



The Mobile Economy 2018



The GSMA represents the interests of mobile operators worldwide, uniting nearly 800 operators with more than 300 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and internet companies, as well as organisations in adjacent industry sectors. The GSMA also produces industry-leading events such as Mobile World Congress, Mobile World Congress Shanghai, Mobile World Congress Americas and the Mobile 360 Series of conferences.

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Executive Summary



Mobile industry set to reach major milestones over the period to 2025

Having surpassed 5 billion people connected to mobile services in 2017, the global mobile industry will reach further milestones over the next eight years. The number of unique mobile subscribers will reach 5.9 billion by 2025, equivalent to 71% of the world's population. Growth will be driven by developing countries, particularly India, China, Pakistan, Indonesia and Bangladesh, as well as Sub-Saharan Africa and Latin America.

The speed of growth is slowing though, with most of the developed world approaching saturation. The more significant growth opportunity will lie in mobile internet – a

market that will add 1.75 billion new users over the next eight years, reaching a milestone of 5 billion mobile internet users in 2025.

Mobile internet adoption will increasingly become the key metric by which to measure the reach and value created by the mobile industry, including its contribution to the UN's Sustainable Development Goals (SDGs). It also contributes to developments in the wider digital ecosystem, as mobile internet users are the addressable market for e-commerce, fintech and a range of digitally delivered services and content.



4G takes the lead in 2019, while 5G moves from trials to early commercialisation

In 2019, 4G will become the leading mobile network technology worldwide by number of connections (more than 3 billion) – another major milestone for the mobile industry, about 10 years since the launch of early 4G commercial services. Meanwhile, the mobile industry continues to make progress with 5G, including successful trials around the globe and the approval of the non-standalone 5G new radio specifications in December 2017.

A number of mobile 5G commercial launches are expected over the next three years in North America and major markets across Asia and Europe. China, the US and Japan will be the leading countries by 5G connections in

2025, while Europe as a whole will continue to make progress with 5G deployments. In total, these four economies will account for more than 70% of the 1.2 billion 5G connections expected globally by the end of the forecast period.

By 2025, two thirds of mobile connections (excluding cellular IoT) across the world will operate on high-speed networks, with 4G accounting for 53% of total mobile SIMs and 5G at 14%. To support customer migration and further drive consumer engagement in the digital era, mobile operators will invest \$0.5 trillion in mobile capex worldwide between 2018 and 2020.



Scaling the Internet of Things: 25 billion connections by 2025

The number of Internet of Things (IoT) connections (cellular and non-cellular) will increase more than threefold worldwide between 2017 and 2025, reaching 25 billion. While IoT is rapidly becoming a mainstream technology in some consumer markets such as consumer electronics and smart homes, the industrial IoT segment is still in its infancy – but is set to be the largest source of connections growth going forward. Globally, the industrial connections base will overtake consumer IoT connections in 2023.

Growth in IoT will be driven by a proliferation of uses cases for smart homes, cities, buildings and enterprises, as well as rising investor financing and a supportive ecosystem for innovation. Developments in network connectivity to suit a variety of IoT use cases, led by operators, also play a key role; at the end of 2017, there were 30 commercial deployments of LTE-M and NB-IoT in 20 countries, including the US, China and across Europe. Looking out to 2025, licensed cellular IoT connections will reach 3.1 billion worldwide, or 12% of total IoT connections.



Mobile contributing to economic growth and addressing social challenges

In 2017, mobile technologies and services generated 4.5% of GDP globally, a contribution that amounted to \$3.6 trillion of economic value added. By 2022, this contribution will reach \$4.6 trillion, or 5% of GDP, as countries around the globe increasingly benefit from the improvements in productivity and efficiency brought about by increased take-up of mobile services and M2M/IoT solutions. In 2017, the wider mobile ecosystem also supported a total of 29 million jobs (directly and indirectly) and made a substantial contribution to the funding of the public sector, with almost \$500 billion raised through general taxation and \$25 billion through mobile spectrum auctions.

As well as contributing to economic growth, mobile technology is increasingly used for disaster preparedness and response, and to help address the challenges of access, cost and quality of service in key industries, including healthcare, agriculture, utilities, education and financial services. Two years into the 2030 Agenda for Sustainable Development, the mobile industry is increasing its impact across all the 17 SDGs as a result of wider mobile reach and better networks. There is also growing adoption of mobile-based tools and solutions that aim to spur the digitisation of systems, processes and interactions across a number of industries, especially in low- and middle-income countries. Agriculture and healthcare are notable examples.



Innovation reaching unprecedented levels in a fast-evolving ecosystem

Globally, private equity companies, venture-capital firms and corporates have invested \$1.2 trillion over the last five years to finance tech start-ups and emerging companies in a range of sectors, with an all-time record level of financing in 2017. This continues to support innovation and development in technology areas such as IoT, augmented reality (AR), virtual reality (VR), networks, autonomous vehicles and the wider area of artificial intelligence (AI).

Recent trends and initiatives also show increasing corporate venture capital (CVC) activity among operators in both developed and developing markets, to drive innovation

and in some cases moves into new business lines such as media, content and fintech. Across Asia Pacific and Africa, collaboration between mobile operators and start-ups is gaining momentum as operators have the scale and reach that start-ups lack, while start-ups have the local innovation that operators need. Vodacom, MTN and Orange have successfully collaborated with start-ups in Africa, as have Telenor and Axiata in Asia. To support innovation across verticals and drive positive socioeconomic impacts, the GSMA Ecosystem Accelerator Innovation Fund is rapidly moving to its third round of applications for start-ups.



Artificial intelligence is the next frontier

While the AI industry is currently dominated by the big tech players in the US (Google, Amazon, Apple, Facebook, Microsoft and IBM) as well as the Chinese ‘BAT’ companies (Baidu, Alibaba and Tencent), leading telcos across the world are also increasing their focus on AI. From an operator perspective, the range of AI-based applications is moving beyond chatbots and digital assistants, already launched by a number of telcos across Europe and Asia. There is widespread recognition that AI will be key to future business and digital transformation as well as driving increasingly autonomous and intelligent networks and improving

the customer experience through better understanding of customer behaviour.

As emerging technologies – including AI, IoT and advanced data analytics – converge, 5G could play an enabling role in realising their full potential. For example, IoT will require both more pervasive intelligence and a ubiquitous connectivity layer to allow devices to communicate and to support the provision of data analytics and intelligence on-demand. Looking ahead, we expect this convergence to intensify, with AI increasingly integrated into a growing number of IoT applications and services as well as networks.



Policy and regulation – extending the benefits of the digital age

For nearly three decades, policy and regulatory developments have supported growth in the global mobile industry by creating the conditions that attract investment and enable widespread access to mobile services. However, regulatory reform has struggled to keep pace with the converged, highly dynamic and evolving digital ecosystem. Regulatory and policy objectives are best met by focusing on the services delivered to consumers, rather than the type of company or technology that delivers them. To promote market dynamism,

competition and consumer welfare, prescriptive (ex-ante) regulations should be replaced – where possible – with measurable, performance-based approaches.

As the mobile industry moves into the 5G era, the need for pro-investment, pro-innovation policies and modernised regulatory regimes has never been greater. Streamlined regulation and further policy developments in three main areas – spectrum, infrastructure and economics – are key to realising the full potential of 5G for consumers, societies and industries.

GLOBAL MARKET

Unique mobile subscribers



2017

5.0bn



66% PENETRATION RATE (% of population) 71%

CAGR 2017-25

5.9bn

2.1%

2025

Mobile internet users



43% PENETRATION RATE (% of population)

61%



3.3bn 2017

CAGR 2017-25

5.0bn

5.3%

2025

Smartphones

% of connections*



57% 2017

77% 2025

4G

% of connections*

29% 2017

53% 2025

5G

1.2bn 2025

14% of connections*

*Excluding cellular IoT

SIM connections

Excluding cellular IoT

7.8bn

2017



9.0bn

2025

1.9%

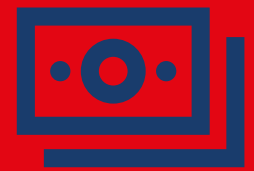
CAGR 2017-25

103% PENETRATION RATE (% of population) 110%

Mobile operator revenue

2017

\$1.05tn



\$1.10tn

2025

Mobile operator capex



\$479bn

2018 — Capex (cumulative) — 2020

Internet of Things



7.5bn

2017

Total connections

25.1bn

2025



Mobile industry contribution to GDP

4.5%

\$3.6tn

2017

5.0%

\$4.6tn

2022

Public funding

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

\$500bn

2017



Employment



Number of jobs directly and indirectly supported by mobile ecosystem

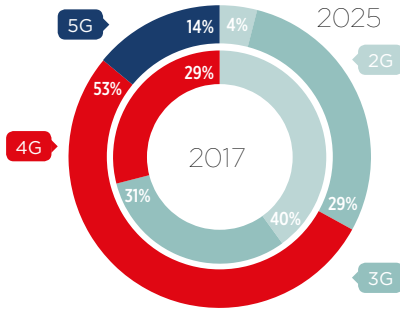
29m

2017

Global



TECHNOLOGY MIX*



SUBSCRIBER PENETRATION



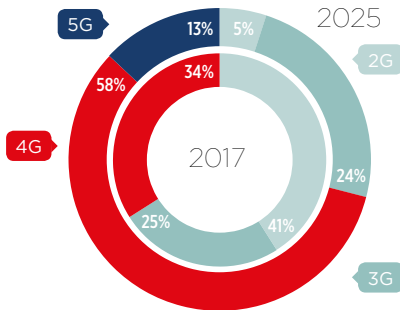
MOBILE INTERNET PENETRATION



Asia Pacific



TECHNOLOGY MIX*



SUBSCRIBER PENETRATION



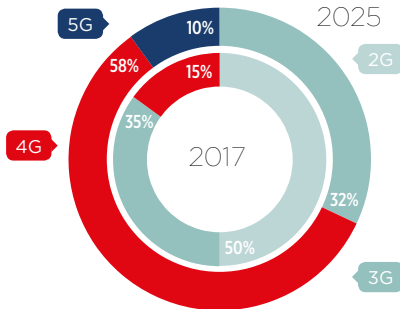
MOBILE INTERNET PENETRATION



CIS



TECHNOLOGY MIX*



SUBSCRIBER PENETRATION



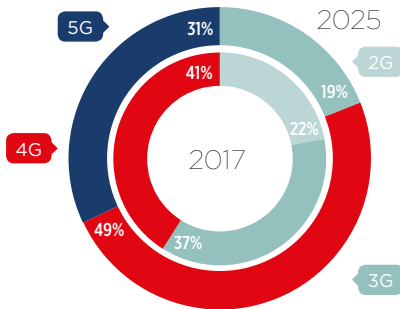
MOBILE INTERNET PENETRATION



Europe



TECHNOLOGY MIX*



SUBSCRIBER PENETRATION



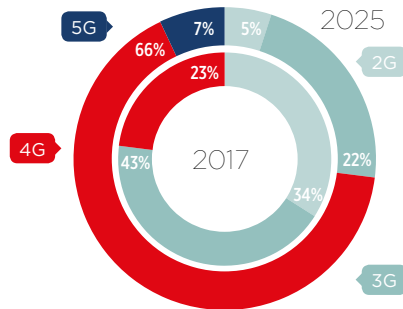
MOBILE INTERNET PENETRATION



Latin America



TECHNOLOGY MIX*



SUBSCRIBER PENETRATION



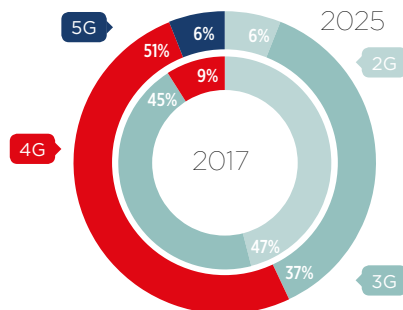
MOBILE INTERNET PENETRATION



MENA



TECHNOLOGY MIX*



SUBSCRIBER PENETRATION



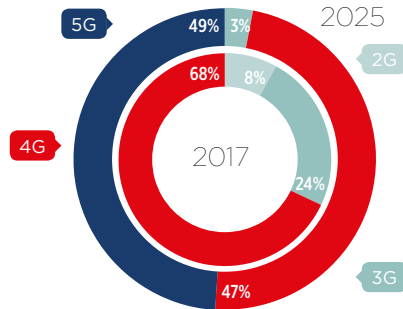
MOBILE INTERNET PENETRATION



North America



TECHNOLOGY MIX*



SUBSCRIBER PENETRATION



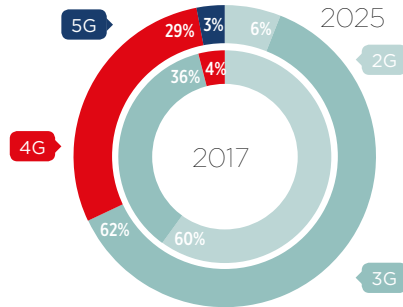
MOBILE INTERNET PENETRATION



Sub-Saharan Africa



TECHNOLOGY MIX*



SUBSCRIBER PENETRATION



MOBILE INTERNET PENETRATION



*% of mobile connections excluding cellular IoT



01

Industry overview

1.1 Mobile industry set to reach major milestones over the period to 2025

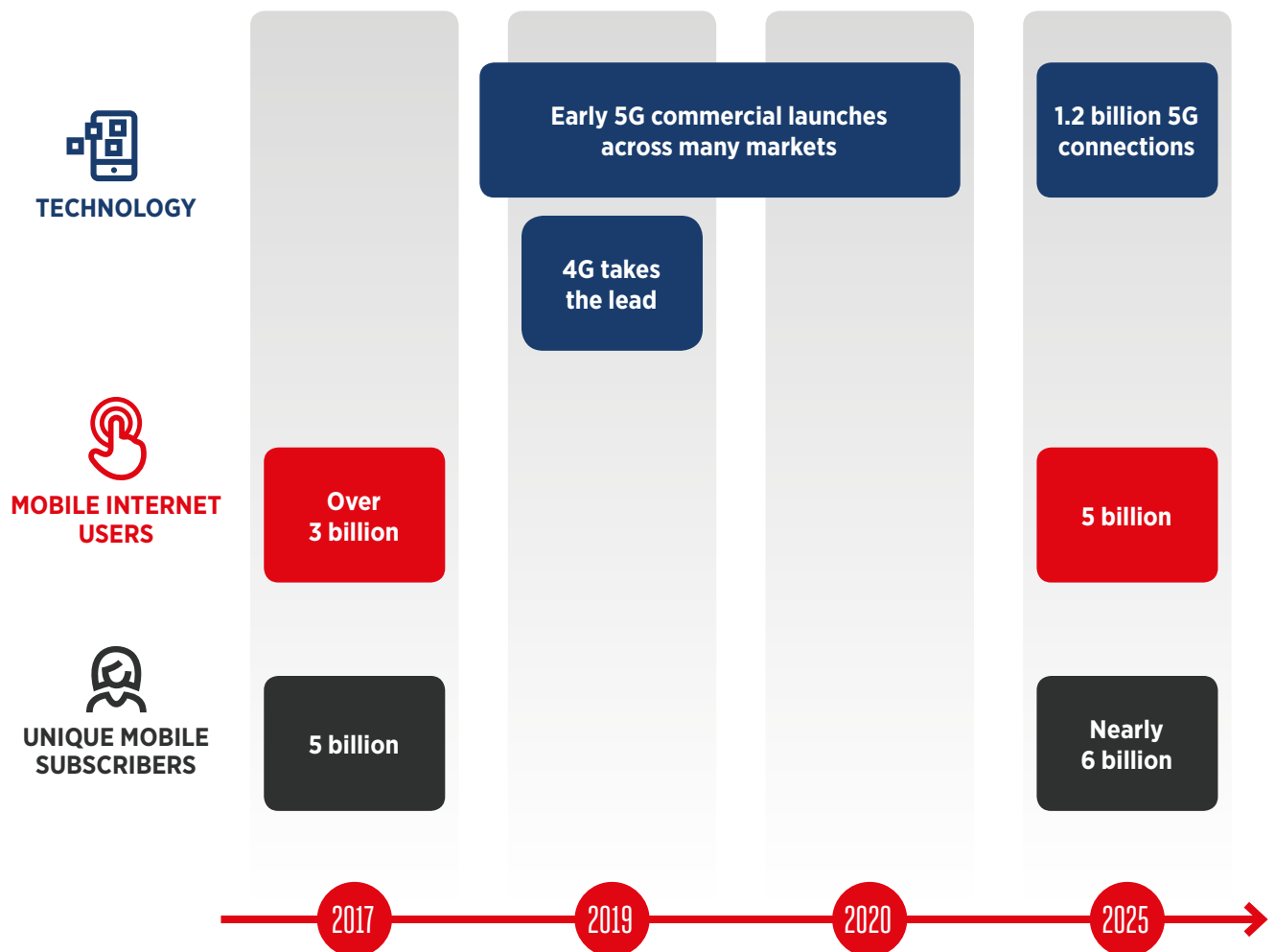
2017 was a milestone year for the mobile industry: the number of people connected to mobile services surpassed 5 billion globally, with 3.7 billion in developing markets. As such, two out of three people in the world had a mobile subscription at

the end of 2017. Looking out to 2025, the mobile industry will reach new major milestones across key indicators – unique subscribers, internet users and 4G/5G connections.

Figure 1

Source: GSMA Intelligence

Major mobile milestones over the period to 2025



1.2 Mobile represents the highest scale consumer tech worldwide

With more than 5 billion unique mobile subscribers at the end of 2017, mobile has a greater reach than any other technology. Growth is slowing though as an increasing number of developed mobile markets are approaching saturation¹; as such, it will take more than eight years to move from 5 to 6 billion mobile subscribers compared to the four years it took to move from 4 to 5 billion. Between 2017 and 2025, India and China will add more than 200 million and 70 million new subscribers respectively, while Sub-Saharan Africa, Latin America and three other major Asian countries (Pakistan, Indonesia and Bangladesh) will generate a total of more than 350 million new subscribers.

