LTE PREPARES FOR THE IOT AGE

By Tara Seals

The Internet of Things (IoT) is perhaps the most buzzed-about opportunity out there when it comes to wireless, and no wonder: Over the past decade, digital technologies have begun to blanket our lives, forming the backbone of a large, intelligent infrastructure that can support, in theory, billions of new connected devices. And as traditional mobile broadband subscriptions reach the saturation point in the U.S. and other developed markets, connecting things rather than people opens up potentially lucrative new revenue streams to keep business growing.

But the IoT isn't a one-size fits all proposition, nor are the traditional wireless players the only ones interested in exploring that landscape. To address the market successfully, mobile network operators (MNOs) are looking at a cornucopia of new LTE standards that will allow them to optimize their IoT offerings to specific applications—tweaking for metrics like cost-performance ratios and battery life. The growing technology standards arsenal ranges from EC-GSM to CAT M to 5G and beyond.

THE NEXT INDUSTRIAL REVOLUTION?

Vendors, visionaries and others have been discussing the potential of the IoT for years now: Tens of billions of new devices are expected to connect to the Internet and to each other in the coming years. That means installing sensors on everything from home thermostats and fridges to wind turbines, self-driving cars and even cattle and wheat fields.

In fact, the IoT has been heralded as the biggest technological change for humanity since the Industrial Revolution—a rather grand pronouncement. But while it's still a nascent market, industry-watchers are unanimous in expecting a hockey-stick growth curve to kick in within the next two to three years as operators and others deploy enabling technologies.

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GLENN LAXDAL, CTO NORTH AMERICA & HEAD OF STRATEGY AT ERICSSON

According to Ericsson's latest Mobility Report, IoT connections will overtake phone subscriptions by 2018. And, overall mobile connections will number 27.5 billion by 2021, with the IoT accounting for 15.7 billion of that total. By comparison, the number of mobile phone connections is expected to reach 8.6 billion in that time period. Further, a recent BI Intelligence report says that nearly $6 trillion will be spent on IoT solutions over the next five years.

The demand drivers are certainly there: Businesses see the ways the IoT can improve their bottom line by lowering operating costs, increasing productivity and expanding market and product development. A Verizon Wireless report this year found that 72 percent of businesses see IoT as "critical to their competitive advantage." Benefits are there for consumers too: Connected-everything boosts convenience, utility and puts time back into the day—often while helping them save money.

As a result, "there's not a wireless operator out here that's not laser-focused on the IoT market," said Glenn Laxdal, CTO North America and head of strategy at Ericsson. "The growth from smartphones is starting to dwindle. The next wave of growth will come from, number one, video, and number two, the IoT opportunity. We see a world where sensors will be embedded in any machine or use case that can benefit from connectivity, be it wind turbines, oil pumps, jet engines, vineyards, cars. At MWC [the industry's recent Mobile World Congress trade show] we demonstrated a connected water solution where, on a real-time basis, it's possible to monitor the quality of the water. And many of these connections have to happen over a wireless interface. Operators can provide that optimized connection."

Indeed, the CTIA said that U.S. wireless penetration stood at 115 percent as of the end of last year. So, new smartphone connections are becoming scarce, but the IoT is already filling the gap: Two-thirds of AT&T's new mobile connections in its last earnings report were IoT-related; more than half of them were for connected cars. AT&T also has close to a million connections just for car insurance dongles.

So far, so good. But there's one small caveat: The IoT is not going to happen at scale unless the solutions have lower cost profiles and other attributes that make sense for wide-area, narrowband, low-power applications. Examples are smart grids, home automation, agriculture and so on—applications where the average revenue per connection is much lower than the $50 per month most smartphone users pay today.

"There's tremendous pressure to get costs down, because operators have to figure out how to make their service available at much lower price points than what's available today," said Craig Miller, vice president of worldwide marketing at Sequans, the chipmaker. "A farmer is not going to spend $50 per chicken to monitor their health. The business case has to make sense."

And that's where the alphabet soup of new standards comes into play.

