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Intelligence

Global Mobile Trends

What's driving the mobile industry?

September 2018

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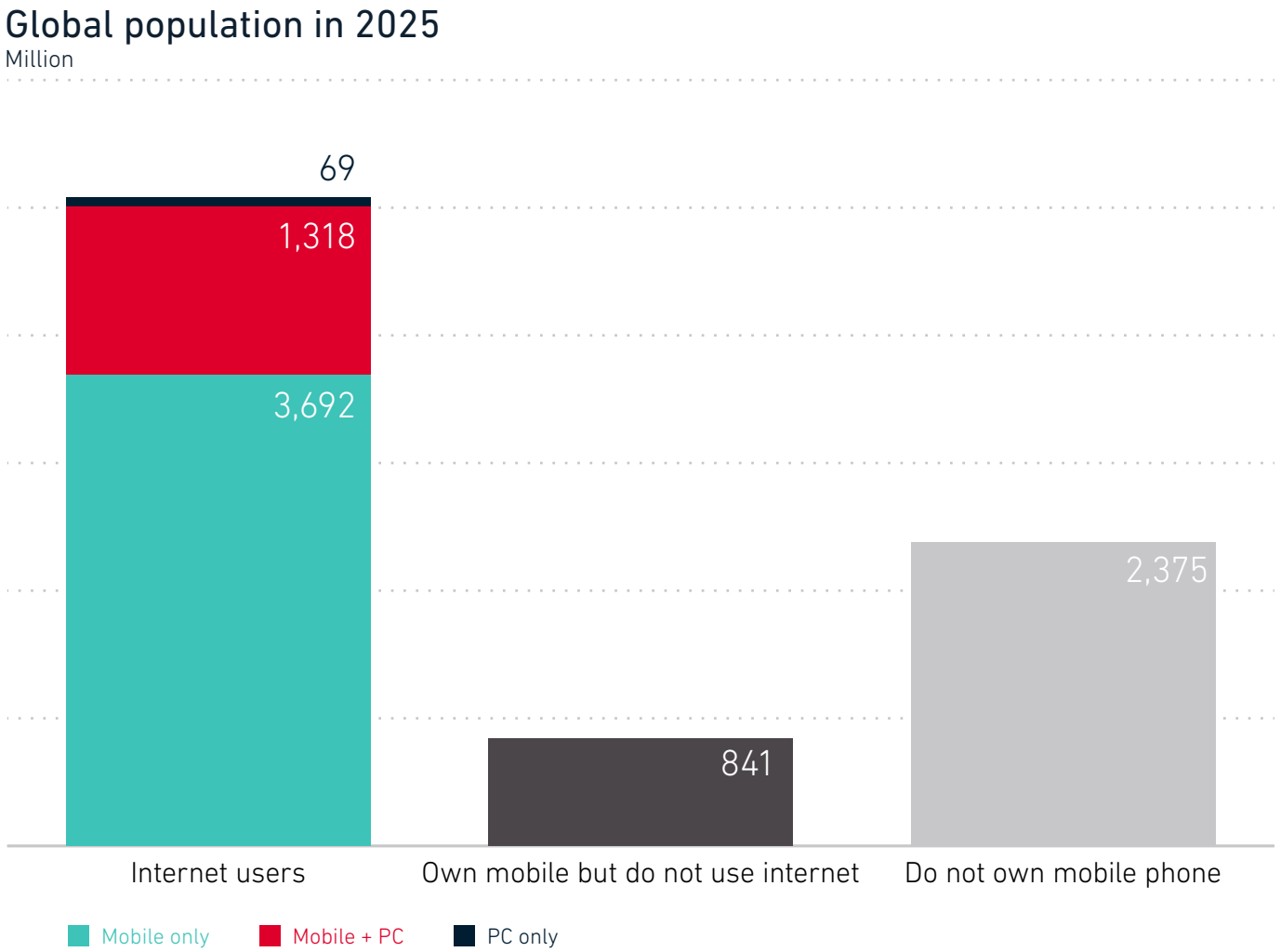
GLOBAL MOBILE TRENDS

Mega trends shaping the telco industry

A view to 2025

An incoming generation of mobile-only consumers changes the game for digital services

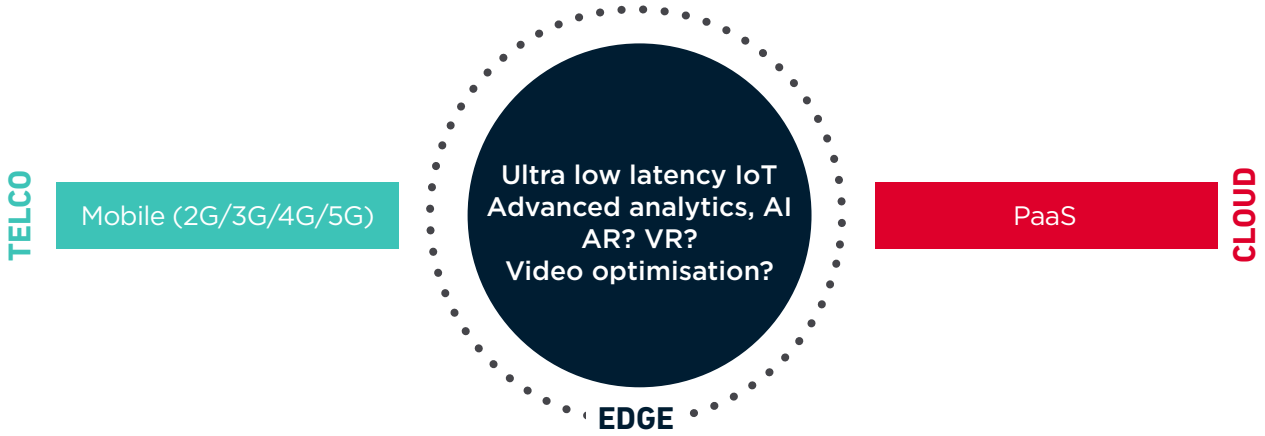
- Of the 1.6 billion new mobile internet users between now and 2025, five countries account for 50% of the growth.
- China and India are by far the biggest, but Indonesia, Nigeria and Pakistan will each account for 50 million+.
- Because fixed broadband is negligible in these markets, the next internet generation will not just be mobile first, but mobile *only*.
- This raises profound implications for how to access such a large, youthful and mostly non-English speaking demographic in delivering services ranging from healthcare to e-commerce.



Source GSMA Intelligence

The 5G and IoT opportunity for telcos lies more in enterprise than consumer

- 5G and IoT will open up new opportunities to tap diverse enterprise demands in sectors from manufacturing to power generation.
- The push to the edge raises a tension. Services could be hosted solely within the operator's own network (private hardware) or on hardware owned and operated by third-party cloud providers (public hardware).
- Telcos will become frenemies with Amazon Web Services (AWS), Microsoft, IBM and other cloud companies: on the one hand, they will compete for enterprise clients on low-latency IoT and analytics; on the other hand, they will be partnering or outsourcing for capacity.



69% of CEOs surveyed in 2017 rated enterprise services as the most important revenue growth opportunity from 5G

Enterprise connections

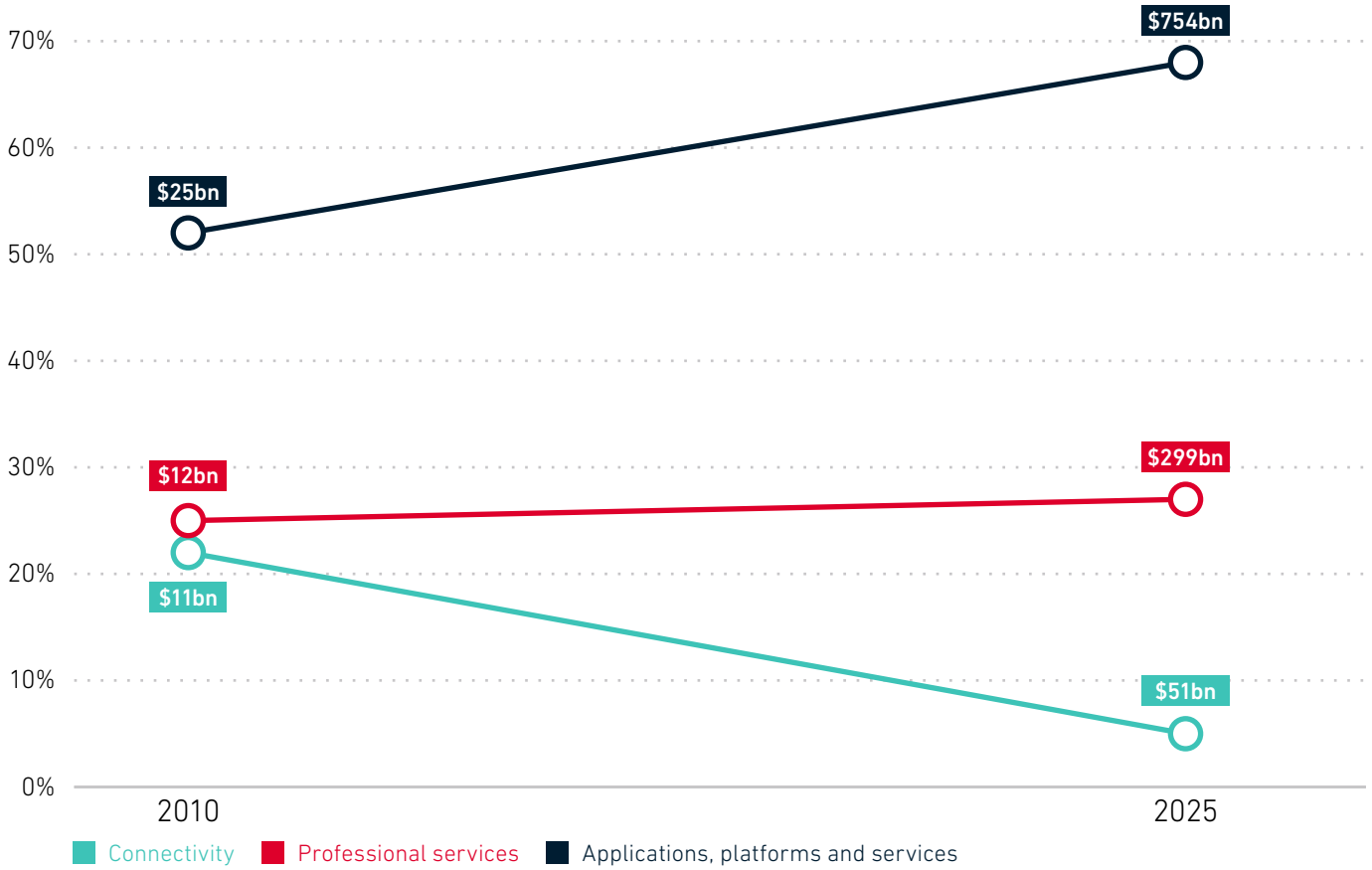
As a percentage of IoT connections

Source GSMA Intelligence

Connectivity will be commoditised; value creation sits higher up in the platform and analytics layers

- Connectivity will remain important but less of a value driver, particularly for non latency-sensitive use cases in IoT such as smart metering.
- For operators, this raises the question as to whether IoT and 5G enterprise services will be sold as connectivity only (lower value) or as part of a service package including analytics (higher value).
- It may be that high-grade connectivity is offered as an 'anchor service' but not priced independently of the wider service package. In any case, consultant-style thinking "in the client's shoes" becomes as important as off-the-shelf technology sales.

Global IoT revenue projections

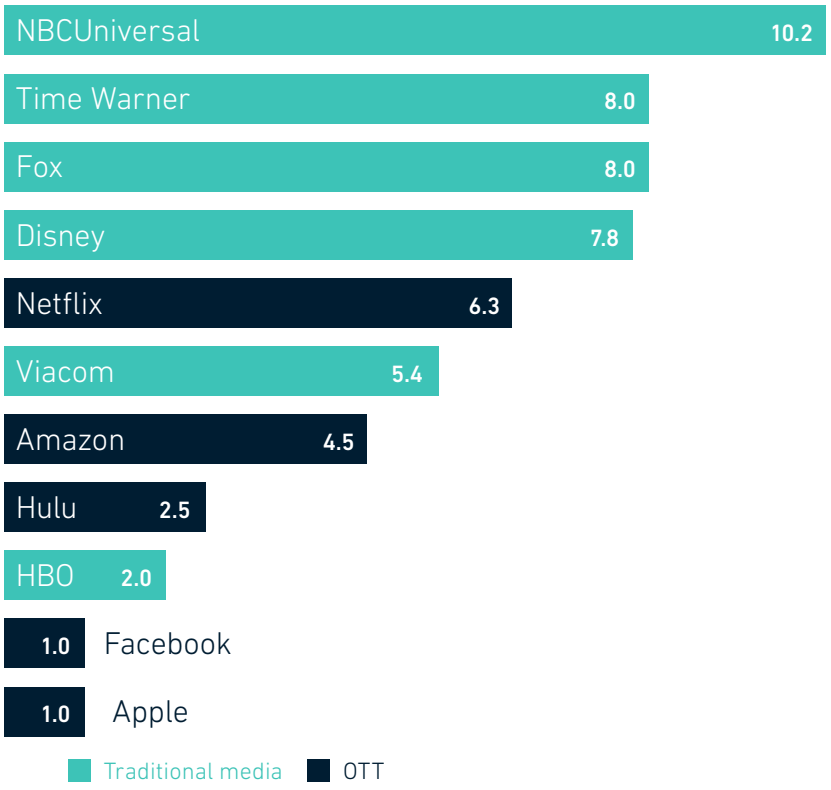


Source GSMA Intelligence

For the majority of telcos, an asset-light approach on content is most realistic

Content spend excluding sports

$ billion, 2017



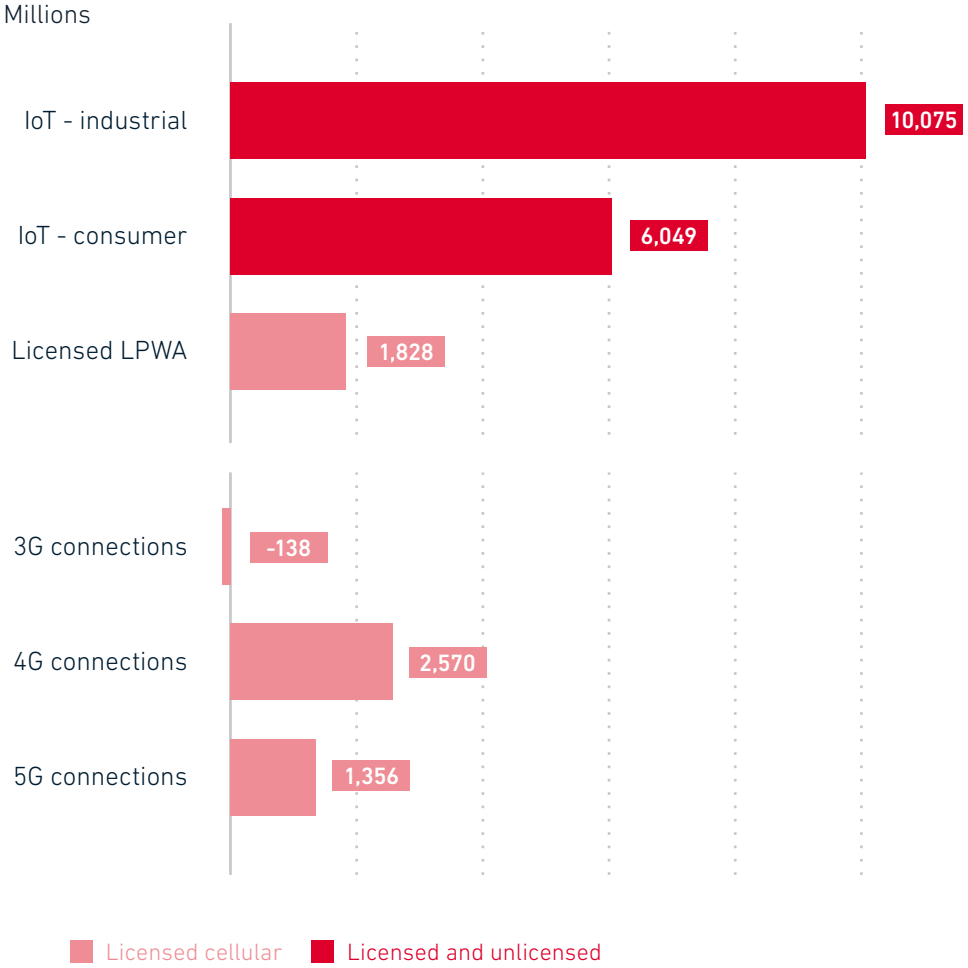
The choice of build/buy versus license/bundle has become clearer

Build	• Build exclusive content in-house (e.g. AT&T, Orange, China Mobile)	**Benefits** Churn reduction, data volumes, can shorten time to market **Drawbacks** Expensive, integration risk, risk of content bidding wars that spiral out of control
Buy	• Premium sports rights (e.g. Elisa, BT)	
License	• License from third parties such as Netflix, Amazon and HBO (e.g. Telefonica, Vodafone)	**Benefits** Cheaper way of offering good breadth of content to customers **Drawbacks** Licensing offers less differentiation as competitors can carry similar offering
Bundle	• Aggregate content provided by long-tail of media players, leverage existing billing relationship and distribution network (e.g. Airtel, Etisalat)	

Source GSMA Intelligence

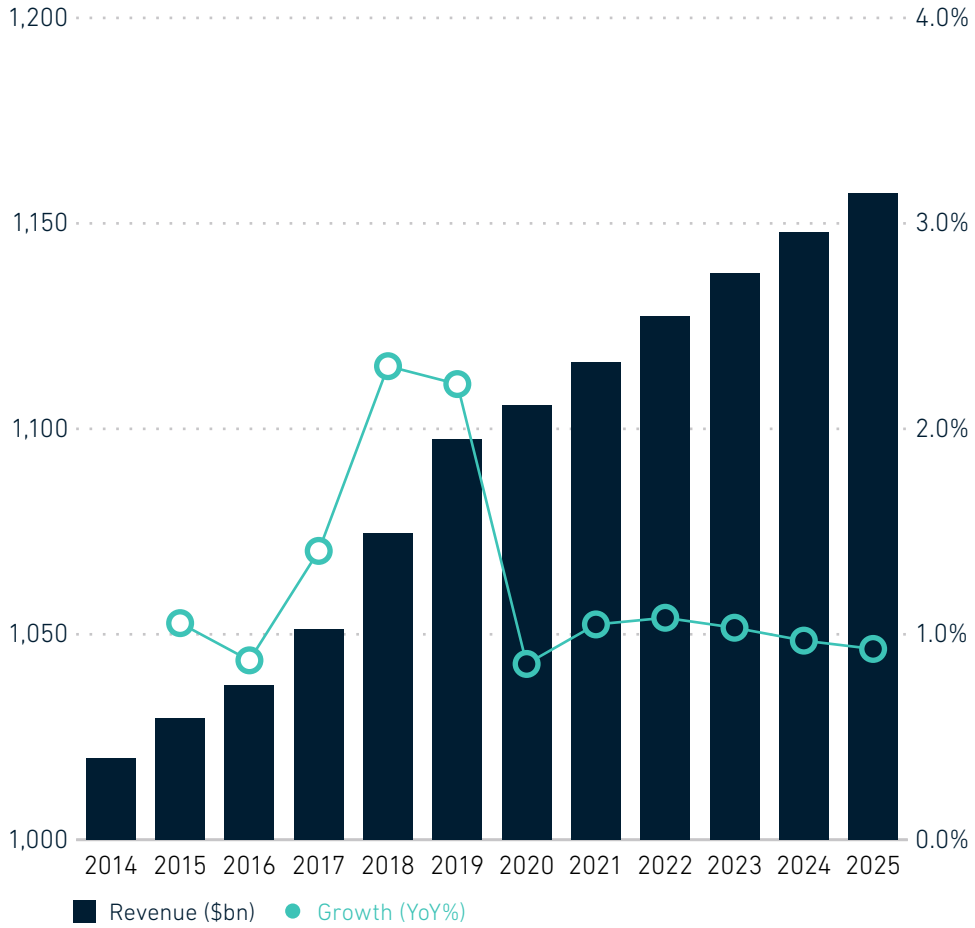
Until proven revenue streams emerge for IoT and 5G, overall growth outlook for telcos is conservative

Connections growth between 2017 and 2025



Source GSMA Intelligence

Projected growth in global mobile revenue



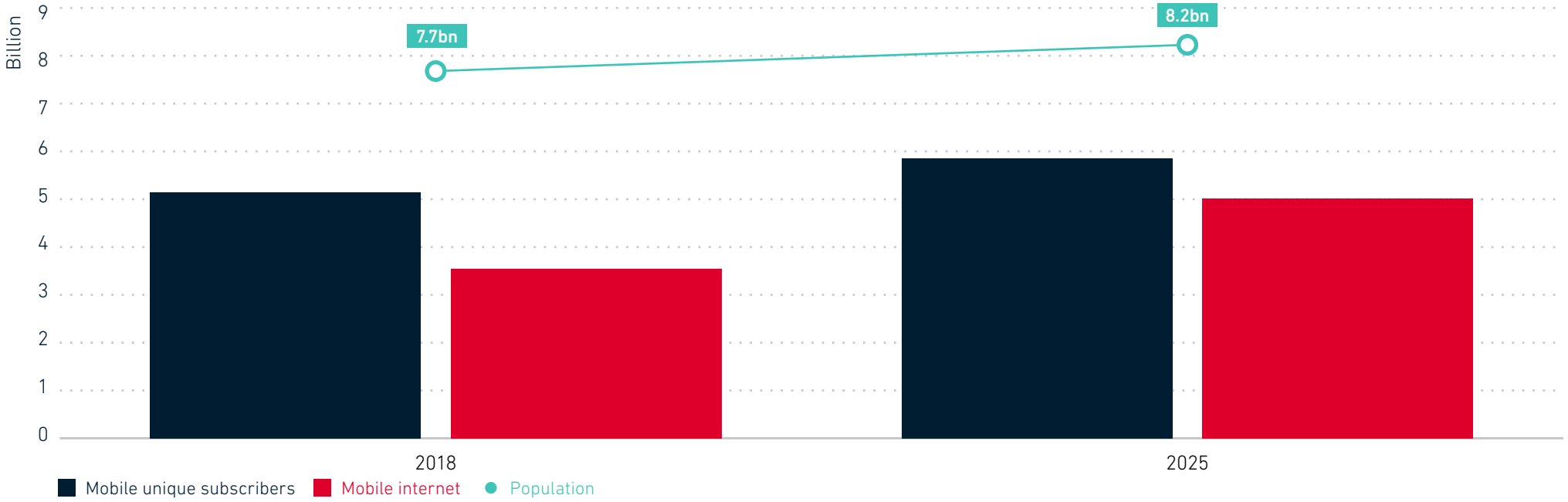
Source GSMA Intelligence

GLOBAL MOBILE TRENDS

Consumers and mobile

Some 5.1 billion use mobile but the dynamic is more about usage than growth

- Mobiles are now used by two thirds of the global population. The net increase of 180 million people in 2017 is large in absolute terms, but annual growth continues to slow from the peak of 300 million reached in 2012.
- This is a consequence of mobile nearing a natural ceiling of 70–80%, with the remaining unreached demographic segments those that are the hardest to reach (such as elderly people or those in rural areas).
- The more important shift is the rise in mobile internet access; we forecast an increase in the attachment rate (the share of mobile users also using the internet) from 65% in 2017 to 86% in 2025.



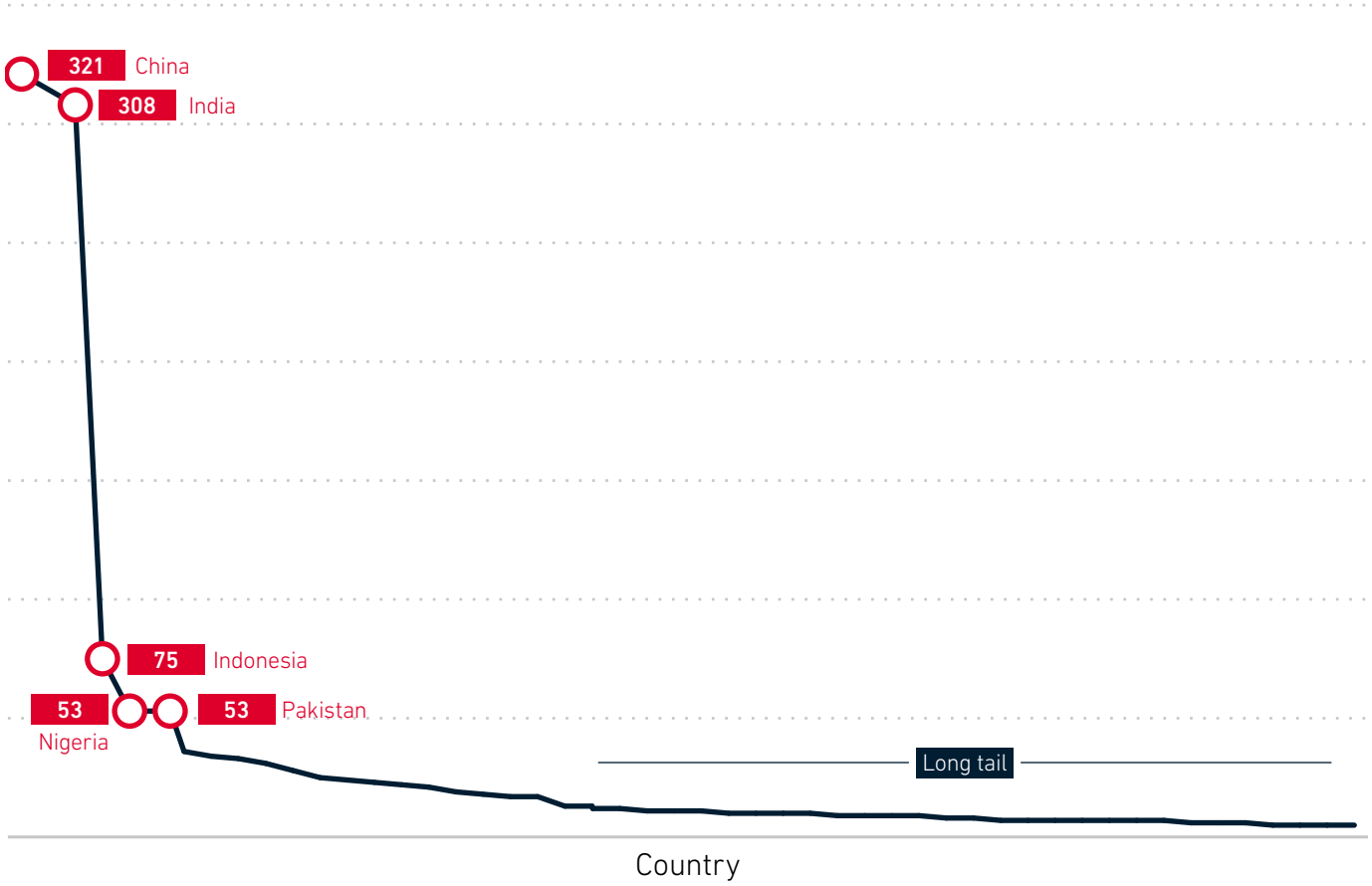
Source GSMA Intelligence

50% of growth in internet users to 2025 will come from five countries

- Of the 1.6 billion new mobile internet users between now and 2025, five countries account for 50% of the growth.
- China and India are by far the biggest. The next tier includes Indonesia, Nigeria and Pakistan: each will account for 50 million+.
- The rest comprises a long tail, clustered in Sub-Saharan Africa and South East Asia.
- Smartphone access will be a near-given. The more nuanced challenge will be how to engage and retain customers that are mostly young, lower income and non-English speaking, and lack access to services taken for granted in western countries (banking, health, education).

Increase by country in mobile internet users between mid-2018 and 2025

Million



Source GSMA Intelligence

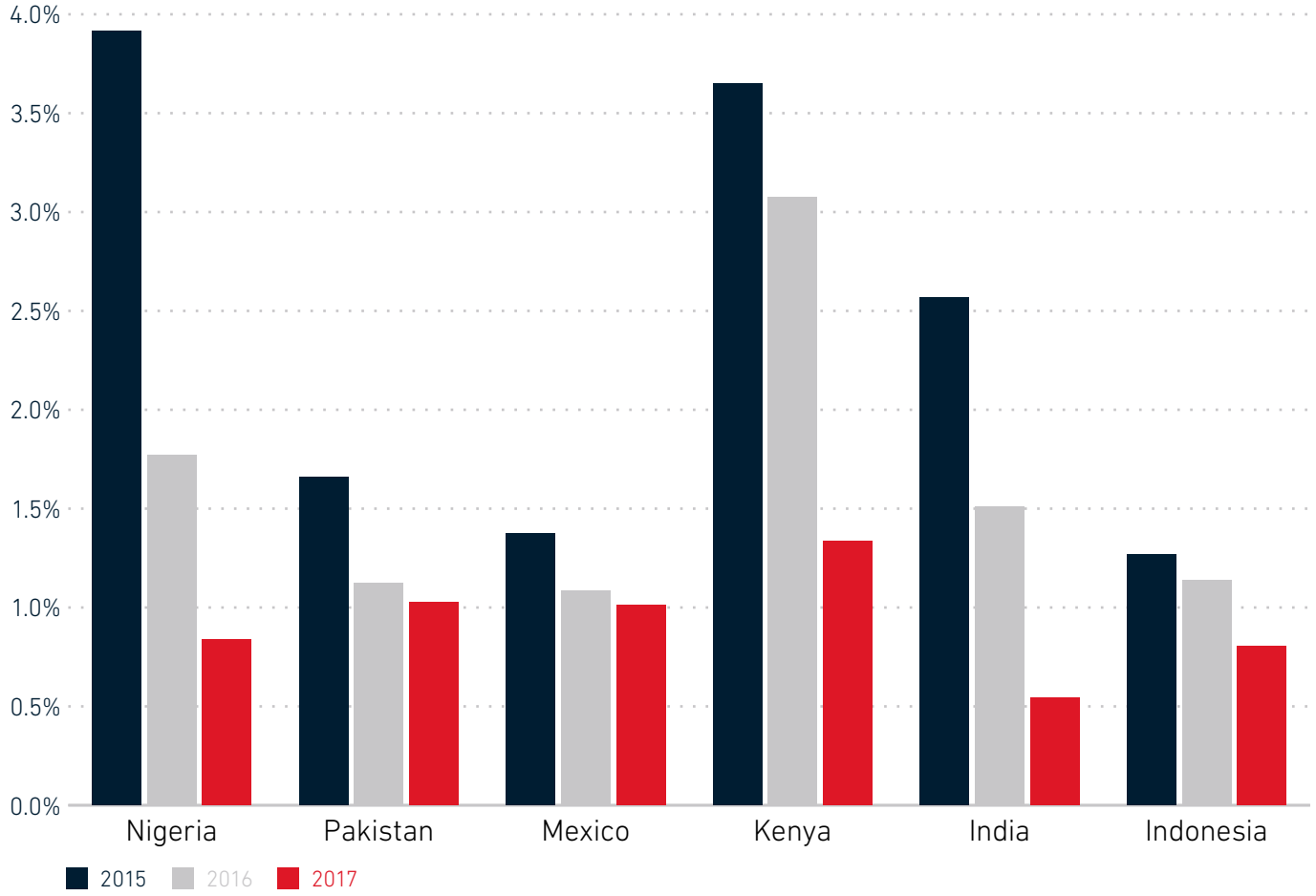
Low-cost Android smartphones and falling data prices are driving the rise in emerging markets

- Two main factors are behind the mobile internet rise in emerging markets:
  - the continued decline in prices of smartphones, driven by a range of Chinese OEMs, mostly running Android
  - a more recent reduction in the burden on income from mobile data prices.
- From our analysis of pricing data in a range of large developing countries, a 'medium' level bundle (with allowances of between 600 MB and 2 GB) has fallen from 2–3% of income in 2015 to 0.5–1.0%.
- This particularly matters in developing countries with lower income populations because fixed broadband is not an option.

