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Addressing the challenges of FirstNet in-building coverage

By Kelly Hill

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Two years ago, AT&T won the more than $6 billion, 25-year contract to build out a national network for the First Responders Network Authority. This kicked off a public-private partnership that is unique in its scope and in ts particulars: a nationwide, LTE network with its own private network core, whose users can access all of AT&T's commercial spectrum bands plus FirstNet's Band 14 700 MH spectrum, with priority use over commercial subscribers sharing the same spectrum and even the ability to preempt commercial users in emergencies. It paired a nationwide carrier which had heretofore played a secondary role in the public safety cellular market with a federal agency expressly tasked with serving first responders, and gave contract partner AT&T a springboard to a major network overhaul that has helped the carrier improve its overall network performance, expand its footprint and lay the groundwork for 5G.

AT&T will be spending $40 billion of its own money on the FirstNet network—in addition to the $6.5 billion that it received from FirstNet for the build—over the 25-year life of the FirstNet contract. It had to put together specific build-out plans for each of the 56 U.S. states and territories – but while the carrier's existing Distributed Antenna Systems and even its Wi-Fi hot spot network were mentioned as contributors to FirstNet coverage, the initial plans focused on macro-network-based, outdoor cellular coverage and augmenting AT&T's existing coverage footprint where necessary. However, now that FirstNet devices are getting into public safety hands (there were about 750,000 active FirstNet connections, per AT&T's latest update), in-building usage has become a larger part of the conversation. That's a conversation that includes not just enabling communications systems that not only help emergency responders do their jobs, but helping public safety in the sense that people who need help can get a cellular signal when they need one as well.

"Over the last year or so, you can really see a change in their positioning and in the technology message that they're going out with – they're really changing their focus to include indoor," said Joe Schmelzer, senior product director for signal booster company Nextivity, which has introduced products aimed specifically at enabling FirstNet coverage indoors.
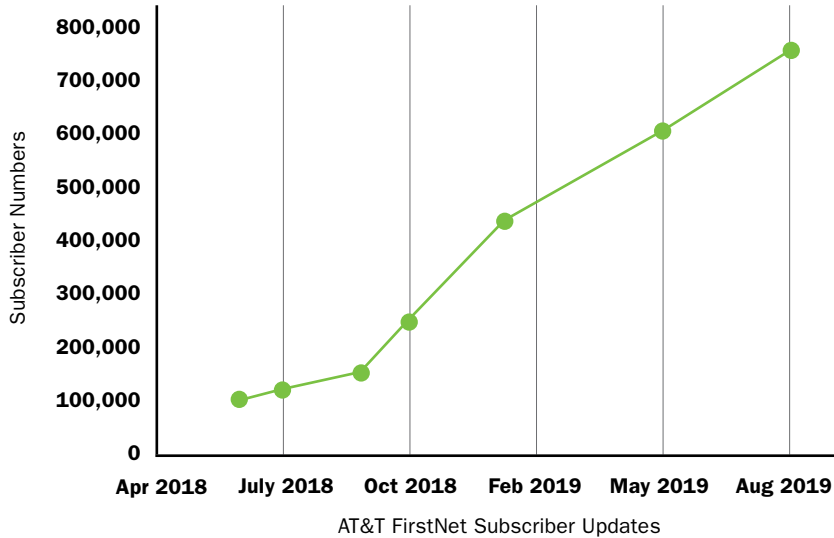
So how does in-building coverage fit into the overall FirstNet strategy? This report looks at the progress of FirstNet thus far, how in-building coverage fits into the overall FirstNet roadmap for serving first responders, and some of the challenges presented by the convergence of public safety communications and cellular technologies in an in-building environment.

FirstNet: Gaining momentum

FirstNet's subscriber base has been growing—sometimes quite rapidly—since AT&T made its services available in mid-2018. According to AT&T's last update in August 2019, there are nearly 9,000 agencies and organizations which have subscribed to FirstNet, and more than 750,000 FirstNet connections, a number that the carrier says is "growing daily."

