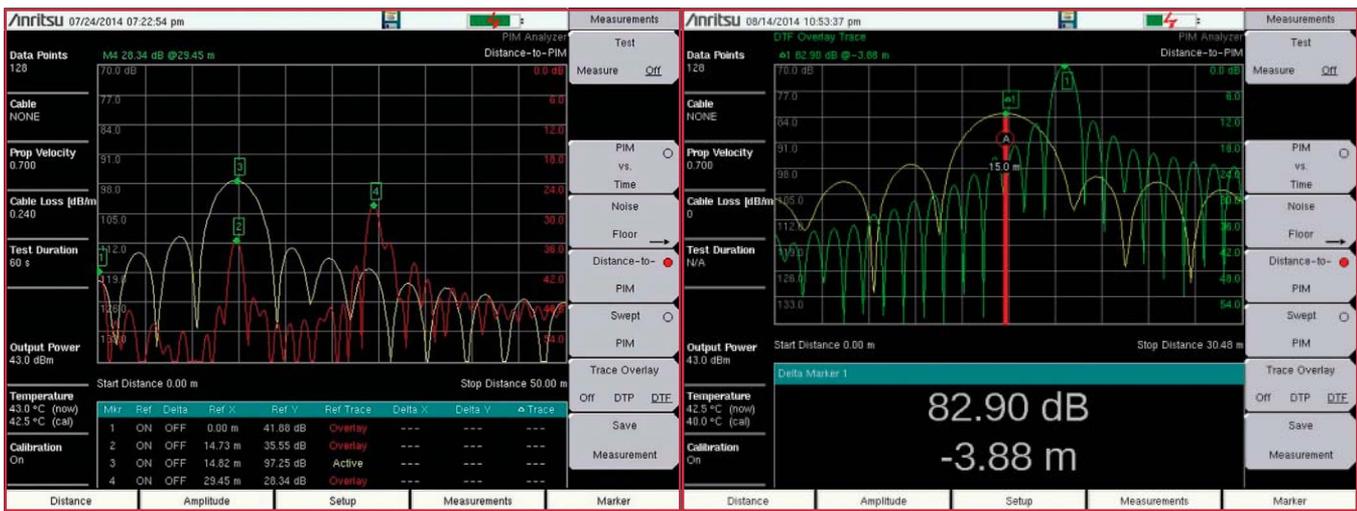


Figure 4. eDTP/eDTP and eDTP/DTF overlay functionality of MW82119B.

technician will need to find the actual cable joints, rusty connectors or other nonlinear passive components responsible for generating PIM products. At this stage, a PIM measurement instrument that can calculate the distance from the instrument to a fault can save a great deal of time that might otherwise be wasted disassembling, inspecting and verifying each component in the system. In addition, the possibility to overlay these results with well-accepted distance-to-fault (DTF) measurements may give absolute proof of the PIM location.

For instance, the portable MW82119B PIM Master from Anritsu both measures PIM products and locates their sources (see Figure 3). In addition, it incorporates a cable and antenna line analyzer that provides for operation at frequencies between 2 MHz and 3 GHz. Combining these capabilities provides an integrated test solution that can be used to certify PIM and line

sweep performance.

An enhanced distance-to-PIM (eDTP) feature is also now available that can find the distance and relative magnitude of all static PIM sources in an antenna system and even beyond the antenna (see Figure 4). The resolution of the eDTP function is dependent on the available sweep bandwidth and the sweep step

“ PIM is a growing problem in cellular networks, especially in indoor DAS, because of the aging of existing 2G and 3G systems. ”

size. Table 3 shows the best resolution is available from the 1800-MHz model because of its wide 75-megahertz sweep bandwidth.

The eDTP function in the PIM Master can locate the following

fault conditions:

- Connectors with bad workmanship
- Dirty connectors or corroded connectors
- Under-torqued connectors
- Microscopic arcing inside connectors
- PIM outside the antenna system (up to hundreds of meters away)

This capability helps shorten the time required to fix PIM problems, and gives network operators confidence in their ability to extend LTE coverage through collocation in DAS, without giving rise to the risk that PIM will disable existing 2G and 3G systems hosted on the same site.

Ferdinand Gerhardes studied communication engineering at the University of Federal Armed Forces Germany, Hamburg, and has held several management positions in different companies dealing with wireless communications as well as test and measurement. At Anritsu, he is responsible for business development and program management at education and research accounts.

Wireless Innovation Act Would Boost Antenna Sites on Federal Land



U.S. Sen. Marco Rubio (R-Fla.)

A U.S. Senate bill promotes the deployment of wireless infrastructure on federally owned buildings and property by streamlining the process by creating a standard fee and master application to grant real property interests.

By the *AGL Magazine* staff

U.S. Sen. Marco Rubio (R-Fla.), a member of the Committee on Commerce, Science and Transportation and the Subcommittee on Communications, Technology, Innovation, and the Internet, joined with subcommittee chairman Roger Wicker (R-Miss.) and fellow members Kelly Ayotte (R-N.H.), Cory Gardner (R-Colo.) and Ron Johnson (R-Wisc.) to introduce the Wireless Innovation Act of 2015, a bill to reallocate spectrum used by the federal government for commercial wireless services, ensure greater transparency and accountability of the federal government's spectrum use, and promote wireless innovation and deployment.

"As wireless broadband and Internet-connected devices continue to grow, the United States must continue to lead the world in wireless innovation and technology by making sure the federal government is using its spectrum in an efficient and

responsible manner and freeing up additional spectrum for commercial use," Rubio said. "The Wireless Innovation Act promotes the deployment of wireless infrastructure on federally owned properties to increase wireless coverage and capacity, so Americans can access 21st-century technologies and so the infrastructure is there to support the Internet of Things. This policy would also provide transparency in the use and value of federal spectrum and informs the public about how federal entities use a scarce resource. Passing this bill will promote economic growth and innovation while ensuring that consumers continue enjoying the benefits of wireless technology."

"This bill encourages efficient use of spectrum to meet the soaring consumer demand for greater wireless capacity," said Wicker. "As the number of wireless-only households in Mississippi and across the nation continues to grow, it is critical that we evaluate federal spectrum use to ensure that this finite, taxpayer-owned re-

source is best allocated to serve the needs of the American people. I applaud Sen. Rubio for his leadership on this issue."

"New Hampshire desperately needs better connection to wireless services, with gaps in coverage throughout large portions of Coos, Grafton, Sullivan, and Cheshire Counties," Ayotte said. "Expanding access to communications technology in the Granite State is a top priority to ensure that businesses can grow and create jobs, and this bill will promote wireless deployment and innovation, putting into motion the efficient transfer of spectrum so that carriers are able to acquire crucial spectrum needed to build out to rural areas."

"In today's economy, more spectrum means more jobs," said Gardner. "Opening up more spectrum for commercial use will foster more innovation, more entrepreneurship and more growth in mobile data. I'm proud to support this act, and I'll work hard to ensure it passes."

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“Mobile traffic is expected to grow eleven-fold between 2013 and 2018, according to industry projections,” Johnson said. “Industry is clearly doing its part to prepare, bidding an unprecedented \$41 billion on the most recent FCC spectrum auction. This bill will require the federal government to do its part, opening up more spectrum opportunities, expediting FCC review of spectrum transactions on the secondary market, and streamlining the process for broadband infrastructure to locate on federal buildings. The real solution to broadband openness and availability is breaking down regulatory barriers, not building them up. This bill is an important first step and I look forward to working with Sens. Rubio, Wicker, Ayotte and Gardner to continue to find ways to promote broadband deployment.”

“Today, by encouraging the careful deployment of wireless infrastructure on federal lands, Sen. Rubio has taken a crucial step toward ensuring that all Americans have equal and reliable access to the

mobile data that’s transforming our economy and society,” Jonathan Adelstein, president and CEO of PCIA – The Wireless Infrastructure Association, said. PCIA is a membership organization that represents companies that build, design, own and manage telecommunications facilities throughout the world. Its members include carriers, infrastructure providers, equipment manufacturers, systems integrators and professional services firms.

“Nearly a third of America’s landmass and thousands of buildings are owned or controlled by the federal government,” Adelstein said. “Sen. Rubio’s bill seeks to ensure federal resources are efficiently tapped to bridge the digital divide and bring broadband services to Americans living in hard-to-serve rural areas, as well as the dense urban locales home to federal buildings — which would spark jobs and economic growth.”

The PCIA executive said that the bill would improve wireless service for members of the armed services because

U.S. military bases fit within the definition of federal lands and stand to benefit from the clarifications the bill provides.

“Our soldiers’ and their families’ smartphones, tablets and laptops require instant access to mobile broadband,” Adelstein said. “They deserve world-class wireless broadband as they make sacrifices on behalf of our country. In today’s world, delivering quality health care and education services is more dependent than ever on wireless networks. The same goes for providing firefighting and other emergency services in and around military bases.”

Adelstein said that Rubio’s bill is aimed at ensuring that the U.S. Treasury receives fair and full value for property leased for installation of wireless broadband facilities. He said the bill already has garnered broad support from industry groups, the Obama administration and federal agencies.

Sources: Prepared statements from Sen. Marco Rubio and PCIA.

The Wireless Innovation Act of 2015 would:

- Require NTIA to identify and reallocate 200 megahertz of spectrum below 5 GHz and currently allocated primarily to the federal government for commercial mobile use (140 megahertz for licensed use, 40 megahertz for shared, 20 megahertz for unlicensed use)
- Establish an auction pipeline to ensure the 200 megahertz of spectrum identified by NTIA is reallocated in a clear, predictable manner
- Allocate portions of the auction proceeds be made available to federal entities for conducting research and development and other engineering activities to:
 - Identify alternative spectrum (either federal or non-federal) that existing systems can be relocated to
 - Develop technologies that will allow existing systems to be relocated and shared with other federal systems
 - Develop cost and time estimates for relocating existing systems
- Require the Office of Management and Budget to report to Congress details of how agencies are using these funds and what bands agencies are considering for potential use
- Promote secondary spectrum markets by expediting the FCC review period for routine license transfers
- Require OMB to review agency requests for new or modified frequency assignments for a wireless service by requiring agencies to submit an analysis addressing issues including whether commercial services could be used instead of new or modified frequencies, whether other federal spectrum could be used or shared, and whether the service requires frequency below 3 GHz
- Provide transparency on the use and value of federal spectrum by requiring the National Telecommunications and Information Agency to develop a framework to determine the commercial value of each federal spectrum band, and requiring federal agencies to report the opportunity cost borne for each spectrum band that is entirely under the control of that agency as part of its budget
- Promote the deployment of wireless infrastructure on federally owned buildings and property by streamlining the process by creating a standard fee and master application to grant real property interests

Source: Sen. Marco Rubio

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How to Decommission Equipment on Cell Towers

Part One — Technology upgrades and the use of additional frequency bands and RF hardware trigger the need to decommission the older equipment. Play it safe, and budget for replacing the antenna mounts.

By Don Bishop

CommScope's vice president of network engineering, Ray Butler, spoke to an audience at the Wireless Infrastructure Show in April about the need to decommission equipment. He described some best practices for budgeting for decommissioning and for performing work on the tower, as well as what to consider when choosing replacement equipment. Butler spoke at the session "Decommissioning Aging Cellular Infrastructure" led by Rich Berliner, chief executive officer of Red Wing Electric.

Butler covered the decommissioning of equipment from the tower out

to the antennas, including the cables and antennas. He discussed what causes changes to be made at cell sites and why it's necessary to decommission equipment.

In the wireless communications industry's early days, the days of 1G cellular technology and Advanced Mobile Phone Service, it was common for carriers to use heavy monopoles and fairly robust antenna-mounting equipment. Butler said technicians performed rudimentary return loss sweeps and passive intermodulation (PIM) interference testing. With 2G technology, antennas and mounting

equipment became smaller and lighter. The RF testing evolved. With 3G technology, the amount of equipment placed on towers increased incrementally. Then with 3G came more radio-frequency spectrum, which affects everything on the tower.

The advent of LTE and LTE-Advanced, the use of additional spectrum, the appearance of additional wireless carriers and the use of remote radio heads at the tops of towers change the nature of the equipment on the tower, how it's tested and how it functions. Where 2G antennas usually had two or



Ray Butler, vice president of network engineering, CommScope.
Photo by Don Bishop

Decommissioning Article Series

- September, Part One, Equipment: "How to Decommission Equipment on Cell Towers"
- October, Part Two, Technology and Spectrum: "Carrier Mergers and New Spectrum Lead to DAS Upgrades and Decommissioning"
- November, Part Three, Software: "Software Aids in Decommissioning Telecommunications Antenna Sites"
- December, Part Four, Landlord Perspective: "What Owners Need to Know About Cell Site Decommissioning"

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four ports, today antennas with six and eight ports are common, and there's a trend toward antennas with 10 and 12 ports. Butler said those would be bigger and heavier than today's antennas.