Note: Data allowances for the listed countries are taken from representative operators and range from 600 MB to 2 GB per month

Monthly data bundle costs in major emerging markets

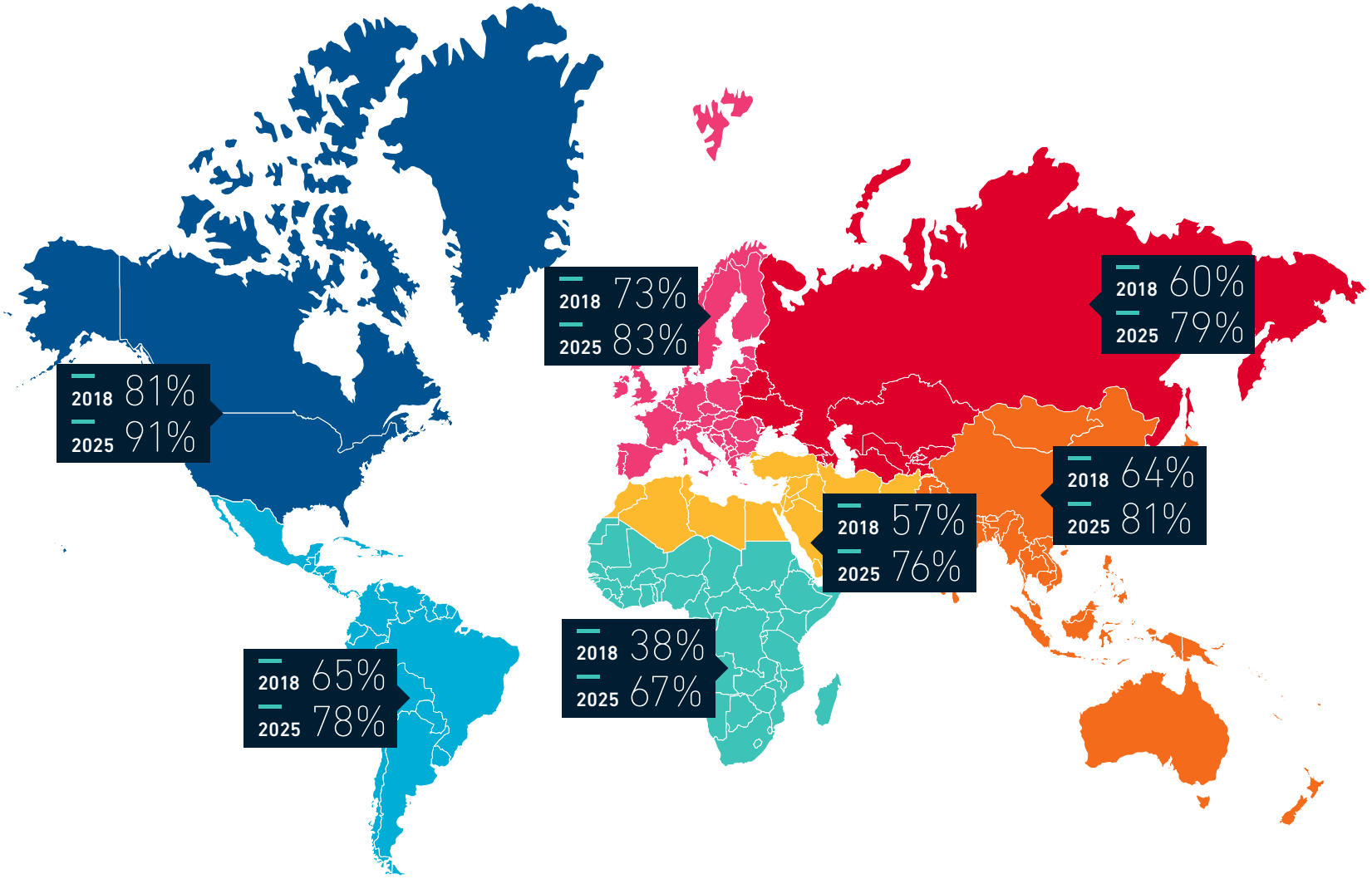
Tariff as percentage of monthly income, medium bundle



Source GSMA Intelligence, Tarifica

Global smartphone adoption will reach 80% by 2025

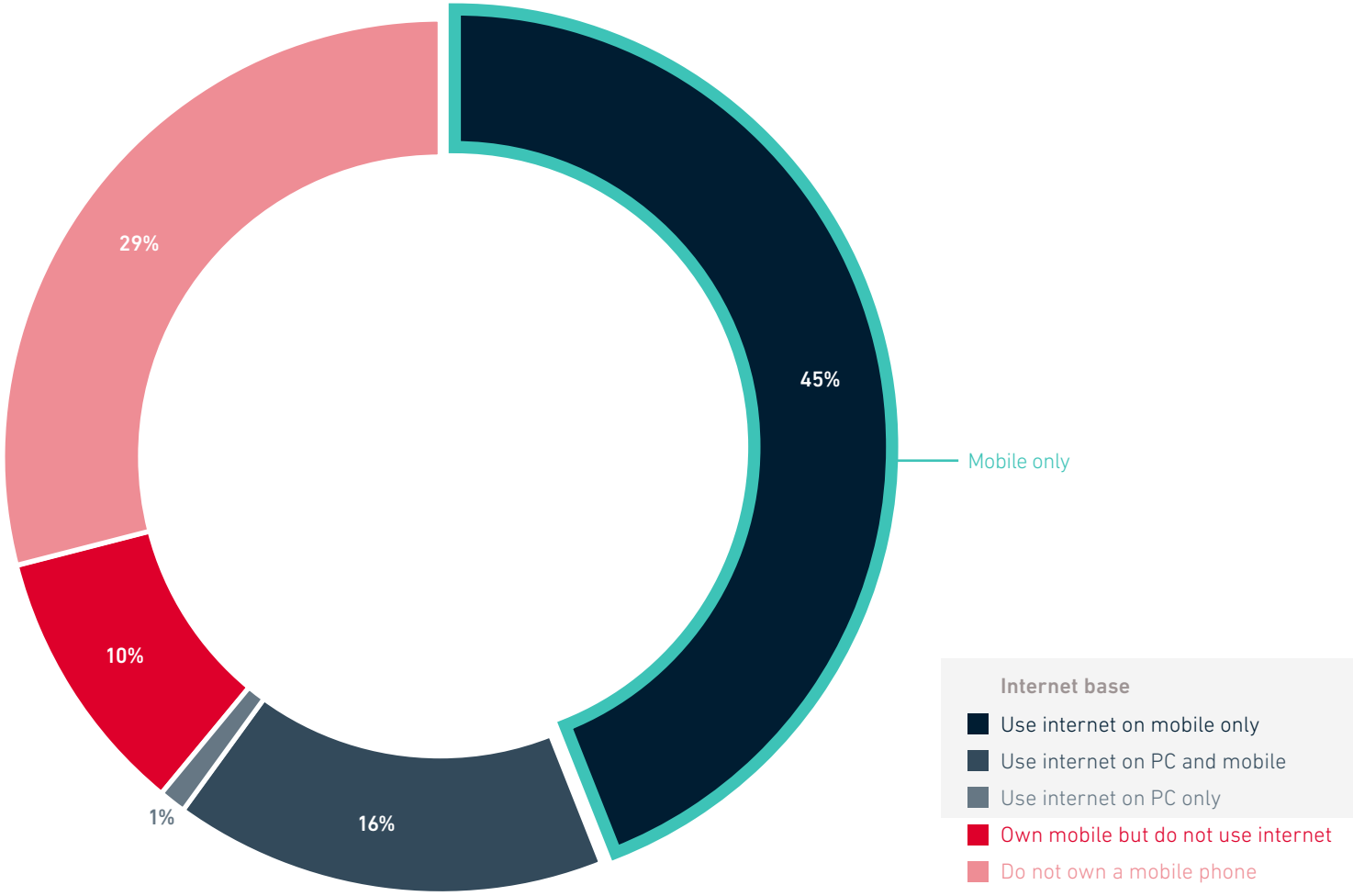
Smartphone connections as a percentage of total mobile connections



Source GSMA Intelligence

Almost three quarters of the global internet base will be mobile *only*

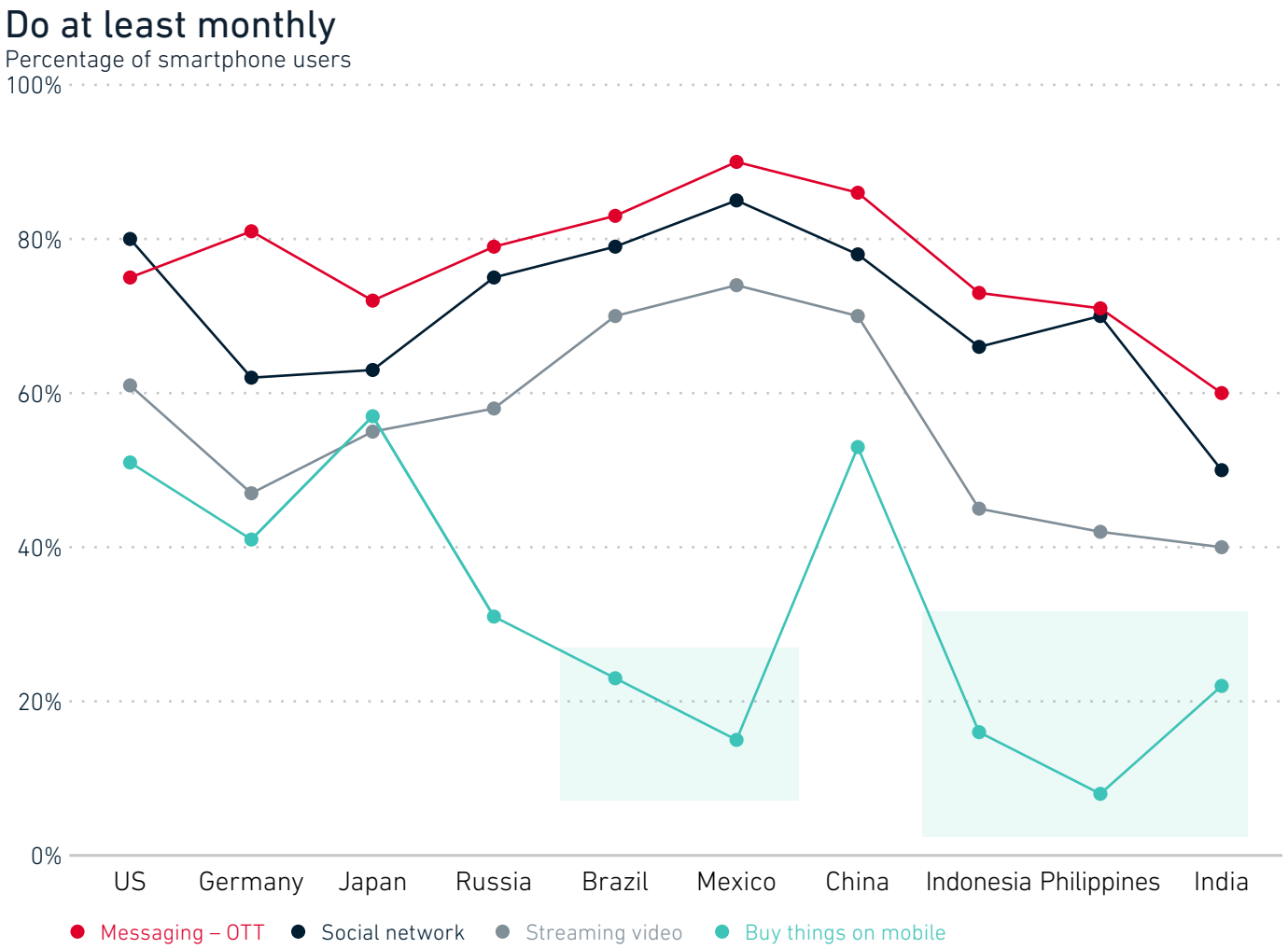
2025
Percentage of global population



Source GSMA Intelligence

Social and messaging have already adapted to mobile-first; e-commerce still to play for

- Facebook, Google, Netflix, WeChat and other large consumer tech platforms redefined their approach to mobile-first four years ago.
- This helped cement social networking and OTT messaging as widespread among smartphone users, regardless of income.
- E-commerce is a digital category *not* yet capitalised on (with the exception of China), with take-up rates in fast-growth markets less than 30%.
- India is an interesting live test case being fought by Flipkart and Amazon. The country has around 400 million smartphone users, around 20% of which buy something on their mobile at least monthly. Even if this rose to 30%, it would make India nearly as big as the US in user terms.

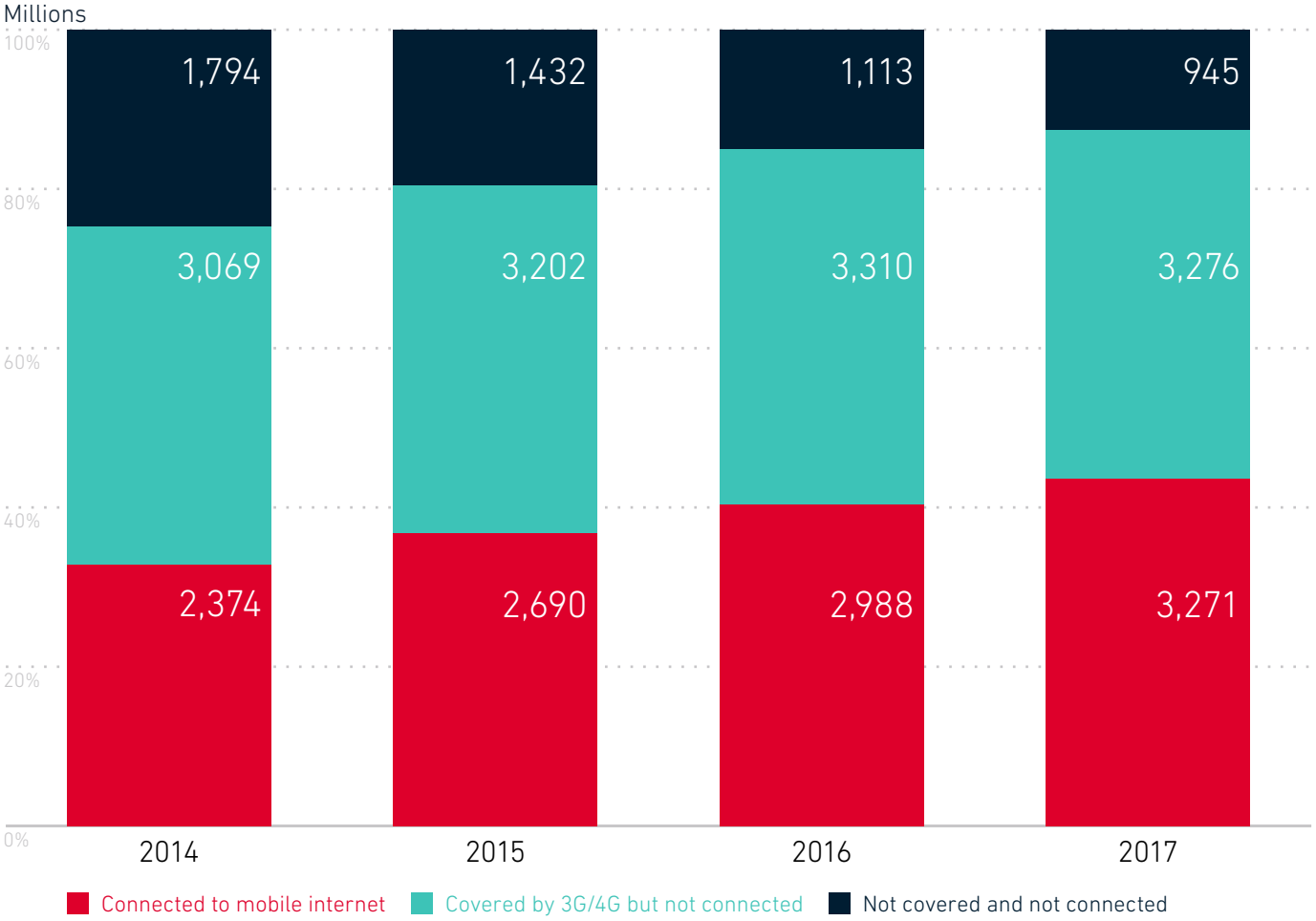


N=1,000 respondents per country

Source GSMA Intelligence Consumer Survey 2017

80% of people without internet are covered by 3G/4G – what's the problem?

Connected and unconnected population



Source GSMA Intelligence

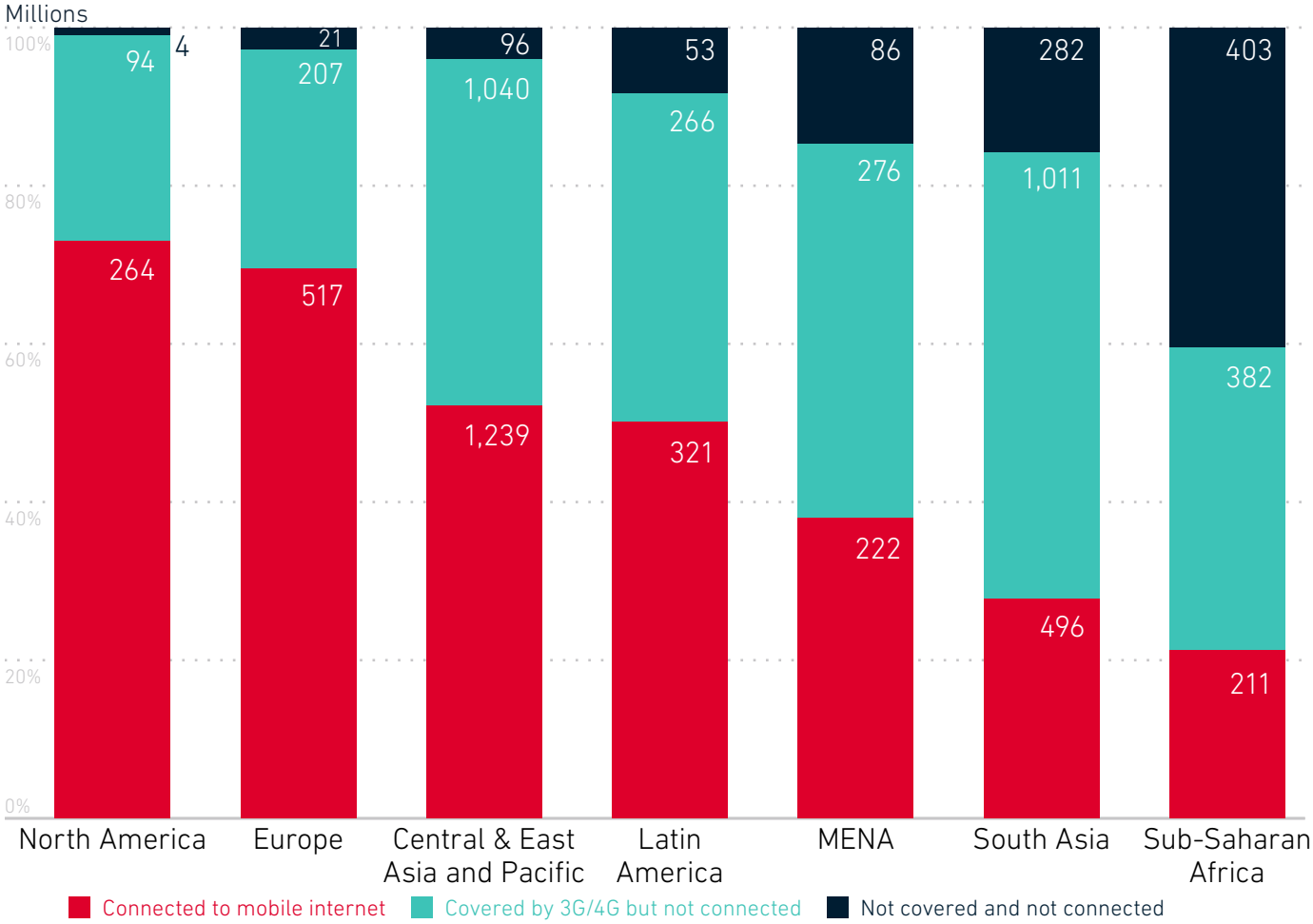
- At the end of 2017, 3.3 billion people (44% of the population) were connected to mobile internet. Some 4 billion people in the world remain offline.
- The lack of infrastructure availability is often cited as a problem – and it is, but not nearly as much as would be thought.
- Of the unconnected, 80% live within range of a 3G or 4G signal. The trickiest problems now lie with 'hidden' factors; for example, in low-income countries:
  - 40% of adults are illiterate
  - 500 MB of data costs almost 10% of monthly GDP per capita
  - only 0.2% of all active mobile applications were developed in low income countries in 2017.

For further information see:
www.mobileconnectivityindex.com

Breaking down the unconnected population

- Sub-Saharan Africa continues to be the largest non-internet population in the world, with rural coverage still a major challenge along with other barriers.
- The Indian subcontinent is next but that is changing quickly.
- Less obvious is that internet access is not only a developing world challenge. In the US and Europe, 300 million people are non internet users even though they live within range of a 3G or 4G mobile network. Stripping out the very young and old, this would appear mostly to come from low-income segments, constraining anything from basic information access to social mobility.

Connected and unconnected population

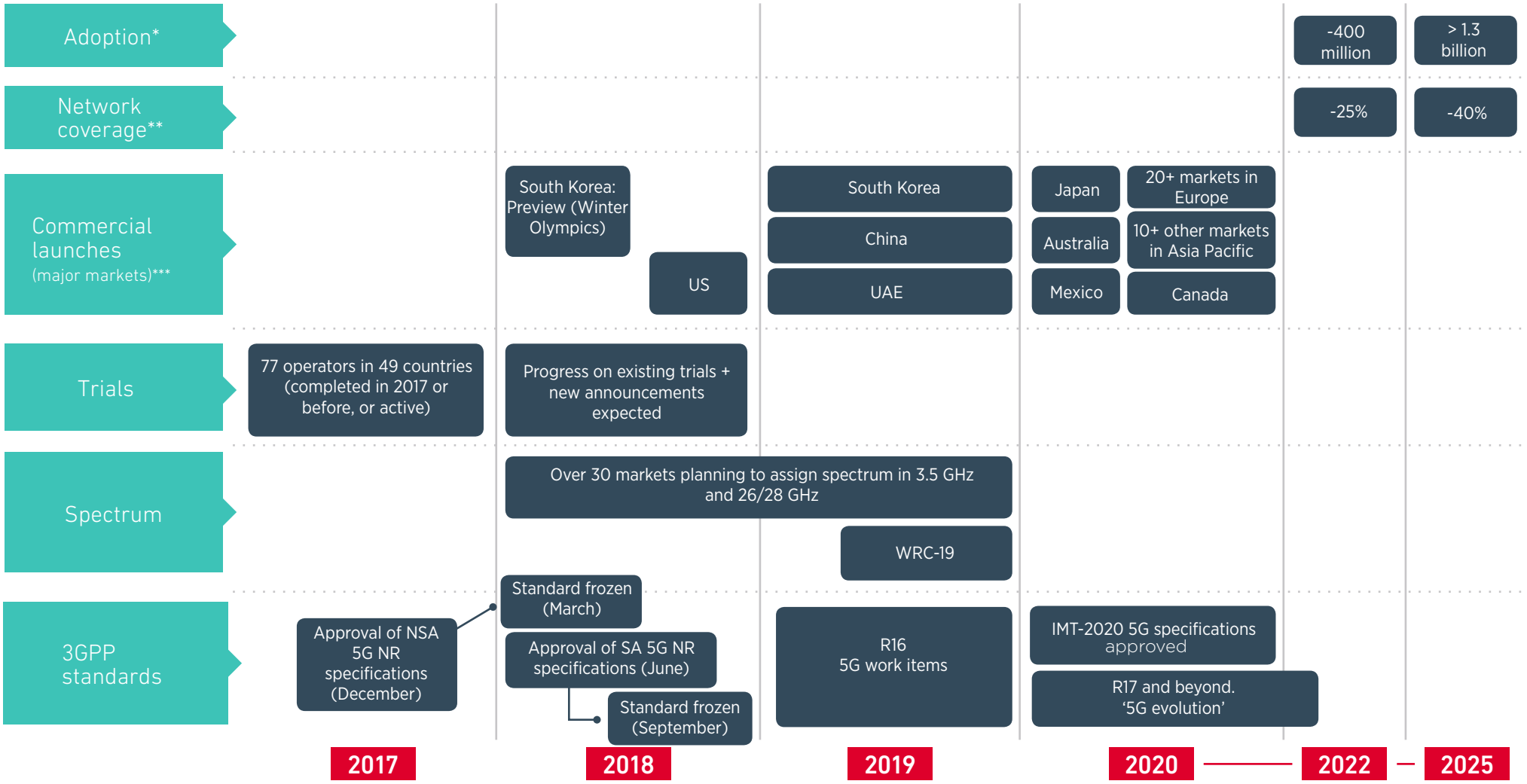


Source GSMA Intelligence

GLOBAL MOBILE TRENDS

Networks

5G is coming to a place near you (if not already there)



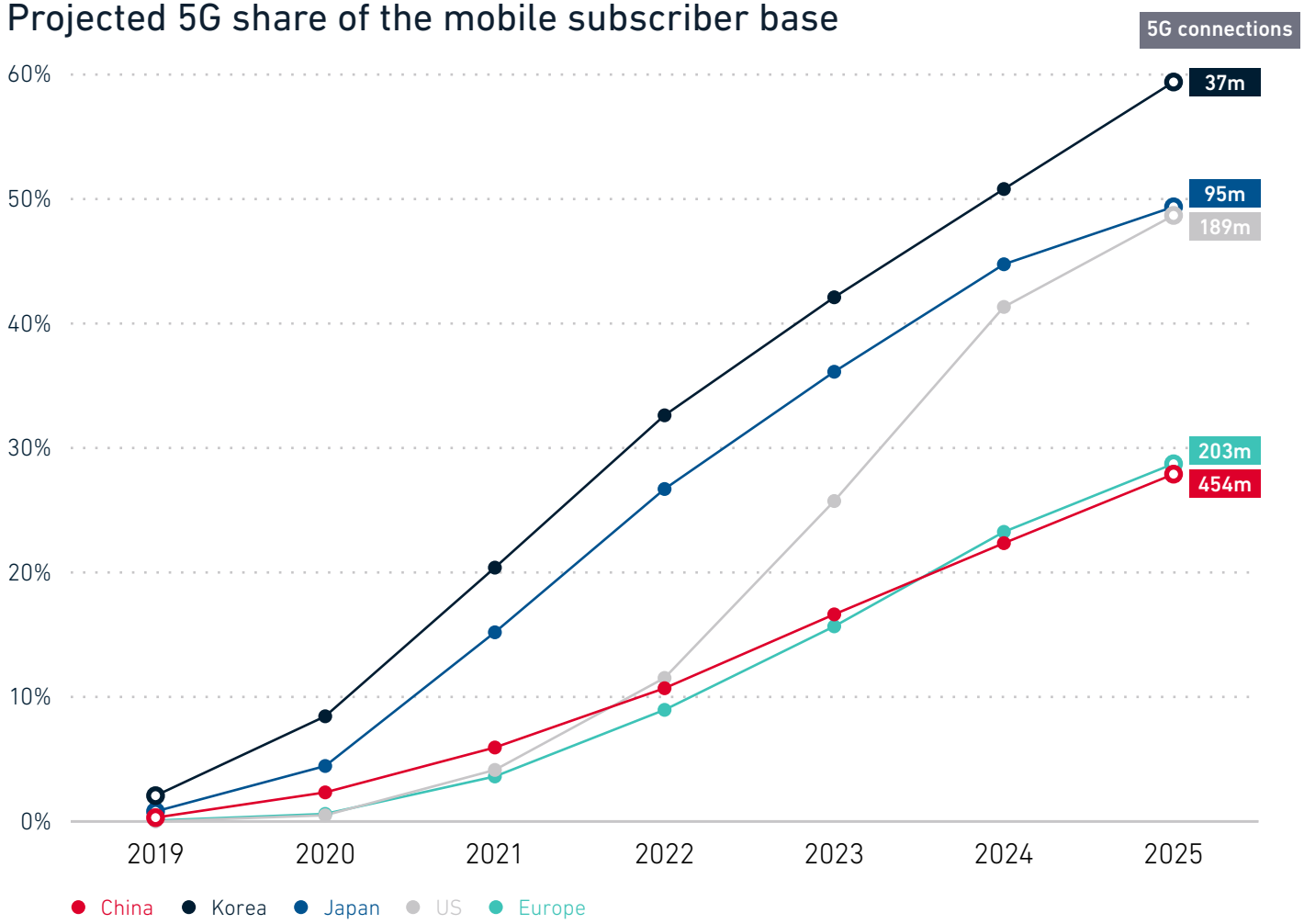
* Number of mobile connections excluding cellular IoT, worldwide.
** Percentage of global population.
*** Not exhaustive.