ONE SIZE DOES NOT FIT ALL

LTE networks were originally architected to support the mobile broadband opportunity—i.e., consumers and enterprise employees using their smartphones. These are high-ARPU subscriptions that required significant investments to support, in terms of power, traffic-shaping, speed provisioning and spectrum. But most IoT applications don't need that kind of horsepower, so standards are emerging that allow operators to more efficiently support the wide-range, low-power, low-throughput universe.

"It's important to remember that the IoT is not one thing," Miller said. "There are so many applications and use cases that are trying to get connected—so from a technology standpoint, you need different horses for different courses."

To that end, LTE CAT 1 emerged in release 8 of the LTE standard, optimized for mid-level IoT apps that need up to 10 Mbps download speeds. And CAT 0 was included in the existing release 12 standard, enabling 1 Mbps download speeds. But even these are too expensive and provide more than what would make sense for very low-power sensor use cases. For a connected water meter, even 150 Mbps of throughput would be overkill.

As a result, the 3GPP is working on new standards designed for extended coverage, deep in-building penetration, and long battery life.

So, release 13 of the LTE standard, expected to be ratified in June, has defined CAT M for narrowband

THE TRUE OPPORTUNITY MAY LIE BEYOND CONNECTIVITY

Operators are clearly well-positioned to go after the "connected things" space, because the base function of a wireless network is just that—it connects things. But adding new device subscriptions is just the first step for mobile operators looking to grab a piece of the trillion-dollar Internet of Things market: The application layer and Big Data are where the real money may well be.

Ericsson expects that connectivity will account for only five to 10 percent of the overall IoT market opportunity.

"When something connects to the network, you have the sensor and the network and the cloud," said Glenn Laxdal, CTO North America and head of strategy at Ericsson. "What needs to go into the cloud is the analytics that make use of the information being collected by the sensors."

For instance, in a wind turbine scenario, information about atmospheric conditions is uploaded to the cloud, where analytics are applied to see if the turbine's position is optimized to take full advantage of the wind direction. Then, new instructions are formulated and downloaded back to the turbine to re-orient it in real time to maximize its power output.

Each vertical requires quite a bit of expertise to deliver the kind of value that industries expect, so operators are choosing the two or three they want to focus on, Laxdal said. "They may want to own the connectivity level for all sensors out there, and then add analytics and data capabilities on top of that for specific use cases," he noted. "So you might find that operators aren't competing directly across industries, but instead will become specialists."

In looking to the value of information,

IoT. It comes in two flavors:

- CAT M1 (also called CAT MTC), which uses 1.4 MHz of spectrum to deliver 300-400 kbps, so it looks and feels like a 2G GPRS connection
- CAT M2 (also called Narrowband 1, NB-IoT or CAT NB1), which offers 30-50 kbps of throughput and uses 2200 KHz of spectrum.

Both technologies support a device battery life of 10+ years.

"You're not driving the Maserati very fast here down the information superhighway, but it's ideal for sensor applications," said Jim Parker, director of wireless small cell product management at Huawei and a former AT&T exec.

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Then there's EC-GSM, which is a low-power, high-range technology intended for operators like T-Mobile planning to maintain their GSM networks. But this is widely seen as a niche play: Most Tier 1 wireless carriers, like AT&T, are sunsetting their 2G and 3G networks in the coming years; GSM has already been retired completely in some countries.

carriers can go further still, according to Sam Lucero, senior principal analyst for M2M at IHS Technology.

Because of the nature of LTE technology, and soon 5G, "the connectivity will become more like a fabric," he explained. "And this leads to a shift from point applications being deployed by a specific entity for a specific purpose, to a situation where sensors are deployed for a primary economic rationale and then we have that data available to third parties for other uses."

He compared it to the rise of the iPhone and the third-party app developer phenomenon. "The iPhone spurred creative ingenuity because it enabled a vast third-party ecosystem," he said. "That's what needs to happen with IoT. Right now, we're in the pre-iPhone phase. But this has the ability to create entirely new industries that we haven't even thought of yet."

LTE has another card to play: The trend towards virtualization of software-defined network resources in core networks.

