Small Cells on Pole Facilities

A Primer on How Utility Poles, Street Lights and Traffic Signals Will Help Drive Next-Generation Mobile Broadband Networks

Content

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This white paper is meant to be an educational tool and does not reflect Wireless Infrastructure Association policy.

Abstract

Reliable wireless coverage promotes economic development, and is critical to attract and maintain a vibrant business environment and a competitive workforce. The attachment of small wireless antennas and associated equipment on pole structures – which can include Distributed Antenna System (DAS) remote units, remote radio units and self-contained small cells –significantly improves the coverage and capacity of 3G, 4G and soon-to-be-deployed 5G wireless networks. Installing wireless infrastructure at the precise location where it is needed improves the network and immediately benefits the community. To deploy these network solutions, a combination of existing infrastructure, and, in some situations, new pole infrastructure with the appropriate power and connectivity, are needed. Attaching this equipment to poles involves close collaboration with local municipalities and utility companies. Local jurisdictions should make their infrastructure available for collocation so that multiple deployments can co-exist on one pole.

This white paper provides information to municipal planners, site acquisition firms, architectural and engineering (A&E) firms and others interested in supporting small wireless equipment deployments on existing and new pole structures. For the purpose of this paper, the definition of small wireless communications equipment includes DAS remote units, remote radio units, self-contained small cells and associated equipment that can be mounted on a utility pole or similar structure. Street furniture is defined as utility poles and other structures located in the public right-of-way (ROW).

Specifically, this document addresses:

- Small Wireless Communications Equipment Deployment Options
- Retrofit Considerations for Existing Poles
- Streamlining the Permitting Process for Wireless Facilities Deployments
- A View of New Smart Pole Design Features and their Applications

Introduction

Commercial cellular networks are handling more traffic than ever as society embraces broadband mobility. In its 2015 Global Mobile Consumer Survey, The Rise of the Always-Connected Consumer US Edition, Deloitte describes society's smartphone use as an obsession.[1] The survey found that 93 percent of smartphone users check their phones within three hours of waking. Beyond consumers' individual habits, mobile broadband penetration impacts the local economy. The Brookings Institute estimated that "for every 1 percentage point increase in broadband penetration as a state, employment is projected to increase by 0.2 to 0.3 percent per year."[2] Mobile broadband penetration is also important from a public-safety standpoint because people are dropping wired home phones, or they never had them in the first place. An estimated 48.3% of Americans have only cellular phones in their homes, according to the Center for Disease Control, which tracks the trend.[3] This is notable because 70 percent of calls to 911 are made from mobile phones.[4]

Not surprisingly, U.S. carriers have had to fortify their networks to keep up with ever-growing customer demand. Along with macrocellular towers to build out coverage across the United States, carriers and infrastructure providers are deploying smaller equipment to bring antennas closer to the end user. In some cases, these deployments can take place using pole facilities, including utility poles, street lights and traffic signals.

Small wireless communications equipment supplements the macrocellular tower layer. The selection of the type of wireless equipment is decided on a market-by-market basis by the carrier or infrastructure provider, depending upon which solution best meets customers' needs.

Small Wireless Communications Equipment Deployment Options

Each type of small wireless communications equipment has its own nuances. Small cells typically support a single carrier, operate on only one or two frequency bands and transmit less power than a remote radio unit or DAS. As a result, a tradeoff must be made between deploying a larger number of small cells using lower power, or deploying a DAS solution, which would require fewer sites using higher power, support multiple technologies and frequency bands and be able to support multiple wireless carriers. Small cells can have embedded or external antennas, but similar to remote radio units and DAS deployments, external antennas offer greater flexibility in reaching the target area. The flexibility to use different types of antennas and evolve to new antenna technologies is critical to accommodate network evolution as carriers and infrastructure providers find new ways to handle increased

cellular traffic. Watching video on a smartphone uses much more bandwidth than sending a text message, for example.

