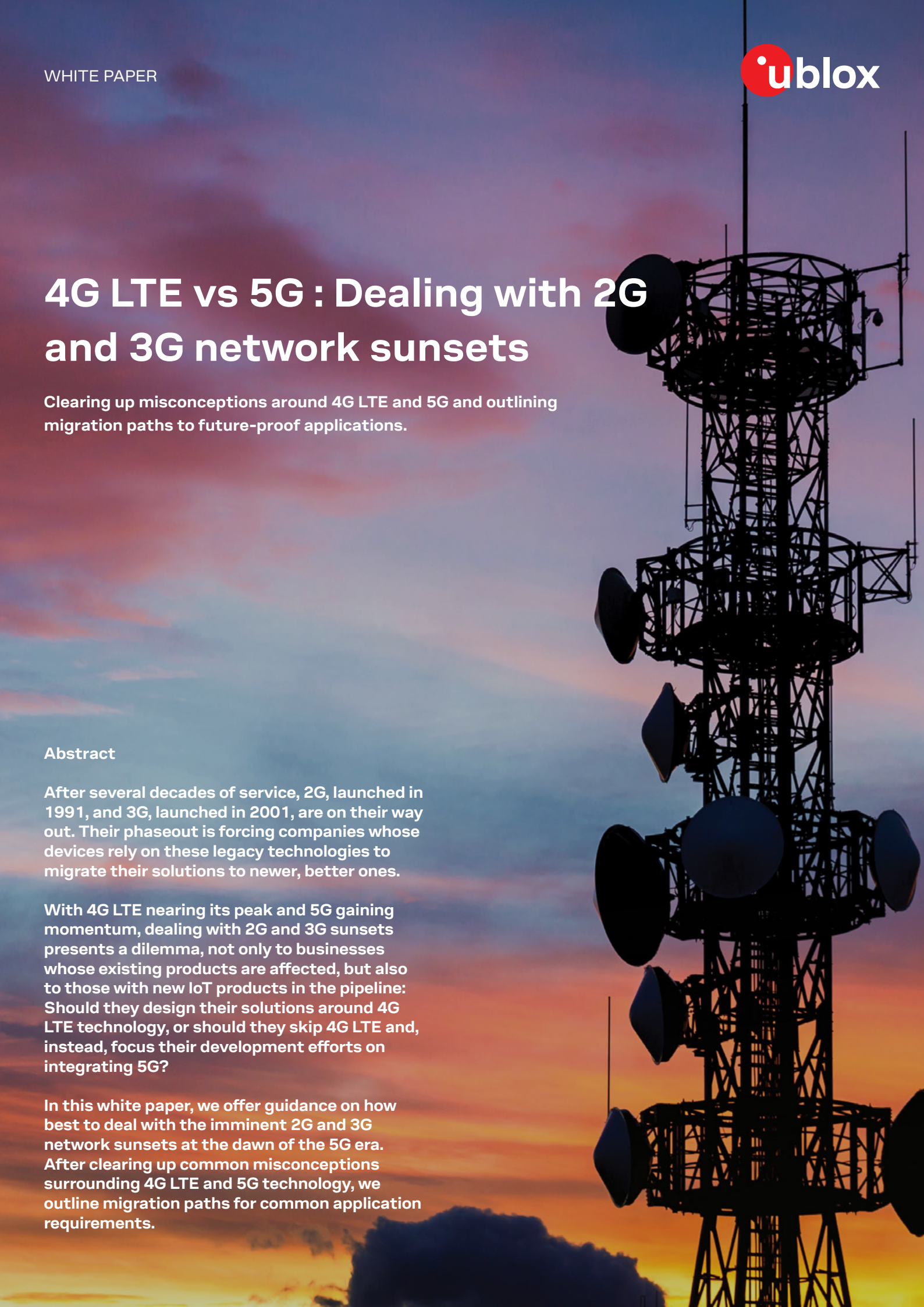
WHITE PAPER

4G LTE vs 5G : Dealing with 2G and 3G network sunsets

Clearing up misconceptions around 4G LTE and 5G and outlining migration paths to future-proof applications.



Abstract

After several decades of service, 2G, launched in 1991, and 3G, launched in 2001, are on their way out. Their phaseout is forcing companies whose devices rely on these legacy technologies to migrate their solutions to newer, better ones.