The addition of new frequency bands affects everything, and But-

ler gave jumper cables used between large-diameter cables and antennas as an example. He said jumpers purchased in the early 2000s would have been tested for PCS frequencies and probably cellular frequencies, but they may not have been tested for today's additional Ad-

vanced Wireless Service (AWS) and the coming AWS-3 and 2.6-GHz frequency bands. Typically, jumpers were only tested for the band for which they were specified. "We recommend as you go to the tower to replace and decommission the old equipment that you replace those jumpers," he said.

Another thing that has evolved is PIM testing. In the early days, factory testing was conducted using two simple tones. That evolved to the use of swept tones, then further evolved to field testing at the site. Butler said that it is common today to vibrate the antennas and jumpers as they are tested in the factory. Each test has become more rigorous, more severe.

"What you don't want is old equipment on the tower that isn't tested to the latest, most rigorous testing requirements," Butler said. "We even see some entire sectors being assembled and tested at the factory on the pipe and shipped to the site for mounting. This is the highest-quality way to deploy a wireless network."

Yesterday and Today

In the early days with time-division multiple-access (TDMA) technology, antennas were 4 inches wide and 8 feet tall, weighing 200 to 300 pounds per sector maximum weight. Compare this with today's systems that have even evolved from LTE two years ago where you see multiple remote radio heads. They might be in the range of 70 pounds each along with other miscellaneous RF equipment at the top of the tower.

Butler said that for the effective



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projected areas (EPAs), the wind loading, going from 2G to 4G, is a 10 times increase from somewhere around 15 to 16 square feet up to 150 square feet in today's world. The weight increased from 250 pounds to more than 1,500 pounds today, reflecting significant shifts in how much is expected of the tower and of the mounting system.

"As you deploy LTE, we recommend replacing the mounting system from the tower to the pipe holding the antenna," Butler said. "You don't know from looking at the mount how old it is. Electronic equipment has serial numbers, so you have a date code. Mounts typically have not been given date codes. When you get to the tower, you don't know when the mount was built. You don't know to what standard it was built. You don't know the thickness of the metal. You don't know the plating. You don't know even the process by which it was manufactured. The manufacturing process is important to the stability, strength and robustness of the mount. So our caution is to work with a supplier that can obtain top-quality mounting systems, from the tower all the way to the antenna. Don't pinch pennies to avoid that."

Butler said it could be even more important for network operators to replace the mounts. "Failure to do so can delay a deployment," he said. "It can cause budgets to overrun because when you do the analysis, you'll find that in fact that ten-fold increase in EPA and six-fold increase in weight makes a huge difference. You should plan to replace those mounts ahead of time so it's in the

budget and part of the plan."

More Functionality

Although antennas are getting larger, manufacturers are putting the functionality of more antennas into the same radome or package, the equivalent of five or six antennas. The EPA would be worse and the weight would be greater with five or six separate antennas. By consolidating and integrating into antennas with more ports and wider bandwidth, antenna manufacturers are making the wind load and the weight increase less than it otherwise would be with multiple antennas.

Butler said that antennas are bigger and heavier than the previous antenna generations, reflecting more frequency bands and placing the remote radio head on the tower. The need to combine, power and distribute equipment at the top of the tower instead of at the base of the tower adds to the complexity of the mounting systems.

Butler said that technology upgrades and the use of additional frequency bands and RF hardware trigger the need to decommission the older equipment. "In addition to replacing the jumpers, we recommend that while technicians are on the tower, they should always be inspecting for cracks and for visual indication of corrosion, and take immediate action to replace defective equipment," he said. "Ultimately, the equipment cost pales in comparison to the cost of revisiting a site and taking care of damaged equipment, usually in a rush-demand approach."

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Jonathan Adelstein, president and CEO of PCIA, testifying before the U.S. House Communications and Technology Subcommittee.



Congress Should Knock Down Barriers to Broadband Network Deployment

Congressional action holds promise for speeding the roll out of infrastructure necessary to provide wireless services where development has been hindered.

By Jonathan Adelstein

On July 22, I urged Congress to adopt further policies that streamline and accelerate the deployment of wireless broadband facilities to meet explosive consumer demand. In my testimony before a House Communications and Technology Subcommittee hearing on the need to spur investment in broadband infrastructure, I touted the many benefits of wireless broadband and challenged leaders in Congress to build on their successful efforts to

eliminate barriers to deployment.

Put simply, wireless infrastructure makes wireless work. Wireless infrastructure is the essential platform that delivers such innovative applications as Uber, Instagram, Twitter and YouTube, as well as life-altering broadband services such as telemedicine, distance learning, improved public safety response, cloud computing, mobile banking and a host of industrial and manufacturing functions. Continued investment in robust wireless

infrastructure will enable future innovation and build on America's historical competitiveness in the technology sector.

One way federal policymakers can expedite broadband deployment is to mitigate municipal proof-of-need requirements before authorizing infrastructure builds. These requirements are both illogical and costly. Local communities should not be in the chief technology officer business of deciding what level of service is appropriate or

what effective competition looks like today or forecasting future demand.

I urged lawmakers to promote deployment on federal lands and buildings, which comprise nearly 30 percent of the landmass of the United States, many in underserved rural areas. Broadband providers currently face significant challenges when working to secure access to federal lands and buildings to deploy infrastructure. Facilitating access would provide the federal treasury with much-needed revenue through lease payments and improve broadband access across the country, especially in rural communities. Negotiations with the federal government take about four years compared with 22 months with a private owner.

The committee should continue its work to encourage deployment on native lands to ensure the promise of broadband is afforded to all Americans. Some tribal nations are putting forward increasing delays and fees when facility

siting requests are submitted.

There is a need for regulatory and legislative certainty when it comes to broadband investment and the open Internet. Certainty leads to investment. Network builders are putting up billions of dollars in private capital, and predictability and consistency are vital to spur further investment. This also is true in the realm of pole attachments, where some jurisdictions have been slow to adopt policies for clear and equitable rates, efficient timing, and access for wireless attachers to existing utility poles in the rights of way.

I was one of five industry experts to testify at the hearing called by U.S. Rep. Greg Walden (R-Oregon), the subcommittee chairman. Other witnesses included Craig Moffett of Moffett Nathanson Research, Michael Slinger of Google Fiber Cities, Deb Socia of NextCentury Cities and Stephen Roe Lewis, governor of the Gila River Indian Community in Arizona.

Wireless infrastructure helps every sector of the economy. The mobile

broadband revolution holds incredible promise for economic growth, job creation and international competitiveness. Yet, there are warning signs on the road ahead that can't be ignored. To realize this promise of economic growth, job creation and innovation, infrastructure builders need the capital to invest — and we need regulators and Congress to help. We are grateful to the Energy and Commerce Committee for its leadership in helping us with the basic blocking and tackling work it takes to get these networks deployed on the ground.

Jonathan Adelstein is president and CEO of PCIA – The Wireless Infrastructure Association, a membership organization that represents companies that build, design, own and manage telecommunications facilities throughout the world. Its more than 220 members include carriers, infrastructure providers, equipment manufacturers, systems integrators and professional services firms.



Seated at the front table, from left: Jonathan Adelstein, president and CEO of PCIA; Stephen Roe Lewis, governor of the Gila River Indian Community; Craig Moffett of Moffett Nathanson Research; Michael Slinger of GoogleFiber Cities; and Deb Socia of NextCentury Cities.

The Tower Market: CFO View

The CFO of Crown Castle International, Jay Brown, said the returns for small cells are among the best of any alternative the company has. At American Tower, maintaining an investment-grade credit rating is a commitment.

By Don Bishop

At the Wireless Investors Conference in April, the CFOs of Crown Castle International, American Tower's U.S. business and SBA Communications spoke about their view of the telecommunications tower market and the economy's effect upon it. They also spoke about their companies' capital structures and about mergers, acquisitions and leasing demand. The session was led by Clayton Funk, managing director, Media Venture Partners, who said that the macro economy and the capital markets appear to be healthy. The Wireless Investors Conference is part of the Wireless Infrastructure Show.

Good Capital Markets

Jay Brown, CFO of Crown Castle International, said that the tower business has a phenomenal backdrop, and that the capital markets have been good for many business sectors for many years. Crown Castle not only

has had the benefit of raising low-cost financing, it has all four of the big wireless network operators spending money with it as they improve their networks.

Crown Castle chose to de-lever its business (reduce the percentage of debt) from its historical levels when it was acquiring the majority of the assets it now owns. The company now distributes about 75 percent of its cash flow as a dividend and is focused on achieving an investment-grade credit rating. Brown said that achievement would require about five turns of debt to earnings before interest, taxes, depreciation and amortization (EBITDA), and the current level is a little above that.

"This is a terrific time to be in the tower business because of what propels revenue and because of the low cost of capital," Brown said.

Rodney Smith, the CFO of the U.S. Tower Division at American Tower, said his company has achieved an investment-grade credit rating and

is committed to keeping it. American Tower targets leverage (the ratio of a company's debt to equity) between three and five times, and goes above that level when certain acquisitions are available. He said when American Tower bought Global Tower Partners, its leverage rose to 5.8. "We committed to getting that right back down below five within 18 months, and we did," he said.

Next, American Tower bought the rights to towers owned by Verizon Wireless, spending \$5 billion dollars on nearly 11,500 assets through a prepaid subleased structure. "Once again, we went above our range of three to five times, reaching into the mid-fives, and we'll de-lever quickly again, with the goal of maintaining investment-grade credit," Smith said.

Interest Rate Insulation

Smith said that although interest rates eventually will rise, American Tower is well insulated from the effect because its debt structure is 80



Brendan Cavanagh, CFO, SBA Communications.

Photo by Don Bishop



Jay Brown, CFO, Crown Castle International.

Photo by Don Bishop



Rodney Smith, CFO, U.S. Tower Division, American Tower.

Photo by Don Bishop



The Wireless Investors Conference panel, led by Clayton Funk, managing director, Media Venture Partners (standing). Photo by Don Bishop

percent fixed, and it's laddered (multiple bonds with different maturity dates). Only 20 percent of the company's debt is subject to variable interest rates.

American Tower is a real estate investment trust, so its capital first goes toward paying a dividend. The company is committed to increasing its dividend by about 20 percent a year over the next five years. After that, it wants to reinvest capital in towers, building towers in the United States and in foreign countries. It now owns towers in 12 countries. "After that, we acquire towers," Smith said.

After paying a dividend and reinvesting capital in towers, a third step Smith identified for capital allocation is for American Tower to buy its own shares, provided there are no other opportunities better for its investors and the company is within its target leverage rate.

Company Differences

Brendan Cavanagh, CFO of SBA Communications, said when it comes to target leverage, the three companies

differ. He said SBA has a much higher target leverage range of seven to seven and a half turns of net debt to its last quarter's annualized EBITDA. That has been the company's target range for about six years, since the capital markets crisis in 2008.

"Leverage could be carried at a higher level, but we balance it against situations that can occur, such as the capital markets crisis," Cavanagh said. "We protect ourselves by staggering our maturities and raising money in multiple markets. We also stay a couple of years ahead of maturities."

For SBA, what's important for leverage is the underlying business, the fundamental strength and consistency, and the cash flow — not only current cash flow but the growth of cash flow year after year, which creates stability that supports the large amount of leverage that SBA carries. SBA has benefited from low interest rates that made it possible to raise additional leverage and pour it into the business in the form of acquisitions, new builds, ground lease buyouts and stock repurchases when opportunities

for well-priced acquisitions have been lacking. "By doing that, we've been one of the fastest growers in the industry," Cavanagh said.

Potential Risks

Funk asked what concerns the CFOs have, and they responded to say that they didn't foresee many risks. They commented about radio-frequency spectrum and about small cell technology. Some companies have licenses for large amounts of spectrum that remain un-deployed. The FCC is prepared to auction additional spectrum. And wireless carriers are making increasing use of small cells.

Noncyclical Industry

Smith said that the tower industry is noncyclical, in that what propels demand for towers depends on what stage the carriers are in for their network development; it doesn't depend on the macro-economic environment. He said the carriers have been active and demand has been strong.

