

# CELLULAR IoT EXPLAINED

Everything you need to know about Cat-M1, NB-IoT, and 5G



## The cellular IoT landscape

The cellular IoT landscape is constantly evolving and it can be confusing to keep up with the latest cellular technologies like Cat-M1, NB-IoT, and 5G. What do they mean? And which one should you choose for your IoT deployment? Don't worry. The purpose of this white paper is to define these cellular technologies and explain their benefits in layman's terms.

Cellular IoT is strengthening ubiquitous connectivity at a rapid pace, with industry experts projecting the number of cellular-connected devices to grow to 1.8 billion by 2023. The majority of these connections are expected to be over LTE networks, which will become the dominant option with 5.5 billion subscriptions by the end of 2023.

**5.5Bn**



**cellular-connected devices by the end of 2023.**

**-Gartner**

## Why is LTE finally becoming a reality for IoT applications?

This is due to the rapid proliferation of Cat-M1 and NB-IoT technologies, which allow IoT devices to connect to LTE networks. This is huge because despite the hype you may have been hearing over the last 2 years, LTE is just becoming a reality for IoT applications.

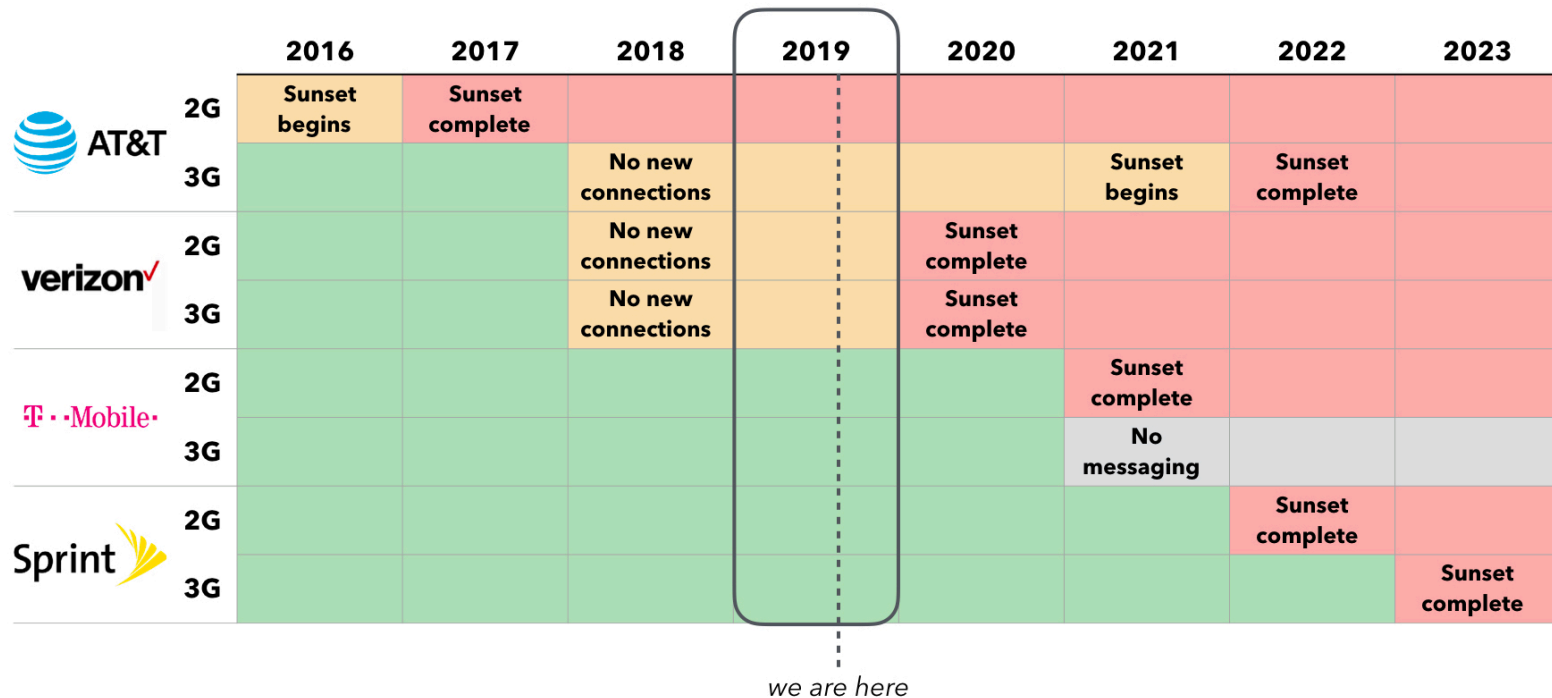
Simply put, the LTE you use on your phone is not the same LTE for IoT. While Verizon rolled out LTE voice in 2014, they didn't announce LTE for IoT until July 2017. From there, it takes time for wireless chip providers to implement LTE into modules that can be used for IoT applications.