Basic Installation Considerations for Power on Utility Poles

- National Electrical Safety Code (NESC) and pole-owner guidelines require that wood poles be possible to climb. New equipment cabinets must be installed on the same side of the pole as existing equipment cabinets.
- Minimum clearances between communications attachments and power attachments must be maintained. Typically, 40 inches of clearance is required between the lowest power attachment and the uppermost communications attachment. When installing an antenna at the top of the pole, 5 feet of clearance above the uppermost power conductor typically is required.
- Utility poles usually offer readily available electric power and often the wireless infrastructure installation will include a meter shell, a disconnect switch, a conduit and weather-head from the meter shell up the pole into the power zone. Some utilities require that all small wireless communications equipment use metered service drops; others will make services available at a flat monthly rate.
- Initial network design considerations will include a backhaul solution, which transports voice and data from the carrier's Base Transceiver Station (BTS) back to its core network. Choices might include dark fiber (unused fiber already in the ground), lit circuits (fiber being used), cable TV or a wireless solution. Since utility poles are used extensively in building fiber-optic communications networks, dark fiber is a common solution.
- The list of candidate sites, which initially is evaluated based upon network planning software, is further refined based upon a field survey so the pole's structural condition can be evaluated. When planning the use of wood utility poles to host small equipment deployments, the condition of the poles and the ability of each to support additional weight and wind loads must be evaluated.
- The pole owner's attachment guidelines will specify how new cabinets, service meters and disconnects, cable pathways, grounding systems, antennas and other items must be attached and positioned onto the existing pole.

Above Ground Level (AGL) Heights for All Components

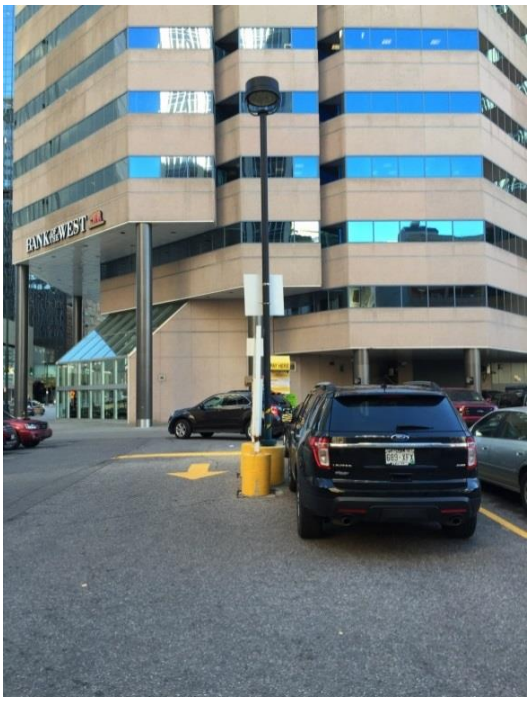
Radios or radio cabinets typically will be positioned at least 6 feet to 8 feet above grade to the bottom of the cabinet on existing poles that are retrofitted to house the equipment. Power service meter, disconnect and any outboard communications devices (such as a backhaul router) must be positioned on the pole, interconnected and grounded, according to the pole-owner's guidelines and NESC.

Antennas will be positioned according to the regulations provided by the utility. An important consideration in antenna attachment heights relates to the positioning of conduit and u-guard cable protection that will be used as cabling pathways.

Loading Considerations

The process of developing a cost-effective wireless network must take into consideration the capacity of the existing structures intended to support the load on the pole-mounted equipment. A structural analysis should take place when mounting secondary equipment directly to the pole to confirm that the structural integrity is maintained with the additional load.

If adding weight on the pole would make it unsafe, there are several options to consider. If the pole overstresses are in a reasonable range, modifications to increase the pole's structural capacity may be considered. In situations when the pole overstress is extreme, full pole replacement may be required. In either case, the design, fabrication and installation will both delay the deployment timeline and increase its cost when the deployment strategy initially did not consider new poles. Relocating secondary equipment to the ground level can eliminate any additional cost or timeline delays associated with pole modifications or pole replacement.



Photos courtesy of Aero Solutions

These structures would only be suitable for small omnidirectional antennas mounted at the top of the structure.

Streamlining the Permitting Process for Wireless Facilities Deployments

The Telecommunications Act of 1996 ('96 Act) designated the Federal Communications Commission (FCC) as the primary entity responsible for rules governing telecommunications services, and designated states and local governments as the primary entities responsible for rules governing access to the public's ROW.[5] Since a number of entities can access the ROW, each entity must be a good steward and follow the proper procedures to ensure work is done safely and does not negatively impact other entities collocated on the street furniture. Local jurisdictions can help to ensure that proper processes are followed so potential concerns are mitigated. Some examples of laws and rulings shaping today's current regulatory landscape include items adopted as part of the 1996 Act, as well as subsequent rulings that clarify timelines for deployments and modifications to existing sites (See Appendix).

