The Mobile Economy

2019

GSMA

Intelligence

The GSMA represents the interests of mobile operators worldwide, uniting more than 750 operators with over 350 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 the industry-leading MWC events held annually in Barcelona, Los Angeles and Shanghai, as well as the Mobile 360 Series of regional conferences.

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Executive Summary

5G is here: opportunity awaits

5G is now upon us, bringing with it the promise of a host of exciting new services. As the boundaries between mobile and the wider digital ecosystem continue to blur, and as data monetisation poses a continued challenge, many operators are moving beyond their traditional telco businesses to explore new opportunities in a fast-changing competitive landscape:

IoT: between 2018 and 2025, the number of global IoT connections will triple to 25 billion, while global IoT revenue will quadruple to $1.1 trillion. With connectivity becoming increasingly commoditised, mobile operators are looking to expand their role in the value chain – from providing essential tools and capabilities for ecosystem partners to build IoT solutions, to becoming end-to-end IoT solution providers themselves.

Content: the content sector is undergoing significant transformation driven by shifting consumer behaviour, new players and changing content production and distribution models. To benefit from an unprecedented level of content consumption, an increasing number of telecoms operators are entering the content space or strengthening their existing content offerings, through vertical integration, partnerships with OTT video service providers or creating content themselves.

Artificial intelligence: AI will be key to future business and digital transformation. It will drive increasingly autonomous and intelligent networks and improve customer experience through greater learning of customer behaviour. Operators across the globe are growing their focus on AI, with AI-based applications including chatbots and digital assistants, network operation/planning, customer care, advertising and AI as a service.

Devices: while their ubiquity means smartphones remain the focal point of the consumer internet economy, the range of connected devices (and therefore internet access channels) is greater than ever. In the most advanced countries, today's digital consumers (using PCs and smartphones) will likely become tomorrow's augmented customers, adopting emerging technologies such as AI (via smart speakers) and immersive reality.

Over the coming years, these new opportunities have the potential to provide an uplift to mobile operator revenue which, particularly in developed markets, is still under pressure from slowing unique subscriber growth, regulatory intervention and intense competition. The US is already seeing early signs of this uplift: modest revenue growth is returning after a difficult 2017, largely due to mobile operators aggressively pursuing new incremental revenue opportunities in content, IoT and 5G. Overall, the global revenue outlook remains positive, with an annual average growth rate of 1.4% between 2018 and 2025.

Some 700 million new mobile subscribers by 2025

By the end of 2018, 5.1 billion people around the world subscribed to mobile services, accounting for 67% of the global population. A total of 1 billion new subscribers have been added in the four years since 2013 (representing an average annual growth rate of 5%), but the speed of growth is slowing. An average annual growth rate of 1.9% between 2018 and 2025 will bring the total number of mobile subscribers to 5.8 billion (71% of the population).

Of the 710 million people expected to subscribe to mobile services for the first time over the next seven years, half will come from the Asia Pacific region and just under a quarter will come from Sub-Saharan Africa.

Meanwhile, mobile continues to make a significant contribution to socioeconomic development around the world. In 2018, mobile technologies and services generated $3.9 trillion of economic value (4.6% of GDP)

globally, a contribution that will reach $4.8 trillion (4.8% of GDP) by 2023 as countries increasingly benefit from the improvements in productivity and efficiency brought about by increased take-up of mobile services. Further ahead, 5G technologies are expected to contribute $2.2 trillion to the global economy over the next 15 years.

The connectivity gap also continues to close: over the next seven years, 1.4 billion people will start using the mobile internet for the first time, bringing the total number of mobile internet subscribers globally to 5 billion by 2025 (over 60% of the population). This growth in connectivity is helping the mobile industry increase its impact across all the UN's Sustainable Development Goals and is spurring adoption of mobile-based tools and solutions (for example, in agriculture, education and healthcare) that aim to improve livelihoods in low- to middle-income countries.

4G takes the lead, while commercial 5G is now a reality

In 2018, 4G overtook 2G to become the leading mobile technology across the world, with 3.4 billion connections accounting for 43% of the total (excluding licensed cellular IoT). With growth continuing apace, particularly across developing markets, 4G will soon become the dominant mobile technology, surpassing half of global mobile connections in 2019 and reaching 60% in 2023.

Meanwhile, 5G is now a reality. Following commercial launches in the US and South Korea towards the end of 2018, 16 more major countries will have launched 5G networks by the end of 2019. In parallel, 5G smartphones are set to be released in the first half of the year and WRC-19 in October/November will have an impact on the future of 5G. While it will take some time for 5G to hit critical

mass, some markets will see relatively rapid growth (for example, South Korea, US and Japan). Three factors will affect the speed at which 5G is adopted and the value that it will generate: the opportunities for value generation, cost considerations and deployment dependencies.

To support this generational shift and further drive consumer engagement in the digital era, mobile operators will invest around $480 billion worldwide between 2018 and 2020 in mobile capex. Half of this will be from countries expected to have launched 5G by 2020. However, since the majority of 5G deployments will happen post-2020 (64 markets over the 2021–2025 period, bringing the total to 116), we expect capex then to grow above the approximately $160 billion expected in 2020.

Enabling policies for digital advancement

Advanced mobile networks are a critical component of the digital future, and governments must play their part. The mobile industry urges governments to set enabling policies for 5G and to reform regulatory frameworks no longer suited to today's digital economy.

The first priority is to allocate sufficient spectrum for 5G. Compared with previous mobile generations, 5G requires larger contiguous blocks of spectrum in the mid-range (e.g. 3.5 GHz) and mmWave (e.g. 26 GHz) frequency bands to achieve its potential. Additionally, given 5G's need for network densification, governments are encouraged to adopt a national code for new mobile sites and modification of existing sites, and should facilitate access to public sites (e.g. buildings and street furniture) for operators to deploy network equipment.

Besides 5G, there remains a need in most countries to modernise regulatory frameworks for the mobile sector. The world has changed, and regulation needs to advance with the times. Authorities should be looking at two key areas for review and reform: firstly, 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. Secondly, governments should reduce the sector-specific tax burden to encourage investment in new technologies. By setting the right regulatory context, governments create incentives for technological innovation and investment that benefit all of society.
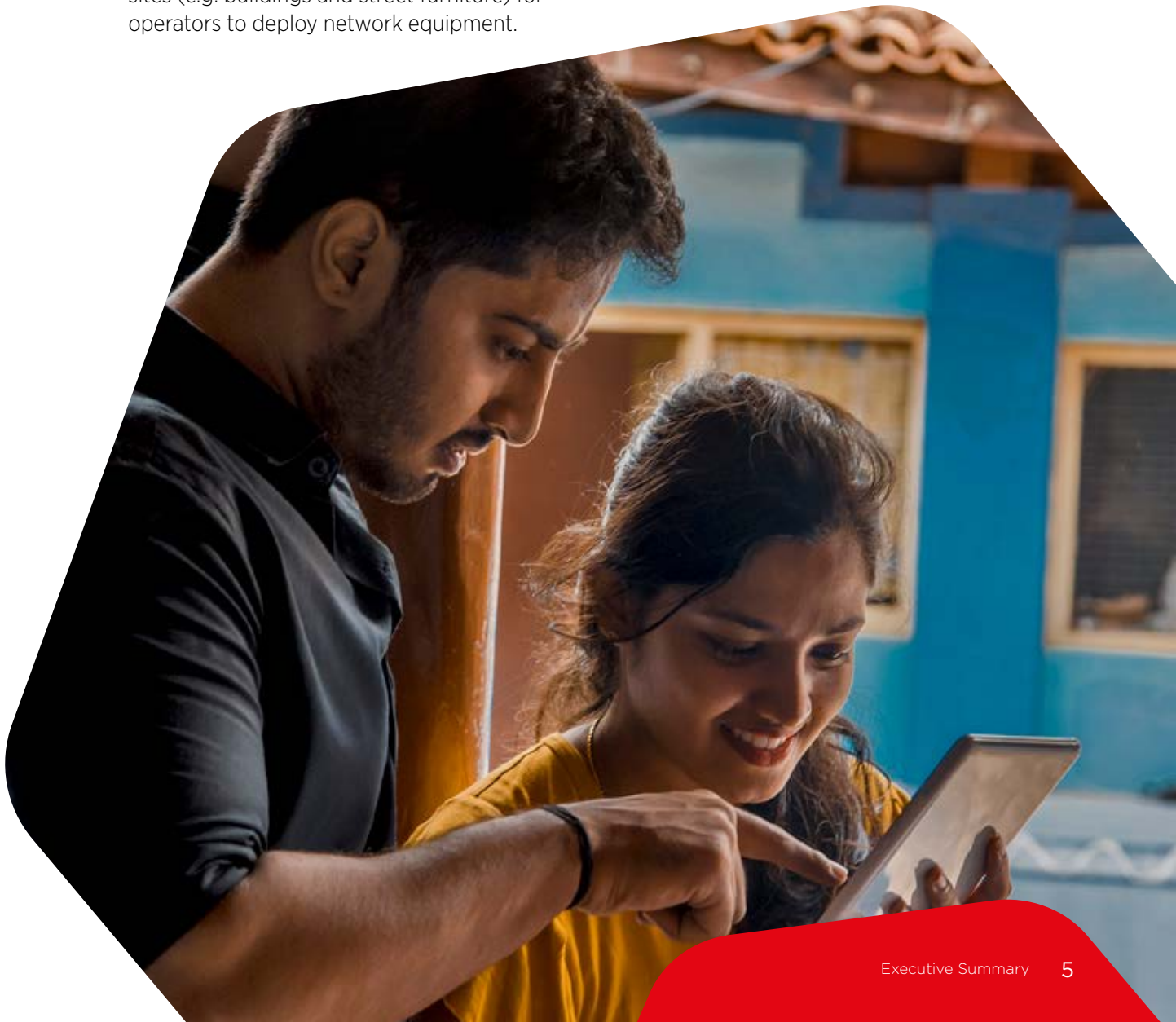
Global market

Unique mobile subscribers

2018

5.1bn

67% — PENETRATION RATE (% of population) — 71%

CAGR 2018–25

1.9%

5.8bn

2025

Mobile internet users

2018

3.6bn

47% — PENETRATION RATE (% of population) — 61%

CAGR 2018–25

4.8%

5.0bn

2025

SIM connections

Excluding cellular IoT

7.9bn
2018

9.2bn
2025

103% — PENETRATION RATE (% of population) — 112%

2.2%

CAGR 2018–25

Operator revenues and investment

2018

$1.03tn

$1.14tn
2025

Operator capex of $321 billion for the period 2019–2020

Internet of Things

9.1bn 2018 — **Total connections** — **25.2bn** 2025

Smartphones
% of connections*

60% 2018
79% 2025

4G % of connections* 43% 2018 — 59% 2025

5G 1.4bn 2025 — 15% of connections*

*Excluding cellular IoT

Mobile industry contribution to GDP

4.6% of GDP — $3.9tn 2018

4.8% — $4.8tn 2023

Public funding

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

$510bn
2018

Employment

2018
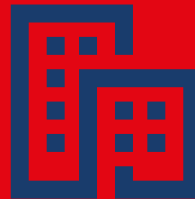
14m Jobs directly supported by the mobile ecosystem

+17m indirect jobs

World

TECHNOLOGY MIX*

2025
5G 15%   5%   20% 2G
43%
4G 59%
2018
29%
28%
3G

SUBSCRIBER PENETRATION

2018 → 2025
67% **71%**

SMARTPHONE ADOPTION

2018 → 2025
60% **79%**
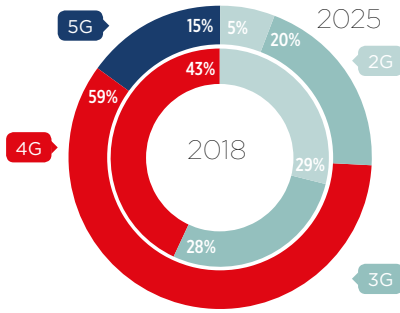
Asia Pacific

TECHNOLOGY MIX*
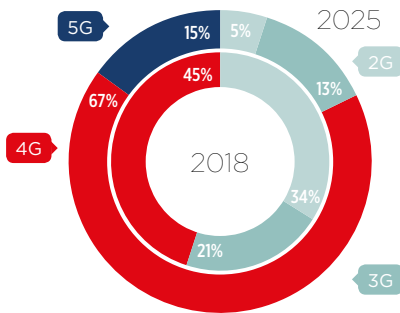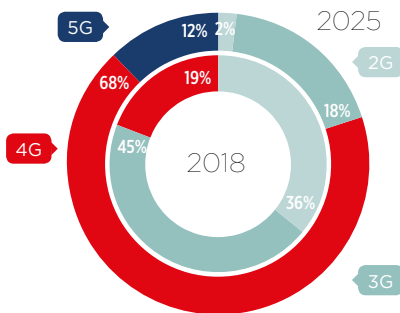
2025
5G 15%   5%
45%   13% 2G
4G 67%
2018
34%
21%
3G

SUBSCRIBER PENETRATION

2018 → 2025
66% **72%**

SMARTPHONE ADOPTION

2018 → 2025
54% **82%**

CIS

TECHNOLOGY MIX*

2025
5G 12% 2%
19%   18% 2G
4G 68%
45%
2018
36%
3G

SUBSCRIBER PENETRATION

2018 → 2025
80% **82%**

SMARTPHONE ADOPTION

2018 → 2025
53% **73%**

Europe

TECHNOLOGY MIX*

2025
5G 29% 1% 7%
46%   18% 2G
4G 63%
2018
36%
3G

SUBSCRIBER PENETRATION

2018 → 2025
85% **88%**

SMARTPHONE ADOPTION

2018 → 2025
72% **82%**

Latin America

TECHNOLOGY MIX*

2025

2018

5G 8%
65%
35%
4G
39%
5% 2G
26% 21%
3G

SUBSCRIBER PENETRATION

2018 → 2025

67% 74%

SMARTPHONE ADOPTION

2018 → 2025

65% 79%

MENA

TECHNOLOGY MIX*

2025

2018

5G 6%
52%
23%
4G
40%
37%
32%
10% 2G
3G

SUBSCRIBER PENETRATION

2018 → 2025

64% 69%

SMARTPHONE ADOPTION

2018 → 2025

52% 74%

North America

TECHNOLOGY MIX*

2025

2018

5G 47% 2%
69%
4G
44%
7% 2G
9%
21%
3G

SUBSCRIBER PENETRATION

2018 → 2025

83% 85%

SMARTPHONE ADOPTION

2018 → 2025

80% 90%
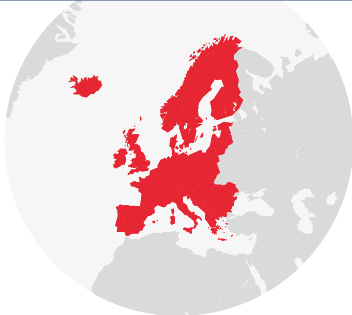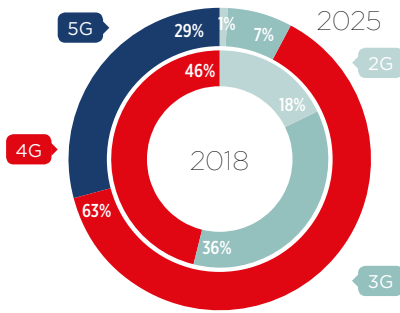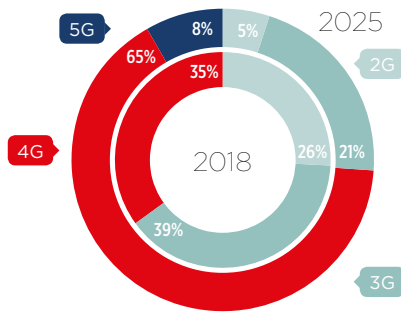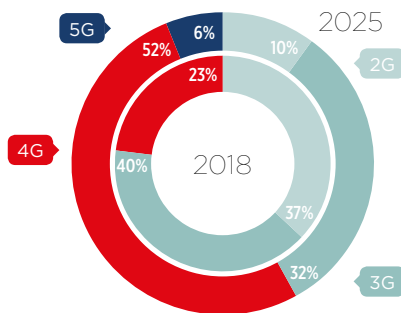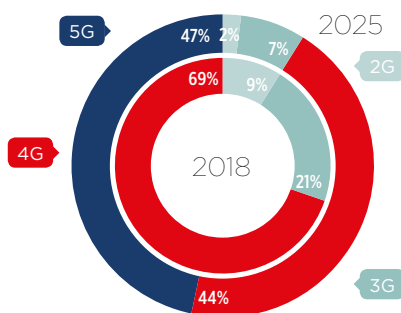
Sub-Saharan Africa

TECHNOLOGY MIX*

2025

2018

5G 24% 3%
6%
35%
4G
59%
59%
14% 2G
3G

SUBSCRIBER PENETRATION

2018 → 2025

45% 51%

SMARTPHONE ADOPTION

2018 → 2025

36% 66%
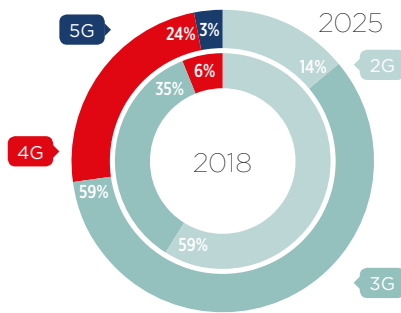
*% of mobile connections excluding cellular IoT

01
The mobile market in numbers

1.1
Key milestones

Mobile subscribers approach 6 billion by 2025

SUBSCRIBERS

2018	2019	2024	2025
Over 5 billion unique subscribers		Over 70% of the population are mobile subscribers	Nearly 6 billion unique subscribers
3.6 billion mobile internet users	Almost ½ of population are mobile internet users		5 billion mobile internet users

TECHNOLOGY

2018	2019	2024	2025
MBB covers 90% of population			
4G overtakes 2G to be leading technology	4G accounts for half of total connections		1.4 billion 5G connections
Early 5G launches	5G launches gain momentum	5G covers 1/3 of population	Almost ½ of countries have launched 5G

DEVICES

2018	2019	2024	2025
Smartphones account for 60% of connections	Over 5 billion smartphone connections	7 billion smartphone connections	Smartphones account for nearly 80% of connections
9 billion IoT connections	10 billion IoT connections		25 billion IoT connections