As for the potential risk posed by rising interest rates, he said American Tower doesn't worry about it much, although the company has laid plans for increases and as a result is somewhat insulated from rising interest rates.

He said leasing demand in 2014 was so good it was almost unprecedented. The U.S. Tower Division of American Tower grew at nearly a 9.5 percent core organic growth rate, the best it had seen in a long time. He saw strong demand in 2015 within and outside of the United States. He said he expects the U.S. core organic growth to be within a target range of 6 and 8 percent over the long term, and right in the

middle of that in 2015.

Smith said the carriers have begun to shift their orders as AT&T Mobility, and Verizon Wireless completed their LTE build out. Now, they're adding capacity sites to improve network quality, along with adding coverage sites. As a result, American Tower is seeing a shift from amendments to new collocations, which gives it some core organic growth. T-Mobile USA and Sprint are near the end of their LTE rollouts, and Smith said American Tower expects that the two carriers will begin shifting to more collocations and building out the new spectrum that they just bought.

Small Cell Risk

With regard to the potential risk posed by small cells, Smith said American Tower has invested in in-building wireless networks and outdoor distributed antenna system (DAS) networks. The company is deploying some lower-level antenna sites similar to macrosites where carriers install them at 30 or 40 feet in elevation. Sometimes the sites have omnidirectional whip antennas, and sometimes they have directional sector antennas. "They consider those to be small cells," Smith said.

Smith said American tower considers DAS and small cells to be complementary to macrosites, which he said are the first choice of the carrier in every instance, over and above rooftops, in-building wireless and outdoor DAS.

"When it comes to the small cells, Wi-Fi networks or outdoor DAS, they're complex to design, build and construct," he said. "They're complex to operate. We have more than 500

nodes on outdoor DAS networks, and they've been in place for a number of years. We haven't seen the same level of organic lease-up that we see on the towers. Our tower portfolio averages 2.5 tenants per tower. Our in-building wireless networks average 2.5 tenants. Our outdoor networks average about 1.1 tenants, a dramatic reduction in the lease-up. The economic model there is challenged."

Smith named two companies and a public safety entity as having spectrum waiting to be deployed. "Dish Network, LightSquared and the First Responder Network Authority (FirstNet) have a lot of spectrum," he said. "It's difficult to predict when and how they'll build it out and what it means to tower companies. But when it gets built out, it should add to the core organic growth of all the tower companies."

Meanwhile, Smith said American Tower doesn't see any technology or other risks that would be directly competing with towers any time soon.

Positive Factors

Cavanagh said that he, too, saw little potential risk to the tower business. He said positive factors include Dish Network and FirstNet with their spectrum to deploy, along with wireless carriers that have not yet contributed as much to SBA Communications' growth and activity level as he expects they will, bringing an incremental positive to the company's business.

The SBA executive said the tower business offers stability and consistency, as evidenced during the credit market crisis in 2008. "Although our stock was punished a little bit, having to do with people's concerns

over leverage, the fundamental operational performance of the business never slowed,” Cavanagh said. “We continued to have growth in EBITDA. We continued to add tenancies and amendments to our towers.”

Carrier Activity

SBA has seen periods when one carrier is active and then might not be as active during the next quarter, yet over time, activity levels out. “Last year was a record year,” he said. “This year may not be as high as last year was, but all of the carriers are busy. I expect that toward the second half of the year, we’ll see activity pick up again.”

Brown said Crown Castle looks at technology risk frequently, and nobody understands technology better than the carrier customers. He observed that every time they initiate the use of a tower, they sign a 10-to-15-year commitment. The cost and effort they put into using macrosites is significant, and

its clear that they anticipate using the sites for a long time. “That probably speaks more than any research we can do anywhere else about the technology risk—the commitment of the carriers to these sites,” he said.

“You would have to be really dumb to break a tower company,” Brown said, continuing to speak of the risk. “When you invest in a tower company, most of the risk is about sub-optimizing what could be the outcome. As we think about allocating capital, it’s never about whether a particular investment clears a given hurdle rate, because given our cost of capital, everything in the tower business clears any reasonable hurdle rate. It’s all about what is the best outcome and optimizing that outcome against various alternatives.”

Capital Allocation

Brown said that when Crown Castle thinks about allocating capital, it considers the best alternative relative

to other alternatives. He said that for many years, one of the alternatives was stock repurchasing. For Crown Castle most recently, it’s been a meaningful investment in small cells.

“Small cells make up about 7 percent of our consolidated revenue,” Brown said. “We’ve seen year-over-year growth in small cells of about 30 percent, and it’s the next wave of deployment we’ll see from U.S. carriers on outdoor systems as they improve network capacity and coverage. We’ve spent a lot of time and capital on small cells for a total investment of about \$1.7 billion, which is yielding about 7 percent. Compare that with our recent tower acquisitions, which yielded about 5 percent initially. With small cells, we’re in the early stages of the first couple of years of investment, and they are already in the 7 percent yield range. The returns for small cells are among the best of any alternative that we have in front of us.”

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Verizon, T-Mobile Lead Tower Leasing; Sprint Ramps

Low expectations for AT&T and for near-term deployment on WCS radio-frequency spectrum lead to a reduced leasing forecast for the rest of 2015. But AT&T probably will resume leasing in 2016, and the setup for tower stocks in 2016 is favorable.

By J. Sharpe Smith

Verizon Wireless and T-Mobile USA continue to lead in tower leasing activity, with Sprint entering a more active phase and AT&T mostly focused on LTE capacity in the United States and on coverage and modernization in Mexico, according to RBC Capital Markets' "Wireless Network & Tower Leasing Update."

"We continue to believe the 2016 setup is favorable for towercos, with a year-over-year ramp in leasing becoming noticeable in the first half of 2016," Jonathan Atkin, an RBC analyst, wrote. "We favor Crown Castle International versus its peers, based on strong prospects for macro-site and small cell leasing, and improved churn."

AT&T appears to be inactive with new leasing and fairly active with LTE carrier additions, but with minimal benefit for towers, according to Atkin.

"We believe AT&T is moving relatively slowly with the turn-down of legacy Leap sites," he wrote. "AT&T

announced \$3 billion of incremental capex in Mexico for modernization and coverage expansion, spread out from 2015 through 2018."

Sprint's network improvement plans are taking shape, with a 70,000 macro-mini-cell site addition project set to launch in July, according to RBC's research.

"We believe the project is about to enter the site acquisition, engineering and permitting phase, once vendors are finalized in the first half of July," Atkin wrote.

T-Mobile appears to be focused on LTE and coverage expansion at 700 MHz and seems to be nearing completion of its LTE overlays in the PCS and AWS bands while ramping up network-hardening efforts on the East Coast.

"We believe T-Mobile will shut down all remaining MetroPCS CDMA equipment at mid-year (June 30) with full decommissioning targeted by late Q3 or early Q4," Atkin wrote.

Verizon remains the most active carrier in deploying new macrosites,



Jonathan Atkin

according to RBC, and its small cell deployments are also more advanced than the other carriers. Its small cells use a cloud RAN design, which inhabits street furniture connected by fiber with centralized hardware locations.

Wireless Infrastructure Effect

Tower beneficiaries from increased activity at Sprint are Crown Castle because of its outdoor small cell focus, and SBA Communications with its U.S. exposure, according to RBC.

AT&T's increased Mexico spend should benefit AMT, which derives roughly 6 percent of total revenues from its 8,700 Mexico sites. AMT should also benefit from 4G upgrades on legacy Iusacell and Nextel leases, which comprise more than 70 percent of its Mexico revenues.

"We maintain our favorable views on American Tower because of improving U.S., Mexico and India trends, and SBAC, because it has the strongest core U.S. growth rate and prospects for Brazil leasing," Atkin wrote.

Leasing Faster in 2016

While the tower industry appears to be taking a breather from its torrid pace of last year, RBC Capital Markets expects it to pick up again next year.

"Despite a slower 2015 leasing environment in the United States and few apparent near-term operating catalysts, we believe the 2016 setup for tower stocks is favorable," Atkin wrote in a "Tower Update."

The firm reduced its leasing forecast from 18,000 to 16,000 broadband equivalents for 2015, based on lower expectations for AT&T and for near-term deployment on WCS spectrum.

RBC is optimistic about 2016, primarily because of expectations that AT&T will resume infill activity and begin overlays in the WCS or AWS-3 bands. Additionally, Sprint is expected to densify its networking using macrocells, helping all tower companies, and to deploy small cells, helping Crown Castle.

"Site additions [at Sprint] should ramp in the second half of 2015 as the company embarks on infill coverage, with activity likely to accelerate during 2016–2017, in our view," Atkin wrote.

Cell Tower Shrinkage Will Give Way to Long-term Growth: SNL Kagan

The number of active cell sites decreased for the first time in 2014. And that may be the last decrease for a long time, according to SNL Kagan estimates.

"Driving the contraction was the decommissioning of Nextel locations and the shuttering of redundant sites following the acquisitions of Leap Wireless and MetroPCS by AT&T and T-Mobile USA, respectively," John Fletcher, SNL Kagan senior research analyst, wrote in the firm's online publication *Wireless Investor*. "We think the shrinkage will pass. A number of positive events and trends outweigh the temporary lull of carrier consolidation."

Cell tower growth will be boosted by mobile data growth, spectrum auctions in the AWS-3 and 600-MHz bands, the rollout of FirstNet, and the involvement of Google and DISH Network in the wireless market, according to Fletcher.

"Through 2025, we project towers will grow at a CAGR of 3 percent with sites growing at 3.9 percent," Fletcher wrote. "Driven by the spike in mobile data use and the other variables, 10 years out the U.S. could have 200,000+ towers and 400,000+ sites in use."

At the end of 2014, there were 154,941 towers and nearly 300,000 sites active in the United States, compared with 96,852 towers and 242,130 sites in 2008 at the beginning of the 4G build out, according to SNL Kagan estimates. Towers are defined as physical structures, and sites are the carriers' equipment on those towers. Fletcher believes these growth trends will continue with future generations of wireless.

"Looking back, the United States has experienced a wireless technology upgrade roughly every 10 years since analog 1G premiered in 1984," Fletcher wrote. "Prior to and following both 3G and 4G commercial launches, tower and site growth spiked, then plateaued. Our forecast for 5G (we think 5G could emerge in the early 2020s) mirrors this pattern."

—J. Sharpe Smith



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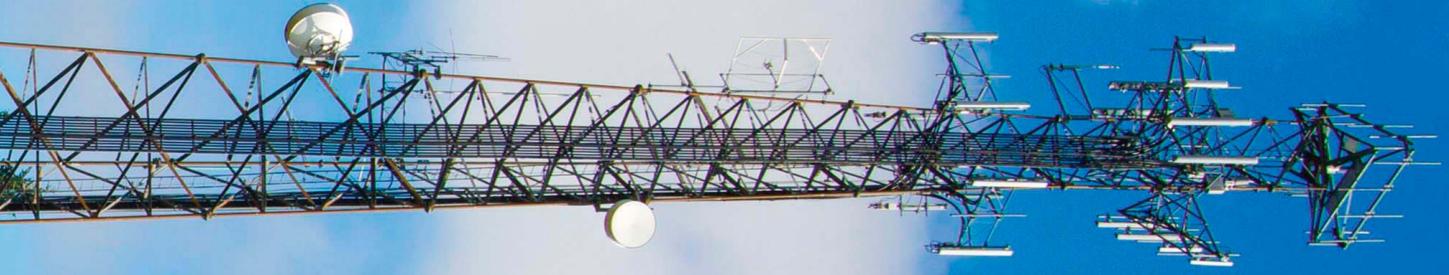
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The View From the Top

THE VIEW FROM THE TOP

Executives of three large telecommunications tower companies assess the state of the industry and make predictions for antenna site development and company operations for the coming year.

By Don Bishop

Speaking in Hollywood, Florida, on April 28, executives of three large tower companies answered questions at a session named “The View From the Top.” The occasion was the Wireless Infrastructure Show, and the executives were W. Benjamin “Ben” Moreland, president and CEO of Crown Castle International; Steven C. Marshall, executive vice president

of American Tower and president of its U.S. tower division; and Jeffrey A. Stoops, chief executive officer of SBA Communications. Jonathan Adelstein, PCIA’s president and CEO, was the host. The following are highlights from the session, edited for length and style.

Adelstein: Business has been good, so 2014 was fabulous. Do you think

you can keep that momentum into 2015, or are you seeing things slow down a little bit?

