
Global Mobile Trends 2020

New decade, new industry?



The GSMA represents the interests of mobile operators worldwide, uniting more than 750 operators with nearly 400 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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GLOBAL MOBILE TRENDS

Predictions for the next 10 years

View from the top

Future of devices

Implications of the 5G era

Enterprise IoT and Industry 4.0

Media and content

Financial performance

Regional outlooks

The Big 5

Trends shaping the future of mobile and TMT

1 Telco efforts are intensifying to drive growth in digital

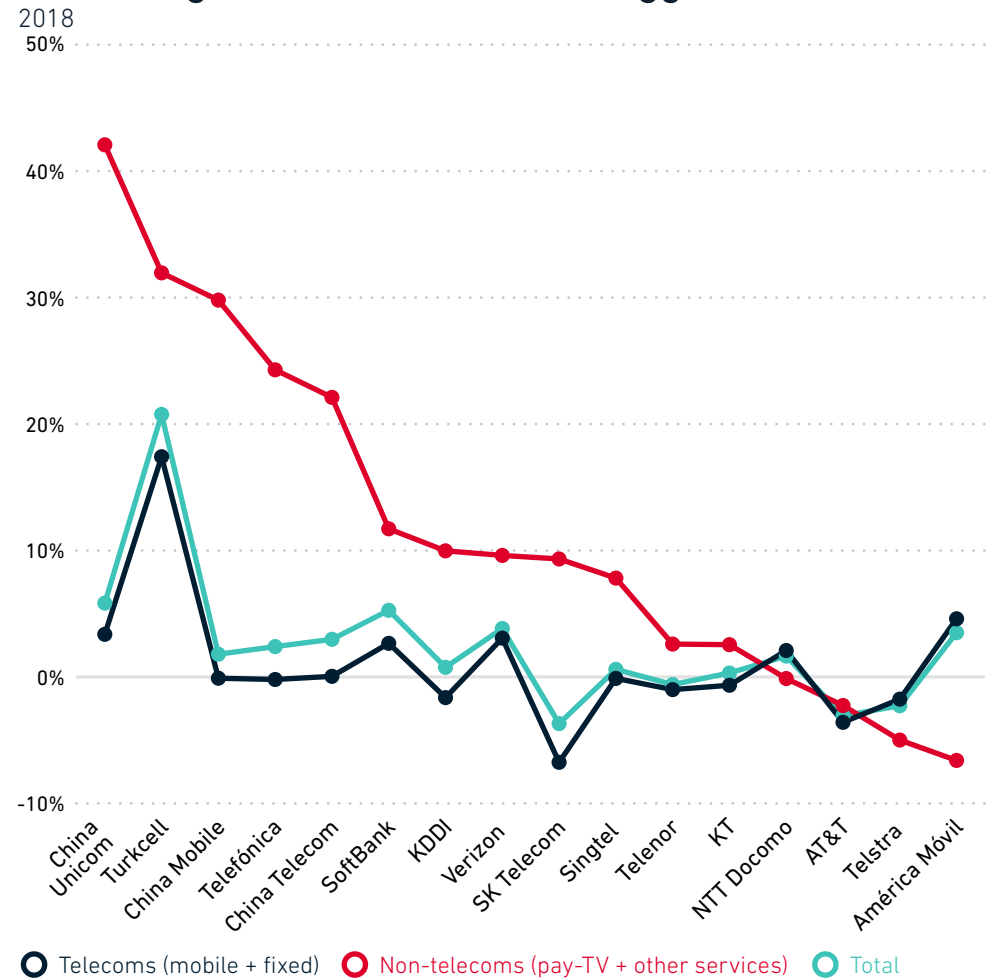
A decade-old challenge

- Operators have long sought a revenue stream beyond connectivity to offset subscriber saturation and competitive pricing pressures.
- Strategies include Internet of Things (IoT), pay TV, advertising and fintech, depending on the country.
- Building a new business to move the overall dial is challenging.
- Of the 20 biggest operator groups worldwide, non-connectivity revenue is on average between 10% and 20% of group top line (AT&T's 40% is an exception driven by the Time Warner acquisition).
- While 'services' occupy much of the CEO rhetoric of where growth will come from, operators are fundamentally still network businesses.

Glass half full versus half empty

- As the 2020s near, there remains significant upside to capture, particularly in the enterprise space as digitisation continues apace.
- Aside from costs associated with infrastructure investment, the biggest challenge will be to engineer internal cultural change that rewards agile operations and risk taking rather than simply hitting quarterly KPIs.

