

Towards a European gigabit society Connectivity targets and 5G

SUMMARY

In September 2016, the Commission put forward new strategic connectivity objectives for 2025 as part of its digital single market strategy. These should prepare Europe for the roll-out of the next generation of broadband infrastructure with gigabit speeds, including both fixed and mobile internet access (5G). Once available, from 2020 onwards, 5G is expected to enable an array of new innovative services that will transform sectors such as manufacturing, energy, vehicle manufacturing and health, bringing them into the era of the internet of things.

Given its importance for EU competitiveness, the Commission is speeding up 5G by co-financing research and development. The 5G-PPP public-private partnership is the largest initiative of its kind in the world, with €700 million in EU funding, to be topped up with private funding to reach a total budget of €3.5 billion by 2025.

There is some concern that not all consumers and businesses in Europe will benefit from the gigabit society, given the current and future digital divide between urban and rural areas and across EU countries. For example if gigabit speeds and 5G are available only to areas with high demand, users are likely to be highly reluctant to pay for it as many new services will need continuity across borders and geographic areas.

Progress in building the European gigabit society is expected once an updated EU telecoms framework is in place. This will enable high levels of investment in network infrastructure and increased policy coordination across Member States, for instance increasing spectrum harmonisation for 5G and co-investment of deployments.

Both the proposed European Electronic Communications Code and the 5G action plan are of high importance for the Council and Parliament, and essential if the EU is to take the lead in the global 5G race.



In this briefing:

- New EU connectivity targets
- Measures put forward to achieve the targets
- Main challenges for 5G technology
- European Parliament and Council positions
- Main references

New EU connectivity targets

In September 2016, in its communication 'Towards a European Gigabit Society' the Commission presented new connectivity targets and policy measures, as part of its [digital single market \(DSM\) strategy](#). The aim is to roll out ubiquitous, very high-capacity networks, and more specifically [5G](#), to boost Europe's global competitiveness and further the [digitisation of European industry](#). The targets also needed to reflect the need to cope with ever-increasing levels of internet traffic from consumers, businesses and connected devices. 5G is the fifth generation of telecommunications technologies and will play a central role in achieving the European gigabit society by 2025. Once available, in 2020, 5G is expected to be the enabler of the internet of things (IoT), where [billions](#) of connected devices, applications and smart objects will share information ubiquitously. The European Commission has set three specific connectivity targets for 2025:

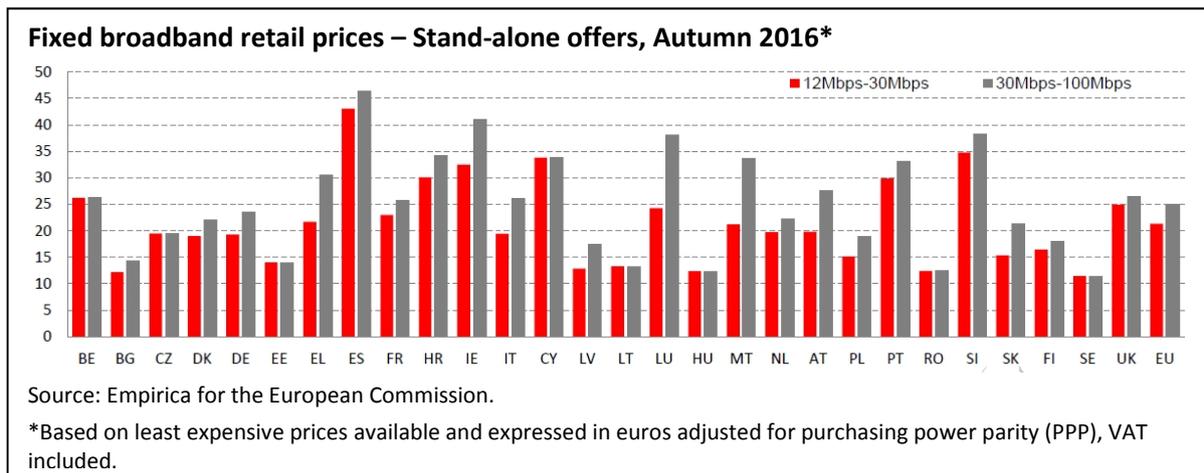
1. All socioeconomic drivers, such as schools, transport hubs and main providers of public services, as well as digitally intensive enterprises, should have access to internet download/upload speeds of 1 gigabit of data per second (Gbps).
2. All European households, rural or urban, should have access to connectivity offering a download speed of at least 100 megabits per second (Mbps), which can be upgraded to gigabit speed.
3. All urban areas as well as major roads and railways should have uninterrupted 5G coverage. As an interim target, 5G should be commercially available in at least one major city in each EU Member State by 2020.

