

The transformative power of telecommunications and its impact on *innovation*

Digital Public Policy, Regulation and Competition

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Telefónica

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1. Executive *Summary*

Innovation, the basis for transforming the European competitiveness model.

The competitiveness of the European Union depends directly on the strength and modernisation of its Member States' economies. Innovation and global competitiveness must inspire the new policies of the European Single Market, to which the contribution of the digital economy and the technological leadership it can bring is essential. Its dynamism would be favoured by an environment conducive to the development, transformation, and innovation of European technology companies, so that they in turn drive growth, innovation, and competitiveness of the economic fabric, generating opportunities for European society.

The innovative nature of the telecommunications sector.

The development of the digital economy is closely linked to the availability of efficient and high-quality connectivity networks. The telecommunications sector is at the forefront of continuous innovation in the fixed

and mobile networks that provide this connectivity. This connectivity needs to be constantly adapted to the new demands and needs of society, which requires an investment effort to innovate and increase its quality, speed, and capacity to respond to the growing use of digital services. This commitment to innovation means that advanced digital experiences are continuously made available to citizens and businesses, while at the same time opening up new opportunities for technological innovation in many sectors, thus contributing to their competitiveness.

Industry vision: transforming the network to enable a new generation of digital services.

Digital services based on technologies such as 5G, IoT, web3, edge-cloud computing and AI will create new economic opportunities. To realise their full potential, enhanced network capabilities are required, such as higher data throughput or different latency levels. The industry's vision is for a major revolution in connectivity networks, similar to that of smartphones at the time: transforming them into programmable

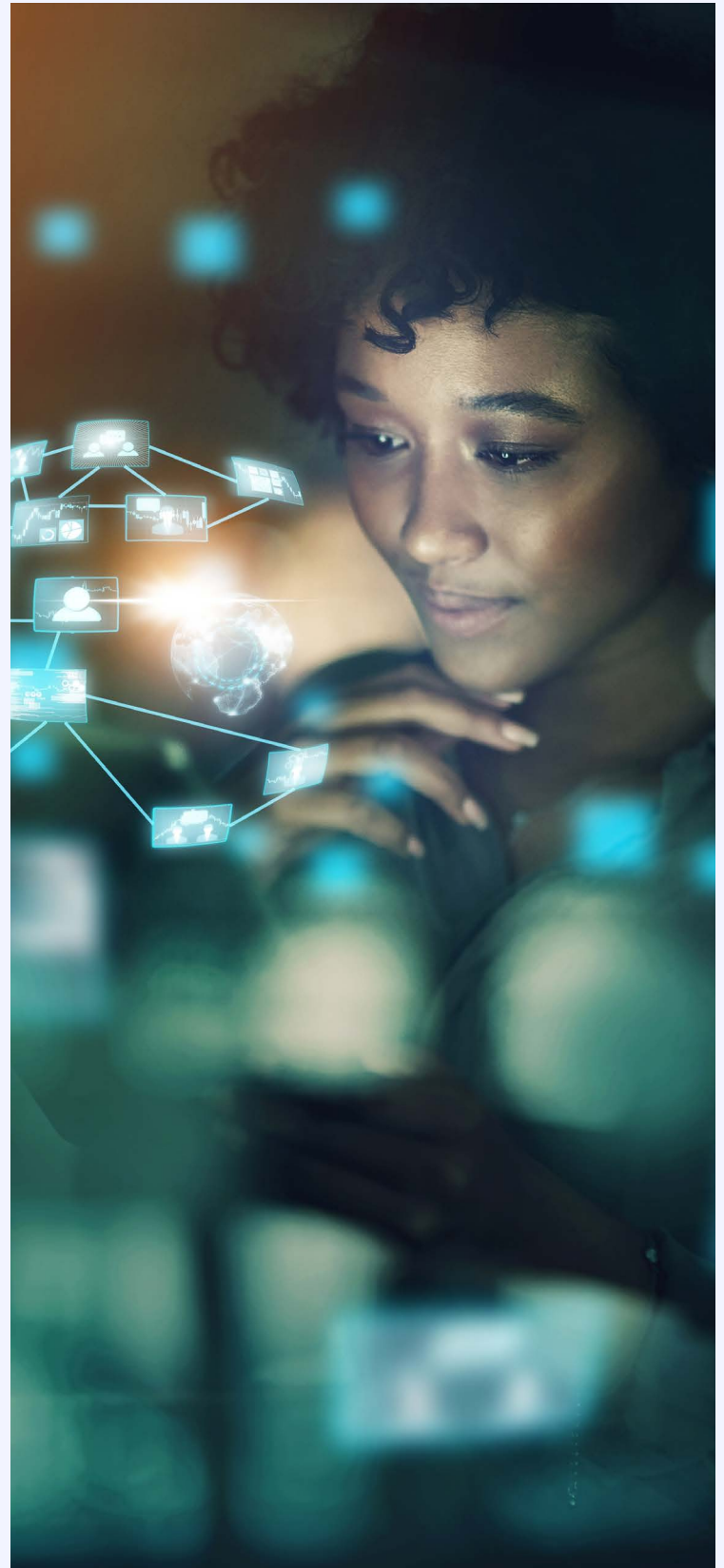
networks and creating an open innovation ecosystem around them. This would increase the pace of digital innovation, accelerate its diffusion and adoption, and strengthen the competitiveness of the European telecoms sector.

