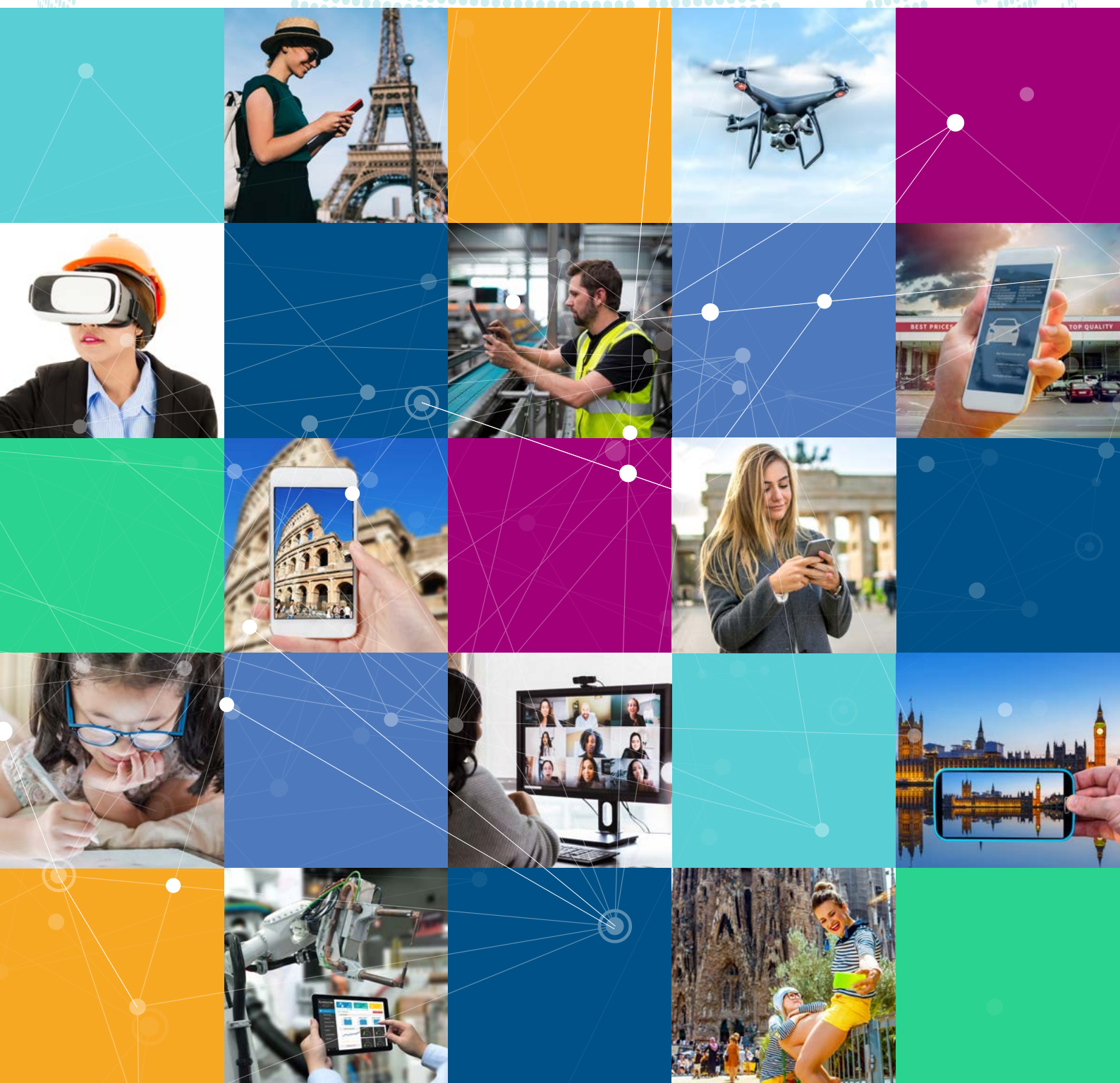




European Telecommunications Network Operators' Association

STATE OF DIGITAL COMMUNICATIONS | 2022



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EXECUTIVE SUMMARY

Europe reaches key 5G and fibre milestones, but lags global peers

- In 2021, for the first time, FTTH coverage in Europe has passed the 50% mark and reached 51.6% of the total next generation access (NGA) connections
- The percentage of population covered by 5G in Europe has almost doubled between 2020 and 2021, reaching 62% last year compared to 30% the previous year
- However, all global peers have much higher shares of the population covered, with the US reaching 93.1% and South Korea reaching 93.9% coverage in 2021.

Pandemic habits accelerate telecom trends: video is flooding networks

- The pandemic has accelerated the uptake of video services, especially streaming and video calling
- As a result, data usage in Europe has grown significantly since 2019. The fixed data traffic per connection was 191 GB/month in 2019, it was 293 GB/month in 2021 (+53% compared to pre-Pandemic) and it is expected to reach 454 GB/month in 2023
- Mobile data traffic per connection was 4.5 GB/month in 2019, it was 8.5 GB/month in 2021 (+90% compared to pre-Pandemic) and it is expected to reach 16.2 GB/month in 2023.

Uptake, usage, spend and revenues: Europe stays on the trail

- Uptake of 5G in Europe has been lagging behind: despite being available to 62% of the population, 5G in Europe constitutes only 2.8% of the total mobile connections, compared to 13.4% in the US and 29.3% in South Korea
- Usage is also lower in Europe: the average mobile data usage per capita per month, in 2020, was 8.52 GB in Europe, 10.62 GB in the US and 12.52 GB in South Korea
- Average spend per capita on telecoms in Europe is forecasted to be €33.8/month, lower than global peers (e.g., it is €71.7 in the US, €36.1 in South Korea)
- Revenues in Europe are also lower than in other geographies. Mobile Average Revenue per User (ARPU) was €14.4 in Europe, compared to €37.9 in USA and €25 in South Korea.



Greener telecoms: fight to CO2 emissions continues, enablement picks up

- The telecom sector is embarked in a double challenge: reduce its own carbon footprint and enable traditional sectors of the economy in reducing their footprint
- In 2020, 75.3% of the total energy used by ETNO members was from renewable sources, up from 60.4% in 2017
- CO2e emissions of ETNO members in Europe were 2.77 kTonne, down from 4.67 kTonne in 2017
- Telecom services have been taken up from several “vertical” industries to reduce their own footprint, including use cases in smart buildings, agriculture and mobility

Telcos increase commercial activities in Edge computing, Open RAN, IoT, Big data, Security

- Telecoms are innovating beyond just networks. Key areas in which operators are investing and innovating in are: edge computing, open ran, big data, IoT, and security
- Europe can count 19 edge cloud offers announced and commercialised in 2021, compared to 10 in North America and 25 in Asia-Pacific
- Europe, in the period 2010-2021, has scored 9 patents in the field of “telecoms and analytics”, trailing the US (52), but ahead of China (2) and India (5)
- The commercialization of security solutions by European telcos is also becoming tangible, with operators’ security retail revenue reaching €3bn in 2021 and expected to reach €4bn in 2025 (Western Europe)
- The growth of IoT is also confirmed, with active IoT connections expected to reach 352mn in 2023, up from 180mn in 2020. The sectors that are expected to contribute the most to such growth are automotive (119mn active connections in 2023) and utilities (50mn active connections in 2023).

Strength of the sector: policymakers must be aware of the strategic implications

- The European telecom sector has achieved a record CapEx of €52.5bn in 2020, up from €51.7bn in 2019, the highest for four years. This reflects investment efforts in fibre and 5G networks
- CapEx intensity (proportion of revenues devoted to CapEx) has reached its highest in recent history, hitting 19%. This is higher than any global peers in US, South Korea or Japan
- The increase of telecom investment and the resilience of the sector are desirable from a societal viewpoint and they are key to Europe’s “Open Strategic Autonomy” plans. Therefore, the sustainability of the sector should encourage strong policy action to dramatically improve the investment climate
- Key financial indicators show how the European telecom sector is suffering, or performing worse than global peers: the EV/EBITDA ratio of European telcos has fallen compared to the pre-pandemic period and the net debt/EBITDA ratios have increased
- European telecom stocks have been consistently underperforming both the Stoxx Europe 600 index and the Stoxx Global 1800 telecoms index since Q1 2016
- Fragmentation of European telecom markets remains the highest among global peers, with 38 operating telecom groups in Europe, compared to 7 in the US, 4 in Japan and 3 in South-Korea

INTRODUCTION: THE YEAR OF THE NETWORK

We live in challenging times, but the challenges we face have demonstrated the power of networks. In the past two years, networks underpinned the services that helped keep people safe and sane, and they kept businesses running under incredibly difficult circumstances. They held up under the pressure of supernormal levels of traffic. The legacy of the pandemic – and we still do not know how long it will play out for – is the acceleration of the digital transformation of lives, businesses and government.

Build back stronger, and greener

All stakeholders want to harness the benefits of digitalisation to build back not only stronger but also greener. Post-pandemic recovery plans reinforce the importance of digitalisation not only for economic purposes, but also for social and environmental purposes. The digital /ICT sector is pivotal to the ability of economies to build back stronger, and it can help to deliver on the promise of decarbonising the rest of the economy, while drastically reducing its own footprint.

Progress inside Europe but falling behind other regions

There is no escaping the fact that Europe lags other major global regions on several supply-side indices; this includes basic 5G mobile coverage and connections, 5G standalone (5G SA), and deployment and commercialisation of Edge cloud computing. There are no major European public cloud providers. There are very few major European OTT services. There is a gap between Europe and other global regions in spend on digital R&D.

There are, however, many positives. On the fixed-line side (it is worth remembering that this is still the workhorse of the digital ecosystem) investment in, and roll-out of, fit-for-purpose FTTH networks is very strong. 5G investment is picking up. Spectrum assignment was, on balance, and despite the disruption of COVID-19 to licensing, reasonably swift. There has been a strong push towards affirming European rights and values: maintaining a level playing field and assuring contestable markets, but in parallel establishing a greater degree of digital autonomy for Europeans.

Europe's investment stretch

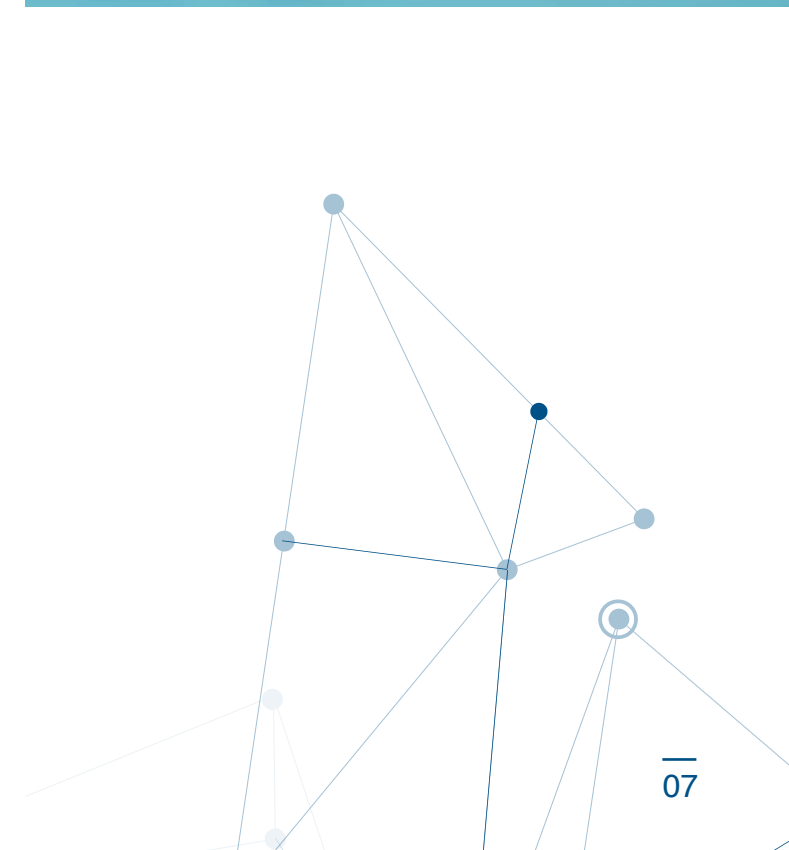
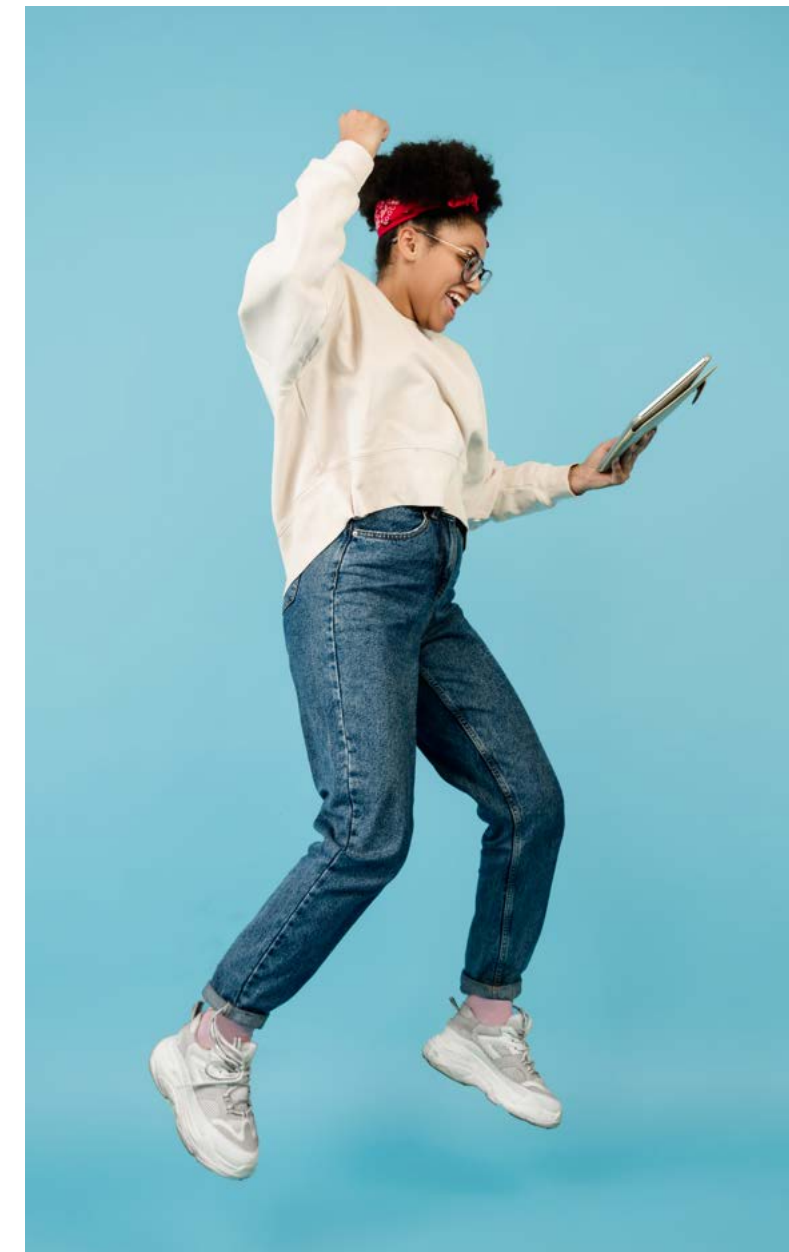
In fact, there has for many years been more investment in relation to revenue in European telecoms than in other parts of the world. This capex intensity ratio is, however, also a reflection of the low prices and low revenue in the sector. There is no premium for more intensive use and no premium for newer generations of connectivity (5G and FTTH). In any case aggregate prices for fixed and mobile connections are lower in Europe than anywhere in the world, to a large extent the result of decades of regulation favouring retail competition over investment. Europeans have choice, but also a deeply fragmented market with a far higher proportion of small players than other regions. This means that European operator return on investment, which has continued to fall over the past five years, is now often below cost of capital, jeopardising the sustainability of investments in future networks. This also has an impact on stock valuations of European telecom companies, which are weaker than their global peers.

The future of telcos and innovation

The logic of the Internet Protocol is the separation of connectivity from service, and this can create an identity crisis for telecoms operators. The business of monetising connectivity infrastructure and the business of monetising digital services can seem remote from one another, and the vertically integrated approach can appear to markets to complicate investment decisions. This identity crisis is not unique to European telecoms, but the separation of these strands of operator businesses is a real prospect in Europe because the fragmentation and low returns of the European telecoms sector leaves it more immediately vulnerable to takeovers. This risks control of the sector being left in the hands of entities that may be less concerned with forging a stronger and more resilient tech sector in Europe.

We live in times where market frontiers are blurring and in which leading on digital innovation is more important than ever. Being ahead of the game on telecoms edge cloud, network virtualisation, Open RAN, 6G and quantum communications are key levers of success in a European Union that strives for Open Strategic Autonomy.

The first section of this report examines the direct and indirect impact of the telecoms sector on Europeans' lives. The second examines the demand for the services that telecoms and other digital communications providers offer. The third section is future-looking: it discusses the ways in which operators can meet the challenges of greening societies, providing ubiquitous gigabit connectivity, expanding economies through innovation, and it discusses the obstacles to doing so. The final section indicates financial trends for operators, and separates global trends for the sector from Europe-specific headwinds.



SECTION 1

Supporting the European digital society as it matures

This section looks at the industry's fundamentals in relation to society. It includes direct and indirect impact on the economy, investment trends, global comparisons and insights on employment and gender.

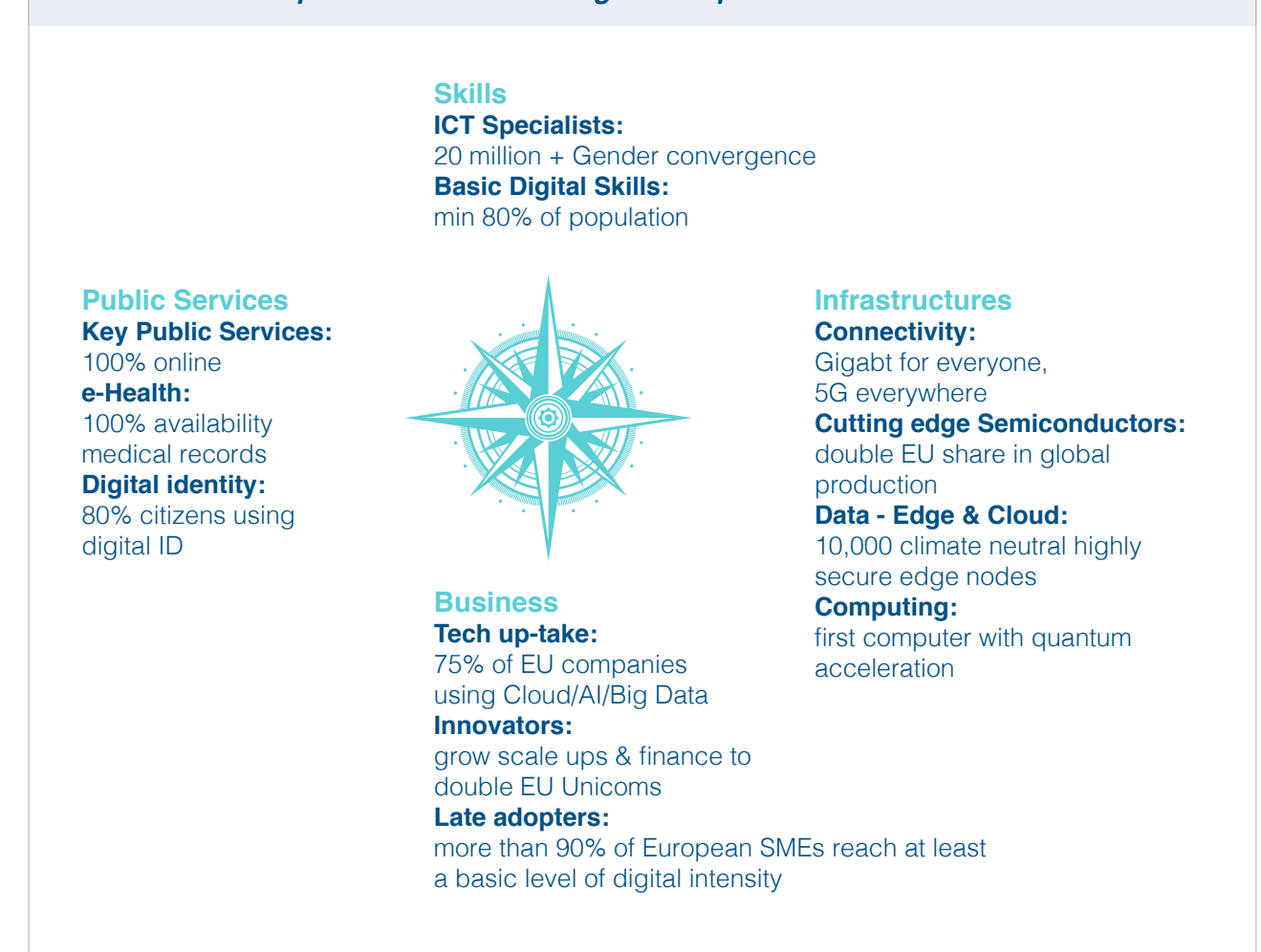
1. DIRECT IMPACT FOR EUROPEANS

The first mission of telecoms operators is to provide capacity and coverage for trusted, resilient and secure connectivity. The pandemic showed just how important that mission actually is. As a result, in 2021 many operators in Europe and the rest of the world have shifted some of their investment focus back onto their core service, connectivity, by accelerating their deployment of fit-for-purpose infrastructure in the form of 5G and fibre. This is not simply a matter of capacity and coverage for ever higher traffic demands from consumers and businesses; it is also about making the networks greener, more resilient, predictable, flexible and adaptable, and fit for new kinds of demand.

The European Commission announced its Digital Decade targets in March 2021. The Commission's targets for 2030 are summarised in the Europe's Digital Decade report, and are structured around the four points of the Digital Compass (**FIG 1-1**):

- the provision of sustainable digital infrastructure
- the digital transformation of businesses
- the digitalisation of public services
- a digitally skilled population and highly skilled digital professionals.

FIG 1-1 : The European Commission's digital compass



Source: European Commission, 2021

The Digital Decade infrastructure targets advance the European Gigabit Society 2025 targets by aiming to provide gigabit connectivity for every European household and 100% 5G coverage of populated areas by 2030 (FIG 1-2). They also, for the first time, include the establishment of edge nodes (10 000 to be deployed in the EU by 2030) as an infrastructure target.

FIG 1-2 : Infrastructure targets of the Connectivity for European Gigabit Society strategy and the EC’s Digital Decade agenda

Connectivity for a European Gigabit Society (2025)	Digital Decade (2030)
• Access to download speeds of at least 100Mbit/s (using gigabit-upgradeable technology) for all European households • Uninterrupted 5G wireless broadband coverage for all urban areas and major roads and railways • Access to 1Gbit/s speeds for all schools, transport hubs, major providers of public services and digitally intensive enterprises	• Full coverage of populated areas with 5G • All households covered by a gigabit-capable network • 10 000 climate-neutral, highly secure edge nodes will be deployed in the EU

Source: European Commission, 2021

The Digital Decade is about more than just enablement through infrastructure. The project also aims to make Europe a hub of technological innovation, rather than having to rely on outsourced services and products. This will bring additional economic benefits and new job opportunities. It is also about digital transformation and the human capital required for that to occur: encouraging citizens to become digitally competent, training highly skilled ICT specialists, supporting businesses and the public sector with their digital transformations. The Digital Economy and Society Index (DESI), which tracks the progress of EU digitalisation, has adapted to reflect the Digital Decade’s new set of targets.

The infrastructure targets are the targets that apply directly to telecoms. They are challenging because there remains a great disparity across Europe in terms of connectivity and in terms of the demand for, or ability to take advantage of, the services that require such connectivity. Strong collaboration is required between upstream suppliers (such as network operators and infrastructure owners) and public administrations in order to achieve the Digital Decade infrastructure targets. A win/win approach is required, which involves more flexibility in network-sharing, in joint-venture initiatives or in other horizontal agreements to bridge connectivity gaps and achieve the desired outcomes. In addition, the issue of building scale both in country and across countries remains currently unsolved, with highly fragmented European markets.

1.1 Fixed broadband and FTTH coverage

Fixed networks continue to be the workhorse of the digital ecosystem and carry about 90% of all data traffic. There is a consensus that FTTH is the best fixed technology in terms of capacity, reliability and operational efficiency. FTTH is also the most energy-efficient access technology essentially because it decouples rising demand from the requirement for increasing density of powered elements in networks. According to Telefónica, it has the potential to reduce the energy consumption of fixed access network equipment by around 85%¹. Being the most energy-efficient technology also makes it the greenest available technology.

The modernisation and migration of fixed networks from copper to FTTH represents the largest and costliest telecoms infrastructure undertaking since the initial roll-out of copper telecoms networks, which began in the early twentieth century. The investment required is far greater than that for 5G. The long asset-life of FTTH passive infrastructure means that, despite the initial capex hit, operators can provide

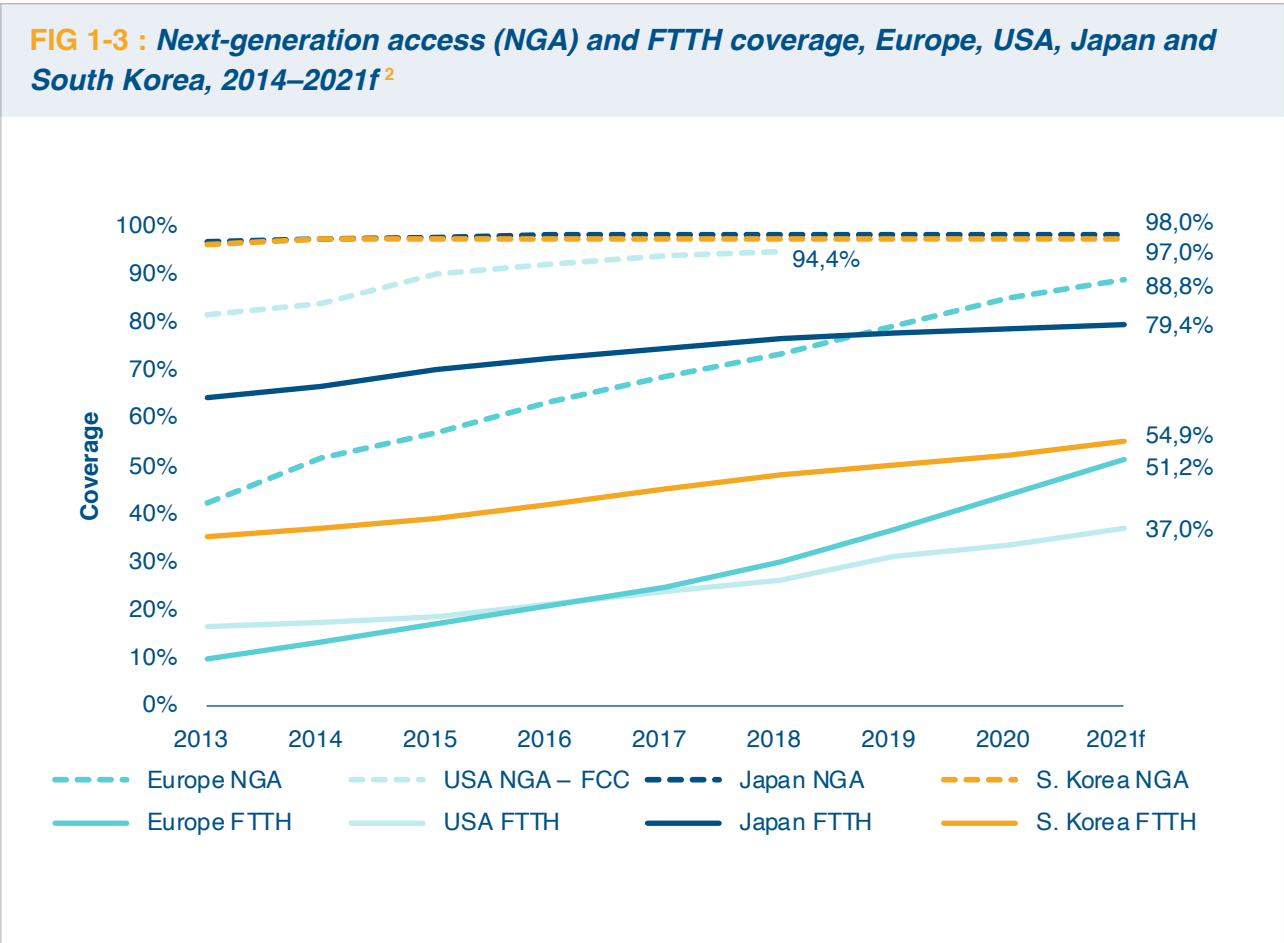
low-maintenance and highly future-proofed services for decades to come, thereby making the total cost of ownership attractive. Many European operators have started the drawn-out process of phasing out copper, and several European cable operators have embarked upon the same process with coaxial cable networks in 2021.

The first phase of lockdowns of 2020 caused some hiatuses in operators’ FTTH roll-outs, and this has been exacerbated by global supply-chain disruptions. However, operators’ and investors’ commitment to FTTH has not waned. Co-investment schemes, often with third-party infrastructure investors, have enabled several European operators to extend, or bring forward, their FTTH roll-out targets. This heavy investment has created a more diversified and more commercial wholesale environment for fixed access in many regions of Europe. For the European consumer this will doubtless bring even lower prices.



¹ See [Telefónica issues the first green bond of the telco sector, amounting to 1 billion euros](#)

FTTH coverage increased by 7 percentage points to 44% in 2020 (113 million premises were passed out of 259 million); we expect it to have risen by a further 7 percentage points to 51% (132 million premises) by the end of 2021 (FIG 1-3). This means that over half of European premises will be passed by at least one FTTH network by the end of 2021. Europe continues to maintain the lead versus the USA in terms of FTTH coverage, but the leading fixed operators in the USA significantly accelerated their roll-out plans in late 2020 and 2021.

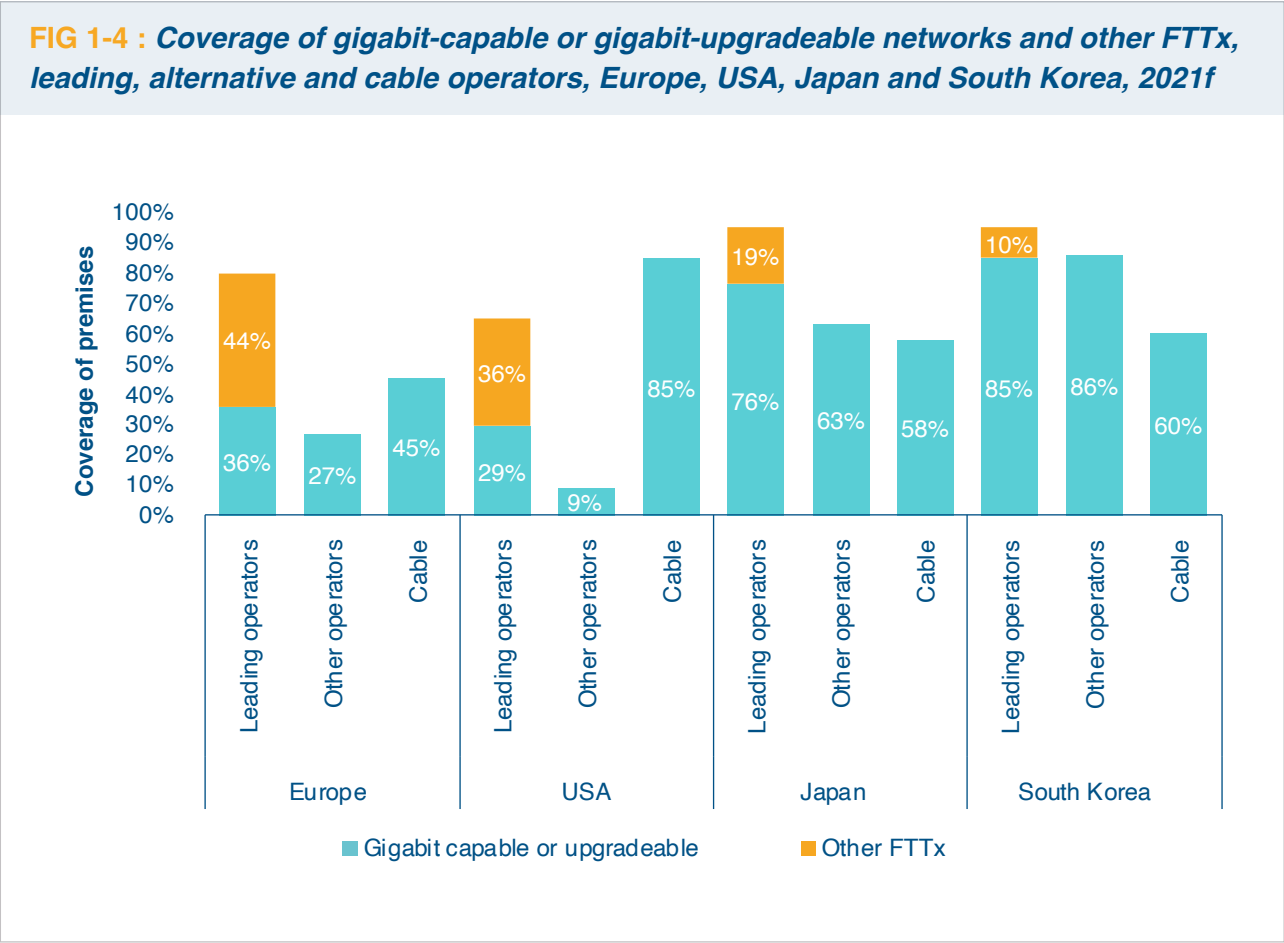


Source: Analysys Mason, 2021

“ FTTH now reaches most Europeans, with coverage at 51.2%. ”

² The figures for the USA are based on calculations published by the FCC. The FCC’s methodology is different to Analysys Mason’s and may overstate real availability. Analysys Mason estimates that the real coverage for NGA in Europe was closer to 87% at the end of 2019. The FTTH figures for South Korea and Japan exclude FTTB/LAN.

FTTH is the gold-standard infrastructure choice, but its deployment is not viable on purely commercial terms in all scenarios. Providing gigabit connectivity in very rural areas remains a challenge. State aid plays a key role in bridging the connectivity gap between urban and rural areas. Through its post-pandemic National Recovery and Resilience Facility the European Union will provide a total of EUR724 billion in the form of grants and loans to member states. This is expected to support the Digital Decade targets since each recipient country must dedicate a minimum of 20% of its funding to enabling digital transitions. Most of the funding, at present, appears to be directed towards demand-side measures – such as digitalising the public administration – and stimulating innovation. Direct funding for network deployment is currently the exception.

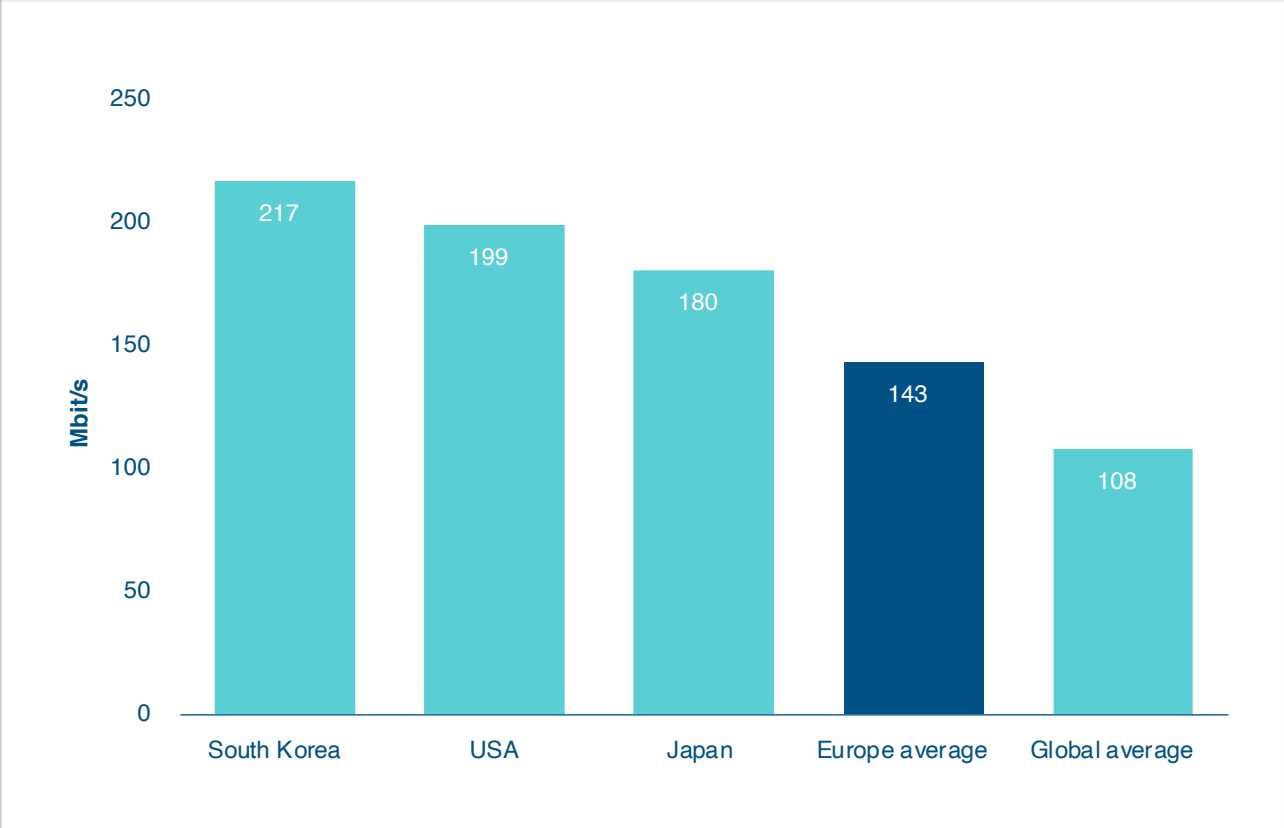


Source: Analysys Mason, 2021

FTTH will be the predominant form of gigabit connectivity across Europe, but fibre-to-the-building (FTTB) with in-building LAN cabling and cable HFC are either already gigabit-capable or are upgradeable without the need for major new infrastructure spending. 5G fixed-wireless access (FWA) also has the capability to provide gigabit speeds under certain deployment scenarios. Only around two thirds of Europeans had access to wired gigabit-capable or upgradeable technology in September 2021, although many have access to more than one such infrastructure. Europe cannot solely rely on one form of fixed access technology to achieve a gigabit society, and it will be the amalgamation of multiple technologies used across different geographies that will enable Europe to achieve its Digital Decade targets. The presence of 5G FWA services in Europe has grown as operators’ 5G networks have matured. This technology has the capability, when appropriately deployed, to provide the required gigabit speeds and can help to fill the connectivity gaps in remote regions.

The average fixed downlink speed in Europe increased by 23% year-on-year in September 2021, though it remains substantially behind that in South Korea, the USA and Japan (FIG 1-5). Europe has a lower baseline of cable broadband coverage than these other markets, so many European users still have to rely on older, and generally slower, xDSL technologies, despite the rapid build of FTTH networks.

FIG 1-5 : Average fixed downlink speeds, Europe, USA, Japan and South Korea, September 2021



Source: Ookla, 2021

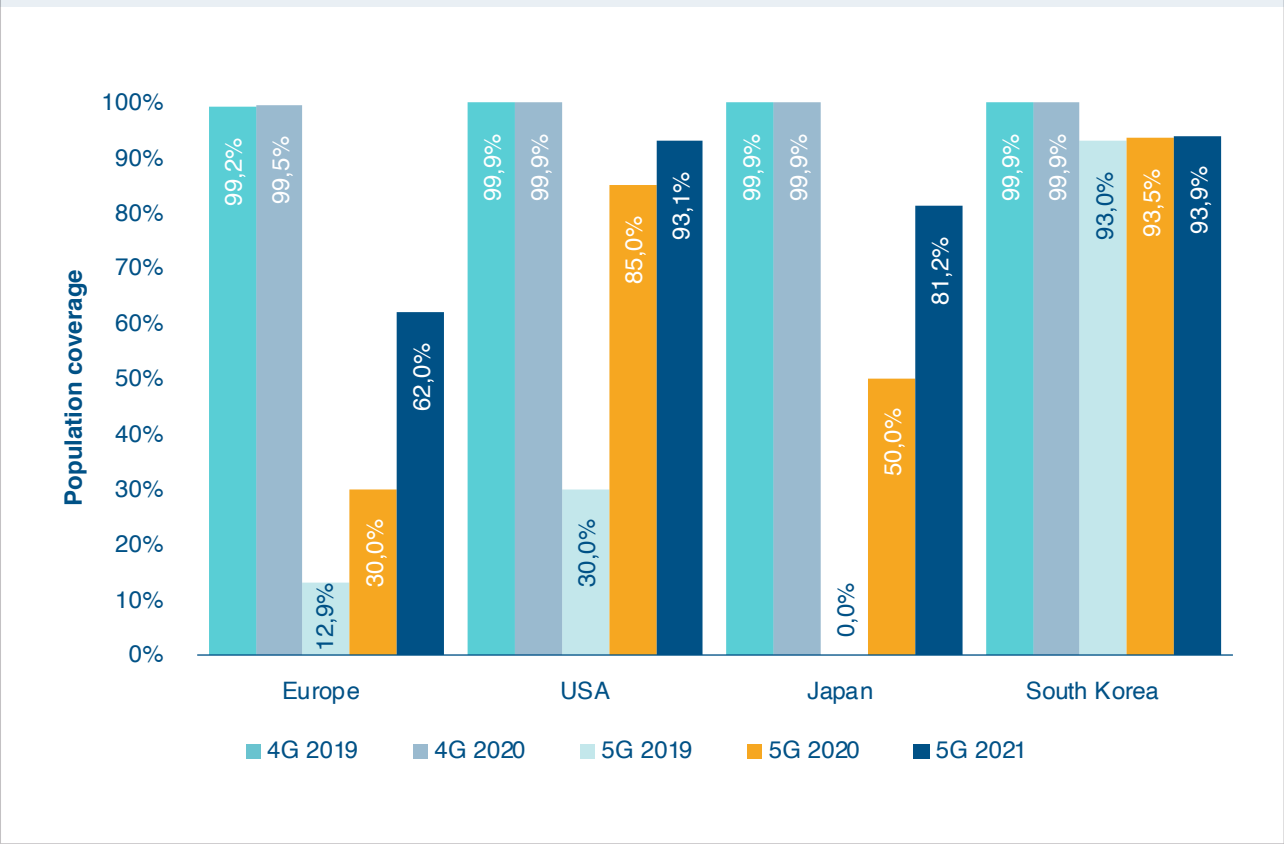
Many operators across Europe are in the process of upgrading to a second-generation of optical access technology on their FTTH networks. Several new builds have opted for 10Gbit/s-capable networks from the outset, and multi-gigabit services up to 10Gbit/s are now commercially available in several markets. Indeed, Proximus deployed the world’s first 25Gbit/s network in June 2021. The economic advantage of FTTH comes into its own here; once the underlying passive FTTH infrastructure is in place, the cost and disruption associated with huge increases in capacity is very low.

