LTE-M vs NB-IoT

Comparing New Cellular Connectivity Options

Cellular Connectivity Brings New Options

Across industries and applications, engineers and product designers are increasingly attracted to the bandwidth and ubiquity of cellular networks to provide connectivity for their devices deployed almost anywhere in the world. With as many as 20 billion IoT devices in service by 2020, cellular is poised to move past low-power WAN infrastructures, thanks to several key advantages:

LOW POWER CONSUMPTION – Most devices can last up to 10 years in the field using a battery of five watt-hours

GREATER COVERAGE – Cellular networks are nearing almost complete coverage and are suitable for indoor and outdoor deployments.

ENHANCED SECURITY – Digi TrustFence® provides a tested and fully integrated security framework designed for the Industrial IoT. The built-in security of Digi TrustFence gives you secure connections, authenticated boot, encrypted data storage, secure JTAG, secure software updates, and TLS v1.2 for secure over-the-air data transmissions.

EFFICIENT DATA TRANSFER – Enabled by small, intermittent blocks of data

NETWORK AVAILABILITY – As carriers continue to build out their networks to the furtherest and remotest areas, there are fewer limits to where you can deploy.

DECREASING COSTS – Many carriers are rolling out data plans expressly targeting the unique nature of IoT devices, making cellular connectivity a far more affordable option.

But the question arises: what's the right cellular infrastructure to adopt for your IoT devices? In this white paper, we compare Narrowband IoT (sometimes called NB-IoT or NB1) with LTE-M (also known as LTE Cat-M or Cat-M1).

Introducing NB-IoT for Cellular IoT Deployments

NB-IoT is a new mobile data standard that responds to the rapidly expanding market for low power wide area (LPWA) connectivity. It's part of the Release (13) from the 3GPP cellular standards body. Like its LTE-M counterpart (see below), NB-IoT is optimized for lower-bandwidth applications with data rates at or below 250 Kbps. Initial NB-IoT deployments in 2017 and 2018 are primarily in Europe and in parts of Asia. Since U.S. carriers have already invested heavily in LTE-M infrastructure updates, it is unlikely they will deploy NB-IoT networks in the near future.

However, in those European and Asian regions the characteristics of NB-IoT make it ideal for applications where devices sleep most of the time, waking up only periodically to report readings or other data such as sensors on remote equipment. NB-IoT uses a simple architecture based on the single-carrier frequency division multiple access (SC-FDMA) standard and a DSSS modulation scheme that decreases hardware costs and complexity.

NB-IoT supports ultra-long battery life (up to 10 years), extended range (up to 700 percent better than current LTE technology) and better building/obstacle penetration for a wide range of applications and use-cases. For instance, NB-IoT is ideal for remote or sleepy industrial sensors, commercial meters, precision agriculture sensors, and a wide range of smart city applications.

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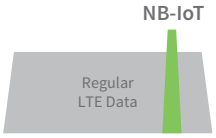
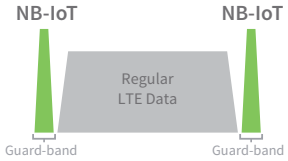
Note that NB-IoT is not, strictly speaking, an LTE technology. Instead, it branches away from the LTE framework and can be deployed in a number of different ways, such as:



IN-BAND

Utilizing single source block (180 kHz) within the GSM spectrum



GUARD-BAND

Utilizing unused resource blocks within an LTE carrier guard-band

STANDALONE

Utilizing stand-alone 200 kHz carrier

The Advantages of NB-IoT

Optimized for low-power consumption, even while transmitting

Other cellular technologies (such as LTE-M) derive most of their power-saving advantages by sleeping and limiting transmission times and frequencies. NB-IoT excels in its ability to sleep (with support for Extended Discontinuous Reception (eDRX) see page 5) and minimize power consumption during data transmission, primarily due to a simplified data-transmission method and lower data rates, which reduce the need for power-hungry signal processing and improve overall efficiency.

Simpler and less-expensive radio design with a single antenna

This characteristic reduces the barrier to entry for new customers and applications that can integrate low-power cellular technology into their solutions.

Improved range and clarity

With its reduced data rates and simplified radio design, NB-IoT has stronger link budgets than other cellular technologies. That means greater range/coverage and strong penetration through buildings and other obstacles. That makes NB-IoT ideal for applications using devices deployed in difficult-to-reach places.

Introduction to LTE-M Cellular Technology

LTE-M is another new standard for the LPWA market that's part of Release 13 from the 3GPP. Like NB-IoT, LTE-M is optimized for lower bandwidth applications using devices that sleep and report their data periodically. It supports multi-year battery life with extended ranges and better penetration of buildings and obstacles for devices that are deployed in hard-to-reach places. It is ideal for use-cases including remote/low-density industrial sensors, automated commercial meters for water or gas systems, connected healthcare devices, and even intelligent industrial lighting systems. LTE-M offers two key features that provide exceptional power efficiency Power Savings Mode (PSM) and Extended Discontinuous Reception (eDRX).

