# The Mobile Economy 2022


GSMA Intelligence

The GSMA is a global organisation unifying the mobile ecosystem to discover, develop and deliver innovation foundational to positive business environments and societal change. Our vision is to unlock the full power of connectivity so that people, industry and society thrive. Representing mobile operators and organisations across the mobile ecosystem and adjacent industries, the GSMA delivers for its members across three broad pillars: Connectivity for Good, Industry Services and Solutions, and Outreach. This activity includes advancing policy, tackling today's biggest societal challenges, underpinning the technology and interoperability that make mobile work, and providing the world's largest platform to convene the mobile ecosystem at the MWC and M360 series of events.

We invite you to find out more at **gsma.com**
Follow the GSMA on Twitter: **@GSMA**

GSMA Intelligence is the definitive source of global mobile operator data, analysis and forecasts, and publisher of authoritative industry reports and research. Our data covers every operator group, network and MVNO in every country worldwide – from Afghanistan to Zimbabwe. It is the most accurate and complete set of industry metrics available, comprising tens of millions of individual data points, updated daily.

GSMA Intelligence is relied on by leading operators, vendors, regulators, financial institutions and third-party industry players, to support strategic decision-making and long-term investment planning. The data is used as an industry reference point and is frequently cited by the media and by the industry itself.

Our team of analysts and experts produce regular thought-leading research reports across a range of industry topics.

**www.gsmaintelligence.com**
**info@gsmaintelligence.com**

# Contents

# Executive summary

## Collective effort needed to close the usage gap

In 2021, the usage gap stood at 3.2 billion people, or 41% of the global population.

As the world emerges from the pandemic and social and economic activities begin to recover, connectivity will continue to play a vital role in the way people live and businesses operate. Indeed, digital services, underpinned by high speed and high performance networks, are set to become more integral to society in a post-pandemic world. In this context, unconnected populations will be at greater risk of exclusion from many life-enhancing services online. The mobile industry has been instrumental in extending connectivity to people around the world. In 2021, the number of mobile internet subscribers reached 4.2 billion people globally.

Operators' investments in network infrastructure over the last decade have helped to shrink the coverage gap[1] for mobile broadband networks from a third of the global population to just 6%. But although the industry continues to invest in innovative solutions and partnerships to extend connectivity to still underserved and far-flung communities, the adoption of mobile internet services has not kept pace with the expansion of network coverage. This has resulted in a significant usage gap.[2] In 2021, the usage gap stood at 3.2 billion people, or 41% of the global population.

The reasons for the usage gap are multifaceted and vary by region, but they generally relate to a lack of affordability, relevance, knowledge and skills, in addition to safety and security concerns. Furthermore, the barriers to mobile internet adoption are particularly acute among certain segments of the population, including women, the elderly, those in rural areas and persons with disabilities – or a combination thereof. Addressing the usage gap for these key groups will extend the benefits of the internet and digital technology to more people in society, and will require concerted efforts by a broad range of stakeholders working together with mobile operators and other ecosystem players, such as device manufacturers and digital content creators.

1. The 'coverage gap' refers to those living outside of areas covered by mobile broadband networks.
2. The 'usage gap' refers to those who live within areas covered by mobile broadband networks but do not yet subscribe to mobile broadband services.

# 5G accelerates as 4G adoption begins to decline

5G adoption continues to grow rapidly in pioneer markets, with the total number of connections set to reach 1 billion in 2022. Momentum has been boosted by a number of factors, including the economic recovery from the pandemic, rising 5G handset sales, network coverage expansions and overall marketing efforts by mobile operators. Meanwhile, a new wave of 5G rollouts in large markets with modest income levels (such as Brazil, Indonesia and India) could further incentivise the mass production of more affordable 5G devices, which in turn could further bolster subscriber growth. By the end of 2025, 5G will account for around a quarter of total mobile connections and more than two in five people around the world will live within reach of a 5G network.

4G still has room to grow in most developing markets, particularly in Sub-Saharan Africa, where 4G adoption is still below a fifth of total connections and operators are stepping up efforts to migrate existing 2G and 3G customers to 4G networks. However, rising 5G adoption in leading markets, such as China, South Korea and the US, means that 4G adoption on a global level is beginning to decline. Globally, 4G adoption will account for 55% of total connections by 2025, down from a peak of 58% in 2021.

# Subscriber growth continues as mobile's contribution to the global economy grows

By the end of 2021, 5.3 billion people subscribed to mobile services, representing 67% of the global population. In a growing number of markets, most adults now own a mobile phone, meaning that future growth will come from younger populations taking out a mobile subscription for the first time. Over the period to 2025, there will be an additional 400 million new mobile subscribers, most of them from Asia Pacific and Sub-Saharan Africa, taking the total number of subscribers to 5.7 billion (70% of the global population).

In 2021, mobile technologies and services generated $4.5 trillion of economic value added, or 5% of GDP, globally. This figure will grow by more than $400 billion by 2025 to nearly $5 trillion as countries increasingly benefit from the improvements in productivity and efficiency brought about by the increased take-up of mobile services. 5G is expected to benefit all economic sectors of the global economy during this period, with services and manufacturing experiencing the most impact.

# Mobile technology will be at the centre of efforts to achieve the SDGs

The Covid-19 pandemic has slowed progress on the UN Sustainable Development Goals (SDGs) around the world, with the pandemic exacerbating existing social and economic inequalities. With lockdown restrictions and social distancing measures in place, people have relied on mobile networks to stay connected and access life-enhancing services. As a result, mobile adoption has continued to increase during the pandemic, despite sluggish economic growth and the negative effects on consumer incomes. With only eight years until the deadline for the SDGs, stakeholders are renewing their efforts to achieving the SDGs. Mobile technology will play a central role in those efforts, from improving access to education and healthcare to addressing issues with poverty and inequality.

# Policies for resilient recovery

The pandemic highlighted the power of digital connectivity and technologies in supporting individuals, businesses, governments and societies, and increased the profile and political awareness of the advantages of digitisation. However, successful digital transformation requires all levels of government to actively support policies that lead to long-term digital strategies and promote the private investment required to deliver them. Mobile technology will play a key role in governments' recovery strategies and present a significant opportunity to foster inclusive and resilient growth through appropriate policy and regulatory environments for mobile services, in order to accelerate investment and innovation.

Mobile operators are facing a capex investment requirement of over $600 billion worldwide between 2022 and 2025, roughly 85% of which will be in 5G networks. To support the mobile industry in delivering on this commitment and closing the usage gap, governments and regulators can implement policy frameworks that are conducive to investment, including:

- actively investing in digital skills training for the general public, so that all citizens are able to access essential digital services and use connected devices
- utilising public funds for connectivity for demand-side stimulation
- adopting a balanced approach to collecting revenues through taxes and fees on the mobile sector, without jeopardising medium-term investment and economic growth
- prioritising digital transformation of government services so that all citizens will be able to access government services digitally
- avoiding costly restrictions on the use of spectrum beyond those needed to manage interference.

# The Mobile Economy

## Unique mobile subscribers

2021 **5.3bn**
2025 **5.7bn**

**67%** 2021
**70%** 2025
**Penetration rate**
Percentage of population

CAGR 2021-2025 **1.8%**

## Mobile internet subscribers

2021 **4.2bn**
2025 **5.0bn**

**53%** 2021
**60%** 2025
**Penetration rate**
Percentage of population

CAGR 2021-2025 **4.5%**

## SIM connections

Excluding licensed cellular IoT

2021 **8.3bn**
2025 **8.8bn**

**Penetration rate**
Percentage of population
**104%** 2021
**107%** 2025

CAGR 2021-2025 **1.5%**

## 4G

Percentage of connections *(excluding licensed cellular IoT)*

2021 **58%** → 2025 **55%**

## 5G

Percentage of connections *(excluding licensed cellular IoT)*

2021 **8%** → 2025 **25%**

## Smartphones

Percentage of connections *(excluding licensed cellular IoT)*

2021 **75%**

2025 **84%**

## Internet of Things

2021 **15.1bn** Total connections

2025 **23.3bn**

## Operator revenues and investment

2021 **$1.08tn**

2025 **$1.16tn**

Total revenues

Operator capex

**$620bn**

2022 — 2025

**85% on 5G**

## Mobile industry contribution to GDP

2021 **$4.5tn** 5% of GDP

2025 **$4.9tn**

## Public funding

**$500bn**

Mobile ecosystem contribution to public funding (before regulatory and spectrum fees)

## Employment

**12 million jobs**

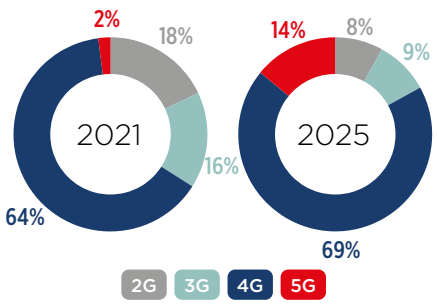
**Directly supported by the mobile ecosystem**

**14 million jobs**

supported indirectly

## Asia Pacific

TECHNOLOGY MIX*




SUBSCRIBER PENETRATION

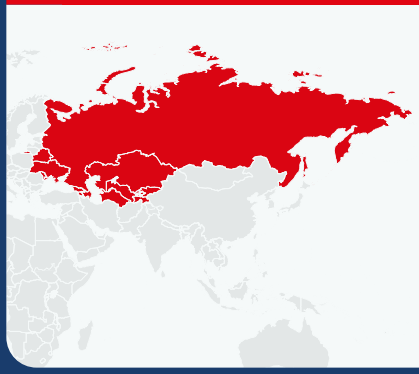
2021 59% → 2025 62%

SMARTPHONE ADOPTION

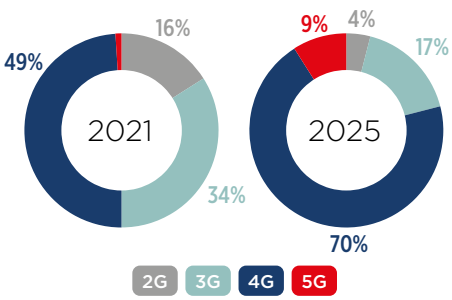
2021 74% → 2025 84%

*Note: All data for Asia Pacific in this report excludes China, Hong Kong, Macau and Taiwan unless otherwise stated.*

