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DAS and Small Cell Update Fall 2015

By Martha DeGrasse

OCTOBER 2015



Introduction

Distributed antenna systems and small cells hold tremendous promise and tremendous uncertainty for the U.S. wireless industry. Mobile operators know they need to add capacity to their networks as LTE unleashes demand for mobile data, especially mobile video. But operators also need to stay profitable, and the cost of DAS and small cells has kept many potential projects in the planning phase.

The good news for operators is that businesses and municipalities are learning that they need to be proactive if they want to offer reliable access to high-speed mobile data. In-building deployments are finding new sources of financing from the companies that will use the services, and outdoor deployments are taking place in an improved regulatory environment.

This report will review trends in network densification both indoors and outdoors. Key focus areas include cost control through new network architectures and intelligent optimization, small cells as a service, and new business models for small cells and DAS.

Definitions

A **distributed antenna system** (DAS) consists of antennas, base stations, and a transport medium to connect them, typically fiber or cable. A DAS remote unit may be an antenna/amplifier or it may be a remote radio head that includes digital processing capabilities.

Passive distributed antenna systems

are usually antennas linked by cable to a base station or head-end. Active DAS systems get an extra boost from fiber, antenna amplifiers, remote access hubs and expansion hubs. Passive DAS and cellular signal boosters are good solutions for many buildings, but larger venues like stadiums or hotels will usually need an active DAS.

Small cells is a term that is used broadly in the wireless industry to refer to a variety of solutions. According to The Small Cell Forum, 'small cells' is an umbrella term for operator-controlled, low-powered radio access nodes, including those that operate in licensed spectrum and unlicensed carrier-grade Wi-Fi. They typically have a range from 10 meters to several hundred meters.

The words "small cell" may be used to describe equipment that includes a baseband unit and functions as a miniature version of a cell tower, as well as equipment that is simply used to access the radio network. DAS remotes may at times be called small cells, and indoor access points that connect to controllers via fiber or cable may also be called small cells at times.

"Everyone's got such a different definition of what a small cell is," said analyst Earl Lum of EJM Wireless Research. "I would consider a small cell to have both the modem and the radio integrated into one unit, so it's self-sufficient and all it needs is backhaul."

Small cells are starting to look more like distributed antenna systems as operators



"I would consider a small cell to have both the modem and the radio integrated into one unit, so it's self-sufficient and all it needs is backhaul."

Earl Lum, EJM Wireless Research

and vendors explore architectures that separate the baseband equipment from the access equipment in order to save space and money. By centralizing the baseband equipment and connecting it to the small cells via fiber or cable, operators can deploy smaller, less expensive access nodes.

The word "small" is also a relative term, as small cells come in several sizes. Femtocells are small cells that are used in homes or small businesses. They usually have a range of less than 100 meters. Picocells, or metrocells, have a range of up to several hundred meters, and microcells can cover more than a thousand meters.



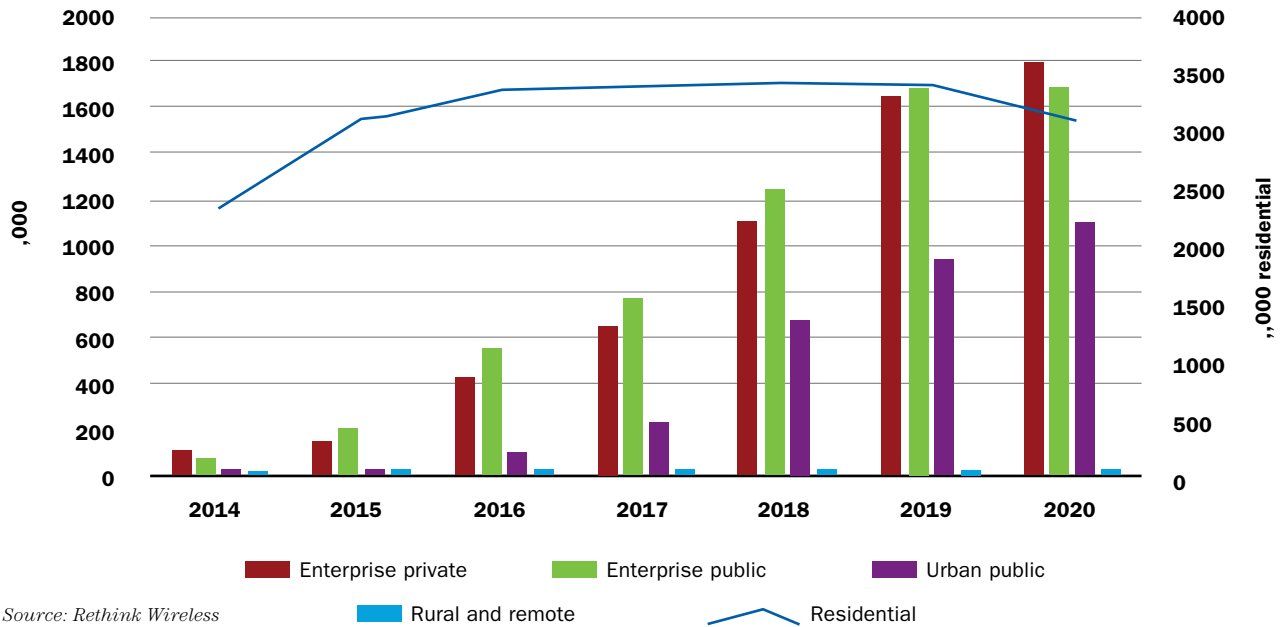
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New deployments of small cells, by environment



Source: Rethink Wireless

According to the analysts at Rethink Wireless, purchases of residential small cells will peak within the next couple of years. Urban small cells are expected to grow exponentially, and enterprise small cells are forecast to become the biggest part of the market. The vast majority of enterprise small cells are indoors.

Indoor small cells

Most mobile data usage occurs indoors, and most of it happens on Wi-Fi. Cell service providers can't support all the activity that takes place on smartphones and tablets, but they want to keep as much of the traffic as they can handle. To do that, they need to provide reliable indoor

coverage, even in crowded buildings that are not near a tower. The larger buildings may be candidates for an in-building DAS, but the hundreds of thousands of smaller buildings that operators want to serve are candidates for indoor small cells.

“Only about 2% of enterprise buildings actually have mobility in the building,” said Philip Sorrells, VP of strategic marketing at CommScope.

But a much higher percentage of the buildings that carriers will pay to cover have already gotten a system. The addressable market for carrier-funded indoor small cells is limited. Bringing better connectivity to the millions of people in office buildings who would love to see more bars on their



“Only about 2% of enterprise buildings actually have mobility in the building”

Philip Sorrells, CommScope

phones will require carriers to convert corporate customers into partners in the small cell investment process. Building owners and their enterprise tenants are getting a crash course in cellular, and one of the lessons they are learning is that technology is still evolving.

“They are very hesitant to invest in something that they may have to rip and replace in two years,” said Sorrells. “So the operators are approaching them in ... a tentative way ... trying to help the building owners understand the value of the investment and to bring them in at entry points that make sense for that size of building.” Sorrells expects to see significant traction in the enterprise segment during 2016.

Driving down the cost of indoor small cells

Mobile operators and enterprises can reduce the cost of indoor small cell deployments by streamlining the equipment and the installation processes, and by properly testing small cells to avoid high maintenance costs.

Vendors are working hard to deliver simple, scalable solutions that can be deployed by IT technicians who may have limited radio frequency experience. Centralizing control of the small cells is one way to keep the cost of each individual access point down. Standard Ethernet cable is used to connect indoor small cells to a central controller in the solutions developed by SpiderCloud Wireless and by Airvana, which is in the process of being acquired by CommScope.

Ericsson, Huawei and ZTE have all developed indoor small cells that function as antennas and amplifiers but do not include baseband processors. LAN cabling is typically used to connect the small cells to a remote base station.

Alcatel-Lucent, Ericsson and Nokia all offer small cells that are compatible with their macro base station equipment and include baseband processing units. These solutions require less interoperability testing than those from small cell specialists like SpiderCloud, Airvana, ip.access and Airspan, but they are also less flexible because operators can only deploy them with macro equipment from the same vendor.

Small cells as a service

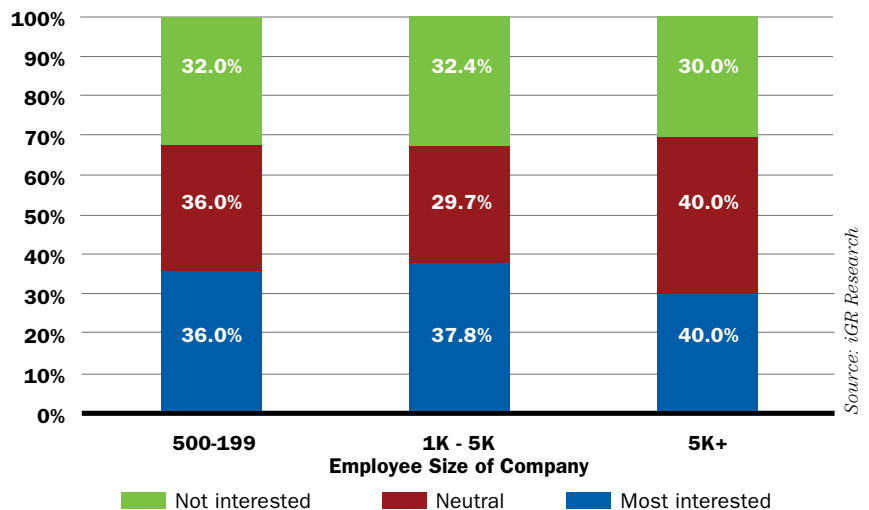
Small cells as a service is a term that can have several different meanings. Ericsson uses the term to refer to a small cell

network that can be shared by multiple operators and can integrate carrier-grade Wi-Fi. Other small cell vendors may use the term to describe a carrier offering that companies could pay for as an operating expense. Or, the word “service” can describe offerings like unified communications and mobile device management that are enabled by a small cell network.

iGR Research founder Iain Gillott said that many IT managers are uneasy with the concept of small cells that are remotely controlled by a mobile operator.

“IT managers do not want to lose direct control of the small cell environment,” said Gillott. “To an IT manager, the phrase ‘managed solution’ means that they retain some control and have a secure environment, while benefiting from a solution that reduces IT overhead and capital expense.”

Interest in enterprise small cell solutions as a managed service by employee size of firm



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“IT managers do not want to lose direct control of the small cell environment.”

Iain Gillott, iGR Research



“Virtualization for small cells, as defined for macro, doesn’t really make sense economically.”

Pierre Lynch, Ixia.



“We’ve found clear benefits and drivers towards centralization and virtualization of the small cell network.”

Alan Law, Chairman, Small Cell Forum.

Virtualization

Small cell vendors are exploring network function virtualization (NFV) as a way to potentially bring down the cost of small cells, but this movement is in its infancy.

“Virtualization for small cells, as defined for macro, doesn’t really make sense economically,” explained Pierre Lynch, lead technologist of Ixia’s product management team. Currently, virtualization of the radio access network is defined by ETSI, the European Telecommunications Standards Institute.

“Their definition requires very high-throughput fronthaul to be able to get accomplished because of where they selected to do the virtualization,” said Lynch. “For a macro network that makes economic sense, but [not] for a small cell network.”

“It is typical to link the data center to the radio unit with fiber, for instance, but that’s expensive and so folks are looking at other ways of partitioning the baseband,” explained analyst Nick Marshall of ABI Research. “There are multiple approaches. ... The Small Cell Forum recently published its work on virtualization of the RAN and came up with multiple partitioning approaches for the baseband which would be suitable for small cells.”

“We’ve found clear benefits and drivers towards centralization and virtualization of the small cell network,” said Small Cell Forum Chairman Alan Law. “These facilitate the scalability of small cells and enable functions to be moved around depending on loading conditions or availability of compute and transport resources.”

Testing techniques

Just as virtualization techniques that make sense for the macro network may not work for small cells, testing techniques also need to be adjusted for small cell environments.

“You want to have the same level of performance as a macro cell, but using the tools that would normally be deployed ... for a macro cell to monitor and assure its performance are cost-prohibitive,” said Scott Sumner, VP of solutions development

and marketing Accedian Networks. “So the size, the power of your testing solutions, the operational expense, has to be sized right.” Sumner said that virtualized versions of the probes and field tests used to test macro sites can be appropriate for small cells.

“When you look at the evolution towards SDN, towards self-organizing networks, towards the dynamic pathing of traffic as networks move toward more full fabric instead of RAN and core, this optimization that will be done automatically in many cases needs to have a feed of real-time metrics coming in from all parts of the network so that you can [not only] detect issues but also fix them right away,” he said.

Sumner said that optimizing small cells can be more challenging than optimizing macro sites because often capacity can shift within a small cell network to meet user demand, and because handoffs happen very quickly. The complexity will increase significantly if operators start to deploy LTE small cells in the 5 GHz spectrum that is used for Wi-Fi.

Wi-Fi and indoor small cells

Nokia, Alcatel-Lucent and Ericsson all offer indoor small cells that include Wi-Fi connectivity chipsets. These vendors would like to see carriers bring their small cells to customers as all-in-one solutions, but they are learning that sometimes it is Wi-Fi, not cellular, that enterprises care about the most. Therefore, vendors are partnering with Wi-Fi access point makers.



“This optimization that will be done automatically in many cases needs to have a feed of real-time metrics coming in from all parts of the network.”

Scott Sumner, Accedian Networks

Ericsson recently announced an alliance with HP, which owns Wi-Fi access point maker Aruba Networks. Ericsson plans to use Aruba’s Wi-Fi technology in future versions of its indoor small cell, and it will sell Aruba’s Wi-Fi networking gear along with its small cell portfolio. Likewise, enterprises that are buying servers or Wi-Fi access points from HP will be able to also purchase Ericsson’s small cells.

Other vendors are also partnering with Wi-Fi access point makers who can add

small cells to their portfolio of solutions. SpiderCloud Wireless has partnered with Cisco and Alcatel-Lucent has partnered with Ruckus Wireless.

The Alcatel-Lucent/Ruckus partnership includes significant technical collaboration as well as co-marketing. The companies are using LTE Wi-Fi link aggregation (LWA), which aggregates both Wi-Fi and cellular on the downlink and uses cellular for the uplink. Alcatel-Lucent said that LWA can more than double download speeds relative to standalone network capabilities.

LWA is seen as a competitive technology to LAA or license-assisted access, which uses the 5 GHz spectrum for LTE transmissions. The 5 GHz spectrum is currently used for Wi-Fi, so Wi-Fi equipment vendors are concerned about interference from cell signals that could result from carrier deployments of LAA.

Indoor DAS

Some of us have had the experience of sitting at a ball game staring at a phone with no bars, while our friends chatted away happily on their phones. In highly congested areas, each carrier network may perform differently, and often the difference is a DAS.

Indoor DAS is a tried and true solution for airports, hotels and sports arenas. But even though operators, equipment makers and installers have worked on hundreds of distributed antenna systems, each DAS is a bespoke solution.

“Each build is unique and each building

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has its own particular characteristics,” said Ray Hild, Galtronics’ VP for infrastructure in North America. “One size does not fit all.”

A single operator DAS will boost network performance for that service provider, while a multi-operator or neutral host DAS will improve service for several service providers, although the first provider on the DAS will often have the best service.

According to ABI Research, CommScope is the world’s leading vendor of DAS equipment. The company recently solidified its leading position with the purchase of TE Connectivity’s wireless



“Each build is unique and each building has its own particular characteristics.”

Ray Hild, Galtronics

business. CommScope expects capacity adds to be the biggest part of the its DAS business in the year ahead.

“What will be happening in 2016 is adding more capacity,” said CommScope’s Philip Sorrells. “Stadiums and airports have a very solid foundation now.” Demand for new indoor DAS systems has declined during the past year, as carriers have focused their capital expenditures elsewhere.

“The slowdown in DAS deployments in the US over the last year reflects the broader slowdown in the wireless industry over that time,” said CommScope’s Matt Melester, head of the company’s DAS/small cells team. “DAS remains a very attractive solution for high-capacity venues where multi-operator, multi-technology support is needed.”

“The last 12 months have seen a significant recession in the US market, starting in the 4th quarter of 2014,” said Mike O’Day, VP wireless networks at Corning. “A lot of new DAS builds were either put on hold or funding that was originally planned to support those new builds was no longer available. ... Over the last 12 months most of the spending in the U.S. DAS market specifically has been for upgrades.”

O’Day said that carriers were pre-occupied with other investment priorities, and that they are also taking a second look at the traditional DAS

funding models. Normally the carrier pays for the DAS and perhaps leases space to subsequent carriers who join the DAS, or leases space on the DAS from a neutral host provider who has taken the investment risk. Now carriers are looking for venues to help shoulder the cost of some potential DAS builds or upgrades.

“The venue will play the lead role in funding and owning the network. That means the venue owner must be able to negotiate with the carriers to plug into the network,” said Mike Collado, VP of marketing at SOLiD Technologies.



“Over the last 12 months most of the spending in the U.S. DAS market specifically has been for upgrades.”

Mike O’Day, Corning

“Solutions within the ‘middleprise’ need to empower the venue to help themselves. This potentially looks like a carrier-approved / carrier-certified radio that the venue can purchase, but that the carrier needs to turn on.”

Collado sees this next tier of enterprise customers as a major opportunity for DAS vendors now that the largest venues already have systems. But these customers look at cellular connectivity as just one piece in the IT puzzle.

