



5G

Introducing 5G networks – Characteristics and usages

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Mobile Connectivity Solutions

The fifth generation networks (5G) is currently under development and will hit the market at the horizon 2020. Compared with the current 4G LTE technology, 5G is targeting to reach both high speed (1 Gbps), low power and low latency (1ms or less), for massive IoT, tactile internet and robotics.

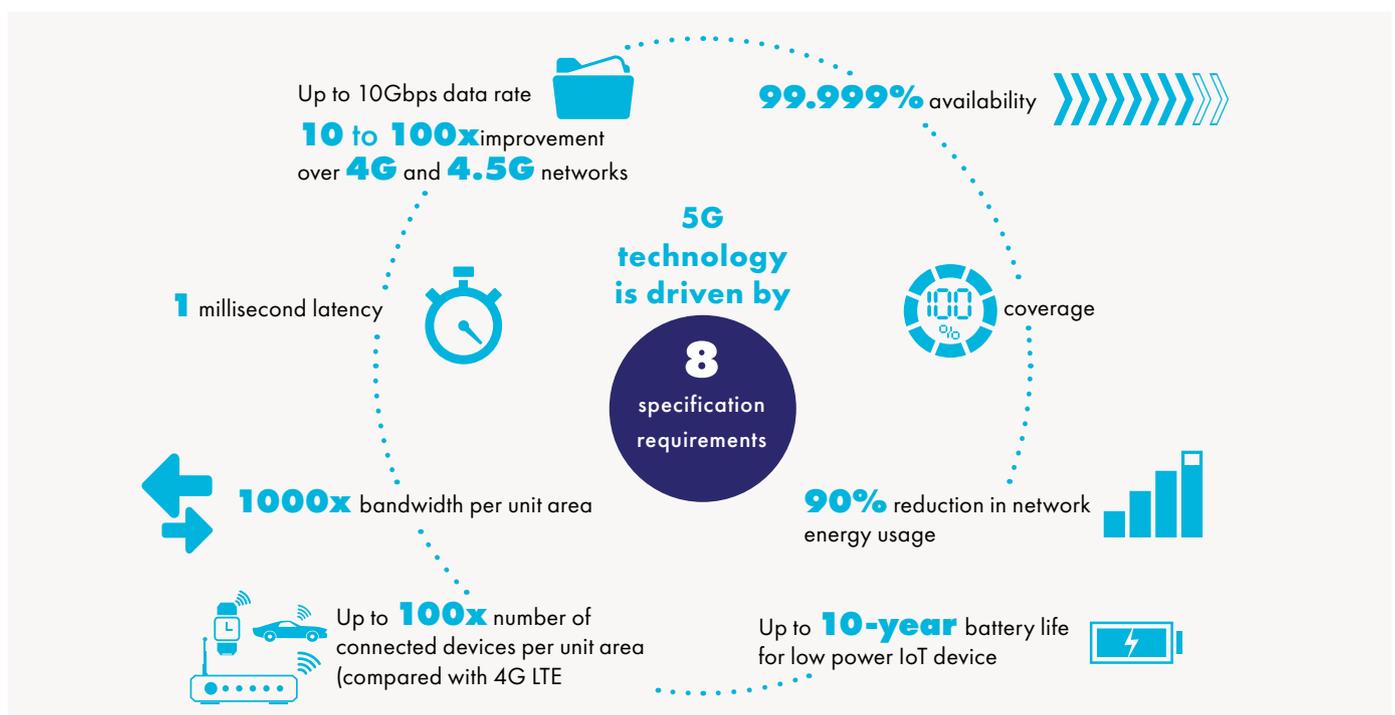
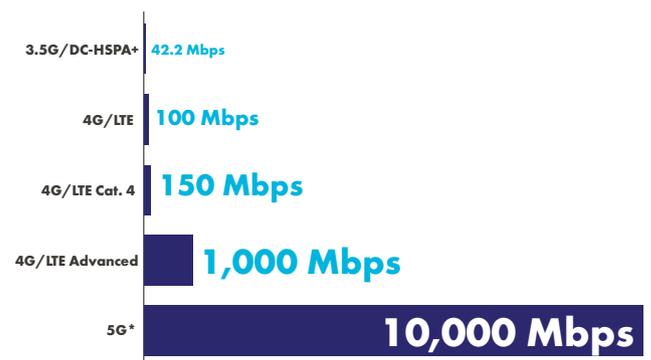
The following Q&As will give you a first introduction to 5G technology and its uses cases:

What is (and what isn't) 5G, and what is the difference between 4G / LTE and 5G?

The next (5th) generation wireless network will address the evolution beyond mobile internet to massive IoT (Internet of Things) for the horizon 2020. The main evolution compared with today's 4G and 4.5G (LTE advanced) is that beyond data speed improvements, new IoT and critical communication use cases will require new types of improved performance. For example "low latency" is what provides real-time interactivity for services using the cloud: this is key for the success of self-driving cars for example. Also, low power consumption is what will allow connected objects to operate for months or years without the need for human assistance.

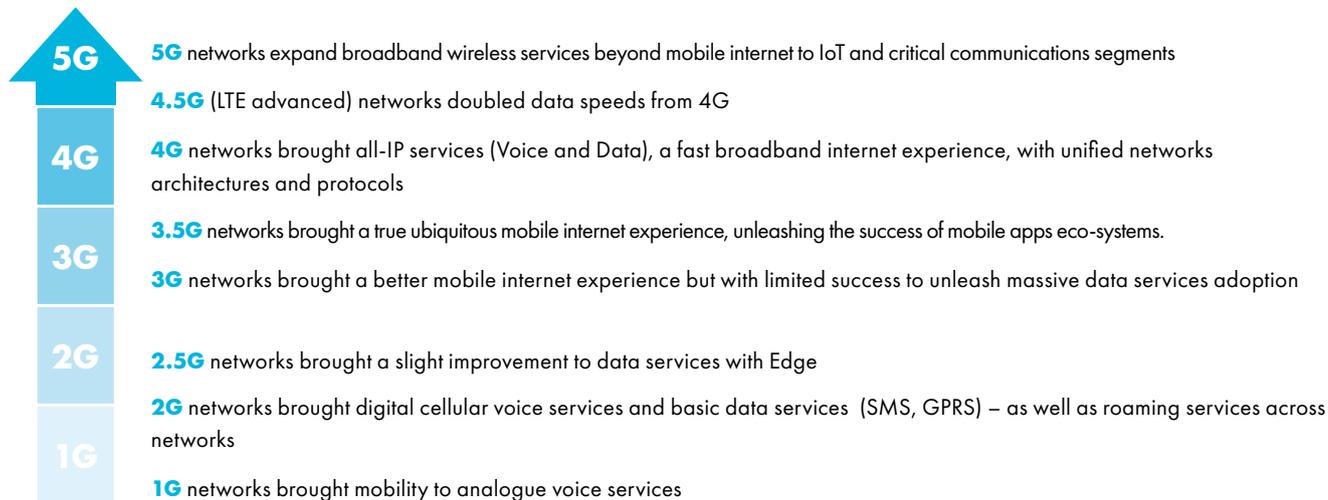
Unlike current IoT services that make performance trade-offs to get the best from current wireless technologies (3G, 4G, WiFi, Bluetooth, Zigbee, etc...), 5G networks will be designed to bring the level of performance needed for massive IoT. It will enable a perceived fully ubiquitous connected world.

