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Mission-Critical Implications of Small Cells

As mobile operators roll out small cells to enhance Long Term Evolution (LTE) coverage, the technology is likely to expand to mission-critical broadband networks as well.

By Tracy Ford

Small-cell technologies are becoming big business, as commercial wireless service providers deploy a variety of small-cell solutions to keep up with increased demand from end users to connect with each other and access content when they want, where they want and however they prefer. Small-cell deployments enable stronger cellular signals by targeting areas with spotty coverage, including inside buildings and large public venues, and will add data capacity to existing coverage areas. This is good news for the public-safety community in two ways — better 9-1-1 call connectivity from commercial networks, and small-cell technologies likely will be deployed to enable public-safety network coverage as well.

One of the most asked questions

Photo courtesy CBNL

CBNL's small cell unit recently provided backhaul for Telefonica U.K.'s first public small cell Wi-Fi network in London.

around small cells, however, is how to define this nascent technology. "A small cell is anything not attached to a tower," says industry researcher Iain Gilliott, president and founder of iGR.

The HetNet Forum, a membership group within PCIA, defines small cells as a group of technologies that includes distributed antenna systems (DAS), microcells, metrocells, picocells, femtocells and Wi-Fi access points. These small cells, along with the mainstay macrocellular tower and rooftop antennas, make up the heterogeneous network (HetNet).

The public's embrace of wireless broadband has led wireless service providers and the public-safety sector to employ a variety of technologies — in licensed and unlicensed spectrum bands — to connect with the people and world around them. No single frequency band or technology protocol will be able to meet the surging demands of wireless users. AT&T has seen wireless data use increase 50,000 percent on its network during the past seven years, illustrating consumers' growing demand for data.

This insatiable wireless broadband demand puts pressure on cellular networks. To meet that demand, wireless operators are deploying a variety of small cells — both indoors and outdoors — to bring the network closer to the end user and to offload traffic from the macrocellular network. Further, reliance on cellular networks has never been higher. It is estimated that between 70 and 80 percent of cellular calls take place inside, and 90 percent of data connections are made indoors. The FCC estimates that 70 percent of 9-1-1 calls are made from wireless devices; moreover nearly 40 percent of households in 2012 were "wireless-only," according to data from the Centers for Disease Control and Prevention, which tracks the trend.

"While macrocellular towers remain the most efficient way to bring wireless broadband to the greatest number of people, the statistics underline the need to get the network closer to the end users, especially indoors and in dense, urban environments," says Jonathan Adelstein, president and CEO of PCIA – The Wireless Infrastructure Association. "Small cells and DAS are going to be deployed with increasing urgency to address the growing wireless data crunch."

Small cells can be deployed at elevation levels that bring service closer to the end user, including on utility poles and along the sides of buildings. As such, the market for small cells is increasing. ABI Research estimates the market for in-building wireless equipment and deployments to generate $4.4 billion this year, while outdoor small cells will ratchet up $1.8 billion in sales in 2014.

What does this mean for first responders? "Better cellular coverage benefits everyone who ever needs to call 9-1-1 during an emergency and the first responders who tend to that emergency," says Rob Benson, director of strategic accounts at Connectivity Wireless. "Spotty or nonexistent cellular coverage will hinder access to this critical service we've come to rely on."

Small Cell Definitions

A variety of small-cell technologies are available, and each serves a specific purpose, depending on an operator's specific coverage and capacity needs in each unique environment.

DAS are attractive solutions in outdoor and indoor environments because they are scalable and flexible. Like macrocell sites, DAS networks can be configured to support multiple wireless service providers deploying a variety of frequency bands and wireless service technologies in a small form factor. While DAS networks are often driven by the same radio transceiver equipment used in macrocell sites, they enable these resources to be narrowly targeted to the areas where they are most needed; capacity can be shifted to different parts of the DAS network as subscriber locations and demands shift. DAS networks can be used to augment cellular, public-safety and Wi-Fi communications. They are typically deployed in large public venues such as stadiums, transportation centers and shopping malls, as well as healthcare facilities, hotels and convention centers, higher education campuses, and large commercial and corporate real estate buildings.

In these environments, a DAS can bring coverage and capacity to a large number of users from more than one service provider. DAS deployments are tightly coordinated and require upfront design work and capital, planning and cooperation among several entities, including the service provider, neutral-host third-party network provider, systems integrator, venue owner and manager, and municipality or utility, depending on the deployment.