Stoops: 2014 was a remarkable year in many respects. 2015 has turned out more traditional, which means our carrier customers start slower in the first quarter and then build, so we’re expecting more of a back-end loaded year. There so much work



Aussie Asset Sale Fuels Crown Castle Fiber Deployment

By J. Sharpe Smith

Crown Castle plans to use the net proceeds of \$1.3 billion from the sale of its Australian subsidiary toward the deployment of fiber through its new acquisition, Quanta Fiber Networks (Sunesys), which owns or has right to 10,000 miles of fiber in major metro markets across the country.

“The sale [of the Australian subsidiary] was opportune as it allows us to redeploy capital from a slower growth asset toward an opportunity with an expected higher growth profile in Sunesys,” Jay Brown, Crown Castle’s chief financial officer, said.

The acquisition of Sunesys’ fiber footprint, which is expected in the third quarter of 2015, will more than double Crown Castle’s fiber footprint for small cell deployment, according to Brown.

“Our focus and continued investment in the U.S. is based on our view that the continuing growth in U.S. consumer demand for mobile data, which is projected to increase seven-fold between 2014 and 2019, will require significant investments by the wireless carriers to increase the density of their networks,” Brown said.

“Due to the timing difference between the completion of the sale of Australia and the expected closing of Sunesys, we applied the net proceeds from the sale of Australia to pay down our revolving credit facility and term loan,” he said.

Sunesys is expected to contribute as much as \$85 million to site rental gross margin with \$20 million of general and administrative expenses during the first full year of ownership, according to Brown.

“We believe that as mobile demand continues to grow, carriers will need to deploy small cells in conjunction with macro towers to address network congestion. And while it’s still early days, we are seeing evidence that support our investment pieces,” he said.

yet to be done. The AWS-3 spectrum hasn’t even started yet. You have the First Responder Network Authority (FirstNet), Dish Network and others, none of which may even hit in 2015. The future continues to be very bright for our industry.

Moreland: With data services and cell site density requirements, we have a long way to go. The economics of what we do are extremely compelling and favorable for the carriers that locate on our sites. This year is shaping up fine. It looks similar to last year, with the added influence of a rapidly growing small cell and distributed antenna system (DAS) business, which is keeping us busy and consuming capital.

On the traditional macrosite side, we see cell site densification, about 60/40 in collocation versus amendments.

/ TOWER MARKET REPORT /



Steven C. Marshall, executive vice president of American Tower and president of its U.S. tower division

Jonathan Adelstein, president and chief executive officer, PCIA

W. Benjamin "Ben" Moreland, president and CEO of Crown Castle International

Jeffrey A. Stoops, chief executive officer, SBA Communications

Marshall: 2014 was a super year for the industry and for American Tower. This is the decade of wireless. We'll see continued growth and development in our industry for a number of years.

Adelstein: Crown purchased AT&T Towers and American purchased Verizon Wireless's towers. How are those integrations going?

Marshall: We've been living with ours for a little over a year so they're pretty well-integrated and rolling and open for business, and we're leasing them in accordance with our plans. We made two \$5 billion acquisitions in the last 18 months. Eighteen months ago, we acquired Global Tower Partners, which we integrated ahead of time. We experienced over 10 percent core organic growth on those assets.

One thing you can say about Verizon is they build really great assets. They maintain assets exceptionally well. We love being a great custodian of those towers for everybody that wants to use them — Verizon and anybody else. When we closed on March 30, all of those towers became actively marketable in our online portal.

Adelstein: With those big portfolios gone, what's left to claim? What's your acquisition strategy, and what are you doing to create value if there are no more big deals to be had?

Stoops: There are many developers building towers every day. Also, there's a tremendous amount of international activity. In addition to portfolio growth, we can buy our own stock back to drive growth in adjusted funds from operations (AFFO) per share. What drives value creation is growth in cash flow or AFFO per share.

The best growth is organic growth, the growth on assets we already own. Last year was a record year for that. We're off to a solid start this year. Future organic growth will be strong.

Moreland: We're in build mode. We're spending \$300 million a year on constructing new sites, mostly small cells and DAS. Nevertheless, about 80 percent of the value is created with organic growth, which is leasing assets we already own. Given the 17,000 towers we bought in the

past couple of years and the legacy sites behind them, we average just over two tenants per tower. Existing sites are the most expeditious way to add capacity. You get the benefit of the shared economics with carriers only paying for incremental use of the asset. The ability to grow organic revenue on existing sites is far and away the biggest value creator. We all sort of scaled up with assets. If the objective is to create shareholder value, we all have plenty of assets to do that.

Marshall: We have more than 40,000 towers in the United States. When we close a couple of foreign acquisitions, we'll have close to 100,000 towers worldwide. We see great opportunity in the United States and abroad.

Continued opportunity in our industry is driven by increasing demands of wireless data communications, which will be growing at 50 percent a year for the next five years. 4G penetration is 40 percent. It will increase. By 2018, there are estimates that there'll be two connected devices per capita in the United States. I already have four. There will be a long tail on the growth here in the United States,

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Adelstein: Where do you see carriers' deployments in the coming year?

Moreland: Carriers have to have network quality to differentiate

their service and attract consumers. And the spectrum auction indicates the long-term value they place on licensed spectrum for providing more and more services. In the next 10 years, we'll be talking about video, over-the-top television

and the potential unraveling of the cable bundle. Wireless network video sessions are expected to surpass wired next year. These networks were not originally built to handle this kind of capacity.

Fortunately, consumers see value in the product when it works as advertised and are willing to pay for it. That is a key element of the cycle. If consumers continue to pay for the service so the carriers can deploy capital for an incrementally positive result, we'll continue to see success in the wireless infrastructure industry.

Stoops: Each of the big four U.S. carriers is doing different things. AT&T is coming off an unprecedented three years of investment and is now doing a little bit more talking and fixing while getting ready for AWS-3 deployments.

Sprint is working on its 2.5G, finishing its Network Vision, with dialogue going on its next-generation plans. T-Mobile USA is focused on its 700-MHz build out and finishing LTE. Verizon continues to be the steadiest in spending.

People talk about the levels of amendments versus new collocations and try to draw conclusions. Those metrics and percentages are driven by what each individual carrier is doing at that particular time and not anything that uniformly applies to the entire industry. We tend to speak with a broad brush about high activity levels, but each carrier is doing something different from the others, the way it's always been.

Adelstein: Is there any relevance to the metric about the level of amendments?

SBA Communications Exits Part-ownership as Digital Bridge, Stonepeak Invest \$1 Billion in ExteNet

By J. Sharpe Smith

ExteNet Systems received \$1 billion in recapitalization from Digital Bridge Holdings and Stonepeak Infrastructure Partners in a transaction that saw part-owner SBA Communications exit. Its ownership interest, along with those of Columbia Capital, Centennial Ventures, Sevin Rosen Funds, CenterPoint Ventures, Palomar Ventures and Quantum Strategic Partners, was acquired as Digital Bridge and Stonepeak injected additional capital besides to support ExteNet's growth.

"After a great run with our initial venture investor group that started with us 10 years ago and the other significant investors who joined in 2010, Digital Bridge and Stonepeak are the ideal partners for this recapitalization," Ross Manire, ExteNet's cofounder and CEO, said in a prepared statement.

The recapitalization enables ExteNet to continue pursuing strategic deployment of outdoor and indoor distributed networks, including small cells, to meet network densification and advanced wireless connectivity needs of its customers, which include wireless carriers and venue owners.

ExteNet executives, including Manire, remain with the company and retain ownership interests. Digital Bridge CEO Marc Ganzi becomes chairman of the board. Also joining Manire on the board are Warren Roll of Digital Bridge and Trent Vichie and Brian McMullen of Stonepeak.

"I am looking forward to working with Marc, with whom I have a long industry relationship, and the other new board members to make use of their extensive experience and proven success in the communications infrastructure industry," Manire said.

THE VIEW FROM THE TOP

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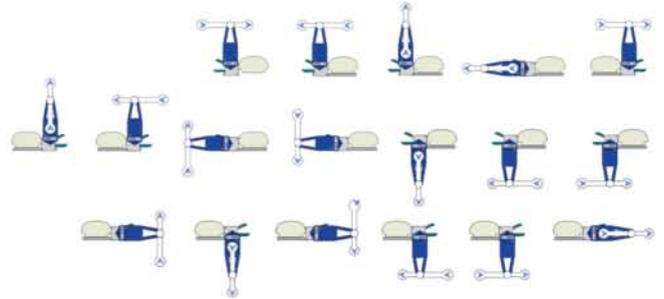
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/ TOWER MARKET REPORT /

Moreland: It's mildly interesting just to see where the mix of activity is, but it depends where each carrier is in its cycle. A couple of years ago, it was all amendments. We're all doing LTE overlays, and that's all there were.

Stoops: And when AWS-3 comes, it's going to be a lot of amendments again. Does that make it any better or worse than collocations? I don't think so.

Adelstein: Are you seeing an effect as a result of the regulatory progress we've made?

Marshall: The FCC order that clarified time frames under the shot clock legislation makes it clearer for municipalities to determine what they can and can't do, and more municipalities are getting behind a more streamlined process. More exclusions from the National Environmental Policy Act are helpful because they make more assets available and faster. More exclusions from the National Historic Preservation Act also help.

Moreland: We continue to encounter arbitrary obstacles in municipalities that are not necessarily in law. There still seems to be an aversion to wireless infrastructure in many places. It can be a collocation where we now have a little authority. It can be siting a new tower. It can be pole attachment rights.

We haven't done as well as we

ultimately can on telling our industry's value story, what the public gets out of wireless infrastructure. Many other industries more mature than ours tell great stories about what their industries do for America. We need to do more of that, so when we walk into meetings, we're on a level playing field and there's some recognition in that we're not the bad guys. We facilitate emergency services and commerce.

greatly appreciative.

Adelstein: Tribal lands are some of the most underserved for wireless broadband in the United States, probably as a result of the rules and the ownership there.

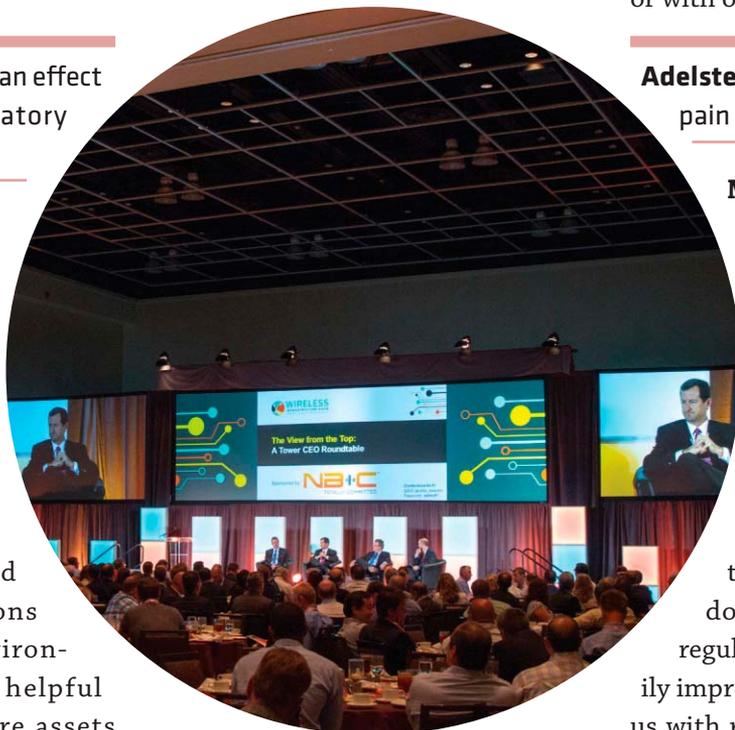
Marshall: Although PCIA is doing a phenomenal job, it's incumbent upon all of us to get the message out, whether it's in our own communities or with our members of Congress.

Adelstein: Are there other major pain points?

Moreland: OSHA is interested in our industry these days. We need to be proactive in setting training and safety standards and working with the Telecommunications Industry Registered Apprenticeship Program and take other steps in setting the standards so that we don't end up with a set of regulations that don't necessarily improve safety but that burden us with regulations that don't add to climbing safety.

Marshall: Enormous progress has been made in safety. And it is needed. In 2013, there were 14 fatalities on tower infrastructure. In 2014, there were 10 fatalities. This year, there have been none to date. Let's make sure we keep that up. We are seeing unprecedented levels of cooperation among various parties involved in our industry.

