UNLOCKING TELCOS IOT POTENTIAL

HOW TELECOM OPERATORS SHOULD STRATEGICALLY NAVIGATE THE COMPLEX LANDSCAPE OF IOT LPWAN TECHNOLOGIES

By Thibault Werlé, Rachid ElAmeri, Rüdiger Schicht, and Rodolphe Frugès

The Internet of Things (IoT) allows computing devices and machines to share data directly without human input. It boosts productivity – via speed, accuracy, and system integration – across a wide range of applications, and is already transforming consumer, commercial, industrial, and infrastructural activities.

Low-power wide-area network (LPWAN) technologies can support diverse large-scale use cases across all sectors and are attractive in terms of range, power consumption, and cost. LPWAN runs on both licensed (cellular) or unlicensed (non-cellular) frequencies and includes proprietary or open standard options. With their pre-existing LTE infrastructure, telecom operators have focused on cellular IoT, with more than 100 operators already deploying Narrowband IoT (NB-IoT) and Long Term Evolution for Machines (LTE-M).

However, the IoT space is evolving quickly with implications for all stakeholders. Developments from the emergence of cutting-edge use cases require telecom operators to adapt.

This paper offers an overview of the LPWAN space, major cellular and non-cellular technologies and their corresponding use cases, the key focus of telecom operators today, and the key strategic levers for telecom players to stay relevant in the future.

LPWAN technologies are critical enablers of today's large scale IoT use cases

LPWAN stands for a group of network technologies that connect low-bandwidth, battery-powered devices with low bit rates over long ranges. A fit-for-purpose balance between battery life, cost, and bandwidth have made LPWAN technologies a critical enabler for massive IoT deployments such as smart cities.

LPWAN can be deployed on a licensed spectrum using LTE-M and NB-IoT cellular IoT technologies. It can also run via propri-

etary technologies in the unlicensed spectrum, mainly through Sigfox and LoRa.

Cellular and non-cellular technologies bring distinct strengths and limitations

Differences in performance mean that technology well-suited to one use case may be less appropriate for another. Think of it in terms of priorities and trade-offs, and not a single 'best' technology.

Speed. Short (i.e. faster) latency and high maximum data output make cellular IoT technology critical for sensitive use cases requiring important information to be sent quickly, for example in national fleet management.

Mobility. High scalability and seamless handover help cellular technology LTE-M support smart use cases, involving travel or otherwise mobile elements. Examples include vehicle telematics and autonomous guided vehicles.

Security. All IoT applications present cybersecurity threats, with no single technology mitigating all the risks. Stronger IoT cybersecurity features typically come with a higher price and more processing power requirements which is possible with cellular IoT as they leverage the existing encryption and cybersecurity and Quality of service (QoS) capabilities of LTE.

Range. The high rural range makes unlicensed spectrum technologies such as LoRa and Sigfox a better choice for IoT agriculture use cases like crop management.

Cost. Cellular technology will cost owners more than non-cellular options.

Despite similarities among cellular technologies of NB-IoT and LTE-M, they favor different use cases

Cellular LPWAN solutions NB-IoT and LTE-M, both developed by 3GPP, offer low lag time, high data throughput, excellent QoS, and cybersecurity features. They also compromise range and come at a higher cost. These technologies are ideal for sensitive use cases – in urban settings that require more data throughput, high speeds, and cybersecurity requirements. Typical examples include:

- Remote healthcare: requires real-time data communication with very low latency
- Fleet management: relies heavily on mobility features
- Water and gas metering: sensitive data with nationwide deployment and high complexity
- Smart home: personal and sensitive data (e.g. access control) requiring low latency

However, NB-IoT and LTE-M differ in some respects. LTE-M performs better when it comes to data, usually enabling lower latency, higher data rates, and bi-directional communication. It provides a seamless handover between base stations, therefore more suitable for moving devices.

NB-IoT's handover on the other hand is limited. Although it supports higher data rates than non-cellular IoT, it is slower than LTE-M. But it offers a longer range, better battery performance, and lower costs than LTE-M.