Jurisdictional Permitting Processes

Geographic size, population and/or demographics can play a large role in determining how a particular jurisdiction will react to the current regulatory climate. Wireless-friendly jurisdictions understand the importance of wireless connectivity in today's economy and structure their permitting processes to facilitate wireless deployments. In fact, a few jurisdictions have regulations that allow wireless infrastructure by right in the ROW, so long as the proposed infrastructure is on an existing utility pole. These jurisdictions hold that wireless infrastructure applications should be processed the same as other utility infrastructure installation located in the ROW, such as electric, gas, water, sewer and cable improvements.

Streamlined Permitting Process

In larger jurisdictions, new wireless infrastructure permits are usually processed through a public works department. In these circumstances, an encroachment permit or other administrative process is required. A traffic control permit may be required as well as a building permit for the electrical work. If public notices are required, a public hearing may be necessary only if a duly notified constituent timely objects and requests a public hearing. Public Works employees usually administer such hearings.

Common Goal

Wireless carriers, infrastructure providers, jurisdictions and constituents should all share the same common goal: seamless and ubiquitous wireless coverage and capacity for the community's constituents. Detailed steps and parameters need to be articulated and agreed upon by the stakeholders to advance the stated common goal. A concerted effort should be made to minimize the number of new vertical elements introduced into the ROW.

Existing infrastructure, whether owned by the jurisdiction, joint-pole authorities or others should be considered first for collocation before proposing new poles. Small wireless communications equipment proposed in the ROW within commercial and industrial areas should be processed administratively.

Bifurcated Permitting Structure/Small Cell Exemption

A bifurcated permitting process works best at addressing jurisdictional concerns while giving wireless providers assurances of the process in place. Equipment of a certain size, dimension or volume should qualify as a "small cell," which is either exempt from the wireless ordinance requirements completely or otherwise approved. In general, a small wireless facility would be one that includes the following properties: each antenna is located inside an enclosure of no more than six cubic feet in volume; and all other wireless equipment associated with the facility is cumulatively no more than 28 cubic feet in volume. The following types of associated ancillary equipment are not included in the calculation: electric meter, concealment elements, telecommunications demarcation box, ground-based enclosures, grounding equipment, power transfer switch, cut-off switch, and vertical cable runs.

Communications providers must be free to make decisions about the nature of the equipment needed to improve service or it could negatively impact the wireless broadband service provided to the community. Nonetheless, wireless carriers and infrastructure providers have an incentive to conform to the small-cell parameters to secure the streamlined administrative review process and the certainty of a favorable outcome. Aligning the interests of wireless providers with that of the community is a victory for jurisdictions. All stakeholders benefit from the rapid deployment and improvement of wireless networks.

Collocation

Local jurisdictions should make their infrastructure, including street furniture, available for collocation (the shared use of wireless infrastructure by multiple carriers) to reduce visual clutter and avoid unnecessary duplication of infrastructure. Collocation is today's industry norm, and it works well both for the industry and for communities. The practice of sharing infrastructure offers an ordered and transparent process for all industry players. This streamlined approach helps level the playing field while also lowering barriers for new entrants, encouraging competition in support of increased innovation. Shared wireless infrastructure minimizes the need for infrastructure, which is a practice that is supported by the environmental, historic and cultural preservation communities.

Other Considerations to Streamline the Process

Pre-approved antenna configurations and site layouts are other practices that can assist in streamlining the permitting process. Acceptable antenna attachment configurations should be shown for each pole type that could be encountered including utility poles, street lights or traffic signals. Master plans showing existing wireless

infrastructure and a two-year buildout forecast are typical. Attachment to jurisdictional infrastructure in the ROW should be encouraged. Lease terms and antenna configurations can be codified in a Site License Agreement or another such instrument. Jurisdictions should charge rental rates that are reasonable and reflect the regulated rates typically charged between pole owners and utilities within the ROW.

Public Engagement

One way to win over local jurisdictional support for wireless deployments is to be responsive to local concerns and sensitivities. The size and scale of a proposed wireless deployment should have a commensurate public outreach program. Early meetings with elected officials and staff can go a long way toward identifying local values that need to be observed. Local permitting experts are valuable in identifying these potential pitfalls.