Whether it would be PCIA, the



Stoops: We often run up against the tribal historic preservation officer issue and Native American tribal involvement. At one of our proposed sites, 23 tribes claimed rights. I'm not sure that site ever got built because of the complexities that that process brought about. If we can bring a little bit more rationality to that process, the developer community, of which we're all a part, would be

THE VIEW FROM THE TOP



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American Tower Lands Blockbuster Portfolio from Verizon Communications

By J. Sharpe Smith

In a transaction announced in February and closed in March, American Tower, already one of the largest tower companies, grew even larger with a \$5 billion deal to lease space on and operate Verizon Communications' 11,324 wireless cell towers for 28 years and to purchase 165 additional towers. When the deal closed at the end of March, American had a wireless communications real estate portfolio in the United States sized at more than 40,000 tower sites.

American Tower has the option to acquire the towers based on fair market value at the end of the lease terms.

American Tower obtained committed financing for the transaction from Goldman Sachs, which also acted as financial advisor.

The portfolio features average tower heights of 200 feet, ample structural capacity and ground space, attractive transmission locations with relatively few competing sites and a solid ground lease profile. It is well documented with technical information, according to Jim Taiclet, American Tower's CEO.

"By acquiring access to this high-quality asset base, American Tower will be well positioned to capture incremental leasing activity and extend our ability to drive strong annual organic core growth and solid adjusted funds from operations per share growth, well into the future," he said.

Verizon contracted to sublease space on the towers for a minimum of 10 years with monthly rent of \$1,900 per site and fixed annual rent escalators of 2 percent. Verizon has the option to extend the full term of its sublease to 50 years. Verizon has access to additional space on the towers for future use, and American Tower has the right to sublease other available capacity on the towers to additional tenants.

Additionally, Verizon announced that it is selling wireline assets for \$10.54 billion and buying back \$5 billion of its stock. All told, the carrier raised more than \$15 billion, because it did not have the free cash flow to cover the cost of the frequencies it bought at the AWS-3 spectrum auction, according to AH Research.

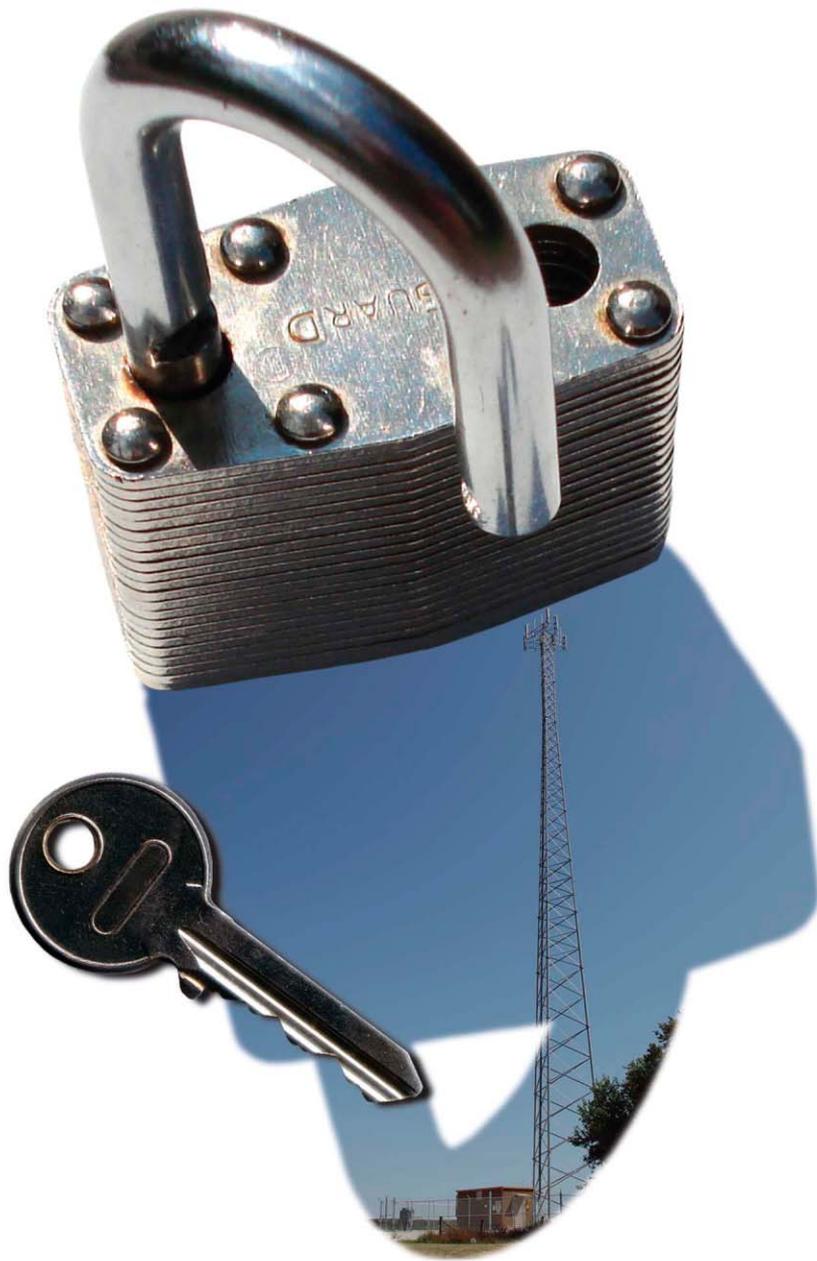
"The company could not take additional debt because its total debt has reached \$113.3 billion, which has elevated its net debt to adjusted earnings before interest, taxes, depreciation and amortization multiple to 2.4x," the firm wrote on Seeking Alpha.

FCC, TIA, or NATE coming together to find common ground and working together to improve safety on towers, it's essential. At American Tower, we've enjoyed some of the highest levels of safety records. I pray it continues. Our recorded incidents and injury rates, have been minor injuries in the main, but nevertheless they get a third of all telecom industry rates and probably about 20 percent of all industry rates. We're pleased with that, but it's not enough.

Stoops: I agree with Ben and Steve. Safety is a huge issue. We've done some analysis over the fatalities that Steve mentioned, and either every single one or every one except one was operator error. It was human issues. It's gotten a lot better, but there are still a lot of not-well-trained, not-well-equipped folks climbing towers.

One thing SBA does, and maybe American and Crown also, is that we'll ban a contractor. We'll shut a job down. We won't take any safety risks at all. Sometimes that leads to some tough conversations with our customers because they're the ones who hire them. But at the end of the day, nobody wants to take any risks on safety. For those of us who own the assets, we're in a position to do that. I would encourage us to do all that with the bad actors. And thankfully, the number of bad actors is dropping, but I think there are probably still some out there.

Adelstein: Do you anticipate labor shortages?



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Moreland: Not as much as a couple of years ago.

Stoops: The labor shortage we saw a year or two ago has ebbed, but it could come storming back quickly. Now is the time to get ahead of the issue, get programs in place and collectively move the services side of the business higher up in terms of its level of training.

Marshall: Our industry has its cycles of ups and downs. Last year was a massive up-cycle and pulled a lot of additional need for labor. We're returning to a more stable run rate in 2015. It's almost inconceivable that we don't have a truly rigorous apprenticeship program that trains people to come into this industry, gives them a common language, and gives them a common level of expectation on safety, training, professionalism and technical skills.

TIRAP is a great initiative, and Warriors 4 Wireless also is a great initiative — what better talent pool than to create opportunities for the heroes of this country to get them into our industry, which has a long runway and an opportunity for them to deploy their skills, energy and capabilities. I encourage people to consider the wireless industry for a long-term career because there'll be great opportunities for many years to come for people who have an interest.

Adelstein: Your companies — all three of them — are real leaders on the board of the apprenticeship program, TIRAP, and helped to move it forward. You're giving time and energy from your

businesses to develop how we'll define these positions, and it's made a world of difference. Let's talk about DAS and small cells. Are we at an inflection point? Is a neutral-host model going to be able to work? If so, when will that be in the small cell world?

Moreland: Crown is actively pursuing the neutral-host model today. One of the benefits of a neutral host — which is a fancy way of saying collocation in the tower — is that we hope to pass through the zoning and the pole attachment rights one time for multiple carriers.

We're building systems today that operate in a similar fashion to a tower. The sharable element is the fiber optics that we install that are proprietary to that system. It's common to see another carrier put equipment on the same pole or the next pole.

We have 14,000 nodes on the air today, with another 400 under construction and almost another 3,000 in the planning stages. They're being fed by 7,000 miles of fiber. The fiber is in all of the major cities where there are macrosites. All of us have macrosites in those areas. And we have some interesting discussion and analysis about where the carriers are on those macrosites, and then, why would they need small cells almost in the shadows of some of those macrosites.

It's fascinating when you get into that level of detail. We're seeing hotspots develop. Not only do you solve that particular issue with the small cell, but also you drastically unload the macrosite, which then creates more capacity for the

macrosite. We're seeing rapid adoption primarily by Verizon, and we have activity with the other three large wireless carriers in smaller ways.

We have high expectations that this will become an efficient way to add capacity and reuse precious spectrum in locations where a macrosite cannot supply all of the necessary capacity. Even if you could add another tower, it would be too big for the job. Thus, small cells represent the next generation of wireless networks. We don't think small cells in any way, shape or form will replace towers. Ninety-four percent of our business today is what you would think of as traditional tower leasing. But small cells represent an interesting growth area and one that has tremendous promise for adding network capacity efficiently.

We want to make deployment cheaper and faster, but it's not simple. For a neutral-host provider, just as with towers, it's a game of averages. What we can provide to the carrier customer is an average price, so we offer an attractive average cost for them to start with. Some nodes may be cheap to install, particularly if it's a collocation, and others could be expensive, if it's a brand new lateral that has to be built. On an average basis, our carrier customers are finding the cost compelling.

Stoops: After several years during which expectations were ahead of reality, small cells and DAS look like they're going to become a permanent part of network architecture. We participate through an investment



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/ TOWER MARKET REPORT /

in a company called ExteNet, which is very active. Volumes are picking up. I would encourage you to pay attention to DAS and small cells because, unlike five years ago when there were some big expectations of something immediate, it's taken a little bit longer. Some of the time was consumed by carrier-specific issues. But clearly, it looks to be a permanent and growing part of network architectures.

Marshall: DAS and small cells will become an important part of network infrastructure, but let's be clear. Today, the macrocell site is still the most cost-effective way of servicing a community. Small cells or DAS tend to be deployed in urban areas where macrocells are not as easy to deploy and you need high levels of capacity.

As a result, we see small cells or DAS as being complementary to the macro network, which tends to service suburbia and rural areas rather than urban areas where we see small cells deployed. They're expensive. There's no obvious solution to dramatically reducing the expense.

We have more than 300 in-build-wireless systems in U.S. convention centers, casinos and large hotels. We have 30 outdoor DAS networks available for multiple tenants in Martha's Vineyard and other places where they were difficult to zone, and they are expensive. Carriers are becoming concerned about the bang for the buck in those investments.

Adelstein: Speaking of densification, nothing underscored the importance of it more than the price paid for spectrum in the AWS-3

auction – \$41 billion after some discounts for a relatively small slice of spectrum, a 12 percent increase in spectrum available to commercial mobile operators. What does that say about the carriers' capacity demands and their needs in the value of infrastructure? Does it mean that they spend all of their capital expense budget on it, or does it mean that they're going to value even more the need for densification to make use of the spectrum they have?

Stoops: It underscores the value of network capacity, which must have infrastructure to work. There's no way carriers would spend so much unless they knew that they had the additional funds to deploy the spectrum, because the two have to go hand in hand. We're going to see a lot of activity around the AWS-3 starting next year and lasting for years.

Moreland: You saw Dish Network participate in the auction, which reinforces the fact that there always are folks either accumulating spectrum or desiring to obtain access to wireless consumers. About the time we conclude that we have four customers, Google being the mobile virtual network operator example of late, there always are other parties desiring access to wireless subscribers. To gain that access, they're willing to invest in a variety of ways. Whatever use they make of the spectrum, it has to be launched using assets we own and operate. It speaks to the value of what we do.

Marshall: Nobody invests in things that they don't anticipate making a

return on. We've seen the value of spectrum rise significantly in 15 years. It reflects the real value in spectrum and the returns that carriers will obtain from it. If you don't own spectrum, you're not in the game.