While some early chips were released around that time, U-Blox, a wireless module provider, became one of the first to offer a cellular module certified to support AT&T's LTE-M network with the release of their SARA-R410M module.

With the SARA-R410M, IoT platform providers finally had the modules they needed to offer LTE to their customers. Due to this, companies should be turning their attention to LTE if they want to work uninterrupted for the next 10+ years.

## Why make the switch to LTE?

The obsolescence of 2G and 3G technologies is the biggest reasons why product creators should start making the switch to LTE if they haven't already. In fact, most cellular carriers are already in the process of sun-setting 2G and 3G networks.



Companies like AT&T and Verizon are expected to completely sunset their 2G networks by 2020, and 3G networks by the end of 2021. And this is a trend that is occurring with cellular carriers around the world. This is because many major operators are starting to repurpose spectrum for LTE. These rapid changes mean that it's critical for product creators to make the jump to LTE before being stymied by abrupt obsolescence.

## Immediate benefits

Making the switch to LTE also provides businesses with a host of immediate benefits that will both make existing applications more cost-effective, and facilitate completely new use-cases. Firstly, LTE hardware will be less costly than its 2G and 3G predecessors. IoT companies seeking to expand their fleet of devices could save if they choose to expand with LTE rather than their existing solution.

Secondly, LTE provides superior coverage. The value of that attribute speaks for itself, but it will also likely facilitate new use cases that weren't previously possible. With wider, more reliable coverage, companies can begin deploying IoT devices in more remote, or hard-to-access locations.

## Summary of cellular technologies

There are many different types of LTE technologies and it can be difficult to decipher them. The illustration below shows the four major LTE technologies that are currently deployed by major carriers around the world (Cat-1, Cat-M1, and Cat NB1 aka NB-IoT).

As you can see, there are a lot of marketing and branding challenges here, and it's understandably confusing. Here is what you need to know to understand the major differences between these technologies:

	LTE CAT 1	LTE CAT M1	NB-IOT (CAT NB1)
<b>BENEFITS</b>	<b>Most mature</b>	<b>Supports mobile handoff</b>	<b>Lowest cost and power</b>
<b>AVAILABILITY</b>	Worldwide	North America Australia	Europe Asia
<b>DRAWBACKS</b>	Size, cost, power	Limited geographies avail.	Largely untested Requires new network rollout
<b>BEST FOR</b>	Global deployments	North American IoT Mobile assets	<i>Not recommended (yet)</i>

