5G: Questions and answers

Find answers to questions about 5G networks.

5G/6G

5G networks and technology
What is 5G?

The fifth generation of telecommunication systems will be a critical building block of our digital economy and society in the next decade. Mobile traffic doubles every 2 years and new applications are emerging. 5G will provide the capacities and performance to meet these connectivity needs. These networks will be able to support millions of simultaneous connections in crowded places, and perform real-time transmissions of high-quality video feeds and remote operations.

5G is about more than smartphones. It can connect our industries, from automated cars to wireless robots, offering opportunities for sustainable growth and jobs across Europe. The highest impact of 5G is expected in key sectors such as transport, health and manufacturing, with a benefit exceeding €500 billion worldwide per year for 5G-enabled service providers.
How does 5G work?

In technical terms, 5G networks are characterised by:

- low-latency: near real-time network responsiveness;
- wider bandwidth: for ultra-fast data sharing;
- guaranteed quality: having a part of the network reserved for a particular use.

These features make 5G the key foundation to test and launch the latest technologies, namely, the Internet of Thing (IoT), Artificial Intelligence (AI), Virtual and Augmented reality (VR and AR).

Edge computing is a key concept to meet these requirements. It means data processing close to, or directly on, the user’s device, rather than sent over the network to a data processing centre and then retrieved and sent it back to the user’s device. Such real-time interaction will enable applications like health and patient monitoring, remote control of factory machines, smart grids for renewable energy management, autonomous vehicles, precise fault detection and quick intervention, and more.
Which frequencies will 5G use?

The deployment of 5G networks depends closely upon access to radio spectrum, or the frequencies that are the basis of wireless communication, namely telecommunications.

Initially, 5G will use similar frequencies as 4G to carry data. In the future, 5G networks will also use frequencies positioned higher on the radio spectrum and operating on shorter wavelengths. This will allow 5G networks to serve even more users and devices simultaneously and deliver data extremely fast.

The distance that these waves can reach is a lot shorter, so instead of cell towers that cover large areas, 5G networks will use less powerful and smaller antennas that cover smaller areas. As the rate of connected devices and their applications increases, it is important to define the use of frequencies by different technologies (i.e. tv and radio broadcasting, public safety applications, hearing aids, medical equipment, telecommunications, etc.).
Allocating spectrum for specific uses keeps different technologies from interfering with each other. It is also important to harmonise these spectrum rules across countries. Having the same rules across Member States ensures that technologies are interoperable across borders.

For the deployment of 5G, the Commission harmonised the use of 3 pioneer frequency bands (or frequency ranges) across the EU:

1. The 700 MHz band, assigned to mobile operators for wireless broadband use. It will allow for wide territorial coverage, including rural areas.
2. The 3.6 GHz band, to support higher data-sharing capacity and moderate reach.
3. The 26 GHz band, for very high data-sharing capacity in dense areas, such as cities.

The Member States should authorise operators to use these 3 bands for 5G by the end of 2020. This will ensure that operators have access to enough spectrum to provide innovative 5G services.

The Commission and Member States continue to exchange best practices and discuss common elements of these national spectrum awards. Information about progress and any major market developments are continually being reported by the EU 5G Observatory.
Is Europe ready for 5G?

European operators are on equal track with China and the United States, with commercial launches of 5G this year. With more than €1 billion invested in European trials, Europe is now a world leader in this field, developing unique business opportunities.

Investments in commercial roll-out amounting to €60-100 billion per year are yet to come. Member States are encouraged to make the necessary frequencies available for sectors relying on wireless services like broadcasting, public safety, research, transport, environmental protection and energy.

The Commission launched the European 5G Observatory in 2018 to monitor the progress of 5G in Europe, including preparatory actions on trial activities, potential 5G-enabled cities, cross-border corridors and spectrum assignment.
How will 5G benefit healthcare?