1.2 Mobile and 5G availability

93 national operators had launched 5G within Europe by the end of 2021, up from 74 by the end of 2020. ETNO members had commercially launched 46 5G operational national networks by the end of 2021. Overall, 5G networks are now available in almost all European nations, though the coverage and capability vary considerably; in some nations, 5G hinges on dynamic spectrum sharing or is deployed on spectrum that is outside the main bands used for 5G. Some of the more-advanced markets in Europe have approaching nationwide population coverage, but others have coverage only in the major cities. Europe’s 5G coverage was approximately 62% of the population by the end of 2021, lower than that in the USA, South Korea and Japan (FIG 1-6). 5G coverage figures are complicated by:

- the use of low-band frequencies (700MHz in most of the world, 600MHz in North America), which add coverage but little in terms of end-user experience.
- the use of dynamic spectrum sharing on what had hitherto been mainly 4G spectrum in order to boost coverage and in order to be able to launch 5G services before 3.5GHz spectrum became available or before 3.5GHz-based networks could be built.
- Coverage of the principal 5G band, 3.5GHz, is significantly lower than overall 5G coverage in all cases bar South Korea.

FIG 1-6 : Percentage of the population covered by at least one 4G mobile operator and the percentage covered by at least one 5G operator, Europe, USA, Japan and South Korea, 2019, 2020 and 3Q 2021

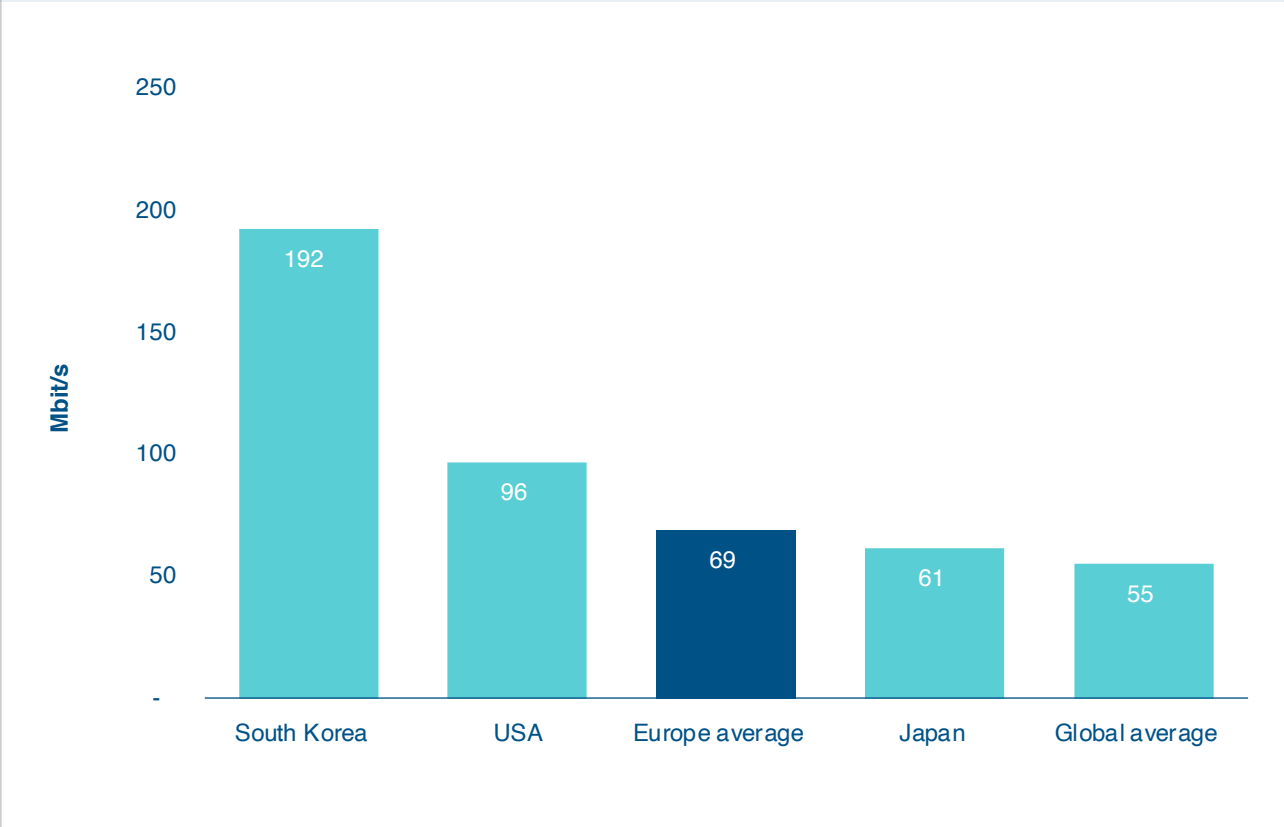


Sources: ITU, Analysys Mason, 2021

Average mobile speeds continue to increase in all regions worldwide. Average speed increased by 53% year-on-year in Europe in between September 2020 and September 2021. The pandemic had mixed effects on usage. In some countries growth in usage stalled; in others, typically those with a higher proportion of the population depending solely on mobile, it surged. When usage is high, this can lead to a reduction in average speeds, and vice versa. However, the overall strong increase in speeds illustrates more than anything the influence of the launch of 5G in many markets.

Individual European nations have some of the highest figures in terms of downlink speed, which is largely dependent on the availability of 5G. Among the comparator countries, South Korea is unique in already having very wide outdoor coverage on the main 5G spectrum bands (FIG 1-7).

FIG 1-7 : Average mobile downlink speeds, Europe, USA, Japan and South Korea, September 2021



Source: Ookla, 2021

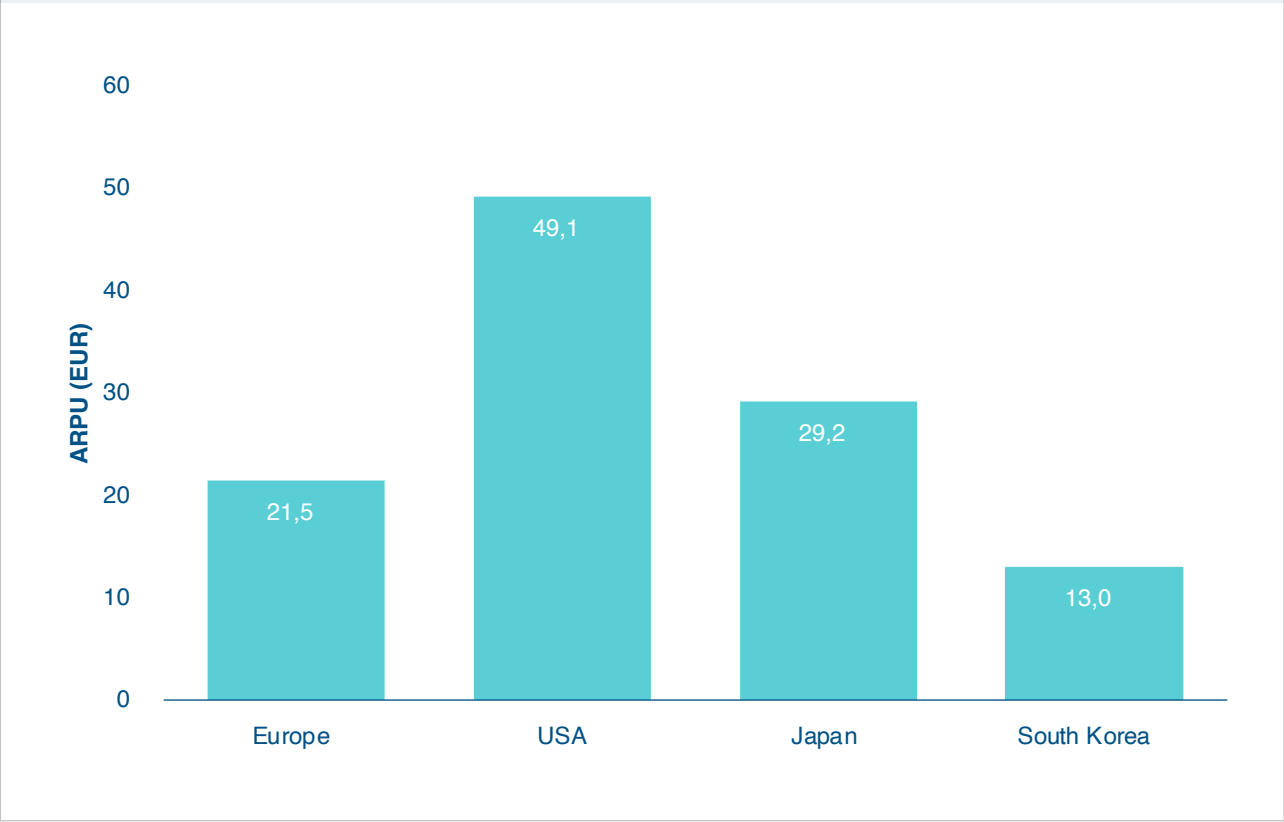
1.3 Prices remain very low by global standards

Europeans enjoy lower prices for digital communications services than those in other developed regions. This low spend puts at risk the long-term sustainability of the sector.

By supporting new entrants – through *inter alia* imposing spectrum or national roaming conditions or preventing much in-market consolidation – the regulatory framework has fostered constant price decreases. Additionally, and as an unintended consequence of preventing in-market mobile consolidation, the regulatory framework has created a high level of fixed-mobile bundle discounting, which tends further to erode prices of stand-alone mobile services.

Competition in the retail broadband market is supported by regulation that creates artificial retail opportunities for players that do not invest in their own infrastructure by ensuring that larger, incumbent players offer access to their networks. Europe is considerably more regulated than any other region. As a result, Europeans pay low retail prices for broadband, which is reflected in the low ARPU (average revenue per user) (FIG 1-8).

FIG 1-8 : Fixed broadband ARPU, Europe, USA, Japan, South Korea, 2020

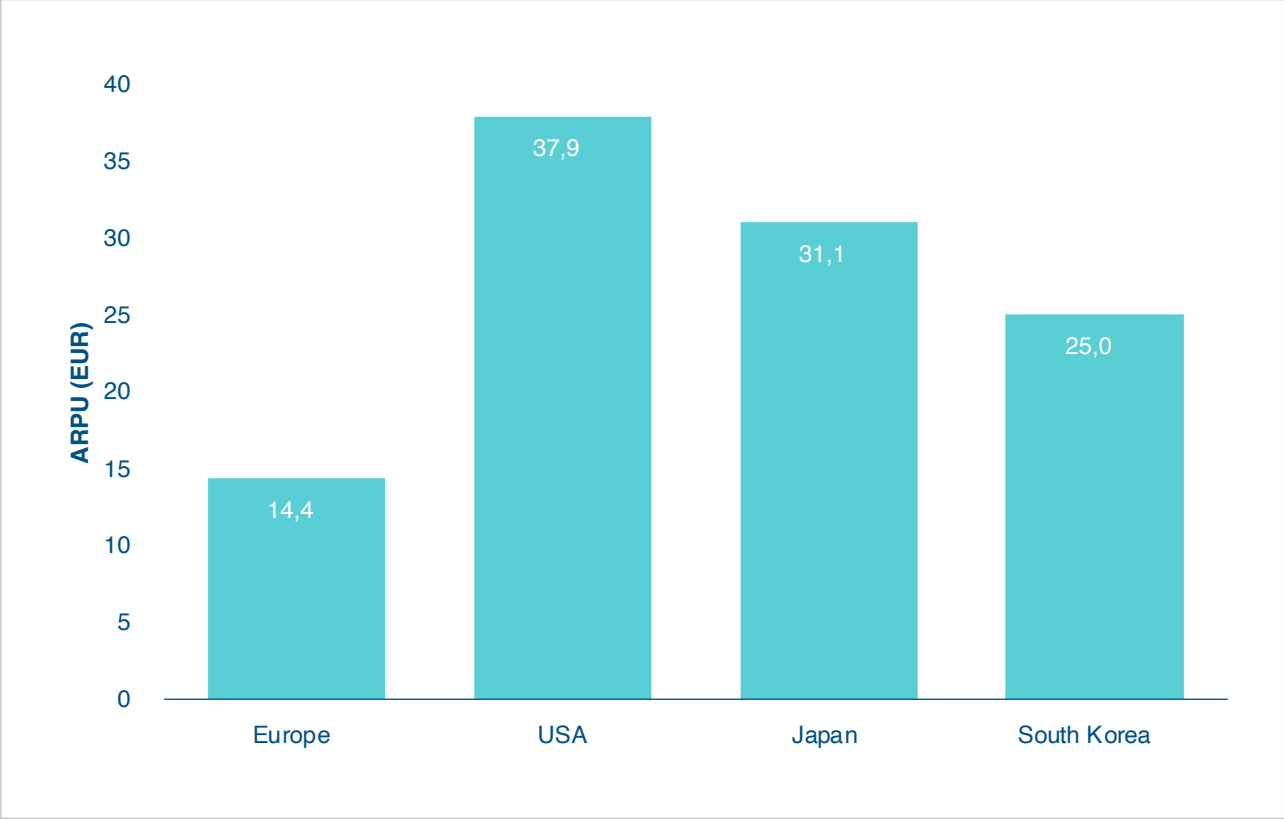


Source: Analysys Mason, 2021

Europe's ARPU is low, but South Korea's ARPU is even lower due to specific market factors. There is a high level of infrastructure-led retail competition in South Korea, but fixed broadband services are commonly cross-subsidised in fixed-mobile convergence (FMC) retail bundles, with higher mobile prices. The USA's high ARPU reflects in part a paucity of meaningful retail competition, no real wholesale component to the market, and often unequal infrastructure-based competition between the local cable operator, which is typically dominant, and a local fixed telco.

A high level of retail competition, reinforced by regulation, also exists in the European mobile market, and as a consequence consumers spend less on mobile than in the peer countries. While in-market mobile consolidation has been stymied, fixed-plus-mobile consolidation has generally been permitted. This has led to a trend towards retail FMC bundling, which tends in Europe to erode standalone mobile contract prices, thereby further lowering mobile ARPU (FIG 1-9). Only a few operators in Europe, where the market allows price stability to prevail, are selling 5G at a premium.

FIG 1-9 : Mobile ARPU (excluding IoT SIMs), Europe, USA, Japan, South Korea, 2020

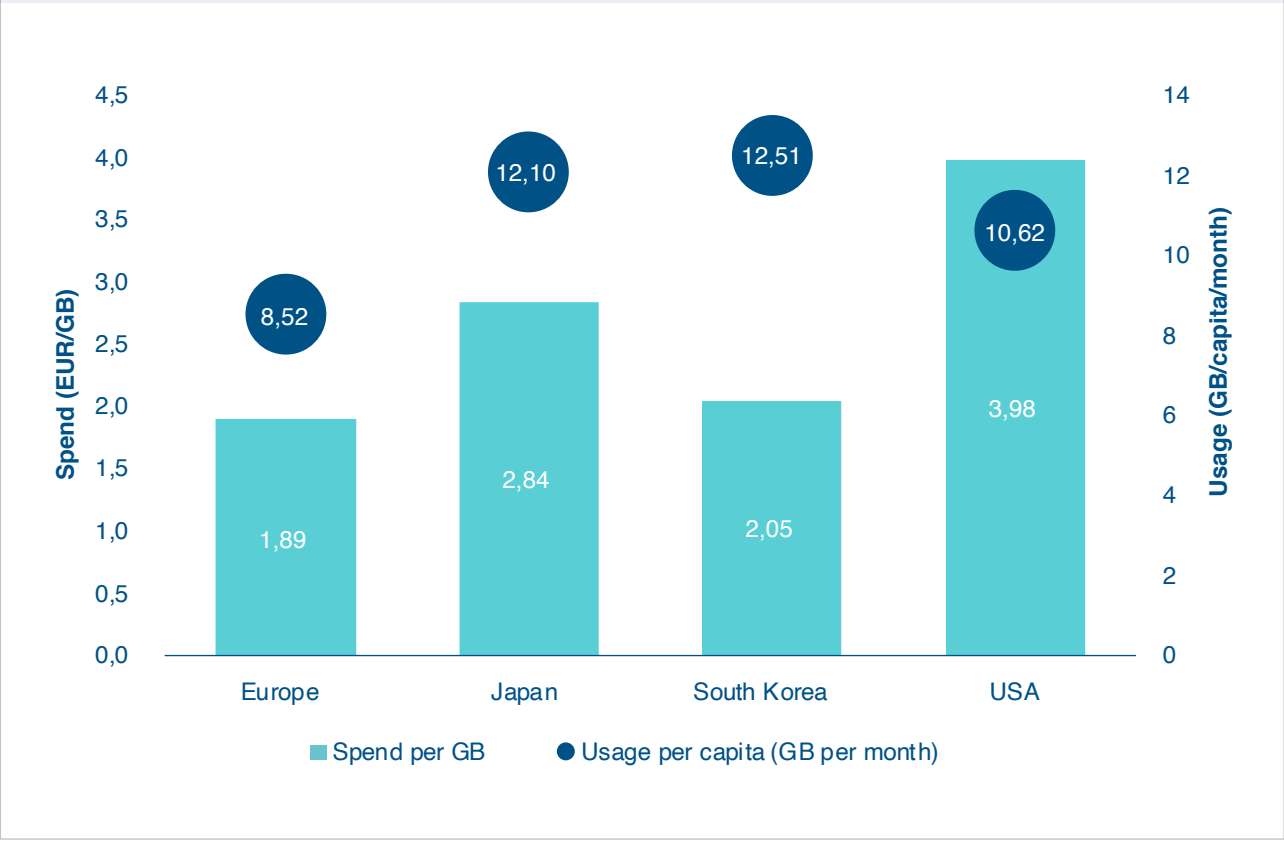


Source: Analysys Mason, 2021



Consumers in the USA, South Korea and Japan use more mobile data than their European counterparts, despite spending more for mobile data on a per-unit basis (FIG 1-10).

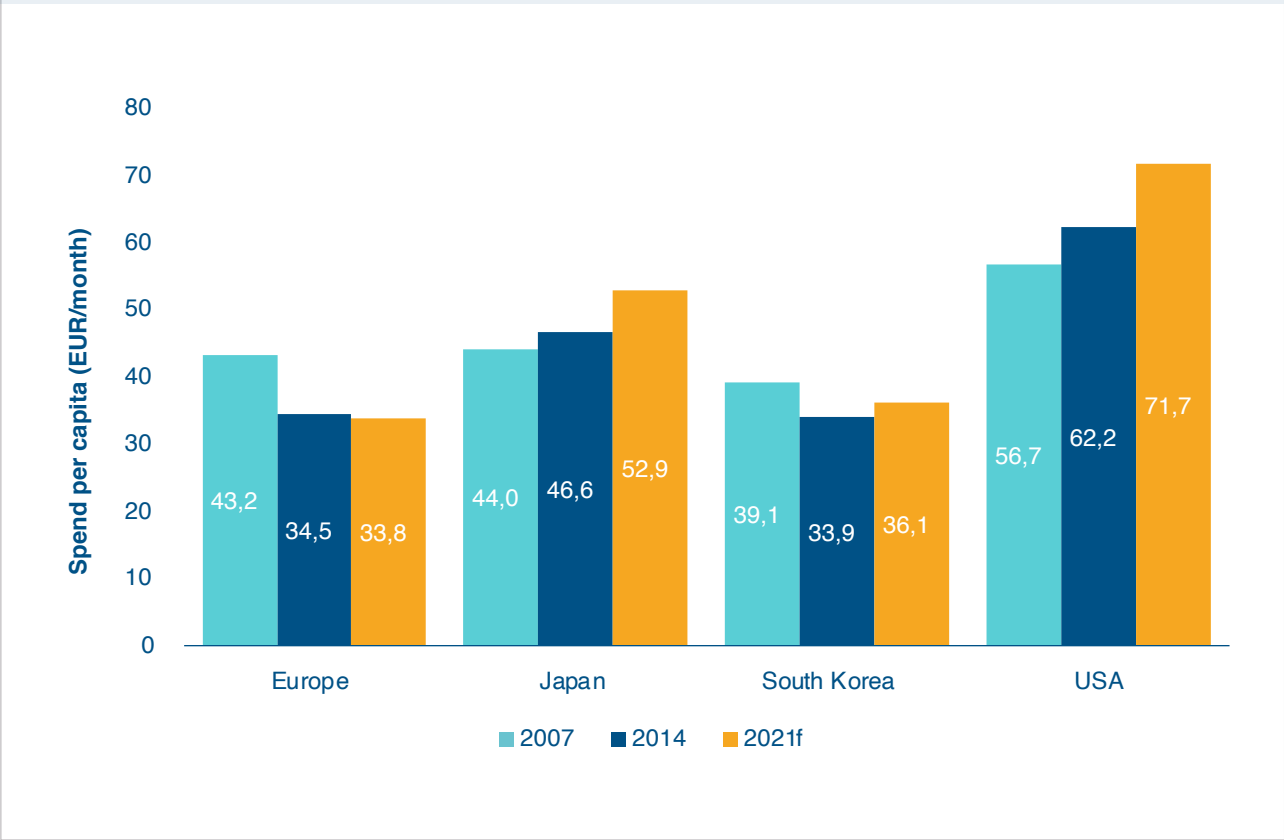
FIG 1-10 : Average spend per gigabyte of mobile data used and average mobile data usage per capita, Europe, South Korea, Japan and the USA, 2020



Source: Analysys Mason, 2021

Overall consumer spend on telecoms in Europe remains lower than that in peer countries (FIG 1-11). and it is decreasing while spend in peer countries is increasing.

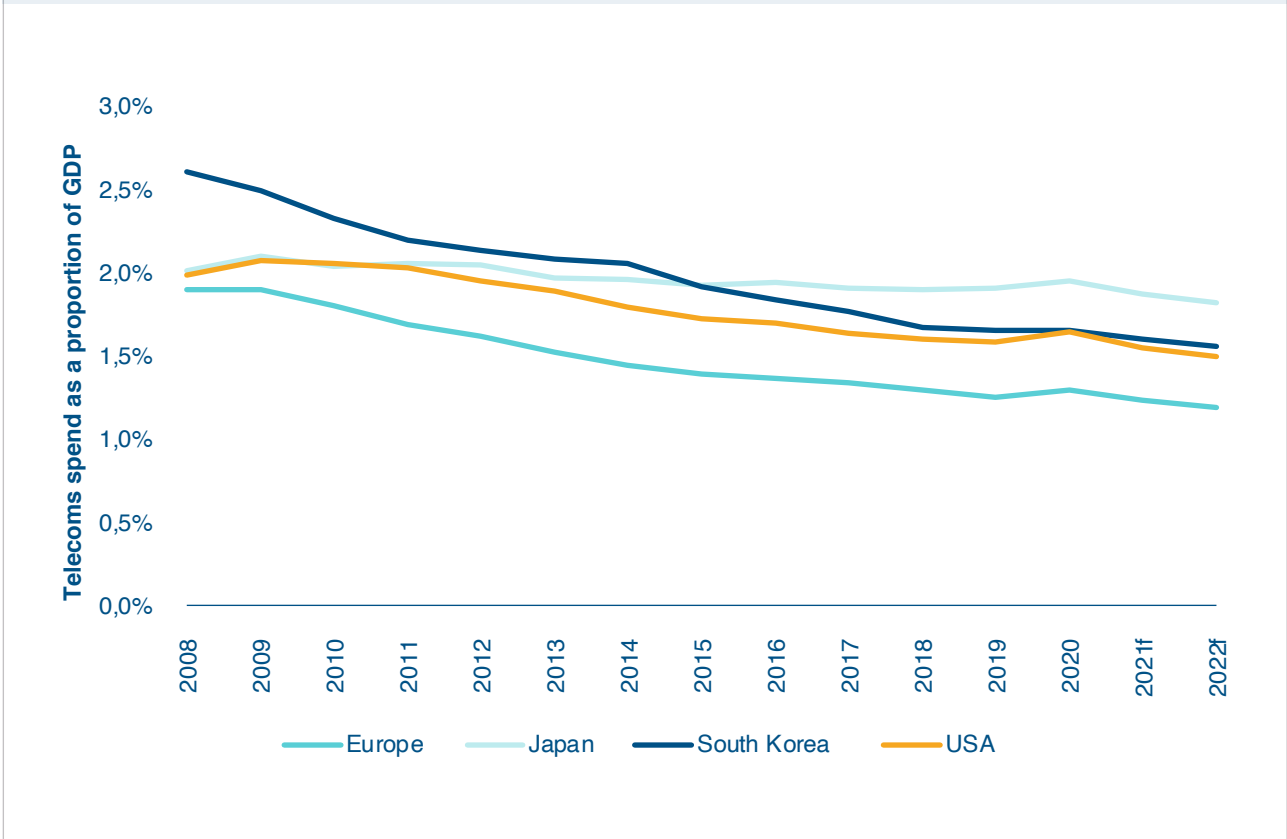
FIG 1-11 : Average spend per capita on mainstream telecoms, Europe, USA, Japan and South Korea, 2007, 2014 and 2021f



Source: Analysys Mason, 2021

FIG 1-12 shows that back in 2008 consumers in the USA, Japan and Europe all spent about the same proportion of GDP on telecoms, but since then, the figure for Europe has declined the most significantly. Of course, in purely quantitative terms, what consumers actually get for their spend has vastly increased since 2008. This can largely be attributed to regulation that creates strong retail competition and depresses prices, which has substantially affected the performance of the telecoms sector.

FIG 1-12 : Telecoms spend as a proportion of GDP, Europe, USA, Japan and South Korea, 2008–2022f

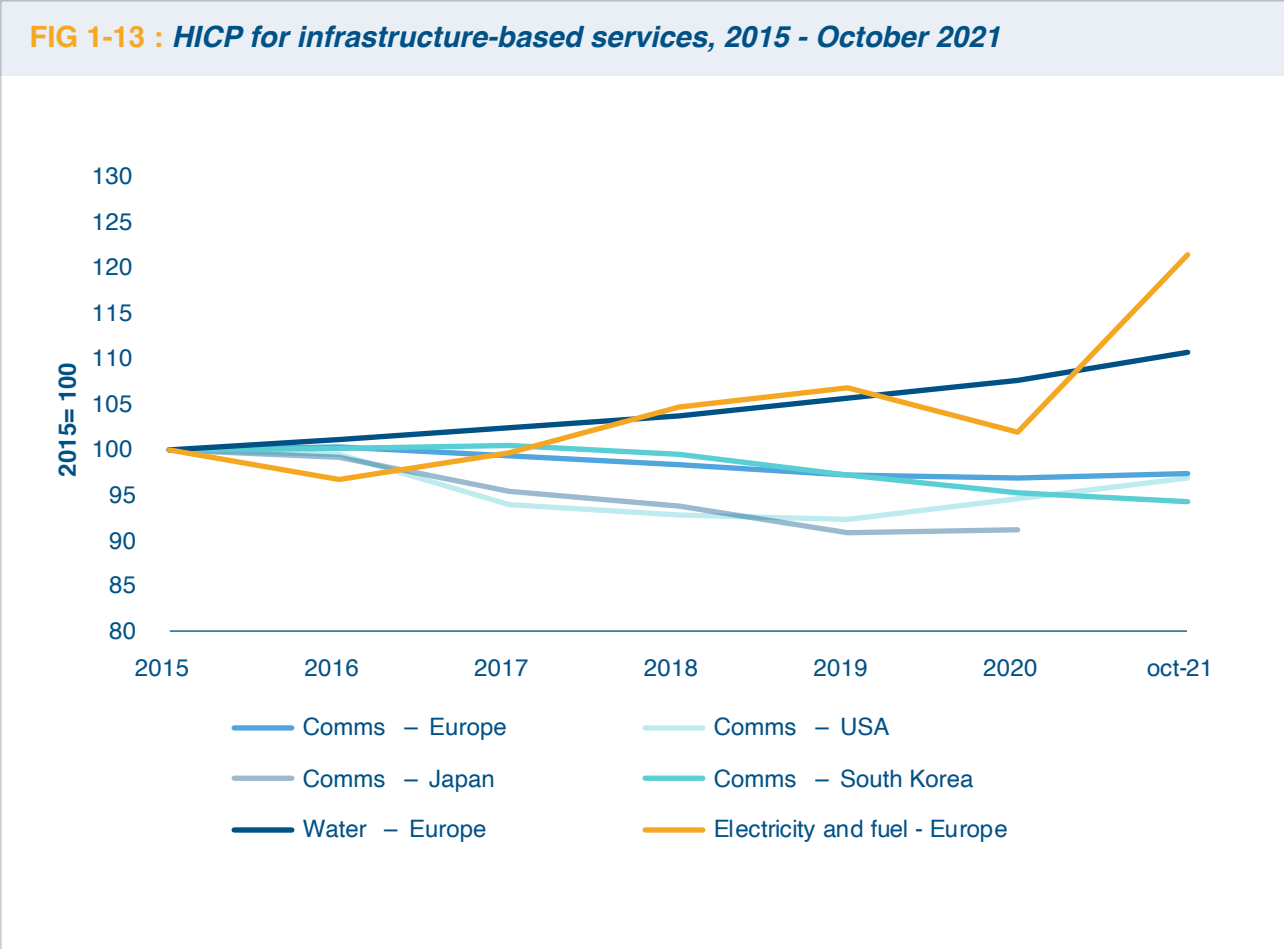


Source: Analysys Mason, 2021

There was a slight increase in telecoms spend as a proportion of GDP in the USA, Japan and Europe in 2020. This reflected the fall in GDP caused by the pandemic and the resiliency of the telecoms industry to that shock. Communications services are an essential resource, which means that the sector was less affected by GDP changes than other verticals, but still revenue for the sector in Europe was lower due to the pandemic. However, 2020 was an anomaly and there are few reasons to doubt a return to previous trends in 2021, or at least as and when the impact of the pandemic is over.

Communications, often thought of as ‘the fourth utility’, is unique among such infrastructure-heavy network businesses in that rising input costs are not reflected in retail prices. The OECD’s Harmonised Indices of Consumer Prices (HICP) benchmarks show rises in energy and water prices but not for communications.

FIG 1-13 : HICP for infrastructure-based services, 2015 - October 2021



Source: OECD, 2021

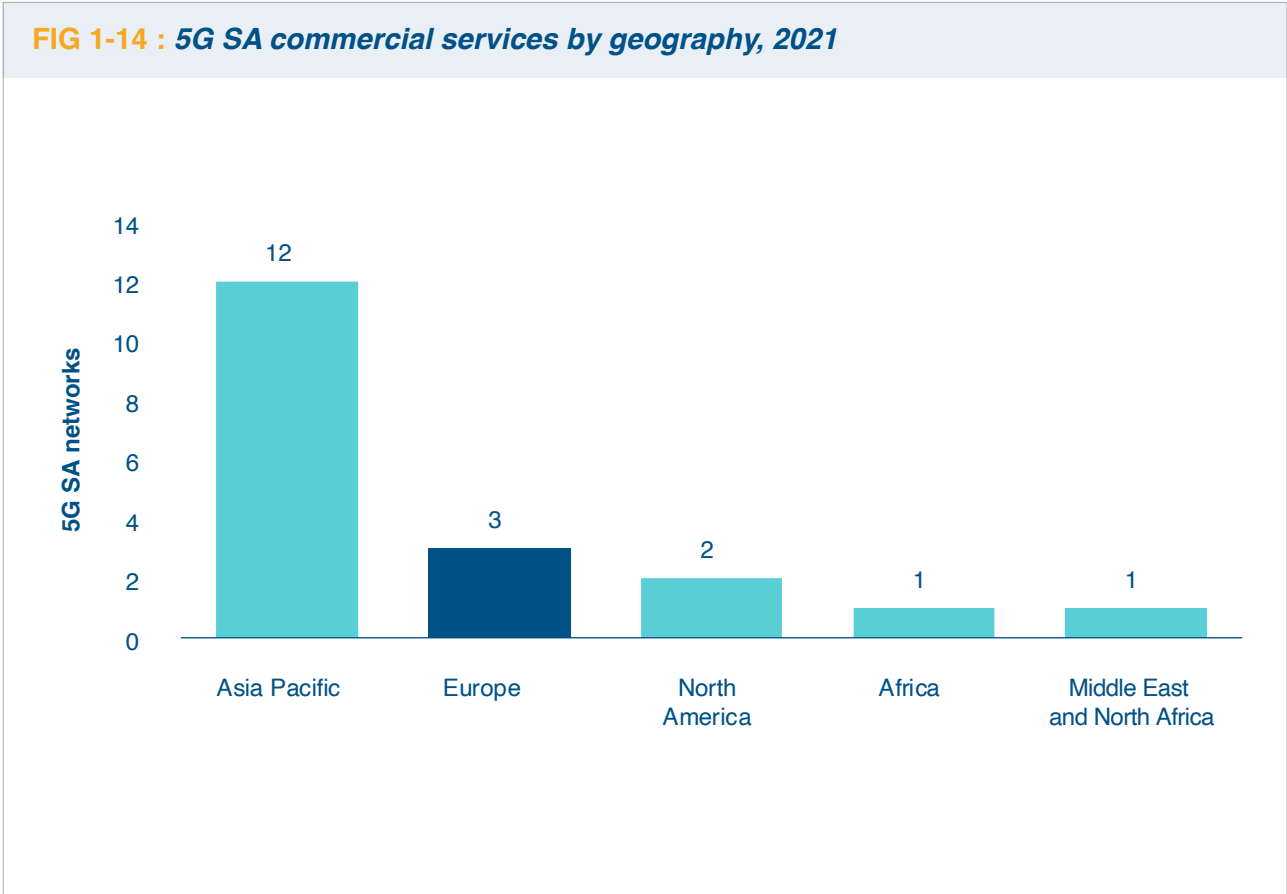
1.4 European operators will play a key role in digital transformations

5G plays a vital role underpinning operators’ broader ambitions of helping to achieve digital transformation in the economic and social spheres. The operators are key local players in the creation of industrial ecosystems in the 5G era where digital business and industry solutions will be boosted.

Initial 5G launches involved relying on existing 4G LTE networks to enable 5G capabilities. However, 5G standalone (5G SA) is a step further; it involves rolling out completely new network architecture with, potentially, a new, cloud-native, 5G core. This advanced 5G architecture provides increased network capabilities and device capacity. It also enables more efficiencies and automation in the running networks, which will enhance the quality of service for consumers and businesses alike. What is particularly important about 5G SA is that it opens up new possibilities in terms of what 5G is capable of achieving. Slices of the 5G SA network can be defined for specific use cases without the capex burden of having to create dedicated networks. This opens up myriad new possibilities for businesses, and it also enables more-efficient digitalisation of public services. Section 3 explores these opportunities further.

19 operators worldwide had introduced 5G SA by the end of 2021, three of which are based in Europe (Elisa Finland, Telia Finland and Vodafone Germany) (FIG 1-14).

FIG 1-14 : 5G SA commercial services by geography, 2021



Source: Analysys Mason, 2021

The COVID-19 pandemic and e-health

One sphere, out of many, that has benefitted from operators’ active participation, and which stands to benefit from new architecture, is health. The dramatic events of 2020 and 2021 brought to light the fact that telecoms are both a lifeline and an enabler for modern societies.

The telecoms sector has played a crucial role in the pandemic, not only in the sense of ensuring that people can stay in contact or businesses can work from home and function, but in terms of helping to stop the spread of the virus. Mobile connectivity was the backbone supporting the use of e-health applications, which included both contact tracing apps and the anonymised use of network data to support the vital work of epidemiologists. Without connectivity, containing the spread of the virus would have been much more challenging. Several operators, like Orange and Deutsche Telekom, played an integral role in the development of COVID warning and tracing applications, whose role in helping to slow the spread has been recognised in several studies³. The German government commissioned SAP and Deutsche Telekom to develop this application, which notifies users if they have been in contact with someone who has tested positive with COVID-19. The app has been downloaded by over 40% of the German population (38 million). In addition, Deutsche Telekom and SAP also developed the European gateway to ensure interoperability between various tracing apps in the EU.⁴ It is these applications that have helped to control the spread and have enabled society to slowly return to normal.

Operators were instrumental in providing fully anonymised mobile positioning data to the European Commission to help control the spread of COVID-19. The data provided was essential for tracking and understanding human mobility and identifying Mobility Functional Areas (MFA), zones of high level of intra-mobility. This information was a critical asset that enabled government officials to determine where to apply targeted lockdowns or mobility restriction measures, regionally and nationally. ETNO members including A1 Telekom Austria, Altice, DT, Orange, Proximus, TIM, Telefonica, Telenor and Telia Company, directly supported this initiative.

Gigabit connectivity (both 5G and FTTH) will play an essential role in the development of predictive medicine, telemedicine, virtual consultations and home healthcare services. It will transform how medical data is stored and shared and will be key enabler for the fourth target in Europe’s Digital Decade report: the digitalisation of public services, which aims for 100% of European citizens to have access to medical records (e-records). Ultimately, telemedicine saves lives.

ETNO members have supported healthcare services in an array of capacities during the challenging months of the pandemic (FIG 1-15).

FIG 1-15 : Examples of ETNO members’ involvement in e-health solutions

Operator	e-Health solution
Proximus	Proximus introduced a telehealth service, doktr, which enables video teleconsultation services for patients with basic care needs. Over 40 000 highly qualified doctors have joined this accredited service. The service will enable patients to receive the care they need while partly relieving doctors of the burden of mounting patient concerns. It will also improve doctors’ efficiency. Proximus is partnering with the Swedish e-health provider, Doktor.se. doktr has been downloaded over 50 000 times on Google Play Store since its release in May 2021.
TIM	TIM launched TIM myBroker, an insurance solution, in October 2021. TIM myBroker offers both home insurance and health insurance to its customers. This can be used alongside TIM’s e-health platform TIM myHealth. TIM myHealth provides 24/7 online consultations with a doctor via phone or video chat. It can also be used for the delivery of medication and professional home assistance.
Telefónica España (Movistar)	Telefónica has partnered with Teladoc Health, a telemedicine provider, to offer Movistar Salud. This telehealth service enables both businesses and consumers to access medical consultations. 30 000 users signed up to the service within the first 6 months of its launch in October 2020.
Telekom Slovenije	Telekom Slovenije launched a 24/7 assisted living service (e-oskrba) in 2017, to improve the sense of connection and security for elderly residents. This involves the installation of smoke detectors, a security phone and a bracelet with active distress buttons.

Source: Analysys Mason, 2021

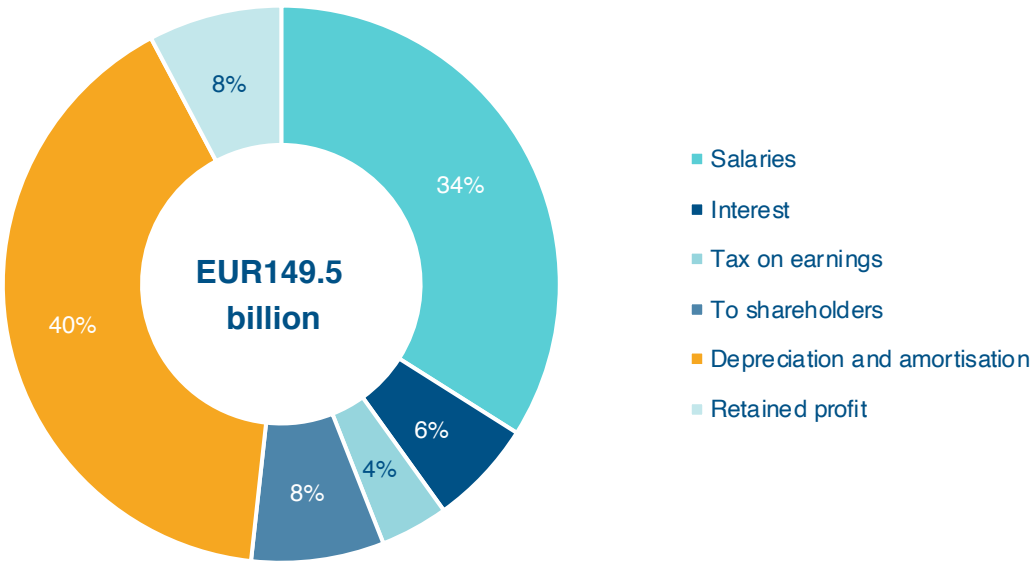
“ European telecom companies have launched remote healthcare services, a sign of how digitisation can boost inclusion. ”

³ The epidemiological impact of the NHS COVID-19 app | Nature
⁴ https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1904

2. INDIRECT IMPACT FOR EUROPEANS

ETNO members contribute indirectly to European well-being in several ways: through taxation, through investment in skills and rewarding employment and through sustained capital investment. At a group level, ETNO members (including non-European subsidiaries) created EUR149.5 billion of value-added (revenue minus the cost of goods and services) in 2020, compared to the EUR141.5 billion of value-added created in 2019.

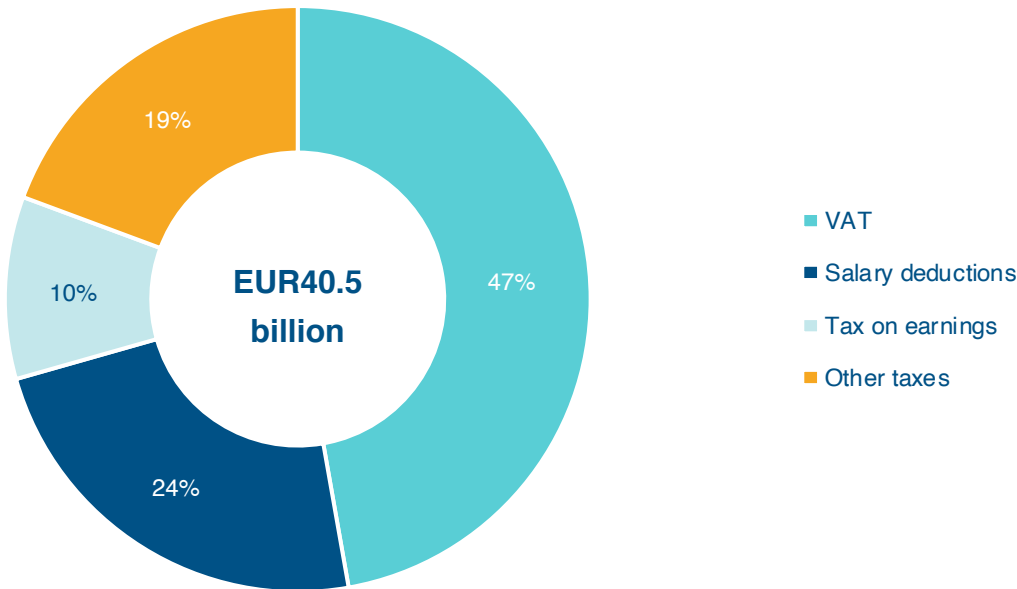
FIG 2-1 : Breakdown of value-added from ETNO members (group level), 2020



Source: Analysys Mason, 2021

ETNO members paid around EUR40.5 billion in direct taxes (tax on earnings and other direct taxes) and indirect taxes (VAT and salary deductions) for their European operations in 2020; this is equivalent to about 21% of their revenue base.

FIG 2-2 : Total direct and indirect tax, ETNO members (Europe only), 2020



Source: Analysys Mason, 2021

The category ‘Other taxes’ includes property taxes and telecoms-specific charges: recurring spectrum licence fees (but not the prices paid at auction), fees for using numbering resources, specific taxes on telecom assets (pylons, copper, etc), universal service costs, the cost of financing national regulatory authorities and obligations to finance other sectors (e.g. public TV). Price paid at auction for spectrum licences are not strictly speaking a tax, but they a similar function. European operators have paid EUR26.8 billion on licences since 2018, an average of EUR6.7 billion per year.