Revenue growth for the world's biggest telcos



2 Smartphones continue their inexorable rise in the developing world

Emerging markets on the up

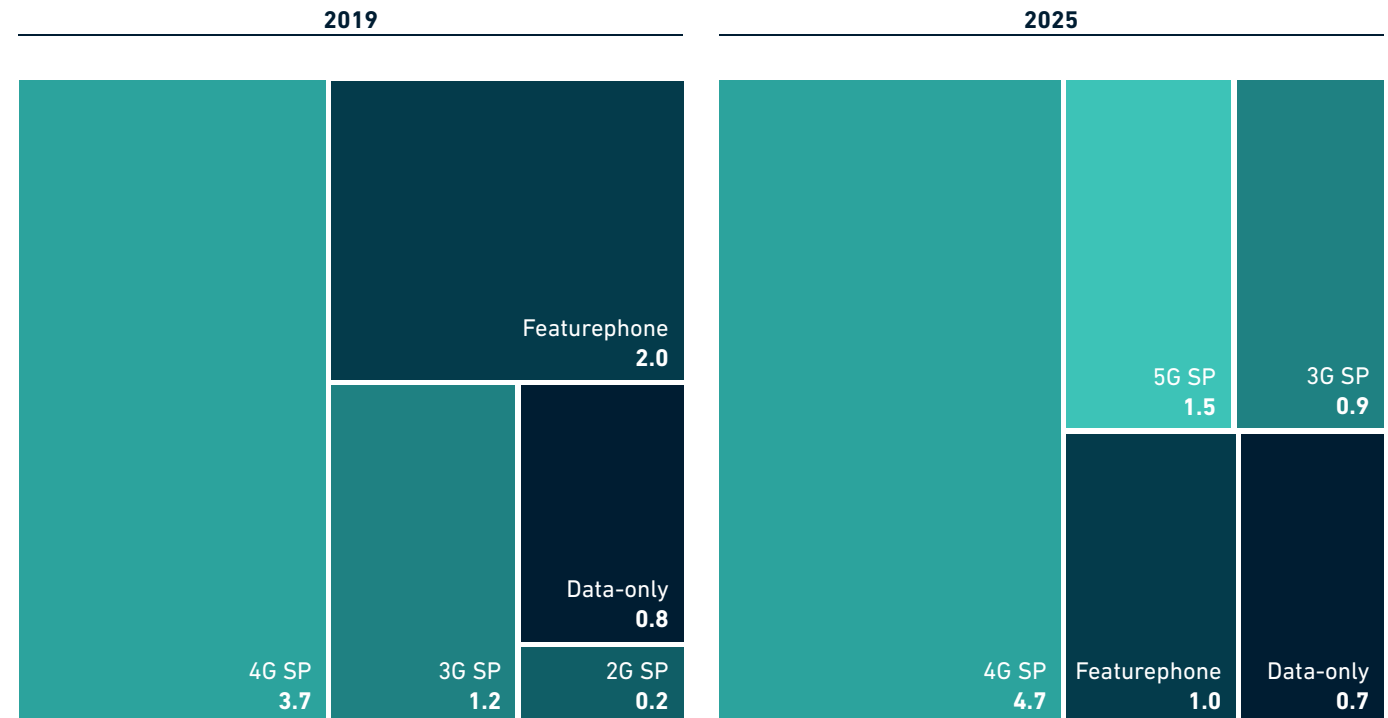
- It would be easy to write off the smartphone era as having passed, considering annual unit sales have been in decline since 2017.
- However, most of the developing world has yet to get a smartphone.
- That is changing fast; by 2025, smartphone penetration will reach 80% globally, driven by India, Indonesia, Pakistan, Mexico and a host of fast followers in Africa.

New people, new behaviours, different dynamics

- The fact that 70% of smartphones will run on LTE speaks to the influence of an impending mobile internet generation in youthful, non-English speaking markets.
- Unlike in the US and Europe where operators lost out in digital value creation to big tech, places like Africa are opportunities for operators to leverage the strong brand recognition and positive associations with providing essential services.

Global installed base on mobile operator networks

Billions of devices connected to a cellular network. Data-only devices include cellular tablets, dongles and modems



SP – Smartphone

3 New platform wars on the horizon centre on AI and immersive reality

New platform wars emerge

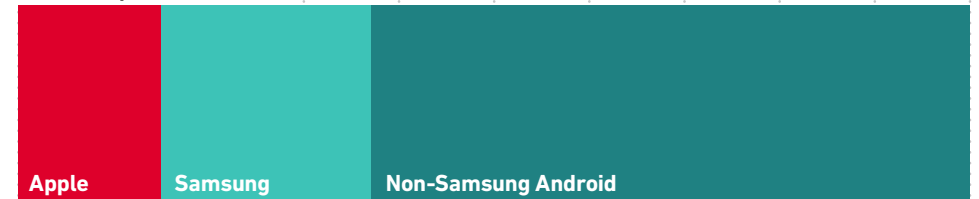
- Apple and Google’s dominance in the smartphone era has long been entrenched.
- As new device categories (whether smart speakers or VR headsets) attempt to find a place in homes, a renewed set of platform wars is in its early stages.