1.2
Where will the next 710 million come from?

Figure 2   Source: GSMA Intelligence

Some 700 million new subscribers by 2025; half from Asia Pacific
Million

Figure 3   Source: GSMA Intelligence

Seven countries will account for half of new subscribers
Percentage of global new additions by 2025
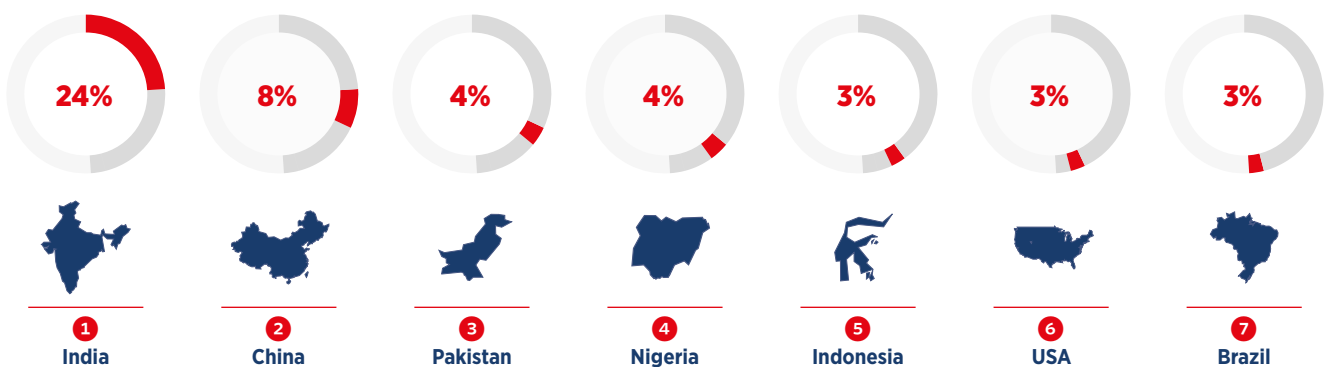
1.3
4G takes the lead, while 5G launches begin

4G took the lead in 2018 and will exceed half of connections in 2019

Percentage of connections (excluding licensed cellular IoT)
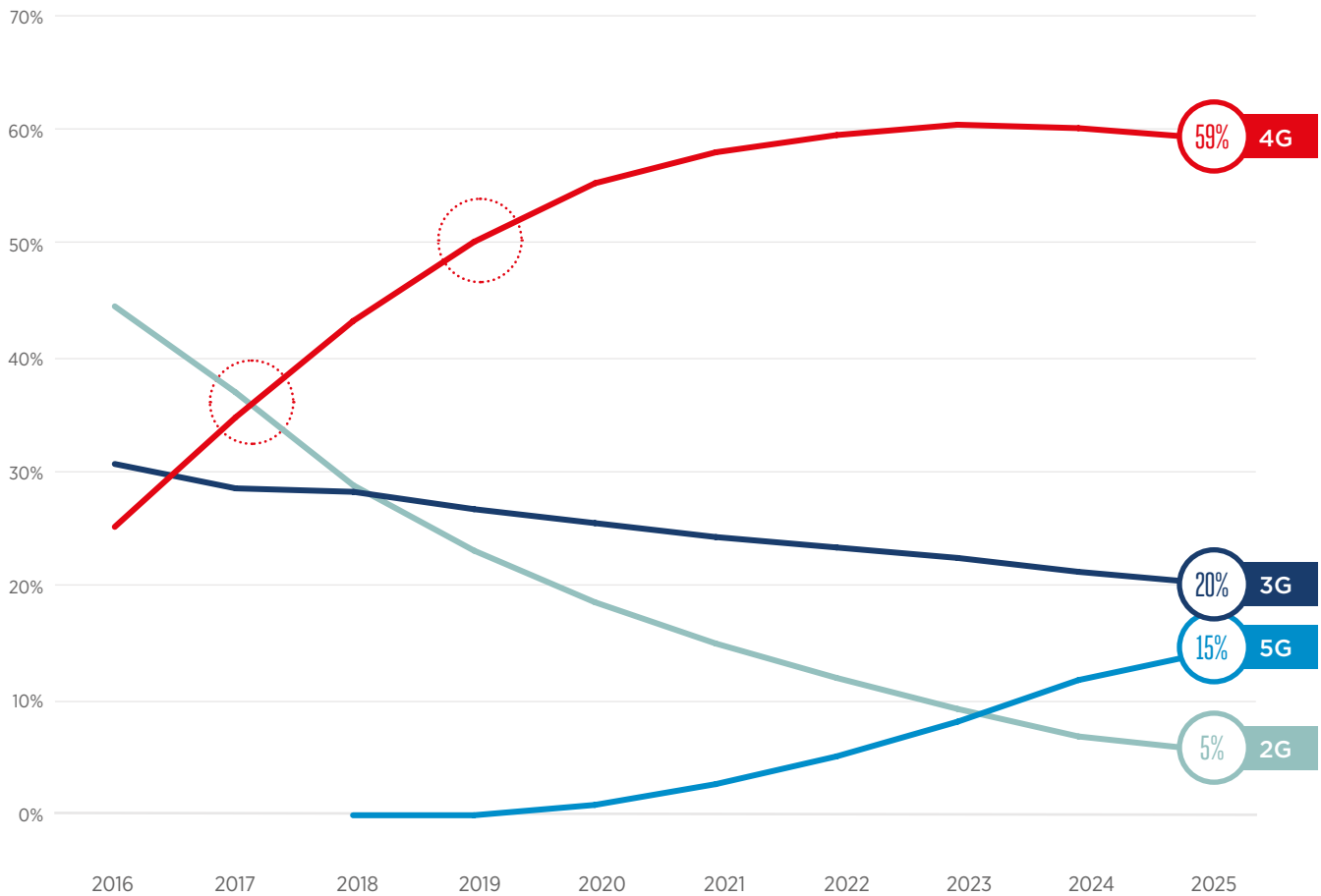
Figure 5   Source: GSMA Intelligence

2019 will see 5G launches accelerate and devices hit the market

Major launches

| South Korea US | Bahrain Czech Republic Estonia Finland Saudi Arabia Switzerland | Australia Qatar | Austria China Hong Kong Kuwait Spain UAE | Portugal UK |

Q4 2018 — **Q1 2019** — **Q2 2019** — **Q3 2019** — **Q4 2019**
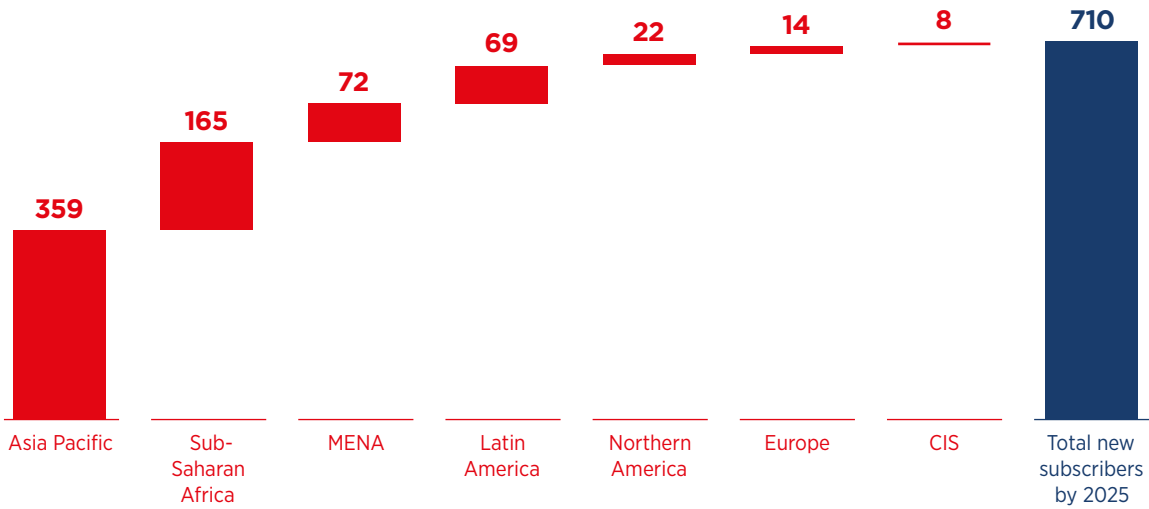
Other milestones

| | 3GPP Release 15 completed | 5G smartphones hit the market | | WRC 2019 |
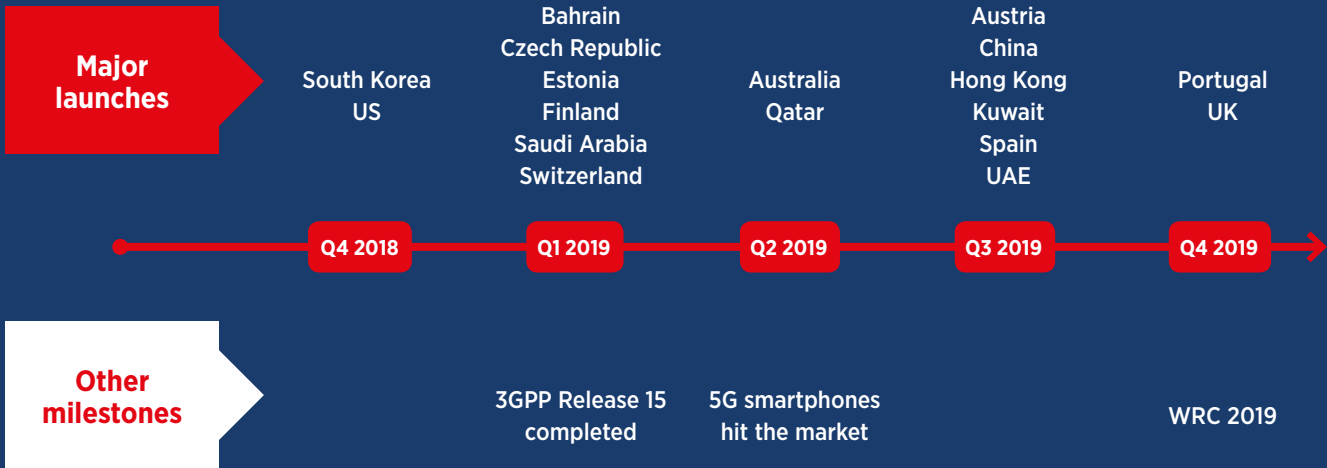
Figure 6   Source: GSMA Intelligence

The US, East Asian and European markets will lead 5G adoption

5G as a share of total connections in 2025 (excluding licensed cellular IoT)

15% WORLD	59% SOUTH KOREA	50% US	48% JAPAN	29% EUROPE
29% CHINA	16% GCC STATES	12% CIS	8% LATIN AMERICA	3% SUB-SAHARAN AFRICA
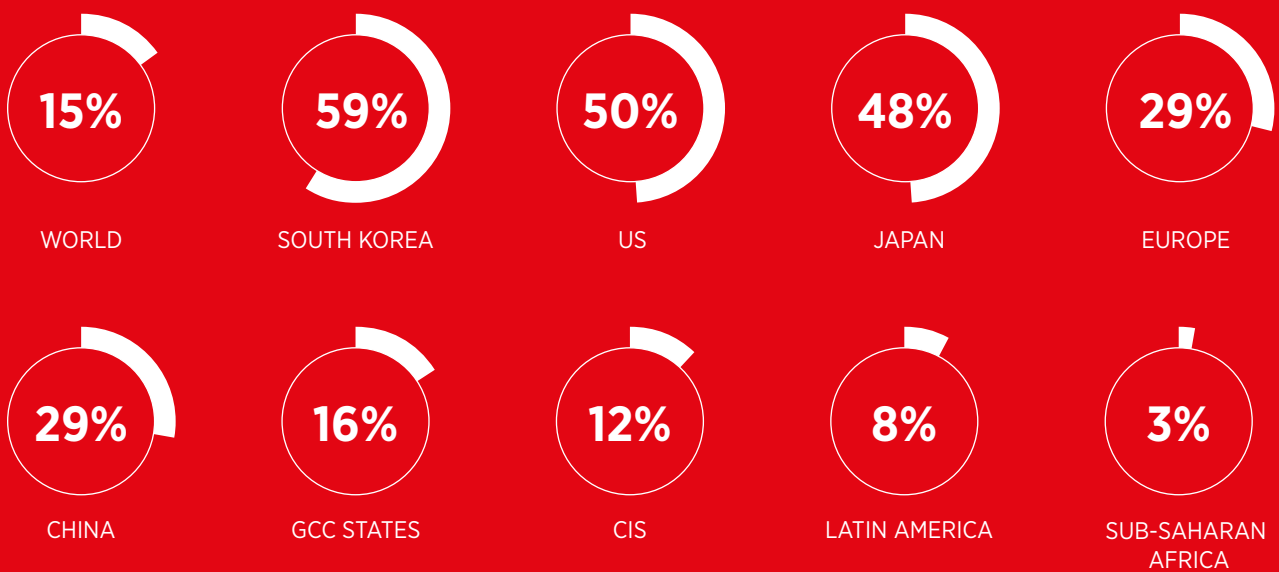
1.4
Consumers transition from 'connected' to 'digital'

Figure 7   Source: GSMA Intelligence

1.4 billion more people will be using the mobile internet by 2025

Mobile internet subscribers (% population)

2018   **2025**
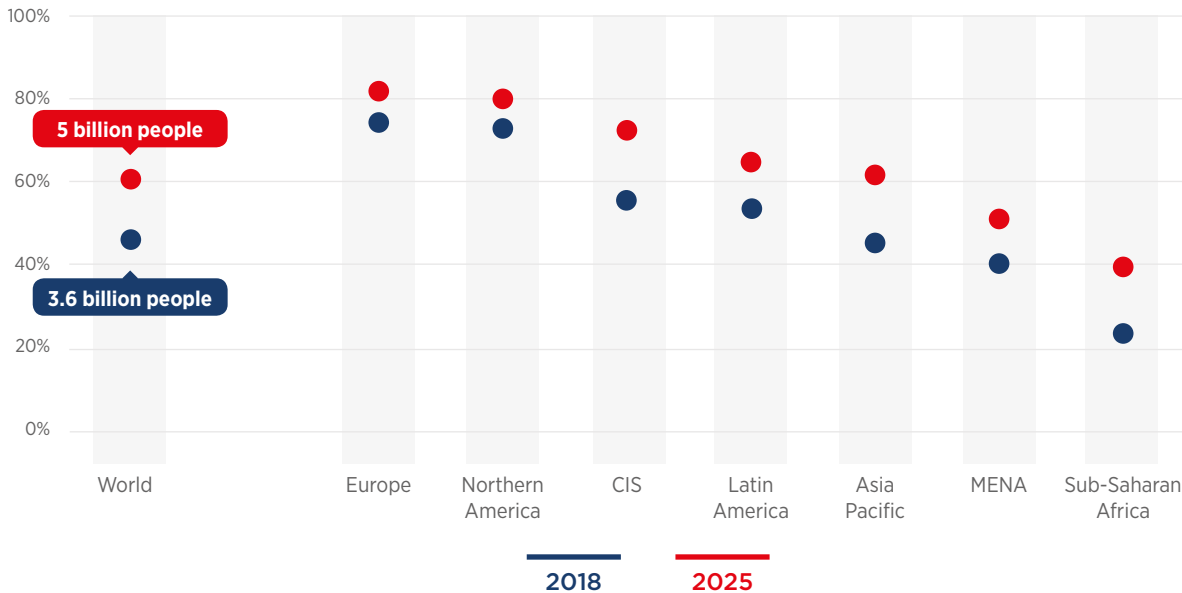
Figure 8   Source: GSMA Intelligence

Four in five connections globally will be smartphones by 2025; smartphone connections in Sub-Saharan Africa will more than double

Percentage of connections (excluding licensed cellular IoT)

2018   2025   Growth 2018-25
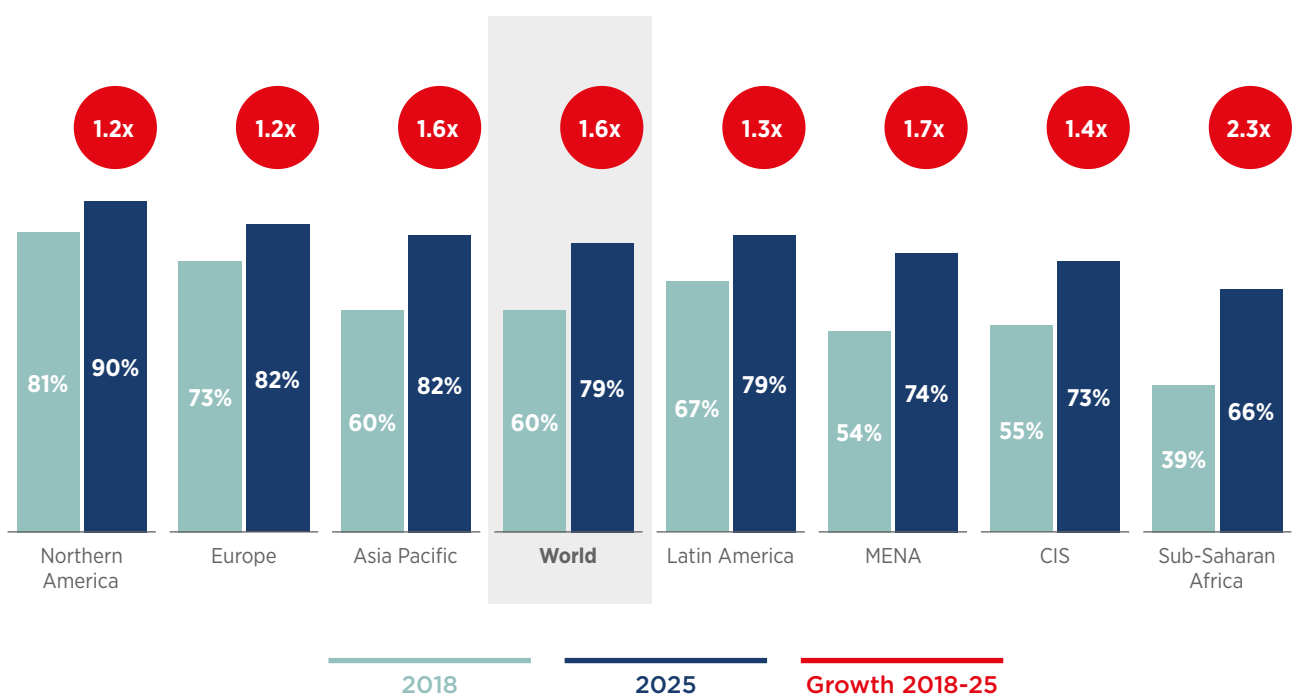
Three new smartphone super-powers will emerge by 2025

2025 rank	Country	Smartphone connections, 2025 (m)	Change in rank since 2018
1	China	1,458	=
2	India	1,171	=
3	Indonesia	410	▲1
4	USA	346	▼1
5	Brazil	204	=
6	Russia	187	=
7	Japan	162	=
8	Pakistan	146	▲14
9	Nigeria	143	▲11
10	Bangladesh	134	▲11

Smartphone ubiquity across the world enables consumer engagement in numerous use cases