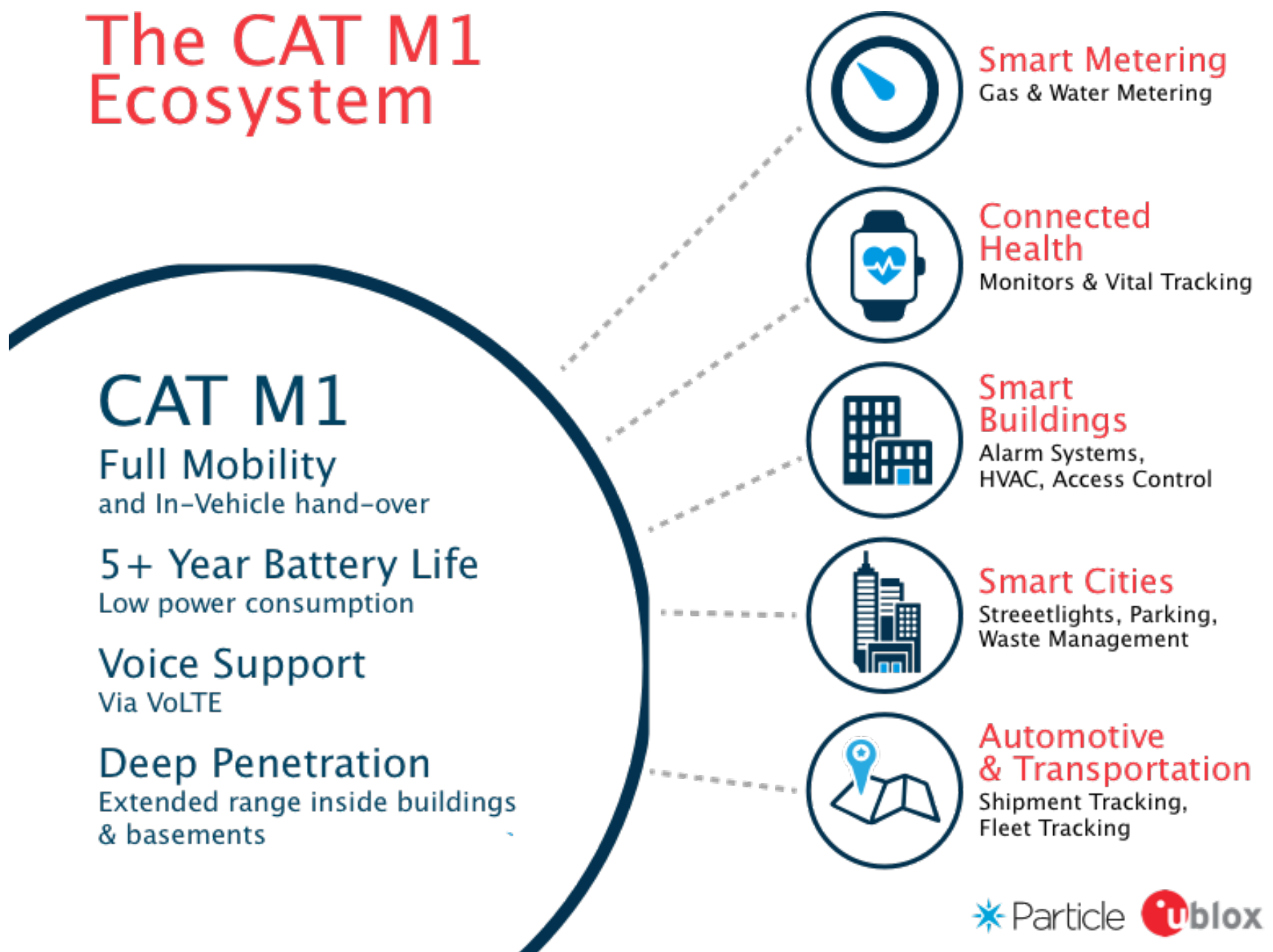
## What Is Cat-1?

Cat-1 is one of the most mature and widely deployed LTE technologies. It is available worldwide and is best used for global deployments.

Cat-1 is best used for higher-bandwidth and higher-power applications such as video surveillance and vehicle telematics. The major attraction is that it's already standardized, and more importantly, it's simple to transition into the Cat-1 network. However, the size, cost, and power of Cat-M1 isn't as powerful as compared to other cellular technologies like Cat-M1 and NB-IoT.

## What Is Cat-M1?

Category M1 (Cat-M1) is one of the newest cellular protocols available for IoT applications in North America. Cat-M1 is an LTE chipset that is designed for mobile applications – it consumes less power, comes with an improved battery life, and can be used in everything from asset trackers to consumer electronics. Verizon was the first cellular network to market with Cat-M1, but AT&T is the current leader with a stable network. Some major key features and use cases of Cat-M1 are:

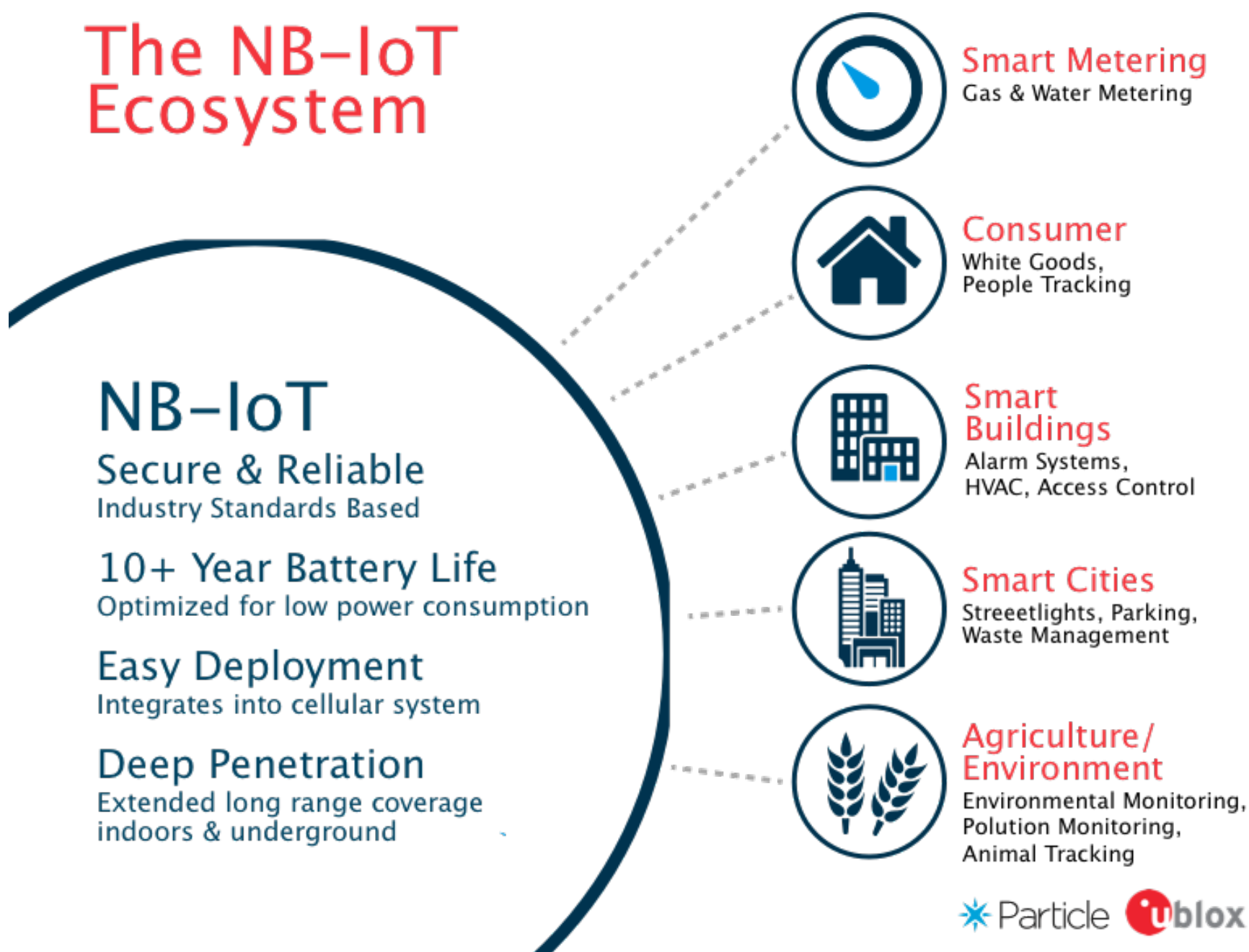


According to UBlox, Cat-M1 specifically supports IoT applications with low to medium data rate needs. At these speeds, LTE Cat M1 can deliver remote firmware updates over-the-air (FOTA) within reasonable timeframes, making it well-suited for critical applications running on devices that may be deployed in the field for extended periods of time.