A View of Smart Pole Design Features and their Applications

In some cases, new poles can be effective in providing wireless coverage for small-cell networks. When integrated into the network deployment strategy from the start, these "smart" poles can be designed as structures that blend into the environment, may carry the required telecommunication equipment internally inside the pole and provide opportunities for new technologies offered in the future. For example, the City of San Jose, California, partnered with Ericsson and Philips to test smart poles that are designed to offer more energy conservation, reduced expenditures on energy and maintenance, use LED lighting on dark streets and better broadband connectivity to residents.[6]

Small Cell integrated into light pole

Photo courtesy of Verizon

In these circumstances, existing available infrastructure may not be accessible or in the right location or height to properly position the telecommunication equipment. In other cases, the existing pole infrastructure may be impractical to reinforce, requiring new pole structures. Smart poles can be deployed to supplement or replace existing poles and conform to the existing infrastructure.Smart pole designs must take into consideration the telecommunication equipment to be deployed today and any known future technology requirements. Smart poles

can be the right solution for strategically placed sites in outdoor parking areas or other urban locations when suitable.

Left photo: CityPole™ installed as standard smart pole in downtown Denver
Right Photo: CityPole™ lighting fixture design

Photo courtesy of Comptek/Aero Solutions

Conclusion

The rapidly accelerating rise of mobile adoption has shifted the way Americans live, work and play. This societal shift shows no signs of stopping or even leveling off. We are a connected society, which is changing the way students are educated, healthcare is administered and business is done. All of that connectivity depends on a strong wireless infrastructure foundation. Small wireless equipment mounted to poles, smart poles and other forms of wireless street infrastructure are going to play an increasingly important role as new technologies are deployed and carriers try to keep up with their customers' insatiable wireless appetites. As such, network infrastructure providers, wireless carriers, utility companies and local jurisdictions must find ways to cooperate to ensure timely deployment of more wireless infrastructure.

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Appendix

Telecommunications Act of 1996

The following are some of the pertinent sections from Section 332(c)(7) of the Telecommunications Act of 1996.[7] The 1996 Act states that "the regulation of the placement, construction, and modification of personal wireless service facilities by any State or local government or instrumentality thereof shall not unreasonably discriminate among providers of functionally equivalent services and shall not prohibit or have the effect of prohibiting the provision of personal wireless services." 47 U.S.C. § 332(c)(7)(B)(i).

"A State or local government or instrumentality thereof shall act on any request for authorization to place, construct, or modify personal wireless service facilities within a reasonable period of time after the request is duly filed with such government or instrumentality, taking into account the nature and scope of such request." 47 U.S.C. § 332(c)(7)(B)(ii).

"Any decision by a State or local government or instrumentality thereof to deny a request to place, construct, or modify personal wireless service facilities shall be in writing and supported by substantial evidence contained in a written record." 47 U.S.C. § 332(c)(7)(B)(iii).

The law also states that "No State or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the [Federal Communications] Commission's regulations concerning such emissions." 47 U.S.C. § 332(c)(7)(B)(iv).

FCC Shot Clock Order

The FCC's "Shot Clock" order, issued on November 18, 2009, was an important step to encourage the expansion of wireless networks.[8] The ruling interprets Section 332 (c)(7)(B)(ii)'s requirement that a local jurisdiction review siting applications "within a reasonable period of time" to create a rebuttable presumption that the jurisdiction acts within a "reasonable period of time" when it approves or denies an application for the collocation of

additional antennas to existing infrastructure within 90 days and an application for the construction of new infrastructure within 150 days.

Middle Class Tax Relief and Job Creation Act of 2012

Section 6409(a)[9] of this law states:
"Notwithstanding section 704 of the Telecommunications Act of 1996 (Public Law 104-104) or any other provision of law, a State or local government may not deny, and shall approve, any eligible facilities request for a modification of an existing wireless tower or base station that does not substantially change the physical dimension of such tower or base station.

"Eligible facilities request. For purposes of this subsection, the term "eligible facilities request" means any request for modification of an existing wireless tower or base station that involves (a) collocation of new transmission equipment; (b) removal or transmission equipment; or (c) replacement of transmission equipment.

"Applicability of environmental laws. Nothing in paragraph (1) shall be construed to relieve the Commission from the requirements of the National Historic Preservation Act or the National Environmental Policy Act of 1969."