Percentage of smartphone users engaging at least once per month
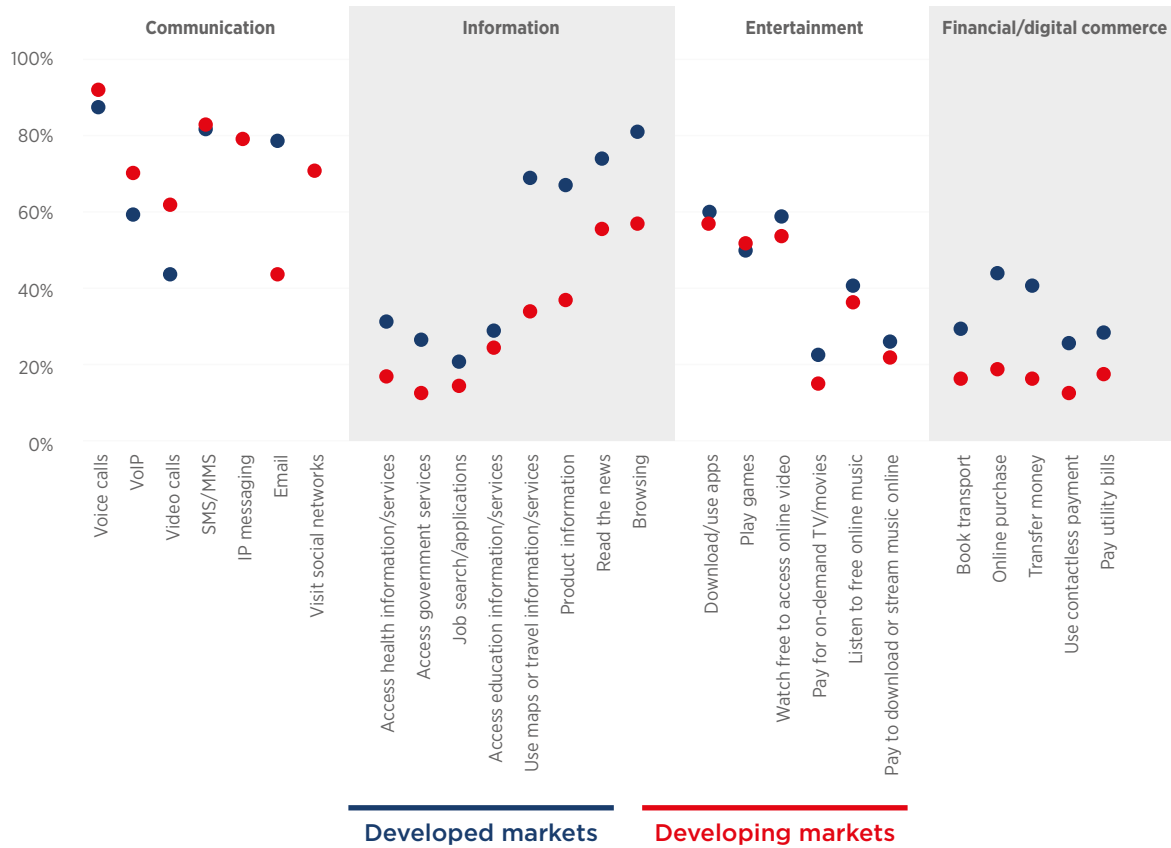
Global mobile data usage will grow five-fold by 2024, spurred by increased smartphone adoption and availability of affordable high-speed networks

GB per subscriber per month
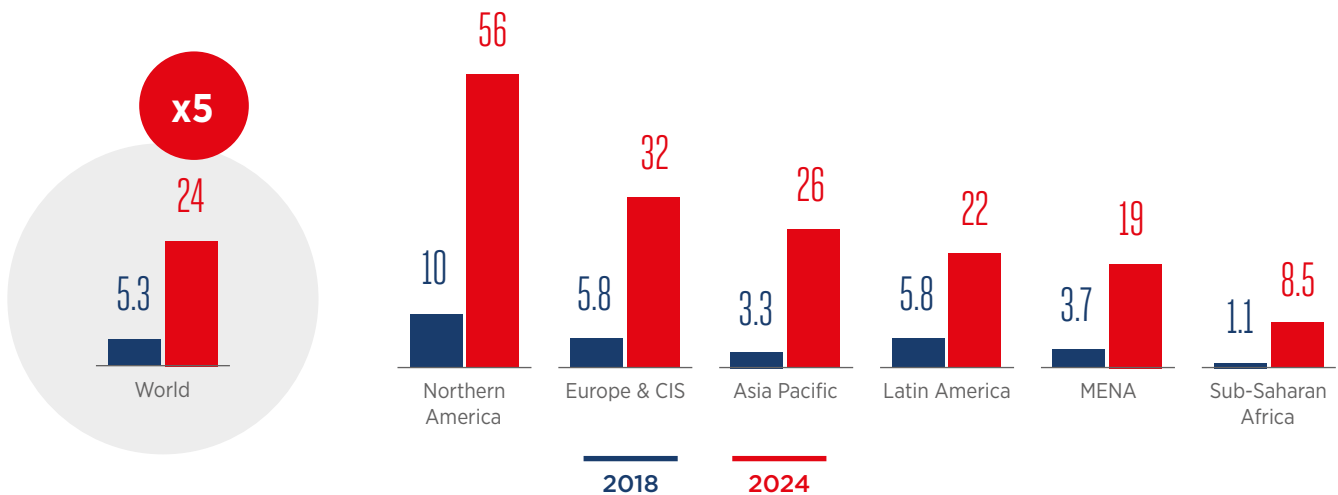
1.5
Financial pressures continue, but outlook improving

Slowing unique subscriber growth, regulatory intervention and intense competition continue to put pressure on operators' traditional mobile revenue

Mobile revenue ($ billion)

Developing

Developed

China and India driving most of the increase

Europe flat, but US showing improvement
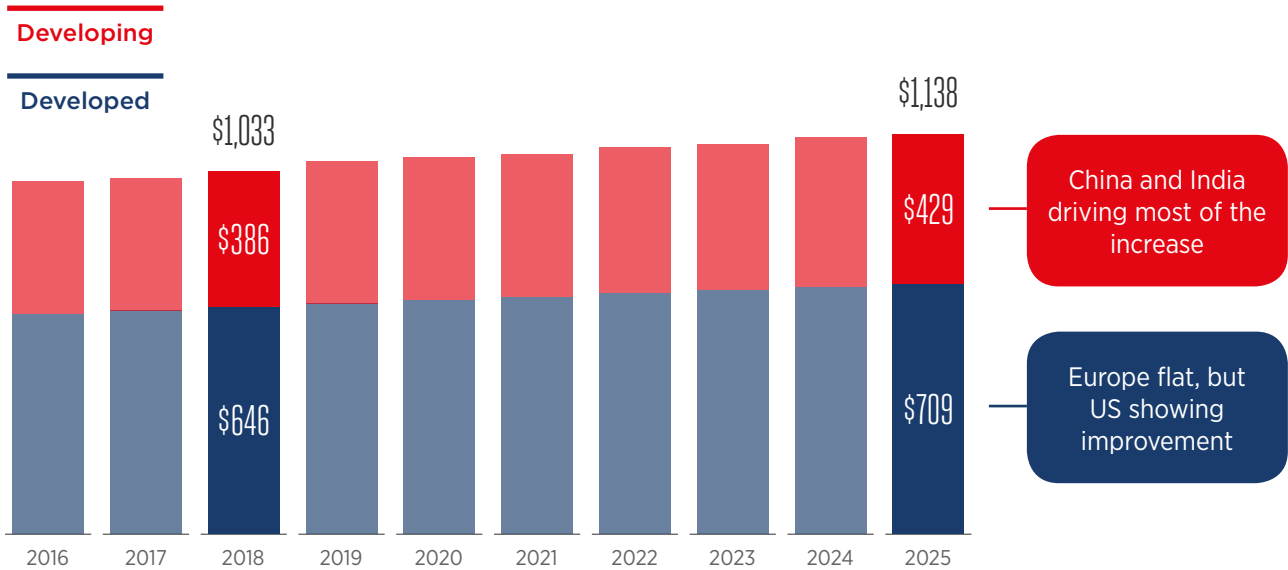
Over a fifth of the world's markets will have launched 5G by 2020, spending a combined $244 billion on networks in the process

Capex ($ billion)

Rest of world

Countries that have (or will have) launched 5G

Investing in...

New rollouts (3G/4G/5G)

Network optimisation

Capabilities beyond core telco
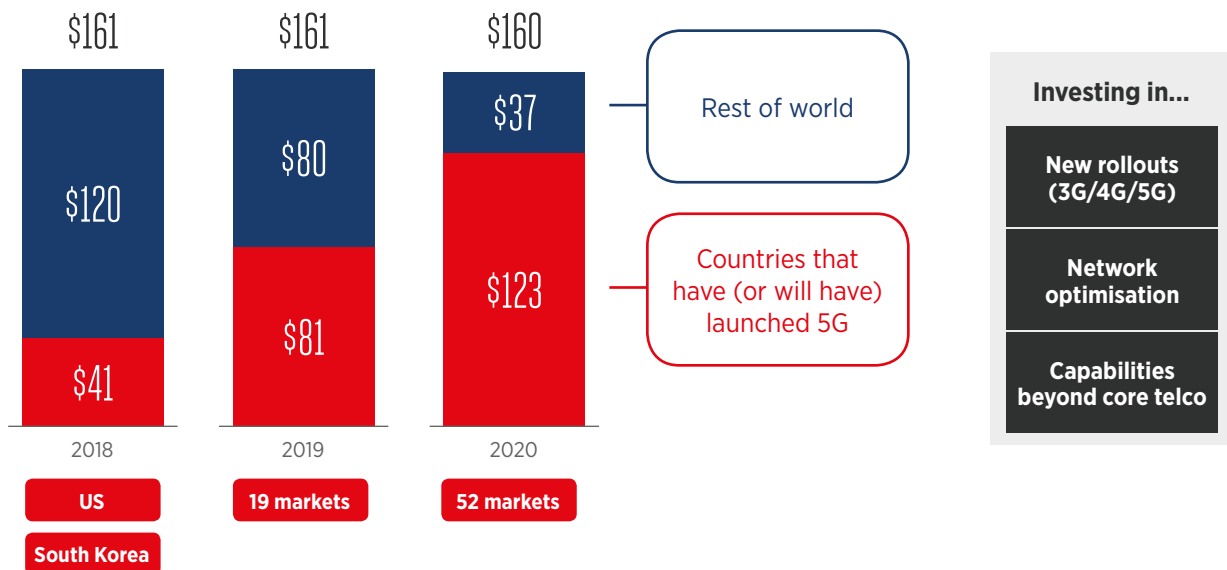
02
Mobile contributing to economic growth and addressing social challenges

2.1
Mobile contribution to economic growth

In 2018, mobile technologies and services generated 4.6% of GDP globally, a contribution that amounted to $3.9 trillion of economic value added. The mobile ecosystem also supported almost 32 million jobs (directly and indirectly) and made a substantial contribution to the funding of the public sector, with more than $500 billion raised through general taxation. By 2023, mobile's contribution will reach $4.8 trillion (4.8% 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.

Further ahead, 5G technologies are expected to contribute $2.2 trillion to the global economy over the next 15 years, with key sectors such as manufacturing, utilities and professional/financial services benefiting the most from the new technology.

Figure 14

Source: GSMA Intelligence

The global mobile ecosystem generated $1.1 trillion of economic value in 2018, with mobile operators accounting for 60%

$ billion, % GDP 2018

	$80	$690	$120	$70	$180
	0.1%	0.8%	0.1%	0.1%	0.2%
	Infrastructure Providers	Mobile Operators	Device Manufacturers	Distributors and Retailers	Content, Apps and Service Providers
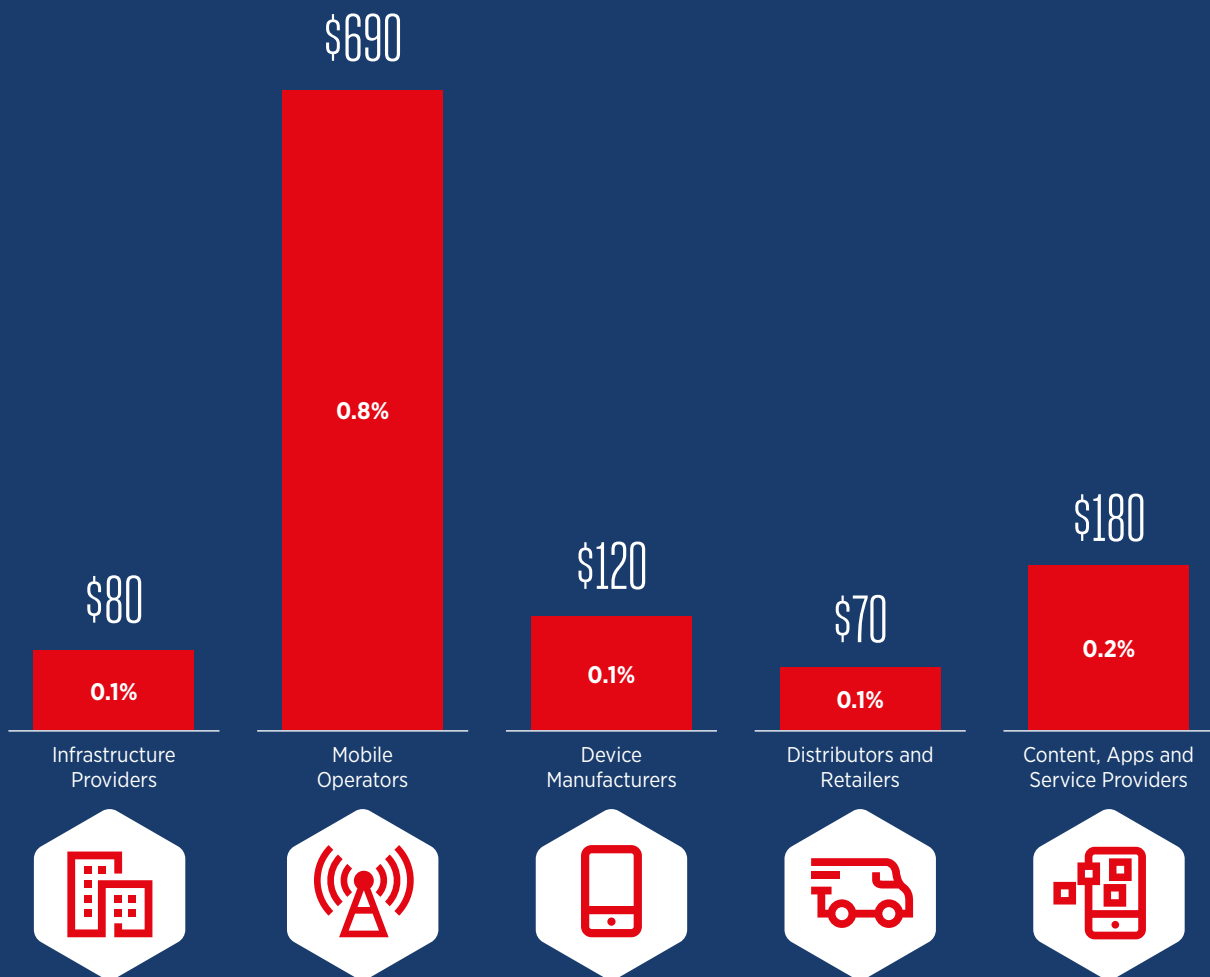
Additional indirect and productivity benefits bring the total contribution of the mobile industry to $3.9 trillion

$ billion, % GDP 2018

$690	$450	$500	$2,270	$3,920
0.8%	0.5%	0.6%	2.7%	4.6%
MOBILE OPERATORS	RELATED INDUSTRIES	INDIRECT	PRODUCTIVITY	TOTAL
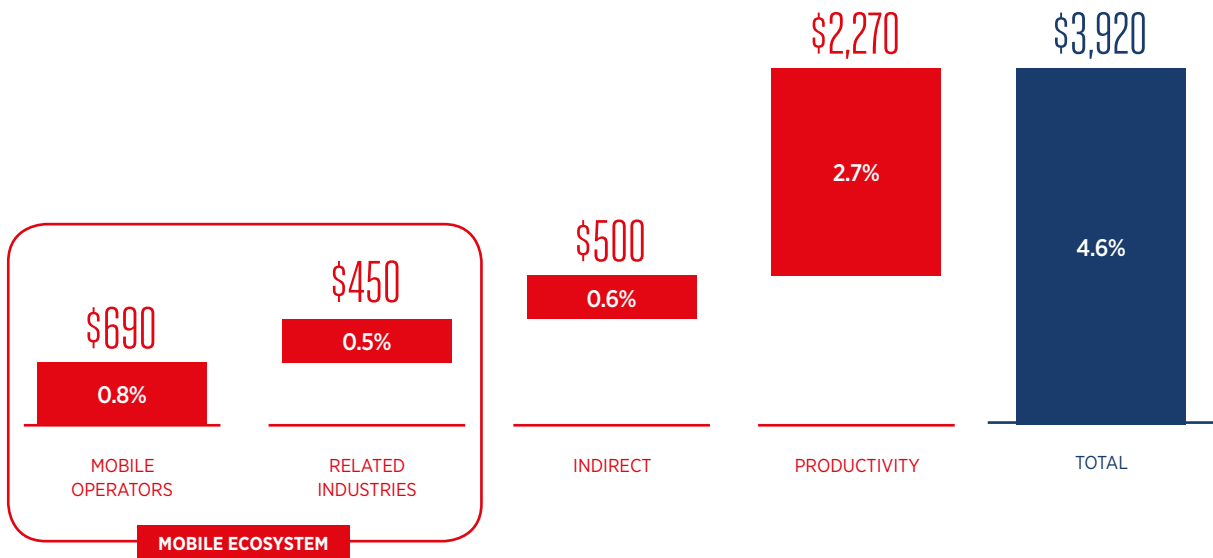
MOBILE ECOSYSTEM

The mobile ecosystem directly employs almost 32 million people globally; 14 million directly and 17 million through related industries

Jobs (millions)

Infrastructure Providers	Mobile Operators	Device Manufacturers	Distributors and Retailers (formal)	Distributors and Retailers (informal)	Content, Apps and Service Providers	Direct	Indirect	Total
1	3	2	2	4	2	14	17	32
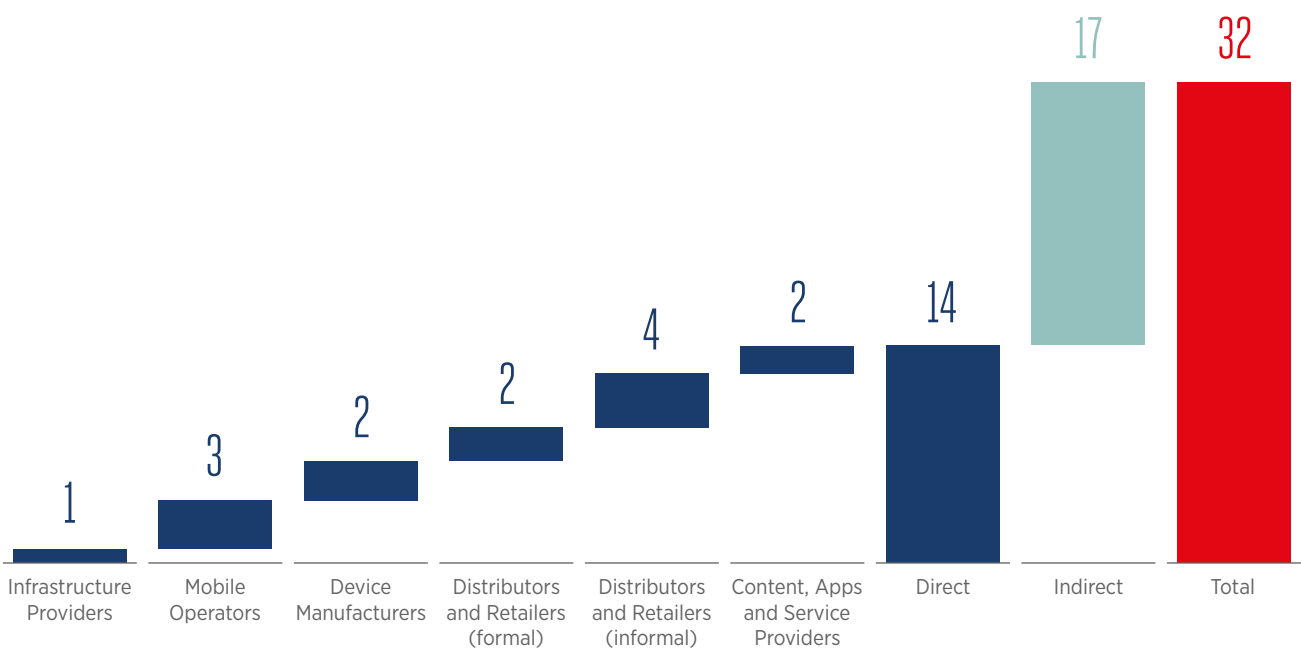
Note: totals may not add up due to rounding.