In terms of mobile penetration of population, Sub-Saharan Africa will have the largest increase between 2017 and 2025 (8 percentage points),

followed closely by Latin America and Asia Pacific – this will largely be due to growing mobile network coverage in rural areas and increasing affordability of both mobile devices and tariffs.

Mobile subscribers differ from mobile connections such that a unique user can have more than one SIM card. The number of connections excluding cellular IoT totalled 7.8 billion globally in 2017 and will reach 9.0 billion by 2025. There will therefore be three SIM cards for every two subscribers (a SIM ownership ratio of 1.5). In developing countries, the SIM ownership ratio is often higher, especially in Sub-Saharan Africa (1.7), where many consumers use multiple SIMs from different mobile operators, often through dual-SIM handsets, to make use of the best network coverage and call quality in certain locations.

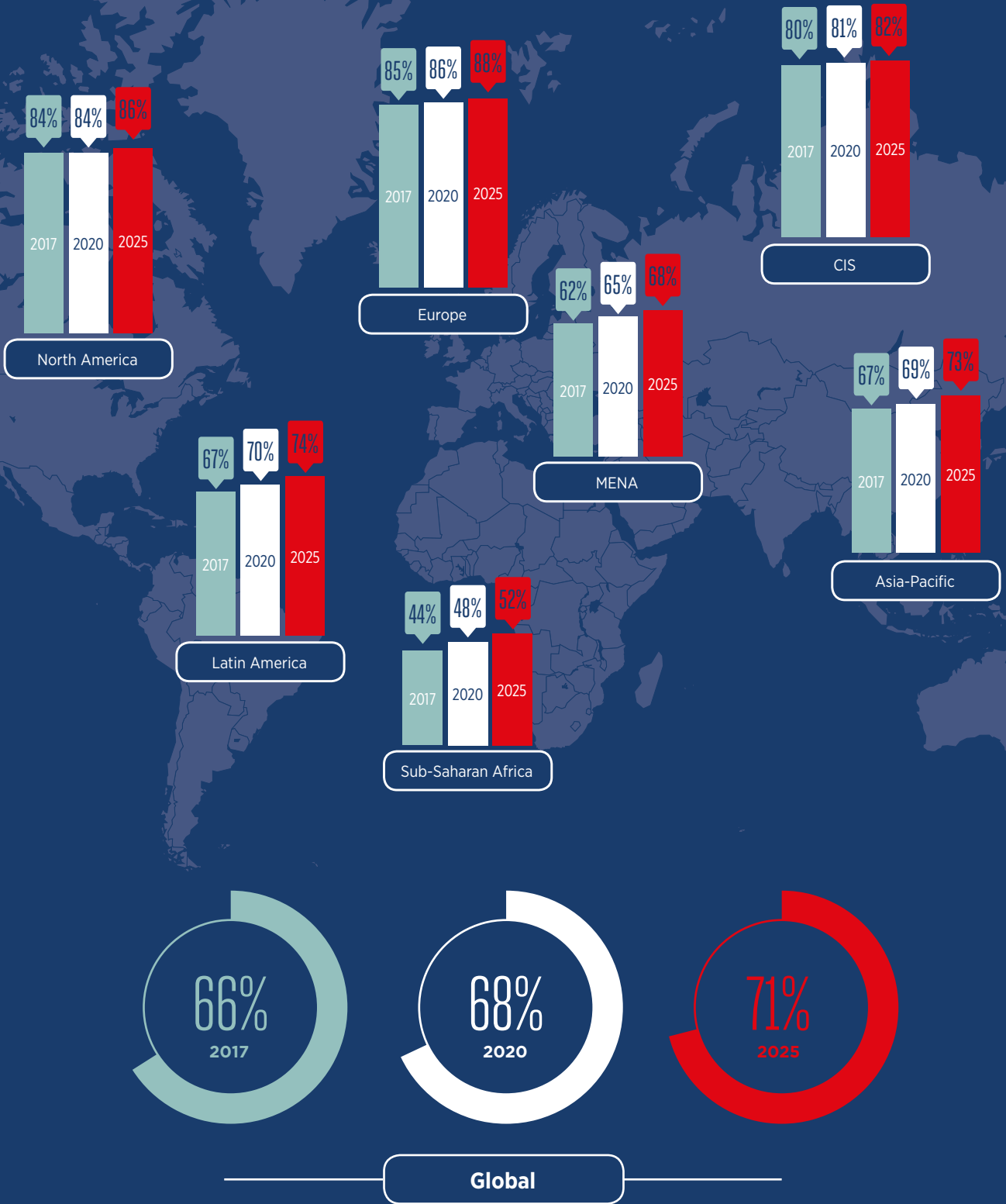
1. By the end of 2017, 30% of the world's mobile markets, including the majority of Europe, Russia, the US and Japan, had exceeded 85% penetration of their addressable market (those aged 5 years and older). As such, future unique subscriber growth in these markets will be closely linked to population growth.

Figure 2

Source: GSMA Intelligence

Unique mobile subscriber penetration

(Percentage of population)



Although the divide in mobile adoption between developed and developing regions will reach its narrowest by 2025, significant differences remain at the country level. For example, among the 10 most populous countries in the world, the gap between

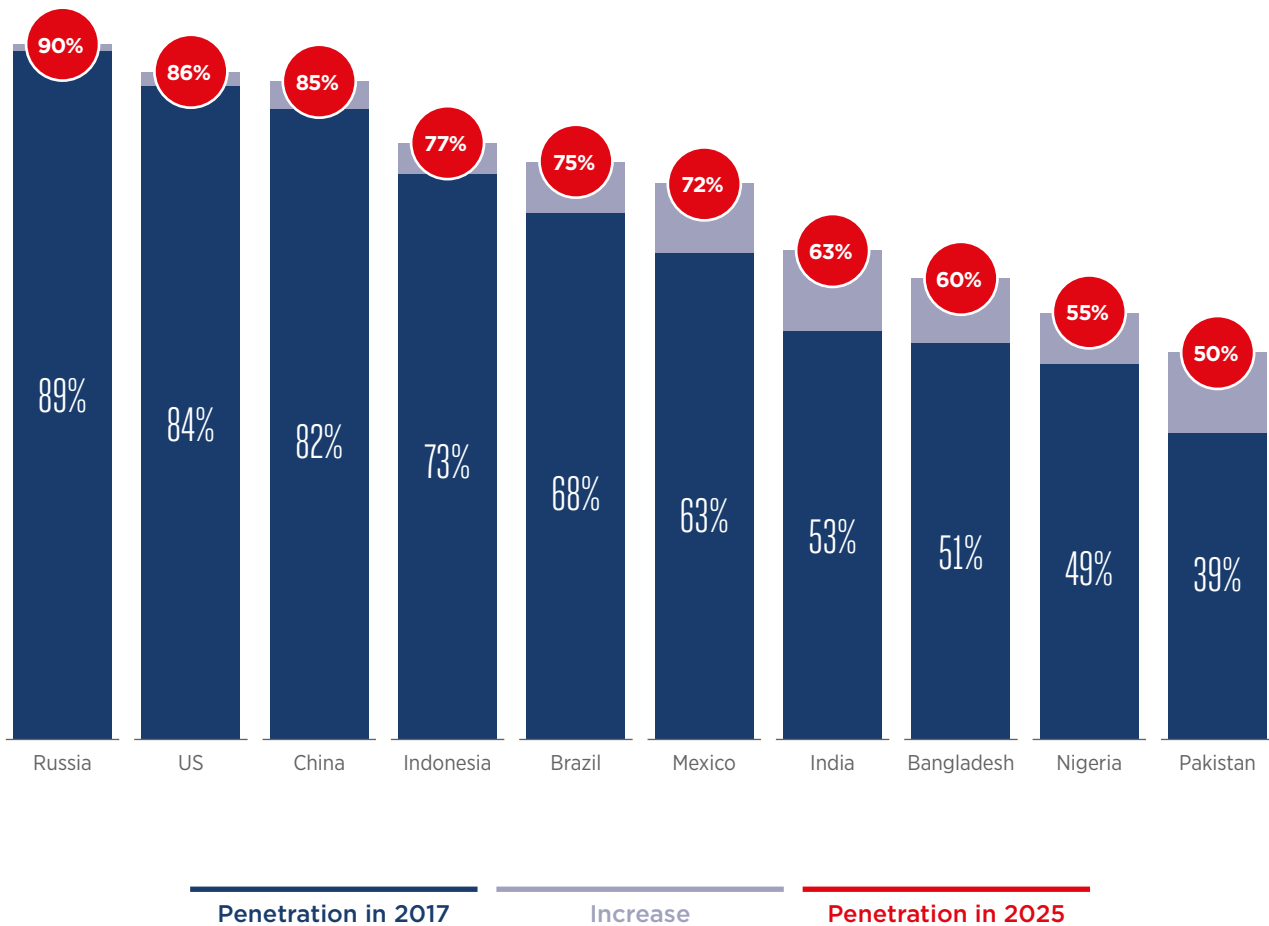
the highest and the lowest unique subscriber penetration will still be about 40 percentage points in 2025. The 10 countries together account for nearly 60% of the global subscriber market.

Figure 3

Source: GSMA Intelligence

Mobile penetration in the 10 largest countries by population

Unique mobile subscribers as a percentage of population



1.3 Mobile internet – new large smartphone markets emerge in the digital era

By 2025, mobile internet penetration will reach 61% of the global population and 86% of unique subscribers. Most of the 1.75 billion increase in the number of mobile internet users between 2017 and 2025 will come from China (around 350 million new users), India (330 million) and Sub-Saharan Africa (280 million). Key drivers of growth include increasing population coverage of 3G and 4G networks, more affordable smartphones and data tariffs, and an increasing willingness among users to consume social media and a range of services and content online.

Smartphone adoption will grow by 20 percentage points globally between 2017 and 2025; by then, three in four mobile connections will operate on smartphones, with the rest on basic/feature phones and data-only devices (e.g. cellular tablets, dongles,

and MiFi routers/hotspots). Smartphones will become the leading handset type in all individual regions by 2020 and almost all individual countries globally by 2025.

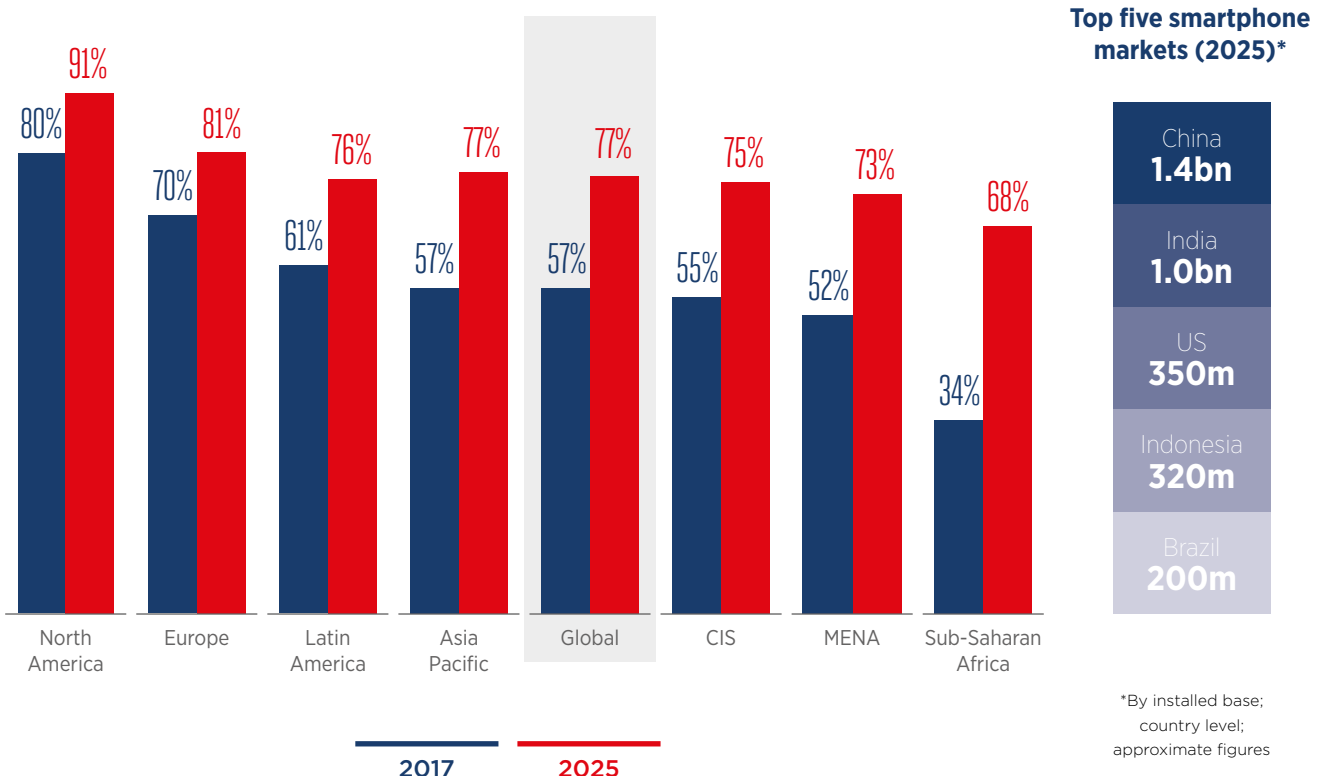
While most developed countries are already highly penetrated, new large mobile internet markets are emerging in the developing world. China overtook the US to become the largest smartphone market by installed base in 2012; four years later, India also overtook the US. Indonesia and Brazil are growing fast too; the number of smartphone connections in Indonesia is approaching that of the US. By 2025, there will be more than 10 markets in the world with over 100 million smartphone connections. These represent major addressable markets for e-commerce, fintech and a range of digitally delivered services and content.

Figure 4

Source: GSMA Intelligence

Smartphone adoption

Smartphones as a percentage of total mobile connections excluding cellular IoT





1.4 Transitioning from the connected consumer to the digital consumer

While more than 3 billion people use mobile internet globally (internet-connected consumers), their digital engagement – measured by the GSMA Global Mobile Engagement Index (GMEI) – varies significantly between countries. On a scale of 0–10, South Korea (6.8), Scandinavian countries (e.g. Finland at 6.7, Sweden at 5.8), Australia (5.5) and the US (5.3) have relatively high mobile engagement scores (2017); many subscribers in these countries use their phones on a regular basis to access not only internet-based messaging and social media but also entertainment content (such as movies, music, games and sports), e-commerce and other digitally delivered services and content (i.e. financial services, health, education, government services). Pakistan, India and Tanzania have the lowest scores (at around 1.0).

A deeper look at the segmentation groups of smartphone users by their mobile engagement pattern reveals that the transition from the connected consumer to the digital consumer

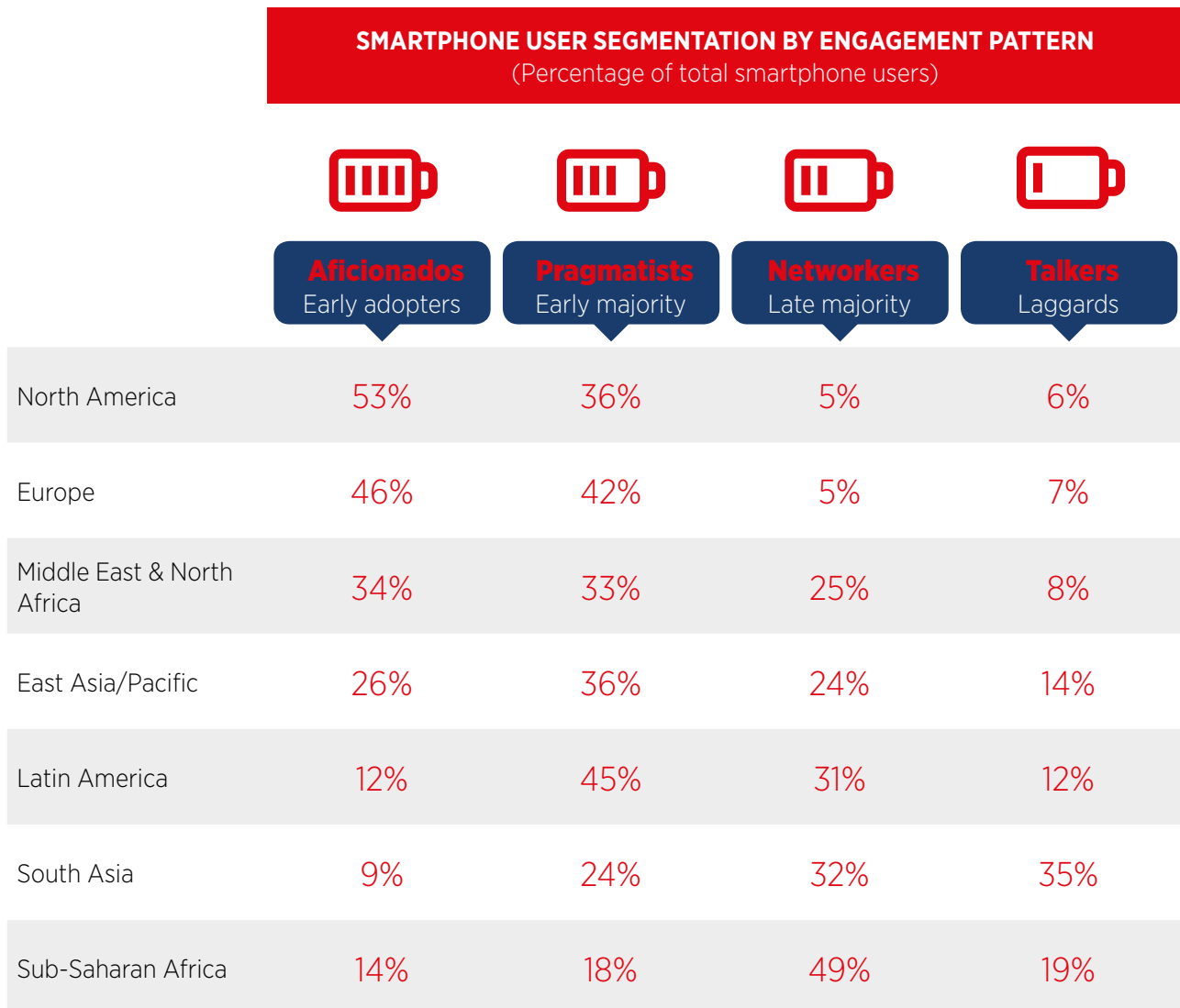
(those who regularly consume digital services and content via their smartphones) has been fastest in some of the most developed and tech-advanced markets such as the US, South Korea, Australia and across Scandinavia. Indeed, the most highly engaged smartphone users ('Aficionados') are predominant in North America, while the least engaged ('Networkers' and 'Talkers') dominate in most developing countries. See Figure 5.