With 4G LTE nearing its peak and 5G gaining momentum, dealing with 2G and 3G sunsets presents a dilemma, not only to businesses whose existing products are affected, but also to those with new IoT products in the pipeline: Should they design their solutions around 4G LTE technology, or should they skip 4G LTE and, instead, focus their development efforts on integrating 5G?

In this white paper, we offer guidance on how best to deal with the imminent 2G and 3G network sunsets at the dawn of the 5G era. After clearing up common misconceptions surrounding 4G LTE and 5G technology, we outline migration paths for common application requirements.

White paper: 4G LTE vs 5G : Dealing with 2G and 3G network sunsets
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The sun is setting on 2G and 3G networks

After several decades of service, 2G, launched in 1991, and 3G, launched in 2001, are on their way out. By 2022, the second and third generation of cellular communication technology standards defined by the 3GPP, which continue to provide a wireless communication backbone to countless IoT applications, will essentially be non-existent in some major markets. Their phasing out marks a major technological upheaval that is already impacting companies and consumers around the world.

The phaseouts are the byproduct of technological progress. 2G and 3G are being replaced by far more capable technologies, in terms of bandwidth, throughput, latency, reliability, and power demand. 4G LTE, for one, makes up the majority of global cellular network connections today and comes in a variety of flavors offering specs tailored to most use cases. Meanwhile, 5G, the latest generation of cellular communication technology, is growing its footprint, spreading outwards from urban centers into less densely inhabited areas.

This technological changing of the guard presents a series of dilemmas:

- Businesses that depend on 2G and 3G networks to wirelessly transmit data to the cloud are confronted with a decision: Should they upgrade their hardware to leverage 4G LTE communication, or should they skip 4G LTE and focus their development efforts on integrating 5G technology?

- Similarly, those setting out to tap into the potential of the IoT have to weigh the pros and cons of integrating a mature technology that they fear may be nearing its peak (4G LTE) versus waiting for the latest and greatest technology that they have seen in the headlines for the past years (5G).

In this white paper, we offer guidance on how best to deal with the imminent sunsets of 2G and 3G networks in the context of the rise of 5G. We first explore the breadth of cellular technologies at the service of Internet of Things (IoT) applications, from 2G to 5G. Next, we look at which regions will be affected by the 2G and 3G sunsets, and by when. Finally, we offer our recommendations on how to build future-proof solutions tailored to the needs – and the longevity requirements – of the IoT.

4G LTE vs 5G: The technology landscape going forwards

A key consideration in the 2G and 3G sunsetting plans of mobile network operators (MNOs) is the availability of more advanced alternatives. In other words, if 4G LTE networks are unavailable and MNOs are likely to lose business by sunsetting legacy networks prematurely, they will be wary to do so. As a result, wherever 2G and 3G are phased out, they will be replaced by far more capable technologies, in terms of bandwidth, throughput, latency, reliability, and power demand.

4G LTE, which today makes up the majority of global cellular network connections, comes in a number of flavors offering specs tailored to a variety of use cases: LTE Cat 1 and upwards (LTE Cat 4, LTE Cat 6...) offer increasing throughput with higher power consumption. At the other end of the spectrum, low power wide area (LPWA) networks including LTE-M, and NB-IoT enable low bandwidth, low power connectivity with wide coverage.

At the same time, 5G is growing its footprint, typically spreading outwards from urban centers into less densely inhabited areas. Current specs were defined in 3GPP Rel 15 and 16 to enable a breadth of applications characterized by a combination of enhanced mobile broadband (eMBB offering ultra-high bandwidth), ultra-reliable low latency communication (URLLC), and massive machine-type communications (mMTC offering low power and bandwidth and high device densities).

The main functional overlap between 4G LTE and 5G for typical IoT applications is between 4G LTE's LPWA technologies and 5G's massive machine-type communication. Selecting between these options will, therefore, be a central task for CTOs of IoT-enabled businesses. It's a decision that at first glance appears daunting but upon closer examination has a clear rational answer: Considering that LTE-M and NB-IoT are included in the 5G spec, they are essentially already 5G technologies.