Open Gateway: the innovation platform for the digital services of the future.

Open Gateway is the telecommunications industry's new project. It makes it easier for developers to integrate network capabilities into their digital solutions through "softwareisation" and virtualisation, using global, standardised APIs (*Application Programmer Interface*). The industry, led by the GSMA, is working to standardise the access to these capabilities to promote the compatibility of a single development across operators networks. This collaboration is essential to drive innovation and industry scale, as well as a wide range of value propositions for developers, start-ups, application providers and users.

Policy recommendations to promote innovation in the telecommunications sector.

To consolidate an open innovation platform, operators consider it necessary to invest in three key areas: edge computing for efficient processing close to the user; low-latency technologies such as 5G and fibre; and programmable networks through global, standardised APIs. To this end, public policies need to improve the investment climate in the sector. This includes promoting efficient market structures that ensure adequate return on investment, mechanisms that encourage the fair contribution of the digital ecosystem and efficient allocation of network resources, as well as the recognition of the key role of networks in the green transition. It is also essential to align public policies with the objectives of the EU Industrial Strategy. The right policies in place will allow to move towards a Single Market and stronger Member States' economies, underpinned by a competitive telecoms sector that grows, transforms, and innovates for the benefit of European society. ●



2. *Innovation*: the basis for transforming the European competitiveness model

Reversing the EU's alarming loss of competitiveness¹ in an increasingly complex geopolitical, economic, and technological context is becoming a matter of "survival" or economic security for the region and for the well-being of its citizens.

The European Union is positioning the Single Market as the engine for renewed competitiveness² and the key to the success of the green and digital transitions, placing it at the heart of its industrial strategy.

However, building a competitive economy at EU level is not possible without strong and modern economies at Member State level. Given the importance of the digital economy and technological leadership in generating economic growth, innovation, and global competitiveness³, the Single Market would benefit from an environment that allows European technology companies to grow, transform and innovate, so that they in turn contribute to the growth, innovation, and competitiveness of the rest of the economic fabric, for the benefit of its citizens.

This is essential given Europe's need to strengthen its technological and innovative capacity⁴. In this context, the telecommunications sector is a key industry for Europe to drive innovation and the transformation of the European economic model, as well as to improve the position of the European Union in the global economy.





3. The innovative nature of the *telecommunications* sector

The digital economy is inextricably linked to the availability of connectivity, which drives technological and digital development. The ever-innovative telecommunications sector has been constantly innovating its processes, systems, commercial strategies and, above all, transforming its fixed and mobile connectivity networks to cope with the pace of change and new digital demands.

The sector's commitment to innovation is demonstrated by the fact that, in just a few years, it has moved from copper (PSTN) and 2G mobile networks to Next Generation Networks (NGN) based on FTTH (Fibre-To-The-Home) and 5G, a milestone that can only be achieved through continuous investment. For example, the industry has invested an average of EUR 50 billion per year over the last decade⁵. The investment effort has not only enabled progress to be made in delivering high quality networks to European society and economy but has also enabled networks to be modernised and upgraded to higher speeds and capacities, to adapt to the growing demand for broadband intensive digital services, and to create enhanced products and

services and new opportunities for technological innovation across a range of sectors.