Source GSMA Intelligence

China, Japan, Korea, US and (potentially) Europe are the early 5G adopters

- We forecast 1.36 billion 5G consumer mobile connections by 2025.
- While this equates to a global average penetration of 15%, in reality 5G will be driven by a small number of countries.
- China is the single largest, more than double the US.
- In each case, the 5G take-up path will be longer than for 4G. LTE speeds are improving, which makes 5G less compelling without new services such as AR/VR. On the supply side, operator capex will be managed prudently to monitor return on investment before commitment to national rollouts.

Projected 5G share of the mobile subscriber base

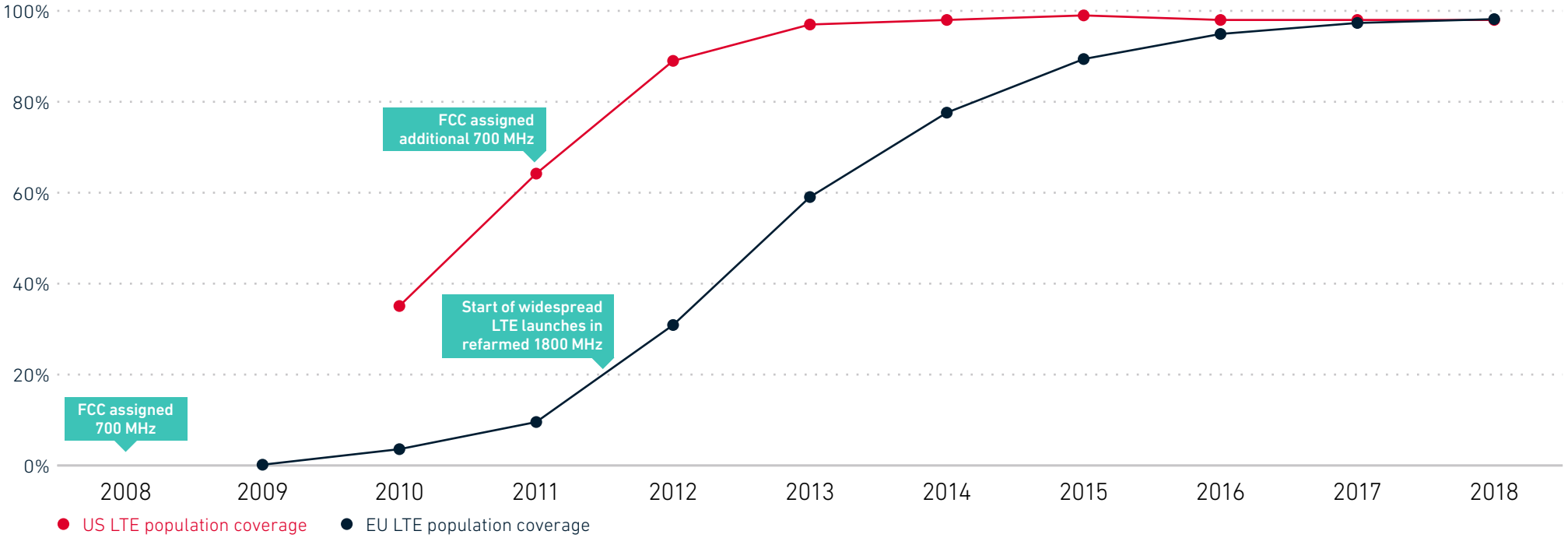


Source GSMA Intelligence

Europe's potential depends partly on 5G spectrum release

- European mobile operators only closed the 4G coverage gap with the US in 2017, with many operators having to refarm 2G spectrum to be able to launch 4G services.
- The EC wants a more proactive approach this time but expectations should be grounded by the fact that Europe only recently returned to positive mobile revenue growth, so operators will be wary of large incremental capex when LTE still has room to run.

4G adoption reflects slower spectrum release in Europe



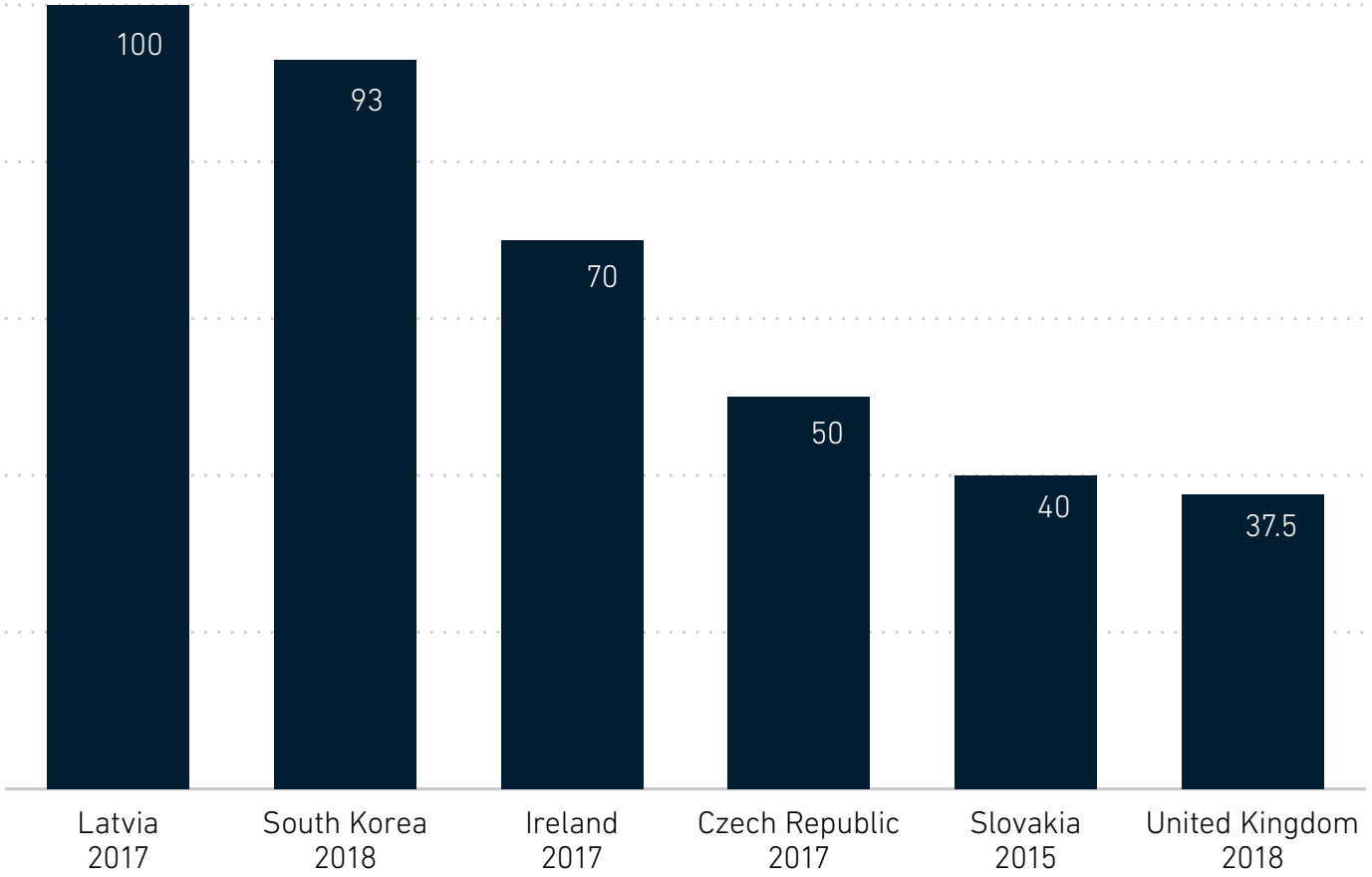
Source GSMA Intelligence

There is also a risk of 5G spectrum fragmentation

- In Europe the C-band is already fragmented – CEPT is trying to find solutions to either move incumbents or re-organise the band to achieve contiguous blocks.
- 5G should ideally be deployed in 80–100 MHz contiguous spectrum per operator. The situation in the 3.5 GHz band following recent auctions shows this fragmentation already exists.
- Fragmentation can increase the time to roll out networks, reduce speeds and increase handset costs (diseconomies of scale).

Assigned 3.5 GHz spectrum per operator

MHz

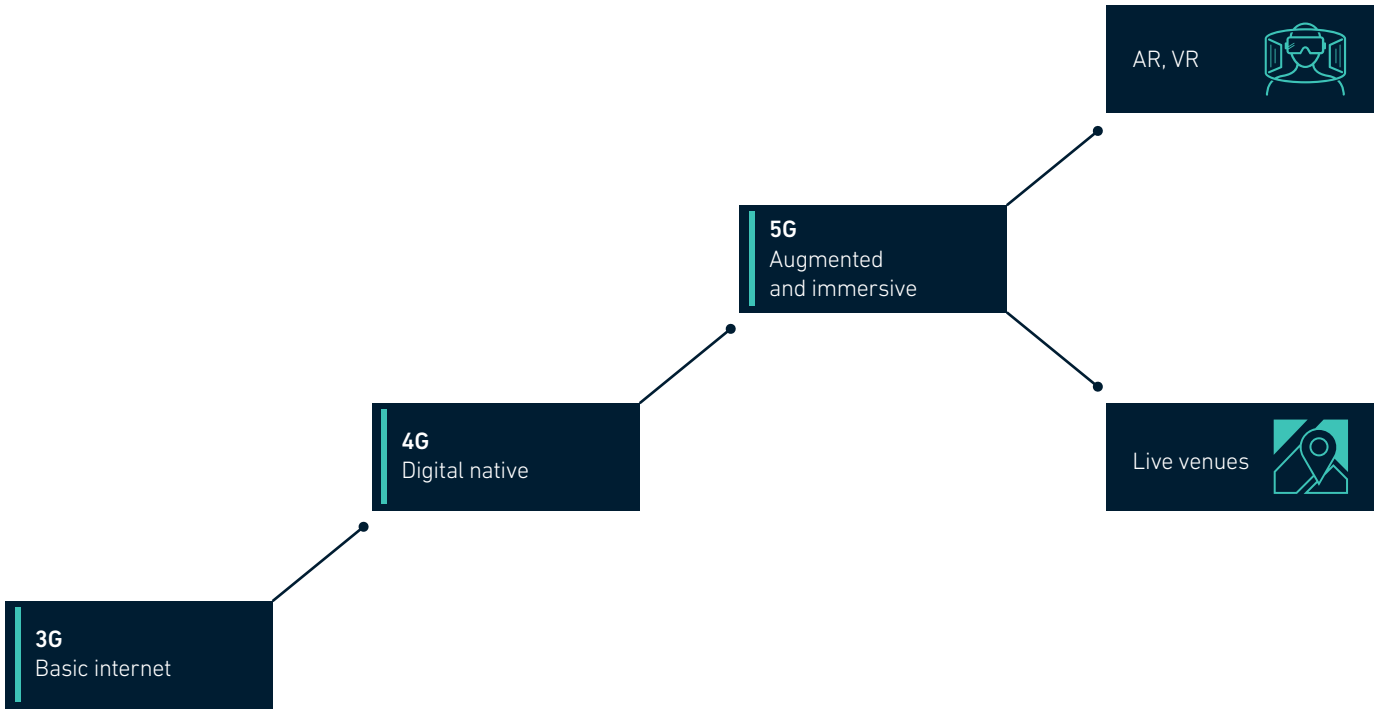


Source GSMA Intelligence

5G for the consumer could be a hard sell – at least initially

- 5G services on smartphones have two broad use cases: faster speeds (enhanced mobile broadband) and immersive entertainment.
- Faster speeds (above 1 Gbps) will be pushed but likely carry minimal pricing uplift on 4G. The incremental opportunity is in immersion (AR/VR/live). Unfortunately the tech is not there yet, with monetisation also a question.
- Absorbing excess LTE traffic is a more near-term benefit of 5G, thanks to new spectrum and air interface.
- The US has introduced a second consumer 5G use case – that of fixed-wireless to the home as a last-mile alternative to cable or DSL. While it is early days, we believe 5G fixed wireless is more a margin than growth play.

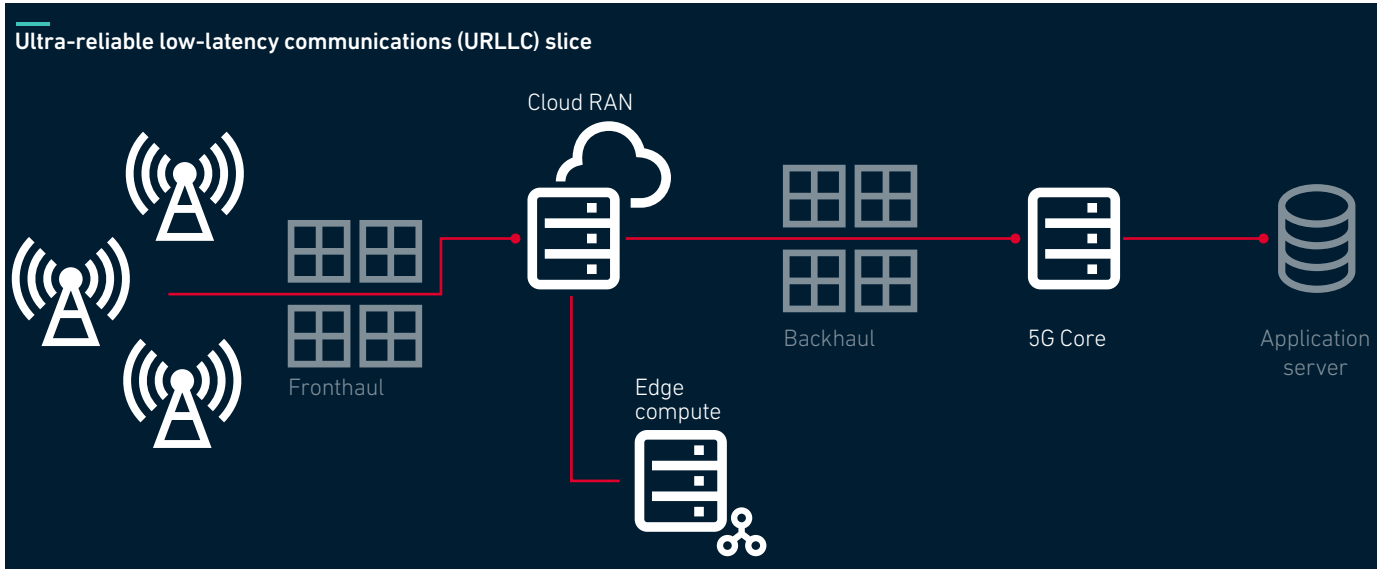
Digital to augmented consumer?



Source GSMA Intelligence

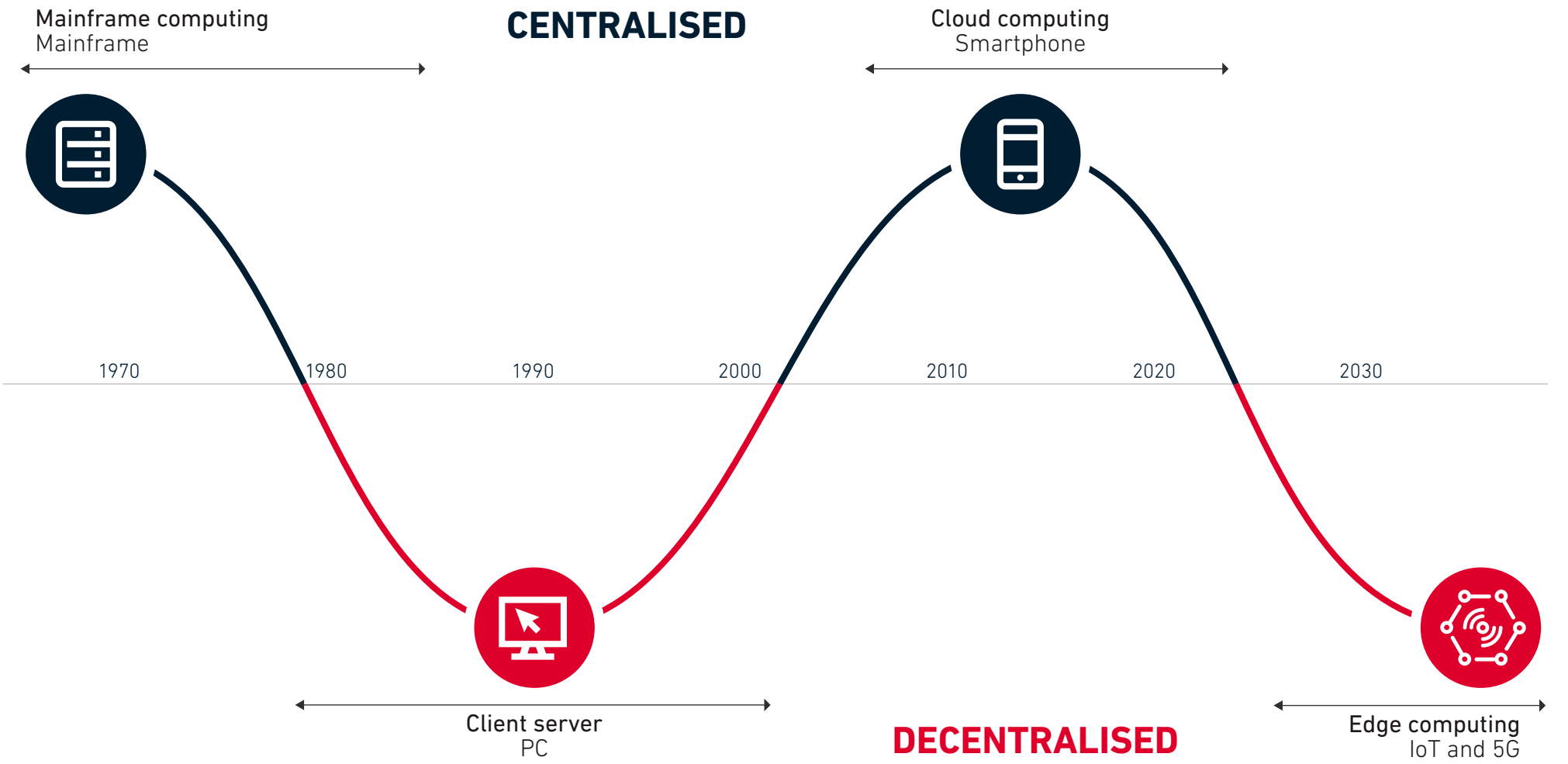
Enterprise 5G has more potential, but value limited if business model ends at connectivity

- 5G promises to open up new opportunities to tap diverse enterprise (B2B and B2B2C) demands.
- Some of those opportunities may engage edge assets due to latency, data ownership or backhaul requirements; others will involve a mix of core and edge.
- Network slicing promises to support service differentiation, allowing edge assets to be invoked (or not) in line with requirements.
- China has become a leading testbed, with trials including automotive, drones and high-tech manufacturing. The key issue is not whether 5G works, but whether clients understand how it solves a problem.
- For operators, the question remains whether 5G is sold as connectivity only (lower value) or as part of a service package including analytics (higher value).



Source GSMA Intelligence

Enterprise 5G plays are part of broader shift to decentralised/edge computing

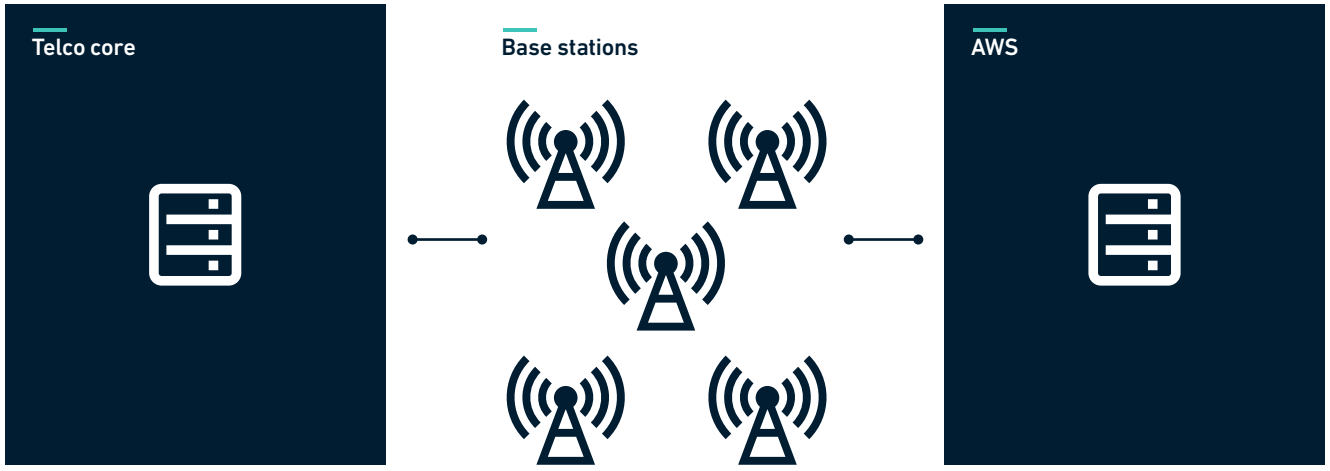


Source GSMA Intelligence

For telcos, public versus private wireless becomes the tension

- Siting network infrastructure at the network edge is not new. The move to build more network functions from software, however, has driven the "edge" discussion in new directions.
- Where NFV and cloud native architectures allow mobile operator functions to be run on general-purpose hardware, there are implications for how (and where) operator services are hosted.
- They could be hosted solely within the operator's own network (private hardware) or on hardware owned and operated by third-party cloud providers (public hardware).
- Working with cloud providers will not make sense for all applications. For example, some applications may have latency or compute requirements which can't be supported (e.g. a telco servicing a car manufacturing plant requiring advanced analytics). Where outsourcing is an option, however, it will change network deployment economics.

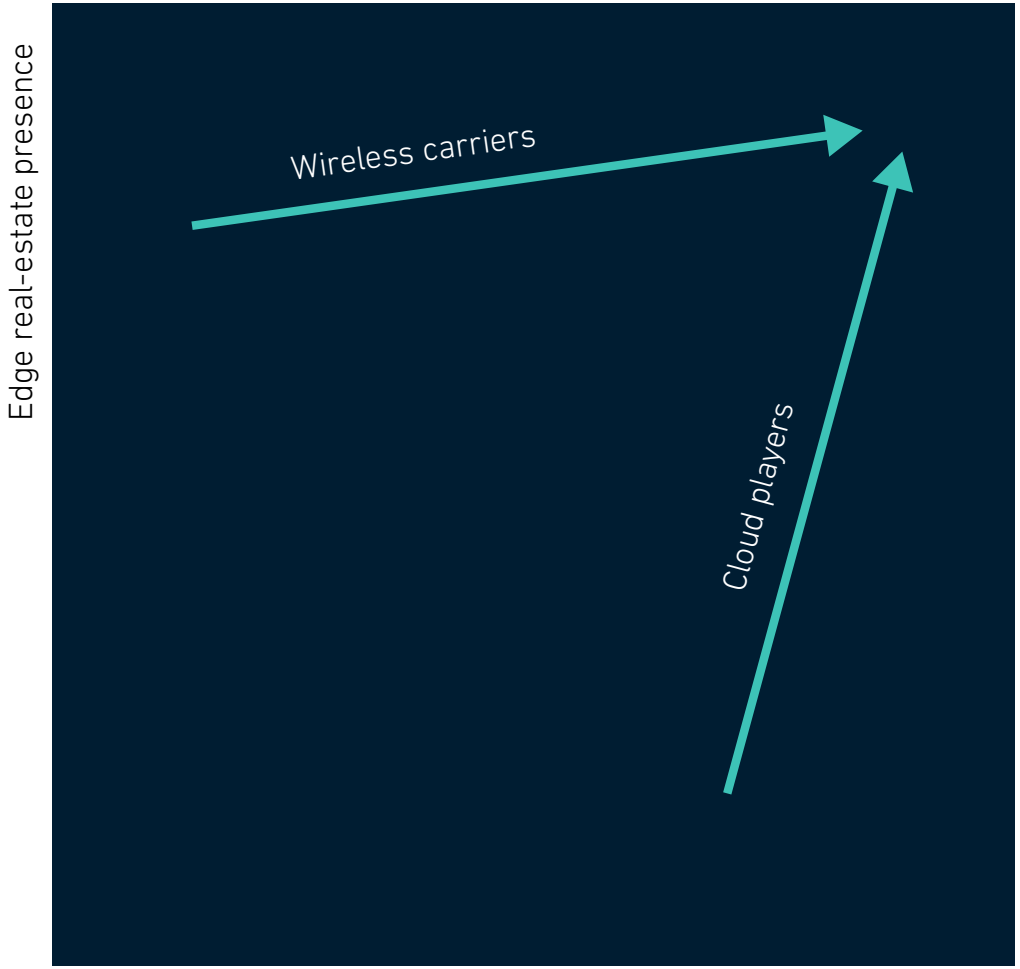
To host or not to host?



Source GSMA Intelligence

This changes how networks are built and services are delivered

- As functions move to the edge, the service delivery paradigm (who is delivering the services) will change. We are in the early stages of a 10–15 year story.
- Extensive real-estate assets (base stations, central offices) may give operators an advantage in hosting edge applications, though a limited history in on-boarding diverse applications could hold them back.
- Cloud players have more experience in hosting apps from diverse parties and are working on moving towards the edge.
- Ultimately, both camps will move to build on their assets and fill their strategic gaps to better compete for the edge opportunity.
- Telcos will become frenemies with AWS, Microsoft and other cloud companies: on the one hand, they will compete for enterprise clients on low-latency IoT and analytics; on the other hand, they will be partnering/outsourcing for capacity in some cases.

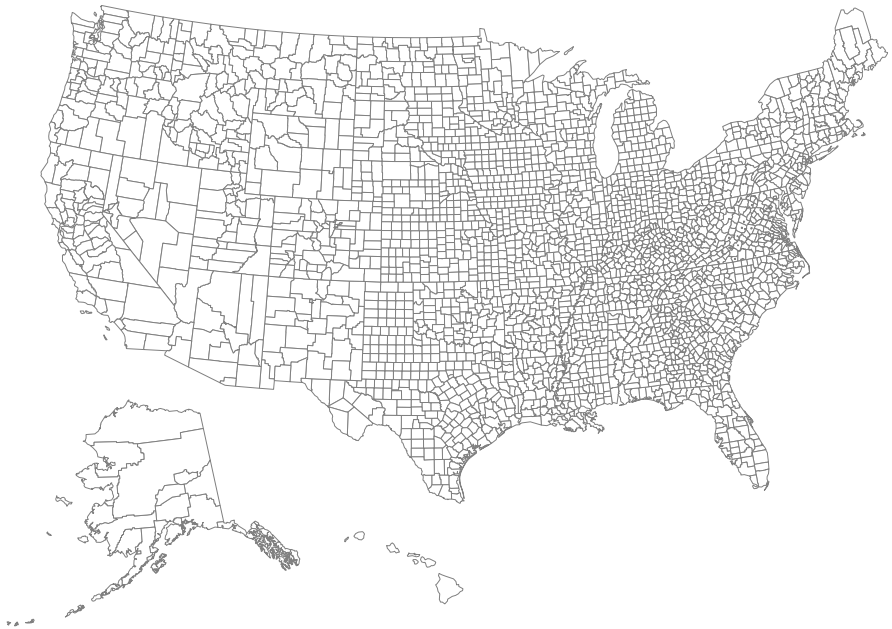


Source GSMA Intelligence

How could spectrum work for private networks?