## CIS



TECHNOLOGY MIX*



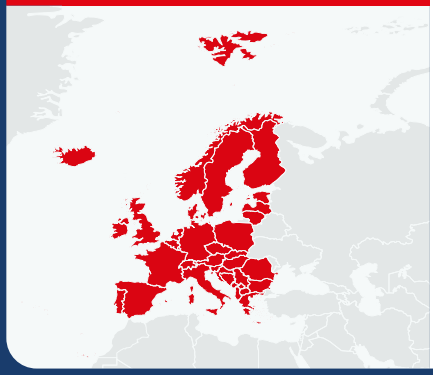

SUBSCRIBER PENETRATION

2021 81% → 2025 82%

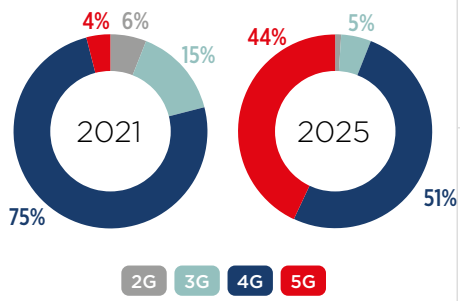
SMARTPHONE ADOPTION

2021 79% → 2025 86%

## Europe



TECHNOLOGY MIX*



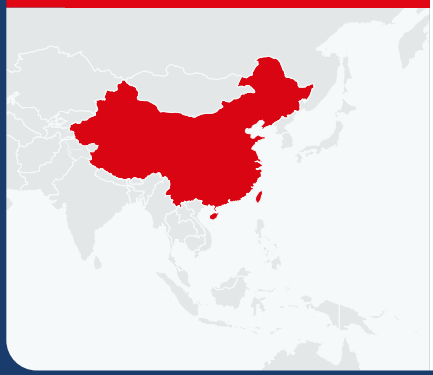

SUBSCRIBER PENETRATION

2021 86% → 2025 87%

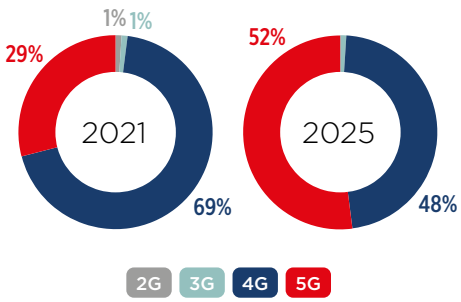
SMARTPHONE ADOPTION

2021 79% → 2025 83%

## Greater China



TECHNOLOGY MIX*




SUBSCRIBER PENETRATION

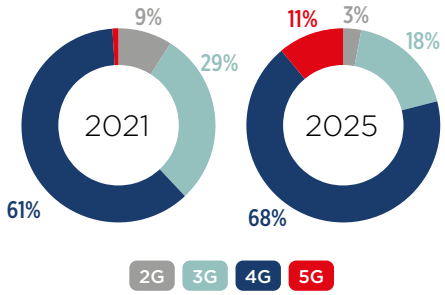
2021 83% → 2025 85%

SMARTPHONE ADOPTION

2021 77% → 2025 89%

## Latin America

TECHNOLOGY MIX*



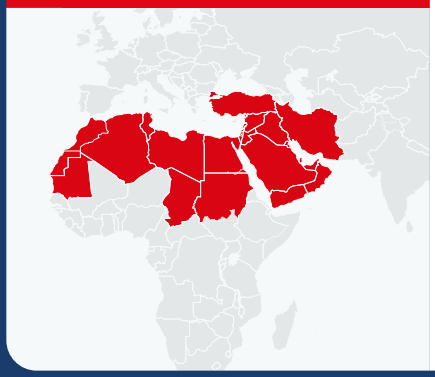

SUBSCRIBER PENETRATION

2021 69% → 2025 73%

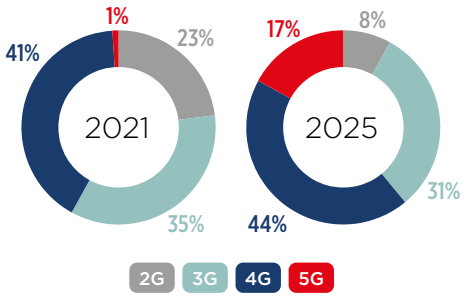
SMARTPHONE ADOPTION

2021 77% → 2025 82%

## MENA



TECHNOLOGY MIX*




SUBSCRIBER PENETRATION

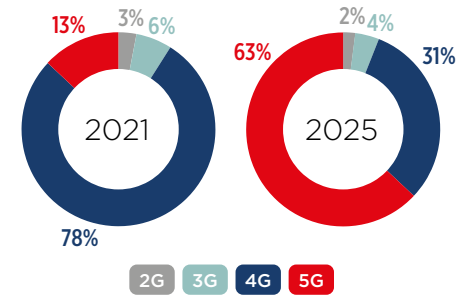
2021 66% → 2025 68%

SMARTPHONE ADOPTION

2021 79% → 2025 82%

## North America

TECHNOLOGY MIX*



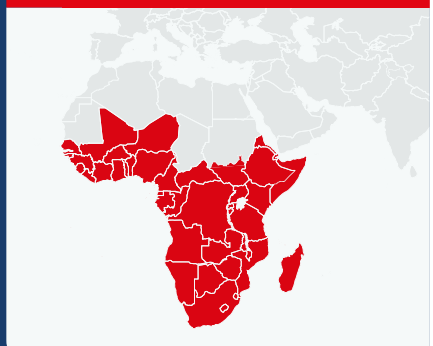

SUBSCRIBER PENETRATION

2021 84% → 2025 85%

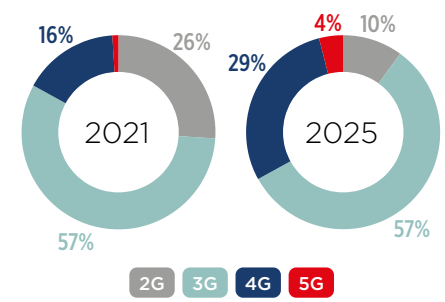
SMARTPHONE ADOPTION

2021 82% → 2025 85%

## Sub-Saharan Africa



TECHNOLOGY MIX*




SUBSCRIBER PENETRATION

2021 46% → 2025 50%

SMARTPHONE ADOPTION

2021 64% → 2025 75%

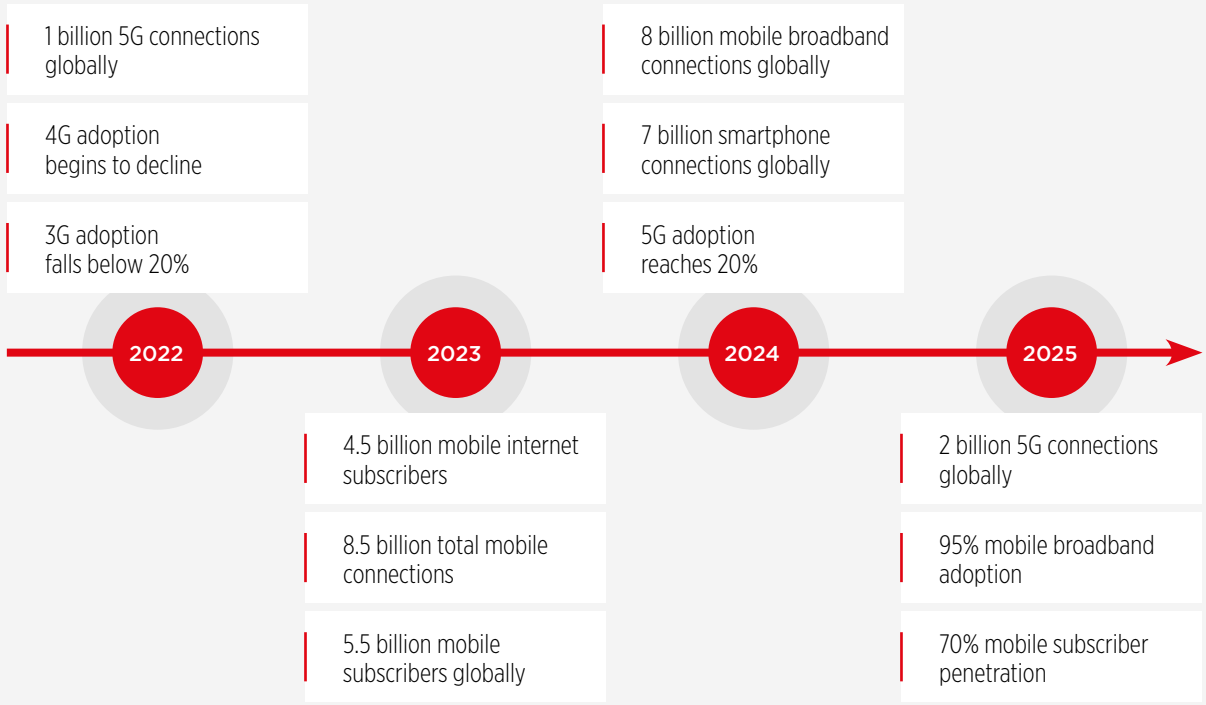
** Percentage of total mobile connections (excluding licensed cellular IoT)*
*Note: Totals may not add up due to rounding*

# 01
# The mobile market in numbers

## 1.1 Subscriptions: mobile adoption continues to rise globally

**Figure 1**

### Key milestones for the mobile industry to 2025

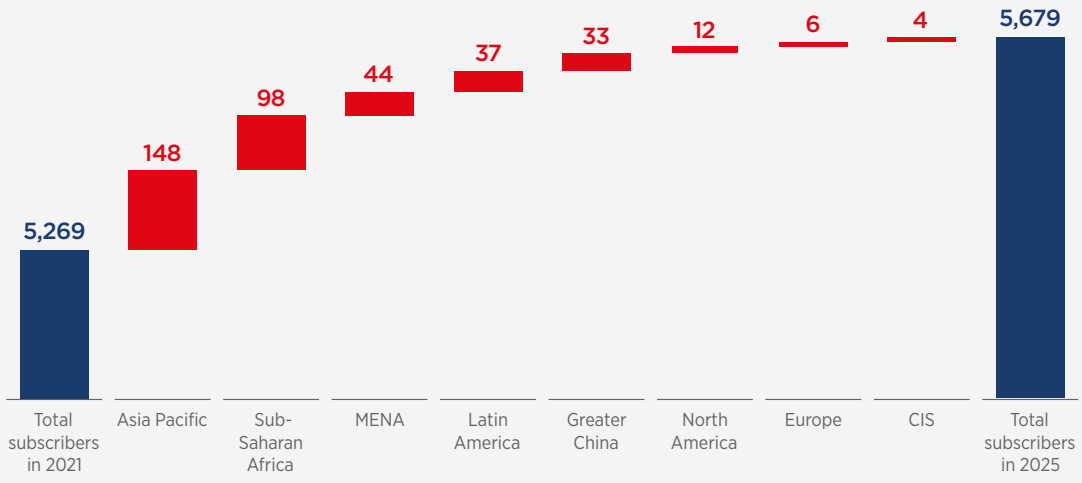



Source: GSMA Intelligence

**Figure 2**

### There will be nearly 400 million new mobile subscribers by 2025; the majority will come from frontier markets in Asia Pacific and Sub-Saharan Africa

New mobile subscribers (million)

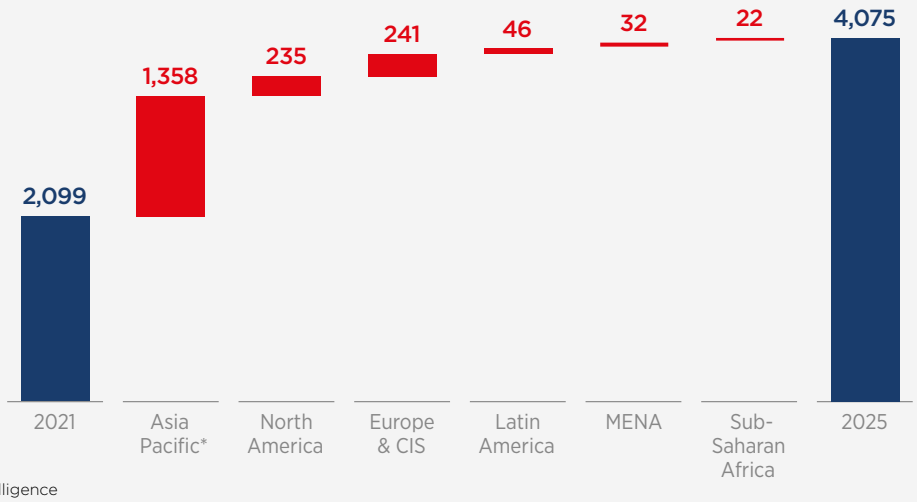



Source: GSMA Intelligence
Note: Total may not add up due to rounding

**Figure 3**

### Licensed cellular IoT connections will reach 4 billion by 2025; two thirds of new connections will be in Asia Pacific

Licensed cellular IoT connections (million)



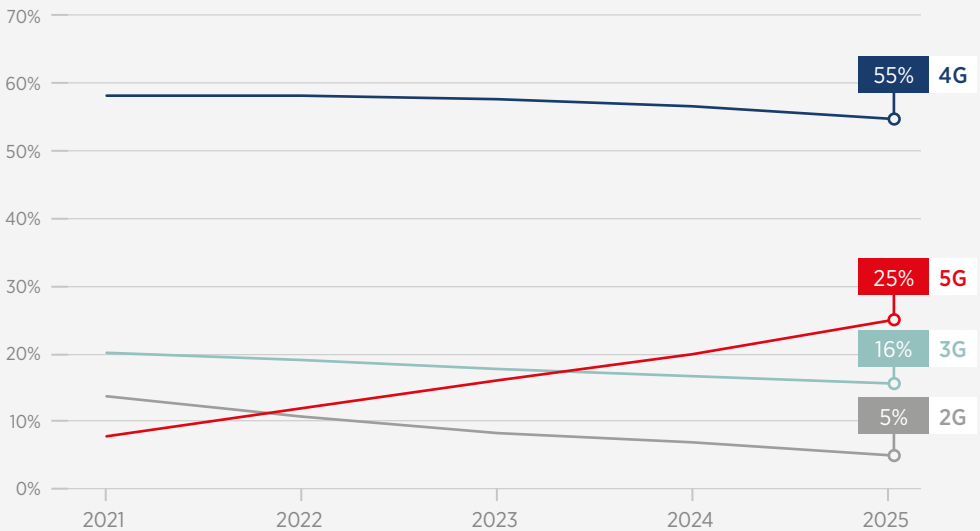

Source: GSMA Intelligence
Note: Total may not add up due to rounding
* Includes China

## 1.2 Tech migration: 4G adoption begins to decline as 5G gains momentum

**Figure 4**

### 5G will account for a quarter of total mobile connections by 2025, more than three times the figure for 2021

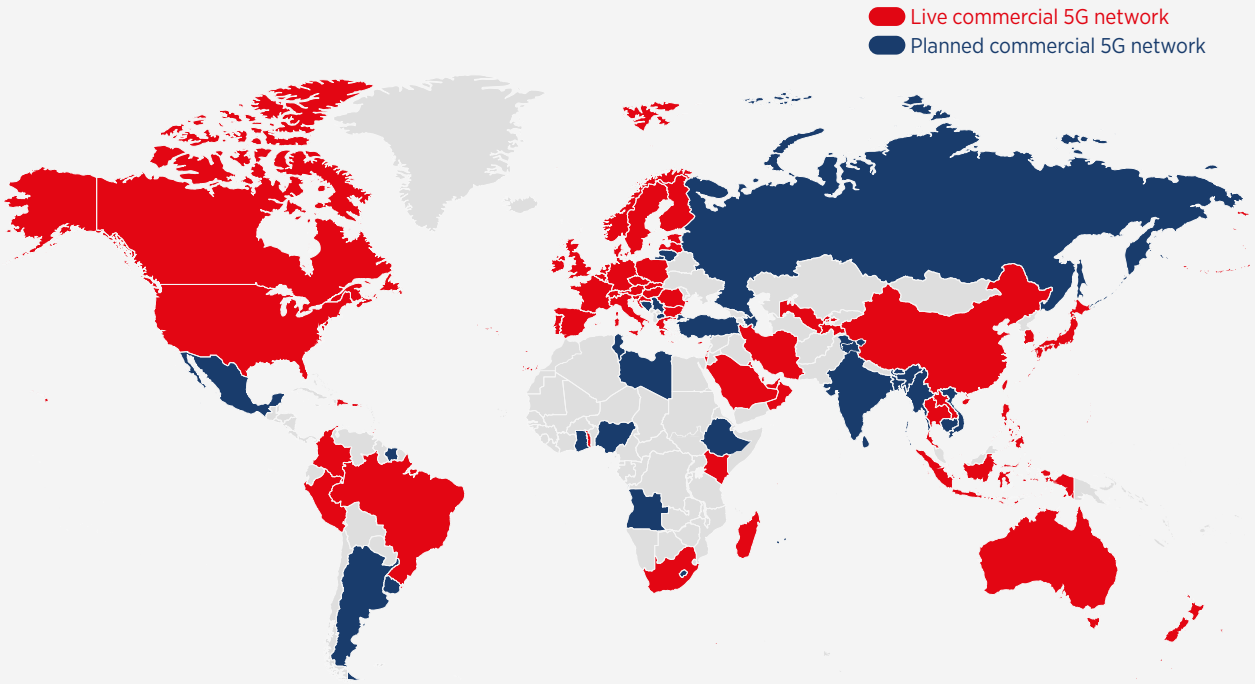
Percentage of connections (excluding licensed cellular IoT)




Source: GSMA Intelligence

**Figure 5**

## 5G's footprint continues to expand, with live services now available in 70 countries around the world

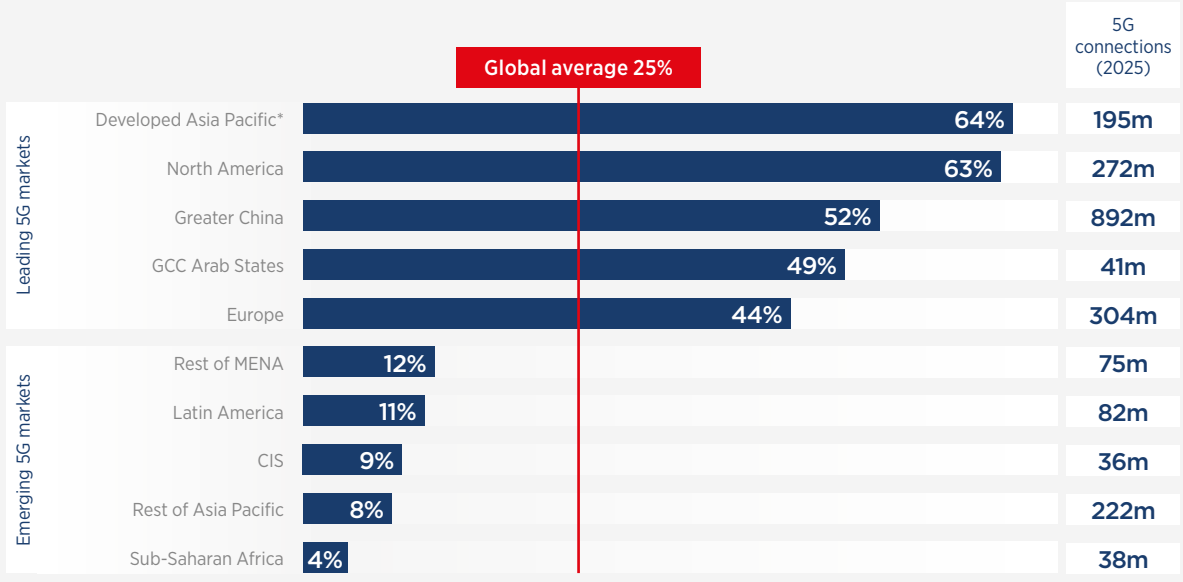



Source: GSMA Intelligence[3]
Note: Data correct to January 2022

**Figure 6**

## The transition to 5G is occurring at varying speeds, with pioneer markets racing ahead

5G adoption in 2025 (percentage of connections)