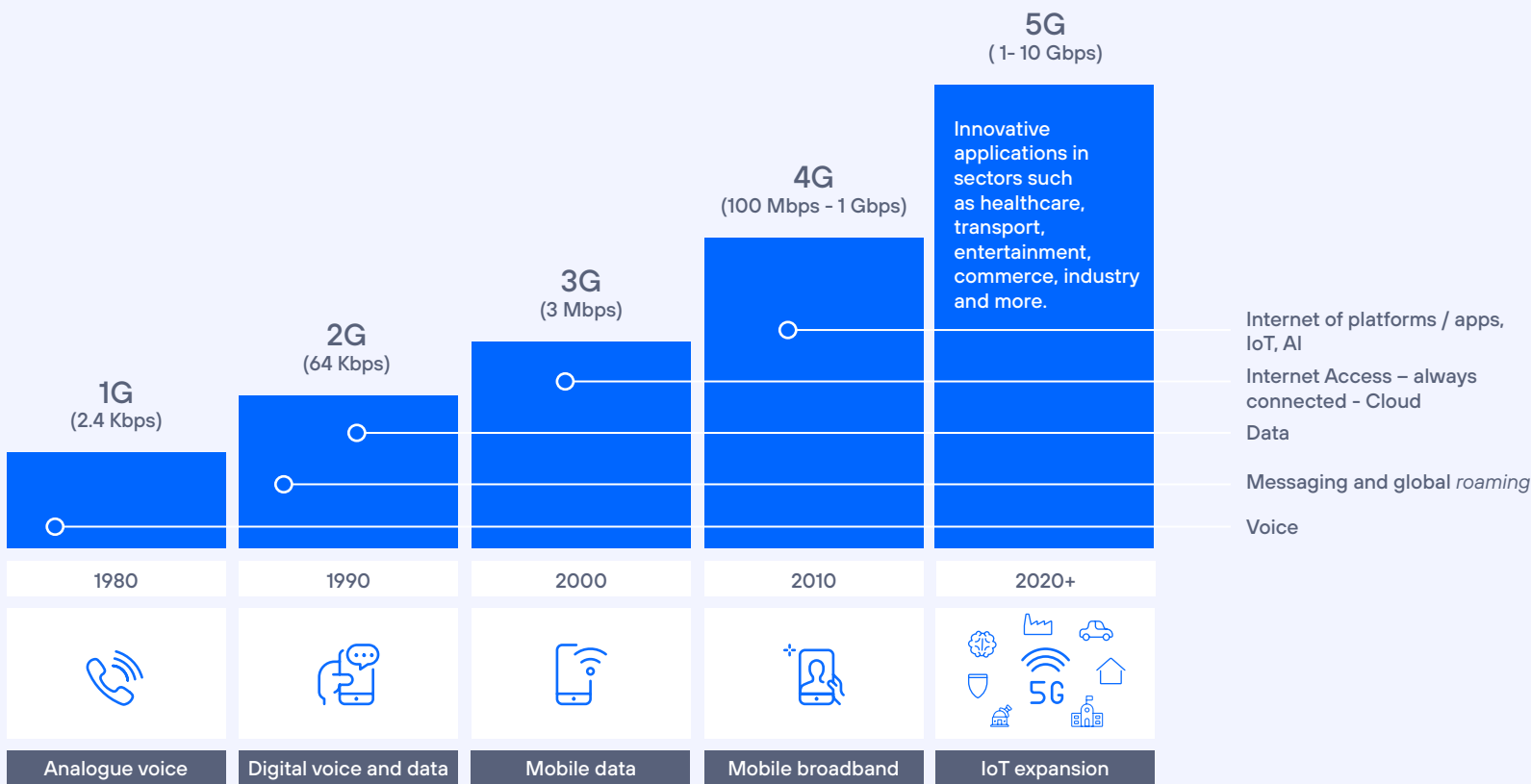
The transformation of mobile networks

Each new generation of mobile networks has brought significant improvements in speed and technological capabilities, always guided by the needs of citizens and businesses. While 2G provided basic communication services such as voice calls and text messaging, 3G introduced the internet and mobile data. The advent of 4G improved data speeds, consolidated mobile broadband and facilitated the development of the innovation ecosystem around smartphones.