Carriers have recognized spectrum value. They've acquired spectrum, and they'll deploy it to meet the demands of the industry. Whether to serve consumer applications, the Internet of Things or the autonomously driven car, the spectrum will be deployed. Deployment will require more equipment to be placed on towers.

Adelstein: Each of you evaluates infrastructure investments in the United States versus overseas in your own way. How do you evaluate where you put your incremental investment and what do you see as big opportunities in foreign countries?

Stoops: It gets back to finding the right ways to allocate capital to drive shareholder value. It's not about growth for growth's sake. It's about maximizing AFFO per share. Historically, we've done that through portfolio growth.

Several years ago, we anticipated U.S. market consolidation and concluded that we would have more capital to invest than the U.S. market would support. So we moved internationally five or six years ago, and we continue to invest abroad. We prefer growth markets, mostly Latin America, Africa and Asia.

Moreland: The U.S. wireless market is a \$190 billion annual revenue market. That's what we all spend on wireless services. Carriers consistently

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/ TOWER MARKET REPORT /



THE VIEW FROM THE TOP

spend more than \$30 billion, plus the spectrum we just talked about, to invest in the North American market. It is far and away the largest investable wireless market in the world.

What we do as shared infrastructure providers works globally. The growth dynamic for wireless in many other markets is clear. For many consumers in the emerging markets, wireless will be their only Internet connection. Thus, our business model can work extremely well globally. When we show up in a foreign country, by definition, we have a mismatch in currency. Therefore, we have to be absolutely certain that we can get an appropriate yield on that asset because we're a financial business.

The input in our business is capital. It's not people. It's not McDonald's hamburgers or Coca-Cola syrup, as some folks actually mistakenly think. Many of our businesses are international. Our input is capital, and that capital is denominated in U.S. dollars. Thus, we have to make sure that we can overcome whatever currency movements

occur that reflect the asset pricing. We have seen few things that overcome that factor over time.

We own a business in Australia. We've done a great job in that business for 15 years. We made a lot of money. But we were up 50 percent on the currency. I can't tell you that it's because we're terrific operators. We were absolutely lucky in that respect. As you've seen with the strengthening of the U.S. dollar this year, the currency difference also can go the other way. So we'll continue to look at it, but it's just one factor that is difficult to overcome — when you show up in the wrong currency.

Marshall: Our board, eight years ago, approved a strategy to explore international opportunities. We've been doing that year in, year out for eight years.

With investments overseas, we have to achieve higher returns than we would expect to have here. Thus, we develop a discounted cash flow model based on expected cash flow growth. We discount the risk-

adjusted rate of return to factor in the cost of currency depreciation, inflation and political risks.

In the United States, we might hope to achieve a return in high single digits. In Latin America and India, maybe it's the low to mid-teens. In Africa and some of the even more challenging markets, maybe it's in the high teens to the low twenties in percentage return on investment. Those rates factor in currency depreciation and other challenges. That's the way we explore it.

With every investment, we also have an eye on whether it will be dilutive to AFFO per share or our return on invested capital in the short term, so that we do try to ensure that — as we promised shareholders — we can and will double AFFO per share in the five-year period from 2012 to 2017. And 2017 is not too far away. We're pleased that we're well on track to achieve that.

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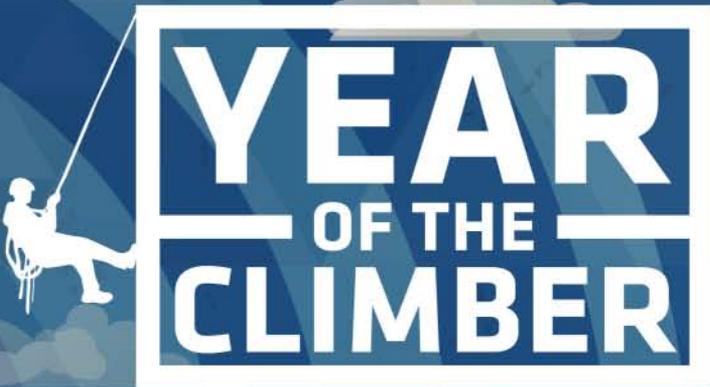
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/ YEAR OF THE CLIMBER /



YEAR OF THE CLIMBER

By Bill McMahon



The first point to make is: personal accountability.

When you look at the cause of many deaths from falls, it points directly at the individual free climbing and not being 100 percent tied off.

The decision to ignore safety measures in the name of speed is the individual's sole decision. I have never heard of a technician being fired or disciplined because they took longer to do the job safely.

Companies from the provider to the subcontractor need to be on the same page when it comes to safety practices. They need to encourage all workers to think "safety first" and give them time to use proper safety measures.

As for accountability, the only way to enforce compliance with safety policies is to observe, educate and fine if applicable. In order for OSHA to do this, they would have to employ experienced safety auditors or subcontract to companies that can provide this service.

Inherently, employees will begin taking safety shortcuts to increase their productivity until it becomes more of a habit than a time-saving tactic. There need to be consequences for their unsafe actions in order to curb these habits.

Last year, AT&T required all contractors and their employees working on their sites to sign a 100 percent tie-off certificate. This was a good start.

Wireless providers and tower owners can require job safety analyses to be turned in on a daily basis to assist in promoting safe practices.

Bill McMahon is director of operations at Bodell Telecom. His words come from the comment he filed in the OSHA request for information about tower worker safety.



Tower Hands: A Group too Small for Union Representation

Although tower hands might benefit from union representation the way industries with large numbers of workers did, they seem to be too small in number to attract attention from union organizers, and they suffer more job-related injuries and deaths as a result.

By Philip Hardy

Telecommunications tower hands have a reputation for working in an industry that is among the most dangerous professions. Danger persists, although some of the finest safety gear is available and schools exist where students become certified climbers. Government agencies, membership organizations and employers write safety procedures, sometimes to no avail.

During the Industrial Revolution, many large industries were plagued with deplorable working conditions resulting in costly accidents marked by grievous injuries and death. Workers in massive groups rallied together and appointed representatives to look out for their well-being, a noble idea.

Lost production time and increasing payouts to settle massive claims led corporations to spend on safety training programs and procedures and on top-dollar safety equipment.

Despite instances of corporate negligence and union mismanagement, these steps improved worker safety, the availability of information and protection for

workers via law enforcement. Getting worker safety laws in force was helped along by well-intentioned union lobbyists.

But what happens in an industry that has provided and that continues to provide vital national infrastructure and that is comprised of a small group of specialists with only 75 to 80 percent of the number of men and women necessary to get the job done with limited budgets and without representatives lobbying for protections? People die.

The group of tower workers was never large enough to interest union backing because there wasn't enough money in it.

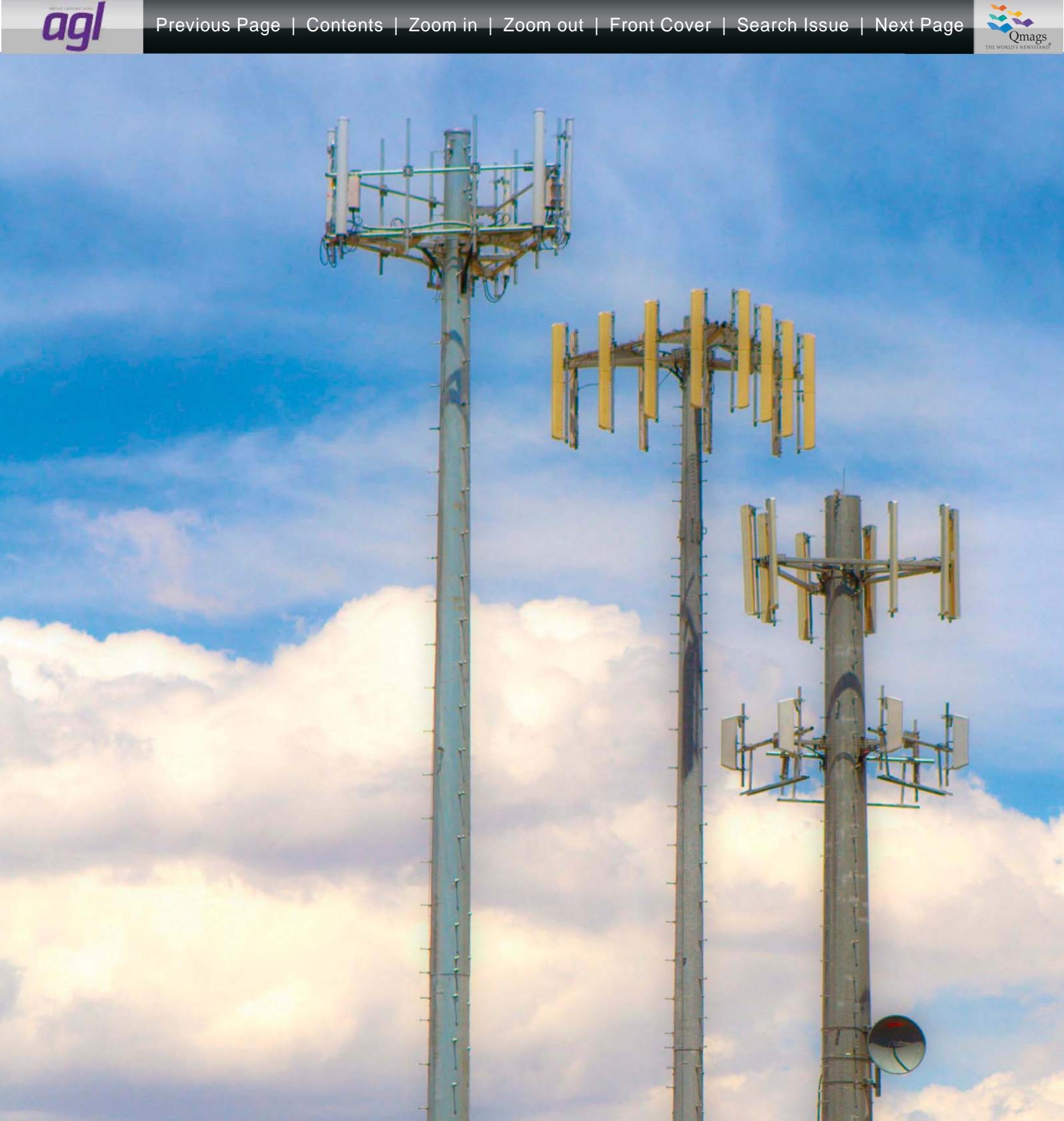
Politicians should pay attention to the concerns of industry leaders no matter the size of the industry or regardless of whether the given industry has money to give to the politicians' causes. Communications infrastructure is important to national security. Tower workers have an important role in maintaining it. The conditions in which they work, the personal sacrifices they make to perform the work and the inherent dangers of

the work deserve politicians' attention.

Perhaps because the tower industry is so small and because the tasks performed by tower workers are so vital to maintaining the national communications infrastructure, having the government subsidize the training at taxpayer expense would be a relatively small expenditure with a huge pay-off compared with huge and wasteful government programs we hear about.

Because large corporations are routinely sued and sometimes are found liable for exorbitant amounts of damages, even if they put out all the proper information and give all the necessary instructions and training, they put up layers of protection that take away from their willingness to pay more for the contracts that would in turn provide more money to spend to protect and train the workers in the field.

Philip Hardy, a 13-year Navy SEAL veteran and a tower foreman for eight years, is chief training officer for tower safety and instruction at TowerSafety.com.



Towers in Carrizozo, New Mexico. *Photo by Don Bishop*

STRUCTURES ARE RESPONSIBLE FOR MORE TOWER WORKER DEATHS THAN FAULTY SAFETY EQUIPMENT

Newer towers are showing some evidence of owners accepting the idea that some antenna configurations are dangerous to workers, and they may be inserting some standards into their bid specifications.

By Richard R. Bell

I read the June article “Cell Tower Deaths Result From Dangerous Conditions, Poor Training and Poor Equipment.” It included remarks made by Liz Day, who was director of research at “PBS Frontline” when the series investigated the deaths of workers who build America’s cell tower network.

Although I appreciate the article’s conclusion and its suggestions about changes that should be made in the “CYA” contracting practices, I have come to the conclusion that the reason for the repeated CYA contracts and the use of numerous lanyards and safety hooks is simply because all the owners, construction managers, turf vendor executives, carrier executives, safety experts lawyers and OSHA representatives either cannot see or refuse to admit what is causing the majority of the accidents. Faulty safety equipment is responsible for very few of these fatalities. The actual structures they are working on are responsible for more deaths than all the other reasons combined, and when you add lack of training, inexperience, tight schedules and no specific plan on how the workers are supposed to access some of these dangerous antenna locations, it is much easier to understand how they are likely to have an accident.

