The Mobile Economy 2021

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Executive summary

Covid-19 emphasises the importance of connectivity to society's wellbeing

The Covid-19 pandemic has had a profound impact on the health and livelihoods of individuals and communities around the world. In these trying times, connectivity has emerged as a lifeline for society by enabling many social and economic activities to continue amid unprecedented social and travel restrictions, supporting new ways for enterprises to operate safely and facilitating effective response measures from government and other stakeholders.

Mobile has been particularly instrumental during this period, keeping people connected and underpinning new services in response to the pandemic. Around the world, the exceptional scale and utility of mobile networks and services have:

- enabled people to work and learn remotely, stay in touch with loved ones, and perform many other everyday activities online
- supported innovative health solutions, such as remote patient monitoring and contact tracing, to control the spread of the virus
- provided a platform for people to access digital financial services, given efforts to reduce the reliance on cash
- facilitated the safe and efficient distribution of social welfare to vulnerable people
- generated valuable insights on mobility patterns from anonymised and aggregated mobile big data to inform government response measures at various stages of the pandemic.

As the world emerges from the pandemic, connectivity will be crucial to helping economies recover and become more resilient to future shocks. This will come in the form of timely access to life-saving information and services for otherwise excluded populations, enhanced productivity and efficiency through 5G- and IoT-enabled digital transformation of industries, and new opportunities and market access for people and enterprises. With the digital economy set to be at the heart of a post-Covid-19 world, the urgency to bring unconnected communities online has never been greater.

5G momentum builds, but 4G still has room to grow

The launch of commercial 5G services in Latin America and Sub-Saharan Africa over the last year means that the technology is now available in every region of the world. The pandemic has had little impact on 5G momentum; in some instances, it has even resulted in operators speeding up their network rollouts, with governments and operators looking to boost capacity at a time of increased demand. By the end of 2025, 5G will account for just over a fifth of total mobile connections and more than two in five people around the world will live within reach of a 5G network.

In leading 5G markets, such as China, South Korea and the US, 4G has peaked and, in some cases, begun to decline. In many other countries, particularly in developing regions, 4G still has significant headroom for growth. Much of the growth in 4G will come from existing 4G infrastructure, as 5G will account for 80% of total capex over the next five years. Globally, 4G adoption will peak at just under 60% by 2023 as 5G begins to gain traction in new markets.

Subscriber growth is slowing, but mobile's contribution to the global economy remains significant

By the end of 2020, 5.2 billion people subscribed to mobile services, representing 67% of the global population. Adding new subscribers is increasingly difficult, as markets are becoming saturated and the economics of reaching rural populations are becoming more difficult to justify in a challenging financial climate for mobile operators. That said, there will be nearly half a billion new subscribers by 2025, taking the total number of subscribers to 5.7 billion (70% of the global population). Large under-penetrated markets in Asia and Sub-Saharan Africa will account for the majority of new subscribers.

In 2020, mobile technologies and services generated $4.4 trillion of economic value added (5.1% of GDP) globally. This figure will grow by $480 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 seeing the most impact.

The mobile industry continues to lead in efforts to tackle climate issues

In April 2021, the mobile sector was credited by the United Nations (UN) for achieving a critical breakthrough towards its mission of combatting climate change. Being the first major sector to achieve the rigorous criteria set by the UN's Race to Zero campaign demonstrates the commitment and leadership of mobile operators in the push to meet the goals of the Paris Agreement. This comes at a time when political and economic leaders are giving renewed impetus to delivering a zero-carbon world. Today, 50% of operators by connections and 65% by revenue have committed to science-based targets (SBTs) on the reduction of carbon emissions.

Policies to shape the post-pandemic digital economy

Mobile technology will play a key role as governments look to reinvigorate their economies and build a better, more inclusive society. Now is the right moment for governments to reassess the business and regulatory environment for mobile services in order to accelerate investment and innovation. To realise this, governments need to:

- direct stimulus funds towards digital development
- support financial sustainability of the mobile sector
- remove barriers to network deployment
- ensure fair competition
- harmonise EMF limits
- establish balanced policies for personal data.

Further, positive decisions that help drive the availability of spectrum are crucial for governments and regulators that want to realise high-performance networks and services, particularly for 5G. Successful 5G networks and services depend on a significant amount of new harmonised mobile spectrum. 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 (600 and 700 MHz) are also required to provide wide-area capacity and ensure that 5G reaches everyone.

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. 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).

Global Market

UNIQUE MOBILE SUBSCRIBERS

2020-2025
CAGR: 1.8%

2020 **5.2bn**

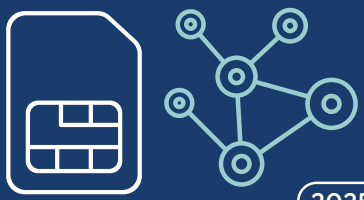
2025 **5.7bn**

67% Penetration rate → 70%

Percentage of population

SIM CONNECTIONS

(excluding licensed cellular IoT)



2020-2025
CAGR: 1.7%

2020 **8.1bn**

2025 **8.8bn**

103% Penetration rate → 107%

Percentage of population

MOBILE INTERNET USERS

2020-2025
CAGR: 4.3%

2020 **4.0bn**

2025 **5.0bn**

51% Penetration rate → 60%

Percentage of population

OPERATOR REVENUES AND INVESTMENT

Total revenues

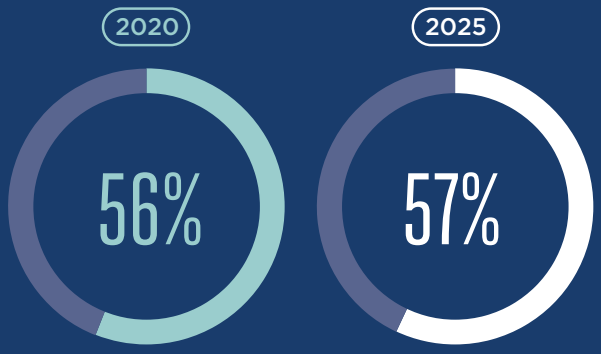
2020 **$1.04tn**

2025 **$1.15tn**

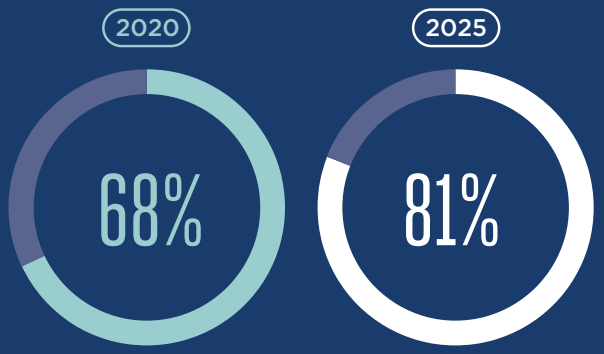
Operator capex of **$900 billion** for the period 2021–2025 (80% on 5G)

4G

Percentage of connections
(excluding licensed cellular IoT)



SMARTPHONES



Percentage of connections
(excluding licensed cellular IoT)

MOBILE INDUSTRY CONTRIBUTION TO GDP

2020
$4.4tn
5.1% of GDP

2025
$4.8tn

5G

2025
1.8bn
Connections

Percentage of total connections
(excluding licensed cellular IoT)

INTERNET OF THINGS

2020
13.1bn
Total connections

2025
24.0bn
Total connections

PUBLIC FUNDING

2020
$410bn

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

EMPLOYMENT

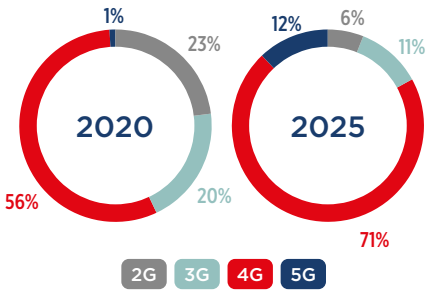
Jobs directly supported by the mobile ecosystem

2020
12m

+13m jobs supported indirectly

Asia Pacific

TECHNOLOGY MIX*



SUBSCRIBER PENETRATION

2020 → 2025

58% 62%

SMARTPHONE ADOPTION

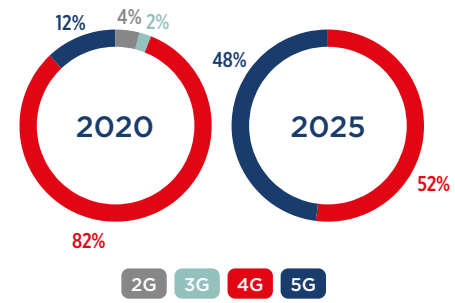
2020 → 2025

68% 83%

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

Greater China

TECHNOLOGY MIX*



SUBSCRIBER PENETRATION

2020 → 2025

83% 85%

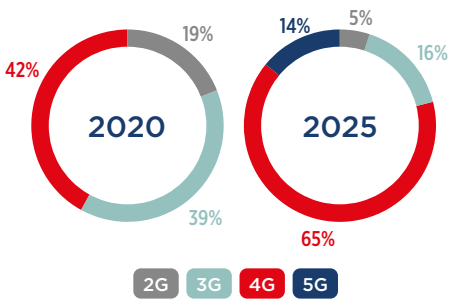
SMARTPHONE ADOPTION

2020 → 2025

73% 89%

CIS

TECHNOLOGY MIX*



SUBSCRIBER PENETRATION

2020 → 2025

81% 82%

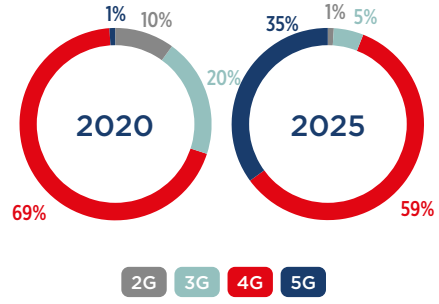
SMARTPHONE ADOPTION

2020 → 2025

69% 81%

Europe

TECHNOLOGY MIX*



SUBSCRIBER PENETRATION

2020 → 2025

86% 87%

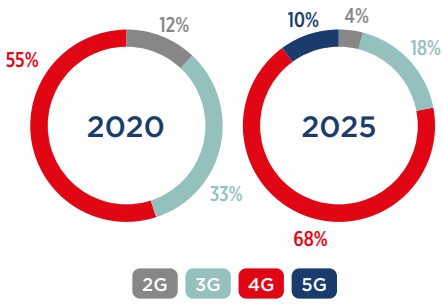
SMARTPHONE ADOPTION

2020 → 2025

78% 83%

Latin America

TECHNOLOGY MIX*



SUBSCRIBER PENETRATION

2020 → 2025

69% 73%

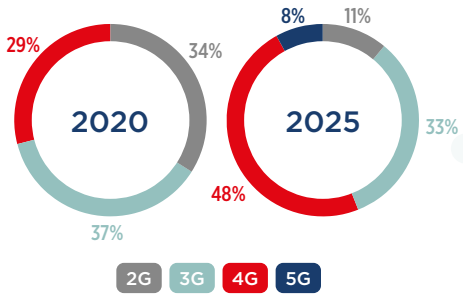
SMARTPHONE ADOPTION

2020 → 2025

72% 81%

MENA

TECHNOLOGY MIX*



SUBSCRIBER PENETRATION

2020 → 2025

65% 68%

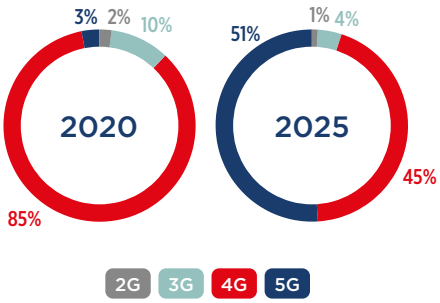
SMARTPHONE ADOPTION

2020 → 2025

66% 80%

North America

TECHNOLOGY MIX*



SUBSCRIBER PENETRATION

2020 → 2025

84% 85%

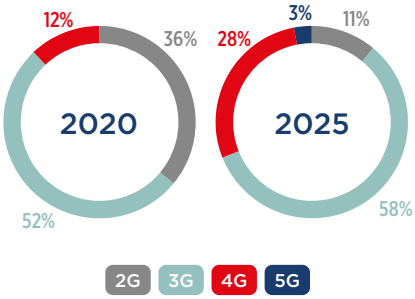
SMARTPHONE ADOPTION

2020 → 2025

82% 85%

Sub-Saharan Africa

TECHNOLOGY MIX*



SUBSCRIBER PENETRATION

2020 → 2025

46% 50%

SMARTPHONE ADOPTION

2020 → 2025

48% 64%

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

01

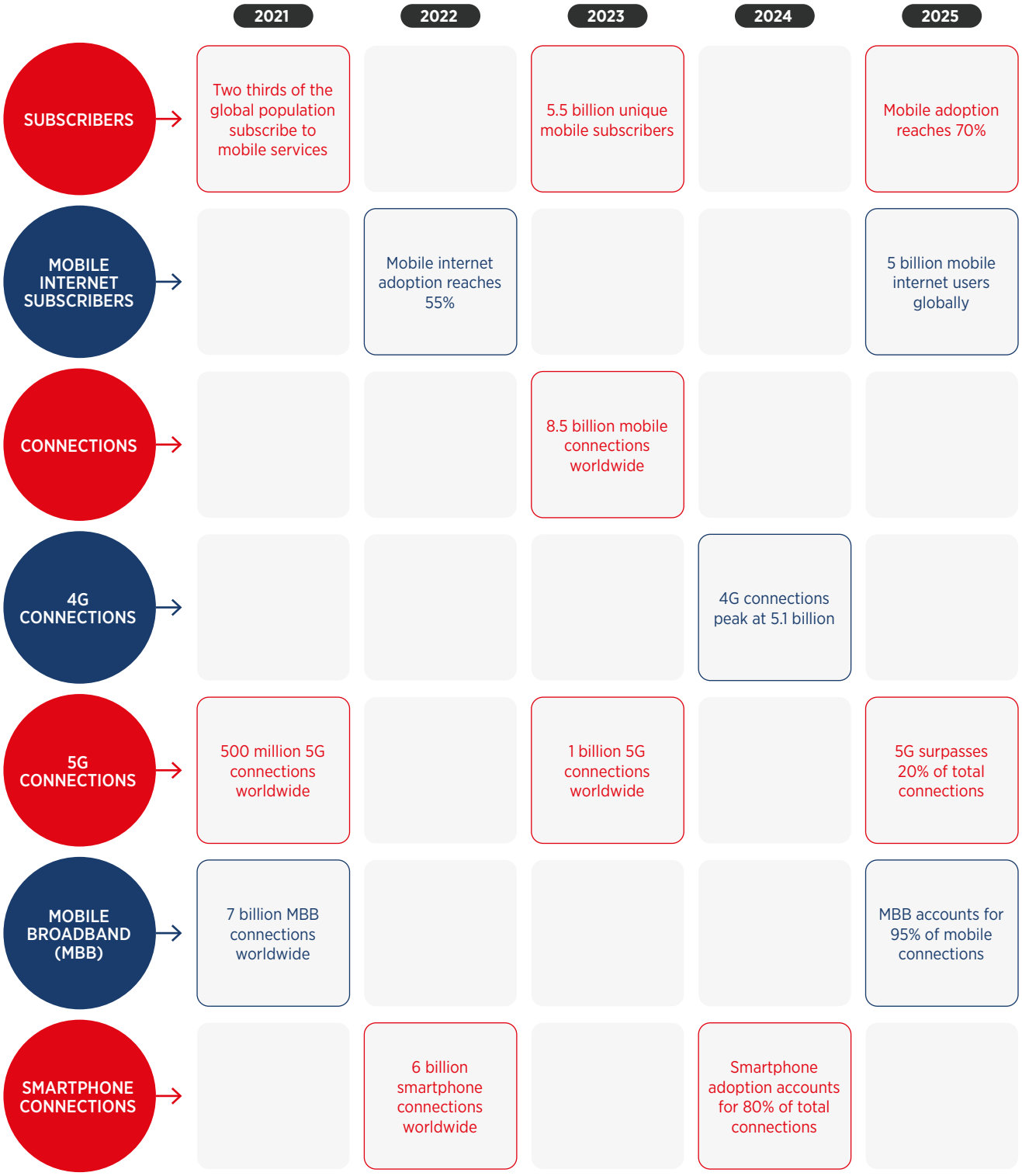
The mobile market in numbers

1.1 Subscriber growth continues everywhere, but at varying speeds

Source: GSMA Intelligence

Figure 1

Key milestones over the next five years

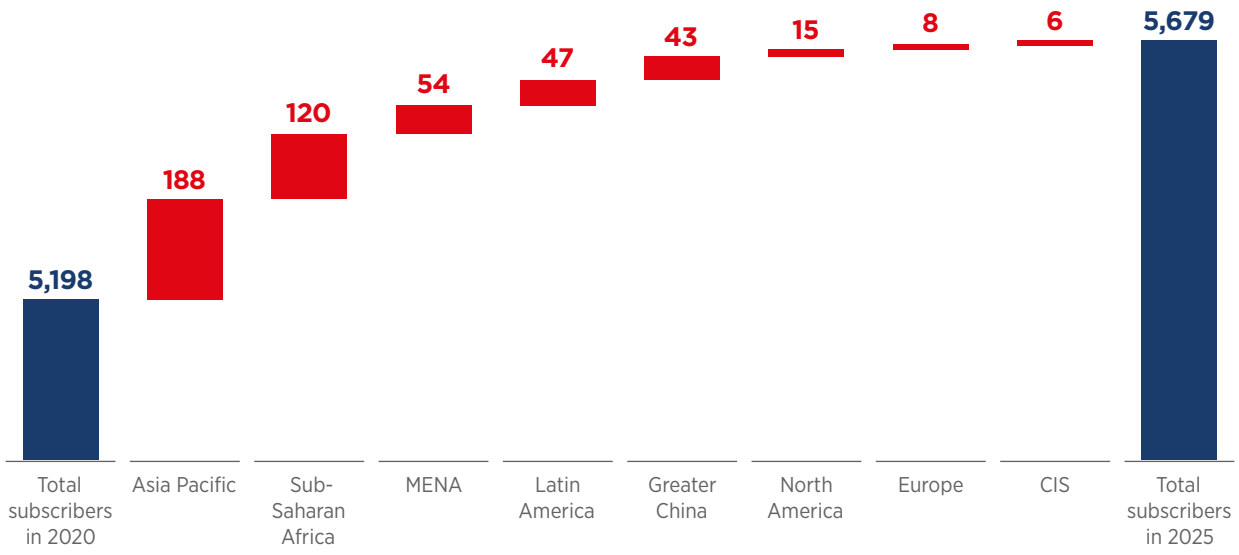


Source: GSMA Intelligence

Figure 2

There will be nearly half a billion new subscribers by 2025; nearly two thirds will be from Asia Pacific and Sub-Saharan Africa

New mobile subscribers (million)