Figure 17 Source: GSMA Intelligence

In 2018, the mobile ecosystem contributed more than $500 billion to the funding of the public sector through general taxation
$ billion

$190	$90	$90	$140	$510
Mobile services VAT, sales taxes and excise duties	Handset VAT, sales taxes, excise and customs duties	Corporation taxes on profits	Employment taxes and social security	Total
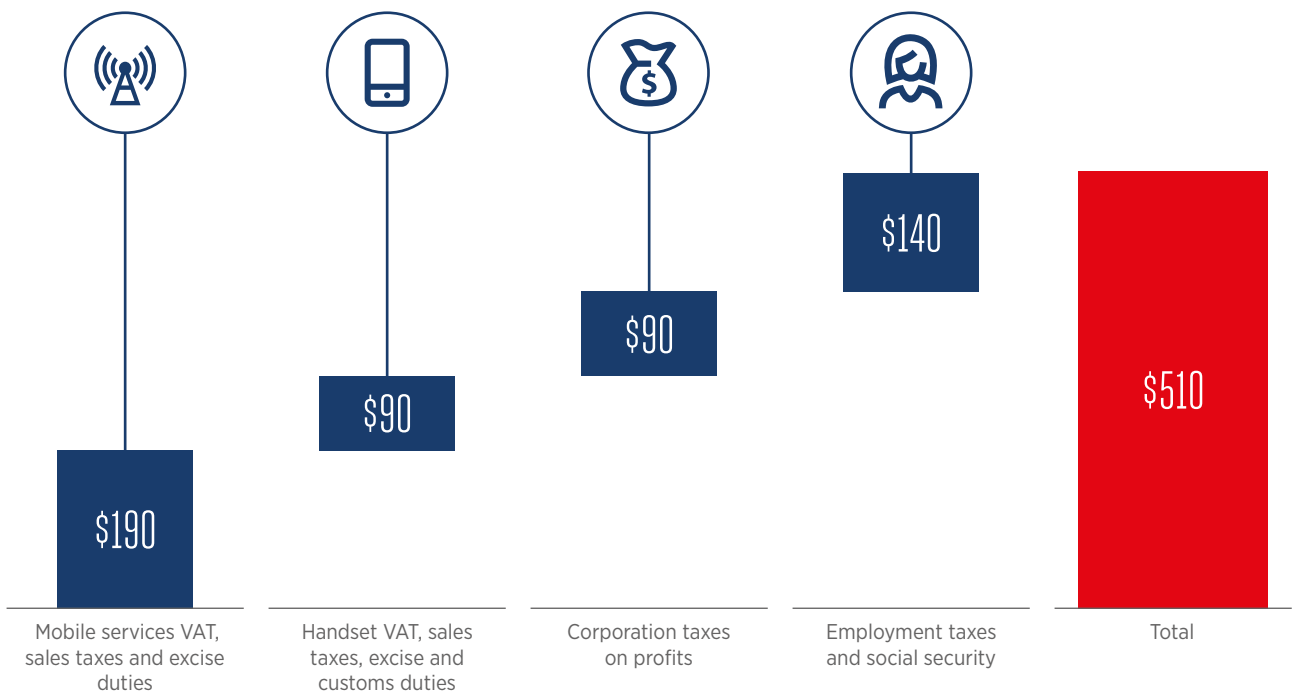
Driven mostly by productivity gains, the global economic contribution of mobile will increase by almost $850 billion by 2023

$ billion, % GDP

| | Direct | Indirect | Productivity | % of GDP |
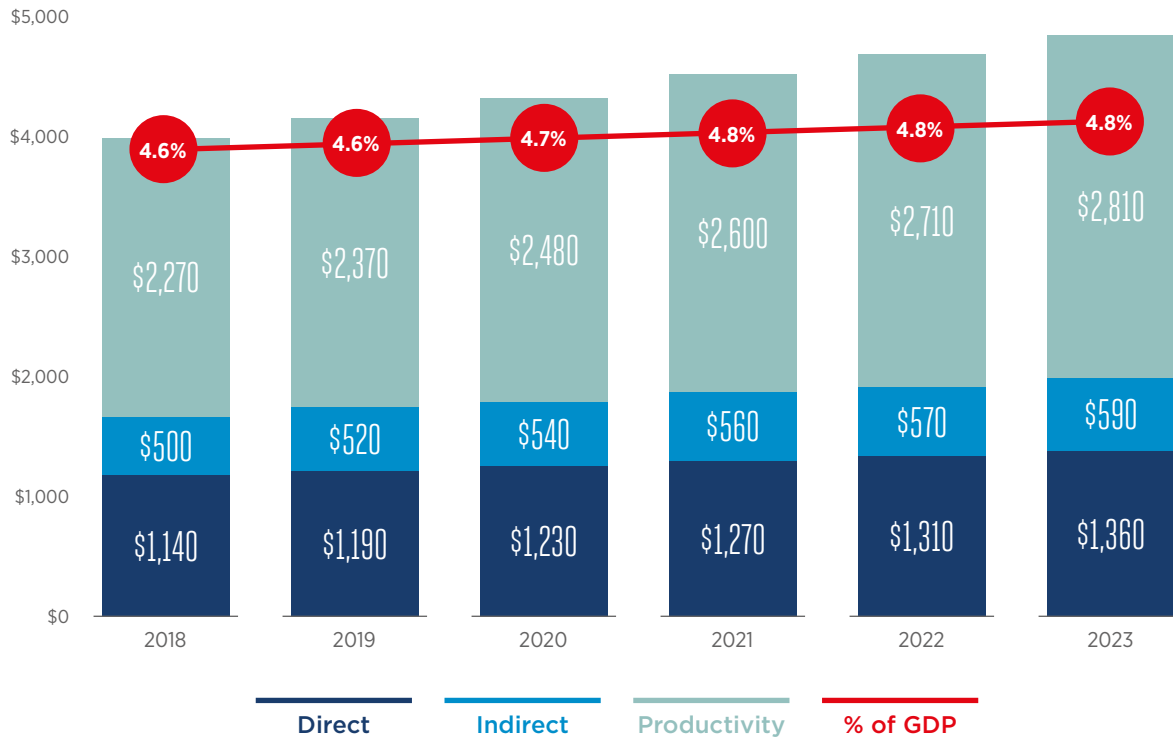
5G will contribute $2.2 trillion to the global economy over the next 15 years

$2.2 trillion by 2034
5.3% of GDP growth

Agriculture & Mining — 6%
ICT & Trade — 14%
Public Services — 16%
Manufacturing & Utilities — 35%
Professional & Financial Services — 29%
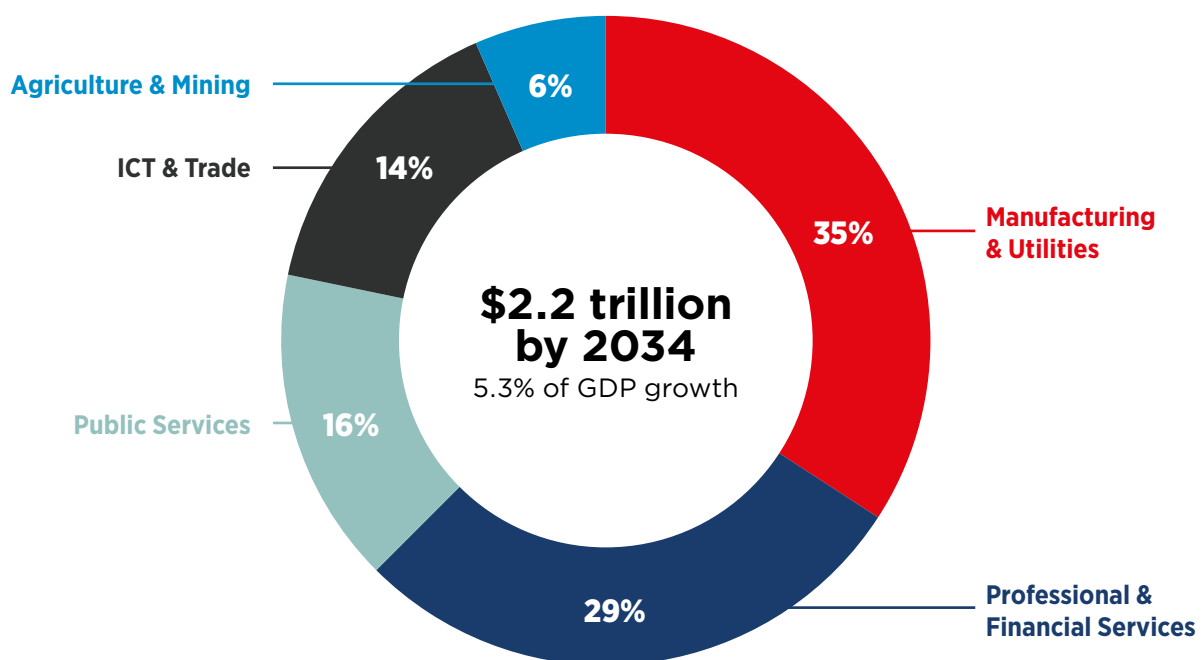
1. For more information, see Study on Socio-Economic Benefits of 5G Services Provided in mmWave Bands, GSMA, 2018

2.2
Expanding the benefits of the mobile internet

At the end of 2018, 3.6 billion people were connected to the mobile internet, representing an increase of just over 300 million compared to the previous year. However, more than 4 billion people remain offline. Around 1 billion of these are not covered by mobile broadband networks (the 'coverage gap'), while around 3 billion live within the footprint of a network but are not accessing mobile internet services (the 'usage gap').

Over the next few years, as the enablers of mobile internet adoption (infrastructure, affordability, consumer readiness and content/services) continue to improve, millions of people will start using the mobile internet for the first time. By 2025, 5 billion people across the globe (more than 60% of the population) will be mobile internet subscribers.

Figure 20   Source: GSMA Intelligence

More than 4 billion people don't use the mobile internet

Percentage of population, 2018

Mobile contributing to economic growth and addressing social challenges

By 2025,
5 billion people
across the globe (more
than 60% of the population)
will be mobile internet
subscribers.

All four enablers of mobile internet adoption have improved over the last few years (2014–2017)[2]

GSMA Mobile Connectivity Index[3]
Global score 52 → 60

INFRASTRUCTURE
36 → 50

AFFORDABILITY
64 → 66

Has progressed the most. Network coverage scores are relatively high, but network quality and spectrum assignments are key barriers.

- 3G coverage increased from 75% to 87% globally between 2014 and 2017, reaching an additional 1.1 billion people.[4] However, coverage remains limited in rural and remote areas: only around a third of rural populations in low-income countries are covered by 3G networks.

- Network quality has improved[5] but there is substantial variation across countries. Average download speeds for leading performers are approaching 40 Mbps but the vast majority (75%) of countries have not achieved speeds of even a quarter of this.

- The majority of countries that achieved the biggest improvements in network coverage and quality between 2014 and 2017 were those that assigned additional spectrum to operators, particularly in the digital dividend bands.[6]

Has improved, but remains a key consumer barrier.

- The average monthly cost of a 500 MB data plan fell from 4.8% to 2.5% of monthly GDP per capita between 2014 and 2017[7]. The average cost of an entry-level internet-enabled device fell from 2.6% to 2.3% of GDP per capita. However, affordability remains one of the biggest barriers for consumers to mobile internet adoption in low- and middle-income countries.[8]

- In 2017, more than half the low- and middle-income countries in the Index imposed sector-specific consumer taxes, which on average accounted for around 7% of the total cost of mobile ownership. The cost of accessing 500 MB of data in low- and middle-income countries that impose sector-specific consumer taxes is almost 4% of monthly GDP per capita, compared to 2.5% in countries that do not.

2. For more information, see State of Mobile Internet Connectivity 2018, GSMA, 2018
3. In order to better understand supply- and demand-side factors in connecting the unconnected, the GSMA's Mobile Connectivity Index measures the performance of 163 countries – representing 99% of the global population – against the key enablers of mobile internet adoption: infrastructure, affordability, consumer readiness, and content and services. See https://www.mobileconnectivityindex.com/
4. 4G coverage doubled from 36% to 72%, covering an additional 2.8 billion people
5. Average download speeds increased from 2.6 Mbps to 8.6 Mbps and average upload speeds increased from 0.9 Mbps to 3.3 Mbps between 2014 and 2017 (GSMA Intelligence calculations based on analysis by Ookla of Speedtest Intelligence data)
6. This includes spectrum in the 600, 700 and 800 MHz bands
7. GSMA Intelligence calculations based on data from Tarifica
8. GSMA Intelligence Consumer Survey

CONSUMER READINESS
68 → 69

Slower to change, with literacy levels and gender inequalities holding back some countries.

- While the global adult literacy rate is 87%,[9] with more than 200 million more adults becoming literate between 2014 and 2017, a significant proportion of the unconnected continue to lack the skills (or confidence) to access and engage with mobile technology. This issue is particularly significant in low-income countries, where 40% of adults are not literate.[10]

- There is a significant gender gap in mobile internet use in low- and middle-income countries, with women 26% less likely than men to use mobile internet services. This equates to 327 million fewer women using mobile internet than men.[11]

CONTENT AND SERVICES
50 → 58

Proliferating with greater language diversity, but still require further development.

- Penetration of social media through mobile, which can provide a platform to generate relevant content, increased from 23% to 40% between 2014 and 2017, with more than 1 billion new accounts.[12]

- In 2017, 35% of all mobile applications were developed outside of North America and Europe, and 25% were from low- and middle-income countries (up from 28% and 15% respectively in 2014). This has generated significantly more mobile content in local languages.[13]

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9. UNESCO
10. UNESCO. In low-income countries, adults have also generally completed only four years of formal education compared to almost nine years globally
11. The Mobile Gender Gap Report 2018, GSMA, 2018
12. We Are Social
13. Appfigures

Asia-Pacific and MENA are the most improved regions, due to significant improvements in scores for infrastructure and content & services

2014 score (average)

Improvement by 2017

	World	Northern America	Europe	Latin America	MENA	Asia Pacific	CIS	Sub-Saharan Africa
Total	60	83	77	63	60	60	58	39
Improvement by 2017	8	5	7	8	9	9	8	6
2014 score	52	78	70	55	52	51	50	32

2014-2017

	World	Northern America	Europe	Latin America	MENA	Asia Pacific	CIS	Sub-Saharan Africa
Infrastructure	+14	+13	+16	+15	+16	+16	+14	+9
Affordability	+2	+1	+1	+1	+2	+4	+4	+3
Consumer readiness	+1	+0	+1	+1	+2	+1	+1	+1
Content & services	+7	+4	+6	+7	+11	+9	+7	+6
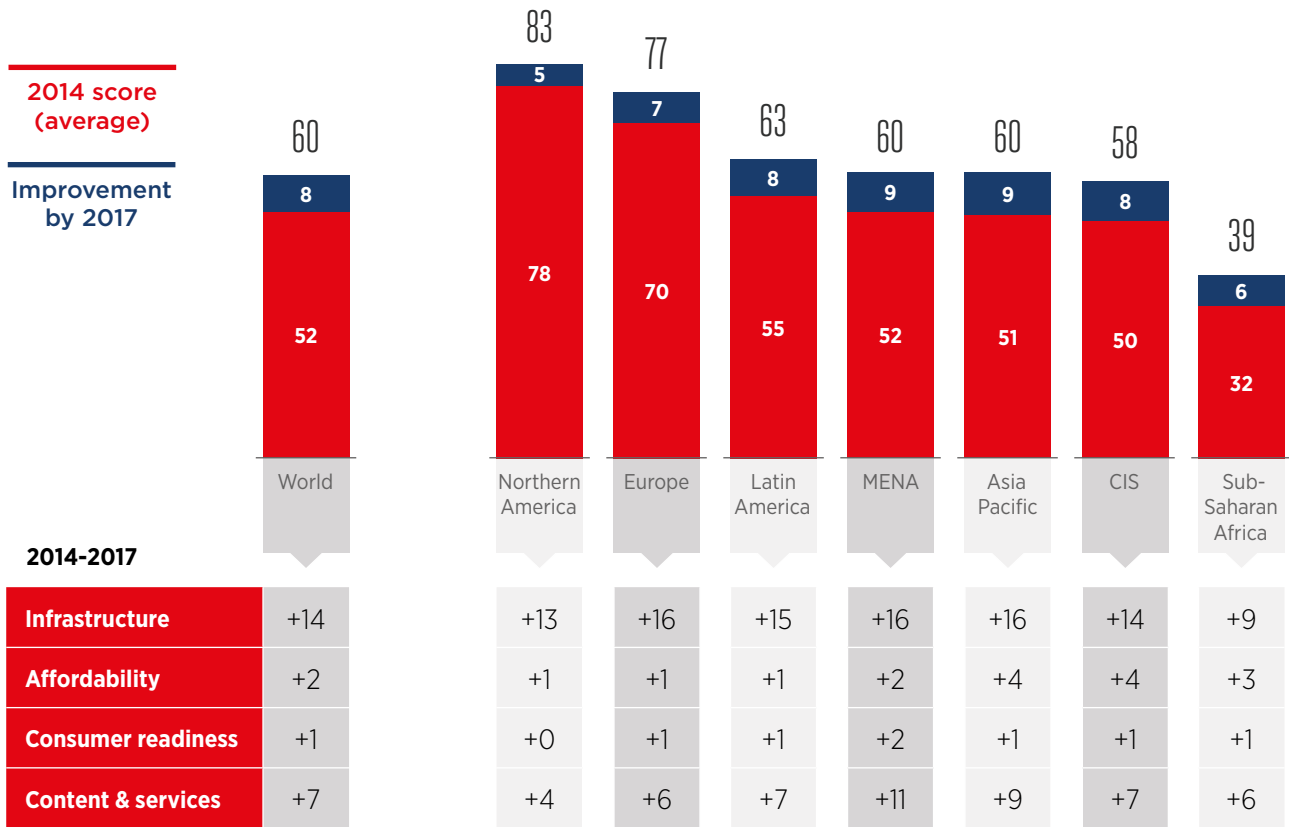
Top scoring and most improved countries by region

	World	Americas	Asia Pacific	Europe & CIS	MENA	Sub-Saharan Africa
Top scoring countries	Australia New Zealand Iceland Singapore Norway	Canada US Bahamas Uruguay Chile	Australia New Zealand Singapore South Korea Hong Kong	Iceland Norway Denmark Sweden Finland	Israel Qatar UAE Bahrain Saudi Arabia	Mauritius South Africa Cabo Verde Ghana Botswana
Most improved countries, 2014–2017	Iran Myanmar India Bhutan Turkey	Guatemala Guyana Uruguay Bahamas Panama	Myanmar India Bhutan Indonesia Vanuatu	Georgia Cyprus Serbia Kyrgyzstan Macedonia	Iran Turkey Libya Jordan Morocco	Cameroon Kenya Lesotho Côte d'Ivoire Angola

In focus: some of the most improved countries

Guatemala was Latin America's most improved country between 2014 and 2017, increasing its score by 10 points. While the majority of countries making good progress in the Index have done so with exceptional gains in one or two enablers, Guatemala achieved strong progress across three enablers. It improved its infrastructure score with the rollout of 4G networks (from 10% population coverage in 2014 to more than 50% in 2017) and enhanced network quality.[14] This was accompanied by the development of more locally relevant content and services, including e-government, social media platforms and mobile applications. Guatemala achieved an almost 10-point increase in its consumer readiness score – the largest gain of all countries in the Index. This was driven by improvements in skills, with increases in education outcomes (such as adult literacy and schooling); and gender equality, with increases in gender parity ratios for education and financial inclusion.[15] As a result, mobile internet adoption increased from 23% in 2014 to 32% in 2017.