Digital innovation is happening at a rapid pace and authorities’ taxation legislation is playing catch-up; as such, taxation laws do not directly cover the full scope of the digital communications sector. Current tax rules are largely based on physical presence and were not designed to cope with business models that are driven primarily by intangible assets, data and knowledge, and which have fewer constraints on where they establish a physical presence. Because they have local presence in the form of tangible assets, telecoms operators already have a local taxable presence, as well as being subject to pre-existing sector-specific taxes and significant spectrum licence fees.

In October 2021, the OECD agreed on a new taxation framework for the digital economy and published its model rules on minimum taxation in December 2021. In the same month the European Commission proposed a directive “on ensuring a global minimum level of taxation for multinational groups in the Union”, the minimum rate being 15% for every jurisdiction in which they operate. The directive follows closely the OECD rules, differing only to ensure compliance with EU law. Those initiatives are welcome in order to fix the current unsustainable system where large digital companies do not contribute as they should to the countries from which they generate income.

2.1 Quality employment

ETNO members employed about 615 000 people in Europe at the end of 2020. They create high-quality employment, not only for their own staff, but also for the suppliers that sell them goods and services and for the service providers that are further down the value chain.

Beyond the basic skills, the future of digital communications businesses will depend significantly on ICT skills, especially those relating to cyber security, AI and software-based services. In addition, a new breed of engineers will be required to carry operator businesses forward and to compete against service providers that are cloud-native as the intelligence of networks moves away from dedicated hardware and towards the data centre and the cloud.

Europe, unlike the USA and Asia-Pacific, lacks highly skilled ICT specialists, despite the high demand. The European Commission wants to reposition the EU as a technology hub and as such, it is putting significant amounts of funding towards education and ICT skills training due to the importance of highly skilled labour. Indeed, one of the Digital Decade targets is to employ 20 million ICT specialists in the EU by 2030.

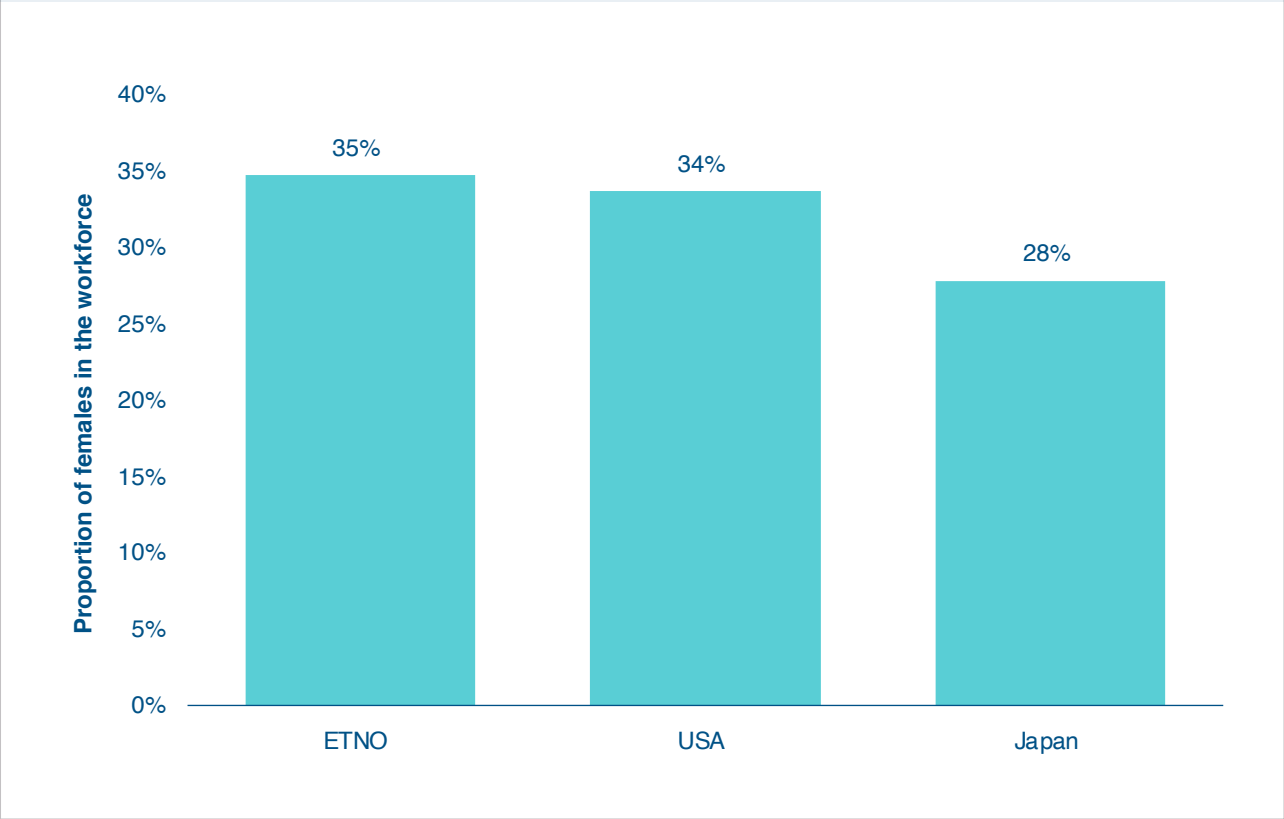
The average remuneration for ETNO member employees is around 30–40% above the average full-time salary in each market. Efficiency drives and competition have slowly eroded the number of people employed by telecoms operators, but the long-term trend is for increasing remuneration, which reflects the need and demand for highly skilled personnel. Indeed, ETNO members are proactively seeking to reskill/upskill employees to meet the high skill demand needed within the telecom sector. For instance, Telefonica introduced a worldwide reskilling/upskilling program with its partner SAP, and over 91% of employees have utilised the application. TIM Group, as part of its ESG initiative, has set the target to promote digital upskilling of employees through providing more than 6.4 million hours of training.



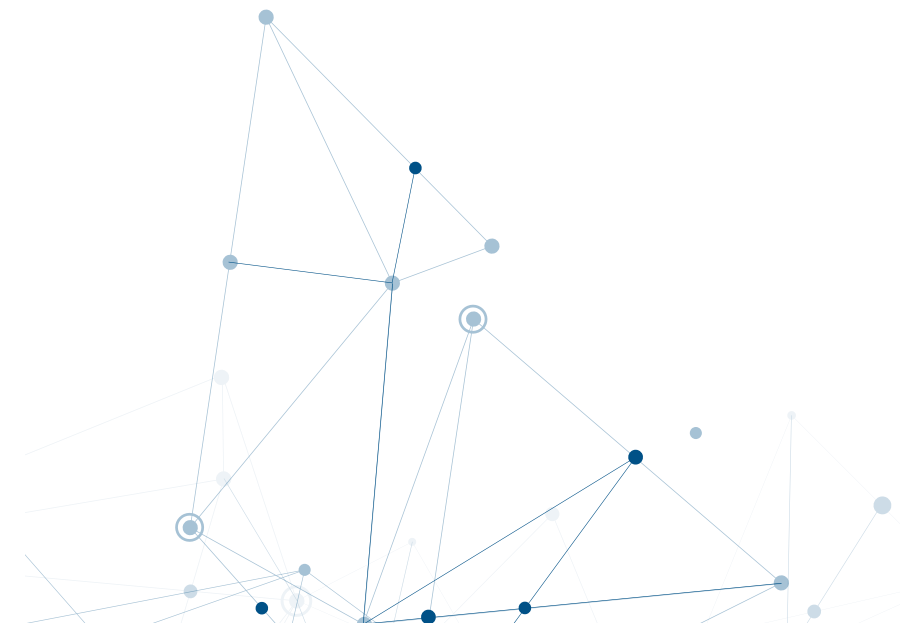
Gender gap

The gender gap within the ICT sector is an area for improvement. The European Gender Equality Index 2020 shows that women accounted for just 20% of employees in high-tech industries in 2020. Telecom operators perform better than the overall ICT sector, and European operators are ahead of their counterparts in the USA and Asia-Pacific in terms of bridging the gender gap (based on the proportion of women in their workforce). On average, 37.7% of their operator employees in Europe were women in 2020.

FIG 2-3 : Female share of the operator workforce, ETNO members, USA and Japan, 2020



Source: Analysys Mason, 2021



However, much more remains to be done to tackle the gender gap in the telecoms sector. Gender equality is about more than just the proportion of employees, and it has been observed that women’s current roles are often those that are more vulnerable to automation. The risk is that digital transformation actually reinforces the gender gap. Operators need to not only employ more women; they must also ensure that women have key management roles within the organisation and/or they have positions that require high levels of skill.

ETNO members have adopted practices to try to encourage women to join what has historically been a male-dominated vertical, and are aligning their strategies to meet the Digital Decade aim of ‘deleting’ the gender gap from the tech sector. Orange has committed to fill 35% of senior positions and 25% of technical/digital roles with women by 2025, and it has launched programs such as Hello Women, then aim of which is to raise awareness of tech jobs among young girls and students, to identify, attract and recruit more women into technical professions, and to convert and retain more women for technical professions. Similarly, Deutsche Telekom is aiming to fill 30% of its middle management roles (and higher) with women by 2030. Telenor committed to fill 35% of senior leadership roles and 40% of its work force with women by 2023. TIM Group has collaborated with the Young Women Network to empower and monitor young women in the industry; it is also implemented training initiatives to support the professional development of young women. Telia Company’s aim is to achieve gender equality in senior positions by 2025 – one target in a wider diversity and inclusion agenda that has also included concrete steps to make recruitment process more inclusive, to incorporate inclusion as part of leadership training, and to update the supplier code.

2.2 Shareholder return

ETNO members regularly distribute an important share of their net profit to shareholders. Dividend payments in 2020 were about 51% of the 2019 net profits. Shareholders are often institutional investors such as pension funds, so the steady profitability of major European telecoms operators is important. Net profits for ETNO members (excluding the impact of one-off sales of assets) increased by 19% year-on-year in 2020. The combination of planned fibre and 5G infrastructure upgrades (which are sometimes coupled with significant spectrum outlay that cannot easily be funded from regular cashflow) and uncertainty about the effects of the COVID-19 pandemic exerted pressure on some operators to reduce their dividend payments in 2020.

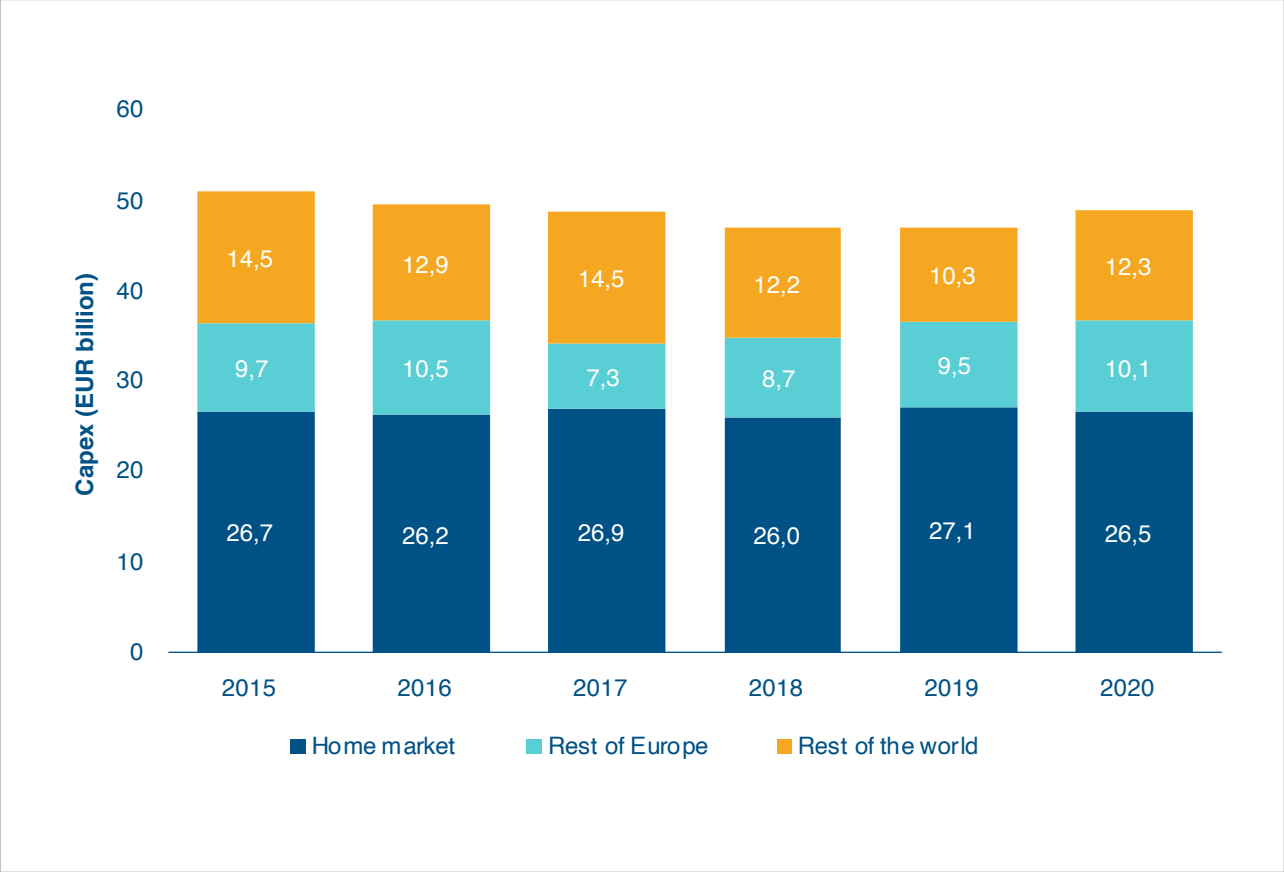
2.3 Capital investment: sustained investment in 5G and FTTH

Telecoms operators continue to invest heavily in upgrading their infrastructure and this is reflected in high capex intensity by global industry standards. This has both indirect and direct benefits for Europeans: good-quality jobs and investment in a European supply chain (two of the top three global telecoms equipment vendors are based in Europe).

Two cycles of heavy investment are converging in the early part of this decade: the upgrade to 5G and the fiberisation of local access networks. European countries are at different stages in this latter process, but there has been a significant capex uptick in some of the largest such as Germany and the UK.

The total capex by ETNO members, including investments outside Europe, was EUR49.0 billion in 2020; this represents 4.4% year-on-year growth.

FIG 2-4 : ETNO member capex (excluding spectrum costs), home markets, rest of Europe and rest of the world, 2015–2020⁵



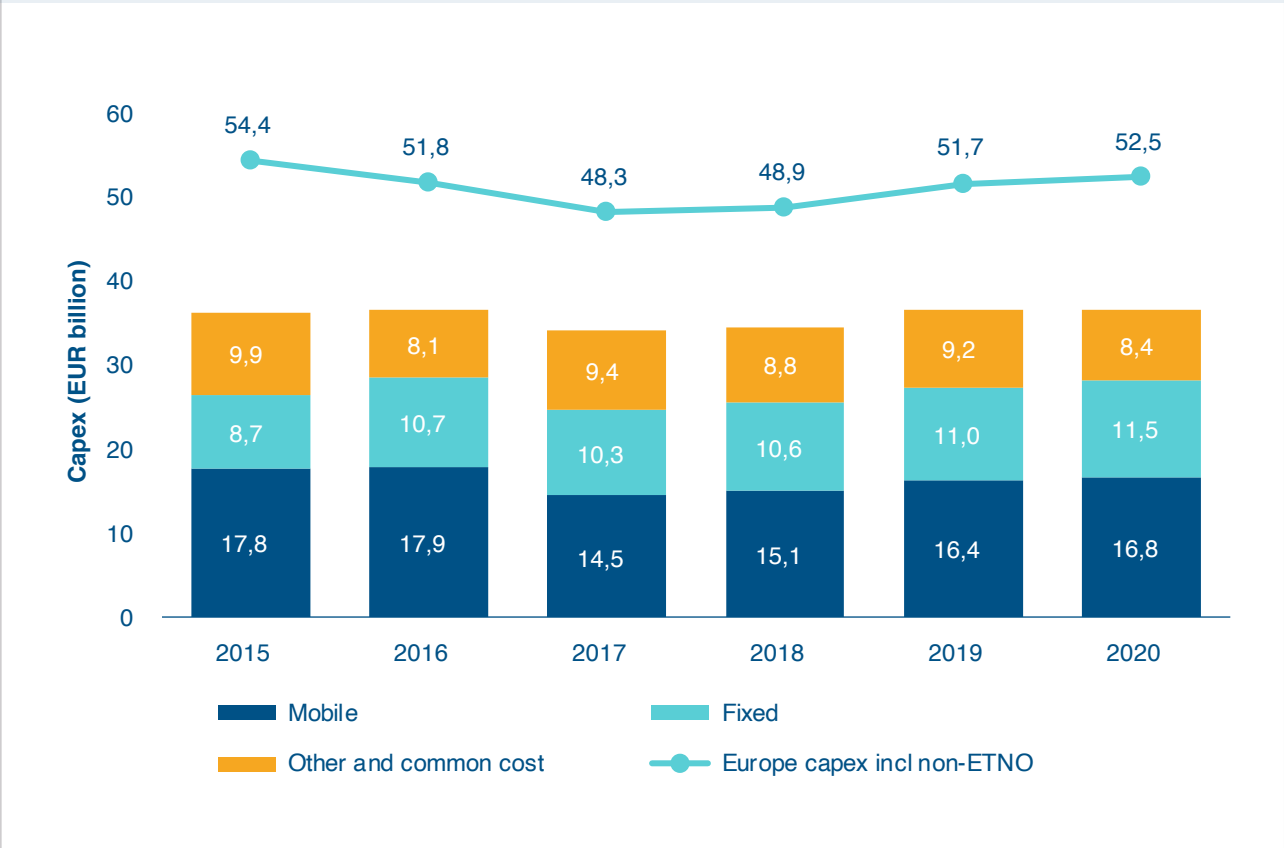
Source: Analysys Mason, 2021

⁵ Home markets are the countries in which the operator is the historical incumbent. The definition includes lines of business that serve multinational enterprises, but excludes mainstream operating businesses based in other countries. Comparator operators outside Europe have few mainstream operating businesses outside their home markets, and hence a comparison on the basis of ‘home markets’ is appropriate.



ETNO member capex in Europe only was EUR36.7 billion in 2020; this is fractionally up on the figure from 2019 (FIG 2-5). The Europe-only figure includes co-investments by ETNO members.

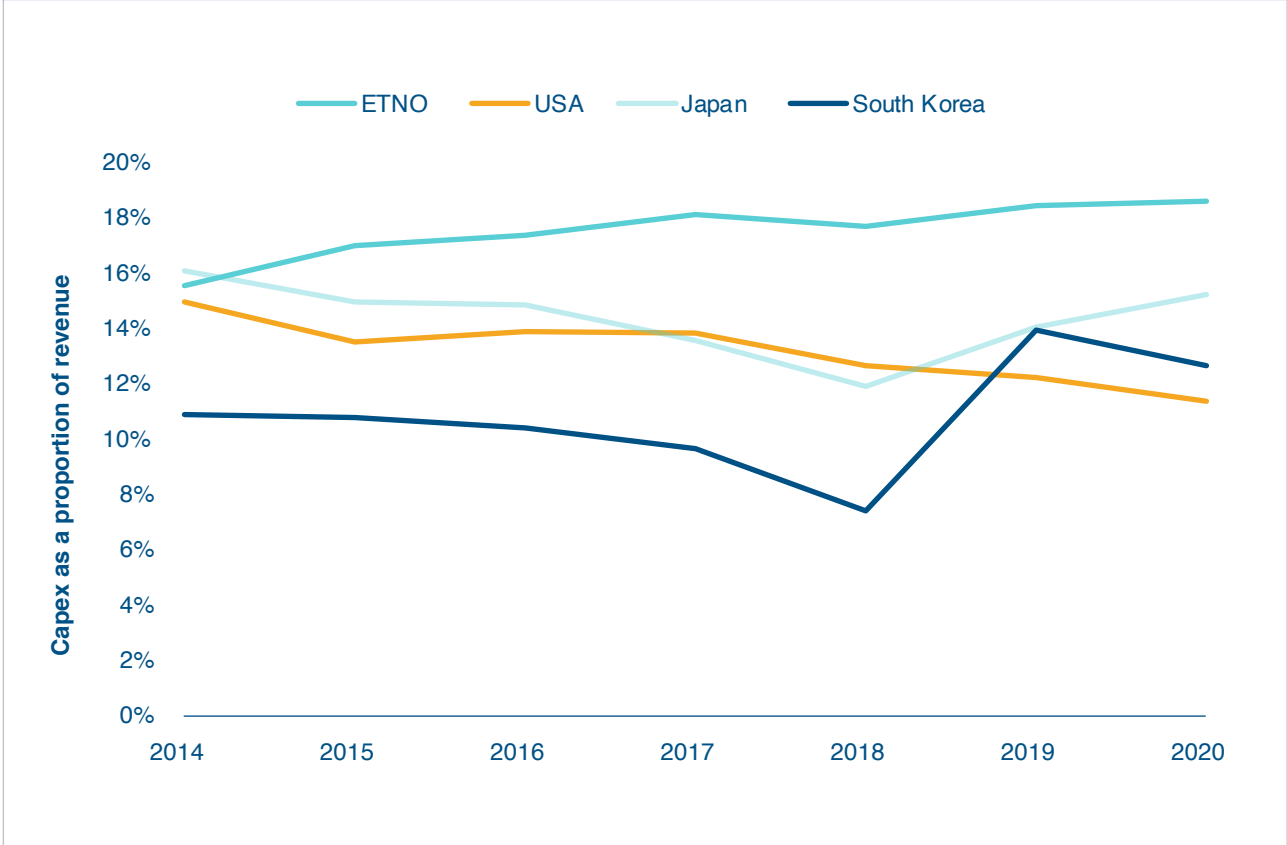
FIG 2-5 : ETNO member capex in Europe only (excluding spectrum costs), plus total capex in Europe, 2015–2020



Source: Analysys Mason, 2021

ETNO members spent EUR26.5 billion in their home markets⁵ in 2020, down by 2% from 2019. This decline was partly due to supply-chain issues and hiatuses in construction brought about by the pandemic. However, revenue also fell due to the pandemic, so the EUR26.5 billion figure actually represents an increase in capital intensity, understood as capex as a proportion of revenue (18.6% compared to 18.4% in 2019). ETNO members' capital intensity in home markets remains significantly higher than that of comparator operators in similar regions such as the USA, Japan and South Korea, due to declining revenues.

FIG 2-6 : Capital intensity in home markets, ETNO members and comparable leading operators in the USA, Japan and South Korea, 2014–2020

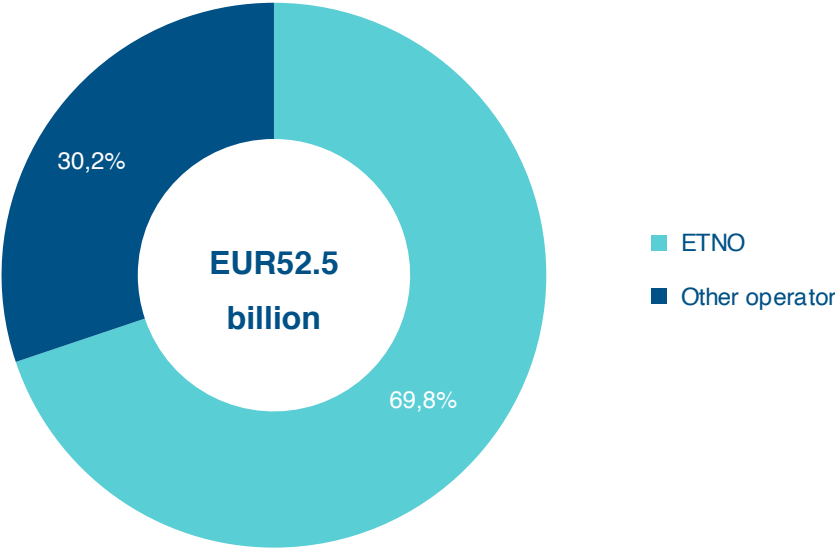


Source: Analysys Mason, 2021

“ ETNO members, who are integrated telecom operators, constitute nearly 70% of the total telecom investment. ”

ETNO members accounted for 69.8% of European telecoms capex in 2020 (FIG 2-7), substantively in line with the 2019 figure, at 70.7%. This decline in proportion of capex disguises the fact that capex actually grew in absolute terms.

FIG 2-7 : Split of capex between ETNO members and other operators, Europe, 2020

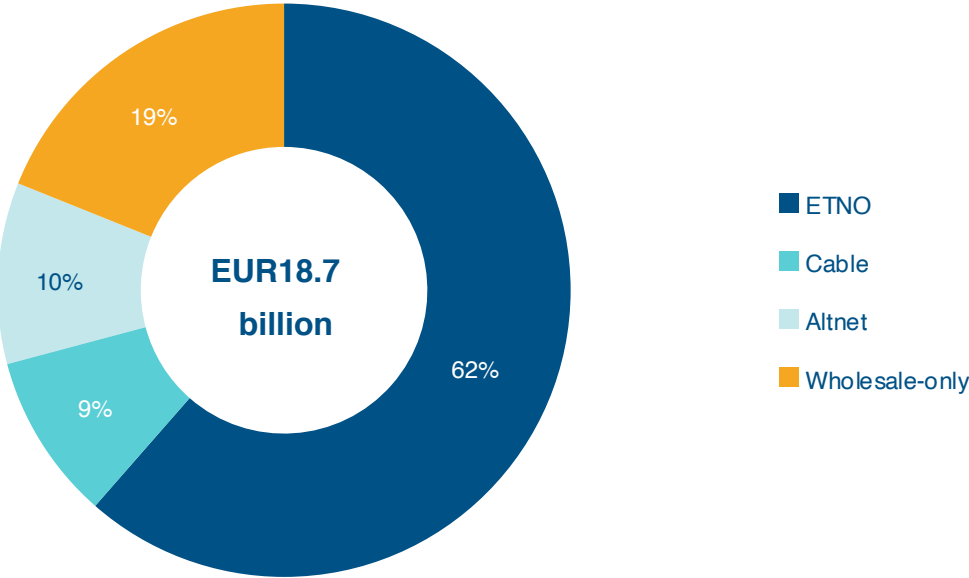


Source: Analysys Mason, 2021

ETNO members’ mobile capex (excluding spectrum costs) rose by 2% year-on-year in 2020. There was sustained investment in 5G, but operators also faced headwinds caused by global supply-chain issues and the pandemic. The capex burden of 5G has historically fallen largely upon the shoulders of operators. However, the dynamics of 5G capex is beginning to change. Operators are starting to share the burden with (operator) co-investors, and the divestment of ever more towers and rooftop sites to dedicated towercos has altered the ownership, and hence the capex dynamics, of mobile networks.

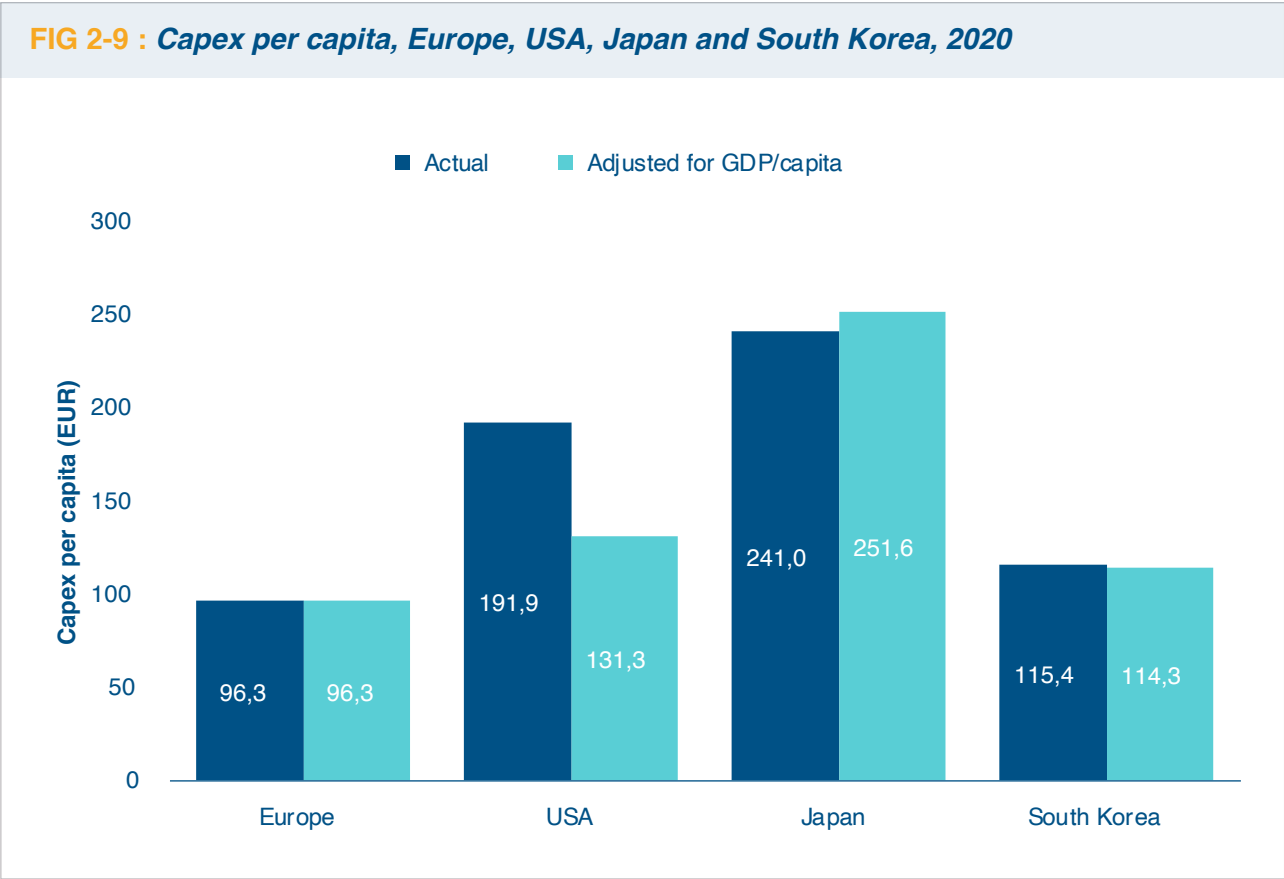
ETNO members accounted for 62% of fixed access capex in 2020, up from 60% in 2019 (FIG 2-8). Fixed network capex is distributed among a greater number of players than mobile capex; emerging regional infrastructure players and new local players compete with traditional telecoms operators. There is only one new wholesale-only player that originates outside ETNO membership with a national ambition: Open Fiber in Italy. At the time of writing, it was expected to be merged with other entities. There are, however, several growing wholesale-only players that are active at regional or local level, though many of these are at an early stage of development and their actual coverage so far remains limited. In addition, there is a large number of new, mostly quite local, altnets with a vertically integrated business model. In the UK, their number reaches high double digits. Further infrastructure-based competition in FTTH will come from cable operators, several of which (including Virgin Media O2, Virgin Media Ireland, SFR, Telenet, Norlys, TeleColumbus and Euskaltel) have embarked on upgrades to FTTH. Some of these have signalled possible entries into the wholesale market.

FIG 2-8 : Split of fixed capex between ETNO members and other operator types, Europe, 2020



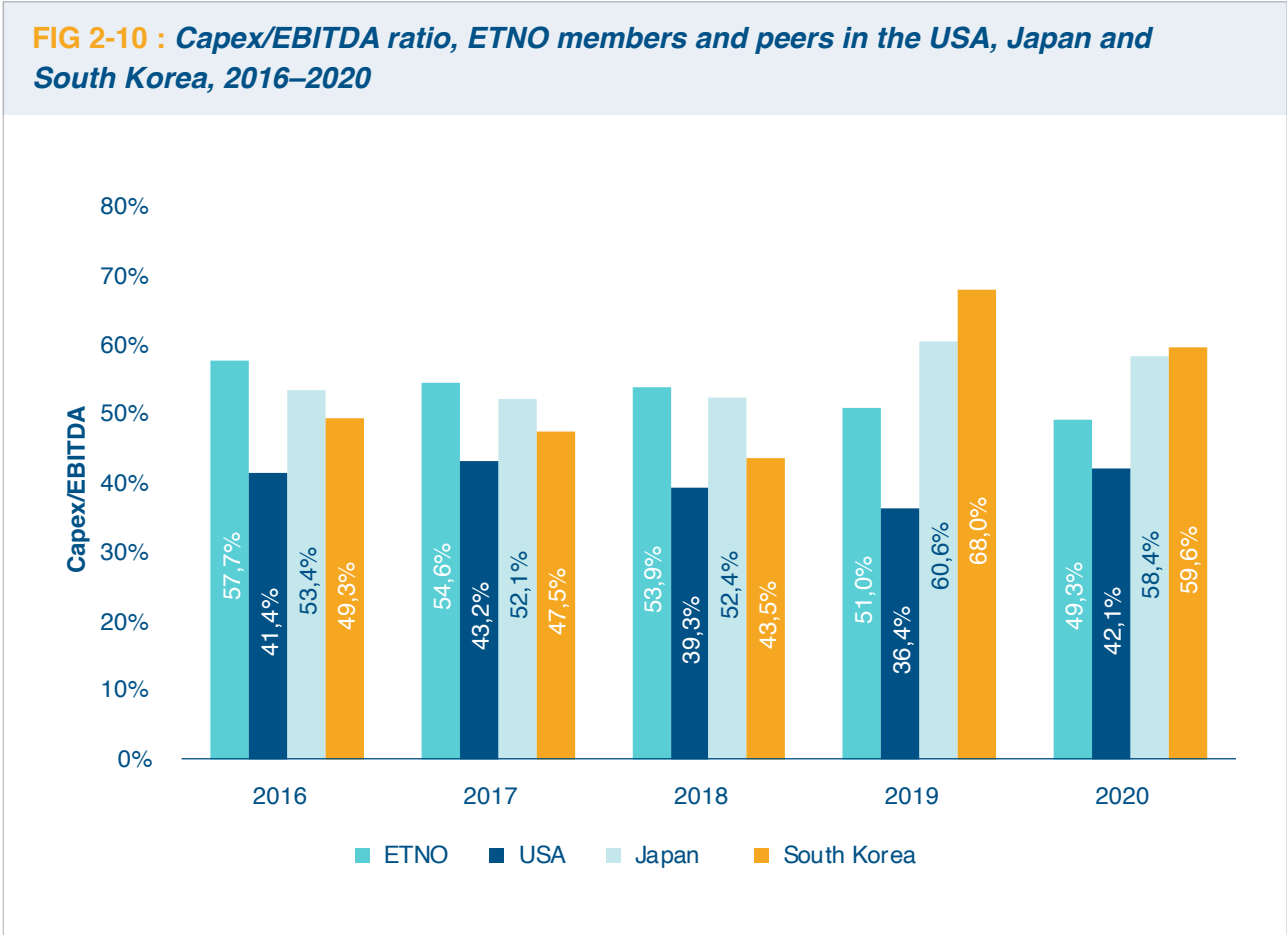
Source: Analysys Mason, 2021

Capex as a proportion of revenue is high among European telecoms operators, but the European telecoms investment of EUR96.3 per capita in 2020 was significantly lower than the amounts invested by equivalent operators in the USA, Japan and South Korea (even when taking into account differences in GDP per capita) (FIG 2-9). This reflects the low prices paid for telecoms services in Europe.



Source: Analysys Mason, 2021

Another way of looking at this is to consider the ratio of capex to EBITDA (FIG 2-10). At a group level, this has been higher among ETNO members than among their peers elsewhere in the world in recent years because of the phasing of fixed network modernisation. However, this ratio has changed rapidly among the comparator operators in Japan and South Korea, which have historically lower EBITDA margins than those in Europe and the USA, and which are ramping up investment in 5G. The ratio also increased in the USA in 2020 because of 5G, but it is still not as high as that in Europe because of lower proportionate investment in fixed networks. A further factor affecting the figure in Europe is the slow but steady increase in ETNO members' EBITDA and EBITDA margins over the past 5 years; this is a reflection of increased efficiency in operations.



Source: Analysys Mason, 2021

2.4 Investment beyond 2021 in 5G and FTTH

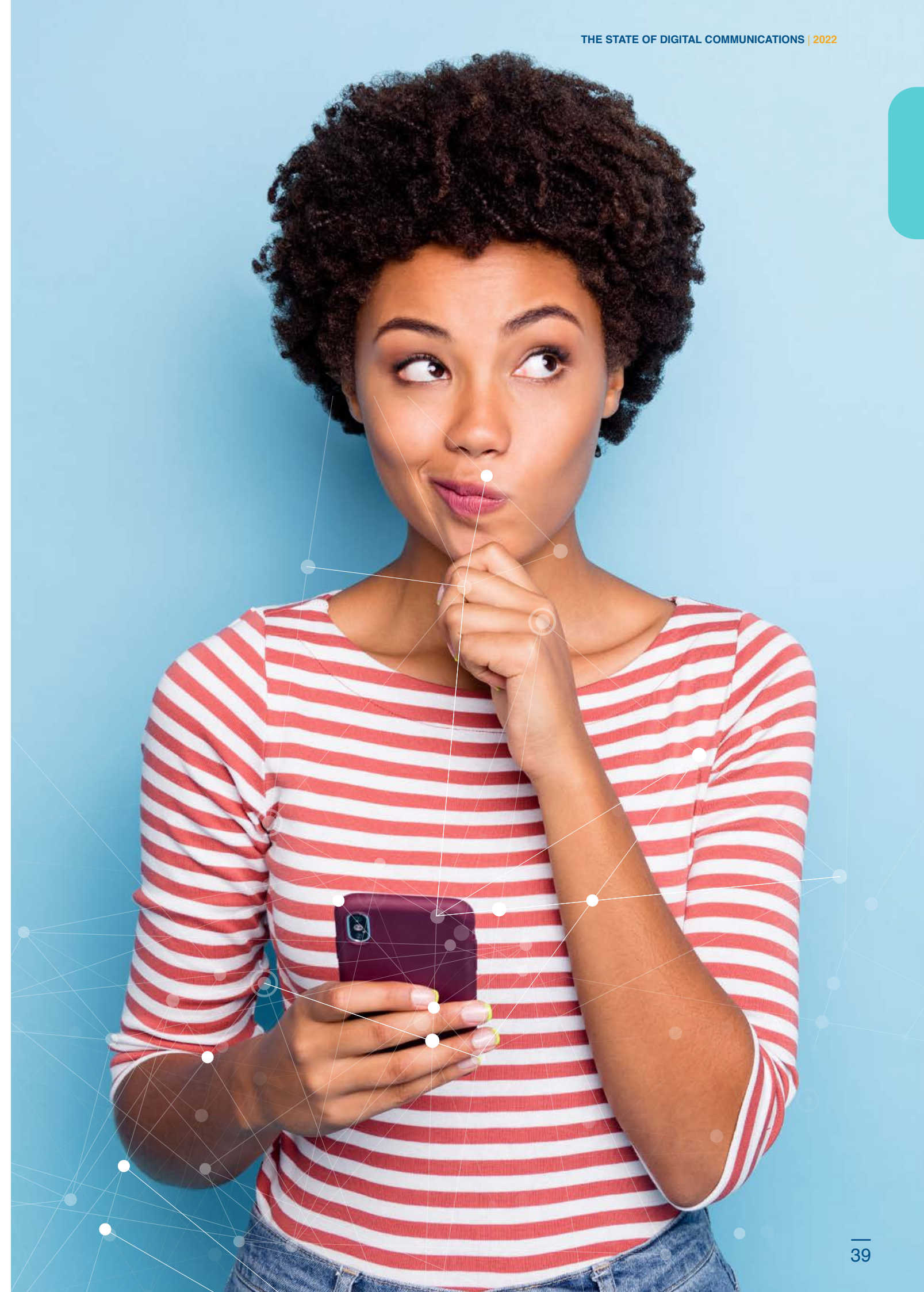
FTTH will remain the largest item of capex for those operators that have recently embarked on the upgrade of access networks, at least for the first part of this decade. The timing of spectrum auctions has meant that 5G capex is unavoidable. However, in the long-term, the capex burden should fall away.

Operators in those markets that are approaching full FTTH coverage have already shifted their capex to 5G roll-outs. 5G will require not only an upgrade to existing cell sites (which often involves additional construction work), but also eventually investment in new cell sites, cloud and a new 5G core. These features will enable operators to find new ways of monetising 5G beyond the familiar mobile data use cases, such as AR/VR, sensors with AI, 5G positioning and drones.

In addition, operators are investing in upgrading their current FTTH networks as the demand for high-speed internet increases and users' expectation of what is an acceptable connectivity speed rises. Deploying 10Gbit/s (already common), 25Gbit/s (emerging in 2021/2022) or even 50Gbit/s (in a few years' time) fixed access technologies ensures that European operators remain competitive and fully future-proofed. These higher-speed fibre access networks have the additional advantage that they can also serve as transport for new, densified, mobile small cell infrastructure, thereby enabling new mobile use cases and reducing capex costs on the mobile side. Passive FTTH infrastructure has an asset life of many decades, so once the one-off heavy-lifting of rolling it out is complete, any future fixed capex will be much less intensive.

As 5G matures, and with FTTH infrastructure roll-out complete, operators should be left with lower capital intensity for infrastructure, and many expect this to happen later in the decade. Indeed, some of the earlier European deployers of FTTH are already benefitting from this effect. This will allow European operators, should they see this as an opportunity, to expand their businesses by investing outside core connectivity services.

“Bringing 5G and FTTH to all Europeans is a huge investment effort. Next is expanding beyond connectivity.”



SECTION 2

The demand for digital services

This section looks at the demand-side and includes insights on the pandemic, revenues, B2C vs. B2B, new services as well as relationship with OTTs.

3. TELECOMS DEMAND METRICS

3.1 Demand for services has been profoundly affected by the pandemic

The pandemic has significantly altered connectivity demands and has rapidly accelerated digital transformation. Society and businesses had to act quickly in order to maintain operations by enabling virtual working through processes such as migrating to the cloud and adopting unified communication solutions. This accelerated adoption of technology has cemented behavioural changes, and has probably made society more open to adopting new technology in the future.

Many behavioural trends associated with lockdown measures still remain almost two years on from the onset of the pandemic. People started to stack video services to keep themselves entertained, and data traffic soared as a result. This trend has not evaporated completely as lockdowns have eased. Video calling established itself as a long-term rival to voice calling. Video calling over IP has persisted as a common communication method between friends and family, as well as within business settings. Its popularity is all the more astonishing because it had never found great favour with Europeans prior to the pandemic. However, daytime data traffic has fallen as children have returned to school and virtual learning has become much less widespread.