## What is Narrowband-IoT?

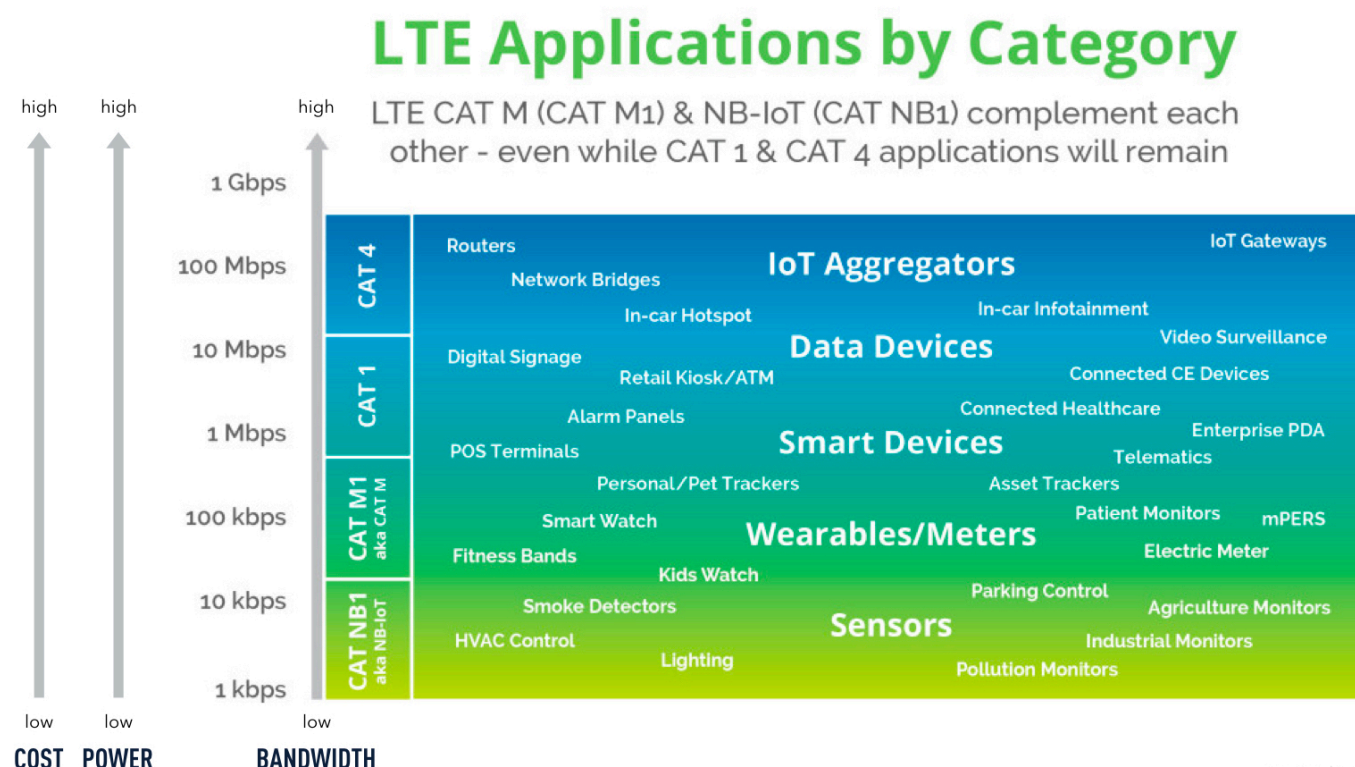
Narrowband IoT (also known as NB-IoT or NB1) is a Low Power Wide Area (LPWA) technology. Whereas Cat-M1 is part of the LTE umbrella, NB-IoT was designed in isolation and requires new hardware and software to deploy across cellular infrastructures for it to be operational. NB-IoT is primarily available in Europe, and slowly being deployed across the United States.

NB-IoT can be used as a standalone deployment within its own dedicated spectrum where deemed necessary. It is optimized for applications that need to communicate small amounts of data over long periods of time. Another major facet of NB-IoT is that it is best for static cellular assets, not moving ones. Some of the touted benefits and use cases of NB-IoT are:



## What Is the differences between Cat-1, Cat-4, Cat-M1, and NB-IoT?

The primary differences between these technologies is bandwidth, power, and cost. Cat-4 is most often used for higher-bandwidth applications while NB-IoT is more practical for lower bandwidth applications (like devices that just need to send simple on or off messages). Cat-M1 and NB-IoT are best designed for applications that are related to IoT because they use lower bandwidth.