Source: GSMA Intelligence
*Australia, Japan, Singapore and South Korea

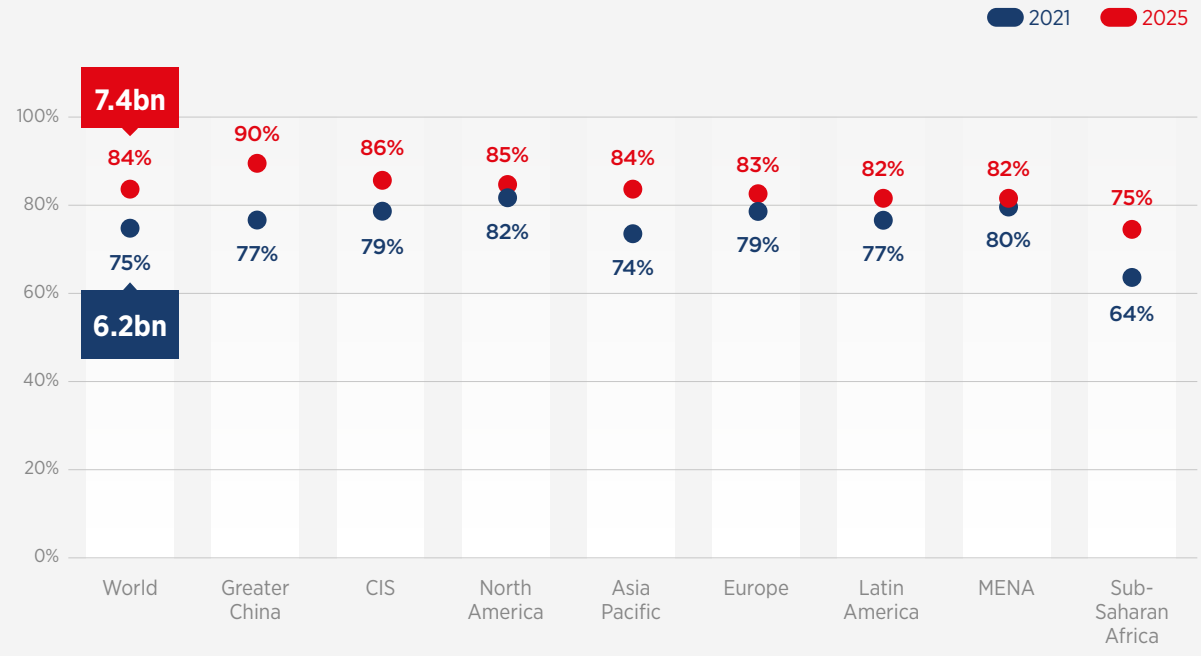
3. Maps in this report based on United Nations map.

## 1.3 Digital consumer: smartphone adoption and data traffic continue to rise

**Figure 7**

**There will be nearly 7.5 billion smartphone connections by 2025, accounting for over four in five mobile connections**

Percentage of connections (excluding licensed cellular IoT)

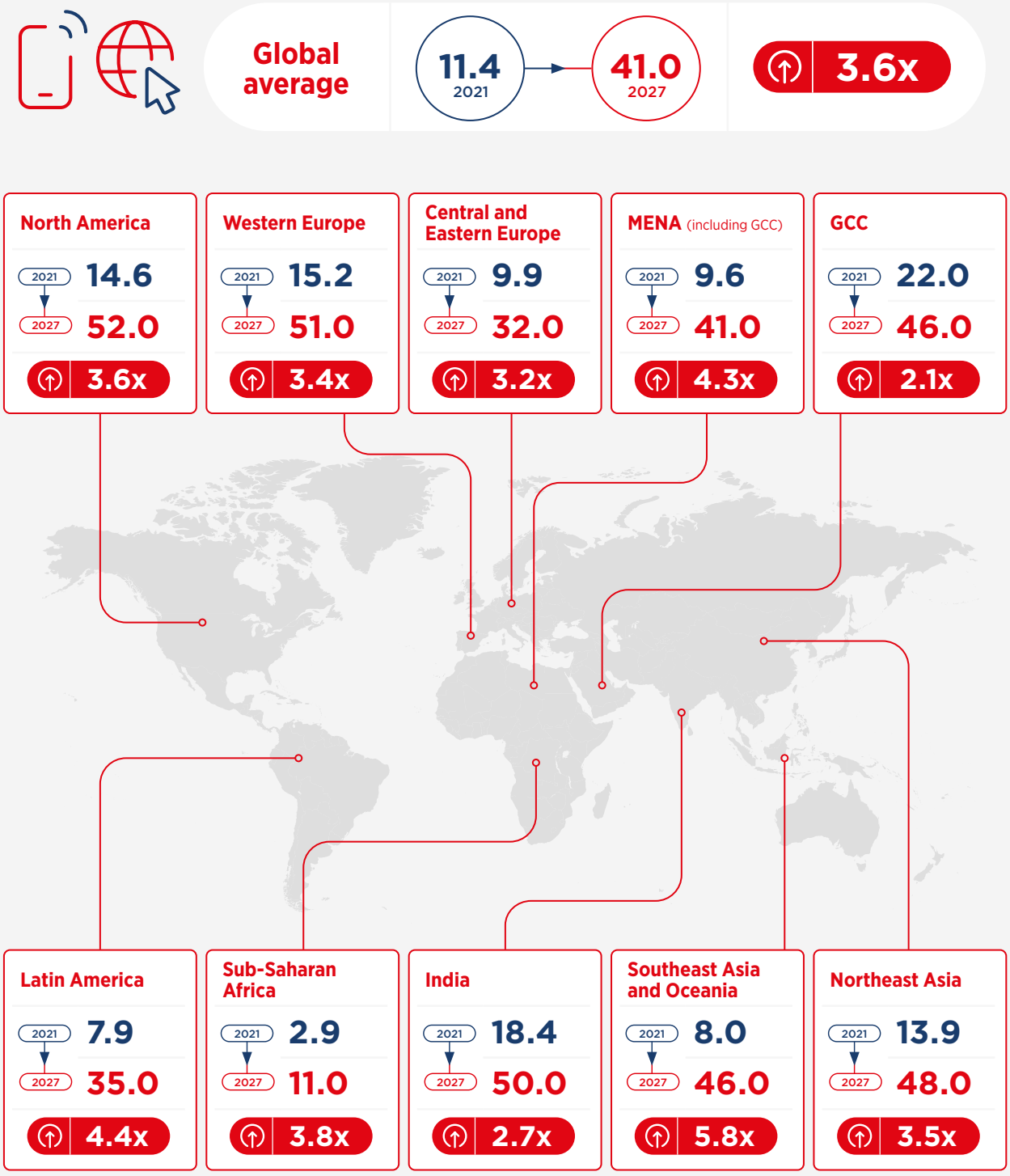



Source: GSMA Intelligence

**Figure 8**

## Mobile data will more than triple in most regions over the next six years, driven by increasing smartphone adoption and video usage

Mobile data traffic per smartphone (GB per month)



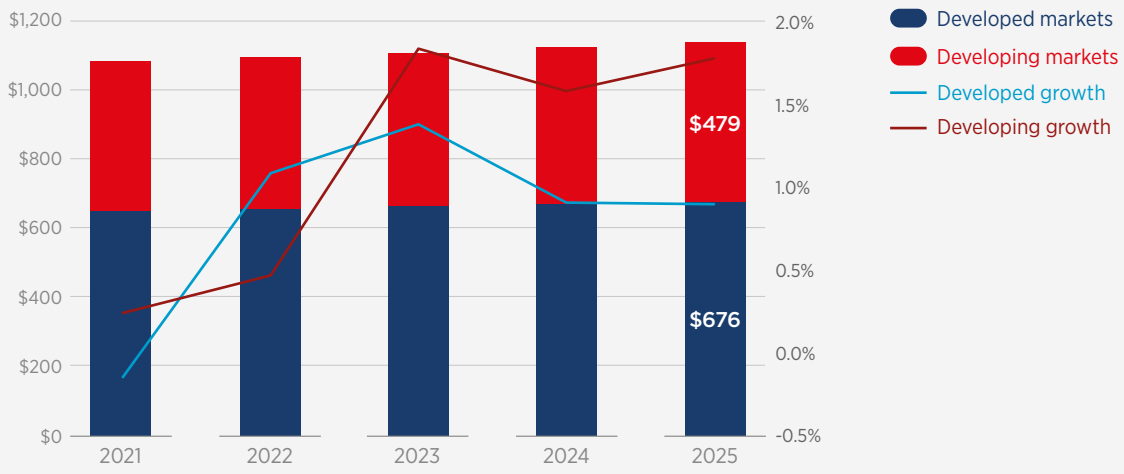

Source: GSMA Intelligence, based on Ericsson Mobility Report November 2021

## 1.4 Financials: revenue growth recovers as Covid-19 impact begins to wane

**Figure 9**

**Revenue growth back in positive territory as economic activities pick up around the world post lockdowns**

Mobile revenue (billion), year-on-year growth

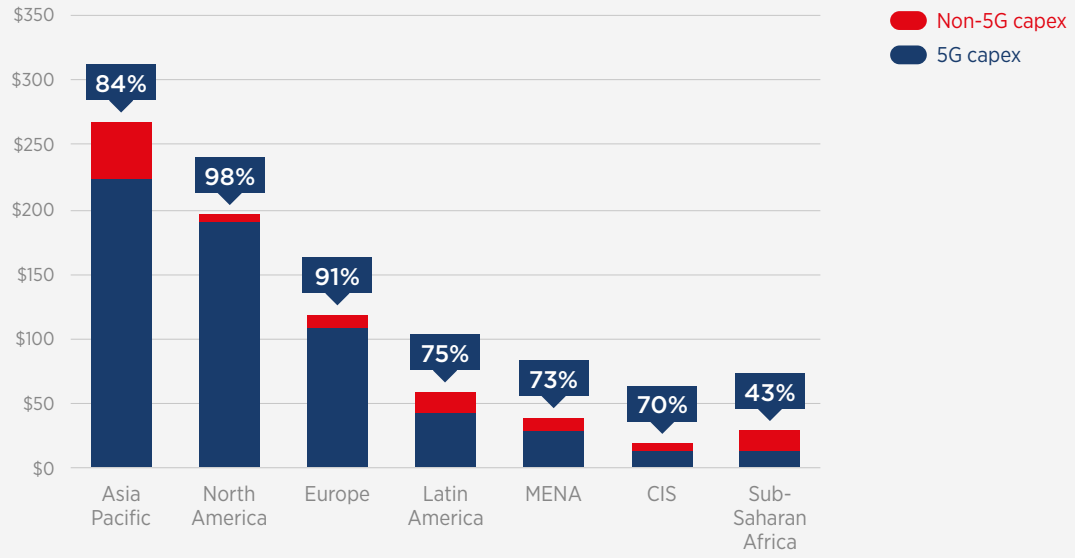



Source: GSMA Intelligence

**Figure 10**

**Mobile operators will invest $620 billion in their networks between 2022 and 2025, of which 85% will be on 5G**

Capex (billion), 2022–2025




Source: GSMA Intelligence

# 02
# Key trends shaping the mobile industry

# 2.1 5G becomes mainstream in pioneer markets, makes progress elsewhere

## Consumer interest in 5G is growing

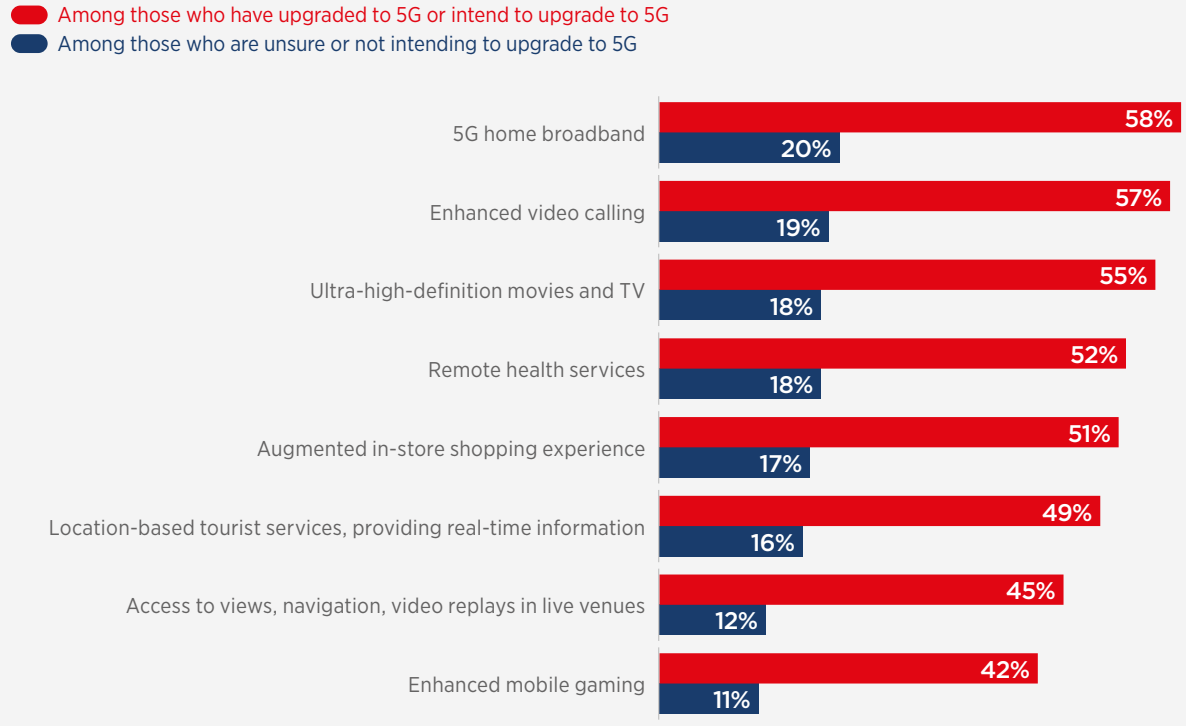
5G has become mainstream in many pioneer markets (notably China, South Korea and the US) and is making considerable progress elsewhere. At the end of 2021, 176 mobile operators in 70 markets around the world had launched commercial 5G services. This includes 68 operators that offer 5G fixed wireless access (FWA) services. 5G adoption is also rising and will reach double-digit figures this year, on average. Momentum has been boosted by a number of factors, including the economic recovery from the pandemic, rising 5G handset sales, network coverage expansions and overall marketing efforts. For example, Samsung has revealed that it expects 5G smartphones to account for more than half of all smartphone sales in its portfolio in 2022.

A new wave of 5G rollouts in large markets with modest income levels (such as Brazil, Indonesia and India) could further incentivise the mass production of more affordable 5G devices to cater to consumers in lower-income brackets. It could also drive the development of new 5G applications for consumers and enterprises in emerging markets. This is significant given that the majority of 5G applications and use cases to date have been focused on more advanced markets. Meanwhile, the average retail price for a 5G phone has now fallen below $500, with devices under $150 available from some vendors, such as Realme. This bodes well for 5G adoption in less wealthy markets and opens the door to innovative services built around the technology.