Speed-wise, the evolution of data services since 3.5G network is spectacular as shown in the following diagram:

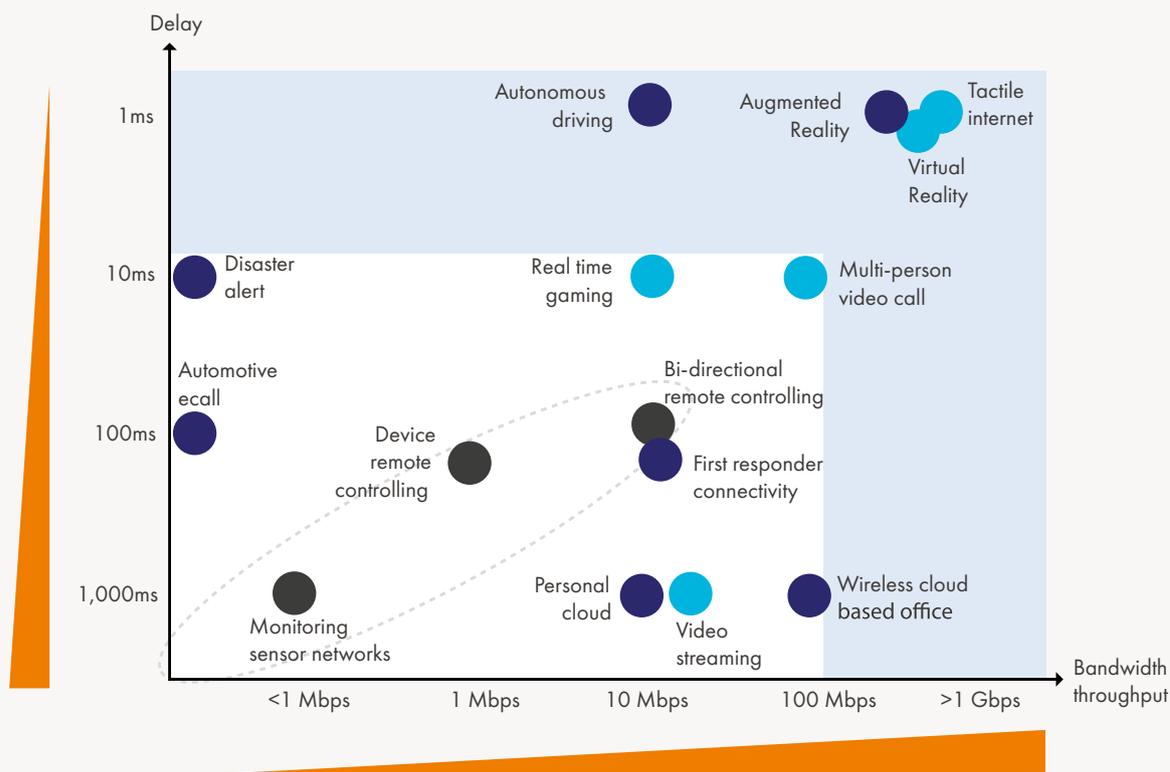


What are the real 5G use cases?

Each new generation wireless network came with all new set of new usages. The next coming 5G will make no exception and will be focused on IoT and critical communications applications



The following table from GSMA maps various uses cases vs their needs for speed and for fast response time (Latency). The grey area shows which services will benefit from 5G speed improvement, or latency improvements, or both.



- Services that can be delivered by legacy networks
- Services that could be enabled by 5G
- Fixed
- Nomadic
- On the go
- M2M connectivity

Some key applications like self-driving cars require very aggressive latency (fast response time) while they do not require fast data rates.

Conversely, enterprise cloud base services with massive data analysis will require speed improvements more than latency improvements.

Latency benefits example:



A car running at 100Km/h will move 27.6m every second, or 2.7cm every millisecond. If the road sensors capture an unexpected event on the road, <1ms network(s) latency means that the information will reach the car from the cloud in a time frame that corresponds to less than 1 meter motion (between the time the event occurred and the time the car control system gets the information).