Bhutan's improved performance between 2014 and 2017 was driven by infrastructure in particular, pushing it above the regional average. The Bhutan Infocomm & Media Authority (BICMA) assigned two 2x20 MHz lots in the 700 MHz spectrum band to operators in 2016 and 2017 respectively, increasing its dimension score for spectrum. As a result, network coverage expanded rapidly, with 4G increasing from 10% in 2014 to more than 70% in 2017, and 3G increasing from 50% to more than 80%. At the same time, Bhutan's operators were able to provide better quality services, with download and upload speeds substantially improving. Bhutan's mobile internet adoption rate consequently increased from 21% in 2014 to 29% in 2017.

Turkey increased its Index score to almost 70, driven by an improvement in its infrastructure score, which was the largest of all countries in the Index between 2014 and 2017. Following the assignment of 800 MHz spectrum in 2015, operators quickly rolled out 4G networks to 90% of the population by 2017. The assignment of spectrum in the 2600 MHz capacity band also helped operators improve network quality for users, with average download speeds almost tripling between 2015 and 2017 to 28 Mbps.[16]

Kenya's improved score was due to performance on two enablers: infrastructure and affordability. The former was driven by improved network coverage, with 3G increasing from 67% in 2014 to 85% in 2017, and 4G reaching more than a third of the population. Network quality was enhanced, notably in terms of latency. The country also improved the enabling infrastructure that supports mobile connectivity: more than half the population now have access to electricity, compared to around 30% in 2014. The country has also established additional Internet Exchange Points.[17] The affordability of mobile data baskets improved, especially for a 500 MB allowance; in 2017, this cost 1.3% of monthly GDP per capita compared to 3.7% in 2014.[18] Lastly Kenya, along with Uganda and Tanzania, has benefitted from exponential growth of mobile content in Swahili, with the number of mobile apps in the language increasing from around 5,000 in 2014 to almost 30,000 by 2017.[19] More than 4 million people in Kenya connected to the mobile internet between 2014 and 2017, increasing adoption from 16% to 24%.

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14. GSMA Intelligence calculations based on analysis by Ookla of Speedtest Intelligence data
15. UNESCO and World Bank Global Findex
16. GSMA Intelligence calculations based on analysis by Ookla of Speedtest Intelligence data
17. Packet Clearing House
18. GSMA Intelligence calculations based on data from Tarifica and ITU
19. Appfigures

2.3
Mobile delivering social impact

As the connectivity gap closes, 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). Three years into the 2030 Agenda for Sustainable Development, the mobile industry is increasing its impact across all 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 stakeholder interactions across a number of industries, notably agriculture, education and healthcare in low- and middle-income countries.

Three industry-specific characteristics help explain how the industry continues to increase its contribution across all the SDGs:

1. **Deployment of infrastructure and networks:** the mobile industry drives impact through the provision of and investment in high-performing mobile networks, which provide the foundations for the digital economy and act as a catalyst for a diverse and innovative range of services. By the end of 2018, 3G coverage reached more than 90% of the world's population, while over 80% of the global population were covered by a 4G network.

2. **Access and connectivity:** mobile operators are continuing to connect the unconnected, with more than half a billion new mobile subscribers since 2015. An increasing number of people are moving beyond voice to adopt mobile internet services, enabling them to participate in the digital economy. Since 2015, there have been over 850 million new mobile internet users, bringing the total to 3.6 billion people globally.

3. **Enabling services and relevant content:** mobile technology has enabled a range of life-enhancing services such as mobile financial services, mobile agriculture and mobile health. By the end of 2018, there were 866 million registered mobile money accounts worldwide,[20] helping to expand financial and social inclusion. Meanwhile, emerging areas such as IoT, big data and artificial intelligence are demonstrating their potential for transformative impacts on lives.

However, there is still much more the mobile industry can do. For 16 of the 17 SDGs, the industry is achieving less than half its full potential impact, and the increase in impact has slowed for most SDGs. With just 12 years left until the 2030 deadline, concerted action and an acceleration of efforts is necessary from all stakeholders – governments, the mobile industry and other sectors.

1. **Accelerating mobile connectivity**, especially mobile internet access, to unconnected populations is the first area of importance. The private sector and policymakers need to jointly address the key barriers to mobile connectivity, particularly around incentives for infrastructure investment, affordability, digital skills, the gender gap and the availability of locally relevant content and services.

2. **Providing and scaling mobile-enabled solutions** that will help achieve the SDGs, such as mobile money, digital identity and mobile health, as well as the products and services IoT is beginning to support. Here, it is important that operators, governments, international organisations and other industries work together to support the scaling of new and existing mobile business solutions.

3. The mobile industry must also **continue to drive improvements beyond 'business as usual'** and accelerate activities that contribute to the SDGs. As more companies build the SDGs into their core business, including the products and services they provide, the industry's impact on the SDGs will continue to grow.
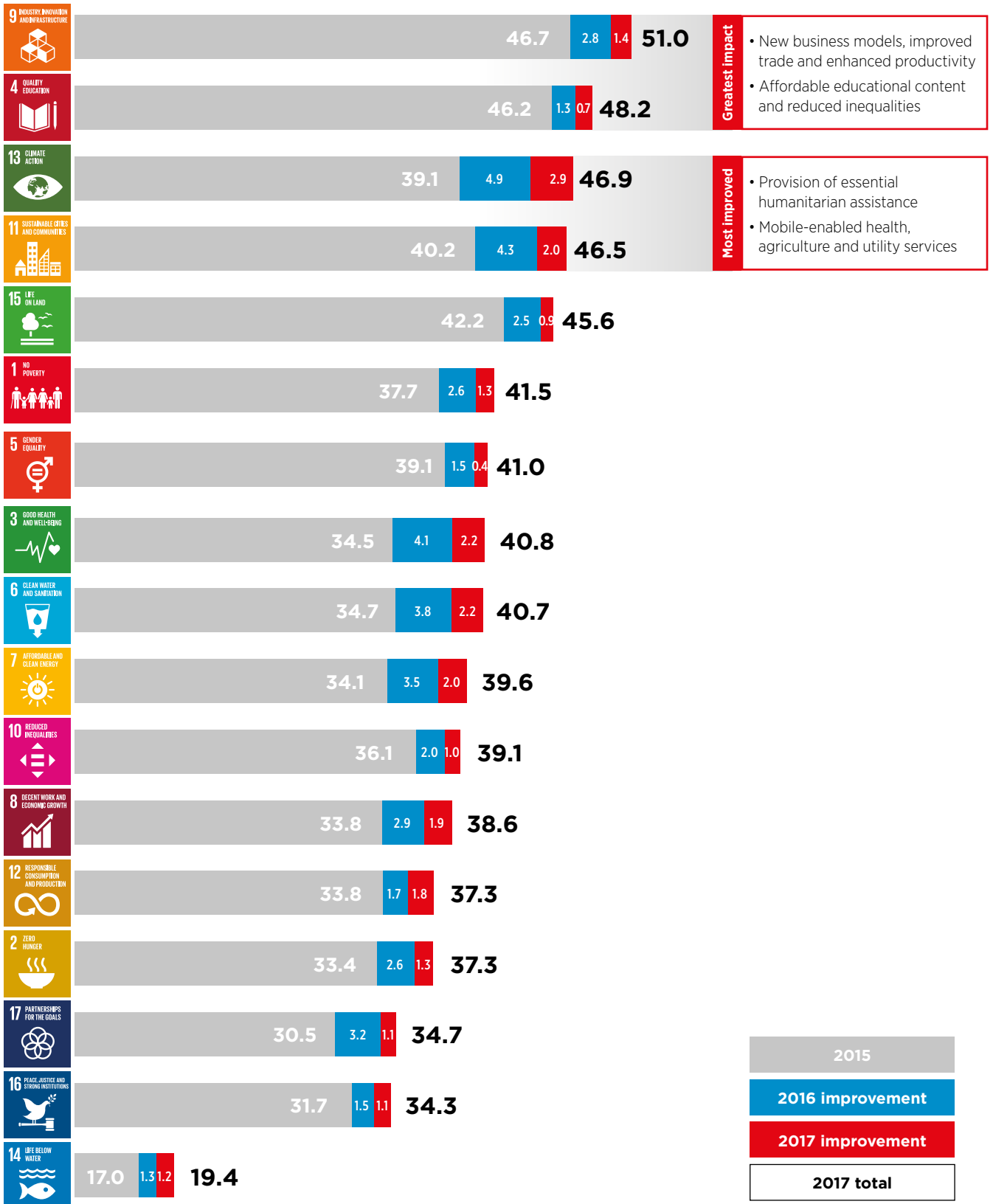
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20. 2017 State of the Industry Report on Mobile Money, GSMA

Figure 24   Source: GSMA Intelligence

Mobile is a powerful tool for achieving the UN's SDGs: since 2015, impact has increased across all 17 SDGs[21]

Normalised score (out of 100)

SDG	2015	2016 improvement	2017 improvement	2017 total
9 Industry, Innovation and Infrastructure	46.7	2.8	1.4	51.0
4 Quality Education	46.2	1.3	0.7	48.2
13 Climate Action	39.1	4.9	2.9	46.9
11 Sustainable Cities and Communities	40.2	4.3	2.0	46.5
15 Life on Land	42.2	2.5	0.9	45.6
1 No Poverty	37.7	2.6	1.3	41.5
5 Gender Equality	39.1	1.5	0.4	41.0
3 Good Health and Well-being	34.5	4.1	2.2	40.8
6 Clean Water and Sanitation	34.7	3.8	2.2	40.7
7 Affordable and Clean Energy	34.1	3.5	2.0	39.6
10 Reduced Inequalities	36.1	2.0	1.0	39.1
8 Decent Work and Economic Growth	33.8	2.9	1.9	38.6
12 Responsible Consumption and Production	33.8	1.7	1.8	37.3
2 Zero Hunger	33.4	2.6	1.3	37.3
17 Partnerships for the Goals	30.5	3.2	1.1	34.7
16 Peace, Justice and Strong Institutions	31.7	1.5	1.1	34.3
14 Life Below Water	17.0	1.3	1.2	19.4

Greatest impact
- New business models, improved trade and enhanced productivity
- Affordable educational content and reduced inequalities

Most improved
- Provision of essential humanitarian assistance
- Mobile-enabled health, agriculture and utility services

Legend:
- 2015
- 2016 improvement
- 2017 improvement
- 2017 total

21. For more information, see 2018 Mobile Industry Impact Report: Sustainable Development Goals

03
Key trends shaping the mobile industry

5G is now upon us, bringing with it the promise of a whole host of exciting new services and opportunities. As the boundaries between mobile and the wider digital ecosystem continue to blur, and as data monetisation poses a continued challenge, many 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 approaches, timelines and scales, the predominant drivers are the rise of IoT, the evolution of the content ecosystem, the transformative power of AI for network operations and services, and the onset of a new era of connected devices.

While telecoms will continue to be the dominant source of revenue for operators in the near to medium term, these new opportunities have the potential to provide new revenue streams and add business capabilities to allow operators to play a key role in the future digital ecosystem.

3.1
The 5G era is here: where is the money?

The US and South Korea have already launched commercial 5G networks, and 16 more major countries will have launched 5G networks by the end of 2019. In parallel, 5G smartphones are expected to be released in the first half of the year, and WRC-19 in October/November will have an impact on the future of 5G. It will take some time for 5G to hit critical mass. Three factors will affect the speed at which 5G is adopted and the value that it will generate.

1. Opportunities: Operators around the world generally agree that the provision of enhanced mobile broadband (eMBB) to the consumer market will be the core proposition in early 5G deployments, along with, in some cases, 5G-based fixed wireless access (FWA) services offering a potentially lower cost and faster means – compared to FTTH – of expanding high-speed services to households and businesses.

Enterprise use cases that use massive IoT and/or ultra-reliable, low-latency communications to transform existing verticals (such as manufacturing, utilities, healthcare, retail, agriculture and automotive) could gain scale at a later stage. Further unknown use cases could be developed, with the potential to revolutionise industries and consumer experiences.

2. Cost considerations: 5G networks are distinct from previous generations because of the level of heterogeneity, flexibility and automation inherent in their design. The cost dynamics of 5G networks will therefore not only be influenced by traditional factors (e.g. capacity and coverage), but also new factors such as network flexibility and network ownership. Some of these factors are already being addressed in 4G networks (for example, NFV/SDN for network flexibility and edge computing for low-latency capabilities), but their impact on the cost of 5G network rollout and operations is less clear.

While much of the industry consensus has been shaped by infrastructure competition among operators (with networks built by established equipment vendors and managed by engineers), the 5G era will likely see the introduction of new models of network ownership (e.g. private 5G networks), new ways of building networks (e.g. using open source concepts) and new network management approaches (e.g. using AI-based automation).

3. Dependencies: Various elements will act as barriers to 5G development if not in place, such as a supportive policy framework (of which spectrum is key), completion of standards and availability of 5G devices. The rate of 5G adoption will also be determined by prevailing market conditions including legacy network availability, affordability and value perception.

In terms of value perception, an immediate awareness issue needs to be addressed. Despite much being made at events and in the media of the new services that 5G will enable, these do not resonate so strongly with consumers.[22] More widespread is the perception that 5G will mainly deliver improved data speeds and coverage – essentially a continuation of previous generations of mobile technology and doing the same thing, just better. The challenge for operators therefore lies in influencing how consumers think about 5G; this will go a long way to determining its value.

22. "5G's great expectations: do consumers see anything novel?", GSMA Intelligence, January 2019

5G is an inevitable network evolution, and will create significant opportunities if the right conditions are in place

Opportunities
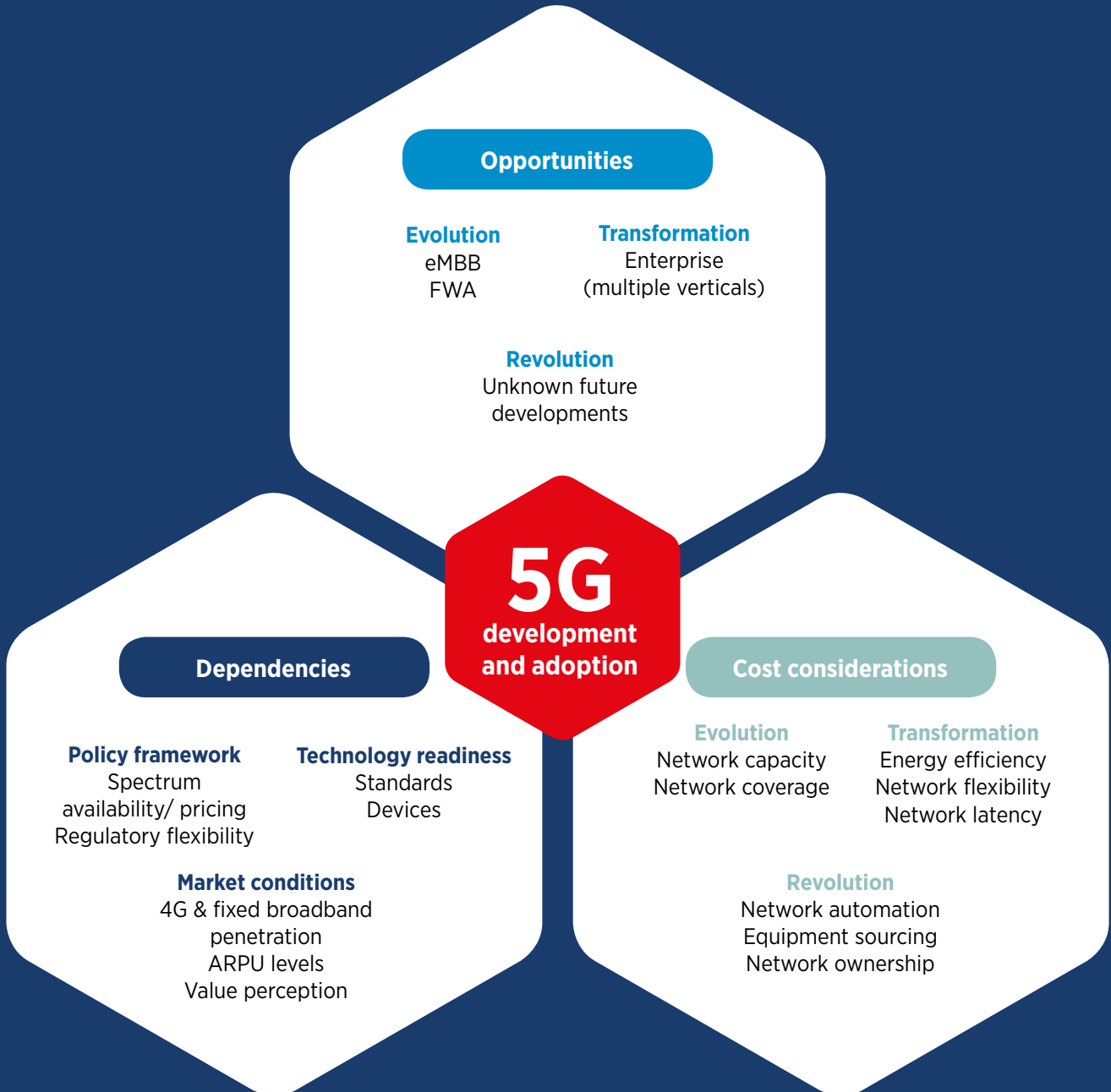
Evolution
eMBB
FWA

Transformation
Enterprise
(multiple verticals)

Revolution
Unknown future
developments

5G
development
and adoption

Dependencies

Policy framework
Spectrum
availability/ pricing
Regulatory flexibility

Technology readiness
Standards
Devices

Market conditions
4G & fixed broadband
penetration
ARPU levels
Value perception

Cost considerations

Evolution
Network capacity
Network coverage

Transformation
Energy efficiency
Network flexibility
Network latency

Revolution
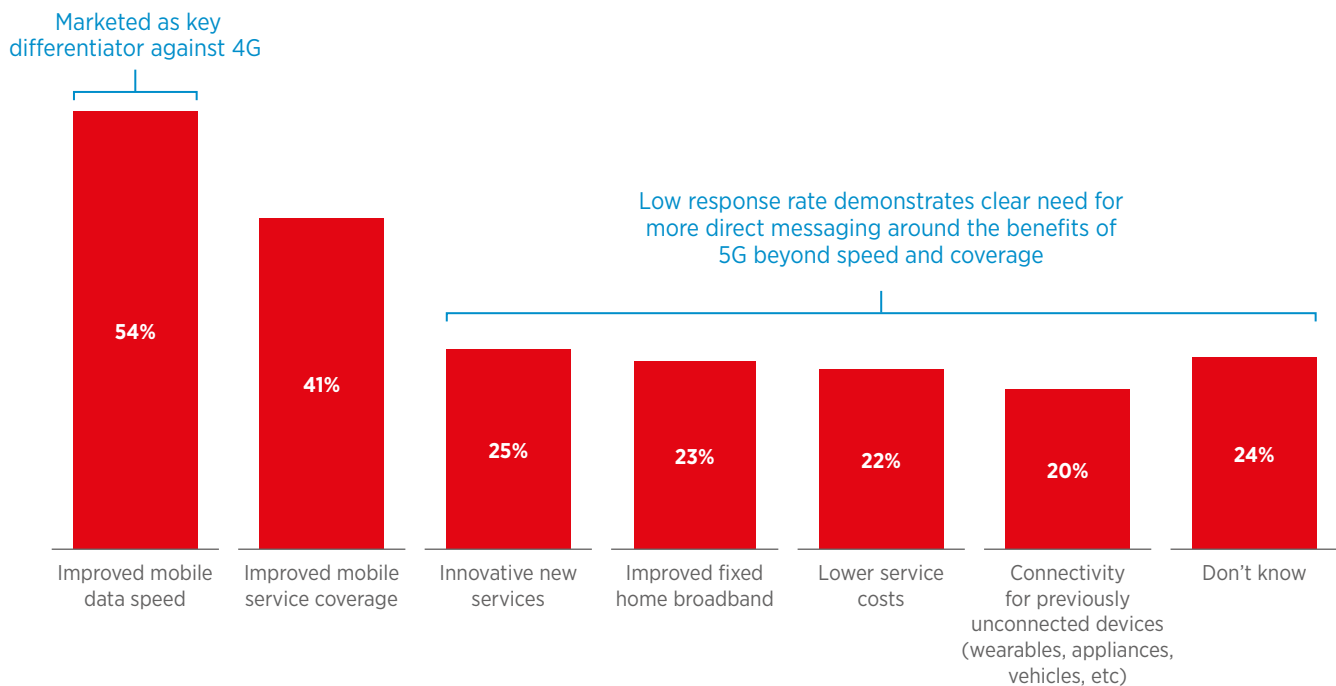Network automation
Equipment sourcing
Network ownership

Despite opportunities for new services and experiences, consumer expectations for 5G centre on faster speeds

Percentage of respondents

Question

"From what you know of 5G, what do you expect it will deliver?"