These new ambitious connectivity targets for a gigabit society are non-binding legally and complement the three existing broadband connectivity targets already set by the Commission in the [Digital Agenda for Europe](#) strategy in 2010, namely, to secure:

1. 'basic broadband' access for all Europeans by 2013;
2. access to 'fast broadband' speeds of over 30 Mbps for all Europeans by 2020;
3. access to 'ultra-fast broadband' speed connections of over 100 Mbps for at least 50 % of European households by 2020.

The Commission tracks annual progress against these targets on the digital agenda [scoreboard](#). The basic broadband for all target was [achieved](#) in 2015 and the target on ultra-fast broadband (download speed of at least 100 Mbps) is within reach (49 % in June 2016), although mainly for households in urban areas and with wide differences across countries. The second target, on fast broadband (download speed of at least 30 Mbps), is still ongoing. In 2016, 76 % of European households – but only 40 % of those in rural areas – had access to fast broadband which is still far from the target of 100 % by 2020. Major progress has, however, been made since 2015 (68 % and 28 % respectively).

When it comes to take up, in 2016 27 % of European homes subscribed to fast broadband and 11 % to ultra-fast broadband, with wide differences across countries and between rural and urban areas. This might be explained in part by widely differing prices. According to the European Commission, broadband access prices vary between €11 and €43 for a stand-alone offer with a minimum download speed of 12 Mbps. In some countries the price difference between fast and ultra-fast broadband is very small, whereas in others it remains substantial.



In this context, the three new connectivity targets towards a gigabit society might seem quite ambitious. However, in setting the new connectivity targets for 2025 the Commission argued that at the current pace of network development it would be impossible to satisfy increasing user demands. According to industry [analysis](#), global mobile data traffic grew by 63 % in 2016 and over 18-fold over the past five years, and it is expected to continue growing at a rapid pace. A booming market of mobile applications and ever-increasing mobile connectivity by end users (whether consumers, businesses or connected devices) requires the expansion of the network bandwidth capacity and speed, as envisaged with the three new targets. For the time being, operators are continuing to roll out 4G networks to improve mobile connectivity until 5G technology is fully ready for deployment (from 2020 onwards). Mobile operators' association GSMA [expects](#) 5G to scale up rapidly after its launch in 2020, with coverage reaching just over a third of the global population within five years, and 5G mobile broadband connections exceeding 1 billion, (i.e. 12 % of total mobile connections), over the period. According to industry [estimates](#), 5G will offer capacity 40 times that offered by current 4G technology.

Measures put forward to achieve the targets

As part of the European gigabit society strategy, and in addition to the targets, the Commission has proposed three legislative proposals¹ and one non-legislative measure, all of which aim to reform the regulatory framework for electronic communications and make it fit for purpose and able to achieve the EU's connectivity targets.

The first of the legislative proposals is for a new [European electronic communications code \(ECC\)](#) that will review the current EU telecommunications framework dating back to 2009 so as to increase investments in infrastructure. It also includes simplified rules to make investing more attractive for companies. [Industry](#) has estimated that €660 billion is needed to deploy the new infrastructure, while another [study](#) carried out for the Commission estimates that reaching the targets would cost €500 billion by 2025.² This will be a challenge for operators as revenues across the telecoms industry continue [falling](#). Nevertheless big revenues are expected from the gigabit economy: according to the [Commission](#), the investments triggered by the new framework could boost the EU's gross domestic product (GDP) by an additional €910 billion and create 1.3 million new jobs by 2025. According to a recent [study](#) on the economic impact of 5G, investment of approximately €56.6 billion could create 2.3 million jobs in Europe by 2025 and revenues of €113.1 billion per year in four key sectors (automotive, health, transport and energy). Globally, Swedish operator [Ericsson](#) predicts US\$582 billion annual revenues by 2026.

The Commission's second legislative proposal is known as [Wifi4EU](#), and aims to increase the number of free public Wi-Fi internet access points for citizens, to help with reaching the new connectivity targets. For instance it has been [estimated](#) that almost 100 million pupils and students, more than 70 million workers, and almost 2 million doctors and more than 2.5 million patients in hospitals across Europe will benefit directly from the new objective of 1 Gbps connections for businesses, all schools, transport hubs and main providers of public services by 2025. The Commission has planned for an initial budget of €120 million provided by a voucher scheme, to benefit between 6 000 to 8 000 local communities by 2020.