AT&T said that it has so far built out 650 markets with Band 14 coverage, and that it's about 65% of the way through its contracted coverage area requirements for FirstNet - and ahead of schedule. AT&T executives have said that the

FirstNet Subscriber Growth

Subscriber Numbers

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AT&T FirstNet Subscriber Updates

carrier expects to complete about 70% of the build-out by the end of this year.

Among the individual, new FirstNet sites which AT&T has highlighted recently are:

· Two new sites in Maryland, including one on Tilghman Island in the Chesapeake Bay, located across from the volunteer fire department.

· Two new purpose-built sites in Warren County, North Carolina: One in Warrenton to resolve a previous coverage gap and another one near Lake Gaston to serve public safety response and visitors at the lake.

· One site at Red Cliff Reservation in northern Wisconsin, located near the Apostle Islands National Park. Public safety stakeholders "identified this location as a prime spot for increased network coverage and capacity to better support emergency communications," according to AT&T and the FirstNet Authority.

· A purpose-built FirstNet-AT&T site in Fellowsville, West Virginia along Route 50, which was "identified as a top spot where rural connectivity challenges exist in West Virginia."

As of September 2019, there were 138 devices which have been certified to operate on the FirstNet network, ranging from wireless modules and in-vehicle modems to laptops, tablets and smartphones. The FirstNet app ecosystem had

The groundbreaking for a new FirstNet-AT&T site at Red Cliff Reservation in northern Wisconsin.

Image courtesy of FirstNet Authority

more than 50 applications certified for public safety use, and a fleet of 75 deployables, including three flying cell sites, to establish coverage in the wake of natural disasters or additional capacity for planned events. AT&T said it has supported more than 175 such deployments through August, ranging from wildfires and flooding to outdoor concerts. Deployables can augment macro-network coverage for outdoor scenarios and boost nearby in-building coverage as well.

The network and features continue to evolve. Although FirstNet was originally envisioned as a network that would provide cellular data service to augment Land Mobile Radio systems—because true mission-critical voice services in LTE were years off and would have to demonstrate absolute reliability and availability before public safety would adopt them—AT&T anticipates that it will be rolling out standards-based mission-critical push-to-talk in its network by the end of this year. Still, the FirstNet Authority says that the network "is built with the expectation that public safety will continue to rely on land mobile radio" and that its priority in this area is to ensure that FirstNet voice capabilities are designed to interoperate with LMR. The FirstNet board also recently gave the go-ahead for doing the initial work to upgrade the FirstNet private network core for 5G services.

The Authority has said that it plans to continue playing an active role in 3GPP and other standards bodies which develop related specifications for LMR-LTE and dispatching technologies, and it said that it will advocate for continued implementation of mission-critical features such as device-to-device communications, LMR-LTE interconnection and dispatch capabilities. (Among the First-Net services which AT&T has introduced is added network redundancy for Public Safety Answering Points via a private mobile connection over the FirstNet network.)

On the leadership side, AT&T announced in late September that Chris Sambar, who has headed up the carrier's team responsible for constructing and managing the FirstNet network since AT&T won the FirstNet contract, will be moving into the role of executive VP, AT&T Technology Operations, responsible for both wireless and wireline network planning, investment,

A FirstNet-AT&T SatCOLT, a Cell on Light Truck deployable that uses satellite-based backhaul.

Image : FirstNet Authority via Twitter

engineering, construction and operations for AT&T's consumer, business and government customers. His role as senior vice president for the FirstNet program at AT&T will be filled by Jason Porter, a fellow military veteran who has been serving as AT&T's chief data officer and SVP for strategic planning for AT&T's Technology Operations, where his responsibilities have included prioritization of more than half of AT&T's capital spending; his previous roles also include leading AT&T's cybersecurity business.

FirstNet's roadmap for reinvestment

The FirstNet Authority has two major financial directives: it has to be financially self-sustaining, and it has to continue reinvesting in the FirstNet network.

The authority will be receiving about $18 billion in payments from AT&T over the 25-year-term of the FirstNet contract. An estimated $16 billion of that is expected to be reinvested in the network, as is required under the law which established FirstNet. Those funds, as the Authority puts it, "may only be used for constructing, maintaining, operating, or improving the network." This year, the FirstNet board

has budgeted about $145 million for network reinvestments.

So how and where is FirstNet going to direct those dollars?