There is a wide range of health applications of 5G, which include expanding telemedicine, reliable, real-time remote monitoring, and using artificial intelligence to help with diagnoses and more.

Telemedicine allows doctors and other clinical staff members to collaborate more efficiently to deliver healthcare from remote locations. It might be particularly useful in rural areas to be able to send real-time, quality videos and images to a specialist for review.

Also, when one needs to deliver very large data files, like 3D medical images, the transmission can take a long time or not send successfully if the network is low on bandwidth. This means the patient waits longer for treatment and providers see fewer patients in the same amount of time. With high-speed and reliable 5G networks, patients can get treated sooner and have access to specialists otherwise not available, by improving both access and quality of care.

Reliable, real-time remote monitoring involves the use of Internet of Things devices to help healthcare
providers monitor patients and gather data for a more preventive and personalised care. Wearables, which are commonly used for remote monitoring, increase patient engagement with their own health, while decreasing hospital costs.

However, remote monitoring technology usage is limited by the capacity of the network to handle the data. Slow network speeds and unreliable connections prevent doctors to get the real-time data they need to make quick decisions. 5G technology, with its low latency and high capacity, will allow for reliable remote monitoring of patients.

Many key healthcare decisions will be made or facilitated using artificial intelligence (AI). For example, to determine potential diagnoses, or to decide on the best treatment plan for a specific patient. Additionally, AI can help to predict which patients are more likely to have post-operative complications, allowing healthcare systems to provide early interventions when necessary.

The large amounts of data needed for rapid learning require ultra-reliable and high-bandwidth networks. Additionally, providers often need to access data from mobile devices. By moving to 5G networks, healthcare organizations can use AI tools to provide the best care possible – from wherever they are. By enabling all these technologies through 5G networks, healthcare systems can improve the quality of care and patient experience, as well as reduce the cost of care. Instead of only reacting to patients' condition, 5G networks can give providers the ability to deliver more preventive and personalised care.
What does 5G mean for consumers?

Consumers can expect better mobile services, new IoT-enabled applications for better energy management, improved safety and engaging entertainment. We can expect much faster and more reliable mobile internet, where greater network capacity will eliminate internet traffic congestion and make seamless connectivity a reality. With wider bandwidth and reliable connections, more people will have access to the internet, digital services and education.

5G will enable better energy management and lead to a more sustainable future. With more connected objects that are able to share real-time information, cities and families could turn to intelligent energy consumption based on real-time needs.

The unprecedented speed, connectivity and high capacity of 5G can improve our road safety. With connected cars that are able to exchange information in real-time, drivers will be able to “see” the road ahead to avoid incidents and unsafe conditions. Notably, 5G is the building block of connected and automated transport, of self-driving cars, trains and automated port services.
Entertainment will become more engaging through immersive and integrated media. Collaborative video and game production will become easier, faster and simpler. 5G supports faster uploads, so you can share more user-generated, high-quality content and faster downloads, so you can enjoy more high-quality games & videos. 5G also opens up new possibilities.

Quick 3D imaging could put us into our favourite movie scenes, make eSports more interactive and let us virtually try-on clothes. The low latency, quick response time of the 5G networks means we could enjoy a smooth, no-lag experience in augmented reality entertainment.
What does 5G mean for industry & business?

The unprecedented performance and reliability levels achieved by 5G connectivity services will make it compatible with the most demanding professional use case requirements currently contemplated by multiple industrial sectors. From that perspective, industries and businesses will be the key players in driving innovation enabled by 5G, which will in turn accelerate digitisation of multiple vertical sectors.

With 5G, faster and more stable connections can connect teams in multiple locations at once, opening more opportunities to adopt remote working and giving employees the opportunity to work from home. Sharing heavy data files will become much faster and easier, enhancing data sharing and facilitating long-distance collaboration.