Thirdly, the Commission has proposed an [updated](#) regulation on the Body of European Regulators of Electronic Communications (BEREC). This would reinforce BEREC's role with national regulatory authorities, in tasks such as geographical surveys, developing common approaches in order to meet end-user interests and deliver peer-reviewed opinions on draft national measures (e.g. spectrum assignments) and on cross-border disputes.

In addition, the Commission has proposed the '5G action plan', a key element in the strategy to achieve the connectivity targets and improve EU's global competitiveness.

The 5G action plan

In September 2016, as part of the connectivity package, the Commission also presented its 5G strategy in the [communication](#) '5G for Europe: an action plan'. Its main elements are:

- a common EU calendar for a coordinated 5G commercial launch in 2020, while encouraging the adoption of national 5G deployment roadmaps across all EU Member States and an early roll-out in at least one city per Member State in 2018 and ensuring that all urban areas and major terrestrial transport paths have uninterrupted 5G coverage by 2025, as envisaged by the new connectivity targets;
- joint work with Member States and industry stakeholders to identify, allocate and coordinate spectrum bands for 5G, in order to work towards a recommended approach ahead of the [2019](#) World Radiocommunication Conference (WRC-19);³
- support for common global 5G standards by co-funding research and development, including the launch of pan-European pilot demonstrators.

The Commission is keen to accelerate 5G deployment in Europe, so as not to fall behind other regions in the world, as it felt was the case [with 4G](#). 5G is not fully standardised yet but its key specifications and technological building blocks are already being developed and tested. There is a worldwide race to research, develop and roll out 5G technology. Industry [predicts](#) that by 2022 North America will be winning it, with over 110 million 5G subscriptions, versus only 20 million in Western Europe. Asia Pacific will be the second fastest growing region for 5G subscriptions, with 10 % of all subscriptions being 5G in 2022. By way of example, South Korea and Japan plan to deploy 5G by the time they host the Winter and Summer Olympics in 2018 and 2020 respectively. The USA is moving fast and has recently opened nearly 11 gigahertz (GHz) of high-frequency spectrum for 5G and [has also announced](#) plans to open up spectrum above 95 GHz as a test bed for 5G technology.

In Europe, in order to support the 5G action plan goals, the Commission has put forward the 5G-Public Private Partnership project ([5GPPP](#)) under the umbrella of the [Horizon 2020](#) research programme. This will be the largest of its kind in the world with €700 million in

EU funding, which is expected to leverage substantial private investment to create a total of €3.5 billion dedicated to the research and development of 5G, contributing to the global standardisation process. After a first phase dedicated to research and innovation around 5G technologies and architecture, pilot trials are ongoing in the second phase and large scale trials are expected for the third phase, between 2018 and 2021. The path to 5G, including all the technical specifications and standards, represents the most [complex](#) evolution that the mobile industry has undertaken to date. The EU is seeking to gain a competitive advantage by taking a leading role⁴ in the technology's definition and standardisation in order to capture a significant share of the related markets for intellectual property and 5G development. A recent [study](#) underlined that controlling the 5G market includes controlling the relevant patents, and that the cost of patent royalties may even exceed the cost of the 5G handset's components.

Finally, the 5G action plan is also aimed at achieving more convergence in national spectrum policies across the EU, so as to achieve agreement on the allocation and coordination of the spectrum needed for 5G. As of 2020, EU Member States following the recently agreed [EU legislation](#) will for the first time coordinate their use of the [700 MHz](#) band, which can be used to roll out mobile broadband. In addition, as part of the ECC, the Commission proposes to improve the coordination and use of radio-frequencies across the EU, including longer licence durations and more efficient spectrum use. The Commission is also working with the Member States in the [Radio Spectrum Policy Group](#) (RSPG), which has recognised the importance of the early identification of common EU-wide pioneer spectrum bands above 6GHz ahead of the 2019 World Radiocommunication Conference where they will be decided at a global level.

Main challenges for 5G technology

There are many challenges ahead on the way to achieving the European gigabit society, especially when it comes to the 5G related target. There are industry [concerns](#) about whether plans to keep 5G on track for a fully commercialised launch by 2020 will actually happen, given all the complexity involved at technical level and the investment required. Other challenges to overcome include, for instance, the digital divide and ubiquitous connectivity, the creation of sufficient demand for 5G, security concerns and other potential emerging issues such as health and safety aspects and ecological aspects.