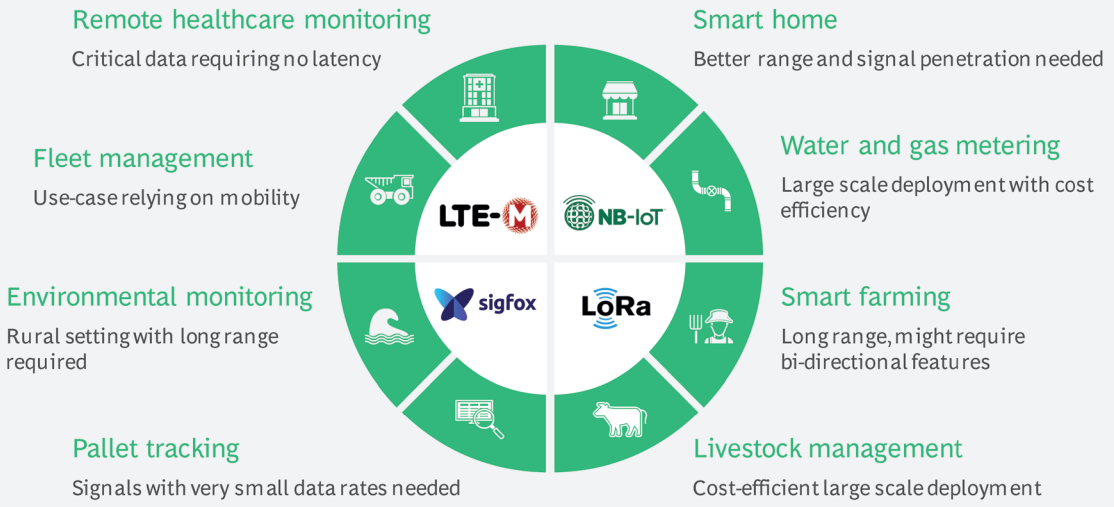
These differences enable us to further segment cellular use cases. (See Exhibit 1.)

Non-cellular technologies, SigFox and LoRa also feature distinct strengths and uses

In contrast with cellular-technologies, Sigfox offers low data throughput and high latency but to the benefit of a high capacity, extended coverage and resistance to jamming. LoRa offers characteristics similar to NB-IoT, solving for the hand-over limitation but being prone to interferences that limits QoS and scalability.

Non-cellular IoT technologies suit massive use cases requiring cost-efficiency, in rural

EXHIBIT 1 | NON-EXHAUSTIVE LPWAN USE CASE EXAMPLES



settings, with low data throughput, and limited speed and cybersecurity requirements. When data is not critical, security can be de-emphasized for the sake of lower costs. Ideal uses include:

- Smart farming: requires a low-cost and longer battery life, as many rural areas lack LTE coverage
- Environmental monitoring: usually in remote areas, with data exchanged in batches
- Pallet tracking: moving objects requiring limited data
- Livestock management: high cost-efficiency is needed

As with cellular technologies, Sigfox and LoRa also present technical differences that favor or eliminate specific use cases. While Sigfox is the optimal solution when it comes to range, cost efficiency, and jamming immunity, LoRa supports higher data rates and allows some limited bi-directional communication. Sigfox has the edge in use cases that require very limited data, while LoRA better supports long ranges requiring more data. These nuances allow us to further define each technology's ideal use cases. (See Exhibit 1.)

In the last five years, three strategic choices drove telecom operators' LPWAN deployment

TELECOM OPERATORS FOCUSED ON CELLULAR NETWORKS TO BUILD ON THEIR LTE INFRASTRUCTURE.