For medium data rate applications using LTE Cat 1 or Cat 4, the transition to 5G lies even further ahead in the future. The most suitable 5G spec, NR RedCap, that will cover the middle ground (mid-range speed, mobility, voice functionality), will not be completed until mid 2022. Following typical development and market adoption timelines, this means devices will be in market starting about 2025 and mass market volumes may not be reached until close to 2030. LTE Cat 1 is aided by its cousin, LTE Cat 1bis, a more affordable, yet performance-constrained version of LTE Cat 1 utilizing a single receive antenna. Properly implemented, LTE Cat 1 bis also requires network support such as a higher power downlink, yet few network operators have implemented such features.

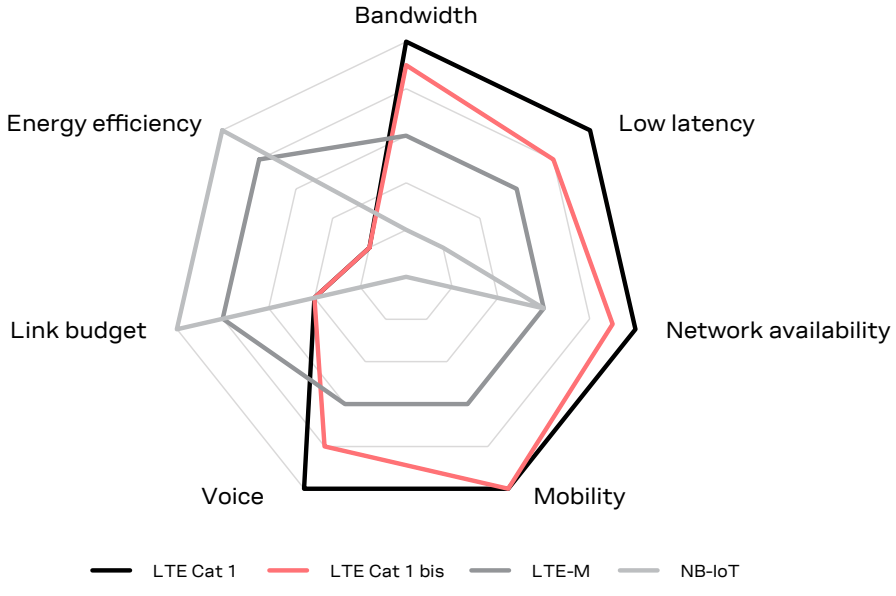

Figure 1: Comparison between technology options

The when and where of 2G and 3G sunsets

The maps below highlight countries in which at least one MNO has already discontinued or made public plans to sunset 2G or 3G technology by 2025.

Figure 2 Countries where at least one MNO has announced a 2G shutdown before 2025

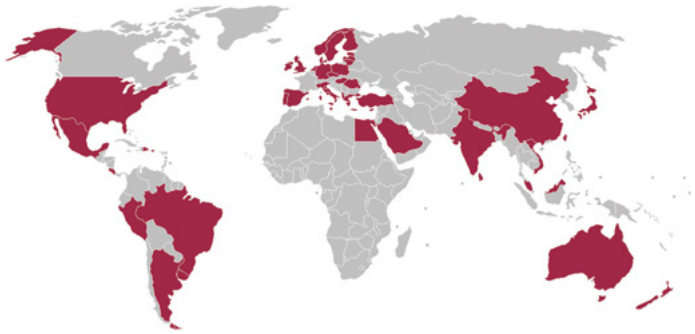

Figure 3 Countries where at least one MNO has announced a 3G shutdown before 2025

In the Americas, 2G/3G sunsets are broadly split by hemisphere. In North America, where 4G LTE networks are ubiquitous and 5G is fast growing its footprint for mobile and fixed broadband access, 2G and 3G networks will be essentially non-existent as early as 2022. Meanwhile in South America, where 4G LTE still has less coverage than 2G in most places and where low power wide areas networks are only available in isolated regions, 2G and to a lesser degree 3G technology will remain widely available for the foreseeable future at least on some networks.

In EMEA, where there is a significant legacy 2G IoT market, 3G will be decommissioned in the 2020-2023 period, while 2G sunsets will be pushed out to 2025-2030 or beyond in many markets. Because LPWA coverage is not as ubiquitous as in the United States, MNOs are not in a position to provide their customers a seamless migration path to LTE-M or NB-IoT. As a result, 2G will remain a required fallback option for IoT with LTE Cat 1 and LTE Cat 1bis a major transition technology for legacy 2G and 3G devices. Meanwhile, voice over LTE (VoLTE) will replace services provided by 3G voice, diminishing the need to maintain 3G services.