The introduction of 5G represents a radical new shift in mobile communications and network architecture. With speeds up to 100 times faster than 4G, 5G will significantly reduce latency, the time it takes for data to reach its destination, enabling new services that would not be possible with high latency. This next-generation network also supports a greater number of connected devices, which is essential for the expansion of the Internet of Things (IoT).

An innovative feature of 5G is *network slicing*⁶, which optimises the use and allocation of network resources. Specifically, it offers the possibility of creating, on a common shared physical infrastructure, several virtual networks adapted to the specific connectivity and data processing needs of applications, services, devices, or users. The enhanced capabilities of 5G pave the way for innovative applications in various sectors such as healthcare, transport, entertainment, and smart cities, among others, boosting their competitiveness.

Open RAN⁷ is also about innovation in mobile network architecture and the availability of interoperable interfaces based on open standards. This novel approach represents an evolutionary leap towards an open mobile network architecture that allows the separation of hardware and software functions at base stations or the interconnection of elements from different vendors. In this way, this innovative architecture promotes not only interoperability between different network components, but also vendor diversity, stimulating competition and the creation of new solutions.



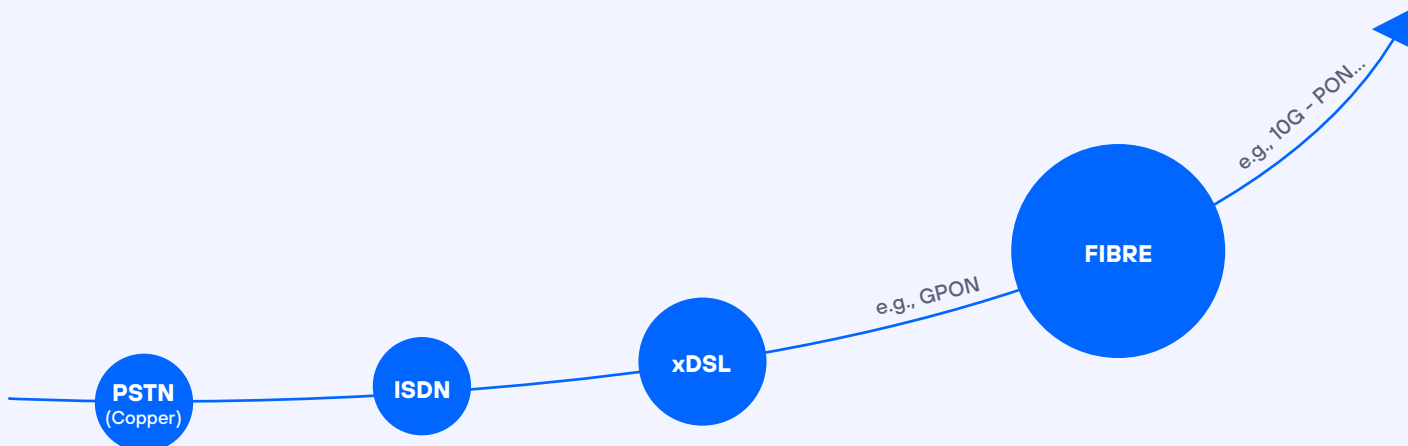
The transformation of fixed networks





The transformation of the fixed network, on the other hand, has been no less significant. While copper networks (PSTN) were built to carry basic communications services such as voice calls, the arrival of ADSL technology shifted the paradigm by transforming them into fixed broadband networks. ADSL enabled the creation of two separate channels, one for voice and one for data, with asymmetric Internet access speeds, i.e., faster download speeds than upload speeds. ADSL enabled Internet browsing, file downloading and basic online activities.

As digital services became more sophisticated, the ADSL network became obsolete. The introduction

of fibre once again revolutionised telecommunications infrastructures. Fibre offered virtually unlimited, symmetrical bandwidth and extremely low latency. This technological evolution has significantly changed the user experience, enabling services such as high-definition video streaming, cloud computing, or the deployment of advanced technologies such as 5G mobile networks, for which fibre provides adequate backhaul.