**Figure 11**

**Nearly three in five users who have upgraded or intend to upgrade to 5G find 5G-based home broadband an appealing proposition**

Percentage of smartphone users who find the following 5G use cases or 5G-enhanced services extremely or very appealing (aggregate)

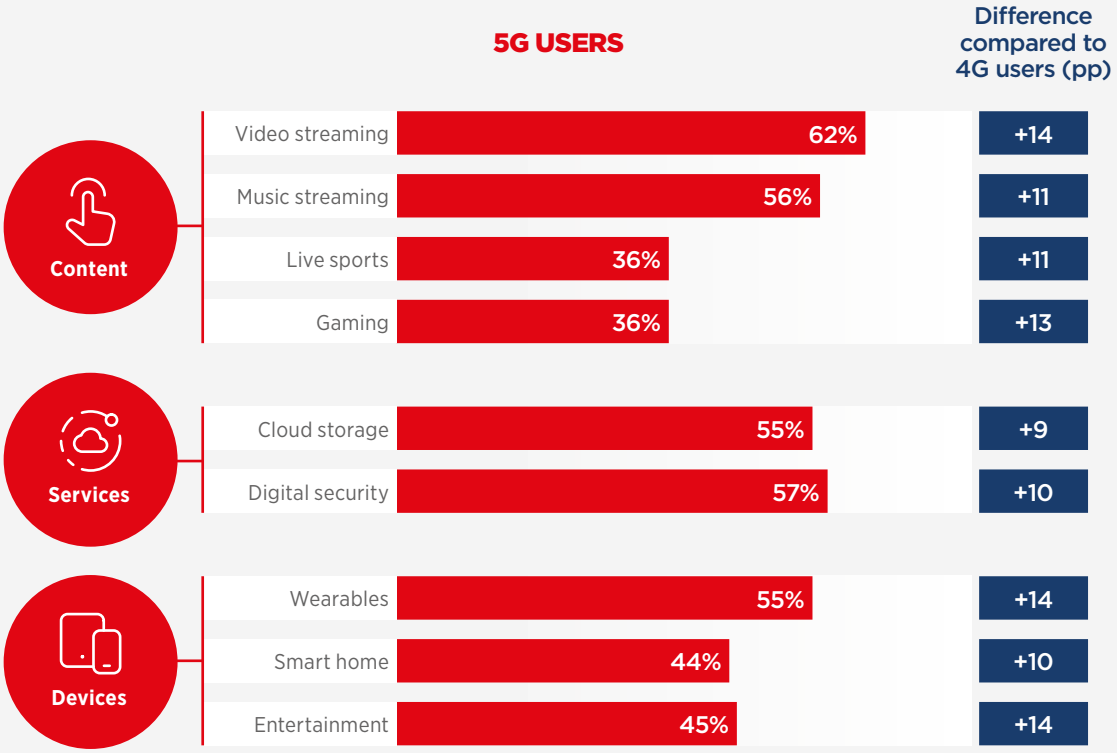



Source: GSMA Intelligence Consumers in Focus Survey 2021

**Figure 12**

## 5G consumers are increasingly interested in adding non-connectivity offerings to their mobile subscriptions

Percentage of contract mobile subscribers who have added or are interested in adding the following to their contract subscriptions (aggregate)




Base: Smartphone users who are most frequently connected to 5G or 4G networks.
Source: GSMA Intelligence Consumers in Focus Survey 2021

## 5G standalone takes off

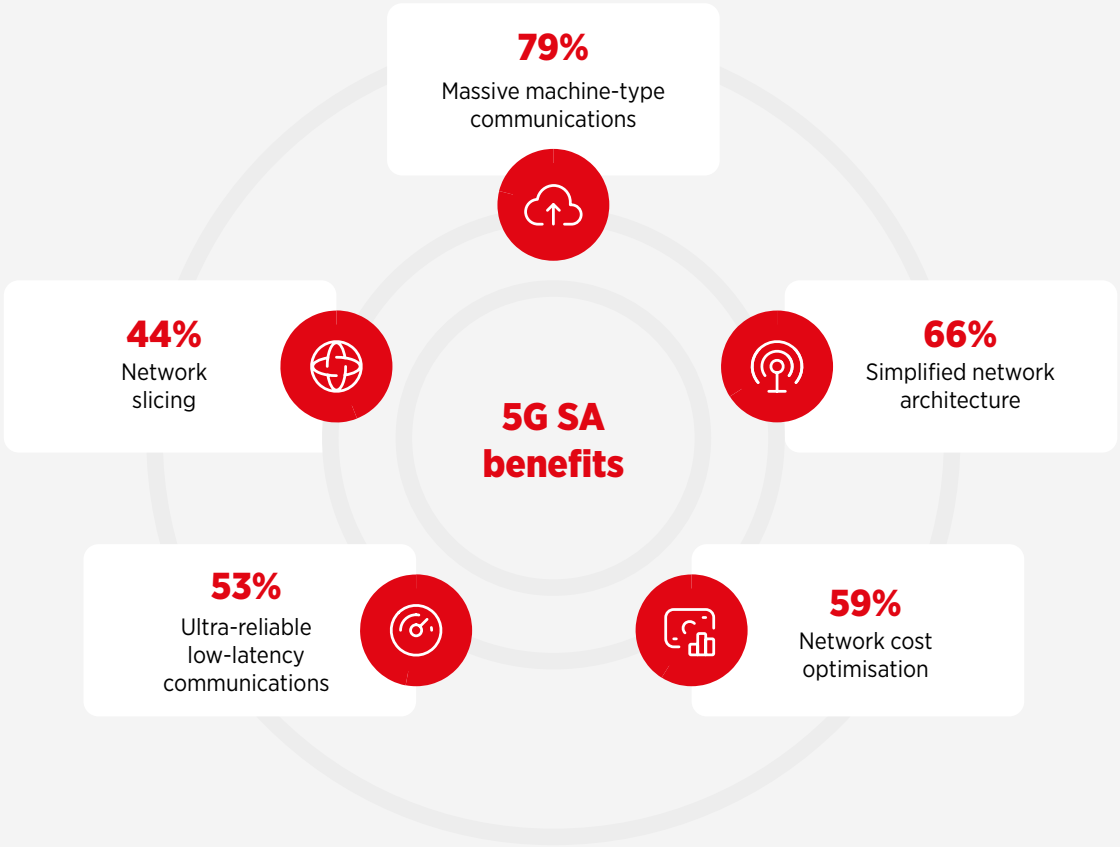
Operators around the world began their 5G deployment efforts with the non-standalone (NSA) version of the technology. However, after a slow start, 5G standalone (SA) deployments are beginning to ramp up. At the end of 2021, there were 22 commercial 5G SA networks in 16 countries around the world, with several more expected to go live in the coming years. The added functionalities enabled by 5G SA are key to delivering on the 5G promise of fully supporting enhanced mobile broadband (eMBB), ultra-reliable low-latency communications (URLLC) and massive IoT use cases.

Mobile operators are collaborating with vendors and enterprises across different verticals to explore the potential of 5G SA. For example, SoftBank and Honda are working together to test the effectiveness of using 5G SA and a cellular vehicle-to-everything (C-V2X) system to reduce collisions between pedestrians and vehicles. In Spain, Telefónica has announced plans to target three enterprise 5G use cases for its 5G SA network in 2022: automated guided robot vehicles for use in places such as warehouses; remote maintenance systems using technology such as smart glasses; and drones for site surveillance.

**Figure 13**

**5G SA holds the promise of enabling a range of services for enterprise as well as delivering cost benefits for operators**

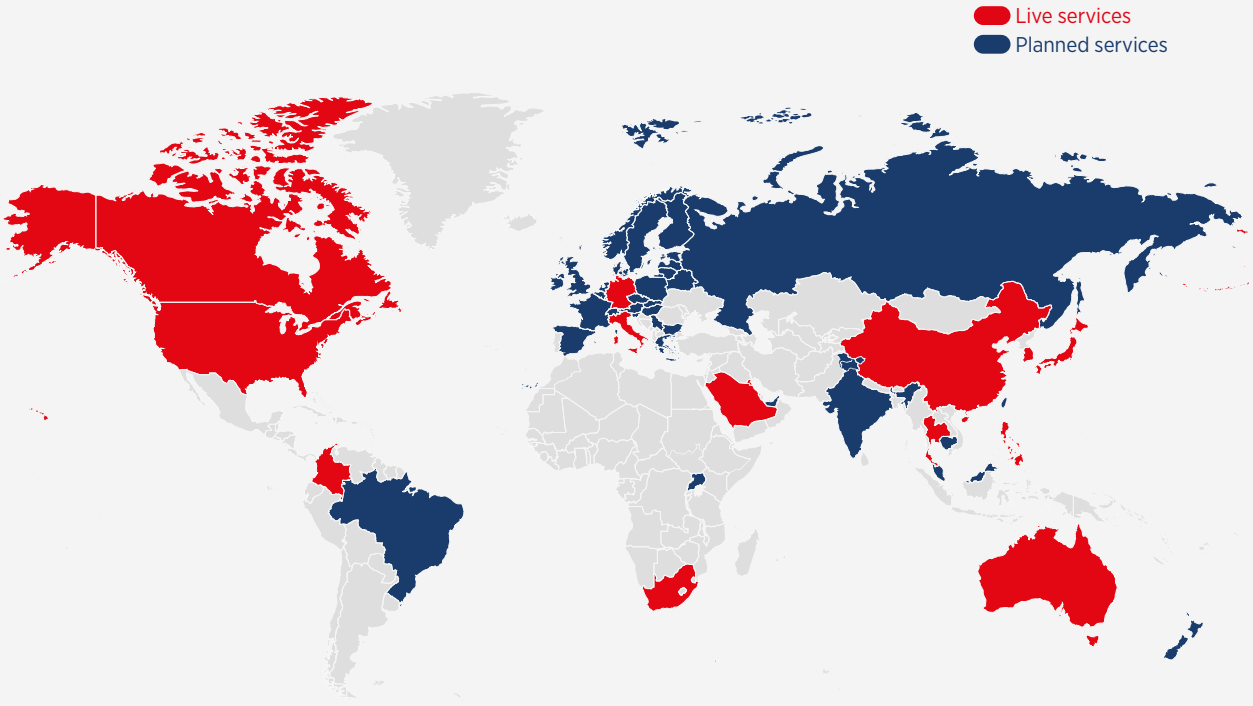
Top benefits of 5G SA (percentage of operators)




Source: GSMA Intelligence Operators in Focus: Network Transformation Survey 2021

**Figure 14**

## 5G SA is gaining momentum




Source: GSMA Intelligence
Note: Data correct to January 2022

## Mobile industry begins setting the roadmap for 6G

Although 5G is still in its early days and the full potential of the technology is far from being realised, the mobile industry is already preparing for what comes next given the typical 10-year technology cycle. While 5G promises download speeds many times faster than current speeds offered by 4G LTE networks and significantly lower latency times, 6G is set to raise the bar even higher, with much faster speeds and increased bandwidth to keep consumers more connected than ever before.

There has been a flurry of announcements related to 6G in recent months, with governments and industry players outlining plans to move the concept beyond just a vision to identify use cases and roadmaps:

- The ITU-R 6G Vision Group has been tasked with defining the technology and its capabilities as the industry moves towards 6G standardisation.
- Orange has laid out its view of future 6G use cases, including holoportation[4] and large-scale digital twin technology.
- The government in China plans to prioritise development of 6G to 2025 in a bid to make 6G part of its wider digital strategy.
- In North America, the Next G Alliance has started working groups on the 6G roadmap and 'Green G' (focused on achieving energy efficiency).
- The University of Texas has launched a 6G research centre (6G@UT) with the support of AT&T, Samsung, Qualcomm, Nvidia and InterDigital.
- Oppo has established a research team to conduct preliminary research on 6G technology.
- MIT and Ericsson have entered into a research collaboration to design new hardware for 5G and 6G networks.

It is worth mentioning that the mobile industry is currently focused on 5G deployments and use cases, despite the growing enthusiasm and commitment to 6G. Since it takes nearly a decade to move from research to commercialisation, today's 6G discussions are timely and necessary to ensure equal opportunities and a global approach to 6G standardisation and development.

4. A new type of 3D capture technology that allows high-quality 3D models of people to be reconstructed, compressed and transmitted anywhere in the world in real time.

## 2.2 Telco of the future: sustainability and revenue growth on the front burner

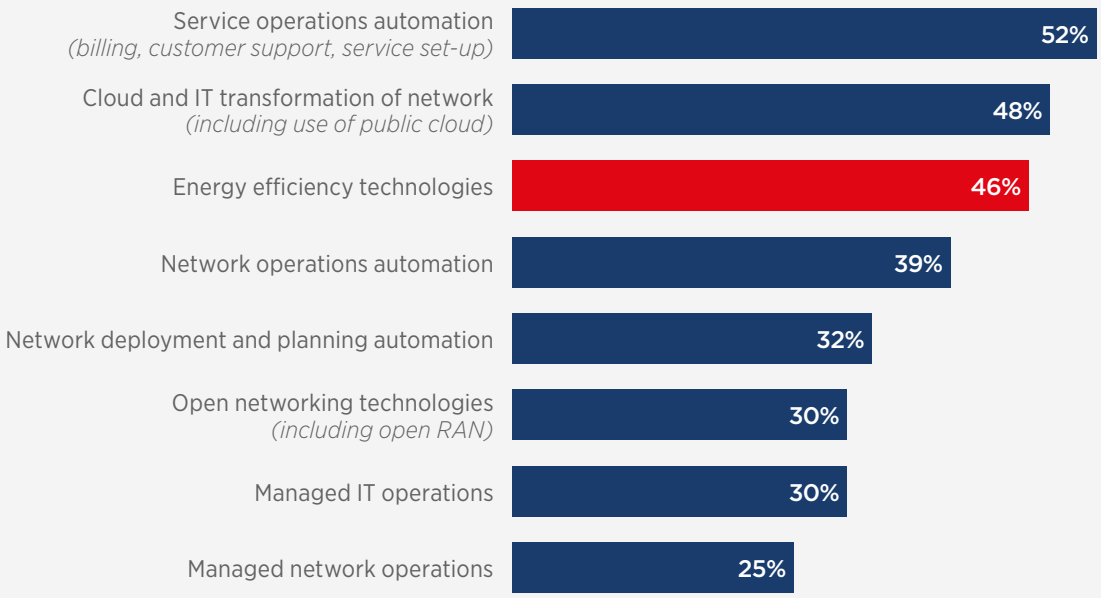
### Climate and costs accelerate push for sustainability

Sustainability is now a day-to-day business for mobile operators and the wider telecoms ecosystem, with initiatives spanning green networks, energy efficiency, devices and SIM cards. With the increase in climate-related activity in the telecoms sector in recent years, the focus has been on improving network energy efficiency and instigating a broader culture change that puts sustainability at the core of corporate strategy. Because of rising costs, increased densification in the 5G era and the urgency of achieving $CO_2$ reductions to meet net zero deadlines, the industry is in the midst of a large-scale paradigm shift towards energy-efficient networks and sustainable business practices.