The Internet of Things (IoT) will allow objects to exchange information in real-time. 5G will support real-time control of devices, which means factories could upgrade their automated processes and interconnected machines to improve efficiency and employee safety.
Reliable and seamless connections can have workers monitor hard to reach or dangerous environments and remotely operate equipment. 5G can bring much needed safety to dangerous professions – construction work, mining, emergency services, and more.

Similarly, the real-time high reliability response of 5G will bring healthcare application like remote consultation or telesurgery to operational reality. The availability of great amounts of data and the possibility to quickly access and share it will give businesses insights into their operations in order to improve and optimise them. This in turn will expand growth, increase savings and improve customer experience.
How will 5G support sustainable energy and energy efficiency?

5G technology has been designed to be more energy efficient than previous generations. This is mainly achieved through low-power, small antennas and through efficient technology where transmission power is only generated when really needed.

Notably, 5G uses a power saving mode more systematically, only activating network resources when there is active traffic. 5G will also support greener and more sustainable energy consumption. 5G networks will support better management of renewable energy resources and allow families, businesses, and cities to have more insight into their energy use and a smarter way to manage it. Internet of Things (IoT) enabled objects can allow for better monitoring and control of energy use. Combined with 5G networks, which can transmit information in real-time, energy use can be based on real-time needs in smart homes and smart cities.
What is the Commission doing for 5G innovations in Europe?

Connectivity is one of the key areas that the Commission is continually strengthening across the EU. 5G plays a key role in making better, faster and more reliable connections available to everyone throughout the EU. The Commission has been taking steps to bring this revolutionary technology to life in Europe.

In 2013, the Commission set up the 5G public-private partnership (5G-PPP) to secure Europe’s leadership and potential in new markets. Together with the industry, the initiative has seen the launch of projects in areas such as smart cities, ehealth, intelligent transport, education or entertainment & media.

It was followed by the Commission’s 5G Action Plan, published in 2016, which set out the road map for Member States to set the scene for 5G services and products. The plan includes coordinating regulatory measures, granting operators access to radio spectrum for 5G networks, incentivising investment in network infrastructure and promoting 5G trials. Market developments and 5G
availability can be tracked through the EU 5G Observatory. Europe is leading in 5G trials for vertical sectors, such as transport, media, and manufacturing.

Some of the areas in which the Commission is strongly collaborating with the industry under the 5G-PPP is connected and automated mobility in transport, which would allow for autonomous or remotely controlled vehicles on roads, in-land waterways, railroads and in ports.

Connected vehicles will be able to access mission-critical information in real time. This will contribute to safety, to a lower carbon footprint, and to a broad range of digital services for drivers and passengers. In parallel, the Commission is continuously supporting and funding 5G connectivity on designated major transport paths, or connected cross-border corridors to develop large-scale testing sites.

The Commission recognises that 5G can transform whole cities, creating smart cities. Smart cities are cities whose networks, for example transport, utility and lightning, are equipped with advanced connectivity making them easier to manage, significantly more sustainable, efficient and safer. Smart cities are synonymous with networks that generate and make available real-time information on traffic, energy consumption and needs so urban services can be better managed by public administrations and better serve commuters. In the EU, there are 5G trial cities that are continually advancing to create 5G ecosystems that can support smart city technology and services.
The Commission adopted an implementing regulation on 5G networks. Why do we need new legislation?

5G networks will use much smaller antennas compared to current systems. At the same time, the new antennas will achieve much better coverage and higher connection speeds. They will also be less visible and produce less electromagnetic emissions. In fact, they could be compared to Wi-Fi installations.

As existing rules on small cells have been burdensome and fragmented, the EU adopted in June 2020 uniform rules to avoid heavy procedures for antennas of low volume, weight, visual impact and emission. This regulation also ensures high levels of protection against electromagnetic fields, in line with the Council Recommendation and a smooth integration into the surrounding environment.

The new rules are set by the Commission Implementing Regulation in accordance with the EU telecom rules set in the European Electronic Communications Code, adopted in 2018 and transposed into
Member States’ national law by the end of 2020.