Respondents could select multiple answers.

Marketed as key differentiator against 4G

Low response rate demonstrates clear need for more direct messaging around the benefits of 5G beyond speed and coverage

Improved mobile data speed	Improved mobile service coverage	Innovative new services	Improved fixed home broadband	Lower service costs	Connectivity for previously unconnected devices (wearables, appliances, vehicles, etc)	Don't know
54%	41%	25%	23%	22%	20%	24%

3.2
## IoT: seizing a share of the trillion-dollar opportunity

The number of IoT connections (cellular and non-cellular) will triple worldwide between 2018 and 2025 to reach 25 billion. Growth will be driven by a proliferation of uses cases in the smart building and smart home segments, which will together account for more than half the 16 billion new IoT connections over this period. Rising investor financing and a supportive ecosystem for innovation will help support this growth, along with regulatory pressure for energy efficiency. In addition, developments in network connectivity to suit a variety of IoT use cases, led by operators, will play a key role. At the end of 2018, there were 83 commercial deployments of LTE-M and NB-IoT worldwide.

Global IoT revenue meanwhile will increase at an average annual rate of 23% to 2025 to reach $1.1 trillion, a fourfold increase on 2018. However, connectivity will become increasingly commoditised, declining from 9% of total IoT revenue in 2018 to 5% in 2025. Mobile operators are therefore deploying different strategies and business models to move beyond offering connectivity only: their role in the value chain could vary from providing essential tools and capabilities for ecosystem partners to build IoT solutions, to becoming an end-to-end IoT solution provider themselves.

Some 16 billion new IoT connections by 2025; smart building and smart home are key growth verticals

Billion
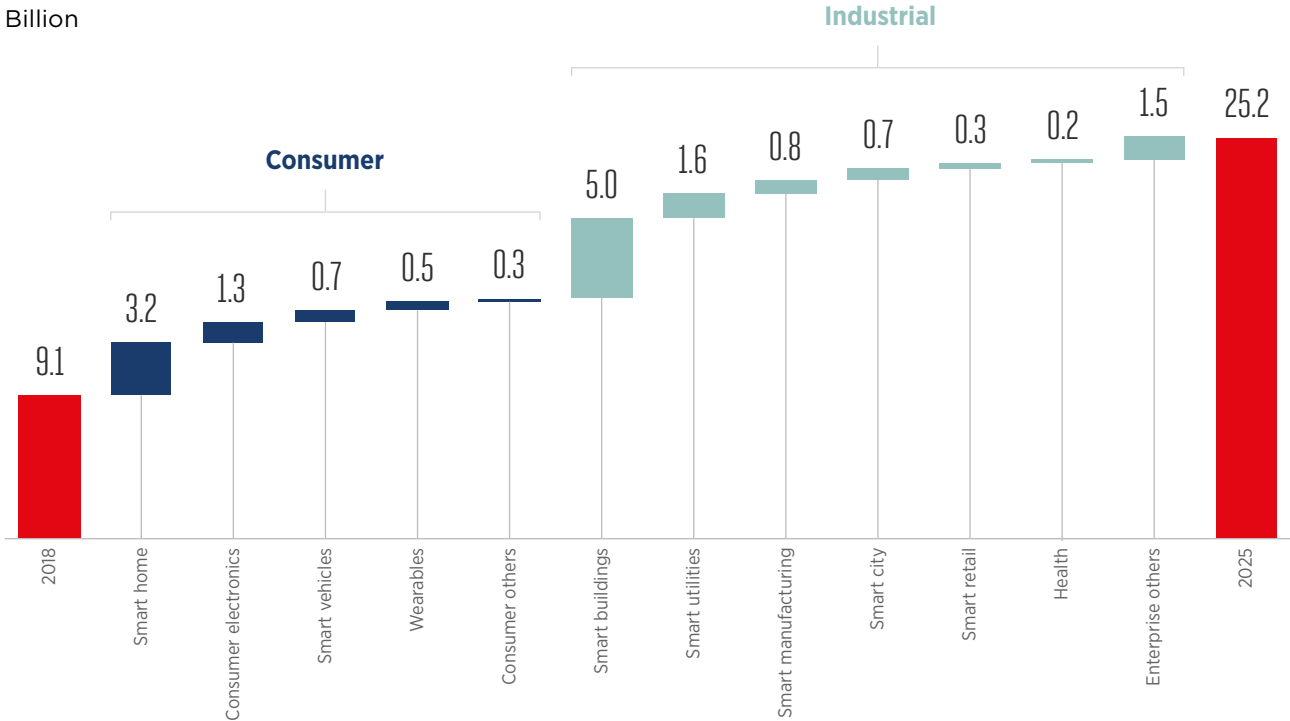
Several trends are driving early development of the two largest growth areas within IoT:

Smart buildings

- **Regulatory:** Energy efficiency directives continue to drive adoption of IoT technologies in lighting, HVAC and building automation, where the reduction of energy consumption becomes the key compliance metric for building owners to meet emissions reduction targets. Examples include Europe's Energy Performance of Buildings and 2012 Energy Efficiency directives, and China's recent (13th) 5-year Plan. Such directives are also putting pressure on lighting vendors to launch smart products in a bid to be more energy efficient and reduce costs. To this end, Osram acquired Digital Lumens in August 2017 (gaining IoT capabilities in industrial buildings), while Philips Lighting relaunched as a new smart lighting brand 'Signify' in March 2018.

- **Building automation and security/surveillance:** Traditional building automation giants are expanding their propositions to support increased requirements. For example, Siemens acquired building automation software specialists J2 Innovations and Englighted Inc in May 2018, while Otis and Kone have added maintenance service packages to their elevator selling/leasing businesses. Meanwhile, mobile operators such as Vodafone, AT&T and Telefonica are adding connected CCTV and security analytics services to their IoT contracts.

- **Enterprise readiness and productivity gains:** Building and facilities owners are keen to maximise automation to improve work processes and adapt to changing working methods, increasingly using IoT and cloud-based IT processes as part of their digital transformation strategies.

Smart home[23]

- **Innovation:** Smart home applications are being driven by advances in smart speakers, voice recognition, open-source software and smart lighting/appliances. There are also ongoing developments in connectivity to best suit a variety of use cases, as well as open labs to help developers test new concepts and certify products.

- **Financing and M&A:** Over the last three years, nearly $2 billion has been invested globally in smart home startups and emerging companies: Amazon, Baidu, Intel, Microsoft, Qualcomm and Samsung have been the most active investors in recent years. Amazon's acquisition in March 2018 of Ring (a video doorbell and home security camera maker), worth more than $1 billion, is one of the largest deals in the smart home arena, along with Google's acquisition of Nest Labs in 2014.

- **Proliferation of use cases:** Smart homes are increasingly becoming a platform for a suite of digital services, applications and devices. Enabling home network infrastructure (routers, extenders and other home networking devices) is currently the largest application. However, home security devices (internet-enabled cameras, security alarms, smoke alarms and locks), energy monitoring (smart plugs, lighting, air conditioning and thermostats) and home appliances (a niche market consisting of connected fridges, washing machines and smaller home appliances such as coffee machines) will be the fastest growing segments.

- **Early customer benefits:** While smart homes are still a niche market, early adopters are experiencing a range of benefits including greater energy cost management and simplicity of use of digital applications. Environmental consciousness is also a driver of smart home adoption, with an increasing number of governments and local municipalities introducing incentives to boost energy efficiency.
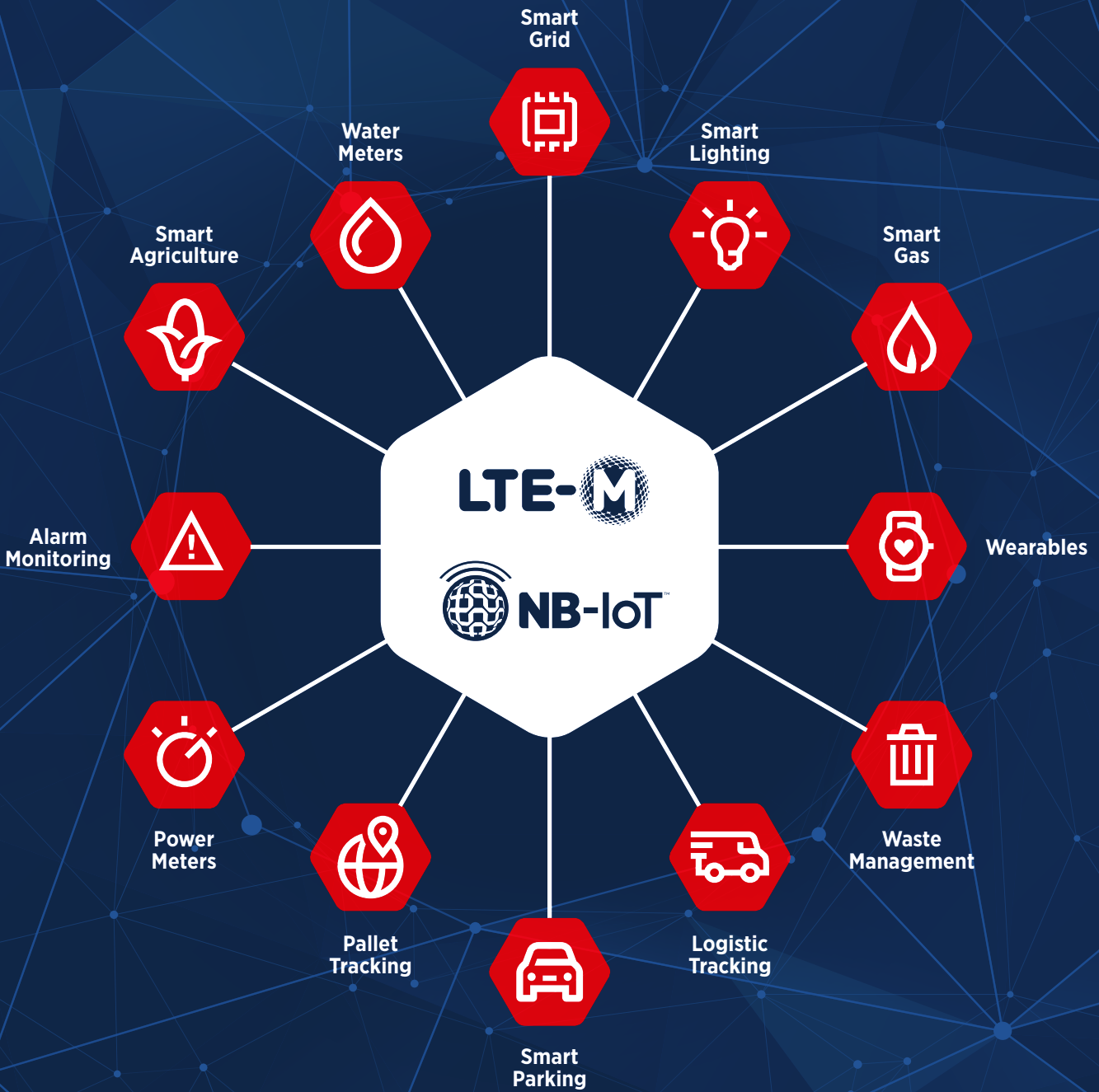
23. For more information, see Smart home: from niche to mainstream by 2025, GSMA Intelligence, 2018

Rapid growth in mobile IoT deployments[24] supporting applications requiring broad coverage, a long battery life and low cost, yet secure, connectivity
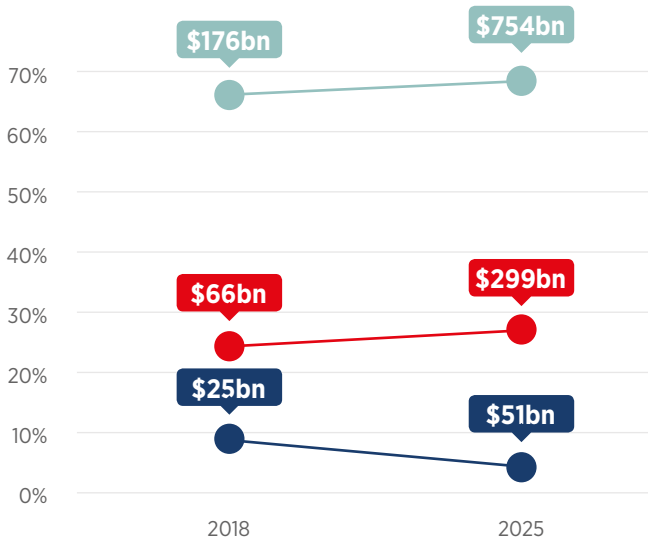
24. 83 by the end of 2018, up from 30 in 2017. For more information, see: https://www.gsma.com/iot/deployment-map/#deployments

Connectivity will be commoditised; value generation lies in the applications, platforms and services layer

Percentage of total IoT revenue

Applications, platforms and services (which includes cloud data analytics and security) is the key growth area of IoT
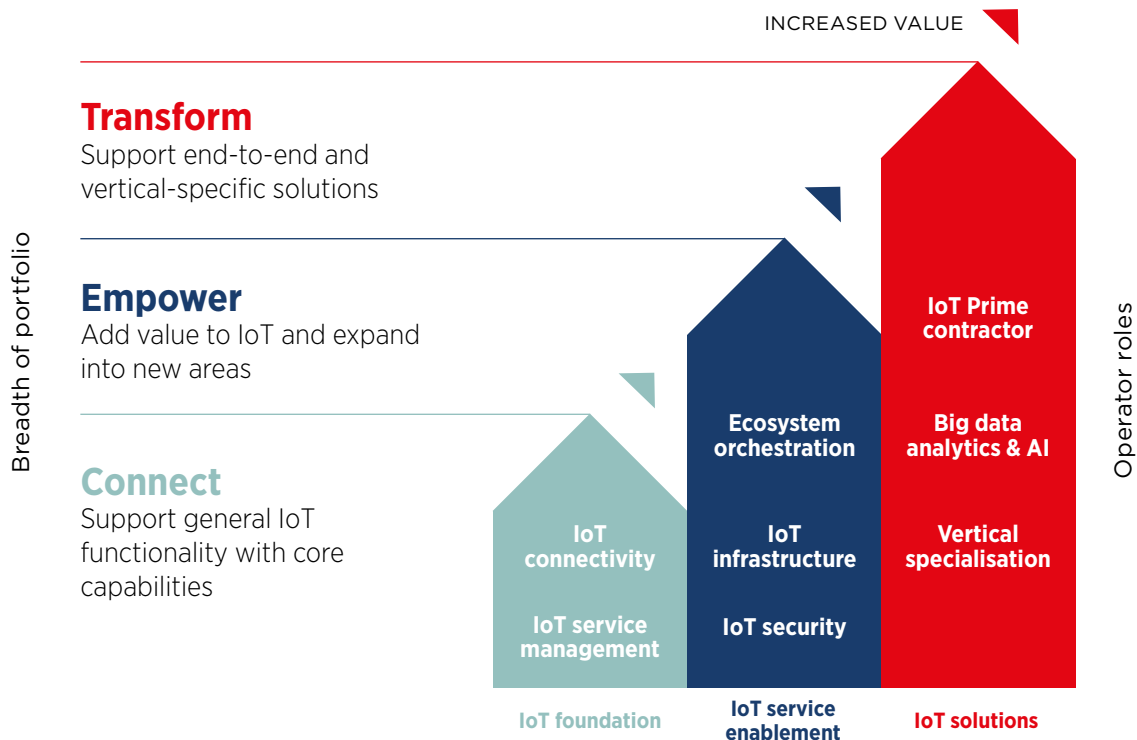
Professional services (encompassing systems integration, consulting and managed services) will increase in share, fuelled by the continued digitisation of industries

Connectivity will commoditise and decline in share, making it difficult for operators to compete on the data pipe alone

Operators should expand beyond connectivity into service enablement and/or end-to-end service provision, to create significant value[25]

Transform
Support end-to-end and vertical-specific solutions

Empower
Add value to IoT and expand into new areas

Connect
Support general IoT functionality with core capabilities

Breadth of portfolio

INCREASED VALUE

Operator roles

IoT Prime contractor

Ecosystem orchestration

Big data analytics & AI

IoT connectivity

IoT infrastructure

Vertical specialisation

IoT service management

IoT security

IoT foundation

IoT service enablement

IoT solutions

25. For more information, see Opportunities in the IoT: Evolving roles for mobile operators, GSMA, 2018

3.3
Content: operators seeking to capitalise on rapidly evolving ecosystem

The content sector is undergoing significant transformation driven by shifting consumer behaviour, new players and changing content production and distribution models. Consumption of digital content, particularly video, is growing in most markets around the world, and mobile is a key driver. The number of people regularly watching video on their devices, as well as the average time spent and frequency, are increasing globally. To benefit from this unprecedented level of content consumption, a growing number of telecoms operators are entering the content space or strengthening their existing content offerings.