“Ideally, the infrastructure is converged, where a single backbone serves multiple services including commercial cellular, public-safety and IP (Wi-Fi),” said Collado. “This approach enables the infrastructure to stay in place while the end pieces get swapped out to avoid expensive rip and replace.”

DAS vendors and operators agree that building owners and their enterprise tenants will need to help finance DAS for many of the venues that want them. But that does not mean that carriers and neutral host providers will stop building DAS.

“A variety of DAS funding models exist, and we expect that to continue,” said CommScope’s Mike Melester. “Of course, each application is different and can dictate the use of different solutions. That is why CommScope continues to develop and invest in a variety of solutions to meet customer needs—whether it’s sector-splitting antennas, DAS or other



“The venue will play the lead role in funding and owning the network.”

Mike Collado, SOLiD Technologies

small cell solutions for adding capacity.”

CommScope and Corning are examples of DAS vendors that are adapting to the changing demand for in-building solutions. CommScope has acquired TE Connectivity’s wireless business, which includes a digital DAS solution that can save money and space by connecting remote nodes directly to Alcatel-Lucent base stations without the need for head-end equipment. CommScope is also buying small cell vendor Airvana, which has developed a small cell solution that is a direct competitor to DAS. Airvana recently outfitted Gross Coliseum in Kansas (shown on the cover of this report)

with a small cell system for Nextech Wireless. The carrier said the system was less than half the cost of a DAS.

Corning has leveraged its background in fiber optics to create an in-building solution that combines fiber backhaul for cellular, Wi-Fi and Ethernet. The company appears well-positioned as enterprises take a more active role in financing in-building cellular systems, because it offers a solution that also supports other enterprise connectivity requirements.

Passive DAS and signal boosters

An active DAS may be beyond reach for many companies, even though they may need more coverage than they can get from a small cell. Analyst Earl Lum of EJL Wireless Research sees a significant opportunity to connect enterprises that are too large to be supported by a small cell but not large enough to attract carrier investment in a DAS.

“You have still a huge opportunity for passive DAS,” he said. “You’re using a repeater source to borrow capacity from a sector of a cell site and just light up the inside of a building and you’re not worried about capacity or anything – you’re just trying to get some signal inside the building. The building owner has to pay for it; it’s not being paid for by the operator. There’s not a signaling source that the building owner has to buy or the operator has to buy, so the cost per square foot is substantially



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less than a full-on DAS or even an Ericsson Radio Dot, etc.”

For buildings that are less than 100,000 square feet, cell signal boosters may be effective and cost even less than a passive DAS. Cell signal boosters, also called cellular repeaters, perform three functions. They receive, amplify and then rebroadcast existing cell signals. A cell signal booster will not be a good solution if the signal outside a building is already weak. But if signal deterioration occurs indoors, a cell signal booster can be a very good alternative to a distributed antenna system. Boosters use on-premise power, and they typically cover the bands of all the leading U.S. wireless carriers. In essence, they can perform like a multi-operator passive DAS.

“A signal booster system set up in a building of whatever type is a passive DAS system in itself,” said Curtis Burkhardt, director of sales and marketing at Surecall. “So it’s cable, antennas, amplifier without any other need for a fiber connection to a tower or carrier-specific connectivity of any type, or backhaul. I think a lot of purists out there would say that we don’t qualify as a true passive DAS or as a DAS system at all. But as they say, the proof is in the pudding. ... Installers are deploying literally hundreds of the Force 5s across the country every month now.” The Force 5 is a 5-band amplifier that supports 3G and 4G.

Some cell signal boosters can also be integrated with small cell networks. A small cell could be used to increase



“A signal booster system set up in a building of whatever type is a passive DAS system in itself.”

Curtis Burkhardt, director of sales and marketing at Surecall

capacity and the cell signal booster can provide the increased coverage.

DAS and small cells come together indoors

Indoor small cells are expected to grow more quickly than indoor DAS, as operators and building owners look for less expensive ways to boost indoor capacity.

Analyst Joe Madden of Mobile Experts said that even when operators choose to deploy a DAS, they may use small cells as signaling sources.

“The new trend now is, instead of doing one of those big macro base station cabinets as a signal source, they can use a small cell ... with a low power output

to feed into that DAS system and support one sector of the DAS. So now instead of a big rack, you’ve got a little box.”

Madden said that six or seven small cells might fit into the same space previously occupied by a rack of DAS head-end equipment. He added that the small cells do not need to come from a single vendor, and that this can make it easier for a DAS to support multiple operators.

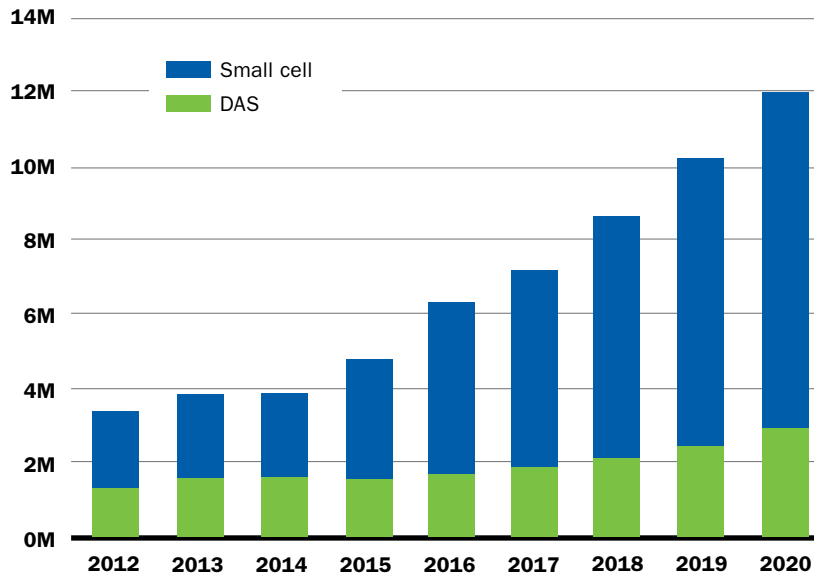
Eliminating large DAS head-ends in high-end buildings is one way to cut the cost of in-building systems. Analyst Earl Lum of EJL Wireless sees remote headend architectures as a convergence of DAS and small cells.

“Today in DAS, the majority of the DAS has to have a head-end room inside the building, which takes up a lot of room and it’s really expensive if the building is in a dense metro area like Manhattan or Chicago downtown or wherever,” he said. “If you can move the head-end room away to some cheaper part of the city and run fiber back to each of the buildings that you want to connect, and have all of the signaling equipment from the operators in that one building, that’s essentially a baseband hotel or a form of C-RAN.” Lum said that Verizon Wireless will use a remote head-end architecture like this to cover the Super Bowl in 2017.

In-building networks and the wireless workforce

As data usage and network deployments move indoors, infrastructure service

In-building radio node shipments



Source: Mobile Experts

providers need new skill sets from the wireless workforce.

“It’s not the guy who’s climbing the towers outside ... it’s more the IT-type competencies basically that are coming into play,” said Greg Rogers, head of Ericsson’s mobile broadband engagement practice. “I need a person who can interconnect the networks, someone who can connect the indoor network to the outdoor network.”

Ericsson hopes to get ahead of the curve by developing skill sets internally, but the company also expects to work with new subcontractors on small cell and DAS deployments.

“What we’ll see is a new set of vendors starting to come in because it is a new set of competencies,” said Rogers. He added that

RF engineers are well-advised to develop an understanding of in-building RF coverage and Wi-Fi, as emerging small cell solutions like Ericsson’s RBS 6402 support both and are expected to work with an enterprise’s existing Wi-Fi plans when deployed.

IT professionals might also be well-advised to learn about RF, but an operator cannot assume that an installer will have RF expertise in-house. Vendors recognize this, and are trying to design solutions with the IT professional in mind.

“What we’re doing is trying to drive toward a platform of solutions that look like and feel like IT-type technologies,” said CommScope’s Philip Sorrells. “An IT technician who is used to doing Wi-Fi or used to setting up computer networks or platforms

– they’ll look at this technology and say, ‘Hey, I get this, and I can install it and run it seamlessly.’” Sorrells added that CommScope’s access points can recognize the required frequency band, meaning that the IT technician does not need to know which access point is for which band.

Outdoor small cells

Outdoor small cells have been slow to take off, and it is clear that not all operators and infrastructure providers agree on the potential here. Within the last year, AT&T has backed off a commitment to deploy 40,000 small cells and SBA Communications has sold its stake in ExteNet Systems, saying that small cells and DAS represent a “lower margin, capital-intensive business” and that the company saw “10, 20, 30 reasons why we simply prefer the macro site business.”

ExteNet was purchased by another tower company, Vertical Bridge, which clearly has a more optimistic view of outdoor small cells and DAS. Tower giants Crown Castle and American Tower also remain bullish on outdoor deployments, and carriers are definitely testing the waters.

Sprint has encouraged vendors with news that it plans to deploy 70,000 strategically located small cells. Verizon is deploying 4,000 small cells in San Francisco. The nation’s largest carrier has earmarked half a billion dollars for small cell deployments this year, and is expected to target Cincinnati, New York and Boston.



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Verizon Wireless is deploying small cells on wooden utility poles in San Francisco.

Fiber is one reason that outdoor small cells are beginning to make economic sense to operators. As more dark fiber becomes available for backhaul, operators are able to plan deployments without trenching streets.

“With the growth of fiber, we are doing a tremendous amount of both outside plant and inside plant fiber work,” said Jeff Ebihara, national director of business development at NB+C. NB+C serves operators primarily on the East Coast, and Ebihara said he sees a lot of outdoor small cell and DAS activity tied to fiber backhaul.

In San Francisco, Verizon was able to leverage dark fiber and utility poles that belong to the public utility. The baseband equipment is housed in an undisclosed remote location, and fiber will connect each small cell to the baseband.

C-RAN architectures like the one Verizon is deploying may be able to significantly reduce the cost of outdoor small cells. Vendors have been working hard to deliver solutions like these in order to jumpstart the small cell market.

“For three years we’ve been chasing technology,” said Surya Bommakanti of Ericsson, Verizon’s small cell vendor for the San Francisco project. “We don’t need to chase technology anymore, we’ve got the technology. What we really need to be figuring out is the most effective deployment model both in terms of the business model as well as just the logistics of creating small cell deployments in the right places. The bottlenecks truly are: sites, backhaul,

Source:



“With the growth of fiber, we are doing a tremendous amount of both outside plant and inside plant fiber work.”

Jeff Ebihara, NB+C

and getting power to those sites.”

Site acquisition costs, power and backhaul are usually cited as the three main constraints that can delay or even derail a small cell project. CommScope’s Philip Sorrells points out that the box has a fourth corner: the potential small cell needs to be carefully evaluated in the context of the overall network before a commitment is made.

“Ultimately at the end of the day, the performance from that small cell ... needs to have a high enough quality level that it really impacts the overall performance of the network without creating interference,” said Sorrells. Rigorous testing is the process that insures that performance.

“Now that we’re adding small cells into

the mix ... we’re adding additional elements into the chain of the backhaul itself, so adding an additional step, adding additional processing, latency, and all this can make achieving the same kind of performance over a small cell more challenging than the macro itself,” said Accedian’s Scott Sumner. Outdoor small cells also face more potential interference from the macro network than do indoor small cells, and this adds another important element to the testing process.

“You won’t necessarily have the same vendor for your small cell coverage as the macro, so you have an interop challenge there, far more than with indoor small cells,” said Ixia’s Pierre Lynch.

Before small cells even hit the streets, they undergo extensive testing in the lab. Engineers need to test small cell interactions with user equipment and with the operator’s core network.

“We ... test a small cell from both sides,” said Lynch. “We’ll simulate the subscribers over the radio interface ... and then conversely we’ll sandwich that test and replace the EPC and everything behind it to make the test easier and more manageable and repeatable.”

Vendors agree that small cell technology is ready for prime time outdoors. Now the challenge is finding affordable ways to get the show on the road. Operators can identify the network hot spots that could benefit from a small cell, but getting that site deployed can be an arduous process.

“A lot of that is going to hinge on



“It’s probably going to go through several iterations of trial and error.”

Steve Kemp, CommScope

whether there is actual real estate there to put something,” explained Steve Kemp, CommScope’s manager of small cell site solutions. “It’s going to have to fit in with the environment. There is going to be a permitting process. It’s probably going to go through several iterations of trial and error vis-à-vis the photo simulations that have to be done to see if everybody’s going to be happy with the look and feel.”

Kemp said that site acquisition and development costs are among the expenses that may be underestimated when a small cell project is first evaluated. He said operators are finding that the cost of equipment, installation and site development are all comparable.

RCR Editorial Webinar:

DAS and Small Cell Update



Featuring *Pierre Lynch, Lead Technologist of Ixia's Product Management Team*

With traffic from mobile devices growing faster than the Earth's population, operators worldwide face massive opportunity. Small cells and distributed antenna systems (DAS) are an efficient and economical solution for enhancing the customer experience, improving retention, slashing cost, and unlocking new revenues.

“ Small cells will carry nearly half of all mobile network data traffic by 2016, and . . . offload more than 200 exabytes of data per year by 2017¹

By 2020, SNS Research predicts HetNets will account for more than \$350 billion in mobile data service revenues² ”

Watch Ixia's Pierre Lynch discuss small cell testing strategies and ramifications

RCR Editorial has supported this report by running a webinar with industry experts on the DAS and small cell market. In this webinar:

- Learn about current metro cell deployments
- Learn how to determine the cost of small cells
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- **Raymond Hild**, Vice President, North America, Galtronics

¹ Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2012–2017

² Signals and Systems Market Intelligence and Consultancy Solutions, The HetNet Bible (Small Cells and Carrier WiFi) – Opportunities, Challenges, Strategies and Forecasts: 2013 – 2020 © 2013 SNS Research

“Proportionately it’s probably a third equipment, a third installation and then probably a third everything else, like three times through the permitting cycle at \$3,000 a throw,” he said. “So there’s quite a bit of money that is everything else.”

“Everything else” can be managed best by upfront planning. Vendors are working hard to help operators with this process. Nokia and Alcatel-Lucent (which are planning to merge) have both developed databases that using mapping technology to help carriers cross network hot spots with locations that could support small cells. The databases catalog supporting structures like utility poles, as well as the availability of power, backhaul, and potential problem structures like gas lines.

Outdoor DAS

Some industry veterans say that outdoor DAS was conceived by an executive who was frustrated because he could not get a signal on his drive home from work through Topanga Canyon in Los Angeles. For years, outdoor DAS has been a steady part of the wireless landscape without ever seeing breakout growth. Nor is outdoor DAS expected to take off in the years ahead.

Roughly 30,000 outdoor radio nodes are shipped each year, according to analyst Joe Madden of Mobile Experts. Madden estimates that more than half the nodes currently deployed are remote radio heads made by equipment vendors like Ericsson and Alcatel-Lucent.

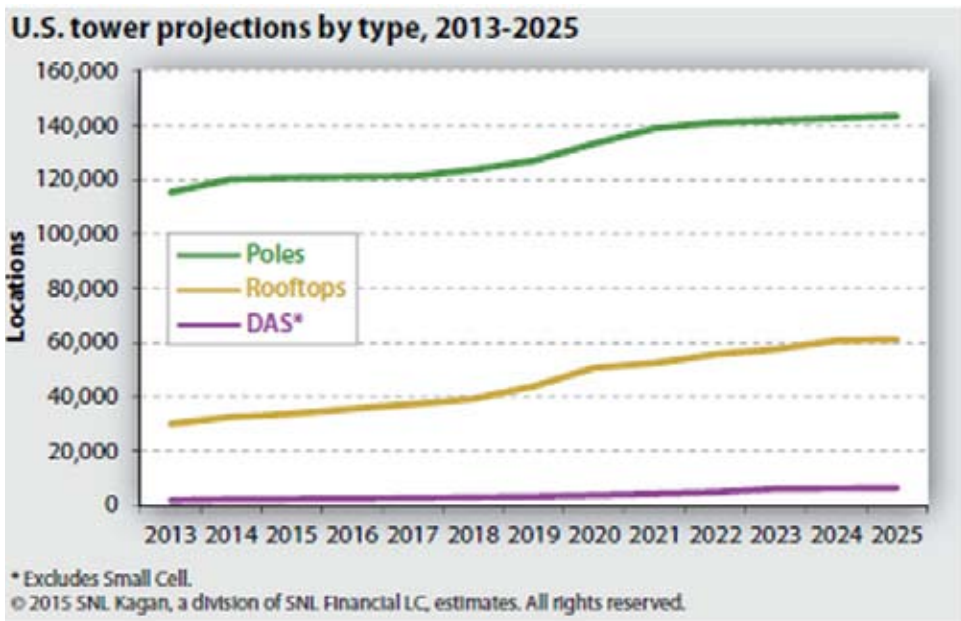
“Over the past few years, the architecture has migrated from DAS nodes (which can be seen as a higher power version of the amplifier in an indoor DAS node) to remote radio heads,” said Madden. “A remote radio head includes the digital processing for up/down conversion, as well as CPRI-based operational/maintenance features which help the major OEMs and operators to manage and maintain the system. Remote radio head units generally work more seamlessly with the macro network.”

Even when a radio equipment maker supplies the DAS node, traditional DAS vendors will supply antennas and cable for a typical outdoor deployment. Antenna vendor Galtronics said that these equipment makers can expedite

the zoning and permitting processes by creating form factors that can accommodate several RF configurations. If a zoning entity approves a form factor, it can be used repeatedly for different deployments within the approved area.