Other small cell solutions, including metrocells, microcells, picocells and femtocells, generally only provide coverage from one wireless service provider and only on one or two frequency ranges. Metrocells, microcells and picocells all require professional installation and maintenance and are used by service providers to provide pinpoint coverage and capacity in a certain area. Also, different equipment manufacturers use different parameters to define this group of small cells.

Microcells generally can cover up to 200 users across 1 mile and are deployed outdoors and inside. Metrocells

are generally deployed inside buildings and can fill in coverage for up to 32 users across 7,000 to 10,000 square feet. Picocells can also provide coverage for up to 32 users but only cover 750 feet. Femtocells are typically used in homes and small businesses to improve coverage and don't have to be professionally installed.

Wi-Fi technology allows electronic devices to exchange data over a computer network wirelessly using unlicensed RF spectrum. Devices such as personal computers, video game consoles, smartphones, tablets and TVs can use Wi-Fi to access the Internet via wireless access points, also called "hot spots." Hot spots have a range of about 20 – 200 feet indoors. A Wi-Fi hot spot can contain one or more access points (APs) that deliver the connectivity to a specific network.

Carriers and Small Cells

Wireless service providers are taking an "all-of-the-above" approach to small-cell solutions in their networks to give customers a better wireless experience. For instance, AT&T established its Antenna Solutions Group (ASG) several years ago "to provide our customers with the best mobile broadband experience and extend the capabilities of AT&T's macro network to large public venues," says Jim Parker, senior manager for AT&T's ASG. "By deploying an in-building wireless system, we can offload traffic from the macro network. Our team is focused on improving the customer experience by focusing resources where our customers live, work and play.

"To do this, ASG works closely with each radio access network (RAN) market to evaluate venues for a potential deployment. Our group evaluates venues for potential deployment largely based on how many people are affected and which deployments will provide the greatest improvement of our overall network, and then we take the approach of making the DAS 'neutral-host.' By doing that, the cost is shared with the other providers that want to join the DAS, which enables us to do more buildings and more locations."

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Verizon Wireless, Sprint and T-Mobile USA all use a variety of small-cell technologies to add coverage and capacity for their customers, although they have not publicly announced the number of DAS installations and other small cells they plan to deploy.

Public-Safety Implications

DAS networks, sometimes called the original small cell, can often meet the needs of first responders with simple coax passive systems using signal boosters and active fiber-based DAS for larger buildings. "Each type of solution has benefits depending on the characteristics of the building, the status of the outdoor public-safety network, available financial budget and other considerations," says Matthew Thompson, vice president of sales, Americas, Axell Wireless.

Increasingly, Authorities Having Jurisdiction (AHJs) are adopting the sections of the National Fire Protection Association (NFPA) and the International Fire Code (IFC) that address adequate first responder communications inside buildings, Thompson says. (See "Your Guide to In-Building Coverage," in the June issue of *MissionCritical Communications*.)

Small-cell technologies will continue to evolve in the commercial and public-safety sectors.

"Small cells will have a significant impact in supporting the future wireless needs of public safety," says Keith Kaczmarek, principal of InPhase Wireless, a wireless consultancy firm. "First, small cells have the opportunity to improve connectivity for public safety in underserved locations for both voice and data."

There will always be challenges with stairwells and elevators, but as small cells and the "Internet of things" (IoT) take hold and the cost to deploy small cells decreases, even those challenging locations will be better served, Kaczmarek says.

Small cells are likely to have a huge impact on the ultimate architecture of the First Responder Network Authority (FirstNet) network. Placing small cells, supporting the public-safety broadband network, in key locations such as police stations, fire stations and major government buildings will allow public safety an opportunity to cost effectively add the coverage and capacity they need, where they need it, he says.

"Also, the use of small cells as deployables on public-safety vehicles will allow coverage and capacity to be transported to planned and unplanned events," Kaczmarek says. "The increased granularity of location that will come from small cells, augmented with other location-based technology, will provide enhancement to locating the public and first responders."

DAS and other small cells continue to evolve to meet the increased demand for robust communications for the public-safety, commercial cellular and enterprise markets. Matching the right technology to the right venue or outdoor deployment will enable better voice and data communications among all users on all networks. ■

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