# 5G whitepaper

## Managing component-level risks

muRata
INNOVATOR IN ELECTRONICS

# 5G: Managing component-level risks for commercial success

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# 5G's growing momentum

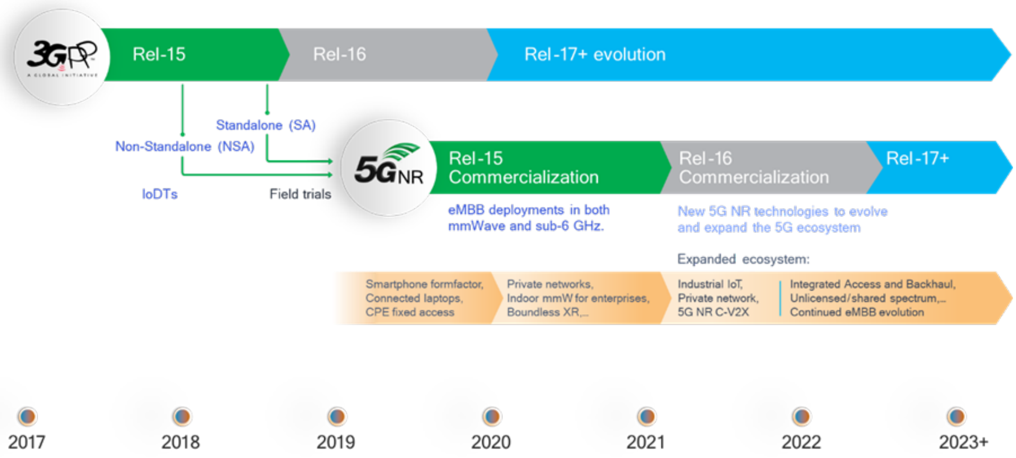
It's a 5G world already. The year 2019 witnessed the first wave of standards-based 5G commercial launches. According to the Global mobile Suppliers' Association (GSA), at the end of 2019, 61 operators had launched 3GPP-compliant 5G commercial services across 34 countries. Half of these had launched 5G fixed wireless access (services), targeting areas lacking quality fixed broadband connectivity. In all, GSA noted, 348 operators in 119 countries were investing in 5G.

The development of the 5G device ecosystem has also been ramping up quickly. As of January 2020, according to GSA, 78 vendors had announced over 200 5G devices. These came in no less than sixteen different form factors, such as smartphones, indoor and outdoor CPE (customer premises equipment), laptops/notebooks, robots, drones, enterprise routers, IoT routers and dongles/adapters. Of the over 200 announced 5G devices, 60 were commercially available, including 35 smartphones.

To put this progress in context, the first year of LTE availability (following TeliaSonera's launch in December 2009), just 4 operators launched services and 3 vendors offered devices. Within 9 months of launching 5G, South Korea's three mobile operators had attracted 4.7 million 5G subscriptions, around 8% of their mobile customer base.

But we are still in the early days of 5G. Today's commercial networks are based on 5G New Radio Non-Standalone (5G NR NSA) specifications that completed in December 2017, 6 months ahead of schedule due to a strong push from various stakeholders that wished to deploy 5G as soon as possible. The remainder of 5G Stage 3 (also part of 3GPP Release 15), including Next Generation Core Network (5G CN), also abbreviated NGCN, was completed 14 June 2018, during 5G World in London, and enables 5G deployments in a standalone (SA) mode.

## Exhibit 1: 5G Standardization and Commercialization Timeline




*Source: 3GPP*

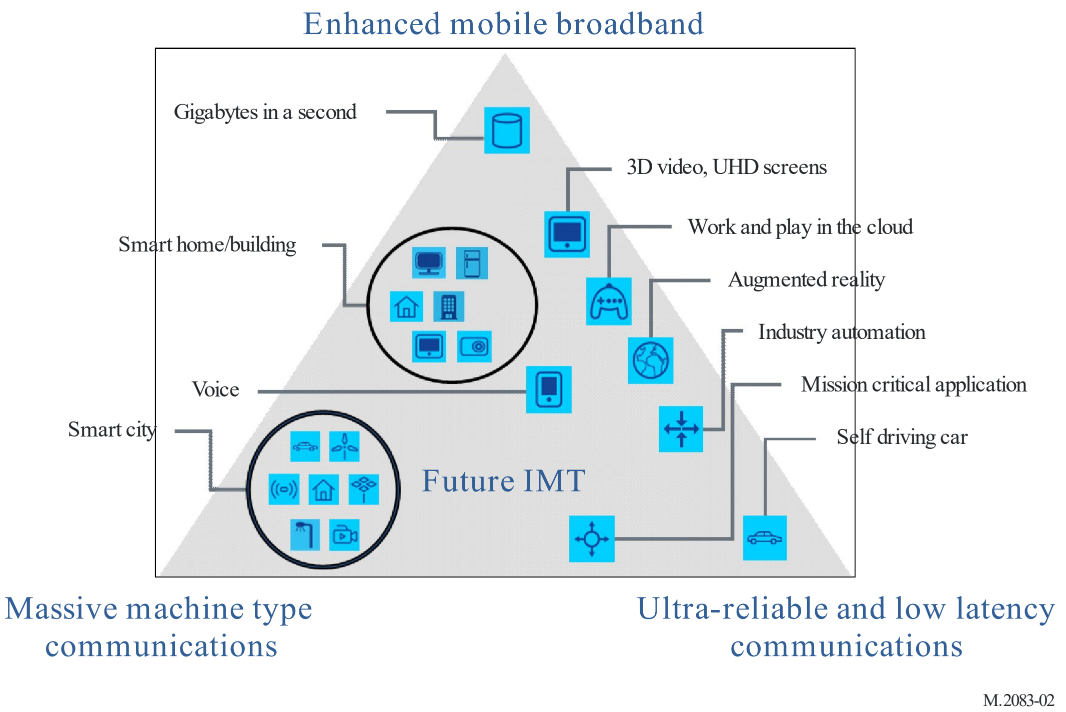
Today's commercial services primarily offer enhanced mobile broadband (eMBB) speeds for consumers on smartphones. Mobile operators across the world are leveraging 5G's improved bandwidth and latency characteristics compared with LTE to introduce new immersive experiences like 4K video streaming, cloud gaming and XR or extended reality (e.g., 360 degree viewing of sport events). The success of these innovations will require resilient 5G connectivity and performance across their footprints (including indoor locations), a keen understanding of consumer needs, cooperation with a broad range of ecosystem partners and business model flexibility.