Widening the digital divide

As described earlier, there is already a [digital divide](#) between urban and rural areas and across Member States that could widen still further with the arrival of 5G. The Commission's target of at least 100 Mbps download speeds by 2025 for all households, both rural and urban, is ambitious. While 58 % of the EU's population live in rural, remote and mountainous areas, only 40 % of homes are covered by speeds above 30 Mbps. Urban areas are better suited to the roll out of fast speed infrastructure, whereas rural areas do not have the same infrastructure deployments and expected returns on investment. The Commission has put various financial instruments and state aid arrangements in place over the years to support [broadband development](#) in rural areas. As part of the gigabit society strategy, and in addition to the other instruments in place, the Commission [has launched](#) a dedicated investment platform 'the Connecting Europe Broadband Fund' that will raise over €500 million through commitments from private and public investors, such as the European Investment Bank and the Commission, between 2017 and 2021. The operational launch of the fund is expected to take place in mid-2017. Overall, it is expected to unlock additional investments of between €1 billion and

€1.7 billion in broadband deployment in underserved areas, where very high-capacity networks are not yet deployed.

In addition the ECC is also expected to support the 5G action plan by means of more favourable investment conditions, including [for small cell deployment](#). Many of these services will require the same level of quality and continuity across borders and geographical regions (e.g. connected vehicles). On the application side, some in the transport industry are [sceptical](#) of the benefits of 5G if coverage is insufficient.

Ubiquitous, resilient connectivity

The 5G approach must be fully convergent across technologies and sectors, as there will be no distinction between fixed and mobile, but simply a seamless infrastructure. Achieving greater capacity, better reliability and increasing reach of coverage will require mobile networks to transform. 5G will enable ubiquitous connectivity, allowing for the IoT revolution with the deployment of innovative services such as remote surgery and personalised medicine, connected cars, smart factories and smart cities, or the detection of faults in energy grids.

To achieve these goals, the Commission recommends a mix of fixed and wireless technologies, as technological neutrality and [flexibility](#) are needed. The ECC calls mainly for an infrastructure based on optical fibre complemented by the use of smaller cells for Wi-Fi, more spectrum allocation and the use of other technologies such as satellite. To narrow the digital divide it is important to consider all possible ways to deliver ubiquitous 5G access, including satellite communications, complemented by a European terrestrial optical fibre network and better allocation and coordination of the spectrum. New time-demanding applications requiring instant reaction, (i.e. very [low latency in the order of 1 ms](#)), cannot be served adequately by today's technology. [Improved](#) performance is needed in terms of reduced latency, increased reliability and higher mobility. According to the [Commission](#), 5G time-critical applications, such as connected cars, will in most cases have to combine 5G connectivity with distributed (mobile) cloud technology in order to meet the required end-to-end response times. The technical complexity and cost involved in reaching the European gigabit goals are considerable. According to French operator, [Orange](#), in addition to spectrum licencing costs, much of the cost is likely to come from network 'densification', with the rollout of the small cells that will be needed to transmit signals in much higher frequency bands. Yet this may not suffice. Dense deployment of 5G small cells is possible in dense urban areas where bandwidth demands are high, but not in rural areas. Other suitable solutions will have to be put in place, but the digital gap might not be overcome in time to reach the targets.

Getting a return on investment

One 2016 [study](#) highlighted as a challenge the gap in knowledge about consumer demand for 5G. The industry is advancing deployments without having a clear business case for consumers. It remains to be seen whether consumers will be willing to pay for 5G. Although there has been an explosion in demand for mobile data traffic, this does not necessarily imply that consumers will pay to receive connectivity via an expensive new cellular infrastructure. For instance an increased number of smartphone users spend more time on public [Wi-Fi](#) than on 3G/4G. A [recent Eurobarometer survey](#) showed that only one third of citizens had used a paid internet service. At present, according to the Commission, 27 % of European homes subscribe to fast broadband access of at least 30 Mbps and only an estimated 11 % of European homes subscribe to ultrafast broadband (at least 100 Mbps). However, consumer demand is needed to bring a return on

investment to the industry. [Studies](#) performed for Nokia have shown a return on investment for 5G to the home after four years as long as the average revenue per user remains above €40. Another recent [study](#) from the mobile operators' association GSMA expects that 5G will primarily provide users with an enhanced mobile broadband experience. 5G ubiquitous connectivity will unleash the age of intelligent automation later on with other user cases developed around massive IoT and critical communications targeting consumers and businesses.