The June issue featured an AGL Tower of the Month that reveals much of the problem without a word being written (see photo on the facing page).

Picture yourself doing antenna work on these three towers, wearing a full body harness and climbing up each tower to work on antennas. Which one would you prefer to work on? The one on the left obviously has the easiest access to the antennas; however, the designer could have moved the antennas up one foot higher and the installers wouldn’t have to lie on their bellies, hooking them up and weatherproofing the connections.

But how would you like to try to hook up the top antennas on the other two monopoles? I’ve been doing this sort of stuff for more than 50 years, and I can’t understand why anyone would design such a problematic array. Why not just put handrails on the platform and attach the antennas above the platform as they did for the tower on the left?

Notice the monopole on the right has the same top configuration, but apparently the designer of the lower array at least had the brilliant idea to design the horizontal member across the bottom of the mount between the antennas, so the installer has something to stand on. Kudos to this designer, one of the few that has given

/ YEAR OF THE CLIMBER /

any thought at all to providing a safe workplace for installers.

Also notice that all three monopoles have staggered step bolts spaced about two feet apart horizontally. If the designers of these three monopoles ever

had to climb what they design, you would never see another step bolt again. This is by far the most challenging climb I ever had to make — and I used to climb straight up I-beam columns without any safety equipment at all. The sad

part of this story is that a regular climbing ladder is less costly than the step bolt climbing system, and if you read all the accident reports from 2001 through 2012, you know how many were falls from towers with step bolts.

If you look at the image that appeared on the cover of the June issue, you will notice that some designer is getting it right. The structure shown appears to be a newer tower. This tower's antenna configuration may be an indication that the owners are accepting the idea that they have some very dangerous towers out there, and maybe they are inserting some standards into their bid specifications.

Richard R. Bell is president of Bell Tower.



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Private-public Collaboration Underway to Create Wireless Workforce of the Future

By Nick Maynard and Royce Ebenal

On July 15, the Office of Science and Technology Policy hosted more than 80 leaders from wireless companies, federal agencies and academic institutions at the White House Summit On Wireless Workforce Development, focusing on the urgent need to train workers for careers in the wireless industry and commitments that will change the trajectory of workforce development for the wireless industry.

The attendees recognized the great opportunity to create an even more diverse workforce through increased recruitment of underrepresented groups, including veterans, women and minorities.

There is a nexus between the highly skilled veterans community and the skill sets required for wireless infrastructure deployment. Using this nexus will help improve the proficiency of the workforce that builds, upgrades and maintains wireless infrastructure, ensuring that America can meet the growing demand for wireless broadband and enabling the United States to continue to lead in the global telecommunications marketplace.

In response to OSTP's call to action,

PCIA – The Wireless Infrastructure Association, the Telecommunications Industry Registered Apprenticeship Program (TIRAP), and Warriors 4 Wireless (W4W) collaborated to define three basic goals to improve workforce training for the wireless industry: identifying the best curricula, creating model apprenticeships through TIRAP and expanding diversity. Realizing these objectives will enable the wireless industry to keep up with evolving technology and the massive build out of infrastructure needed to meet consumer demand for wireless data.

Warriors 4 Wireless has already placed or graduated more than 700 veterans from its groundbreaking program. Retired Master Sergeant Gerald Patterson, who attended OSTP's June 15 event, completed the W4W program and now holds a leadership position with a wireless infrastructure company. "Veterans have the 'it' factor that employers are looking for," Patterson said. He elaborated on the veteran skill set, which includes project oversight, team building and personnel management.

The Obama administration understands the role of broadband in creating

jobs and fostering economic development. America's connected economy will only succeed if we continue to meet the ever-expanding demand for wireless data. This demand cannot be met without a properly trained workforce that realizes the value of safety — something our veteran community knows well. The summit attendees recognized that developing best practices to be taught through training and apprenticeships is key to meeting the industry's specialized needs.

Wireless workforce training is imperative to America's economic and technological future. This is why cooperation between public and private leaders is so promising. The outpouring of support from participants made clear that there is a strong impetus for continuing to expand the opportunities available in the wireless industry for veterans and other skilled workers nationwide.

Nick Maynard is assistant director for telecommunications innovation at the White House Office of Science and Technology Policy. A U.S. Army veteran, Royce Ebenal is an intern in the office's Science Division.



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How the National Wireless Safety Alliance Will Certify Tower Workers

For NWSA, it's all about certification. Edited for length and style, the following information comes from the National Wireless Safety Alliance's comments in the OSHA request for information about tower worker safety.

By Chuck Slagle

The National Wireless Safety Alliance national assessment and certification organization is being developed to provide thorough, independent assessments of knowledge and skills and provide verifiable worker certification to enhance safety, reduce workplace risk, improve quality, encourage training and recognize the skilled professionals who work on towers and other nonstandard structures. A non-profit organization, NWSA is a byproduct of collaboration among a broad coalition of the industry's subject matter experts, companies and stakeholders representing wireless carriers, tower owners, original equipment manufacturers, turnkey management firms, engineering firms, small contractors, tower workers and industry associations.

Training and Certification

A national assessment and certification organization has been needed in

the wireless industry for quite some time. Recognizing this need, the industry has collaborated to establish NWSA. The organization and operation of NWSA will be in compliance with the International ISO/ANSI/IEC Standard 17024. NWSA will evaluate workers to credential their skill levels via practical skills assessment and computer-based knowledge tests in accordance with the standard. Testing will not favor or endorse any training method. NWSA does not train.

NWSA will standardize the assessment and certification process and provide a greater degree of confidence to the industry that an employee who is trained in Massachusetts and an employee trained in California (at the same level of worker category) are qualified to perform the competencies and scope of work required of their work title. Workers, regardless of their training pathway, will be required to

take standardized NWSA skills assessment and computer-based knowledge testing. An NWSA certification card will be a source of pride for industry workers and will ultimately raise the bar on safety and quality.

To accomplish its objectives, NWSA is developing written and practical skill assessments for various levels of worker categories outlined in the National Wireless Skills-Based Training Matrix. NWSA also is forging strategic partnerships with a renowned national testing firm and a prominent website certification database firm. A board of governors representing a broad cross section of industry stakeholders will be appointed to provide organization oversight.

NWSA will offer a variety of certification categories based on defined categories of workers within the industry. NWSA plans a gradual, progressive roll out of these programs.



Tower Family
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Providing Support by Standing Together

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

Chris Wener

Nevada Wireless Association President

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

John Gates

Tower Climber from ATS

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

Russ Chittenden

Vice President of Synergy Concepts, Inc.

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/ YEAR OF THE CLIMBER /

It is anticipated that the Signal Person, Rigger I and Rigger II programs will be the first to launch. The Telecommunications Tower Technician I (TTTI — Authorized Climber) and Telecommunications Tower Technician II (TTTII — Competent Climber) programs are the programs most likely to be the next ones launched.

Other assessment and certification programs NWSA probably will develop include Antenna & Line Foreman, Tower Stacking Foreman, Structural Modifications Foreman, DAS Systems, Small Cell Systems, Broadcast Structures and Outside Plant/Fiber to the Home and Business.

Additionally, NWSA will offer

national, portable worker certification that will be verifiable through a database to ensure that worker credentials are current.

Industry companies, training providers and education institutions, will ultimately be able to access NWSA's Skills-Based Training Matrix and NWSA certification

“ Testing will not favor or endorse any training method. NWSA does not train. ”

handbooks from the NWSA website. These organizations will be able to use the resources to ensure that their training programs are

offering instruction in the knowledge-based competencies and field-based competencies required for each worker certification category.

NWSA Certification Benefits

NWSA is raising the bar on safety and quality and will have a positive, transformational effect on the entire industry.

Tower climbers, technicians and other industry workers will ultimately benefit through a safer working environment, through opportunities to enhance and diversify their skillsets and by receiving the recognition of national credentialing that they deserve as skilled professionals.

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Contractor companies will benefit because a safe and qualified employee base will level the playing field for all companies. Simply put, NWSA's national certification program will reward the contractors that do things the right way when it comes to safety and quality while forcing the fly-by-night contractors to raise their performance through an investment in safety and quality or get out of the game.

Tower owners will benefit through diminished liability exposure and by receiving greater assurance that the men and women working on their tower sites are adequately trained and prepared to perform the scope of work required to work on their valuable property.

Wireless carriers will benefit by

receiving a better quality network build out from a reliable, safe and qualified contractor company. The carriers know that there is a direct correlation between their network performance and the qualifications of the contractor. NWSA will provide wireless carriers with a national certification requirement to place in their contracts and provide greater assurances that the men and women working on their network build outs will perform quality work.

Equipment manufacturers will benefit by receiving greater assurance that their personal protective equipment is being used properly and safely by more of the industry's workforce.

Industry training providers will benefit through the consistency of

the uniform vernacular, worker categories, knowledge-based skills and field-based skills outlined in NWSA's National Wireless Skills-Based Training Standard.

Government agencies will benefit by referencing and recognizing NWSA's national wireless skills-based consensus matrix and having a national assessment and certification organization that offers ANSI-accredited programs.

Industry leaders have pledged to provide timely and relevant updates to the industry as key benchmarks are achieved in the establishment of the NWSA national assessment and certification program.

Chuck Slagle is a consultant to the National Wireless Safety Alliance.



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National Wireless Safety Alliance Chooses Board Members

The alliance's board of governors will develop policy and provide oversight for the alliance's assessment and certification programs.

By Chuck Slagle

The National Wireless Safety Alliance (NWSA) named its board of governors on Aug. 6. The board consists of representatives from a broad cross-section of the wireless telecommunications industry. It will be responsible for developing policy and overseeing the activities of the alliance's committees.

The inaugural board members have the requisite level of experience and expertise necessary to help guide the NWSA's assessment and certification programs through the critical stages of development and to the marketplace. The alliance conducted inaugural meetings in Denver, Colorado, on Aug. 12–13.

"The diverse backgrounds of the individuals represented on the board of governors will be an incredible asset to the NWSA and serve the organization very well as it prepares its assessment and certification programs to go through the ANSI/ISO 17024 accreditation process," Joel Oliva, director of operations and program development for the National Commission for the Certification of Crane Operators, said. Oliva will be

The National Wireless Safety Alliance Board of Governors

Beau Aero, GME Supply, a distributor

Eric Bicknese, Vertical Limit, a small contractor

Danny Bishop, The Crosby Group, an equipment manufacturer

Brandon Chapman, Valmont Site-Pro 1, an engineer

Kevin Denis, Gravitec, a trainer

Don Doty, FDH Velocitel, a large general contractor

Dr. Gemma Frock, Aiken Technical College, a community college

Monica Gambino, Crown Castle International, a tower owner

Heather Gastellum, T-Mobile USA and T-Mobile Towers, a national carrier and tower owner

Dean Hane, Multi Agency Communications Center 911, a public safety agency

Phil Larsen, Hazon Solutions, a technology provider

Ron Lewis, U.S. Cellular, a regional carrier

Chris Mallon, Tower MRL, a small contractor

Duane MacEntee, Tower Innovations, a manufacturer

AJ Manion, Manion Stigger, a law firm

Eric Munsell, Black & Veatch, a large general contractor

Ed Owens, Broken Arrow Communications, a tower technician

Yana Patton, USDA Forest Service, a government agency

Mike Powers, Atlas Tower Companies, a tower owner

Art Pregler, AT&T Mobility, a national carrier

Sonya Roshek, MyCom USA, a DAS and small cells company

David Sams, SBA Communications, a tower owner

Dieter Schifferdecker, Ericsson, a manufacturer

Kevin Schmidt, Sioux Falls Tower and Communications, a tower technician

Patrick Shea, All Risks, an insurance provider

Jocko Vermillion, Safety Controls Technology, an occupational safety and health specialist

Brian Wiedower, Sprint, a national carrier

Jim Williamson, SAC Wireless, a large general contractor



AJ Manion



Art Pregler



Don Doty



Beau Aero



Brian Wiedower



Brandon Chapman



Joeko Vermillion

collaborating with the board of governors and will be directly involved in NWSA's program development and test administration phase.