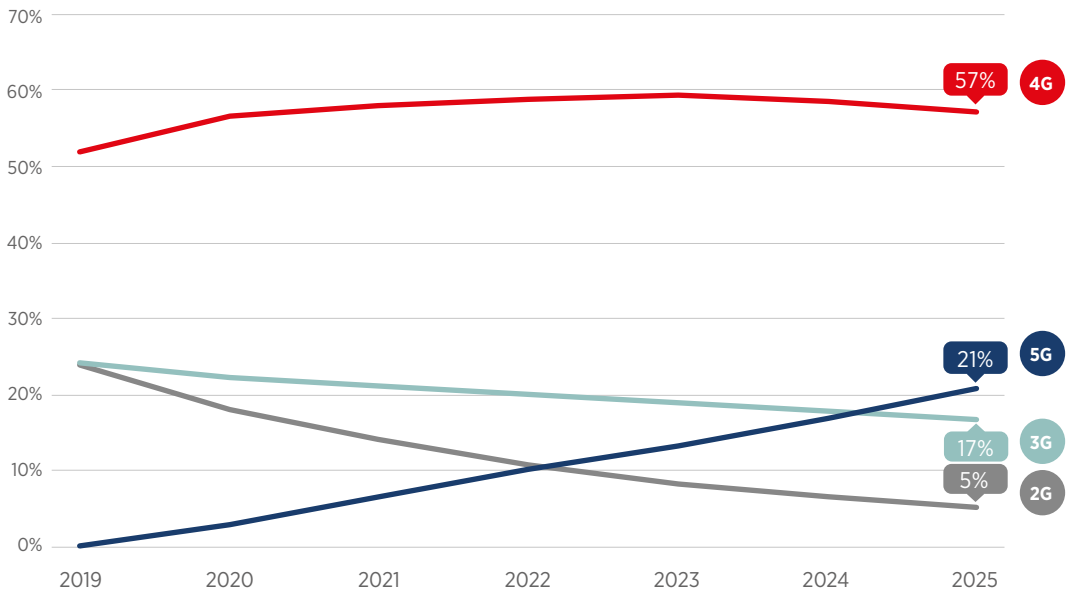
1.2 4G nears peak as 5G adoption accelerates

Source: GSMA Intelligence

Figure 3

Nearly three in five connections are based on 4G; the momentum behind 5G is growing

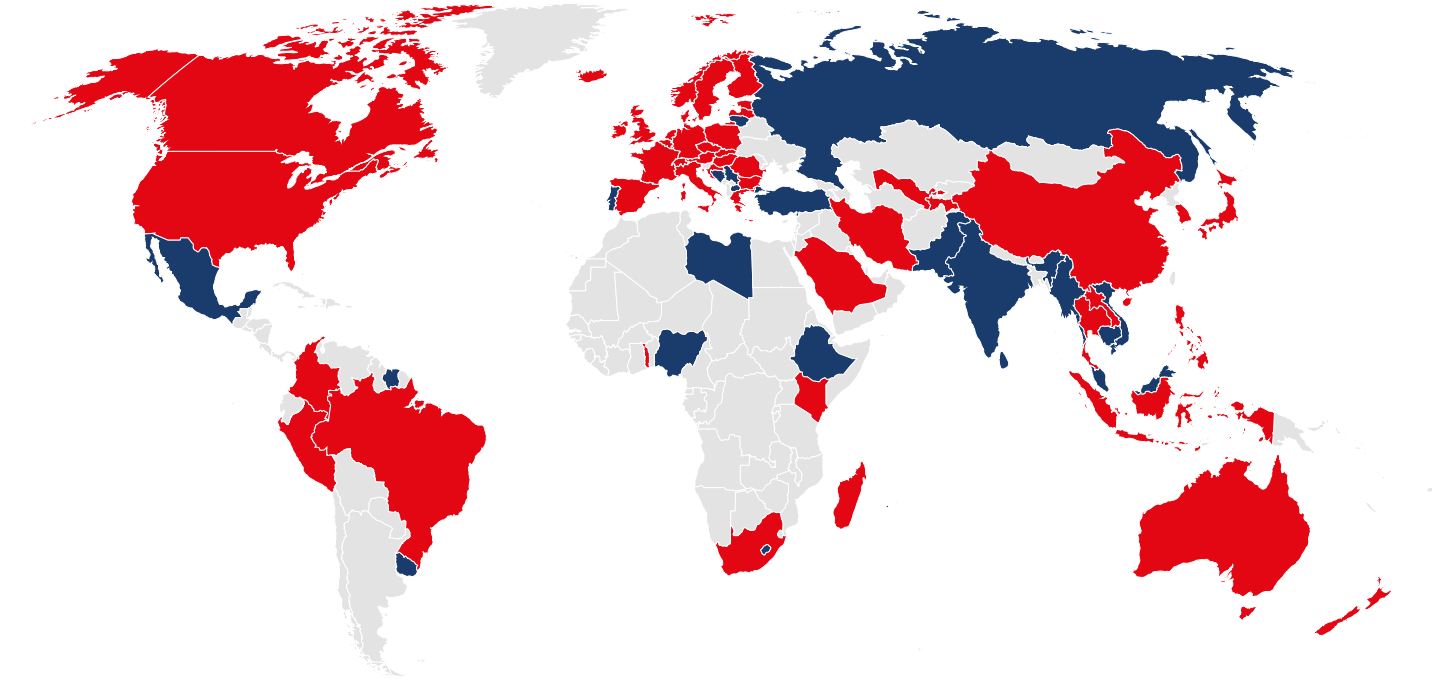
Percentage of connections (excluding licensed cellular IoT)



Source: GSMA Intelligence

Figure 4

5G is now available in every region, making it a truly global technology



Live commercial 5G network

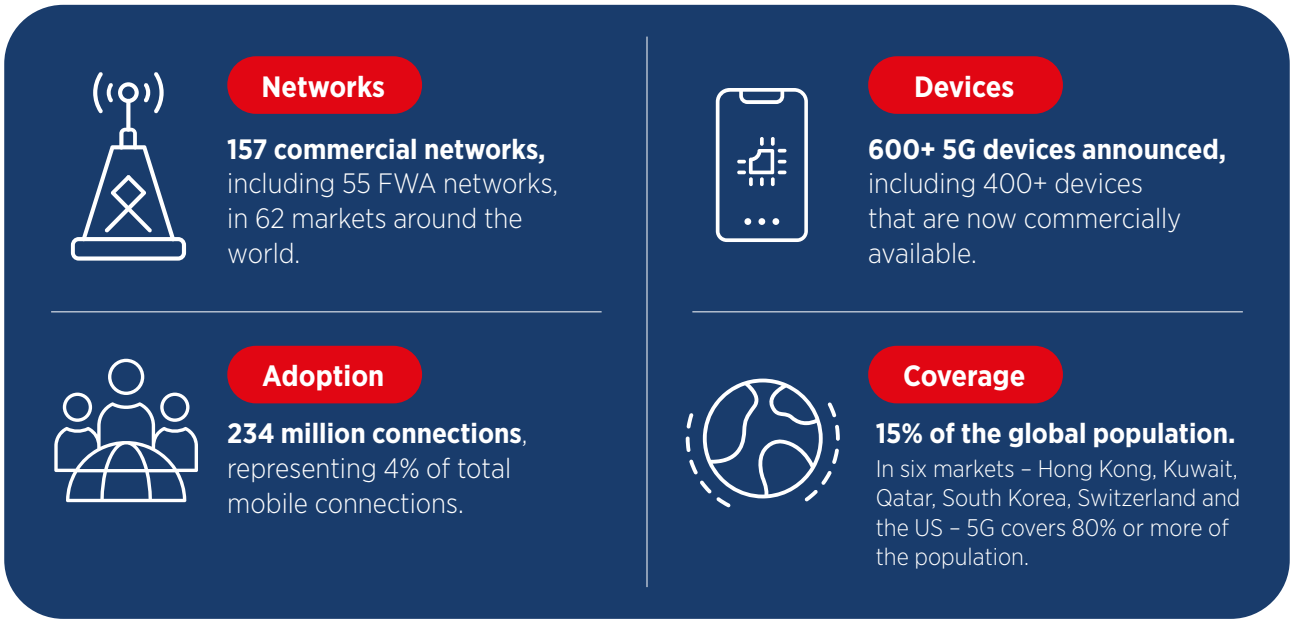
Planned commercial 5G network

Note: Data correct to June 2021

Source: GSMA Intelligence

Figure 5

5G commercialisation at a glance: network investment and an expanding device ecosystem are helping to drive adoption globally



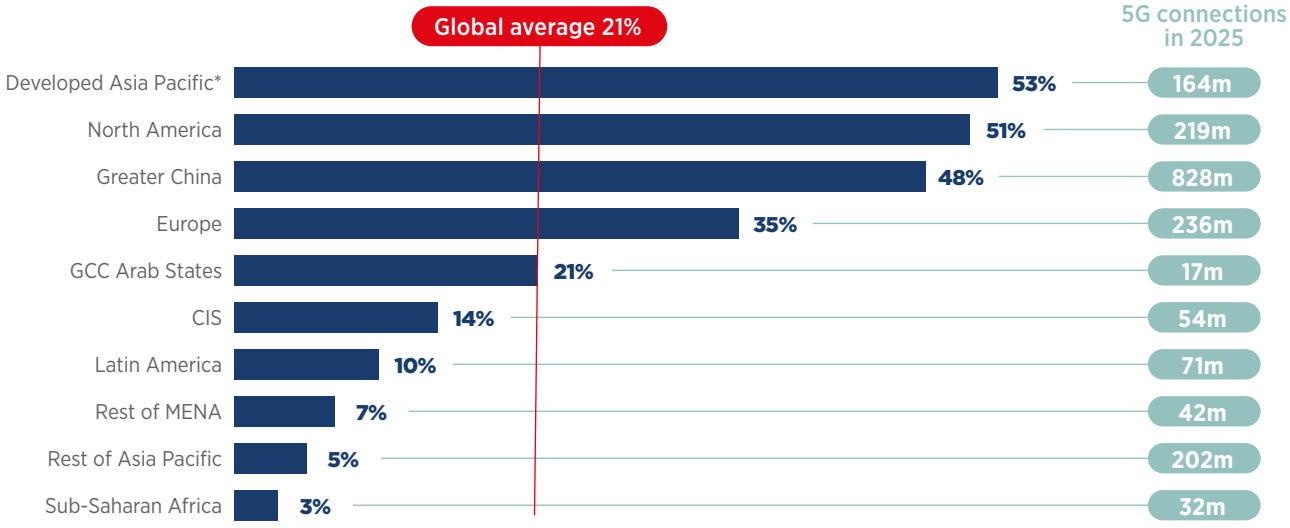
Note: Data correct to March 2021

Source: GSMA Intelligence

Figure 6

China alone will account for nearly half of total 5G connections by 2025, while adoption will be highest in developed Asia Pacific and North America

5G adoption in 2025 (percentage of connections)



**Australia, Japan, Singapore and South Korea*

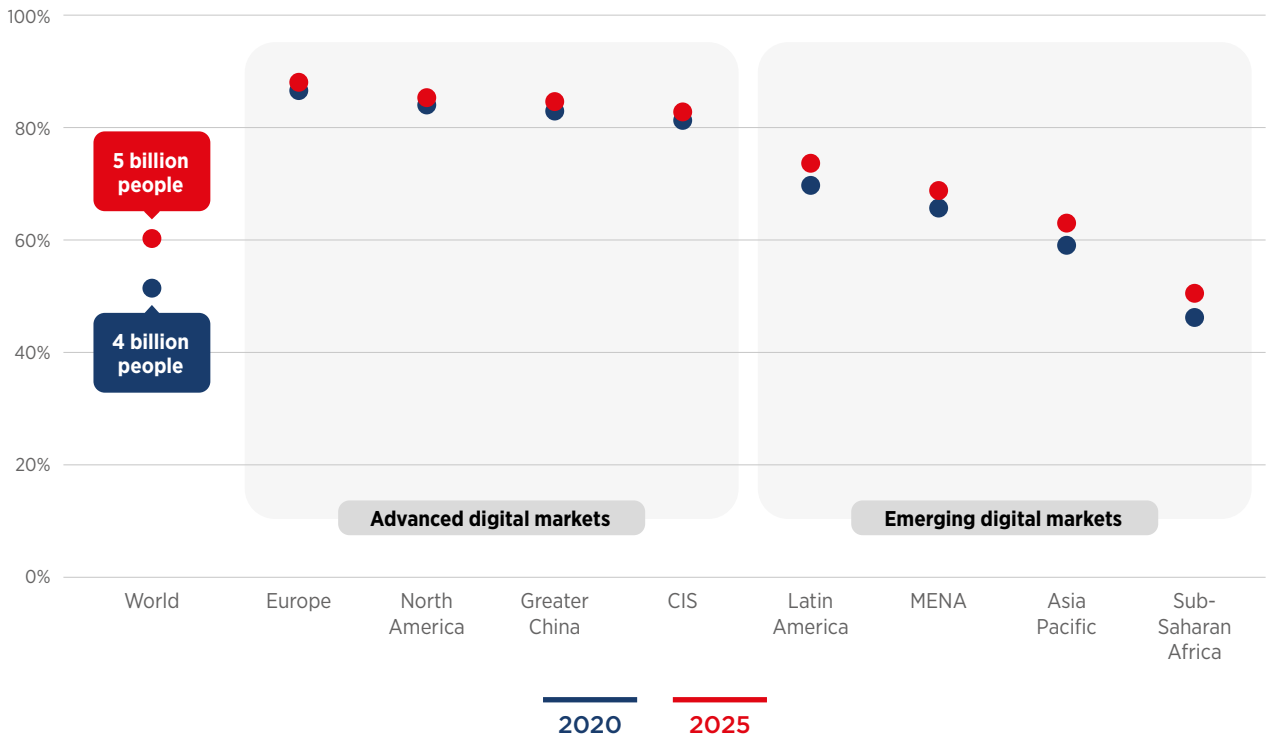
1.3 Consumers go digital

Source: GSMA Intelligence

Figure 7

Another 1 billion people will be using mobile internet by 2025; much of this growth will come from emerging digital markets

Mobile internet users (percentage of population)

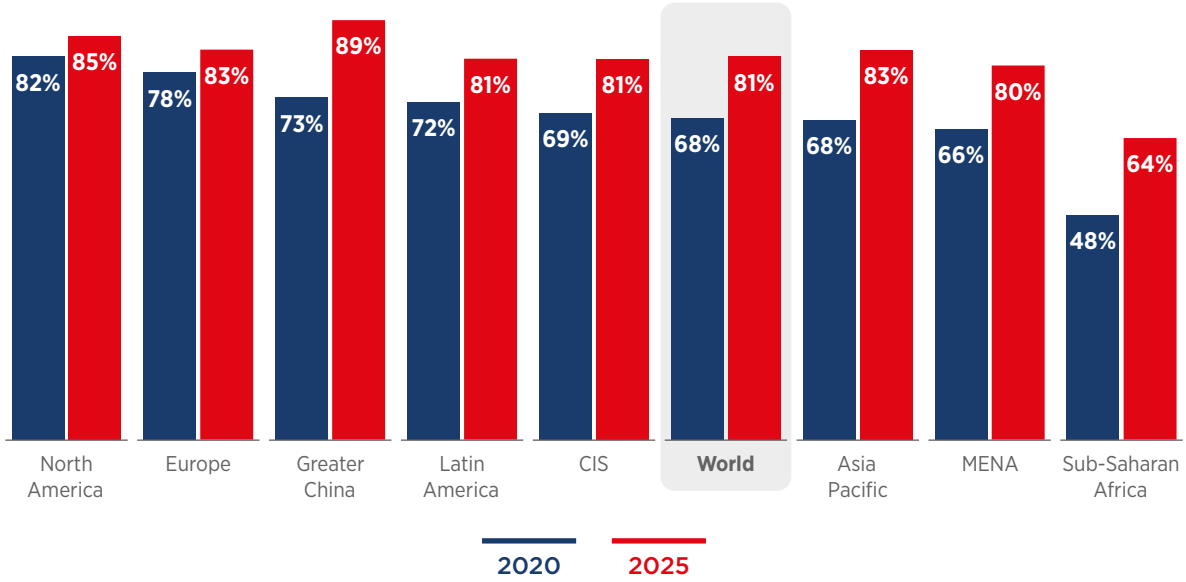


Source: GSMA Intelligence

Figure 8

There will be an additional 1.6 billion smartphone connections by 2025, bringing the overall adoption level to over 80% of total mobile connections

Percentage of connections (excluding licensed cellular IoT)



The smartphone industry adapts to a transformed market landscape

Before Covid-19, the world was in the midst of a prolonged period of economic growth, with global smartphone sales holding relatively steady for several years. However, the pandemic has led to supply-chain disruptions and a sharp drop in consumer demand due to economic uncertainty. This could have profound implications for the smartphone industry.

Longer replacement cycles – Prior to the pandemic, the average handset replacement cycle was 2.25 years. With consumers facing tough economic prospects, the replacement cycle could extend to 3 years or more, potentially dragging down overall sales in the short-to-medium term.

A pivot to lower-cost handsets – The weak outlook for the global economy in the near term has caused manufacturers to rethink their strategies, with some shifting to compete more heavily on price than ultra-premium features. This trend is particularly visible in the 5G handset market, where average retail prices have fallen by more than a third since 2019.

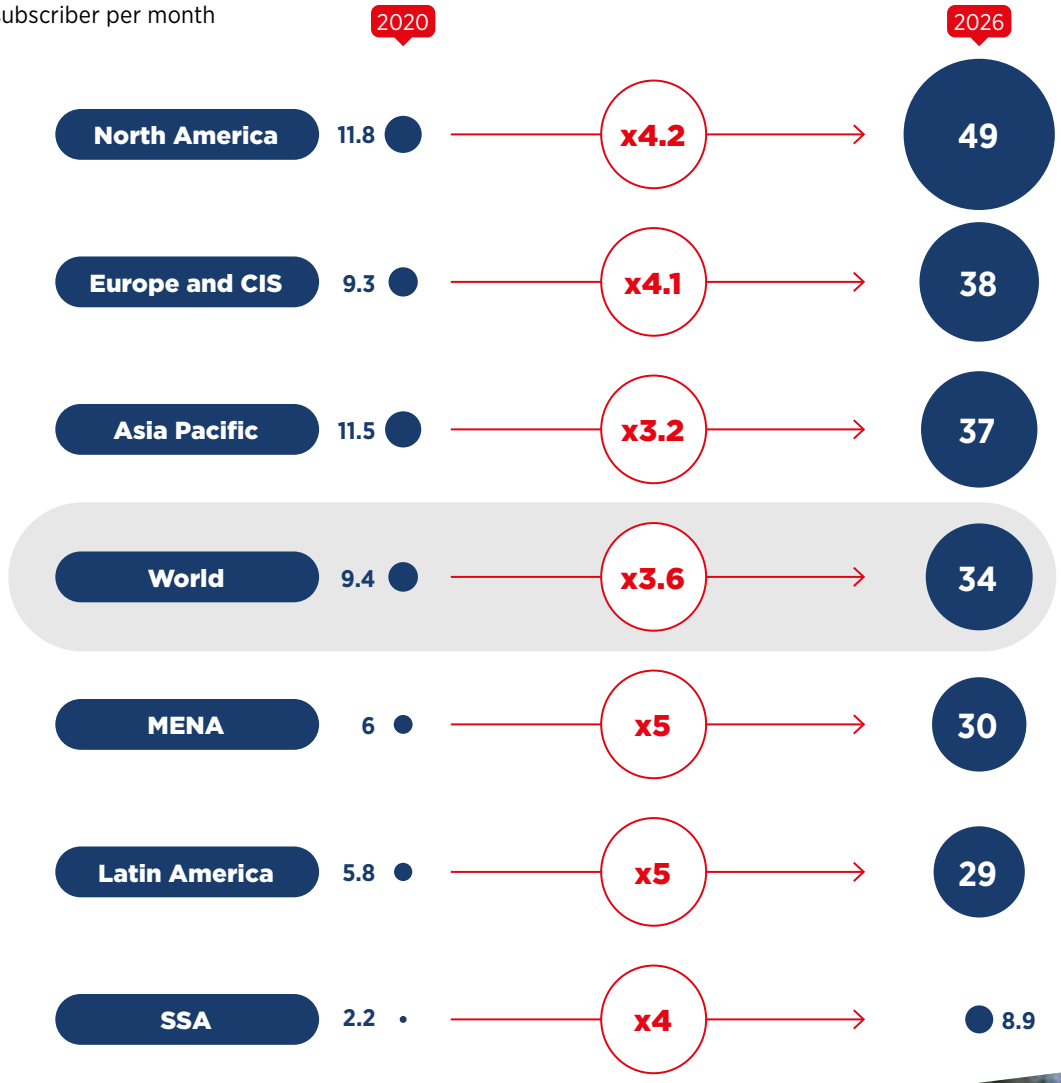
Migration to digital channels – As 35–40% of handset sales for operators still go through retail outlets, pandemic-related social restrictions have had a detrimental impact on upgrade volumes and handset revenues. Digital channels have consequently become more important for handset sales. In the US, some stores have shut permanently as operators anticipate that the pandemic will accelerate the shift to digital channels.