Addressing privacy, security, energy efficiency, and health and safety aspects

For the development of the European gigabit society, it will also be important to address issues of data privacy and data transfer, cybersecurity, energy efficiency, and health and safety. Some new innovative applications for transport systems or remote healthcare will need significantly improved safety and security standards. The EU data protection framework has recently been [reformed](#) to be fit for the digital age. At the same time, the data driven economy brings many challenges as the EU needs to ensure that non-personal data flows freely across borders and sectors. The Commission has planned measures in this area under the DSM strategy and is aiming to deliver the [free flow of data](#) in the EU before the 5G era. Some [security](#) aspects are already being considered within the technical design of the 5G standards. In addition, the EU [cybersecurity strategy](#) and the [European agenda on security](#) provide the overall EU strategic framework for measures against cyber-attacks. These are expected to be updated as part of the DSM strategy [mid-term review](#) follow-up, since the Commission has identified both cybersecurity and the cross-border free flow of non-personal data as key areas for further EU action.

Another key challenge to overcome is that of making the new technology more energy efficient. With each new generation of mobile technology the energy consumed by the network has grown significantly as data traffic has continued to increase. According to the European Telecommunications Standards Institute ([ETSI](#)), if this dynamic continues then migration to 5G will be difficult both from an economic and an ecological standpoint.

Finally, little research has been performed on the health impacts of 5G, as most of the studies to date related to previous generation of mobile technology. According to one recent [study](#), this could prove a further bottleneck should 5G pose health risks owing to 'its urban concentration and dense cellular structure, its use of much higher microwave frequencies and its highly directional concentration'. In the USA a 2016 [government-funded study](#) raised concern, as in its preliminary results it found significantly greater rates of rare tumors of the brain and heart in rats exposed to wireless radiation. Other 2017 [research](#) and [publications](#) also suggest that long-term mobile phone use could increase brain cancer risk. However the latest opinion published by the Commission's expert group⁵ in 2015 and research by the [World Health Organization](#) do not recognise a direct link. In France, meanwhile, a [review](#) of wireless radiation has concluded that there is a need to evaluate all wireless devices for their impact on children's health and recommends only moderate and supervised use by children. This complex issue therefore remains controversial while further research is ongoing. An [ongoing study](#) by researchers in New Zealand and India is looking specifically into the health impacts of 5G. The findings will be compared against the existing thresholds set by a number of regulatory bodies.

European Parliament and Council positions

On 2 December 2016, the Transport, Telecommunications and Energy [Council](#) ministers expressed support for the connectivity objectives in the Commission proposals and agreed on the need to work together to achieve them, including on 5G.

Parliament adopted a [resolution](#) 'Internet connectivity for growth, competitiveness and cohesion: European gigabit society and 5G' (rapporteur: Michał Boni, EPP, Poland) on 1 June 2017. It welcomes the connectivity targets while calling on the Commission to tackle the digital divide and frame a coherent timetable and 5G financing strategy in line with the ECC. It also calls for an investment-friendly regulatory environment, a coherent European spectrum strategy and acceleration of the EU's 5G standardisation efforts. Emphasising the positive impact that 5G would have on European society in terms of education, health, culture, cohesion and employment, the resolution calls for the development and improvement of digital skills, and asks the Commission to produce an annual 5G action plan review to report on progress made and make recommendations.

Main references

[European Leadership in 5G](#), C. Blackman, Camford Associates Ltd and S. Forge, SCF Associates Ltd., for the European Parliament, December 2016

[Identification and quantification of key socio-economic data to support strategic planning for the introduction of 5G in Europe](#), Tech4i2, Real Wireless CONNECT, Trinity College Dublin, and InterDigital, for the European Commission, September 2016

'[High expectations for 5G confront practical realities](#)', J. Scott Marcus, Bruegel, March 2017
[Costing the new potential connectivity needs](#), Analysys Mason, for the European Commission, October 2016

Endnotes

¹ EPRS briefings: [The new European electronic communications code](#), [WIFI4EU – Promotion of internet connectivity in local communities](#) and [Body of European Regulators for Electronic Communications \(BEREC\)](#), November 2016.

² The report estimates that €360 billion is needed to bring fibre-to-the-premises broadband to all European households, €200 billion in 5G radio access networks and €100 billion for low-latency proximity data centres.

³ The World Radiocommunication Conferences are held every three or four years. They review the Radio Regulations, an international treaty on radio-frequency spectrum and geostationary and non-geostationary-satellite orbits.

⁴ It should be noted that 5G was one of the five ICT standardisation priorities selected for the DSM in COM(2016) 176.

⁵ The Scientific Committee on Emerging and Newly Identified Health Risks ([SCENIHR](#)).

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