Telecoms operators have been facing slowing revenue growth in their core mobile and fixed markets and are therefore looking for opportunities in adjacent markets. Pay-TV is a clear opportunity, as it is the most adjacent market to telecoms where

the addressable market and distribution and pricing schemes are the same. Meanwhile, operators are looking to reduce subscriber churn in their core businesses, upselling to existing subscribers and attracting higher ARPU premium customers.

Content addresses these different operator needs and is therefore seen as a natural next move for telecoms operators. There are various potential routes to content, ranging from vertical integration to partnerships with OTT video service providers. These routes are not mutually exclusive – for many, the content strategy chosen will be a combination of routes. For more information, see the GSMA Intelligence reports *Digital disruption in consumer entertainment: what lies ahead?* and *All eyes on content: operator routes to success.*

Figure 31   Source: GSMA Intelligence

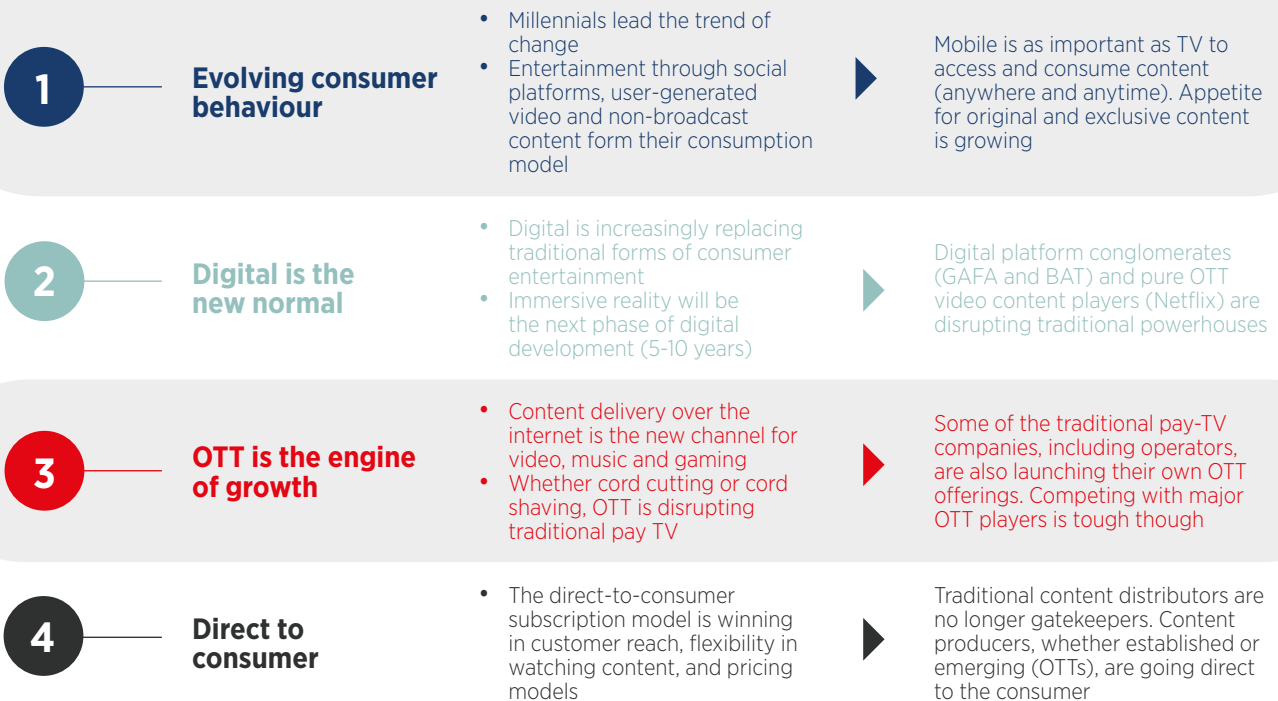## Four major trends are driving unprecedented transformation in the consumer entertainment sector

1	Evolving consumer behaviour	• Millennials lead the trend of change • Entertainment through social platforms, user-generated video and non-broadcast content form their consumption model	▶	Mobile is as important as TV to access and consume content (anywhere and anytime). Appetite for original and exclusive content is growing
2	Digital is the new normal	• Digital is increasingly replacing traditional forms of consumer entertainment • Immersive reality will be the next phase of digital development (5-10 years)	▶	Digital platform conglomerates (GAFA and BAT) and pure OTT video content players (Netflix) are disrupting traditional powerhouses
3	OTT is the engine of growth	• Content delivery over the internet is the new channel for video, music and gaming • Whether cord cutting or cord shaving, OTT is disrupting traditional pay TV	▶	Some of the traditional pay-TV companies, including operators, are also launching their own OTT offerings. Competing with major OTT players is tough though
4	Direct to consumer	• The direct-to-consumer subscription model is winning in customer reach, flexibility in watching content, and pricing models	▶	Traditional content distributors are no longer gatekeepers. Content producers, whether established or emerging (OTTs), are going direct to the consumer

Content consumption, particularly video, is rising. Mobile is a key driver, with more people watching video on their devices for longer and more frequently

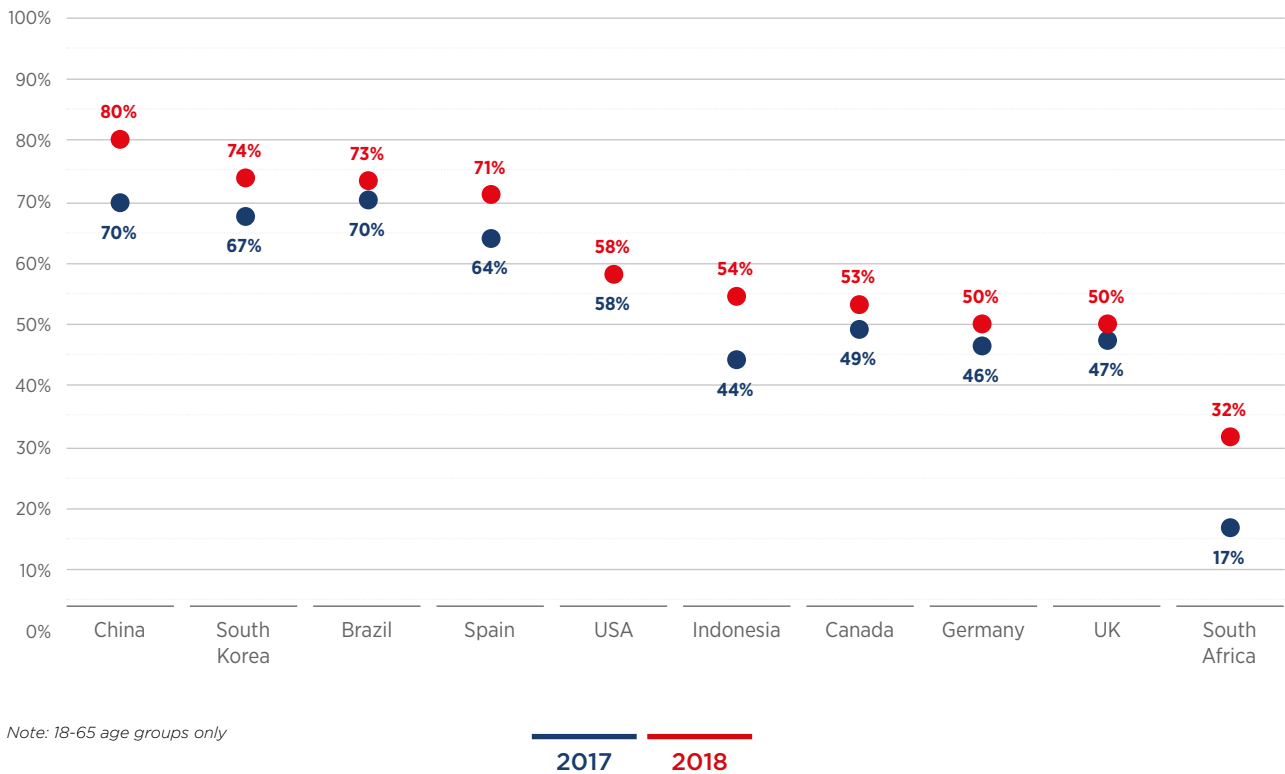Percentage of smartphone users watching free online video at least once a month

Note: 18-65 age groups only

2017   2018

Three main reasons for operators entering the content space

| New revenue stream beyond core business | Media and Entertainment as percentage of total revenue (Q3 2018) AT&T ~40% | kt ~15% | T ~10% |

| Defending core business | Fixed broadband churn reduction (Q3 2018, year-on-year) orange FR 3ppts ES 5ppts PL 5ppts |

| Building a premium customer base | Fusión ARPU all-time high in Q2 2018 Telefónica €89.5 (+5.5% yoy) |
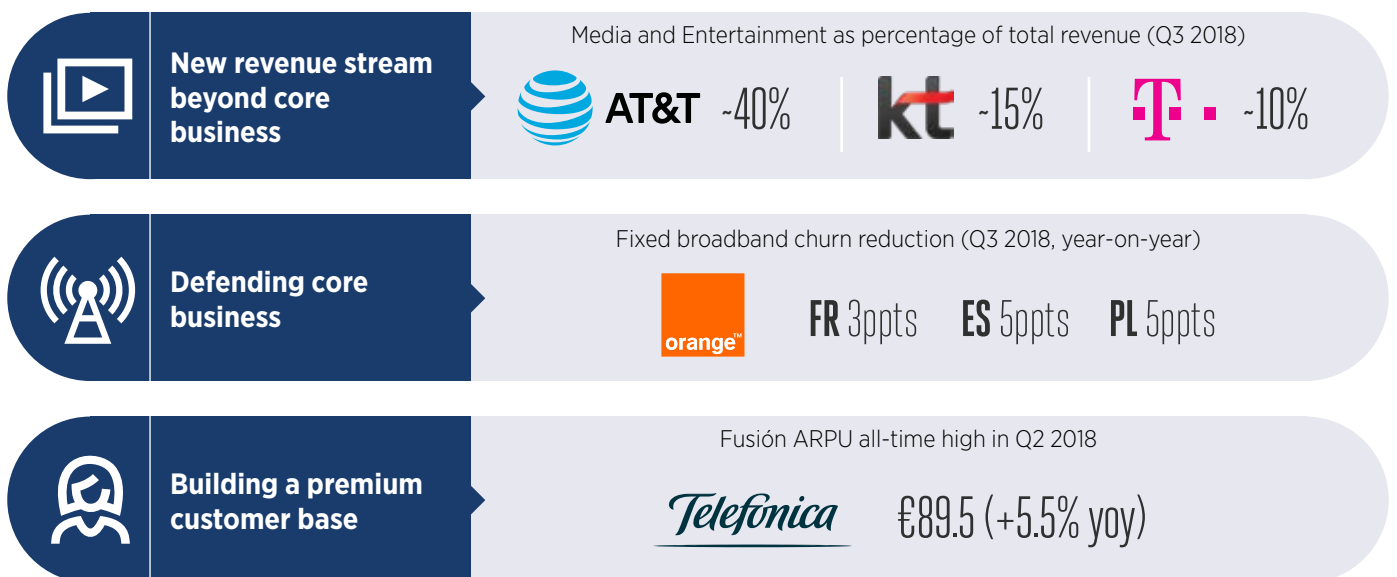
Figure 34   Source: GSMA Intelligence

Operators have different routes to content; for some, content strategy is a blend of routes

Greater presence across the content value chain	Aggregation and distribution	Premium content as competitive advantage
❶ Vertical integration Expanded presence in the content value chain Requires large-scale M&A *E.g. AT&T acquisition of Time Warner*	**❷ Pure content aggregation** Traditional aggregation and distribution Most prevalent strategy for operators *E.g. Vodafone, America Movil, Deutsche Telekom, China Telecom, Airtel*	**❹ Acquire premium content rights** Sports rights is the most common approach Is becoming more expensive *E.g. BT Sport's acquisition of UK Premier League football rights*
	❸ Partner Gaining momentum as an attractive route for both telecoms operators and OTT video service providers *E.g. Telefonica partnership with Netflix*	**❺ Commission content** Entry point for exclusive original programming *E.g. Atrium TV commissioning club with members including BT, Deutsche Telekom and Orange*
		❻ Own content production Set up their own production studios Provides full content rights *E.g. Telefonica producing own content under its Movistar+ brand*

Figure 35   Source: GSMA Intelligence

No single strategy to success: different routes to content have different challenges/rewards

	Time to market	Media expertise required	Cost	Monetisation potential	Contribution to revenue
1 Vertical integration	❌ LONG	✅ LOW	❌ HIGH	✅ HIGH	✅ HIGH
2 Pure content aggregation	❌ LONG	🟠 MEDIUM	❌ HIGH	🟠 MEDIUM	✅ HIGH
3 Partnering	✅ SHORT	✅ LOW	✅ LOW	❌ LOW	❌ LOW
4 Acquiring premium content	🟠 MEDIUM	🟠 MEDIUM	🟠 MEDIUM	🟠 MEDIUM	🟠 MEDIUM
5 Commissioning content	✅ SHORT	🟠 MEDIUM	✅ LOW	🟠 MEDIUM	🟠 MEDIUM
6 Own content production	🟠 MEDIUM	❌ HIGH	🟠 MEDIUM	✅ HIGH	❌ LOW

3.4
AI: transforming telcos

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 greater learning of customer behaviour. This is reflected in rapidly growing investments in AI at the venture-capital, enterprise and national levels.

Global revenue from AI services is expected to reach $90 billion by 2025.[26] Beyond that, AI could have a significant impact on the wider economy: AI could potentially contribute $16 trillion to global GDP by 2030, equivalent to an uplift of 14% (this could be as much as 26% in China).[27] This would be through a combination of productivity gains from businesses automating processes and augmenting their existing labour force with AI technologies and increased consumer demand resulting from the availability of personalised and/or higher-quality, AI-enhanced products and services.

While the AI industry is currently dominated by the big tech players in the US (Amazon, Apple, Facebook, Google, IBM and Microsoft) and increasingly China (Alibaba, Baidu and Tencent), operators across the world are also growing their focus on AI. For operators, the range of AI-based applications is moving beyond chatbots and digital assistants to network operation/planning, customer care, advertising and AI as a service.

Figure 36   Source: CB Insights, KPMG

AI is supported by a vibrant and rapidly growing investment ecosystem

$ billion

GLOBAL VC FUNDING IN AI

$18.9

$4.6

2015 — **4x** → 2018

ENTERPRISE INVESTMENT IN AI

$232

$12

2018 — **19x** → 2025
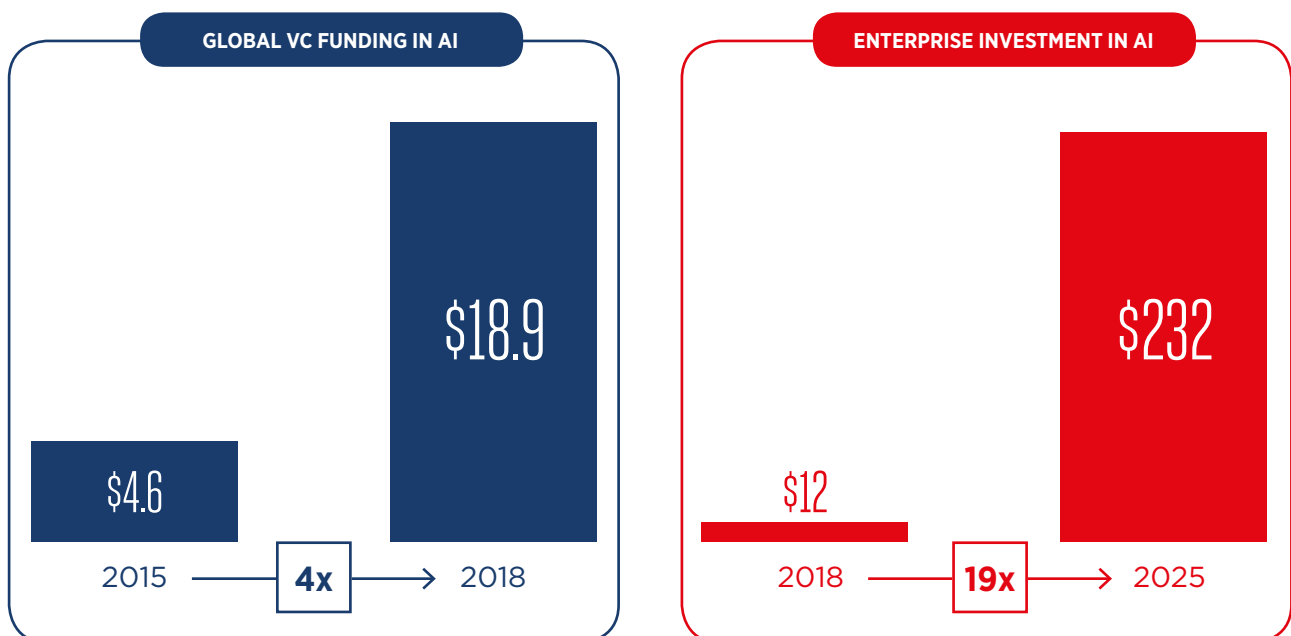
Note: includes AI, machine learning and RPA (robotic process automation)

26. Statista
27. "Sizing the prize: What's the real value of AI for your business and how can you capitalise?" PwC, July 2017

China's influence is growing in AI

	🇺🇸 USA	🇪🇺 EUROPE	🇨🇳 CHINA
	The world leader Cutting-edge expertise held by private tech companies	**A more ethical approach** AI leadership based on European principles	**The future AI super-power?** Seeking AI world leadership by 2020
PUBLIC POLICY	No central AI policy	Focus on role of ethics in addition to AI capabilities	National plan to accelerate AI development by 2020
PUBLIC FUNDING	$0bn for 2018-2020 $2bn DARPA funding	EU investing €1.5bn by 2020 UK £1bn, France €1.8bn	Estimated government investment ~$30bn by 2020
STRATEGIC ADVANTAGE	Mature research, talent and venture capital pools	Strong regulation and privacy protection	Enormous amount of data Less stringent regulation on privacy

Operators are experimenting with AI across different areas to improve internal operations and to offer new products/services to customers

OPERATIONS	SERVICES	PLATFORMS
Network operations	Digital assistance	Micro-services
Network planning	Smart devices & robotics	Incubator
Customer care	Marketing & sales	Strategic Investment
Security	Advertising	AI as a service

3.5
Devices: onset of a third wave focused on AI and immersive entertainment

Modern computing since 1980 has been defined by overlapping PC and smartphone eras. While smartphone ubiquity means it remains the focal point of the consumer internet economy, the range of connected devices (and therefore internet access channels) is now greater than ever. While there is still an adoption gap in emerging countries, penetration has peaked in most developed markets, where we are in the early stages of a third era of connected devices. In the most advanced countries, today's digital consumers (using PCs and smartphones) will likely become tomorrow's augmented customers, adopting emerging technologies such as AI (via smart speakers) and immersive reality.