The home ‘laboratory’ for AI and immersive reality

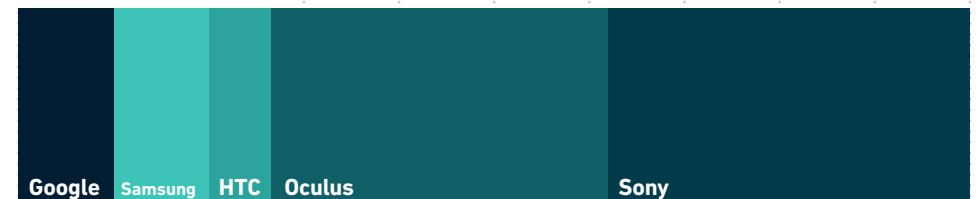
- Whereas the smartphone wars centred on the app economy, the new battleground is in AI development and a push towards immersive reality.
- The competitive landscape is also much more crowded.
- In VR, Oculus (Facebook), Sony, Google and Samsung are all involved. Microsoft is a sleeper because its ambition is not in hardware but rather in mixed reality, which would make VR obsolete. Apple is for now not a factor, placing it at risk of falling behind as iPhone sales continue to slow.
- Smart speakers are a window into AI development. Amazon’s position with Echo devices is a worrying sign for competitors. There is a clear strategy of vertically integrating its e-commerce and Prime business, and it is well ahead in third-party apps that work with Alexa.

Market shares

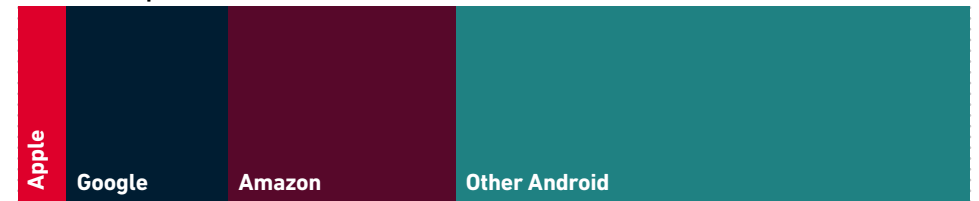
Smartphones



VR headsets



Smart speakers



0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Smartphones Q1 2018; smart speakers and VR headsets 2019

Source GSMA Intelligence Consumer Survey (2018 and 2019), Strategy Analytics, Super Data Research

4 Network innovation has never been greater as we enter the 5G era

Pragmatic reasons for change

- Over the last 10 years, the mobile network model has moved from owning everything to sharing infrastructure, in an effort to take cost out of the business in a low-growth environment.
- 5G brings further complexity and new ways of operating a network with or without licensed spectrum.

The 'unbundled' network breaks down entry barriers

- Private networks to service enterprises are a prime example. Telcos are, in theory, the default provider – but in practice there are multiple options, from enterprise own-builds using reserved or shared spectrum (e.g. CBRS in the US, Germany) to edge cloud infrastructure from AWS and Microsoft.
- For operators, this means:
 - infrastructure competition becomes harder, not easier
 - capex will need to be spent more selectively, particularly for small cells
 - frenemy-style partnerships with adjacent sector competitors become the norm rather than the exception.

New types of network, new types of network operator

		Full stack (traditional)	Hybrid	Private network	Neutral host
Active	VAS	MNO	MNO	<ul style="list-style-type: none"> • Enterprise • MNO • Cloud 	<ul style="list-style-type: none"> • MNO • Hotspot operator • Equipment vendor • Other
	Billing				
	Core				
	Backhaul				
	RAN				
	Spectrum	Licensed	Licensed	<ul style="list-style-type: none"> • Licensed • Dedicated • Unlicensed (5G NR-U) 	<ul style="list-style-type: none"> • Licensed • Unlicensed
Passive	Ancillary (power, cooling)	MNO	MNO Towerco	<ul style="list-style-type: none"> • Enterprise • MNO • Cloud 	<ul style="list-style-type: none"> • MNO • Hotspot operator • Equipment vendor • Other
	Macro or small cells				
	Sites				Enterprise