**Electromagnetic fields and 5G**
Some citizens are concerned about 5G and Electromagnetic fields (EMFs). What does 5G mean for EMF?

Some people are worried that more antennas means more EMF exposure. The European Commission takes protection of public health very seriously and ensures that any emissions are subject to high precautionary measures. 5G networks will use small cells with lower power levels and therefore lower EMF exposure levels than the existing large cells in 4G networks.

A recent Commission study showed that in urban areas where 5G will be deployed and 4G antennas are still in use, the overall exposure levels will modestly increase, but this will still be a long way below safe limits, which are 50 times lower than levels at which health effects are possible. As the 4G antennas go out of use, exposure levels will go down.

Moreover, 4G and older generation antennas, which operate with higher emission powers, are expected to be used less and less in these areas. The new, small cell networks will develop and
distribute sources of electromagnetic fields more evenly at lower power levels.
What are the EU’s rules and views on EMF exposure?

The European Union takes a precautionary approach by recommending maximum exposure limits with a wide safety margin. This means that EU exposure limits for the general public are set at 50 times lower than the emission levels at which health effects may start to be seen, according to World Health Organisation (WHO) estimates.

The Council Recommendation sets out strict limits for electromagnetic fields in line with the guidelines set by the 1998 International Commission on Non-Ionising Radiation Protection, or ICNIRP. These guidelines have been adapted in 2020 in order to take into account the new 5G applications and will be assessed accordingly.
What about higher frequencies created by 5G networks? Aren't they risky?

EMF exposure from 5G networks, including through the use of new frequency bands, has to remain below the recommended limits, just like 2G, 3G and 4G networks. New guidelines from the International Commission on Non-Ionizing Radiation Protection (ICNIRP) were released in March 2020.

ICNIRP 1998 guidelines are protective for current applications of radio frequency EMFs, while their new guidelines incorporate also EMF exposure for frequencies above 6 GHz, where future 5G technologies will operate. This will result in reducing the maximum magnitude of localized exposure.

Limits for the exposure to EMFs that are currently recommended at international and EU level were classified by the World Health Organisation’s International Agency for Research on Cancer (IARC) at the third level in a scale of five levels of risk, which puts them in the group with other ‘possibly carcinogenic’ elements, such as pickled vegetables. This means that radio EMFs are less risky than eating red meat, working night shifts or drinking hot coffee, which are at the second level and assessed as ‘probably carcinogenic’.
Radio EMFs are considered even less risky than air pollution, wood dust or alcoholic beverages, which, being at the first level, fall into the ‘carcinogenic’ category. More information on classifications is available on the International Agency for Cancer Research website.
The International Commission on Non-Ionizing Radiation Protection (ICNIRP) published new guidelines on EMF in March 2020. What is the position of the Commission regarding the new guidelines?

ICNIRP announced that while their 1998 guidelines include current commercial applications of radio frequency EMFs, their new guidelines have incorporated a number of adaptations for the use of new technologies, particularly for EMF frequencies above 6 GHz. Future 5G technologies will operate on these frequencies, which have the result of reducing the maximum magnitude of localized exposure that a person can receive.

ICNIRP indicated that all scientific literature of good scientific quality was used to set the guidelines including major reviews by the World Health Organization (2014), the Swedish Radiation Safety Authority (2015, 2016, 2018), the Scientific Committee on Emerging and Newly Identified Health Risks (2015), as well as individual studies identified following those reviews, and that the literature included research searching for effects of both brief and long-term exposures to radiofrequency
electromagnetic fields (RF EMF), on both immediate (e.g. pain) and delayed (e.g. cancer) health outcomes. This included evaluation of self-reported hypersensitivity to RF EMF exposure.

See ICNIRP Q&A.

The European Commission will consider the new ICNIRP’s guidelines findings and re-examine the situation in relation to the 1999 Council Recommendation.
Do all Member States have to apply the same EMF limits?