While AI functionality is still rudimentary in the context of its potential, consumers are drawn to easy-win use cases of music and third-party app integrations (e.g. Uber): a key reason why smart speaker ownership rates have nearly doubled in high-income countries over the last 12 months. While VR has been limited by weak content libraries, expensive devices and awkward social presentation, the potential for AR is significantly higher, with use cases around entertainment, education, health and manufacturing/design.

This sets the foundations for a new set of platform wars. Amazon (vertically integrating e-commerce and Prime), Apple (extending the footprint of its services ecosystem) and Google (future proofing search by establishing a voice channel) share a common vision of colonising the home via AI-enabled speakers as a channel to their core business. Meanwhile, in VR, Samsung and Google have apparent commanding positions with Gear VR and Daydream, but Microsoft's vision of mixed reality, while longer term, could be significant. For more information, see the GSMA Intelligence report *Future of devices: smartphones, AI, immersion and beyond.*

Figure 39

Source: GSMA Intelligence Consumer Survey 2018

The range of connected devices is now greater than ever, reshaping how people interact with the digital world
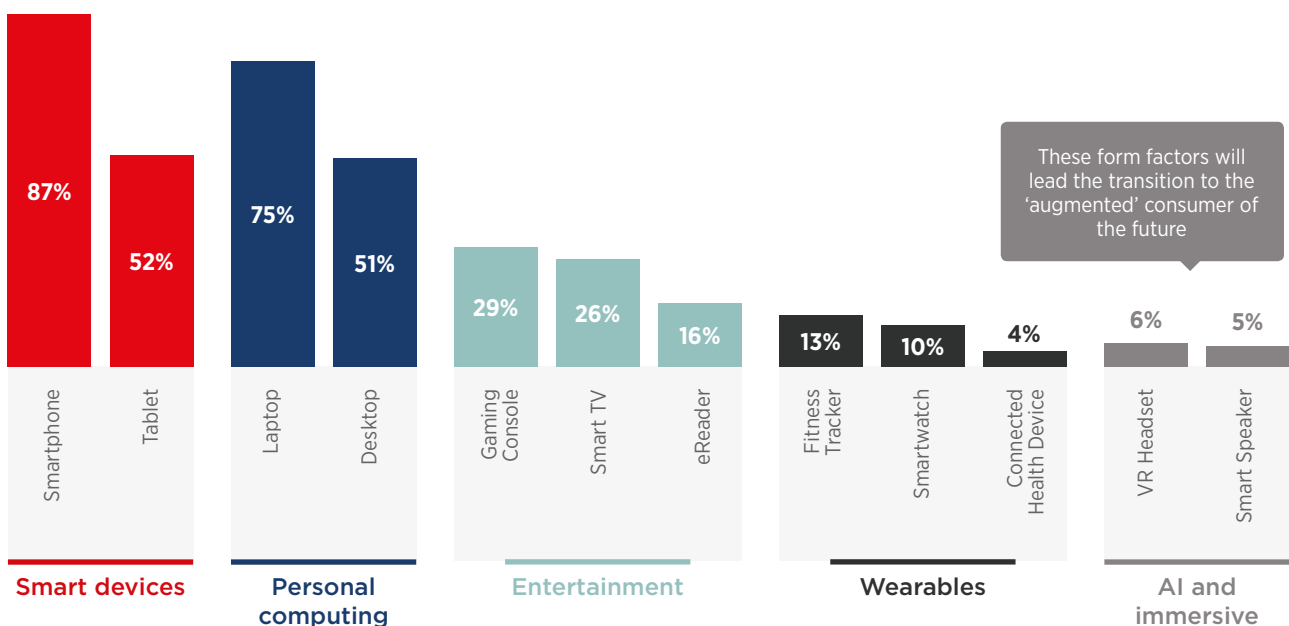
Percentage ownership (developed world average)

Smart devices		Personal computing		Entertainment			Wearables			AI and immersive	
Smartphone 87%	Tablet 52%	Laptop 75%	Desktop 51%	Gaming Console 29%	Smart TV 26%	eReader 16%	Fitness Tracker 13%	Smartwatch 10%	Connected Health Device 4%	VR Headset 6%	Smart Speaker 5%

These form factors will lead the transition to the 'augmented' consumer of the future

Figure 40

VR has been limited by weak content libraries, expensive devices and awkward social presentation; potential for AR is significantly higher


Ultra-light headset

Mobile processors and 5G modems

5G connectivity

AR

Example use cases

360-degree advertising platforms

Virtual fitting rooms

Virtual educational trips

Visualisation of patient health

Virtual attendance at sports events

Holographic assistance in site inspections

Platform and APIs

Developer tools and kit

AR content

Smart speaker ownership is growing faster than almost any other household electronics category. Amazon and Google still dominate

Smart speaker ownership
(Percentage of households)

2017   2018

- USA: 9% / 16%
- UK: 6% / 11%
- Germany: 4% / 8%
- Japan: 1% / 4%
- France: 1% / 4%
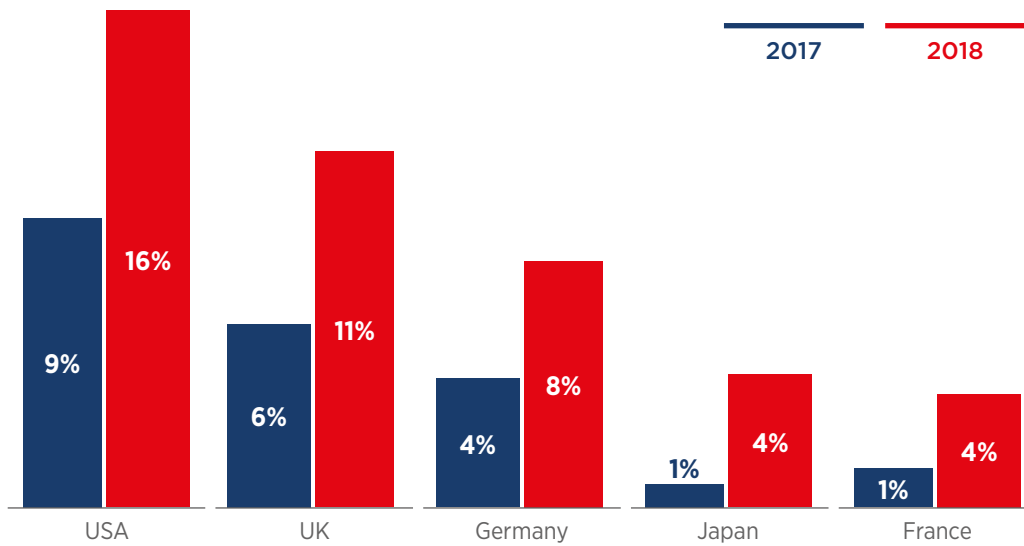
Smart speaker shipments, Q4 2018
(millions)
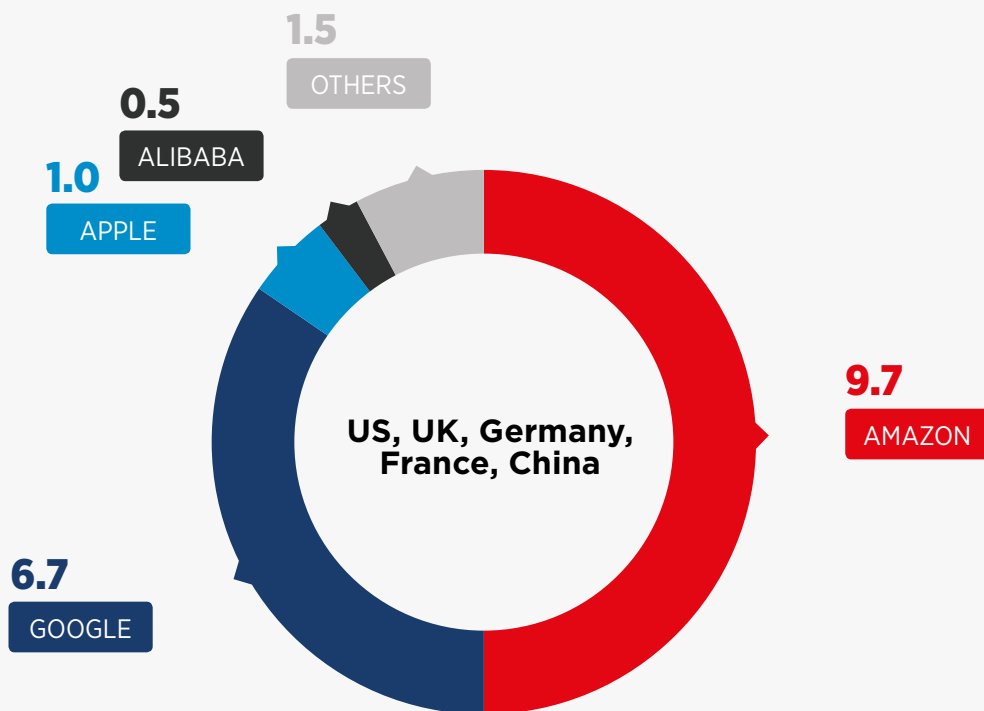
1.5 OTHERS
0.5 ALIBABA
1.0 APPLE
9.7 AMAZON
6.7 GOOGLE

US, UK, Germany, France, China

Apple and Google have built huge ecosystems around their platforms. Will history repeat itself in new device categories?

Legend:
- Other
- Non-Samsung Android
- Amazon
- Oculus
- HTC
- Samsung
- Google
- Apple

Smartphones
- Non-Samsung Android: 63%
- Samsung: 22%
- Apple: 15%

VR headsets
- Other: 22%
- HTC: 4%
- Oculus: 1%
- Samsung: 46%
- Google: 27%

Smart speakers
- Other: 10%
- Amazon: 50%
- Google: 35%
- Apple: 5%
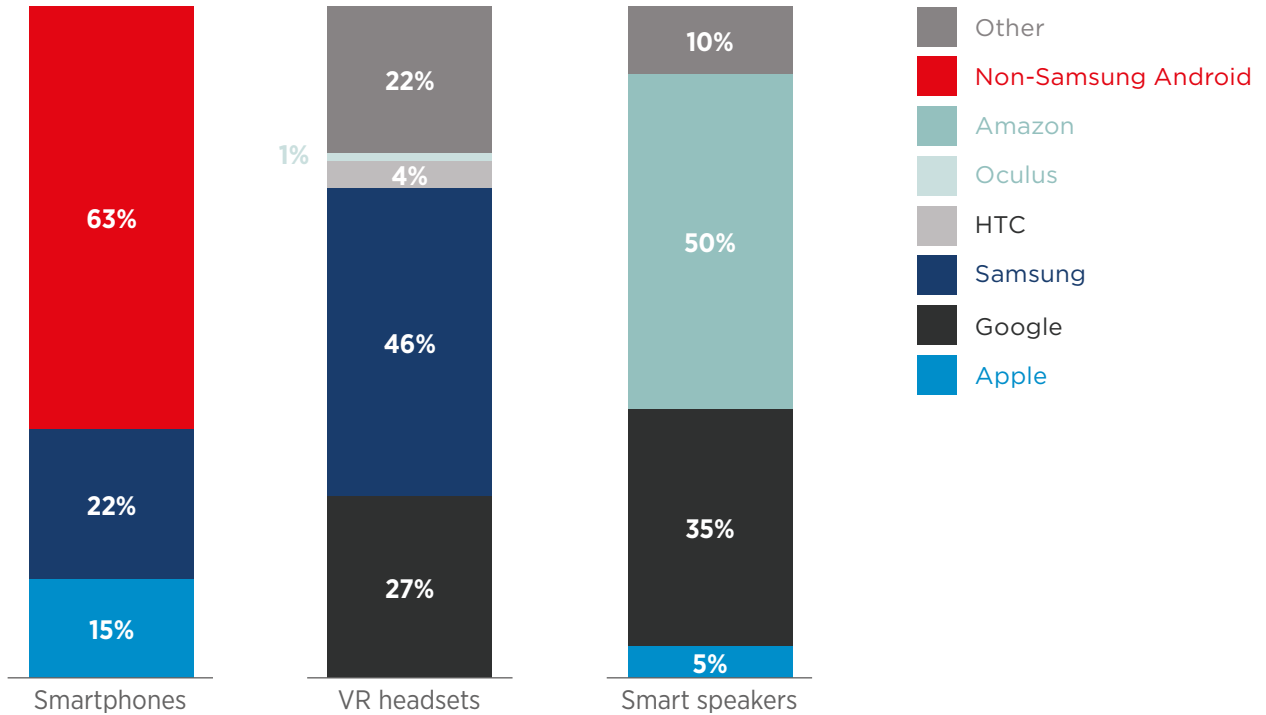
Samsung (Gear VR) and Google (Daydream) have commanding positions. But Microsoft's impact may be significant: while it doesn't manufacture VR devices itself, it has opened APIs to others (e.g. Acer and Dell), and is focused on achieving mixed reality (which could make VR obsolete)
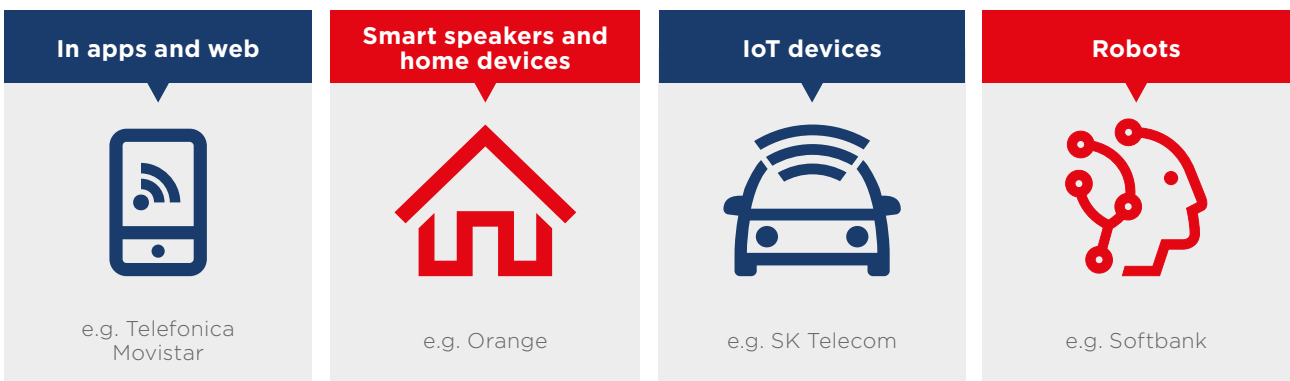
The platform is only as good as the AI. Amazon's position with Echo is a worrying sign for competitors: there is a clear strategy of vertically integrating its e-commerce and Prime business, and it also is well ahead in third-party apps that work with Alexa

Note: Smartphone and smart speaker shares for Q1 2018. VR share for 2017

Operators are integrating AI into a range of devices and services

In apps and web	Smart speakers and home devices	IoT devices	Robots
e.g. Telefonica Movistar	e.g. Orange	e.g. SK Telecom	e.g. Softbank

04
Policies for digital advancement

Global political and economic uncertainties abound in the early months of 2019, but one thing is certain: the digital transformation of society and the economy will continue, enabled by advanced mobile connectivity and technologies such as artificial intelligence, big data analytics, augmented reality and robotics. Never before has 'the future' felt so close.

To a large degree, technology policy and sector regulation determine the speed at which new technologies are adopted and implemented. Countries that embrace new technologies and reward innovation are likely to find themselves in an advantageous position over time, generating stronger digital infrastructure, a more digitally adept workforce and more robust economies.

Advanced mobile networks are a critical component of the digital future, and governments must play their part. With commercial 5G on the horizon as well as the ongoing process of 4G network expansion, the mobile industry is under considerable pressure to finance new infrastructure and new spectrum licences while paying high regulatory fees and sector-specific taxes. The mobile industry therefore urges governments to set enabling policies for 5G and to reform regulatory frameworks that are no longer suited to today's digital economy.

4.1
Laying the regulatory groundwork

In 2019, 5G is becoming real as mobile operators move from development and testing to commercial deployment. This promises network performance improvements that are essential, particularly in cities where dense populations and rising data demand put the greatest strain on mobile networks. 5G connectivity promises new waves of product and service innovation, particularly in vertical sectors. Governments and regulatory authorities have a choice: actively shape a favourable business environment that allows mobile operators to roll out 5G more quickly and broadly, or wait until operators can justify 5G deployment under current regulatory conditions. The latter risks holding back the digital advancement of the country.

The first priority is allocating sufficient spectrum for 5G. To deliver widespread, high-quality, affordable mobile broadband services, mobile operators require access to sufficient radio spectrum in specified frequency ranges. Compared with previous mobile generations, 5G requires larger contiguous blocks of spectrum to achieve its potential. Each operator needs access to 80-100 MHz of contiguous spectrum in mid-range radio frequencies (e.g. 3.5 GHz) and 1 GHz in millimetre wave bands (e.g. 26 GHz). Millimetre wave mobile bands will largely be agreed in 2019 at the World Radiocommunication Conference, where the GSMA recommends support for the 26, 40 and 66-71 GHz bands.

Authorities should not deviate from the use of exclusive licences as the mechanism for providing spectrum access. Without the guaranteed, exclusive use of specified bands, operators would not be able to justify the long-term investment that mobile networks require. Spectrum sharing frameworks can play a complementary role, but they must avoid undermining the potential of 5G.

Some authorities have considered spectrum 'set-asides', reserving spectrum in 5G priority bands for use by specific vertical sectors. This practice should be avoided as it could limit the assignment of spectrum in sufficiently large contiguous blocks to allow mobile operators to deliver the fastest 5G services. The needs of vertical sectors are better met by mobile operators, which can provide customised 5G services with all the advantages of network slicing, small cells and geographical coverage, as well as the diverse spectrum assets at mobile operators' disposal.

Complex planning procedures involving multiple layers of approval can significantly delay 5G site deployment, which requires a denser distribution of base stations, small cells and advanced antenna systems. Governments are encouraged to adopt a national code for new mobile sites and modification of existing sites, implemented by local authorities. Small cells meeting predefined criteria, considering their low visual impact, should be allowed with minimal administrative burden and be exempt from planning requirements. Governments should also facilitate access to public sector sites for operators to deploy network equipment, making buildings and street furniture accessible to mobile operators.

4.2
Regulatory reforms for the digital age

5G-related matters aside, there remains a need in most countries to modernise regulatory frameworks for the mobile sector. Countless rules are still in place that were devised for a mobile industry that was fundamentally different to how it is today — different technologies, different competitive dynamics, different market realities. The world has changed, and regulation needs to advance with the times. Authorities should be looking at two key areas for review and reform: outdated regulation and sector-specific taxation.

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. Competition policy 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 product quality and performance. Furthermore, electromagnetic field (EMF) limits should be no more stringent than international (ICNIRP) guidelines.

The mobile industry urges governments to adhere to the accepted principles of taxation and reduce the sector-specific tax burden. Lower mobile-specific taxation can free up funds for investment, supporting the future growth of the mobile network. Governments should use the tax system to encourage investment in new technologies that expand network capabilities and increase efficiency.

Technology is changing the world around us. By setting the right regulatory context, governments create incentives for technological innovation and investment that benefit all of society. When the right policy and regulatory frameworks are in place, a digital future can emerge, supported by high-speed, low-latency, secure connectivity that is as ubiquitous as it is reliable.

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