The authority has a recently released roadmap that is guiding its reinvestment decisions, what it calls a "living document" of a five-year plan, based on feedback from public safety responders across the country which will be updated annually. FirstNet Authority officials laid out the details of the first iteration of the roadmap during a session at the at the Association of Public-Safety Communications Officials-International conference in Baltimore earlier this year. That roadmap covers six vital technology and capability domains: the network core, coverage and capacity, situational awareness, voice communications, secure information exchange and user experience. Within those six domains, the roadmap identifies the underlying, enabling technologies; what public safety responders around the country have identified as their needs; and the resulting priorities for FirstNet network reinvestment.

In-building coverage falls under the domain of coverage and capacity, which FirstNet officials have said

continues to be one of the top areas of concern for public safety: quite simply, is FirstNet available when and where they need it? In-building coverage is specifically identified as a priority in the roadmap.

FirstNet identified the "key enabling technologies" for coverage and capacity as:

- Macro coverage
- The capacity to "deliver mission-critical services at all times and under all conditions."
- In-building solutions to provide "persistent coverage" in areas that the macro network may have difficulty reaching, including inside commercial buildings, in underground public transit stations, and in venues such as crowded sports arenas.
- Range extension, or the ability for FirstNet users to maintain connectivity beyond the Radio Access Network edge through options such as vehicular network systems, LTE relays or high-powered user equipment.
- Device-to-Device communications, also known as "direct mode" or proximity services (ProSe), without relying on the core network.
- Temporary, on-demand or as-needed coverage via FirstNet

deployables.

What do first responders want in terms of coverage and capacity? FirstNet's feedback from first responders across the country public safety boiled down to three areas:

- Public safety wants transparency on where coverage exists today and the ability to guide where it will expand in the future.
- Responders prefer fixed, reliable wireless broadband coverage for public safety operations, especially as it becomes foundational to public safety communications.
- However, temporary coverage solutions must also be readily available to an agency and easily integrate into operations.

With the context of those underlying technologies and desires of public safety, the FirstNet roadmap priorities for reinvestment in support of coverage and capacity include:

- Increasing outdoor and indoor coverage, particularly in Band 14, at locations "deemed to be public safety priorities."
- Advocating for changes in policies, codes and standards to facilitate in-building coverage enhancement.
- Growing and enhancing

FirstNet's fleet of deployables. FirstNet customers can request deployables for additional or emergency coverage during planned events or disaster recovery, at no additional charge.

Those roadmap priorities are generally in-line with FirstNet's overall strategy as it went through the RFP and state plan process – but those conversations largely revolved around AT&T's macro network and outdoor coverage. While AT&T's DAS and even its Wi-Fi assets were sometimes mentioned as FirstNet representatives discussed coverage and network plans, that conversation has shifted somewhat now that FirstNet devices are actually in first responders' hands on a nationwide scale.

"They've come out and put it squarely in the list of expectations now," said John John Foley, general manager of the Safer Buildings Coalition, a non-profit advocacy group that focuses on improving building safety.

The FirstNet board recently approved the first reinvestment areas as part of its fiscal 2020 budget, which includes $145 million for network reinvestment. The board has approved network

reinvestment in two areas so far: expanding the FirstNet fleet of deployables, and making initial generational upgrades to the FirstNet core network in order to support 5G network capabilities.

But as Jeremy Zollo, executive director of enterprise strategy for the FirstNet Authority, noted at APCO 2019, the plan "doesn't just mean dollars" – it also will direct where the FirstNet agency will dedicate time, effort and resources to policy, processes and best practices that emerge from the public safety community.

"We have an opportunity as a nationwide organization to work with every level of government, and take advantage of folks that are already adopting and have lessons learned, and bring it back to folks considering [adoption]," Zollo said.

That includes work on improving in-building coverage via advocating for changes to existing regulations. The Authority takes the position that its public-private partnership with AT&T has already established a "robust coverage network" (particularly if you consider that technically, the FirstNet network has only been operating a little more than a year).