# Future standards promise significant performance enhancements…

3GPP Release 16 and 17, which are currently set for completion in 2020 and 2021 respectively, will include a raft of work items addressing the requirements of Ultra Reliable and Low Latency Communications (uRLLC) and a host of other features, such as multicast/broadcast, positioning and C-V2X (Cellular V2X). This standardization work will gradually facilitate the expansion of the 5G ecosystem of chipsets, modules and devices and pave the way for industry verticals to develop proof of concepts (POCs).

The graphic below shows examples of the 3 broad types of use cases that 5G is designed to serve: eMBB; Massive IoT; uRLLC.

**Exhibit 2: Enhanced mobile broadband**




*Source: International Telecommunications Union*

The technical requirements for eMBB, Massive IoT and uRLLC are diverse. MBB use cases like 4K video streaming and cloud gaming are bandwidth intensive. Massive IoT use cases such as smart metering typically require deep coverage, extended battery life and potentially tens of thousands of devices to be able to simultaneously connect per cell. Industrial automation, a mission critical services (MCS) use case, demands very low latency and very high levels of availability. 5G's targeted technical characteristics seek to address these diverse use cases through performance levels that include 1–10Gbps connections to endpoints in the field (bandwidth); 1 millisecond end-to-end round-trip delay (latency); perception of 99.999% availability or 10–5 packet loss rate and up to 10-year battery life for low-power, machine-type devices.

3GPP's 5G NR uRLLC specifications introduce new technical features that can provide a minimum level of reliability and latency required to support MCS, specifically in the areas of industrial IoT (smart factories, process automation), energy and utilities (electric grid), medical (connected hospitals) and enhanced Cellular Vehicle-to-Everything (eV2X).

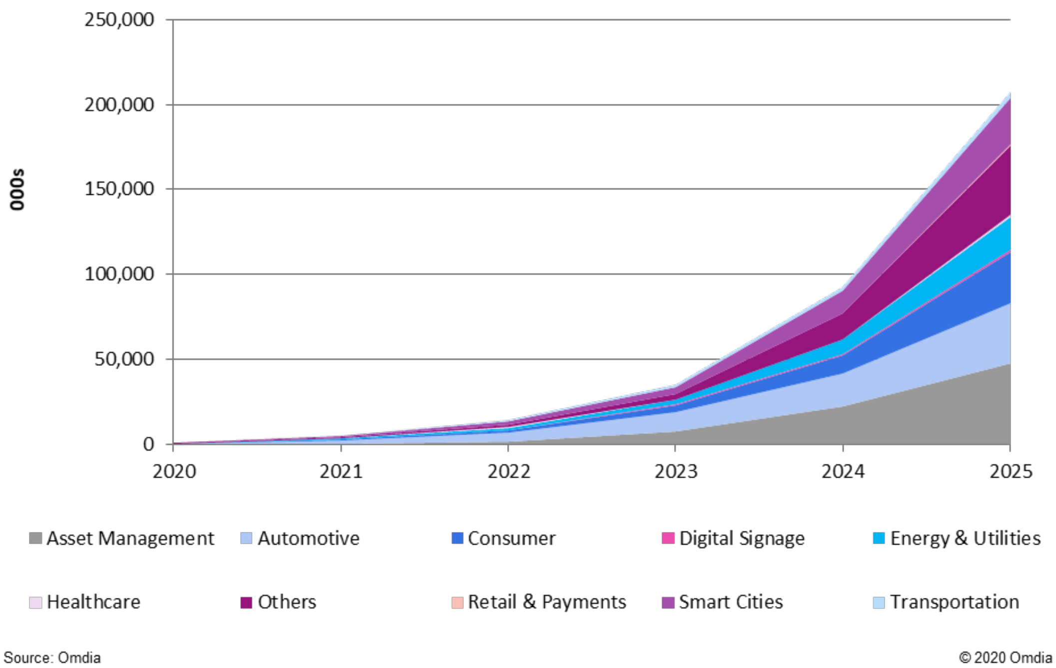
The technical bar for 5G NR uRLLC is set very high, for instance, 3GPP has set the availability requirement of electric-power distribution use case at 99.9999% availability and latency of up to 5 milliseconds. Robotic aided diagnosis, a medical use case, will require 99.9999% availability and maximum 20 millisecond latency. Achieving such performance levels in the field represents a major developmental challenge for the 5G ecosystem.