Two major trends will occur over the next decade. In the developing world, smartphone users will gradually transition to higher levels of engagement. In the most developed markets, today's digital consumers will likely become tomorrow's augmented customers in the 5G era; they will increasingly adopt emerging technologies such as augmented reality; virtual reality; technology solutions and applications for smart homes, cities and buildings; and emerging services such as drone delivery, consumer robotics and autonomous cars.

Figure 5

Source: GSMA Global Mobile Engagement Index

Consumer mobile engagement, 2017



Migration to smartphones that operate on high-speed mobile networks, coupled with increasing consumer propensity to engage in the digital world, is driving mobile data traffic up in all regions. According to Ericsson (in its Mobility Report November 2017), global mobile data traffic for all devices will increase eight-fold between 2017 and 2023, reaching 110 exabytes per month. Smartphones will account for close to 95% of total mobile data traffic by 2023.

As video technology continues to evolve (i.e. 4K, 8K, 3D video, 360-degree video) and video-based content is increasingly consumed across all regions and use cases, video will account for around 75% of mobile data traffic worldwide by 2023, up from 55% in 2017 (Ericsson). Newer applications that make content even more immersive and data intensive (such as AR and VR), as well as the future availability of 5G networks, will also be drivers of video traffic growth in the most developed markets.

1.5

4G takes the lead in 2019, while 5G moves from trials to commercialisation

In terms of number of mobile connections, 4G will become the lead mobile network technology in 2019 (at more than 3 billion) and will continue to dominate over the period to 2025. Developing markets are driving overall 4G connections growth. Of the 2.5 billion new 4G connections over the next eight years, 1.1 billion will come from three major markets in Asia (India, China and Indonesia) and a further 1 billion will come from Latin America, Middle East and North Africa, and Sub-Saharan Africa.

Meanwhile, the mobile industry continues to make progress with 5G, with early commercial launches expected over the next three years in North America and in major markets across Asia and Europe. The US will see its first commercial launch in late 2018. The non-standalone 5G new radio (NSA 5G NR) specifications were officially approved in December 2017 as part of a wider plan that targets complete standardisation of the 5G system for both non-standalone and standalone models by mid-2018. A large number of 5G trials are also currently being conducted worldwide using various spectrum bands, especially 3.5 GHz and 26/28 GHz. More than 30 markets are planning to assign spectrum in these two spectrum bands over the next couple of

years. As well as most of Europe, the list of countries includes Australia, China, Hong Kong, India, Japan, South Korea and the US.

While 4G has been driving and enabling the transition from the connected consumer to the digital consumer during 2010–2020, 5G will play a key role in the transition to the augmented consumer in the longer term. Today's digital consumers are the key addressable market for 5G services. Many of these consumers will increasingly adopt a range of technologies that are expected to benefit from the faster speeds and lower latencies promised by 5G. These include advanced video capabilities (i.e. 4K, 8K, 3D video, 360-degree video for sports broadcasting), AR and VR applications for gaming and immersive TV, autonomous cars, and digital services and content for connected stadia and smart cities.

China, the US and Japan will be the leading countries in terms of connections by 2025, while Europe as a whole will continue to make progress with 5G deployment. In total, these four economies will account for more than 70% of the global 5G market in 2025 – nearly 900 million connections in a global market that will reach 1.2 billion.

Fixed wireless

Fixed wireless will be an initial 5G-based use case in the US, with early commercial launches in 2018 following trials in 2017. Verizon will launch in three to five US markets in the second half of 2018. The company is targeting a 20–30% penetration rate in these markets, with an initial focus on the residential space. Verizon plans a broader rollout in 2019 and has indicated that over a three-year period

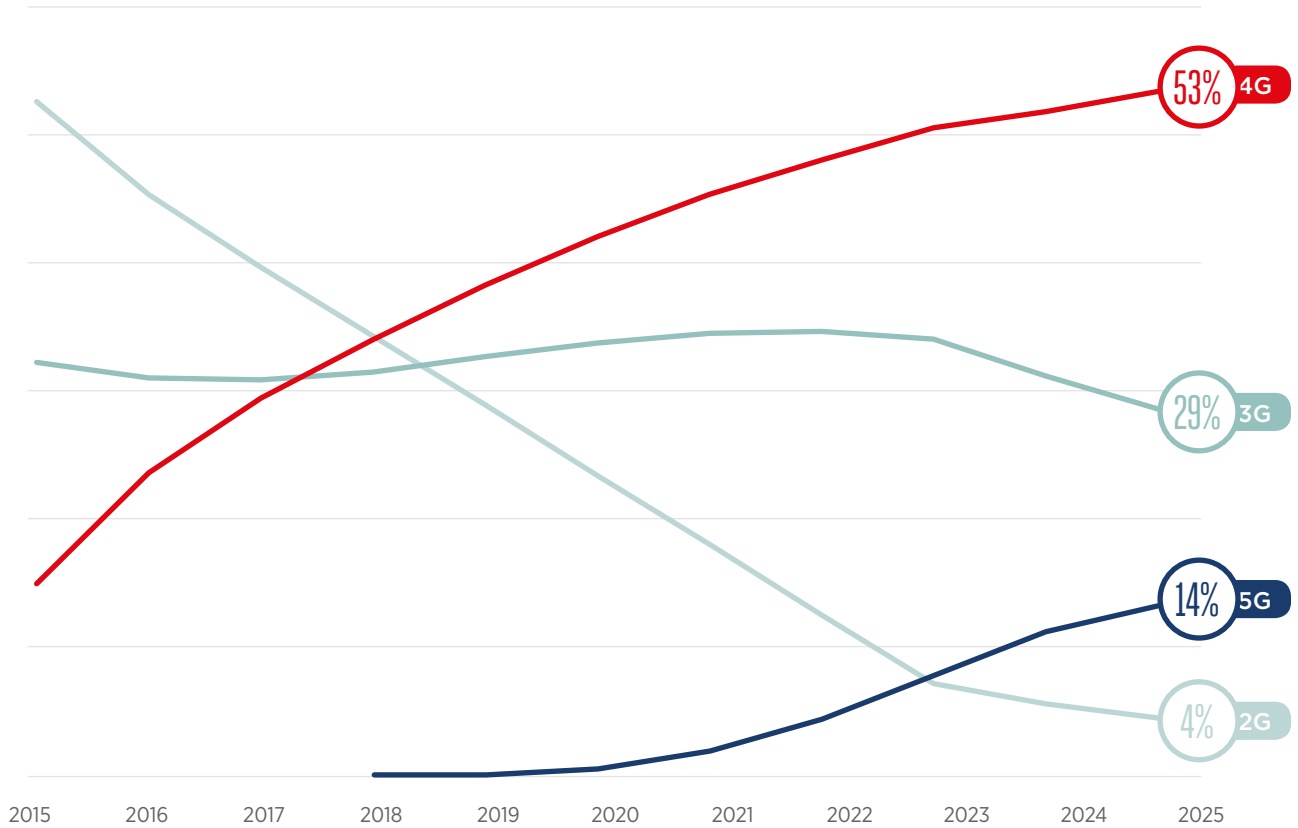
the opportunity expands to around 30 million households outside of its existing fibre footprint. For operators, 5G-based fixed wireless offers a potentially lower cost and faster means – compared to FTTH – of expanding high-speed offerings to households and businesses, bringing the opportunity to gain market share and incremental revenue.

Figure 6

Source: GSMA Intelligence

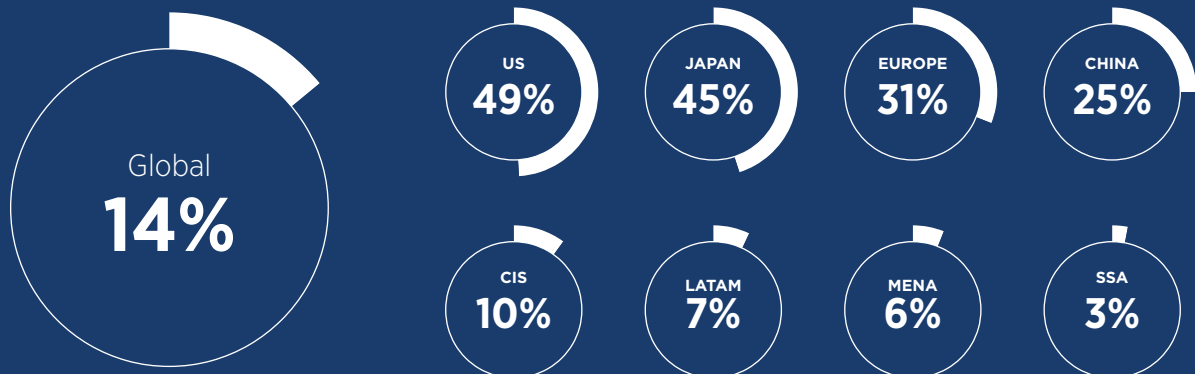
Global mobile adoption by technology

Share of mobile connections, excluding cellular IoT



5G adoption in major countries/regions

(2025, percentage of connections excluding cellular IoT)



1.6 Financial outlook – pressure on traditional mobile revenue, while 5G capex still uncertain

Challenging revenue outlook for traditional mobile services

Slowing unique subscriber growth, regulatory intervention and intense competition continue to put pressure on operators' traditional mobile revenues. Global revenue will grow by around 1% between 2017 and 2020 (CAGR) and will roughly stabilise beyond 2020 at \$1.1 trillion.

China offers the largest revenue growth opportunity for operators. Despite growth slowing, especially beyond 2020, China will account for around 40% of global mobile revenue growth between 2017 and 2025. Three major Chinese mobile operators will grasp this opportunity, while smaller revenue growth in Sub-Saharan Africa, Middle East and North Africa, and Latin America will be spread across a larger number of operators.

In the US, competition has reached unprecedented levels; unlimited plans are now the norm and traditional mobile revenue is under pressure after years of growth. However, despite near-stable revenue going forward, the US will remain the largest mobile market in the world by revenue (\$245 billion in 2025).

Europe's mobile revenue over the period to 2025 will also be roughly stable across the majority of markets. After several consecutive years of mobile revenue declines (since 2008), the European mobile sector is benefitting from a lessening regulatory impact, in-market consolidation, a shift to higher 4G data usage and an improved macro-economic performance across many countries.

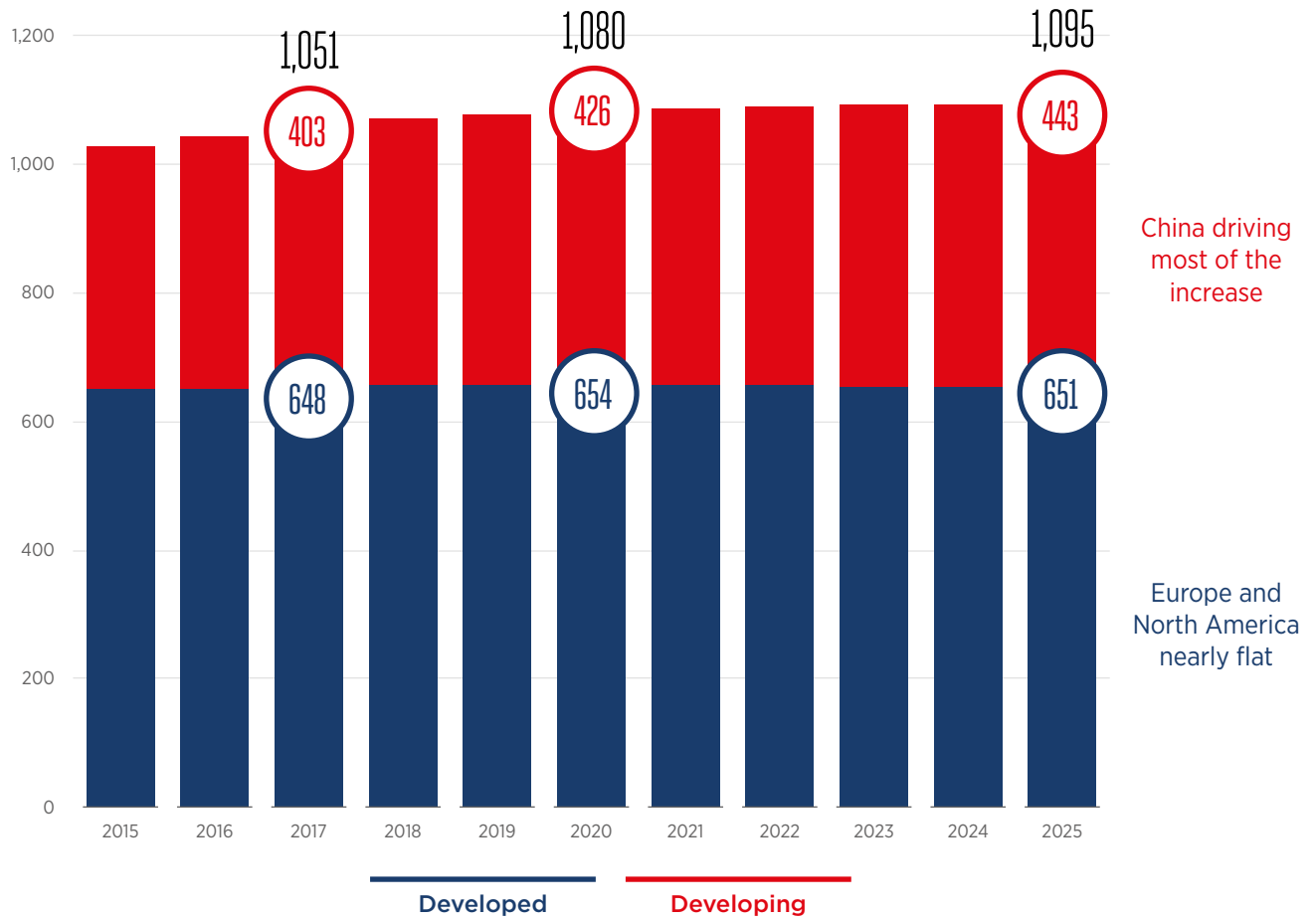
Cross-sector competition is also intensifying in the digital era; taking a share of the consumer wallet is increasingly challenging for companies across the telecoms, media and technology (TMT) ecosystem. Internet-based subscriptions for films and music are growing rapidly, and new devices and technologies are entering the market such as home speakers, AR, VR, and the wider consumer Internet of Things. This adds revenue pressure to the most established streams including mobile and fixed access, smartphones and traditional media content.

Figure 7

Source: GSMA Intelligence

Mobile revenue outlook

\$ billion



Note: totals may not add up due to rounding.



Mobile industry capex has peaked for 4G but 5G to come post-2020

Between 2018 and 2020, mobile operators will invest \$0.5 trillion worldwide in mobile capex, excluding spectrum acquisitions. Some operators in the most developed markets are upgrading their 4G networks to faster speeds and lower latencies, while 5G investment is still in its infancy. In developing countries, many operators are still investing in increasing the coverage and capacity of their 3G and 4G networks.