Source: Ericsson, GSMA Intelligence

Figure 9

Growth in global mobile data usage will continue as digital content and services become more integral to everyday life

GB per subscriber per month

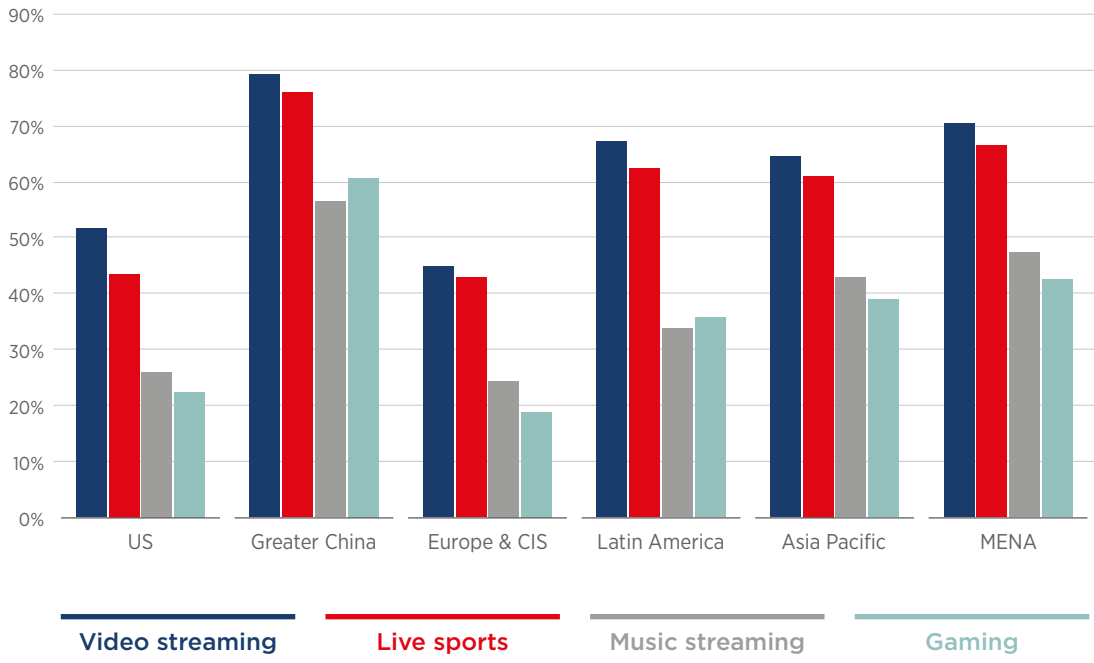


Source: GSMA Intelligence Consumers in Focus Survey 2020

Figure 10

Consumers are most interested in video streaming and live sports; gaming will benefit from rising 5G adoption

Which of the following do you already have or would consider adding to your mobile subscription? (Percentage of respondents)



Cloud gaming provides key 5G use case for consumers

Globally, around 2 billion people game on a monthly basis. The vast majority (90%) are casual smartphone gamers and spend little to no money on gaming, but there is a growing trend towards subscription-based cloud gaming services. Prominent cloud gaming services are run by big tech companies with cloud businesses. Microsoft, Sony, Apple, Google (via Stadia), Amazon and Facebook have recently made significant investments in mobile gaming.

Operators around the world are increasingly considering opportunities in the gaming sector. South Korea is a benchmark here, as all three mobile operators offer cloud gaming services to their customers. China Mobile, Deutsche Telekom, Orange, Telefónica and Vodafone have launched cloud gaming propositions in collaboration with third-party companies. More recently, A1 Telekom, Singtel and EE have launched their own propositions.

These developments help improve the attractiveness of 5G for consumers, as the technology effectively provides the latency and bandwidth requirements for a seamless gaming experience. The GSMA Intelligence Consumers in Focus Survey indicates that gamers are more likely to upgrade to 5G than an average smartphone customer (45% and 35% of respondents respectively).

1.4 Covid-19 weighs on financials, but recovery will be swift

Mobile revenue growth fell sharply in the first half of 2020 due to store closures, loss of roaming revenue and discounts on mobile services to support vulnerable customers. The financial outlook is mixed. Lower consumer spending in developed markets could compound limited subscriber growth and price competition, while developing markets could see sustained growth from mobile data uptake and a surge in new subscribers, given the reliance on mobile networks for internet access.

Source: GSMA Intelligence

Figure 11

Covid-19 took a heavy toll on mobile revenue growth in many markets during 2020, but the impact will ease off as economic activities resume around the world

Mobile revenue (billion), YoY growth

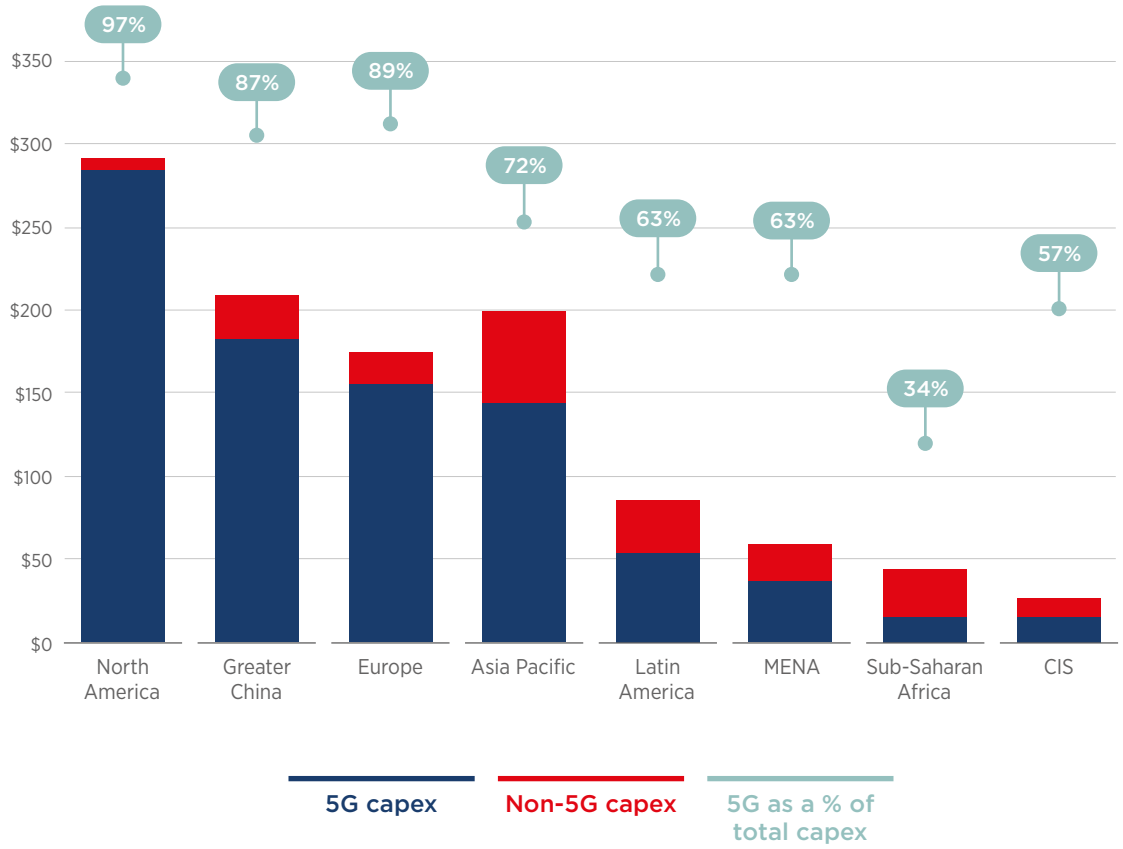
Mobile networks around the world showed notable resilience during the pandemic, despite the changes in consumption levels and patterns. Service continuity in these challenging times emphasises the considerable investment in network capacity by operators. With connectivity set to play an even more prominent role in a post-pandemic world, operators' continued investment in advanced networks, particularly 5G, and digital services will be crucial to the functioning of society in the future.

Source: GSMA Intelligence

Figure 12

Mobile operators will invest $900 billion in their networks over the period to 2025, of which more than 80% will be on 5G

Capex (billion), 2021–2025



02

Key trends shaping the mobile industry

2.1 5G: commercialisation gathers pace

5G's prospects remain strong despite the pandemic

5G commercialisation is well underway, with operators scaling their 5G networks and services to reach more consumers and enterprises. By the end of 2021, 5G networks will cover a fifth of the global population. The pandemic has had little impact on 5G momentum; in some instances, it has even resulted in operators speeding up their network rollouts. In China, for example, the government made 5G deployment a priority, supporting operators' aggressive network rollout efforts. Meanwhile, in South Africa and Sweden, operators launched 5G services ahead of schedule after receiving additional spectrum to boost capacity at a time of heightened demand.

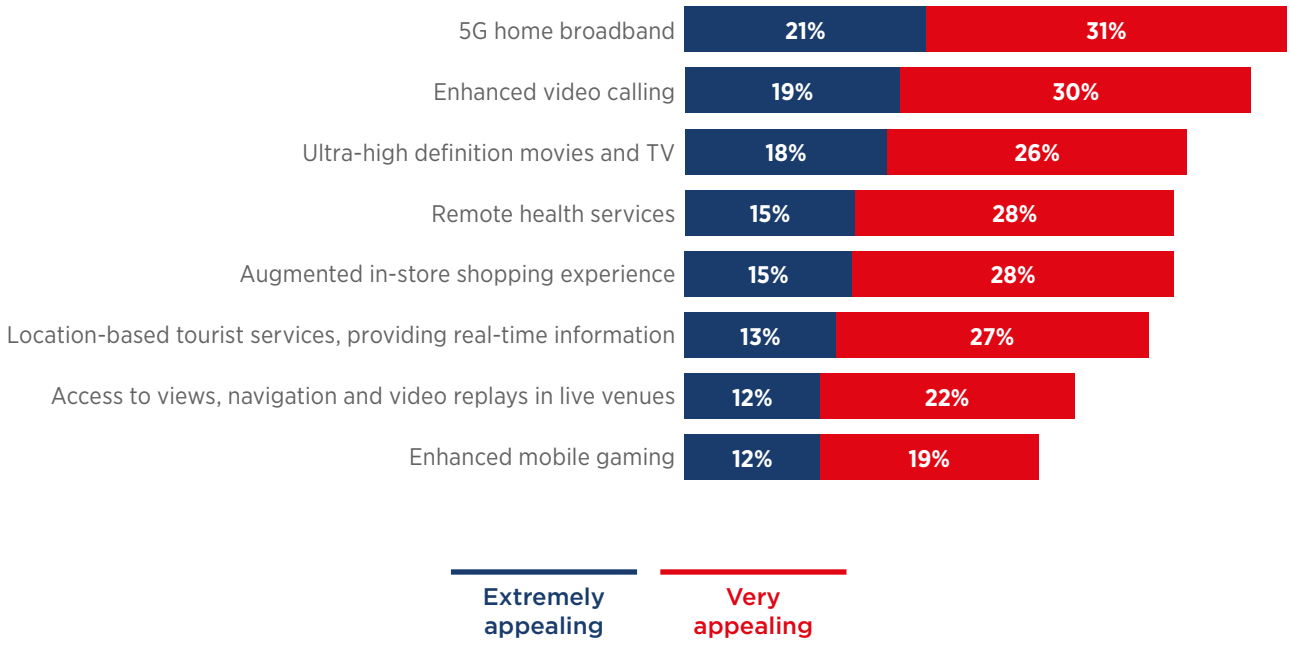
Enhanced mobile broadband (eMBB) and fixed wireless access (FWA) connectivity remain the dominant 5G use cases, helped by an ever-growing portfolio of 5G-enabled smartphones across various price points. Apple launched the 5G-compatible iPhone 12 line of smartphones in late 2020, raising the prospects for adoption, given Apple's size, influence, brand power and loyal customer base in the US and beyond. Chinese vendors, such as Xiaomi and OnePlus, are having a similar impact on adoption, having established 5G handset portfolios that cater to lower-price segments.

Source: GSMA Intelligence Consumers in Focus Survey 2020

Figure 13

Broadband connectivity and video calling are top of mind among smartphone users, but a significant proportion of users find other potential 5G use cases appealing too

To what extent does each of the potential services below appeal to you? (Percentage of smartphone users)



As 5G begins to expand to more devices, beyond smartphones, new opportunities will emerge for commercialisation. This is already happening with new 5G applications and form factors around augmented and virtual reality (AR/VR) technologies:

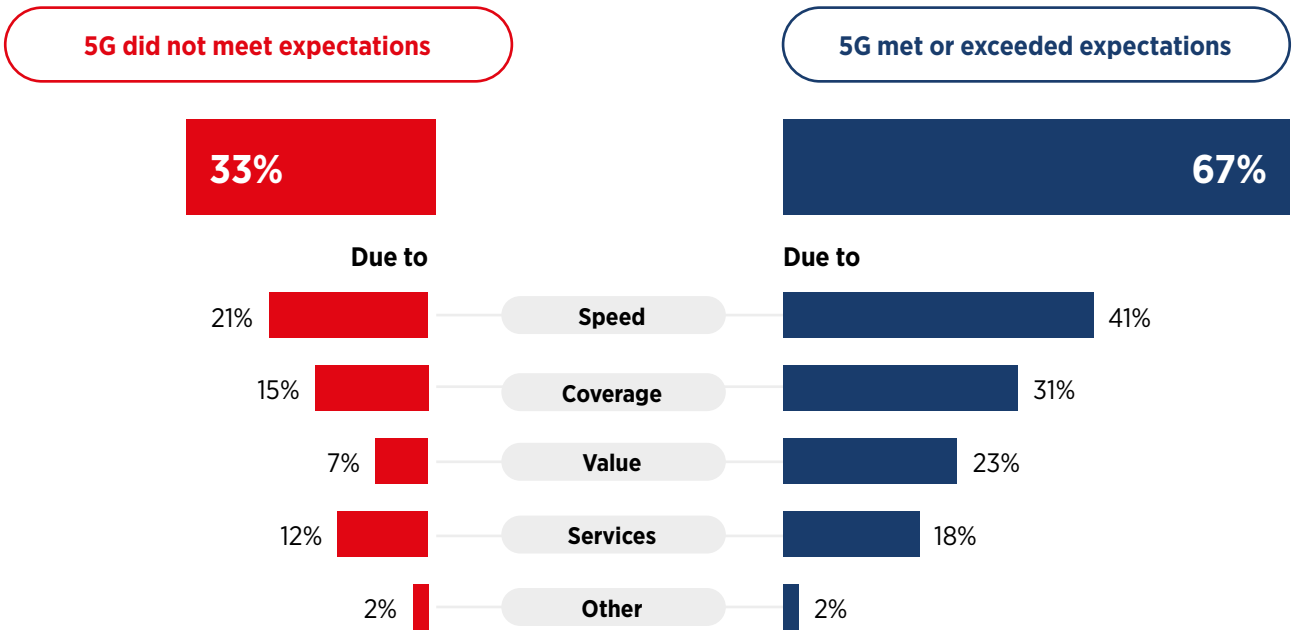
- South Korea's LG Uplus has formed the Global XR Content Telco Alliance, in partnership with global operators, content developers and US-based chipmaker Qualcomm, to develop 5G-based AR/VR content. Other operator members include Bell Canada, Chunghwa Telecom, China Telecom, KDDI, Orange and Verizon.
- Global telecoms operators, including Deutsche Telekom, EE, Globe, Orange, Softbank, SKT, Telstra, Telus and Verizon, are participating in the Niantic Planet-Scale AR Alliance, which is leveraging 5G's low-latency and high-bandwidth capabilities to develop and distribute AR-based content and game titles.
- AT&T is working with Delta Airlines and Apple to equip Delta Airlines flight attendants with iPhone 12s for two potential AR-based 5G network use cases. In one use case, flight attendants would be able to more accurately assess in-cabin inventory using the iPhone 12 camera. The other would enable flight attendants to experience immersive AR-based training on safety checks, passenger assistance and other tasks from anywhere.
- In the UK, BT Sport launched Match Day Experience, which uses EE's 5G network to deliver AR-based features to fans during live sports events, including real-time match statistics, a 360-degree viewing experience and virtual stadium tours.
- Vodafone has introduced Nreal Light glasses for augmented and mixed reality experiences over its 5G network in Germany and Spain, which support everyday consumer activities, including internet browsing, online shopping, viewing media and playing games.

Source: GSMA Intelligence Consumers in Focus Survey 2020

Figure 14

Feedback on the 5G experience is overwhelmingly positive; users are impressed by the speeds on offer, but also highlight the limited number of services available

Which of the following statements best describe your experience with your 5G networks?
Why has 5G met/not met your expectations?
(Percentage of respondents)

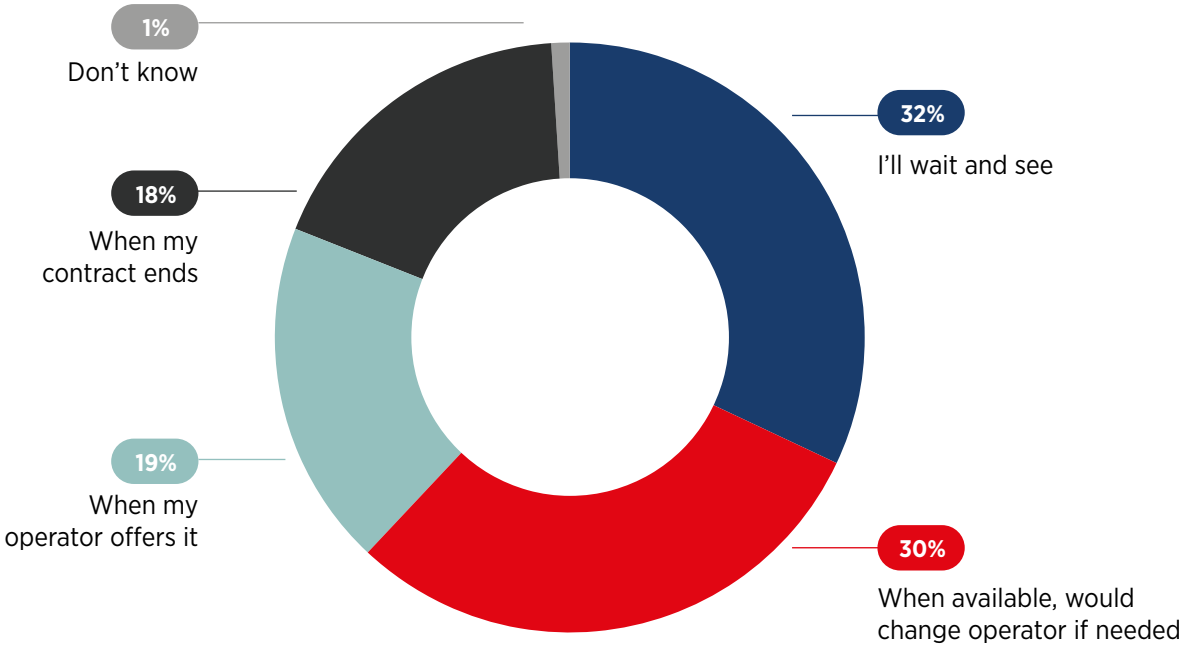


Source: GSMA Intelligence Consumers in Focus Survey 2020

Figure 15

5G upgrade intentions continue to rise; the majority of users intend to upgrade, but nearly a third plan to wait and see

When do you intend to upgrade to 5G? (Percentage of smartphone users)



mmWave 5G ecosystem shows signs of market readiness

Most 5G launches globally so far have relied on 3.5 GHz spectrum, with very few exceptions. This is because this type of spectrum adequately supported the required bandwidth and speeds for initial 5G services. But as adoption increases and more consumers and diverse services migrate to 5G networks, spectrum across low, mid and high bands will be needed in order to deliver widespread coverage and enough capacity to support the delivery of 5G:

- Low-band spectrum (sub-1 GHz) supports widespread coverage across urban, suburban and rural areas and helps support IoT services.
- Mid-band spectrum (e.g. 3.5, 4.8 and 6 GHz) typically offers a good mix of coverage and capacity benefits.
- mmWave bands (24 GHz and above) will be crucial to meet high traffic demand at high network speeds to maintain the performance and quality requirements of 5G services.