A few Member States have decided that the limits should be at a level lower than the maximum exposure limits set out in the ICNIRP guidelines or in the Council Recommendation. The health protection policy is a competence of the Member States, who are free to adopt stricter requirements. The Commission remains confident that the currently recommended limits are adequate to protect public health.

Cybersecurity and 5G
What are the main findings of the review of the Commission Recommendation?

The review shows that Member States have been highly appreciative of the process initiated by the Commission Recommendation of 26 March 2019 on the cybersecurity of 5G networks. It also shows that Member States are keen to continue the coordinated work on this topic at EU-level.

The Toolbox of mitigating measures is perceived as a useful instrument providing comprehensive guidance based on risks and an objective methodology. The review also shows that most Member States have made further progress in implementing the Toolbox measures at national level since the progress report was published in July 2020.

While national processes are still underway, most Member States are well on track to complete them in the coming months. However, there are some differences between individual measures, as some Member States are more advanced in certain areas than in others.
Overall, this review confirmed that, as regards areas where more efforts and particular attention is needed, the assessment and conclusions of the progress report remain entirely valid. The review also provides highlights on the actions undertaken by the Commission and ENISA to support the implementation of the Toolbox in the fields of standardisation and certification, EU funding for secure 5G roll-outs, actions to promote EU capacities in the area of network technology, and fostering a diverse and sustainable 5G ecosystem in the EU.

The conclusions of this review details the way forward and proposes a set of actions, categorized by key objectives, for the future of the coordinated work at EU-level.
**Where do Member States stand in implementing the toolbox measures?**

Since the progress report was published in July 2020, most Member States have made further progress in implementing the various measures of the Toolbox at national level. A very large majority indicated clear plans and timelines for the roll-out of the main Toolbox measures.

Overall, nearly all Member States estimated that they would complete the ongoing implementation process by mid-2021. However, as demonstrated in the Progress report of July 2020, a number of areas require specific attention and there are still a few Member States were no clear plans have yet been communicated as regards certain measures.

Regulatory powers of national authorities have been strengthened in a large majority of Member States, to be able to impose security requirements on mobile network operators and to be able to impose restrictions or to prohibit the supply, deployment and operation of 5G network equipment, and requirements for mobile network operators have been or will be strengthened in most Member States through concrete activities.
Member States have introduced measures aimed at applying restrictions based on the risk profile of suppliers have been adopted, proposed or planned in nearly all Member State. The reliance on high-risk suppliers is therefore expected to decrease in the coming years as 5G network roll-outs progress, albeit with variations between individual countries.

Several Member States have introduced measures on diversification. These measures request that mobile network operators (MNOs) submit their sourcing and diversification strategies to national authorities and ensure that they take measures to increase resilience.

Other Member States have not yet taken specific measures due to several challenges, already identified in the Progress report of July 2020.

Finally, foreign direct investment (FDI) screening mechanisms are in place in 15 Member States, while the process is underway in several others.
What is the state of play of supporting actions undertaken by the Commission and ENISA?

The Commission Communication of 29 January 2020 on ‘Secure 5G deployment in the EU - Implementing the EU toolbox’ sets out a number of actions for the Commission and ENISA to support the implementation of the Toolbox.

These actions are in the fields of standardisation and certification, EU funding for secure 5G roll-outs, actions to promote EU capacities in the area of network technology, and fostering a diverse and sustainable 5G ecosystem in the EU. Main developments in these areas include standardisation and certification, EU funding for secure 5G deployment, investments in EU capacities in the area of network technologies, facilitation of research and innovation, and international activities.

In the area of standardisation and certification, a sub-group on 5G standardisation was set up under the Security of Network Information Systems (NIS) 5G Work Stream. The aim of this sub-group is to
facilitate coordination between Member States in the areas of 5G standardisation, avoid duplication of national approaches, and promote more secure products and processes.