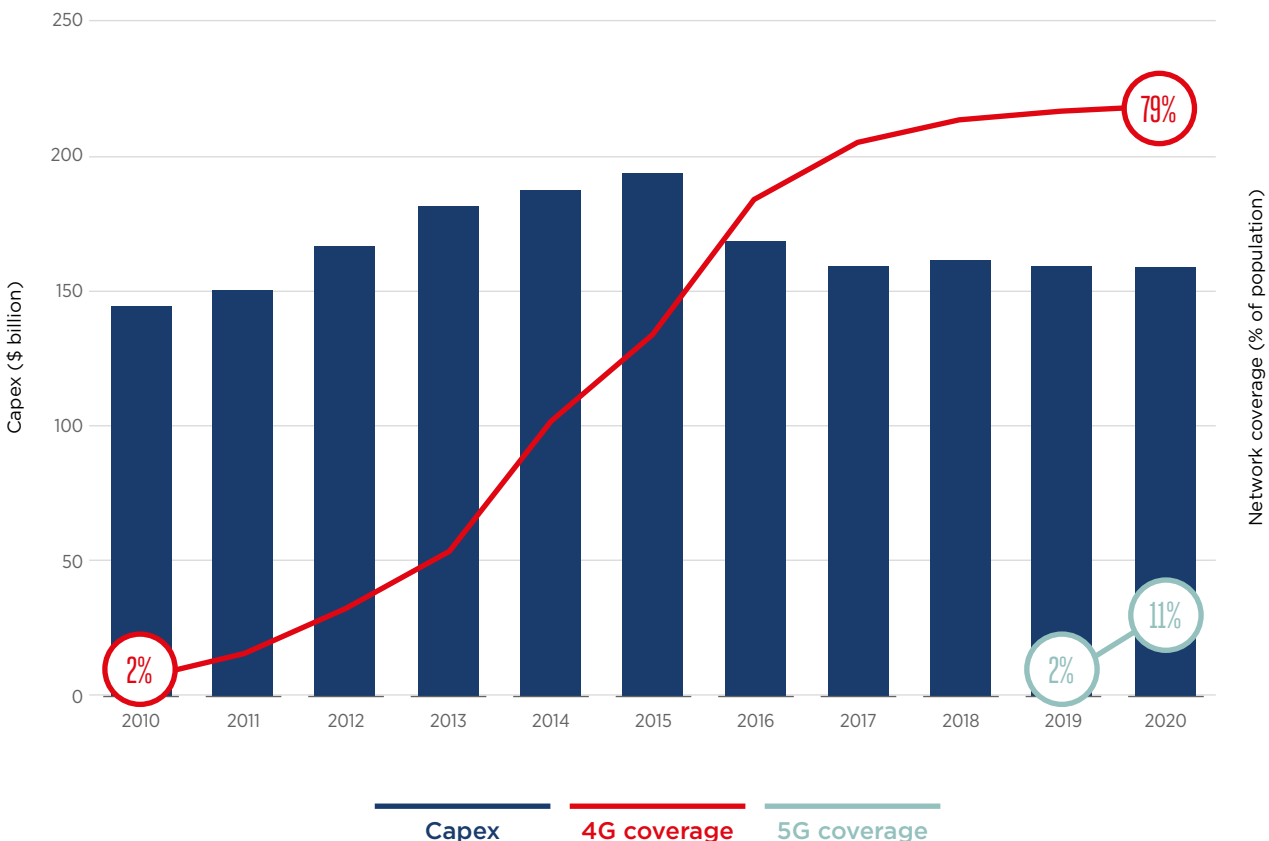
The expansion of 5G to a larger footprint could require incremental capex, above the approximately \$160 billion expected in 2020. As many mobile markets face pressure on traditional mobile revenues, any further capex increase beyond 2020 would push global capex as a percentage of revenue above the 15% expected during 2018–2020.

There is little guidance on 5G operator mobile capex around the globe. Ultimately, it will depend on a number of factors including the model (standalone, non-standalone or phased approach) selected for 5G network deployments, the targeted network coverage, the range of spectrum bands in use, and the availability of fibre infrastructure and nationwide LTE networks. It is also reasonable to assume a gradual rollout path; indications from the Chinese mobile operators are that 5G investment will follow a more gradual route and over a longer period than 4G, roughly seven years, from 2018 to 2025. Japanese operators claim that the deployment of 5G will not lead to any significant spike in capex.

Figure 8

Source: GSMA Intelligence

Global capex and network coverage



1.7

Major operators exploring adjacent businesses in an evolving ecosystem

The largest operators are moving beyond their traditional telco businesses (mobile and fixed) to explore new revenue streams in a fast-changing competitive landscape. While this strategic play has different flavours, timelines and scales, the predominant drivers are the convergence of telecoms and media, the rise of IoT and the evolution of the wider digital ecosystem.

In the US, AT&T is taking a lead position in the Media and Entertainment industry, although its Time Warner bid – which follows that of DirecTV in 2014 – is still subject to regulatory approval. Verizon has also made a number of acquisitions across several areas – digital media and advertising (Yahoo and AOL), IoT (telematics and smart cities) and fibre networks – ahead of the 5G era.

In the IoT space, many European operators such as Telefónica, Orange and Vodafone have IoT-dedicated lines of business that provide solutions across verticals. In November 2017, Vodafone also launched ‘V by Vodafone’ in Germany, Italy, Spain and the UK. This is a consumer-oriented IoT product range that includes tracking solutions for cars, pets

and bags, as well as home security.

Several operators – such as Turkcell in Turkey and SK Telecom, Singtel and NTT DoCoMo in Asia – are also targeting the wider digital consumer space by offering a range of digital services and content including fintech, e-commerce, content, lifestyle, advertising/digital marketing, identity and security solutions. In the fintech market, Orange Bank launched across France in November 2017, offering a full consumer banking service on a mobile-only platform.

While telecoms will continue to be the dominant source of revenue for operators, these new businesses provide new revenue streams, help navigate the IoT learning curve and add business capabilities in the digital space. For example, Turkcell makes nearly 20% of its domestic revenue from digital services, while Smart Life accounts for 10% of NTT DoCoMo’s revenue (both as of Q3 2017). In the US, AT&T makes 26% of its revenue (2017) from DirecTV – this figure could become nearly 40% if the acquisition of Time Warner goes through.

1.8 Scaling the Internet of Things – 25 billion connections by 2025

According to GSMA Intelligence, the number of IoT connections (cellular and non-cellular) will increase more than threefold worldwide between 2017 and 2025, reaching 25 billion. While IoT is rapidly becoming a mainstream technology in consumer markets such as consumer electronics and smart homes, the industrial IoT segment is still in its infancy – but is set to be the largest source of connections growth going forward. Globally, the industrial connections base will overtake consumer IoT connections in 2023.

A number of trends will drive development and growth in the IoT ecosystem over the period to 2025:

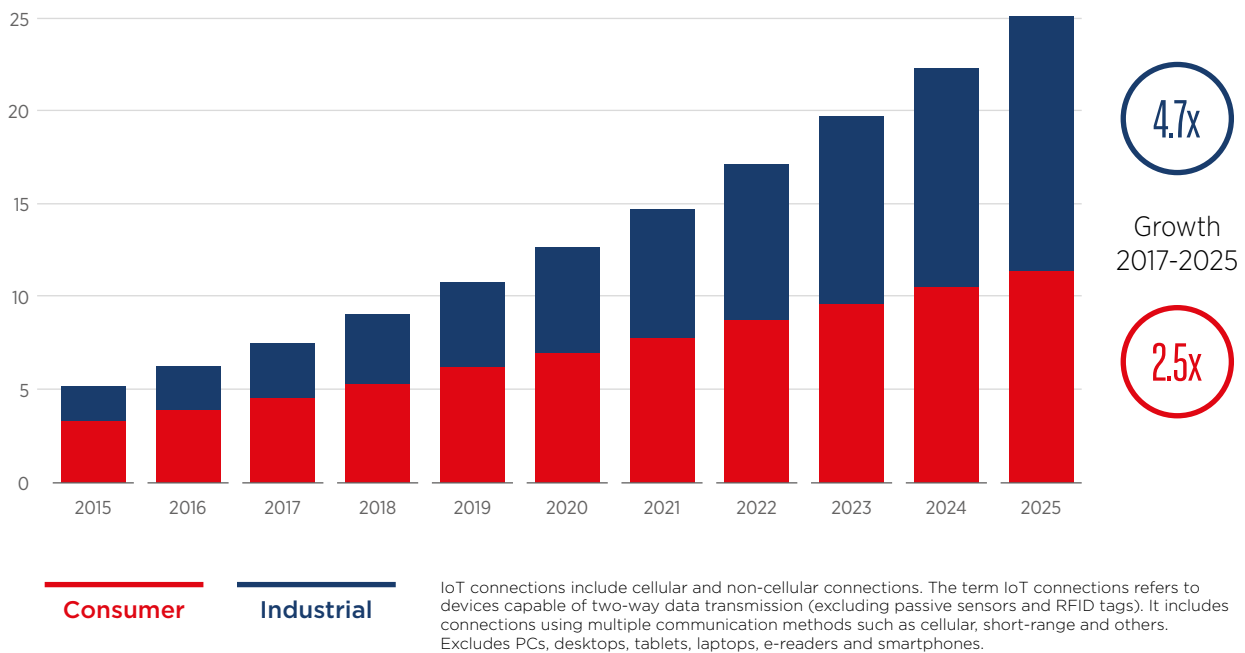
- Funding and innovation** – IoT start-ups are increasingly backed by private investor financing and a supportive ecosystem for innovation. Amazon, Cisco, GE, Google, Intel, Microsoft, Qualcomm and Samsung have invested significant amounts into the developing IoT arena over the last five years. Some of them are also adopting a horizontal business model by establishing their presence across multiple sectors and segments of the IoT value chain. A growing number of companies (such as Sierra Wireless, Gemalto, MobileTEK, Quectel and Telit) commercialise mobile IoT² modules for both LTE-M and NB-IoT, typically supported by software development kits. Some mobile operators and equipment vendors are also establishing open labs to help solution developers test new concepts and certify products.

Figure 9

Source: GSMA Intelligence

IoT connections worldwide

Billions



2. Mobile IoT refers to low power wide area (LPWA) 3GPP standardised secure operator managed IoT networks in licensed spectrum; in particular, LPWA networks designed for IoT applications that are low cost, use low data rates, require long battery lives and often operate in remote and hard to reach locations.

- Development in connectivity to best suit a variety of use cases** – While the majority of IoT devices – typically in indoor environments – will likely be connected by radio technologies designed for short-range connectivity (such as Wi-Fi, Z-Wave and Zigbee), other IoT devices that require wide-area network coverage, coverage on the move, lower latency and ultra-reliability will likely be primarily connected by cellular networks using licensed spectrum. At the end of 2017, there were 30 commercial deployments of LTE-M and NB-IoT across 20 countries, including the US, China and across Europe. Looking out to 2025, licensed cellular IoT connections³ will reach 3.1 billion worldwide, or 12% of total IoT connections.
- Proliferation of use cases across verticals** – The number of industrial IoT connections will grow from 3 billion to almost 14 billion between 2017 and 2025, driven by rising adoption of solutions for smart buildings (for heating, air conditioning, building security, lighting, office equipment and automation), utilities (energy, water & gas smart metering and smart grid solutions) and manufacturing (inventory tracking, monitoring and diagnostics, warehouse management).
- Momentum in smart cities** – Smart city initiatives are on the rise across major metropolitan areas in

the US and in other regions such as China (part of the 13th Five Year Plan), Singapore (Smart Nation), India (100 Smart Cities Mission) and Qatar (2022 FIFA World Cup). Dubai is also taking a lead role in preparation for Dubai Expo 2020; the CEO of the Smart Dubai project announced the ambition for 25% of all journeys in Dubai to be autonomous (i.e. driverless) by 2030.

- The rise of smart homes** – Smart homes are increasingly becoming a platform for a suite of digital services, applications and devices, and will be the largest source of growth within the consumer segment. Connections will grow threefold to more than 5 billion by 2025, driven by home security, thermostats for energy monitoring, and enabling infrastructure such as routers and extenders.

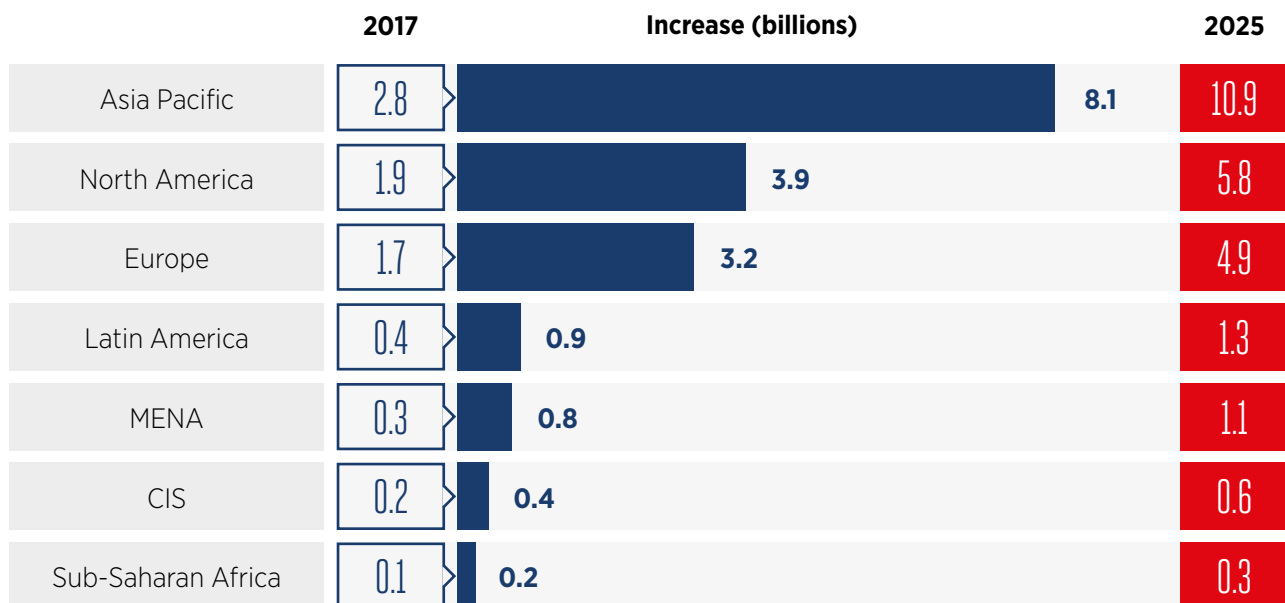
Asia Pacific will continue to be the largest regional IoT market by number of connections. In terms of growth, nearly 90% of all IoT net additions between 2017 and 2025 will be in Asia Pacific, North America and Europe. Developing markets will lag behind in growth and scale due to lower affordability among consumers and enterprises, and a less developed ecosystem and environment for innovation and technology deployment.

Figure 10

Source: GSMA Intelligence

IoT connections and growth by region

Billions



3. Licensed cellular IoT refers to cellular M2M (2G/3G/4G/5G) and mobile IoT (NB-IoT/LTE-M)

02

Mobile contributing to economic growth and addressing social challenges

2.1 Mobile contribution to economic growth, employment and public funding

The direct economic contribution of the mobile ecosystem

The mobile ecosystem consists of mobile operators; infrastructure providers; retailers and distributors of mobile products and services; mobile device manufacturers; and mobile content, application and service providers. The direct economic contribution to GDP of these firms is estimated by measuring their value added to the economy, including

employee compensation, business operating surplus and taxes.

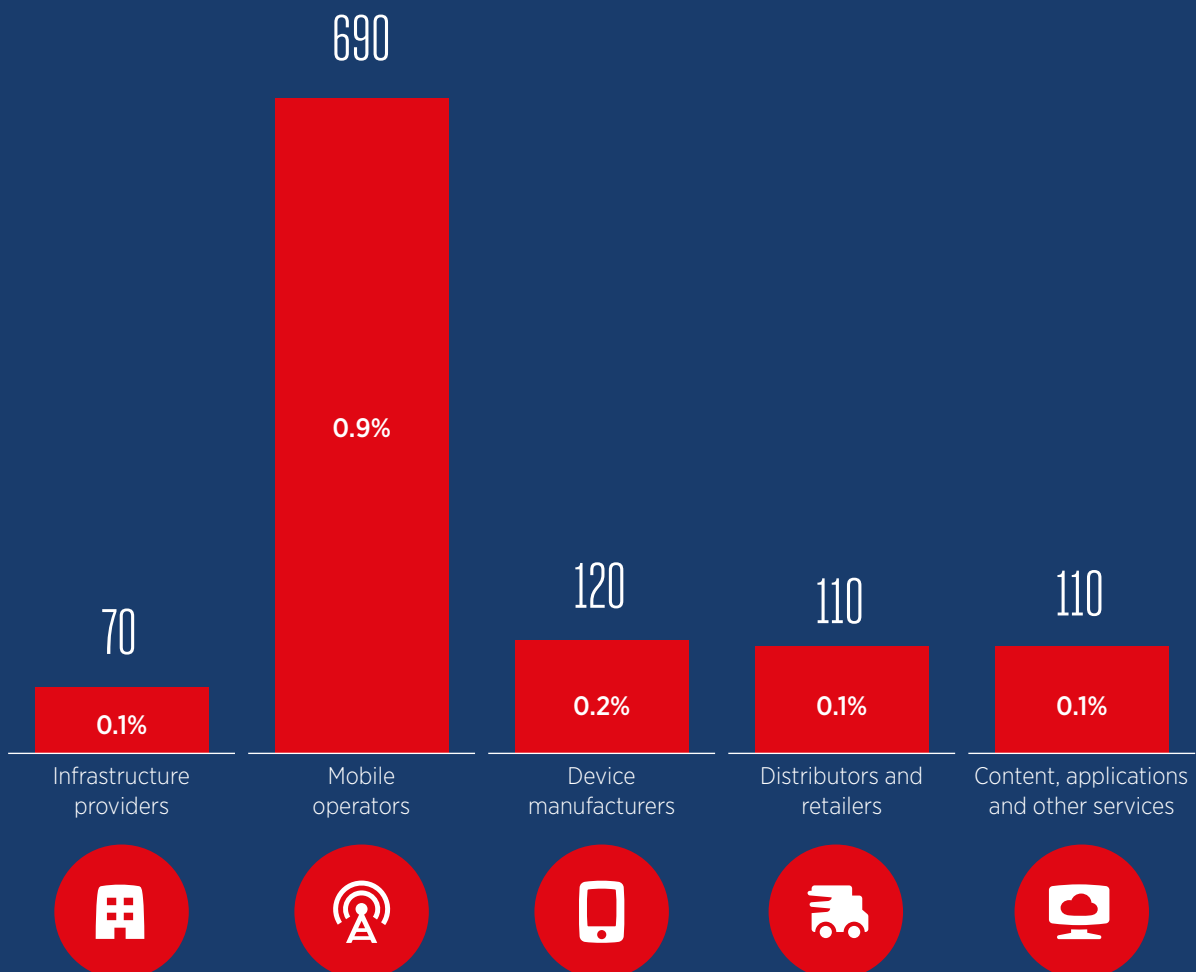
In 2017, the total value added generated by the global mobile ecosystem was \$1.1 trillion (or 1.4% of GDP), with mobile operators accounting for more than 60% of this.

Figure 11

Source: GSMA Intelligence

Direct contribution of the mobile ecosystem to GDP

\$ billion, % 2017 GDP



Indirect and productivity impacts of mobile technology

In addition to their direct economic contribution, firms in the mobile ecosystem purchase inputs from their providers in the supply chain. For example, device manufacturers purchase inputs from microchip providers, and mobile content providers require services from the broader IT sector. Furthermore, some of the profits and earnings generated by the mobile ecosystem are spent on other goods and services, stimulating further economic activity in those sectors. We estimate that in 2017, this additional economic activity generated a further \$490 billion in value added globally (or 0.6% of GDP).