**Figure 15**

**Nearly half of operators expect energy efficiency technologies to drive opex savings, underlining the potential of such technologies and solutions being brought to the market**

Which technologies hold the most promise of driving opex savings in your network operations? (Percentage of operators)



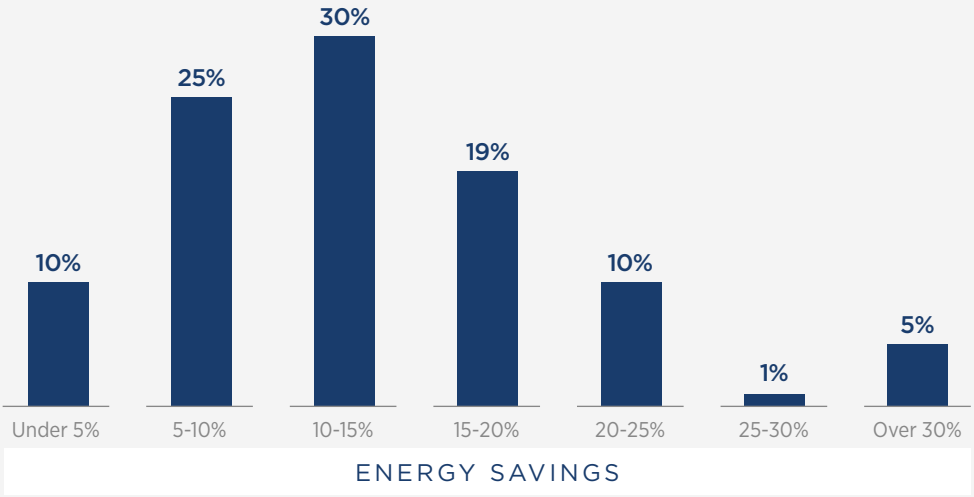

Source: GSMA Intelligence Operators in Focus: Network Transformation Survey 2021

The shift towards sustainability and energy-efficient solutions has become a key driver of innovation among equipment vendors and others in the supply chain. One such innovation is the use of artificial intelligence (AI) and machine learning (ML) to improve energy efficiency in the network. As energy consumption is a key opex cost for all mobile operators, there is growing optimism among operators about the opportunity to improve energy efficiency through AI-driven network management solutions. For example, the inaugural standard release of 3GPP 5G-Advanced specifications is expected to boost network efficiency and effectiveness by leveraging AI and ML to improve power efficiency.

**Figure 16**

**Two thirds of operators expect energy savings of over 10% from AI over the next two years**

Over the next 24 months, what level of energy saving do you expect from your AI-driven energy management solutions? (Percentage of operators)




Source: GSMA Intelligence AI and Energy Efficiency Survey 2021

Beyond energy-efficient solutions in the operation of telecoms networks, operators and vendors are exploring a variety of innovative solutions to drive sustainability across different layers of the ecosystem, such as the following:

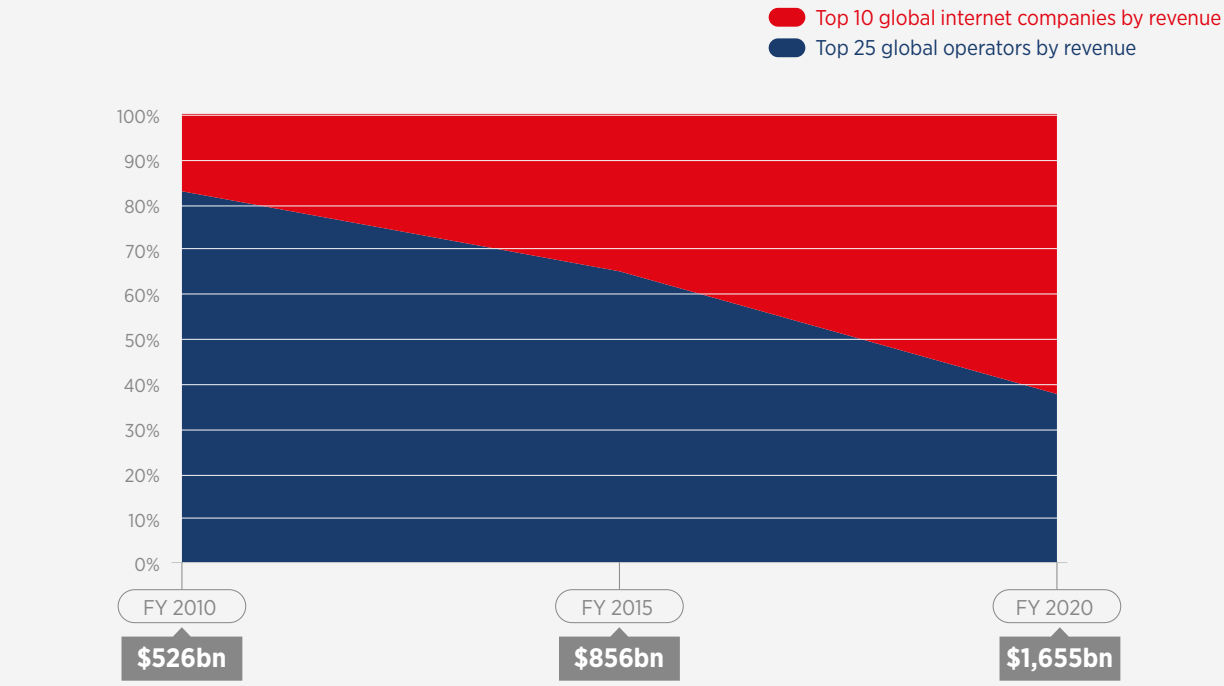
- Orange and Nokia have joined forces to increase the use of refurbished radio access network (RAN) kit in order to reduce waste and minimise the costs and carbon emissions associated with deploying network equipment. Orange subsidiaries will use refurbished Nokia RAN equipment, in line with EU and ITU recommendations and directives on equipment reliability thresholds, with plans to expand to other parts of the network infrastructure in the future.
- Deutsche Telekom, Orange, Telefónica, Telia and Vodafone have joined forces to launch Eco Rating, a pan-industry labelling scheme to score the environmental impact of mobile handsets. Rollout has expanded beyond the initial 24 European countries to include South Africa and Brazil, and now also Argentina, Chile, Colombia, Ecuador, Mexico, Peru and Uruguay. There are already 15 device vendors participating, including four of the top-five OEMs by smartphone shipments, with more than 150 mobile phone models assessed.
- Apple unveiled Self Service Repair, a programme allowing customers to access the parts and tools to complete their own work on damaged products. Extending the lifespan of devices through maintenance and repair is an important way to improve sustainability and reduce the climate impact of consumer tech by minimising the emissions impact that occurs at the manufacturing stage.

## Revenue growth underpins network transformation strategy

Over the past decade, operators have been under continuous pressure as their traditional value pools have gradually eroded, while network investments have continued to rise to meet increasing performance and capacity requirements. 5G rollout and commercialisation bring a new set of opportunities and challenges around capex and monetisation. This comes against the backdrop of a growing shift of economic value away from operators towards internet giants, which have leveraged new technologies and delivery models to capture a rising share of engagement and value.

**Figure 17**

**Over the last decade, economic value has increasingly shifted to internet companies**



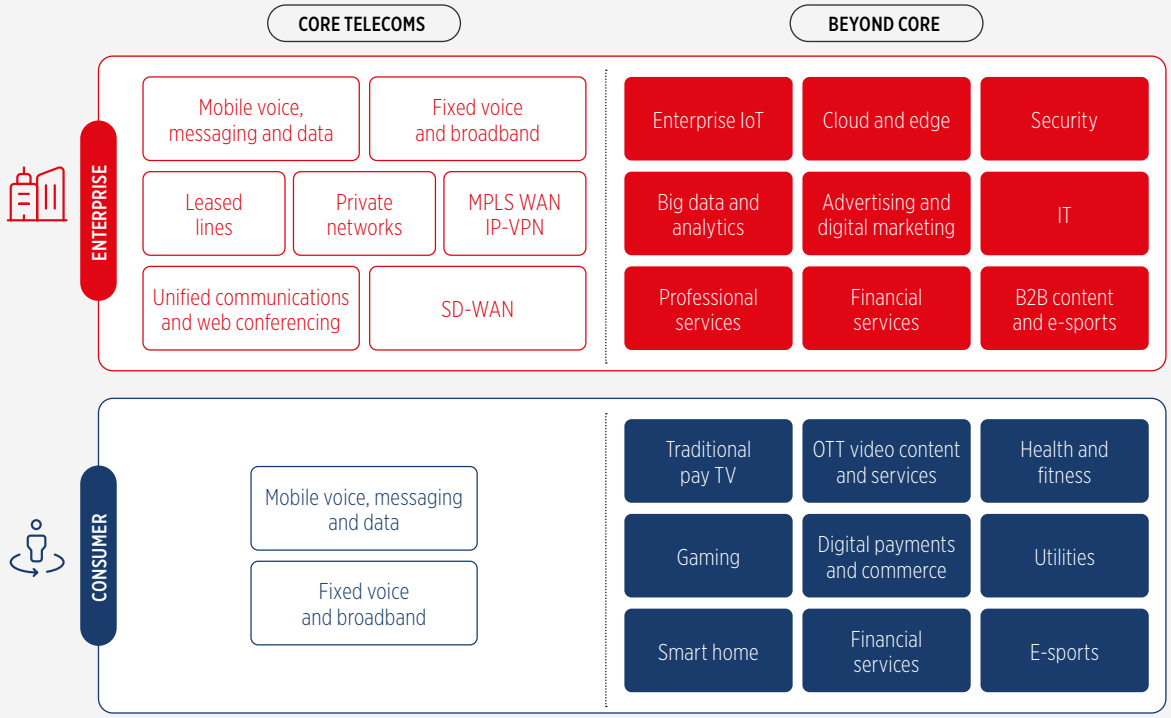

Source: Company results, GSMA Intelligence

In this context, revenue diversification has become a strategic focus for major operators, with services beyond core now a key component of growth stories. The goal is twofold: to offset stagnating (or declining) core telecoms revenues and to capture incremental value from new growth areas (such as digital services and platforms). One silver lining for operators is that the shift to digital for consumers and enterprises has accelerated due to the Covid-19 pandemic, fuelling further growth in services beyond core.

While internet giants have benefited significantly from the adoption of digital services during the pandemic, notably e-commerce and digital payments, mobile operators are offering a growing portfolio of products as part of bundled or integrated solutions. A number of operators offer consumer services (e.g. digital entertainment, financial services and commerce) via multiservice platform-based models. For example, Rakuten Group's three-pronged strategy includes linking its consumer services to the company's e-commerce ecosystem and aligning mobile services with its shopping, travel, content and fintech offerings.

**Figure 18**

## The portfolio of services beyond core offered by operators spans a variety of sectors



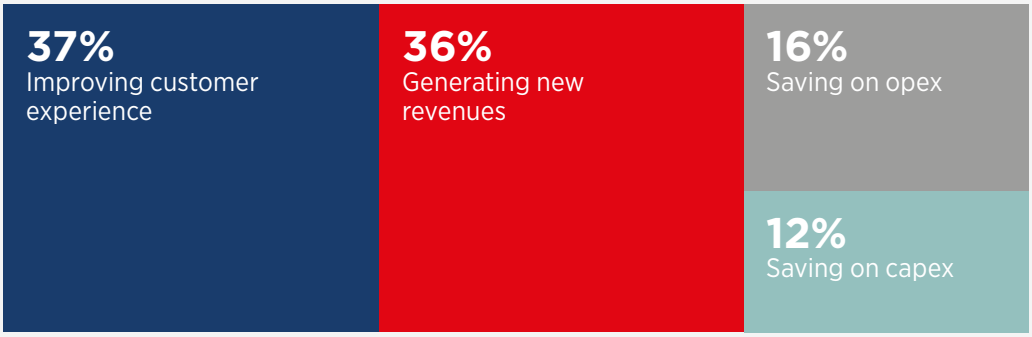

Source: GSMA Intelligence

Meanwhile, revenue growth – either through new revenues streams or by improving the customer experience – remains a top consideration for operators in their network transformation efforts. With new mobile network innovations such as open RAN, edge networking and network automation coming to market, decisions on network transformation strategies are now more important than ever.

**Figure 19**

## Customer experience and revenue generation are key factors driving operators' network transformation strategy

What is the primary goal driving your network transformation strategy? (Percentage of operators)



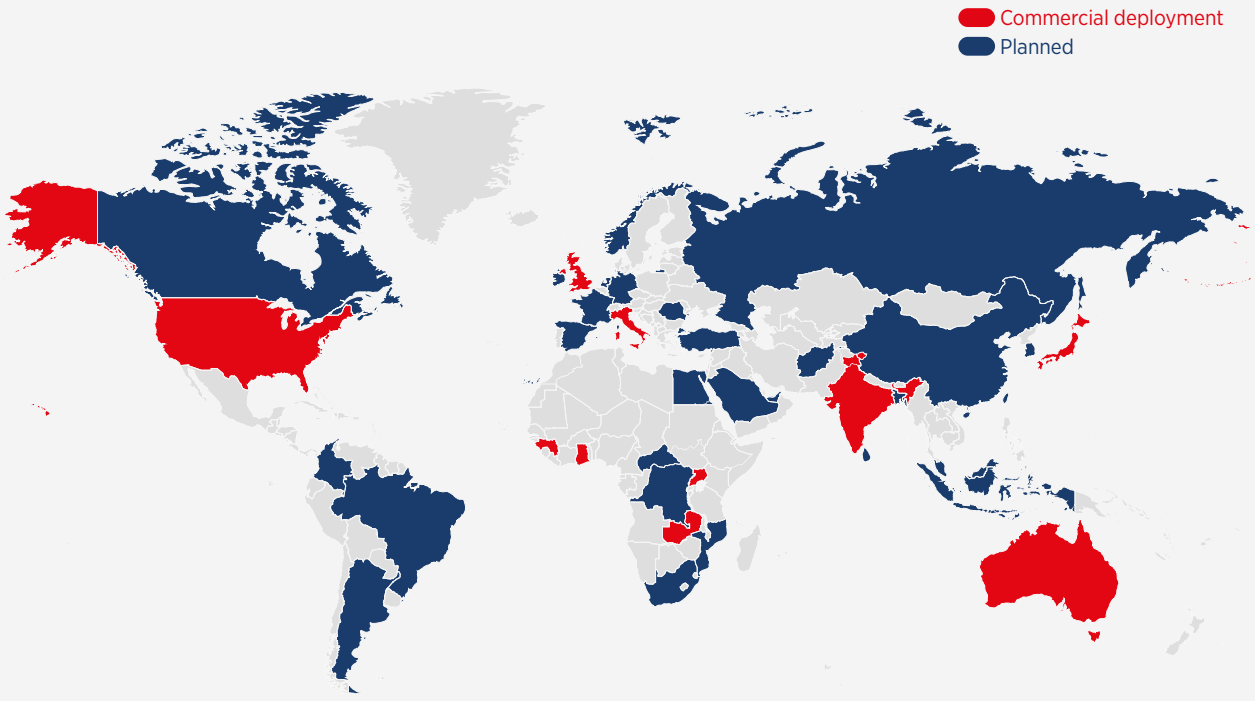

Source: GSMA Intelligence Operators in Focus: Network Transformation Survey 2021
Note: Total may not add up due to rounding

Open RAN in particular has attracted considerable attention in recent years. Flexibility, scalability and vendor diversity are some of the main drivers of this innovation. While commercialisation is still in its early stages, there is growing commitment from a broad set of stakeholders, including governments, to accelerate open RAN adoption:

- The UK government has increased funding for open RAN projects and has set targets for operators to run 35% of the UK's mobile network traffic over open RAN by 2030.
- Japan's Ministry of Internal Affairs and Communications is working with local operators to trial open RAN in Tokyo. NTT Docomo and NEC have also completed interoperability testing for 5G SA using a baseband unit conforming to open RAN specifications.
- The German government has selected the first projects to receive cash from a €300 million fund created to develop and test open RAN technology. One of the winning projects is an open RAN test lab run by a consortium of partners, including Deutsche Telekom, Vodafone and Telefónica.
- In France, Orange has launched its Open RAN Integration Centre, the first laboratory to be dedicated to open RAN technology in the country.
- Vodafone UK has activated its first 5G open RAN site as part of plans to roll out 2,500 4G and 5G open RAN sites across the UK by 2027.
- In the Middle East, Etisalat, Mobily, STC, Zain Group and Du have signed a collaboration agreement to push the implementation of open RAN forwards. The collaboration involves sharing knowledge and deploying open RAN across their footprints.