As of March 2021, 44 operators[1] around the world had been assigned mmWave spectrum, with commercial mmWave 5G networks announced or launched in several countries, including Japan, Singapore and the US. mmWave spectrum was internationally allocated to mobile services at the World Radiocommunication Conference in November 2019 (WRC-19).

1. Excluding US and Canadian regional operators

Source: GSMA Intelligence

Figure 16

A key benefit of mmWave spectrum is the amount available, allowing massive capacity to be delivered to support new use cases

Average bandwidth per operator

Besides spectrum availability, mmWave 5G services will benefit from an expanding network equipment and consumer device ecosystem. All major network equipment vendors now offer mmWave products and support the development of innovative solutions, including the following:

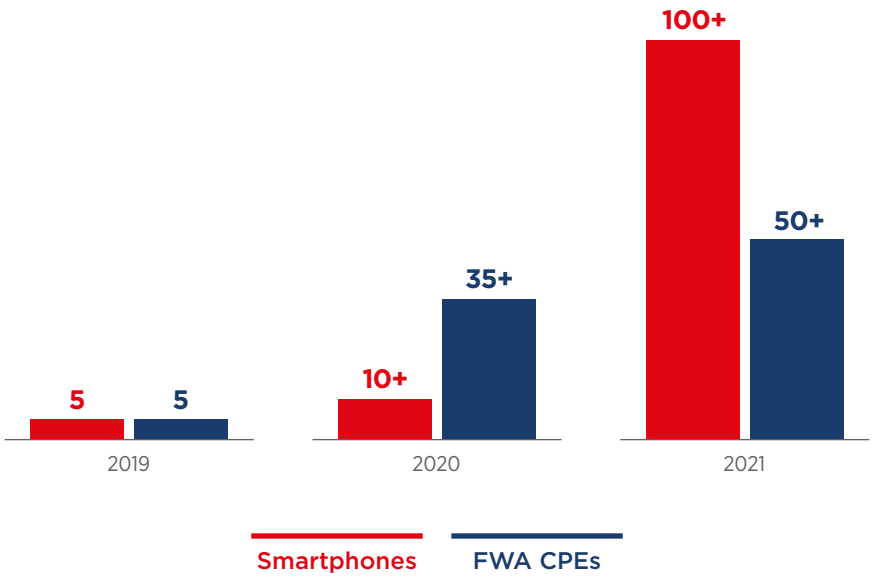
- In April 2021, Qualcomm announced the completion of 5G data calls that combine mmWave with FDD or TDD sub-6 GHz spectrum, a development that could enable the delivery of high speeds and massive capacity over 5G networks to support new consumer and enterprise applications.
- In April 2021, Nokia and Optus achieved a speed of 10 Gbps using 800 MHz of mmWave spectrum at a live 5G test site, demonstrating the potential to enable new 5G solutions for consumers and enterprises, including in the healthcare, mining, ports and manufacturing sectors.
- In December 2020, TIM, Ericsson and Qualcomm achieved a speed of 1 Gbps on mmWave frequencies at a distance of 6.5 kilometres from the site on TIM's live network, highlighting the usability of mmWave spectrum for wider 5G FWA coverage beyond high-density urban areas.

Source: GSMA Intelligence

Figure 17

mmWave consumer devices have seen remarkable growth, with adoption boosted by the launch of Apple's mmWave-capable iPhone 12 series in 2020

Number of mmWave consumer devices



Leading 5G markets will drive the development of the mmWave ecosystem

US: at the vanguard – The US market is a global leader in the use of mmWave spectrum for 5G, with all major US operators already offering commercial 5G services using the band. This has been driven by the Federal Communications Commission (FCC) making mmWave spectrum available for mobile services earlier than in most countries.

Japan: operators prioritise 5G mmWave – All operators in Japan (NTT Docomo, KDDI, Rakuten and SoftBank) have deployed commercial mmWave 5G services and are accelerating rollout beyond their original plans. The number of mmWave base stations in the country tripled between September 2020 and March 2021 to just over 8,000.

China: deployments planned for the 2022 Winter Olympics – Unlike the US and Japan, China has yet to make mmWave spectrum available to operators for commercial deployments. In the meantime, China Mobile, China Unicom and China Telecom are conducting trials and building pilot networks using 26 GHz, in preparation for a large-scale demonstration of mmWave 5G at the Beijing Winter Olympics in 2022.

Europe and CIS: still early days for mmWave – In Europe, the focus to date has been on the 3.5 GHz band, but momentum for the use of mmWave spectrum is building. As of March 2021, four countries have assigned mmWave spectrum to operators in the region, with more planned in the coming years.

Private networks: 5G builds on LTE momentum

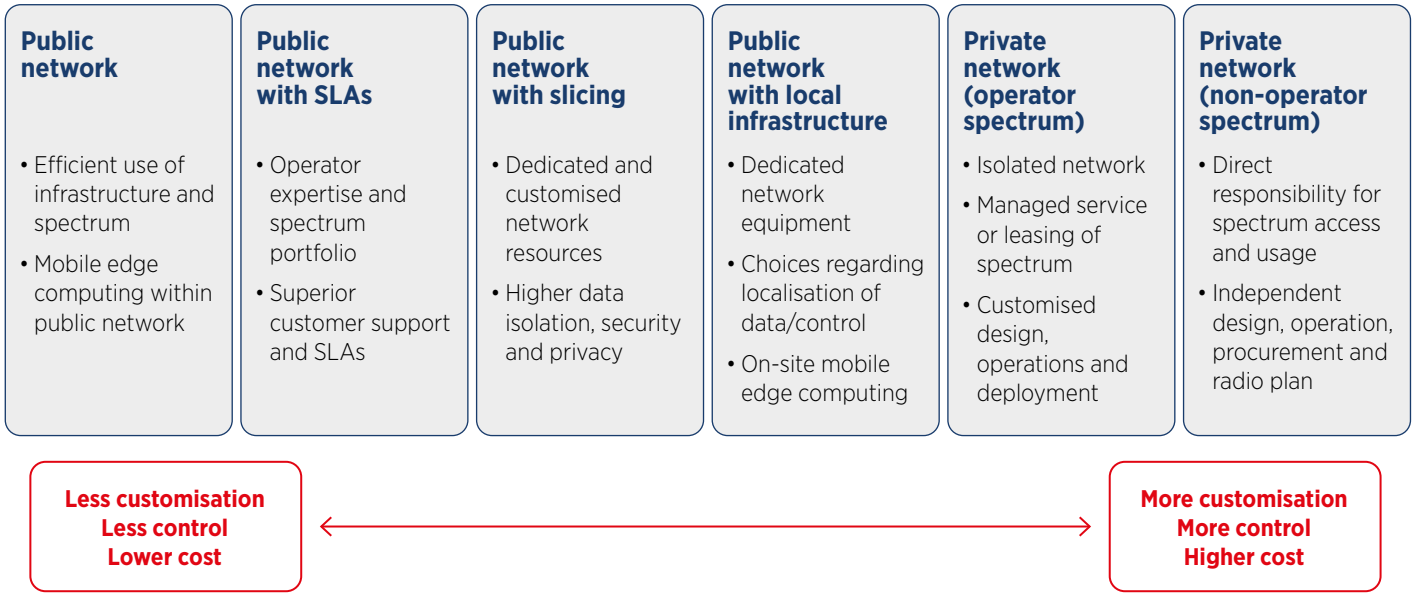
There has been a surge in activity around private networks in recent years. These allow enterprises to have more control over their connectivity and can help fulfil their evolving latency, coverage, edge or security requirements. To date, nearly 150 LTE-based private networks have been announced around the world, with North America, Europe and Asia Pacific being the main hubs. The majority of commercial deployments have been on LTE technology and span several sectors, such as agriculture, manufacturing and mining.

Private wireless networks are delivered in diverse forms – with varying levels of infrastructure managed by the operator or enterprise. This disaggregation of control further feeds into the opportunity to leverage open network technologies and new vendors supporting different functions. In some cases, public networks will be combined with local infrastructure to support private networks. For prospective enterprise customers, these options entail trade-offs centred on cost versus the level of service customisation.

Source: GSMA Intelligence, GSMA Internet of Things Programme

Figure 18

Private networks sit on a scale of customisation, control and cost



Building on private LTE installations, 5G networks have emerged as a solution to address issues around latency, reliability, and density, among other enterprise requirements. This has been borne out by recent developments:

- Verizon has signed a contract with Associated British Ports to equip the UK Port of Southampton, which is responsible for £40 billion in UK exports each year, with a private 5G network. Verizon also recently teamed up with Nokia to develop its international private 5G platform for global enterprises in Europe and Asia Pacific.
- Deutsche Telekom has installed a dual-slice private LTE network at a BMW plant in Leipzig, Germany, with an in-built path for evolution to 5G.
- AT&T has launched a private 5G network for healthcare, connecting researchers and patients. AT&T is working with Ericsson on localised core network equipment and with Nokia on digital automation cloud and a modular private wireless platform.
- China Mobile has announced its 5G private network offering with four types of services (network design, network optimisation, network operations and maintenance, and service guarantees) and three pricing parameters (network speed, extent of private network requirements and the business value expected from the network).
- Vodafone and Lufthansa Technik have launched a standalone private 5G network at the 8,500 square-metre Lufthansa base at Hamburg Airport, Germany.
- The Ford Motor Company is using a private network, based on a combination of 4G and 5G connectivity provided by Vodafone UK, to enhance production quality in real time at an electric vehicle plant in the UK.

Private networks and mobile edge compute (MEC) capabilities are likely to converge, allowing enterprises to better allocate network resources, according to the use case requirements, and personalise services locally where they are consumed. Moving intelligence to the edge can dramatically improve the end-user experience and reduce the economics associated with hosting and managing a network. In May 2021, Telefónica Tech partnered with Microsoft to offer private 5G and on-premise edge computing to address the Industry 4.0 opportunity and related use cases.

5G labs underline efforts to develop new 5G use cases

Mobile operators are acutely aware of the need to develop compelling 5G use cases that leverage the technology's unique capabilities and to support the realisation of Industry 4.0 objectives. Commercialising 5G across the consumer and enterprise segments will require the right blend of partnerships, with a combination of capabilities being key to creating value.

As such, operators and equipment vendors have invested in 5G labs dedicated to co-creating solutions with partners to address specific needs. These labs, which often include startups, academia, cloud providers and systems integrators, and large enterprises, demonstrate how mobile operators and other ecosystem players can come together to facilitate 5G-enabled digital transformation for society.

Examples of 5G labs and focus areas	
Asia Pacific	**China Unicom**, **China Mobile** and **China Telecom**, along with other members of the 5G Slicing Association, including Huawei, China Sports Media and TD Tech, have established a 5G lab on network slicing for enterprises. **NTT Docomo** leads a consortium to develop 5G solutions for industry verticals such as manufacturing and construction. Founding members of the 5G Global Enterprise Solution Consortium include AIS, Fujitsu and NEC. **Vodafone New Zealand** is collaborating with several organisations to explore the development of a variety of 5G use cases, including a 5G drone service for the New Zealand Police and an AI solution for retail stores.
Europe	**Orange** has established nine 5G labs across France, Romania and Belgium to support the development of new consumer and enterprise applications. **Verizon** has opened a 5G lab and production studio in London to support its international business and media customers. The lab allows startups, academics and enterprises to explore use cases for immersive education, AR/VR gaming, autonomous vehicles, smart cities and IoT.
MENA	**STC** is collaborating with Saudi Aramco and Huawei to develop 5G use cases for the oil and gas sector and to explore use cases around MEC, 5G slicing and industrial-scale IoT.
US	**AT&T** is working with universities and vendors to develop 5G applications across a variety of areas, including manufacturing and autonomous car applications. **Verizon** is pursuing initiatives with the NFL, Emory Healthcare, Responder Corp., and the US Department of Energy. Focus areas include use cases for healthcare, first responders, autonomous mobility, smart cities, education and retail. **T-Mobile** is a founding partner of the 5G Open Innovation Lab, alongside global tech players, including NASA, Intel and Microsoft, and academic institutions.

2.2 The telco of the future: operators ramp up eSIM service rollout

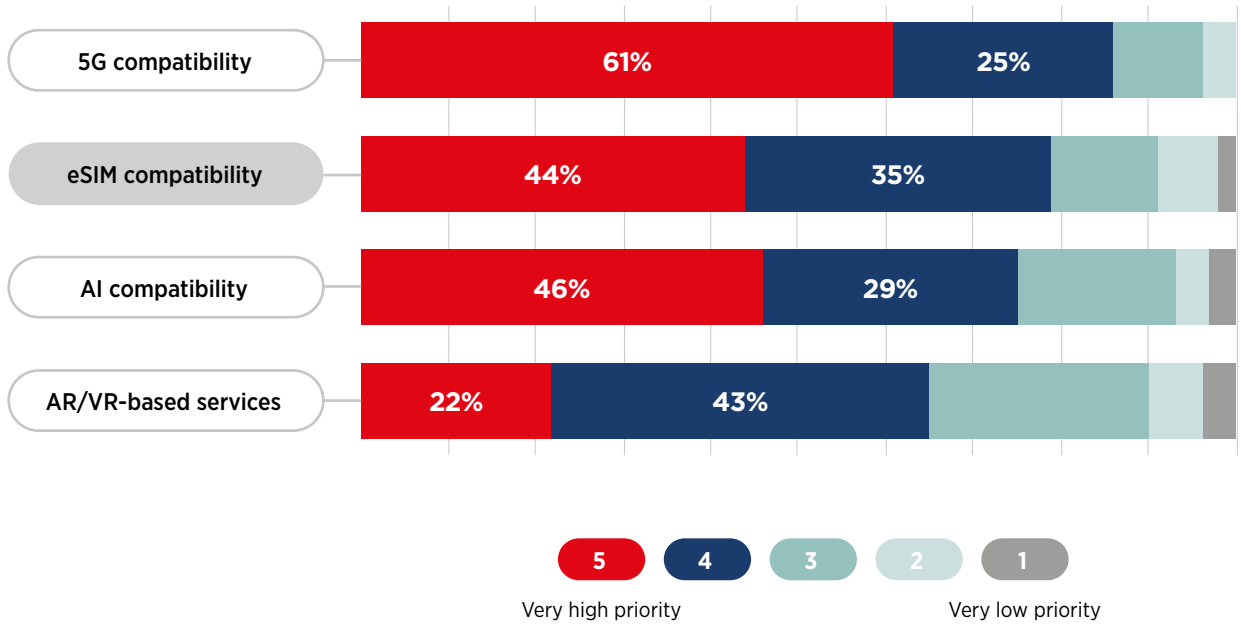
Consumer eSIM (embedded SIM) technology enables remote provisioning, which allows users to download, switch and delete multiple operator profiles without the need for physical SIM cards. eSIM offers numerous benefits for consumers, the most significant of which is the ability to change network providers more readily. Operators increasingly see eSIM as an enabler of new revenue and further digitisation for consumers.[2]

Source: GSMA Intelligence Operators in Focus Survey 2020 (global, 100 operators)

Figure 19

Most operators want OEMs to prioritise 5G in devices; eSIM is a close second, highlighting a growing interest in the technology

Which smartphone feature should vendors prioritise in their devices? (Percentage of respondents)

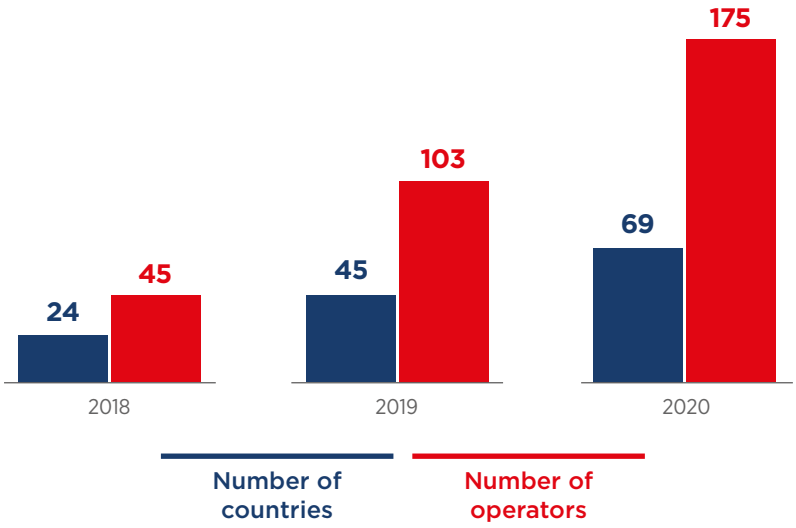


2. GSMA Intelligence Operators in Focus Survey 2020

Source: GSMA Intelligence

Figure 20

At least 175 mobile service providers had launched commercial eSIM service for smartphones across 69 countries by the end of 2020