The use of mobile technology also drives improvements in productivity and efficiency for workers and firms. Different types of mobile technology have their own impact on the productivity of the global economy:

- Mobile voice and text services allow workers and firms to **communicate more efficiently and effectively** (by reducing unproductive travel time, for example).

- 3G and 4G technology allow workers and firms to use mobile data and internet services. This **improves access to information and services**, which in turn drives efficiency in business processes across many industries, including finance and health. The impact of mobile internet is particularly significant in developing countries, where fixed infrastructure is poor and mostly confined to large cities and business/industrial districts.
- M2M and IoT allow for the **digitisation of services and improvement of industrial processes**. As these technologies become increasingly adopted, we expect them to create significant benefits by driving cost savings and operational efficiency gains in areas such as manufacturing, logistics and retail.

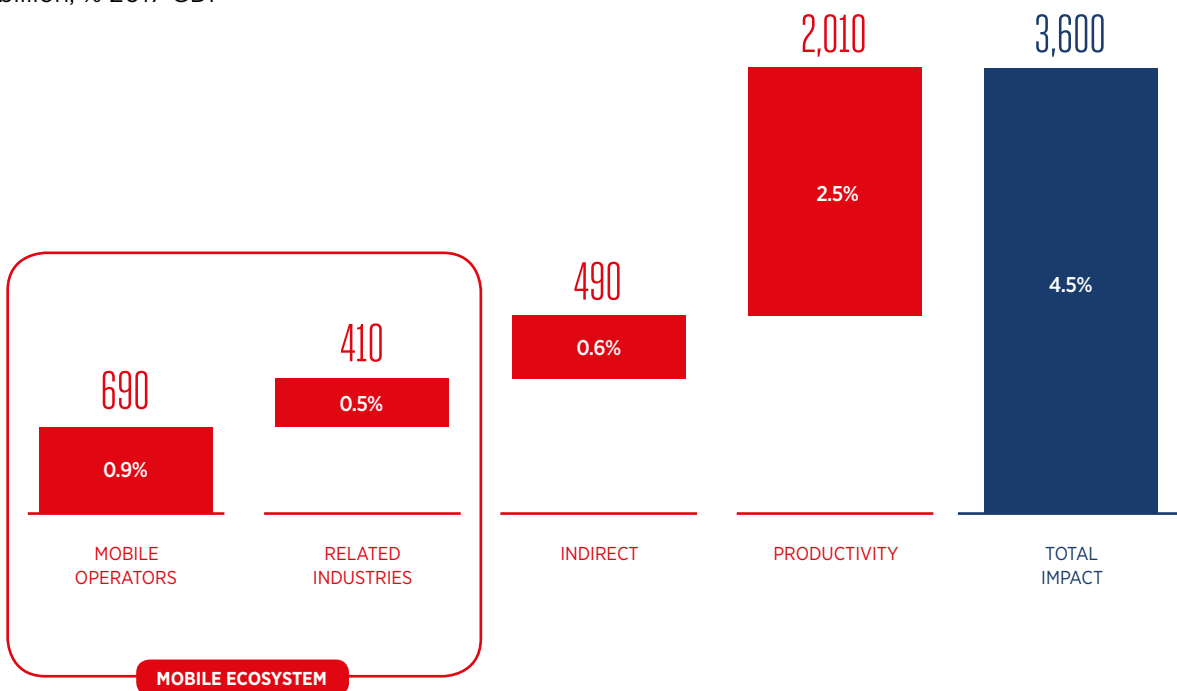
Together, these productivity impacts generated \$2 trillion in value added in 2017 (or 2.5% of GDP). Overall, taking into account the direct, indirect and productivity impacts, in 2017 the mobile industry made a total contribution of \$3.6 trillion in value-added terms, equivalent to 4.5% of global GDP.

Figure 12

Source: GSMA Intelligence

Total (direct, indirect and productivity) contribution to GDP

\$ billion, % 2017 GDP



Note: totals may not add up due to rounding.

Employment

In 2017, mobile operators and the wider mobile ecosystem provided direct employment to almost 12 million people across the world. In addition to this, economic activity in the ecosystem generated jobs in other sectors. Firms that provide goods and services as production inputs for the mobile ecosystem (for example, microchips or transport services) will employ more workers as a result of the demand generated by the mobile

sector. Furthermore, the wages, public funding contributions and profits paid by the mobile industry are spent in other sectors, which provide additional jobs.

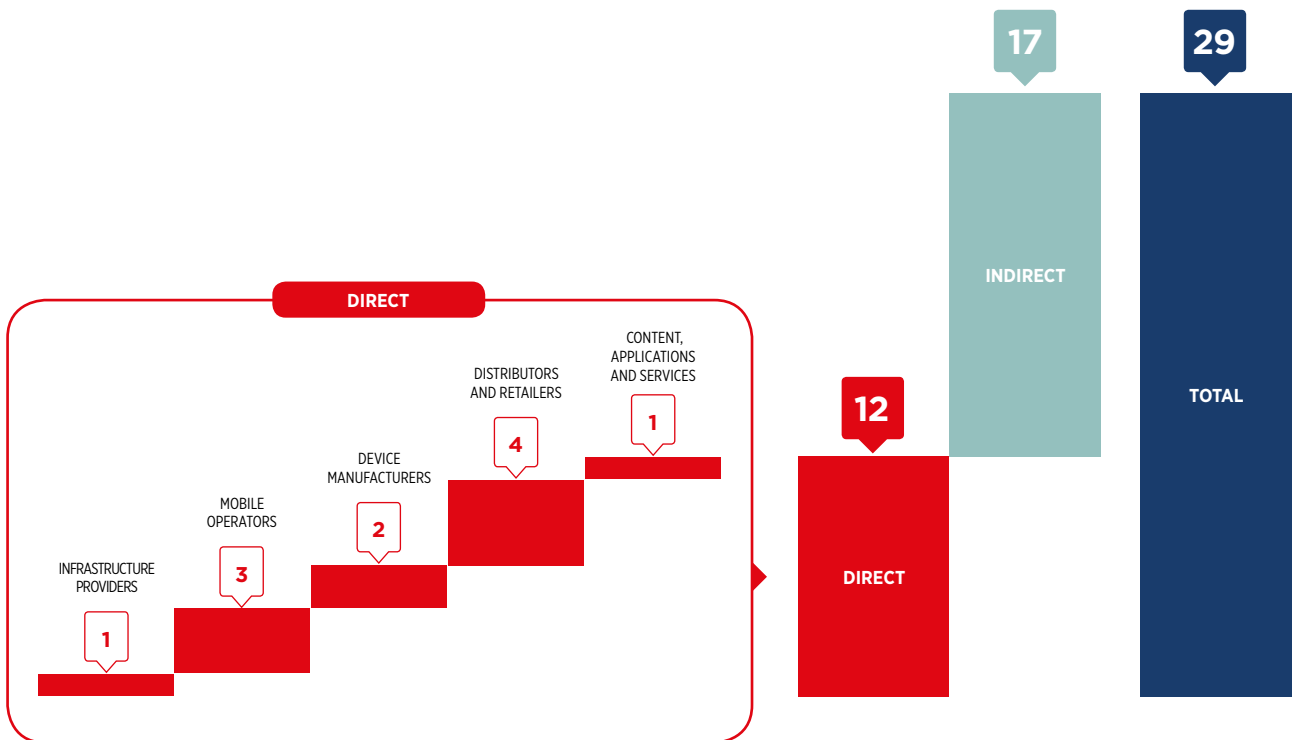
We estimate that in 2017, around 17 million additional jobs were indirectly supported in this way, bringing the total impact (both direct and indirect) of the mobile industry to 29 million jobs.

Figure 13

Source: GSMA Intelligence analysis

Employment impact

Jobs (million), 2017



Note: totals may not add up due to rounding.

Public funding contribution

The mobile ecosystem also makes a significant contribution to the funding of the public sector through general taxation. In most countries, this includes value-added tax or sales tax, corporation tax, income tax and social security from the

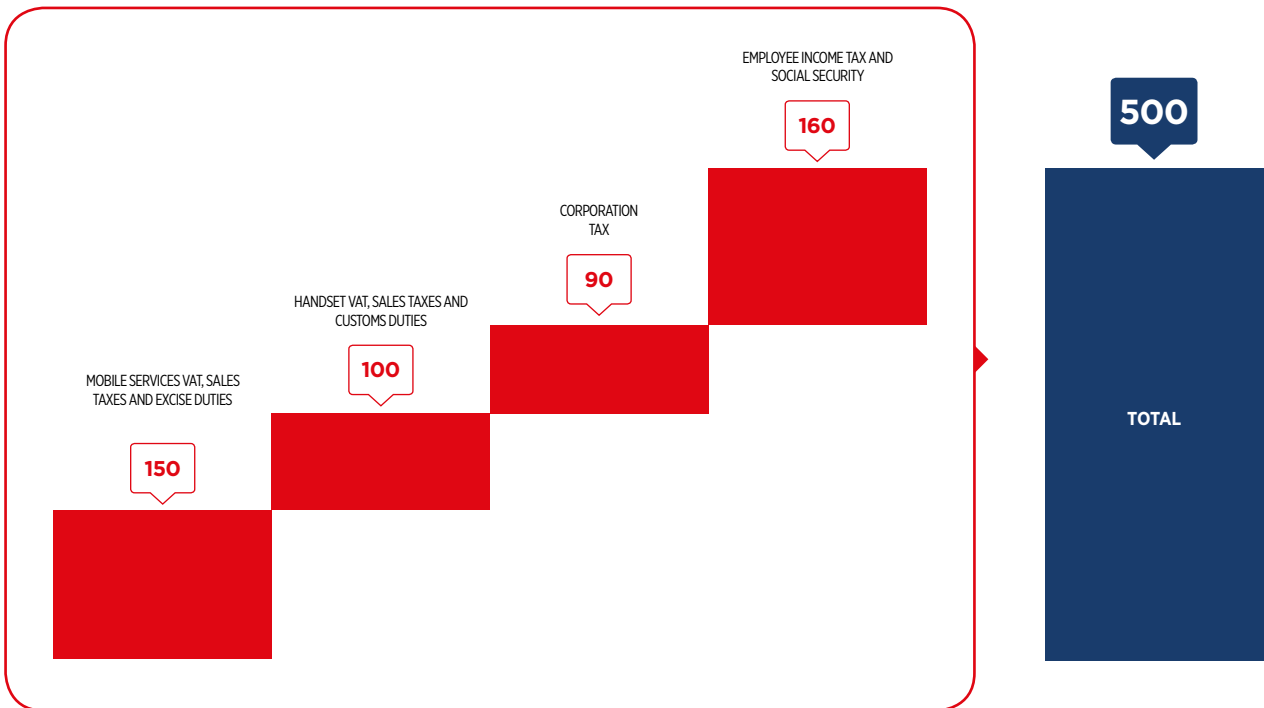
contributions of firms and employees. We estimate that the ecosystem made a tax contribution to the public finances of governments of \$500 billion in 2017.

Figure 14

Source: GSMA Intelligence analysis

Contribution to public funding by the mobile industry

\$ billion, 2017



Note: totals may not add up due to rounding.

Besides the public funding contributions through general taxation, mobile operators made contributions via two additional channels. In 2017, revenues gained from the auction of spectrum for mobile services totalled approximately \$25 billion, with more than three quarters of this (\$19

billion) raised in the 600 MHz auction in the US. Additionally, in some countries, mobile operators are subject to sector-specific taxes such as revenue share taxes, universal service obligation fund contributions, SIM and airtime voucher taxes or annual spectrum fees.

Outlook and trends for the next five years

We expect the global economic contribution of the mobile ecosystem to continue to increase in both relative and absolute terms. In value-added terms, we estimate that mobile will contribute \$4.6 trillion to the global economy by 2022 (5% of GDP), up from \$3.6 trillion in 2017 (4.5% of GDP).

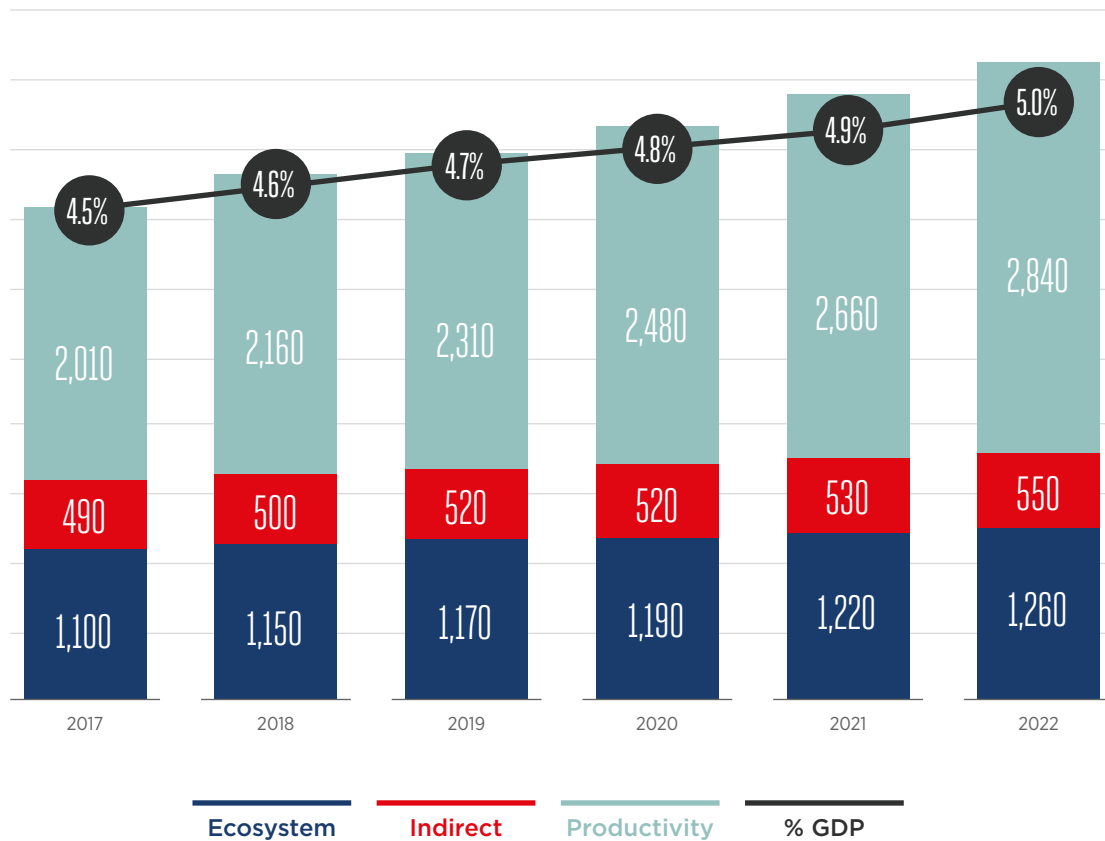
Most of this value-added increase will be due to productivity gains. In the developed world, the adoption of M2M and IoT solutions will drive increased productivity. In developing countries, productivity growth will be mostly driven by the adoption of mobile internet services.

Figure 15

Source: GSMA Intelligence analysis

Outlook to 2022, value added

\$ billion, % of GDP



Note: totals may not add up due to rounding.



2.2

The growing impact of mobile on the Sustainable Development Goals

At Mobile World Congress 2016 in Barcelona, the mobile industry became the first sector to commit as a whole to the Sustainable Development Goals (SDGs) – a universal plan unanimously adopted in 2015 by all 193 countries in the United Nations General Assembly to end poverty, protect the planet and ensure that all people enjoy peace and prosperity.

Two years into the 2030 Agenda for Sustainable Development, the mobile industry is having an important impact, demonstrated by its growing contribution across all 17 SDGs.⁴ The greatest upward movements between 2015 and 2016 were in SDG 3 – Good Health and Well-being, SDG 11 – Sustainable Cities and Communities, and SDG 13 – Climate Action. Of these, two (SDG 13 and 11) are also the SDGs to which the industry is contributing the most (2016 score), along with SDG 9 – Industry, Innovation and Infrastructure.

While operators contribute to each SDG in different ways, three major underlying trends explain much of the improvement in the industry’s impact across all the SDGs between 2015 and 2016:



Better networks

Mobile operators have invested heavily in mobile broadband network infrastructure. Between 2015 and 2016, 4G population coverage grew from 48% to 66% of the world’s population. Including 3G, mobile broadband network coverage reached 83% (2016). In addition to providing wider access to mobile and mobile broadband services, improved network quality and resilience play a critical role before and during epidemics, conflicts and natural or climate-related disasters. They support emergency communication and broadcast services and provide accurate and timely information on the movement of affected populations.



More connectivity

Operators continue to connect the unconnected and drive development in the cellular M2M space. The economic and social benefits of this are wide-ranging, with connectivity driving improvements in economic growth through improved productivity, infrastructure development and efficiency. Operators have been particularly proactive in pursuing more innovative solutions to roll out mobile networks in remote areas; making mobile services more affordable to the poorest individuals; and driving efforts to accelerate digital inclusion for women.



Doing more with mobile

Connected consumers are increasingly engaged in the digital world and consume a range of mobile-enabled services for education, agriculture, health, finance and utilities. Looking at the drivers of SDG score improvement between 2015 and 2016, in 2016 more than 100 million new mobile money accounts were registered to reach a total of more than 0.5 billion, allowing users to access financial services that enable them to make investments and manage expenses. There were also 500 million new users of social media on mobile to reach a total of 2.5 billion, helping promote social and political inclusion and facilitating the development of education networks.