Unlike xDSL technologies⁸, which were an incremental technological improvement over the existing copper network, the deployment of fibre required the replacement of the copper network. Thanks to these efforts in innovation and investment by the telecommunications sector, users today benefit from advanced digital experiences and technological innovations.



1980	1990	2000	2010	2020+
Analogue voice	Narrowband	Broadband	Ultra-broadband	
				
Voice calls	Basic Internet Access (browsing)	Advanced web services, email, search engines, IPTV, e-commerce,...	IPTV-streaming of high-definition video (4K HD) multi-screen,...	Edge-Cloud, virtual/augmented reality, e-Health, cybersecurity, e-entertainment, smart infrastructure, IoT, 5G, AI,...
56 kpbs	128 kpbs	24-300 Mbps	>1 Gbps	>10 Gbps

The evolution of these networks has also led to a move towards more eco-efficient networks. Thanks to lower energy consumption and more efficient management of data transport and processing in the network system, these networks reduce the environmental impact compared to previous generations. According to Telefónica's analysis, the environmental impact per petabyte of its fibre network has been shown to be 18 times lower than the one that caused the copper network, while the impact of 4G/5G technologies has been shown to be 7 times lower than that of 2G/3G⁹.

The future of networks

There is no doubt that the increasingly sophisticated use of digital services made possible by the anticipation and the transformation of telecommunications networks, such as remote learning or working, gaming,

videoconferencing, or the migration of corporate assets to the cloud, among others, are changes in digital demand that are expected to be permanent. Traffic data also shows that this demand is growing¹⁰.

Innovation in the telecommunications sector cannot stand still, just as the needs of European citizens and businesses continue to evolve. The development of digital services and applications based on 5G, the increase in connected devices, IoT¹¹, the rise of the web3¹² driven by the development of immersive technologies, edge cloud computing or Artificial Intelligence (AI) will bring new digital services that will require new network capabilities, such as higher data processing capacity or different latency levels. But it will also create new opportunities for economic growth¹³ and, above all, it will require new ways of innovating or innovation platforms to develop these services in the most efficient way.





4. Industry vision: transforming the network to enable a new generation of *digital* services

The telecoms industry is redefining the connectivity model so that all this digital innovation can reach all users.

At the heart of the industry's vision is a major revolution or disruption of the connectivity networks. The industry is working to make the connectivity networks of the future "programmable", i.e., they will become digital platforms that can generate an open innovation ecosystem around them.

This transformation will be a paradigm shift similar to the one experienced by mobile phones with the advent of the smartphone. In the early days of mobile communications, the mobile phone only enabled basic communication services, such as text messaging or calls. The arrival of the smartphone in 2007 brought a revolution in the development of digital services.

The key was that mobile phones became "programmable". Their capabilities, such as data connection, display, camera or GPS, were opened up to developers, unleashing an ecosystem of mobile innovation that has spawned countless applications and

digital services in all sectors of the economy, from finance or healthcare to entertainment, for the benefit of users¹⁴.

This transformation has boosted the competitiveness of the sector. It boosted the development of the mobile handset market, and generated adjacent economic activities, from the applications market to a wide range of smartphone add-ons¹⁵. It also encouraged the accelerated take-up of mobile broadband¹⁶. All of this has been enabled by the accompanying transformation of mobile networks, without which this revolution and its sustainability would not have been possible. Telecom operators were able to respond quickly by adapting to the new demands of society.

In addition, the global scale of a borderless digital world has created global champions. The profitability of companies such as Apple, which pioneered the smartphone and the App Store, soared¹⁷, but this evolution also helped to fuel digital entrepreneurship and the development of leading digital companies as consumer habits expanded or migrated to the mobile

digital environment¹⁸. Technological leadership that today puts these companies, in a privileged position to capitalise on the new digital era.

The success of the model, in terms of the explosion of digital innovation and competitiveness that this revolution resulted in, lies in the fact that innovation was made easily accessible to developers and users, accelerating both the rate at which this innovation was produced and the rate at which it spread to all users around the world¹⁹.

Similar to the smartphone revolution, the industry's vision is to create an open innovation ecosystem around networks, opening up their capabilities to developers, thanks to "softwareisation" and virtualisation. An innovation platform for the next generation of digital services driven by the telecoms sector.