"Today you might deploy sensors to a raft of devices, but there's a strong economic case to deploy sensors pervasively through an IoT environment, collect mass amounts of information, deploy Big Data analytics against that information, and be able to marry that pervasive connectivity to virtual network topologies," explained Lucero.

As core networks are virtualized, there will be at first hundreds of millions, then billions, then tens of billions of things connecting dynamically to the network. Resources will be instantiated without people having to program the network or set aside resources ahead of time.

"At that point, only the imagination will bind the mobile business case," Laxdal said. ■

Trials and demos for CAT M1 are expected in the second half of the year, with operators deploying commercially by middle of 2017; CAT M2 should be slightly behind that.

"These capture all of the use cases that we believe we can get to in the next two to three years," said Laxdal. "The remaining capabilities and requirements we'll get to with 5G."

And indeed, looking further out, in the three- to five-year timeframe, additional key requirements will be addressed with 5G—most notably the need for very low latencies. 5G should provide a five- to 10X reduction in latency compared to existing LTE.

"As you evolve your thinking from, say, connecting a wind turbine to enabling things like autonomous driving or remote surgery, you want really low latencies, because milliseconds of delay matter," Laxdal said.

MNOs are up against outside competition, it should be noted, including LoRa and Sigfox, which received substantial funding at the end of 2015 to build a dedicated IoT network in unlicensed spectrum. 3GPP and the wireless carriers supporting it hope that CAT-M will bury those players in obsolescence.

"The low-power, wide-area space really got kick-started with the massive funding round that Sigfox enjoyed at the end of last year," said Sam Lucero, senior principal analyst for M2M at IHS Technology.

"And the wireless industry stood up and took notice."

By all accounts, this development lit a fire under the 3GPP to add capabilities in the short term to address what Sigfox and LoRa are doing. Combined with that, MNOs are banking on one distinct advantage that LTE provides: It's not single-purpose, and has incumbency.

LTE is fairly ubiquitous already; it can be amortized across numerous applications of which IoT is just one; it has a thriving global ecosystem; and it's very extensible, meaning that LTE-M is simply a software upgrade for existing LTE carriers. With no new hardware required in the field, chips and sensors automatically can talk to existing LTE networks as they're deployed, boosting time to market.

Spectrally, LTE guarantees a lack of interference, and IoT modules fit right in to existing schemes. "MTC and CAT 1 rely upon existing LTE technology," Parker said. "NB IoT is a different modulation scheme from LTE, so it's ideal in situations where you're refarming old GSM channels and you could dedicate one of those channels to this technology. You can also deploy it in a guard band within LTE itself. You can squeeze it in, and it's not difficult." ■

THE LPWA UPSTARTS ON THE IOT SCENE

by Anne Morris

Companies that wish to exploit the Internet of Things (IoT) have a multitude of factors to consider, not least how they will actually connect billions of new applications and devices that will have much lower power and data throughput requirements compared to today's connected devices such as mobile phones.

Arnaud Vamparys, senior VP for seamless wireless access at Orange, explained that the France-based mobile operator began to explore low power wide area (LPWA) technology options when it realized it required a new type of network that was designed for low data rates — not necessarily a standard cellular network.

By using a different type of wireless connectivity that is not designed for high data rates, the company said it would be able to address different use cases for B2B and eventually B2C customers in the area of IoT and machine-to-machine (M2M) communications.

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ARNAUD VAMPARYS, SENIOR VICE PRESIDENT FOR SEAMLESS WIRELESS ACCESS AT ORANGE

"The cost structure has to be very low with low data throughput," said Vamparys.

Thomas Nicholls, EVP for communications at Sigfox, which is one of a new breed of proprietary LPWA players, noted that he initially "spent all of my time justifying the need for a new type of connectivity — people thought we were crazy."

For mobile operators, cellular LPWA options are an obvious route to follow, and primarily include EC-GSM, NB-IoT (now renamed LTE CAT M2) and LTE CAT M1. However, the LPWA market is also littered with alternative, proprietary options that are jostling for their slice of the future global IoT market and are making their play before cellular standards for IoT are finalized.