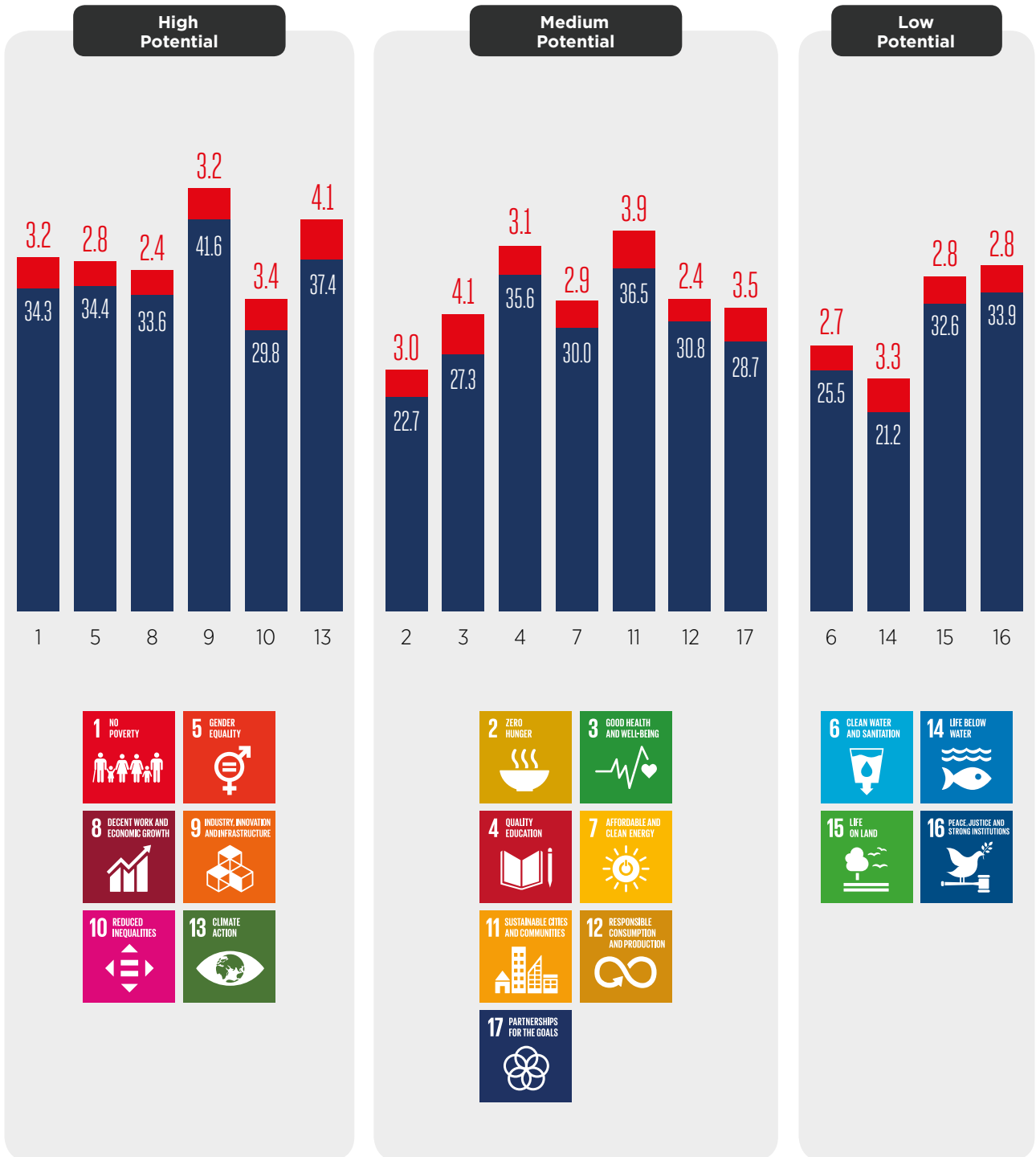
4. 2017 Mobile Industry Impact Report: Sustainable Development Goals, GSMA, 2017

Figure 16

Source: GSMA Intelligence

SDG impact scores

Normalised score (out of 100)



2015 Impact score 2016 Improvement

Moving forward – key challenges and initiatives

Although the mobile industry is delivering substantial achievements and its impact is growing across all SDGs, it is still far from realising its full potential impact. On a scale of 0–100 (where a score of zero means no impact at all and a score of 100 means the industry is doing everything possible to influence that SDG), SDG 9 – Industry, Innovation and Infrastructure had the highest score in 2016 at nearly 45, followed by SDG 13 – Climate Action and SDG 11 – Sustainable Cities and Communities, both at just over 40. The overall impact remains lowest for SDGs 14 – Life below Water, 2 – Zero Hunger, and 6 – Clean Water and Sanitation.

Mobile operators, working with the broader mobile ecosystem, still have much to do to contribute to achieving the SDGs. This includes working towards universal access, scaling up new solutions such as IoT, and helping to fill gaps in areas such as health, education, finance and utilities through the development of mobile-enabled solutions. Only when this has been achieved will operators be able

to maximise their impact across all the SDGs.

The GSMA – in collaboration with operators – has made several commitments and is working on a number of initiatives to grow the mobile industry's impact. See Figure 17. During 2018, the GSMA will focus on delivering these commitments. In September 2017, the GSMA also launched a new global campaign – Case For Change – that will put the spotlight on the work of the mobile industry to help achieve the SDGs and, in doing so, connect everyone and everything to a better future.

Meanwhile, the GSMA and the mobile industry will continue to report on its progress each year and will continue to develop and improve the evidence used to track operators' impact on the SDGs. With this framework in place, both the industry and the international community will be able to understand the impact, progress, challenges and ultimately action needed for the mobile industry to harness its full potential to achieve the SDGs.



Figure 17

Source: GSMA

GSMA initiatives to grow mobile industry impact on SDGs



2.3

Disaster response and the central role of mobile technology

From Nepal's 2015 earthquake to the recent unprecedented hurricanes in the Caribbean, mobile technology is being used to support preparedness and response activities and to maintain dignity for those impacted by natural and man-made disasters. There are a growing number of examples of mobile technology being used in innovative ways in disaster and humanitarian preparedness and response as well as helping people after natural events – from 'super base stations' to innovative connectivity provision for displaced populations, humanitarian call centres and digitised response activities, to country-wide early warning systems.

New technology-enabled services have supported communities and increased resilience around the world. As natural and man-made disasters increase in their frequency and impact, so the number of people requiring help is growing. More than 90 million people across the world will have needed assistance over the course of 2017, with the number of displaced people exceeding 65 million and growing every day.

In response to the growing challenge, mobile operators, humanitarian organisations and innovation labs around the globe are exploring the potential role of mobile technology in disaster preparedness and response. The GSMA recently launched the Disaster Response Innovation Fund providing an opportunity to unite these efforts, linking initiatives which have mutual goals and bringing their innovative ideas to life.⁵

It is essential that both the mobile industry and the humanitarian sector continue to innovate in order to improve their capacity to deal with crises, and ensure that the needs of affected populations can be met. While great strides are being made in the development of innovative services and solutions, no single sector can tackle the scale of the challenges alone. The Disaster Response Innovation Fund will support collaboration that has the potential to enhance or transform preparedness and response activities and improve the delivery of dignified aid.

Humanitarian payment digitisation in Northern Uganda

Uganda is the largest recipient of fleeing migrants in Africa, with daily new arrivals of refugees averaging nearly 3,000 in March 2017. In less than a year, the refugee population in Uganda doubled to more than 1.3 million, largely as a result of the deteriorating situation in South Sudan. The Bidi Bidi refugee settlement in Yumbe is now the largest refugee settlement in the world, hosting more than 280,000 refugees.

In Northern Uganda, the mobile industry and humanitarian sector have collaborated to deliver humanitarian assistance to refugees via mobile money. Such partnerships are a first for mobile operators in Uganda who are rapidly developing their mobile money services to meet the needs of their humanitarian partners, allowing NGOs to deliver humanitarian cash transfers to refugees. Leveraging mobile money for such transfers can reduce logistical costs, give refugees greater dignity and choice, and offer the potential for financial inclusion.

5. <https://www.gsma.com/mobilefordevelopment/programmes/disaster-response/innovation-fund>

2.4 The challenge to connect the unconnected

Despite significant mobile internet penetration growth in recent years, nearly 2 billion of the 5 billion mobile subscribers in the world remain offline (2017), mostly in low- and middle-income countries, unable to benefit from the social and economic opportunities of the internet. The digital divide is greatest in Sub-Saharan Africa and some large Asian markets such as India and Indonesia where, at the end of 2017, half of mobile subscribers were not yet on the internet.

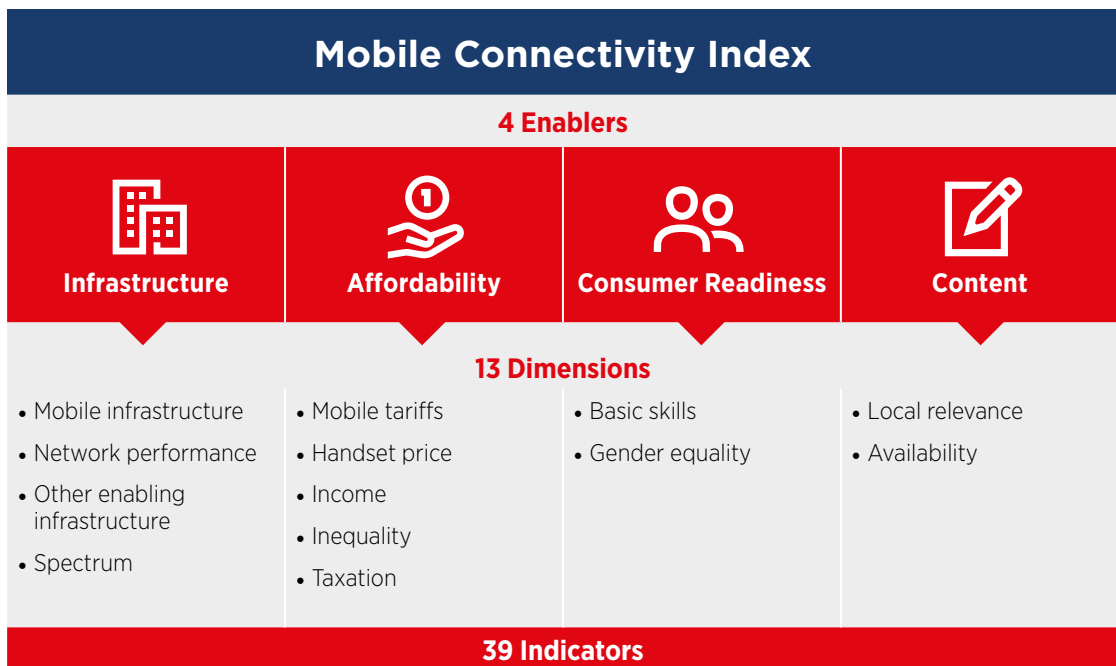
According to the GSMA Mobile Connectivity Index⁶, there are four key barriers to mobile internet adoption. While many people still live outside a 3G

or 4G signal, the majority of the unconnected face other barriers such as network performance, the relatively high costs of connectivity and handsets, a lack of locally relevant content, and poor digital literacy. The scores of the Mobile Connectivity Index improved between 2014 and 2016 across all regions, particularly in Asia Pacific where significant enhancements in infrastructure coverage and content drove a more than 7-point increase in the overall score (to 60 in 2016, on a scale of 0-100). Countries in Latin America, MENA and Sub-Saharan Africa all achieved similar improvements of more than 5 points, with Sub-Saharan Africa at nearly 40 in its overall score.

Figure 18

Source: GSMA

GSMA Mobile Connectivity Index



Regional scores for 2016 on a scale of 0-100

Region	Infrastructure	Affordability	Consumer Readiness	Content
Sub-Saharan Africa	32	43	49	29
Middle East & North Africa	52	62	59	63
Latin America & Caribbean	52	58	72	71
Asia-Pacific	51	65	68	58

6. <http://www.mobileconnectivityindex.com/>

2.5

Digitisation of the last mile across key industries

While significant challenges remain, the mobile industry has made great progress over recent years connecting the world's population to mobile services, particularly in developing regions. By 2025 nearly 6 billion people will have a mobile subscription. However, the challenge beyond the provision of mobile connectivity is to develop mobile-enabled solutions and ecosystem initiatives to address specific social and economic issues faced by people, businesses and governments in developing and often remote areas.

In developing countries, there is a growing opportunity for mobile operators to target the business sector and governments with mobile-enabled solutions that enable efficiencies by streamlining operations in the last mile. These business-to-business (B2B) and business-to-government (B2G) solutions can in turn generate socioeconomic benefits for people at the bottom of the socioeconomic pyramid. The livelihoods of these people depend on economic relationships with the private sector (e.g. farmers working with agribusinesses in agricultural value chains) and on the efficient delivery of critical services by the public sector (e.g. national and regional governments delivering healthcare services to patients).

Digitising the last mile in agriculture and health sectors means transitioning from paper to digital a wide range of systems and processes at the point of interaction between organisations and individuals

who are more difficult to reach and are underserved.

In the agricultural sector, the last mile is the web of relationships and transactions between buyers of crops such as agribusinesses, cooperatives and middlemen, and the farmers who produce and sell their crops. It is in the last mile that global markets connect with local rural economies, before the processes of transformation and value addition take place in the upstream parts of agricultural value chains, ultimately generating the products that end up on consumers' tables. In the health sector, the last mile can be described as the set of processes for the continuous and adaptive delivery of healthcare services to patients, which involves interactions and coordination between a broad range of systems (drug inventory, supply-chain management, patient records, platforms for doctor booking and payment) and professionals (doctors, nurses and community health workers).

As well as healthcare and agriculture, mobile-based tools and solutions to address key challenges such as access, cost and quality of service are increasingly important for other key sectors of the economy, such as utilities, financial services, digital identity and education. Below we focus on agriculture and healthcare but a whole range of initiatives and case studies across other verticals can be found on the [GSMA Mobile for Development homepage](#).

Agriculture

Agriculture contributes between 10% and 35% of GDP in developing countries (World Bank, 2016). As global food demand is rising, the vast majority of agribusinesses, including major corporations in the food and beverage industries, directly procure from smallholder farmers, who supply the majority of the food production consumed worldwide. However, agribusinesses face business inefficiencies when sourcing from smallholder farmers, primarily related to the challenges of operating in cash (i.e. theft, fraud, time and logistical inefficiencies of cash payments). In addition, those agribusinesses procuring cash and export crops from smallholders are under pressure to ensure not only that supply

chains are reliable and efficient but also that the produce they source is adherent to international standards and, increasingly, traceable.

Digitising the last mile offers significant opportunities to address these challenges. Use of mobile-enabled digital tools in the last mile allows agribusinesses to optimise procurement and business performance and promotes smallholder farmers' financial inclusion, empowerment through transaction transparency and better agricultural practices. As mobile is vital to the digitisation of this last mile, mobile operators are increasingly engaged in this space, with initiatives under way in countries such as Côte d'Ivoire, Ghana, Pakistan and Uganda.

Digitising the agricultural last mile

Telenor's Easypaisa digitises payments for Nestlé dairy farmers in Pakistan

Pakistan is the third largest milk-producing nation in the world, behind the US and India, with dairy and livestock accounting for around 12% of GDP. The local unit of multinational food business Nestlé works with around 150,000 dairy farmers across the country. Every year, the company pays approximately PKR22 billion (\$208 million) for nearly 0.5 billion tons of milk through an extensive chain of more than 2,500 milk collection centres. Most farmers receive their payments in cash from the supply agent routed via the traditional banking channel.

Telenor's Easypaisa mobile money service collaborated with Nestlé Pakistan to make disbursement of milk collection payments swift, easy and transparent. Easypaisa provided Telenor SIMs and registered Easypaisa mobile accounts for around 15,000 farmers across Pakistan for the transfer of funds into their accounts on a weekly basis. Easypaisa processed payments totalling more than PKR1 billion to dairy farmers annually.

Olam enterprise tool digitises last mile data collection in Côte d'Ivoire's cocoa value chain

In Côte d'Ivoire, more than 5 million people depend for their livelihoods on 700,000 farmers working in the cocoa value chain (cocoa is the country's top export). The Olam Farmer Information System (OFIS) is an enterprise tool that replaces data collection using pen and paper with a purpose-built Android application and cloud-based server. Olam uses OFIS to collect targeted farm gate data, record GPS data points directly on the ground, analyse and visualise key statistical data, keep track of field training implementation, and communicate directly with field staff through application notifications. OFIS allows farmer groups and cooperatives to manage their operations, offers end-to-end traceability through a barcoding system and integrates digital payments functionality via mobile operators' mobile money platforms. In Côte d'Ivoire, OFIS is also used in the coffee, rubber and cashew nut value chains. So far, more than 100,000 farmers in 21 countries have been enrolled in the system, and Olam aims to reach 500,000 by 2020.

Healthcare

Developing countries continue to face poor healthcare funding, which affects access, quality of service, cost and key health outcomes. Some 400 million people do not have access to essential healthcare services, mostly in Africa and South Asia, and the shortage of health professionals and facilities is significant. Seven of the 10 most populous low- and middle-income countries have maternal mortality rates above the SDG target (less than 70 per 100,000 live births by 2030) – India, Indonesia, Pakistan, Nigeria, Bangladesh, Philippines and Ethiopia.⁷

While digital health in developing countries is still in its infancy, recent initiatives show how last-mile digital solutions in the health sector can help expand coverage (access), enhance services (quality) and optimise resources (cost). Several public-private partnerships (PPPs) have been launched over the last few years to address key health challenges

faced by developing countries, including high maternal mortality. These partnerships involve governments (who play the role of funders or payers), health tech companies (providers of healthcare solutions, content, software) and mobile operators (ICT partners), and increasingly represent a viable business model to share resources, capabilities, opportunities and risks among stakeholders.