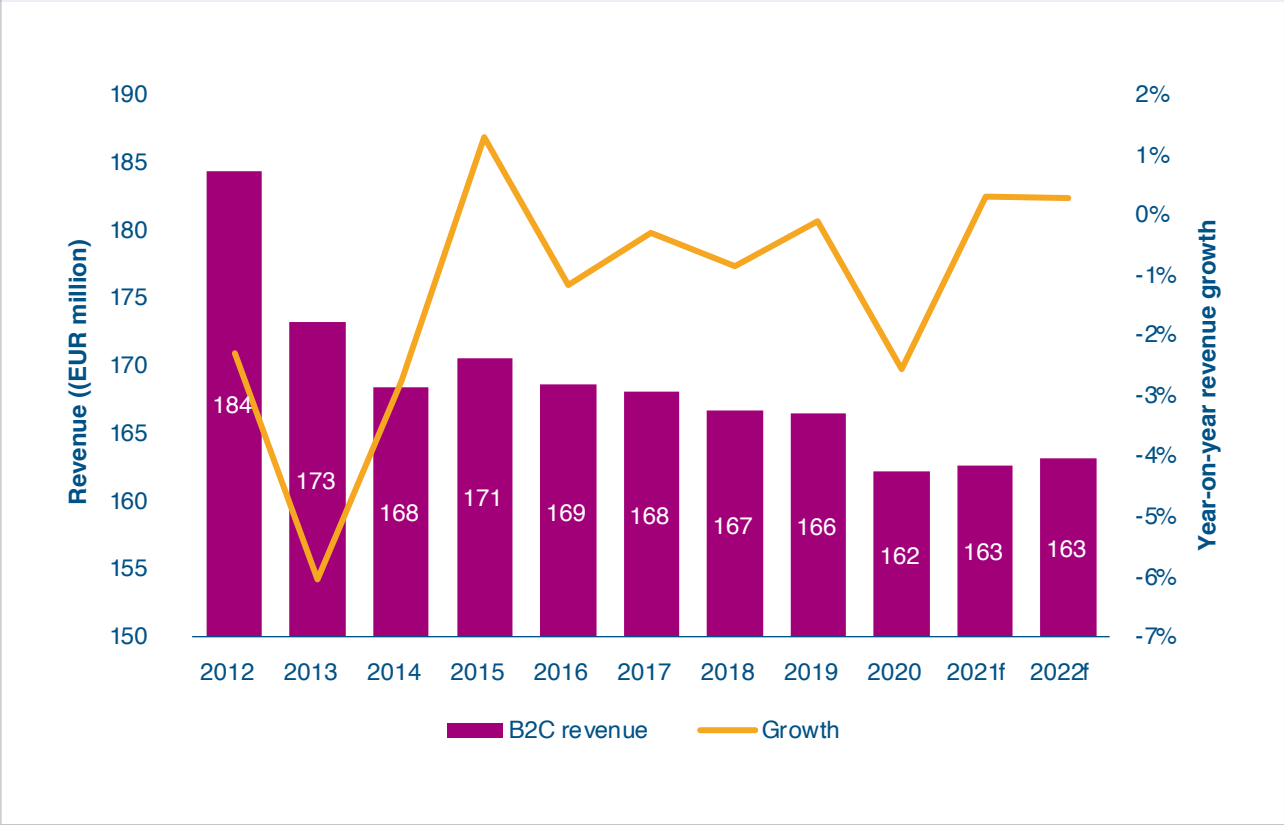
Working from home (for those in jobs where this is possible) and flexible working look certain to remain popular, even as COVID-19-related restrictions ease. As such, many businesses are altering their long-term strategies in order to accommodate these changes to working behaviour, and have realised that such changes can help to improve productivity and reduce personnel and office costs. Retail businesses had to adapt overnight to the closure of bricks and mortar sites and to selling solely online, and many of those that survived will not return to the high street.



3.2 Revenue patterns

Total European consumer telecoms service revenue declined by 2.4% year-on-year in 2020. This decline partly reflects the continued and projected trend of falling consumer revenue. Indeed, European mobile and fixed telecoms service revenue decreased by 21% between 2014 and 2019 (FIG 3-1). However, the decline in 2020 can also be attributed to the impacts of the pandemic. Roaming revenue was particularly affected due to the absence of much international travel. Many businesses and consumers faced challenges paying their subscription fees due to the financial uncertainty associated with the pandemic. In addition, operator handset sales were also down; these figures are not included in service revenue, but upgrading a smartphone often coincides with a plan upgrade.

FIG 3-1 : Consumer telecoms service revenue and year-on-year growth, Europe, 2012–2022f



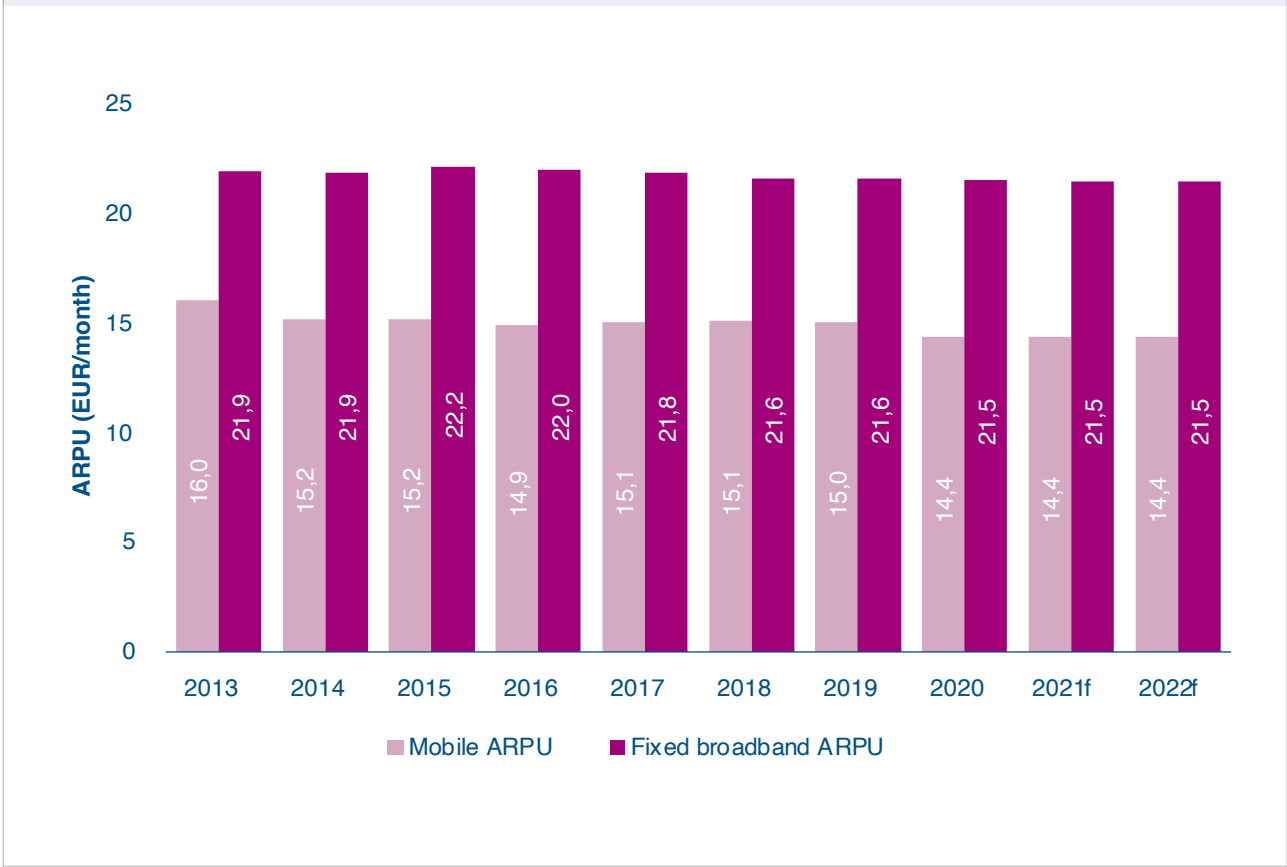
Source: Analysys Mason, 2021

However, the communications services sector was not as badly affected financially during the pandemic as other industries, despite this revenue decline. The role of the telecoms sector as the backbone service supplier needed for society to function provided some resiliency. Some short-term correction to the immediate impact of the pandemic is anticipated.

The long-term decline in revenue is in part due to the heavy regulation in the European market to ensure that retail competition is supported (for example reserving spectrum for a fourth entrant in the recent 5G spectrum auction in Portugal). Yet there are other reasons: increasing intensity of usage does not easily translate into higher revenue, especially where flat-rates have become the norm; the common strategy of pursuing fixed-mobile convergence has tended drag down mobile ARPUs; 5G has made little impact in terms of reversing the secular ARPU trend for consumer mobile (FIG 3-2).

Fixed ARPU in Europe is expected to remain steady until 2022 (FIG 3-2). Any increased willingness to pay a premium for a more-robust service is likely to be offset by stronger price competition. FTTH operators (both wholesale and vertically-integrated) are currently highly incentivised to prioritise growth in take-up over growth in ARPU, and this exerts downward pressure on prices. For example, Openreach introduced in October 2021 new wholesale FTTH tariffs undercutting previous FTTH tariffs often by over 20% so long as the service provider commits to FTTH over copper.

FIG 3-2 : ARPU for mobile and fixed broadband services, Europe, 2013–2022f



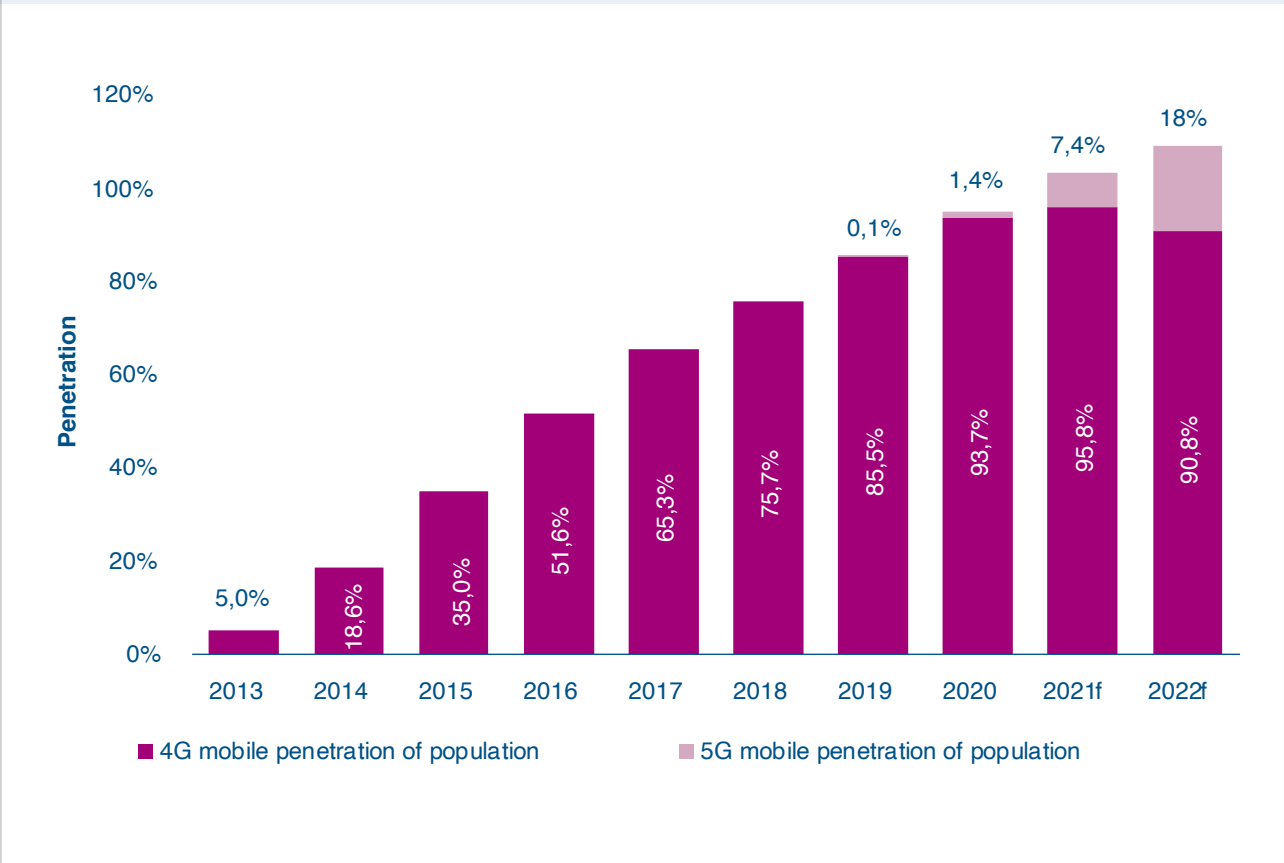
Source: Analysys Mason, 2021

3.3 Mobile connections

The take-up of 5G smartphones and connectivity was not as quick as initially predicted. Indeed, it is expected that 5G will be used for around just 7% of all mobile connections in Europe by the end of 2021 (FIG 3-3). Three factors have impeded take-up: the disruption to the retail market during the pandemic; delays to auctions (and therefore launches of a 5G service that was meaningfully differentiated from 4G); and operators' sometimes limited ability to invest in 5G coverage, in the context of fragmented and highly regulated markets.

Unfounded health concerns associated with 5G became heightened during the pandemic. Schemes such as ETNO's *5G Guide for Local Communities* have highlighted the benefits of 5G, a variety of innovative examples regarding 5G applications and reduced the concerns surrounding the technology by dispelling 5G misinformation.

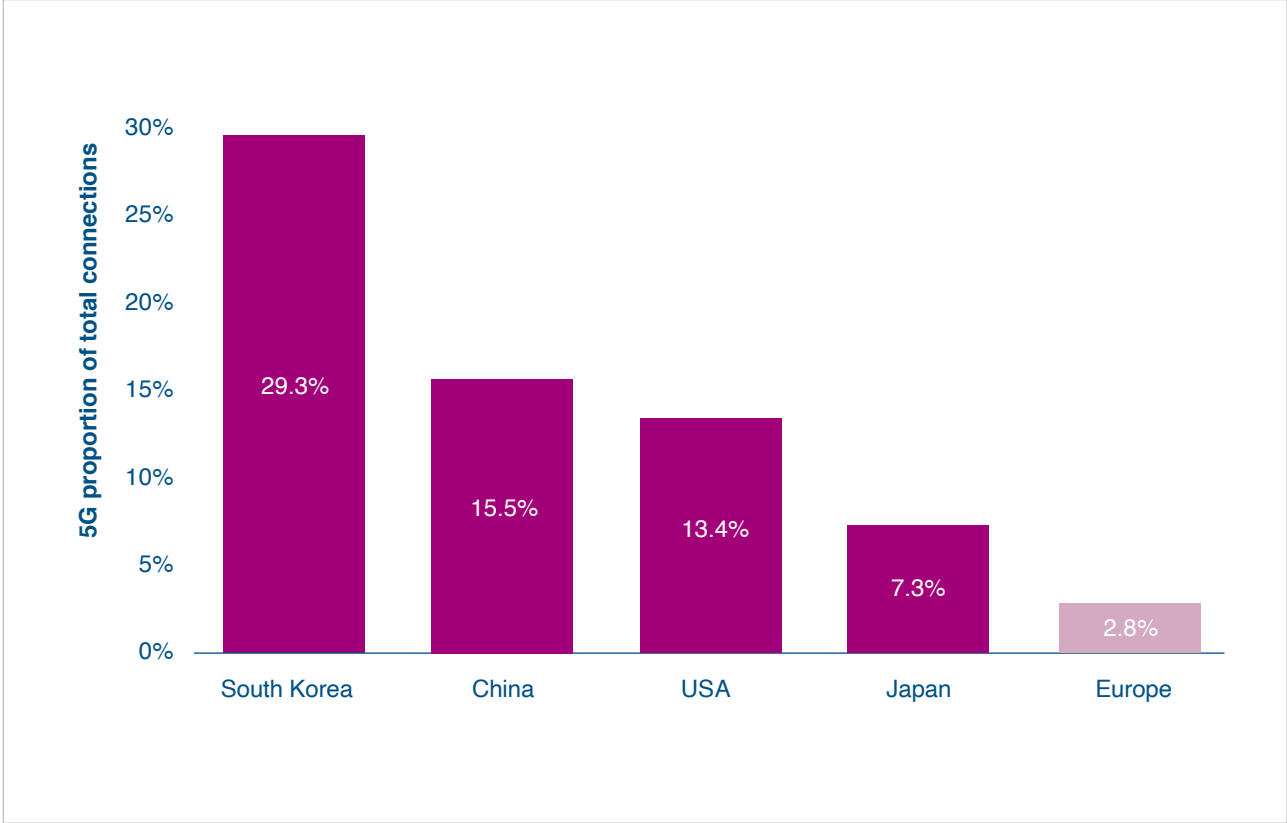
FIG 3-3 : Population penetration of 4G and 5G, Europe, 2013–2022f



Source: Analysys Mason, 2021

Translating this into 5G penetration of total mobile subscriptions (smartphones and other devices) shows that Europe, at about 3%, lags behind South Korea, the USA and Japan, although these numbers can change rapidly. It also significantly lags behind China, where penetration of the base stood at about 16% at the same date, and is rising very fast. The disparities in coverage may be part of the reason why take-up has been sluggish, and it may be that lower intensity of usage – though this varies greatly across the continent - makes Europeans less inclined to upgrade (see Section 3.6 below).

FIG 3-4 : 5G share of all mobile connections, Europe, South Korea, USA and Japan, 2Q 2021



Source: Analysys Mason, 2021

“ Digital transformation requires uptake, but Europe has a gap: in 2021, 5G was available to 62% of the population, but penetration was only 7.4%. ”

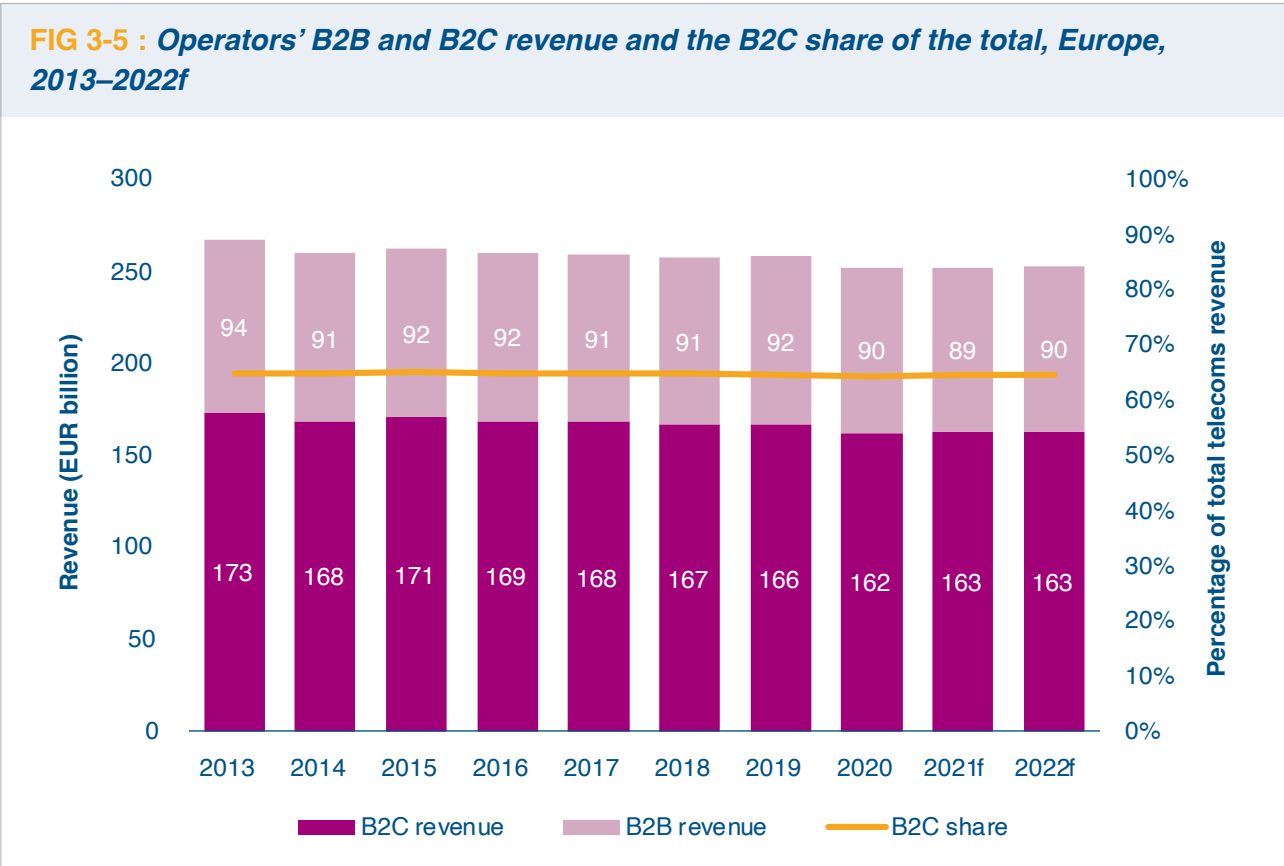
3.4 B2B and B2C revenue comparison

The impact of the pandemic on operators’ B2B revenue was more acute than that on their B2C revenue. Some businesses went under, while others closed down their sites and therefore no longer needed connectivity. Some will clearly return, but a degree of economic uncertainty remains for the time being, and businesses, particularly small and medium-sized businesses (SMBs), have reduced their budgets for telecoms and ICT. However, as economies recover, the businesses’ accelerated digital transformation brought about by the pandemic brings with it the potential to increase revenue in the future via non-connectivity-related services.

Business-related telecoms usage is unlikely to return to pre-COVID-19 levels in some industries because flexible working has become normalised. However, such flexible working brings with it new revenue opportunities, particularly in the form of cloudification and security, which are areas that telecom operators can capitalise on.

Operators in some markets, especially those where 5G is part of government-supported industrial strategies, are increasing their efforts to work with enterprises. They are seeking to place telecoms services, particularly 5G, at the heart of business recovery programmes. 5G could therefore be a key enabler to reverse the trend of B2B revenue decline (B2B revenue declined by 1% in Europe in 2021).

Overall, there is expected to be little change in terms of the split of revenue between B2B and B2C services. Indeed, operators’ B2C share of revenue has hovered around 64–65% since 2014 (FIG 3-5).

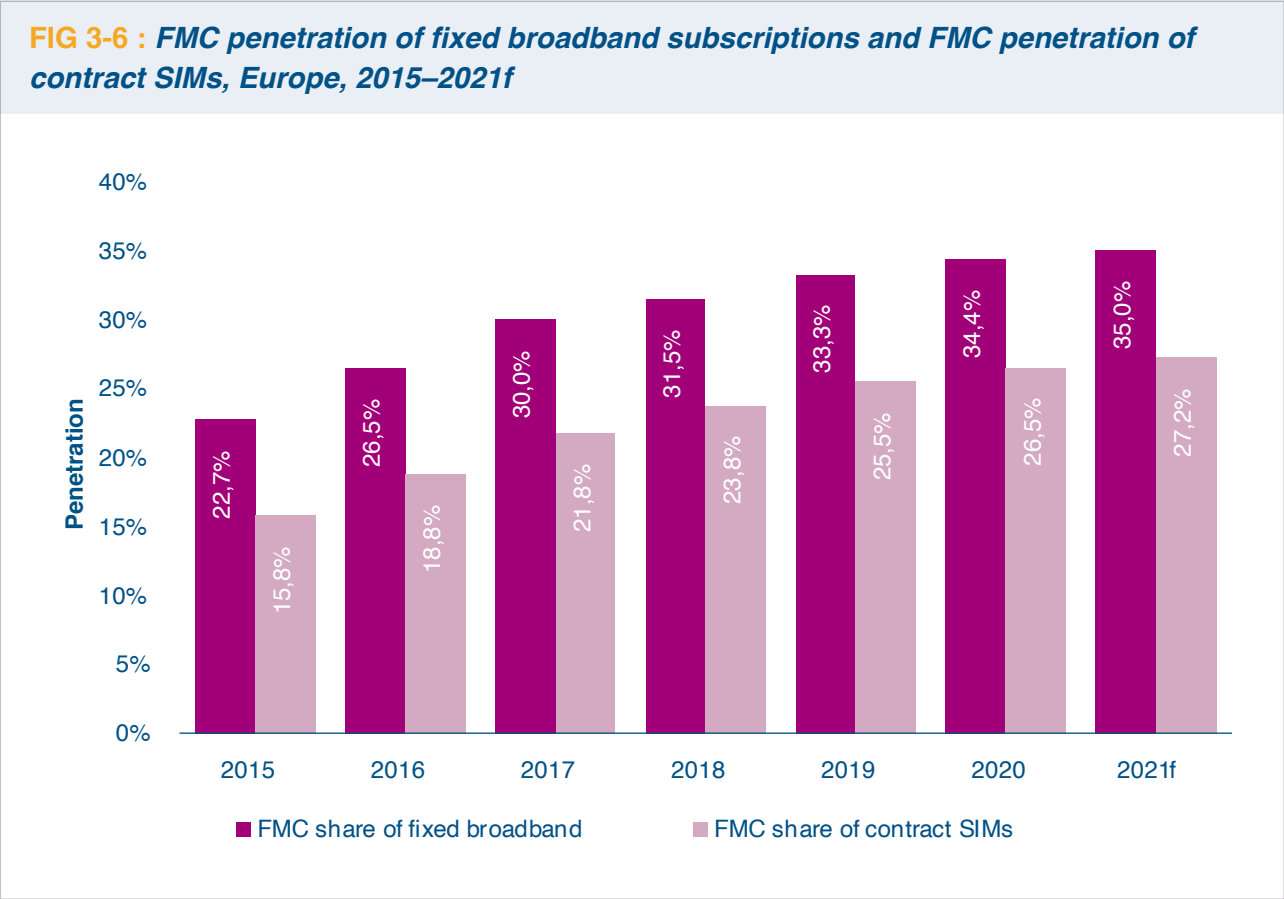


Source: Analysys Mason, 2021

3.5 Fixed–mobile convergence (FMC)

FMC remains a popular choice for consumers in many European markets, although the availability and take-up of such offers varies considerably between individual countries. The market structure in each country has a profound effect on consumers’ adoption of FMC. For example, FMC adoption in Portugal and Spain has been largely driven by upselling FTTH, whereas cross-selling after M&A has been a key market driver in other markets such as the Netherlands.

FMC penetration is expected to increase in several European nations thanks to further M&A activity (although the number of possible combinations has greatly diminished), new fixed network roll-outs and improved access to wholesale fibre (FIG 3-6). The development of the wholesale fibre market, including the emergence of new wholesale-only fibre players, will enable those operators who have not invested in fixed access networks to enter the FMC market. As European operators increase their focus on core connectivity, and as the scale and purchasing power of transnational content plays increase, it is likely that ‘bare bones’ bundles centred around fibre and 5G connectivity will become increasingly prevalent, although it should be noted that in some markets, such as Spain, FMC bundles remain structured around providing premium content, such as live sport content.

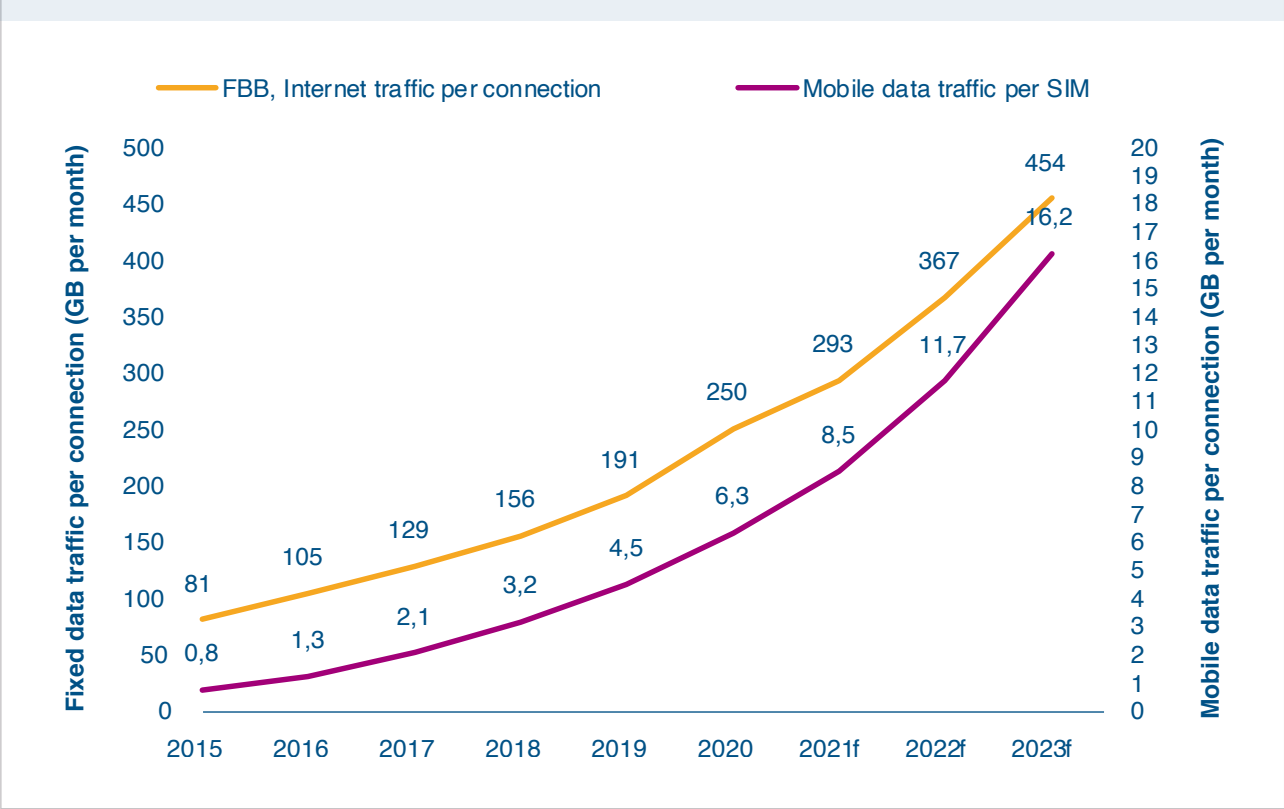


Source: Analysys Mason, 2021

3.6 Fixed and mobile usage trends

The pandemic has highlighted the scale and scope of fixed data traffic. While it is true that mobile network data traffic has historically grown at an extraordinary rate, fixed networks still account for about nine tenths of data traffic in Europe. Fixed traffic growth-rates actually outstripped mobile traffic growth-rates in many countries worldwide in 2020. The picture in Europe was mixed. Mobile traffic growth surged in some countries, but fell back in others. Where it rose and where it fell demonstrated that the rate of mobile data traffic growth is largely determined by the size of the cohort of users that do not have recourse to a fixed connection.

FIG 3-7 : Fixed and mobile data usage per connection, Europe, 2015–2023f



Source: Analysys Mason, 2021

Consumer fixed data use has long been dominated by large-screen devices, particularly TVs; this remains the case even as lockdown restrictions ease. Indeed, it is the popularity of video streaming services such as Netflix, Amazon Prime, Apple TV+ and Disney+ that has sustained fixed data traffic growth. It is salient to remember that the greater part of smartphone traffic in Europe (>60%) is actually on Wi-Fi/fixed broadband rather than on mobile networks. The COVID-19 pandemic served further to reinforce this. This explains why the rising popularity of mobile video apps such as TikTok (which amassed over 500 million downloads in 2020 and became the most downloaded app world-wide) does not automatically translate into strong growth of traffic on mobile networks, with part of the burden being carried by fixed broadband.

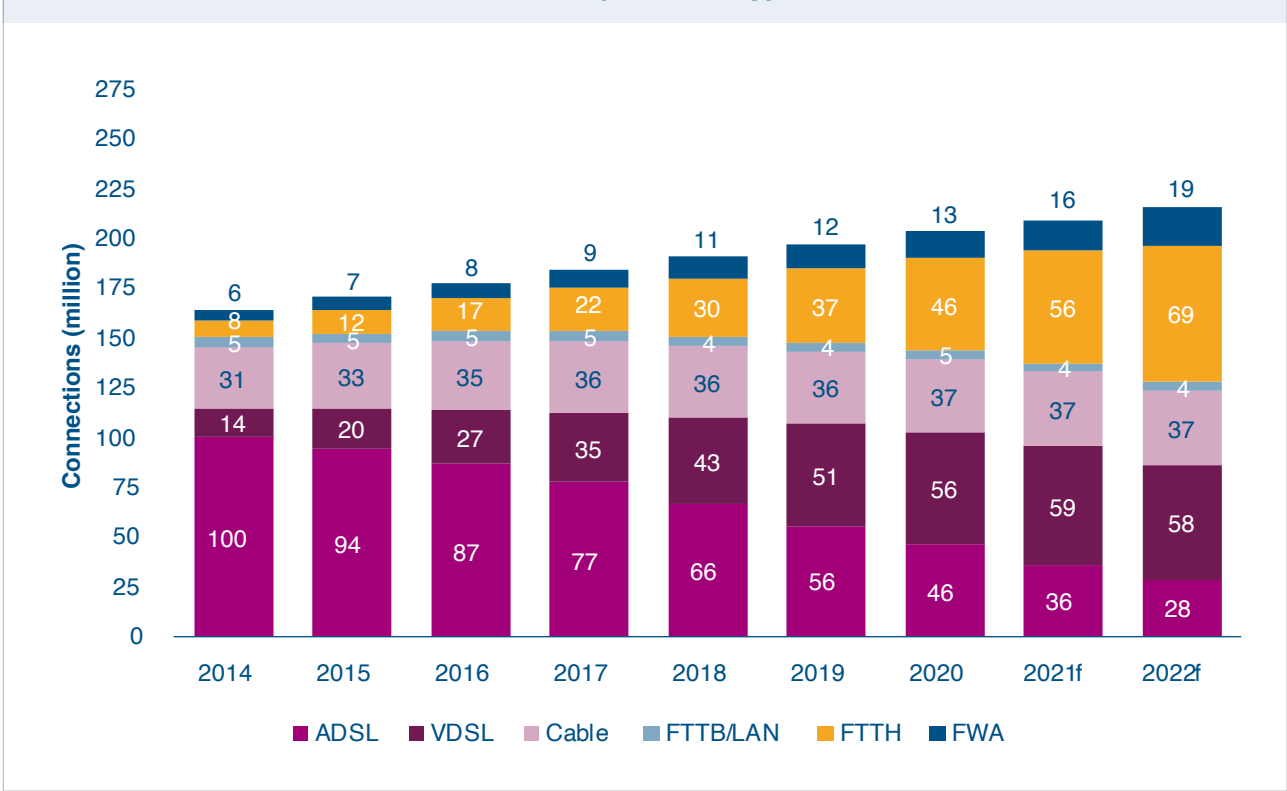
High data traffic can also be attributed to working from home. Growth in fixed data traffic in Europe was super-normal in 2020, but the growth in uplink network traffic was even greater. Some regulators reported that uplink traffic doubled during lockdowns. For example, Italian regulator AGCOM recorded 105% year-on-year growth in fixed upstream traffic during the second period of lockdowns in 4Q 2020, and UK regulator Ofcom reported that over half of all British adults had used one of the five main video communications apps by March 2021. Data usage also became more uniform throughout the day during lockdown periods. The partial return to the office has pushed the busy-hour share of traffic upwards again as the daytime bulge diminishes, but daily traffic trends are unlikely to return to their pre-COVID-19 shape.

3.7 Fixed broadband technology choice

Europeans will rely on a wide range of fixed broadband technologies for several years to come (FIG 3-8). At the time of writing, ADSL is obsolete and VDSL take-up appears to be peaking. The main trends that we expect in the next few years are:

- accelerating migration from xDSL to FTTH
- slower and longer-term migration from cable to FTTH (depending on cablecos' network strategies, which are quite mixed in Europe)
- FWA popularity growth (sometimes as xDSL/FWA hybrids) in non-cable areas and those that do not have other gigabit-capable technologies (FWA in these non-cable areas falling away when gigabit-capable networks become available)
- FWA cementing itself as the main access technology in areas where FTTH or hybrid solutions are unlikely ever to be deployed.

FIG 3-8 : Fixed broadband connections by technology, Europe, 2014–2022f



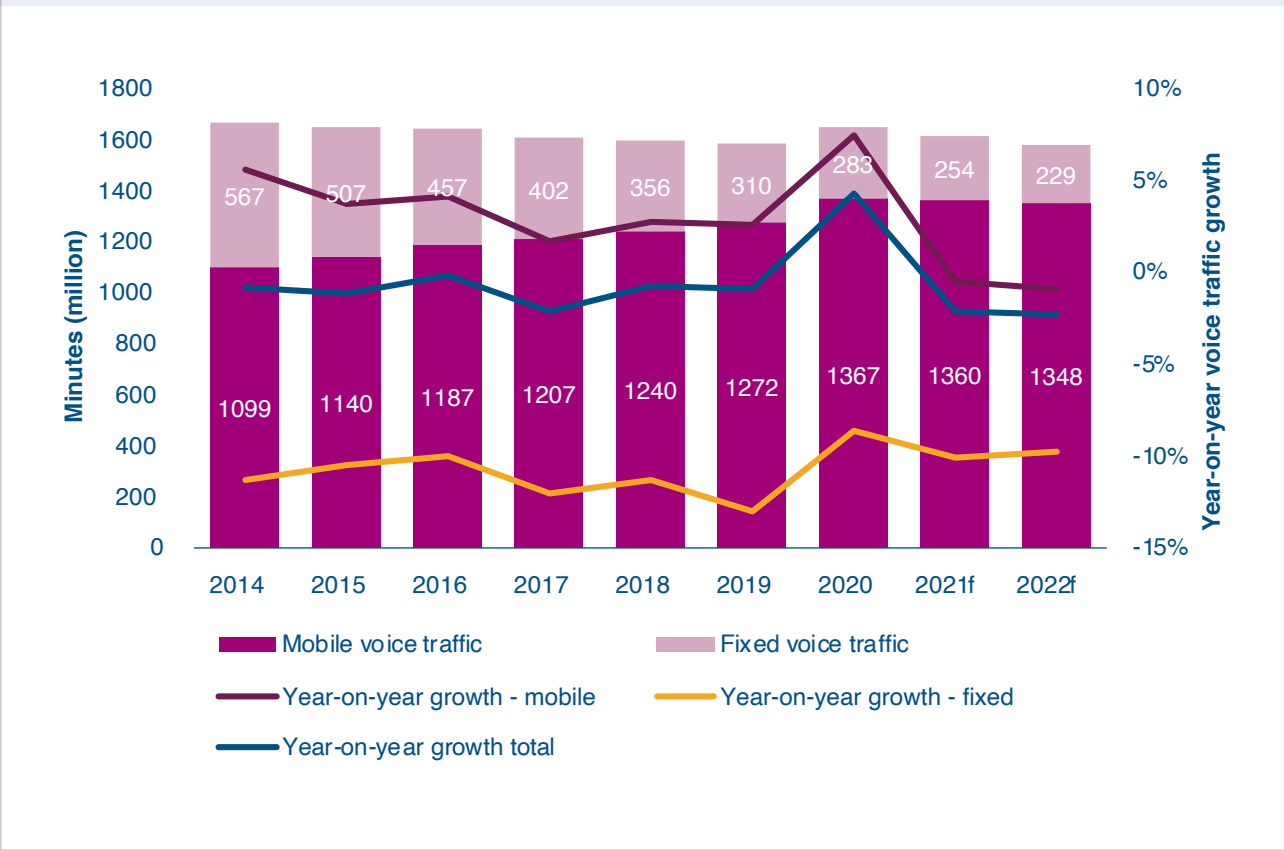
Source: Analysys Mason, 2021

Some operators will seek to monetise new FTTH networks in the short term by offering FTTH as a premium service, but increasing infrastructure-based competition will incentivise existing operators to accelerate the on-demand migration from xDSL to FTTH. Retail and (especially) wholesale pricing has become increasingly geared to high-volume migration over the past 2 years; this incentivises service providers to take out long-term commitments to FTTH in return for lower unit prices. Whether operators can proactively migrate customers to newer, more-efficient technology depends on consumer acceptance and on the regulations surrounding the shutdown of legacy networks.

3.8 Voice

Overall voice traffic growth peaked at 6% in 2020, but has since reverted to the long-term downward trend (FIG 3-9). Conversely, mobile voice traffic has not yet reverted to pre-COVID-19 levels, and is still 5% higher in 2021 than it was in 2019. The decline in fixed voice traffic was merely slowed down by the pandemic. Fixed voice services are of rapidly falling appeal to consumers, and businesses' need for personal fixed office desk phones has greatly diminished as businesses have shifted to remote working and have started to rely on OTT services such as Zoom, Teams and Slack.

FIG 3-9 : Voice traffic and year-on-year growth, Europe, 2014–2022f



Source: Analysys Mason, 2021

The return to a slow decline in consumer mobile voice traffic reflects the underlying trend towards using OTT services. WhatsApp remains extremely popular and is the default OTT communication app in several countries including Italy and Spain. However, the use of voice-over-LTE is growing, and this could help to revert the trend of increasingly using third-party OTT services. In fact, many ETNO members are trialling voice-over-5G as part of their 5G SA trials. Nonetheless, voice is no longer central to the telecoms service stack and its contribution to operators' revenue base will continue to diminish further.

3.9 The demand-side dilemma for operators

The growing demand for better and more reliable connectivity is not a problem for operators, but translating this demand into revenue continues to be a struggle.

The pandemic has highlighted the importance of robust connectivity and some of the older problems associated with consumer indifference have eased considerably. Not having connectivity is not an option, and relying on only mobile connectivity in a multi-person household is challenging. Moreover, the standard of what counts as a 'sufficient speed' is increasing. The balance between customer pull and operator push for new networks has shifted in favour of pull, and this should make the migration away from legacy networks easier. There are schemes to stimulate connectivity where more deep-seated demand-side challenges persist. For example, the government in Italy introduced a voucher scheme to get connect more households to new networks; this has seen good take-up even though the household penetration in Italy has historically been low.

Nobody expected operators to cash in on increased demand during a public health crisis, and they did not. However, going forward, operators still face the challenge of effectively turning an increasingly valued service, which requires significant new investment, into tangible additional revenue.

Consumer and business demand for digital services is also clearly not a problem. Such services do generate additional revenue, even though the familiar applications on which consumers and businesses spend ever more money would not be able to function without the networks that underpin them. Operators have historically struggled to cement their own applications and services in consumers' consciousness and to find ways of providing digital services at a cost-base and scale that matches that of their non-telecoms competitors. Hence operators face a clear dilemma. They can either increase their focus on connectivity and a limited set of services and become better and more efficient in the delivery of this service set, or they can seek new and/or profitable ways to expand their service set and harness the rocketing demand for digital services to grow their own revenue streams.

In the following section, we consider the demand for digital services and assess the interplay between operators and digital service providers.

4. TRENDS FOR DIGITAL SERVICES SUPPLIERS

The confluence of society becoming more susceptible to new technology and the accelerated adoption of e-commerce and digital banking means that operators have a key opportunity to use digital services to drive revenue growth.

Both operators and large-scale internet players ('OTT providers') are looking to expand their portfolios to address a larger share of total household spending and to reduce churn. Operators are adding new options to their bundles, such as smart home or financial services, in order to differentiate. This will be increasingly important as FTTH becomes more prevalent and no longer enough of a differentiator to draw customers. Fixed broadband operators can use the connected home as a way to link their services together and provide a converged customer experience.