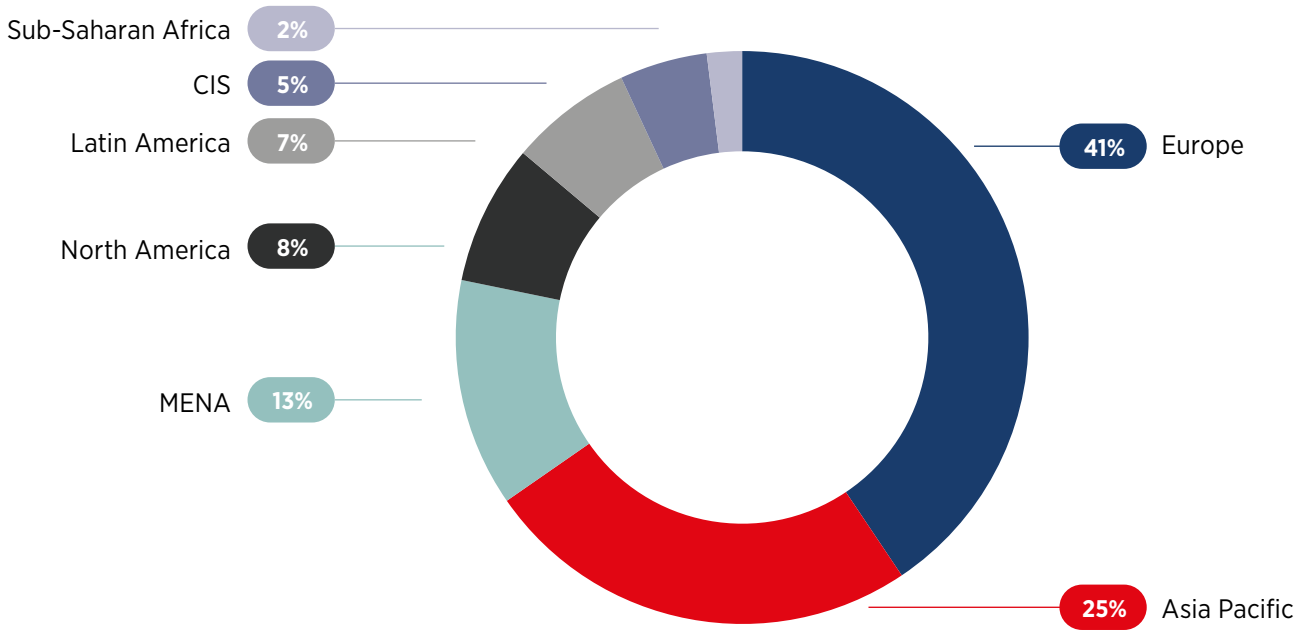
Note: Data correct to December 2020

Source: GSMA Intelligence

Figure 21

eSIM service for smartphones is available in every region; Europe has the highest number of operators that have launched commercial services

Percentage of operators globally that have launched commercial eSIM service for smartphones by region



Note: Data correct to December 2020

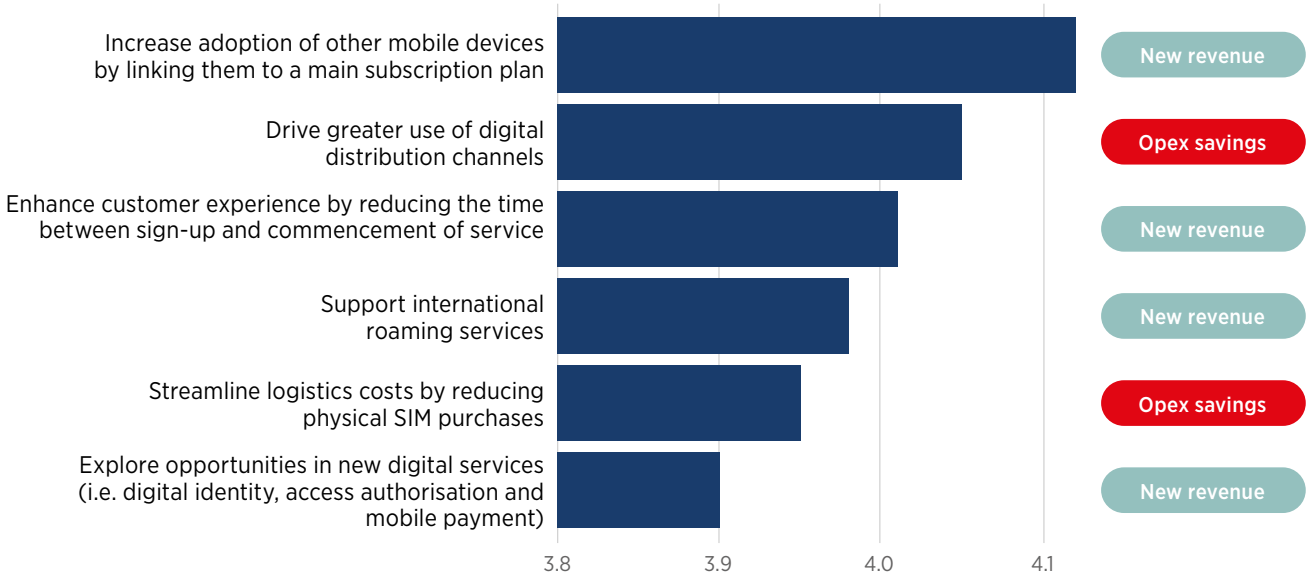
One of the most important benefits of eSIM services for operators is perceived to be the increased adoption of other devices by linking them to a main subscription plan (typically a smartphone plan). This comes as no surprise, as operators are a key distributor of such devices because of the link with connectivity services. In fact, on average across operators, 25% of all device unit sales to consumers are non-phone devices, including smartwatches, tablets and laptops. eSIM allows operators to add companion devices and associated cellular connectivity services to a main data plan more easily than with traditional SIMs.[3]

Source: GSMA Intelligence Operators in Focus Survey 2020 (global, 100 operators)

Figure 22

Operators see a variety of benefits from eSIM services, spanning key operational goals on new revenue generation and cost savings

Rank the following potential benefits associated with eSIM based on how important they are to your business (Scores range from 1 (Not at all important) to 5 (Extremely important))



Despite significant progress on commercial availability of eSIM devices and associated connectivity services, consumer awareness of eSIM remains low. A GSMA Intelligence consumer survey in 17 major markets found that 20% of consumers on average are aware of eSIM. For comparison, awareness of 5G is 85% on average in those same markets. Raising consumer awareness of eSIM and explaining and promoting its benefits are key to drive market adoption. Operators and OEMs have an important role to play here, being the main touchpoints with end users.

Global collaboration is essential to eSIM development

The number of mobile industry players supporting the GSMA project to define and maintain eSIM specifications grew significantly in 2020 to more than 180. This includes MNOs, OEMs, SIM vendors, network vendors, semiconductor manufacturers and end-user enterprises. In 2021 and beyond, the GSMA will continue to work on a range of eSIM activities to support the development and sustainability of the eSIM ecosystem worldwide. These include further work to update eSIM specifications to meet market needs and a new eSIM architecture for constrained IoT devices.

3. eSIM: State of the consumer market and the road ahead, GSMA Intelligence, 2021

2.3 IoT: digital transformation of the enterprise accelerates

The sudden slump in economic activities and disruptions to products and services supply chains due to the Covid-19 pandemic affected IoT sales volumes across multiple sectors, including connected vehicles, smart cities and smart buildings. While global IoT revenues will triple by 2025 to just over $900 billion, this is 20% lower than what it would have been without the pandemic. That said, there is significant upside potential in the long term, as the pandemic has increased the urgency of digital transformation among many enterprises and demand for connected devices among consumers.

Source: GSMA Intelligence Enterprise in Focus Survey 2020

Figure 23

Revenue generation and cost saving remain the two main motivators for IoT implementation, but compliance continues to move up the agenda

How does your organisation measure the success of its IoT deployment? (Percentage of respondents)

Cost saving

2019	2020
69%	65%

Revenue generation

2019	2020
68%	68%

Regulatory compliance

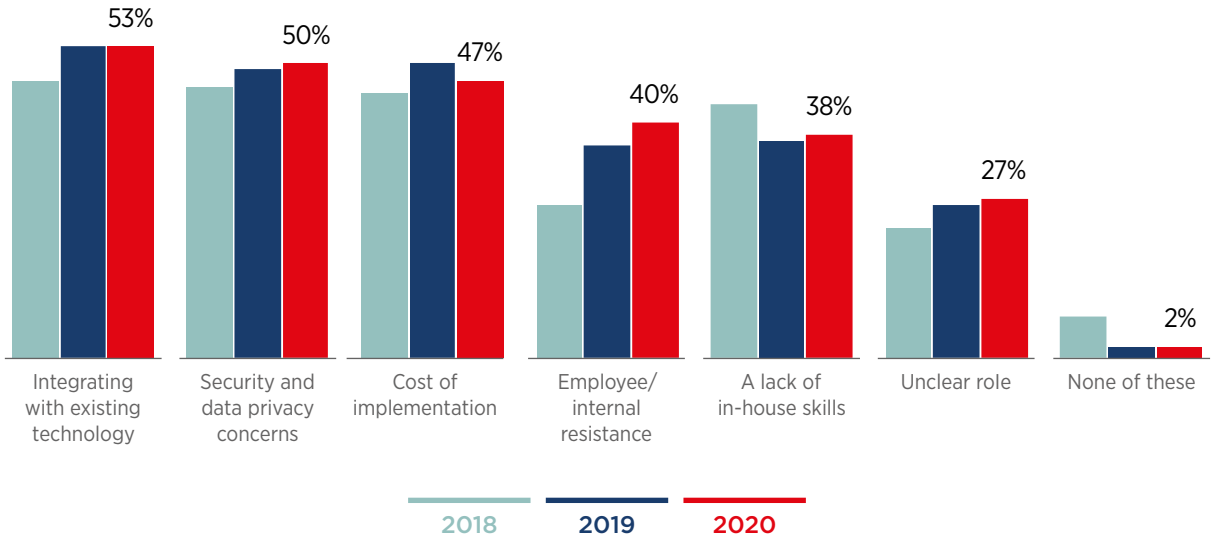
2019	2020
52%	53%

Source: GSMA Intelligence Enterprise in Focus Survey 2020

Figure 24

Top three challenges for IoT deployment among enterprises remain the same; employee resistance has seen the biggest rise since 2018

Which of the following challenges did your organisation face in deploying IoT-based solutions? (Percentage of enterprises with active IoT deployment)



Tackling the integration challenge

The IoT ecosystem is complex and fragmented, with a multitude of players (traditional and new) vying for mindshare among enterprises. The challenge of integrating IoT solutions with legacy infrastructure further adds to the complexity of the overall landscape. When it comes to IoT integration, 69% of enterprises (no change from the 2019 survey) still find information technology (IT) systems tough to tackle, while almost half point to operational technology (OT) as a difficulty.

In this context, IT and OT convergence, as well as interoperability between systems, is key to ensure data can be effectively exchanged to enable business benefits. Indeed, standardisation enables economies of scale. The newly created Industrial Digital Twin Association (IDTA) has shared its goal of driving standardisation of digital twins to make digital value creation more efficient.[4] A plug-and-play approach is only possible if machines work together. As such, industrial vendors should adopt a joint industrial standard, shared data models and open industrial communication protocols to enable interoperability. Moving away from customisation to a standardised modular approach will drive scale and reduce costs.

While integration, security and cost continue to be the top challenges for enterprises when it comes to IoT adoption (see Figure 24), internal resistance is the obstacle that has increased the most in recent years. In the GSMA Intelligence Enterprise in Focus Survey 2020, 40% of respondents identified employee/internal resistance as a challenge, up significantly from 26% in 2018, reflecting the fact that education on the benefits of IoT needs to extend beyond senior management and across the entire organisation. To fully embrace digital transformation, companies need to undergo a change management process to get buy-in from staff that will be directly impacted by the introduction of new and transformative technologies.

4. Ten years in the making: Industry 4.0 meets 5G at Hannover Messe 2021, GSMA Intelligence, 2021

Covid-19 casts a spotlight on IoT applications in healthcare

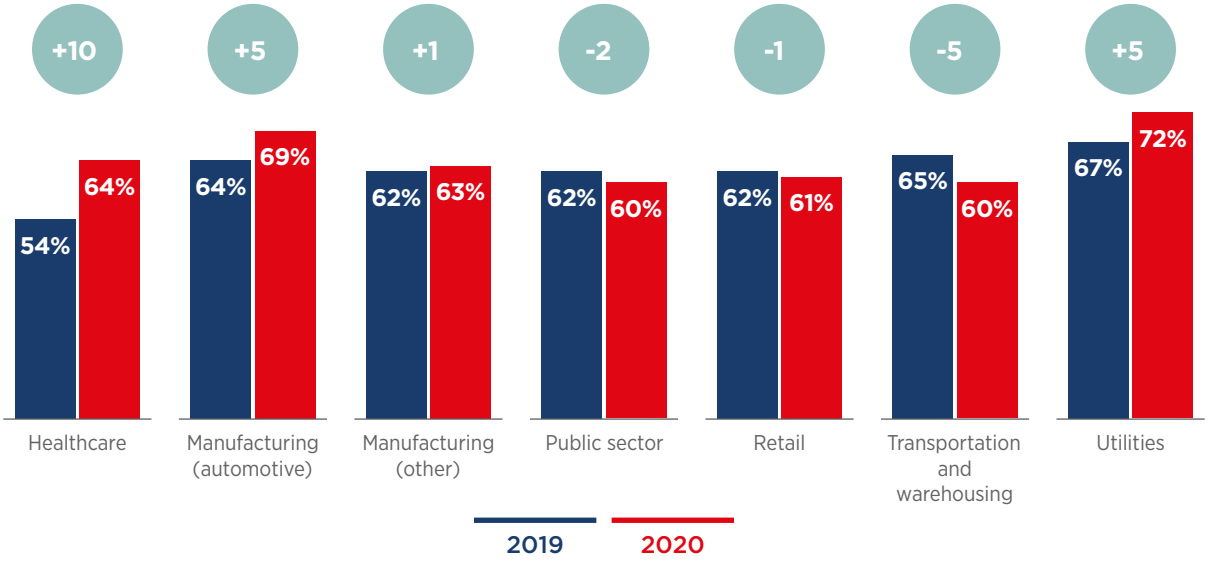
In the wake of the pandemic, healthcare service providers have relied on digital technologies to enhance service delivery and improve efficiency in the delivery of medical supplies, amid increased demand and social-distancing requirements. IoT underpins many innovative digital health products and solutions for consumers and enterprises, as well as new ways of treating patients remotely. For example, wearable IoT devices, such as smartwatches, are increasingly being used for remote and contactless vital signs monitoring.

Source: GSMA Intelligence Enterprise in Focus Survey 2020

Figure 25

Enterprises across different verticals have further plans to deploy IoT; enthusiasm has grown the most in healthcare

Percentage of respondents with further plans to deploy IoT



Source: GSMA Intelligence

Figure 26

Examples of IoT-enabled healthcare solutions utilised to support patients during the pandemic

Remote patient monitoring	Healthcare professionals use IoT devices to track heart rate, blood pressure and blood glucose levels of patients remotely, particularly the elderly and other vulnerable patients that have had to shield during the pandemic.
Contact tracing	A number of contract tracing systems implemented around the world rely on IoT-based solutions to track the movement of patients and enforce social distancing in public areas.
Vaccine cold chain monitoring	IoT platforms have been used to develop cold chain monitoring systems that track the temperature and location of vaccine carriers. For example, the Electronic Vaccine Intelligence Network, developed by the United Nations Development Programme (UNDP) and the Indian government, has reduced vaccine stock-outs by 80%.
Hospital sanitisation	Non-surgical robots connected to IoT systems have been used to clean patient rooms and to disinfect and sterilise surfaces from Covid-19 contamination with a special UV light and chemicals.
Automated temperature screening	IoT-enabled thermal imaging systems have been used to identify people with elevated body temperatures before they enter buildings, such as airports, office spaces, schools, shopping centres and hospitals, for further screening.
Facilities and PPE stock management	IoT system have been used to provide supply-chain planners and policymakers with actionable information on the availability of hospital beds and personal protective equipment (PPE) for medical staff for the efficient allocation of resources.
Healthcare delivery drones	IoT-enabled drones have been utilised to deliver test kits and results, PPE, medicines and other vital medical supplies, especially in developing regions with poor logistics infrastructure. For example, in Ghana, connected-drone company Zipline is supporting the delivery of vaccines to remote parts of the country.

Beyond connectivity: operators expand role in the IoT value chain

Connectivity remains a foundational element for IoT solutions. However, it accounts for a small and declining share of the overall value of the IoT market, relative to professional services and applications, platforms and services, largely due to commoditisation. In recent years, operators have been expanding their capabilities beyond connectivity to capture a larger proportion of the overall market:

- Vodafone has expanded its portfolio of IoT solutions to include devices, sensors and ongoing professional services for enterprises of all sizes.
- Airtel has introduced an end-to-end solution targeted at enterprises, which employs the operator's eSIM technology to offer a range of services.
- Verizon provides a curated ecosystem of hardware, software, design services and vertical solutions that addresses the needs of enterprises of all sizes.
- Orange has introduced Live Objects, a platform that allows enterprises of all sizes to quickly integrate new devices, as well as extract and process data from those devices for business applications.
- Deutsche Telekom has unveiled an open platform for IoT, bringing together key players from across the ecosystem, including developers, operators, partners and suppliers, to enhance the development and time-to-market of new solutions.

03

Mobile contributing to economic growth and addressing social challenges

3.1 Mobile's contribution to economic growth

In 2020, mobile technologies and services generated 5.1% of global GDP, a contribution that amounted to almost $4.4 trillion of economic value added. The mobile industry also supported approximately 25 million jobs (directly and indirectly) and made a substantial contribution to the funding of the public sector, with more than $410 billion raised through taxes on the sector.

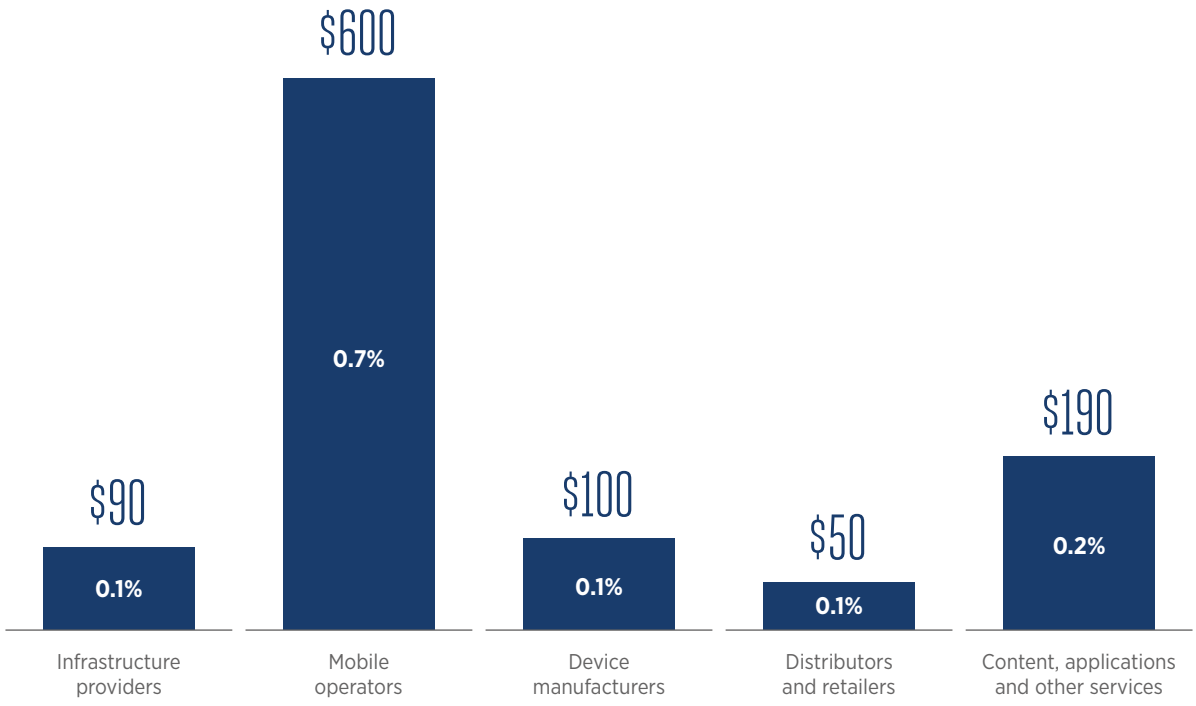
By 2025, mobile's contribution will grow by $480 billion (approaching $5 trillion) as countries around the world increasingly benefit from the improvements in productivity and efficiency brought about by the increased take-up of mobile services.

