

5G OPENS THE PERSPECTIVE FOR A NEW WORLD

5G network enables transformation of our living environment. 5G is only a platform, however, and the implementation of opportunities depends on the service providers and the markets.

The new 5G means a new development phase

- › "G" is short for generation. It refers to developmental leaps in mobile phone technology, i.e. wireless data transmission.
- › 1G was introduced in the 1980s. It was "analogue speech", phone calls using analogue technology (e.g. NMT).
- › 2G (e.g. GSM) became common in the 1990s. Data was already transmitted digitally, as bits. Phone calls were complemented with text messages (SMS).
- › 3G (e.g. UMTS) brought along digital data features in the 2000s, such as the Internet and video calls.
- › 4G (e.g. LTE) increased the information transmission capacity in the 2010s, and watching videos online and using social media on mobile phones became common.
- › Development of 5G was started at the turn of 2000s and 2010s in research institutes (operators, equipment manufacturers, universities). It is not in use yet.
- › The Centre for Wireless Communications of the University of Oulu is one of the most significant 5G developers in the academic world. Its biggest cooperation partners are Nokia and VTT Technical Research Centre of Finland.

Maximal data transfer, minimal latency

- › There are no official standards for 5G yet but the property requirements have been defined. As with the previous generations, the objective of 5G is a technical leap that is in the category of integer multipliers:
 - › One of 5G's objectives is information transmission that is 1,000 times higher than 4G's on certain geographical areas.
 - › Subsequently, another objective is to reduce the energy consumption per bit to one tenth of 4G's energy consumption, at the maximum.
 - › The third requirement is to increase the data transfer rate by ten times (maximum of 20 gigabytes per second). Latency should be below one millisecond (one thousandth of a second).
- › A graph of the International Telecommunication Union (ITU) presents the properties of 5G as a triangle in which the three corners represent:
 - Enhanced mobile broadband
 - Ultra-reliable and low latency communication
 - Massive machine-type communication
- › The technological background that enables 5G includes:
 - development of integrated circuits in accordance with Moore's law

- deployment of new higher radio frequencies and the subsequent increased density of the base station network
- directional multi-antennas where the signals travel as pencil-like beams

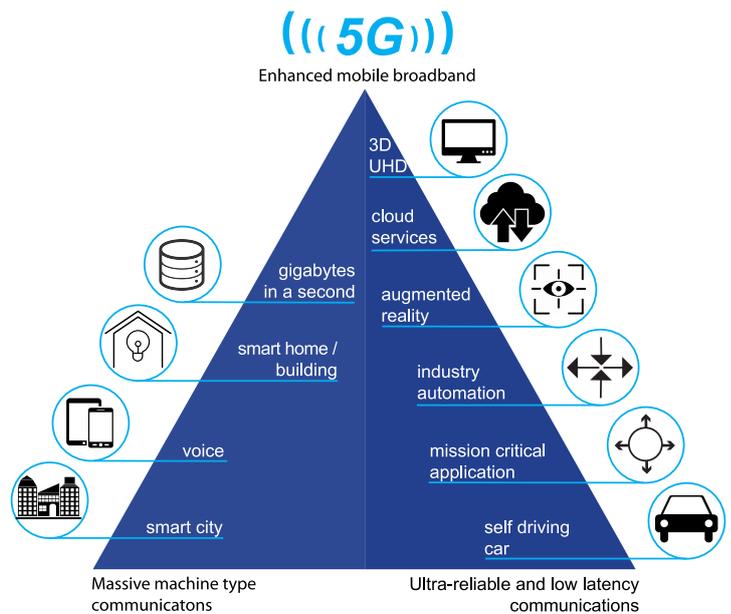
Capacity + speed + reliability = autonomous environment?

- › Thanks to the capacity, speed and reliability of 5G, masses of devices, machines and sensors (transducers) can use wireless data transmission. This is the most essential feature of the new 5G.
- › The Internet of Things (IoT) started with 4G can be implemented on a larger scale. The term refers to connecting devices and machines to a network so that they can send and receive information and operate "smartly".
- › Possible applications include, for example:
 - self-driving cars and other smart transportation
 - industry automation
 - smart home appliances and equipment, such as self-regulating lighting and heating or a refrigerator that can send shopping lists
 - demand response of electricity, i.e. automatic control of electricity consumption
 - use of virtual and augmented reality in education, services and industry, e.g. modelling a construction project with virtual glasses
 - "Smart City" where there are as many as millions of connected devices and sensors per square kilometre

The 2020s will show how 5G will develop

- › 3GPP, a body of commercial operators, will define 5G standards in the summer 2018. Before that, all the merchants' references to 5G are just sales talk or "4.9G".
- › Building of 5G base station networks has not been started yet. Prior to the standardisation, there are only prototypes of base stations.
- › The Tokyo Olympics in 2020 are expected to be the "big bang": Japanese operator NTT Docomo plans on launching the world's first commercial 5G network at the time of the Olympics. At first, 5G networks will be built in big cities and large buildings, such as the University of Oulu.

Usage scenarios of IMT for 2020 beyond



- › To be able to utilise 5G, consumers have to purchase 5G-ready devices. They are not on the market yet.
- › In Finland, the first 5G services are expected to become available in 2020-2021. We don't know yet what they will be. Perhaps 5G/WLAN base stations for households.
- › The first corner of ITU's 5G triangle to become implemented is the enhanced mobile broadband. At first, it only means faster internet connection and sharper video image.
- › Development of other services depends on the providers and the markets. In principle, it is possible that the capacity of 5G will be only utilised for watching videos. On the other hand, in the business world the trend is towards wireless services.

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The story is based on the interview of professor Ari Pouttu.