**Figure 20**

**Open RAN spreads around the world**



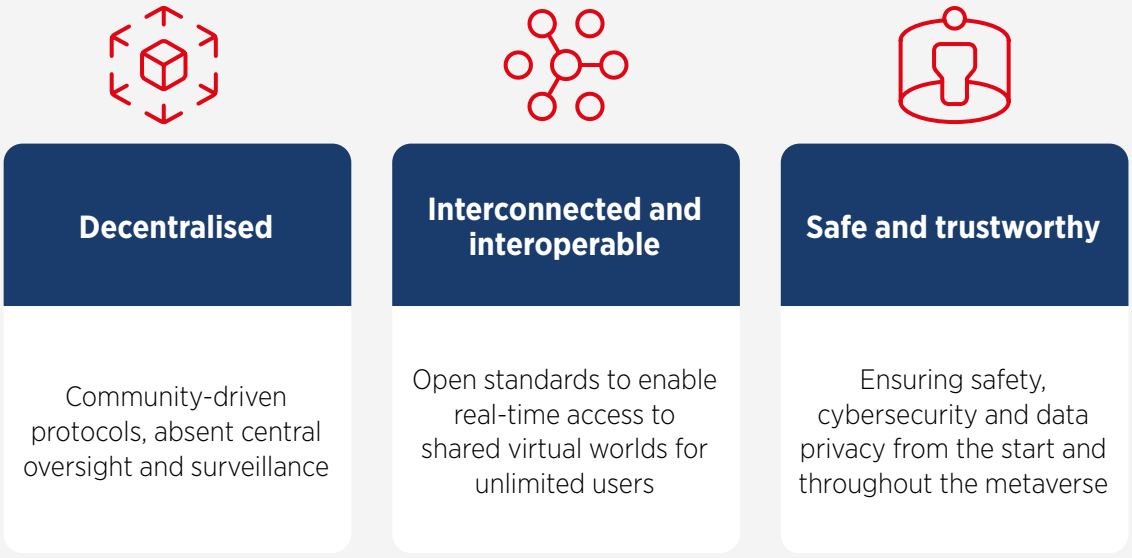

Source: GSMA Intelligence
Note: Data correct to January 2022

## 2.3 Metaverse: merging of the physical and virtual worlds

The term metaverse can trace its roots back three decades to Neal Stephenson's sci-fi novel *Snow Crash*. Since then, the term has been used loosely to describe the integration between virtual and physical spaces, building on the growing interest in virtual reality (VR) technology. In its latest iteration, the metaverse now refers to a scaled, virtual fusion of video games, social networking and entertainment that creates new immersive experiences for users. While the metaverse is still evolving, it has been proposed that innovation should be based on three foundational pillars in order for it to function effectively and be accessible for everyone (see Figure 21).

**Figure 21**

**Three key pillars of innovation in the metaverse to ensure inclusive participation**




Source: GSMA Intelligence

In some quarters, the metaverse may be viewed as another hype word for augmented reality (AR) and VR. It will also undoubtedly start as a niche service, given the connectivity and device requirements. However, the momentum behind applications seeking to incorporate AR and VR with social media and the cloud is very much real. Further, several leading tech companies have outlined long-term ambitions and strategies in this space. This highlights the potential of the metaverse to attract sufficient investment and innovation to eventually hit the mass market. Meta (formerly Facebook) is arguably the most vocal proponent of the metaverse. The company has earmarked $10 billion, which will be employed to develop the AR/VR headsets and glasses that could provide a dominant access point to the metaverse. Figure 22 highlights some of the recent activities by major players.

**Figure 22**

## Examples of ecosystem activities around the metaverse

| | |
|---|---|
| **Microsoft** | Microsoft plans to acquire gaming giant Activision Blizzard in a $68.7 billion all-cash deal. The deal plays into a long-term vision for Microsoft as it aims to be a leading player in the metaverse, with gaming a key component of the future virtual experience. |
| **Nvidia** | Nvidia has built its Omniverse platform to be the 'plumbing' that can connect rich, shared virtual worlds within the metaverse. It is being used across a growing number of industries for projects such as design collaboration and creating simulations of real-world buildings and factories. |
| **Qualcomm** | Qualcomm has announced a collaboration with Microsoft to expand and accelerate the adoption of AR in the consumer and enterprise sectors, with initiatives focused on chips and glasses. |
| **Snap** | Snap, owner of Snapchat, is building custom avatars and AR filters to overlay digital features onto the real world. In 2021, it unveiled the fourth generation of its smartglasses, known as Spectacles, making them available for developers to experiment with creating experiences. |
| **Unity** | Video game software developer Unity is committed to playing a supportive role in the building of the metaverse and to its content creators. Its acquisition of visual effects powerhouse Weta is widely viewed as a sign that it is exploring monetisation opportunities in the gaming vertical and beyond. |

Source: GSMA Intelligence

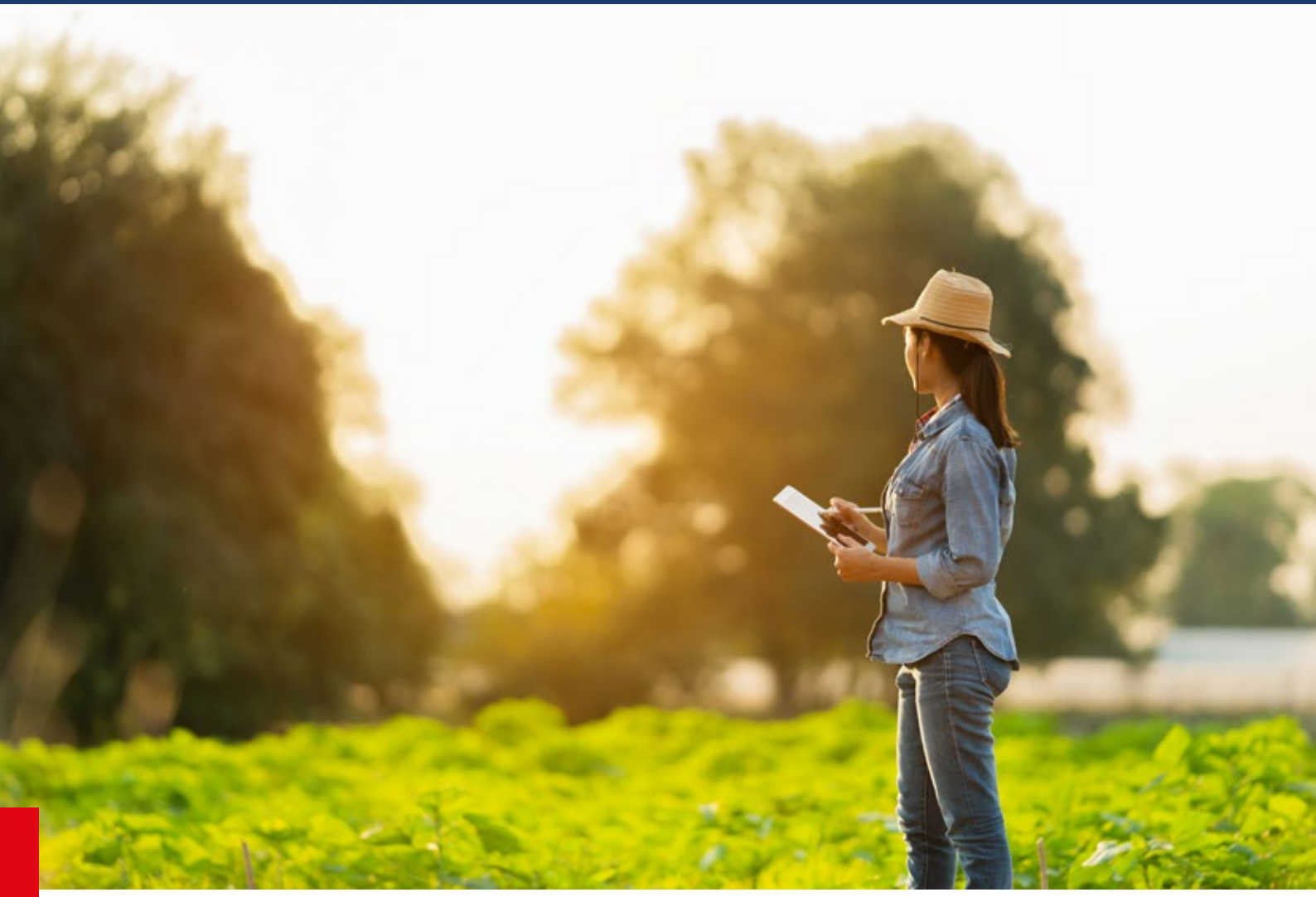
The metaverse has the potential to be wide-ranging, with applications in interactive and immersive use cases, particularly gaming, live entertainment, construction and manufacturing, retail and work. In November 2021, Hong Kong–based gaming platform The Sandbox raised $93 million from investors led by SoftBank's Vision Fund 2. Meanwhile, Seoul has become the first major global city to develop its own metaverse platform for public services and cultural events, committing $3.3 million to fund the initiative. The platform is expected to be fully operational by 2026.

## The role of operators

The metaverse presents a mixed bag for operators. In the 5G (and subsequently 6G) era, the metaverse could provide an opportunity to further monetise high-performance connectivity, in addition to reaping incremental revenue for new services. However, the demand on network infrastructure, especially with mass adoption, could be significant, resulting in additional capex to meet capacity requirements. A number of operators are already taking steps to maximise the opportunity:

- **SK Telecom** has launched a new metaverse platform (Ifland), which provides a more intuitive user interface, allowing users to have a richer experience on Oksusu Social VR (the corporate segment is a key target).
- **AT&T** and e-sports organisation 100 Thieves have collaborated to launch the AT&T Station, an immersive VR space located within the VRChat platform.
- **Verizon** made an initial foray into the metaverse at the 2021 Super Bowl, offering a virtual 5G stadium in Fortnite Creative. The experience let fans come together and interact with their favourite NFL players via games.

# 03
# Mobile contributing to economic growth and addressing social challenges



## 3.1 Mobile's contribution to economic growth

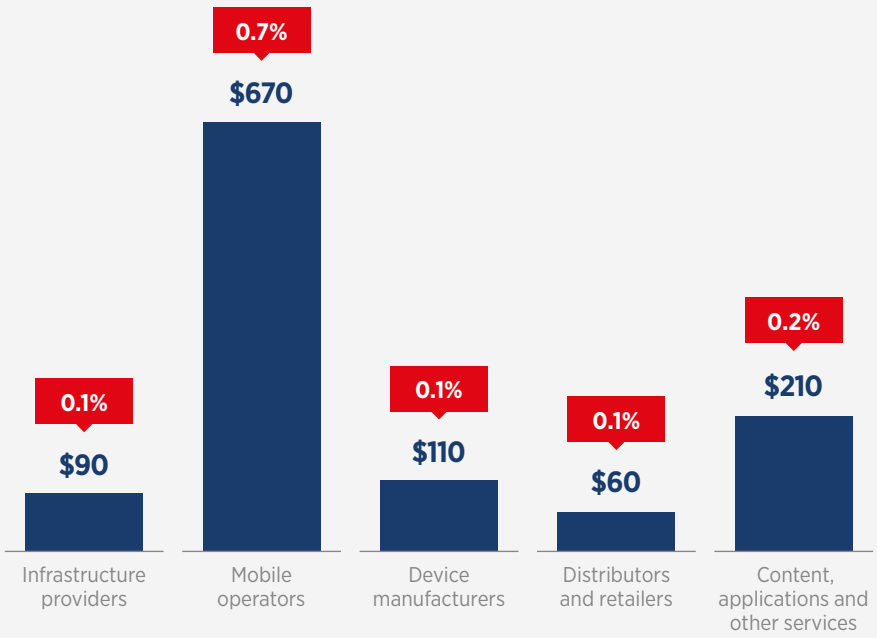
In 2021, mobile technologies and services generated 5% of global GDP, a contribution that amounted to $4.5 trillion of economic value added. The mobile ecosystem also supported approximately 26 million jobs (directly and indirectly) and made a substantial contribution to the funding of the public sector, with almost $500 billion raised through taxes on the sector.

By 2025, mobile's contribution will grow by more than $400 billion (approaching $5 trillion) as countries around the world increasingly benefit from the improvements in productivity and efficiency brought about by the increased take-up of mobile services.

**Figure 23**

**The global mobile ecosystem directly generated more than $1.1 trillion of economic value in 2021, with mobile operators accounting for over half of this figure**

Billion, percentage of GDP

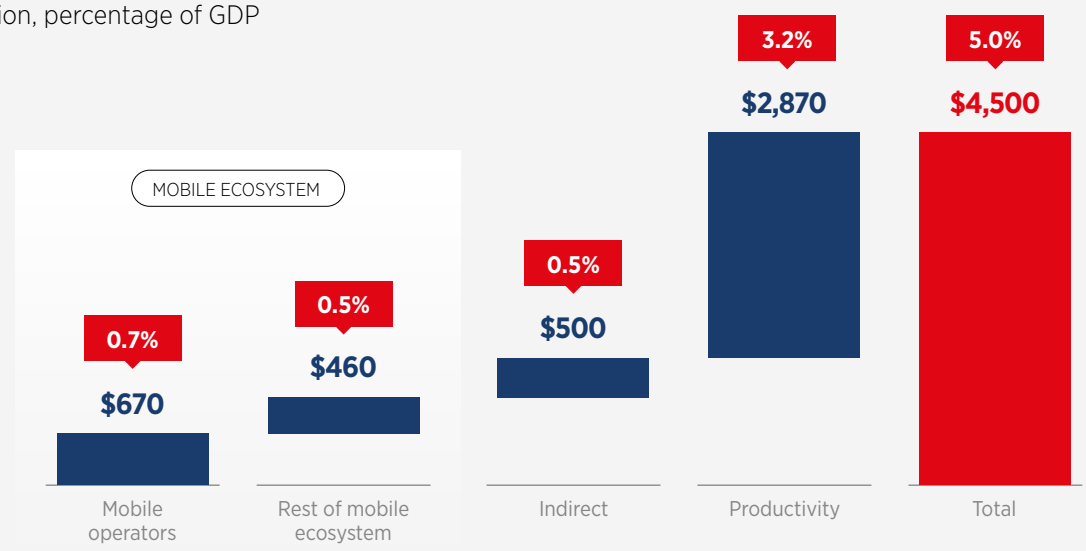



Source: GSMA Intelligence

**Figure 24**

## Additional indirect and productivity benefits brought the total contribution of the mobile industry to $4.5 trillion

Billion, percentage of GDP

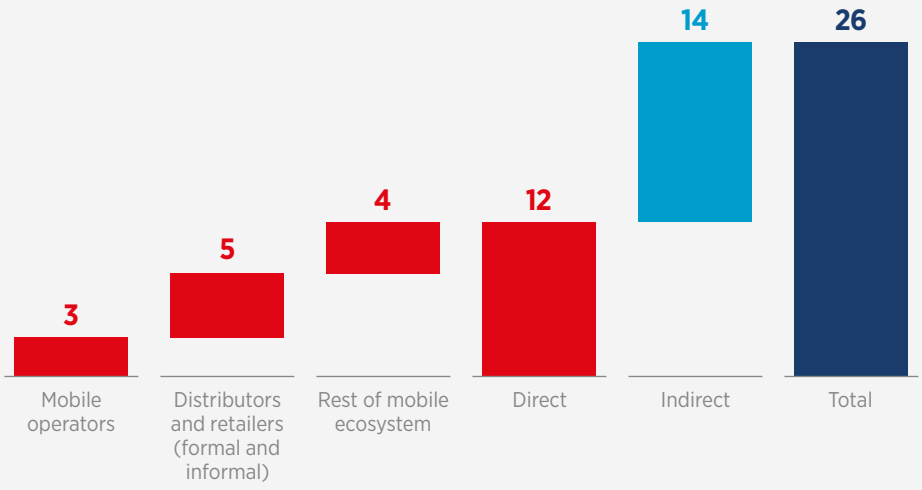



Source: GSMA Intelligence
Note: Totals may not add up due to rounding

**Figure 25**

## The global mobile ecosystem directly employed more than 12 million people in 2021, plus another 14 million indirectly through adjacent industries