# ...that could benefit many new industries and applications

Nevertheless, there is growing awareness across industry verticals of the potential benefits of 5G. According to a 2019 Omdia survey, enterprises across the world are pursuing the opportunities enabled by 5G: 78% of decision makers from six key industries (automotive, consumer, healthcare, manufacturing, power & energy and telecoms) believe there is strong to significant interest in adoption of 5G within their industry.

Omdia segments the cellular IoT opportunity by application, region, generation (2G/3G/4G/5G) and across 12 air interfaces. The chart below shows our forecast for cumulative 5G connections by application between 2020 and 2025. The applications include those, such as automotive and asset management, that have historically adopted cellular M2M (machine-to-machine)/IoT. Also featured are applications such as consumer (e.g., use cases like home automation and pet tracking), that have typically avoided cellular in the past.

**Exhibit 3: Global 5G connections by application**




*Source: Omdia – 2019*

Omdia segments 5G for cellular IoT in three ways: 5G – C-V2X, 5G - eMBB/uRLLC and 5G – Massive IoT. Our expectation is that over the forecast period to 2025, 5G – Massive IoT will account for over half of 5G cellular IoT connections. This is due to the common requirement for long battery life, deep coverage and low total cost of ownership (TCO) across larger application areas like asset management, energy & utilities and smart cities. As discussed elsewhere in this report, the later completion of specifications relating to uRLLC and the extremely stringent requirements around availability and latency among many vertical industries means that initial 5G - uRLLC deployments are unlikely to occur before 2023.

In the past, there have been three main drivers of or incentives behind the adoption of cellular IoT:

- Driving greater efficiencies, for instance, the tracking and condition monitoring of perishable goods in transit can help reduce financial losses due to theft, misplacement or wastage
- Creating new sources of revenue, for instance, OEMs (Original equipment manufacturers) that have traditionally sold products such as washing machines, can leverage cellular IoT and embedded sensors to monetize the ongoing monitoring and maintenance of the product for a recurring fee.
- Complying with regulatory or contractual obligations, for instance, there is a legal requirement to monitor the time spent at the wheel by long-distance drivers in many countries across the world

The enhanced performance capabilities of 5G opens up opportunities across more complex use cases, such as remote control of vehicles, distributed automated switching in an electric power network and robotic aided medical diagnosis. Reaping these opportunities will need technology innovation and business model flexibility.

# To realize these benefits, the 5G ecosystem must address technical and commercial challenges

Deploying and operating 5G networks and services will be considerably more challenging compared to previous generations of cellular technology. The requirement for greater throughput and lower latency will require the utilization of mid-band spectrum, 6–39GHz (including mmWave). This means denser networks – which poses a considerable challenge for operators seeking to access sites and manage both capital and operating expenditure. 5G also brings greater complexity to 5G devices, in the shape of greater component and module count and need to manage power consumption and temperature. New approaches to thermal management and component miniaturization will be critical.

Operators running 5G networks must provide smooth handover to legacy cellular networks in areas which lack 5G coverage. Meeting the very stringent and diverse performance requirements of the three iterations of 5G: eMBB, Massive IoT and uRLLC and the needs of specific industry verticals will be demanding.

The 5G ecosystem should keep an equal eye on its own pain points and those of the ultimate adopters of 5G. For telecoms operators, this means being able to deploy and extend 5G network coverage in a cost-efficient and scalable way. For enterprises that require extensive battery life for their field assets this means a close eye on reducing unnecessary power consumption and data transmissions. It also means factoring in power and communications back-up for mission-critical applications that need very high levels of availability and low latency.

Enterprises that have previously adopted cellular for their IoT deployments will have a fundamental understanding of the core elements of TCO (total cost of ownership) over a device lifetime. This will not be the case for enterprises or applications that have largely avoided  cellular in the past. Nor will this apply to 5G uRLLC or MCS applications, where the levels and sources of cost will be considerably different to massive IoT implementations.

A key challenge for the 5G ecosystem will be to support connectivity pricing that reflects the complex costs involved in providing guaranteed performance levels and aligns with the commercial objectives of 5G enterprise adopters. As the different forms of 5G evolve, Omdia expects to see 5G connectivity pricing innovation based on achieving specific technical or commercial key performance indicators (KPIs). This innovation will require close collaboration across the 5G ecosystem of chipset and module vendors, component and network vendors, telecoms operators and software providers.

## Get in touch

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