Source: GSMA Intelligence

Figure 27

The global mobile ecosystem directly generated more than $1 trillion of economic value in 2020, with mobile operators accounting for over half of this figure

Billion, percentage of GDP (2020)

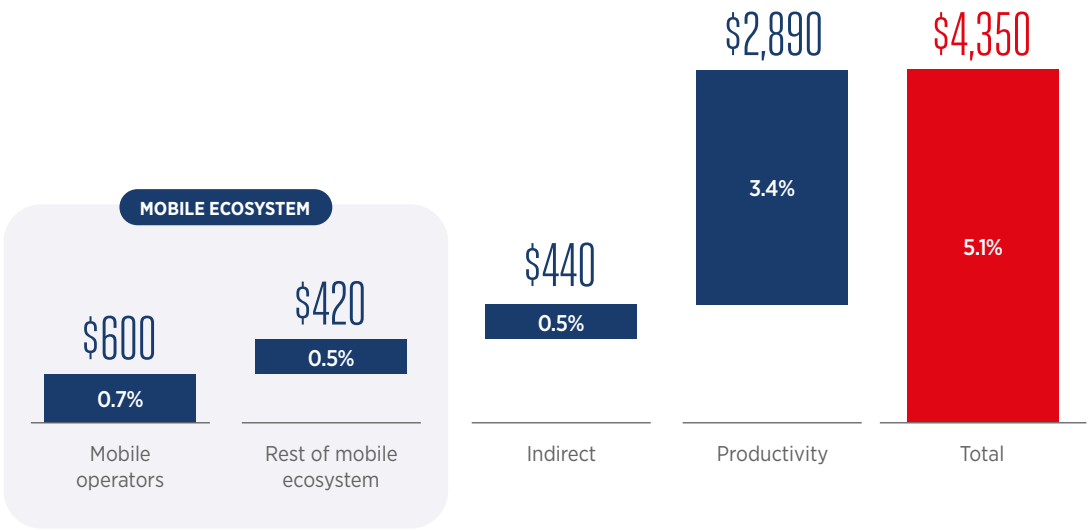


Source: GSMA Intelligence

Figure 28

Additional indirect and productivity benefits bring the total contribution of the mobile industry to almost $4.4 trillion

Billion, percentage of GDP (2020)

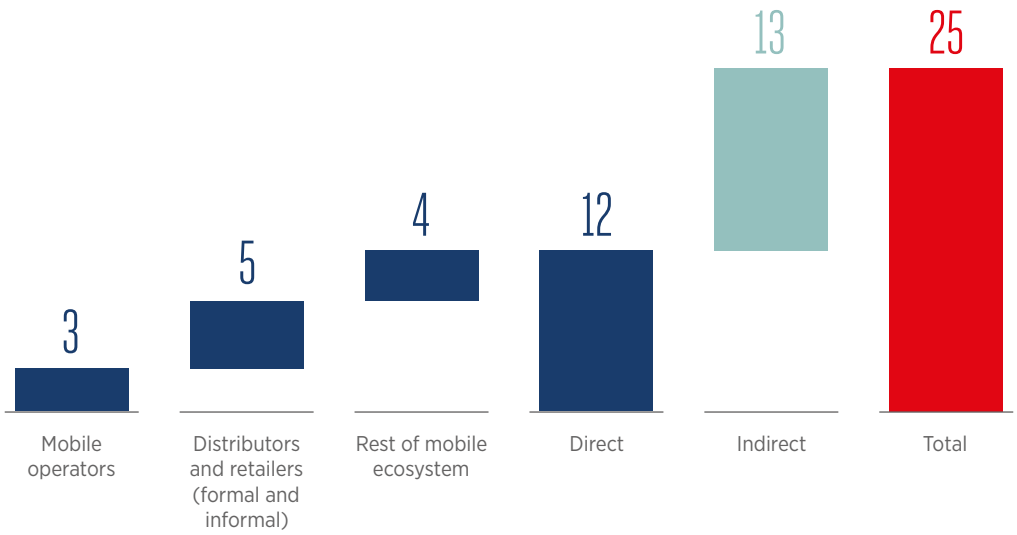


Source: GSMA Intelligence

Figure 29

The mobile industry directly employed around 12 million people in 2020, plus another 13 million indirectly through adjacent industries

Jobs (million)

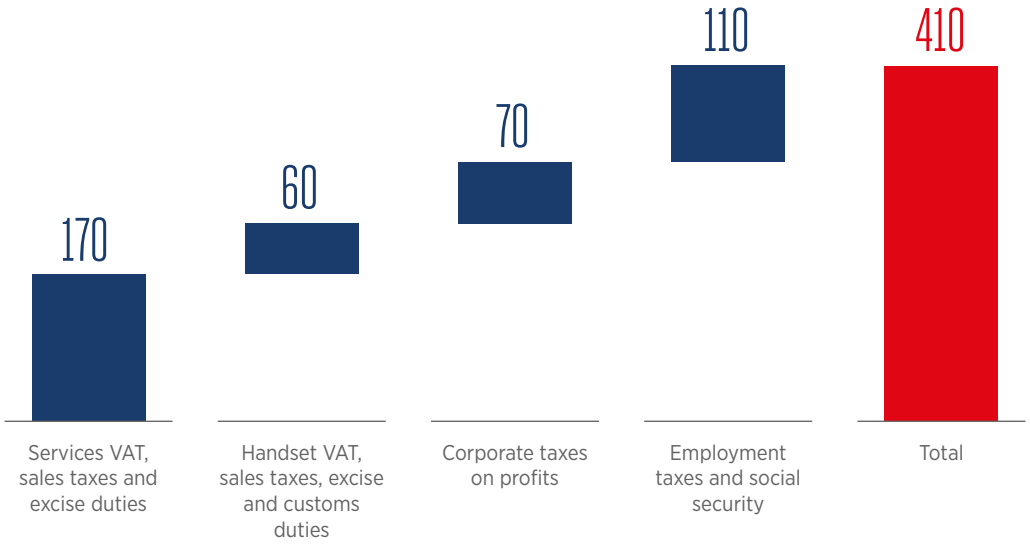


Source: GSMA Intelligence

Figure 30

In 2020, the mobile ecosystem contributed more than $410 billion to the funding of the public sector through consumer and operator taxes

Billion

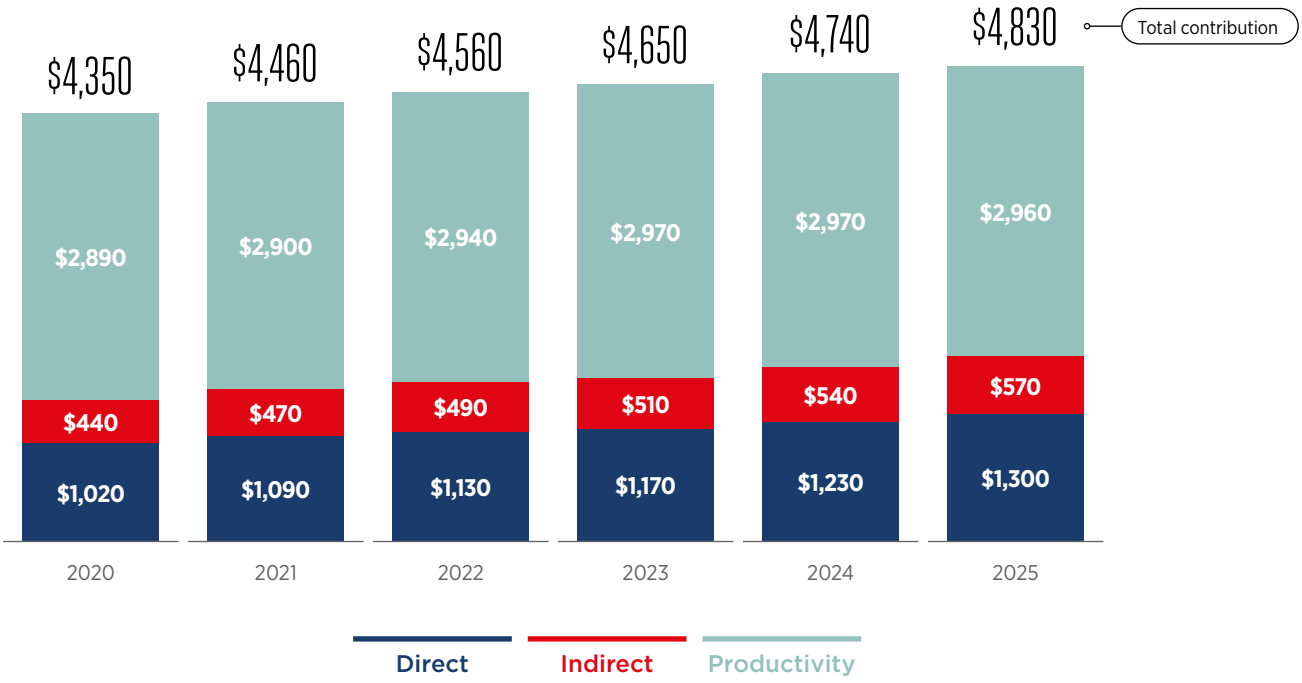


Source: GSMA Intelligence

Figure 31

Driven mostly by continued expansion of the mobile ecosystem, the global economic contribution of mobile will increase by $480 billion by 2025

Billion

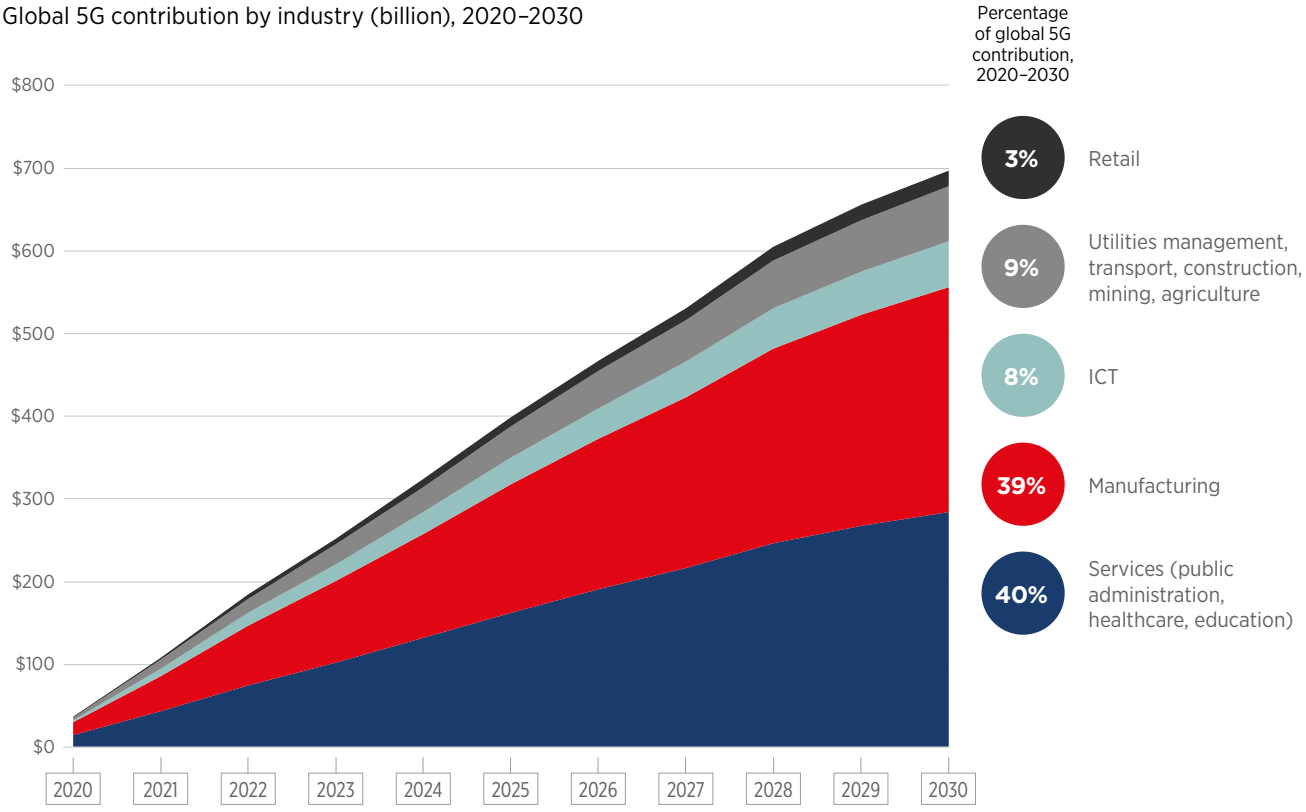


Source: GSMA Intelligence

Figure 32

5G is expected to benefit all economic sectors; some industries will benefit more than others due to their ability to incorporate 5G use cases

Global 5G contribution by industry (billion), 2020–2030

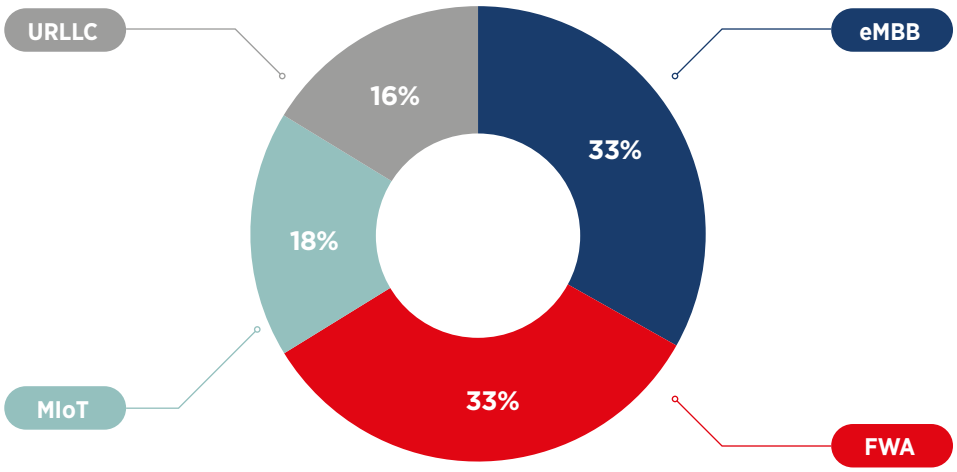


Source: GSMA Intelligence

Figure 33

Of the four main use cases 5G will enable, eMBB and FWA will account for two thirds of the overall 5G-associated economic benefits over the next decade

Global 5G contribution by use case, 2020–2030



3.2 Mobile enhancing digital and financial inclusion

Mobile connectivity serves as a vital lifeline during the pandemic

People around the world have relied on the internet to stay connected and access life-enhancing services during lockdowns. The shift to online activities – including learning, work, shopping, entertainment and social interactions – is evidenced by the sharp growth in data traffic at the peak of the pandemic; mobile network traffic grew 50% on average in the 12 months to September 2020.[5] This figure is much higher in Sub-Saharan Africa and other developing regions, where mobile is the primary and, in many cases only, form of internet access.

The reliance on connectivity and digital services for many daily activities will likely continue post pandemic, with some changes in consumer behaviours and business processes set to become permanent. This brings into sharp focus the risk of exclusion from online services for people still unable or unwilling to access digital services. Much progress has been made in bringing unconnected people online. In 2020, 225 million people connected to the mobile internet for the first time, bringing the total to just over 4 billion people (51% of the global population).

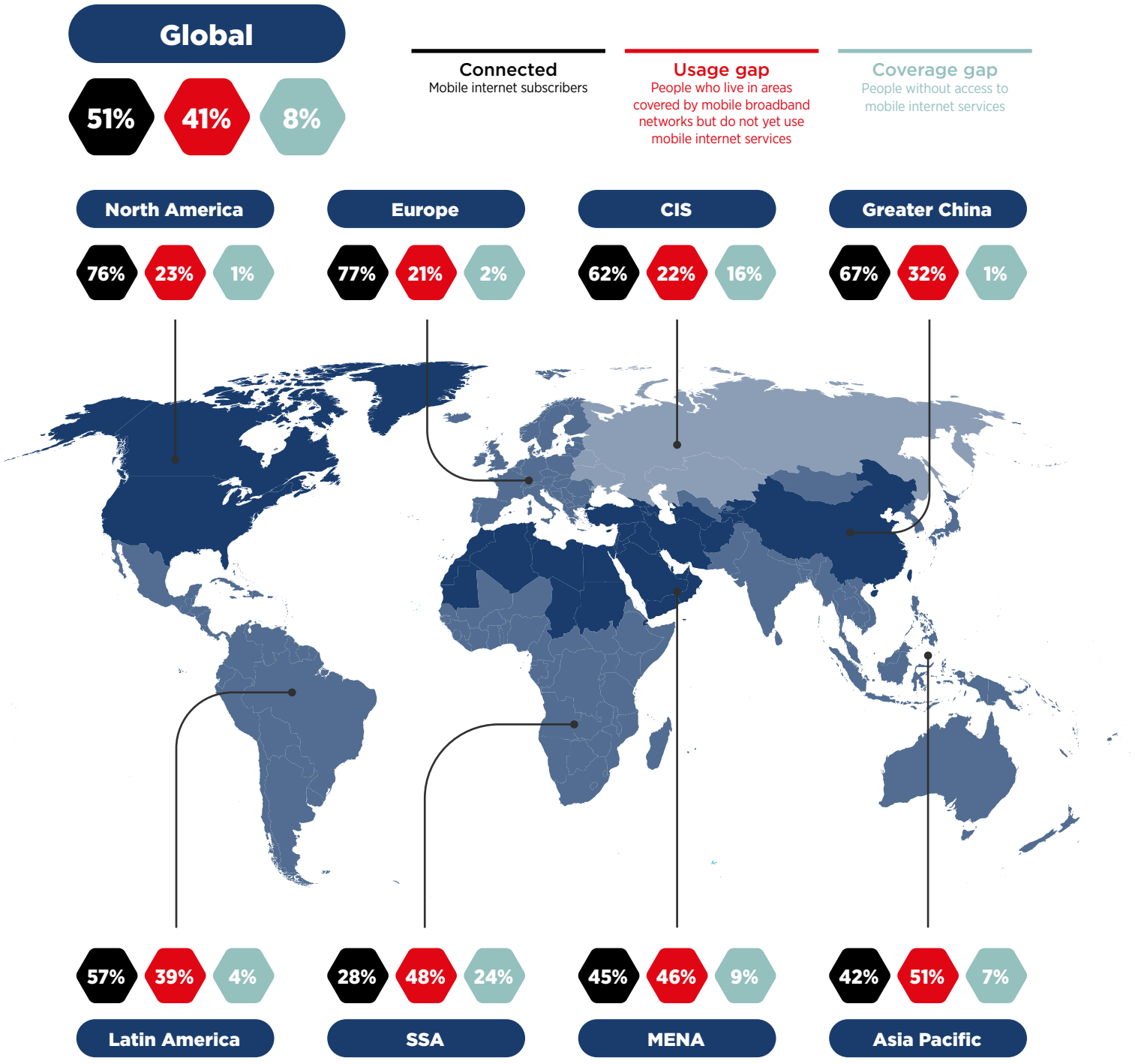
5. Ericsson Mobility Report, November 2020

Source: GSMA Intelligence

Figure 34

Almost half of the world remains unconnected; Asia Pacific and Sub-Sahara Africa account for the largest unconnected populations

State of global mobile internet connectivity by region (percentage of total population), 2020



As digital technologies become more integral to the way people live and businesses operate, the urgency to bring more people online is becoming ever greater. This has resulted in renewed efforts by mobile industry players, governments and other stakeholders to address the challenges people face in accessing and using mobile internet services.