Jobs (million)

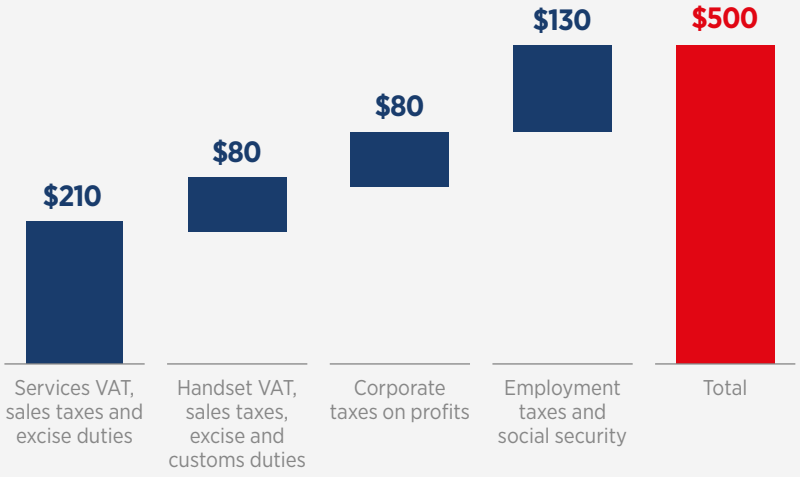



Source: GSMA Intelligence
Note: Totals may not add up due to rounding

**Figure 26**

## In 2021, the mobile ecosystem contributed $500 billion to the funding of the public sector through consumer and operator taxes

Billion

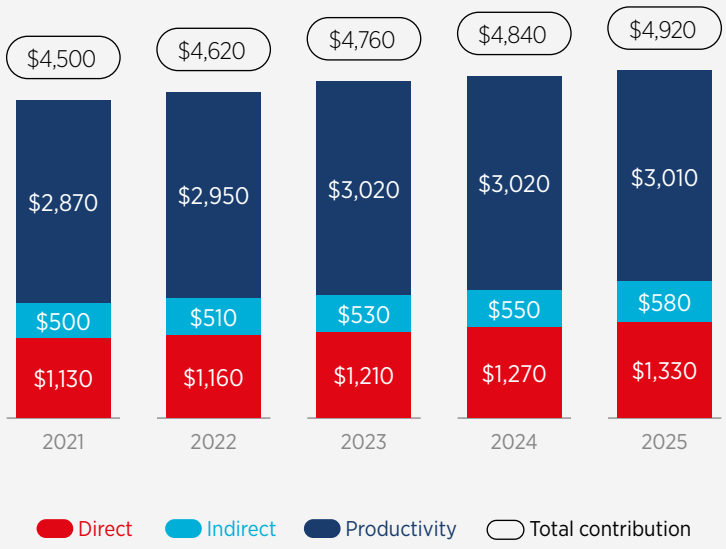



Source: GSMA Intelligence
Note: Totals may not add up due to rounding

**Figure 27**

## Driven mostly by continued expansion of the mobile ecosystem, the global economic contribution of mobile will increase by more than $400 billion by 2025

Billion




Source: GSMA Intelligence
Note: Totals may not add up due to rounding

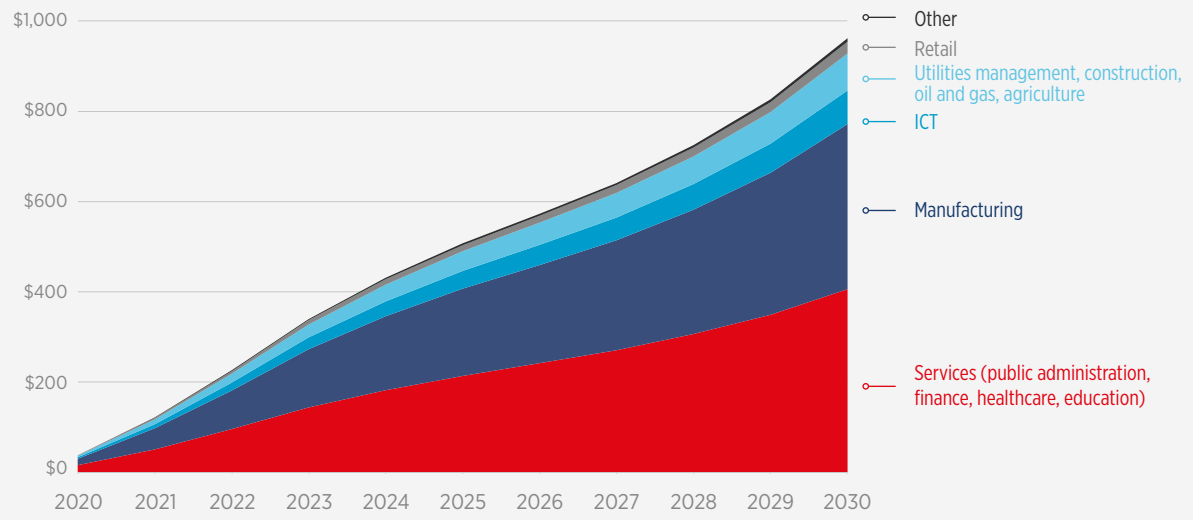
5G alone is expected to benefit the global economy by more than $960 billion in 2030, mostly in developed regions, including East Asia and the Pacific, North America and Europe. Towards the end of the decade, other regions will also start benefiting from 5G, thanks to network deployments.

5G is expected to benefit all economic sectors of the global economy, although some industries will benefit more than others due to their ability to incorporate 5G use cases in their business.

**Figure 28**

## Annual global 5G contribution by industry, 2020–2030

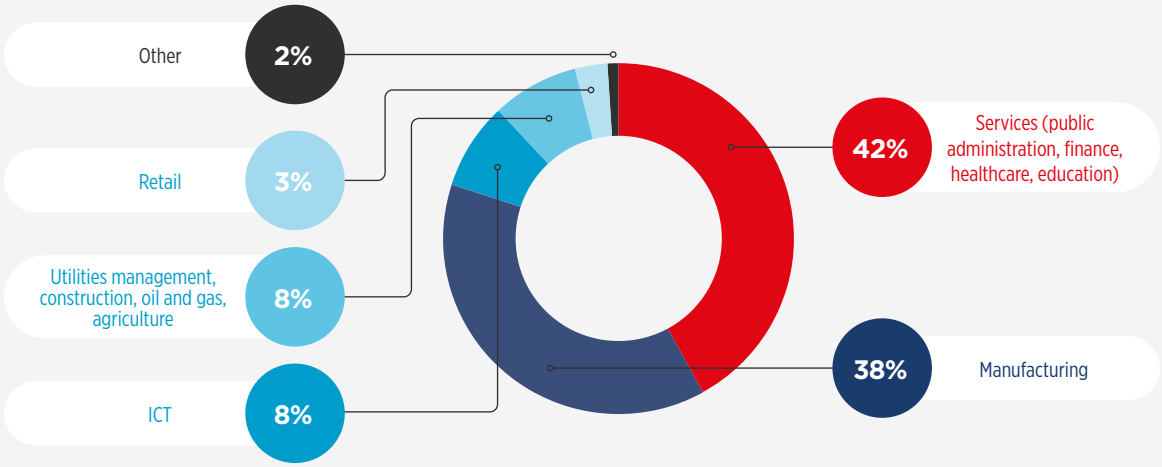
Billion




Source: GSMA Intelligence

**Figure 29**

## Global 5G contribution by industry, 2030




Source: GSMA Intelligence
Note: Total may not add up due to rounding.

## 3.2 Mobile enabling access to the internet and life-saving services

Although the mobile broadband coverage gap[5] has been significantly reduced due to operator investments, around 450 million people globally still live in areas without access to internet services. Meanwhile, the usage gap[6] remains unchanged and is even expanding in some markets; nearly 3.4 billion people are not using mobile internet despite living in areas with mobile broadband coverage. The Covid-19 crisis has reinforced the impacts of the digital divide, with the unconnected less able to mitigate the economic and social disruption to their lives.

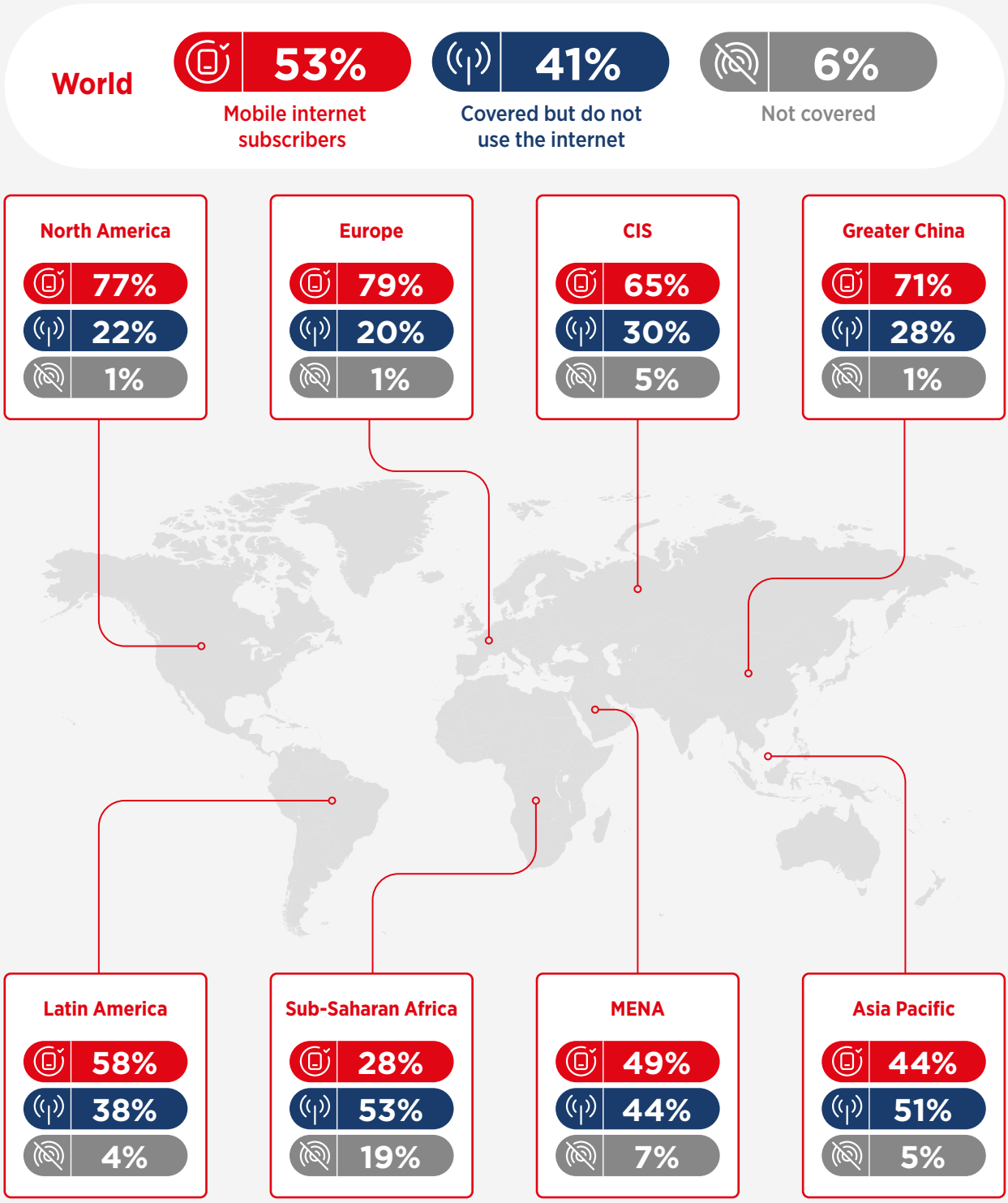
For many people, mobile networks remain the only form of internet access, underlining the urgency to identify solutions to accelerate mobile internet adoption and use. In 2021, more than 200 million people connected to mobile internet for the first time, bringing the total to 4.19 billion people (53% of the global population). By 2025, this number will rise to 5 billion, equivalent to three in five people globally.

5. The 'coverage gap' refers to those living outside of areas covered by mobile broadband networks.
6. The 'usage gap' refers to those who live within areas covered by mobile broadband networks but do not yet subscribe to mobile broadband services.

Figure 30

**More than 200 million people connected to mobile internet for the first time in 2021, with 53% of the global population in total now connected**

State of global mobile internet connectivity by region (percentage of total population)




Source: GSMA Intelligence

Around the world, mobile operators and their partners continue to pursue innovations in network technology and business models to increase access to mobile broadband networks and deliver services more efficiently to unconnected populations. Aerial technologies, such as satellites, could be instrumental in bringing these populations online given the challenge of delivering connectivity in remote areas by conventional means. Over the past year, there has been a wave of partnerships between operators and satellite companies to address the coverage gap that still exists in many rural and remote areas. These include the following:

- Deutsche Telekom signed an agreement with Eutelsat to enable high-speed broadband connectivity in remote parts of Germany.
- KDDI announced that it will use SpaceX's Starlink satellite for internet backhaul in rural areas in Japan starting from early 2022.
- Verizon is collaborating with Amazon's Project Kuiper to deliver cellular backhaul solutions to extend the reach of Verizon's mobile network to remote communities in the US.
- Vodacom and Eutelsat have signed an agreement to bring connectivity to underserved regions of Tanzania.

Reducing the internet usage gap is key to closing the digital divide in countries around the world. In practice, this means addressing the main usage barriers of device affordability and lack of literacy and digital skills. Innovation in device offerings is one of several solutions that can help address the different barriers that persist across regions. For example, in India, Reliance Jio unveiled a mass-market smartphone, jointly developed with Google, with financing options to make it accessible for a wider range of consumers.