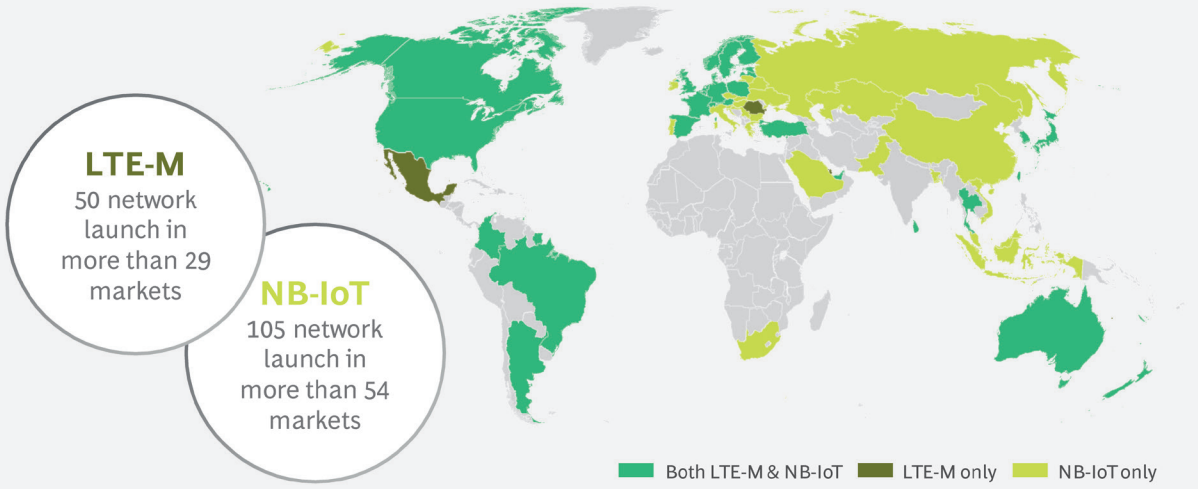
Both cellular IoT technologies are defined by 3GPP as standards evolving from existing LTE. With their preexisting LTE networks and 4G infrastructure, telecom operators have typically focused on cellular IoT rather than the unlicensed spectrum.

Building on these investments, telecom operators will want to leverage their strength in NB-IoT and LTE-M. They must take into consideration available spectrum and frequency compatibility, as well as the future emergence of 5G New Radio (NR) and its implications on LTE.

NB-IOT DEPLOYMENT IS MORE THAN DOUBLE THAT OF LTE-M AROUND THE WORLD

Telecom players globally are deploying NB-IoT and LTE-M, but currently NB-IoT deployment is more than double that of LTE-M. (See Exhibit 2.) 3GPP has defined dedicated frequency bands for these technologies, and Mobile Network Operators (MNO) around the world have already deployed cellular IoT on more than 60 percent

EXHIBIT 2 | MOBILE IOT DEPLOYMENT



Source: GSMA, December 2020

of defined frequencies. As of October 2019, 97 telecom operators in 51 countries offer cellular LPWAN service on different bands.

Live deployments of cellular IoT around the world are diverse, relying heavily on sub-1GHz bands, with B20 (800MHz) accounting for the largest share. Approximately 20 percent of MNOs use a multi-band deployment on higher bands (e.g. 1800 MHz). As the number of compatible frequency bands rises, so too does the price of IoT modules. Telecom operators will want to focus on a limited set of frequencies to ensure technical interoperability without increasing the cost of deployment.

SOME TELECOM OPERATORS HAVE COMPLEMENTED THEIR OFFERING WITH NON-CELLULAR LPWAN TECHNOLOGIES

Several telecom operators have decided to complement their cellular IoT deployment with non-cellular offerings, to provide more options to their clients and prioritize the cellular IoT network for critical and sensitive use cases. Around the world, 24 mobile network operators currently deploy Sigfox or LoRa.

LoRa networks are being actively deployed globally, mainly in the Asia-Pacific region and Europe. Swisscom, a major telecommunications provider in Switzerland, deployed a LoRa network on top of both LTE-M and NB-IoT to cover uses cases such as weather monitoring, plant growth, and livestock tracking.