Mobile operators are engaging in digital health in developing countries by providing – directly or through partnerships – business-to-government (B2G), business-to-business (B2B) and business-to-consumer (B2C) services throughout most of the value chain. These range from digitisation of healthcare professionals to digitisation of health centres, supply chains and patient data, and integrated digital platforms for information, booking, payments and complementary services.

Digitising the healthcare last mile

Mobile Obstetrics Monitoring (MOM) in Indonesia

In 2016, Philips signed an agreement with Sijunjung Regency in West Sumatra, Indonesia, for full-scale commercial implementation of its telehealth service, MOM, in the region. MOM is a software solution – app-based, delivered via smartphone – for care providers such as community health workers, midwives, doctors and health centres. It is designed to help reduce the maternal mortality rate through the digitisation of midwife and doctor tasks, which ensures early monitoring and risk stratification. The digital health solution involves three organisations – the government pays for the service (there is no charge for patients); Philips develops and manages MOM; and Telkom Indonesia sources the software from Philips and sells it to the government. As well as the distribution, the operator provides the backbone, ICT infrastructure and data capabilities. About 1,500 mothers were benefiting from the solution as of January 2017. MOM is expanding in the Philippines and Myanmar, where Philips aims to deploy the solution in the first half of 2018. Pilots have also been launched in India and Kenya.

Stock Visibility Solution (SVS) in South Africa

Drug stock management was a major supply-chain challenge in South Africa. The National Department of Health (NDoH) relied on manual processes to manage drug stock levels in the country's primary healthcare system, as not all clinics are equipped with ICT systems. Clinics and points of care around South Africa often struggled to meet demand for critical and life-saving medication. SVS is a mobile solution developed by Mezzanine – a Vodacom-affiliated company – in partnership with Vodacom for the NDoH. SVS makes a smartphone and application bundle available to dispensing facilities to capture stock levels on a daily basis. The data and information synchronise in real time to a cloud-hosted server that automates alerts and reports for the benefit of various levels of supply-chain management. As such, SVS enables the government to increase access to medicine when and where it is needed, often in remote parts of the country. Vodacom provides SVS as a managed service – it supplies the hardware, software, connectivity, data, training, support and hosting, bundled into a single per-user, per-month cost.

7. [Scaling digital health in developing markets](#), GSMA Intelligence, 2017

03

Mobile driving and enabling innovation in a fast-evolving ecosystem

3.1 Financing of tech innovation and development reaches unprecedented levels

Globally, private equity companies, venture-capital firms and corporates have invested \$1.2 trillion over the last five years in financing tech start-ups and emerging companies across all sectors, particularly those undergoing significant digital disruption – TMT, banking, finance, automotive, transportation, energy, utilities and healthcare.

Financing reached an all-time high in 2017. The US

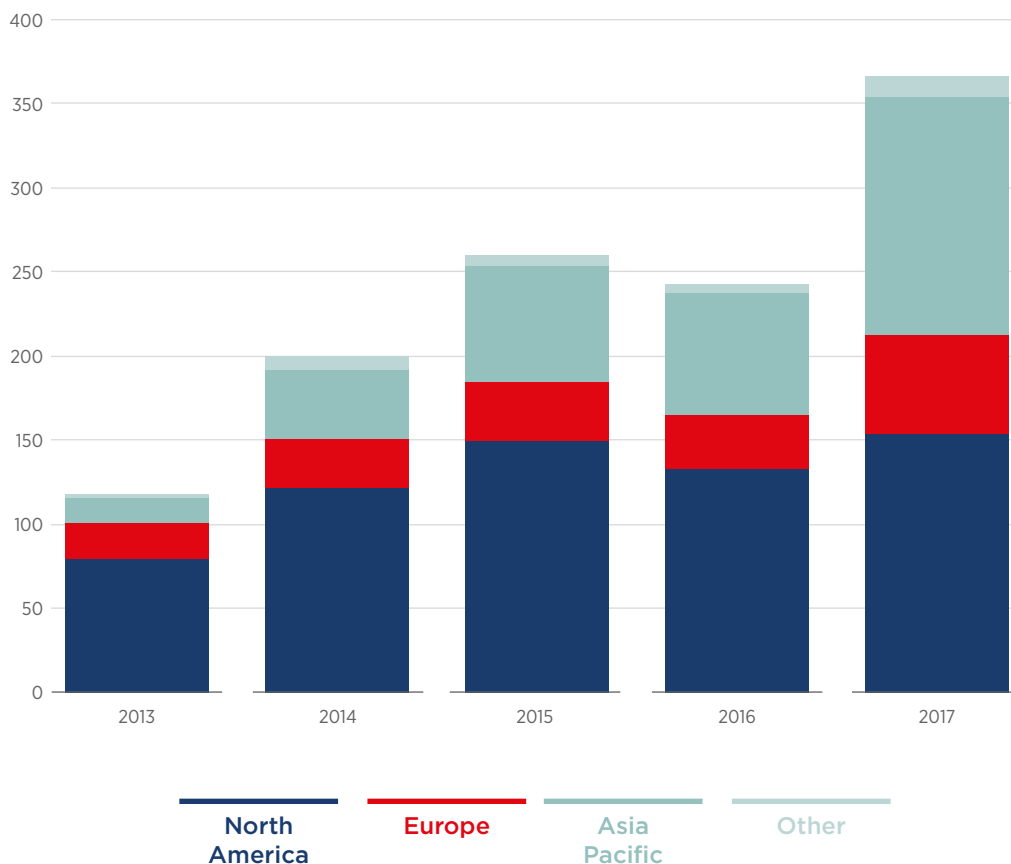
continues to be the largest market with around \$150 billion of funding in 2017, as it is home to most of the leading global tech companies. However, its share is declining – largely due to the rise of financing in China (more than \$90 billion in 2017) where a number of large investors such as Sequoia Capital China, Matrix Partners China, IDG Capital, Tencent Holdings and ZhenFund have financed more than 100 deals each over the last five years.

Figure 19

Source: CB Insights and GSMA Intelligence

Private investor financing

Funding (\$ billion)



3.2 The rise of mobile operator financing and collaboration with tech start-ups

Corporate venture capital (CVC) is on the rise in the wider TMT sector, demonstrated by an increasing number of deals and associated funding over the last few years. While large tech companies such as Intel (through Intel Capital), Qualcomm (Qualcomm Ventures) and Google (Google Ventures) are at the forefront, recent trends and initiatives show increasing telco CVC activity in both developed and developing markets.

Notable examples include Verizon Ventures, SingTel Innov8, Swisscom Ventures, Orange Digital Ventures, Telstra Ventures, SoftBank Capital, Vodafone Ventures and Telefónica Ventures. All three Chinese operators are also active, as are a number of other operators across Asia Pacific. Verizon and Swisscom have been active since the mid-2000s, and Orange originally launched a CVC arm in 2000, later rebranding to Orange Digital Ventures in 2015, investing across its European and African footprint.

An analysis of the CVC investee portfolio of Verizon, Orange and Telstra suggests that roughly two thirds of their portfolios are start-ups that support extension of core assets or a move into new business lines altogether – media, content and fintech are among the most prevalent.

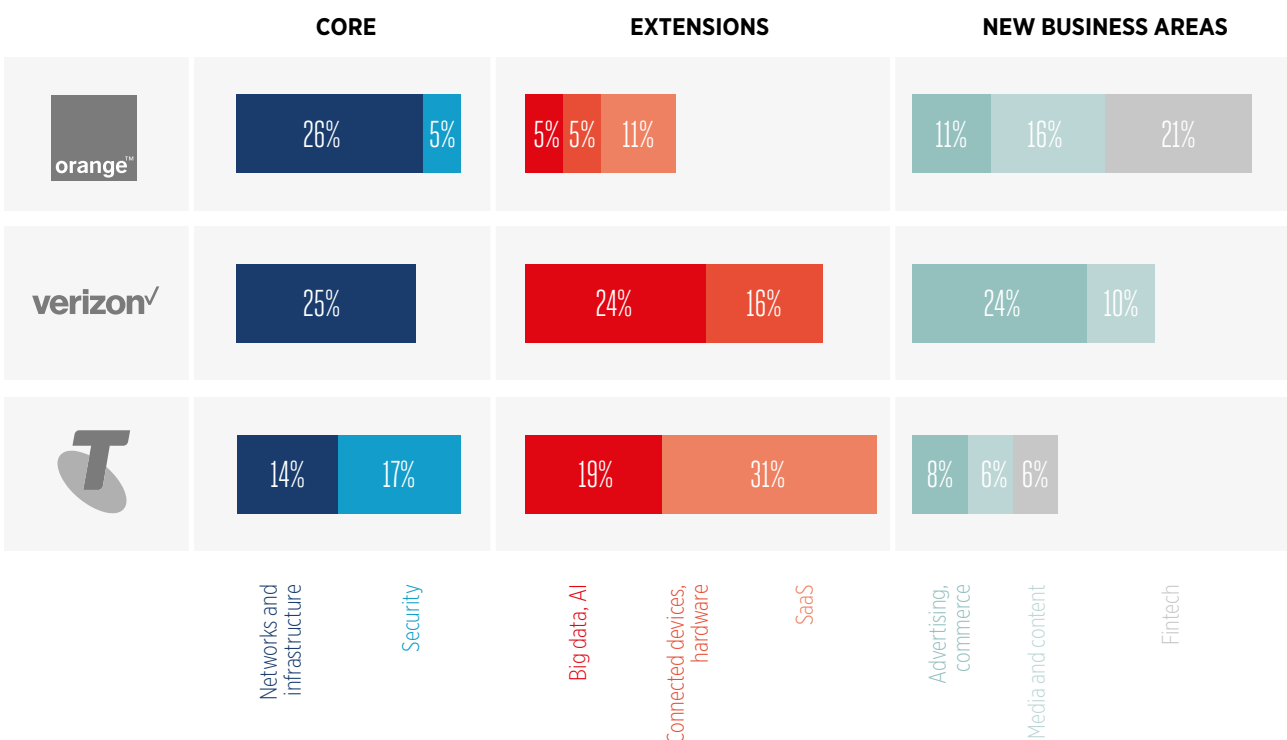
Mobile operator CVC activity is also on the rise in developing markets, where many local start-ups face scarce funding options and struggle to reach scale. Examples include Safaricom’s Spark Venture Fund, which focuses on Kenyan start-ups, and Axiata, which launched a \$5 million innovation fund for digital start-ups in Cambodia in March 2017; it also launched a similar initiative in Sri Lanka in December 2017. Orange Digital Ventures is another notable example – in June 2017, it launched a €50 million investment fund dedicated to African start-ups, through a newly established arm Orange Digital Ventures Africa.

Figure 20

Source: CB Insights, company websites, GSMA Intelligence

Distribution of portfolio companies within CVC arm of operator

Percentages add to 100% for each company. Includes all investment rounds since fund inception



Collaboration between mobile operators and start-ups

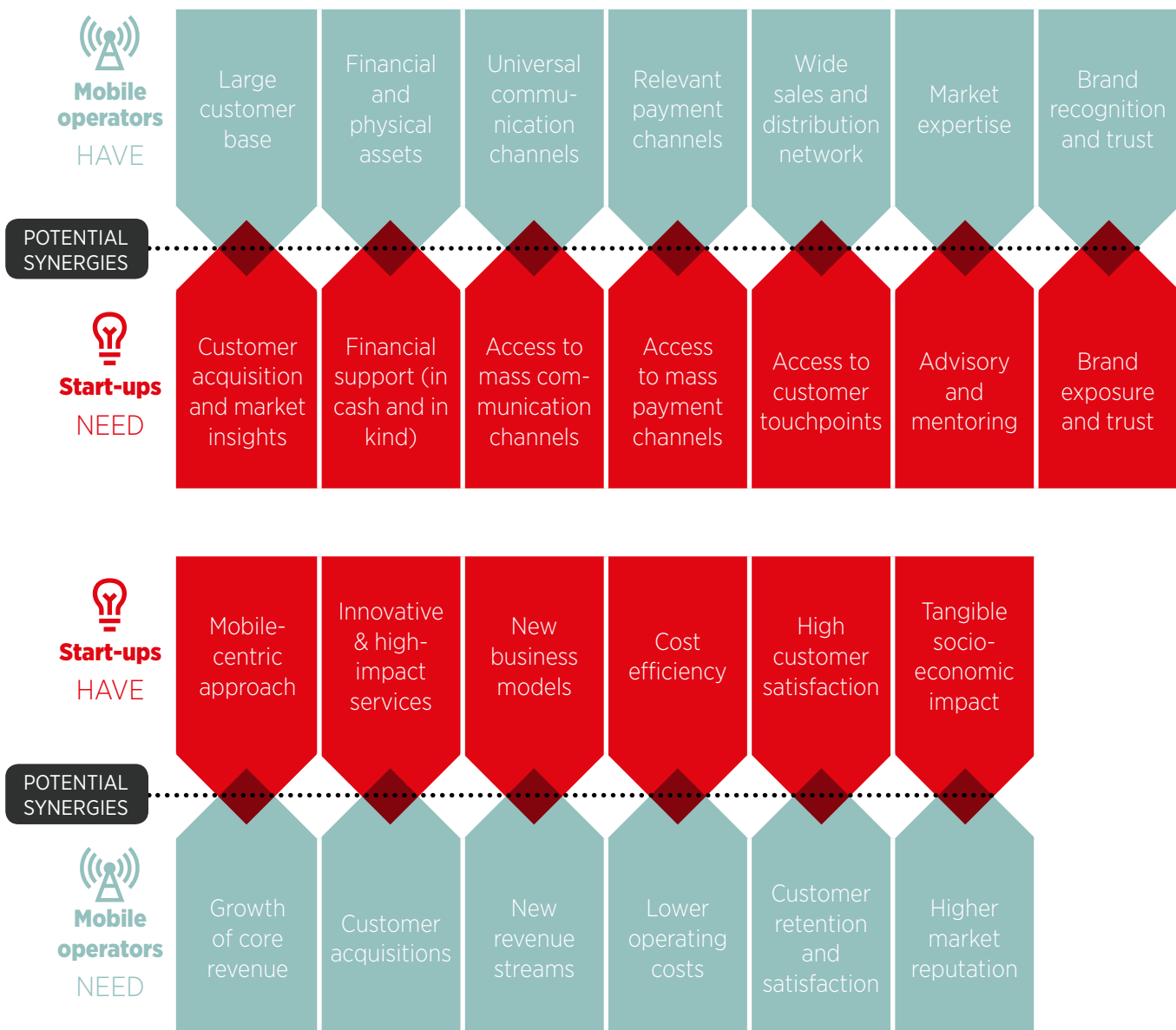
Across Asia Pacific and Africa, collaboration between mobile operators and start-ups is gaining momentum as operators have the scale and reach that start-ups lack, while start-ups have the local innovation mobile operators need. A number of have and needs primarily determine the synergies

and opportunities for sustainable and balanced collaboration. See Figure 21. Mobile operators such as Vodacom, MTN and Orange have formed a number of successful collaborations with start-ups in Africa, as have operators such as Telenor and Axiata in Asia.

Figure 21

Source: GSMA

A synergies framework for mobile operators and start-ups in emerging markets



While collaboration can take different forms and models based on the depth of collaboration and the financial commitment required from the mobile operator, recent initiatives suggest a shift towards deeper collaboration and greater financial commitment. These include in-house tech hubs, start-up investments (through CVC, direct equity investments and joint ventures) and commercial agreements including OTT reselling partnerships.

Several tech hubs run by mobile operators have recently been launched, including MTN Y'ello Startup in Côte d'Ivoire, MTN Solution Space in South Africa, Orange Fab in Côte d'Ivoire, Senegal

and Cameroon, six Telenor-owned incubators and accelerators across Asia, and the Zain Innovation Campus in Jordan. These tech hubs play a critical role in local innovation ecosystems and have the power to promote ideas and collaboration locally. For example, the Grameenphone Accelerator (GPA), an acceleration programme run by Telenor's operation in Bangladesh, provides start-ups with curriculum-based mentorship by international and local experts, connections with investors, relevant industry contacts and professional support on topics such as term sheets, valuation, financial modelling and marketing.

The GSMA Ecosystem Accelerator programme

The digital economy creates many opportunities for start-ups and mobile operators in developing markets to collaborate for mutual benefit, while also providing citizens with new products and services that have a positive socioeconomic impact and, very often, tackle most of the UN SDGs. The GSMA Ecosystem Accelerator programme⁸, supported by the UK Department for International Development (DFID) and the Australian Government, works to bridge the gap between mobile operators and start-ups, enabling partnerships that foster the growth of innovative and commercially sustainable mobile products and services.

In particular, the programme operates an Innovation Fund, which provides selected start-ups in Asia Pacific and Africa with equity-free funding, technical assistance, and the opportunity to partner with mobile operators in their markets to help scale their products and services into sustainable businesses with a positive socioeconomic impact.

Through its first two rounds, the GSMA Ecosystem Accelerator Innovation Fund has built a portfolio of 24 start-ups across Africa and Asia Pacific. The programme will invite applications from start-ups for its third Round in March 2018. Start-ups operating in these geographies can check their eligibility and apply at www.gsma.com/eainnovationfund.