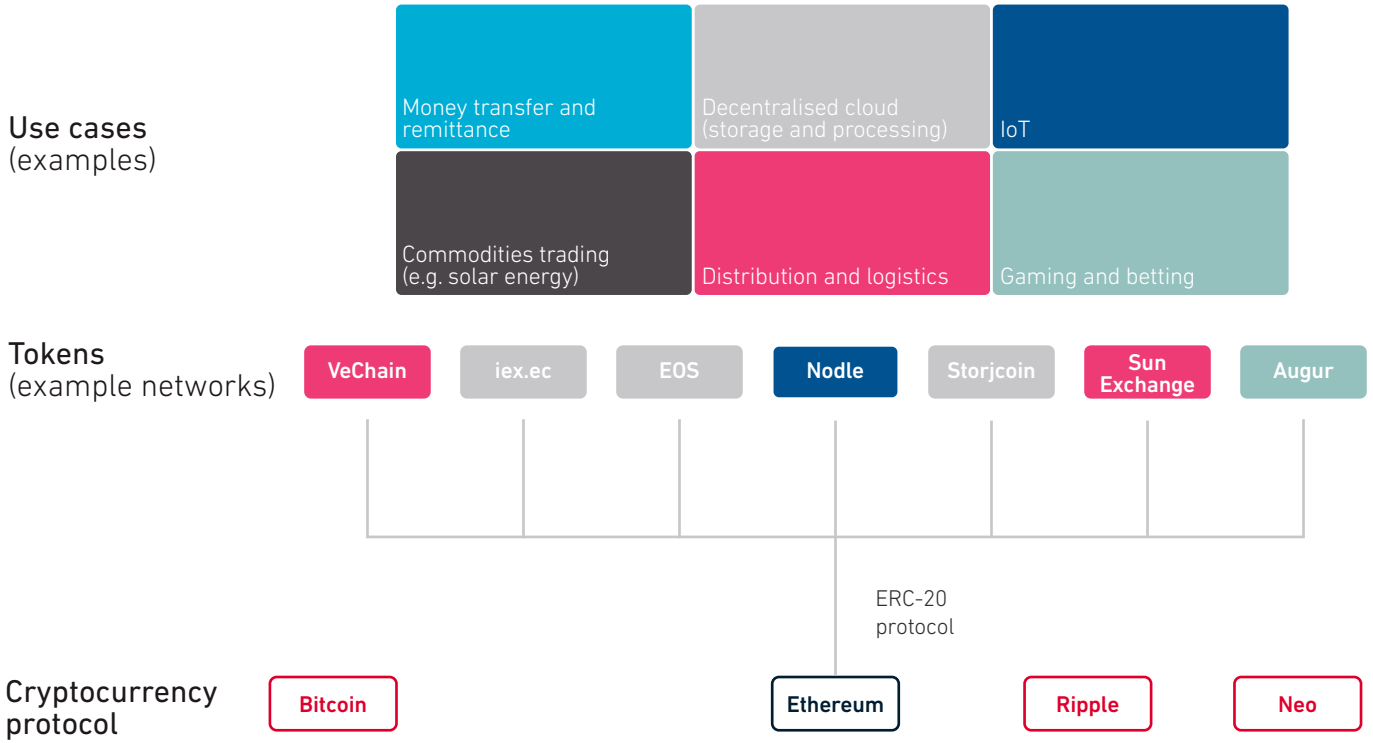
- Regulators can support the move to private wireless networking in a variety of ways. Allowing licensees to sub-lease their spectrum to third parties, for example, can dedicate wireless capacity to specific enterprise demands.
- Allowing enterprises to take a spectrum licence for their own use (sole or preferential) is another option emerging in various markets. The US has the US Citizens Broadband Radio Service, while similar models are being explored in Germany and France for Industry 4.0 and L'industrie du futur initiative respectively.
- There are trade-offs. Beyond the fact that licensing based on limited geographies is complicated, prioritising spectrum for specific enterprises could cause fragmentation and limit its broader societal use.
- For example, proposals to license spectrum in the US based on census tracts (relatively permanent geographic entities within counties) would see more than 65,000 licensed geographies – with a mix of service provider and enterprise licensees.
- There are also potential complications in coordinating spectrum use between companies from specific verticals and the telcos.

US counties



Blockchain then takes decentralisation to its extreme

- Blockchain is the epitome of the decentralised network.
- Early applications have moved from remittances and cloud storage to being a means of facilitating value exchange through the use of crypto tokens (typically built on Bitcoin or Ethereum).
- Use cases are diverse, from selling solar energy to monitoring cold chain logistics.
- Blockchain in telco has so far been limited to roaming but experimentation could take this further, especially if eSIM came to smartphones.

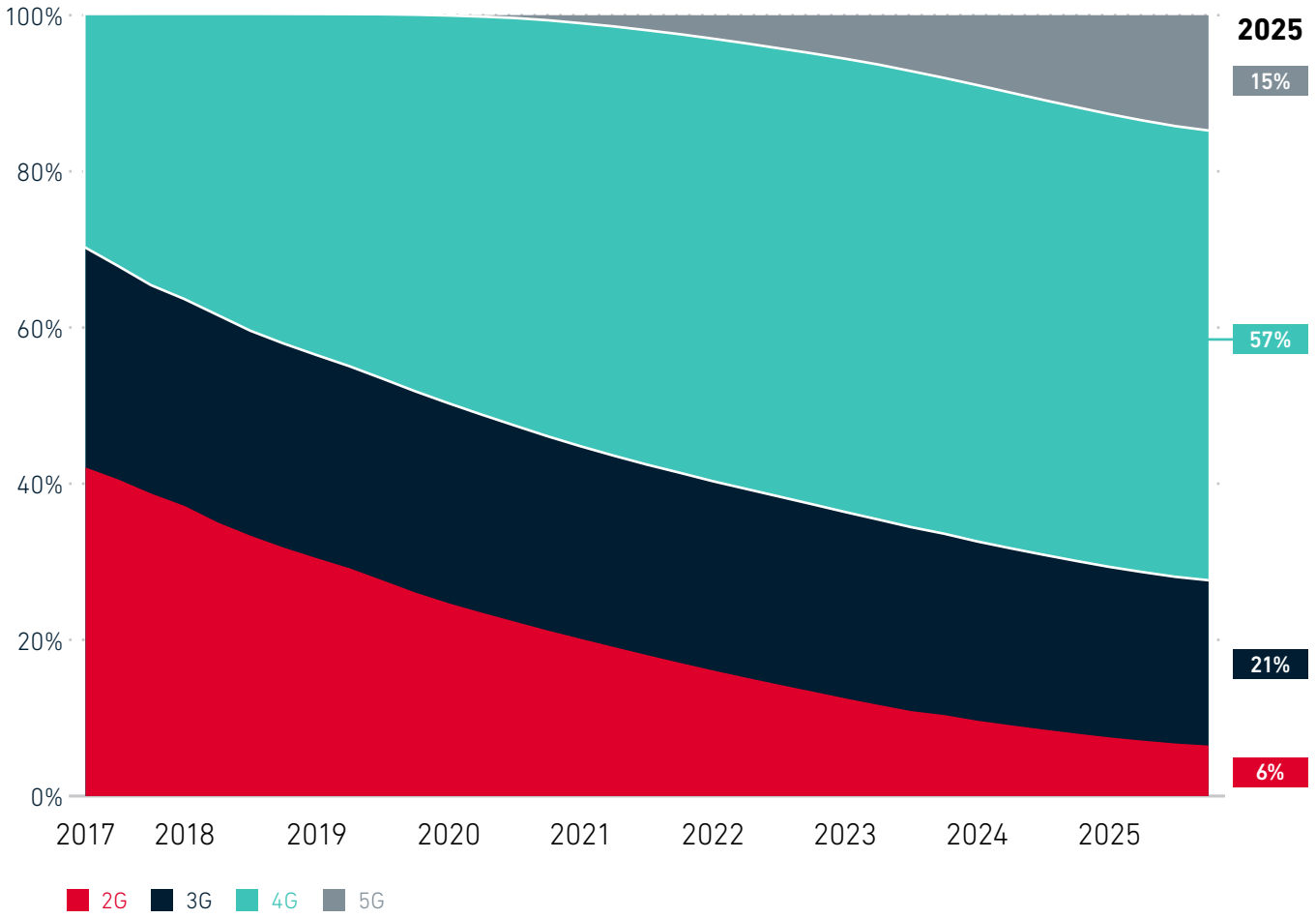


Source Global Mobile Radar, May 2018, GSMA Intelligence

Regardless of 5G, LTE will pay the bills for the next 10 years

- Marketing hype can divert attention from on-the-ground operating realities.
- For operators in many parts of the world, LTE is and will be the foundation for the next 10 years at least.
- Globally we project LTE to increase to 57% of total connections in 2025.
- 5G will reach 15%, but even if it goes higher, it will complement rather than replace LTE.

Share of total mobile connections



Source GSMA Intelligence

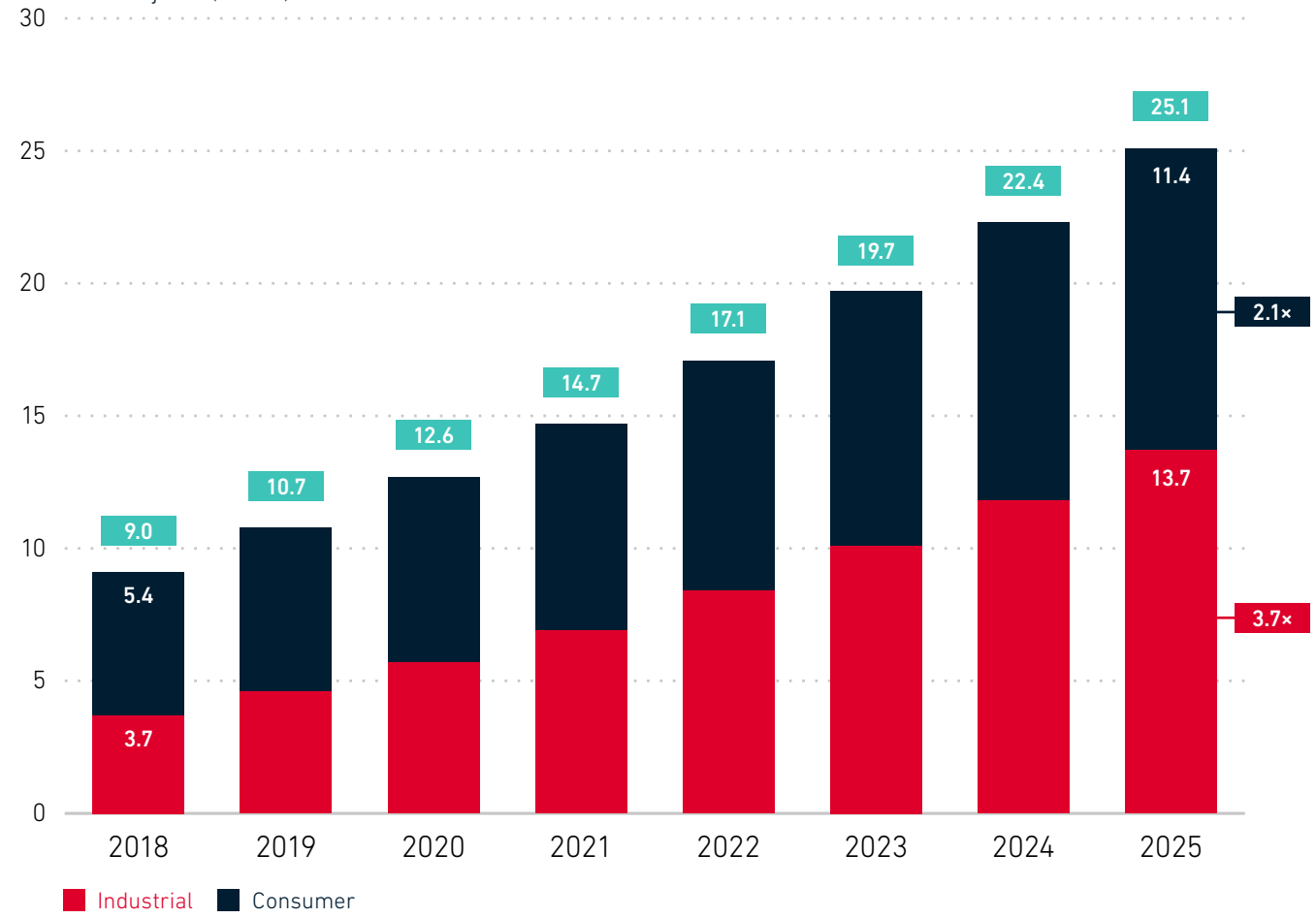
GLOBAL MOBILE TRENDS

Internet of Things

25 billion connected things by 2025; enterprise verticals the main drivers

Global IoT volumes

Connected objects (billion)



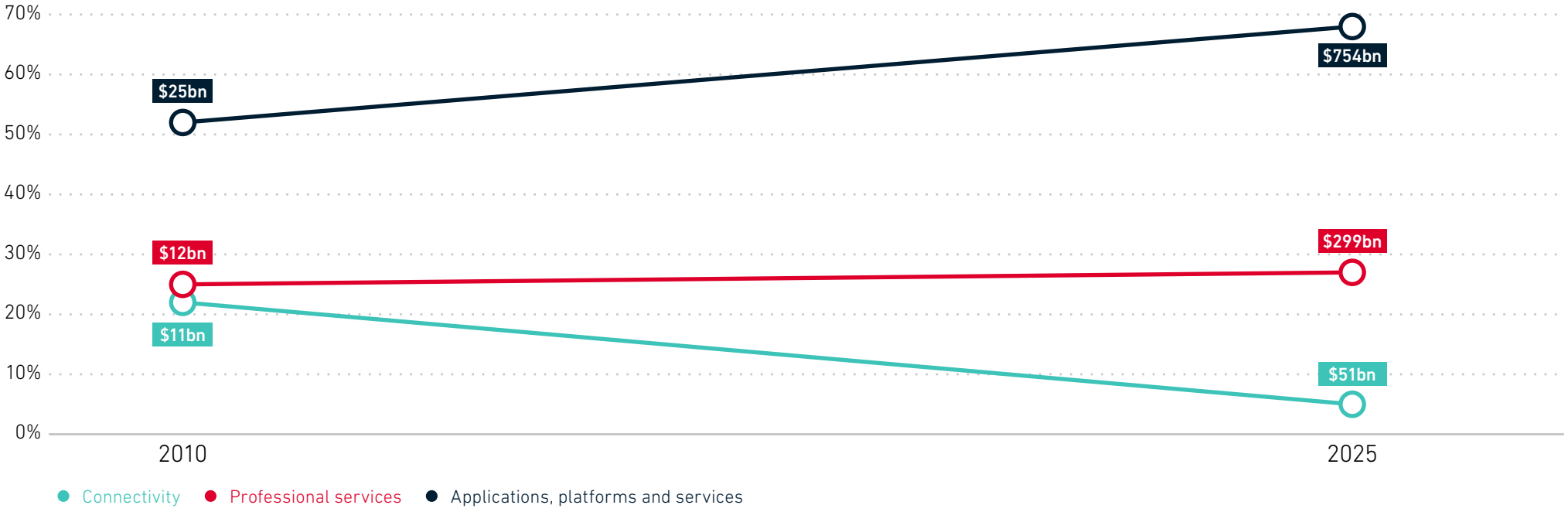
Source GSMA Intelligence

- The majority of IoT devices – typically in indoor environments – will be connected by unlicensed radio technologies, designed for short-range connectivity such as Wi-Fi, Z-Wave and Zigbee. As the size of the IoT market grows and the ecosystem matures, the business case for IoT is shifting from just connecting devices to addressing specific problems or needs with solutions.
- While IoT is rapidly becoming a mainstream technology in consumer markets such as consumer electronics and smart home, the industrial IoT segment will be the largest source of connections growth going forward.
- Energy and power generation, manufacturing and city transportation are all examples of sectors that are already transforming their operations.

Connectivity will be commoditised; value creation sits higher up in the platform and analytics layers

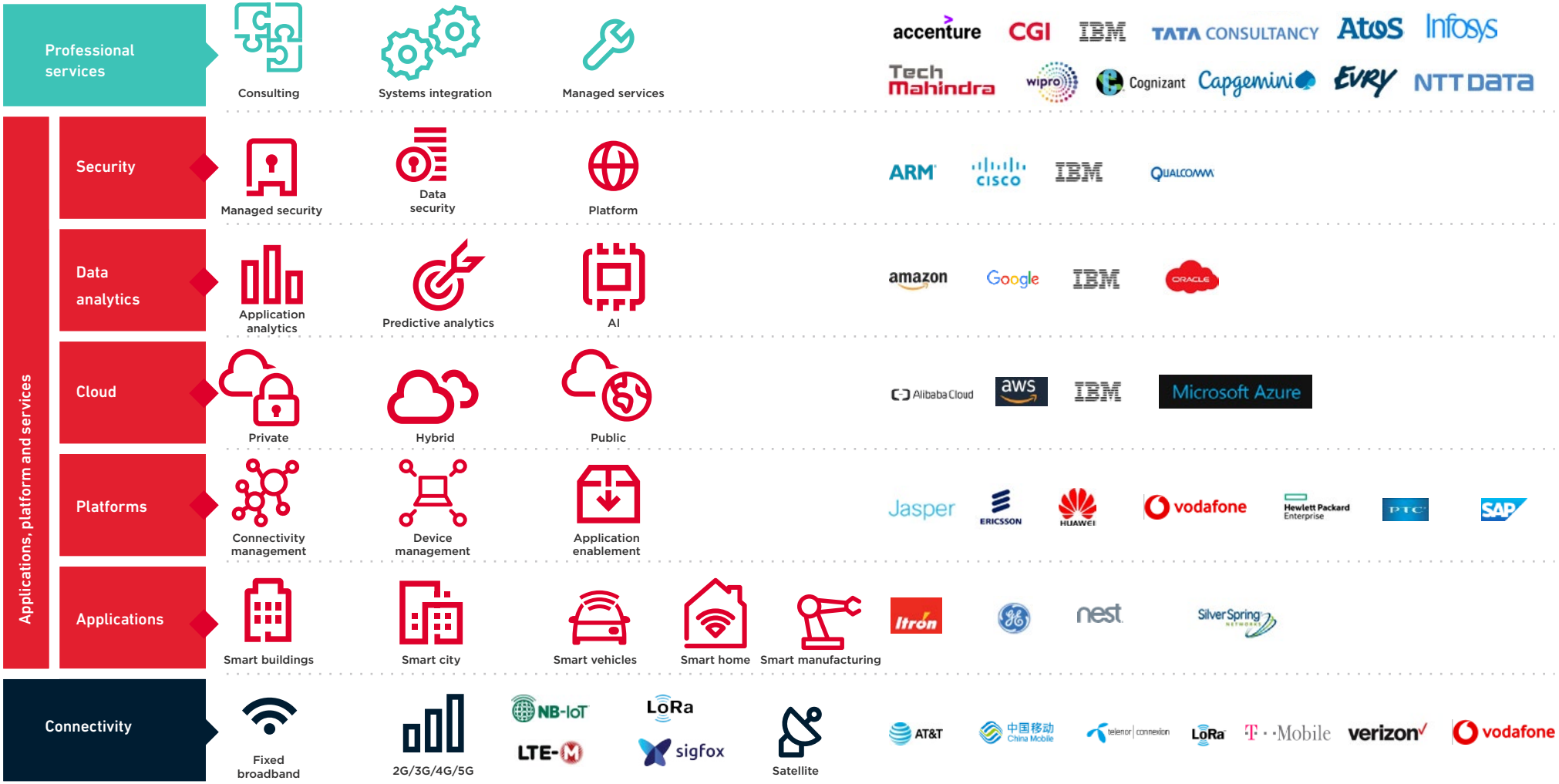
- **Applications, platforms and services** (which also includes cloud data analytics and security) is the growth area of IoT. This will grow 30x from 2010 to 2025, reaching $750 billion or two thirds of all IoT revenue.
- **Professional services**, encompassing systems integration, consulting and managed services, will continue to play an important role in enabling IoT. Its share will increase, fuelled by the continued digitisation of industries.
- By contrast, **connectivity** will commoditise and shrink to 5%, making it difficult for operators to compete on the data pipe alone.

IoT revenue forecasts



Source GSMA Intelligence

One of the biggest challenges is navigating a complex and diffuse value chain



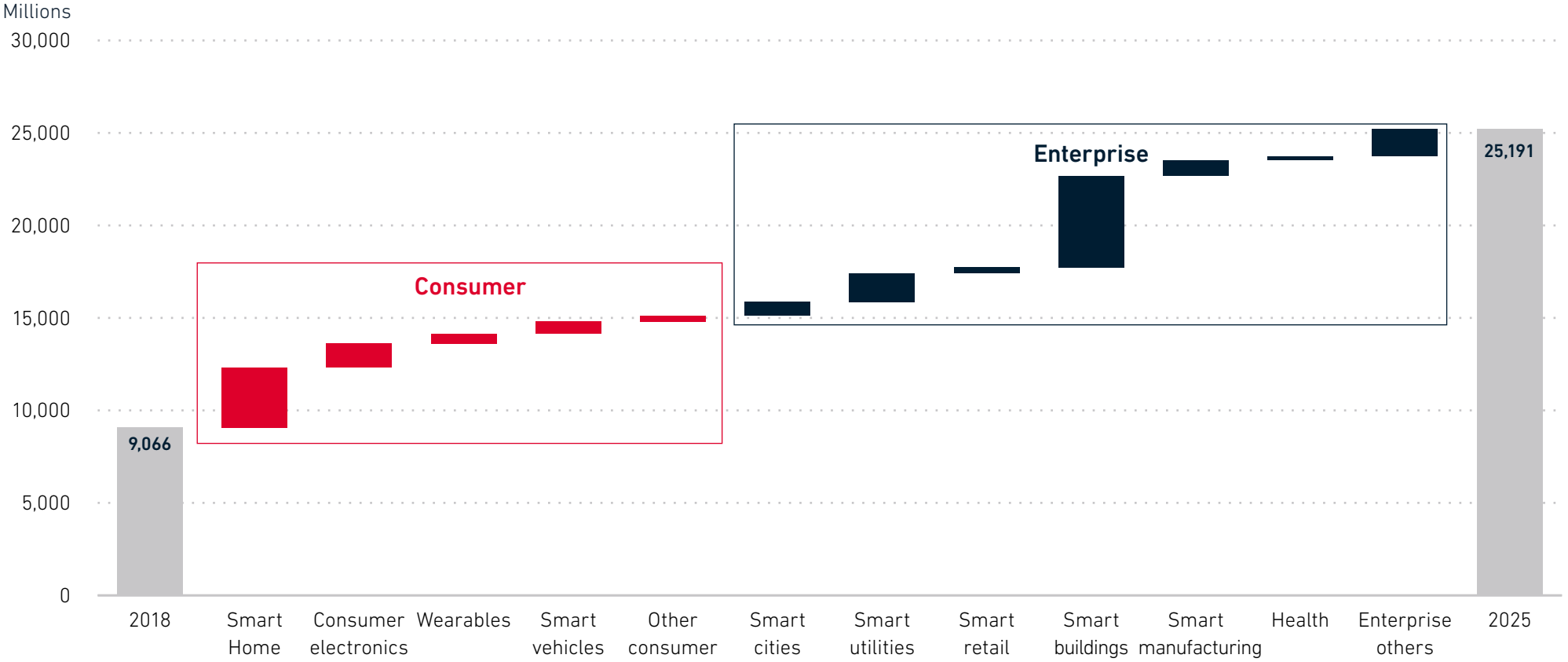
Not exhaustive. Companies shown may operate at multiple levels of the value chain.

Source GSMA Intelligence

The consumer segment is more modest but still large in absolute terms

- The smart home promise has always been built on connecting objects and having a seamless way of controlling them in the home or remotely. The connecting part is not in doubt but no one has solved the issue of linking them.

IoT connections net additions, 2018–2025



Source GSMA Intelligence

In the home there are many players but no clear winners

Home appliances
SAMSUNG iRobot LG KUVÉE

Data analytics
Google amazon Datameer IBM

Platforms
Control4 SAVANT

Connectivity and cloud
Operators amazon Microsoft

Pet and baby monitor
iBaby Petnet tractive MOTOROLA

Home assistants
amazon Google Apple Alibaba.com

Gardening
EDYN rachio Husqvarna greenIQ

Smart home

Home robots
Rokid jibo kuri OLLY

Entertainment
Google amazon SONOS

Security and safety
Google smartfrog canary leeo

Goods on-demand
amazon deliveroo TaskRabbit

Home access
amazon vivint. ALARM.COM August

Health and wellness
Sleepace AWAIR

Lighting
PHILIPS SAMSUNG HIVE IKEA

Solar
SolarCity vivint.Solar SUNPOWER TESLA

Energy
Google ecobee tado sense

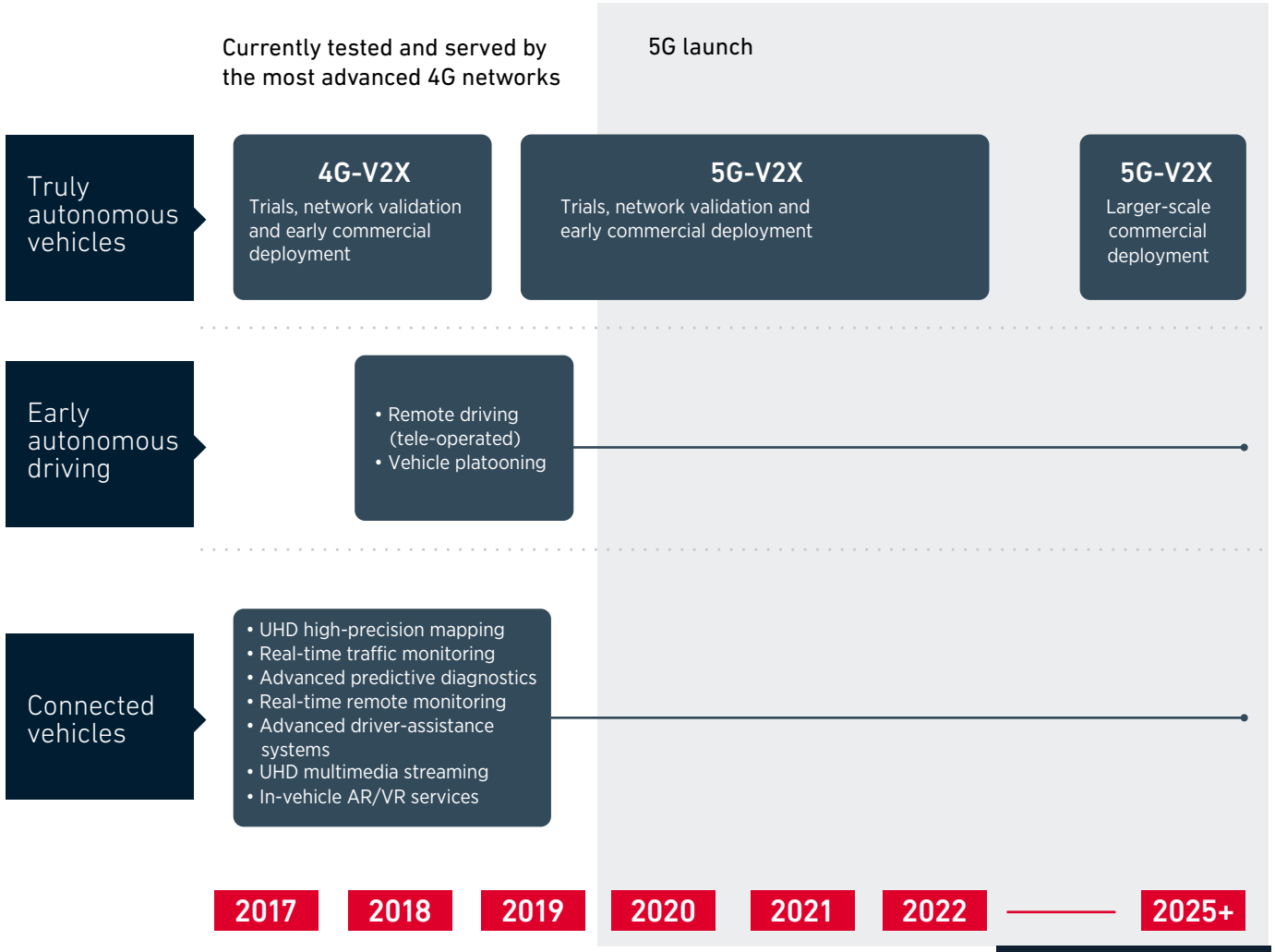
Infrastructure Security Energy management Verticals

Examples only; not a comprehensive list of segments or companies.

Source GSMA Intelligence

In cars, telematics has some traction but the real battleground lies ahead in autonomous vehicles

- Connectivity in the car has mostly been focused on infotainment and telematics.
- Verizon has built out a very good platform, helped by key M&A (such as Hughes), with IoT revenues of $1.5 billion in 2017, most of which come from telematics.
- As this is less than 1% of group revenue, the ability to impact overall growth is limited.
- R&D is now focused on the transition to autonomous driving, where multiple standards are competing for adoption by auto manufacturers.



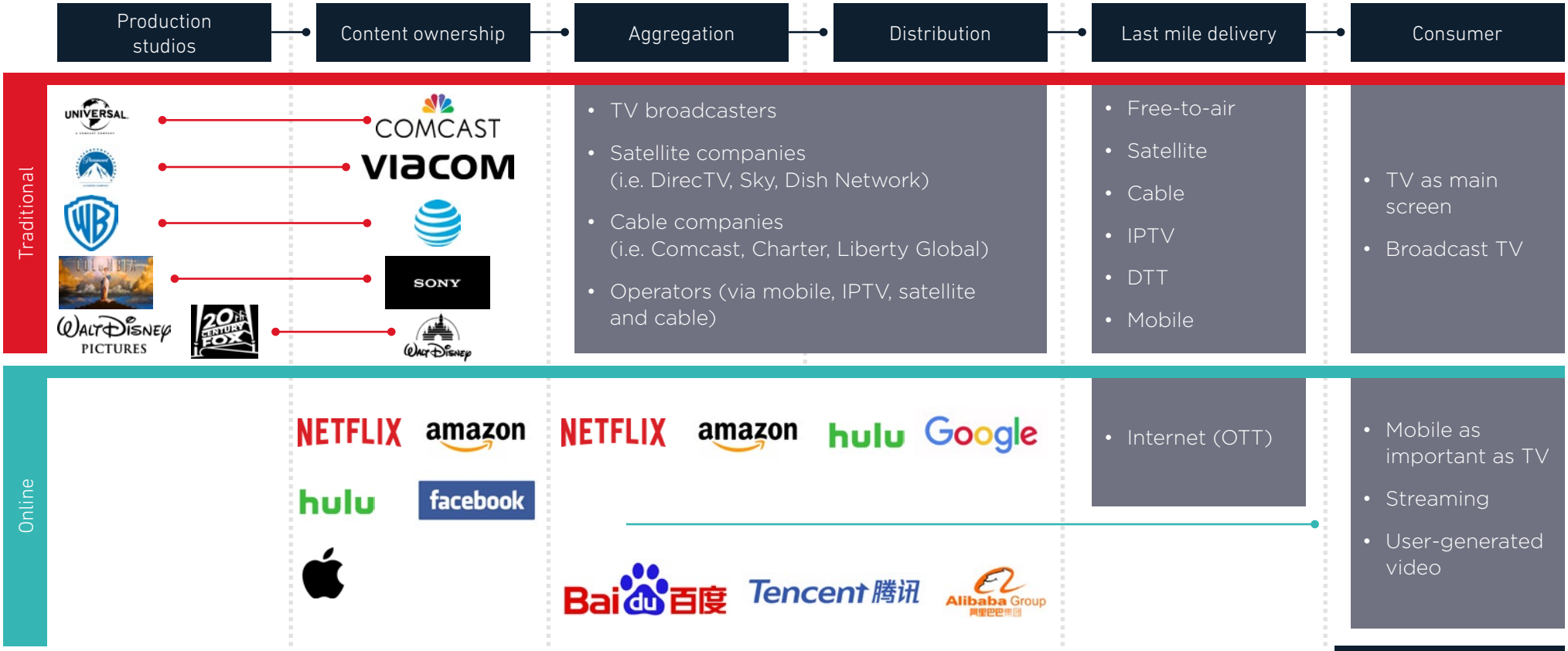
Source GSMA Intelligence

GLOBAL MOBILE TRENDS

Media and content

Content value chain has been upended by SVOD going direct to the consumer

- Digital conglomerates and OTT content providers have created a parallel online video ecosystem, disrupting traditional value-chain players across both content production and distribution by going direct to the consumer.