Some urban DAS deployments call for non-traditional antennas, or for concealment solutions that can disguise antennas as part of the landscape.

“We were approached by a major tower company to come up with a whip-type antenna, a 2-inch and 4-inch whip,” said Ray Hild of Galtronics. “Because at some point in time in this massive urban jungle you run out of places to put things, zoning or otherwise. It’s important that the OEM be receptive and creative.”



Source: SNL Kagan

Backhaul for outdoor DAS and small cells: Operators focus on fiber

Outdoor small cell and DAS backhaul solutions include point-to-point fiber, point-to-multipoint fiber, microwave and Ethernet over copper (DSL). The most cost effective deployments are often those that leverage existing fiber.

Even the wireless carriers that are deploying fiber-to-the-home may turn to other providers for dark fiber.

“Getting dark fiber out there, getting the small cells in there, that’s the direction we’re headed,” said Verizon Wireless’s Brian Mecum, VP-Network for the western United States. “That’s what’s going to give us our ability to deliver to our customers on the promise of reliability.”

Dark fiber is fiber that is not currently in use (lit). Infrastructure providers often lay more fiber than a given project requires in order to avoid the expense of trenching twice. The extra fiber becomes an asset that they hope to “light up” for customers in the future.

Major owners of dark fiber in the United States include Zayo, American Fiber Systems, Lighttower Fiber Networks, Level 3 Communications, Allied Fiber, and CenturyLink. Regional fiber owners include Alpheus Communications, Birch Communications, PEG Bandwidth, Lumos Networks, FirstLight Fiber, and Unite Private Network.

Several other companies are quickly becoming major owners of fiber. Verizon and AT&T are both deploying fiber to support

their high-speed Internet offerings. Google Fiber is currently live in Austin, Kansas City and Provo, with Charlotte, Raleigh-Durham, Atlanta, Nashville, Salt Lake City and San Antonio next on the list. Tower giant Crown Castle has recently become a significant fiber owner through its acquisitions of Sunesys, Access Fiber Group and 24/7 Mid-Atlantic Network.

“Fiber is the horizontal tower,” said Crown Castle CEO Ben Moreland. “Small cells are fed by fiber. So we are typically building fiber-based systems that are brought back to a hub site where they have all the ... base stations. On occasion though, we have found it to be more attractive, more economically efficient, to actually acquire some fiber instead of building.”

Conclusion

The distinction between DAS and small cells is blurring as operators deploy indoor small cells that include antennas but not modems, and DAS remotes outdoors that are actually remote radio heads. Mobile operators, municipalities and enterprise customers are all less focused on categorizing solutions than they are on solving specific problems, and throughout the ecosystem there is agreement that each connectivity issue is unique. Vendors are learning that individual problems require customized solutions, and that it helps to have a variety of tools in the toolkit. To that end, savvy vendors are acquiring new skill sets and even acquiring competitors to broaden their offerings.

Vendors see tremendous opportunities in-building, but growth hinges on the development of new business models. In short, building owners and enterprises need to help fund wireless equipment if they want more cellular capacity in their buildings. These customers are already investing in cell signal boosters and Wi-Fi access points, but DAS and small cell vendors hope to see this extend to their equipment as well. Fortunately, new network architectures such as the centralized radio access network have the potential to make solutions more affordable for building owners.

Outdoor DAS and small cells will continue to be funded primarily by the wireless carriers. Verizon Wireless and Sprint have both made commitments to new outdoor small cell deployments this year. Again, the centralized radio access network is emerging as a cost-effective architecture, with Verizon Wireless choosing this approach in San Francisco.

Analysts and operators remain split on the long-term outlook for small cells and DAS. Some see these deployments rivaling macro sites within a few years, while others are convinced that DAS and small cells will both remain niche markets, and that operators will only deploy strategically to address discrete network problems. Even if the second scenario plays out, the demand for mobile data could create enough “network problems” to necessitate widespread deployments of small cells and DAS. ((☺))

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jonathan.polon@brivo.com
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Broadband T Corporation

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www.broadband-t.com

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1360 Energy Park Drive, Ste. 210
St. Paul, MN 55108
Contact: Bill Buell
651-225-0793
bbuell@buellconsulting.com
www.buellconsulting.com

Building Technology Solutions

Service Company

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Jackson, NJ 08527
Contact: David Williams
848-223-5240
d.w@btsus.net
www.btsus.net

1 to 100 Gbps wireless links with mobile self-contained outdoor/indoor data storage/carrier switch micro-modular units along with providing network infrastructure engineering expertise.

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info@buzbcorp.com
www.buzbcorp.com

BuzB offers detailed field mapping service for all tower structures of any make and model, including guyed tower, self-supporting towers, monopoles and water tanks. BuzB covers the Midwest and Mid-South, from Minnesota to Arkansas and from Kansas to Ohio.

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www.byers.com/about.html

Byers provides outside and inside plant design, planning, project management, inspection, and right of way acquisition services, both wireline and wireless, for RBOCs, ILECs, CLECs, IXCs, utilities, cable television companies, and commercial organizations throughout the United States.

C Squared Systems, LLC

Service Company

65 Dartmouth, Unit A3
Auburn, NH 03032
603-644-2800
siteportal.sales@csquaredsystems.com
www.c2siteportal.com

C Squared Systems, LLC (C. Systems) is an RF engineering and consulting company specializing in providing services for complete wireless coverage from RF analysis to design and implementation to monitoring support. SitePortal., a customizable web-based software, was engineered by C. Systems to remotely monitor and manage complex multi-vendor environments. More than just alarming, SitePortal. delivers a complete management solution to view notifications, system parameters, and reports with the ability to troubleshoot devices directly from your laptop.

Caldwell Compliance

Consulting Company

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www.caldwellcompliance.com

Caldwell Compliance brings unparalleled expertise managing FCC/FAA regulatory compliance for wireless site construction. We ensure compliance is taken care of 100%, so our clients can focus on developing a competitive network of audit-proof sites.

Caltrop

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Rancho Cucamonga, CA 91730
480-241-6363
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www.caltrop.com

Caltrop's workforce has a solid reputation for completing large, complex wireless network projects throughout the country. Their multi-disciplinary team of professionals applies a broad range of experience to provide a streamlined approach to workflow management that generates significant cost savings through reduced deployment time and cost. With Caltrop as your single source for turnkey services, you can count on true value-added services.

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tonym@capitaltower.com
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Carpenter Consulting Group

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Contact: Don Carpenter
585-370-9516
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Wireless Site Development company, providing site acquisition, A&E & construction management services.

CBM of America Inc.,

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www.cbmusa.com

CBM of America, Inc., has been an innovator and niche provider of Network Solutions and Custom Network Products for the Telecom Industry for over 20 years. We specialize in networking products and solutions that provide seamless IP migration of legacy protocol interfaces, such as BX25 & X25.

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www.cellularspecialties.com

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Service Company

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www.centerlinesolutions.com

Centerline Solutions is a full turn key wireless services company. We help design, build, modify and maintain wireless networks.

CES Network Services, Inc.

Service Company

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P.O. Box 810256
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Contact: Chester Manfred
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Voice, Data & Video MAN / LAN / WAN System Integrator Consultant. CES provides professional consulting, planning, design, and construction phase services for multi-user facilities nationwide.

CIC

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Circlepoint Technology specializes in the development and implementation of network infrastructure for wireless carriers and large wireless infrastructure providers. Circlepoint offers its customers fully integrated network solutions specializing in site acquisition, architectural and engineering design, construction, equipment installation, testing and commissioning services. We promise to evaluate your individual needs to bring the most value to your wireless communication requirements.

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CIS Communications is based in St. Louis and provides site development (site selection, lease space and purchase negotiation, architectural and engineering drawings, due diligence, zoning approval and permit coordination including UMTS and LTE upgrade coordination) construction management and rooftop management services.

Civil & Environmental Consultants

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615-333-7797
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www.cecinc.com

Civil Solutions Incorporated

Service Company

www.csicommunications.com

Civil Solutions Incorporated is a full turnkey company established in 2001 providing comprehensive single source solutions to identify, lease, permit, design, construct, implement, and maintain wireless networks Nationwide.

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Carol Stream, IL 60188

Contact: GM Sadat

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gmsadat@concordiawireless.com

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535 Middlefield Road, Ste. 280

Menlo Park, CA 94025

Contact: Wendy Har

855-250-5082

info@daliwireless.com

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Contact: Elizabeth L. Kohler

802-846-8382

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Dynamic Environmental Associates, Inc

Service Company

PO Box 7058

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877-968-4787

DJermakian@DynamicEnvironmental.com

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Dynamic Environmental Associates, Inc. provides full-service, results oriented, environmental consulting to our clients with complete solutions for their environmental issues. By following our core principles: Experience, Commitment, Quality and Innovation, DEA has achieved recognition from both the tower industry and competitors alike as being leading experts in environmental assessment and compliance. For twenty years Dynamic Environmental Associates has been providing the tower and telecommunications industry with thorough and efficient professional environmental services.

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Service Company

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info@earthcom.us

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Earthcom is a full-service provider of wireless services including OSP, DAS/ODAS and cell site construction & maintenance.

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Contact: Marty Halliday

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Eastpointe Industries is a Tower and Structural Components Manufacturer. Located in Muskogee Oklahoma supplying Self Support, Guyed Towers. Manufacturing a wide range of tower modification materials.

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Ehresmann Engineering, Inc. is a tower engineering and manufacturing company. We have been in the Telecommunication Industry since 1983, have engineering staff with over 100 total years of tower engineering experience. We have performed thousands of analysis on numerous types, and heights of towers with various manufacturers. We offer a full line of towers: guyed and self-supporting towers, 3 and 4 legged towers, monopoles, flagpoles, monopines, cross poles, and other concealment solutions. Our 77,000 sq. ft. facility is conveniently located in the center of the US which enables us to provide short shipping times to both coasts. We have provided services in all 50 states, Puerto Rico, and in countries around the world.

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EMF Telecom, Inc. is a veteran owned and run business founded in 2005. We specialize in tower, property and site acquisition services with offices in Nashville, TN, Columbus, OH and Orlando, FL.

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www.engineeringassociates.com

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Environmental Corporation of America

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770-667-2040

marvin.webster@eca-usa.com

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ECA is an environmental, geotechnical, and NEPA/SHPO regulatory consultant specializing in wireless telecommunications. Its staff of engineers, scientists, historians and archaeologists has processed thousands of wireless facilities throughout the United States under the FCC NEPA rules and the EPA Phase I AAI and ASTM standard.

Environmentex

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At Ericsson we use innovation to empower people, business and society. We envisage a Networked Society that is sustainable, and where everything that can benefit from a connection will have one. Our mobile and fixed networks, multimedia solutions and telecom services make a real difference to people's lives, and the world we live in.

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mnorris@express-tek.com

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ExteNet Systems

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Lisle, IL 60532

Contact: Manish Matta

630-505-3800

mmatta@extenetsystems.com

www.extenetsystems.com

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Contact: Joe Derry

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joe.derry@faulkandfoster.com

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Faulk & Foster provides real estate solutions for wireless and wireline network development, renewable utility infrastructure, and commercial mortgage lending.

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St. Louis, MO 63105

Contact: Amy Jokerst

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ajokerst@fdh-inc.com

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Contact: Lindsey McElhatten

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Contact: Eileen Hastings

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Fiorio Communications Consulting

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240-793-2110

pf@fiorio.com

FirstCarbon Solutions

Service Company

FirstCarbon Solutions

Irvine, CA 92602

Contact: Jeffrey Shamas

714-508-4100

jshamas@firstcarbonsolutions.com

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Contact: David Oberholzer

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david.oberholzer@us.fujitsu.com

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Fujitsu Network Communications Inc. is a market-leading provider of communications network equipment and services. The company also offers multivendor solutions for the design, implementation, migration, support, and management of wireless and optical networks.

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Contact: Jeff Latzko

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GlenMartin Holding Co, LLC

Service Company

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Contact: Marie Velazquez

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GlenMartin is a Global leader in the telecommunications industry. Specializing in infrastructure development of support structures and network connectivity for a wide variety of telecommunications and utility solutions. GlenMartin designs, installs, upgrades, services (L&A) and provides maintenance to new or existing telecom sites. Financing options including built-to-suit lease options and full ownership. Our products and services provide end to end solutions for our customers most difficult challenges.

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6400 International Pkwy, Ste. 1000

Plano, TX 75093

Contact: Scott Pickett

942-406-9692

spickett@goodmannetworks.com

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Contact: Paul Tomerlin

210-521-8088

paul.tomerlin@grangertelecom.com

grangertelecom.com

Grapevine Solutions

Service Company

Grapevine Solutions

Lenoir City, TN 37772

Robert Hadigian

sales@grapevinesolutions.com

grapevinesolutions.com

Grapevine Solutions provides technology consulting, vendor evaluation, tower service, construction management and NOC services. Our philosophy is you don't need to be a tier 1 service provider to be treated like one and our experience is from the top of the tower to the boardroom.

Graybar

Service Company

34 N. Meramec

St Louis, MO 63105

Contact: Heather Delz

407-835-4521

heather.delz@graybar.com

www.graybar.com

Green Mountain

Service Company

702 Riverwood Drive

Pembroke, NH 3275

603-717-7117

w.solutions@greenmtncomm.com

www.greenmountaincommunications.com/

Green Mountain is equipped to engineer, install, and furnish wired/wireless systems in the northeast covering site acquisition, indoor/outdoor DAS, Wi-Fi, small cells, wired/wireless backhaul, tower services and optical networking.

Green Mountain

Service Company

702 Riverwood Drive

Pembroke, NH 03275

Contact: Catherine Drouin

603-717-7117

w.solutions@greenmtncomm.com

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Green Mountain is the source for integrated wired/wireless communication solutions for businesses in the northeast. Our end-to-end solutions are customized to meet your entire portfolio of

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GSS

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Urbandale, IA 50322

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sjblazenko@gssmidwest.com

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GTL (USA) INC.

Service Company

5200 Tennyson Pkwy., Ste. 200

Plano, TX 75024

Contact: Raj Kunwar Singh Chhabra

info@gtlamericas.com

www.gtlamericas.com

GTL is a leading network services provider. Our services include Network Design & Optimization, Site Acquisition Services, Micro Network Solutions, Professional (Staffing) Services, Network Operations & Maintenance Services and Customer Experience Management Solutions.

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Contact: Adam Biesecker

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Contact: Tim Haley

thaley@heartlandnetworks.com

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Contact: Bob Dundon

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Henkels & McCoy has helped customers deal with their changing communications infrastructure needs from source to end user since 1923. We perform work for telephone companies, carriers, wireless providers, government agencies, utilities, educational institutions, and the private sector on projects of every scale. With wireless capabilities that span 4G rollouts and complex DAS installations to structural analysis and tower modifications, our wireless network solutions incorporate safety, quality, on-time performance, and effective program and cost management.

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Contact: Brad Gannon

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Service Company

www.huawei.com/us

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Service Company

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Charlotte, NC 28273

Contact: Bill Burress

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info.na@hubersuhner.com

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Hutton Communications

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2520 Marsh Lane

Carrollton, TX 75006

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ID Construction Services LLC

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Ingeuity Industries, Inc.

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Contact: Matthew Younce

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matthew@bondwasher.com

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We provide specialized Washers for Bonding & Grounding with PIM reduction at the Ground Bar. We meet DAFARS Specifications and are an all USA Product.

INOC

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Northbrook, IL 60062

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www.inoc.com

INOC provides outsourced 24x7 NOC support for wireless networks for Neutral Host Providers, Integrators and Carriers. INOC can help improve network availability and reliability. As a seasoned NOC services provider INOC brings 14 years of continuous NOC support experience to bear on and help to improve client's operational workflow.

InSite Wireless Group

Service Company

1199 North Fairfax St, Ste. 700

Alexandria, VA 22314

703-535-3009

www.insitewireless.com

Ira Wiesenfeld & Associates

Service Company

7711 Scotia Drive

Dallas, TX 75248

Contact: Ira Wiesenfeld, P.E.

214-707-7711

iwiesenfel@aol.com

www.IWA-RADIO.com

Consulting firm that is involved with the design, installation, maintenance and training on radio, paging, and other communications systems.

Isotrope

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503 Main St.

Medfield, MA 02052

508-359-8833

riggs@isotrope.im

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Isotrope offers municipalities and industries total support in design, specification, evaluation and construction of wireless facilities. The company provides expert testimony, zoning assistance, coverage mapping, project management, RF design.

IVI Telecom Services

Service Company

55 W. Red Oak Lane

White Plains, NY 10604

(914) 694-9600

telecom@ivi-intl.com

www.ivi-intl.com

IVI Telecom Services offers a wide spectrum of environmental services for nationwide telecommunications infrastructure development ranging from environmental site assessments to FCC and NEPA screenings and Section 106 consultations. At IVI, specialists understand your program and schedule constraints and use their expertise to help you realize your goals in a cost-effective and timely manner.

JTS

[Service Company](#)

**5310 S. Cockrell Hill Road
Dallas, TX 75236
972-620-1435 x.140
sales@jts.net
www.jts.net**

JTS is a systems integrator, specializing in wireless infrastructure. We perform turn-key design, installation, and maintenance of microwave backhaul, Wi-Fi, and WiMAX networks.