This vision promotes the ability of European telecoms operators to compete globally in the digital arena, paving the way for Europe's drive for technological competitiveness.



The revolution of connectivity networks towards programmable networks will drive digital innovation and technological competitiveness in Europe



The smartphone revolution:



2007: Apple launches the iPhone
2008: Apple doubles its revenue (USD 37.5 billion) vs. 2006. Since 2007, its revenue grows at a compound annual growth rate of 18% (2007-2023) to USD 383 billion (2023)



4.4 billion mobile internet users (2022)= 55% of global population (85% in Europe)
76% of global mobile connections are smartphones in 2022 (81% in Europe)



8.93 million smartphone apps worldwide (2023)
Accelerated diffusion of innovation: Netflix (1999) takes 3.5 years to reach 1 million users; ChatGPT (2022), 5 days; Threads (Meta) (2023), 1 hour



Countless applications and services in all sectors, from finance to healthcare to entertainment, easily accessible, enhancing the user experience



Estimated global revenue market of:
Smartphones: USD 0.5 trillion (2023)
Mobile applications: USD 613 billion (2025)
Screen protectors: USD 49.7 billion (2022) (6.8% compound annual growth rate 2023-2030)



In the global top 5 by market cap: Apple (USD 2.9 trillion –Tn- vs. USD 73 billion in 2006); Microsoft (USD 2.8 Tn); Alphabet (USD 1.7 Tn) and Amazon (USD 1.5 Tn) (Dec 2023)

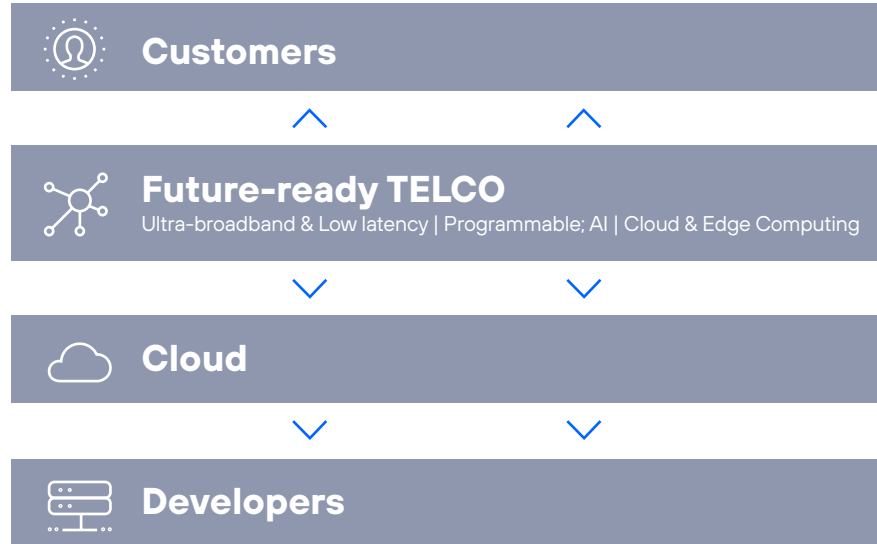
5. Open Gateway: the innovation platform for the digital services of the *future*

Open Gateway is the realisation of this vision. The industry, led by the GSMA, is working on standardisation to make network capabilities accessible to any developer through global, standardised APIs (*Application Programmer Interface*).

These APIs, or interfaces, allow developers to interact with the network and facilitate the integration of their capabilities into the development of new solutions. Available across developer platforms (such as Azure or AWS), APIs enable the optimised service creation, through the efficient use of network resources. This broadens the range of value propositions for developers, *start-ups*, application providers, and ultimately users.



**OPEN
GATEWAY**
The digital innovation ecosystem driven by the telecoms sector



This transformation underlines the value of industry cooperation, which will undoubtedly lead to a new paradigm of digital innovation, offering new opportunities to European citizens and businesses. In this context, standardisation is a key element, as it allows, on the one hand, the compatibility of a single development with the networks of all telecommunications operators. On the other hand, it enables the sector and services to have a global dimension and to compete in the digital environment, thus increasing their competitiveness.

Open Gateway²⁰ therefore enables an open innovation platform on networks for any digital innovation idea to multiply its possibilities and reach. At the same time, it

promotes the optimal development of the digital services of the future through an efficient allocation of network resources, resulting in greater benefits for society.