FirstNet, since it operates across all of AT&T's commercial bands as well as Band 14, can lay claim to already having indoor coverage via the carrier's 6,000-odd existing DAS deployments. But there remain millions of buildings in the U.S. which don't have in-building cellular coverage systems – and as of now, cellular coverage is not a required part of fire or building codes. As the Authority puts it, "Coverage expansion investments will have a direct and meaningful impact when targeted at critical locations, both indoor and outdoor." And, it added, "Meaningful improvements to indoor coverage can be achieved by updating relevant policies to encourage cooperation from building developers and owners."

At APCO, Brian Hobson, director at the Enterprise Strategy Office of the FirstNet Authority, said that the authority is looking at how it can take part in the work that goes into requirements for public safety LMR communications to make sure that in-building coverage requirements begin to consider, and eventually include, mobile broadband. "We have to help drive change in that, with the end result of improving coverage for public safety," he said.

Image: Kelly Hill/RCR Wireless News

Brian Hobson, director at the Enterprise Strategy Office of the FirstNet Authority, presents the FirstNet roadmap at APCO 2019.

Hobson and Zollo also said during the session that while all of the answers aren't clear yet on how best to update codes to include requirements for cellular mobile broadband, it's possible that in-building infrastructure may not be required to be AT&T-FirstNet exclusive – that it may have to be neutral-host in order to support all first responders fairly, regardless of whether they are FirstNet customers.

Public safety in-building coverage needs

So, FirstNet clearly sees in-building coverage as a fundamental part of meeting public safety's communications needs. But cellular systems have a spotty history indoors. Building materials, particularly low-emissivity glass, can kill RF signals pretty effectively, and the problem gets worse the deeper in the building you are. Parking garages, stairwells, elevator shafts and other relatively low-traffic areas typically are not targeted for coverage, even when in-building systems are present.

"Many issues create bad coverage inside buildings. One of the issues is that all the network and the technology really was designed for outside use, it was designed for mobile – and now 80%

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of our calls are made indoors. It's a common problem for cellular coverage to be challenged inside of a building. It's really an identical problem for FirstNet," said Joe Schmelzer of Nextivity.

The cellular industry has been trying to tackle the problem of indoor reception for years, particularly as more and more traffic has moved indoors. In-building cellular coverage has typically been achieved in one of several ways:

1. **In-building penetration from the outdoor macro networks.** This is the most common source of in-building coverage, because it requires nothing extra of mobile network operators than to have a macro site in place – but it's also not completely reliable, as anyone who has tried to continue a phone call while entering an elevator knows.

2. **Distributed antenna systems.** Active DAS systems are usually found in large venues, feeding signal from a base station (or base stations from multiple operators) into a series of antennas in order to create additional coverage and capacity within a specific building or environments such as subway tunnels. They can provide excellent coverage and capacity but are also typically the most expensive type of infrastructure for indoor coverage. DAS can be carrier-specific or neutral-host.

3. **Small cells,** which typically can support a limited number of users and are carrier-specific. They can be used in small-to-medium building environments, but installations need to take into account overlaps between cells in their network design, to avoid interference.

4. **Signal boosters, or bi-directional amplifier systems (BDAs).** These are often the least expensive and most rapidly-deployable option for strengthening a signal. These systems usually rely on an external feeder antenna to pick up signals from nearby base stations, which are then amplified within the building. They can be wideband boosters that strengthen multiple cellular frequencies from outside sources, or they can be carrier-specific, but they generally do require some level of network design in order to ensure that they do not cause interference with the macro network. Federal regulations changes have made cellular BDAs a more popular option than they used to be, when they were more unregulated and often caused interference with the macro network.

All of those options are familiar in the cellular landscape. But existing public safety communications networks have been built with a very different paradigm. Some of the changes that come into play when commercial cellular systems converge with public safety include:

System exclusivity. Public safety users are accustomed to operating on a communications network to which only responders have access, not systems which are shared with consumer or enterprise users. FirstNet-AT&T has addressed this by adding network priority and preemption services for FirstNet users, so that first responders can access the network even in times of high congestion. Verizon and U.S. Cellular have also added private network cores for public safety with priority and preemption services.

Differences in governance and operations. Local, regional or state jurisdictions typically run

Signal boosters, such as Nextivity's Cell-Fi Go Red, are one option for indoor public safety communications coverage.