Kathrein USA

[Service Company](#)

**Greenway Plaza II
2400 Lakeside Blvd., Ste. 650
Richardson, TX 75082
Contact: Capriccio Martin
214-238-8800
sales@kathrein.com
www.kathrein.com**

KCS

[Service Company](#)

**1125 Remington Road
Schaumburg, IL 60173
847-490-8200
m.sethi@kcscorp.com
www.kcscorp.com**

Kenwood Telecom

[Service Company](#)

**3431 Novis Pointe
Acworth, GA 30101
888-439-0500
sales@kenwoodtelecom.com
www.kenwoodtelecom.com**

Manufacturer of tower site infrastructure steel and accessories such as sector frames, ice bridge kits and cable support accessories. Product engineering, development and improvement.

KGI

[Service Company](#)

**Building Three, Ste. 370,
805 Las Cimas Parkway
Austin, Texas 78746
Contact: Mike Kampen
512-345-9595 Ext 210
www.KGIWireless.com**

KGI offers over 16 years of specialized wireless real estate experience, expanding our Inbound Collocation Services operations to a national workforce of 45 employees and contractors. Our site portfolio now includes 20,000 wireless sites (towers, and prime retail sites) in 9,000

cities/50 states. In 2011, KGI initiated our Site Acquisition Group, which has successfully supported 1,000+ projects including UMTS and LTE upgrades, new sites, DAS installations, antenna modifications and regulatory compliance.

KGP Companies

[Service Company](#)

**3305 Hwy 60 West
Faribault, MN 55021
800-755-1950
contactkgp@kgpte.com
www.kgpcompanies.com**

KGP Companies, including both KGP Logistics and BlueStream Professional Services, is a value-added supplier of supply chain services, communications equipment and integrated solutions to the telecommunications industry. With a national logistics network and a complete portfolio of manufacturer partnerships, KGP Companies is uniquely positioned as the solutions provider of choice.

KGP Logistics

[Service Company](#)

**3305 Hwy 60 West
Faribault, MN 55021
800-755-1950
contactkgp@kgptel.com
www.kgplogistics.com**

KGP Logistics is one of the country's largest single-source; value-added suppliers of supply chain services, communications equipment and integrated solutions to the telecommunications industry. With a diverse and valued customer base, a national logistics network, and a portfolio of manufacturer partnerships that is second to none, KGP Logistics is well positioned to provide unique products and services to solve critical deployment needs.

KMB Design Group

[Service Company](#)

**1800 Rt 34, Ste. 209
Wall, NJ, 07719
Contact: Stephen Banks
732-674-2989
sbanks@kmbdg.com
www.kmbdg.com**

KMB Design Group, LLC is a provider of turnkey engineering, construction and project management services. KMB specializes in the design and deployment of complex projects for telecommunication providers across the nation covering terrestrial wireless, satellite, public safety, microwave backhaul and DAS. KMB has offices in New York, Boston, Chicago, San Francisco and Dallas.

KMM

[Service Company](#)

**9 Law Drive, Ste. 13
Fairfield, NJ 07004
Contact: Sarah McNab
973-244-1262
info@kmmcorp.net
www.kmmcorp.net**

KMM specializes in providing best-in-class supply chain and logistics services to the U.S. telecommunications industry. Founded in 1991, KMM is a Woman Owned Business Enterprise.

Kohler Power Systems

[Service Company](#)

**6640 Northwest
Kansas City, MO 64151
Contact: Gene Wanger
816-591-6760
gene.wagner@kohler.com
www.kohlerpower.com**

LandSource

[Service Company](#)

**6730 Exchequer Drive
Baton Rouge, LA 70809
225-752-0995
patterson@landsource.com
www.landsource.com**

Lansdowne

[Service Company](#)

**St. Anna Platz 2
50538 Munich
Germany
Contact: Lothar Hessel
lothar.hessel@lansdowneconsulting.com
www.lansdowneconsulting.com**

Law Office of Ronald Tucceri

[Service Company](#)

**6300 Creedmoor Road, Ste. 170-105
Raleigh, NC 27612
Contact: Ronald Tucceri
919-795-2437
ron@rtlaw.net
www.rtlaw.net**

Experienced attorney providing advice in the areas of towers, DAS, small cells and rooftops, including purchases and sales, network deployments, vendors, collocations and securing properties for installations.

Lawrence Behr Associates, Inc.

Service Company

**3400 Tupper Drive
Greenville, NC 27834
Contact: Mike Britner
252-757-0279
lbagrp@lbagroup.com**

www.lawrencebehassociates.com

Provides consulting, test, project management & design services in communication system coverage, RF interference & compatibility matters, electromagnetic shielding, radio frequency safety & collocation of diverse communications facilities. We have broad expertise in regulatory & allocation matters, & radio system coverage & path prediction.

LCC

Service Company

**7900 Westpark Dr. Ste. A300
McLean, VA 22102
703-873-2000
info@lcc.com
www.lcc.com**

LCC, the largest independent telecom services company in the world with local presence in over 50 countries, is a recognized leader in providing consulting and network services to the telecommunications industry. Proudly providing wireless expertise since 1983, we continue to be the thought leader in advanced engineering services and remain committed to offering innovative solutions, insight into cutting-edge developments and delivering advanced networking services to our clients.

Legacy Telecommunications, Inc.

Service Company

**PO Box 360
Burley, WA 98322
Contact: Robert Irving
253-858-0214
bobi@legacytowers.com
www.legacytowers.com**

Diversified Communication Infrastructure Service firm doing construction, maintenance, optimization, microwave, generators, fiber, remote access and multi disciplined diagnostics. Serving the Pacific NW and Rockies.

Lyle

Service Company

**3140 Gold Camp Drive, Ste. 30
Rancho Cordova, CA 95670
Contact: Matt Johnson
916-266-7019
mjohnson@lyleco.com
www.lyleco.com**

Lyle is a leading solutions partner in the wireless industry, and we're focused on creating value by exceeding our clients expectations. Our expertise includes Lease Management & Optimization, Renewable Energy Solutions, Site Development, Collocation Management, Field & File Audits, and Professional Services.

M-Tel

Service Company

**2370 Nash Road
Bowmanville, ON L1C 3K4
www.mtelinc.ca**

Mainline Communications Inc.

Service Company

www.mainlinecomm.com
Mainline Communications Inc. is a leading provider of telecommunication contractual supplier services, through time & expense (T&E) and/or fixed bid contracts, to leading RBOC and CLEC companies nationwide.

Malouf Engineering

Service Company

**17950 Preston Road, Ste. 720
Dallas, TX 75252
972-783-2578
info@maloufengineering.com
www.maloufengineering.com**

MALOUF ENGINEERING INTERNATIONAL, INC. (MEI) was established in 1992 as a consulting structural engineering firm specializing in telecommunication and utility structures and related facility buildings with the goal of providing high level of technical services with personal involvement and attention to our clients' requirements.

Martin Environmental Solutions

Service Company

**8823 San Jose, Ste. 103
Jacksonville, FL 32217
Contact: Heather M. Cucci
904-737-1034
www.martinenviro.com**

MasTec Network Solutions

Service Company

**4401 Northside Parkway, Ste. 600
Atlanta, GA 30327
Contact: Shauncey Mashia
678-925-8301
shauncey.mashia@mastec.com
www.mastecnetworksolutions.com**

Over the course of the last 80 years, MasTec Network Solutions companies have been involved in some of the largest and most complex telecom infrastructure projects across the country. Our experience has given us a deep and comprehensive understanding of the markets we serve, as well as the ability to effectively manage people, projects and equipment. It allows us to proactively identify challenges, avoid pitfalls, and overcome obstacles, and to accurately set and meet expectations for schedule and budget. With offices across the country, a workforce of nearly 2,000 skilled professionals, and an extensive wholly owned fleet of specialized construction equipment, MasTec Network Solutions has the resources needed to reliably deliver quality work for even the most complicated jobs. Our geographic reach, scalability, and overall financial stability enable us to meet each of our customers changing needs on a daily basis. Our core services are the engineering, building, installing, maintaining and upgrading of infrastructure for communications customers, through self-performed work and project management.

Media Venture Partners

Service Company

**244 Jackson St., 4th Floor
San Francisco, CA 94111
415-391-4877**

**info@mediaventurepartners.com
www.mediaventurepartners.com**

Providing strategic counsel and financial services, mergers and acquisitions, private equity and debt raises, valuations and appraisals, Media Venture Partners has completed over \$14 billion in transactions and focuses on clients in the media, telecom, datacenter, renewables and technology industries. Founded in 1987, Media Venture Partners has offices in San Francisco; Kansas City, MO; Boston and Boulder, Colo.

Mejia Telecommunications Company

Service Company

P.O. Box 8504

Coral Springs, FL 33075

Contact: Diego Mejia

787-409-6024

dmejia@mejiatelecom.com

www.mejiatelecom.com

With more than 20 years of experience, we specialized in tower and equipment installation, technology installation (GSM, 4g, LTE, etc.), RF installation, PIM and Sweep Test, AC/DC Equipment auditing, Turnkey projects and Project Management, steel structures supplies.

Message Center Management, Inc.

Service Company

40 Woodland Street

Hartford, CT 06105

Contact: Chris Gelinias

888-973-SITE (7483)

cgelinas@mcmgmt.com

www.mcmgmt.com

MCM is a wireless tower owner, developer, and rooftop site operator throughout the country. Wireless carriers count on MCM, Inc. to deliver premier site locations, including BTS opportunities where and when they need them. Speed, efficiency, and creativity are critical for carrier network development either in new markets or enhancing existing. Look to MCM, Inc. as your site provider to deliver on those critical needs.

Metaswitch Networks

Service Company

201 Potrero Ave

San Francisco, CA 94103

415.513.1500

contact@metaswitch.com

www.metaswitch.com

Metaswitch is powering the transition of communication networks into a cloud-based, software-centric future.

Metro Network Services

Service Company

90 White Street

New York, NY 10013

212-981-0700

sales@metrons.com

www.metrons.com

Metro|NS is managed and operated by the same team who built and sold the Lextent Metro Connect dark fiber optic network in Manhattan and New Jersey. Leveraging our experience constructing a proprietary network and our acute

knowledge of the New York Metro construction and political fields, Metro|NS consults with clients to ensure their networks are optimized and efficient.

Mikab

Service Company

21 Omaha St., P.O. Box 36

Dumont, NJ 07628

201-387-7700

Davidhauck@mikabcorp.com

www.mikabcorp.com

Milestone Media, LLC

Service Company

848 N Rainbow Blvd #680

Las Vegas, NV 89107

303-335-9843

info@milestonemediallc.com

www.milestonemediallc.com

Acquisitions, divestitures, valuations, appraisals, strategic planning - sites, DAS, broadcast, spectrum, cable television, fiber, and publishing.

Millennium Wireless Services

Service Company

3543 Dreher Shoals Road

Irmo, SC 29063

803-661-7282

sales@mws.us.com

www.mws.us.com

Millennium Wireless Services is a southeastern U.S. telecom contractor specializing in cell-site equipment installation and integration devices. Established in 1998, Millennium Wireless Services is a licensed general and electrical contractor and its employees often travel extensively for selected projects. Millennium Wireless Services takes great pride in each and every completed site.

Mosaik Solutions

Service Company

6423 Shelby View Dr., Ste 101

Memphis, TN 38134

901-377-8585

sales@mosaik.com

www.mosaik.com

Mosaik Solutions builds world-class applications backed by comprehensive wireless network intelligence. Make better decisions and attract more customers with accurate datasets and tailored marketing solutions.

Multiwave Sensors

Service Company

8510 Torbram Road, Unit 67

Brampton, Ontario L6T 5C7

Contact: Bruce Clifford

905-458-9060

sales@multiwavesensors.com

www.multiwavesensors.com

MYCOM

Service Company

1080 Holcomb Bridge Rd, Bldg 200, Ste. 350

Roswell, GA 30076

Contact: Virginie Daniel

770-776-0000

virginie.daniel@mycom-usa.com

www.mycom.com

MYCOM is a leading independent provider of carrier-grade Network and Services Performance Management and Advance Engineering Services to the world's largest Communications Service Providers (CSPs). Its products, services and 700 staff are focused on delivering advanced network performance intelligence that enables CSPs to optimize networks, govern suppliers, rapidly launch new technology and services, and deliver high quality customer experiences.

Narda Safety Test Solutions

Service Company

435 Moreland Road

Hauppauge, NY 11788

www.narda-sts.us

National Wireless Ventures LLC

Service Company

1900 West Acre Rd.

Joliet, IL 60435

Contact: Robert Stapleton

847-833-5448

rstapleton@nvw.me

www.nvw.me

Site acquisition services including leasing, zoning, permitting, government relations, special events facility placement (cows/colts) point to point microwave, project management.

NATE

Service Company

8 Second Street SE

Watertown, SD 57201

Contact: Todd Schlekeway

605-882-5865

nate@natehome.com

www.natehome.com

NetNearU

Service Company

6155 El Camino Real

Carlsbad, CA 92009

Contact: Robert Brown

619-955-8128

robert@nnu.com

www.nnu.com

Complete turn-key managed services for WiFi network delivery. From design to ongoing operations and maintenance, NNU can manage the complete network lifecycle.

Network Building + Consulting

Service Company

6095 Marshalee Drive, Ste. 300

Elkridge, MD 21075

Contact: Jeff Ebihara

616-218-9444

jebihara@nbcllc.com

www.networkbuilding.com

Founded in 1984, NB+C is a leading wireless site development firm comprised of three business units: Site Development, Engineering Services and Construction + Technical Services. We are staffed with over 300 professionals who are totally committed to client service and project results.

NexGen Utility Solutions LLC

Service Company

2050 Marconi Drive Ste. 300

Alpharetta, GA 30005

404-403-8149

cwood@nexgenusa.com

www.nexgenusa.com

NexGen Utility Solutions is a provider of device installation solutions and technical resources to leading energy utilities, communications companies and OEM device manufacturers throughout the United States. Our company implements, builds and supports America's infrastructure.

Nexius

Service Company

www.nexius.com

Nexius delivers end-to-end wireless services to leading carriers, and business intelligence solutions to data-driven industries. With over a thousand dedicated professionals, Nexius provides a full range of services in Network Deployment, Network Engineering, Technology Services, Network and Business Intelligence Solutions. Founded in 2001, Nexius has become one of the fastest growing telecom solutions providers by delivering innovative solutions and project success.

Noble Engineering Consultants

Service Company

123 E. Railroad St.

Flora, IL 62839

618-662-5800

eseals@nbleng.com

www.nbleng.com

Nokia Solutions and Networks

Service Company

6000 Connection Drive

Irving, TX 75039

Contact: Pepe Lastres

pepe.lastres@nsn.com

www.nsn.com

Nokia Solutions and Networks (NSN) provides the world's most efficient mobile networks, the intelligence to maximize network value, and the services to make it all work seamlessly.

OMNI-WiFi, LLC

Service Company

70 Sullivan Street

Berwick, MD 3901

800-610-6711

sales@OMNI-WiFi.com

www.OMNI-WiFi.com

OMNI-WiFi manufactures wireless equipment -- transmitters, repeaters, and client-premises equipment that delivers among the most powerful, longest range, and highest quality 802.11 signals available today.

One Source Freight Solutions

Service Company

One Source Freight Solutions

Tempe, AZ 85281

Contact: Dena Riley

480-525-9055

dena@onesrc.com

www.onesrc.com

We work with clients to create a fully integrated, custom solutions across a broad spectrum of project needs, handling everything from route planning and scheduling through communications and construction. We offer the benefit of true turnkey service, covering materials-ordering to delivery and installation/dismantling.

OptiMoS International

Service Company

6290 Abbotts Bridge Rd. #103

Johns Creek, GA 30097

Contact: Craig Rosenblum

info@OptiMoSInternational.com

www.optimosinternational.com

Provide RF Wireless services for Operator's networks; Macro and In-building (DAS, Small Cells).

Parallel Infrastructure LLC

Service Company

4601 Touchton Rd E, Bldg 300, Ste 3200

Jacksonville, FL 32246

Contact: Ed Myers

904-565-4129

ed@parallelinfrastructure.com

www.parallelinfrastructure.com

Parallel Infrastructure LLC is a national Right-of-Way (ROW) management and infrastructure development company. Parallel Infrastructure invests in and manages rights-of-way, creating significant value for both public and private owners. Headquartered in Jacksonville, Fla., Parallel Infrastructure is a wholly owned subsidiary of Florida East Coast Industries, Inc.

Partner Engineering and Science, Inc.

Service Company

2154 Torrance Blvd, Ste 200

Torrance, CA 90501

Contact: Dan Entler

800-419-4923

dentler@partneresi.com

www.partneresi.com

Partner Engineering and Science, Inc. (Partner) is a full-service environmental and engineering consulting firm completing projects nationwide. We specialize in evaluating properties in connection with real estate transactions, financing, development or management.

Patriot Towers Inc.

Service Company

9332 N 95th Way, Ste. B203

Scottsdale, AZ 85258

480-421-0234

dgray@patriot-tower.com

www.patriot-tower.com

Patriot Tower provides communication infrastructure deployment for Federal, State and Local government agencies. Our services include site acquisition, engineering, procurement and construction. Our wireless team also provides sales and service of radio systems.

Paul J. Ford and Company

Service Company

250 E. Broad St., Ste. 1500

Columbus, OH 43215

Contact: Dave Hawkins

614-221-6679

contact_request@pjfweb.com

www.pjfweb.com

Paul J. Ford and Company is a nationally recognized leader in the design and analysis of lattice towers, monopoles, and design of tower reinforcing systems.