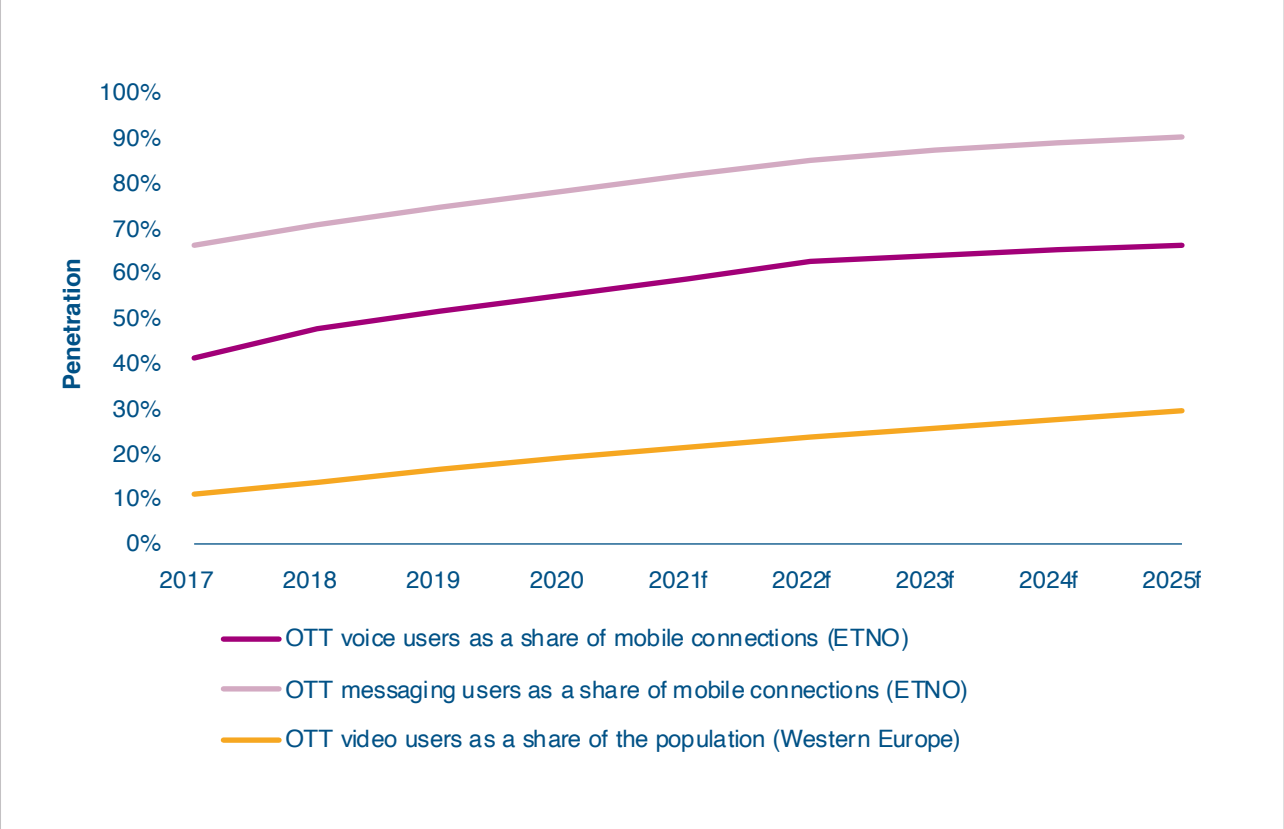
Telecoms operators are also increasingly offering professionally monitored security (PMS) services because of the synergies of these solutions with core telecoms services. Telefónica's smart security solution, Movistar Prosegur, is the second-most-popular PMS service in Spain; it accounts for around 15% of the country's professionally monitored alarm systems. The smart security solution market remains immature, but is expected to grow.

4.1 Operators and OTT providers

OTT providers and telecoms operators have been competing for market share in terms of mobile voice and mobile messaging as well as video consumption for the last few years. OTT providers have been taking an increasing share of the TV and video markets over the past 10 years or so, largely at the expense of pay-TV providers and broadcasters (FIG 4-1). OTT providers have also accounted for a rising share of mobile voice and messaging usage (FIG 4-1). In certain cases, telecoms operators cannot compete with OTT platforms directly, mainly because of smaller scope and scale, weaker financial position or regulatory limitations.



FIG 4-1 : Penetration of OTT services, ETNO members and Western Europe, 2017–2025f



Source: Analysys Mason, 2021

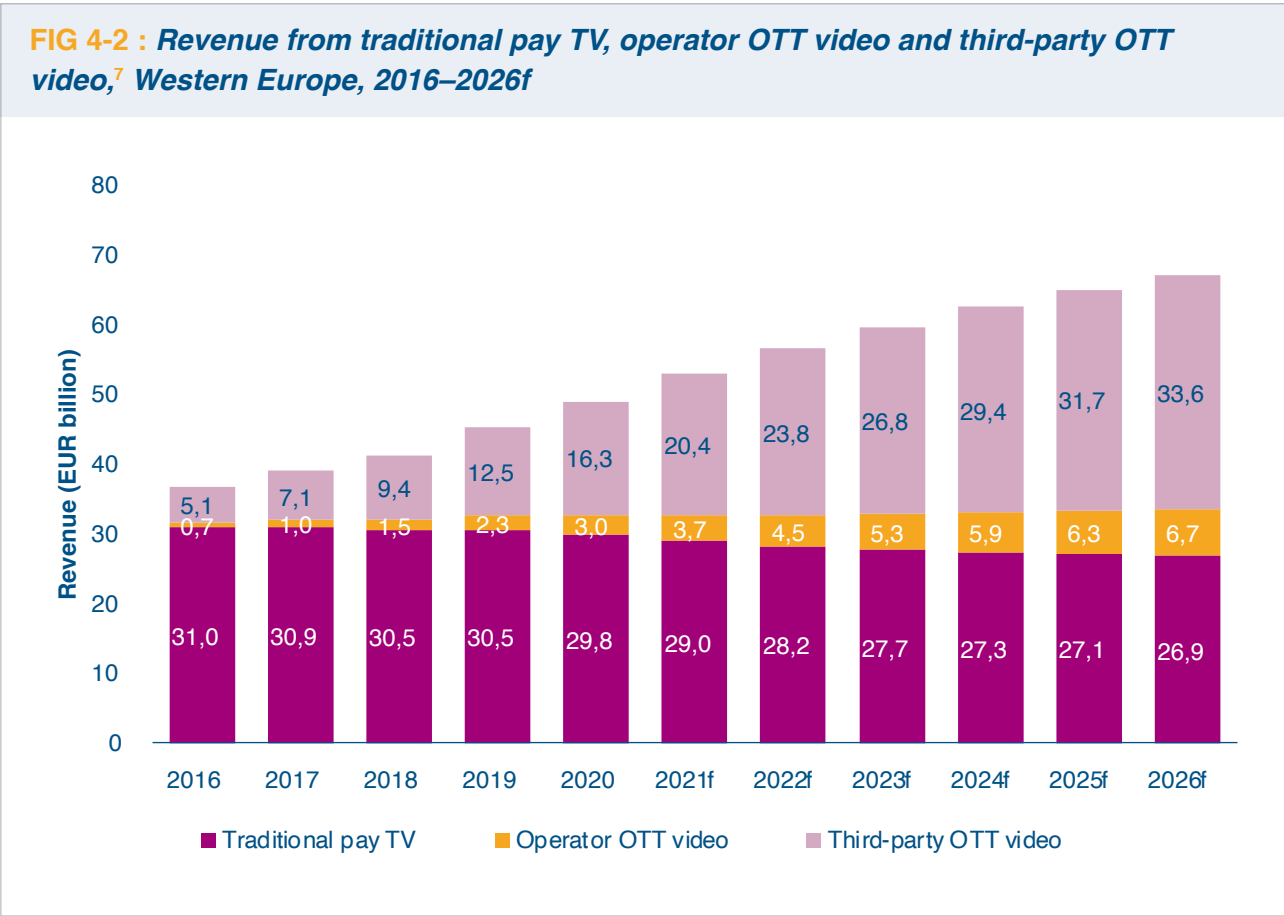
OTT services are inextricably linked to telecoms services because they rely on network connectivity. OTT providers' reliance on connectivity means that the more successful the services offered by OTTs, the more telecom companies must invest in network upgrades and sustain network costs. However the level of investment needed to increase network capacity and cope with ever increasing traffic raises questions as to how sustainable the situation is, as highlighted in a 2021 statement by over 10 European telecom CEOs⁶.

Video is the principal driver of data usage and accounts for somewhere around 80% of data traffic on fixed broadband networks. Video also helps to drive the demand for higher-quality connections, but this rarely translates into additional revenue, and even where it does, it does not cover the cost of upgrades for operators. An interesting example of an operator trying to wrest some of the additional costs from an online content provider comes from South Korea, where SK Broadband sued Netflix to pay for part of its network maintenance and upgrade costs in response to the traffic surge from the hit show, Squid Game. This landmark case is an attempt to change the balance of power between OTT providers and telecoms network operators. The South Korean courts supported this lawsuit, stating that SK Broadband was "providing a service at a cost" and that it was "reasonable" for Netflix to be "obliged to provide something in return for the service" (namely, network usage fees). Whether it is possible to charge depends critically on the bargaining power of the operators with respect to OTT providers but it does highlight the imbalance of investment and return between OTT providers and network operators.

⁶ <https://etno.eu/news/all-news/717-ceo-statement-2021.html>

Despite the power imbalance, it can be beneficial for OTT service providers and operators to collaborate and establish partnerships. For instance, large OTTs (such as Disney+ and Netflix) started to experience dwindling growth in their number of customers. In response, they have started to partner with telecoms providers. This enables OTTs to expand their customer base, while telecoms providers gain the benefit of differentiating their service offering. ETNO members Telefónica, Proximus and TIM entered into partnerships with Disney+ in 2020 and 2021.

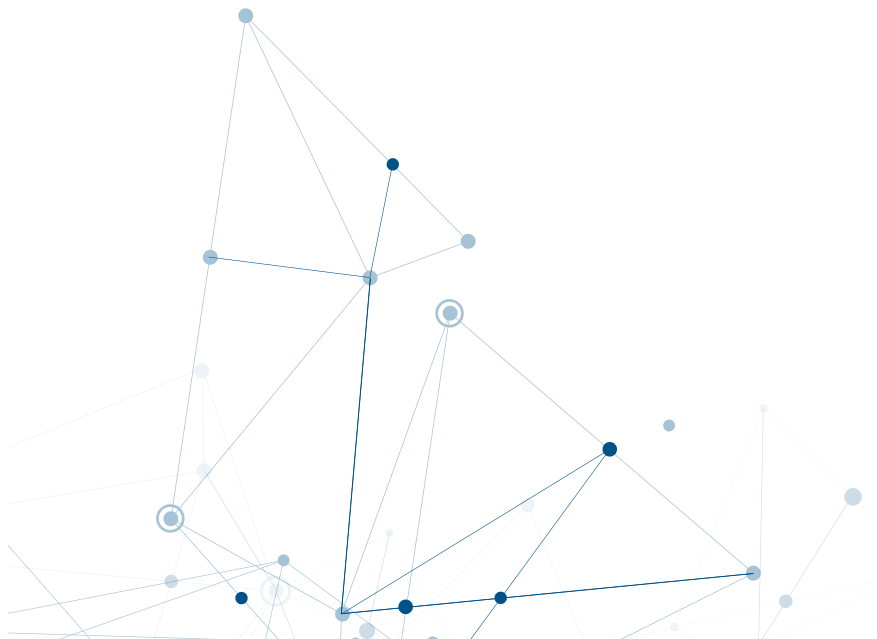
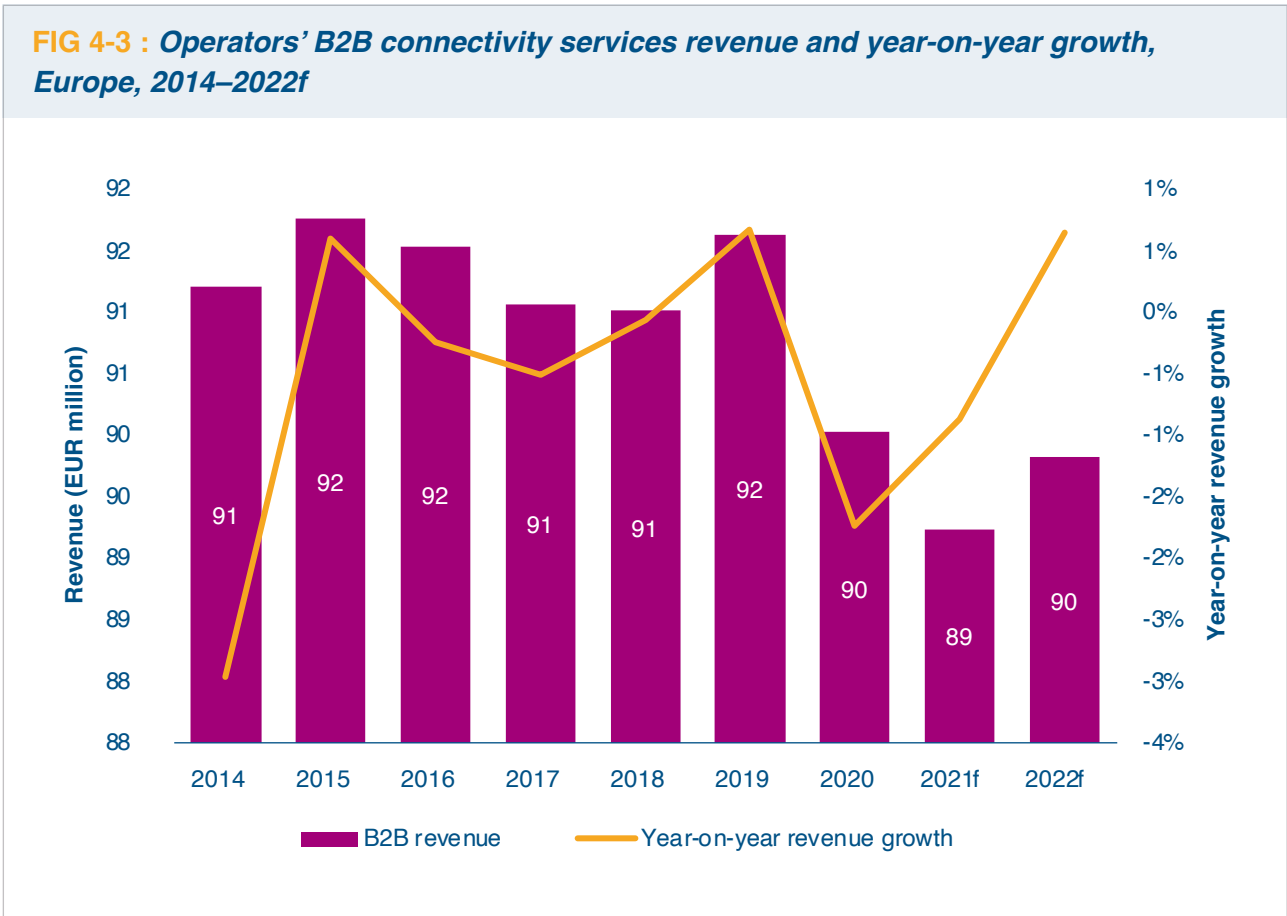
FIG 4-2 shows that OTT providers accounted for 33% of video spending (pay TV and VoD) in 2020; this share is projected to rise to almost 50% by 2025. Overall, total established operator retail revenue (traditional linear pay-TV and their own OTT services) remained stable in Western Europe in 2021, largely because live sport remains a key driver of their revenue in many markets.



⁷ Operator OTT refers to paid-for 'over-the-top' (OTT) video services that are sold independently of a traditional pay-TV service and are provided by a telecoms operator or a pay-TV provider that also offers traditional pay-TV services in the country: for example, Sky's NowTV. Third-party OTT refers to paid-for services offered by OTT video providers that have not offered traditional pay-TV services in a country in the past: for example, Netflix.

4.2 B2B services

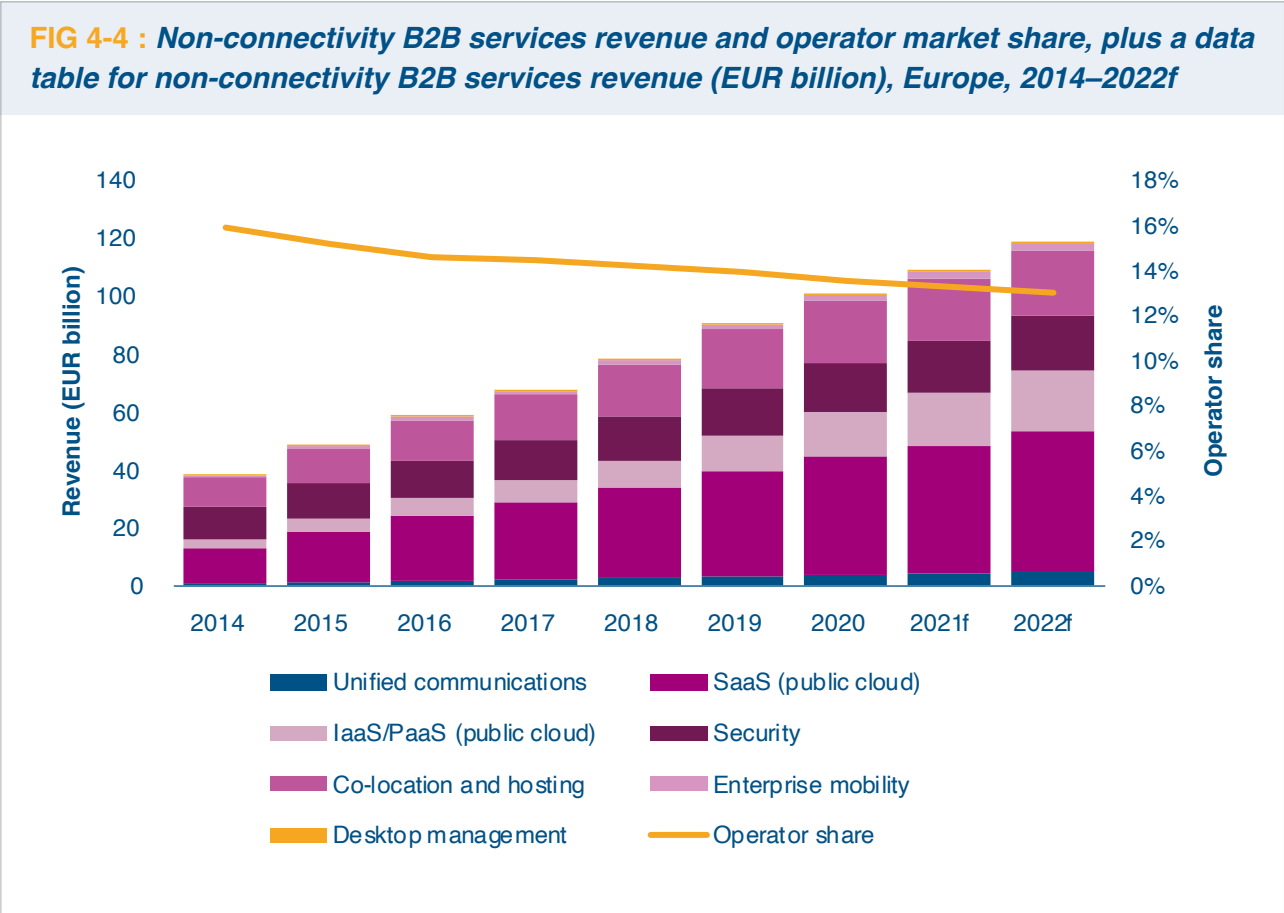
Operators' B2B revenue fell significantly in 2020 as a result of the pandemic (FIG 4-3). B2B service revenue is expected to continue to decline (by 1% year-on-year) in 2021, but it should return to growth in 2022. This is largely a result of businesses reducing their overall ICT and telecoms budgets with telecom providers due to economic uncertainty surrounding the pandemic. However, elements of businesses' ICT budget expenditure did increase to ensure that employees could work from home.



The pandemic also shifted businesses’ services requirements. The priority has shifted away from on-premises telecoms equipment upgrades and towards ensuring accessible, safe remote working. Interest in VPNs, SD-WANs (Software-defined Wide Area Networks) and cloud services have intensified, and SD-WAN, connectivity, IoT and cloud voice services are key areas that businesses are prioritising in their ICT and telecoms budgets. European operators continue to look for ways to make use of their long-standing relationships with businesses in order to encourage them to use non-connectivity services as well as their core services and to increase B2B revenue.

Operators’ market share in non-connectivity B2B services is expected to decline gradually, but these services are nonetheless still an area for revenue growth. Indeed, European operators’ non-connectivity B2B service revenue will reach EUR15.5 billion by 2022 (FIG 4-4). Operators that want to be successful with non-connectivity services need to maintain reliable, core connectivity services. The high level of trust that businesses have with operators is a competitive advantage over some vendors and hyperscalers.

FIG 4-4 : Non-connectivity B2B services revenue and operator market share, plus a data table for non-connectivity B2B services revenue (EUR billion), Europe, 2014–2022f



Source: Analysys Mason, 2021

Operator	2014	2015	2016	2017	2018	2019	2020	2021f	2022f
Unified communications	0.9	1.3	1.7	2.1	2.7	3.3	3.9	4.4	4.9
SaaS (public cloud)	11.9	17.2	22.7	26.5	31.1	36.4	40.6	44.1	48.4
IaaS/PaaS (public cloud)	3.5	4.6	6.0	7.6	9.7	12.5	15.5	18.4	21.2
Security	11.2	12.3	13.0	13.9	14.9	16.2	17.1	17.7	19.0
Co-location and hosting	9.8	11.8	13.7	15.9	18.3	20.5	21.3	21.7	22.6
Enterprise mobility	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.6
Desktop management	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4
Total	38.2	48.5	58.5	67.7	78.5	90.9	100.6	108.9	119.0

Source: Analysys Mason, 2021

Telecoms operators play a key role in transitioning business functions to the public cloud; this includes using software-as-a-service (SaaS), platform-as-a-service (PaaS) and infrastructure-as-a-service (IaaS). This partly reflects the growing number of partnerships between operators and public cloud providers. Indeed, ETNO members are proactively collaborating with public cloud providers to use their network-centric tools, enhance their business portfolios and resell their cloud services to business customers.

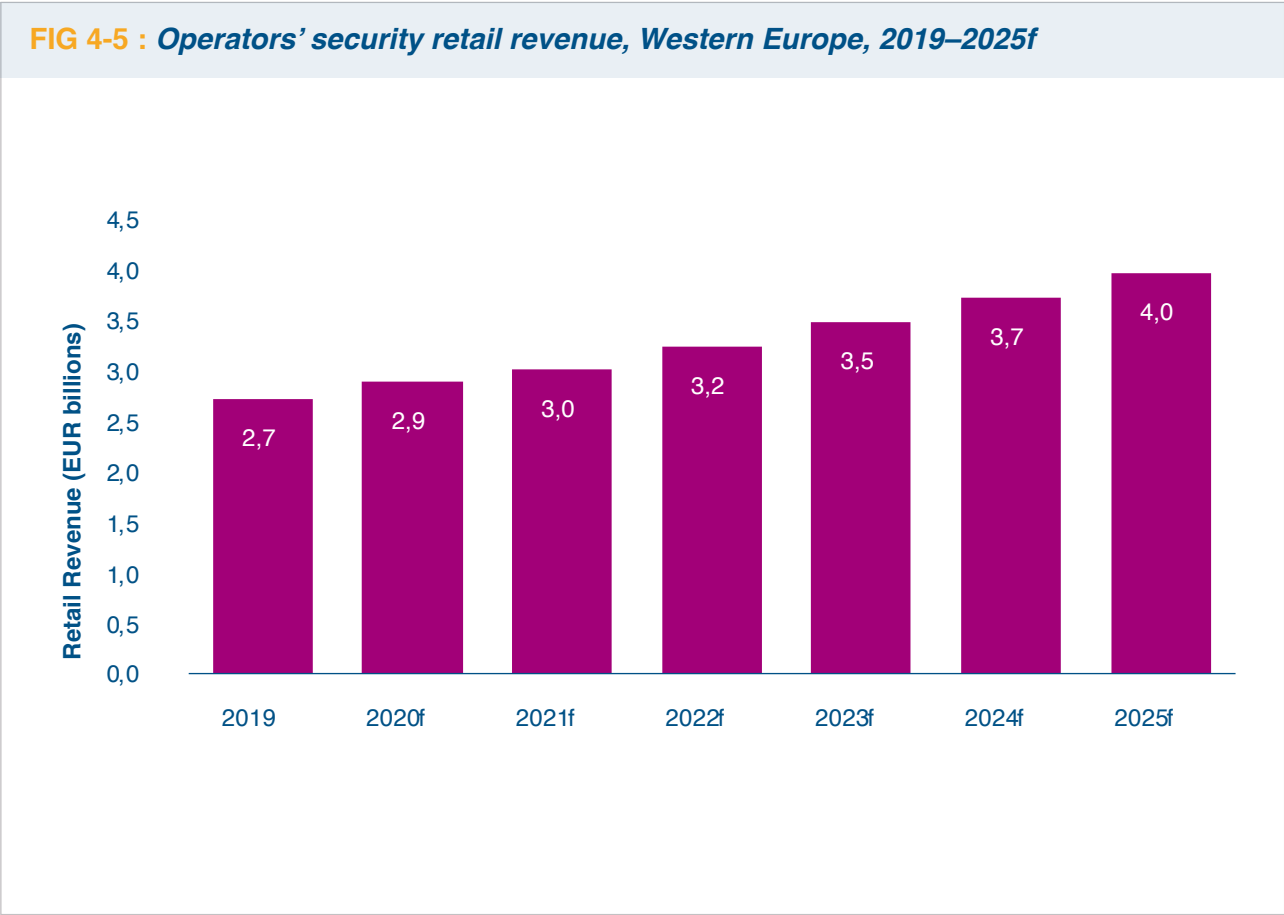
“ Who said telcos are only about cables? Since 2014, European telcos more than tripled their B2B revenues from digital services. ”

4.3 Digital security services

Security is of increasing concern for businesses. Many businesses are continuing to allow (or are even encouraging) flexible working patterns, so identity and access management has become a particular area of concern. This is unlikely to change. As a result, mobile device management (MDM) is a key mobile security solution that operators are selling to businesses. Operators are aware of the growing demand for security services, so are acquiring cyber-security vendors to bolster their security portfolio offerings and entice new business customers. For instance, Telefónica acquired two cyber-security vendor suppliers (Govertis and iHackLabs) in 3Q 2020.

Many businesses still obtain security services through managed service providers, resellers and directly from vendors. Nonetheless, operators' security-related revenue in Western Europe is predicted to reach EUR4 billion by 2025 (FIG 4-5).

FIG 4-5 : Operators' security retail revenue, Western Europe, 2019–2025f



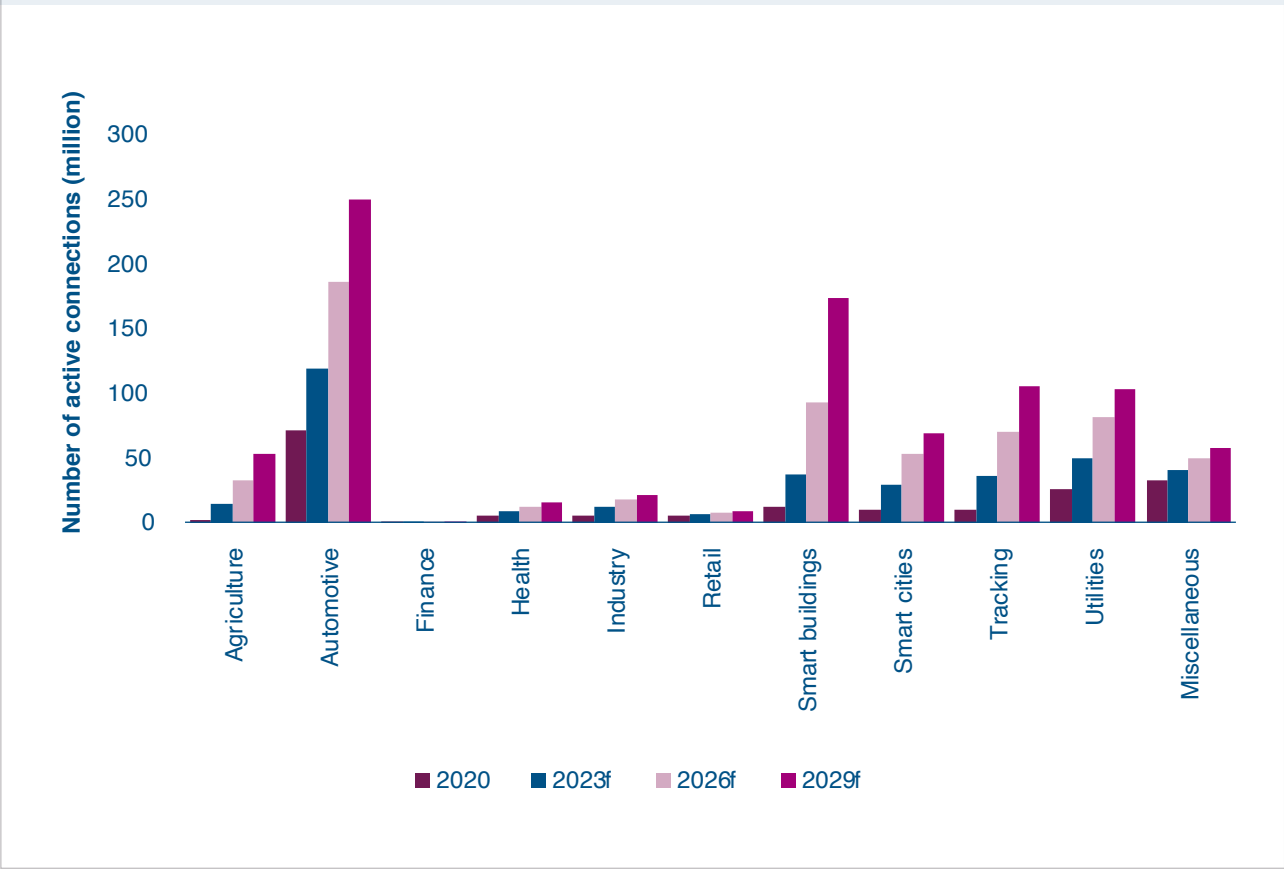
Source: Analysys Mason, 2021



4.4 The Internet of Things

The COVID-19 pandemic caused considerable disruption to the European IoT market in 2020; it reduced IoT budgets and delayed project roll-outs. The IoT sector has continued to face challenges in 2021, including a chip shortage. However, IoT connectivity will be a key driver of B2B revenue growth for operators; IoT connectivity revenue is expected to almost double between 2020 and 2027. The maturing of 5G networks will be a key enabler of further IoT deployment, particularly since IoT will play an integral role in smart cities initiatives. The industry that will use IoT the most by 2028 is expected to be the automotive sector (FIG 4-6).

FIG 4-6 : Number of active IoT connections by vertical industry, plus a data table of the number of connections (million), Europe, 2020, 2023f, 2026f and 2029f

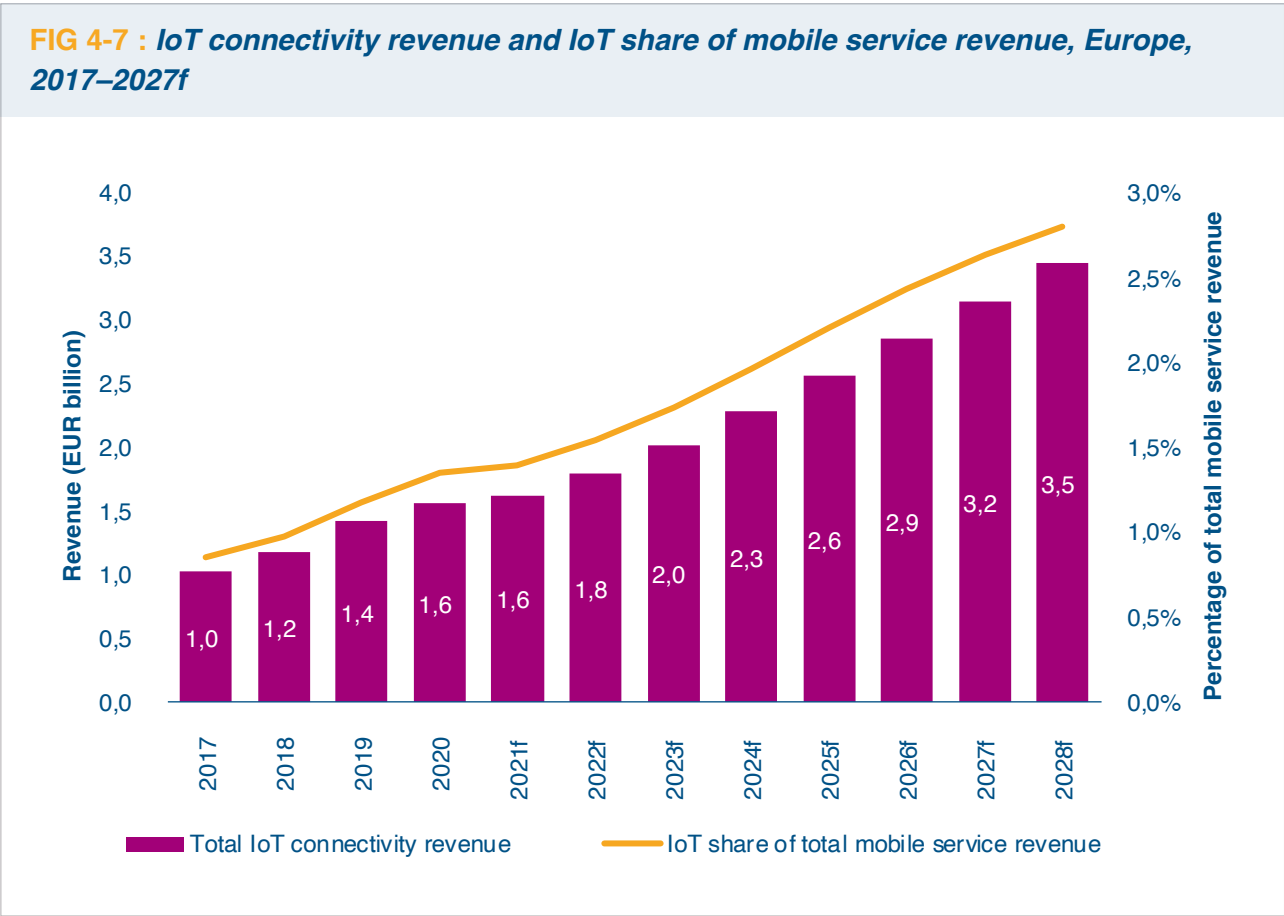


Source: Analysys Mason, 2021

Vertical industry	2020	2023f	2026f	2029f
Agriculture	2	15	33	53
Automotive	71	119	186	250
Finance	0	0	0	0
Health	6	9	12	16
Industry	5	11	17	21
Retail	5	7	8	9
Smart buildings	12	37	92	173
Smart cities	9	29	52	69
Tracking	10	35	70	105
Utilities	26	50	81	102
Miscellaneous	33	40	49	57
Total	180	352	601	854

Source: Analysys Mason, 2021

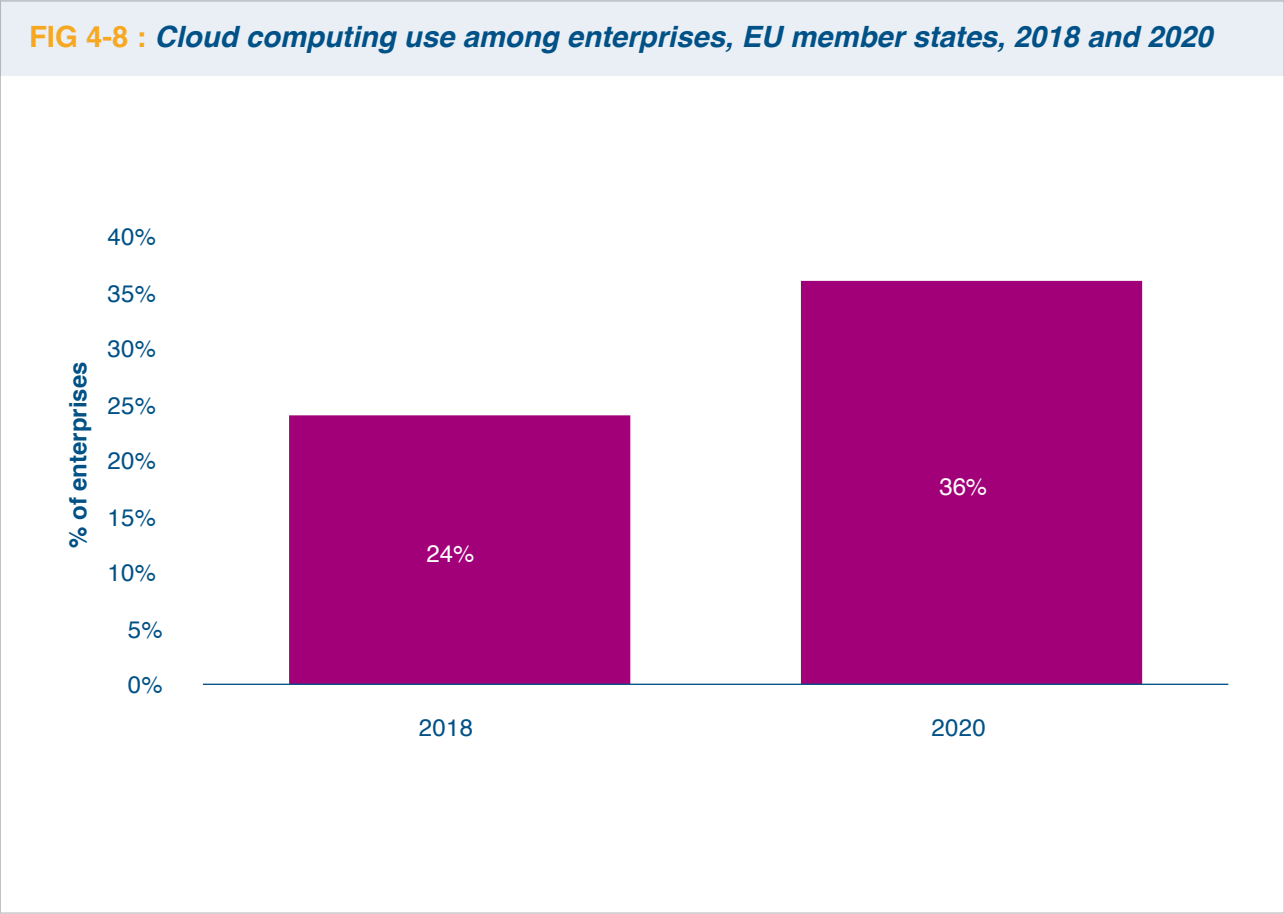
IoT connectivity offers the promise of organic revenue growth, but the contribution of IoT connections to the total mobile service revenue is likely to be modest, perhaps rising to 2.7% by 2027 (FIG 4-7). Connectivity alone generally represents less than 10% of the total revenue from an IoT application. As such, operators are becoming more actively involved at an early stage in the complex IoT value chain in order to optimise the associated revenue. This is particularly important given the high levels of competition in the IoT connectivity market; it is far from the sole preserve of mobile operators. Operators this have to define a long-term approach to IoT and weigh up whether they are going to specifically target one vertical or develop a broader approach. For instance, Telefónica has a long-term vision for IoT and has developed a strong set of horizontal and complementary capabilities. It had 26.2 million IoT connections at the end of 2020 and has invested in several IoT-related platforms.



Source: Analysys Mason, 2021

4.5 Use of cloud computing services

The percentage of enterprises using some form of hosted computing is growing rapidly. However, Eurostat data indicates that under 40% of European enterprises with at least 10 employees have adopted SaaS-based applications or use cloud infrastructure services (FIG 4-8). It is likely that large enterprises, that make up much of the total spend on IT services and technology, have a much higher take-up of cloud services.



Source: Eurostat, 2021

European telecoms operators are supporting enterprises in their migration to the public cloud by acting as a channel for cloud service providers and co-developing solutions with them. In addition, telecoms operators are consuming cloud services to support their own IT divisions and, to a lesser extent, their network infrastructure. As such, the penetration of cloud computing is growing among businesses.

The original resistance to moving workloads and applications to the cloud was based on concerns over security, performance and cost. These concerns have largely been overcome, but resistance still lingers, largely because several non-EU based cloud providers are unable to demonstrate conformance to GDPR (General Data Protection Regulation) and some store and process data outside of Europe, which causes concerns around data access and data protection. The purpose of the Gaia-X initiative is to address these concerns by developing an innovative data infrastructure ecosystem that conforms with EU legislation. Over 300 European organisations have joined the Gaia-X initiative, including DT, Orange, Proximus and TIM. In addition, the recently launched EU Alliance on industrial data, cloud and edge cloud⁸ as well as the future Important Project of Common European Interest (IPCEI) on cloud are expected to further contribute to the development of a federated data infrastructure ecosystem that conforms with EU legislation. This adds to the on-going works of the Gaia-X federation, which also aims at enabling the sharing of data across vertical market sector “data spaces” through data hubs.

⁸ Cloud Alliance | Shaping Europe's digital future (europa.eu)

SECTION 3

How network providers help to deliver a new digital future

This section covers future-looking aspects of European telecoms networks and how they can deliver environmental good, social inclusion and long-term economic benefits.

5. THE ROLE OF TELECOMS IN A GREEN RECOVERY

5.1 Future initiatives have to be green

There was an increased emphasis on the importance of climate protection (e.g. the EU's Fit for 55 target) and green development in 2021, culminating in COP26, where global leaders and enterprises strengthened their commitment to reducing carbon emissions and achieving Net Zero.

In relation to carbon emissions, operators' approach has distinct layers:

- Reducing own emissions (Scope 1 emissions)
- Reducing energy consumption, or making energy consumption more efficient (Scope 2 emissions)
- Reducing emissions across the value-chain (Scope 3 emissions)
- Enabling carbon emission reduction among their clients.

The last of these is critical to understanding the unique and pivotal role that operators play in greening society; telecoms networks are the key enabler of digitalisation initiatives, and these have a huge potential to accelerate reductions in emissions. These are likely to have a broader impact on the environment than an individual operator's own actions, and they are likely to offset many times over the impact of the networks themselves.

The spotlight this year has been on greenhouse gas emissions and climate change, but ETNO members set other targets in their environmental policies such as enabling a circular economy. In 2022, it is likely that more initiatives will focus on circular economy and other sustainability issues, and these will have an impact on all operators' strategies.

The European Green Digital Coalition was formed in March 2021. This body acknowledges the ICT sector's role in the fight against climate change. 13 European telecoms CEOs (including 11 ETNO members) became founding members of this coalition and have committed to becoming carbon neutral by 2040.

In this section, we will analyse operators' effectiveness at achieving their sustainable development goals.



5.2 Greening telecoms networks

For telecoms operators, Scope 2 emissions (emissions related to the power supply) are usually about four times higher than Scope 1. Telecoms operators consume about 2% of all electricity, and the broader telecoms/ICT sector roughly a further 2%, a share that is growing. Hence energy efficiency is key to reducing emissions. The roll-out of optical networks and of 5G has the potential to improve network efficiency in relation to power consumption.