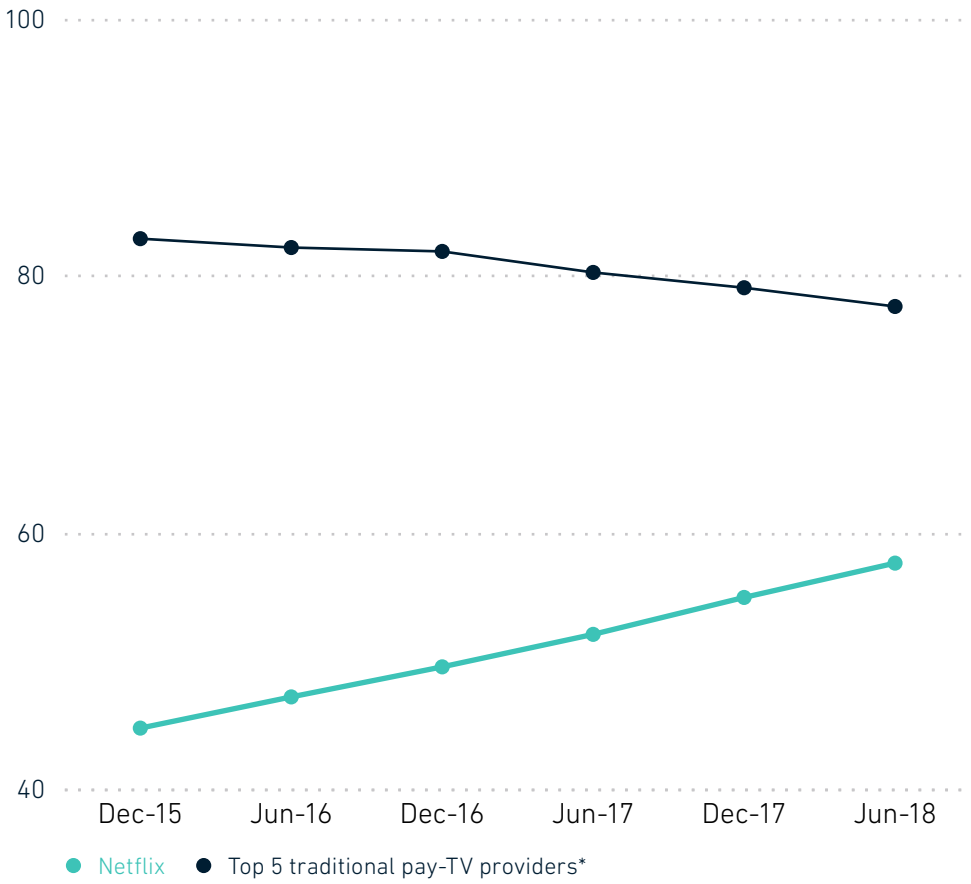


Source GSMA Intelligence

Netflix is creating a virtuous circle of growth fuelled by heavy investment in original programming

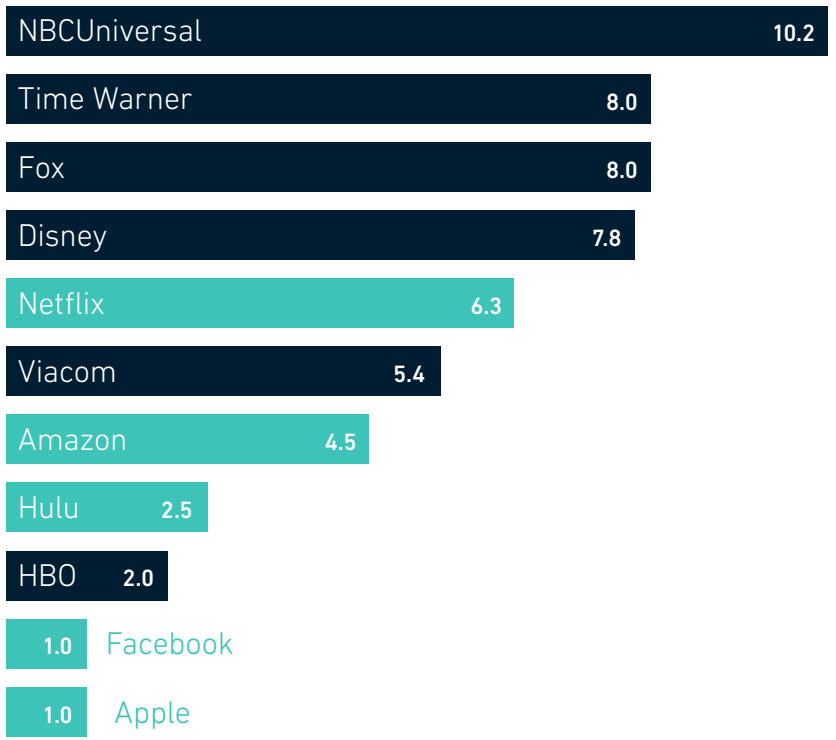
Pay-TV customers in the US

Million



Content spend excluding sports

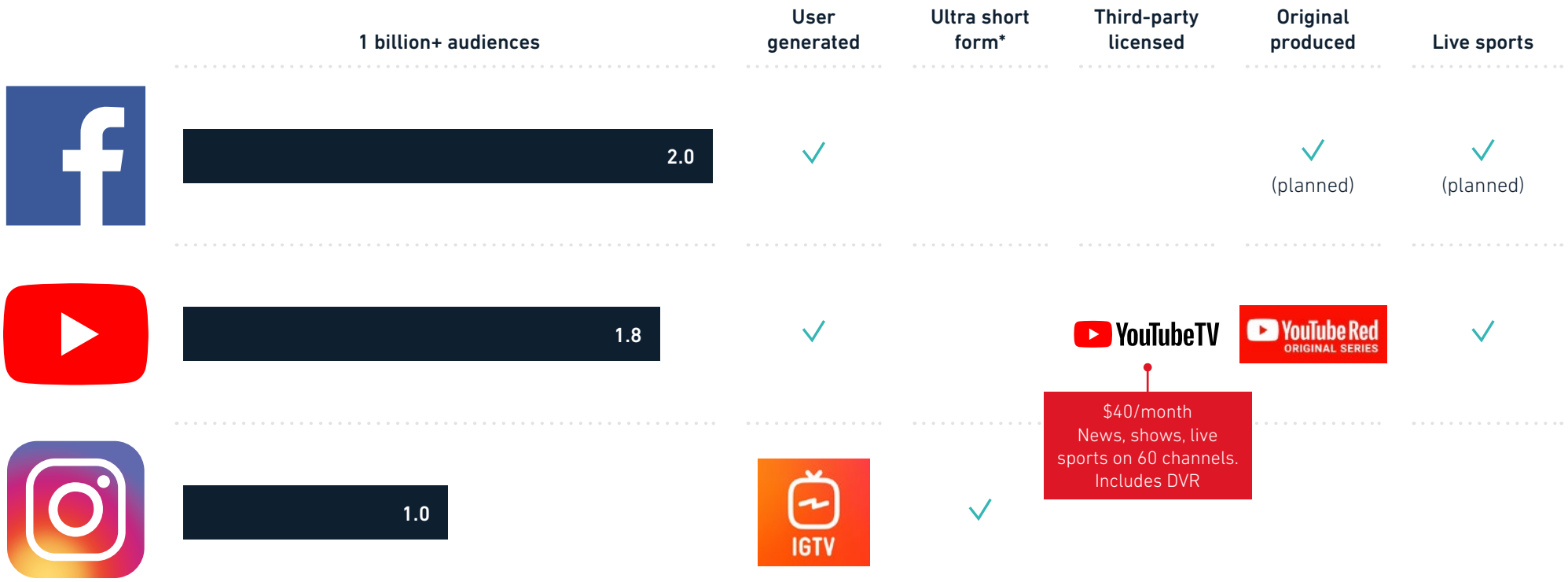
$ billion, 2017



*AT&T, Comcast, Charter, Dish and Verizon. Traditional pay-TV (cable, satellite, IPTV) excluding OTT.

Source Company data and GSMA Intelligence

The other force is social media, which is redefining content formats and distribution

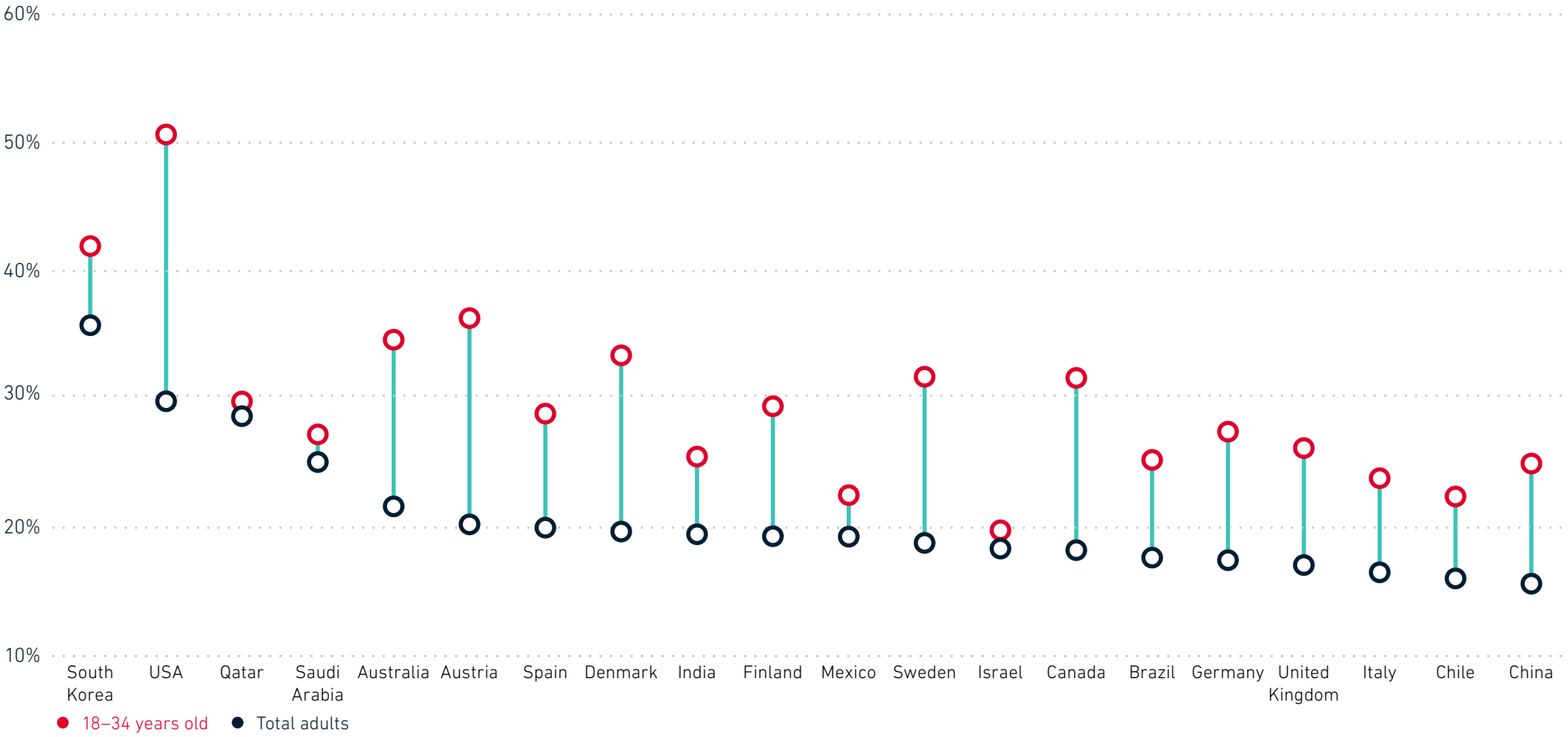


*Enforced time limit. Instagram currently permits 1 minute, although will expand to 1 hour with IGTV

Source GSMA Intelligence

This attracts millennials, who consume more of everything

Percentage of smartphone users paying for on-demand TV/movies at least once per month



Source GSMA Intelligence Consumer Survey 2017

For the majority of telcos, an asset-light approach on content is most realistic

1 Original or exclusive content as a differentiator

- Unique, exclusive and differentiated content will attract and retain customers
- Benefits (in theory) – churn reduction, data volumes
- Capital intensive but can shorten time to market

2 Aggregator (but not necessarily exclusive)

- Content exclusivity is an expensive business; not sustainable in the long-term
- Priority should be breadth of content offered to the user
- Operators should stick to their core strengths on network
- 'Lighter' approach but licensing offers less differentiation as competitors can carry similar offering

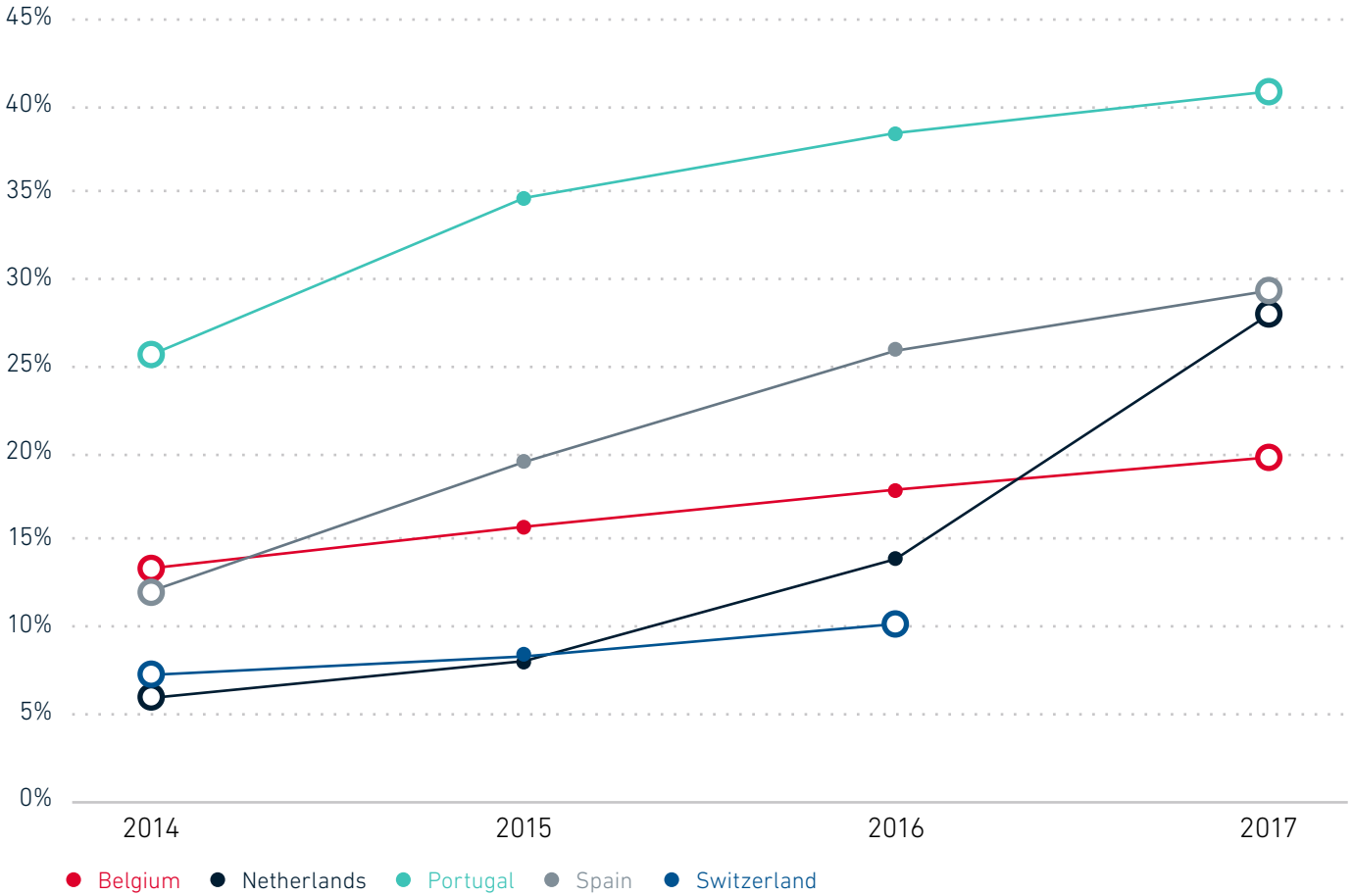
Go-to-market strategies

Build	• Build exclusive content in-house (e.g. AT&T, Orange, China Mobile)
Buy	• Premium sports rights (e.g. Elisa, BT)
License	• License from third parties such as Netflix, Amazon and HBO (e.g. Telefonica, Vodafone)
Bundle	• Aggregate content provided by long-tail of media players, leverage existing billing relationship and distribution network (e.g. Airtel, Etisalat)

Source GSMA Intelligence

Bundling has been the monetisation route, but after years of effort this appears to be more defensive

Quad-play take-up as a percentage of households



Source GSMA Intelligence Consumer Survey

- Positives include churn reduction and some pricing uplift after early discounting.
- The model may be reaching its limits; even the most established convergent markets in Europe (Spain/France/Belgium/Portugal) have household take-up of 20-40%.
- Premium content is unlikely to advance this; it is more of a help with churn and value uplift of the existing base.

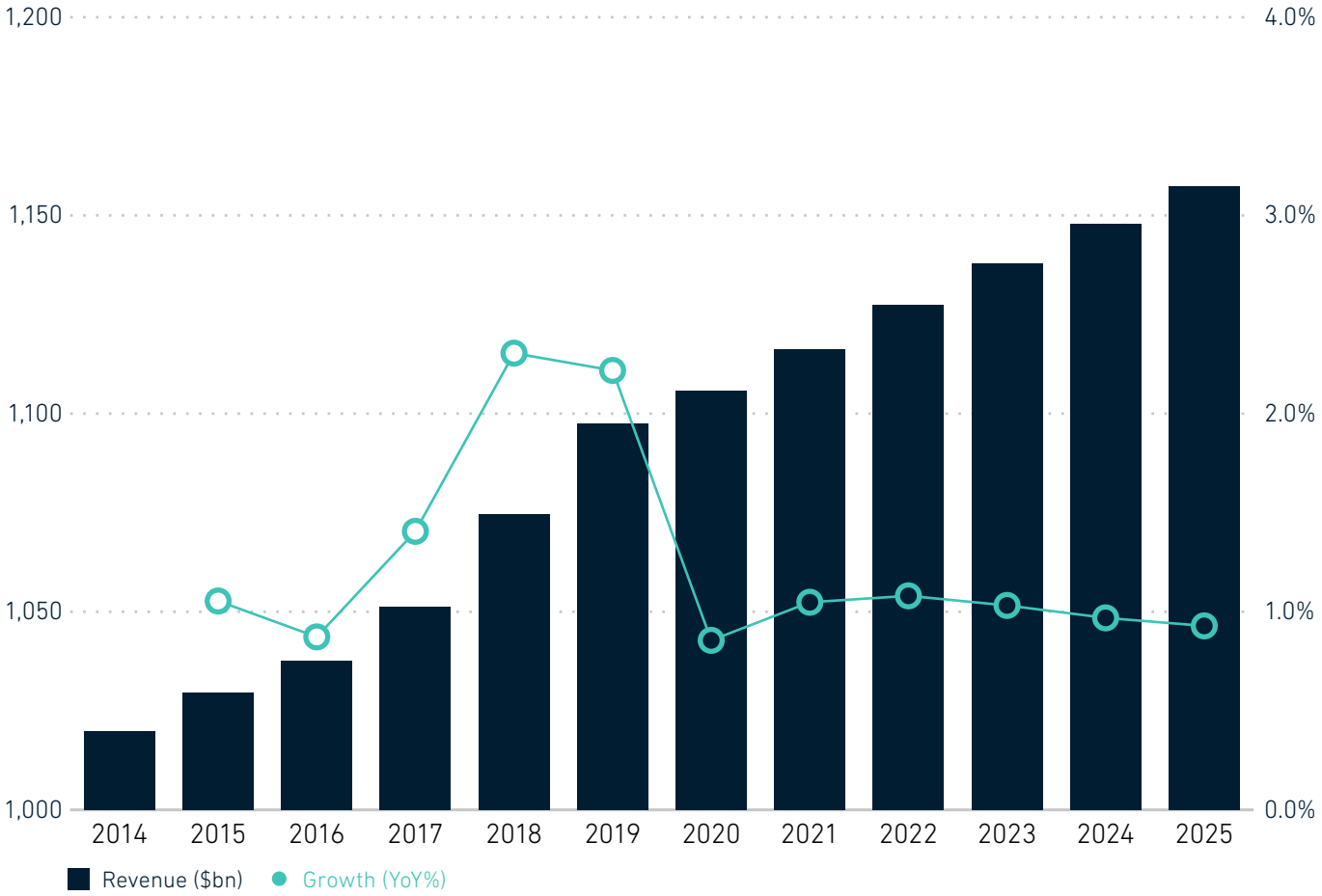
Quadplay includes fixed landline, home broadband, pay TV and mobile on one bill. N=1,000 respondents in each country

GLOBAL MOBILE TRENDS

Financial performance

Global mobile revenue growth outlook remains subdued

Total global mobile revenue growth



Source GSMA Intelligence

- Total mobile revenues reached $1.05 trillion in 2017, up 2% year-on-year. Following a pick up in 2018, driven in part by a return to growth in the US, revenue growth will slow steadily to 1% (real terms) growth out to 2025.
- The modest global growth outlook reflects a combination of slowing unique subscriber growth, regulatory intervention and increased competition.
- Growth out to 2025 includes some modest uplift from 5G launches and IoT services. Upside to forecasts can be driven by growing revenues in IoT beyond the connectivity layer and by developing new service areas.

Revenue headwinds in key markets will affect short-term global performance

China

CAGR	2012–2017	2017–2025
	5%	1.9%

Key drivers

China has been affected by slowing subscriber growth and a mix of competitive and regulatory pressures, including the end of domestic roaming charges. The market is also seeing growing adoption of unlimited data plans as operators react to slowing growth with more competitive offers.

Limited impact in forecast period from 5G given highly penetrated market with high levels of data use by consumers. However, ongoing modest ARPU increases mean revenue outlook remains positive even as growth slows

India

CAGR	2012–2017	2017–2025
	0.9%	1.9%

Key drivers

Despite recent mergers, the market remains highly competitive and revenues are declining as Reliance Jio continues to take market share. Bundled data plan offers are seeing sharp declines in effective price per MB.

We forecast an ARPU inflection point from 2020, as competitive pressures ease, market shares stabilise and the full impact of mergers is felt. Growing 4G adoption is also expected to drive higher data usage and improve the pricing power of operators.

Revenue headwinds in key markets will affect short-term global performance

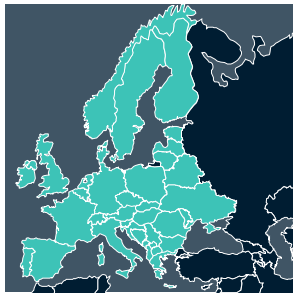
United States

	2012–2017	2017–2025
CAGR	2.3%	2.4%

Key drivers

Competition in the US remains intense, driven by T-Mobile, as well as new MVNO launches by cable operators. The planned T-Mobile/Sprint merger, if approved, is likely to stabilise the competitive outlook.

Further out, new revenue streams particularly from IoT (where connections are seeing strong growth) and from 5G launches (due from 2019 onwards) should help stabilise revenue trends after a period of significant downward pressure on pricing and ARPU.



Europe

	2012–2017	2017–2025
CAGR	-2.2%	0.4%

Key drivers

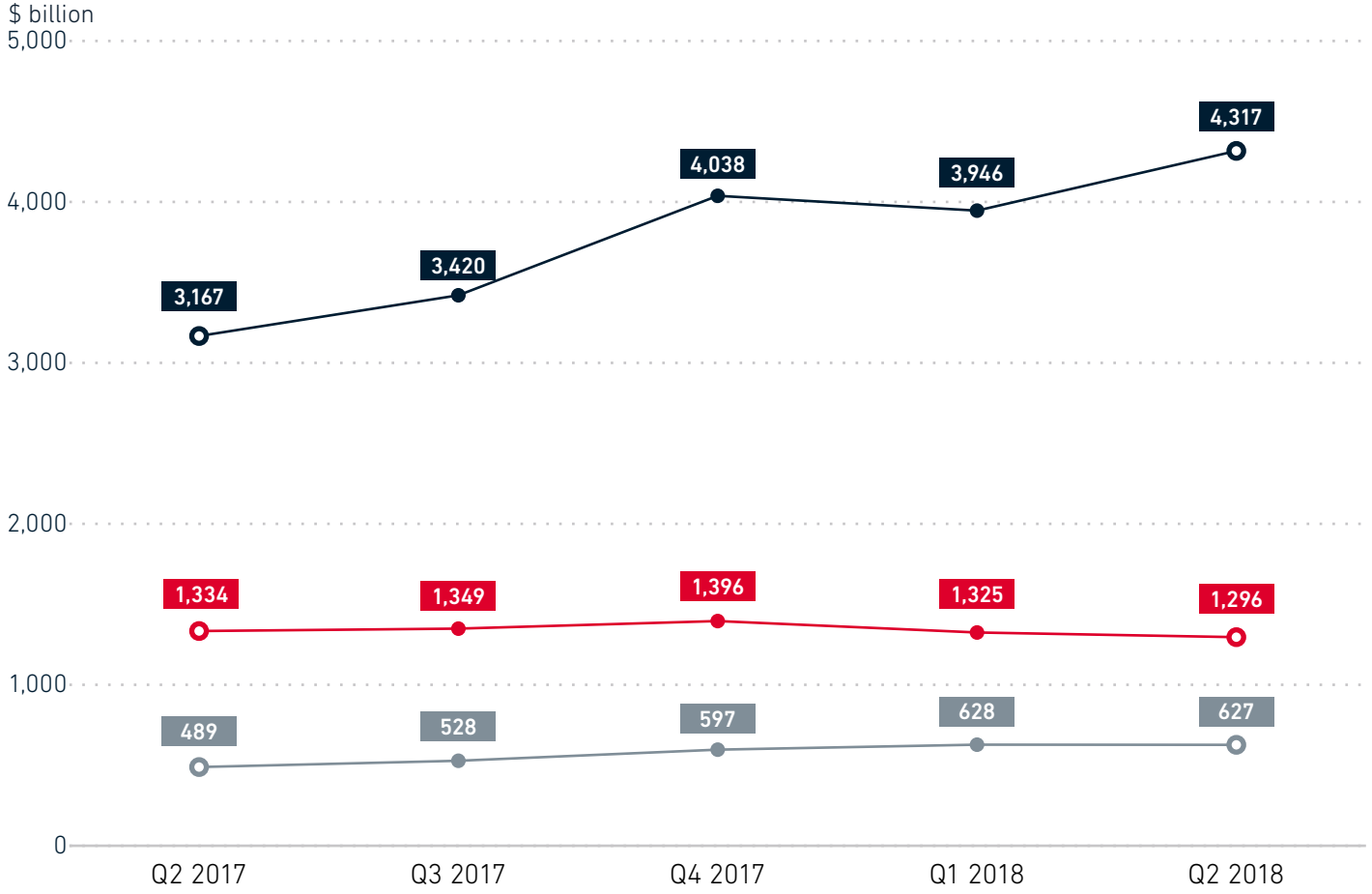
Revenues in Europe are stabilising after several years of decline, helped by fewer regulatory headwinds and an improving macro backdrop. Consolidation in several markets is also helping the revenue outlook, although overall growth rates are close to zero.

The UK is set to see an inflection in revenue trends by 2020 after several years of declines. Competitive pressures are set to ease and ARPU levels stabilise, helped by strong growth in data volumes.

Our forecasts include little uplift from 5G or new services, although signs of a more supportive regulatory approach to consolidation could improve the outlook in some of the region's more competitive markets.