PCTEL Inc, RF Solutions

Service Company

20410 Observation Dr., Ste. 200

Germantown, ME 20876

Contact: Chintan Fafadia

rfs.sales@pctel.com

rfsolutions.pctel.com

PCTEL RF Solutions specializes in the design, optimization and testing of today's wireless communication networks. We develop and build innovative scanning receivers, drive test software, and interference management solutions that help wireless cellular operators get the most out of their wireless spectrum. Our highly-trained engineering services team uses state-of-the-art test, measurement, and design tools to provide engineering services for in-building and outdoor networks. Our commitment to quality, value, and customer service has made PCTEL RF Solutions a trusted vendor for operators worldwide.

Peak Power Services, Inc.

Service Company

www.peakpowerservices.com

Through the years Peak Power employees have held to the belief that its customers deserve more than they expect, as a result, we are currently the primary provider of DC Power, Battery, Tower & RF service and Generator installation and maintenance for AT&T Mobility in the Florida market.

PEG Bandwidth

Service Company

Three Bala Plaza East, Ste. 502

Bala Cynwyd, PA 19004

Contact: Greg Ortyl

610-660-4910

gortyl@pegbandwidth.com

www.pegbandwidth.com

PEG Bandwidth is a provider of customized cell site backhaul and wireless infrastructure solutions for the wireless industry. Whether the challenge is improving network reach and quality, increasing capacity or maintaining cost certainty for the future, PEG Bandwidth's team of wireless experts can deliver a custom-designed, technology- and access-agnostic solution. With a fiber-rich network that provides ackhaul services to 3,000 cell sites across 13,000 fiber route miles, PEG Bandwidth is able to provide its solutions wherever challenging problems exist.

Penn-Tech

Service Company

3 S. Bacon Hill Road, Unit 2

Frazer, PA 19355

484-395-0145

pti@ptii.net

www.ptii.net

Peppertree Capital

Capital Firm

86 West Street

Chagrin Falls, Ohio 44022

Contact: F. Howard Mandel

440-893-0330

hmandel@peppertreecapital.com

www.peppertreecapital.com

Peppertree Capital is a private equity firm focused on wireless telecom infrastructure. Its partners have founded or invested in 17 tower companies dating back to 1997.

Phillips Lytle LLP

Legal Services

3400 HSBC Center

Buffalo, NY 14203

Contact: Douglas W. Dimitroff

716-847-5408

ddimitroff@phillipslytle.com

www.phillipslytle.com

Phillips Lytle is a corporate and commercial law firm with a dedicated Telecommunications Industry Team. This multi-disciplinary team of attorneys handles representation on a full range of transactional, operational, regulatory and litigation matters including asset purchases and sales; site leasing work; zoning and land use; service, interconnection and right of way contracts. In addition, the Team is involved with acquisitions, IPOs, lender financings and venture capital funding. We represent some of the world's largest telecommunications companies, regional providers, site owners, as well as lenders and investors across the United States.

Phillips Lytle LLP

Legal Services

One Canalside, 125 Main Street

Buffalo, NY 14203

Contact: Douglas W. Dimitroff

716-847-5408

ddimitroff@phillipslytle.com

www.phillipslytle.com

Phillips Lytle is a corporate and commercial law firm with a dedicated Telecommunications Industry Team. This multi-disciplinary team of attorneys handles representation on a full range of transactional, operational, regulatory and litigation matters including asset purchases

and sales; site leasing work; zoning and land use; service, interconnection and right of way contracts. In addition, the Team is involved with acquisitions, IPOs, lender financings, and venture capital funding. We represent some of the world's largest telecommunications companies, regional providers, site owners, as well as lenders and investors across the United States.

PierCon Solutions

Service Company

63 Beaver Brook Road, Ste. 201

Lincoln Park, NJ 07035

973-628-9330

jennifer.hagin@piercon.net

www.piercon.net

Phoenix Telecom Solutions

Service Company

3200 El Camino, Ste. 200

Irvine, CA 92602

Contact: Michael Johnson

714-602-3370

mjohnson@phoenix-ts.com

www.phoenix-ys.com

PORTER Site Concealment

Service Company

164 Malbert St Building B

Perris, CA 92570

951-940-9090

porter@porterrf.com

porterrf.com

Custom fabrication of RF transparent concealment products including architectural structures, specialty towers and radomes. We ship our products anywhere in North America. Design and Engineering or build to specification.

Powder River Development Services, LLC

Service Company

219 S Wooddale Avenue

Eagle, Idaho 83616

Contact: Andrew Dewhirst

208-938-8844

drew.dewhirst@powderriverdev.com

www.powderriverdev.com

Powder River Development Services, LLC was formed in 2003 by owners Patrick Campbell and Andrew Dewhirst. We provide the wireless industry our expert services for site acquisition, zoning, permitting, project management, architectural & engineering, structural services, and construction management. We employ knowledgeable team members who perform their tasks in a timely manner, at a competitive price and to the satisfaction of our clientele.

Power & Tel

[Service Company](#)

**2673 Yale Avenue
Memphis, TN 38112**

**Contact: Keith Cress
800-238-7514**

**marketing@ptsupply.com
www.ptsupply.com**

Professional Teleconcepts, Inc.

[Service Company](#)

**P.O. Box 311
Norwich, NY 13815**

**Contact: Stephen T. Marshall
www.pro-tel.com**

Professional Teleconcepts, Inc. (Pro-Tel) is a wholly owned subsidiary of Dycor Industries, Inc. (NYSE: DY). Pro-Tel specializes in turnkey ISP infrastructure services to carriers, OEMs, and enterprise clients throughout the United States. Projects may encompass design, procurement, installation, and testing/commissioning services.

ProMobility Inc.

[Service Company](#)

**40 East Pearce Street
Richmond Hill, ON**

**L4B 1B7
289-695-9595**

**pvan@promobility.com
www.promobility.com**

Wireless Device Lifecycle Management
Services Provider

Qualcomm

[Service Company](#)

**5775 Morehouse Dr
San Diego, CA 92121**

**Contact: Vaidehi Puntambekar
858-651-9300**

**vaidehip@qti.qualcomm.com
www.qualcomm.com**

Quantum Group, LLC

[Service Company](#)

**15130 Broadmoor Street
Overland Park, KS 66223**

**Contact: Philip S. Brown
913-239-9303**

**pbrown@qmerge.com
www.qmerge.com**

Quantum Group is an independent, privately-owned mergers and acquisition firm that provides sell-side advisory services for tower and cellular rooftop owners. Quantum has successfully completed over 600 tower/rooftop/spectrum transactions in the last 16 years, making us

#1 in the industry. Philip S. Brown is the President and CEO of Quantum which is based out of Overland Park, KS, with a satellite offices in Los Angeles, CA.

RAI Wireless LLC

[Service Company](#)

**5 International Drive
Deptford Township, NJ 08080**

**Contact: Mike Foss
856-228-5566**

**mfoss@raiservices.com
www.rayangelini.com**

Team of professionals providing full suite of scalable solutions and services for communications networks, including construction and technical services, tower upgrades, project management, RF Engineering.

Raymond James Financial

[Capital Firm](#)

**880 Carillon Parkway
Saint Petersburg, FL 33716**

**Contact: Justin Cadman
727-567-5102**

**Justin.Cadman@raymondjames.com
www.rjcapitalmarkets.com**

Raymond James Financial is a financial services holding company with subsidiaries engaged primarily in investment and financial planning, capital markets, and asset management. Since 2009, Raymond James has participated in raising nearly \$400 billion in capital for our corporate clients. During this same time, we completed more than 170 advisory assignments, including over 140 M&A buy-side or sell-side advisory assignments with transaction values totaling over \$14 billion. More than 6,200 financial advisors serve more than 2.4 million accounts in more than 2,600 locations throughout the United States and internationally.

RBC Capital Markets

[Capital Firm](#)

**3 World Financial Center
200 Vesey Street, 8th Fl.
New York, NY 10281**

**Contact: Nick Stevenson
212-428-6405**

**nick.stevenson@rbccm.com
www.rbccm.com/communications**

RBC Capital Markets is a premier investment bank which provides comprehensive equity and debt financing products and M&A advisory to the tower and telecom infrastructure industry. According to Bloomberg and Dealogic, we ranked among the top 10 global investment banks for 2012. We

are part of Royal Bank of Canada (RBC). Operating since 1869, RBC is among the top 15 largest banks in the world and the fifth largest in North America, by market capitalization.

Red Wing Enterprises

[Service Company](#)

**15 Daniel Road East
Fairfield, NJ 07004**

**Contact: Maria Morris
973-276-0056**

**mmorris@redwingelectric.com
www.rwellc.com**

Red Wing Enterprises is a licensed electrical contractor and a full service provider of telecom infrastructure services to carriers, OEMs, tower owners, etc. RWE offers site audits, RF engineering, site acquisition and self-performed construction services in addition to being an emergency and disaster recovery provider.

RETEL Services

[Service Company](#)

**Contact: Theresa Sharp
423-596-4444**

**theresa.sharp@retelservices.com
www.retelservices.com**

RETEL Services is a full turnkey solution, including our exclusive RevG certified composite pole, providing quality and care to every endeavor to ensure success.

RF Consulting Services

[Service Company](#)

**P.O. Box 72350
Marietta, GA 30007
770-310-7557**

**ted@rfconsulting.com
www.rfconsulting.com**

RF Consulting, PSC

[Service Company](#)

**PMB 299, 220 Plz Western Auto Ste. 101
Trujillo Alto, PR 976**

**rfc@rfconsultingpr.com
www.rfconsultingpr.com**

RF Consulting is the leader in radio frequency safety compliance, interference hunting and in building design.

RJE Telecom, LLC

Service Company
rjetelecom.com

We increase our customers' operating flexibility by providing service personnel in the areas where they lack the capacity or forces to meet both their day to day and peak demands. We will positively impact your bottom-line by providing professionally-managed personnel for all of your telecommunications needs.

RJR Wireless

Service Company
23501 Park Sorrento, Ste. 218
Calabasas, CA 91302-1381
Contact: Rich Reichler
818-222-7483

rjrwireles@aol.com

Since 1998, RJR Wireless has been providing consulting and special-project services for antenna-site managers, owners and users. Contact Rich Reichler at RJRWireles@aol.com. RJR Wireless is a member of PCIA and EWA, and Rich Reichler is a member of the Radio Club of America.

RKC Site Solutions

Service Company
520 W Lake Mary Blvd, Ste. 100
Sanford, FL 32773
Contact: Ken Cox
407-732-7710
nfo@rkcsitesolutions.com
www.rkcsitesolutions.com

ROHN Products

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Global designer and manufacturer of tower, poles and structures since 1948.

RSI (Radiofrequency Safety International) Corp

Service Company
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Contact: Miranda Allen
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Environmental safety services company specializing in RF (radiofrequency radiation) site safety survey and assessments. Site safety plans. In-house, public seminar, and web based RF safety training.

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Saul Ewing LLP is a 250-lawyer firm with 11 offices in Maryland, Massachusetts, Pennsylvania, New Jersey, Delaware, New York, and Washington, DC. Our Telecommunications Group represents providers and purchasers of voice, video, data, and related services, provides counsel on telecommunications systems acquisitions and dispositions; co-venture, vendor and customer

contracts; finance; litigation/zoning strategy and implementation, including zoning and municipal approvals; federal/state permits, regulatory filings and compliance; environmental permitting and litigation; and government relations.

SBA Communications Corporation

Service Company
5900 Broken Sound Parkway NW
Boca Raton, FL 33487-2797
Contact: Lynne Hopkins
800-487-SITE
information@sbsite.com
www.sbsite.com

SBA Communications Corporation is a first choice provider and leading owner and operator of wireless communications infrastructure in North, Central America and South America. By "Building Better Wireless," SBA generates revenue from two primary businesses - site leasing and site development services. The primary focus of the Company is the leasing of antenna space on its multitenant towers to a variety of wireless service providers under long-term lease contracts.

Schwaninger & Associates

Legal Services
6715 Little River Turnpike, Ste. 204
Annandale, VA 22003
703-256-0637
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www.sa-lawyers.net

Schwaninger & Associates provides all legal services required of tower and rooftop operators, with over 20 years' experience negotiating site leases, fulfilling regulatory requirements, representing buyers and sellers, assuring tenant compliance, and providing valuation of tower properties for sale or commercial financing. Robert Schwaninger, co-author of the "Fryer's Market Report" for over five years, is also available to provide expert witness testimony in a variety of site leasing areas. The firm can help whether it's one tower or a thousand. Call today. Schwaninger & Associates makes the difference in the deal.

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SG Services Inc

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**Contact: Serge Gofman
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Shenandoah Tower Service, formed in 1983, is dedicated to setting the standard in the wireless communications industry by providing exceptional construction, maintenance and management services.

Shireen, Inc

Service Company

**12910 Cloverleaf Center Drive
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**Contact: Greg Alberti
301-838-4380**

**Greg@ShireenInc.com
www.shireen.com**

Shireen, Inc. has been providing Global enhancement of wireless infrastructure for over 10 years. Our leading edge technology provides complementary advantages to WiFi, Cellular, Whitespace, SCADA, m2m, UAV, Robotics, Security, and a host of other vertical markets utilizing a wireless platform.

Shive-Hattery/GSS

Service Company

**3025 Highland Parkway, Ste. 140
Downers Grove, IL 60515**

**Contact: James Downey, Shive-Hattery;
Steve Blazenko, GSS
888-282-8039**

**jdowney@shive-hattery.com;
sjblazenko@gssmidwest.com
www.shive-hattery.com; www.gssmidwest.com**

Shive-Hattery provides engineering and architecture services for switch sites, fiber optic networks, personal communication systems (PCS) and communication towers. GSS provides comprehensive environmental management including Phase 1 ESAs, NEPA studies, SHPO consultation and all related services.

Shulman Rogers

Legal Services

**12505 Park Potomac Ave., 6th Floor
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**301-230-5200
info@shulmanrogers.com
www.shulmanrogers.com**

Shulman Rogers is a full-service telecommunications and business law firm. It provides brokerage services, contract negotiations, regulatory filings, dispute resolution and more for tower owners, lessors and lessees. Shulman Rogers is also pleased to announce that Michael Higgs, counsel to numerous tower owners, has joined the firm.

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Site Acquisition Services

Service Company

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Solutelia

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Solutelia provides RF engineering and DAS services and solutions. Solutelia has recently introduced the WINd software platform that addresses some of the wireless industry's most pressing concerns by providing real-time reporting, testing and analysis of network performance using the latest commercially available Android smartphones.

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**Contact: Bryan Besade
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**info@southshorecom.cc
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Squan specializes in turnkey macro, DAS, and small cell site development for telecommunication carriers, tower companies, neutral host providers, commercial landlords, government entities, universities, health care institutions, and other visionary organizations seeking increased coverage and capacity.

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SureSite is a national provider of site development and staffing services to the wireless and telecommunication industries. With offices in Cleveland, Chicago, Denver and Los Angeles and field locations throughout the country including the east, southeast and central regions, we pair our distributed workforce and professional practices with an extensive network of local experts to provide hands-on service at every phase.

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Contact: David Wasserman

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Provider of Site Acquisition including Small Cell Deployments. EF&I services for P to P and P to MP microwave systems.

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Tectonic provides turnkey program management and site acquisition, engineering and construction management from our strategically located offices nationwide. Tectonic, now ranked in the Top 15 by ENR in Telecommunications Tower and Antennae site development, has been providing these services to the telecommunications industry for over 25 years. Tectonic holds Professional Engineering Licenses in 48 states. Our Engineers are supported by our in-house staff of approximately 500; which performs; site audits, leasing/zoning, site design, structural and geotechnical engineering, tower analysis, environmental studies, photo simulations and surveying. Tectonic has provided these services to all of the major carriers, the foremost tower companies and program managers on more than 50,000 new builds and site modifications nationwide. Tectonic's unique model of providing turnkey services with our in house resources permits us to costeffectively respond to both our client's technical and scheduling goals nationally.

Telecom Capital Group

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Contact: Manish Dureja
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www.telecomcapital.com

Wireless communications tower owner and operator throughout the mid-Atlantic with clients including all of the major wireless operators and local service providers.

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Tempest Telecom Solutions, LLC is a leading provider of telecom infrastructure equipment and repair services, helping service providers and network operators build, expand, and maintain their networks faster and more cost-effectively.

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Terracon is a 100-percent employee-owned consulting engineering firm that has provided quality engineering services to clients since 1965. From its roots in geotechnical engineering, Terracon has evolved into a successful multi-discipline firm specializing in environmental, facilities, geotechnical, and materials services for private and public sector clients. Terracon currently operates more than 140 offices nationwide with more than 3,000 employees and ranks 38th on Engineering News-Record's list of Top 500 Design Firms in the nation.

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Texas Exchange Bank

Capital Firm

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Contact: Beau Chron
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Texas Exchange Bank is a well-capitalized Texas bank with a focus in the wireless infrastructure sector. The bank has been locally owned and operated since it first opened for business in 1970 in Crowley, Texas. We take great pride in providing highly personalized financial services to our business and individual clients. We are actively funding \$2-to-\$5 million commercial loans.

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Thin Air Construction, Inc.

Service Company

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651-319-0152
jules.fisher@thinairconstruction.net
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Thin Air Construction is a general contractor dedicated to constructing, installing, and maintaining wireless networks. We have built a reputation in the wireless industry for our commitment to quality of work. Thin Air delivers professional results safely and efficiently.

Toler Telecom, Inc.

Service Company

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Tower 16, Inc.