The drones use case best illustrates all 5G next coming challenges: Low latency for fast response-time, LAN and WAN combination to support fast moving drones, high speed data rates to exploit

high quantities of navigation data and sensors to actuators communications for complex navigation software heuristics.

Critical Communications use cases:

5G will meet the expectation for ultra-reliable, critical decision making systems in a broad range of industrial and citizens services. For example:



Sensors to actuators real-time communication for industrial applications



Healthcare monitoring systems



Driverless cars navigation

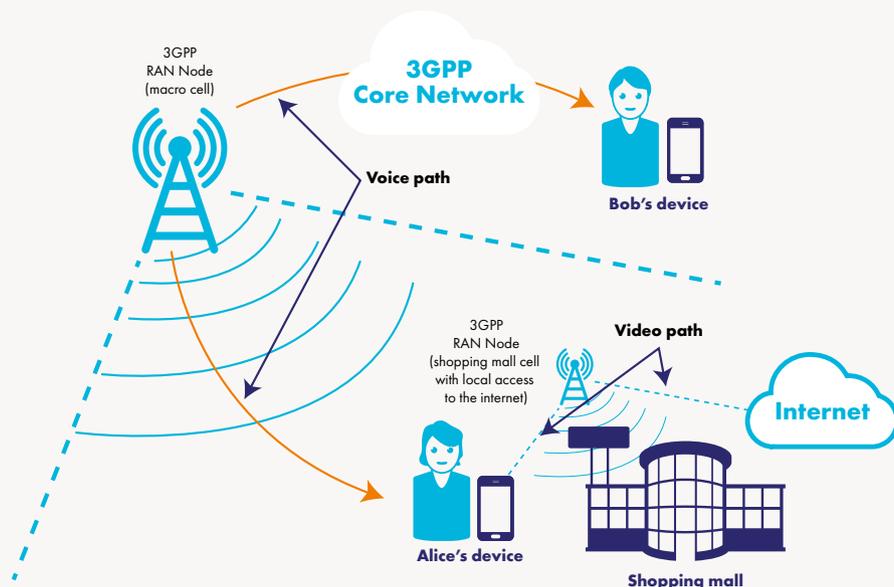


Drones/robotics applications

Virtual networks (5G Slicing) tailored to each use case:

5G will be able to support all communication needs from low power Local Area Network (LAN) – like home networks for example, to Wide Area Networks (WAN), with the right latency/speed settings. The way this need is addressed today is by aggregating a broad variety of communication networks (WiFi, Z-Wave, LoRa, 3G, 4G, etc...) 5G is designed to allow simple virtual networks configurations to better align network costs with applications needs. This new approach will allow 5G Mobile Network operators to catch a larger piece of the IoT market pie by being able to deliver cost effective solutions for low broadband, low power applications.

The concept of "Best Connection per traffic type" will then be achievable



Tactile Internet

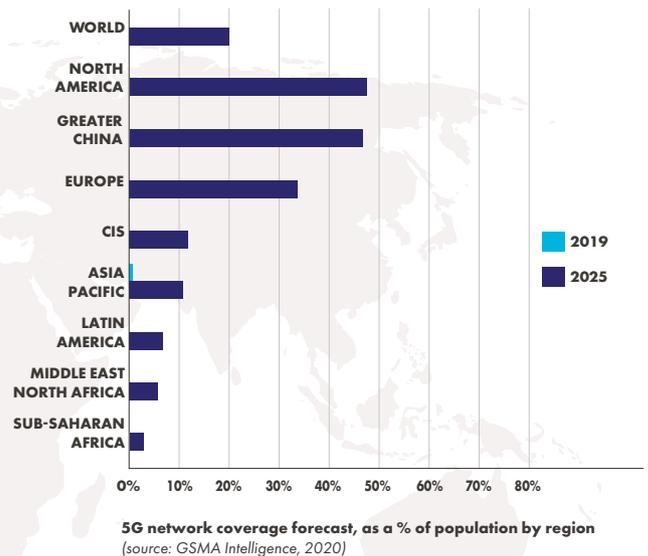
As defined as super-low latency internet applications to meet human level response time. As an example, for medical nano-surgery, intra-body robotics systems will allow the surgeons to perform real-time micro-machining.