Despite a meaningful reduction in the coverage gap in recent years, the pace of growth in mobile internet adoption has been relatively slower, with the usage gap remaining large. At the end of 2020, 41% of the global population (equivalent to around 3.2 billion people) lived within the footprint of a mobile broadband network but did not use mobile internet services. To explain this, the GSMA has identified five main barriers to usage and how these barriers can be overcome:

- **Access:** increasing access to networks and enablers (quality network coverage, handsets, electricity, agents and formal IDs), and usability of handsets, content and services.
- **Affordability:** improving the affordability of handsets, tariffs, data and service fees.
- **Knowledge and skills:** enhancing digital skills and literacy, and increasing awareness and understanding of mobile technology and its benefits.
- **Safety and security:** tackling harassment, theft, fraud and security, and building consumer trust.
- **Relevance:** ensuring availability of relevant content, products and services.

The GSMA has also developed the Mobile Connectivity Index[6] (MCI) to help mobile-industry stakeholders focus efforts and policy actions to address the prevailing coverage and usage gaps. The 2020 edition measures the performance of 170 countries (representing 99% of the global population) against four key enablers of mobile internet adoption: infrastructure, affordability, consumer readiness, and content and services.

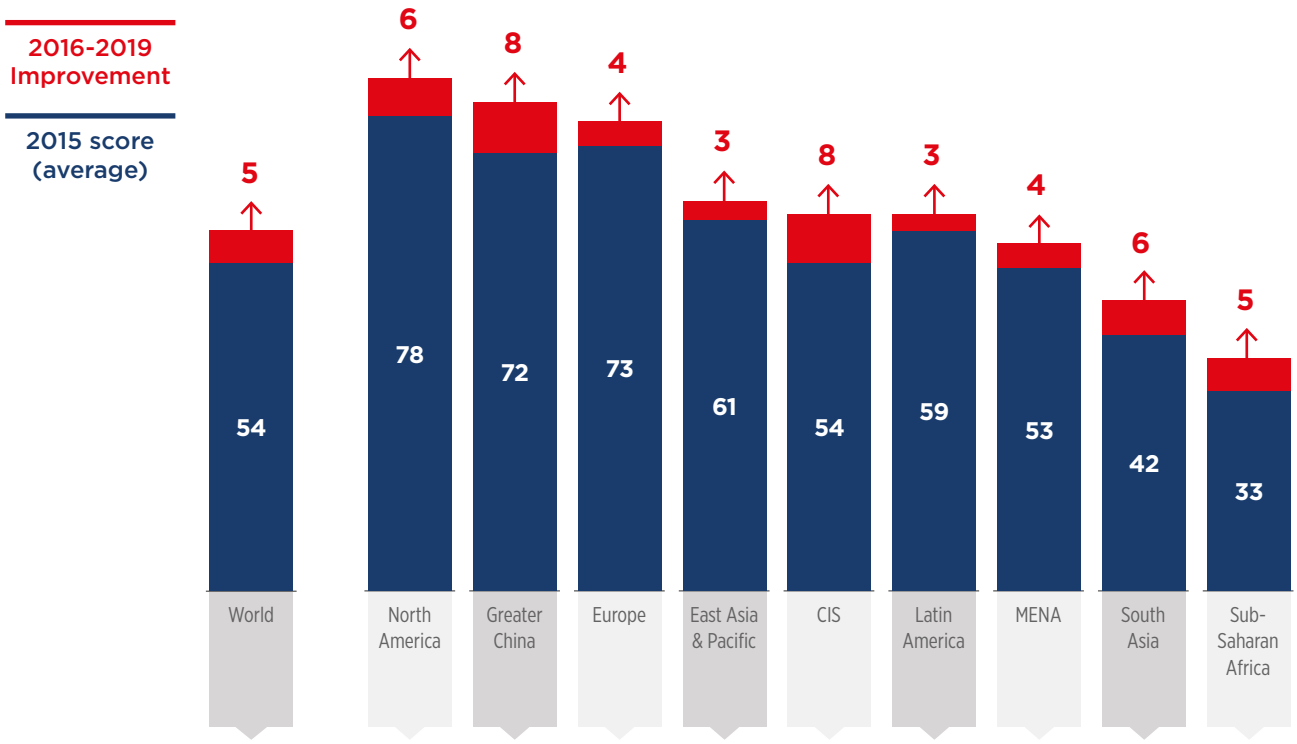
6. www.mobileconnectivityindex.com

Source: GSMA Intelligence

Figure 35

Most regions have made significant progress on infrastructure; more work is required on other enablers

GSMA Mobile Connectivity Index scores (scores range from 0 to 100)



	World	North America	Greater China	Europe	East Asia & Pacific	CIS	Latin America	MENA	South Asia	Sub-Saharan Africa
Infrastructure	+8	+9	+6	+5	+8	+4	+9	+8	+10	+9
Affordability	+3	+11	+8	+2	+4	+6	+1	+5	+6	+2
Consumer readiness	+1	+1	+1	+1	+1	+4	+1	+2	+3	+2
Content & services	+5	+3	+5	+5	+5	+10	+3	+4	+4	+4

Low- and middle-income countries (LMICs) account for more than 90% of the world's unconnected population and 98% of the uncovered population. Results of the GSMA Intelligence Consumers in Focus Survey and analysis from the Mobile Connectivity Index have revealed the following insights in these regions:[7]

- **Awareness of mobile internet is improving, particularly among rural populations and women, but is far from universal:** In the LMICs surveyed, almost a quarter of adults were not aware of mobile internet.[8] However, awareness of mobile internet has been growing in recent years, particularly in South Asia and Africa. Another encouraging trend is that awareness is growing more rapidly for rural populations and women. The average rural-urban gap in awareness in countries surveyed halved from 25% to 12% between 2017 and 2019, and the average gender gap in awareness decreased from 17% to 8% over the same period.
- **Lack of literacy and digital skills persists as a significant barrier to use:** Rural populations are more likely than urban populations to cite literacy and skills as the most important barrier to adoption. Similarly, women are more likely than men to perceive skills as the most important barrier to mobile internet adoption. The lack of robust and comparable measures of digital skills (as opposed to broader skills and education metrics) masks the true extent of the literacy and skills barrier. Encouragingly, these are now being developed – for example, the ITU's Digital Skills Assessment Guidebook,[9] Unesco's Framework of Reference on Digital Literacy Skills,[10] the Coalition for Digital Intelligence,[11] and the EU's Digital Competence Framework.[12]
- **Affordability of handsets remains a key barrier to mobile internet adoption:** For many potential mobile internet users, even a $20 phone represents a significant one-off cost. In Sub-Saharan Africa, for example, the median cost of an entry-level internet-enabled handset represented more than 120% of monthly income for the poorest 20% of the population in 2019. In addition to reducing the cost of handsets, other solutions to increase affordable access of devices need to be considered. During the past few years, many consumers in LMICs who could not afford to purchase a phone in a single upfront payment have benefited from asset financing models (such as payment instalment plans, subsidies, loans, leases or rentals).
- **More mobile users are seeing the relevance of mobile internet and benefiting from locally relevant content:** The number of active apps available to users globally more than doubled (from 2.2 million to 4.5 million) between 2014 and 2019. The majority of apps are still developed in high-income countries; however, an increasing amount of content is being developed in LMICs, especially in Asia (which has witnessed some of the biggest gains in the MCI Content and Services score). This is being driven by the development of digital ecosystems that have increased the amount of mobile apps in local languages (e.g. in Myanmar, Vietnam, the Philippines and Indonesia), in addition to other content such as e-government services and the growing use of social media.
- **Mobile internet use is becoming more diverse and, in the context of the pandemic, more intense:** During the Covid-19 pandemic, individuals have become increasingly reliant on digital services to adhere to lockdown and social-distancing measures. While some of the increased demand may be temporary (e.g. the use of video and conferencing calls during lockdown), the pandemic could drive a broader shift in consumer behaviour, with individuals making greater use of digital technology in their lives (e.g. e-commerce, reading the news, and accessing health and educational services).

7. The State of Mobile Internet Connectivity, GSMA, 2020
8. We define awareness as people who have used mobile internet before or who have not used mobile internet but are aware they can access the internet on a mobile phone
9. Digital Skills Assessment Guidebook, ITU, 2020
10. A Global Framework of Reference on Digital Literacy Skills for Indicator 4.4.2, Unesco, 2018
11. www.dqinstitute.org/
12. The Digital Competence Framework 2.0, European Commission

Mobile money: extending essential financial services to vulnerable people

The pandemic has created an unprecedented human, economic and social crisis. The most vulnerable and hardest hit were those living in circumstances that made social distancing impossible or in geographies where social support was not available. Even those who could benefit from government and humanitarian support were likely to have more difficulty accessing it, mostly due to lack of account ownership at a formal financial institution. In this context, universal access to financial services became more critical than ever.

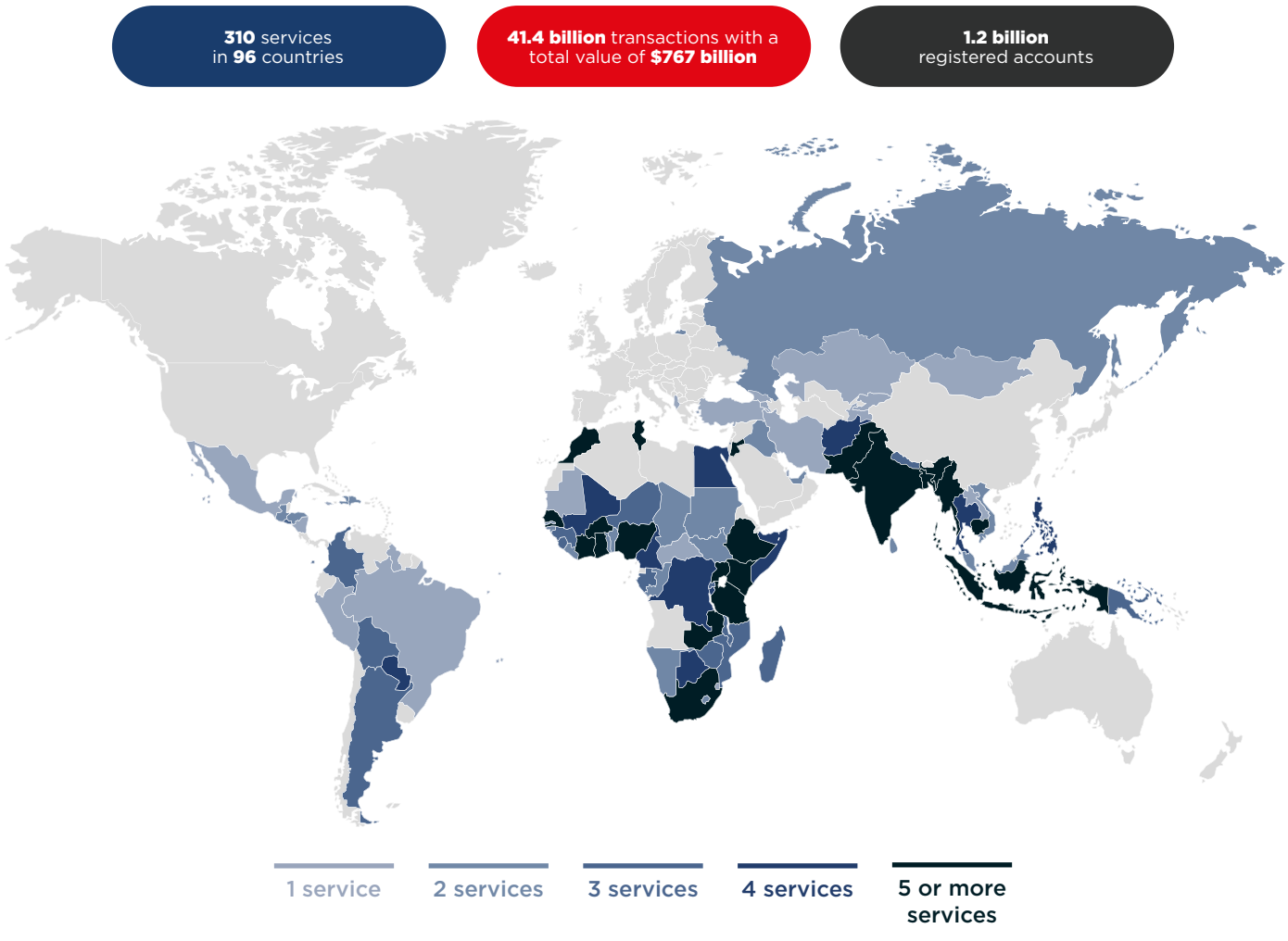
One upshot from Covid-19 is the widespread shift in the adoption of digital tools. Restrictions on movement and the potential risks of handling cash led to consumers quickly turning to digital payments as a safer and more accessible option. In LMICs, mobile money is far more accessible than any other type of digital financial service (including app-based platforms), particularly outside of urban centres. As a result, in many markets, mobile money has become integral to the national Covid-19 response and provided a critical path to delivering financial assistance quickly, safely and efficiently.

Source: GSMA Mobile Money Programme

Figure 36

Mobile money is now available in most markets where access to financial services is low; Sub-Saharan Africa accounts for half of live mobile money services and two thirds of the total transactions value

Number of mobile money services by country, 2020



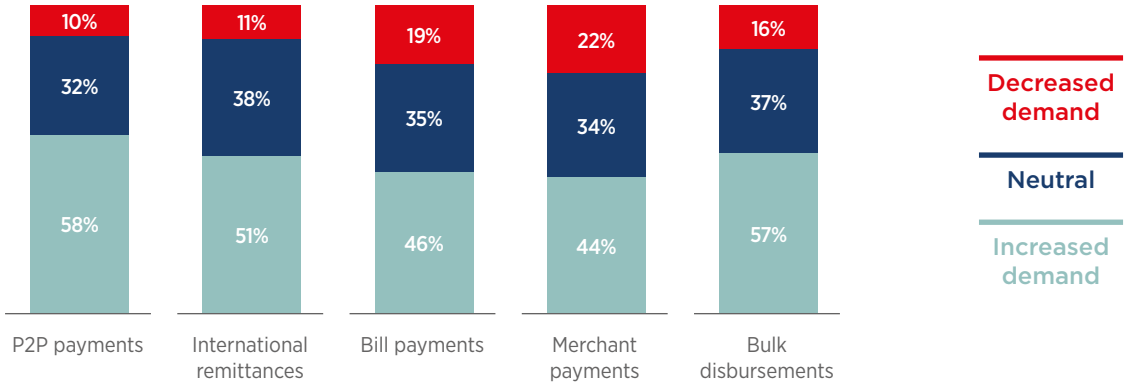
In 2020, the number of registered mobile money accounts grew by 12.7% globally; over 136 million accounts were added in just one year, taking the total number of registered accounts globally to 1.2 billion. This growth, which was twice as high as previously expected, reflects the change in consumer behaviour following the outbreak of Covid-19 and the changes in mobile money regulations in response to the pandemic, such as more flexible know-your-customer (KYC) processes and relaxed onboarding requirements.[13]

Source: GSMA Mobile Money Global Adoption Survey 2020

Figure 37

Demand for mobile money increased during the pandemic; P2P payments and bulk disbursements have the seen the most interest

Perceived impact of Covid-19 on product demand (percentage of respondents)



Accelerating the shift from physical to mobile money–enabled cash transfers

In 2019, humanitarian agencies delivered $5.6 billion in cash and voucher assistance (CVA) to those affected by humanitarian crises. This figure has since doubled, and now accounts for 18% of international humanitarian assistance, compared to 11% in 2016.

The growth of CVA and the need to mitigate the impact of Covid-19 have significantly increased interest in contact-free digital channels, which can increase the speed, efficiency, accountability and transparency of delivering humanitarian aid. The ubiquity and scale of mobile networks also make mobile an attractive digital delivery channel for many types of humanitarian assistance.[14]

The World Food Programme (WFP) significantly increased its use of cash assistance during the Covid-19 pandemic, opting for mobile money as its payment instrument in appropriate contexts. The share of cash-based transfer values channelled through mobile money more than doubled from 3.8% of total cash transfers in 2019 to 8.9% in 2020, transferring $192 million by the end of December. The WFP reached 67 countries with cash transfers in 2020, 25 of which used mobile money. Additionally, the United Nations Refugee Agency (UNHCR) has set up digital payment programmes in 47 countries, a third of which are using some form of mobile money service.

In August 2020, the GSMA Mobile for Humanitarian Innovation and Mobile Money programmes expanded the GSMA's partnership with the WFP to improve its CVA programmes for those affected by crises. The WFP is now able to access and benefit from mobile money industry initiatives, such as the GSMA Mobile Money Certification and Mobile Money API standardisation programmes.

13. State of the Industry Report on Mobile Money, GSMA, 2021
14. COVID-19 and digital humanitarian action: Trends, risks and the path forward, GSMA, 2021

3.3 Mobile delivering social impact

The mobile industry continues to show leadership in the global race to net zero

The mobile sector has been credited by the United Nations (UN) for achieving a critical breakthrough towards its mission of combatting climate change. Being the first major sector to achieve the rigorous criteria set by the UN's Race to Zero campaign demonstrates the commitment and leadership of mobile operators in the push to meet the goals of the Paris Agreement. This comes at a time when global political and economic leaders are giving renewed impetus to delivering a zero-carbon world.

In February 2019, the GSMA Board, comprising members from the largest mobile network operators in the world, set a milestone ambition: to transform the mobile industry to reach net-zero carbon emissions by 2050, at the latest. This was not the first time the sector demonstrated leadership in sustainable development. In 2016, the mobile industry was the first sector to commit to the UN's 17 Sustainable Development Goals (SDGs).

Source: GSMA Climate Action Programme

Figure 38

The journey so far – the mobile industry's progress on climate action[15]

Climate disclosure

A GSMA-led initiative to develop a mobile industry climate action roadmap in line with the Paris Agreement

69% of operators by connections and

80% by revenue disclose their climate impacts

The GSMA is working to support even more operators to disclose.

ICT sector pathway

Decarbonisation pathway for the mobile industry, aligned with the science-based targets initiative (SBTi)

50% of operators by connections and

65% by revenue have committed to science-based targets

The GSMA collaborated with the Global e-Sustainability Initiative (GeSI), the ITU and the SBTi to calculate and consult on a science-based carbon reduction pathway for the mobile sector and the entire ICT sector.

Net zero

Criteria used by the UN Race To Zero campaign, which includes reductions in Scope 3 emissions across the whole value chain[16]

31% of operators by connections and

36% by revenue are aligned to the Race to Zero pledge

Several operators are on track to meet the net-zero target significantly ahead of the 2050 deadline.