Service Company

Tower 16, Inc.
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Contact: Phyllis Hackett
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www.tower16.com

Tower 16 Inc. offers wireless network expansion services. The company also provides (In house) wireless infrastructure design, project management, site acquisition, third party management, and construction services. Tower 16 Inc. was founded in 1999 and is based in Joppa, Maryland.

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Service Company

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Contact: Scott Muschany
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Trileaf Corporation specializes in Environmental and A&E design services for the wireless industry. Trileaf has expertise in all 50 states as well as Mexico, Puerto Rico and Canada. Environmental services include NEPA, SHPO, Phase I and II Environmental Assessment, Biological Assessments, Asbestos/Lead Based Paint Testing and Migratory Bird Evaluations. Trileaf also has 15 years of award winning experience providing A&E services including Site Audits, Lease Exhibits, New Construction Drawings, Antenna and Equipment Modifications, Generator Audits and Installation Drawings, Rooftop Installations, and Stealth Design.

TRM

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UCI Construction Services, LLC

Service Company

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Contact: Todd Schlemmer
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UCI specializes in the construction and installation of communication infrastructure for cellular, PCS, CLEC and fixed/mobile broadband based networks. UCI Construction Services offers turnkey solutions by providing network to transport needs. Providing network and microwave design, implementation and maintenance of customer owned back-haul infrastructures.

UNDC

Service Company

www.undc.com

Universal Network Development Corporation, a telecommunications engineering and consulting company, was incorporated under the laws of the State of California on May 15, 1980. This company is owned and operated by Cinthia Kazee. UNDC is a certified Minority and Woman-owned small business enterprise. We are 8(a) certified by the Small Business Administration.

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Urban Mining2, an R2/ISO 14001 certified, 17 year old asset management and eScrap recycling company using eScrap Resource Recovery 2.0TM methodologies enabling up to 30% more commodity recovery for clients. Our vast database of buyers enables us to pay top-dollar for reuse materials. Our one-of-a-kind, 30,000 square foot resource recovery facility is outfitted with HEPA-filter air scrubbing technology that protects our employees from lead exposure and other toxins - no other facility like it in the world.

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Utility Service Communications specializes in site marketing and management for wireless facilities on water tank sites. The company provides tech services including tank mapping, structural analysis, and architectural and engineering drawings.

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VERTICOM partners with wireless carriers, tower owners, outsourcing firms, and equipment manufacturers to design, develop, maintain and support wireless networks.

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Vision Technologies, Inc.

Service Company

Vision Technologies, Inc.
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Contact: Al Saxon
866-746-1122

asaxon@visiontech.biz
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Vision Technologies, a national and global systems integrator, provides IT services and solutions for Network Infrastructures (including DAS and PON), help desk, onsite support, network management, voice/data, wireless systems, security, audio-visual, VTC, and telephony.

Vision Tower

Service Company

505 Madrid Drive
St. Petersburg, FL 33715

Contact: Scott MacMath
smacmath@visiontower.net

www.visiontower.net

Vision Tower is a wireless services company providing line, antenna and civil crew services. Vision Tower's primary focus is quality of work and safety. We offer our services to the majority of the Southeast US.

W-T Communication Design Group

Service Company

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224-293-6333

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www.wtengineering.com

W-T Communication Design Group is a full service site engineering company focused on the needs of cellular carriers, OEMs, Tower Companies and Tier One Service providers. Structural engineering, architectural design, construction management, site acquisition and environmental services.

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Waterford Consultants offers a wide array of professional and regulatory consulting services with expertise in AM detuning, RF emissions analysis (EME), intermodulation studies, FAA certification and filing, site audit and third-party inspection,

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Contact: Steve McFarlin

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steve.mcfarlin@whitebuffalo.com

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Contact: Bryan N. Tramont

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Btramont@wbklaw.com

www.wbklaw.com

Wilkinson Barker Knauer, LLP is one of the nation's largest communications and technology law firms. The firm is ranked as a top tier communications law firm by Chambers USA, Legal 500, and U.S. News and World Report - Best Lawyers. Firm practice areas include tower siting and infrastructure, as well as wireless and wireline communications, broadcast, cable and other media, privacy, broadband and IP-based services, international and satellite communications, and energy regulation.

Wireless Coverage Inc.

Service Company

526 S Commerce St Ste. 101

Hurricane, UT 84737

888-342-6109

info@wirelesscoverageinc.com

www.wirelesscoverageinc.com

Equipment Installation and Maintenance Services.

Wireless Edge

Service Company

270 North Ave., Ste. 809

New Rochelle, NY 10801

914-712-0000

arthur@wirelessedge.org

www.wirelessedge.org

Wireless Edge is a premier provider of network implementation services and strategic tower sites. Nationwide services include tower development, site management, development of cell sites and satellite terrestrial repeaters and special projects. Wireless Edge specializes in development and permitting of antenna sites on landmark and historic properties.

Wireless Site Services

Service Company

4121 Taliesin Drive

Lincoln, NE 68520

402-817-4135

info@wssinet.com

www.wssinet.com

WirelessWerks

Service Company

8060 165th Avenue NE Ste. 210

Redmond, WA 98052

Contact: Gord Breese

877-760-2565

sales@wirelesswerks.com

www.wirelesswerks.com

WirelessWerks is a leader in network build quality assurance and audit programs, and construction services. We serve all major wireless carriers and their construction partners.

STAFFING COMPANIES

ADEX Telecom

Staffing Company

adextelecom.com

ADEX Corporation is an international service organization that provides turnkey services and project staffing solutions exclusively to the telecommunications industry.

Aditi Consulting

Staffing Company

www.aditistaffing.com

Aditi Staffing is a certified diversity IT staffing firm headquartered in Bellevue, WA, with loca-

tions across the US and operations centers in Bangalore and Coimbatore, India. Aditi Staffing is the flagship IT staffing unit of Aditi Technologies, a leading software development firm founded in 1994.

AIM Technical Consultants, Inc

Staffing Company

aimtechinc.net

At AIM Technical Consultants, we've been recruiting top IT and telecom professionals since 1999. These individuals combine their long-standing expertise with the latest technologies to identify problems, analyze and implement solutions, and provide ongoing expertise when you need it.

Alamon Telecom

Staffing Company

www.alamon.com

Alamon was incorporated in 1975 to provide contract labor to the telecommunications industry. We are a Woman-Owned Business Enterprise providing workforce solutions to industry leading equipment manufacturers, operating telecommunication companies, and utility companies nationwide. Alamon provides a variety of services.

Alternate Communications International L

Staffing Company

alternatetelecommunications.com

Alternate Communications International has over 15 years of expertise providing successful, long and short term placements. Our commitment to responsible and ethical recruiting and placement has enabled us to build strong, loyal relationships with our clients and personnel.

Axis Teknology, LLC

Staffing Company

www.axissteknologies.com

Axis provides people and technology solutions for UMTS/GSM to LTE projects including: core network infrastructure design engineering, transport and data center implementation and testing, E911 solutions, microwave LOS, path and site surveys, DAS and small cell network design and installation, macro network carrier adds and equipment upgrades, deployment and decommission, and project management based on Project Management Institute best practices.

Becon

Staffing Company

Blue Signal

Staffing Company

40 N Central Ave., Ste. 1400

Phoenix, AZ 85283

Contact: Matthe Walsh

847-227-8287

mwalsh@bluesignal.com

www.bluesignal.com

3rd party search firm for the wireless industry.

Brius Telecom Solutions

Staffing Company

www.briustelecom.com

In an industry that is about connecting people, BRIUS Telecom Solutions operates on trust, value and unparalleled professionalism. We provide staffing services to all leading carriers, vendors and suppliers in the fixed line and wireless communications markets. Our combined 30 years of telecom staffing industry experience drive the operations of a proven structure for business, provide motivating leadership to an extraordinary team of experienced recruiters and support staff, and produce outstanding consulting solutions to our existing and growing client base.

CEG Partners

Staffing Company

17200 Chenal Pkwy

Little Rock, AR 72223

Contact: Mike Stafford

501-255-7751

mike@cegpartners.com

www.cegpartners.com

CEG Partners has extensive experience in all aspects of telecommunications and IT staffing and recruiting. Contractors available now to build Mobile Apps, Dashboards, Wireless Networks, and other critical design areas.

DMN Global Services

Staffing Company

www.dmnglobal.com

DMN Global Services has been providing telecommunications network engineering and support services in North America and in over 70 countries since 1989. Our portfolio includes a comprehensive suite of project management, site survey, network design, documentation, logistics, installation, testing, integration, optimization, maintenance, fault management maintenance 24/7 and network management services. DMN Global Services is an ISO 9001:2008 certified company and a NIC EIC approved contractor. With offices based in Fox River Grove IL, DMN Global Services expanded its business in 2000 through the acquisition of GT&K Network Solutions, a network solutions provider.

First Point Group Inc.

Staffing Company

www.firstpointgroup.com

At First Point Group we've made the global telecoms industry our business. For clients such as Ericsson, Huawei and Nokia Siemens Networks, the strategic contribution of FPG, a trusted global partner who knows their industry inside out, is an invaluable business asset.

Fusion Solutions Inc

Staffing Company

www.fusionsolutionsinc.com

Fusion Solutions is a leading provider of telecom technical consulting and staffing services for Fortune 1000 companies. We're knowledgeable of and have worked with virtually all types of telecom infrastructure technologies in Wireless and Wireline.

Genesis10

Staffing Company

www.genesis10.com

Genesis10 is proud to present American businesses with a new opportunity to call on the strengths of our retired service men and women. Our multi-point process enables Genesis10 to proactively prepare veterans for success in business and IT roles, while eliminating traditional hiring risks for our clients. Dedicated selection, training, mentoring and right-to-hire programs work together under the leadership of our Veterans Program Director, Captain Nick Swaggert, USMC Reserve.

Global Recruiters of Blackhawk

Staffing Company

2430 Camino Ramon Ste. # 104

San Ramon, CA 94583

Contact: Paul Harris

925-804-6211

pharris@grnblackhawk.com

www.grnblackhawk.com

Global Recruiters of Blackhawk is an Executive Search Firm specializing in the Telecom sector with the particular niche of Wireless Infrastructure.

Glotel Inc

Staffing Company

www.glotel.com

Glotel is a global professional staffing and managed projects solutions company, specializing in the placement of contract and permanent personnel within all areas of technology.

HarTek Solutions, LLC

Staffing Company

www.harteksolutions.com

At HarTek Solutions, we believe successful placements are the result of a committed partnership with our clients. We help our business clients analyze costs, identify needs, define corporate culture and increase employee retention. HarTek works closely with career seekers to maximize their professional potential in positions compatible with their own skills, goals and interests.

Hepco Inc

Staffing Company

www.hepcoinc.com

We are an Engineering, IT, Telecommunications and Payrolling staffing company that works on both contract and permanent assignments with our corporate office in Saddle Brook, NJ. Whether you are a talented professional who would like to explore new opportunities, or a manager in need of additional support, you can count on HEPCO to provide you with world class customer service. HEPCO is committed to building long term relationships with both our clients and the professionals we place on specific client assignments.

ITC Service Group, Inc

Staffing Company

www.callitc.com/StaffingSolutions

Just as our industry changes, so do your staffing requirements. That's where ITC fits in. We enable you to staff your organization quickly and reduce your recruiting time and costs while maximizing your ability to focus on your client's needs, neatly keeping the door in full swing.

Kenton Group

Staffing Company

www.kentongroup.com

Kenton Group is an industry leader in the telecommunications industry. Since 1993 we have provided Engineering, Professional Staffing and Business Development Consulting Services to firms serving the communications, utilities and information technology industries from coast to coast.

Kineticom

Staffing Company

701 B Street, Suite 1350

San Diego, CA 92101

Contact: Blair Bode

209-482-2030

blair.bode@kineticom.com

www.kineticom.com

Kineticom is an ISO certified, award-winning technical talent firm with a 13-year history in technology recruitment and service delivery in the Information and Communication Technology (ICT) market. We provide on-site talent across 42 states in the U.S. on contract or permanent basis and deliver Professional Services & Solutions governed by Statements of Work. Kineticom aspires to create growth opportunities for our technical professionals and delivers measurable results that set our clients apart in the industry.

Mountain LTD.

Staffing Company

www.mountainltd.com

Welcome to MOUNTAIN, LTD. – a proven leader in engineering solutions. As a trusted source of communications professionals with over 30 years of on-time delivery, we understand your business.

Nextgen Global Resources

Staffing Company

nextgengr.com

NextGen Global Resources represents a revolutionary step forward in telecom recruiting and consulting. Formed by industry veterans who have been changing the global technology recruiting paradigm for decades, NextGen strips away the bureaucratic processes and non-core functions to focus exclusively on placing the best talent at the world's best companies.

Novalink Solutions LLC

Staffing Company

www.novalink-solutions.com

Novalink Solutions is a proven leader delivering managed engineering and staff augmentation services for governments and industries worldwide. Novalink's professionals specialize in software and wireless engineering. The Atlanta-based company has resources and operations located across the U.S. and worldwide.

Onit Management Consulting

Staffing Company

4040 26th Ave SW #635

Seattle, WA 98106

Contact: Edward Byers

206-257-2233

edward.byers@onitmc.com

www.onitmc.com

Project Management consulting in the technology space, with extensive experience in wireless.

Outsource Inc.

Staffing Company

www.linkedin.com/company/outsource-inc.

Outsource, Inc. is an off-site human resources consulting firm which assists employers in developing and maintaining standardized policies and procedures, flexible compensation programs, management training and development, performance evaluations and employee relations.

Pinnacle Technical Resource

Staffing Company

www.pinnacle1.com

Pinnacle Technical Resources is a leader in providing workforce solutions to Fortune 500 companies in the United States and Canada. Since 1996, we continue to be ranked at the top of the staffing industry as one of the fastest growing firms in the industry. In 2010, we were named Supplier of the Year by The National Minority Supplier Development Councils (NMSDC).

Protingent Staffing

Staffing Company

3650 131st Ave. SE

Bellevue, WA 98006

Contact: Chris Zerbo

425-628-9725

czerbo@protingent.com

www.protingent.com/telecom

Please visit our web site for additional information. We are presently working for (both directly and indirectly through other consultants) AT&T Wireless, Verizon Wireless, Sprint, and others.

Skyhawk

Staffing Company

23421 South Pointe Dr., Suite 140

Laguna Hills, CA 92653

Contact: Chris Hubbard

949-468-0118

Chris@skyhawk.net

www.skyhawk.net

Skyhawk provides Tower Climbers, Wireless Technicians and Carrier Technicians on a temporary or contract labor basis. We are a national firm and can provide staff to site projects anywhere in the United States, even remote sites. We maintain a deep bench of skilled workers, ensuring you get top quality, reliable technicians. Skyhawk is certified by the Women's Business Enterprise National Council (WBENC), allowing our clients to benefit from contracting with a more diverse vendor base.

Smartlink

Staffing Company

www.smartlinkllc.com

At Smartlink, we build relationships. We draw on the strength of those relationships, and our rich talent database, to find the best matches for clients who need staffing and/or site development support in the Wireless Telecommunications industry.

SureSite

Staffing Company

3659 Green Road, Ste. 214

Cleveland, OH 44122

Contact: Courtney Schmidt

216-593-0400

c.schmidt@sure-site.com

www.sure-site.com

SureSite is a national provider of site development and staffing services to the wireless and telecommunication industries. With offices in Cleveland, Chicago, Denver and Los Angeles and field locations throughout the country, we pair our distributed workforce and professional practices with an extensive network of local experts to provide hands-on service at every phase. SureSite is a market leader which is proven by our lasting relationships and repeat business since 1999.

SureSite Consulting Group, LLC

Staffing Company

3659 Green Road, Ste. 214

Beachwood, OH 44122

Contact: Courtney Schmidt

info@sure-site.com

www.sure-site.com

SureSite is a national provider of site development and staffing services to the wireless and telecommunication industries. With offices in Cleveland, Chicago, Denver and Los Angeles and field locations throughout the country, we pair our distributed workforce and professional practices with an extensive network of local experts to provide hands-on service at every phase.

T-Staff

Staffing Company

www.t-staff.com

T-Staff was founded in 1998 by an ownership/management team with over 50 years of combined telecommunications industry and technical staffing experience. Their vision was to create a contract staffing service company that specialized in technical placements and the telecom industry sector.

TelForce Group

Staffing Company

4751 Trousdale Drive, Suite 105

Nashville, TN 37220

615-915-3119

info@telforcegroup.com

www.telforcegroup.com

TelForce Group is a provider of professional services, human capital to the communications industry. Our services are integrated directly into our clients' business operations. TelForce identifies talent that stands out among their peers' people with a proven track record of creating value with every placement or assignment. For over 30 years Ron Deese of TelForce has provided professional (staffing) services to the Telecom Industry. TelForce can provide a single technician or a crew of tower climbers. We consistently deliver on small and large complex projects. Our experience in finding mission critical engineers and technicians and industry talent is what sets us apart. TelForce Group LLP is a Native American MBE certified by the NMSCD and the CA Public Utility Commission (CPUC). We ask that you please consider us to become an approved vendor to provide our services to you.

TSRI

Staffing Company

tsrisolutions.com

The leader in technical staff augmentation, consulting, and training for telecommunications and energy.

Verigent

Staffing Company

www.verigent.com

We currently offer our staffing augmentation services in over 45 different states. This year, we are excited to celebrate 10 years in business and are proud to announce that we've deployed over 10,000 employees over to our clients during that time. We specialize in providing Nationwide Support with Local Personnel, providing rapid response to our clients' and employees' requirements.