To consolidate this innovation platform, operators consider it necessary to invest in 3 key areas. First, in edge computing, which allows data to be processed closer and more securely to the end user, making a more efficient allocation of network resources. Second, in low latency technologies such as 5G, fibre or next generation wireless networks. And third, in programmable networks, through the development of global and standardised APIs. The convergence of these three areas will enable a new wave of digital disruption.



6. Policy recommendations to promote innovation in the *telecommunications* sector

To move forward in creating an open innovation platform for the digital services of the future, it is essential to enable an environment for innovation and investment, based on the recognition of the strategic role of connectivity in driving innovation and competitiveness.

The European Commission estimates that Europe will need to invest EUR 174 billion to achieve the 2030 connectivity targets, a figure that could rise to EUR 200 billion depending on the scenario that unfolds²¹.

To this end, the European Union needs to improve the investment environment and a more balanced development of the digital ecosystem to ensure the sustainability of network investments. This is crucial because investment leads to innovation and therefore to improvements in competitiveness.

From this perspective, it is necessary:

- to promote [efficient telecom market structures](#)²² that guarantee an adequate return on investment, with less fragmented markets at the national level, allowing

the creation of the necessary scale to strengthen the sector's investment and innovation capacity.

- to promote mechanisms that ensure a [fair contribution](#)²³ of players of the digital ecosystem, promoting a responsible and efficient use of network resources and the sustainability of investments.

- to recognize the key role of connectivity in driving the [green transition](#)²⁴.

Finally, boosting the competitiveness of European industry requires a comprehensive approach that aligns competition policy, state aid and the regulatory framework with the objectives of the EU's industrial strategy to encourage investment and innovation.

The right policies in place will allow to move towards a single market and stronger Member States' economies, underpinned by a competitive telecoms sector that grows, transforms, and innovates for the benefit of European society.