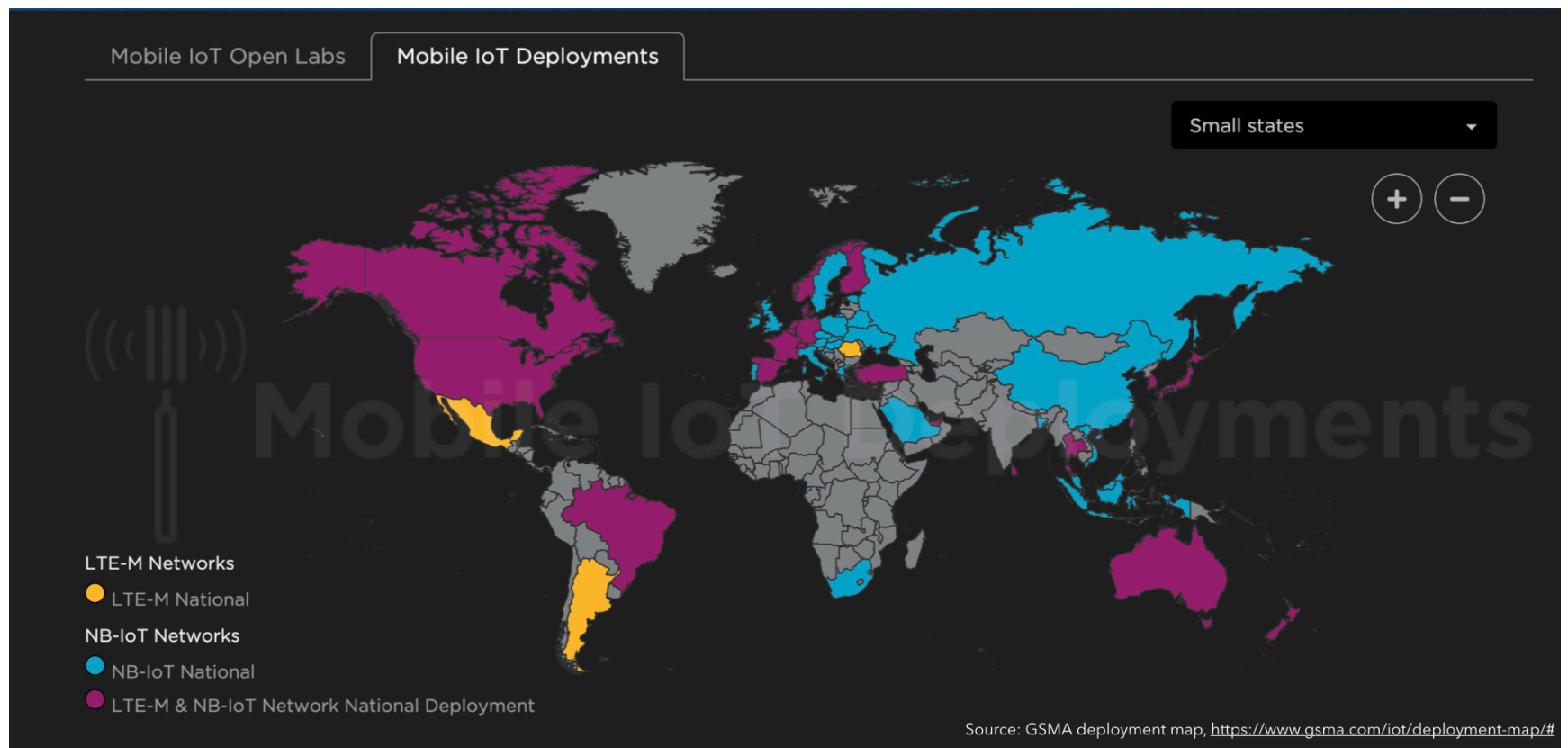
## Cat-M1 and NB-IoT coverage

The rollout of LTE networks has been much more complicated compared to the days of 2G and 3G networks. Currently, Cat-M1 is available across North America and some parts of eastern countries, while NB-IoT can primarily be found in Europe. Of course, over time, this will change and these technologies will become more widely available in different areas.

Why have different countries adopted different technologies? This is primarily due to the fact that these LTE technologies have largely been designed apart from one another, but are designed to solve near-similar use problems.