Full-fibre FTTH networks use less power than copper or HFC networks, irrespective of data usage. They are also substantially more power-efficient than FWA. FTTH networks generally require less cooling and most have no powered outside plant. FTTH therefore has the potential to reduce operators’ fixed access energy consumption by about 85%, as long as older and less-efficient technologies are retired. Moreover, using fibre for mobile backhaul and decreasing the cell size can make mobile networks more power-efficient. The construction of FTTH networks does come at a considerable carbon cost, but given the assumed asset-life of physical fibre networks of at least 30 years, the benefits should easily outweigh the drawbacks.

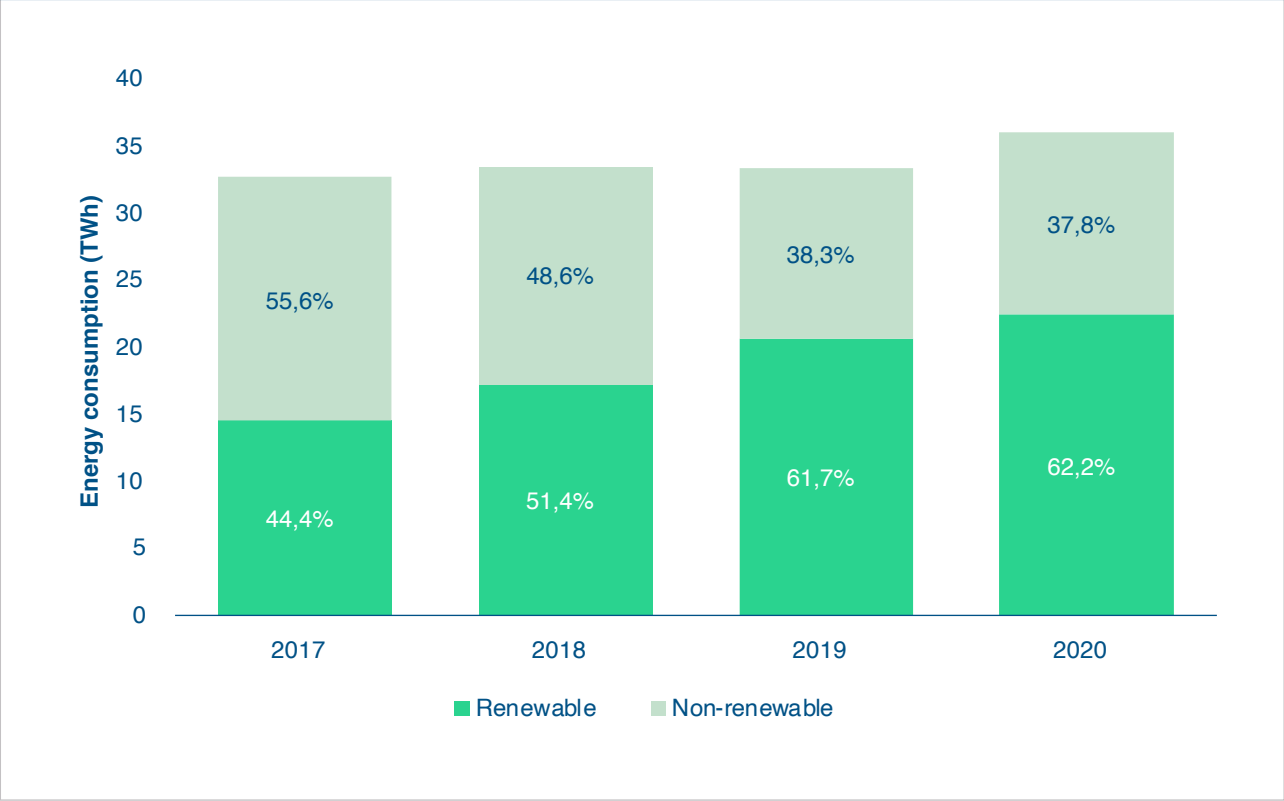
Radio access networks (RANs) account for a far higher proportion of integrated (fixed+mobile) operators’ energy consumption than fixed networks. Managing energy consumption is therefore an area of concern. 5G networks provide, depending on traffic loading, up to 90% more efficient transmission of mobile data for each kilowatt hour of energy consumed than 4G LTE networks.⁹ However, without decommissioning older generations of RANs, a basic 5G upgrade can increase consumption by around 70% at any given cell-site, and adding further bands or deploying larger antenna arrays would increase it even further.¹⁰ There are ways of mitigating this impact. 5G is the most energy-aware standard so far and can for example enable smarter operations that power up and down according to demand.

Additionally, the often-cited Jevons Paradox, whereby efficiency (lower costs) encourages greater consumption, applies as much to telecoms as to any other sector. It is therefore all the more important that the regulations concerning the switch-off of legacy networks take green considerations into account in addition to competition and consumer-protection considerations.

The overall energy consumption of ETNO members at the group level grew by 8% year-on-year in 2020, though this was largely because of operations outside Europe. At a Europe-only level, energy consumption fell by 4%, which demonstrates real improvements in efficiency in the face of the potential for 5G to add to consumption. Moreover the proportion based on renewable sources rose.

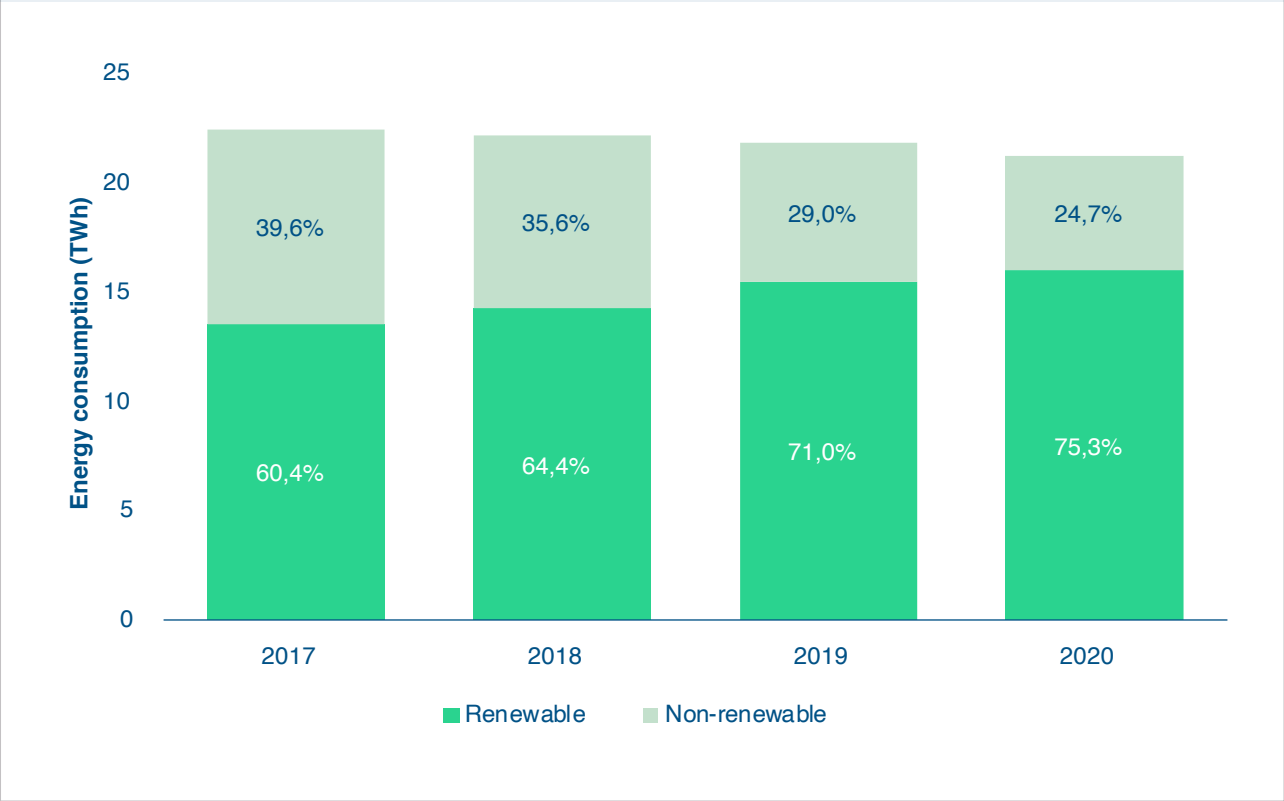
⁹ <https://www.nokia.com/about-us/news/releases/2020/12/02/nokia-confirms-5g-as-90-percent-more-energy-efficient/>
¹⁰ <https://www.huawei.com/uk/technology-insights/publications/huawei-tech/89/5g-power-green-grid-slashes-costs-emissions-energy-use>

FIG 5-1 : Scope 1 and 2 energy consumption from renewable and non-renewable sources, ETNO members, group level, 2017–2020



Source: Analysys Mason, 2021

FIG 5-2 : Scope 1 and 2 energy consumption from renewable and non-renewable sources, ETNO members, Europe only, 2017–2020

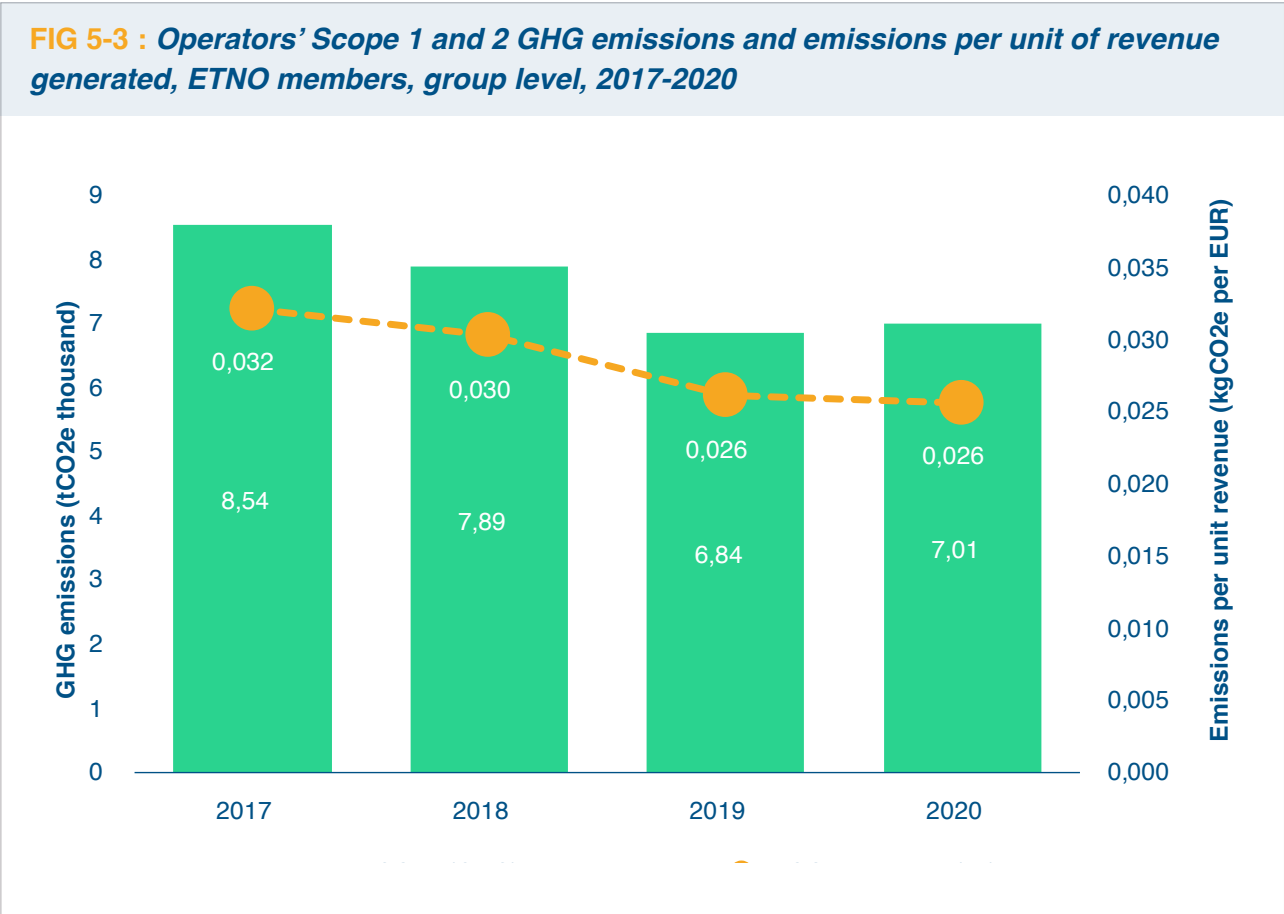


Source: Analysys Mason, 2021

Whether power efficiency translates into a reduction in emissions largely depends on the energy supply. The composition of energy sources on the grid is outside of operators’ control, though contracting with suppliers that use 100% renewable energy sources does encourage investment in renewable energy generation. However, it does not result in zero emissions. Operators report Scope 2 emissions in different ways:

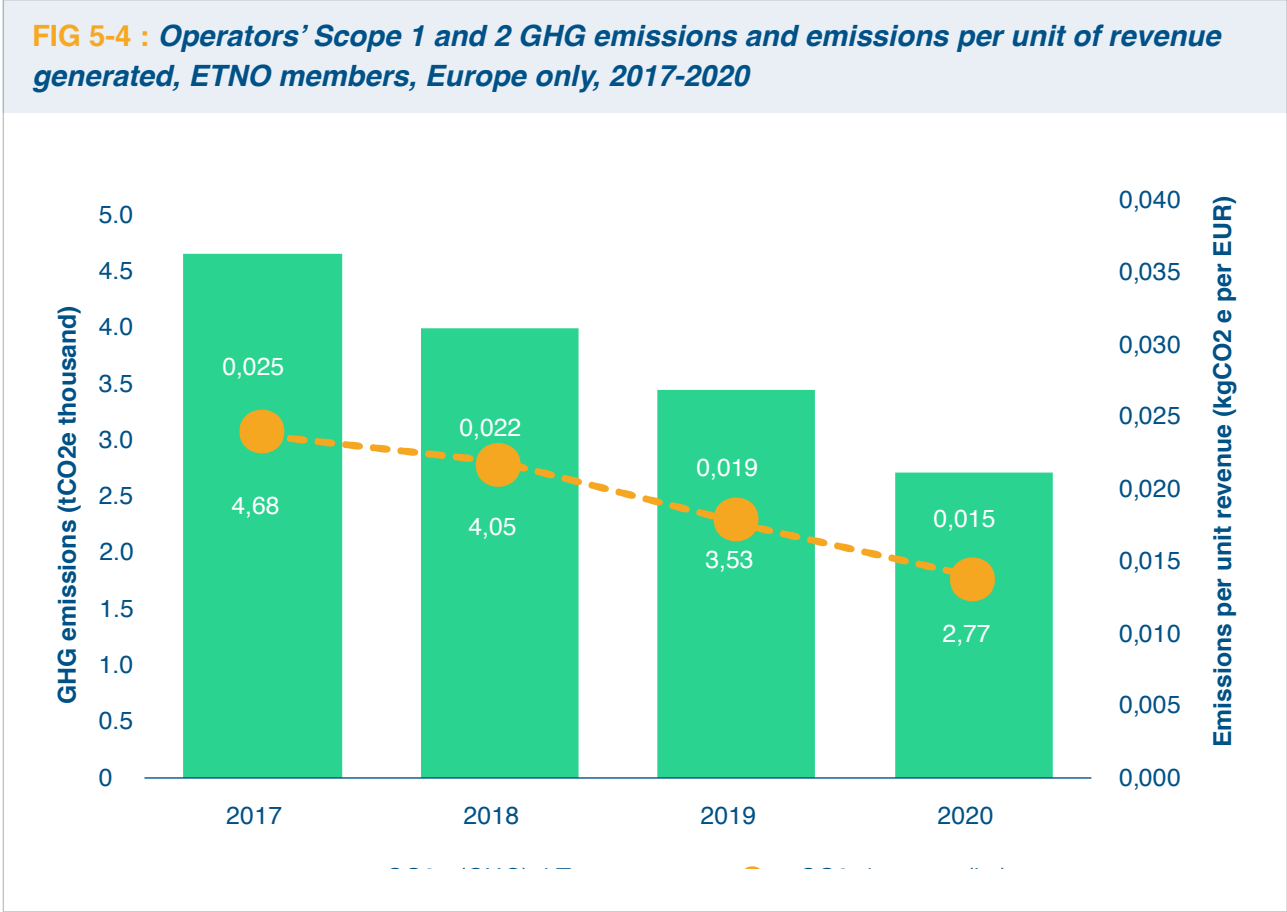
- the location method takes the composition of energy sources for the national grid into account
- the market method takes the contracted suppliers’ energy sources into account.

More operators use the market method, and this is what **FIG 5-3** shows.



Source: Analysys Mason, 2021

At a group level (Figure 5.3), emissions in 2020 actually rose by 2% compared to 2019, but this principally down to the consolidation of Sprint into Deutsche Telekom group company T-Mobile USA. At a Europe-only level, emissions fell by 22%, and the efficiency measure of CO2e (kg) for every euro earned also substantially improved. The corollary of this improvement is that in non-Europe markets, CO2e/EUR fell less swiftly, and CO2e/EUR was at 2020 over three times higher than in Europe, in part a reflection of the difficulty in some countries of contracting a renewable energy supply.



Source: Analysys Mason, 2021

5.3 Greening the telecoms value-chain

Many ETNO members have plans to achieve first zero emissions on Scopes 1 and 2 and subsequently net zero emissions (Scopes 1,2 and 3).

FIG 5-5 : Selected Scope 1& 2 and 3 emission reduction targets, ETNO members, group level

Operator	Target date for zero emissions in Scope 1 and 2	Target date for net zero emissions (Scopes 1,2 and 3)
Deutsche Telekom	2025	2040
TDC	2028	2030
BT	2030	2045
KPN	2030	2040
Telenor	2030 ¹¹	
Telia Company	2020 (achieved)	2030
TIM Group	2030	
Orange	2040	2040
Telefónica	2040	2040

Source: Analysys Mason, 2021

Operators have less control over their Scope 3 emissions than their Scope 1 and 2 emissions, and, as such, Scope 3 targets tend to be longer-term. However, the size of some operators gives them a degree of leverage with suppliers. Quantifying the end-to-end carbon cost of services is important because:

- it includes the carbon cost of customer equipment, which typically comes from end users’ own energy supplies
- it includes the carbon cost of services that operators may have self-supplied but that are now outsourced to suppliers. This is particularly important for understanding the impact of migrating workloads to the cloud.

¹¹ For European operations only: <https://www.telenor.com/sustainability/responsible-business/environment-and-climate/climate-impact/>

Ensuring telecoms is a sustainable business is a multifaceted issue. It is not just about reducing CO2e emissions and energy consumption in the telecom networks, but also about conserving resources across the supply chain. The principles of a circular economy revolve around minimising waste and reutilising resources effectively. In the telecoms sector this largely involves collecting old set top boxes or mobile devices to recycle, resale or repurpose the parts.

- Deutsche Telekom Group has established a mobile phone collection campaign and collected over 390 000 mobile devices in 2020 alone. Since 2003, Deutsche Telekom has collected over 3 million mobile devices in Germany alone.
- At KPN’s stores customers and non-customers alike can recycle their old mobile devices.
- Orange has set the target that by 2025 all of its European operations will offer its customers the choice of a reconditioned phone.
- Telia Company offers to buy back customers’ devices in all of its Nordic and Baltic markets. In 2020, 8% percent handsets sold or leased by the company were bought back. 18% of handsets sold to business customers in the same year in all Telia Company markets were sold as a service, maximising the re-use of devices through repairs, upgrades and refurbishment.
- Proximus launched the “Don’t Miss the Call” campaign aimed at collecting 150 000 phones to be recycled in Belgium, throughout 2022.

Several ETNO members have introduced initiatives to increase customer’s awareness of the ecological impact of their devices. The introduction of ‘eco rating’ for mobile phones in May 2021 by Deutsche Telekom, Vodafone, Orange, Telefónica and Telia Company has enabled customers to make more informed purchasing decisions. This scheme illustrates the steps being taken to improve transparency within the mobile telecoms market. Across other non-customer-facing areas of telecoms business, operators have adopted circular economy principles. For instance, Orange and Nokia have established an agreement to utilise refurbished RAN equipment in Orange’s networks across its entire footprint, whilst BT has set the target of ensuring zero waste goes to a landfill by 2025.



5.4 Enabling more extensive change

The broader impact of digital communications on GHG emissions is potentially vast, but it is hard to quantify; just because people now like video-calling services does not mean that they will use them as a replacement for travel. Several operators have set ‘enablement’ targets in which they offset the negative impact of each kilowatt hour of energy used or tonne of carbon dioxide equivalent emitted with actions whose impact on the environment is larger and positive.

The range of enablement examples is vast, and often not determined by operators: sometime positive changes just happen as a by-product of consumer choice. But operators do play a proactive role by offering digital solutions that foster more sustainable and green ecosystems. The potential to make transport and logistics more efficient, or to eliminate the need for transport at all, is one of the areas with the clearest and most obvious impact, but there are many others: for example in industrial settings, in smart-cities and smart-buildings, in smart-metering and in retail.

Example A: smart buildings



Telefónica has partnered with Siemens Spain to offer a portfolio of smart building solutions. These include smart lighting, smart parking, CCTV, predictive monitoring and energy monitoring. The energy used to power buildings accounts for 36% of the total energy consumption worldwide, so smart building solutions will play a key role in optimising energy use. These new solutions will be incorporated into Telefónica’s range of Eco Smart solutions, which have enabled the operator’s customers to prevent over 9.5 million tCO₂e.

However, not every example of enablement is associated solely with a reduction in GHG emissions. The following example uses several of the tools in the modern digital communications provider’s toolkit to tick several environmental boxes beyond just reducing GHG emissions; there is also a tangible economic benefit.

Example B: automated precision agriculture



Telia Company has partnered with Ekobot, Axis communication and RISE to test real-time communication between Ekobot’s farming robotics. Ekobot’s autonomous field robot for mechanical weed control uses AI and camera sensors to identify and remove weeds. Telia’s 5G network capabilities (including high bandwidth and low latency) meet the requirements for Ekobot’s solution to operate. As such, Ekobot’s weed control solution can be connected to Telia’s 5G network to automate weeding and subsequently reduce costs. In addition, farmers will be less reliant on chemical herbicides, which can have a detrimental impact on the environment.

Overall, Telia Company has calculated that its products and services enabled its customers to reduce their GHG emissions by 490 000t CO₂e in 2020.

Some operators have created platforms of applications and services that deliver green solutions.

Example C: Green tech innovation platform



In June 2020, BT introduced the Green Tech Innovation Platform to support the public sector as it recovers sustainably after the pandemic. This platform leverages the expertise from BT’s partner Plug and Play, and will help enable the public sector to reach Net Zero through utilising innovative technologies. The Green Tech Innovation prioritises three areas: Smart Streets, Smart Building and Remote Working. The project will explore traffic optimisation sensors, IoT solutions for energy and water monitoring, and applications such as AR/VR and remote diagnostics that minimise the need to travel for work. In January 2021, BT partnered with iOpT, an IoT provider, and Everimpact, a climate monitoring company, to bolster its Green Tech Innovation Platform.

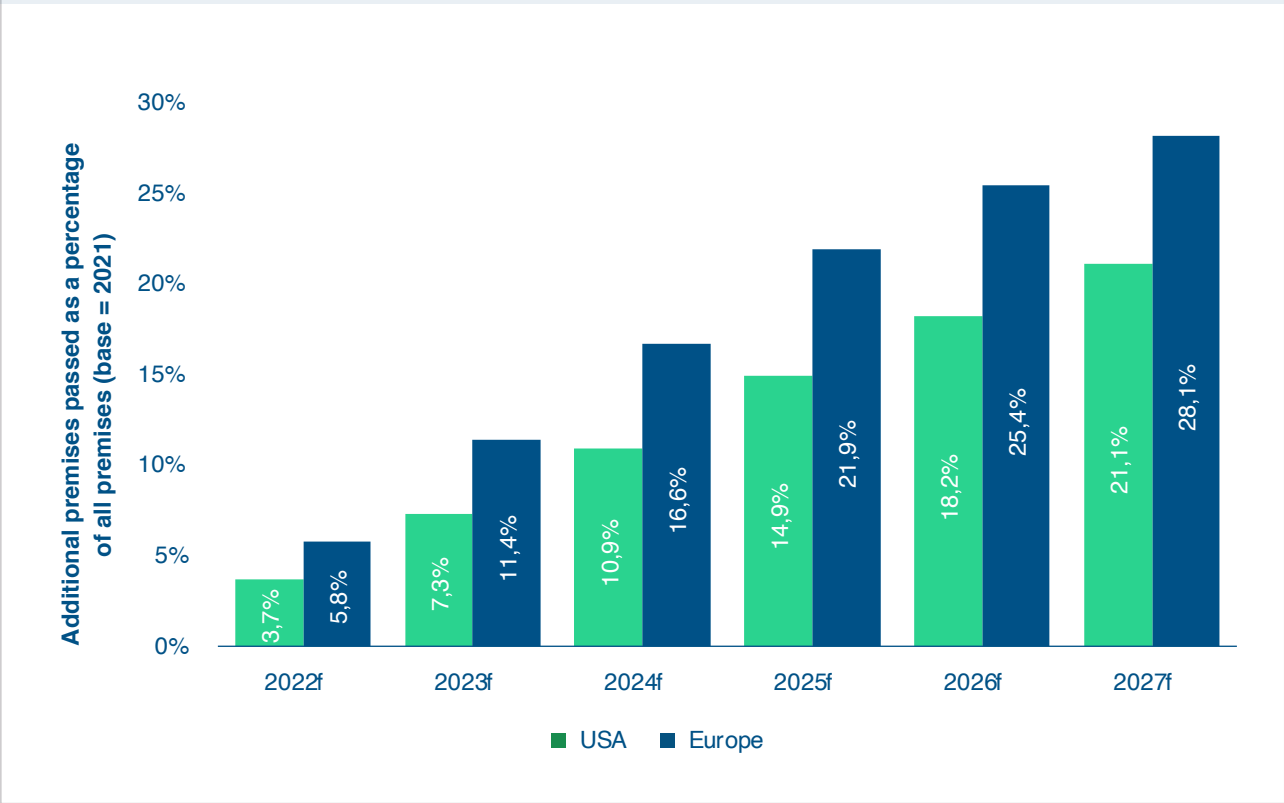
6. ENSURING FIT-FOR-PURPOSE NETWORKS FOR ALL

Ensuring that all European citizens have access to fit-for-purpose networks is a key aim of the European Digital Decade, as well as for non-EU member states. However, it will come at a great financial cost. Both industrial and telecoms-specific policies have a direct impact on network operators' ability to deliver on this aim. This section outlines what work there is still to do and describes the barriers and incentives of achieving this goal.

6.1 FTTH and gigabit access

FIG 6-1 indicates the scale of future build, based on operator commitments, in Europe and the USA. In Europe, the additional proportion of premises passed each year, over and above what was built by the end of 2021, continues to outstrip that in the USA.

FIG 6-1 : Additional FTTH premises passed as a proportion of all premises, Europe and the USA, 2022f-2027f

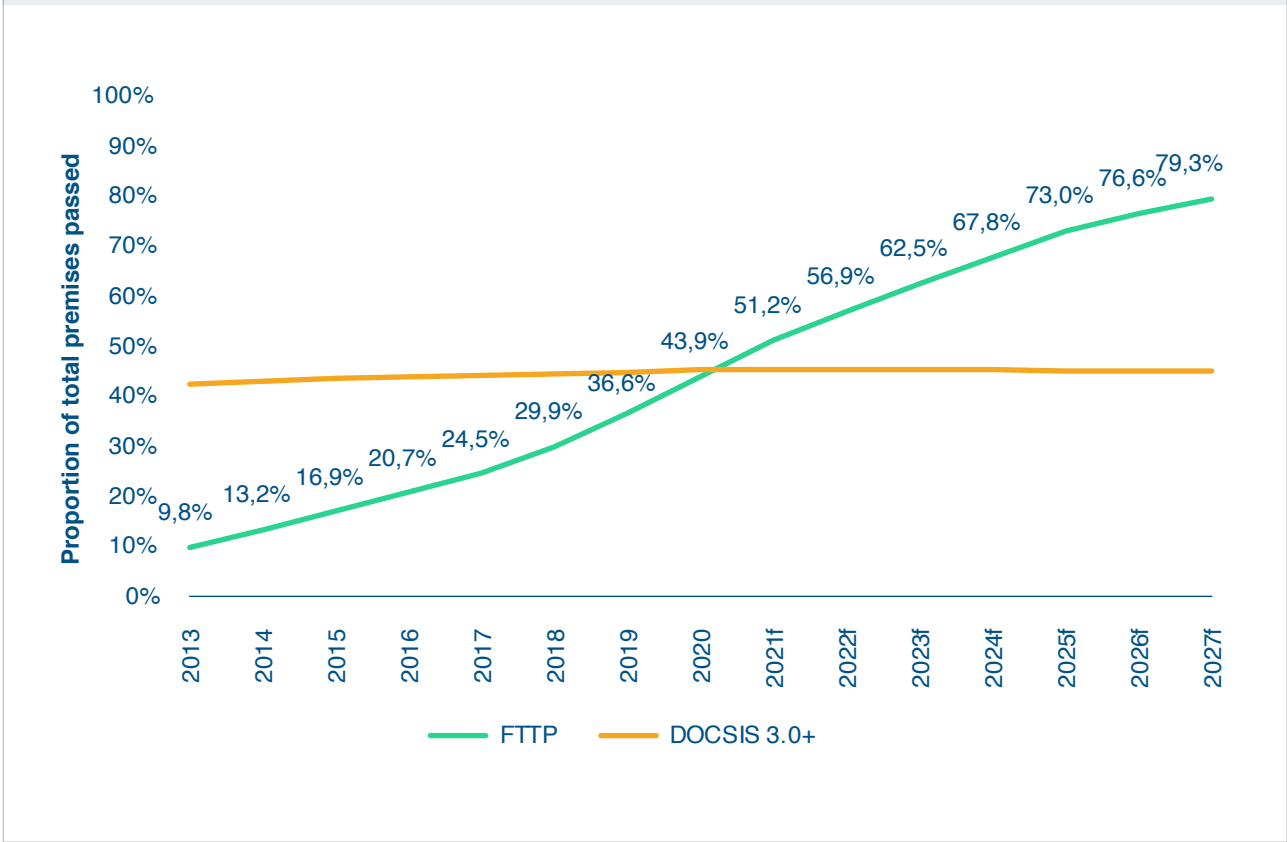


Source: Analysys Mason, 2021

“ By 2027, we expect that FTTH will reach almost 80% of European households. ”

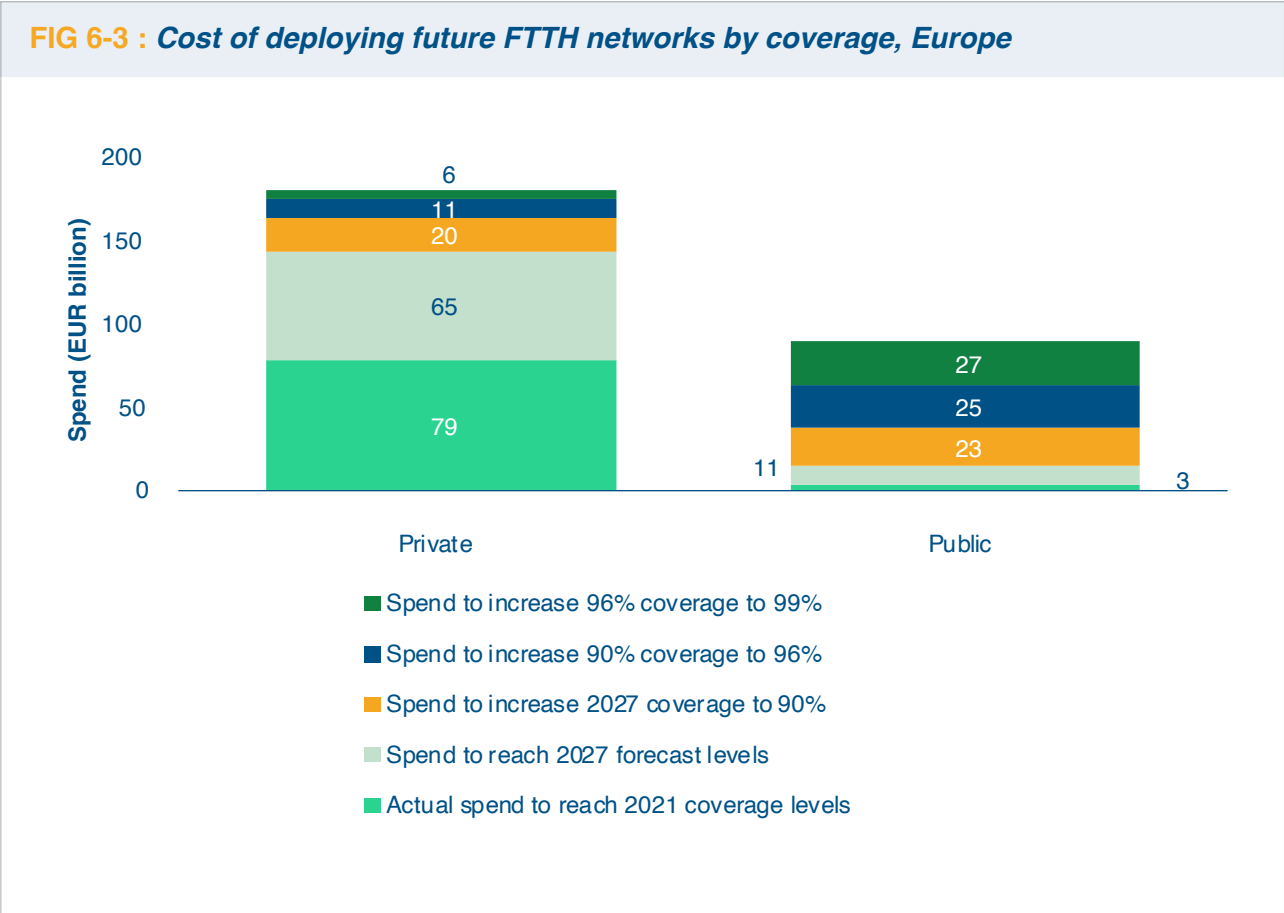
The data in FIG 6-1 translates to a coverage figure of 79.3% in Europe by 2027. This is equivalent to passing 209 million unique premises out of an estimated 263 million. In addition, cable broadband (DOCSIS 3.0 and above) will cover 45% of premises (118 million premises) by the same date (FIG 6-2). Nearly all of this footprint will have been overbuilt by FTTH, often by the cable operators themselves.

FIG 6-2 : Premises passed by FTTH and DOCSIS3.0+, Europe, 2013-2027f



Source: Analysys Mason, 2021

ETNO members’ commercial commitment to roll-out FTTH networks has increased over the past year. This allows them to maintain network and investment leadership, despite returns that are lower if compared to global peers. In some markets this increased commitment happened in the context of competitive pressures from new investors, but improving take-up rates were also a major factor. The tapering off of deployments in the later years of this forecast may indicate that operators have not yet committed to commercial builds so far in the future, but it also suggests that there are limits of what can be achieved in terms of commercial investment. **FIG 6-3** shows a projection of the total costs to cover 90%, 96% and 99% of premises with FTTH, with an estimate of what would have to be covered by public money.



Source: Analysys Mason, 2021

The ETNO-commissioned report *Connectivity and Beyond: how telcos can accelerate a digital future for all* indicated that, as of the end of 2020, a further EUR150 billion would be required to offer every European citizen gigabit access (in this case with a mix of FTTH and 5G FWA).¹²

At least 20% of the funding from the post-pandemic European Commission Recovery and Resilience Plan will go towards digital transformation. The bulk of this sum is likely to be allocated to the digitalisation of public administration (eJustice, eHealth, etc), and therefore only a small proportion will be allocated to network itself. Nevertheless the roll-out of gigabit broadband has been established as a flagship area of investment, which means that policy makers should now ensure that private investment is granted additional incentives to achieve the Digital Decade goals. Support for gigabit roll-outs in the final segments of the hardest-to-reach premises will depend on:

- whether national policymakers adopt a largely technology-agnostic approach allowing a mix of technologies where needed
- whether they see broadband as a strategic investment or as part of an industry that can largely fund itself.

FTTH costs per premises passed rise to several thousands of euros for the last 10% of premises, so 5G FWA and hybrid solutions are likely to prove to be more commercially prudent than FTTH, at least in some cases. However, achieving genuinely gigabit services in remote areas using 5G FWA comes with considerable additional costs. These include costs due to:

- the need for engineer-installed outdoor antennas to optimise performance
- the need to upgrade remote cell sites with 5G where the commercial case for 5G mobile is weak, or to build new sites where otherwise they would not be required
- higher opex than for FTTH
- a shorter asset-life for FWA than for FTTH

FIG 6-3 does not include the final 1% of hardest-to-reach properties, where unit costs will be both very high and very uneven. A new generation of LEO satellites such as Starlink, OneWeb and Kuiper may be part of the solution. However, they are still unlikely to be able to deliver gigabit access.

¹² <https://www.etno.eu/downloads/reports/connectivity-and-beyond.pdf>

6.2 5G networks and spectrum

Spectrum is a critical input for mobile networks. The less spectrum that is available to MNOs, the poorer (slower) the service. Mobile network usage continues to rise worldwide, but the intensity of usage is itself a consequence not only of underlying consumer demand, but also of supply-side factors including, importantly, the amount of spectrum made available to MNOs and the timing and conditions under which it is assigned.

Several spectrum auctions took place in Europe in 2021 following delays due to the COVID-19 pandemic. More mid-band spectrum has become available, and several additional regulators have announced plans for high-band (mmWave) spectrum allocation.

Not all of the available spectrum has been allocated to mobile networks. 480MHz of spectrum in the 6GHz band was allocated for unlicensed use (typically for the new Wi-Fi standard Wi-Fi 6E) in July 2021 by the European Commission, following an earlier similar decision by Ofcom (the regulator in the UK) and the FCC’s decision to assign an even wider tranche of spectrum for the same purpose in the USA.

FIG 6-4 shows the allocations of spectrum in the 5G bands as of November 2021.



FIG 6-4 : Assignments of spectrum in the main 5G bands, Europe, November 2021

Country	Spectrum assigned in the 700MHz band (MHz)	Spectrum assigned in the 3.4–3.8GHz band (MHz)	Spectrum assigned in the mmWave band (MHz)
Albania	0	0	0
Austria	60	390	0
Belgium	0	190	0
Bosnia and Herzegovina	0	0	0
Bulgaria	0	300	0
Croatia	60	320	1000
Cyprus	60	400	0
Czech Republic	60	400	0
Denmark	80	390	2850
Estonia	0	0	0
Finland	60	390	2400
France	60	310	0
Germany	60	300+100 local	3250 (assigned per application)
Greece	60	390	1000
Hungary	50	390	0
Iceland	40	300	0
Ireland	0	340	0
Italy	60 (15 unsold)	242	1000
Latvia	0	150	0
Lithuania	0	0	0
Luxembourg	60	330	0
Malta	0	300	0
Netherlands	60	0	0
North Macedonia	0	0	0
Norway	60	400	0
Poland	0	0	0
Portugal	60 (10 unsold)	400	0
Romania	0	255	0
Serbia	0	0	0
Slovakia	60	0	0
Slovenia	75	380	1000
Spain	60 (15 unsold)	380	0
Sweden	40	320+80 local	0
Switzerland	70	300	0
UK	80	390	0

Source: Analysys Mason, 2021

Clearly there are differences in the amount of spectrum offered and assigned between countries, and the main assignment of 5G spectrum has not yet taken place in some countries at the time of writing. Some operators have had to resort to using other spectrum bands for 5G, sometimes by implementing dynamic spectrum sharing.

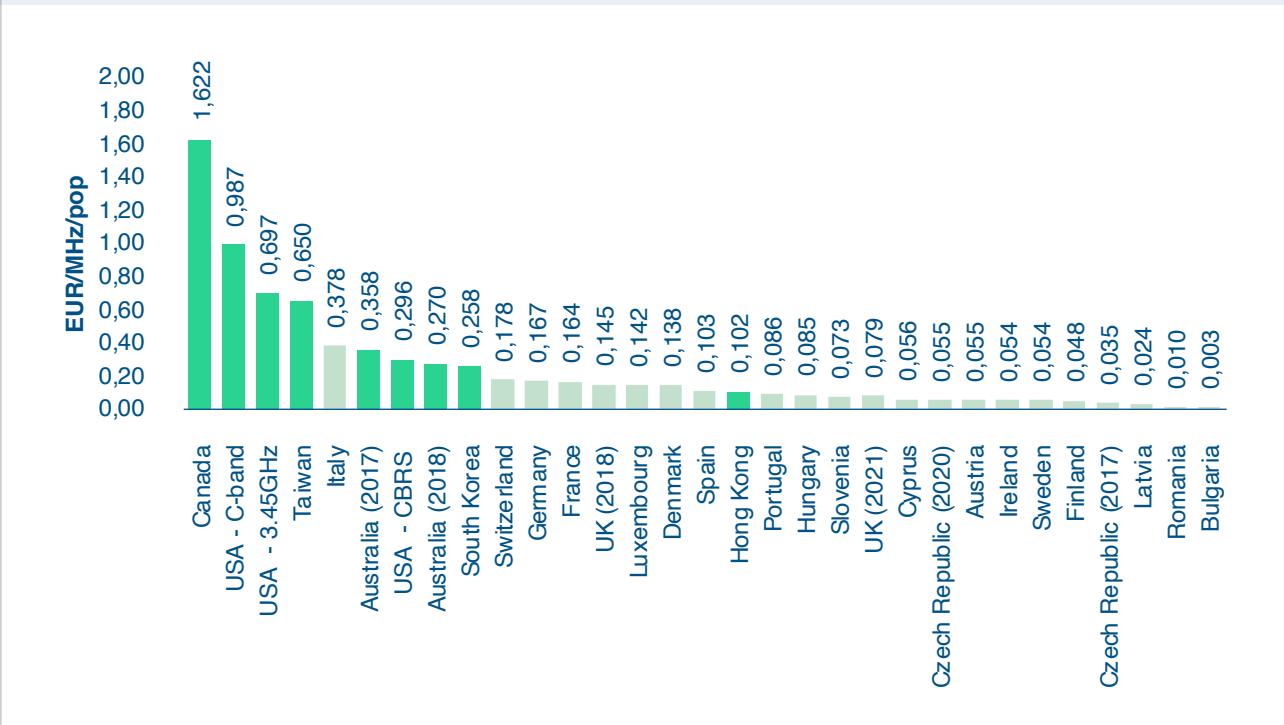
The ITU's minimum technical requirements to meet the IMT-2020 criteria specify at least 100MHz of contiguous spectrum per operator. The aggregation of non-contiguous blocks of spectrum is possible, but 100MHz of contiguous spectrum enables faster networks and allows for more-efficient network operation. In the 35 European countries listed in FIG 6-4, 3 had at least 1 operator with 100MHz of contiguous spectrum, 2 had 2 operators and 12 had 3 or more.

Spectrum is ultimately a public good and policy should reflect this and should be shaped in such a way as to maximise benefits for the public. It should ensure:

- support to private investments when designing the spectrum auctions
- a good quality of service and coverage for mobile users
- the enablement of brand new purposes for networks that could boost productivity and economic development (for example, in transport or industrial networks).