The impact of tactile internet will also revolution the gaming industry. It will also expand to the other four human senses beyond touch (hear, sight, smell, taste) to enable new virtual reality user interfaces where applications will meet human senses response time.

When is 5G coming? Where is 5G technology in terms of standardisation and how long will this take?

- As of end-February 2020, 63 mobile operators have launched commercial 5G services in 35 countries across all continents, and 359 operators are investing in 5G networks (tests, trials, pilots, planned and actual deployments).
- Countries with 5G commercial services include Australia, Austria, Bahrain, China, Croatia, Estonia, Finland, Germany, Hungary, Ireland, Italy, Latvia, New Zealand, Oman, the Philippines, Poland, Qatar, Romania, South Africa, Saudi Arabia, South Korea, Spain, Switzerland, Tajikistan, Thailand, Uruguay, the UK, the US...
- ITU-R launched "IMT for 2020 and beyond" in 2012, setting the stage for 5G.
- Japan and Korea started to work on 5G requirements in 2013.
- NTT Docomo did the first 5G experimental trials in 2014.
- Samsung, Huawei, and Ericsson started prototype development in 2013.
- South Korean SK Telecom demoed 5G in 2018 at the Pyeongchang Winter Olympics.
- Ericsson and TeliaSonera made commercial services available in Stockholm and Tallinn in 2018.
- North America 5G is available in some locations in 2019. It won't take off in most areas until 2020.
- In the US, more precisely, AT&T is announcing nationwide coverage in the first half of 2020. Verizon 5G was the first carrier to roll out 5G.
- Deutsche Telekom started 5G in Berlin, Darmstadt, Munich, Bonn, and Cologne in Sept 2019.
- In the UK, many cities will see 5G in 2019 and more in 2020. EE, Vodafone, and O2 are actively deploying 5G since mid-2019.
- As of March 2020, recent 5G services are live in Japan (KDDI, NTT DoCoMo, Rakuten and Softbank), Noarway...

- Brazil, Colombia, Czech Republic, India, Iran, Kenya, Malaysia, Mexico, the Netherlands, Nigeria, Singapore, Sweden and Vietnam are among the countries to target 2020 for 5G roll-out.
- China Unicom has set up 5G in a few locations in 2019. 460 million 5G connections are expected by GMSA in China by 2025.



5G will continue to evolve as new use cases will be introduced:

- Fixed wireless access (from 2018-2019 onwards)
- Enhanced mobile broadband with 4G fall-back (from 2019-2020-2021)
- Massive M2M / IoT (from 2021-2022)
- Ultra low-latency IoT critical communications (from 2024-2025)

How fast will 5G take-up be?

The projected adoption rate for 5G differs drastically from all previous generation networks (3G, 4G): While previous technology were driven by mobile internet usage and the availability of "killer apps", 5G is expected to be mainly driven by new IoT usages, such as connected and self-driving cars for example.

Given that new perspectives of usage for broadband connectivity, some equipment suppliers such as Ericsson predict more than 150 Million 5G connected devices in less than 12 months after network launch

By 2025, 1.7 billion 5G connections are expected, which represent 20% of total connections (source: GSMA Intelligence, 2020).



What are the implications of 5G for mobile operators?

5G is still a cellular broadband technology and is a network of networks. MNOs expertise and knowledge in building and operating networks will be key for the success of 5G.

Beyond providing network services, MNOs will be able to develop and operate new IoT services

The implementation of 5G networks while keeping 3G and 4G networks operational will likely trigger a new challenge for MNOs regarding the ability of frequencies in the spectrum (especially if the forecasted massive volume on IoT occurs). MNOs will need to

require then operate new spectrum in the 6 to 300 GHz range, which means massive investments in the network infrastructure.