Telco valuations are in line with growth expectations: flat

Market capitalisation



Growth rate[1]

GAFAMT 36%

Mobile industry -3%

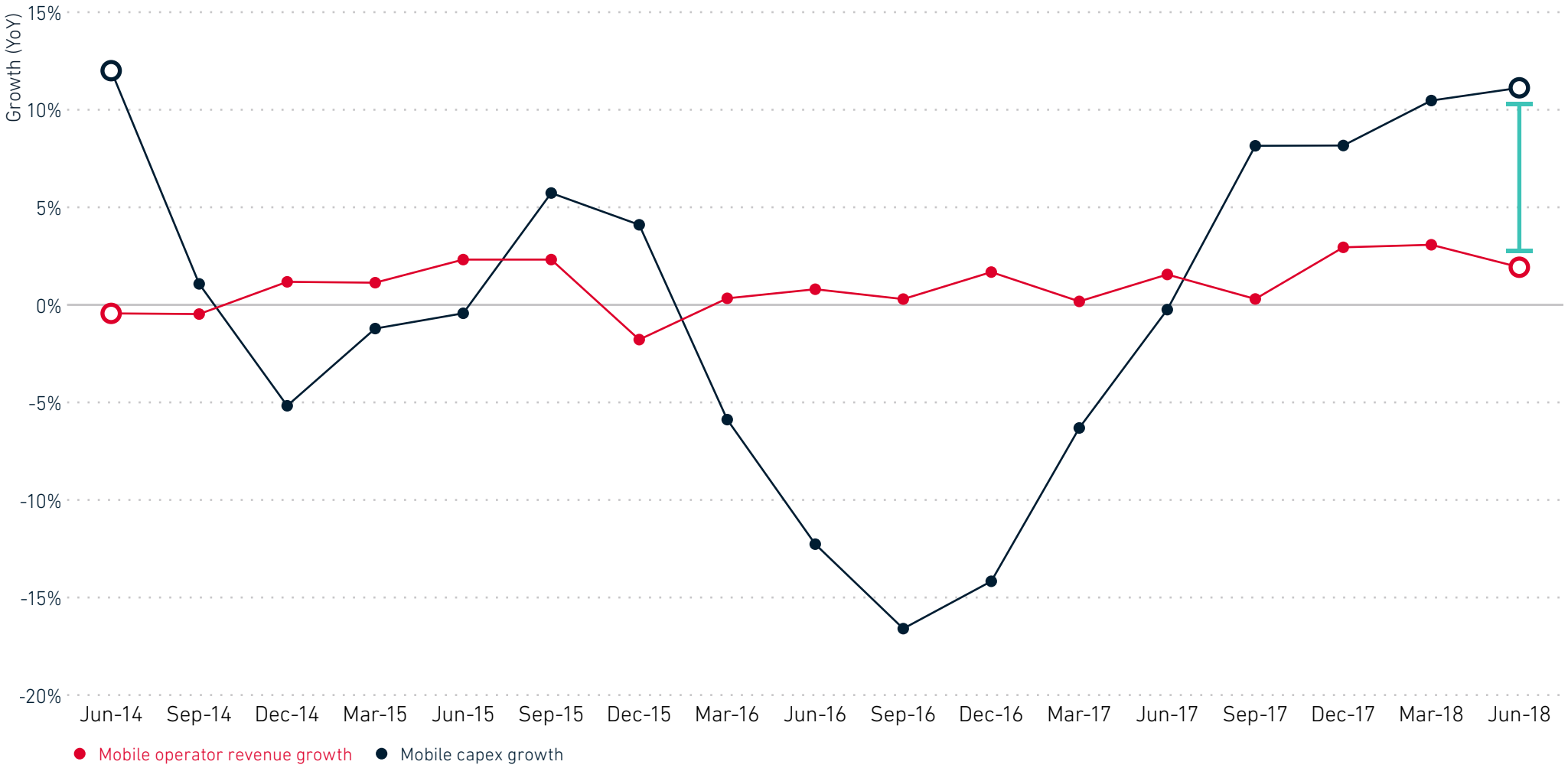
Vendors/ Chips[2] 28%

S&P Global 500 (growth rate only) 8%

1 Growth rate between Q2 2017 and Q2 2018
2 Qualcomm, Nvidia, Broadcom, Intel, Ericsson, Nokia, ZTE (Samsung and Huawei do not report market cap)

Source GSMA Intelligence

Investment is needed for the sector's future, but so is growth



Source GSMA Intelligence

GLOBAL MOBILE TRENDS

Regional outlook

Europe

Smartphones

	2017	2025
Connections	470 million	583 million
Adoption rate	70%	83%

Unique subscribers

	2017	2025
Total	465 million	481 million
Penetration rate	85%	88%

Connections by technology

	2017	2025
2G	20%	1%
3G	38%	7%
4G	42%	63%
5G	—	29%

Operator total revenues

	2017	2025
	€143 billion	€144 billion
CAGR	0.1%	

Capex

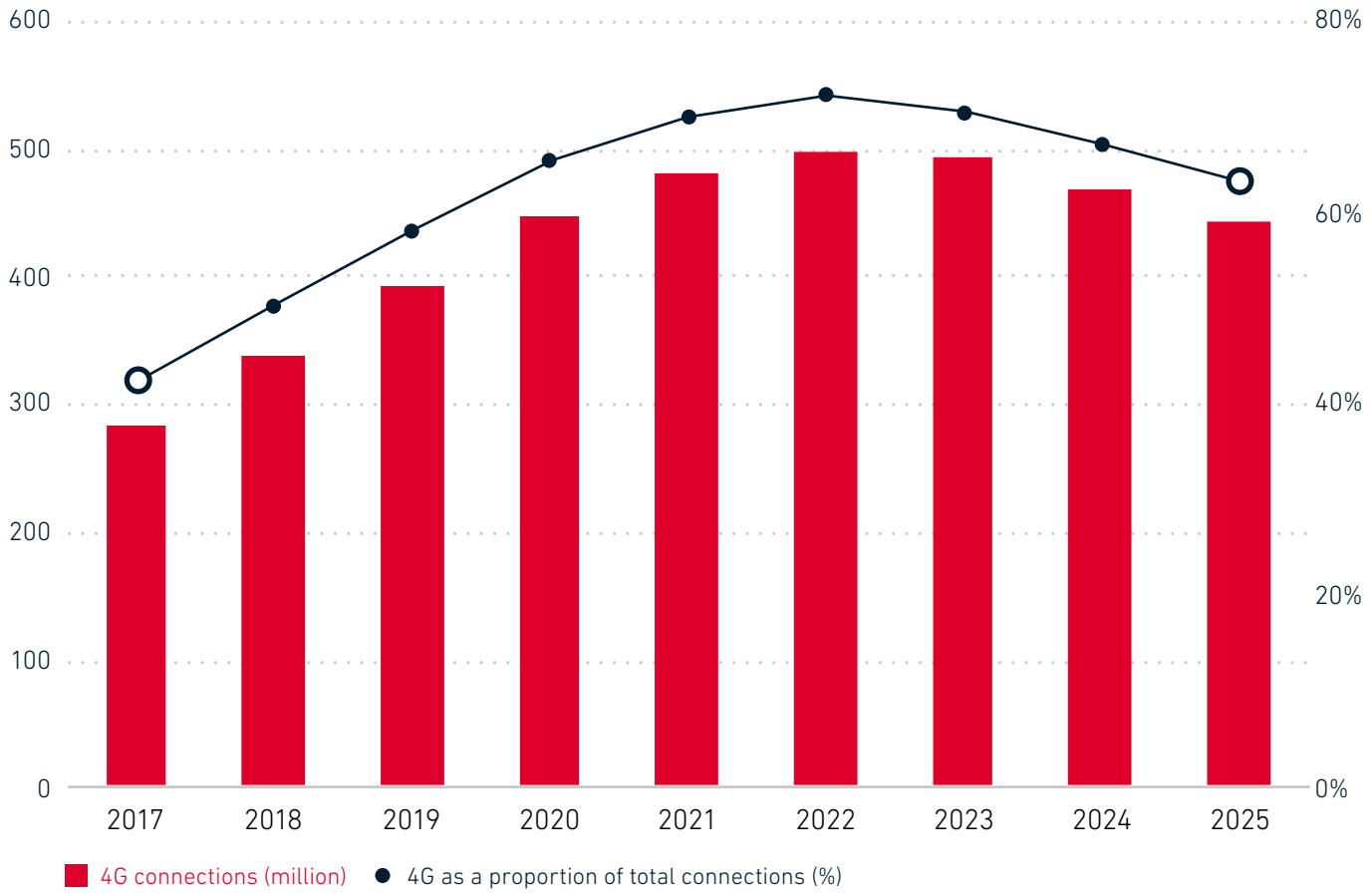
	2017	2020
	€24 billion	€22 billion
CAGR	-2.6%	

4G migration continues and still presents opportunities in some markets

- 4G overtook 3G during H2 2017 to become the region's dominant mobile network technology after years of investment (population coverage reached 97% at the end of 2017).
- The 4G lifecycle is not yet over, and investment is likely to continue to the end of the decade.
- Attention is now on network upgrades driven by technological evolution (e.g. LTE Advanced Pro).
- The gap between 4G take-up and smartphone adoption in some markets (including Austria, Greece and Hungary) presents operators with opportunities for customer upgrades and growth.

4G connections in Europe

2017–2025

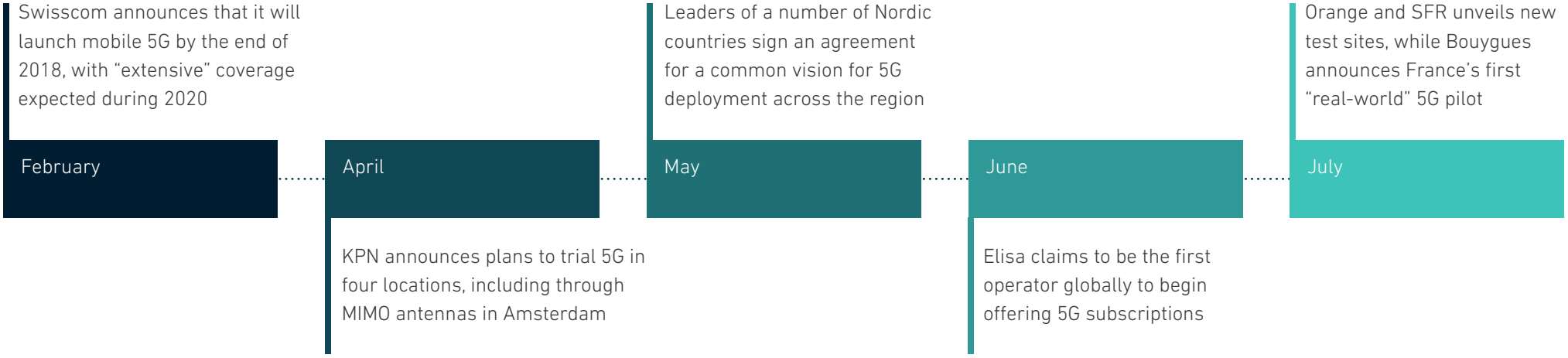


Source GSMA Intelligence

Much expected as European operators begin their 5G journeys

- The EC is keen to spearhead the development of 5G, having launched the '5G for Europe Action Plan' in September 2016
  - More recently, it has established the '5G Verticals INNovation Infrastructure (5G-VINNI)' project, which is funded by the EU's Horizon 2020 programme and aims to accelerate 5G uptake in the region.
- While the US, China, Korea and Japan are set to be the front-runners in 5G commercialisation, we forecast Europe to reach 29% penetration by 2025 (203 million connections), comparatively lower given later launch timelines and the slower pace of network rollout.

Developments from 2018



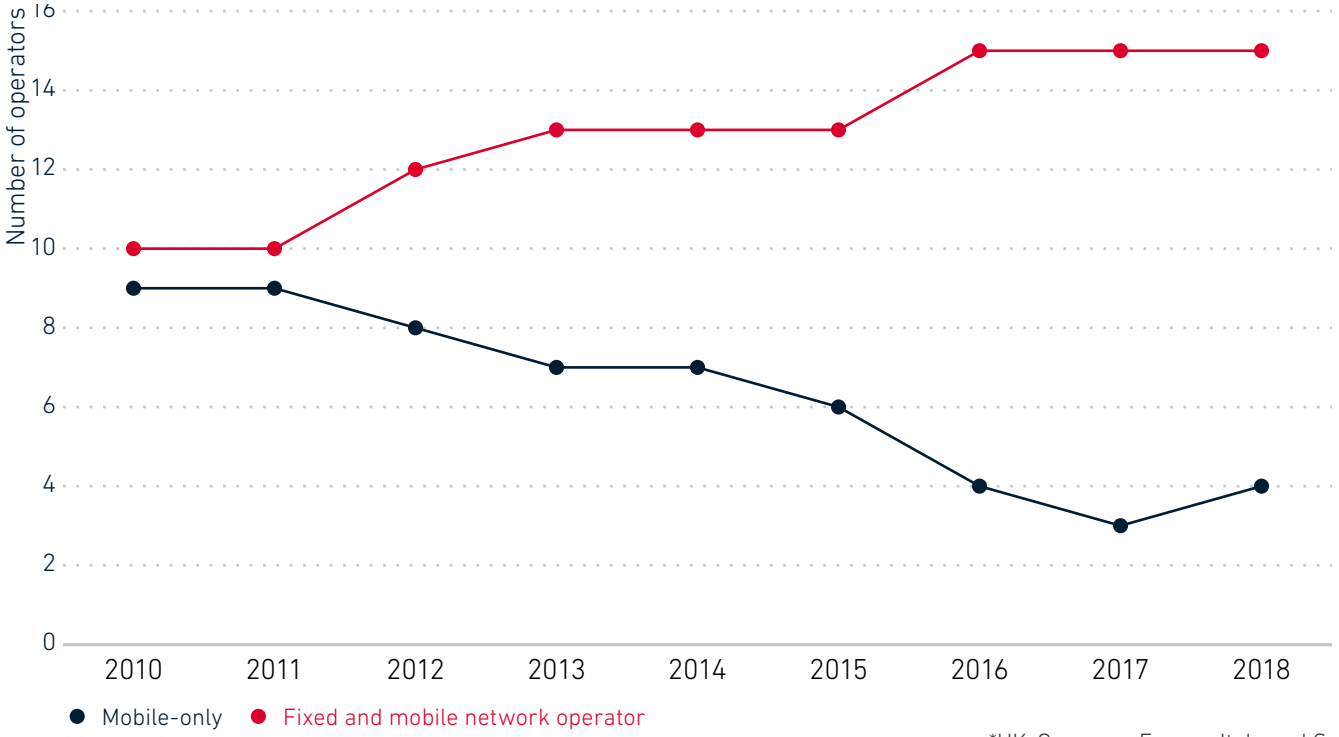
Source GSMA Intelligence

80% of operators in Europe are now integrated fixed-mobile players

- The mobile market structure in Europe has altered dramatically over the last eight years to predominantly comprise converged fixed-mobile operators (80%), with very few remaining mobile-only players.
- The main reason is to drive economies of scale in network and fibre builds. Revenue growth ticks from converged offerings have, however, proven largely elusive.

EU5* market compositions

2010–2018



*UK, Germany, France, Italy and Spain

Source GSMA Intelligence

Vodafone to acquire Liberty Global

In May 2018, Vodafone announced the acquisition of Liberty Global's cable operations in Germany, Czech Republic, Hungary and Romania for €18.4 billion.

The transaction would increase Vodafone's fixed line customer base by 9.6 million across its European footprint, as well as its share of total revenue.

The EC will be the ultimate decision-maker for the merger and may seek some remedies in order to grant approval.

GLOBAL MOBILE TRENDS

Regional outlook

US

Smartphones

	2017	2025
Connections	275 million	350 million
Adoption rate	81%	92%

Unique subscribers

	2017	2025
Total	275 million	297 million
Penetration rate	84%	86%

Connections by technology

	2017	2025
2G	8%	2%
3G	22%	4%
4G	70%	44%
5G	—	49%

Operator total revenues

2017	2025
$239 billion	$288 billion

CAGR 2.4%

Capex

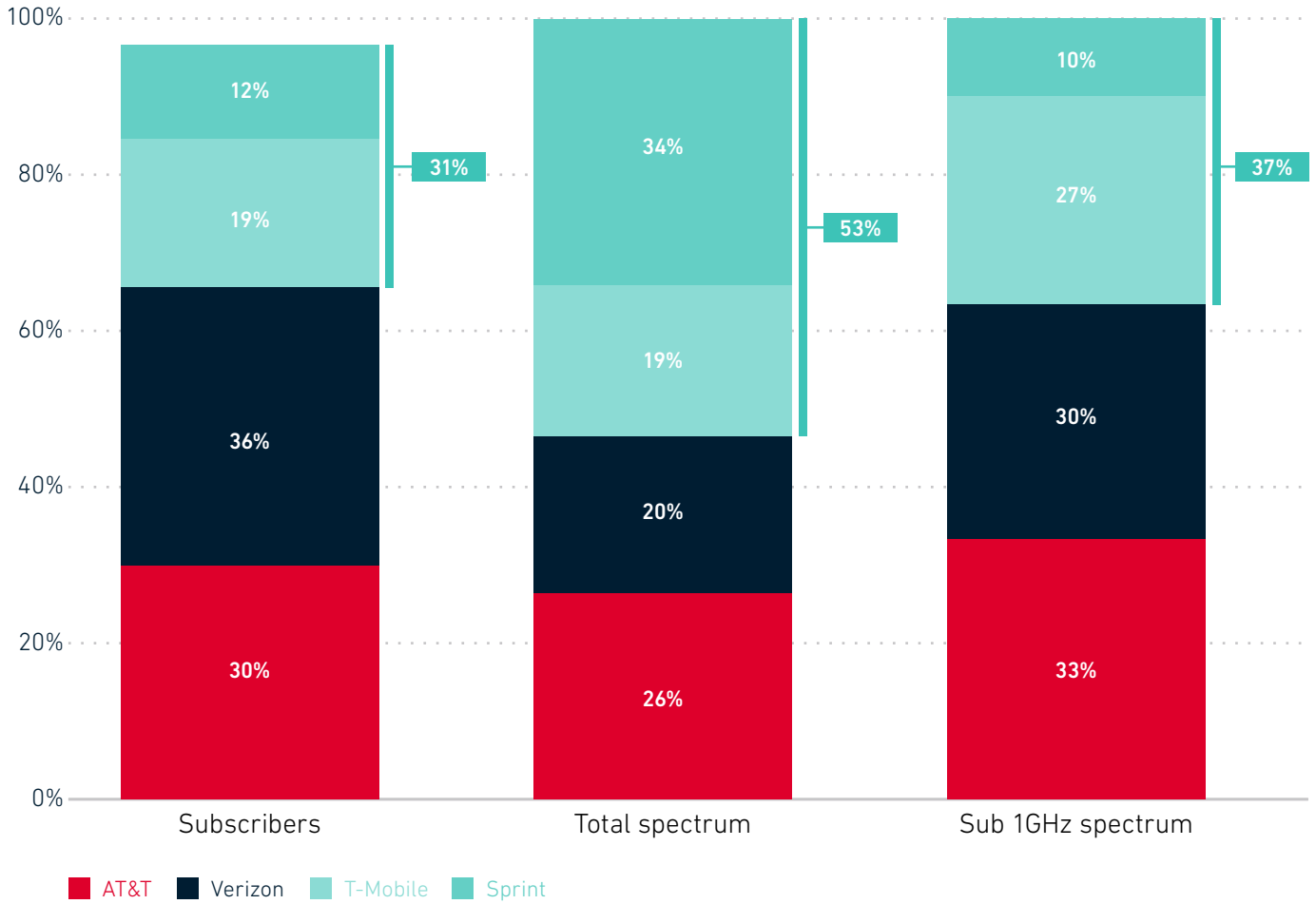
2017	2020
$34.6 billion	$39.1 billion

CAGR 4.2%

T-Mobile and Sprint finally merge, reshaping the playing field

- After years of talks, T-Mobile and Sprint finally announced a planned merger.
- The transaction would reshape the US market, creating a new number 3 with around 30% of the market.
- T-Mobile had played a disruptive role and successfully gained market share at the expense of the incumbents but remained sub-scale with low cashflow margins.
- The combined entity will be able to realise cost synergies and scale economies in network rollout for 5G.
- It will also benefit from a larger concentration of low frequency spectrum; however, exactly how large that is remains to be seen; the company may be forced to divest a portion of its spectrum as a condition for merger approval.
- Traditionally the FCC has adopted a spectrum screen that limits the amount of spectrum an operator can hold to a third of the spectrum available in the market.

Market shares post T-Mobile/Sprint merger



Subscribers are for mobile services as of March 2018. Spectrum holdings are those currently held by T-Mobile and Sprint but these shares may decline if merged entity is subject to divestment requirements

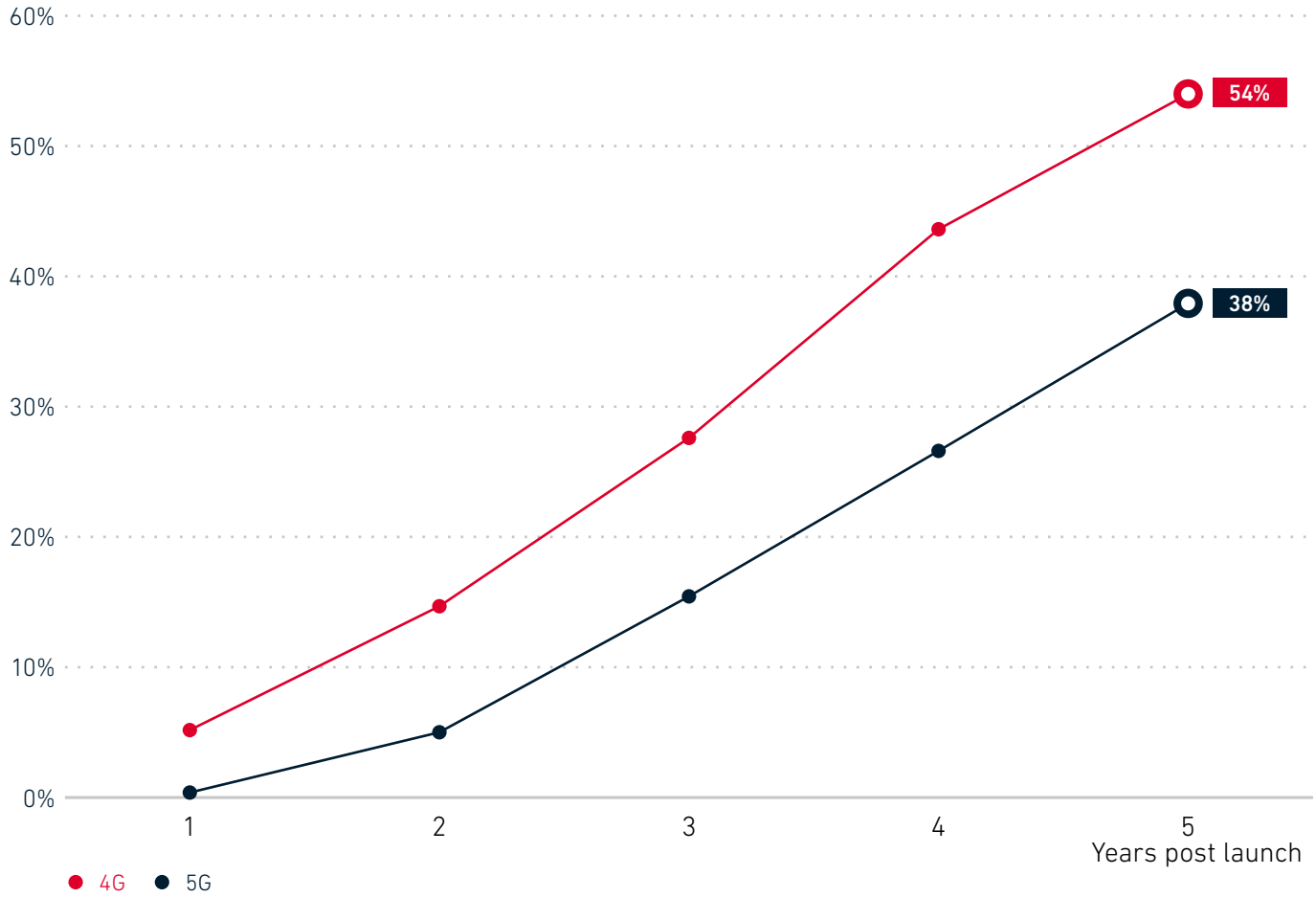
Source GSMA Intelligence

A more cautious, incremental approach to 5G than LTE

- The US will be one of the first countries to launch commercial services for 5G, as was the case for 4G.
- Consumer take-up of 5G will take time to evolve; our expectation is for 38% penetration five years after launch (2023), well below LTE on the same basis (54%).
- The main opportunity for incremental operator revenues in the US will come from 5G-based fixed wireless as well as services targeted at the enterprise sector.

Comparing 4G and 5G take-up paths

Share of mobile customer base



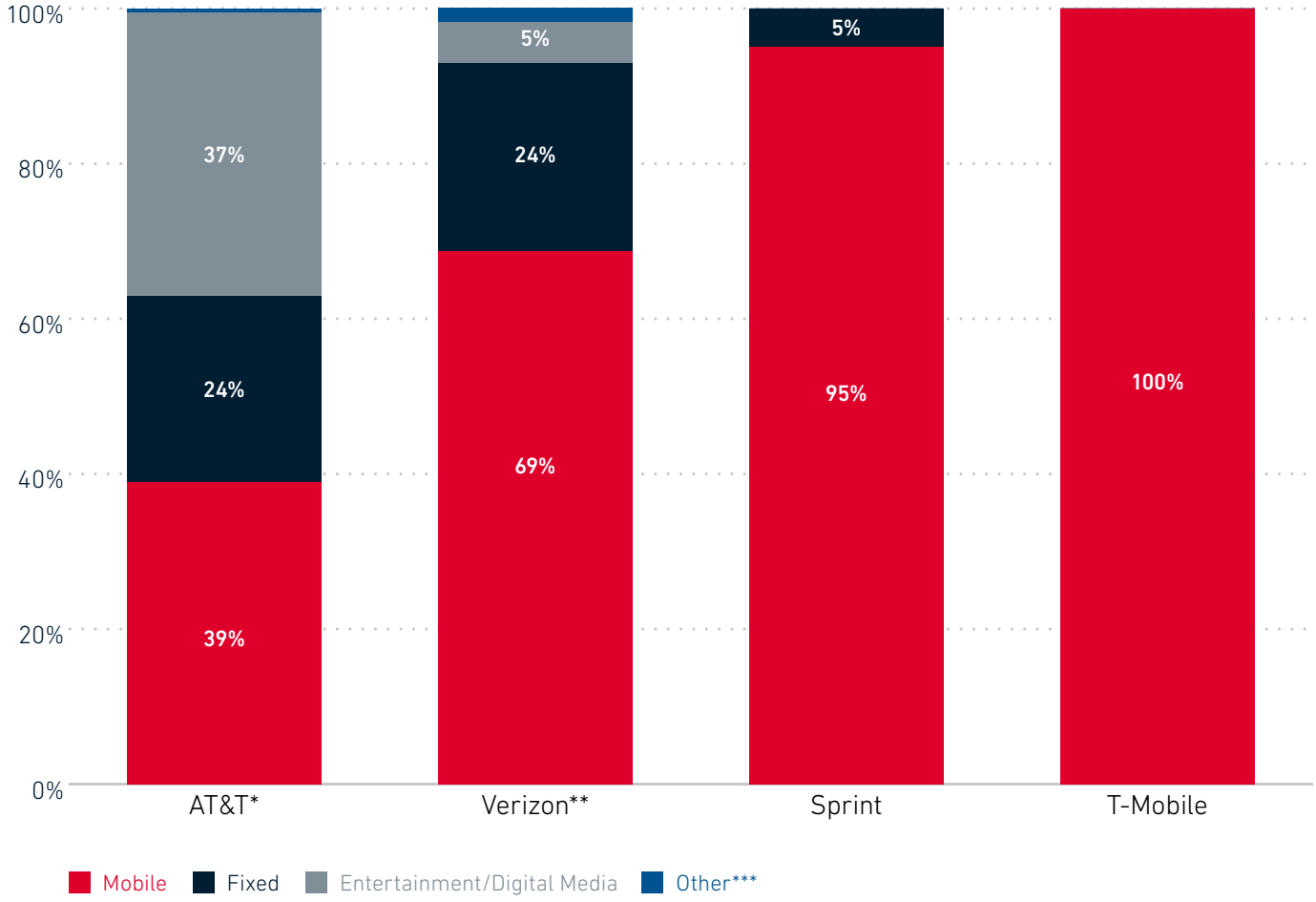
Launch years: 4G = 2010, 5G = 2018. 5G connections exclude fixed-wireless

Source GSMA Intelligence

The US is at the coalface for the wider convergence of telco and media

- AT&T and Verizon have reshaped their businesses with entertainment and media assets to complement traditional communications.
- On a pro forma basis, AT&T will have roughly equal contributions from entertainment and mobile, justifying its claim to be a modern entertainment company.

Revenue distribution



Mobile and fixed figures are full-year 2016. Sprint and T-Mobile shown as pre-merger.

*Including Time Warner (aggregate). **Including Oath. ***Corporate, Other & Eliminations

For Verizon: most IoT revenue (e.g telematics) is included within Corporate and Other.