The prices paid for mid-band spectrum in Europe have not been particularly high by global standards, though there have been some outliers (most notably, Italy). US operators (at C-band auctions) and Canadian operators respectively paid 2.8 times and 4.3 times more per megahertz per member of the population (normalised according to duration of licence) than the highest price paid in Europe (Italy) (FIG 6-5). Nevertheless, the amount paid in Europe since 2018 is equivalent to about 2% of the annual revenue for European operators and about 14% of the total annual telecoms capex in Europe.

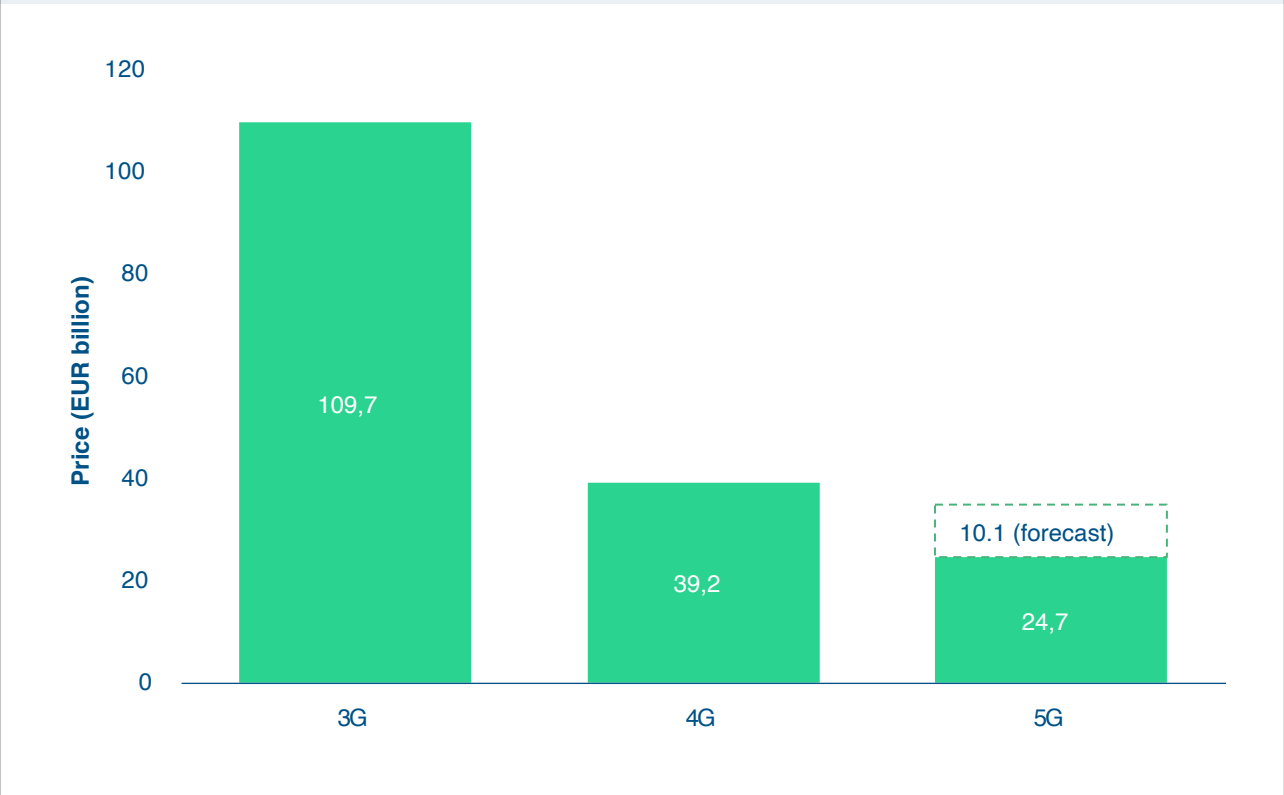
FIG 6-5 : 3.4GHz - 3.8GHz spectrum prices, normalised to a 20-year duration, worldwide



Source: Analysys Mason, 2021

Total prices paid for 5G spectrum are likely to be slightly lower than those for 4G spectrum, and only around a third of the amount paid for 3G spectrum 20 years ago (FIG 6-6).

FIG 6-6 : Total prices paid at auction for the main 3G, 4G and 5G licences, worldwide, 2000–November 2021¹³



Source: Analysys Mason, 2021

Prices for 3G spectrum were exceptional, and driven by factors that in some cases no longer apply. At the time there were growing and profitable retail mobile markets that induced market-entry. Moreover, there was an assumption that incumbent 2G licence-holders would be at risk without 3G spectrum.

¹³ The figures are for the principal bands associated with each generation. These are the 700MHz, 3.4–3.8GHz and mmWave bands in the case of 5G. pdf

6.3 Industrial and IoT spectrum policies in Europe

Operators in the EU were not the first to launch 5G, but the EU still hopes that Europe will become a leader in industrial 5G use cases and private networks. Many European governments have given 5G a prominent role in their industrial and digital strategy programmes, and it is also likely to be central to some post-COVID-19 recovery initiatives. This will mean that networks in the 5G era will have to be built differently; they must be optimised for low latency, high availability, high-density or ultra-low-power operations - and not just for generic mobile broadband - in order to enable a wide range of enterprise and IoT services. As a result, regulators have evaluated ways to ensure that spectrum regulation facilitates the use of 5G for industrial and IoT applications. These range from spectrum being earmarked for B2B use or for private networks (as in Germany and Sweden for example) to obligations being placed on MNO spectrum owners to support industrial requirements such as improved indoor or remote site coverage.

Broadly, there are two models for private enterprise networks:

- those in which the industrial network user deploys a private network using either dedicated local spectrum (where available) or unlicensed spectrum, and an operator or vendor potentially plays a role in building, integrating and managing the network
- those in which the industrial network user takes a configurable slice of an existing public network. The network slice model can be deployed on 4G and non-standalone 5G networks via software upgrades, but it is an integral feature of future standalone 5G networks.

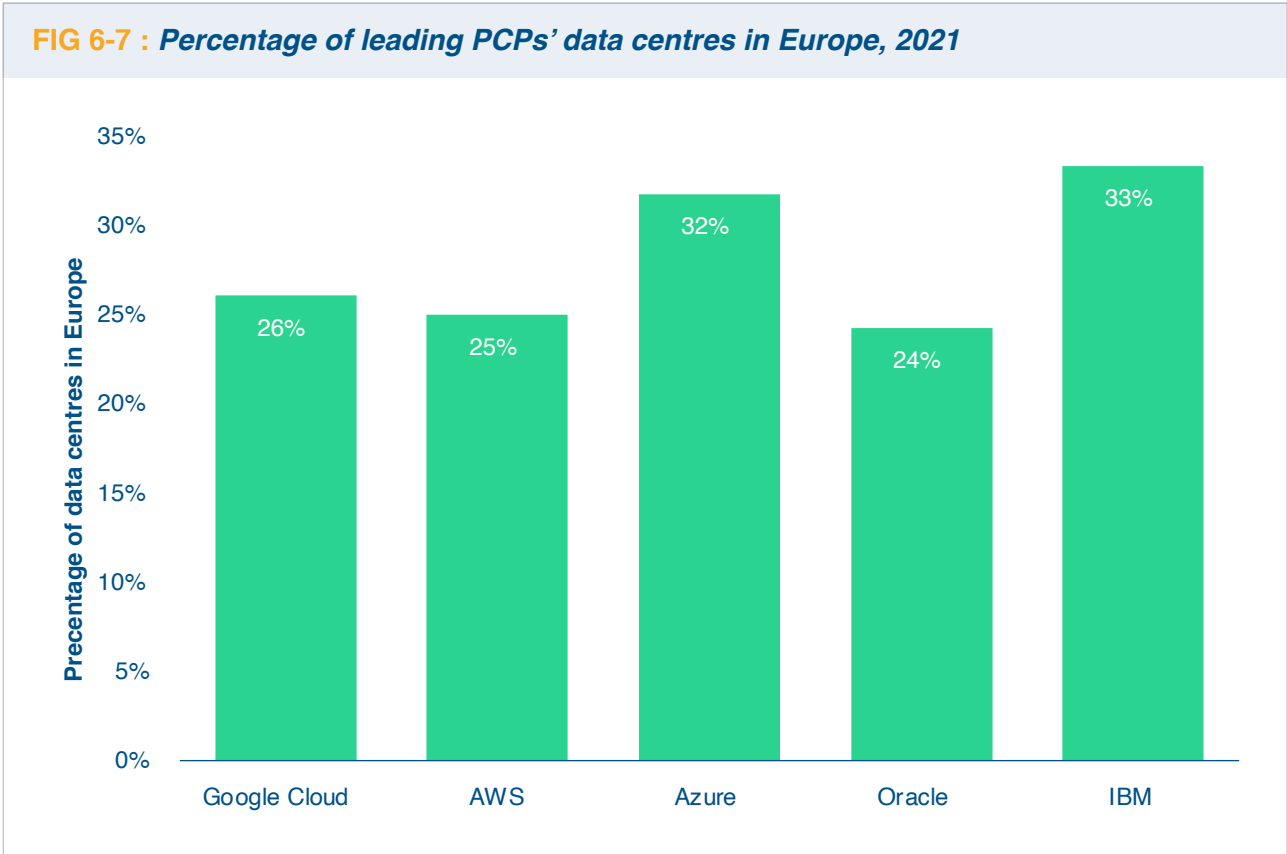
There is a role for existing mobile operators in both models. In the first model, existing operators act as experienced network builders and integrators without being traditional licensed operators. In the second model, virtualisation introduces new ways for new types of enterprise users to expand the geographical presence of their networks without commissioning new physical network infrastructure. In other words, it offers considerable scope for capex avoidance.

These models can coexist under some circumstances, but consideration has to be given to whether the first model acts to the detriment of not only of the second, but also of more traditional mobile use.

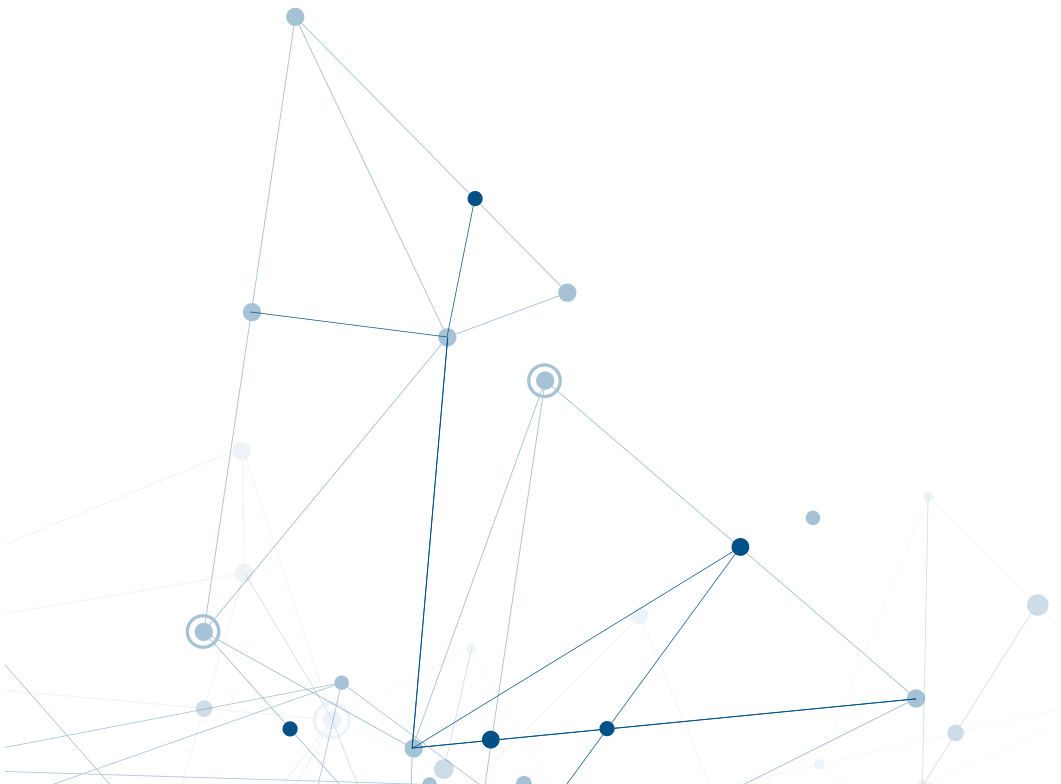
“European leadership in cloud requires more work. Today, most of the market remains in the hands of a few non-European companies.”

6.4 Operators' relationships with public cloud providers

Public cloud providers (PCPs) have greatly extended their presence in Europe (FIG 6-7).

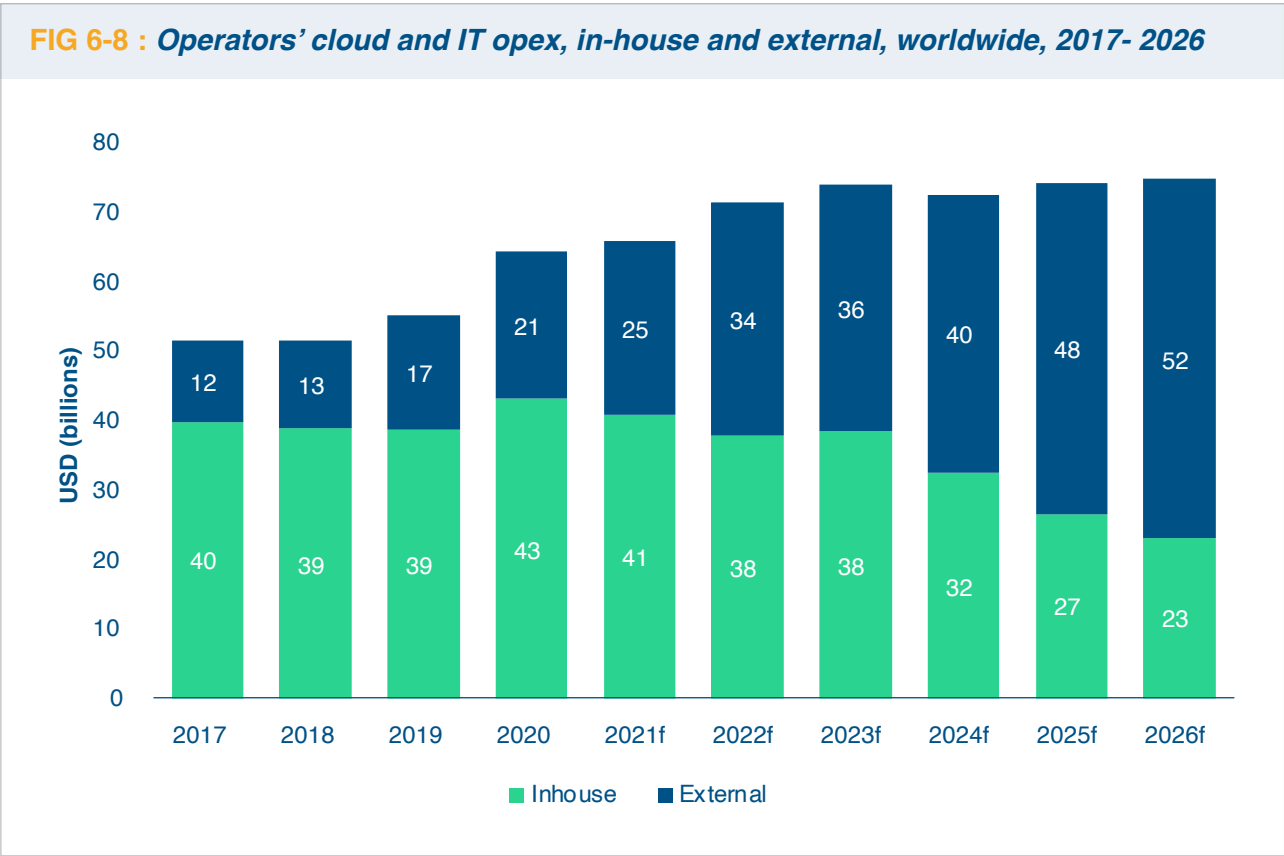


Source: Analysys Mason, 2021



PCPs offers benefit from the scale of their cloud infrastructure and the scope of the services that they can supply. As such, operators (including ETNO members) have to establish the best ways of benefitting from the cost advantage of working with PCPs while preserving value for themselves and maintaining and developing relationships with their existing enterprise customers. Moreover operators are well-placed to respond to growing demand for greater sovereignty in the cloud.

Operators themselves are increasingly shifting their in-house spending to external providers, and this trend is expected to continue (FIG 6-8).



Source: Analysys Mason, 2021

FIG 6-9 : Partnerships between ETNO members and PCPs

Operator	PCP	Services shared
BT Group	Google Cloud	Google Cloud Platform
	IBM	
	Azure	Azure
	AWS	
Deutsche Telekom	AWS	IoT, DevOps, Cloud with T-Systems
	Azure	
	Google Cloud	
Elisa	Google Cloud	Google Cloud Platform
	AWS	AWS
	Azure	Microsoft 365, Office 365, Dynamics 365 and Azure services, Power BI and Power Apps
KPN	Google Cloud	
	Azure	
	IBM	Cloud Orchestrator software to automate cloud and hybrid cloud environments
Orange	Azure	Public, private and hybrid secure environments and Flexible Engine
	Google Cloud	
	AWS	
Proximus	Azure	Azure Edge Zone and public cloud for AI
Swisscom	AWS	AWS Outposts
	Azure	Microsoft 365 and Azure
Telefónica	Azure	Azure Private Edge Zone
	AWS	
	Google Cloud	Google Cloud Platform
	IBM	IBM Blockchain Platform and IBM Watson Assistant
Telekom Austria (A1)	Azure	Microsoft 365, Exchange Online, Windows, SharePoint, OneDrive, Project and Visio
	IBM	Digital OSS solution, Resource Inventory, Workflow Management, Discovery and Reconciliation and Network Planning and Design
Telenor	AWS	
	Google Cloud	
Telia Company	Azure	
	Google Cloud	
	AWS	
TIM	Google Cloud	Google Cloud Platform
	AWS	

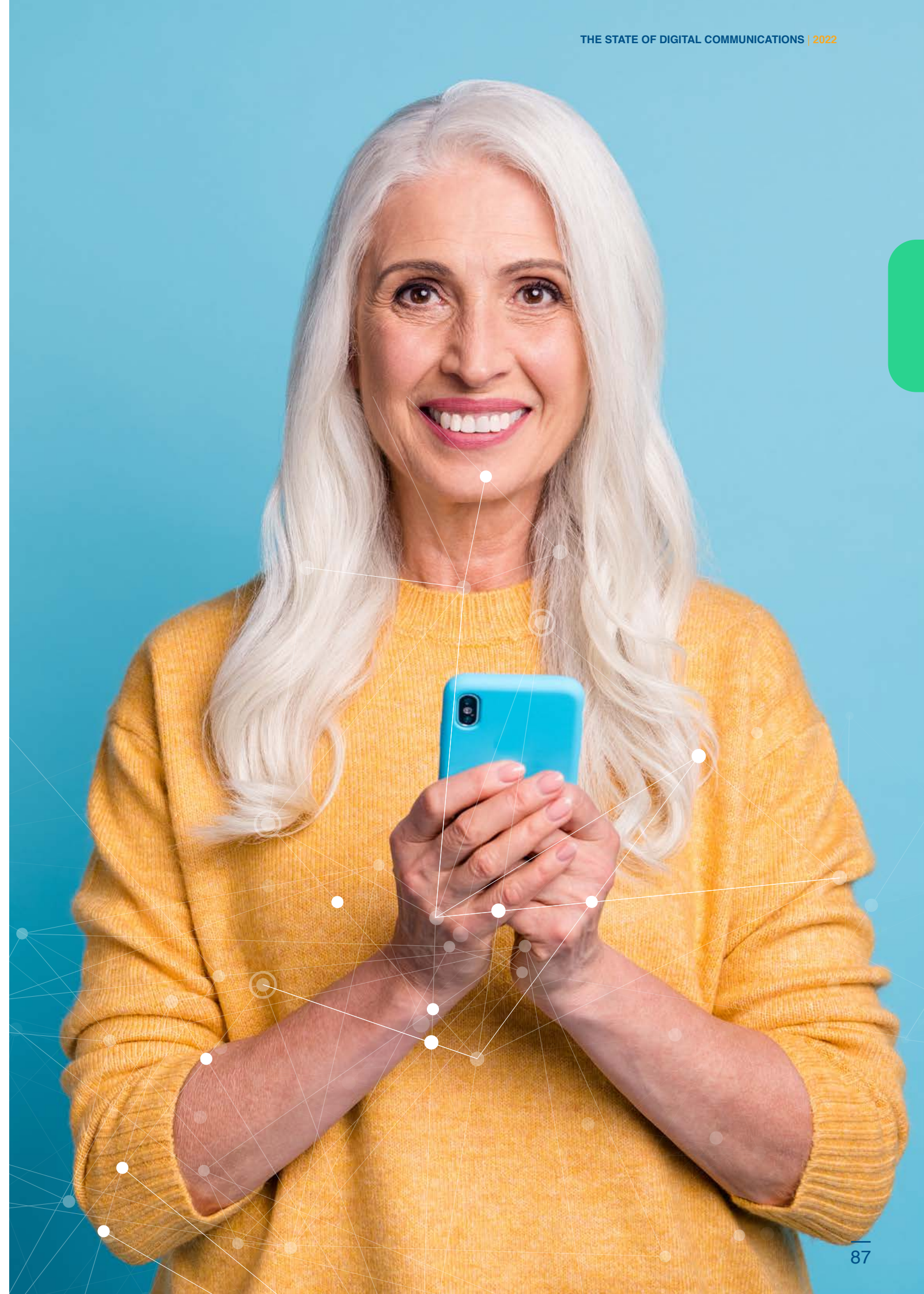
Source: Analysys Mason, 2021

The top four global leaders on the public cloud infrastructure market – often referred to as hyper-scalers – are Amazon Web Services (AWS), Microsoft Azure, Google Cloud and Alibaba Cloud. They will account for over 80% of global revenues in 2021 according to Gartner.¹⁴

The creation of so-called sovereign or compliant clouds is intended to ring-fence European or national-level data and to apply European levels of security and privacy. A key objective of the Gaia-X initiative, for example, is to create federated and secure data infrastructure. Companies, citizens and the state/public sector will collate and share data in such a way that they can maintain control over it. Some ETNO members have launched sovereign clouds that disable the flow of data out of the jurisdiction of the EU or of sovereign states. These can involve the participation of large PCPs, but not on their standard terms. For example, Orange has announced the setup of a new Company Bleu together with CapGemini that will offer a “Cloud de Confiance” as defined by the French security agency ANSSI. The service will rely on Azure and targets the public sector as well as Vital Importance Operators and Essential Service Operators. It intends ultimately to join the Gaia-X initiative of which Orange and CapGemini are members. Deutsche Telekom has also launched a sovereign cloud, this time in partnership with Google. It is targeted at enterprises, the public sector and the healthcare sector, and is initially for Germany only, but may extend into Switzerland and Austria.



¹⁴ <https://www.gartner.com/en/newsroom/press-releases/2020-08-10-gartner-says-worldwide-iaas-public-cloudservices-market-grew-37-point-3-percent-in-2019>



7. USING NEW 5G OPPORTUNITIES TO EXPAND ECONOMIES

As 5G matures and as 5G SA is deployed, 5G can be used for new use-cases and to improve the efficiency of existing networks. This creates value and thereby expands economies. Many studies have shown that 5G is expected to drive GDP growth; for example, PwC estimates that 5G will have added USD1.3 trillion to the worldwide GDP by 2030 (equivalent to 1.0% of the 2019 figure). This figure is forecasted to be USD119 billion in Germany and the UK alone.¹⁵

Operators are a key part of the new 5G-enabled ecosystem, although their exact role and their share of the new value created will vary according to local circumstance.

7.1 Enterprise/private networks and 5G use-cases

Operators can develop 5G use cases in both the consumer and business sector to differentiate their services. The potential of 5G has largely been linked to the business sector.

Consumer 5G use cases largely revolve around gaming, the introduction of AR/VR headsets and immersive fan viewing experiences. The concern for operators is the degree to which 5G connectivity uniquely enables such services. AR and low-latency mobility seem well-matched, but consumer entertainment applications involving fully immersive VR and 5G seem, on the face of it, unlikely. Some operators are weighing up their potential roles as enablers and are qualifying the opportunity with potential partners in the gaming space, for example.

Enterprise 5G use-cases appear to provide more commercial promise. ETNO members are exploring 5G use cases for a wide range of verticals including manufacturing, sports, entertainment, automotive and public safety. It is still early days, and the slicing capability largely depends on the implementation of a 5G SA core. **FIG 7-1** provides some key early examples of operators' 5G use-cases.

FIG 7-1 : Assignments of spectrum in the main 5G bands, Europe, November 2021

Operator	5G use cases
KPN	KPN has deployed an array of networks at Unmanned Valley, including 5G, LoRa, LTE-M and 4G. It plans to use these networks to enable businesses to trial drones and sensor-related technologies/applications.
Orange	Orange has implemented a 5G network at the Orange Vélodrome stadium in Marseille and is exploring 5G use-cases. These include 360-degree immersive viewing using VR, augmented acoustics and IoT solutions that use sensors to ensure an optimal environment for customers. Orange Vélodrome was the first 5G stadium in France. Orange is also testing indoor 5G connectivity at Schneider Electric. Its 5G indoor network and network slicing are being used to improve factories' operational efficiency. Orange has also tested an AXYN mobile telepresence robot on the 5G network, which enables remote visits to the factory site.

Proximus	Proximus opened its first 5G lab in Wallonia in October 2021, and aims to test 5G-connected solutions to optimise industrial processes.
Deutsche Telekom	Deutsche Telekom has introduced a 5G campus network at the University Hospital in Bonn, which uses spectrum in the 3.6GHz band. The hospital will use 5G to transport images from x-rays, radiology and MRT to secure locations. Deutsche Telekom and Nokia have been testing the use of network slicing in 5G networks at the Port of Hamburg. The three major use cases that have been tested so far are using sensors to track ships' positions and monitor conditions in real time to improve port navigation and connecting a traffic light system to the 5G network.
Telefónica	Telefónica has deployed in Spain alone over 60 use cases testing the benefits of this technology and its potential with different clients in all types of sectors, in various fields of activity such as Industry 4.0, ehealth, connected car, infrastructure and transport, tourism or media, among others. ¹⁶

Source: Analysys Mason, 2021

More and more industries are beginning to deploy private networks. LTE-based private networks remain popular, largely because LTE technology has been available for longer and industries may not always need or demand the same upgrade cycles as public mobile network operators. The industries that are using mainly private LTE networks include mines, factories and ports. LTE-based private networks have mostly been used for mobile broadband connectivity (for example, for a mobile workforce), industrial equipment connectivity and asset tracking. However, 5G's enhanced capabilities, including low latency, high throughput and high reliability, have resulted in an increasing interest in private 5G networks in factories. Private 5G networks are also being used for industrial equipment connectivity and asset tracking, but are additionally used in automatic guided vehicles (AGVs). New 5G spectrum availability has been instrumental in enabling operators to deploy networks.

European operators face stiff competition in the private network space from network equipment providers, which still deploy the majority of private networks. However, operators' network management expertise puts them in a good position to challenge vendors in the private network market. Indeed, operators are increasingly getting involved with the deployment of private 5G networks because the complexity of 5G technology has made their involvement vital (their involvement was less essential for private LTE networks).

Over 111 publicly disclosed private networks have been deployed across Europe as of October 2021, and 45 of these involved operators as the main contractor (40.5%). Over half of the 45 private networks deployed by an operator were deployed by ETNO members, thereby demonstrating that ETNO members are leading the way in terms of private network deployment.

¹⁵ PwC (2021), The global economic impact of 5G. Available at <https://www.pwc.com/gx/en/industries/technology/publications/economic-impact-5g.html>.

¹⁶ <https://www.telefonica.es/es/casos-de-uso-5g>.

8. OPERATORS' ROLE IN EUROPEAN TECHNOLOGICAL INNOVATION

EU initiatives aim for the development of new technology to occur within Europe, rather than relying on other regions to produce solutions, as done previously. The EC kicked off two new industrial alliances in July 2021: the Alliance for Processors and Semiconductor Technologies and the European Alliance for Industrial Data, Edge and Cloud. Both of these alliances aim to bring together businesses, state representatives, academia, users and research and technology organisations in order to progress the development of chips and data, edge and cloud technology within Europe. This section discusses operators' role in the key areas of technological innovation.

8.1 Open RAN

Open RAN is becoming a key area of interest among operators as they evaluate cloud-based RAN infrastructure, disaggregated RAN and alternative deployment options for 5G. The key feature of Open RAN is that it widens the overall supply options and increases specialisation in the development of sub-components, thereby allowing new innovation to be introduced more quickly. Operators will be able to select RAN equipment (such as the antennas and the DU/CU) or software from the providers that best furnish their needs, and connect them through a vendor-agnostic interface. A more diversified RAN ecosystem is expected to spur more innovation in support of new capabilities, such as customised 5G networks or energy efficiency improvements on both the semiconductor and software side, as well as to increase European strategic capabilities in this area. The hope is that Open RAN will transfer some control back to operators that have become over-reliant on large monolithic RAN vendors. Open RAN benefits include avoiding vendor lock-ins, reducing the total cost of ownership and providing operators with more flexibility and possibility for service innovation. ETNO members have been at the forefront of Open RAN development. Several ETNO operators are members of industry alliances such as the O-RAN Alliance, the Telecom Infra Project (TIP) and the Open Networking Foundation (ONF). Orange's support for Open RAN is demonstrated in its plan to solely deploy Open RAN compatible equipment in its network from 2025. In fact, Orange, Deutsche Telekom, Telefónica, TIM, and Vodafone have all committed to Open RAN deployments in a memorandum of understanding.¹⁷ These five operators, four of which are ETNO members, will work together and with industry bodies to develop Open RAN architecture across Europe.

- Deutsche Telekom has switched on its 'O-RAN Town' deployment in Neubrandenburg, Germany. O-RAN Town is a multi-vendor Open RAN network that will deliver open RAN based 4G and 5G services. The first sites are now deployed, including Europe's first integration of massive MIMO (mMIMO) radio units using ORAN open fronthaul interfaces to connect to the virtualised RAN software.
- Orange has launched in July 2021 a 5G SA experimental network in France to act as a blueprint for the next generation of more efficient and agile networks. This network includes a cloud 5G Open RAN. In addition to the recently launched Open RAN test and integration centre, it will contribute to prepare Orange's commitment to deploy only Open RAN based solutions from 2025 onwards.
- Telefónica has collaborated with NEC as an integrator to develop pre-commercial trials of multi-vendor-based Open RAN solutions, validating and implementing cutting-edge Open RAN technologies and various use cases in Telefónica's Technology and Automation lab in Madrid.

There are global examples of Open RAN networks already up and running (for example the new network established by Rakuten Mobile with NEC in Japan). However, Open RAN is still perhaps three to five years away from being commercially rolled across established European operators' networks. Several aspects are still under progress before full implementation, including standardisation, cybersecurity or energy efficiency.

Open RAN architecture also creates potential benefits for enterprises and opportunities for operators in the private LTE/5G networking space. The cost reduction and flexibility associated with Open RAN will be the key benefits for enterprises. Concentrated networks where traffic can be managed and controlled (such as in a factory or port) could be an ideal testing ground for open and disaggregated technologies, further driving the development of mature solutions for macro deployments in public mobile networks.

Open RAN creates the opportunity to build and develop a strong local EU ecosystem. If the EU is to maintain its competitiveness, assert some technology leadership and resilience, decisive action by policymakers and collaboration by industry stakeholders is needed. Policy in the USA and in Japan strongly incentivises the development of home-grown Open RAN. If Europe does not also do so, it risks falling behind North America and Asia in the development and deployment of 5G and 6G, and it leaves operators with little choice but look elsewhere for Open RAN.¹⁸

¹⁷ <https://telecominfraproject.com/OpenRAN-MoU-Group/>

¹⁸ See <https://media.orange.com/c/sirius/building-open-ran-ecosystem-europe-1.pdf>

8.2 Edge cloud computing

Edge cloud computing is becoming important to enterprises in a wide range of verticals that wish to process and store large amounts of data locally, rather than in their centralised corporate clouds or public clouds, for reasons related to regulation, security, performance and/or cost efficiency. The term ‘edge cloud computing’ is used to describe cloud-enabled application and data processing that takes place in multiple, highly distributed locations that are far closer to the sources of the application data than private and public cloud computing locations are today. This proximity is typically measured in terms of round-trip latency; edge computing locations are often at most 10ms¹⁹ away from the data source, whereas public cloud data centres (of which there are just a few hundred worldwide) can be 100ms away.

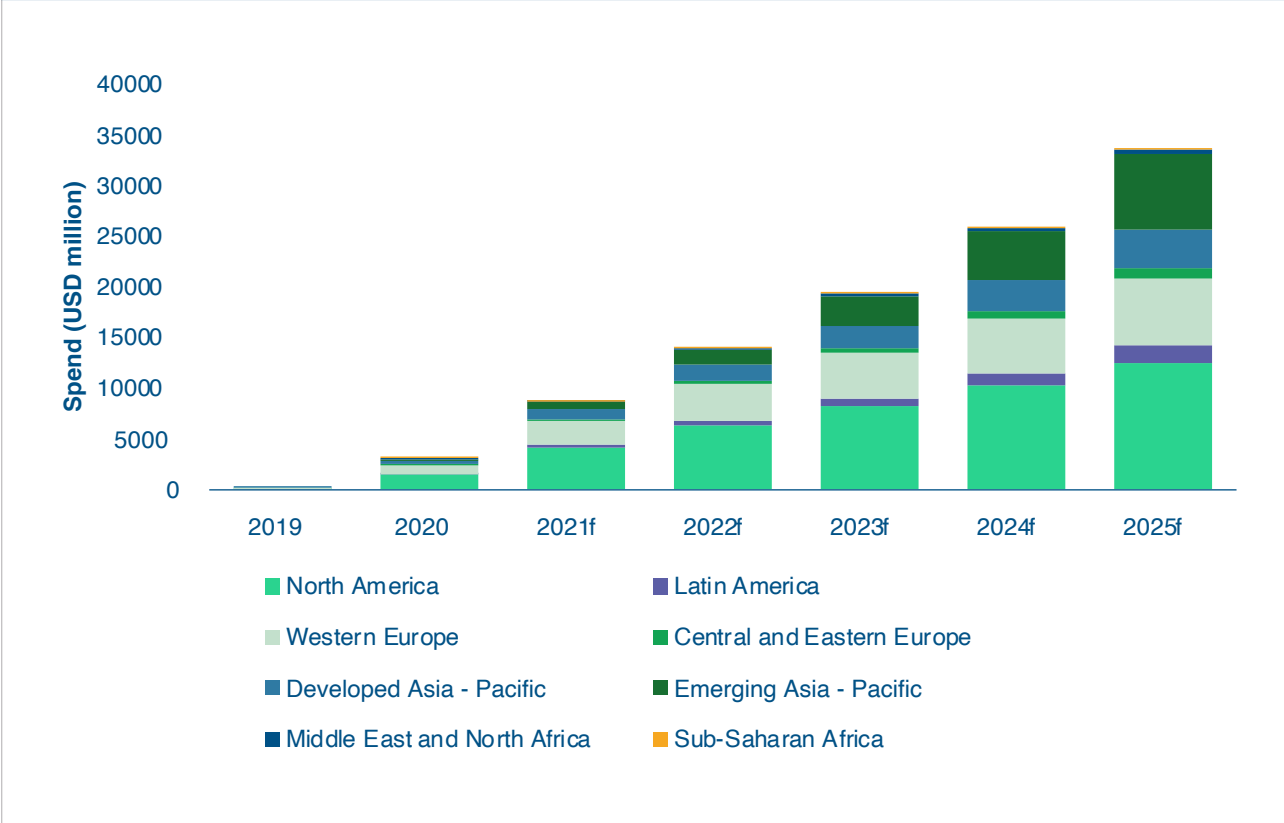
Owners of high numbers of potential locations for edge computing are in a strong position to become public edge cloud providers (that is, providers of on-demand compute resources to multiple customers). Telecoms operators match this profile because the delivery of telecoms networks requires them to have large numbers of highly distributed locations at the edges of their networks to house ‘last mile’ networking equipment. Such sites include cell towers, street cabinets, central offices, metro nodes and data centres. Many operators have made a clear link between edge cloud and 5G, but it should be noted that not all of the use cases cited by operators require 5G. Indeed, fibre could be just as effective in some cases. Operators are also in a good position to play a stronger role than that of the infrastructure provider due to their existing enterprise and consumer customer bases and their local knowledge.

Operators have cited a range of use-cases for edge computing and a dominant use case is yet to emerge. However, real-time analytics and autonomous and connected vehicles are the most commonly cited use-cases and are mentioned by an increasing number of operators. Industrial/manufacturing and consumer gaming/entertainment are the most cited verticals that would use edge cloud services. For example, edge specialist MobileEdgeX focuses on gaming and entertainment use-cases. The wide range of use-cases highlights the immaturity of the edge computing market. Operators are still trying to establish the applications that are best-suited to the technology.

The scale of the edge computing opportunity is significant. The European Commission’s “New Industrial Strategy report 2020” cited that “generated data is greatly increasing, and a growing proportion of data is being processed at the edge.” The report noted that “by 2025, 80% of all generated data are expected to be processed at the edge”.²⁰ Furthermore, it is forecasted that spending on edge cloud services by enterprises alone will amount to USD 7.6 billion in Europe and USD 35 billion worldwide by 2025 (FIG 8-1).

¹⁹ <https://assets.lumen.com/is/content/Lumen/trend-report-the-edge-compute-imperative?Creativeid=73b32a74-65bb-4be5-a8be-a4edc71d945d>
<https://www.landmobile.co.uk/news/amazon-teams-with-vodafone-on-uk-edge-computing-launch/>
²⁰ https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-industrial-strategy/depth-reviews-strategic-areas-europes-interests_en

FIG 8-1 : Enterprise spending on public edge computing services, by region, worldwide, 2019–2025

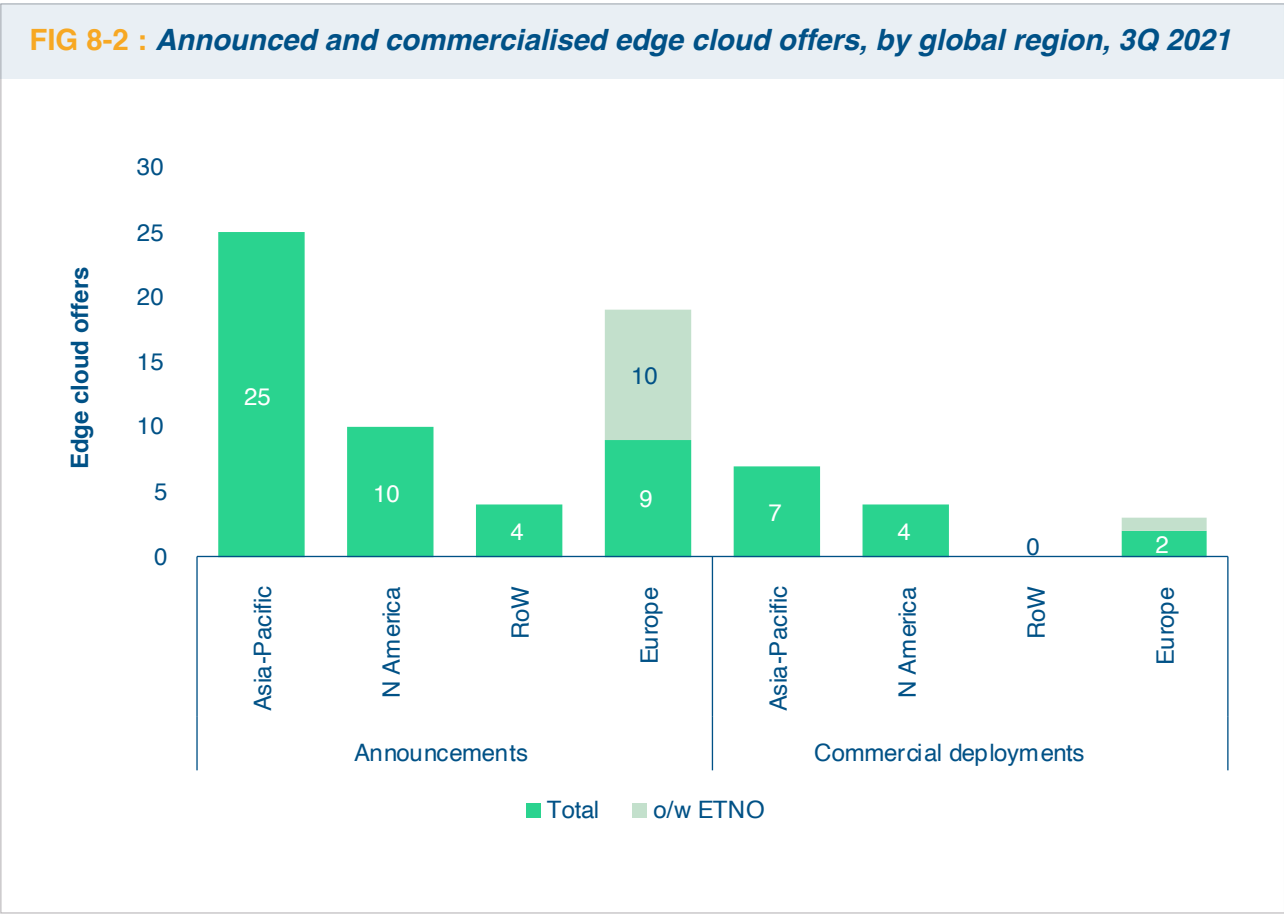


Source: Analysys Mason, 2021

The EC’s Digital Decade target of establishing 10 000 edge cloud nodes by 2030 was its first target for deploying edge nodes. Breaking this target down to a Member State level implies a much denser distribution of computing resources than what could be achieved with a traditional and centralised cloud architecture today. By deploying such a network of edge nodes across EU territory, the European Commission aims to provide the processing capacity and latency that is needed to enable the next generation of innovative use-cases in Europe. The IPCEI on Cloud Infrastructure and Services aims to support the technological development and deployment of cloud-edge infrastructure and technology that aligns with EU regulations and values. The IPCEI-CIS will outline standards on security and scalability for future data processing ecosystems. By May 2021, 12 EU states have become actively involved in this project. The recent European Alliance for Industrial Data, Edge and Cloud, of which several ETNO operators have become members, also aims to strengthen EU capacity in edge deployment.

58 operators worldwide had announced plans for edge cloud infrastructure and services as of September 2021, 19 of which are in Europe and 10 are ETNO members (FIG 8-2). Most of these operators are working with the 3 largest PCPs, although edge specialist MobileEdgeX, which focuses on gaming and entertainment use cases, is working on pilots with Deutsche Telekom, KDDI, NTT, Telefónica and TELUS. 14 operators worldwide had commercially launched edge cloud offers as of 3Q 2021, 3 of which are in Europe. KPN’s infrastructure is one of the densest in the world in terms of the number of sites at which edge cloud is now commercially offered: it offers it from 161 metro core locations.

FIG 8-2 : Announced and commercialised edge cloud offers, by global region, 3Q 2021



Source: Analysys Mason, 2021

8.3 Operators’ investment in big data

Operators have invested heavily in data platforms for their internal operational requirements and continue to do so. They initially used these platforms to support more-precise customer engagements in order to provide better experiences for their subscribers. This is now changing; operators are now carrying out big data analysis to support network functions and operational systems.