NWSA formed as a result of collaborative efforts among a broad coalition of subject matter experts, companies and stakeholders representing wireless carriers, tower owners, original equipment manufacturers, turnkey management firms, small contractors, tower technicians and industry associations. Industry leaders have pledged to provide timely and relevant updates to the industry as key benchmarks are achieved in the

establishment of the NWSA national assessment and certification program.

NWSA will provide thorough, independent assessments of knowledge and skills and provide verifiable worker certification in order to enhance safety, reduce workplace risk, improve quality, encourage training, and recognize the skilled professionals who work on towers and other nonstandard structures.

Chuck Slagle is a consultant to the National Wireless Safety Alliance. He is a former Sprint environmental health and safety executive. Visit www.nws-a.org.

CERTIFICATION

Warriors 4 Wireless Training – First-Person Stories

In their own words, trainees and instructors tell what Warriors 4 Wireless training for tower workers means to them.

By Dave Anthony

Shenandoah Tower Service was privileged to be the host of the inaugural Mid-Atlantic class for Warrior 4 Wireless Training in December 2014. The class ran from December 8 thru December 19. The schedule was chock full of great training from 7 a.m. to 5 p.m. every day except Sunday, Dec. 14, a day of rest. Eight veterans of military service attended. From the start of the training, I was impressed with the attentiveness of this group of outstanding individuals. They were laser-focused on every word, and their interaction with the instructors created a lively environment.

After meeting these men and seeing how committed to the training they were, I was ready to hire all of them myself. We did make job offers to five of them. Four accepted our offers and started work at STS on Jan. 5, 2015.

I have been hiring tower crew employees for 32 years. W4W has provided me with the best means to find quality candidates that we have ever had. The benefits of hiring W4W candidates over nonmilitary candidates is that they all have been tested and refined by fire. They understand authority, both how to submit to it and how to exercise it. They understand teamwork and its many benefits. They are willing to try new things, and they learn quickly.

What follows are first-person accounts from the trainees and their instructors.



Malkom Kidd
Trainee

I have been in the U.S. Army for seven years. I heard about the Warriors 4 Wireless program at a post-

deployment event. I thought I was crazy for even considering this as a career. I was petrified of heights; I mean, I absolutely hated them. I'm the type of person who likes to challenge himself. I went to the two-week course in Virginia. The course was hosted by Shenandoah Tower Service. The Warriors 4 Wireless team partnered with some of the best organizations to teach us the safest ways to climb and to certify us in this field. I would like to thank John Paul Jones from SafetyLMS and Capital Commitments. I would

also like to thank Zach Johnson from Shenandoah Tower service for helping me overcome my fear of heights. I am still leery at times, but I am comfortable and I trust my safety gear. It is an unexplainable feeling when you come off the tower after a long day. I never foresaw myself in this industry, now I can't imagine not doing it. Every day is a challenge, and I have to keep pushing myself. I am now a proud member of Shenandoah Tower Service. Thank you so much, W4W, for all the help and encouragement.

James Hodsen
Trainee

My name is James “Jim” Hodsdon, and I enlisted in the U.S. Marine Corps in February 2000. I was honorably discharged in October 2012. I successfully completed four combat tours, with my first being in Afghanistan in 2001, my second to Iraq in 2003, my third to Iraq in 2007, and my fourth was back to Afghanistan in 2012.

I was in the infantry while in the Marine Corps, and I was with many units and had the opportunity to serve side by side with the nation’s finest young men. I now have the chance to serve next to another group of fine men by working within the tower industry. On Dec. 1, 2014, I received an email from a veteran recruiter with contact information for Warriors 4 Wireless. Reading the qualifications for a position, I saw myself as a candidate and applied. I was contacted a day later by the owner and discussed the training that I was going to attend. After a detailed explanation of the job, I was still unsure about what I was getting myself into, but willing to try.

The first day of training was nothing short of eye-opening, and the majority

of the class said the same thing: “I didn’t even know this work existed.” After two weeks of some of the best training that I have ever received — due in part to Zach Johnson, JP Jones, and Al Katz — we all were able to conquer our fears and doubts of climbing a tower, rescuing another person off the tower and understanding what was going to be expected of us in this industry.

I have been trained by and with the best in the world when it comes to military tactics, techniques and procedures, and I can now say that I have done the same when it comes to the tower industry. I have been put into a position here where thank you is not enough, but it is a start. Thank you, W4W, for your continuing effort, commitment and sacrifice to ensure that veterans are getting properly trained and placed in the industry in order to start a career, not just another job. Dave Anthony, Angie Beadles, Zach Johnson, JP Jones, Al Katz and all others who had a hand in accommodating us, training us and teaching us the right way to accomplish our new mission, thank you. To future classes I would say, “Leave your pride at the door and open your minds.”



Al Katz
Instructor
Eureka Safety Service

The opportunity to provide the authorized OSHA 10-hour Construction Safety Outreach Course to the Warriors 4 Wireless students was a highlight of the year. In addition to the standard course content for the OSHA 10-hour course, many anecdotes, examples and real-life pictures illustrating expected safety issues these men would be challenged with once fully employed with a cell tower company were added to the course.

As a retired U.S. Navy captain, I considered it a privilege to work with these men who have sacrificed and served our country during a trying time in our history. These men were motivated, attentive and involved in each of the sessions for the day-and-a-half course.

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Their personal experiences and background contributed greatly to the application of the course material.

In addition, helping these men transition from the military to a civilian organization, which I had to do many years ago, is a small way I can share my experiences and thank them

for their service and dedication to the United States of America. The wireless industry is a rapidly developing industry whose success will significantly affect our nation. These are the quality people we need to ensure this development is accomplished safely and securely.



JP Jones
Instructor
SafetyLMS

If you are lucky, you learned at a young age the great feeling you get when you give to something you believe in. That is the case with Warriors 4 Wireless for me. I have been lucky to be able to watch the project grow over the last year and blessed to have my company chosen as the training provider for Warriors 4 Wireless as well.

I have been involved in training returning veterans in the past, but the efforts resulted in failure because the mission focused more on the company reaping the benefits of placing more bodies on a contract job than giving the soldiers a career path that can take them on to retirement if they choose to stick with the industry.

Warriors 4 Wireless is different. From the moment I met Kelley Dunne and his wife Tara, I knew their hearts were in the right place. They both work tirelessly with their respective teams to ensure the project's success and the soldiers' futures.

I arrived in Staunton, Virginia, at the headquarters of Shenandoah Tower Service and its chief executive officer, my good friend, Dave Anthony, the morning of Dec. 15, 2014. Dave has a premier training facility



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“ Jessica graduated from the University of Arizona with a 4.0 GPA and a B.S. in Business Management. She began her professional career as the principal sales representative for RockBottom Rentals, a leading communications rental vendor for the Feature Film and Television industry in Los Angeles, CA. Jessica not only generated exceptional sales numbers with RockBottom, but also further developed her exceptional management skills making her the ideal candidate for Quantum's Acquisition's Director position.

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WARRIORS 4 WIRELESS

and shares it with the Warriors 4 Wireless project. I was there to teach my part of the next Warriors 4 Wireless class. I was greeted by a room full of the finest young men whom, I would soon realize, were some of the nicest, most polite and eager guys I had ever met.

It wasn't long before I heard the stories of the trials and tribulations of coming home and seeking employment after being deployed and shot at on a daily basis. Some of the guys were infantry, some special units from the U.S. Army and the U.S. Marine Corps, and even a Blackhawk helicopter pilot. All of these men made me see instantly that I was surrounded by a group of individuals who believed in training and performing their best while using that training, that brotherhood counts, that everyone has everyone else's back at all times, and that quality of work and integrity are paramount within every team.

I spent the next seven days training these gentlemen in hazard awareness, fall protection, authorized climber/authorized rescuer, rigging and capstan operations. I can easily say these men were some of the best students I have ever had. I am confident that they will all go on to be great assets to the companies that are lucky enough to employ them and will have long and successful careers in the telecommunications industry.

I left Virginia with a feeling that made me feel good inside and out and a profound sense of pride. Proud to be an American, proud to have spent the last week with some of America's finest, proud to be part of Warriors 4 Wireless, and proud to

know I had made some great new friends. I look forward to all of the future training events for Warriors 4 Wireless and working with these outstanding individuals.

I recommend that any company looking to hire new employees visit

with Kelley Dunne and see how your company can benefit from employing these veterans who have given so much to protect our freedom. Visit www.warriors4wireless.com/contact-us/ to learn more about this great program.



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Zach Johnson
Instructor
Shenandoah Tower Service

This program allows veterans a chance to continue their devotion to our country by creating and maintaining part of the country's infrastructure. Telecommunications and its associated technology are necessities in today's world. The advancement of wireless networks now allows everyone the ability to rapidly respond, protect and coordinate with others on a daily basis.

The students in the class were ready to learn the skills needed to enter this demanding industry. Students stated that the precision, technical and physical demands of

this industry can be compared to some situations that the students have undertaken while they served our nation. Technical skill, precision and problem-solving are everyday goals for a soldier and also a tower technician.

The students of the Virginia class were excited to learn about key tasks and the process of building and maintaining a cell site. The way the class had the ability to see, touch and perform essential tasks allowed the students to gain confidence so they are able to enter this industry and make a difference. A greater respect for the job was created during the real-world exercises on-site and in the air. Every student commented that just safely climbing a tower alone is no joke; handling tools and actively installing or removing items from height takes the right person with a lot of training. Learning about the recent accidents in the industry, the students vowed to not let themselves or others work in a manner

that would possibly cause harm or loss of life.

The brotherhood that is instilled in those returning from combat is a positive attribute for all employers. Having an employee who actively cares for others around them creates a stronger and safer work environment. Participants understood that they are only as strong as their weakest teammate, that they must be able to trust their fellow employees, and that they are responsible for not creating or allowing hazardous conditions to remain within striking distance.

Students entering the W4W program know that the class would propel them into a new career path and not just their next paycheck; they are here to make a difference.

Having students in the class from all branches and ranks of the military allowed for a variety of perspectives. All of the students realized that they were on an equal playing field and were just taking their first steps into the industry.



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Tara Dunne
Recruiter
Warriors 4 Wireless

I am a recruiter for W4W. A nurse by trade, I guess you could say my entrance into veteran recruiting was a happy accident; however, I don't believe there are accidents, only people in the right place at the right time. I embarked on a journey where I have been fortunate to meet thousands of veter-

ans, each with their own special story, each story leaving me in awe of the strength and character that these men and women possess. Like the formation of diamonds from coal, these veterans have endured high heat and high pressure in combat, and they are the most rare gems looking for a chance at a new career after risking their lives for our freedom. I am honored to meet them, and I thank all of our partners for their continued support filling the tower industry with "rock" stars. As President John F. Kennedy said, "As we express our gratitude, we must never forget that the highest appreciation is not to utter words, but to live by them."



Jason Jordan
Microwave Projects Manager
Shenandoah Tower Service

The Warriors 4 Wireless program combined with Shenandoah Tower Service and Safety LMS training and assembled new-hire employees who were performing demanding tasks after only two weeks in the field. The stature of these employees is far above most others and will only benefit other organizations looking for

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employees with the highest level of new employee training and character.

For example, on their second week in the field, these climbers were landing 20-foot Bogner antennas at elevations of 300 feet, rigging steel winch lines, and installing microwave dishes and ice shields. They worked together to train, teach and learn how to build a difficult intermediate frequency radio system for the backhaul on a three-site layout.

I feel privileged to have the opportunity to work with some of the most exceptional employees both mentally and physically that I have been around in a long time. Their care for the given tasks and for others is immediately observed, and I hope that more of these intrepid men and women will enter this program.



Kelley Dunne
President
Warriors 4 Wireless

We have been fortunate to have trained, certified and placed hundreds of transitioning service men and women over the past two years in the wireless industry. Whenever I have the opportunity to speak to the classes or spend time with these dedicated veterans, I always leave a little better off than I came. It is an honor and privilege to see them seize the opportunity to join our industry, contribute to a profession and create a career path that will help bet-

ter support themselves and their families.

This class in particular stood out as one of the best classes I have seen. Their courage, commitment and passion in the training, the support they showed for each other and the respect they had for our industry was truly inspiring to witness firsthand.

I am extremely grateful for our partner companies that have committed the job opportunities that enable this program to run. I would encourage those companies that are considering getting involved, just come to one class, spend some time with our Warriors and you, too, will leave a little bit better off than you came.

Dave Anthony is chief executive officer of Shenandoah Tower Service, Staunton, Virginia. He is a member of the Telecommunications Industry Registered Apprenticeship Program board of directors.

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