www.pipelinepub.com
Volume 19, Issue 9

Massive IoT and 5G: What's Next for Large-Scale Cellular IoT?

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Without a doubt, the proliferation of the Internet of Things (IoT) has forever changed the way we live, work, and play. It's a phenomenon that continues to grow at an exponential pace as IoT adoption gains traction throughout the world. IoT is so pervasive, in fact, that it has spawned a pair of subsections: Critical IoT and Massive IoT. The former concerns applications that require a constant, data-rich connection to operate—with use cases that telemedicine, first responders, and factory automation. Massive IoT, as the name implies, is driven by scale rather than speed, and the more widespread IoT devices become, the more important it is to ensure cost-effective, scalable connectivity for the masses. Fortunately, low-power wide-area network (LPWAN) technologies like Long-Term Evolution for Machines (LTE-M) and Narrowband IoT (NB-IoT) cellular networks are uniquely suited for precisely the purpose of supporting massive IoT.

Offering myriad technical advantages over traditional cellular networks—including lower power consumption thus an extended battery life, and better coverage in difficult-to-reach areas—LTE-M and NB-IoT enable IoT deployments to connect a wide array of devices more economically while consuming minimal amounts of data and power, making them ideal technologies for running applications that call for infrequent, small-sized data transmissions. Verticals that fall under the "Massive IoT" umbrella include smart utility metering, smart cities, and asset tracking, among others. As the transition to 5G marches forward, however, new challenges emerge for massive IoT—perhaps the most pressing of which is addressing how to avoid a potential gridlock of data traffic as millions of additional IoT devices come online.

Measuring Up

From calculating electricity use in homes to water usage at businesses, smart utility meters—known for their precision and ease of use—make life simpler and help people become more responsible consumers of resources. In fact, the installation and use of smart utility meters in homes and places of business are on the rise all around the world, with Berg Insight predicting the installed base of smart electricity meters to grow from 110.4 million to 153.8 million in North America, and from 659.3 million to 886.1 million in the Asia-Pacific region between 2019 and 2025. LPWANs like LTE-M and NB-IoT have long been and will continue to be the prevailing and most affordable selections when it comes to smart metering solution connectivity. Both technologies are 5G-ready and as such will coexist with 5G networks in the longer term, even beyond 4G LTE sunset. As both NB-IoT and LTE-M are essential standards of 5G, by selecting cellular 4G or 5G over unlicensed spectrum options, utilities can effectively future-proof their solutions and prolong the need for restructuring. Understanding the significance of supporting next-generation IoT applications with technology that can grow, develop, and evolve as networks come to embrace 5G, it becomes increasingly standard's speed and availability. Scalable deployment strategies and architecture are essential to harness the benefits of 3GPP technologies like 4G LTE and 5G, enabling businesses to expand their IT and OT networks—even in places hardest to reach. In water and gas grids, for example, thousands of sensors as well as control valves and regulators have to be monitored remotely to support consumer usage and avoid or mitigate line breaks and other failure conditions across multiple sites. Managers need to react quickly to avert catastrophes. And they can, thanks to IoT, which provides them with the necessary tools and resources to do so. As cellular networks continue their evolution of servicing billions of devices, there is a growing demand for connectivity solutions that meet both business and technical needs.

Street Smarts

To some, smart cities represent the last stop on society's road to utopia. The successful implementation of smart city technology depends on several key factors, however. The collection andanalysis of big data to influence improvements in city operations is one such example; therefore, it is imperative that the orchestration and management of device data is carried out in an efficient manner. Another factor has to do with planning for the integration of large volumes of IoT devices and sensors into most operations within a given city. Cities must prepare for and continuously weave connected devices and sensors into their existing infrastructure. Additionally, mission-critical security that is both scalable and extremely effective is paramount. As cities become increasingly reliant on the digital capabilities facilitated by smart cities, they inherently become more vulnerable to cyberattacks from nefarious actors. The mitigation of such risks requires that security measures be

baked into mobile networks, wired internet infrastructure, and the cloud from the edge.

Of course, no smart city is truly "smart" without 5G technology, which maximizes the technical capabilities for everything from high-speed cameras and large-scale vehicle fleet automation to smart monitoring of the environment. 5G technology is continuously evolving, and the latest 2022 5G specification introduced a new 5G technology flavor called Reduced Capability (RedCap, aka NR-Light or NR-Lite)—the perfect trade-off to bridge the capability and complexity gap between 5G enhanced mobile broadband (eMBB) and ultra-low latency communication (URLLC), and the low power consumption and cost efficiency typical of LPWAN technologies.