In APAC, MNOs are largely speeding up the sunset of 2G technology. That being said, the huge installed base of legacy 2G IoT will slow down the transition in markets like India. With 3G still heavily relied on for voice services by some MNOs, support for 4G VoLTE will play a critical role in informing MNO's 3G sunsetting timelines. Transitioning away from 2G and 3G will look different from country to country, depending on MNO network choices. In China, for example, the focus will be on NB-IoT and LTE Cat 1bis, whereas Japan will be supporting LTE-M and LTE Cat 1.

A strong case for 4G LTE

Many factors need to be considered when deciding whether to migrate IoT applications from legacy 2G/3G networks to 4G LTE or 5G technology. Key among them: performance, availability, coverage, and longevity.

For reasons outlined above, solutions requiring LPWA connectivity will be perfectly served by 5G-ready LTE-M and NB-IoT (depending on the availability of these networks in the target markets). And as we show here, for solutions with higher bandwidth requirements, the case for 4G LTE (LTE Cat 1, LTE Cat 4) is equally strong.

In terms of performance, 4G LTE and 5G solutions represent a dramatic improvement over the performance delivered by 2G and 3G cellular technology. That is true across the board, in terms of achievable coverage, power autonomy, bandwidth, latency, reliability, etc.

While 4G network infrastructure is mature and widely deployed across North America, EMEA, and parts of APAC and 5G mMTC in the form of LTE-M and NB-IoT is mature in some regions such as North America and parts of EMEA / APAC, 5G NR RedCap is still years from widespread adoption.

Projections by Ericsson indicate that 5G adoption will still be lagging behind 4G LTE by 2026. Clearly, there will be a day when 5G overtakes 4G LTE in terms of global subscription numbers. Even when they do, for the next decade there will likely be no place on earth where devices will be able to communicate via 5G without also being able to connect to a 4G LTE network.

Which brings us to longevity. If past is prologue, cellular communication technologies persist much longer than the devices they connect. 2G, launched in 1991, saw its first shutdowns 25 years after it was first launched and continues to represent around 15% of global connections today. 3G, which was launched to replace 2G, endured for 21 years before the first shutdowns and represents 28% of global connections today.

4G LTE, launched in 2010 to replace 3G represents around 59% of today's global connections and is anticipated to continue to grow until at least 2023. The number of 4G LTE shutdowns announced to date: zero. The technology is also uniquely unthreatened by its successor: 5G was launched in 2019 with the explicit goal of complementing, not replacing 4G LTE.

In conclusion, we believe that it is safe to say that 4G LTE is ready to be deployed today and that it will be here for the foreseeable future.

The right choice

Now that we've established that LTE Cat 1 (including Cat 1bis), LTE-M and NB-IoT are the rational technology alternatives for devices in the wake of 2G/3G sunsets, which type of the technology is the right one for your specific application?

The optimal technology choice will always depend on use case specific constraints. Figuring them out involves asking the right questions: What are the application's demands in terms of throughput, power consumption, coverage (e.g., in challenging environments), and latency? Is the application mobile or stationary? What are the requirements in terms of roaming across networks or borders? Where will it be deployed, which technologies do the local MNOs provide there?

Acknowledging the complexity of the task, the table below offers a starting point to explore possible migration paths and their benefits.

2G		3G	
NB-IoT	**LTE-M**	**LTE Cat 1bis**	**LTE Cat 1**
• Very low data rate • Extended coverage • Ultra low power • Not suitable for roaming or mobile applications • Networks not available in all geographies	• Low data rate • Extended coverage • Low power • Mobility • Networks not available in all geographies	• Medium data rate • Mobility • Voice • Lower cost than standard Cat 1 • Not supported by all network operators.	• Medium data rate • Mobility • High quality voice • Low latency • Robust coverage • Available globally

Figure 4: Comparison between different technology options to replace 2G or 3G

Telematics example

A telematics company makes wirelessly connected devices for driver behavior tracking and fleet management. They sell their products globally and have a large, embedded base of 3G modules in markets all over the world. Due to the announced sunsets of 3G by MNOs in several countries, they are now migrating their platform to LTE Cat 1. They selected LTE Cat 1 (with the u-blox LARA-R6 module) for its global availability and seamless roaming between different networks. This allows them to minimize the number of SKUs they have to deploy, simplifying the logistics of having sufficient inventory for all of their markets. Since to this day, no LTE sunsets are announced anywhere in the world, they are confident that their telematics units will easily meet their planned lifetime of 10-15 years.