IoT Deployment in the MENA region

DEPLOYMENT OF CELLULAR IOT IN THE MENA REGION HAS REMAINED CONSTRICTED TO A FEW GEOGRAPHIES

To date, the United Arab Emirates (UAE), Kingdom of Saudi Arabia (KSA), and Qatar are the only ones who have driven cellular IoT deployment in the Middle East and North Africa (MENA). The UAE is leading the way in the region, having deployed both NB-IoT and LTE-M. KSA has also followed suit with one confirmed NB-IoT deployed, and more being announced. Qatar launched the first NB-IoT in October 2019. Additionally, Tunisia is the first to test the first NB-IoT network in North Africa. With limited participation of MNO's in the deployment of a cellular network for IoT, these developments leave the region wide open for many new entrants to the space.

TELECOM OPERATORS INVOLVED IN THE CELLULAR SPACE HAVE NOT SHOWN STRONG INTEREST IN THE DEPLOYMENT OF NON-CELLULAR IOT

In non-cellular LPWAN technologies, the MENA region currently sees a diverse geographical distribution. LoRa enjoys more

dominance with a presence in Egypt, Lebanon, Morocco, Oman, and KSA. Sigfox on the other hand has only been deployed in Oman, UAE, and Tunisia.

However, most of the non-cellular technologies deployment are done by new players (e.g. startups, global IoT players) with little participation from regional MNOs. Non-cellular deployment in the region has been used to cover a wide range of applications from waste management, smart meters to smart agriculture.

To stay relevant telecom operators should consider five key strategic levers

The IoT space is evolving quickly, with the intensification of LPWAN deployments around the world, the growth and maturity of new edge-cutting use cases, and the increase in fragmentation of the players in the ecosystem.

This fast evolution will require telecom operators to think strategically and adapt continuously if they want to ensure a sustainable and positive impact of their long term LPWAN deployments and stay relevant in the IoT landscape

As telecom players attempt to adapt to this rapidly changing environment, there are five strategic levers they should consider:

1. **Build strategic partnerships**
   Build local and regional LPWAN strategic partnerships with manufacturers, integrators, researchers, and end-users to drive IoT adoption and success. This encourages collaboration within the IoT ecosystem and boosts innovation. Strategic partnerships can help IoT players develop their skills and build key competencies along the entire value chain. In addition, they can develop regional certifications for IoT devices and equipment, supporting cross-regional IoT deployments and international roaming.

2. **Manage the complex interoperability challenge**
   Navigate the increasingly complex and fragmented stakeholder ecosystem. Given the heterogeneity of the current IoT ecosystem, IoT solutions from different vendors are rarely interoperable resulting in closed vertical silos. Telecom operators in the center of massive IoT deployments should define and integrate an interoperability approach into their offerings to gain customers' trust, break silos, and accelerate the integration of new use cases.

3. **Establish roaming agreements**
   Accelerate the national cellular IoT roaming agreements agenda and coordinate with other mobile operators to establish regional roaming agreements. These help telecom operators accelerate the adoption of IoT, especially for use cases involving cross-border mobility. In 2017, Deutsche Telekom started an NB-IoT European trial to test international roaming. Following its success, the company began to partner with European MNOs to ensure full coverage across Europe. By April 2020, the Deutsche Telekom NB-IoT roaming agreement covered 18 European countries.

4. **Evaluate the strategic relevance of LPWAN alternatives**
   Although cellular IoT is the top priority for telecoms players, they should also assess the strategic relevance of non-cellular LPWAN alternatives to support IoT adoption. For example, LoRa may be an attractive complementary solution for managed private networks. Or perhaps there is value in acquiring the license to be a country's sole Sigfox network provider and leverage its anti-jamming capability and cost-efficiency. French telecom giant, Orange, has deployed LoRa since 2016 and is currently covering more than 30,000 municipalities and 95 percent of the population of Metropolitan France.

5. **Prepare for 5G**
   As 5G deployments continue to grow significantly around the world, Telecom operators should plan the evolution of their existing LPWAN technologies to ensure continuity of service for the end-users and manage efficiently the cost of transition.

DEUTSCHE TELEKOM
Winning as a global IoT orchestrator

By leveraging connectivity as the "right to play", Deutsche Telekom spun its IoT unit into a separate business unit, Deutsche Telekom IoT, on 1 July 2020 to expand horizontally into the IoT value chain by focusing on a unique winning approach: Being a global IoT orchestrator.