THE NON-CELLULAR ALTERNATIVES IN THE LPWA GAME

Leading contenders in the proprietary LPWA market include Sigfox, the LoRa Alliance with the LoRaWAN standard, Silver Spring Networks and Ingenu, which has developed an IoT network technology called random phase multiple access (RPMA). Plenty of others are also out there, including Wi-Fi HaLow, Weightless-N, Weightless-P, NB-Fi (WAVIoT), Accellus, Flexnet (Sensus), Telensa UNB, and Synergize (Aclara), according to Aapo Markkanen, principal analyst at Machina Research.

Each of these options has defining technology characteristics. Some allow faster upstream and downstream speeds, some have larger ranges of coverage, and some have longer expected device battery life.

Peter Jarich, vice president of consumer and infrastructure services at Current Analysis, said it is also important to acknowledge the different models at play here.

"Sigfox and Ingenu are building out networks, LoRa is building an ecosystem. That means that each will appeal to different use cases. On the technology side of things, you've got Ingenu claiming that RPMA is better suited to robust IoT services. Again, however, it's a question of 'horses for courses' when you consider the needs of different use cases—not every

IoT sensor needs a capable downlink, for example," Jarich said.

Indeed, Sigfox is tackling the very low throughput segment of the market by selling a low power, low cost and low connectivity data subscription service. In other words, its solution is aimed at enabling companies to spend a small amount of money for a very slow-speed connection, and still be profitable.

The company's approach is to roll out its own network market-by-market and sell data subscriptions via distributors such as Arqiva in the UK. Sigfox itself acts as the service distributor in France and the U.S., where it now covers the metropolitan areas of the 20 largest cities and is targeting 100 cities or regions by the end of the year.

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MIKE BELL, CEO OF SILVER SPRINGS NETWORKS

SFR has also chosen Sigfox in France as its IoT partner and plans to sell solutions using Sigfox's LPWA technology. Orange, for its part, has opted for LoRaWAN because it wants to be in charge of its own technology developments; Orange also recently joined the LoRa Alliance in order to be more involved in the development of this standard.

Vamparys explained Orange moved to LoRa because the technology is flexible, bi-directional and could be deployed for a variety of different use cases.

"We are not investing billions of euros to just resell someone else's technology," he added, noting that Orange has a long-term commitment to LoRa and sees it as complementary to future 2G and 4G cellular LPWA technologies.

Vamparys added that LoRa would also help the company build on its existing M2M business: Orange already connects 9 million objects in Europe, for example. It's targeting €600 million in revenue from this business area by 2018.

In terms of other contenders, Markkanen noted that Telensa and Silver Spring Networks are filling a specific niche, "but they've built on a mesh architecture so they sit under a different technology umbrella [from LPWA]," he said.

Silver Spring Networks CEO Mike Bell conceded that the company has been pigeonholed as a smart energy company and has initially focused on solutions for street lighting, smart meters and other smart city and smart energy-focused applications.

However, Bell is convinced his company's SilverLink technology can punch much higher: "We have an open, standards-based IPv6 network … and a mesh architecture so the devices can communicate with themselves."

Although the company plans to maintain a focus on smart energy and smart cities, its goal is to become an IoT network provider for everything. It also believes its technology will be a great adjunct to cellular options in the future.

Ingenu's RPMA is also regarded by some as a niche option because of its previous focus on private networks. However, the company has big ambitions to become a global provider of public networks for IoT connectivity and is already seeking partners worldwide. In the U.S., the company will build, manage and operate the network.

Ingenu CEO John Horn said the company's technology was built specifically for machines.

Unlike the low data-rate approach of Sigfox, for example, RPMA is designed to connect devices with higher downlink and uplink requirements.

"We want to capture as big a footprint as possible," Horn said, noting that the company has networks under construction on four continents and is aiming for six by the end of this year. Ultimately, it is Ingenu's goal to establish RPMA as the global standard for IoT connectivity.

The message from the alternative LPWA players is broadly similar: they all want to push their technology into the global marketplace and they believe their approach offers considerable benefits for users.

Clearly, this space is bound to shake out. As things stand, IoT market share is there for the taking. Market forces, proof of concepts and return on investment will determine which ones will survive in the long term. ■