Image courtesy of Nextivity

the LMR or Project 25 networks (or contract it out) and so there has been a relatively close relationship between local public safety agencies and license holders. Public safety agencies haven't had to work with MNOs to get those systems certified or on-air, and building owners have not had to deal with carrier-directed timelines for installing or certifying public safety systems that are required for occupancy.

"Acceptance testing for the public safety systems is difficult. It's very difficult. It's very time-consuming. It required skilled professionals," said Schmelzer. A commercial cellular site, he added, can be an 18-month to three-year project with completely different technology and expertise requirements than two-way radio systems.

Funding. While responder agencies have had to work within the constraints of municipal budgets for funding their communications systems and equipment, when it comes to the in-building environment, there are established LMR coverage requirements governed by requirements in the International Fire Code and/or the National Fire Protection Association with input from local officials on frequency support. Building owners must comply with requirements around coverage and pay for systems to be installed, in order to get the all-important certificate of occupancy so that their buildings can be leased or sold.

Meanwhile, in-building cellular systems have been installed and paid for by building owners or carriers based on customer demand and ROI. Carriers' capital spending on in-building cellular systems has fluctuated over time, with the last few years seeing generally lower allocations for equipping specific buildings with DAS. However, several vendors and industry observers said that AT&T's spending on in-building coverage has seen an uptick.

"AT&T has stepped up their funding of AT&T-funded in-building systems, where the spark, the genesis of it was signing up a FirstNet customer," said Foley. "That's a sea change."

Tormod Larsen, CEO of infrastructure company ExteNet Systems, said that his company also is seeing an increase in demand from AT&T for in-building systems.

"In addition to AT&T's bigger push into 5G [Evolution] or 5G, they're looking at in-building

in-general – and FirstNet is getting a free-ride position, a good, positive message in terms of that," he said. "We see the uptick there."

Frequencies used by public safety systems in the U.S. also are different than those used by cellular. Public safety frequencies used in the U.S. range from around 30 MHz to 150 MHz, 450 MHz and 800 MHz – all pretty low-frequency bands compared to cellular systems, with excellent propagation and penetration characteristics. Responders also been able to rely on LMR handsets which typically transmit with between 3 to 5 watts of power – far more than the typical cellular handset and enough to substantially increase in-building connectivity.

Hardware and coverage requirements. The public safety communication system hardware and installation itself also has significant differences from commercial cellular systems. Public safety coverage is required by to cover "critical areas," generally considered to be 99% of the building interior – not just high-traffic areas, but basements, elevator shafts and stairwells that are often a low priority or difficult for cellular system coverage. Public safety radio

systems must have hardened equipment with battery back-up which is placed in protected rooms that have to be rated to be able to withstand a fire for a minimum of two hours. Some codes even demand that public safety and commercial cellular communications systems not share any active components.

The challenges, and the good news

Given those fundamental differences,there are more than a few challenges associated with establishing solid cellular coverage for FirstNet users.

Perhaps the biggest one at the moment is that there are no clear, First-Net-specific in-building technical requirements for building owners or jurisdictions which would like to be early supporters of cellular coverage for first responders, and no formal process by which they can go to AT&T and find out how they can go about getting a system in place that supports FirstNet's needs, or write their codes to require such systems.

"We still have a great need for AT&T to communicate technical requirements and process to the market, so building owners, third party operations and industry can be certain that when they put

How well do LTE devices handle audio in public safety environments?

Inside a burning building, alarms are going off – and the first responders on-scene still need to be heard and hear their communications devices. Outside, fellow responders are conversing as they stand next to a fire truck with its pump running, as more emergency vehicles arrive with sirens blaring. As public safety agencies more frequently rely on commercial LTE devices as they perform their duties, how well are those devices likely to perform in noisy emergency scenarios?

It's a lot more technically challenging to deliver understandable speech in active emergency situations than to deliver good, consumer-grade cell phone audio, according to a new report from test company Spirent Communications. Although some LTE devices used for public safety purposes can outperform purpose-built public safety devices on audio quality, performance is uneven and there is plenty of room for improvement, the testing company found.