Metering example

With the phase-out of 2G by all US MNOs, a metering company based in the US needs to find a replacement solution for installed equipment connecting to 2G networks. They selected LTE-M (with the u-blox SARA-R5 module) because it is readily available in the US and meets their technical requirements: LTE-M's deep in-building penetration lets them deploy their smart meters in areas that would previously have been difficult for cellular signals to reach. LTE-M's low power requirements reduce service requirements, allowing the company's field technicians to focus on other tasks. Meanwhile, LTE-M's relatively low data rates are more than enough to transmit the intermittently captured data. And because LTE-M is 5G-ready, meaning it is part of the 5G specification and compatibility will be retained as 5G networks roll out, the company can be assured that their installed equipment will be able to connect well into

Summary

After several decades of service, 2G, launched in 1991, and 3G, launched in 2001, are on their way out. Their phaseout is forcing companies whose devices rely on these legacy technologies to migrate their solutions to newer, better ones.

With 4G LTE nearing its peak and 5G gaining momentum, dealing with 2G and 3G sunsets presents a dilemma, not only to businesses whose existing products are affected, but also to those with new IoT products in the pipeline: Should they design their solutions around 4G LTE technology, or should they skip 4G LTE and, instead, focus their development efforts on integrating 5G technology?

In this white paper, we show that, while daunting at first glance, this dilemma has a clear rational answer. First, when it comes to use cases best served by LPWA technologies, companies don't have to choose: LTE-M and NB-IoT, which were released as 4G LTE technologies, are included in the 5G spec, making them compatible with both 4G and 5G networks.

We also argue that solutions requiring higher bandwidths can develop future-proof solutions by leveraging LTE Cat 1, Cat 1bis, and upwards, considering that 4G LTE is likely to stick around for at least another decade. Furthermore, because 5G was launched in 2019 with the explicit goal of complementing, not replacing 4G LTE, it's reasonable to assume that any location with access to a 5G network will also be covered by a 4G one for the foreseeable future.

Finally, we offer guidance on how to go about selecting the right technology to upgrade existing applications or build new ones.

Appendix: u-blox solutions

u-blox has a broad portfolio of solutions offering a future proof migration path from 2G and 3G to 4G LTE technology for all global markets and application types.

	LTE Cat 1		LTE-M		NB-IoT
	LARA-R6	**LENA-R8**	**SARA-R5**	**SARA-R4**	**SARA-N3**
Size (mm)	25 x 26	27 x 30	16 x 26	16 x 26	16 x 26
LTE Category	Cat 1	Cat 1	M1 / NB2	M1 / NB2	NB1
3G	•	-	-	-	-
2G	•	•	-	•	-
Rx Diversity	•	-	N/A	N/A	N/A
Integrated GNSS	-	•	•	•	-
VoLTE/CSFB (2G)	•		-	-	-
Certification	Conformance, Regulatory, MNOs	Conformance, Regulatory	Conformance, Regulatory, MNOs	Conformance, Regulatory, MNOs	Conformance, Regulatory
Grade	Professional	Standard	Professional	Professional	Professional

About the authors

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Craig Miller joined u-blox after being VP, Worldwide Marketing at Sequans Communications and Director of Marketing at Intel. He has over 20 years of leadership experience in product management, strategy, marketing and business development roles in the semiconductor industry, with a focus on cellular, broadband, networking and computing technologies.

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About u-blox

u blox (SIX:UBXN) is a global provider of leading positioning and wireless communication technologies for the automotive, industrial, and consumer markets. Their solutions let people, vehicles, and machines determine their precise position and communicate wirelessly over cellular and short range networks. With a broad portfolio of chips, modules, and a growing ecosystem of product supporting data services, u blox is uniquely positioned to empower its customers to develop innovative solutions for the Internet of Things, quickly and cost effectively. With headquarters in Thalwil, Switzerland, the company is globally present with offices in Europe, Asia, and the USA.

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