

BACK TO THE 5G FUTURE

How 5G propelled your business to win
in the digital revolution



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97%

CAGR in the global 5G market from 2020 to 2025

\$123B

Global market for new 5G enabled services by 2025

70%

of all global companies aim to have 5G use cases deployed by 2021

99.9999%

Reliability can be achieved for mission-critical applications managed by 5G

49.2%

CAGR in the global 5G chipset market from 2020 to 2026

\$76B

Revenue opportunity in healthcare from 5G in 2026

Introduction

2025: A world free of wires. Pervasive communication technologies serve humans by connecting everything, everywhere. Technologies have adapted to the new communication intent, the context, and the constraints. Connected vehicles everywhere live in harmony with each other, with pedestrians and with smart cities. Factories have seen their productivity dramatically increased, first by replacing wires with wireless connectivity, and second by planning configurable on-the-fly factory layouts without the wires' constraints. The world now has 1.1 billion 5G connections, and this is just a beginning.

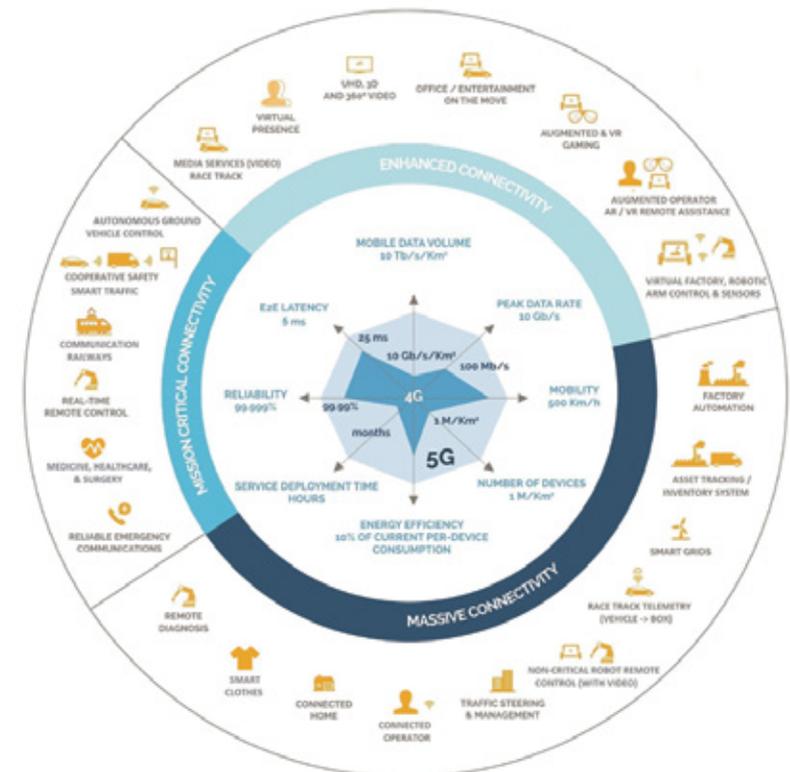
5G has become a ubiquitous connectivity platform, interconnecting several communication technologies, humans, and machines. 5G systems of interconnected smart objects have enabled distributed cognitive functions including Artificial Intelligence (AI) capabilities. Analysts foresaw 5G as the fuel that would propel the digital revolution and that 5G would disrupt the traditional value chains and ecosystems in all vertical industries, not just in the communication industry. And right they were.

Successful players in all vertical industries from this new industrial revolution had some things in common: an inclusive vision to understand the 5G potential and collaborative innovation. They tried and failed fast; and learned until they got it right.

We will present to you the way this virtuous ecosystem developed, coming back to 2018, when 4G was dominant and 5G business models uncertain.

5G: the next business enabler

5G is the next revolution of mobile communication technology, which will connect humans and machines everywhere, in all types of situations. Everything that is currently possible with 4G technology will be supported by 5G with far better performance. 5G has even more to offer.



A new ecosystem emerges

From a peak data transfer rate perspective, 5G will be 20 times faster than 4G. Theoretically, 5G has a peak download speed of 20 Gbps[1] while 4G is parked at 1 Gbps. But practical tests show 5G peak data download rate at 10 Gbps vs 100 Mbps[1] for 4G. However, 5G will bring much more benefits than download speeds, especially regarding new connectivity possibilities, and thus new business potential for the enterprise market.

5G uses all available spectrum types and spectrum bands. Apart from exclusive use of the licensed spectrum[2], 5G can also be launched using unlicensed or shared spectrum. Mobile carriers can thus aggregate a licensed spectrum and an unlicensed spectrum to deliver superior 5G performance. Case in point, 5G is poised to utilize ultra-high frequencies in the 30 GHz to 300 GHz range. These high frequencies support a huge capacity or bandwidth for fast data transfers.