Further, to fully take advantage of 5G's potential, both private 5G and LTE networks may be utilized. In leveraging the available technology in such a way, it's possible to separate specific IoT applications and services from the wider network—a delineation that allows entities with elevated security concerns, such as hospitals and financial institutions, to experience the benefits of first-class connectivity with minimal risk of data loss or theft. Additionally, locations like school campuses and city streets can benefit from seamless roaming while offering smart citizens the ability to switch between public and private networks.

To be sure, the rise of IoT applications has led to the connection of millions of devices. Behind the scenes of it all, helping facilitate the magic are mobile broadband networks, which allow for the connection of low-data smart sensors that generate the massive machine communication infrastructure we know as Massive IoT. As such infrastructures grow over time, the limitations of traditional mobile networks to enhance technological progress become increasingly apparent. While small cells play a major role in the further evolution of these networks, they serve something of a different purpose when comparing their effects on mobile broadband to their effects on Massive IoT. In the case of the former, small cells are integral for delivering mmWave coverage. By overlaying new signals in the mid-band spectrum, they can achieve greater capacity as well as higher average data rates. With Massive IoT, however, small cells boost the areal density of 5G connections for swarms of sensors and similarly low-power, low-data IoT devices. Consequently, 5G integration is absolutely central to accommodating advanced AI- and sensor-enabled technology.

Tracking Along

Asset tracking is another prime use case for Massive IoT. The extraordinary telematics solutions made possible by Massive IoT technology can assist fleet managers and logistics specialists in streamlining and optimizing their supply chains and enhancing overall operations by keeping costs down and efficiency up. By enabling real-time monitoring of equipment, goods, and vehicles within a fleet, response times to address lost or stolen assets are diminished dramatically, while maintenance decisions and other crucial choices can be decided upon using the most up-to-date data possible.

Naturally, real-time communication of information and data is positively essential for IoT-enabled telematics devices used in industries like shipping and supply chain management. To successfully guarantee the reliability and global compatibility of their connectivity solutions, it is imperative that device manufacturers consider that 2G and 3G cellular networks will be virtually put out to pasture sooner than later. As the great pivot to 4G and 5G networks comes to its long-awaited fruition, IoT modules will need to be ready to accommodate those higher standards, ensuring continuous and uninterrupted operation of dated devices when the time is right.

Cellular IoT—or Mobile IoT—is a critical component of both GPS tracking devices and sensors that power the real-time asset monitoring vertical. Simply put, such tracking devices are rendered obsolete without a way to communicate the data they collect. With 95% of the planet's population covered by existing mobile networks, Cellular IoT represents an ideal connectivity solution for

intelligent asset tracking. Originally developed and introduced as part of 2016's 4G-LTE specification, LTE-M and NB-IoT networks are today formally acknowledged as bona fide 5G technologies; therefore, IoT devices connected to these networks will receive support even after the predicted sunsetting of 4G networks.

Challenge Accepted

The path to full-5G for Massive IoT is not without its challenges. For starters, steps must be taken for advanced LTE networks to be equipped with bolstered capabilities to handle the monumentally increased amounts of data traffic stemming from the arrival online of millions of new mobile and IoT devices. Yet another hurdle along the way has to do with data security. As IoT networks grow, hacker collectives and other bad actors are more than likely to up the ante of their attacks, launching aggressive assaults on the existing infrastructure to seek out vulnerabilities. So, it's essential that data security be top of mind for any customer seeking to get in on the IoT solutions frenzy. The expectation is that AI, machine learning, edge computing, and beefed-up authentication methods will all play key roles in building out robust security protocols for Massive IoT adoption. To help maintain consumer confidence and limit unauthorized intrusions, it is important, too, that organizations seeking to invest in Massive IoT be proactive in strengthening their own security standards prior to joining the 5G fray.

While it is true that Massive IoT's promises of heightened 5G connectivity for devices worldwide may manifest as difficult trials and tribulations, particularly for things like network reliability and security, as President Theodore Roosevelt famously stated, "Nothing worth having comes easy." When one considers what is truly on the horizon—seamless utility monitoring and environmental stability, as well as Rhodes Scholar-like municipalities and the ability to pinpoint assets anywhere on the planet in real time—it becomes increasingly clear that the Internet of Things is not only about making life easier—it's about ameliorating people's homes, their cities, and their livelihoods.

In other words, what's next for large-scale cellular IoT is well worth the blood, sweat, and tears it will take to get there.