To reach the 1ms latency goal, 5G networks imply connectivity for the base station using optical fibers.

On the cost savings side, 5G networks are planned to be capable to support virtual networks such as low power low throughput (LPLT) networks for low cost IoT. Unlike today where LORA networks address that need, separately from 4G.



Will 5G technology be secure?

4G networks today use the USIM application to perform strong mutual authentication between the user and his/her connected device and the networks. The entity hosting the USIM application can be a removable SIM card or an embedded UICC chip. This strong mutual authentication is crucial to enable trusted services. Security solutions today are already a mix between security at the edge (device) and security at the core (network). Several security frameworks may co-exist in the future and 5G is likely to re-use existing solutions used today for 4G networks and for the cloud (SEs, HSM, certification, Over-The-Air provisioning and KMS).



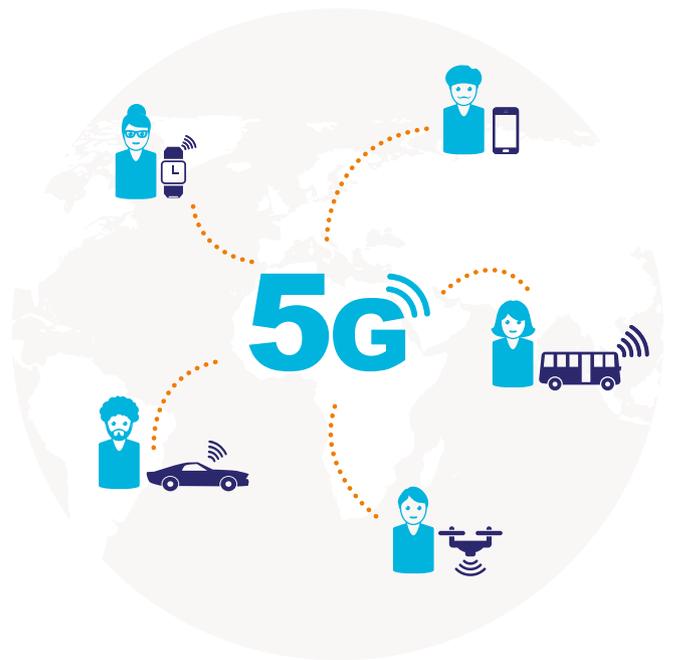
5G standards as worked out by ETSI and 3GPP are having a specific and permanent focus on security to be sure that specifications are continuously matching the reality on the field. The role of the regulators is to complement this work, by for instance defining the adequate implementation per vertical market or geography.

A key part of this is creating a framework of certifications to ensure the mobile ecosystem can leverage an adequate level of end-to-end security. This will be ensured by the usage of protection profiles on the device side, and best-in class practices like using dedicated, tamper-resistant, certifiable hardware such as 5G SIM cards (which is a tamper-proof secure element which is the only solution allowed to secure 5G network access).

5G what does it mean for consumers?

5G for consumers means not just faster mobile internet, but mainly internet connectivity in many more objects than what you see today.

Laptops and tablets, robots, televisions, drones, head-mounted displays, vending machines, connected cards, connected homes are among the many examples of the big IoT revolution coming ahead, supported by 5G networks.



How will 5G technology accelerate the commercialisation of IoT devices relying on cellular rather than Wi-Fi technology?

Wi-Fi wireless is a "Local Area Network" technology, limited in operation range and very limited in both speed and latency. Many IoT services are demanding more ubiquity, more mobility, and more performance speed-wise and response time-wise. 5G will truly unleash a true IoT eco-system



How will 5G networks / use cases change the world?



The "perception" of speed, instantaneous response time and performance for IoT will become a reality thanks to 5G. As an example, the well expected success of self-driving cars will only be possible when 5G networks are available.