The functioning of 5G can be geared to provide three differentiated 5G services:

1. Mission-critical connectivity: Ultra-Reliable Low-Latency Communications (URLLC)

The objective is to offer key services such as monitoring and control in real time, and to minimize end-to-end latency (at millisecond levels) to make communication almost instantaneous. The additional need for reliability and security is of utmost importance, as instantaneous communication will be applied to mission-critical applications. Applications include

autonomous transportation, remote surgery, emergency communications, and critical industrial processes such as manufacturing robotics.

2. Enhanced connectivity: Enhanced Mobile Broadband (eMBB)

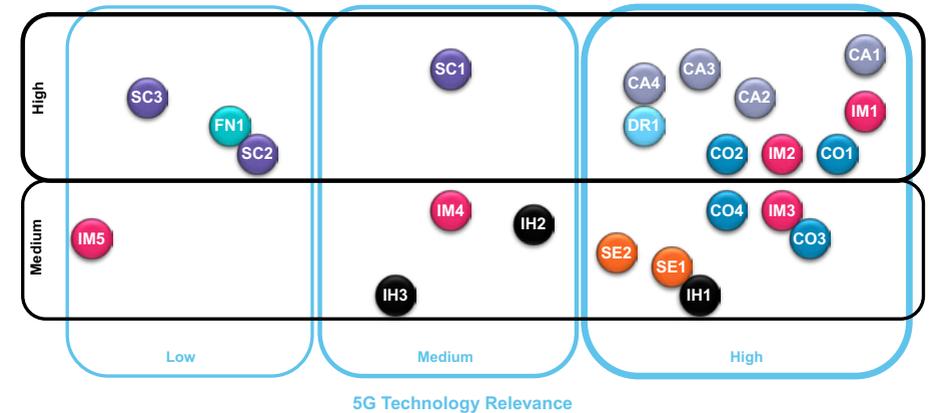
The objective is to provide extremely high data transfer rates. The target is to meet the new market demand for an increasingly digital lifestyle, focusing on services that have high requirements for bandwidth such as Ultra High Definition (UHD) videos, Virtual Reality (VR) applications, and Augmented Reality (AR) use cases.

3. Massive connectivity: Massive Machine Type Communications (mMTC)

The objective is to provide connectivity with an extremely high density i.e. for a large number of devices per km², along with wide coverage. The target is to provide ubiquitous connectivity with relatively low software and hardware complexity, low energy consumption, and with minimum connectivity cost. This 5G service can be used in monitoring, tracking, and automation of massive industrial objects as well as smart agriculture, logistics, fleet management, wearables, smart cities, and smart homes. It is interesting to note that combinations of the above three major 5G service categories enable even more applications of 5G and the realm of possibilities is only stretching.

The need for connectivity everywhere is extending the usual base of stakeholders, i.e. telecom operators, telecom equipment manufacturers, and chipset manufacturers to include all industries, in particular: manufacturing, health, automotive, finance, and energy. The chart below provides a synthesized view of the most promising 5G vertical-market use cases mapped with their 5G technology relevance and relevant business opportunity/market size.

Each bubble on the chart represents a use case and similar colors represent the same industry



CO# – Consumer use cases such as AR/VR gaming (CO1), 8K TV (CO2), AR/VR shopping experience (CO3), and high Quality-of-Service (QoS) mobile broadband (CO4) will digitize many aspects of our lives while delivering new age entertainment

CA# – Connected Auto leads the pack in business potential with widely accepted use cases such as fully or partly autonomous vehicles (CA1), AR/VR dashboards (CA2), and cellular vehicle-to-everything or C-V2X

(CA3) that have much market traction and are backed by leading automobile manufacturers and chipset providers. Connected infrastructure (CA4) such as traffic lights and bus stops will contribute to the connected-auto ecosystem and is a big business potential as well

[1]. 1 Gigabit per second (Gbps) = 1000 Megabits per second (Mbps)

[2]. Spectrum refers to the frequency band used to deliver cellular connectivity

IM# – Industry Manufacturing is slated to be transformed into Industry 4.0 as 5G enables autonomous factories (IM1), real-time production monitoring (IM2), remote controlled machinery (IM3), augmented production (IM4), and smart logistics (IM5). There will be unprecedented efficiency and as demand for goods and services increase, we can enter an age of uninterrupted smart manufacturing

FN# – Financial instruments are set to be transformed to provide the next generation of financial services. We are witnessing the growth of disruptive fin-tech services. Services such as e-wallets are gaining more and more traction. With 5G, the applications are expected to get broader and include equity trading, insurance, and use of VR for everyday banking services and consultation (FN1)