FCC Report and Order: Acceleration of Broadband Deployment by Improving Wireless Facilities Siting Policies

In its Report and Order dated October 17, 2014 (2014 Infrastructure Order)[10], the FCC promulgated new rules on wireless siting and clarified some existing rules. Specific provisions of the Order include:

• Defining the terms of Section 6409(a) of the Spectrum Act and developing rules for its implementation at the state and local level, including a new 60-day shot clock during which an application must be addressed or it is deemed granted. This ensures the efficient use of previously approved structures to support new antennas and technology upgrades;

• Excluding certain distributed antenna systems (DAS), small cells and other discrete wireless facilities from environmental and historic preservation review, particularly for those deployments leveraging utility poles in rights-of-way and building rooftops;

• Clarifying the shot clock and defining wireless facility siting application processes, including applying the shot clock to DAS and small cells, limiting when additional application information can be requested, and clarifying when the shot clock begins and when it can be tolled;

• Removing barriers to the deployment of temporary towers to boost coverage for large gatherings like festivals and rallies.

Amendment to the Nationwide Programmatic Agreement for the Collocation of Wireless Antennas

On August 8, 2016, the FCC's Wireless Telecommunications Bureau, along with the Advisory Council on Historic Preservation (ACHP) and the National Conference of State Historic Preservation Officers (NCSHPO), signed the *First Amendment to Nationwide Programmatic Agreement for the Collocation of Wireless Antennas* (Amended Collocation Agreement)[11] to eliminate historic preservation review for small facility deployments that do not adversely impact historic sites and locations. A continuation of an effort begun in the 2014 Infrastructure Order, the Amended Collocation Agreement establishes new exclusions from the Section 106 review process for small wireless facility deployments like DAS and small cells with a focus on attachments on deployments in historic districts or on historic properties. It also provides greater clarity on attachments to non-utility infrastructure.

Author Information

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Jim Lockwood is CEO and founder of Aero Solutions, a leading provider of structural engineering, A/E services and tower reinforcement products since 2002 to the wireless infrastructure industry. Aero optimizes macro-cell co-locations on tower structures and buildings and small cell applications on buildings, light poles, utility structures and other street furniture. Headquartered in Boulder, CO, the company has completed over 4.000 co-locations across the United States, Caribbean, Asia and Europe, providing professional engineering, construction management and reinforcing materials. Jim has 15 years of experience in the wireless infrastructure industry and 30 years as an entrepreneur in the engineering, products, and construction industry. He established Comptek in New York in 1998, a provider of structural components and engineered products; and Wind Tower Technologies in 2013. Prior to 1998, Jim was a Principal of J. Muller International, responsible for the firms Chicago and New York offices and CEO of Egis, Inc. in New York. Jim is a professional engineer, P.E., and holds a BSCE degree from the Univ. of Cincinnati and an MSCE degree from the Univ. of Washington, Seattle.

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Andre de Grasse has over 25 years of successful professional domestic and international experience in technology, operations, professional services and project management in different industries with end-to-end people management. Andre graduated with a Bachelor of Applied Sciences in Electrical Engineering from the University of New Brunswick and graduated from the Goizueta School of Business with an MBA at the University of Emory. He is president of Mobile Form Solutions, partner of RD3 Inc., Andre has held positions from global manager of engineering at Bechtel Corporation; USA national site development lead of wireless at Cox Communications to project leads internationally such as Unicom China, Nortel, Nextel, BellSouth, Unefon Mexico, Vespa Brazil and others.

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Ray Preston Hild is an accomplished senior management and strategic partnership professional with over 26 years of experience in the wireless industry. He has consulted on several major government and enterprise initiatives and co-authored several industry white papers. Ray has been a member of the WIA Innovation and Technology Council for several years. In addition, he has served on a variety of wireless committees and boards for major industry associations on such topics as: Unified communications, DAS in mid-tier markets, oDAS, mobile broadband, wireless as the 4th utility, enterprise wireless systems and network densification. In addition, Ray has created the Public Safety Code Guidebook which is meant to track the changing landscape of first responder wireless requirements across the US. Ray has held management and leadership positions with several prominent corporations over the years. Those include Sprint-Nextel, Corning, Galtronics, Kavveri Telecom and most recently JMA Wireless, a global supplier of world-class telecommunications equipment, where he serves as area vice president. He has won dozens of awards over several decades for service and performance. Ray is involved in the Johns Hopkins Mentorship Academy working with teenagers needing guidance in their career choices. He is also invested in supporting those who served through 185 for Heroes, an organization that hosts events for Operation 2nd Chance to help our warriors when they return from duty.