This sub-group also provided a forum to discuss activities related to the development of certification schemes for 5G networks, leading to the 5G cybersecurity Work Stream expressing its support for the preparation of an EU candidate scheme in this area. In addition, ENISA is currently finalising a report containing recommendations for the implementation of security measures in existing 5G standards.

For funding secure 5G deployment, the Commission is working to introduce appropriate cybersecurity provisions into relevant EU funding programmes, including at the level of work programmes and calls. These funding programmes include Horizon Europe, the Digital Europe Programme, Connecting Europe Facility 2, European structural and investment funds, and more.

Regarding investments in EU capacities in the area of network technologies and promotion of a diverse and sustainable 5G ecosystem, the Commission proposed a Smart Networks and Services (SNS) Joint Undertaking under Horizon Europe, focused on 5G deployment and research and innovation (R&I) activities in 6G.

The objective of the SNS Joint Undertaking is to enable the EU to develop next generation network technologies and put on the market European solutions that are competitive, enrich the globally available alternatives and diversify the sources of supply, in line with the EU industrial strategy and the 5G Toolbox.

In order to facilitate research and innovation, the Commission has been facilitating R&I in the area of software-based networks, including open radio access networks (Open RAN). Nine innovation actions in this field have been selected under a recent Horizon 2020 call and are expected to kick off in January 2021.

In the field of Open RAN, the Commission has also recently launched an independent study to identify market trends, risks and opportunities.

The Toolbox has been presented by Member States, Commission and ENISA representatives in numerous international events. The Commission services, together with the European External Action Service, are also actively monitoring relevant developments in third countries, including through the EU network of Delegations. The Toolbox has also become an important element in the EU’s strategic dialogues and partnerships with third countries.
What are the activities in the field of 5G certification?

Several meetings of the sub-group on 5G standardisation were dedicated to discussing the appropriate way to work on 5G certification.

On 27 November 2020, Member States expressed support for the preparation of a candidate certification scheme related to 5G components and suppliers’ processes. The Commission is now preparing a request for ENISA to start developing a candidate certification scheme in this area, under the Cybersecurity Act. The European Cybersecurity Certification Group (ECCG) and the Stakeholder Cybersecurity Certification Group (SCCG) will also be involved in the preparation of the candidate scheme.
What are the next steps in the EU coordination process on 5G cybersecurity?

The Commission called on Member States to complete the implementation of the main Toolbox measures by the second quarter of 2021 and to ensure that identified risks have been mitigated adequately and in a coordinated way. In particular, this should be done with a view to minimise the exposure to high risk suppliers and to avoid dependency on these suppliers.

To continue and deepen the EU coordination process on 5G cybersecurity, the EU Cybersecurity Strategy details the way forward and identifies 3 key objectives, which are:

1. ensuring further convergence in risk mitigation approaches across the EU;
2. supporting a continuous exchange of knowledge and capacity building;
3. promoting supply chain resilience and other EU strategic security objectives.

A set of actions for the short- and mid-term to achieve these objectives have been identified. They include continuing and intensifying the exchange of information and best practices on specific
strategic and technical measures, and on updated national risk assessments within the Network and Information Security Work Stream, monitoring the evolutions in 5G technology, its architecture, the threats associated with it, and organising knowledge-building activities on various topics and making use of EU funding opportunities to support the Toolbox implementation. The Commission also plans to:

- define a concrete action plan to enhance EU representation in standard setting bodies and to promote security and interoperability;
- prepare a candidate certification scheme for key 5G components and suppliers’ processes;
- analyse and support supply chain resilience, notably by analysing the 5G ecosystem and identifying key assets;
- invest in R&I and capacities, ensuring the secure roll-out of 5G networks through appropriate security requirements in EU funding programmes.

Finally, the Commission will respond to requests from third countries who would like to understand and potentially use the Toolbox approach developed by the EU.

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