IH# – Healthcare services will be decoupled from geographic presence by remote healthcare (IH1) and enriched by AR/VR assisted living (IH2) and telemedicine and patient data management (IH3)

DR# – Drones. We are already witnessing the explosion of drone usage from security to entertainment applications (DR1) and the innovative use cases continue to emerge

SC# – Smart City. The relevance of 5G for smart city applications might be medium to low, yet municipality management (SC1), natural disaster management and response (SC2), and smart homes (SC3) present big business potentials

SE# – Smart Energy and Utilities. Lastly, the emergence of smart meters (SE1) and automated grid management (SE2) will further efficient energy use and distribution for the energy dependent world

There are strong market expectations to create an ecosystem and a virtuous cycle to successfully secure the launch of new 5G use cases in different industries with maximum profitability and viability.

The virtuous cycle as the answer to challenges

The highest potential of 5G technology will be unlocked if the current mutualism of vertical industry companies and telcos evolve toward a more symbiotic relationship that is already starting to be experimented in several 5G initiatives, which sit telcos and vertical industry companies around the same table.

Furthermore, the key to unlock the 5G potential is in the definition of a common industrialization framework, i.e. an Open 5G Platform (O5GP) that would lead vertical industry companies and telcos to be part of the same processes and industry life cycle that can be envisaged to have the following cyclic steps.



1. Discovery & Learn

As briefly discussed, the 5G paradigm is not only multi-Gbps bandwidth but also has a plethora of other benefits i.e. low latency, high data transfer speed, improved coverage, increased capacity, and increased density of networks. The discovery of 5G use cases achieving the monetization of 5G investments can be structured in a process that is inherently enabled by the comprehensive knowledge of the 5G technologies and its potential. The Open 5G Platform plays an important role in the process of Discovery & Learn since it provides:

Learning

- The possibility to join communities and forums in a social industrial community that would stimulate the discovery of new services and in turn would accelerate and prioritize 5G deployment features e.g., edge computing[3] vs network slicing[4], as demanded by the rising service scenario
- Platform specification and usage. The definition of a single multi-industry convergent framework, including catalogued and documented 5G network features and functionalities along with complementary microservices, supports a structured and 5G native use case and application design process. Platform specifications define and maintain up-to-date best practices to translate use

cases and application requirements into 5G network and platform requirement specifications that may also evolve along with future 5G technology deployment (e.g., edge computing, cloud and virtual radio access networks (RAN)[5], network slicing), in this case synched with the different future use case scenarios

Discovery

- 5G use case repository and proof-of-concepts (POCs) that can be used to represent examples on how the 5G potential can enable different use case scenarios in different industries and how use case components (microservices) can be combined to achieve specific functionalities
- Tutorials and samples providing examples of use cases implementation and defining a proper process for requirements specification and understanding to unveil the potential of 5G and explain best ways to exploit its features

2. Conceptualize & Prototype

The O5GP provides the lab environment used in the embryonic stage of use case definition and prototype development, dynamically adaptable to support disruptive solutions, but at the same time mimicking production environments to enable comprehensive requirements specification and successful validations. Moreover, the availability of well-defined interfaces to manage 5G capabilities accelerates the design verification process while supporting specific requirements such as less than 1 millisecond (<1ms) latency or edge computing support.

The testing environment should also provide access to third party services (GPS positioning, multimedia messaging, user profiling, etc.) and microservices (text-to-voice, video streaming coding, AR/VR, etc.) to enable cost and time savings that allows developers to focus on the actual functionalities of the use cases.

The O5GP also provides a use case simulation environment aiming at testing and validating usability and application performance, considering all the networking aspects from the very beginning.

3. Build & Deploy

The next step in the virtuous cycle refers to the technology deployment in real conditions and production environments i.e., in a fully functional 5G network. This involves the solution validation and certification, assuring expected behavior and performance when integrated with essential operational blocks across the mobile architecture – 5G radio access and core components, mobile edge computing platforms, Operations Support System (OSS), and Business Support Systems (BSS). OSS includes management,

orchestration, and assurance frameworks while BSS includes order and revenue management platforms.

For passing such a certification process, alignment of the implemented service to standardized application programming interfaces (APIs) is mandatory to avoid support issues with currently deployed OSS/BSS, as well as tackling vendor lock-in and ensuring automated and standardized provisioning by the network and its resources for the newly introduced service.