WFI/LCC

Staffing Company

Wise Connect

Staffing Company

wisconnectinc.com

WiseConnect is greater than the sum of its parts, having positioned itself to understand the integration between each technological component and address emerging technologies as they arise. Not only does our company provide staffing and managed services for a full range of telecom projects, Wiseconnect adds distinct value through true experience and dependability.

TRAINING COMPANIES

Advanced Safety

Training Company

111 Exchange Place

Lafayette, LA 70503

337-231-1323

www.advancedsafetytraining.com

Advanced Safety offers classes in General Industry and Construction Industry to help employees meet OSHA requirements for a safe and healthy workplace that is free of occupational hazards.

Aiken Technical College

Training Company

PO Drawer 696

Aiken, SC 29802

Contact: Dr. Gemma K. Frock

803-508-7278

frock@atc.edu

www.atc.edu

AccessRescue

Training Company

20 Orchid Lane

Ringgold, GA 30736

207-620-6169

info@accessrescue.com

www.accessrescue.com

AccessRescue provides industrial safety, rescue, confined space, work at height, and rope access training to those who want to solve operational issues effectively and efficiently with simple rigging solutions in order to perform work or rescue those in need.

Capital Safety USA

Training Company

800-328-6146

info@capitalsafety.com

www.capitalsafety.us

Capital Safety is one of the world's leading manufacturers of fall protection, confined space and rescue equipment, with a passionate commitment to quality, innovation and safety.

CITCA LLC

Training Company

727 Larry Power Road

Bourbonnais, IL 60914

800-313-5159

www.citca4training.com

CITCA is a nationally recognized training academy, developed by a group of industry specialists, offering a complete line of college accredited tower erection and safety training programs directly related to the communications and wind turbine industries.

COM-TECH CONSTRUCTION

Training Company

**17827 Commerce Dr
Westfield, IN 46074
317-867-4486
www.comtechservices.net**

“Expedite, Turn Up, Target Date.” Understanding these terms is what separates Com-Tech Services from the rest of the implementation groups in the communication industry. Some of the largest bottlenecks in the development of next generation communication networks will be site acquisition, permitting, engineering, construction and installation phases. Com-Tech Services, founded in 1991 and incorporated in 1992, understands our customer’s unique needs and presents sophisticated engineering solutions to avoid these roadblocks to business development.

COMTRAIN

Training Company

**3409 Executive Center Dr., Suite 202
Austin, TX 78731
512-275-6600
comtrain@comtrainusa.com
www.comtrainusa.com**

ComTrain is an authorized training provider for American Tower, Black and Veatch, Bechtel, General Dynamics, Mastec, Union Pacific Railroad, CSX Railroad and many other global companies. Comtrain is named as the preferred training provider for the major carriers and infrastructure providers around the globe. Comtrain is recognized as a N.A.T.E. Member Training Company that meets or exceeds the requirements of the N.A.T.E. Tower Climber Fall Protection Training Standard (N.A.T.E. CTS)

Corporate College

Training Company

**4647 Stone Avenue
PO Box 5199
Sioux City, IA 51102
866-528-4024
CorpCollege@witcc.edu
www.corporatecollege.biz**

The Corporate College offers employers custom-designed training and consulting solutions that can help them reach their goals. Today’s organizations face increasing challenges to remain competitive. We can help you by designing training to meet these demands. The Corporate College will partner with you to find solutions to your unique and specific needs for increased workplace skills, productivity, profitability and efficiency. We will help you focus on both management and worker skills to attain the competitive advantage you are looking to achieve.

DSI Distributing

Training Company

**10425 Plano Rd
Dallas, TX 75238
Contact: RJ Price
720-545-9754
ricky.price@dsisysteminc.com
www.dsisysteminc.com**

ENSA North America

Training Company

**5510 E Marginal Way S
Seattle, WA 98134
Sherry Sandness - Training Coordinator
206-762-8500 ext: 290
www.ensa-northamerica.com**

Utilizing effective management systems, ENSA will support and guide the organization by consistently providing services at a level that meets or exceeds customer expectations. In particular, ENSA strives to meet the needs of company health and safety executives and program managers faced with an evolving compliance environment, operation deadlines, program limitations and the requirement for skilled personnel.

ETA International

Training Company

**5 Depot St.
Greencastle, IN 46135
Contact: Michele Altman
800-288-3824
eta@eta-i.org
www.eta-i.org**

ETA International represents electronics professionals with over 80 industry recognized certifications. ETA certifications align with international standards and confirm both technical knowledge and skills.

Global Safety Consultants

Training Company

**106 Rolls Royce Drive
Broussard, LA 70518
337-330-2642
www.safetygsc.com**

GSC was founded in 2004 and has developed an unique training experience. GSC focuses on client, state, and federal regulatory compliance. GSC allows your company to benefit from our highly trained and experienced staff. Our goal is simple: provide unparalleled service in a cost effective manner. GSC is committed to meeting all the needs of your company. Allow us to help assist you with all your HSE requirements.

Grand Rapids Community College

Training Company

**143 Bostwick Avenue NE
Grand Rapids MI 49503-3295
616-234-4000
www.grcc.edu**

GRCC offers flexible course formats including weekday, weekends, summer Saturdays, on-line/ distance learning and 7-week accelerated classes.

Gravitec Systems, Inc.

Training Company

**21291 Urdahl Road NW
Poulsbo, WA 98370
800-755-8455
solutions@gravitec.com
www.gravitec.com**

Do you need fall protection training? Peek into our modern classrooms. There you’ll find uniformed instructors, unparalleled training aids and the best fall protection equipment on the market. At Gravitec’s Fall Protection Campus, our indoor training facility devoted to hands-on fall protection instruction, you’ll gain practical experience on a variety of climbing structures, representing nearly every industry working at height.

Lakeshore Technical College

Training Company

**1290 North Avenue
Cleveland, Wisconsin 53015
888-GO-TO-LTC
info@gotoltc.edu
www.gotoltc.edu**

Lakeshore Technical College is a leading provider of technical education offering over 100 career programs, customized training for business and industry, continuing education for personal and professional enrichment, and basic skills education.

LBA University

Training Company

**3400 Tupper Drive
Greenville, NC 27834
252-757-0279
lbau@lbagroup.com
www.lbauniversity.org**

On site & online safety training with courses in RF safety, outdoor safety, GHS HazCom, OSHA 10/30 & more. OSHA certified instructors, 1,000s trained.

Miller Fall Protection by Honeywell

Training Company

1345 15th Street

P.O. Box 271

Franklin, PA 16323

800-873-5242

millertechexpert@sperianprotection.com

www.millerfallprotection.com

The Miller Collective Systems concept incorporates a wide range of product solutions, technical support, research and development projects, component testing, training, installation and consultancy services. Through Miller Collective Systems, Honeywell can support the needs of a project at any stage, however, early involvement will permit the greatest solution flexibility, and will always produce improved results practically, commercially and safely.

Pacific Safety Solution LLC

Training Company

Contact: Corey Messer

760-504-1180

corey@pacsafety.net

www.pacsafety.com

Pacific Safety Solutions provides a myriad of solutions based on the specific needs of our clients. We believe that safe and healthy employees are a vital asset to any successful business. Providing a safe and healthy work environment improves productivity, reduces operating costs, and allows our clients to maximize profits.

Parsons Infrastructure & Technology Group

Training Company

100 W Walnut St

Pasadena, CA, 91124

626-440-2000

www.parsons.com

Founded in 1944, Parsons, an engineering, construction, technical, and management services firm with revenues of \$3 billion in 2012, is 100% owned by the Employee Stock Ownership Trust. Parsons is a leader in many diversified markets with a focus on transportation, environmental/infrastructure, defense/security, and resources. We conquer the toughest logistical challenges and deliver design/design-build, program/construction management, and other professional services packaged in innovative alternative delivery methods to federal, regional, and local government agencies, as well as to private industrial customers worldwide.

Peak Career Services / Pinnacle Career Institute

Training Company

1601 W 23rd St, Ste 200, Lawrence, KS 66046

877-241-3097

www.pctraining.edu

When it comes to practical training in today's career fields, Pinnacle Career Institute can offer you a variety of program options. For more than 50 years, we have been helping qualified students find direction in life with relevant career training in the medical, health & fitness, trades & technical, and alternative energy fields. Our instructors bring relevant experience to the classroom and can help you gain applicable skills that today's employers are looking for.

Pigeon Mountain Industries, Inc.

Training Company

PO Box 803

LaFayette, GA 30728-0803

800-282-ROPE

custserv@pmirope.com

www.pmirope.com

PMI's Vertical Specialist program exists to establish a group of excellent, experienced athletes in various rope related sports and rope access skills across the USA.

Radiofrequency Safety International (RSI)

Training Company

Safety Connection, Inc.

Training Company

6032 Fieldstone Ave, Ste. H

Baton Rouge, LA 70809

800-480-3521

sales@safetyconnection.com

www.safetyconnection.com

We have certified professional trainers that conduct various classes for Fall Protection and Rescue at our in-door training facilities in Baton Rouge, LA and Houston, TX; or at your location. We conduct hands on training with real life scenarios to ensure you have the best understanding and knowledge available.

Safety LMSystems LLC

Training Company

210-861-3140

www.safetylms.net

Our courses are continuously evolving. This allows us to ensure that the most current regulations, standards and equipment changes are covered. We are also committed to an effective and efficient curriculum. That is evidenced by our combination of online, classroom and on-site training. We can design a total training solution for your company that will make the most of your time and training dollars.

Safety One, Inc.

Training Company

8181 W. Brandon Dr.

Littleton, CO 80125

800-485-7669

www.safetyoneinc.com

We specialize in training programs for employees whose work involves special hazards in areas beyond easy access and rapid emergency aid. We focus on workers who must negotiate terrain which presents unique hazards in any line of work or industry.

Selling Solutions

Training Company

28591 Craig Ave.

Menifee, CA 92584

Contact: Phil Cook

951-301-5769

cook278@verizon.net

aglmediagroup.com

Sales and Marketing Consulting.

SpanSet USA

Training Company

3125 Industrial Dr

Sanford, NC 2733

800-334-7505

ssales@spanset-usa.com

www.spanset-usa.com

For us, safety takes top priority when it concerns the protection of a person's life, the lifting of heavy loads or the transportation of goods. We can offer you professional and fully developed solutions for safe lifting, material handling and working at heights through high-quality products, our expertise and services.

Spectracom

Training Company

Tech Safety Lines, Inc.

Training Company

3204 Skylane Drive, Carrollton, Texas 75006

Contact: Brandon Waghorne

214-987-4680

brandon@techsafetylines.com

www.techsafetylines.com

Tech Safety Lines, Inc. (TSL) is dedicated to providing a culture of safety and protecting workers at height with proprietary training and patented safety equipment. TSL goes above and beyond by providing our clients with a program of safety ensuring a safe work environment.

Technical Rescue Systems

Training Company

1612 West Laporte Avenue

Fort Collins, CO 80521

Contact: Steve Fleming

877-561-1291

steve@technicalrescuesystems.net

www.technicalrescuesystems.net

TRS offers a service that teaches departments and industrial safety/rescue organizations throughout the world in Emergency Services Rope Rescue, Confined Space Entry & Rescue, Rescuer Safety & Scene Evaluation, Industrial Fall Protection, Communication Tower Climbing and Rescue and Teaching Techniques to adults. These courses have been developed and taught to the industrial sector, fire and emergency services, military, construction industry, including, but not limited to: wind power, electrical power, mining operations and rescue, communication towers and inspection engineers.

TES, Inc.

Training Company

10909 Murdock Dr.

Knoxville, TN 37932

800-327-4036

training@towergear.com

www.towergear.com

TES Inc. is your "Go To" expert for fall protection, rescue and access for work at height, confined space and technical rescue. We offer our customers the opportunity to communicate, train and find the resources to accomplish the task at hand.

Tower Safety Inc.

Training Company

8363 NW 26th Court

Cooper City, FL, 33024

305-345-2470

towersafetyconsulting@gmail.com

www.towersafety.net

Tower Safety Consulting (formerly Tower Safety International) has been training individuals, Fortune 500 companies, major defense contractors, the United States Military as well as many other Government agencies for the last 15 years. We specialize in offering OSHA mandated safety training for construction workers, maintenance personnel, telecom engineers and design personnel regardless of their hands on involvement in working on elevated structures.

Vertical Systems International Inc.

Training Company

611 Main Street, Box 868

Frisco, Colorado 80443

303-907-1891

info@vsimountainsafety.com

www.vsimountainsafety.com

Vertical Systems International Inc. (VSI) is dedicated to providing safe solutions for industries that have workers exposed to fall hazards and extreme conditions, whether in the mountains or on industrial structures. VSI is the expert in consulting and training for Fall Protection, Tower Climbing, Confined Space, Rope Access, Wilderness Mountain Safety and Technical Rescue throughout the world.

HARDWARE, COMPONENT, AND ACCESSORY COMPANIES

3Z Telecom

Hardware

3361 Executive Way

Miramar, FL 33025

Contact: Joey Villamil

954-581-6565 ext. 302

jvillamil@3ztelecom.com

www.3ztelecom.com

Based in South Florida, USA, 3Z Telecom was founded in 2005 with a simple business philosophy in mind: offering the best quality products in the Telecom Solutions Industry at the best prices with the best service. 3Z

offers In-Building DAS, RF Engineering, RF EME Compliance, Interference Hunting, Tower Services & Drive Testing. Along with these services, 3Z also offers the World Leader Antenna Alignment Tool: The 3Z RF Aligner for both Panel Antennas and point to Point Microwave Systems and the Antenna WASP, the World's First Wireless Antenna Monitoring Sensor, which monitors the antenna alignment and reports any undesired changes occurred. 3Z Telecom's RF Aligner and 3Z Antenna WASP will maximize and sustain your antenna's performance from initial installation throughout its usable life.

A.G. Franz

Hardware

5 Stanton Court

Plainsboro, NJ 08536

609-936-1919

sales@agfranz.com

www.agfranz.com/narda-df

A.G. Franz is the North American master distributor for RF test-equipment for interference and direction finding measurements and remote spectrum analyzers from Narda Test Solutions

Advanced RF Technologies

Hardware

3116 W Vanowen

Burbank, CA 91505

Contact: Arnold Kim

818-840-8131

sales@adrfttech.com

www.adrfttech.com

AdvanceTec Industries, Inc

Hardware

1150 NW 163rd Drive

Miami, FL 33169

305-623-3939

sales@advancetec.com

www.advancetec.com

Wireless communications manufacturing and distributing company

Aero Solutions

Hardware

5500 Flatiron Parkway

Boulder, CO 80301

Contact: Ryan Spalding

720-304-6882

rspalding@aerosolutionsllc.com

www.aerosolutions.com

AFD Industrial Filters

Hardware

865-525-8697, 888-251-8668

AFD Industrial Filters is a source of all types of air conditioning filters for cell tower equipment. These filters are now available to the industry, and are shipped directly from the factory to you at huge savings. AFD Industrial Filters has provided filters to many wireless companies, including Nortel Networks and AT&T Mobility, since January, 2000. Replacement filters available for older Nortel BTS-S8000 and BTS-S12000 outdoor units.

AirHop Communications Inc.

Component

6150 Lusk Blvd., Ste. B204 & B205

San Diego, CA 92121

858-848-6188

info@airhopcomm.com

airhopcomm-web.com

Founded in 2007, AirHop is a privately held startup that develops advanced RAN intelligence software critical to the next wave of the mobile Internet. AirHop's eSON products are the first to completely address the installation, operation, performance, and multi-vendor support challenges of multi-layer, small cell and HetNet deployments.

Airvana

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250 Apollo Drive

Chelmsford, MA 01824

Contact: Josh Adelson

978-250-3000

info@airvana.com

www.airvana.com

Airvana provides 4G LTE small cell solutions for residential, small/medium business, enterprises and public spaces.

Alcatel-Lucent

Hardware

Allfasteners USA

Hardware

15401 Commerce Park Dr.

Brook Park, OH 44142

Contact: Bruce Carmichael

440-232-6060

sales@allfasteners.com

www.allfasteners.com

Fasteners to the tower industry, Ajax Oneside, A490, A325, V bolts, U bolts, steel for tower modifications.

Alliance Corporation

Hardware

2 Frassetto Way

Lincoln Park, NJ 07035

888-821-4797

sales@alliancecomm.com

www.alliancecomm.com

Alliance Corporation is a full-service value-added distributor of products and solutions for the Wireless industry. We help build thousands of new cell sites every year.

Allied Fiber

Hardware

845 Third Avenue, 16th Fl.

New York, NY 10022

Contact: Lauren Sauer

212-920-8300

lauren.sauer@alliedfiber.com

www.alliedfiber.com

ALLTEC LLC

Hardware

64 Catalyst Drive

Canton, NC 28716

800-646-9290

online-info@alltecglobal.com

www.alltecglobal.com

ALLTEC is an international, full-service company specializing in engineered grounding/earthing and bonding, surge/transient protection and lightning protection systems.

ALT Fabrication

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Altery Systems

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140 Blue Ravine Road

Folsom, CA 95630

Contact: Vito J. Coletto

480-772-8224

vito.coletto@altery.com

www.altery.com

Ambor Structures Inc.

Hardware

PO Box 3763

St. Paul, MN 55101

Contact: Andrew Murray

651-414-1276

andrew.murray@amborstructures.com

www.amborstructures.com

AN Structures

Hardware

3850 Hendricks Road

Austintown, OH 44515

Contact: James Tinsley

319-327-3438

jt@anstructures.com

www.anstructures.com

AN Structures provides pre-engineered and custom designed communication tower packages, especially well suited to international Broadband Deployments and Two-way applications. These tower ship very economically internationally.