Source GSMA Intelligence

GLOBAL MOBILE TRENDS

Regional outlook

China

Smartphones

	2017	2025
Connections	1.08 billion	1.4 billion
Adoption rate	76%	89%

Unique subscribers

	2017	2025
Total	1.15 billion	1.22 billion
Penetration rate	82%	85%

Connections by technology

	2017	2025
2G	21%	0%
3G	8%	0%
4G	71%	72%
5G	—	28%

Operator total revenues

2017	2025
$173 billion	$201 billion

CAGR 1.9%

Capex

2017	2020
$27.7 billion	$32.8 billion

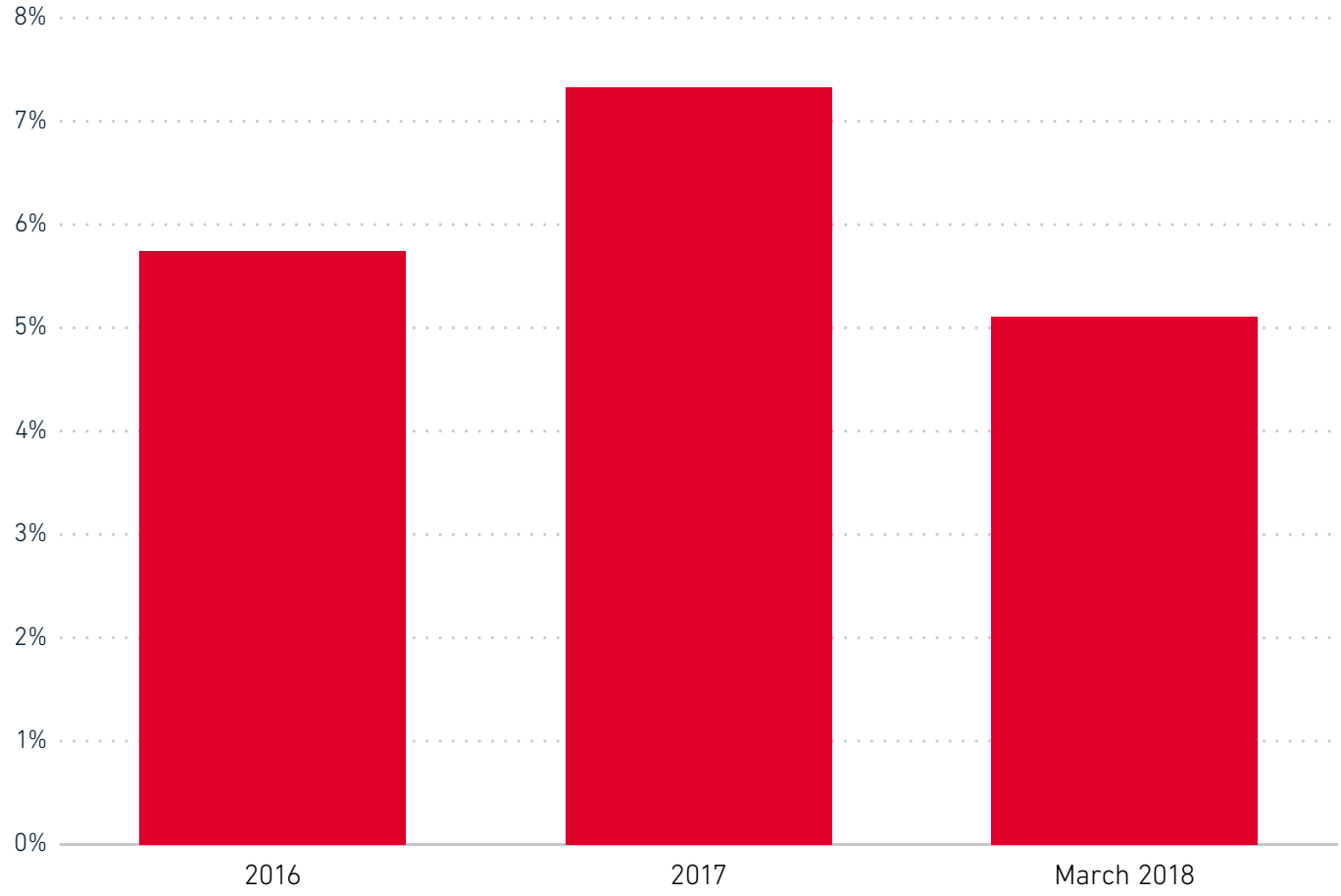
CAGR 5.8%

Growth slowing as 4G nears saturation

- China has suffered a general deterioration into 2018. Service revenue growth slowed to 5.1% in Q1 compared to 12.5% in Q4 2017 and 7.3% for 2017, driven by a slowdown in 4G subscriber growth.
- LTE adoption is reaching an expected penetration plateau in the range of 70–80% (largely mirroring internet user penetration), which means that revenue growth will likely continue to slow over the coming quarters in the absence of meaningful contributions from new service lines.

Mobile service revenue growth trend

Year-on-year

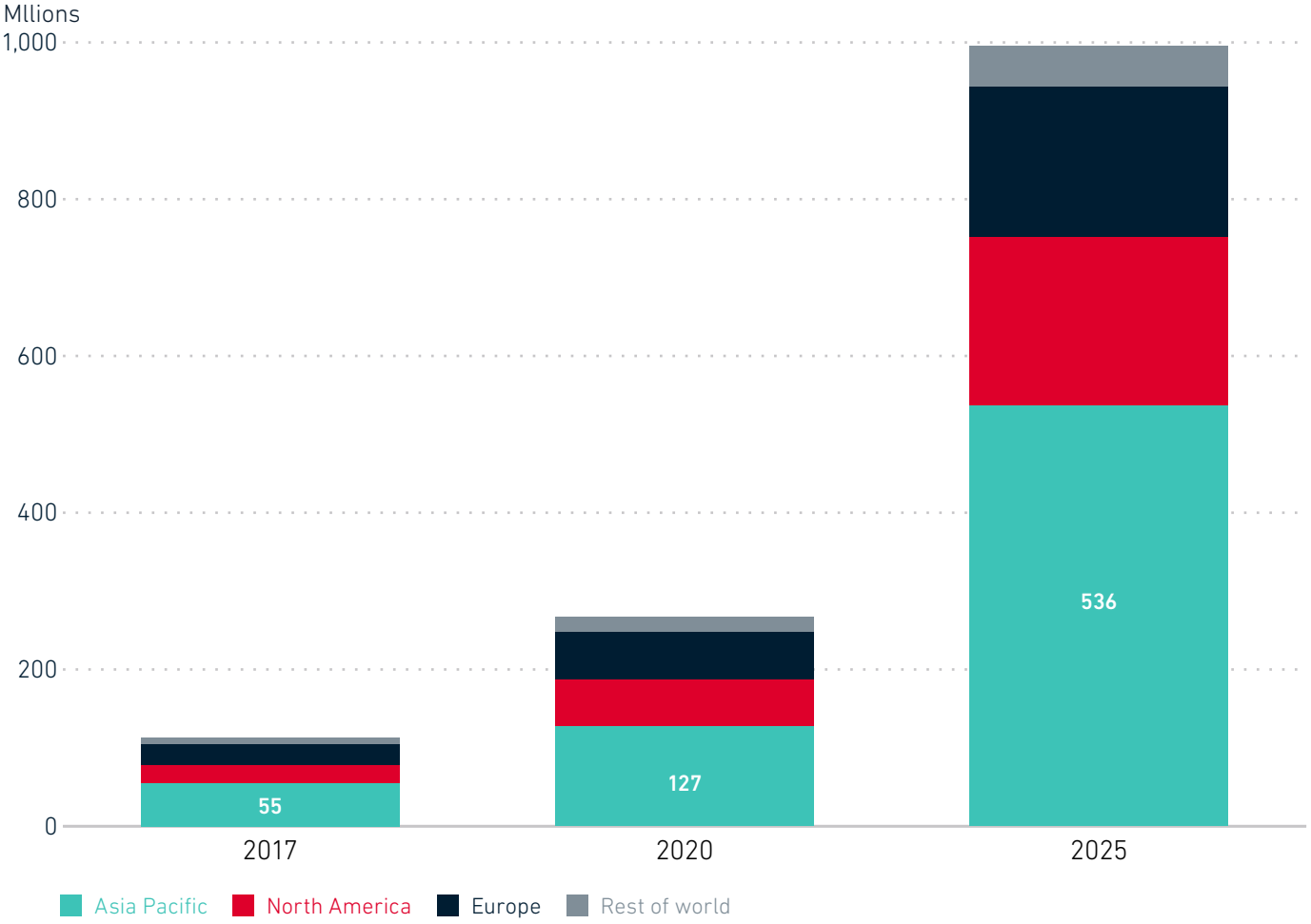


Figures include China Mobile and China Unicom only

Source GSMA Intelligence

Manufacturing is going digital

Smart manufacturing connections



Source GSMA Intelligence

- The Chinese government has made industrial modernisation a key pillar of its Made in China plans.
- The goal is to retool factories with connected machinery to allow advanced robotics and skills training for labour with AR.
- The country is already the world leader in production of cars, ships, smartphones and TVs – the scale is there.
- We forecast Asia to account for around 530 million smart manufacturing objects in 2025 (more than 50% of the global total), with China the major driver.
- Chinese operators are engaged in trials, but so are a number of competitors including cloud players and others such as GE, IBM, Bosch and Foxconn.

AI wars: China versus US

- China has made AI a national strategic priority, backed by huge state financial investment.
- While not specifying exactly what would be included, the government is targeting an AI industry that goes from RMB15 billion in 2016 to RMB1 trillion ($150 billion) in 2030 – a 66× rise.
- Semi-conductors are an important component and have been the basis of a range of proposed international M&A since 2016. However, several deals have been blocked on the grounds of national security.
- Despite its promise as a technology for good, there is a risk that AI becomes a zero-sum game with a host of unintended consequences.

Recent proposed M&A related to AI

Date	Acquirer	Country	Target	Country	Sector	Value ($bn)
September '16	Softbank	Japan	ARM	UK	Semi conductor	30
December '16	Fujian Grand Chip Investment	China	Aixtron	Germany	Chip manufacturer	0.7
December '16	Midea	China	Kuka	Germany	Robotics	5
May '17	Hytera	China	Sepura	UK	Telecom network equipment	ND
January '18	Ant Financial	China	Moneygram	US	Payments	1.2
March '18	Broadcom	Singapore	Qualcomm	US	Semi conductor	117
July '18	Gardners	China	Northern Aerospace	UK	Aerospace	ND
July '18	Qualcomm	US	NXP	Netherlands	Semi conductor	44

Approved Blocked ND – not disclosed

Source GSMA Intelligence

GLOBAL MOBILE TRENDS

Regional outlook

India

Smartphones

	2017	2025
Connections	519 million	1.1 billion
Adoption rate	45%	76%

Unique subscribers

	2017	2025
Total	710 million	919 million
Penetration rate	53%	63%

Connections by technology

	2017	2025
2G	65%	15%
3G	15%	18%
4G	21%	63%
5G	—	5%

Operator total revenues

2017	2025
$25 billion	$30 billion

CAGR 1.9%

Capex

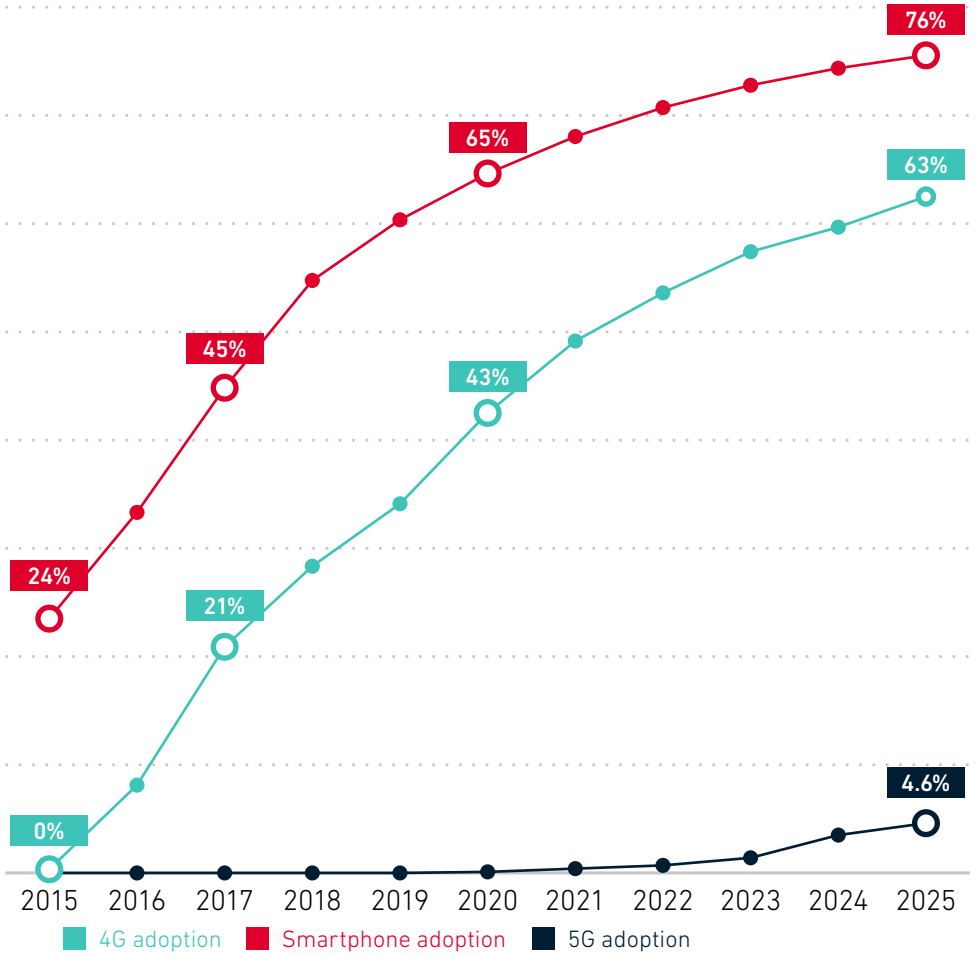
2017	2020
$8.1 billion	$5.7 billion

CAGR -11.0%

4G takes off; smartphone connections to reach 1.1 billion by 2025

- India remains a predominantly 2G market, but this is changing rapidly; the 4G connection base is forecast to grow three-fold to 890 million out to 2025, by which time 4G will account for 6 in 10 connections.
- This growth is being fuelled by a combination of falling data prices, better network coverage, improved smartphone affordability and development of locally relevant content.
- While up to now, smartphone adoption has led 4G uptake in India, this gap will gradually narrow out to 2025. Smartphone connections are forecast to reach 1.1 billion, accounting for three quarters of the total by 2025.
- Despite the 4G era only just beginning in India, initial deployments of 5G are expected in 2020, and the government has targeted 2022 for the completion of the 5G rollout. However, 5G consumer adoption will not significantly impact 4G to begin with, reaching 5% of total connections by 2025.

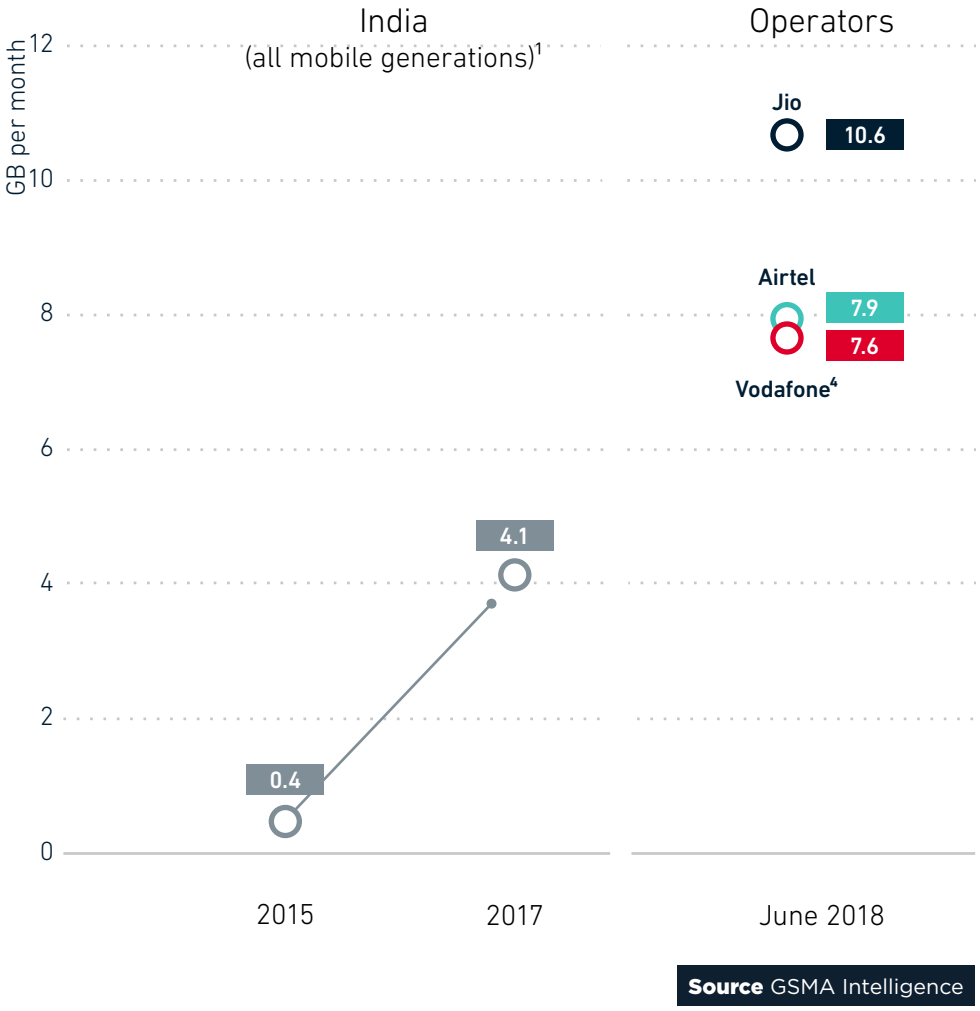
4G, 5G and smartphone adoption in India



Source GSMA Intelligence

Mobile data usage soars but ARPU pressures remain

Average mobile data usage in India



Source GSMA Intelligence

- India has experienced a paradigm shift in data usage since Reliance Jio's entry into the market, which led to intense competition and drove down data pricing.
- Average data consumption per user has risen sharply – by 10× to 4 gigabytes across all wireless generations between 2015 and 2017[1]. However, this has come at the expense of ARPU, which has decreased by almost 40% since mid-2016, to $1.50.
- Meanwhile, low data costs have resulted in phenomenal video growth in India. In 2017, online video consumption increased almost five times in the country[2], while video streaming also contributed to 65–70% of 4G mobile data traffic.[3]
- A key driver of this video demand has been the increased production and availability of relevant local content, in Hindi and other regional dialects.

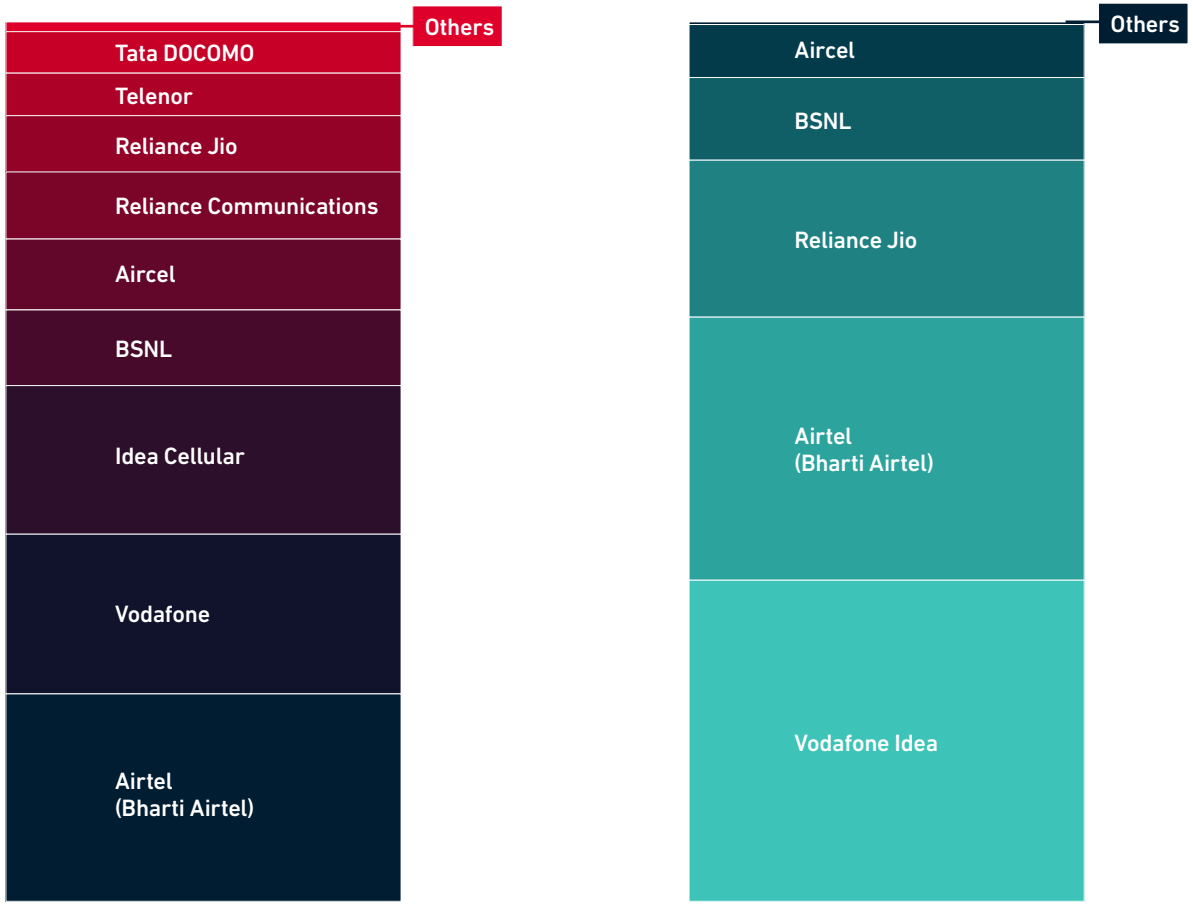
1 TRAI; average mobile data usage (in GB) per active data user per month represents all technologies (2G, 3G, 4G & CDMA)
2 Hotstar
3 Nokia MBIT Report 2018
4 Vodafone average data usage on 4G

Consolidation has reshaped the Indian mobile market

- India's mobile market has undergone radical transformation over the last two years. The consolidation following Jio's entry was imperative for the long-term financial stability of the sector and to attract investment vital to achievement of Digital India and national policy aims.
- Further consolidation, in preparation for 5G and to accommodate the rising consumer demand for data, is already underway. Indus Towers, controlled by Vodafone and Idea, announced a merger with Bharti Infratel to create the world's largest tower company outside China.

Market share pre- and post-consolidation*

Connections



*Assumes completion of Vodafone's acquisition of Idea and Airtel's acquisition of Tata Teleservices

Connections data as of Q2 2018

Source GSMA Intelligence

GLOBAL MOBILE TRENDS

Regional outlook

Asia excluding China/India

Smartphones

	2017	2025
Connections	893 million	1.45 billion
Adoption rate	56%	81%

Unique subscribers

	2017	2025
Total	873 million	1.02 billion
Penetration rate	65%	70%

Connections by technology

	2017	2025
2G	39%	4%
3G	33%	26%
4G	28%	57%
5G	—	13%

Operator total revenues

2017	2025
$213 billion	$216 billion

CAGR 0.2%

Capex

2017	2020
$32.3 billion	$29.5 billion

CAGR -2.2%

Aside from China, Japan and Korea are the 5G pioneer markets in Asia

- Japan and South Korea will be at the forefront of 5G commercialisation, helped in equal measure by operating in digitally hyper-advanced countries and having natural showcases for new technology in the form of the Olympics.
- Because their populations are concentrated in cities, coverage rollout can proceed at faster rates. We expect 5G will represent 48% (Japan) and 59% (South Korea) of their total connections by 2025 – the highest densities in the world.

Early adopters

Japan

The country will be in the first wave of 5G deployments, as operators continue trials. In January 2018, NTT DoCoMo announced an agreement with Nokia to supply hardware for a 2020 launch. 5G is also set to be demonstrated at the Tokyo Olympic games.

South Korea

In April 2018, the Ministry of Science and ICT amended the current infrastructure sharing regulation for fixed networks. The decision requires that all three mobile operators co-deploy and share 5G network elements, with the aim of accelerating take-up and reducing rollout costs.

Smart cities and smart manufacturing initiatives will power IoT connections

- 5G will lay the foundation to support the massive connectivity and/or low-latency services for IoT and a range of other future use cases and innovations.
- For the wider Asia Pacific region, smart cities and smart manufacturing will be the fastest growing IoT applications in terms of connections – 33% on average annually between 2017 and 2025.

Singapore

Through its Smart Nation initiative, Singapore is utilising IoT technologies to develop solutions that better deliver public services to citizens, while also supporting business innovation and growth.

Indonesia

At the 2017 Indonesia Smart City Summit, the MCIT launched the "movement towards 100 smart cities" strategy. So far, the ministry has identified 25 cities to be part of this initiative, with 75 more expected by 2019.

Taiwan

Under its DIGI+ plan, Taiwan is aiming to increase its share of the global IoT market to 5% by 2025. More than 140 organisations have joined the Asia Silicon Valley IoT Alliance to further advance the industry within the country.

Mobile is addressing social challenges in the region's emerging economies

- Wide adoption and use of digital technologies are key drivers of measurable economic, social and cultural value.
- However, millions of people still remain offline. The factors below reflect barriers to mobile take-up, which help to perpetuate the connectivity gap.

Mobile Connectivity Index: enabler scores

Country	Network performance	Spectrum	Basic skills	Local relevance
Bangladesh	18	14	39	41
Indonesia	28	18	56	51
Pakistan	20	15	28	39
Vietnam	23	17	56	61
Asia Pacific	**35**	**33**	**59**	**54**

Mobile contributing to the UN's Sustainable Development Goals

Big Data for Social Good
In 2017, preparatory work began for studies by a Telenor-led collaboration on the spread of Multi-Drug-Resistant malaria in a contiguous, three-nation area of Thailand, Bangladesh and Myanmar.

Connected Women
In Bangladesh, the Infolady Social Enterprise empowers communities through female entrepreneurship. The women, known as Kallyani, travel between villages, charging for digital services and dispensing simple legal and medical advice.

GLOBAL MOBILE TRENDS

Regional outlook

Latin America

Smartphones

	2017	2025
Connections	417 million	609 million
Adoption rate	62%	78%

Unique subscribers

	2017	2025
Total	436 million	517 million
Penetration rate	67%	74%

Connections by technology

	2017	2025
2G	29%	6%
3G	41%	22%
4G	30%	64%
5G	—	8%

Operator total revenues

2017	2025
$74.1 billion	$82.3 billion

CAGR 1.3%

Capex

2017	2020
$15.2 billion	$15.5 billion

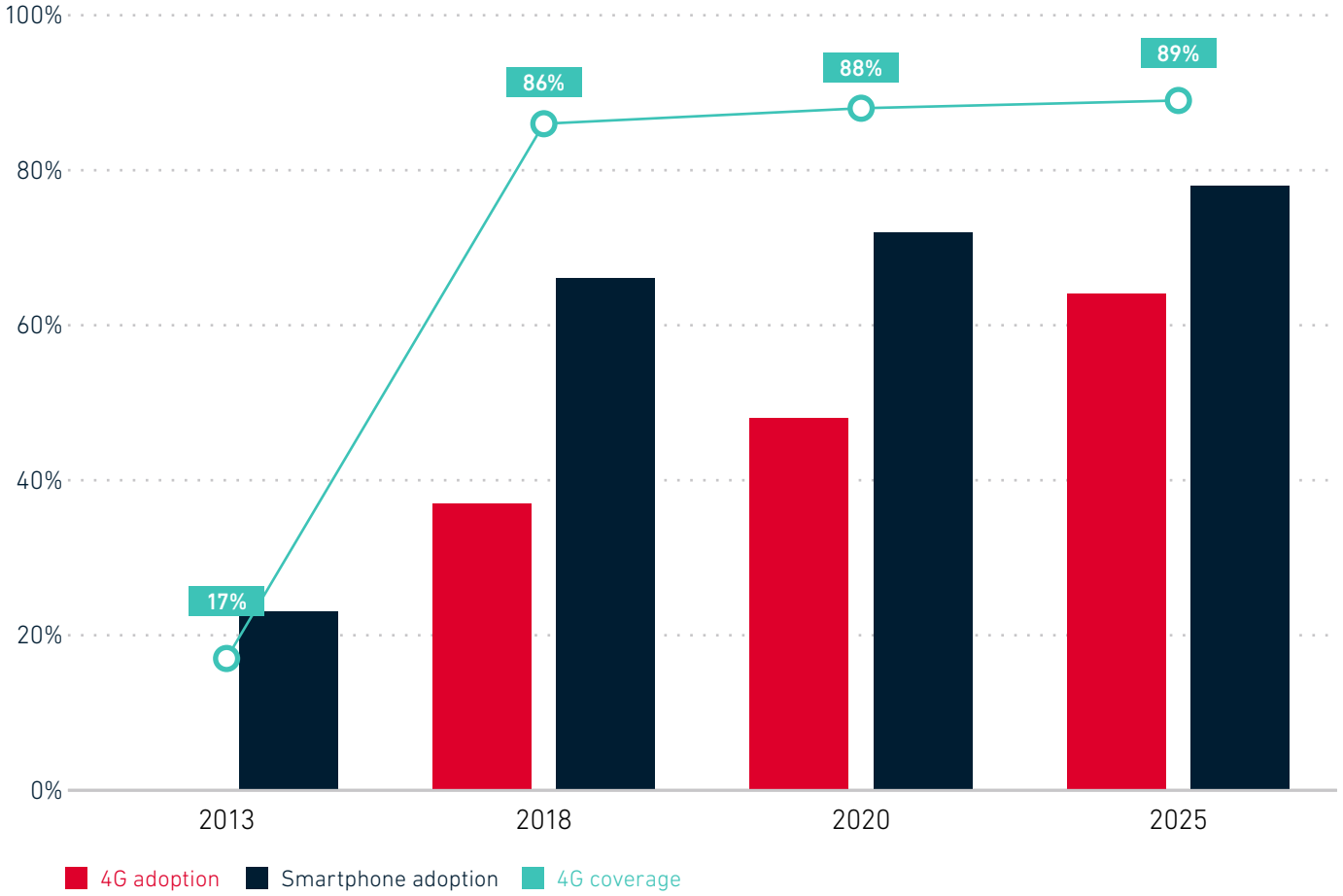
CAGR 0.6%

Boosting 4G adoption is the priority

- There is wide variation in 4G adoption among countries in Latin America, while smartphone adoption is consistently strong. Raising 4G take-up rates is a major priority given operators' coverage expansion.
- Countries such as Venezuela, Paraguay and Panama are below 20% of connections but a concerted push will increase aggregate penetration to above 60% by 2025.