8. <https://www.gsma.com/mobilefordevelopment/programmes/ecosystem-accelerator>

Figure 22

Source: GSMA

GSMA Ecosystem Accelerator Innovation Fund – start-up portfolio



Addressing Sustainable Development Goals around the world





3.3 Key areas of innovation – IoT, AR/VR, networks and AI

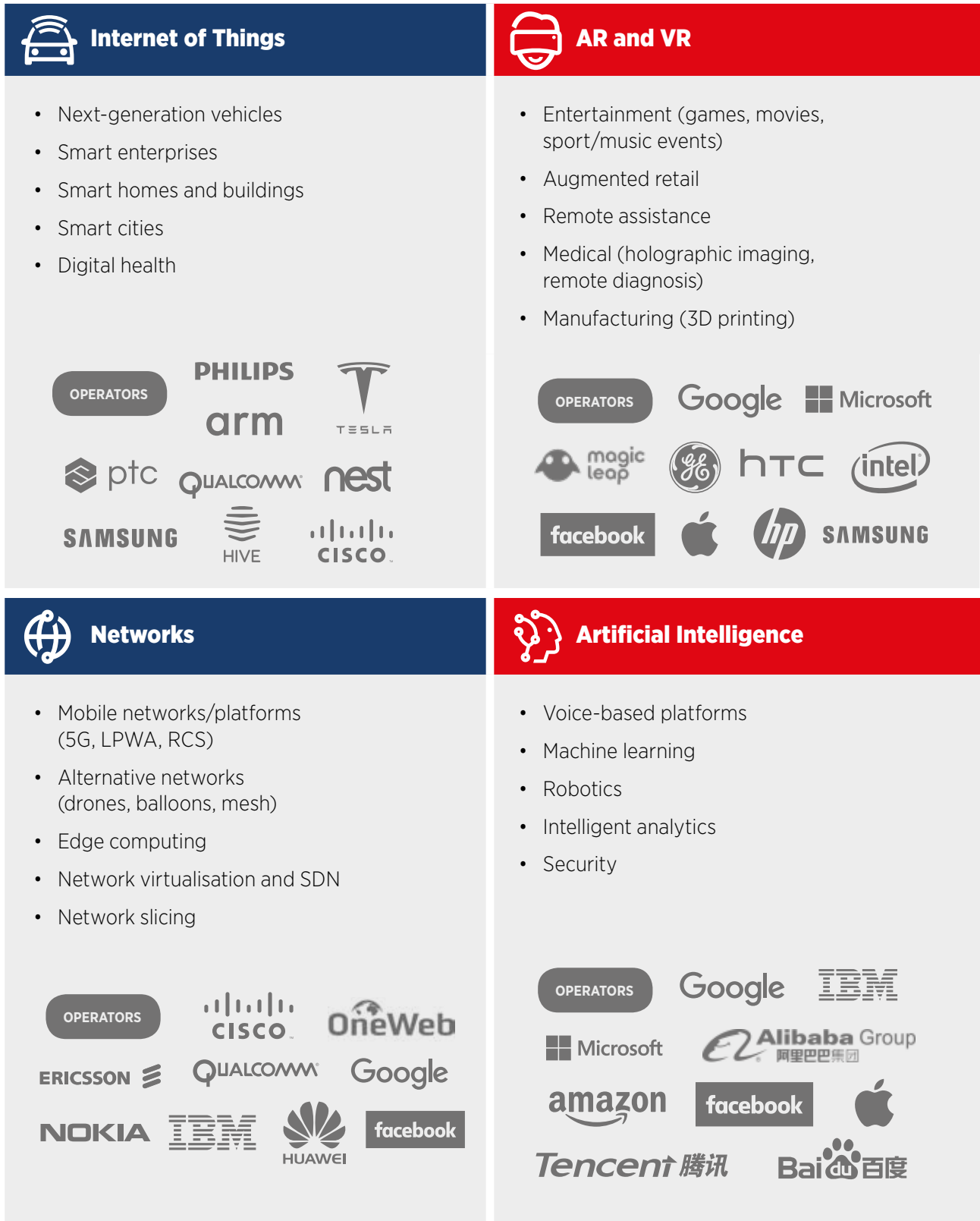
While innovation has plateaued in smartphone design and services, new form factors show momentum in the IoT, AR/VR and AI spaces. For example, increasing penetration of AI-driven smart speakers in the home has become a key battleground for customer reach and control, leading to the “resurrection” of voice as a user interface. Apple (through HomePod) and Samsung are set to join the smart speaker market in 2018 to compete with the Amazon Echo and the Google Home devices. These four companies – along with other major corporations such as Microsoft, Facebook, Intel and Sony – are also betting on AR and VR as a next major computing platform.

In the network space, a number of initiatives and projects are taking place across multiple dimensions: access, core, backhaul and economics. These initiatives are led by mobile operators (with 5G, LTE-M, NB-IoT), internet companies such as Facebook (with TIP) and Google, and satellite companies. There is also renewed momentum behind establishing RCS as a truly global messaging platform, with 50 RCS networks launched globally and a further 40 announced and in the process of launching at the end of 2017. Some 170 million monthly active users are expected by the time of Mobile World Congress 2018.

Figure 23

Source: GSMA

Key areas of innovation - major players and use cases (not exhaustive)



3.4 Artificial intelligence moves towards mainstream adoption

AI-related financing and M&A activity have reached unprecedented levels worldwide. Financing more than doubled between 2016 and 2017 to over \$15 billion, with the US leading the way, followed closely by China. In addition, numerous companies around the globe have created dedicated research centres, and a number of governments, including Canada, China, South Korea, the UK and the US, have created AI-related funds to encourage research in their domestic markets.

The AI industry is currently dominated by the big tech players in the US – Google, Amazon, Apple, Facebook, Microsoft and IBM – as well as Alibaba,







Baidu and Tencent in China. These provide an increasing number of solutions across most use cases and verticals.

Their AI strategies differ in terms of approach to data privacy, their presence in the value chain, their data ecosystem and the location of AI. For example, Facebook is targeting AI to further improve user engagement through the integration of AI-based solutions in services, while Apple is integrating AI seamlessly into its devices. Amazon, Google and Microsoft are increasingly driving developments in AI in the cloud.

Figure 24

Source: GSMA

Artificial intelligence: key US players and use cases (not exhaustive)

							
CHIPS	AI chips	✓		✓			
APPLICATIONS	Digital assistants	✓	✓	✓	✓	✓	✓
	Chatbots	✓		✓	✓	✓	
	AI in own services	✓	✓	✓	✓	✓	✓
	Health solutions	✓		✓			✓
	Smart home	✓	✓	✓		✓	
INFRASTRUCTURE & TECHNOLOGY	Connected cars	✓					✓
	Intelligent cloud	✓	✓			✓	✓
CONNECTIVITY	AR/VR	✓	✓	✓	✓	✓	
	Connectivity	✓			✓		

Chinese internet players are investing heavily in AI. The government has announced its ambition for China to be the global leader in AI by 2030, and today initiatives are being led by Tencent, Baidu and Alibaba:

- **Tencent** has increased its focus on AI in recent quarters, with the company developing a research lab in Seattle and announcing plans to invest \$15 billion over the next three years in AI-related technologies. The company has already launched AI cloud services for the healthcare and manufacturing industries. In May 2017, Tencent launched its Xiaowei virtual assistant. Offering similar capabilities to its Western counterparts such as Alexa, Xiaowei also brings access to the broader Tencent ecosystem of services.
- **Baidu** is investing heavily in AI and already offers a range of AI-powered services (Baidu Brain), as well as a voice assistant platform (DuerOS). The company's overall strategy has been described as looking to commercialise AI and then build ecosystems, as seen in its use to support the company's autonomous car plans.
- **Alibaba** plans to spend \$15 billion on R&D into "foundational and disruptive technology", including areas such as big data and AI. The company has already launched commercial products utilising AI, such as FashionAI. This incorporates deep learning capabilities and the company's extensive data on customer preferences and the fashion market to produce personalised suggestions and outfit selections.

Mobile operators in the AI space

Mobile operators across the world are also increasing their focus on AI, with widespread recognition that this technology will increasingly be key to future business and digital transformation as well as driving autonomous and intelligent networks. To that end, AI creates opportunities for mobile operators to undertake digital transformation for two of their core business areas: networks and customer care/experience. These changes promise increased operational efficiencies, more agile operations and improved customer satisfaction. In terms of network, alongside the increasing softwarisation of the network, the goal is to achieve "autonomous action" and "intelligent networks", whereby AI can help both identify a problem and implement a solution based on a given framework. In the shorter term this will reduce operating costs,

but in the longer term it holds the promise of reduced hardware costs.

Operators are also working hard to improve customer service and reduce dependence on call centres, creating AI-driven assistants and chatbots to deal with customer issues. A number of operators including Telefónica, Vodafone, Deutsche Telekom and Telenor have already launched chatbots or digital assistants in various guises. These differ in purpose and complexity: some are bots built on large-scale messaging platforms, such as Olybot from Telenor. Olybot was launched using Facebook Messenger's bot service in time for the 2016 Olympics to provide users with news on the event, and has since evolved to include more features. Meanwhile, Deutsche Telekom's Tinka is seeing over 50,000 new subscribers in Austria every month.



Many of these draw on external support and consultants such as from IBM Watson, IPSoft and Nuance. Other digital assistants have been designed and built from the ground up to be deeply embedded into the operator's core operations, such as Telefónica's Aura. Launched in February 2017, Aura is a cognitive intelligence platform that sits on top of its network and other operational layers. As a digital assistant, Aura provides customers with much greater transparency and control over personal information, empowering them to perform tasks and access services (such as checking their data allowance), which ultimately simplifies the user experience. For Telefónica, the digital assistant can provide efficiency and productivity gains by servicing various user requests that may otherwise have been routed through other means such as call centres.

The interesting question for operators is to what extent these services can move the use case of digital assistants from customer care to more direct competitors with offerings such as Amazon's Alexa and Google Home. The focus then shifts from defending existing core operations to expanding into new markets and developing new business models.

Some operators are looking to collaborate with the likes of Amazon – for example, rolling out Alexa Skills enabling users to ask Alexa for information about their mobile account using voice interaction. Others are launching products and services that more directly compete with other digital assistants in the market. Orange will commercially launch its Django home assistant and smart speaker in the first half of 2018, allowing control of home connected devices and access to entertainment as well as communications services. SK Telecom launched its

NUGU smart speaker and digital assistant in 2016, and has been expanding the range of services accessed through the service, including banking. Korea Telecom has its own home assistant, GiGa Genie, which can be accessed via a set-top box, but the company has been expanding the range of access devices. Such offerings from local players have the advantage of local language capabilities (Alexa currently only works in English or German).

AI is also closely linked with IoT and autonomous vehicles as it helps process the enormous quantities of data gathered. The option to monetise data generated by IoT will create further potential revenue streams and is seen by mobile operators as an important element of the business opportunity. In February 2017 Verizon launched Exponent, a technology and business venture offering a portfolio of software and internet platforms that includes both IoT and AI solutions. Verizon has also invested in AI companies through its venture-capital arm, most notably investing in SparkCognition, an AI-based security platform. Meanwhile AT&T has been developing AI solutions through AT&T Labs, focused on solving software-defined networking (SDN) and storage challenges for the operator.

Mobile operators are also promoting collaboration and developments in the AI ecosystem through their participation in open and connected AI platforms. There is growing interest surrounding the recent launch of Project Acumos, a new AI open-source initiative in which AT&T and IT outsourcing company Tech Mahindra are project co-founders, with the Linux Foundation hosting. This is the first initiative of this type launched by an operator, and aims to become a marketplace for accessing, using and enhancing AI applications and micro-services.

04

Policy and regulation – extending the benefits of the digital age

Delivering the digital revolution

With mobile services reaching near-ubiquity and mobile internet access spreading quickly, the digital revolution is empowering citizens and reshaping society all over the world. Recognising the value of mobile to society, many governments have set bold policies to cultivate the digital economy and protect consumers in the online environment, while ensuring the benefits of connectivity reach remote and underserved communities. As the mobile industry looks to 5G to meet the demands of a digitised world, the need for pro-investment policies and modernised regulatory regimes has never been greater.

As a result of rapid development of digital technologies, often enabled by mobile networks, today's generation are experiencing fundamentally different lives to their parents. They have unprecedented access to information, resources and digital services that give them greater choice and ability to direct their lives. Digital is not a panacea – that is abundantly clear; but if industry and governments approach the digital revolution with the right mix of policies, regulations and consumer protections while providing the framework for companies to compete and innovate, society will advance and the welfare of citizens will grow.

Mobile operators delivering continuous network innovation

Responding to commercial opportunities, competition and consumer demand, the mobile industry has continually enhanced mobile network technologies, introducing 2G, 3G and 4G networks to deliver ever-increasing service performance and to accommodate the explosion of data traversing mobile networks. These waves of mobile evolution and expansion gave rise to the mobile internet and proliferation of smartphones, changing the very nature of the digital economy.

The next generation of mobile networks, 5G, promises boundless connectivity and intelligent automation, taking network performance to a new level and providing a platform on which new digital services and business models can thrive. To achieve the potential of the 5G era for consumers and industry, however, two critical elements are required: substantial investment in digital infrastructure, which should largely come from private sources, and a digital environment that inspires trust.

Policies for progress

Policymakers and regulators create the conditions that can attract telecoms investment and strengthen digital trust. However, to date, regulatory reform has struggled to keep pace with the converged, highly dynamic and evolving digital ecosystem. A holistic policy framework that reflects the changing digital landscape while reducing costs and barriers to network deployment will deliver the best outcomes for society and the economy.

Regulatory frameworks should be reviewed and updated to promote market dynamism, competition and consumer welfare, while discarding legacy rules that are no longer relevant in the context of the digital ecosystem. Regulatory objectives are best met by focusing on the services delivered to consumers, rather than the type of company or technology that delivers them. Prescriptive (ex-ante) regulations should be replaced, where possible, with measurable, performance-based approaches⁷.

Competition policy is an effective and versatile tool to ensure the proper functioning of markets, and should be updated to reflect a number of

characteristics of the digital economy. For example, control of data can confer a competitive advantage, and digital market assessments should not focus solely on price but also consider other dynamic effects on quality of service and performance. Better balance is required between telecoms sector regulation and competition law, with the latter augmented by better procedures and faster decision making.⁹

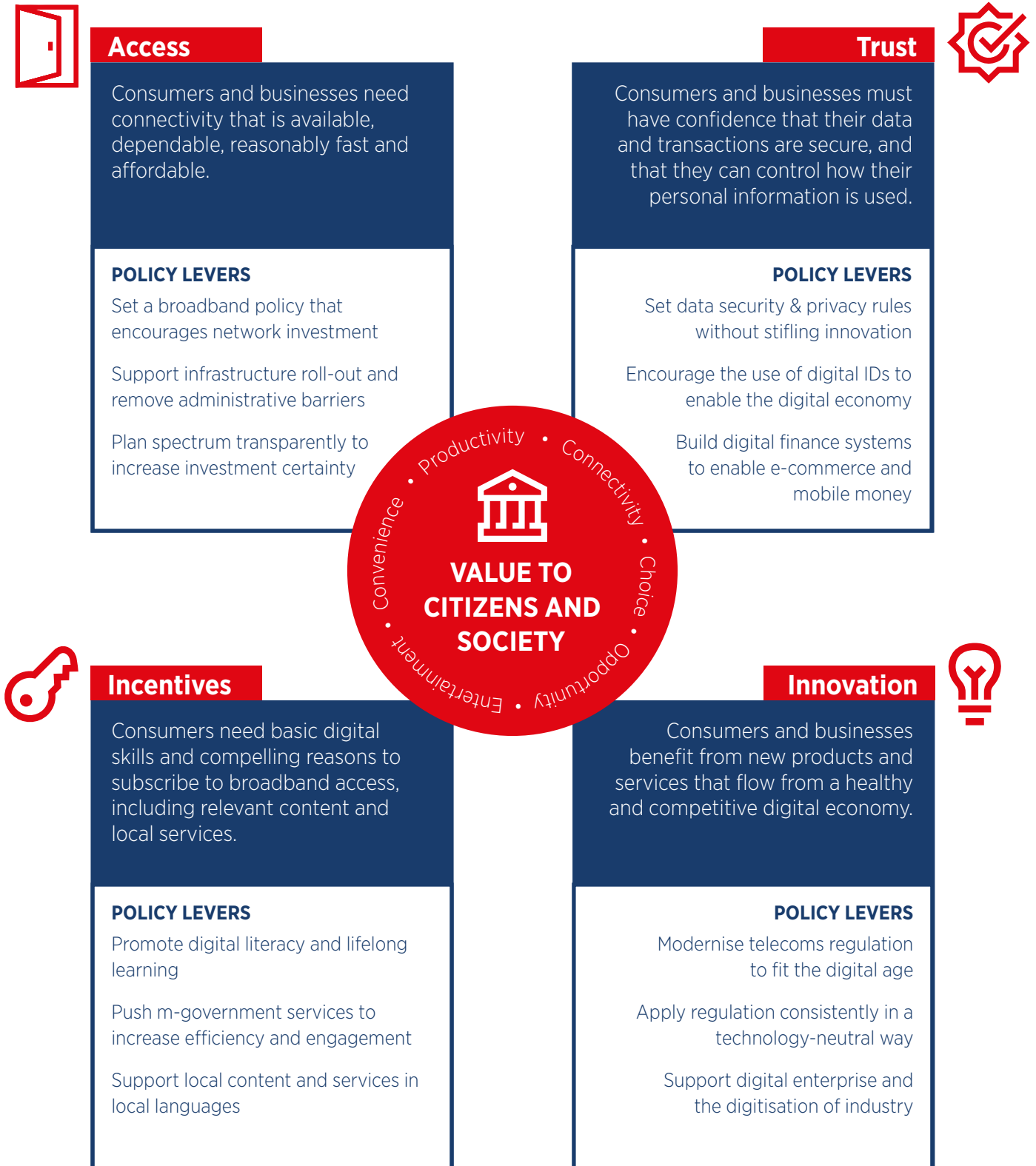
The rules designed to protect society should be applied evenly across the digital economy and not be so prescriptive that opportunities to innovate are blocked. In the dynamic digital environment, industry and business need the freedom and responsibility to figure out what works best. One example of this is the mobile industry's commitment to the principle of the open internet, while advocating flexibility in network management to deliver additional innovation and consumer benefits. Being too prescriptive in regulation and enforcement can get in the way of the best outcomes for consumers.

9. Resetting Competition Policy Frameworks for the Digital Ecosystem, GSMA, 2016

Figure 25

Source: GSMA

Extending the benefits of the digital age



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