Spirent tested four devices that support public safety LTE; it did not disclose which devices or their manufacturers. While the traditional Mean Opinion Score for cellular calls focuses on assessing audio quality, Spirent focused on testing speech intelligibility, which it explained is the ability of a device to transmit all the critical components of speech in the presence of these background noises so that words and phrases can be easily understood," Spirent explained.

Spirent created a controlled lab environment in its Maryland Performance Center where it could simulate challenging acoustic situations from the field. The test subject was a head-and-torso simulator dubbed Horatio, placed in the center of an acoustic isolation chamber. Voice phrases were played out of Horatio's mouth and captured by a device-under-test, while real-world recordings of background noise were played through speakers placed around the torso in order to create 360-degree sound reproduction, and upstream audio was recorded at the receiving end, the company said.

infrastructure in to support First-Net inside buildings, that it meets the AT&T requirements and the fire code requirements. We have a lot of work to do here, and some of that's got to come from us educating the market on fire codes and frankly, some of it's got to come from AT&T establishing the technical requirements," Foley said. Building owners, he said, "need a predictable process where they can go to AT&T and say 'Here's my design, is it approved, will you connect, how are you going to connect, who's going to pay for that box, who's going to pay for the backhaul, and when will I be connected?' Those are gaps in the process right now. Those are gaps in the technical definition and until they're resolved, it's going to be very difficult for there to be a workable regime where building code officers can, in reality, require FirstNet in-building."

Kevin Pershing, head of public safety for North America at infrastructure company Cobham Wireless and a board member of the Safer Buildings Coalition, said that it is "just a matter of time" before AHJs (authorities having jurisdiction for code enforcement) begin to push for cellular in-building coverage

for FirstNet. He added that other details that will need to be determined include whether the signal source for FirstNet frequencies will need to adhere to existing fire code regulations on a hardened housing, alarm functionality, placement and other requirements which currently only apply to LMR systems. Pershing added that since the frequencies which AT&T leverages in a given market vary by region, it would make sense for the carrier to have regional points of contact established for system integrators to work with and figure out how to best handle a given deployment.

Pershing also pointed out that supporting FirstNet's Band 14 in-building isn't as easy as just flipping a switch to add a frequency. Cobham, he said, has sought to work with AT&T to test how well the addition of Band 14 to existing DAS actually pans out in terms of coverage. If the system has been designed with antenna placement to support higher cellular frequencies, there could potentially be interference when 700 MHz is added; if it was designed with a focus on lower frequencies, there could be coverage gaps that don't meet codes' 99% coverage requirements.

Fire code requirements are

technology-agnostic: they require that a selection of frequencies, dictated by local public safety agencies, must be supported by an in-building communications system. To date, that has not included cellular frequencies – even though many first responder agencies are already using mobile broadband devices. However, while cellular coverage has not to this point been required, fire codes are evolving to have LMR/P25 network requirements that look a bit more like cellular network requirements, such as specifically calling out a required received signal strength and requirements around DAQ or delivered audio quality.

Code implementations also vary significantly across the country. As Foley puts it, "There's no one truth across the whole country – and then, each jurisdiction makes local changes and tweaks," he said. Eric Mercil, director of sales for signal booster company SureCall, said that he works with some markets which are still working off of 2012 fire code versions rather than the more recent ones which have specific requirements for signal strength.

Asked about jurisdictions who are leading the push on cellular

coverage requirements in their local code implementation, Foley pointed to Washington, D.C., which first required that in-building public safety comms systems be "expandable" to cover FirstNet frequencies and this year, attempted to require FirstNet coverage in-building – but received pushback on the requirement from other carriers who also serve first responders. D.C., Foley said, is trying to figure out how to accommodate the desire of its first responders (some of whom have become FirstNet customers) to use FirstNet in-building, with the reaction from competing carriers, which Foley described as "an expression of concern that the district was requiring the service of one carrier to be included in buildings. I think they were also looking for an understanding or some consideration for, what about the other agencies and first responders who are using other carriers? Which is, frankly, a legitimate question: Whether you can draw an equivalency between First-Net, which is, at its concept level, a government agency and a communications service that was intended to be built specifically with special features for public safety – whether you can draw an equivalency

between that, and public safety agencies who use commercial cellular service, even maybe expanded-feature-set cellular service." Safer Buildings Coalition takes the position that the market needs to figure that out, Foley said, but added that, "It is a reasonable question."