Keith Kaczmarek, Public Safety Ventures

Keith is a general partner at Public Safety Ventures, a private equity firm focused on the public safety and critical industry markets. Keith has more than 30 years of wireless telecommunications experience. He has held prominent business, technology and operations leadership roles at inPhase Wireless, Intrado, Powerwave, Cyren Call, FiberTower, inOvate Communications Group, Teligent, Nextel, AirTouch, PrimeCo and GTE. Keith was a co-founder of Cyren Call Communication, focused on supporting public safety in the creation of a

nationwide public safety broadband network. He was also a general partner at inOvate Communications Group a venture fund focused on early-stage wireless companies. Keith is a Radio Club of America Fellow, holds an MBA degree, a M.S. in Electrical Engineering and a B.S. in Electrical Engineering from the University of Illinois.

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Mike Kelly is the Director of the Program Support Services Group - HMI Technical Solutions, LLC, a subsidiary of Henkels & McCoy Group, Inc. Mr. Kelly's group provides a wide range of support services – administrative, technical, and operational - to customers whose requirements include the implementation of multiple projects, or highly complex projects. Mr. Kelly joined Henkels & McCoy in 1986. He has served the company in many capacities, including Supervisor of Field Operations, Major Account Manager, and manager – Federal Government Group. Mr. Kelly served in the US Army. He received a degree in Electronic Theory from RETS Technical Institute. He is a member of AFCEA and BICSI.

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Patrick Lau is director of business development, Distributed Coverage & Capacity Solutions in the North American region for CommScope. In this position, Patrick is responsible for coordinating sales opportunities between engineering, project management and sales teams and qualifying new in-building opportunities with wireless operators and enterprise customers. Patrick has 18 years of experience in the RF telecommunications field. Prior to joining CommScope, Patrick worked in various engineering and business development roles for Allen Telecom, Allgon and Andrew Corporation. Patrick earned Bachelor of Science and Master of Science degrees in Electrical Engineering from the University of Akron (Ohio).

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Joe Mullin oversees all DAS projects for InSite. He has more than 25 years of experience designing and deploying wireless networks, including expertise developing specialized in-building coverage solutions for medical, industrial, and entertainment venues throughout the U.S. Previously, Mr. Mullin was Vice President of Engineering for Arch Wireless, where he was responsible for network design, facility management, and regulatory compliance. Mr. Mullin also has developed and marketed wireless network products with Glenayre Electronics and Harris RF Communications. He managed construction projects for the U.S. Army Corps of Engineers in the U.S. and Europe. Mr. Mullin holds a B.S. in Civil Engineering from Worcester Polytechnic Institute and an MBA from Boston University. He is a Registered Professional Engineer and is a member of the IEEE and the Radio Club of America.

Meghan Riley, Verizon Wireless

Meghan Riley served as North Territory Planning Manager for Special Venues, In-building, and Small Cells for Verizon Wireless at the time of contribution, a role in which she led planning, acquisitions and system design, development, and management of HetNet solutions for the Midwest and Northeastern states (Meghan has since transitioned into the role of Senior Manager, System Performance for Verizon's Illinois/Wisconsin Submarket). Meghan began her wireless career working as a consultant representing clients in difficult zoning matters and specializing in major venue acquisition and project management of large-scale DAS and small cell deployments throughout the Midwest. Meghan holds a B.A. from University of Iowa and a J.D. from The John Marshall Law School in Chicago.

Ken Sandfeld, SOLiD Americas

Ken Sandfeld is President of SOLiD Americas and is responsible for SOLiD's wireless coverage and capacity enhancing product portfolio including Distributed Antenna Systems (DAS) and Optical Transport solutions. Ken's wireless experience spans over 20 years with industry notables including Spectrian, Remec and MobileAccess. With a proven track record launching innovative wireless technology, Ken is focused on solving the industry's densification challenges by bringing SOLiD's Next Generation DAS solutions for indoor and outdoor applications as well as advanced tunable DWDM & high capacity passive CWDM optical solutions that provide ultra-densification of wireless coverage across all verticals and venues.

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