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2. Created in 1993, the European Union counts the Single Market among its greatest achievements. Today the Single Market is home to 23 million businesses; its GDP reached 14 522 billion euros in 2021; 17 million EU citizens live or work in an EU country other than their own; and trade within the Single Market accounts for 56 million jobs. <https://www.consilium.europa.eu/en/policies/deeper-single-market/>
3. The World Bank estimates that the digital economy contributes to more than 15% of global gross domestic product (GDP), and in the past decade it has been growing at two and a half times faster than physical world GDP. According to GSMA, the mobile industry represented EUR 910 billion in economic value added to Europe's economy in 2022 (4.3% of GDP). GSMA, The Mobile Economy Europe 2023. <https://www.weforum.org/agenda/2022/08/digital-trust-how-to-unleash-the-trillion-dollar-opportunity-for-our-global-economy/#:~:text=The%20World%20Bank%20estimates%20that%20the%20digital%20economy,a%20half%20times%20faster%20than%20physical%20world%20GDP.https://www.gsma.com/mobileeconomy/europe/>
4. According to the Australian Strategic Policy Institute (ASPI), China leads 37 out of 44 technologies in crucial technology fields such as defence, space, robotics, energy, environment, biotechnology, AI, advanced materials and quantum computing, followed by the United States. And there is a big gap between China and the US and the rest of the world. Europe is losing its lead in cross-cutting technologies, such as 5G, AI, quantum computing and the cloud. For example, in 5G innovation, a key element for future industrial competitiveness, China accounts for almost 60% of external funding, the US for 27% and Europe for 11%. None of the top 10 technology companies investing in quantum computing are in Europe, but are split between the United States and China (<https://www.aspi.org.au/report/critical-technology-tracker>). Regarding 5G, while the EU has 69 5G base stations per 100,000 people, South Korea has six times more, namely 515. China surpasses Europe with more than 150 5G base stations per 100,000 inhabitants <https://ert.eu/wp-content/uploads/2023/11/ERT-Expert-Paper-on-Connectivity-November-2023.pdf>. By 2022, 15% of mobile subscriptions in Europe are 5G, compared to 40% in the US, 24% in Japan, 53% in South Korea and 74% in China (Analysys Mason).
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- 9.** Telefónica, November 2022. <https://www.telefonica.com/en/wp-content/uploads/sites/5/2022/03/connectivity-solutions-life-cycle-assessment.pdf>
- 10.** Largely driven by video traffic, global data consumption over telecommunications networks will almost triple from 3.4 million petabytes (PB) in 2022 to 9.7 million PB in 2027, 79% of which will consist of digitized video content. PWC, 2023. <https://www.pwc.com/gx/en/industries/tmt/telecom-outlook-perspectives.html>
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- 12.** Web3 is a term used to describe the next generation of the Internet, based on blockchain technology, decentralisation, and the token economy.
- 13.** By 2030, 5G connectivity and services will generate economic benefits of EUR 153 billion in Europe. GSMA, The Mobile Economy Europe 2023. <https://www.gsma.com/mobileeconomy/europe/>
- 14.** In 2023, there are 8.93 million smartphone apps worldwide, with 3.5 million in the Google Play Store and 1.64 million in the Apple App Store. Mobile apps are expected to generate more than USD 613 billion in revenue by 2025. <https://www.bankmycell.com/blog/number-of-mobile-apps-worldwide>
- 15.** The screen protector market is forecast to reach a value of USD 49.7 billion in 2022 with a CAGR to 2030 of 6.8% (2023-2030). On the other hand, the smartphone revenue market will reach USD 0.5tn in 2023 globally. [https://www.skyquestt.com/report/smartphone-screen-protector-market#:~:text=Global%20Smartphone%20Screen%20Protector%20Market%20Insights,period%20\(2023%2D2030\).](https://www.skyquestt.com/report/smartphone-screen-protector-market#:~:text=Global%20Smartphone%20Screen%20Protector%20Market%20Insights,period%20(2023%2D2030).) <https://www.statista.com/outlook/cmo/consumer-electronics/telephony/smartphones/worldwide#:~:text=Revenue%20in%20the%20Smartphones%20market%20amounts%20to%20US%240.5tn%20in%202023>
- 16.** According to GSMA, globally, there are 4.4 billion mobile Internet users by 2022, equivalent to a penetration of 55% of the global population. This rises to 85% in Europe, 83% in North America and 79% in China by 2022. GSMA estimates a year-on-year growth in mobile internet users of 4.5% by 2030 (CAGR 2022-2030), reaching a penetration of 64% of the world's population, or 5.5 billion users. Similarly, 76% of mobile connections in 2022 are smartphones worldwide (81% in Europe). GSMA, The Mobile Economy 2023. <https://www.gsma.com/mobileeconomy/wp-content/uploads/2023/03/270223-The-Mobile-Economy-2023.pdf>
- 17.** Apple had a turnover of USD 383 billion in 2023. In 2006, the year before the smartphone was launched, Apple had a turnover of USD 19 billion. The year after the iPhone's launch, in 2008, Apple nearly doubled its revenue from 2006 to USD 37.5 billion. Since the launch of the iPhone in 2007, Apple has seen exponential revenue growth with a compound annual growth rate of 18% (2007-2023). Its market cap in Dec. 2023 reached USD 2.9 trillion, an exponential value growth considering that in Dec. 2006 its market capitalisation was USD 73 billion https://ycharts.com/companies/AAPL/revenues_annual; <https://companiesmarketcap.com/apple/marketcap/>
- 18.** Four of the world's top five companies by market capitalisation are US Big Tech: Apple (USD 2.9 Tn); Microsoft (USD 2.8 Tn); Alphabet (USD 1.7 Tn) and Amazon (USD 1.5 Tn). Their combined market capitalisation exceeds USD 6 trillion. This is higher than the GDP in 2023 of some of the G7 countries (in USD Tn): the UK (3.1), Germany (4.3), France (2.9), Italy (2.2) or Canada (2.1). Source: Bloomberg, 30 November 2023, and IMF, 2023.
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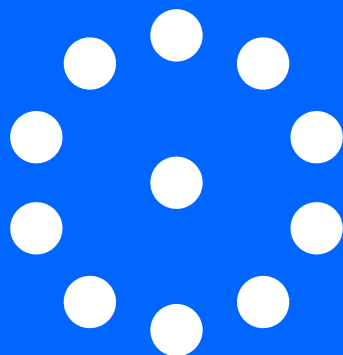
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The transformative power of telecommunications **and its impact on *innovation***



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