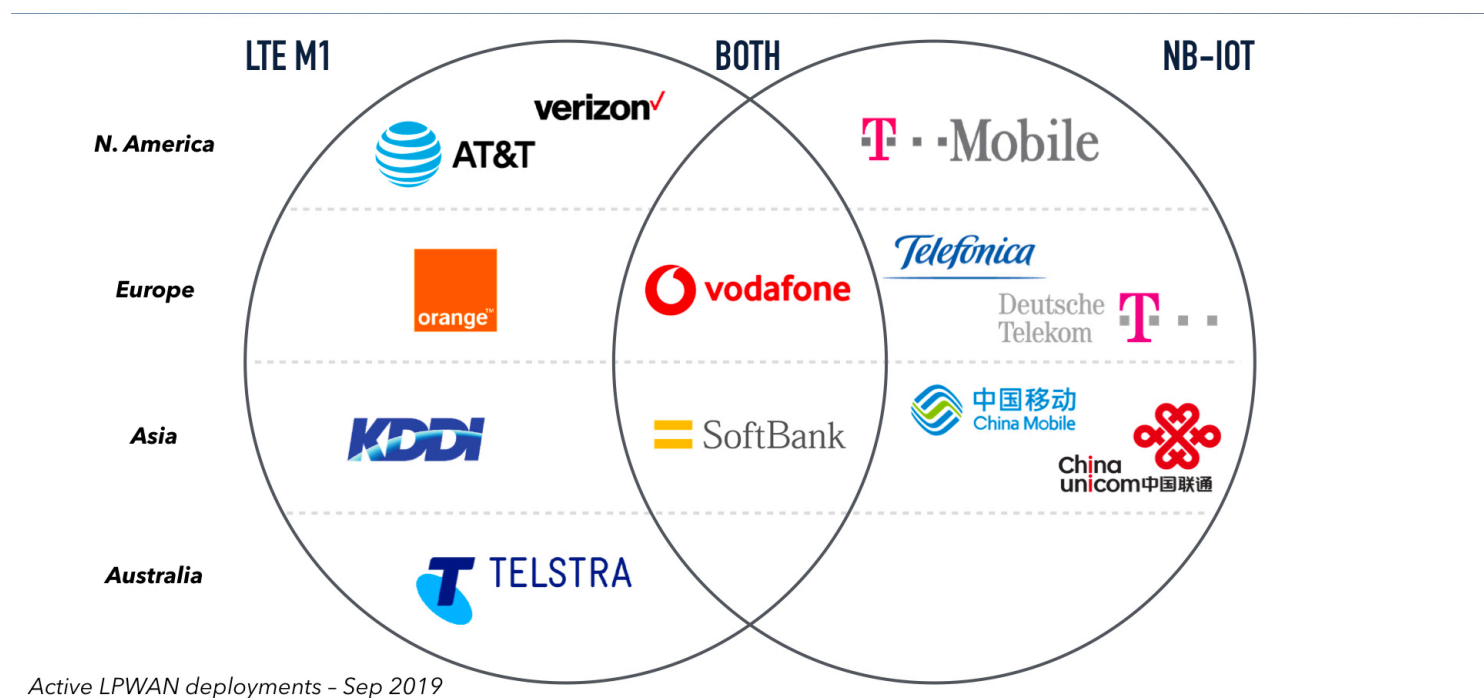
It's similar to the HD-DVDs and Blu-Ray deployment situation. Different countries adopted different technologies at first. And even within the same countries, you have different primary operators driving adoption and making investment in different cellular technologies.

## Cat-M1 and NB-IoT coverage



Global LTE M1/NB-IoT networks are fragmented and immature

Currently, cellular carriers are pursuing highly varied LTE technologies. Even if a company is driving the adoption of multiple LTE technologies (like Vodafone and Softbank), they may only be investing Cat-M1 in some countries and NB-IoT in others. Which of these two solutions will ultimately emerge as the de facto gold standard is still unclear. There is also the possibility that these divides will persist, and hardware manufacturers will step in to offer their own solutions for global implementations.



## What about 5G?

The hype around 5G and its relation to the IoT industry has been growing exponentially since its initial launch in 2012. So far, numerous telecoms have promised that 5G will be the next-generation mobile network that provides everything from superfast bandwidth speeds, to ultra-low latency, to ten-times the geographic coverage.

However, the attempts to decode what all this means for product creators and enterprises who have some investment in 5G and IoT typically lacks real substance and clarity. While 5G networks may fundamentally transform mobile cellular networks, they are still in early deployment stages despite the just-around-the-corner narrative that is being spread.