PSM

PSM enables the device to notify the cellular network that it's going to sleep and when the network can expect it to wake up. This is achieved using timer values sent by the device. Registration to the network is maintained even when the device is asleep, so the device uses very little battery power. Then, it awakens on schedule to exchange data, or it awakens earlier if important information (e.g., an alarm) must be transmitted immediately. The LTE-M device can remain in this registered sleep state for up to 12 days. Once the device awakens and transmits its data, it must wait for a short period of time to listen for responses from the network (four idle frames), after which it can return to sleep.

eDRX

Extended Discontinuous Reception (eDRX) improves power efficiency for cellular devices by reducing the "chattiness" between the device and the network. A normal LTE device must be active for a paging cycle every 1.28 seconds. However, an LTE-M device using eDRX is only required to be active for a paging cycle every 10.24 seconds. In other words, a device that is connected to the network (communicating or idle) need only be in an active, power-consuming state for about 10 percent of the vs. non-eDRX devices. eDRX also allows the device to notify the network that it will skip a predetermined number of these 10.24s cycles, extending paging intervals to 40 minutes or more. Both eDRX and PSM save power, but eDRX facilitates reduced power consumption for devices that are awake and connected/idle.

The Advantages of LTE-M

Simpler, less expensive hardware

Devices can connect to LTE networks with simpler modems that only require one antenna, because they are half-duplex and have a narrow bandwidth.

Longer battery life

Devices can leverage new Power Savings Mode (PSM) and extended discontinuous reception (eDRX) to achieve up to 10 years of battery life.

Cheaper data plans

LTE-M devices use lower data rates than other LTE devices (typically less than 300 Kbps), so they are less network-hungry, enabling carriers to vastly reduce monthly costs of data plans for OEMs.

Comparison of Narrowband Technologies

NB-IoT and LTE-M are very similar. The real question is which narrowband standard will be supported by carriers. NB-IoT is "newer," and potentially less expensive, but the carriers will not necessarily be able to use the same LTE radios they use for their data networks today. But, as both technologies roll out, cellular carriers will have to choose which technology to deploy to service narrowband applications.

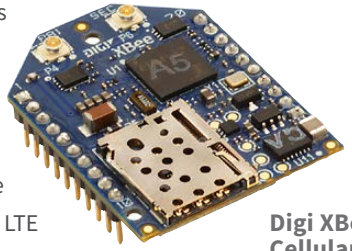
LTE-M	NB-IoT
Verizon and AT&T Rolling Out in North America	Vodafone, Deutsche Tk, Orange, and others Rolling Out in Europe
384 Kbps–1 Mbps (Half or Full Duplex)	<250 Kbps (Half Duplex)
IP-Based Communication	Message-Based Communication
4X Range Compared to LTE Cat 1 Good Building Penetration	7X Range Compared to LTE Cat 1 Great Building Penetration
Full Mobility and VoLTE (Voice over LTE) Support	No Mobility or VoLTE (Voice over LTE) Support

Different Technologies, Same Footprint

Build for Today

LTE Cat 1 is today's critical cellular technology for low-power, low-bandwidth IoT deployments. However, since it only supports data rates of 10Mbps/5Mbps (down/up), it's not well-suited for higher bandwidth applications that require streaming data or large file transfers. LTE Cat 3 or 4 are better suited for applications requiring higher data rates (150 Mbps/50 Mbps).

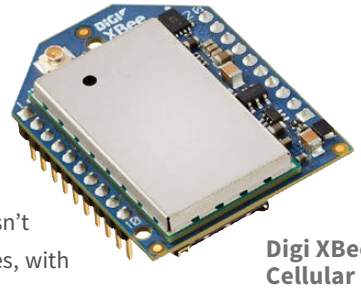
On the other hand, LTE Cat 1 is a great option for LPWA applications that require low-power consumption and transmit smaller amounts of data less frequently. LTE Cat 1 is fully available across North America, so it's ready for immediate deployments. With the Digi XBee Cellular® and its industry-leading sub-10uA Deep Sleep functionality, OEMs can design LPWA devices to work with existing LTE Cat 1 infrastructure today—and, in the future, swap to the ultra-low-power Digi XBee LTE-M or NB-IoT with little to no hardware or software redesign.



Digi XBee® Cellular LTE Cat 1
Shipping Now

Be Ready for Tomorrow

LTE-M and NB-IoT promise to improve range by 4–7x while further enabling battery life of up to 10 years—all with significantly lower hardware and data plan costs. However, these new networks are still being deployed and availability isn't yet widespread. Carriers are in the early stages of upgrading their infrastructures, with plans for full service availability by the end of 2017 that includes new advanced power management features like PSM and eDRX. Forward-looking OEMs are starting with LPWA implementations that leverage LTE Cat 1 and preparing a seamless transition to LTE-M and/or NB-IoT as those platforms become fully available.



Digi XBee® Cellular LTE-M
Available Fall 2017

Digi XBee® Cellular NB-IoT
Available Winter 2018

For more information about Digi XBee Cellular visit www.digi.com/xbee

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