## Global initiative to tackle smartphone affordability barrier

In September 2021, Vodafone Group teamed up with the UN's International Telecommunication Union (ITU) to launch a multi-stakeholder initiative to address the global mobile internet access gap. The Vodafone CEO and ITU secretary-general serve as co-chairs of the new Broadband Commission Working Group on increasing access to smartphones. The goal is to address issues of device affordability, which limit internet access, by identifying political, commercial and economic interventions to increase smartphone access.

The new Broadband Commission Working Group, which includes the GSMA, has been tasked to identify interventions to help achieve "Smartphones for All" by 2030. Much of its focus will be on low- and middle-income countries, which account for more than 90% of the world's unconnected population. However, there also remains a significant digital inclusion gap in high-income countries. Operators in these markets are making efforts to address this. For example, in the US, Verizon is expanding its initiative to provide wireless broadband to underserved communities, while in France, Orange is running workshops in its stores to provide free group lessons on smartphone use and digital skills.

## 3.3 Mobile industry's impact on the SDGs

Covid-19 has slowed progress on the UN SDGs around the world, with the pandemic exacerbating existing social and economic inequalities. Furthermore, efforts to contain the spread of the virus and keep people safe have stalled a number of activities geared towards achieving the SDGs. For example, in 2020, 255 million full-time jobs were lost, an additional 119–124 million people were pushed into extreme poverty and 101 million children fell below the minimum reading proficiency level amid widespread school closures.[7]

With lockdown restrictions and social distancing measures in place, people relied on mobile networks to stay connected and access life-enhancing services, reflecting the importance of mobile connectivity to societies and economies everywhere. Consequently, mobile adoption has continued to increase during the pandemic, despite sluggish economic growth and the negative effects on consumer incomes. This underpins the mobile industry's contribution to an array of SDGs. For example, mobile technology contributes to SDG 1: No Poverty by driving sustainable economic growth, which increases household welfare and reduces poverty.

Mobile technology can also help with education through the dissemination of online content and support. More than 2 billion individuals now use mobile to access educational information for themselves or their children. Growth is highest in regions where mobile is the primary and, in many cases, only form of internet access. Moreover, mobile operators are supporting edtech startups by opening up APIs to integrate their communication channels (e.g. mobile voice, SMS, USSD) and mobile money services into e-learning platforms. For example, Eneza Education reaches 300,000 learners per day across its footprint in Sub-Saharan Africa. While adoption of e-learning services has accelerated during the pandemic, these solutions fulfil a constant need in many cases. For instance, a study in Côte d'Ivoire showed that over two thirds of people intend to continue using e-learning solutions post lockdown, demonstrating the ongoing importance of mobile technology to achieving SDG 4: Quality Education.

> With only eight years until the deadline for the SDGs, stakeholders are renewing their efforts to achieving the SDGs – mobile technology will play a central role in these efforts.

In the last two years there has also been a strong increase in the number of people using mobile financial services to purchase goods and services, further supporting the industry's contribution to SDG 1: No Poverty, SDG 8: Decent Work and Economic Growth and SDG 10: Reduced Inequalities. Mobile operators have helped farmers during the pandemic by adding Covid-19 information to their existing advisory tools. This supports the industry's contribution to SDG 2: Zero Hunger, as well as SDG 14: Life Below Water and SDG 15: Life On Land. Furthermore, mobile health solutions are playing a growing role in achieving SDG 3: Good Health and Well-being. Most countries have seen an increase in the proportion of people using mobile for health purposes on a weekly basis in the wake of the pandemic.

With only eight years until the deadline for the SDGs, stakeholders are renewing their efforts to achieving the SDGs – mobile technology will play a central role in these efforts.

7. The Sustainable Development Goals Report, United Nations, 2021

# 04
# Policies for resilient recovery

The digital economy creates significant social and economic benefits for society through ongoing investment and innovation. Over the years, mobile operators have invested in the infrastructure that today allows billions around the globe to benefit from being connected online. The pandemic showed the power of digital connectivity and technologies in supporting individuals, businesses, governments and societies, and increased the profile and political awareness of the advantages of digitisation. However, successful digital transformation requires all levels of government to actively support policies that lead to long-term digital strategies and promote the private investment required to deliver them.

## 4.1 Supporting the evolution of mobile networks

Mobile technology will play a key role in governments' recovery strategies and present a significant opportunity to foster inclusive and resilient growth through appropriate policy and regulatory environments for mobile services, in order to accelerate investment and innovation.

### Flexible regulatory and policy frameworks

Regulatory reforms can ensure a country's digital infrastructure meets ever-expanding needs and create the conditions for digital investment and innovation to flourish.

Mobile operators are facing a capex investment requirement of over $600 billion worldwide between 2022 and 2025, roughly 85% of which will be in 5G networks.

To support the mobile industry in delivering this commitment, governments and regulators can implement policy frameworks that are conducive to investment in a number of ways. They should:

- implement flexible, light-touch regulation that creates an environment for continued mobile sector investment and innovation and removes obstacles to network deployment (e.g. rights of way regulations, planning procedures, site installation requests, approvals of voluntary network sharing).
- adopt a balanced approach to collecting revenues through taxes and fees on the mobile sector, without jeopardising medium-term investment and economic growth
- provide fair and efficient spectrum awards to maximise access to affordable mobile broadband services
- ensure fair competition and regulation to reflect the evolving structure of the digital economy to ensure contestable and fair markets for the different players in the digital ecosystem – this should include ex-ante and ex-post regulatory interventions, including merger assessments, that limit anti-competitive conduct in the digital ecosystem while taking into account the benefits arising from investment and innovation.

Mobile operators are facing a capex investment requirement of over $600 billion worldwide between 2022 and 2025, roughly 85% of which will be in 5G networks.

In 2021, a number of countries led the way with reforms and legislative initiatives to advance connectivity. For example, India announced a sweeping telecoms reform that will increase business certainty through an annual calendar of spectrum auctions and longer licence terms (30 years); eliminate annual spectrum usage charges for new licences; and streamline customer-acquisition requirements. The EU has been leading the way on ex-ante regulation of digital platforms with two legislative proposals aimed at creating harmonised rules for providers of core platforms services, to avoid anti-competitive practices and regulate illegal content and misinformation.[8]

8. Digital Markets Act: Joint Position Paper by the GSMA and ETNO, May 2021 and Digital Services Act: Joint Position Paper by the GSMA and ETNO, April 2021

## Policy actions to close the digital divide

The pandemic has emphasised the global urgency to close the digital divide, with 3.7 billion people still unconnected and excluded from the benefits of accessing digital tools. While great strides have been made to extend network coverage, the usage gap remains sizeable. Governments have an important role to play in fostering demand-side interventions such as:

- actively investing in digital skills training for the general public, so that all citizens are able to access essential digital services and use connected devices
- implementing policies that lower the cost of internet-enabled handsets, such as financing mechanisms that reduce the upfront cost to consumers and promotions or subsidies that make handsets and data bundles more affordable for different user segments
- reducing spectrum fees and discriminatory taxation on the mobile sector to improve affordability, including reducing spectrum costs when operator obligations require them to close the coverage gap in areas with low or no ROI
- utilising public funds for connectivity for demand-side stimulation and rural connectivity only as a last resort, given that public ownership or oversight of networks has proven ineffective compared to private investment.

Colombia, for example, has recently taken important steps to improve affordability of services with the creation of the Unified Single Fund, with a reduced contribution for network operators from 2.2% to 1.9% of gross income from the provision of telecommunications networks and services.

However, as revenues from voice and SMS have steadily reduced in recent years, many governments, especially in Sub-Saharan Africa, are looking to new revenue sources to address fiscal shortfalls and are increasingly targeting mobile money services, which creates inevitable negative repercussions on digital and financial inclusion. In Tanzania, where mobile money is a key driver of socioeconomic growth (33.2 million mobile money accounts), a new levy on mobile money services was introduced in June 2021 and has created a huge spike in transaction costs for users and up to a 38% contraction in number of transactions.[9]

## Leveraging the digital economy to propel economic recovery

As countries emerge from the pandemic, governments around the world are looking to the digital economy to build more resilient and sustainable economies and to kick-start economic growth. To this end, policies should be focused on:

- encouraging digitisation of vertical sectors and SMEs to leverage connectivity and the technical advancement of 5G to improve efficiency and reliability of business processes
- prioritising digital transformation of government services so that all citizens will be able to access government services digitally
- investing in higher education and reskilling programmes to expand the digital workforce.

In 2021, the EU earmarked €7.5 billion for the Digital Europe programme, aimed at accelerating economic recovery and shaping Europe's digital transformation. This will be achieved by funding projects in supercomputing, AI, cybersecurity and advanced digital skills, and ensuring widespread use of digital technologies.

9. Tanzania Mobile Money Levy Impact Analysis, GSMA, 2021

### Harmonising EMF limits

Ongoing mobile network developments, such as the introduction of 5G, the expanded use of small cells and active antenna systems, have spurred public interest in the possible health effects of electromagnetic fields (EMFs).

It is important that national regulatory authorities take a leading role in communication efforts to inform the public and address misinformation about radiofrequency (RF) EMFs. They should also adopt the updated exposure guidelines of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) in order to ensure that citizens, industries and public administrations benefit from the efficient deployment of mobile network infrastructure.

Steps to take include the following:

- National RF-EMF policy should be harmonised with the international RF-EMF exposure guidelines and technical standards for compliance assessment.
- Good practices for compliance should be encouraged, such as accepting operator declarations of site compliance, allowing RF-EMF assessment by calculation rather than measurement where appropriate and adopting uniform small cell deployment rules.
- Effective communication should be practised with the industry and with the public on compliance with RF-EMF limits.

## 4.2 Effective spectrum policy – meeting future connectivity demand

Effective spectrum licensing is critical to encourage the investment required to expand mobile access, meet the increase in demand for data services, and enhance the quality and range of services offered. Successful 5G networks and services depend on a significant amount of new harmonised mobile spectrum. Ensuring the timely availability of prime bands, including those requiring defragmentation, should be prioritised. Initially, regulators should aim to make available 80–100 MHz of contiguous spectrum per operator in prime 5G mid-bands (e.g. 3.5 GHz) and around 800 MHz per operator in high bands (mmWave spectrum). Lower bands (below 1 GHz) are also required to provide wide-area capacity and ensure that 5G reaches everyone.

The vast majority of commercial 5G networks all over the world depend on mid-band frequencies. This initial focus – particularly on the 3.5 GHz range, which has become the birthplace of commercial 5G – produces the scale needed to bring down the cost of network equipment and mobile devices.

At its core, a mobile spectrum licensing framework should:

- ensure operators have access to sufficient spectrum
- provide predictability to support the new network investment needed
- avoid costly restrictions on the use of spectrum beyond those needed to manage interference.

Spectrum harmonisation has always played a vital role in the success of mobile networks and the rollout of 5G is no different. However, more mid-band spectrum beyond the initial 80–100 MHz per operator will be needed as 5G demand increases. This work is vital to 5G's future and requires forward-planning from policymakers. On average, a total of around 2 GHz of mid-band spectrum will be required for 5G per country by 2030.

Based on conservative assumptions, mid-band 5G spectrum will drive an increase of more than $610 billion in global GDP in 2030, accounting for almost 65% of the overall socioeconomic value generated by 5G.[10]

10. Vision 2030: Insights for Mid-band Spectrum Needs, GSMA, 2021

> Based on conservative assumptions, mid-band 5G spectrum will drive an increase of more than $610 billion in global GDP in 2030, accounting for almost 65% of the overall socioeconomic value generated by 5G.[10]

Refarming 2G, 3G and 4G bands can, in time, contribute to meeting future spectrum requirements, but adding new bands is necessary to keep up with demand. A number of frequency ranges have the potential to help support future mid-band needs. Mobile use within the 3.5 GHz range (3.3–4.2 GHz) is being maximised in some countries, while additional capacity in both 4.8 GHz and 6 GHz benefits from harmonised equipment ecosystems. These bands are all part of the process of the next World Radiocommunication Conference (WRC-23).

For these planning efforts to succeed, countries should develop spectrum roadmaps that reflect growing demand. Roadmaps are an important means of ensuring there is sufficient spectrum for future demand from consumers and new technologies. Information on spectrum releases is critical for businesses to prepare investment plans, secure financing and develop arrangements for deploying particular technologies.

The timely release of spectrum bands is also vital. An early release of spectrum drives better consumer outcomes, which is important in markets where long-term value, innovation and cost reductions are driven through relatively short technology cycles. If spectrum is released earlier, operators have more time to invest in making new technologies available nationwide. The spectrum also eases capacity constraints in urban areas so operators are better able to invest in rural areas. Conversely, unnecessary delays to spectrum awards risk harming mobile broadband service rollouts and leaving more people unconnected.

Spectrum carve-outs for vertical industries are causing a barrier to meeting this demand in some cases and should be avoided in priority 5G bands (i.e. 3.5, 26 and 28 GHz). Sharing approaches such as leasing[11] are typically better options in these situations.

The momentum behind mmWave spectrum is growing. There is already a harmonised identification of 26, 40 and 66 GHz for ultra-high-speed and ultra-low-latency consumer, business and government services. The next step is for countries to assign it to operators. As of September 2021, 16 countries around the world had done that, with more countries soon to follow. Existing commercial mmWave 5G networks are showing the significant potential these bands have.

11. Spectrum leasing in the 5G era, GSMA, 2022

## Spectrum pricing and conditions

Beyond spectrum availability, the cost of spectrum also has a major impact. Governments and regulators should assign 5G spectrum to support their digital connectivity goals rather than as a means of maximising state revenues.

Effective spectrum pricing policies are vital to support better quality and more affordable 5G services. In turn, that will help address issues such as the usage gap. High reserve prices, artificially limited spectrum supply (including set-asides) and poor auction design can all have a negative impact (i.e. slower mobile broadband and supressed network investments).

Regulators should apply the right 5G spectrum licence terms and conditions and carefully consider best practice for awarding spectrum. Additionally, licences should be technology and service neutral to allow the upgrade of existing bands to 5G. Consulting with the industry will help maximise consumer benefits and ensure 5G is available for all.

To maximise the benefits of 5G, governments and regulators should:

- make available sufficient 5G spectrum and avoid limiting the supply via set-asides
- set modest reserve prices and annual fees to let the market determine spectrum prices
- carefully consider auction design to avoid unnecessary risks for bidders (e.g. avoiding mismatched lot sizes, which create artificial scarcity)
- develop and publish a 5G spectrum roadmap with the input of stakeholders to help operators plan effectively around future availability
- consult stakeholders on the award rules and licence terms and conditions, and also take them into account when setting prices (onerous obligations reduce the value of spectrum).

### The GSMA's Ministerial Programme at MWC

The GSMA's Ministerial Programme brings together global policy leaders, heads of regulatory agencies, data privacy authorities, industry executives and technology experts from across the mobile ecosystem to discuss strategies for economic recovery and building a digitally inclusive world.

The pandemic has impacted people and businesses in all corners of the globe, but new opportunities have emerged with mobile connectivity at the heart of economic and societal recovery. The Ministerial Programme 2022 addresses long-term goals to, among other things, close the connectivity and usage gaps, meet global climate targets and build policies for our new digital world.

The Ministerial Programme is an invitation-only event hosted by the GSMA at the heart of MWC Barcelona. In 2022 the event is taking place between 28 February and 2 March 2022 at Fira Gran Via.

**www.mwcbarcelona.com/ministerial**

gsma.com

For more information, please visit the
GSMA website at **www.gsma.com**