But extending in-building coverage of cellular systems is good for citizens and for public safety – after all, a call from someone needing help is usually what triggers emergency response personnel to respond in the first place. According to the National Emergency Number Association, around 240 million 911 calls are placed in the U.S. each year, and in many areas, 80% or more are from wireless devices. Schmelzer said that the conversations around FirstNet are just part of an overall shift around cellular technologies and how they work indoors to promote public safety: the ability for callers to make 911 calls from inside buildings, and to be located with GPS. The Federal Communications Commission has paid attention to in-building communications capabilities for public safety as well, with new accuracy requirements on being able to physically locate 911 callers within buildings, including

on the vertical axis so that they can be found in multi-story buildings.

"I think that balance between the public safety needs and the commercial needs is going to be more obvious in the indoor, than in the outdoor-based environment," Larsen of Extenet says. "AT&T is going through the process of figuring out, what is that balance?"

In-building FirstNet coverage also has to take into consideration the ability of responders to use the service while they are on-duty at fire and police stations – which are likely to be challenging coverage environments as well. A recent National Fire Protection Association study found that 43% of fire stations are more than 40 years old, most of them serving small communities of fewer than 10,000 people; and 35% of fire stations do not have access to back-up power. Mercil said that one of SureCall's recent public safety implementations was for a small police department in Minnesota which wanted better in-station performance for cellular phones.

"You need this type of coverage," Mercil said. "It's the way the world's going, and if you don't have it, you're going to be left behind."

Schmelzer of Nextivity said that

his company also sees individual jurisdictions who want to purchase equipment to satisfy individual sites or needs that fall outside of FirstNet's commitments for coverage plans.

While FirstNet is in relatively early days of deployment and there are still many details around in-building coverage that have to be determined, Foley is optimistic about the direction that things are headed for strengthening in-building coverage.

"Our outlook is that AT&T recognizes the need and that they are taking this very seriously, as evidenced by the behaviors that we're seeing. They're not just paying lip service to it, they're investing. And we think that that's going to continue to expand. I think it's going to continue to expand," said Foley. Still, he went on: "What's exciting for us is when you have the level of conversations that we've been having … and you see how the discussion has evolved from where AT&T is thinking about how to support FirstNet in-building or how they might communicate technical requirements to the market where the market may want to provide their own systems. That certainly happens a lot, whether it's an end-user-funded system or a third-party operator

system that AT&T might join. AT&T recognizes there's many different use cases both on the technical and on the funding side – and they have to consider all of them.

"The move toward mobile devices in the public safety space and the inclusion of LTE … can't be underestimated," Foley said. "The capabilities that LTE brings, as an adjunct to the LMR voice network, have only begun to be understood and explored. It had the potential to really significantly change not just the operational models, but the funding and the cost structure of these systems." Cellular-based use of data, he added, has the potential to free up money, time and staff to focus on their primary mission of ensuring public safety. Still, "Technology itself is not a strategy," said FirstNet Board Chairman Ed Horowitz put it during a keynote address earlier this year. "We must be careful not to become too attached to a specific technology. Instead, look at the end goal—in this case, public safety. We must look at how to use technologies to make public safety's job more efficient and effective—not necessarily easier, because it is never easy." "FirstNet is extremely important. Public safety LTE is extremely important, and we have a lot

of work to do to figure out how this all fits, and how it can be used. But if it doesn't work in-building, everything falls apart," Foley said.

Key takeaways

- FirstNet in-building coverage, like the network/partnership itself, is in the early days, even though AT&T is already leveraging existing spectrum and systems (including about 6,000 DAS).

- The FirstNet Authority has specifically called out in-building coverage as one of its roadmap priorities for reinvestment.

- Many questions remain, and conversations are happening now, around technical requirements and processes for FirstNet-specific in-building coverage to be expanded – including as part of building/fire codes.

- AT&T has a unique public-private partnership with FirstNet, but it isn't the only provider used by public safety responders. Better in-building coverage can benefit citizens as well as responders. In-building systems can be carrier-specific or neutral-host, and it remains to be seen which will be required in future regulations. ((•))

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