"Not only does Deutsche Telekom IoT enable vertical solutions by understanding each sector's pain-points, developing bespoke IoT solutions, and speaking the same language as our customers, but we also expand horizontally into the full value chain by playing the role of an orchestrator", says Ingrid Wistrand, VP Business Strategy & Execution at Deutsche Telekom.

By making devices and data work together in perfect harmony, Deutsche Telekom IoT is bringing together relevant stakeholders across geographies to enable end-to-end solutions across the ecosystem tailored to their customers' needs

1. Building strategic partnerships

The German giant was able to build and nurture strategic partnerships with key IoT players across the value chain. The recent launch of the Telekom Open IoT Labs in conjunction with the Fraunhofer Institute for Material Flow and Logistics is a clear example of how strategic partnerships could drive collaboration to develop and test innovative NB-IoT solutions and make them market ready.

2. Managing the complex interoperability challenge

Deutsche Telekom understands the importance of interoperability and actively launch new initiatives to address it. This year, it introduced the IoT Hub, the world's first open IoT platform, connecting existing heterogeneous systems with each other to create new possibilities for innovative IoT solutions. It brings together all players, including customers, partners, operators, and developers and ensures the complex interoperability challenge is taken into consideration while discussing with their customers.

3. Establishing roaming agreements

In 2017, Deutsche Telekom started an NB-IoT European trial to test international roaming, After the success of the trials, Deutsche Telekom partnered with European MNOs to ensure full European coverage. As of April 2020, the Deutsche Telekom NB-IoT roaming agreement covered 18 European countries. GSMA estimates that the success of the Deutsche Telekom initiative will provide guidance to all other operators in how to deliver NB-IoT international roaming consistently.

4. Evaluating the strategic relevance of LPWAN alternatives

While focusing its connectivity on 3GPP standardized technologies, NB-IoT and LTE-M, Deutsche Telekom is always in communication with their clients to anticipate their potential needs for other LPWAN technologies. Their IoT platform, Cloud of Things, is already offering add-ons to integrate data from the two major non-cellular LPWAN technologies LoRa and Sigfox.

5. Preparing for 5G

Today, 5G is used in a few German cities, however, Deutsche Telekom aims to deliver 5G to 99 percent of the population and to cover 90 percent of the country's surface area by 2025. As LTE-M provides higher data rates and swifter reaction time than NB-IoT, it is the technology that will build the bridge to 5G for Deutsche Telekom.

About the Authors

Thibault Werlé is a managing director and partner in the firm's Middle East office. He is a core member of BCG's Technology, Media & Telecommunications practice. You may contact him by email at Werle.Thibault@bcg.com

Rachid ElAmeri is a principal in the firm's Middle East office. He is a core member of BCG's Technology, Media & Telecommunications practice. You may contact him by email at ElAmeri.Rachid@bcg.com

Rüdiger Schicht is a managing director and senior partner in the firm's Zurich office. He is a core member of BCG's Technology, Media & Telecommunications practice, focusing on mobile spectrum auctions and telecommunication networks. You may contact him by email at schicht.rudiger@bcg.com

Rodolphe Frugès is a senior advisor in the firm's Paris office. You may contact him by email at fruges.rodolphe@advisor.bcg.com

Boston Consulting Group partners with leaders in business and society to tackle their most important challenges and capture their greatest opportunities. BCG was the pioneer in business strategy when it was founded in 1963. Today, we help clients with total transformation—inspiring complex change, enabling organizations to grow, building competitive advantage, and driving bottom-line impact.

To succeed, organizations must blend digital and human capabilities. Our diverse, global teams bring deep industry and functional expertise and a range of perspectives to spark change. BCG delivers solutions through leading-edge management consulting along with technology and design, corporate and digital ventures—and business purpose. We work in a uniquely collaborative model across the firm and throughout all levels of the client organization, generating results that allow our clients to thrive.