Runtime capabilities such as active monitoring shall be embedded into the provided application or service, providing real-time awareness to each deployed instance during runtime through the analysis of information such as:

- Number of total or simultaneously deployed instances
- Total instance usage time
- Instance health indicators
- Application-specific key performance indicators (KPIs)

These service monitoring processes must be realized in parallel to network-related Quality of Service (QoS) monitoring, which are used to verify and assure Service Level Agreement (SLA) guarantee and ultimately correlated for analysis against expected 5G KPIs (refer below).

[3]. Edge computing refers to computing at the edge of a network (where it is the terminal connection to the end user), to better deliver and manage related applications

[4]. Network slicing refers to the possibility to differentiate virtually independent networks on the same physical infrastructure to provide differentiated services with varying data transfer rates, latency, etc.

[5]. A radio access network (RAN) is the termination part of a telecommunications system that connects individual devices to other parts of a network through radio connections

4. Tune & Evolve

This specific step would address the tuning of the 5G service performance and features depending on the actual use implemented and in production while addressing possible evolution aspects. In particular, services related to a specific 5G use case and composed by a number of features can be analysed in different perspectives:

- Overall performance reporting and dash-boarding related to the user experience key quality indicators (KQIs) elaborated through 5G network KPIs
- Features usage i.e., which specific features and their combination are the most used
- Features wish list from users via direct feedback and/or social networking platforms

All the above information can be provided by next generation planning and optimization tool frameworks that:

- Combine counters and KPIs provided by the network elements (RAN and edge computing nodes) with service specific KQIs/KPIs in order to improve the end-to-end service performance and customer experience, possibly empowered by Artificial Intelligence (AI) algorithms in dedicated engines to monitor and study the correlation between user experience (UX) quality and network performance (cell level)

- Implement machine learning and AI support to detect and handle exceptions (post rollout) especially devoted to address mission-critical use cases
- Generate reports about the most used functions within a specific use case. Such reports can be useful to define the "most wanted" additional functions that would maintain and even increase the customer base
- Generate reports analyzing customer feedbacks via social networking platforms or applications that would detect customer needs and intercept suggestions that could act as the base for identifying new use cases

5. Improve & Industrialize

This step is key to a successful 2025 business, which leverages 5G and must maintain the momentum in a rapidly changing market. Growing a large ecosystem, whose forefront is the marketplace, where it is possible to easily submit and publish new applications and services, is critical to leverage the business dynamics associated with 5G. The marketplace will be able to integrate existing operators' charging and billing systems following current best practices of cloud-based business models, reducing the complexity of service subscription and deployment.

Another important aspect of the marketplace is the ability to centralize and improve the interface with customers, thus making it easier to promote new applications and services as soon as they become available. This ability is essential to augment customer engagement because of:

- Added simplicity – single point of access
- On-demand service subscription – fast deployment
- Easy update or modification process – fast and automated service upgrades

All of these factors combined contribute to the retention and increase of the customer base.

Finally, the use of AI mechanisms and algorithms in an increasing number of functional areas has the potential to dramatically boost efficiency and reduce operational costs, herein are included:

- Customer relationship management: using mechanisms based on machine learning and natural language processing for direct customer interface that are able to understand individual customer context and needs
- Marketing: using big data and deep learning to create accurate customer profiles and optimize sales strategies
- Application and service development: development optimization with data analysis for better requirement identification and automated testing for improved assurance and certification
- Application and service deployment: machine learning and deep learning can be amazing tools to fine tune deployments and personalize delivery for individual customer environments

Conclusion

The five steps of the virtuous cycle are the key for all successful business launches of new 5G use cases. 5G implementation, besides the virtuous cycle, will need some industrial alignments externally.

Regulatory requirements

Each region of the world has to cope with strong constraints in terms of wireless regulations (spectrum, competition rules, security, roaming, etc.). As a result, each industry has to face multiple constraints, compliance, and agreements for global operational success.

Safety and security architectures need to fit real-time 5G industrial applications

A clear safety policy must be elaborated, including a deep analysis of the extent to which safety-critical industrial applications can be supported by 5G infrastructures. In addition, cybersecurity will be a key challenge as well.

New 5G devices (machines, robots, etc.) differ completely from existing mobile devices (such as smartphones)

It is crucial to understand the implications for a 5G-capable industrial device: a seamless integration, migration, and compatibility path with existing systems should therefore be thought of from the very beginning. Furthermore, since industrial machinery is typically in use for significantly long periods, specific requirements should exist to enable long-term reliability of 5G systems.

Establishment of a common language is required for different market players

The overall success of 5G in all vertical industries depends strongly on close collaboration between the different stakeholders throughout the ecosystem, with common terminology and conceptual structures.

5G is at the heart of the new industrial revolution. The virtuous cycle is the key to your business' success in this revolution.

Start now to see a wire-free 2025.

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