Antenna Products Corporation

Accessory

ARE Telecom and Wind

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St. Paul, MN 55101

Contact: Dion Johnson

651-330-1263

djohnson@aretelecom.com

www.aretelecom.com

Athena Wireless Communications

Hardware

12425 W. Bell Rd, Ste. 144

Surprise, AZ 85378

623-242-7224

sales@athenawave.com

www.athenawave.com

Athena designs and manufactures SiGe-based millimeter-band wireless Gigabit backhaul links and SoC-based LTE small cells for wireless telecommunication operators, governments and private enterprises around the globe.

Attochron, LLC

Hardware

P.O. Box 1036

Lexington, VA 24450

310-670-1777

tc@attochron.com

www.attochron.com

Free Space Optics

Avlite

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Bracnet Ltd.

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Dhaka

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www.bracnet.net

ISP & Nationwide Data Connectivity Company.

Buckingham Mfg. Co., Inc.

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BTI Wireless

Hardware

6185 Phyllis Drive, Unit D

Cypress, CA 90630

Contact: Ron Poulin

714-856-9604

ronp@btewireless.com

www.btiwireless.com

Cablcon

Hardware

379 Executive Drive

Troy, Michigan 480083

Contact: Dan Tomica

248-703-6493

dtomica@cablcon.com

www.cablcon.com

Carrier iQ

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640 W. California Avenue, Ste. 100

Sunnyvale, CA 94086

650-625-5400

bbergeret@carrieriq.com

www.carrieriq.com

As market leader in mobile intelligence, Carrier iQ provides mobile operators and device vendors with actionable analytics and insights into the real mobile customer experience.

Carwell Specialty Coatings

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Cavium Inc.

Component

2315 N. First Street

San Jose, CA 95131

408-943-7100

info@cavium.com

www.cavium.com

OCTEON Fusion Family, the industry's most powerful, small cell Base Station-on-a-chip family are specifically designed for LTE & 3G multi-mode small cell base stations, including picocell and micro base stations.

CBNL

Hardware

Cambridge Business Park

Cambridge, UK

CB4 0WZ

Contact: Chris Wright

info@cbnl.com

www.cbnl.com

CBNL is the market-leader in licensed point-to-multipoint backhaul and enterprise access solutions. CBNL's wireless technology offers transformational capacity, carrier-grade services and cost-savings over alternative solutions.

Cell Blocks Inc.

Hardware

PO Box 1167

Jackson, CA 95642

Contact: James Fey

510-418-4322

philcolflesh@cellblocksinc.com

www.cellblocksinc.com

Cellsite Solutions

Hardware

1720 I Ave NE

Cedar Rapids, IA 52402

Contact: Amber Kramer

319-826-3404

amber@cellsitesolutionsllc.com

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CITCA LLC

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Comarcom designs, manufactures and markets VEGA, very high gain antenna, the most cost effective solutions to meet Radio Access Network coverage challenges.

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Contact: Kevin Geary

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sales.nam@comba-telecom.com

www.combausa.com

CommScope

Hardware

4 Westbrook Corporate Center, Ste. 400

Westchester, IL 60154

708-236-6634

bill.walter@commscope.com

www.commscope.com

CommScope has played a role in virtually all the world's best communication networks. We create the infrastructure that connects people and technologies through every evolution. Our portfolio of end-to-end solutions includes critical infrastructure our customers need to build high-performing wired and wireless networks.

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Cable Assembly House.

Dali Wireless, Inc.

Hardware

535 Middlefield Road, Ste 280

Menlo Park, CA 94025

Contact: Johnny Truong

916-934-2583

information@daliwireless.com

www.daliwireless.com

Dali Wireless is the global provider of an all-digital RF ROUTER® platform. This revolutionary platform transcends the capabilities typically associated with traditional Distributed Antenna Systems (DAS) to deliver more data throughput and value at the lowest Total Cost of Ownership.

Dantel Inc.

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For more than 40 years Dantel Inc continues to provide alarm monitoring, control and mediation for a variety of network alarm applications worldwide.

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DeltaNode

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Contact: Tom Boyle
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www.birdrf.com

DEUS Rescue

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Dialight Corporation

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EnerSphere Communications, LLC

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404-448-4729
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ERICO, Inc.

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Contact: Caroline Dalpiaz
704-360-3647
caroline.dalpiaz@essentia-inc.com
www.essentia-inc.com

Ethertronics Inc.

Hardware

5501 Oberlin Drive, Ste. 100
San Diego, CA 85259
619-847-9855
amccray@ethertronics.com
www.ethertronics.com
Ethertronics develops antenna and RF Front End system solutions for 3G and 4G (LTE and LTE-Advanced) mobile devices, as well as solutions for M2M, IoT and Distributed Antenna Systems (DAS).

Exalt Communications, Inc.

Hardware

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Campbell, CA 95008
408-688-0200
info@exaltcom.com
www.exaltcom.com
Exalt Communications the leading innovator of next-generation point-to-point and point-to-multipoint systems for private networks and Internet infrastructures.

Fairview Microwave

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1130 Junction Dr. Suite 100
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www.fairviewmicrowave.com
Fairview Microwave offers immediate delivery of RF components including attenuators, adapters, coaxial cable assemblies, connectors, terminations and much more.

FASMETRICS S.A.

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FASMETRICS S.A. offers a revolutionary robotic antenna platform that dramatically changes how an antenna network operates and behaves. It increases the capacity and quality of broadband services, sharply reduces costs and keeps your customers loyal

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315-736-2206
www.fiberinstrumentsales.com

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Fibrolan is an experienced vendor of Optical Access Equipment, for the Telecom (fixed and mobile) and Government markets.

fieldSENSE RF Safety

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www.fieldsense.com

FIMO USA

Component

Fiplex Communications, Inc.

Hardware

7331 N.W. 54th Street

Miami, FL 33166

305-884-8991

info@fiplex.com

www.fiplex.com

Fiplex develops, designs and manufactures a wide line of passive and active products for the Telecommunications Industry, which includes standard and customized wireless coverage solutions.

First Element Energy

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9972 Lakeview Ave.

Lenexa, KS 66219

775-450-3028

squai@firstelementenergy.com

www.FirstElementEnergy.com

Small business manufacturer of hydrogen and methanol fuel cells for tower backup power and off-grid locations requiring weeks/ months of run time.

Flash Technology

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332 Nicol Lane

Franklin, TN 37122

www.spx.com/en/flash-technology

Fujitsu

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888-362-7763

fncinsidesales@fnc.fujitsu.com

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With our long history of cutting-edge technology in the field of telecommunications, Fujitsu is well positioned to supply and support end-to-end solutions for wireless networks.

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Galtronics

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Galtronics is a market leader in antenna solutions of the highest quality and design. Markets served include mobile phones, broadband (home networking, M2M, LMP) and wireless infrastructure.

GME Supply Co

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GPS Networking Inc.

Hardware

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Contact: Steve Vasquez

719-595-9880

salestech@gpsnetworking.com

www.gpsnetworking.com

GPS Networking, Inc. is the only company which specializes in providing global positioning products and solutions to enable you to effectively distribute the GPS signal throughout your site or facility. We have developed a line of GPS products which allow you to design your own GPS network to meet your individual needs. For over 20 years, GPS Networking has been the number one provider of GPS Antenna Splitters, GPS Amplifiers, and GPS Re-radiating Kits in the world.

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Hutton Communications, Inc.

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Innovative Systems

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605-995-6120

sales@innovsys.com

www.innovsys.com

Innovative Systems provides voice, video and OSS/BSS telecommunications services to wireless and wireline companies with over 1200 systems in service. The APMAX delivers voice services including Unified Messaging, Mass Notification, Conference Calling, Web Portal Customer Care and many other enhanced voice services.

International Treescapes, LLC

Accessory

2580 Progress Street

Vista, CA 92081

760-631-6789

www.treescapes.com

www.treescapes.com

Manufacturer of cellular, surveillance and sound system concealment products, including replica tree wraps for rooftop and hillside sites.

International Tower Lighting, LLC

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PO Box 41875

Nashville, TN 37204

Contact: Katie Taylor

615-256-6030

ktaylor@itc-llc.com

www.itl-llc.com

Interop Technologies

Hardware

Iron City Telecom, Inc.

Hardware

12 Pulaski Street

Brooklyn, NY 11206

347-742-0610

vbarlow@ironcitytelecom.net

ISCO International

Hardware

444 E. State Parkway, Suite 123

Schaumburg, IL 60173

888-472-3458

sales@iscointl.com

www.iscointl.com

Solutions maximizing performance of the RF uplink through spectrum conditioning to mitigate interference, manageability to react to spectrum dynamics, and spectral awareness tools.

ITL, LLC

Component

iTrinegy

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www.itrinegy.com

iTrinegy provides network profiling and network emulation for de-risking application performance out in the field for Satellite, Virtual, WAN/LAN, Mobile, Radio over IP etc

JDSU

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info@jdsu.com**

www.jdsu.com

JDSU serves markets that are at the heart of what's important, making virtually every network in the world faster and more reliable. JDSU leads the fastest-growing segments of the optical-networking market: tunable XFPs, transport blades, and reconfigurable optical add/drop multiplexers (ROADMs).

JMA Wireless

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Liverpool, NY 13088
Contact: David Lawrence
315-431-7126
dlawrence@jmawireless.com
www.jmawireless.com**

Kaipac

Hardware

**724 Canyon Drive
Coppell, TX 75019
www.haipac.com**

Kimberly Steel Solutions

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josborne@kimberlysteelsolutions.com
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L-Com

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Schaumburg, IL 60173
Contact: Gus Basualdo
954-240-2036
gus.basualdo@lairdtech.com
www.lairdtech.com**

Lattice Communications

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Launch 3

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www.launch3telecom.com**

Launch 3 Telecom is an international distributor of new, used, and refurbished telecom equipment. Launch 3 carries all major manufacturers such as Andrew, Cisco, Alcatel-Lucent, Tyco, Kathrein Scala Division, Powerwave, and many more.

LBA Technology

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lbagrp@lbagroup.com
lbatechnology.com**

Fabricates lightning mast protection systems, sophisticated radio antenna tuning & coupling systems, provides transmission & shielding system design-build integration & markets test equipment for the RF sector.

LNA Solutions, Inc.

Component

LOCO International

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**2 Countryside Dr
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sales@locointl.com
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LOCO International is the leading global provider of new and refurbished networking equipment, computer systems, computer parts, and test and measurement equipment. We buy and sell electronic hardware, test equipment, networking and computer parts at reduced prices.

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www.matsing.com**

Maximum Signal LLC

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Cheektowaga, NY 14225
716-818-5896
maximumsignal@aol.com
www.maximumsignal.com
Manufacturer and Distributor of Cellular Amplifiers**

Melody Wireless Infrastructure

Hardware

**60 Arch Street
Greenwich, CT 06830
Contact: David Bacino
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dbacino@melodypartners.com
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Midsun Specialty Products, Inc.

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Midwest Unlimited LLC

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Multiwave Sensors Inc.

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Component

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Nello

Hardware

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South Bend, IN 46601
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574-288-3632
tkneller@nelloinc.com
www.nelloinc.com

Neptuno - NAAP

Hardware

401 E Las Olas Blvd, Ste. 1520
Fort Lauderdale, FL 33301
Contact: Nelsy Arellano
954-525-1906
narellano@neptunousa.com
www.naapsolution.com

Nextivity

Hardware

12230 World Trade Drive
San Diego, CA 92128
Contact: Joe Schmelzer
858-485-9442
jschmelzer@nextivityinc.com
www.cel-fi.com

Nextivity Inc. is a leading developer of indoor cellular coverage technology which optimizes the experience of wireless subscribers and increases Radio Frequency (RF) network capacity for mobile operators.

Northstar Battery Company

Hardware

4000 Continental Way
Springfield, MO 65803
Contact: Al Aflague
530-503-5053
al.aflague@northstarbattery.com
www.northstarbattery.com

Omitron

Component

Optica Network Technologies, LLC

Accessory

Optical Zonu Corporation

Hardware

15028 Delano Street
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818-780-9701
info@opticalzonu.com
www.opticalzonu.com

Manufacturers of carrier-grade RF-over-Fiber interconnect links for small cell and DAS deployments.

OTL Solutions

Hardware

4920 Louis-B. Mayer
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Contact: Michel Lavallee
800-647-9110
info@otlsolution.com
www.otlsolution.com

Phoenix Contact

Component

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717-944-1300
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www.phoenixcontact.com

Phoenix Contact develops and manufactures industrial electrical and electronic technology products that power, protect, connect and automate systems and equipment for many industries.

Pigeon Mountain Industries, Inc.

Accessory

Precision Tower Products

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PRINOTH

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Pro-Tec Mobile Communications

Hardware

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protecmobile@aol.com
www.protecmobile.com
Motorola, Kenwood Dealers

Prysmian Group

Hardware

PO Box 39
Claremont, NC 28610
Contact: John Lavalette
800-879-9862
john.lavalette@prysmiangroup.com
na.prysiangroup.com

Pulse Electronics

Hardware

3611 NE 112th Ave
Vancouver, WA 98682
Contact: Denise Kegley
360-859-5016
dkegley@pulseelectronics.com
www.pulseelectronics.com

Quest Controls

Hardware

208 9th Street Drive West
Palmetto, FL 34221
Contact: Robert Vachris
941-224-1005
rvachris@questcontrols.com
www.questcontrols.com

Quintel USA Inc.

Hardware

1200 Ridgeway Ave.
Rochester, NY 14615
Contact: Joseph Veni
408-687-1093
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RAD Data Communications

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chris_f@rad.com
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RAD addresses communications service providers with Service Assured Access and packet migration solutions that reduce operational cost and complexity and improve service agility.

Radio Frequency Systems (RFS)

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800-437-3045
paula.mennone@rfsworld.com
www.rfsworld.com

Radio Frequency Systems (RFS) is a global designer and manufacturer of cable, antenna and tower systems, as well as active and passive RF conditioning modules, providing total-package solutions for outdoor and indoor wireless infrastructure. RFS serves OEMs, distributors, system integrators, operators and installers. Its customers currently include the four largest wireless carriers, the majority of tier 2 and 3 wireless carriers in North America and many of the top wireless and microwave OEMs worldwide.

Radisys

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info@radisys.com
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Radisys' T-Series platforms are pre-configured to meet mobile operator's high-performance requirements and optimized for Deep Packet Inspection (DPI), Policy Management, SDN/NFV and Load Balancing.

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sales@rakon.com
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Rakon is a global high technology company that designs and manufactures world leading timing and frequency control solutions using advanced crystal and oscillator technology.

Raycap

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806 S. Clearwater Loop
Post Falls, ID 83854
Contact: Lisa Duckett
lduckett@raycap.com
www.raycap.com

RedSky Technologies

Hardware

925 W. Chicago Avenue, Ste. 300
Chicago, IL 60642
312-432-4300
info@redskytech.com
www.redskyE911.com

RedSky Technologies is the leader in E911 solutions, providing premise and cloud-based location determination solutions to the enterprise, including location support for any type of device.

RF Industries

Hardware

7610 Miramar Road
San Diego, CA 92126
Contact: Manny Gutsche
800-233-1723
mgutsche@rfindustries.com
www.rfindustries.com

Richard Tell Associates, Inc.

Component

350 Falcon Ridge Parkway, Ste. 103
Mesquite, NV 89027
919-900-8412
sales@radhaz.com
www.radhaz.com

Richard Tell Associates, Inc. is a scientific consulting business focused on electromagnetic field exposure assessment, compliance with applicable standards and regulations on radiofrequency (RF) and power frequency fields and training related to the measurement, analysis and interpretation of electromagnetic fields.

ROHN Products, LLC

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Hardware

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www.saftehnika.com

Shireen, Inc.

Accessory

12910 Cloverleaf Center Dr.
Germantown, ME 20874
301-838-4380
greg@shireeninc.com
www.shireen.com

Shireen, Inc. has a full line of Outdoor Cables and Connectors Ste.d for the Wireless, Wired and Fiber telecom market. Our Cable Products Division, maintains over 30+ SKUs of Bulk RF Coaxial and both Indoor and Outdoor Category Products for Cat5e, Cat6 and Siamese Fiber.

Signum Wireless Cprporation Inc

Hardware

7-8362 Woodbine Ave., Ste. 360
Unionville, ON
L3R 2M6
416-910-1804
robert.lane@signumwireless.com
www.signumwireless.com

A Canadian supplier of In-building wireless solutions- DAS (design+ hardware) as well as cell towers across Canada.

Siklu

Hardware

43 HaSivim St.
Petach Tikva, Israel 49517
+972 3 9214015
shahar.peleg@siklu.com
www.siklu.com

Siklu, the market leader in E-band backhaul systems, delivers Gigabit capacity millimeter wave wireless backhaul solutions operating in the 60, 70 and 80 GHz bands.

SKYLOTEC North America, LP

Accessory

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Component

SpanSet USA

Accessory

Specialty Tower Lighting, Ltd., Div. of TWR Family of Cos.

Component

Spinner Atlanta, Inc.

Component

Star Solutions International Inc.

Hardware

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contact-sales@starsolutions.com

www.starsolutions.com

Star Solutions supplies innovative mobile network infrastructure to carriers and wireless network operators worldwide. Our 3G/4G systems target rural, enterprise, public safety applications worldwide.

Syniverse Technologies

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Component

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Hardware

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