Operators continue to look for new ways to use data for external monetisation. However, due to strict sectorial requirements set out on the telecoms sector by the current ePrivacy Directive (which is currently under review), innovation based on processing communications data remains a challenge for operators. By contrast, the horizontal General Data Protection Regulation (GDPR) enables more flexibility through its risk-based approach, especially for all those sectors that are not covered by the additional ePrivacy Directive.

European operators have been involved with the commercial selling of aggregate and anonymised data in compliance with data protection rules for a number of years and this activity offers the potential for additional revenue streams. Selling data insights has historically accounted for a very low percentage of operators’ total revenue, but the arrival of new services and new EU-based initiatives may result in market growth. Some examples of operators’ external data monetisation solutions are shown in FIG 8-3.

FIG 8-3 : Examples of operators’ external data monetisation services in a range of verticals, worldwide²¹

Sector	Applications	Operators (solution name)
Retail	Footfall analysis, customer journey profiling, client profiling, campaign insights, competitor insights and new store planning	EE (mData), Orange (Flux Vision) and Telefónica (LUCA Store)
Tourism and events	Footfall analysis, client profiling, traffic and crowd analysis and event planning	Orange (Flux Vision), Telefónica (LUCA Tourism) and Spark (Qrious Voyager)
Transport	Traffic and crowd analysis, real-time traffic information and traffic and route planning, travel emission insights	EE (mData), Orange (Flux Vision), Telefónica (LUCA Transit), Telia Company (Crowd Insights), Singtel (DataSpark)
Government, public services and smart cities	Traffic and crowd analysis, disaster detection and smart city and public services planning	EE (mData), Telefónica (LUCA Transit), Telia Company (Crowd Insights), Singtel (DataSpark)
Financial services	Fraud reduction, credit scoring and improved customer experience	Telefónica (LUCA Smart Digits). Turkcell (Analytics as a Service - Credit Risk Scoring with Telco Data)

Source: Analysys Mason, 2021

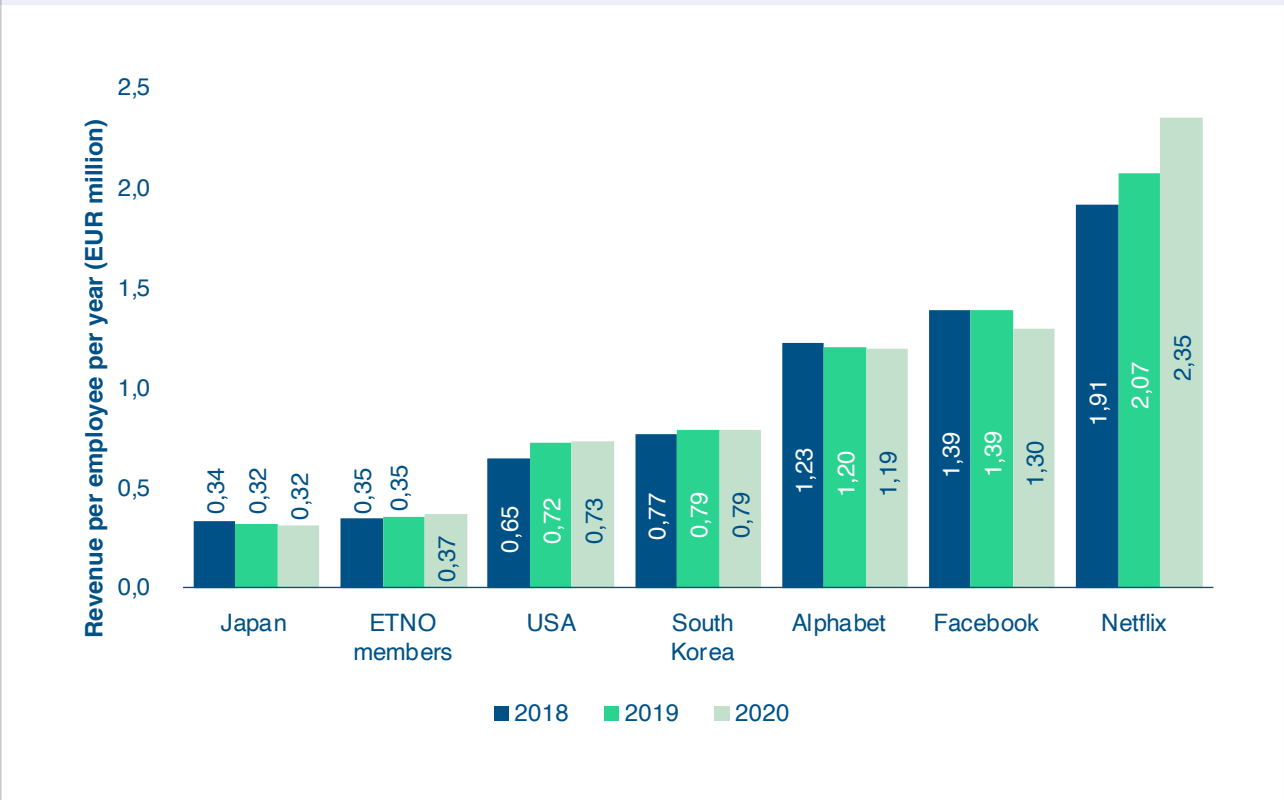
²¹ ETNO members are shown in **bold**.

The EC unveiled its new Data Strategy in 2020, built around the creation of a single market for data within the EU. This market will be supported across sectors and for the benefit of all, especially through the establishment of common European *data spaces* to standardise data formats and to ease data sharing and pooling in nine areas (Health, Industrial & Manufacturing, Agriculture, Finance, Mobility, Green Deal, Energy, Public Administration, and Skills).

8.4 Operators' investments in analytics and artificial intelligence (AI)

The advent of 5G SA, combined with new services using network slicing, open architecture and the disaggregation of network appliances into functions running on general-purpose hardware, is accelerating the demand for more intelligence for networks and operations. This demand is founded upon the proven efficiencies found in hyperscaler business and from telecom operators from other regions globally. FIG 8-4 shows that ETNO members are behind peers in other regions around the world in terms of the revenue generated per employee. There are critical differences between hyperscalers' companies and telecoms operators' businesses, but a higher degree of automation is known to support increased revenue per employee.

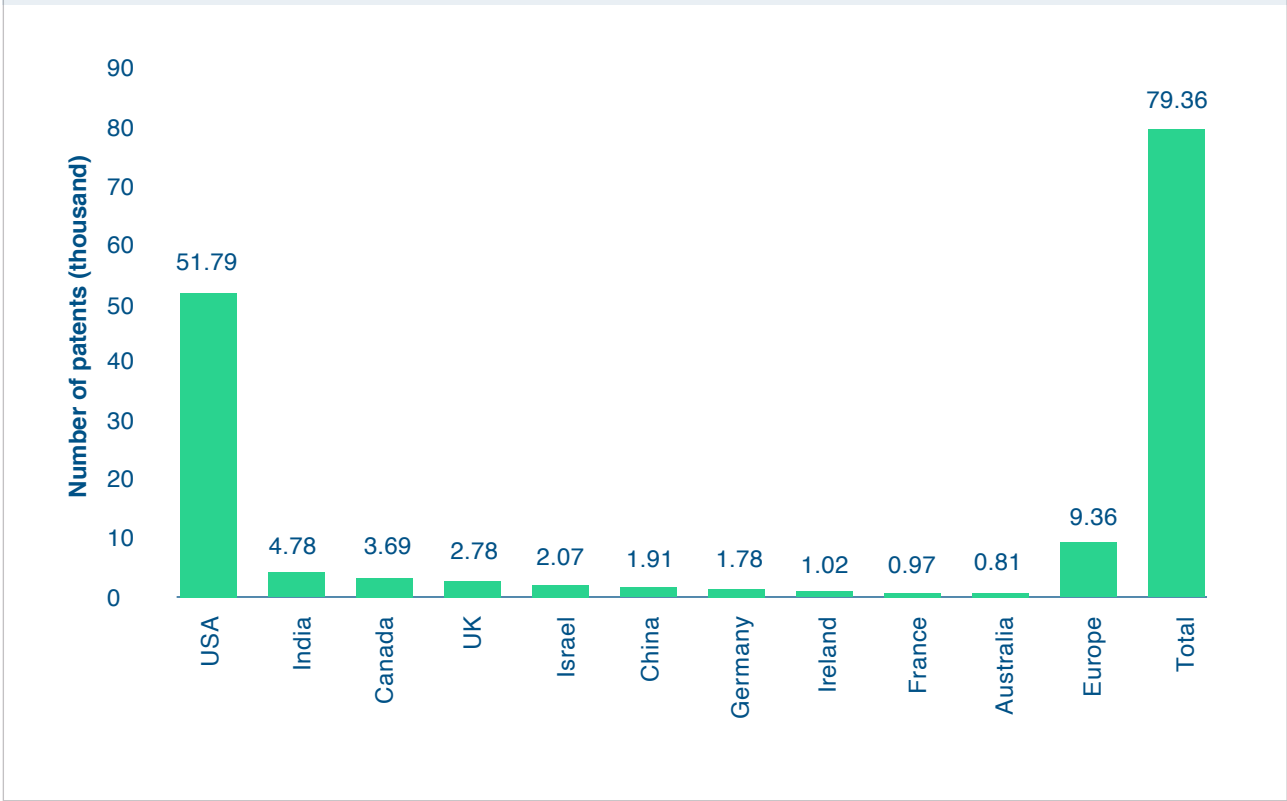
FIG 8-4 : Revenue per employee for ETNO members, operators in Japan, the USA and South Korea and selected hyperscalers, 2018–2020



Source: Analysys Mason, 2021

The use of data-driven decisioning in the form of AI or related analytics tools is recognised as part of the solution to enable personnel to make operations more efficient and to support the increasingly complex new 5G use-cases. European operators have also been investing in big data, analytics and more-advanced AI solutions for improving the functioning of internal systems, and vendors that support telecoms operators have also been actively supporting operators with their new requirements by helping to build new technology. The European patent office reflects the activity in the telecoms space; nearly 70 000 patents including the terms telecoms and analytics have been filed since 2010. However, even more such patents have been filed in the USA (FIG 8-5).

FIG 8-5 : Number of patents including the terms telecoms and analytics filed by country, worldwide, 2010–2021



Source: Analysys Mason, 2021

The European stance on using AI to help build a long-term leadership for the Digital Decade is focused on building trust in the use of AI. The EC published an AI package in April 2021 that proposed new rules to help promote and facilitate increased trust in the technology through creating strong regulations and governance for high-risk AI.

8.5 Playing a leading role in the early development of 6G

It is a reasonable assumption that there will be something called 6G, and that it will come to market in about 8-10 years (as is typical for the next generation of mobile networks). However, what it will be in terms of use cases and spectrum arrangements is still to be decided.

Regaining some technology leadership and affirming technology sovereignty in strategic R&D areas are at the core of the EC's aim for 6G. The EC announced that it would invest EUR900 million into 5G deployment and 6G research as part of its new R&D technology strategy, Horizon Europe, which replaces the old Horizon 2020 strategy and is due to run until 2027. Additionally, a joint undertaking on smart networks and services has now been created under Horizon Europe.²²

The 5G Public Private Partnership (5G PPP) was established as a joint initiative between the EC and the European ICT industry (formed of vendors, operators, service providers, SMEs and academia). The private industry arm of the 5G PPP, the 5G Infrastructure Association, stated that, "Europe's goal shall be to ensure leadership in strategic areas and find alternate ways of establishing a secure and trusted access to those technologies, where a European supply network cannot be established."²³ A further aim of the EC is that 6G should contribute to the UN's Sustainable Development goals.

Much of the initial focus on 6G research has come from academia. There is significant interest in exploring the potential of sub-terahertz spectrum (up to 275GHz), which will be both plentiful and extremely short-range, and will therefore be suited to use cases that involve massive-scale connectivity fuelled with distributed AI.

- The German government has allocated EUR 685 million to 6G research until 2025, with specific funding to universities in Munich and Dresden.
- The University of Oulu's 6Genesis project, which has attracted EUR 250 million of public and private funding, has partnerships with the University of Tokyo and with Singapore's Future Communication Research and Development Programme.
- Establishments in the UK are developing their own technology research partnerships. British universities Bristol and KCL have jointly established 6G Futures, a hub for research in 6G. The British government formed a science and technology partnership with the US government in June 2021, the scope of which extends to 6G, AI and quantum technologies, among other areas.



ETNO members have also participated in academic research.

- Orange's Operator of the Future programme is focused on 6G research and cloud-oriented, software-enabled networking.
- Deutsche Telekom envisions "a human-centred global communication network," but stresses that its current priorities remain on 5G.
- The pan-European Hexa-X project has participation from Orange, TIM, Telefónica and Siemens.

It may transpire that it is more desirable, from an operator perspective, that 6G turns out to be an evolution of certain aspects of the IMT vision for 5G that have not yet been implemented, and that it uses a combination of the high frequency bands that have already been identified for 5G plus other bands above the current mid-band and below the current low-band (in effect what 4G/LTE was to 3G/UMTS). Some European operators have questioned the desirability of another major transformation towards the end of this decade while the capital cost of 5G transformation remains high and the industrial use-cases for 5G remain largely at the trial stage.

²² <https://digital-strategy.ec.europa.eu/en/policies/smart-networks-and-services-joint-undertaking>

²³ See 5G IA, *European Vision for the 6G Ecosystem*, June 2021

SECTION 4

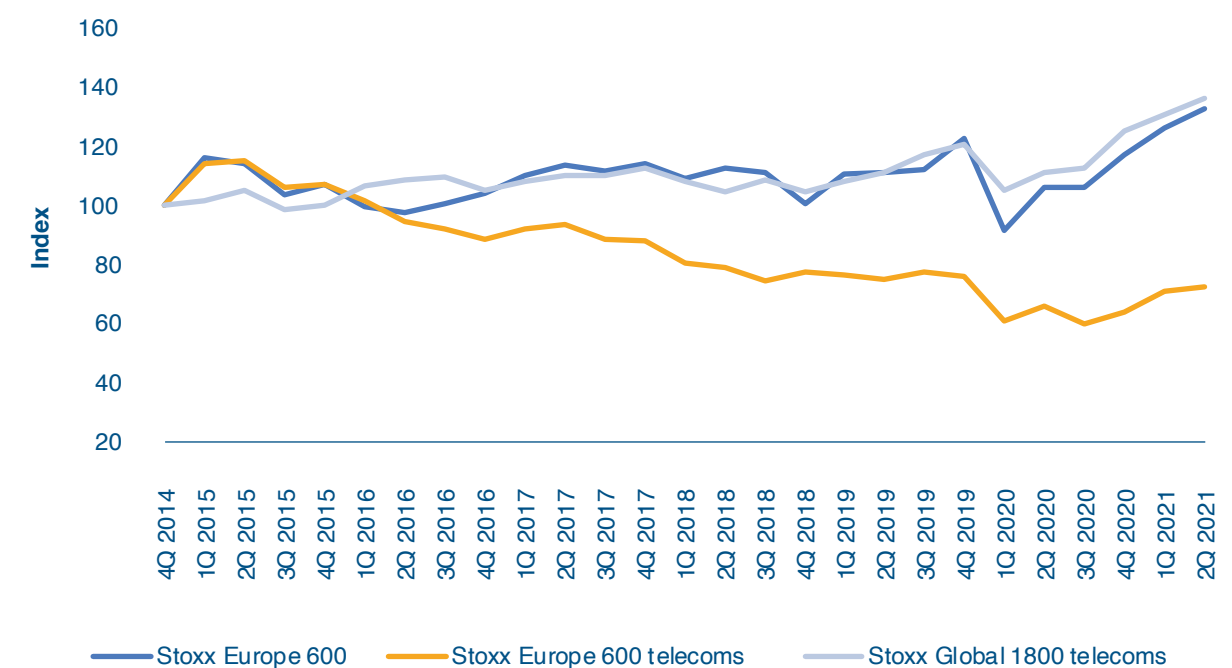
Networks are vital, but the financial outlook remains unclear for the telecoms sector

The pandemic has accelerated the digitalisation of lives and businesses. This would not have been possible without investment in robust, secure, high-capacity, high-coverage networks. Nearly two years after the start of the pandemic there is still a mismatch between the financial value of the telecoms industry and its social value. This section highlights Europe-specific problems in relation to the global trends in the telecoms market.

9. THE MARKET CONTINUES TO NOT VALUE EUROPEAN TELECOMS SERVICES

Stock prices for European telecoms businesses continue to lag behind both general European stock indices and global telecoms indices. The COVID-19 pandemic laid bare the social value of telecoms and created unprecedented levels of usage, but the European telecoms sector had not, by 2Q 2021, returned to its valuation immediately prior to the pandemic (4Q 2019), whereas the value of the global telecoms had risen by 13% (FIG 9-1).

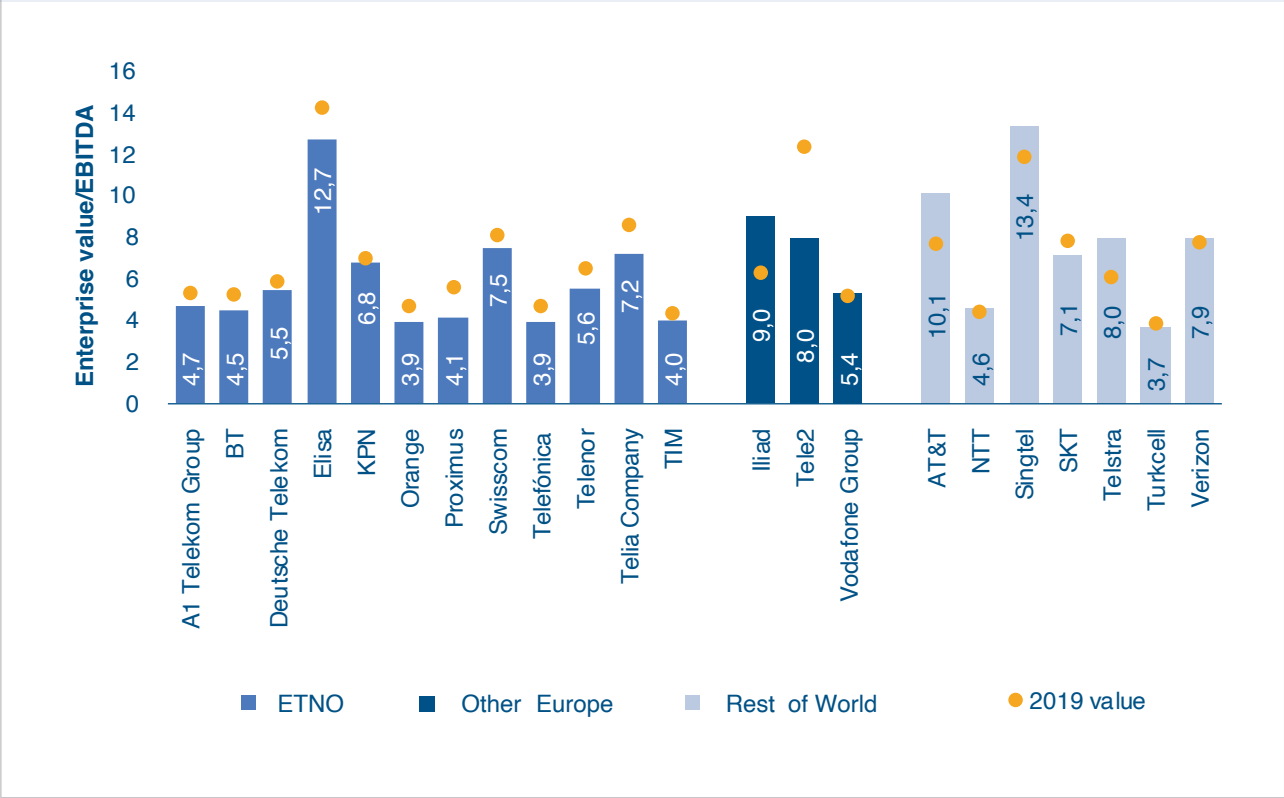
FIG 9-1 : Stoxx Europe 600 index, Stoxx Europe 600 index for telecoms and Stoxx Global 1800 index for telecoms, where the value in 4Q 2015 is set to 100, 4Q 2015–2Q 2021



Source: Analysys Mason, 2021

Operators’ enterprise value/EBITDA multiples had mostly declined at the end of 2020 around the world compared to the end of 2019, though this partly reflects the general slump in market capitalisations at the end of that year (FIG 9-2). The multiples for all ETNO members fell. On one side of the equation, these multiples tell of improving EBITDA margins for the operators, but on the other side they also reflect what is increasingly being considered to be poor revenue growth prospects and a concern that the sum of the parts of the European telecoms industry is worth more than the whole. While this might be desirable for some financial players, it is unclear whether it can serve the broader purpose of accelerating network roll-out and fostering innovation in digital services, as well as EU’s digital autonomy.

FIG 9-2 : Enterprise value/EBITDA, ETNO members and other operators, worldwide, end of last full financial year



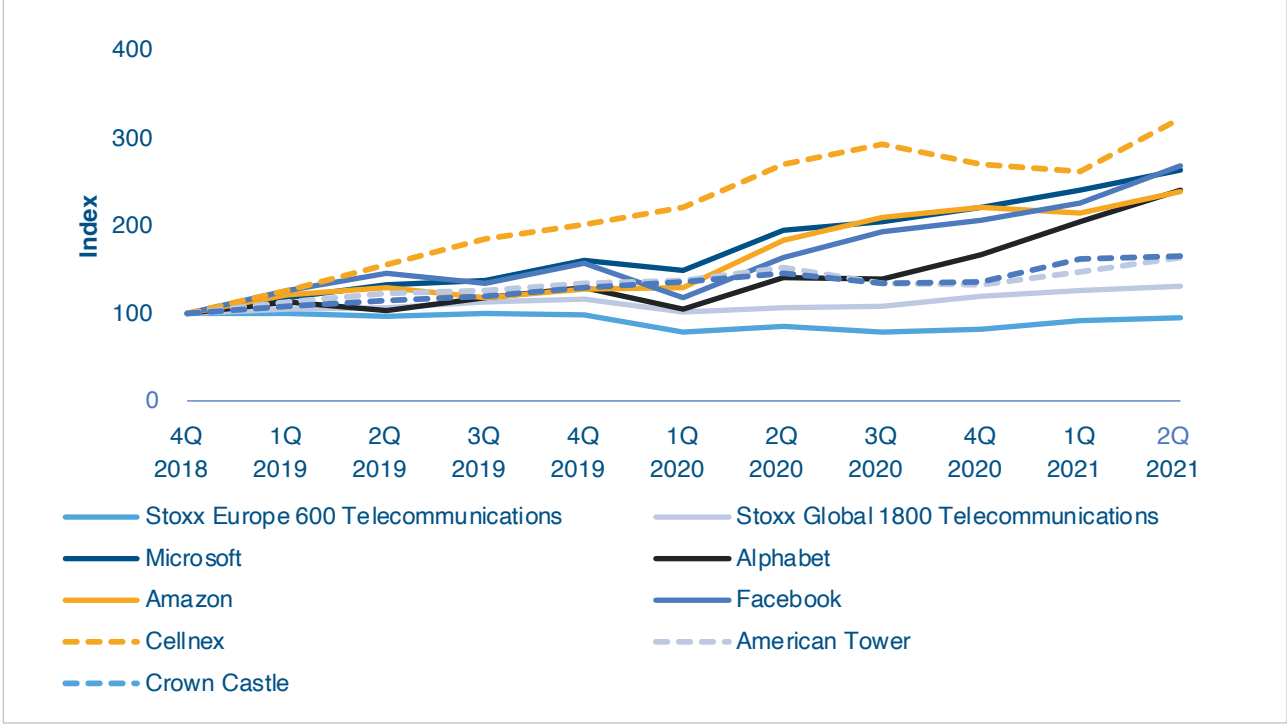
Source: Analysys Mason, 2021

Clearly European operators have bled more value than their peers elsewhere, although many of these have also seen falls in EV/EBITDA ratios. Much of the difference in outcomes can be put down to the consequences of regulation. However, at least some of this bleeding of value can be put down to a worldwide trend, namely the possible long-term disaggregation of:

- The service layer, in which the key asset is software. This value in this layer is driven by scale and data analytics, and is dominated by a mere handful of supernational players. No telecoms operator is likely to be able to become a global player, though there are some prospects where local regulation ring-fences participation.
- The physical network layer, the world of fibres, towers, spectrum and antenna investments that are specific to geographic locations. Players in the physical network layer have higher margins and regular returns, but weaker revenue growth prospects. They tend to only be able to generate strong revenue growth when bottlenecks can be established and defended; this is something that European regulators will not tolerate.

The financial markets tend to value more highly players with focus in either one or the other camp. FIG 9-3 shows a comparison of the stock performance of global telecoms and European telecoms against hyperscalers and selected leading towercos since the end of 2018.

FIG 9-3 : Stoxx Europe 600 index, Stoxx Europe 600 index for telecoms and Stoxx Global 1800 index for telecoms, where the value in 4Q 2018 is set to 100, 4Q 2018–2Q 2021 [Source: Analysys Mason, 2021]



Sources: Stoxx and Analysys Mason, 2021

EV/EBITDA multiples for Alphabet, Amazon, Facebook and Microsoft were between 20x and 34x at the end of 2020 and continued to grow in 2021. Implied EV/EBITDA multiples for towercos tend to be two to three times higher than the operator from which they were spun out, and similar multiples apply to FTTH spin-outs.

10. OPERATORS ARE REASSESSING THEIR ASSET PORTFOLIOS

At the same time as pressures to loosen or even undo vertical integration, operators also bear the heavy burden caused by the cost of deploying and operating 5G networks, expanding FTTH networks and migrating to the cloud. These operations place an additional strain on operators' financials and drive them to reassess their asset portfolios, sell or share asset classes and seek new, more co-operative business models.

10.1 Physical asset sales and carve-outs

Tower divestment continues, although it happens according to differing models: sometimes the straight sale of assets, sometimes the creation of a subsidiary over which the operator maintains a majority stake. European towers typically command a value between EUR 180 000 and EUR 400 000 each, and generally 16–25 times the annual EBITDA. These multiples are far higher than those of the businesses from which the towers are spun off.

Operators have also become more open to coinvesting in, and sharing, other physical asset classes. Indeed, many ETNO members (and other European operators) have entered into co-investment partnerships for FTTH, sometimes for their entire physical footprint and sometimes for just parts of that footprint. TIM has recently launched the first co-investment model covering the national territory.

Smaller players are increasingly splitting up: the former Icelandic incumbent operator's networks (passive and active, fixed, mobile and transport) have since 2021 been under completely separate ownership from the retail business since October 2021. Similar operations in Denmark and the Czech Republic have been separated, though they currently still have common ownership. Private equity take-overs with separation in mind are a distinct possibility for some of the larger European operators. Private equity funds tend to favour separation because they believe that the service business and the network business would separately have more focus and would deploy the correct level of investment without special consideration for the other part.

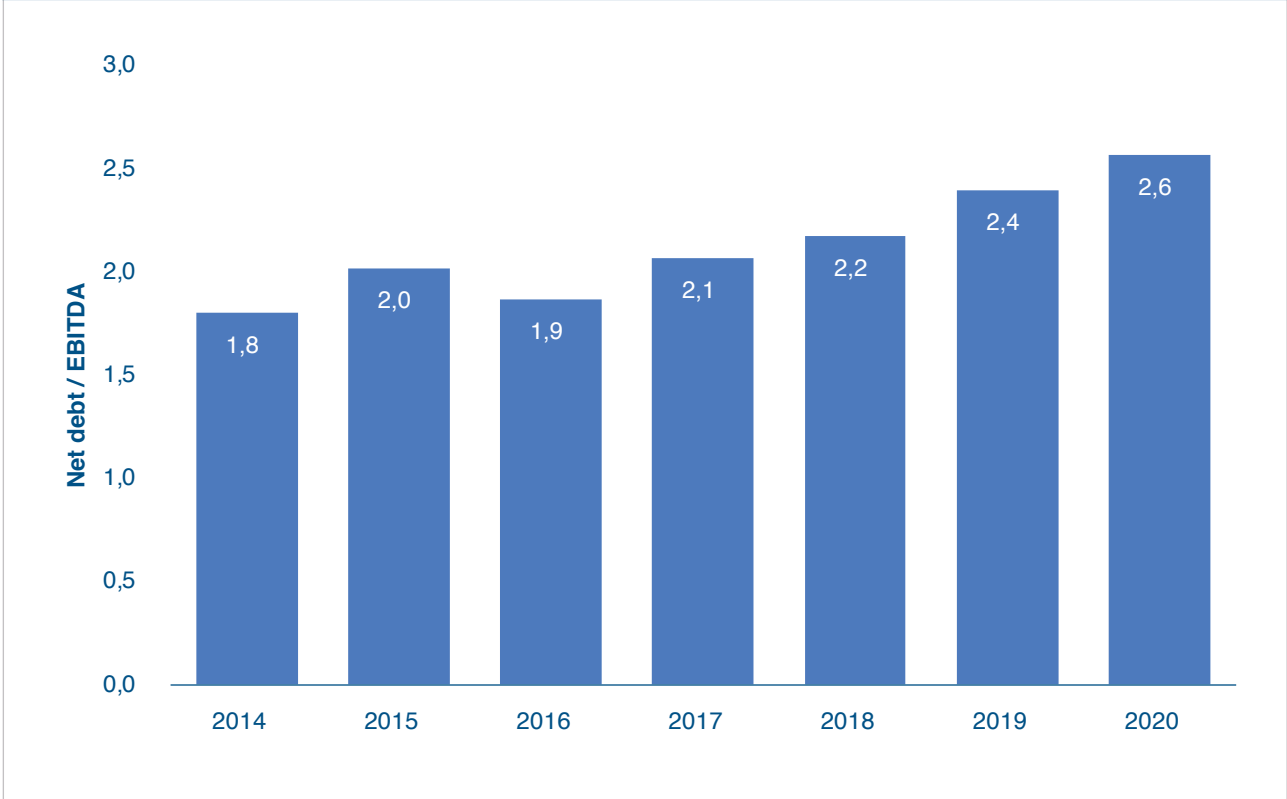
The assets that operators are selling are not confined to the traditional physical assets of a telecoms network. Indeed, operators have also pulled back from data-centre ownership and from individual service businesses, either by creating separate units, selling stakes to investors or selling these units off completely.

Co-investment trends enable new investors to enter the market in partnership with experienced operators, rather than as competitors. They also enable perhaps a fuller realisation of the revenue growth potential of the assets in question. However, they also risk operators' losing control over the end-to-end value chain.

These trends are not unique to Europe. Towers are being sold off around the world, FTTH assets are being carved out elsewhere (particularly in Latin America) and US giants AT&T and Verizon have returned to more connectivity-focused businesses because forays into content and web properties failed to pay off.

Nonetheless, these trends are stronger in Europe than anywhere else in the world. The European telecoms market has a high level of debt (FIG 10-1) and low ARPU, and European operators are relatively small scale. All three of these factors are further exacerbated by a high level of regulation.

FIG 10-1 : ETNO member net debt/EBITDA, Europe, 2014–2020

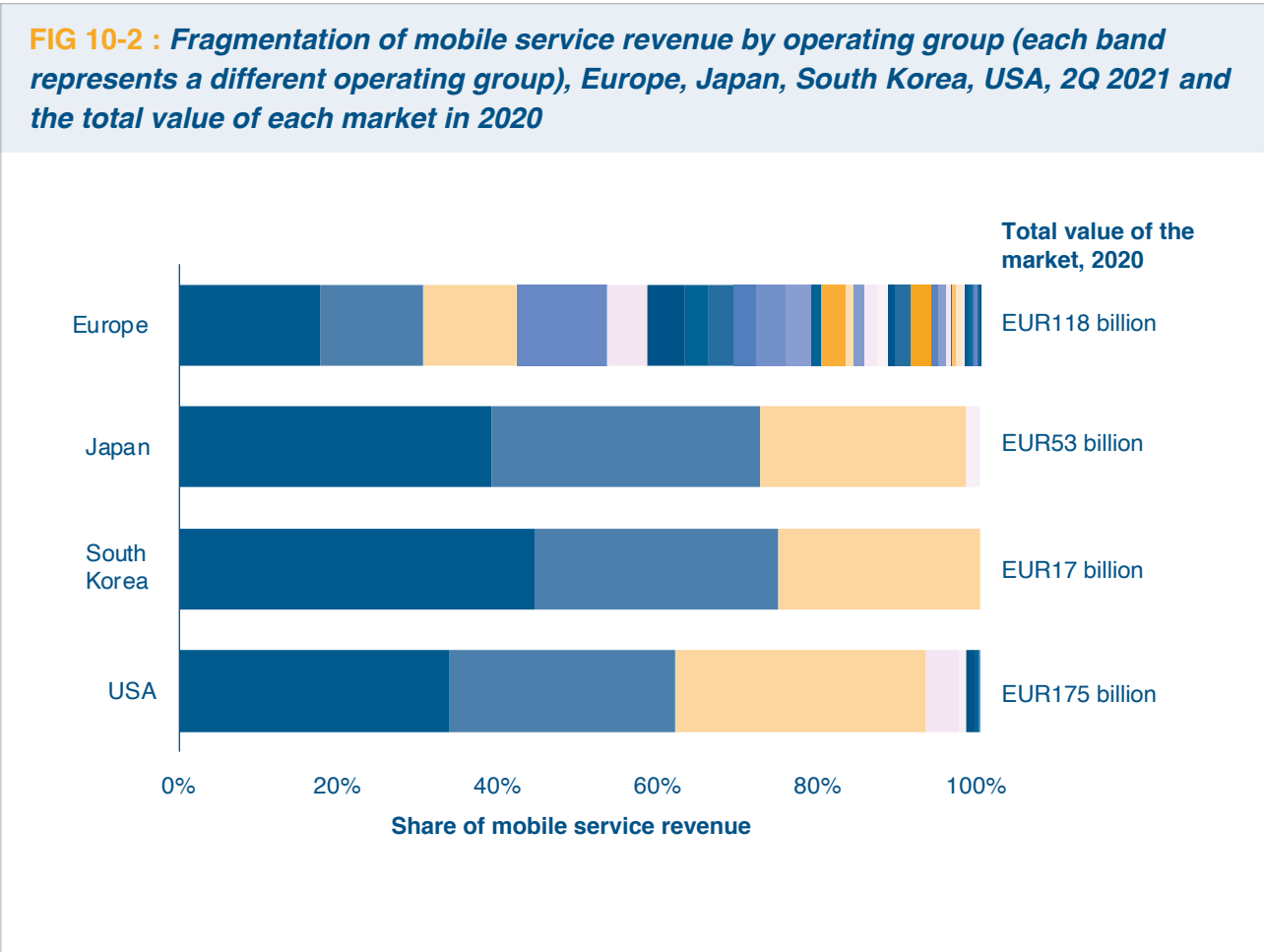


Source: Analysys Mason, 2021

“ Europe has created fragmented telecoms markets. As a result, the health of the sector is weaker. We believe this is not in Europe's strategic interest. ”

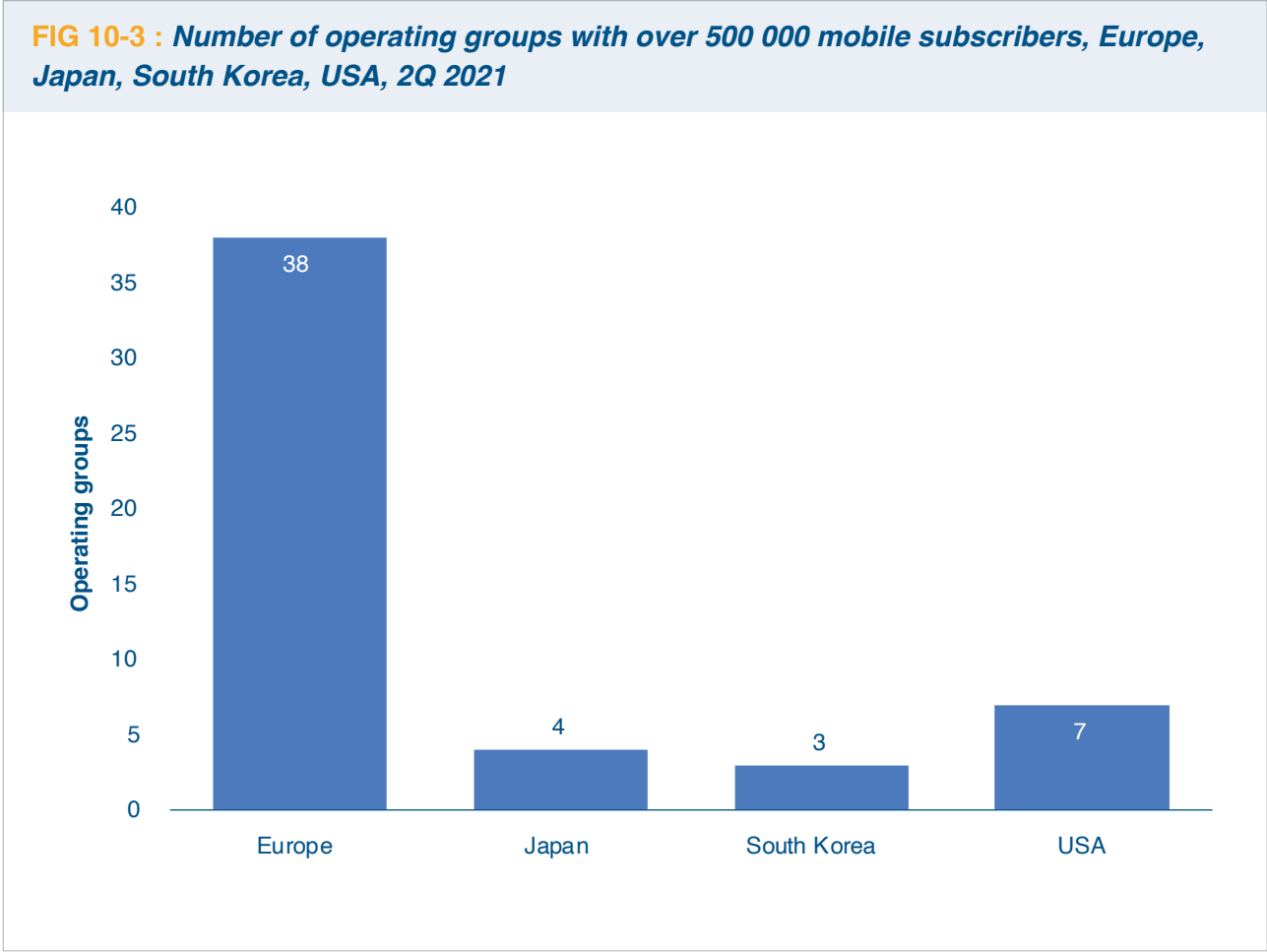


FIG 10-2 shows how fragmented the European mobile market has become compared to the markets in Japan, South Korea and the USA.



Source: Analysys Mason, 2021

The European telecoms market remains heavily regulated and in-market consolidation is difficult. As a consequence, the make-up of the sector is quite unlike that in similar advanced economies. The fixed broadband market is particularly heavily regulated and allows multiple entry possibilities for players that do not invest in their own infrastructure. In mobile, there are 38 operating groups with a mobile subscriber base of over 500 000 in Europe as of 2Q 2021 (**FIG 10-3**).



Source: Analysys Mason, 2021

The broader ICT sector is also unevenly regulated in Europe. In addition, telecoms operators have long been barred from making acquisitions following competition law assessment, but there are few constraints on hyperscalers buying out players in order to remove competition. Such moves are known as 'killer acquisitions' because they stifle fledgling innovative competition. Operators, similarly, to players in other sectors, have to operate in contestable markets, and those players that have enjoyed great success over the past two decades in the online space (the current hyperscalers) should also bear the same kinds of responsibilities that historical incumbent operators (that is, ETNO members) have had to shoulder. This will become increasingly important as ever more industries digitalise and become dependent on the same hyperscale providers.

11. OPERATORS, OVER-THE-TOPS AND UNDER-THE-FLOORS: WHO OWNS THE TELECOMS SECTOR?

Two classes of players are currently making inroads into the telecoms space: ‘Over-The-Tops’ (OTTs) , which receive a lot of attention, and ‘Under-The-Floors’ (UTFs), which receive less. It is tempting to think of these as, respectively, pure service providers with little interest in the core business of telecoms, and pure infrastructure owners with no interest in digital service provision. This would be wrong. The ownership of the value-chain that European telecoms operators encompass is increasingly open to external challenges.

The term ‘OTT’ is unavoidable common currency, but it is also a deeply misleading term because it implies a pure service business with little interest in infrastructure except insofar as it provides a low-cost means to achieve its commercial ends. In fact, the largest OTTs are investing ever more in infrastructure, including not only digital infrastructure such as data-centres, but also the physical fibre networks to interconnect their global properties. Moreover, as operators move their core networks to the cloud and experiment with disaggregated Open RANs, the possibility that hyper-scalers will be significant partners in the core with considerable stake in the intellectual property becomes increasingly real.

UTFs come in different forms, and they currently typically focus on single asset-classes (such as towers or unlit fibre). However, they are starting to offer broader and more-active ranges of services and are building up multiple and interlocking asset-classes. Indeed, there have been instances of towercos building up or acquiring active equipment and offering open-access active mobile wholesale services, thereby coming one step closer to becoming an operator. Some towercos are also moving into transport and metro fibre, edge computing facilities and even FTTH, all at a wholesale level.



11.1 Physical asset sales and carve-outs

Operators want to be part of both the infrastructure provision space and the services space. This can lead to something of an identity crisis, and this approach is not always valued by financial markets. This is particularly true in Europe, where regulators have traditionally denied mergers and imposed extensive revenue-depressing measures, therefore contributing to push shareholders to find alternative ways to generate value. However, despite this identity crisis, there are at least two good and overlapping reasons for holding the vertically integrated model together, especially with respect to the aims of the Digital Decade.



Open Strategic Autonomy.

European telecoms operators are largely under European ownership and abide by European rules and values. The low valuation of telecoms stock makes the sector more susceptible to aggressive M&A and potential hostile approaches from non-European actors. Private equity has never been larger and debt is cheap. Private equity has proven to be valuable for timely co-investment in infrastructure, but these players have no special interest in building a digital competitive advantage in Europe.



European technology leadership.

European telecoms operators are some of the largest ICT businesses in the continent, and they have, in their current form, the resources and skills to advance areas in which Europe can maintain some competitive advantage. 3G was very much pioneered by European technology and European operators, but the regional advantage has been lost in subsequent generations. Splitting up the European telecoms sector, long held back by over-zealous and unevenly applied regulation, will stifle innovation and investment in new technologies.

ETNO Members

Albania	Austria	Belgium	Bosnia and Herzegovina	
Bulgaria	Croatia	Cyprus	Denmark	
 Member of United Group				
Finland	France	Germany	Greece	
Hungary	Iceland	Italy	Lithuania	Luxembourg
Macedonia	Malta	Netherlands	Norway	
Poland	Portugal	Romania	Serbia	Slovakia
Slovenia	Spain	Sweden	Switzerland	UK

ETNO Observers

Finland	Sweden	Italy	USA	USA
USA	China	USA		



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