Note: Data correct to April 2021

15. Mobile Net Zero: State of the Industry on Climate Action, GSMA, 2021
16. unfccc.int/climate-action/race-to-zero-campaign

Figure 39

Leading operators in every region have committed to climate action targets

Climate targets by operator

Mobile network operator	Science-based targets	Carbon neutral target year	Net zero target year
A1 Telekom	1.5°C	2014	
America Movil	1.5°C		2050
AT&T	2°C	2035	
Airtel (Bharti)	Committed Aug 2019		2050
Bell (Canada)	Committed Jun 21	2025	2050
BT (EE)	1.5°C		2045
Deutsche Telekom	1.5°C	2025	2040
Elisa	1.5°C	2020	
Far EasTone	2°C		
Globe Telecom	Committed Jun 21		2050
Iliad Group		2035	
JT Global		2030	
KPN	1.5°C	2015	2040
Liberty Global	1.5°C		
LG Uplus		2030	
Magyar Telekom	1.5°C	2016	2050
MTN Group	1.5°C (pending)		2040 (pending)
NTT Docomo	1.5°C		
Orange	1.5°C		2040
Proximus	<2°C	2016	2050
Reliance Jio	Committed Aug 2019		2050
Safaricom	<2°C	2050	2050
SoftBank	Committed Mar 21		
STC	Committed Mar 2020		2050
Singtel	<2°C		2050
SK Telecom	Committed Feb 2020	2050	
Swisscom	1.5°C	2020	2050
Taiwan Mobile	2°C		
TDC	Committed Jul 2019	2028	2050
Tele2	1.5°C	2020	
Telefónica	1.5°C		2025/2040*
Telenor Group	1.5°C	2030**	
Telia	1.5°C	2020	2030
Telstra	Committed Feb 2020	2020	2050
Telus	1.5°C	2030	2050
Verizon	1.5°C	2035	2040
Vodafone	1.5°C	2030	2040
VodafoneZiggo	1.5°C		2050

** 2025 in its four main markets; 2040 including all operations and value chain.*
*** Nordic operations*
Science-based targets – Carbon reduction targets in line with limiting global heating to below 2°C[17]
Carbon neutral – Reducing and offsetting carbon emissions from own operations (Scope 1 and 2 emissions), e.g. electricity use for networks and diesel fuel use for transport and generators
Net zero – Criteria used by the UN Race to Zero campaign

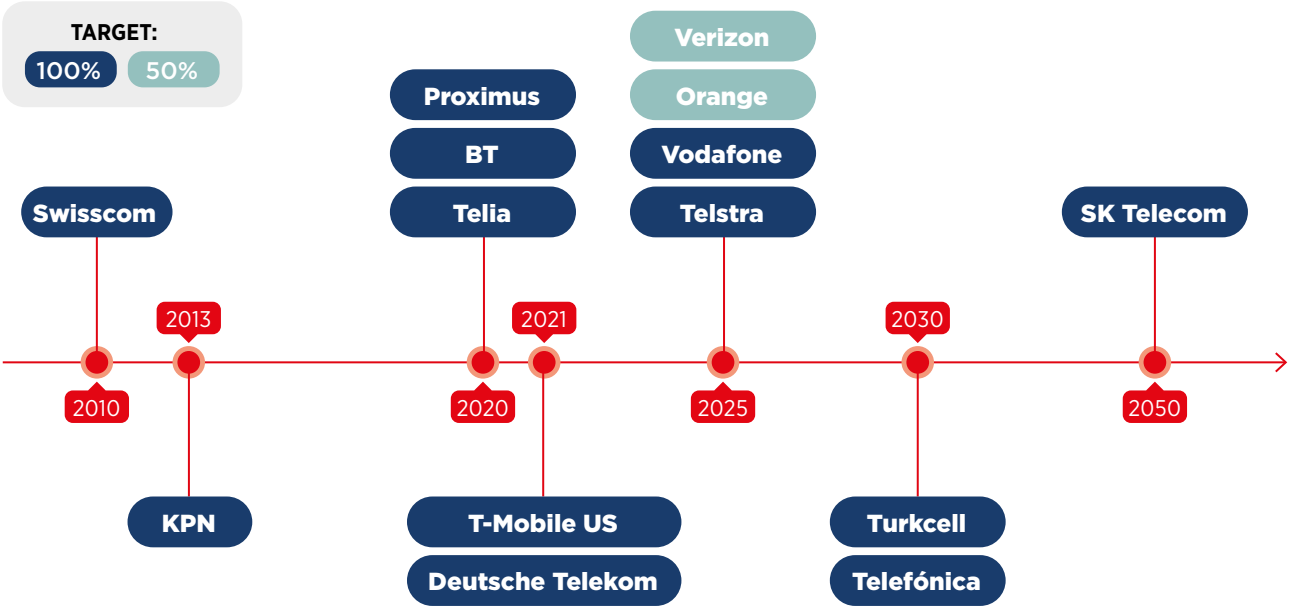
17. gsma.com/betterfuture/%20setting-climate-targets

Renewable energy will be essential for the mobile industry to reach net-zero carbon emissions. Most emissions within the direct control of operators are from electricity and diesel consumption by power networks. For example, in off- and bad-grid locations in LMICs, emissions from diesel generators used to power mobile towers accounted for 3% of the industry's total emissions in 2020.[18]

Source: Company announcements, GSMA

Figure 40

Several operators have achieved or set ambitious targets to use renewable energy in their networks



Sustainability financing on the rise

Green bonds represent a paradigm shift from traditional modes of financing by securing funding on the basis of achieving climate and environmental – rather than purely financial – targets. The telecoms sector is among the leaders in embracing this model of investment as part of overall plans to achieve net-zero emissions by 2050. The fact that institutional investors are increasingly gearing capital allocations with climate covenants is a clear sign that sustainability is very much a part of a new normal in the corporate world. Below we highlight examples of recent issuances:

- In April 2021, Singtel launched a sustainability-linked revolving credit facility of SGD750 million ($400 million).
- In April 2021, Bell Canada announced its Sustainable Financing Framework to guide its future issuances of green, social and sustainability bonds and other sustainable financings.
- In February 2021, TIM joined the Nasdaq Sustainable Bond Network – a brokering platform bringing together like-minded companies and investors. In January, the operator issued its first 'green bond' valued at €1 billion.
- In February 2021, Telefónica closed a sustainable hybrid bond issue, amounting to €1 billion.
- In September 2020, Verizon priced its second green bond, which is expected to bring in net proceeds of $1 billion.
- In May 2020, Swisscom issued a €500 million green bond under its Green Bond Framework.

18. Renewable Energy for Mobile Towers: Opportunities for low- and middle-income countries, GSMA, 2020

Using MBD analytics in the Covid-19 response

The everyday use of mobile networks generates enormous amounts of data, often referred to as mobile big data (MBD). Through the use of mobile operators' MBD analytics and AI expertise, MBD can be aggregated, anonymised, analysed, combined with data and information from other relevant sources, and packaged into valuable products and services, such as reports and dashboards. These can be powerful support tools for decision-making across a wide range of problems – such as determining how to respond to epidemics and natural disasters, mitigating pollution, planning infrastructure deployment or allocating scarce resources.

In the context of Covid-19, MBD analytics has been used to inform government response measures at various stages of the pandemic. Given the impact of mobility on the spread of infectious viruses, it is essential to have accurate, up-to-date information on aggregated mobility patterns to identify transmission hotspots and understand how quickly a virus is spreading. In LMICs, where lockdowns can further limit economic opportunities for poorer people, potentially leading to an increase in hunger, deprivation and related mortality, an evidence-based approach to public health is crucial for the surveillance, prevention and control of Covid-19.

Source: GSMA

Figure 41

MBD analytics can provide valuable and trusted insights for decision-making

Examples of MBD analytics use cases in the Covid-19 response	
Tracking population migration	Tracking migration from one part of the country to another or across borders is important given the likelihood for travellers to take diseases from areas with high infection rates to areas of low incidence. In India, the enforcement of lockdown measures sparked the migration of many workers in the informal sector from urban to rural areas with limited healthcare capacity.
Locating and identifying vulnerable population groups	This includes daily-wage earners and people reliant on the informal sector of the economy, who could be more adversely impacted by lockdowns and social-distancing measures.
Monitoring compliance with lockdown enforcements and their impact on infection rates	A study in the three most affected regions in Italy (Lombardy, Veneto and Emilia-Romagna) found that greater compliance with lockdown measures reduced the daily infection rate.
Managing scarce resources	Understanding the dynamic locations and clustering of the population, for example, can help identify gaps in the provision of water, sanitation and hygiene (WASH) facilities and optimise medical supplies and logistics in areas of greatest need.

Since the World Health Organization (WHO) declared Covid-19 a global pandemic, mobile operators have implemented MBD analytics to support the Covid-19 response in 40 countries around the world, including the following:

- **Argentina –** Telefónica partnered with the University of San Martín to develop The Citizen Mobility Index, an MBD and AI solution, to help national, provincial and local governments monitor and control mobility flows during the enforcement of lockdown measures.
- **France –** Orange worked with the French National Institute for Health and Medical Research (Inserm) to prepare and evaluate lockdown measures. Analysis showed a 65% reduction in journeys during lockdown and how effective the lockdown was in reducing work and recreational trips.
- **Japan –** KDDI provided its big-data analysis tool, KDDI Location Analyzer, to 47 regions of Japan, including 20 cities. The tool enabled municipalities to understand mobility patterns using anonymised smartphone location data and certain demographic characteristics.
- **Nigeria –** MTN provided data-driven insights to shape resource planning and response measures. The solution helped to identify geographies with the most vulnerable people by using anonymised and aggregated mobile money transactions as a proxy indicator for economic status.
- **Tunisia –** Ooredoo developed dashboards to display the number of calls to emergency services in each region, and shared insights with the ICT and health ministries.

As lockdowns ease and economic activities recover in a post-pandemic scenario, MBD tools can also evolve to help inform other government decisions. This includes decisions on the safe re-opening of businesses and the wider economy to prevent new spikes in infection rates; the reallocation of public services and logistics resources based on changes in usage patterns due to the pandemic; the targeted deployment of vaccines and other healthcare resources; and the identification of economic and social vulnerabilities within populations.

The GSMA AI4I Covid-19 response

The GSMA AI for Impact (AI4I) initiative develops global partnerships to accelerate action on the use of MBD analytics and AI as powerful forces to transform business and society, and achieve impact in alignment with the UN SDGs. Following the Covid-19 outbreak, the GSMA has spearheaded collaborations between mobile operators and governments in LMICs to implement MBD analytics and AI decision-making tools, under the AI4I Covid-19 response initiative.

The 10-month project, which was funded by the UK Foreign Commonwealth and Development Office (FCDO), facilitated in-country collaborations between key stakeholders in four primary countries – the Democratic Republic of the Congo, Benin, Burkina Faso and Rwanda. In addition, the GSMA provided support to government agencies and other stakeholders in Bangladesh, Gambia, India, Niger, Nigeria, Pakistan, Sierra Leone, South Africa, Sudan and Zimbabwe. Through multiple engagements, the GSMA AI4I Covid-19 response has:[19]

- successfully co-created and delivered valuable MBD analytics products and services, including dashboards and reports, to support the Covid-19 response
- increased awareness of the power of MBD analytics among local stakeholders and its potential to help tackle epidemics and other global challenges
- promoted best practice in data privacy and governance to safeguard trust in the handling of mobile customer data and ensure the ethical application of AI-based solutions
- created new local AI4I ecosystems, and expanded existing ones, by providing a platform for dialogue and collaboration between public- and private-sector partners
- enhanced technical skills among local stakeholders, particularly government agencies, by leveraging expertise in building technical skills for MBD analytics
- disseminated knowledge and lessons learnt from the AI4I Covid-19 response activities to local and global stakeholders to support the efficient deployment of MBD analytics in the future.

19. Utilising Mobile Big Data and AI to Benefit Society, GSMA, 2021

04

Policies for shaping the post-pandemic digital economy

The digital economy creates significant social and economic benefits for society through ongoing investment and innovation. This is largely underpinned by a healthy and competitive mobile sector, which enables enterprises to expand, societies to develop, and citizens to access new opportunities and life-enhancing services. With the Covid-19 pandemic casting a spotlight on mobile technology, the importance of a digitally connected world has never been clearer.

4.1 Accelerating investment and innovation

Mobile technology will play a key role as governments look to reinvigorate their economies and build a better, more inclusive society. Now is the right moment for governments to reassess the business and regulatory environment for mobile services in order to accelerate investment and innovation.

Direct stimulus funds towards digital development

Governments around the world will put digital technologies at the centre of efforts to rebuild their economies after the pandemic. Continued network evolution and expansion will be essential to stimulating economic growth, mobilising the workforce and enabling new levels of industrial efficiency across various parts of the economy.

Public funding can be applied to objectives that cannot be achieved purely through competitive, market-based activity — particularly where R&D or collaborative, cross-sector efforts are required. For example, the EU has established a €750 billion recovery fund to improve economic resilience and deliver green, digital advancement. The focus on a digital and green recovery serves as an example for countries around the world to consider for their respective recovery strategies.

Support financial sustainability of the mobile sector

Recognising the significance of connectivity, governments frequently set policy targets that put additional pressure on operators to extend and upgrade their networks. At the same time, artificially high levels of competition in many countries limit operators' share of revenues, and spectrum fees and other tax and regulatory cost burdens remain high. This scenario does not support accelerated network investment. Given that a financially sustainable mobile sector is key to the delivery of innovative services and the deployment of new networks, to create favourable conditions for investment, governments should consider:

- implementing flexible, light-touch regulation that creates an environment for continued mobile sector investment and innovation
- adopting a balanced approach to collecting revenues through taxes and fees, and incentivising investment and economic growth
- providing fair and efficient spectrum awards to maximise access to affordable mobile broadband services, which in turn can have a major impact on the digital economy – evidence shows that higher state revenues from excessive spectrum pricing are outweighed by losses incurred to the digital economy.

Essentially, governments and regulators have a choice: implement short-term policies that hold back connectivity and limit the widespread benefits it generates, or drive economic growth and social welfare through pro-investment policies and regulatory restraint.

Remove barriers to network deployment

As the uptake of mobile 4G and 5G connectivity continues to grow, progressive infrastructure policies can help accelerate the rollout of networks and services. Simplifying planning procedures and regulations for site acquisition, and co-locating and upgrading base stations should be top priorities.

Policies should also offer a reasonable expectation of approval for voluntary network-sharing deals, but avoid implementing mandated sharing agreements. It is important that policies apply to both base stations and small cells. Enabling small cells is an important step in realising the full potential of 5G.

Ensure fair competition

The evolving structure of the digital economy requires a change in the way regulators approach digital regulation. The overarching aim should be to ensure that everyone is competing on a level playing field. To achieve this, regulation should be technology agnostic and applicable across sectors and to all competitors that are providing the same service. Regulatory intervention, including merger assessments, should take full account of the benefits arising from investment and innovation.

By adopting horizontal regulatory frameworks and competition policy suited to the digital economy, policymakers can ensure that all actors across the ecosystem continue to invest, produce and innovate, creating new services and applications that consumers need and want.

Harmonise EMF limits

Public interest in the health effects of electromagnetic fields (EMF) associated with mobile networks may arise with the introduction of every new generation of mobile technology, and 5G is no exception. Last year's updated radio frequency (RF) exposure guidelines by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) — which include frequencies above 6 GHz, including 5G mmWave — confirm that the international limits remain protective of all people, including children, against all established health hazards.

It is important that authorities adopt the updated guidelines. Disparities between national limits and international guidelines can foster confusion for both regulators and policymakers, increase public anxiety, and provide a challenge to manufacturers and operators of communications systems that need to tailor their products to each market. In the view of ICNIRP, national limits that are more stringent than the international guidance do not offer any additional health protection.

Establish balanced policies for personal data

The pandemic has underscored the importance of protecting mobile users' personal data. For example, data privacy was a major consideration in the development of contact-tracing applications for Covid-19. Some governments also called on mobile operators to provide aggregated, anonymised data on the movements of mobile users to inform the public health response to the pandemic. Mobile operators collaborated with governments in many such efforts while adhering to data protection rules and the mobile industry's longstanding privacy principles.

The renewed focus on data privacy and responsible data governance is an opportunity to create smarter laws, which can help countries take advantage of the huge opportunity that digital transformation offers while also strengthening trust in technology. These should be guided by principles that:

- protect personal data while offering flexibility instead of excessively prescriptive requirements
- align with international data privacy frameworks
- promote cross-border data flows.

If these principles are not adhered to, there is a serious risk that the resulting laws or regulations will end up being too prescriptive, rigid and rapidly outdated. Conversely, laws that are guided by these principles can bring about a win-win situation for all stakeholders and allow organisations to prioritise their resources to achieve effective privacy outcomes while operating and innovating responsibly.

4.2 Effective spectrum policy – meeting future connectivity demand

Positive decisions that help drive the availability of spectrum are crucial for governments and regulators that want to realise high-performance networks and services, particularly for 5G. Making sure the necessary spectrum resources are available at the right time, the right price and under the right conditions helps lower mobile broadband costs, increases coverage and boosts connectivity.

Spectrum availability and timing

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.

Mid-band frequencies have been used as the basis for the first commercial 5G networks all over the world. 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. 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. On average, a total of around 2 GHz of mid-band spectrum will be required for 5G per country by 2030. Countries should develop roadmaps that reflect this growing demand.

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 are typically better options in these situations.

Refarming 2G, 3G and 4G bands can, in time, contribute to meeting future spectrum requirements, but adding new bands will be 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 subject to discussion at WRC-23.

The momentum behind mmWave spectrum is growing. At WRC-19, countries supported a harmonised identification of 26, 40 and 66 GHz for ultra-high-speed and ultra-low-latency consumer, business and government services. As of March 2021, 15 countries around the world had assigned mmWave spectrum to operators, with more countries soon to follow. The first commercial mmWave 5G networks are showing the significant potential these bands have.

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. 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).

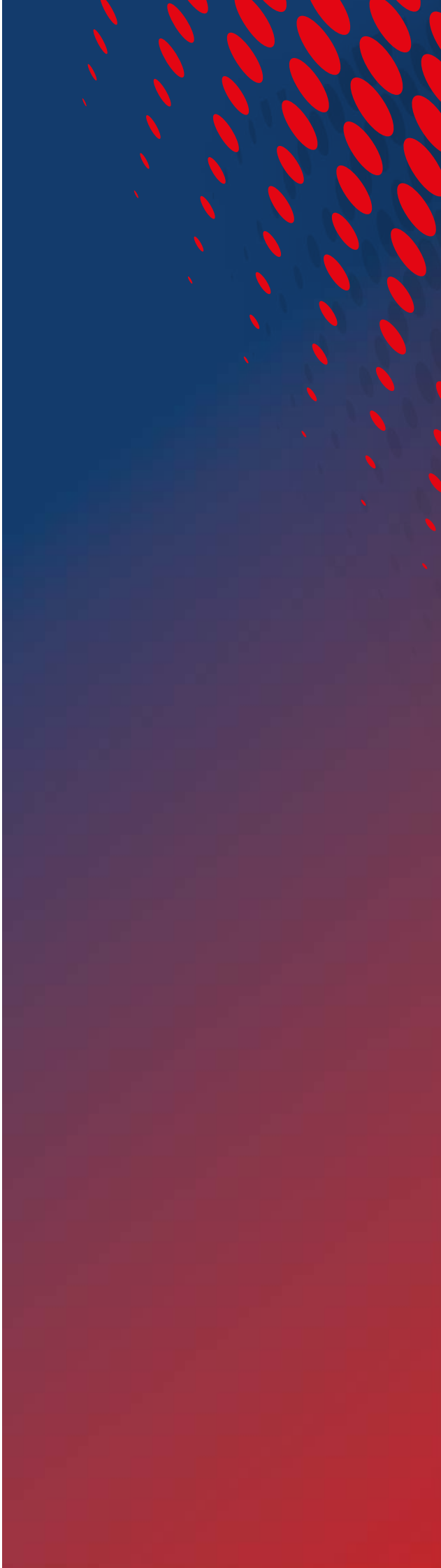
Regulators should apply the right 5G spectrum licence terms and conditions, and carefully consider best practice for awarding spectrum. Additionally, licences should be technology and service neutral to allow the upgrade of existing bands to 5G. Consulting with the industry will help maximise consumer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

The success of 5G services is heavily reliant on national governments and regulators. The speed, reach and quality of these services depend on governments and regulators supporting timely access to the right amount and type of affordable spectrum, under the right conditions. To maximise the benefits of 5G, governments and regulators should:[20]

- 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).

20. 5G Spectrum: GSMA Public Policy Position, GSMA, 2021

gsma.com



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