4G and smartphone adoption in Latin America

Percentage of connections



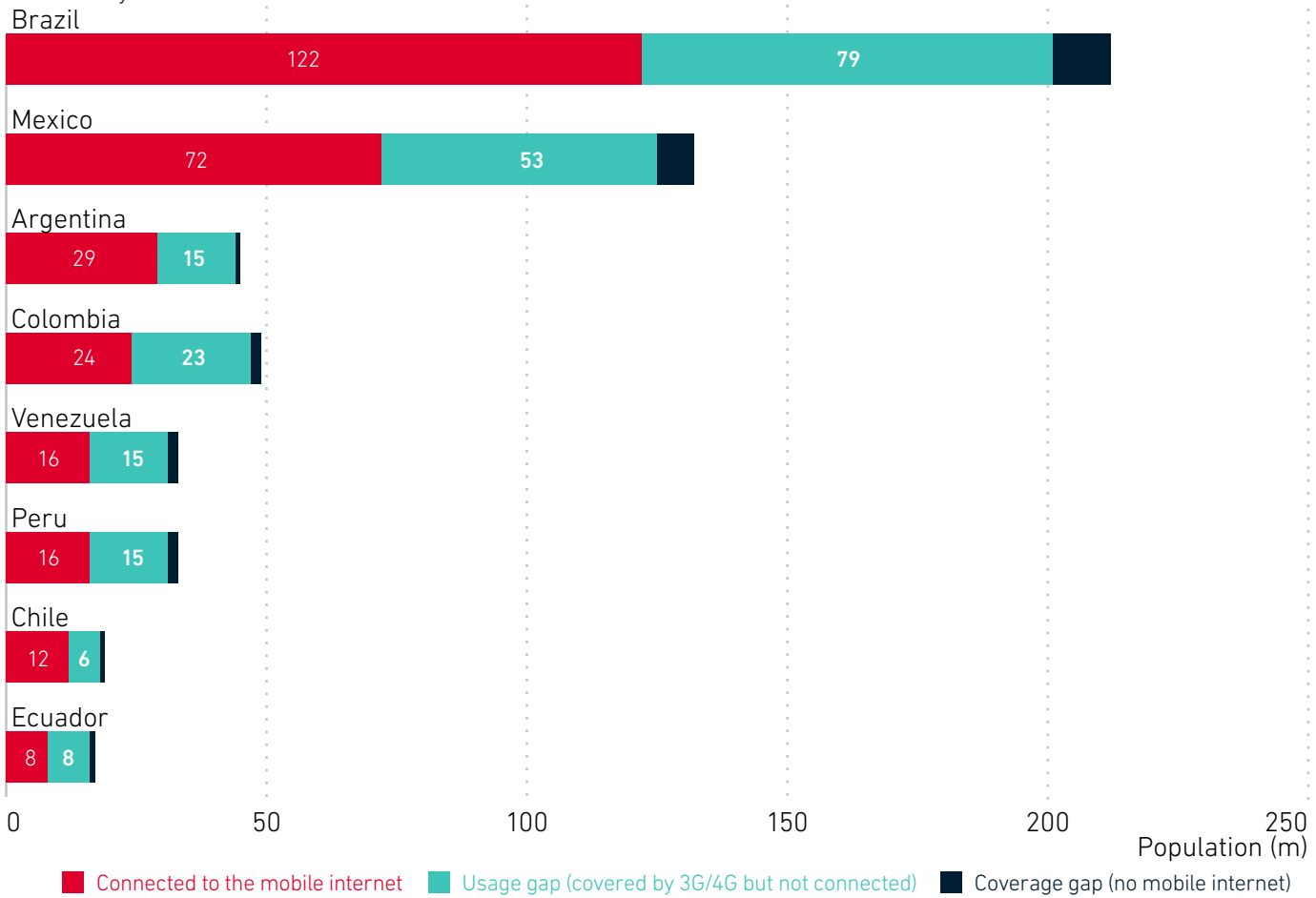
Source GSMA Intelligence

Reaching the internet unconnected: affordability and relevance are the barriers

- Mobile internet penetration varies widely between countries. Argentina, Chile and Uruguay are set to record penetration levels of 60% of population for 2018, while others such as Guatemala and Haiti remain below 35%.
- Network coverage is no longer the main access barrier. The challenge now is in affordable tariffs and developing locally relevant content.

Mobile internet coverage and usage gap

Forecast by December 2018



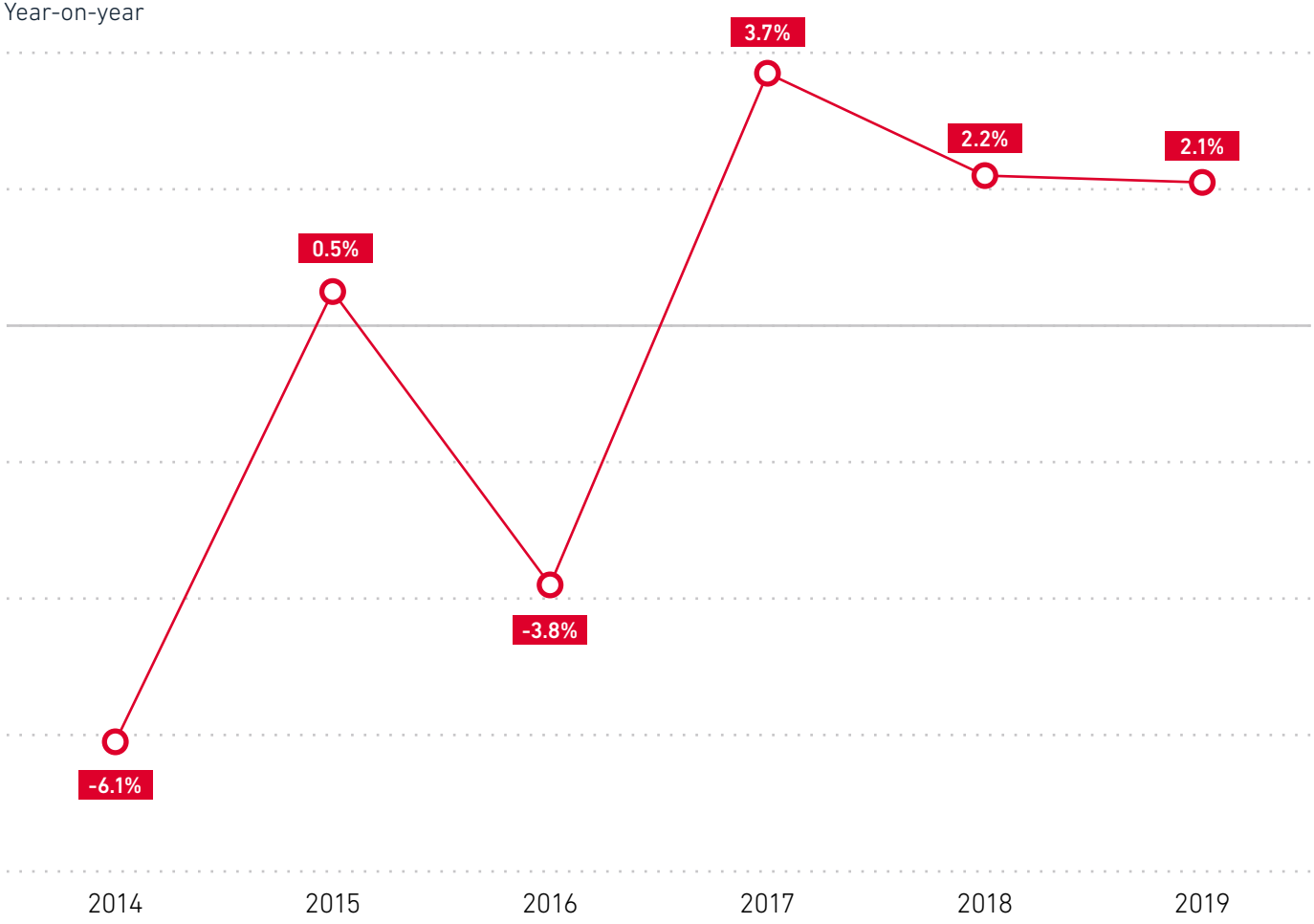
Source GSMA Intelligence

Revenue growth is still in positive territory, driven by data consumption

- Mobile revenue growth will dip in 2018 and 2019 but still remain around 2%, driven by rising 4G and smartphone adoption.
- The mobile sector is, however, vulnerable to economic shocks. The IMF forecasts real GDP growth of 2.0% in 2018 and 2.7% in 2019, but this could be affected by political instability, inflation or a general sell-off of emerging market currencies
- Foreign exchange sell-offs also increase network equipment costs as capex budgets in the region are often denominated in foreign currencies.

Mobile revenue growth

Year-on-year



Source GSMA Intelligence

GLOBAL MOBILE TRENDS

Regional outlook

Sub-Saharan Africa

Smartphones

	2017	2025
Connections	244 million	691 million
Adoption rate	33%	67%

Unique subscribers

	2017	2025
Total	444 million	634 million
Penetration rate	44%	52%

Connections by technology

	2017	2025
2G	62%	13%
3G	34%	60%
4G	4%	24%
5G	—	3%

Operator total revenues

2017	2025
$43 billion	$50 billion

CAGR 1.9%

Capex

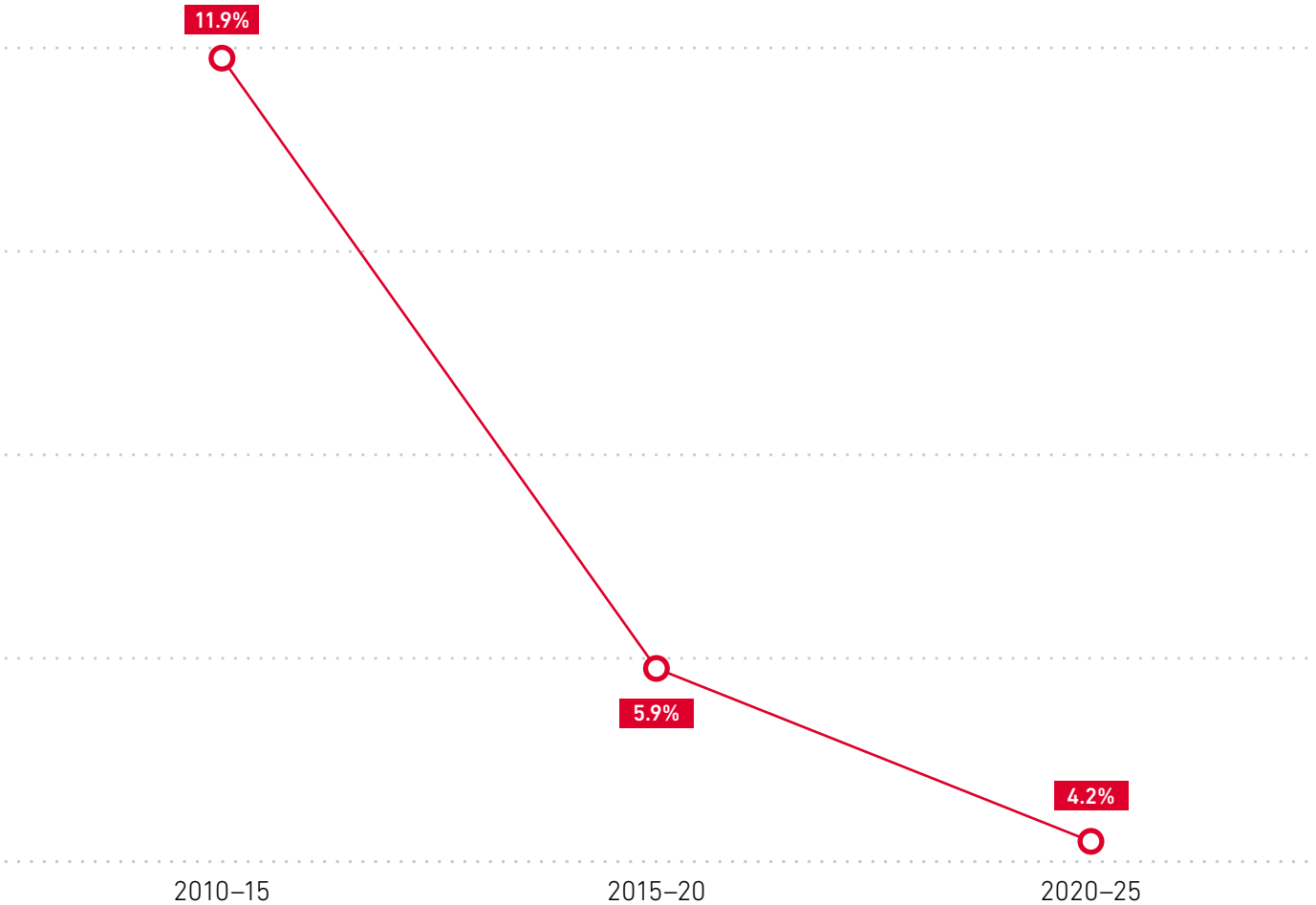
2017	2020
$7.89 billion	$7.98 billion

CAGR 0.1%

Slowing subscriber growth underscores challenge of closing digital gap

- Mobile subscriber growth is now firmly in single digits and will fall below 5% in the first half of the next decade.
- Around 40% of the population are 14 years and under. Future growth will be driven by that segment, with a considerable opportunity for services that appeal to young consumers.
- By 2025, around 3 in 5 people in the region will remain offline and excluded from the digital economy in the region.
- Lack of network coverage remains a major barrier for many unconnected people in the region: around a third of the region's population are not covered by a mobile broadband network, most of them in rural areas where more than half of the population live.

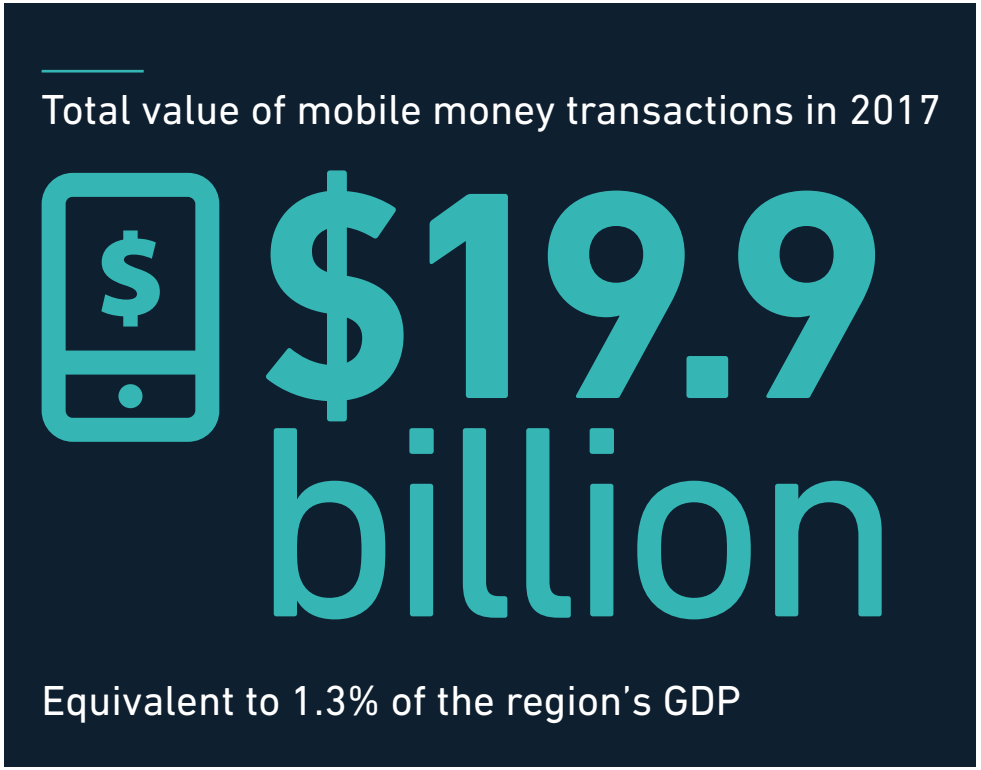
Mobile subscriber growth in SSA



Source GSMA Intelligence

Telcos bet on digital services to drive revenue growth

- While connectivity (voice and data) still accounts for the largest share of mobile revenues, several operators have developed digital offerings to buttress the core.
- Given the region's digital content gap, mobile operators are betting on digital services to increase customer engagement and drive revenue growth.
- Mobile money is central to this strategy; in 39 countries across the region, the service enables financial transactions across multiple verticals while also bringing large portions of the population with limited access to a traditional financial institution into a growing digital payments ecosystem.
- The service has emerged as a key revenue growth driver for mobile operators: in the last financial year, Safaricom's mobile money revenue of $620 million accounted for 28% of service revenues compared to 23% in FY 2016, while MTN generated an ARPU of $1.10 from 22 million mobile money customers across 14 countries, around a quarter of overall ARPU.



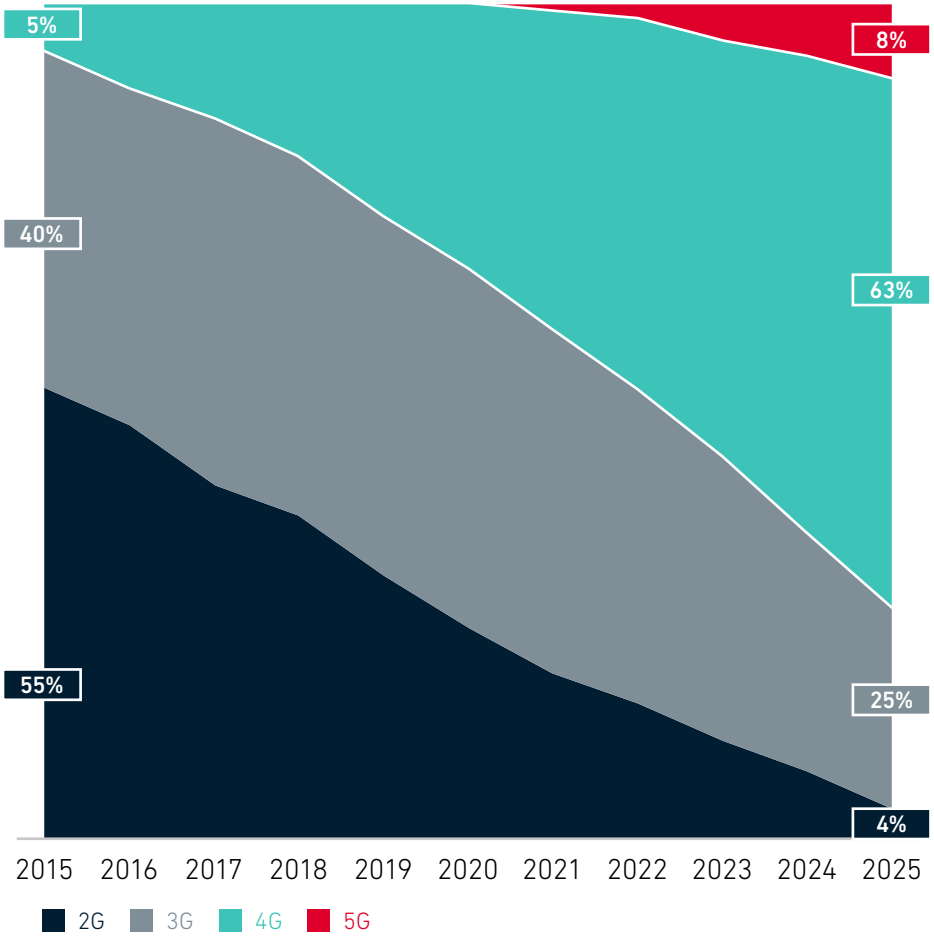
Source GSMA Intelligence

Spotlight on South Africa: mobile data offers long-term growth opportunities

- South Africa is the most developed telecoms market in the region, and with mobile penetration at 66% operators are looking to data and enterprise services to sustain growth.
- Vodacom and MTN investment in data networks continues to pay off, with double-digit data revenue growth in the last financial year supporting overall service revenue growth of 4.9% and 3.9%, respectively, amid declining voice revenue growth.
- Data revenues now account for 40% or more of service revenues for both operators, compared to 12% on average in other countries in the region.
- Although 4 in 5 people in South Africa are now covered by a 4G network, the technology accounts for a little over a tenth of total connections. This underscores the significant upside potential for data revenue growth as 4G adoption rises.
- Meanwhile, MTN's 5G trial, in partnership with Ericsson, has put region on the 5G map, though commercial deployment is not expected for at least another two or three years.

4G uptake to sustain data revenue growth

Percentage of connections



Source GSMA Intelligence

GLOBAL MOBILE TRENDS

Regional outlook

Middle East

Smartphones

	2017	2025
Connections	233 million	389 million
Adoption rate	57%	77%

Unique subscribers

	2017	2025
Total	232 million	285 million
Penetration rate	63%	68%

Connections by technology

	2017	2025
2G	42%	11%
3G	34%	34%
4G	24%	47%
5G	—	8%

Operator total revenues

2017	2025
$56.9 billion	$59.6 billion

CAGR 0.5%

Capex

2017	2020
$9.8 billion	$9.1billion

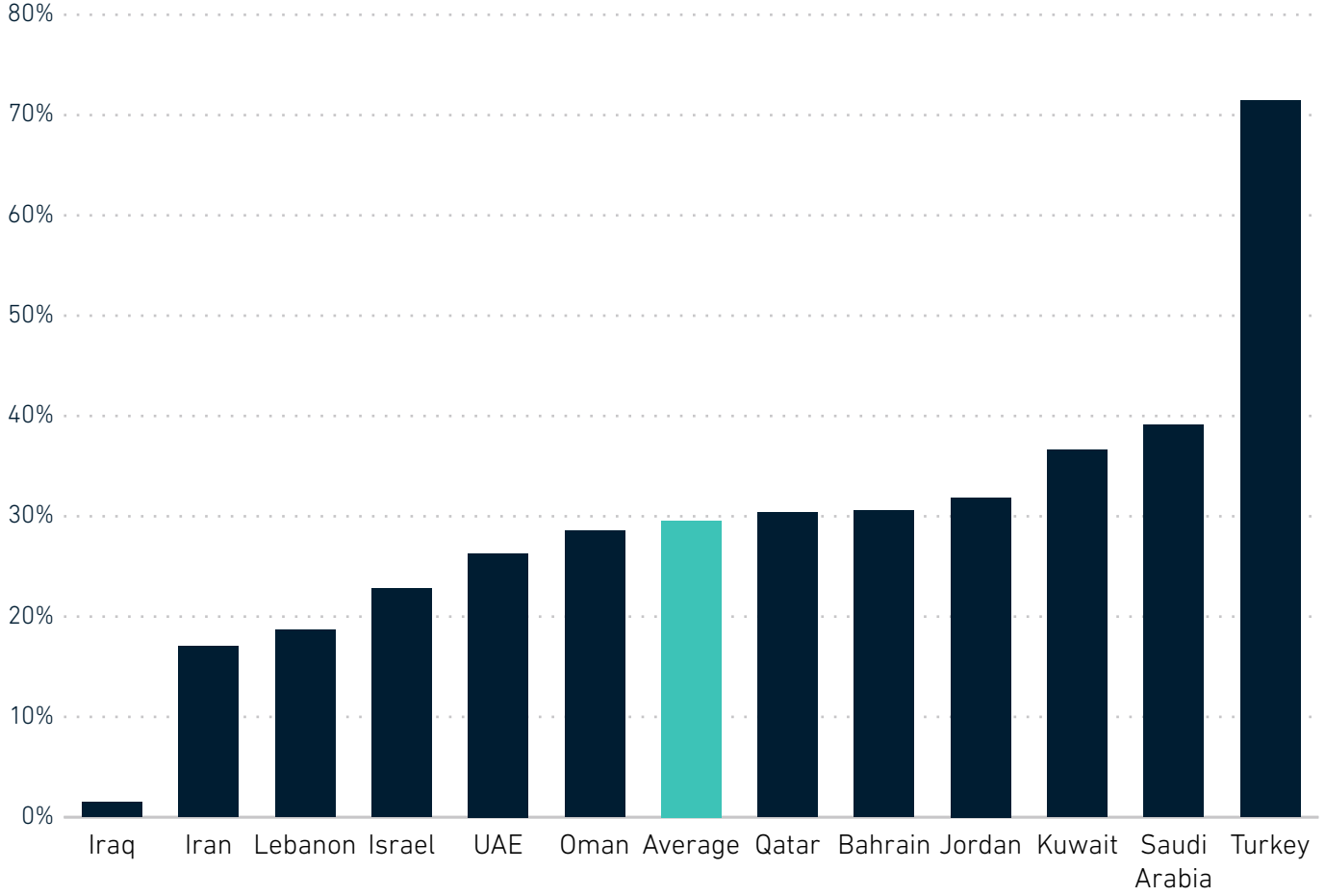
CAGR -1.8%

Despite 4G migration, modest revenue growth expected across most markets

- Subscriber migration to 4G is ongoing, with connections reaching 110 million as of H1 2018.
- However, variations in take-up mean the region remains digitally diverse. The progression to advanced mobile broadband should have a positive financial effect due to increased data usage and ARPU uplift.
- Revenue will face pressure from a number of sources, including cannibalisation by IP messaging platforms.
- We forecast mobile revenues to grow at -0.5% in 2018 and 1.3% in 2019.
- Turkcell, however, has made a highly successful play for diversification, growing domestic revenues by 21% in 2017. This is due, in part, to the expansion of its digital services brand Lifecell, which had over 1 million subscribers in July 2018.

4G adoption, H1 2018

4G as a proportion of total connections



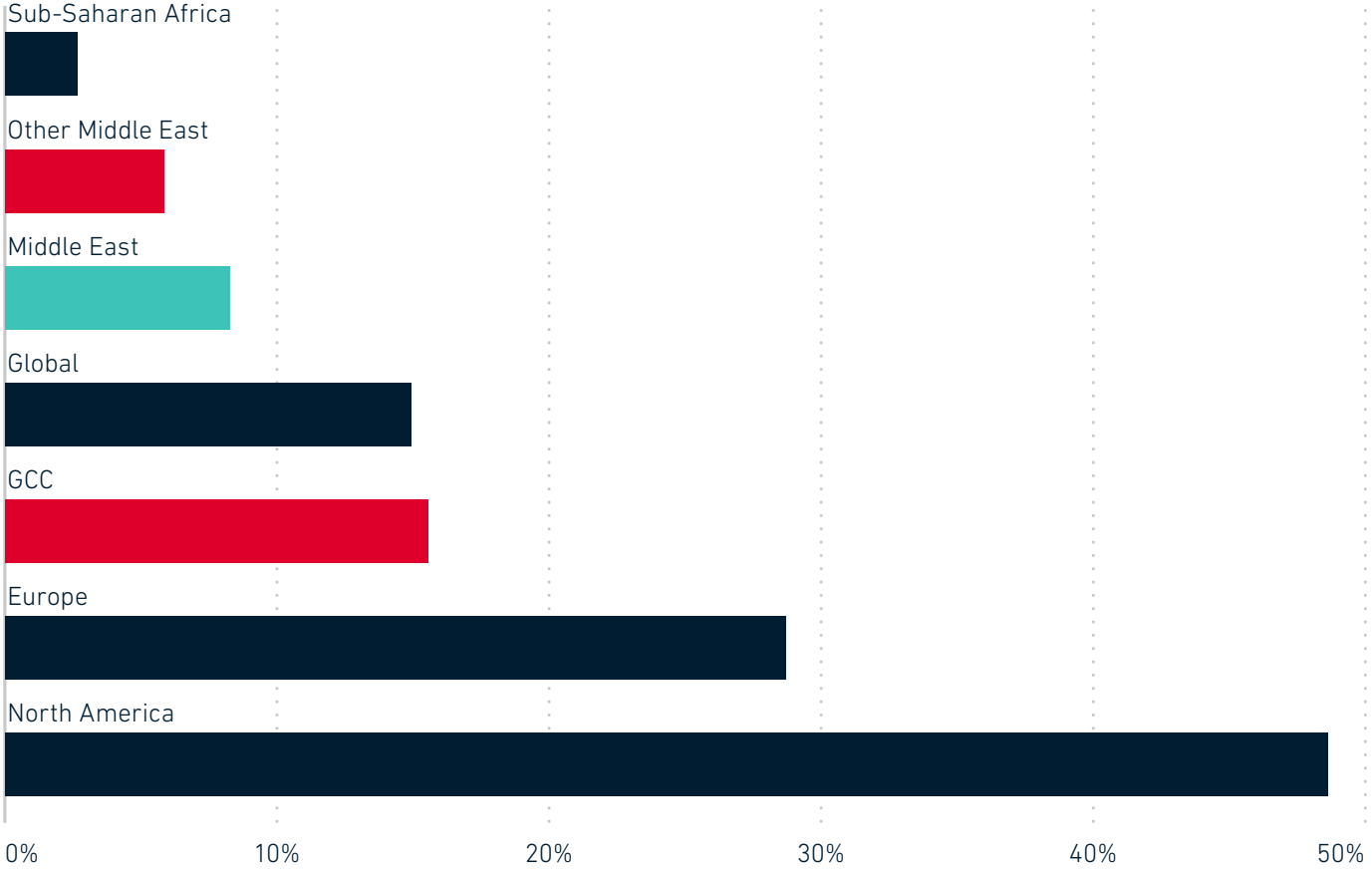
Source GSMA Intelligence

5G adoption to lag other regions despite some early launch plans

- As mobile broadband expands across the region, some countries (particularly the GCC States) are looking further ahead.
- Operators such as Etisalat, Ooredoo, STC and VIVA have conducted lab or field trials, inked innovation partnerships with vendors, or announced pre-commercial launches of 5G technology.
- By 2025, 5G services are expected to cover 35% of the Middle East's population, with total 5G connections reaching 38 million.

Comparison of 5G adoption

5G as a proportion of total connections (2025)



Source GSMA Intelligence

The Middle East is home to highly engaged mobile users

GSMA Mobile Engagement Index score

Out of 10

Country	2017 rank	2018 rank	Change	2018 score
South Korea	1	1	—	6.0
Qatar	**2**	**2**	**—**	**6.0**
Finland	6	3	+3	5.6
Sweden	9	4	+5	5.4
Austria	14	5	+9	5.3
Israel	**13**	**6**	**+7**	**5.2**
Denmark	5	7	-2	5.1
Australia	7	8	-1	5.1
Saudi Arabia	**4**	**9**	**-5**	**4.9**
US	3	10	-7	4.8

- Of the 50 countries we surveyed, three Middle Eastern countries sit within the 10 most engaged in terms of mobile and internet service usage.
- For example, 86% of Saudi smartphone owners use IP messaging apps on a monthly basis, while 80% of Qatari users make or receive IP phone calls monthly.
- The index scores can be partly explained by the level of smartphone adoption, which is relatively high in these countries and delivers a greater degree of engagement.
- It also suggests youthful populations that are highly expressive, which could be made more so given limits on expression through traditional media outlets in some countries.

Source GSMA Intelligence

GSMA Intelligence

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