## Why you should hold out on 5G

If we think about our current needs for IoT, what we care about are three things: price, coverage, and lower power consumption. But 5G is focused on increasing bandwidth, and while increased data transfer and speeds are nice, they are not entirely necessary for IoT products. The GSMA outlines 5G will possibly offer 1000x bandwidth per unit area. However, bandwidth per unit area is not dependent upon 5G, but more devices connecting with higher bandwidths for longer durations.

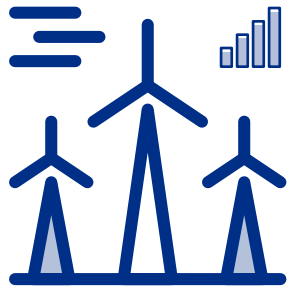
While it is great that 5G aims to improve this service, the rollout of LTE has already had a significant effect on bandwidth consumption. We should be excited about continued incremental improvements on Cat-M1 and NB-IoT as we get even lower cost and lower power solutions for our IoT applications. Unlike LTE, 5G lacks a solid definition, which means cellular providers could eventually label a slightly-faster-than-LTE connection as 5G. And truly, the only thing that is certain about 5G is we won't know what it can and cannot do until it arrives. Until then, product creators should be turning their attention to LTE if they want to work undisrupted for the next 10+ years.

## LTE is here to change the future of cellular

LTE lacks the flair of most major innovations. However, IoT product creators would be wise to treat LTE with the kind of enthusiasm that comes with major innovations. LTE stands to both disrupt and remake the IoT landscape with new applications, and significant improvements on existing ones. Although many questions still remain about the future of LTE, there is no doubt that LTE is the future of cellular IoT.

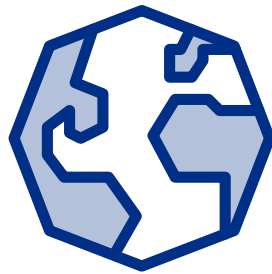
## Particle offers a range cellular connectivity solutions for IoT

If you are looking to build cellular-connected product, Particle provides everything you need to build reliable IoT products with cellular connectivity. Currently, Particle offers LTE cellular coverage in over 150 countries with hardware and SIMs that connects using a comprehensive network of carriers.



### Connect anywhere

Our cellular offering is ideal for outdoor applications or mobile products.



### Global coverage

Particle offers LTE and 2G/3G cellular coverage in over 150 countries.

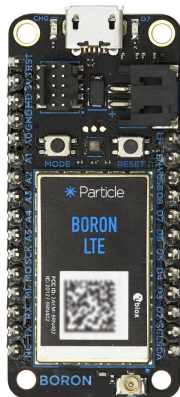


### Minimize data usage

Our communication protocol is designed to make the most of every byte.

## Cellular hardware from prototype to production

Bring your device online with our easy to use development kits and industrial hardware modules.



### Boron

The Boron is a CAT-M1 development kit that can be used to prototype projects.

[Learn more](#)



### E Series

The E Series is CAT-M1 module that is designed for cellular-projects at scale.

[Learn more](#)



### B Series

The Particle B Series B402 Brings Boron wireless tech to production-ready projects

[Learn more](#)

## Benefits of using Particle

Developing your own connected device has a few key benefits. First, you can easily customize and tailor a solution to meet your organization's specific needs. You will not be tied to a rigid system that cannot adapt to your fleet's evolution and shifting requirements. Second, you can scale new revenue channels by having open access to any business or performance data you need, and integrate these data streams into your existing analytics platforms. With this data, you can take action in the physical world using predictive analysis on both real-time and historical data, which, in turn, trigger actions on devices or through other web services

## How Particle abstracts the complexity of IoT projects

Starting your own IoT project may seem challenging or near impossible (as a matter of fact, nearly three-fourths of self-initiated IoT projects are considered a failure, while a third of all projects were not seen as a success). The two biggest contributors to the failure rate are: lack of internal IoT expertise and platform (hardware/software) reliability. With Particle, you have full access to IoT experts, a large community of IoT enthusiasts, support services, and professional engineering services to help you get your IoT projects off the ground.

### Check out the Particle store



Start your IoT journey by checking out our industrial hardware on the [Particle Store](#).

### Contact our experts



Contact our team of experts at [Particle.io/sales](https://particle.io/sales) to get a personal demo of the platform.