5 The US and China pull away as the two global tech powerhouses

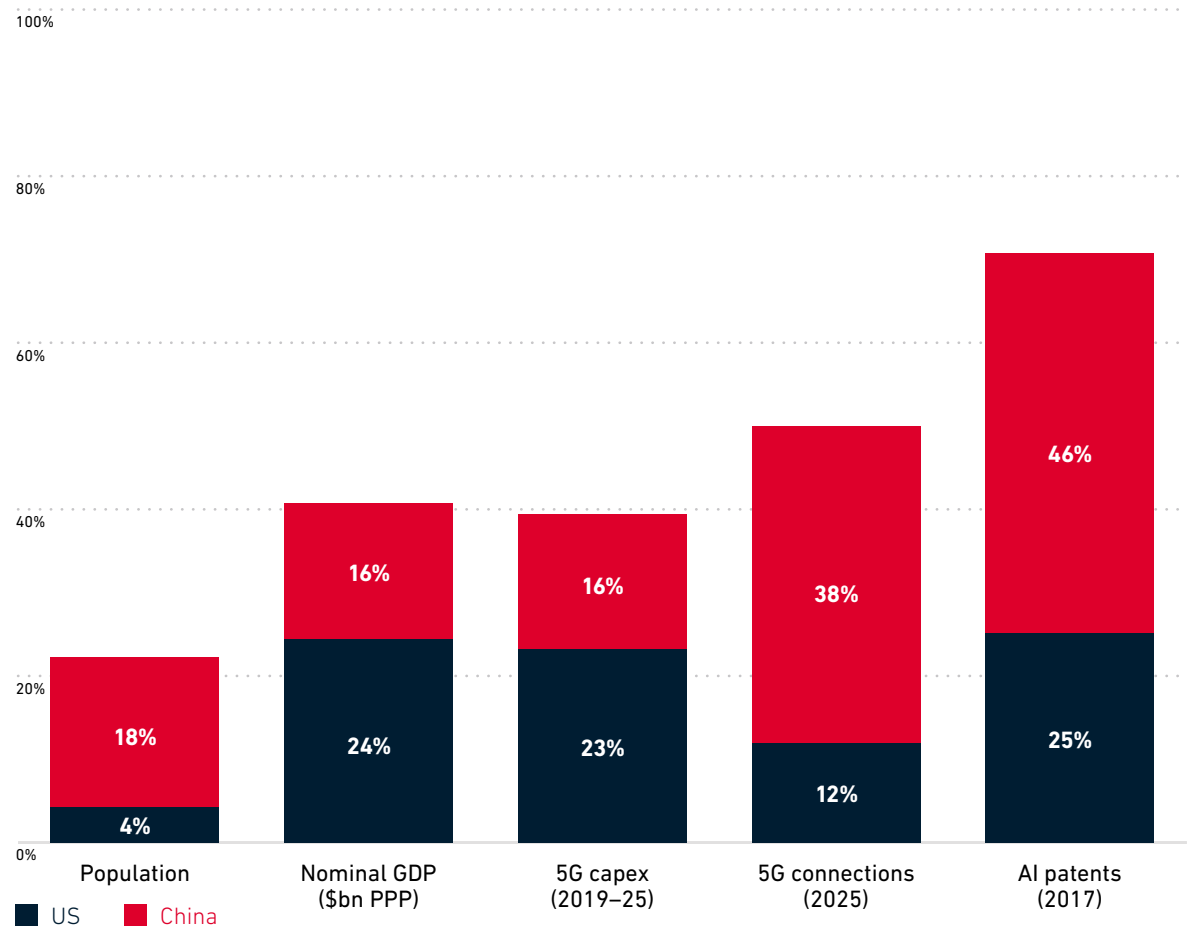
Geopolitical tensions boil over

- The onset of advanced technologies such as AI, 5G, edge computing, IoT and autonomous vehicles has contributed to a return of geopolitical tension not seen since the satellite ‘star wars’ of the 1960s.
- The rise of the US and China typifies this trend, though with opposing political dynamics.

Scale and state-craft

- China has put huge state investments into its national champion companies to help cement its position as a global hub of advanced computing and manufacturing. By contrast, the US has pursued a trade war to the detriment of its own tech groups.
- The net effect is significant consolidation of power and influence in two countries, which will continue over the next decade.
- For Europe, this puts renewed importance on governments supporting their own telco and tech groups, be that through relaxing regulations, lowering spectrum prices, providing co-investment or other means.

US and China: share of...



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“We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten.”

— Bill Gates

5 years

by 2025

- 1 One of the GAF A companies is broken up
- 2 AR eye glasses reach the mass market with a form factor from at least one global OEM
- 3 5G becomes the first generation in the history of mobile to have a bigger impact on enterprise than consumers
- 4 Private enterprise networks explode and become competition battleground between telcos and cloud companies
- 5 Health wearables become part of the solution to over-pressed public health systems. Over 50% of people in high income countries aged 55+ own a connected health device prescribed by their doctor (2019 = 5%)

10 years

by 2030

- 1 The world's first autonomous mobile network becomes commercially active
- 2 Global internet penetration inflects to reach 90% (2019 = 50%)
- 3 Data hubs established to facilitate public access to commercial IoT data
- 4 China becomes world's largest mobile market by revenue (US = \$247bn, China = \$163bn in 2018)
- 5 Autonomous vehicles take hold. 35% of annual new car sales in the US are Level 4 by 2030

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State of play and
outlook for mobile
access

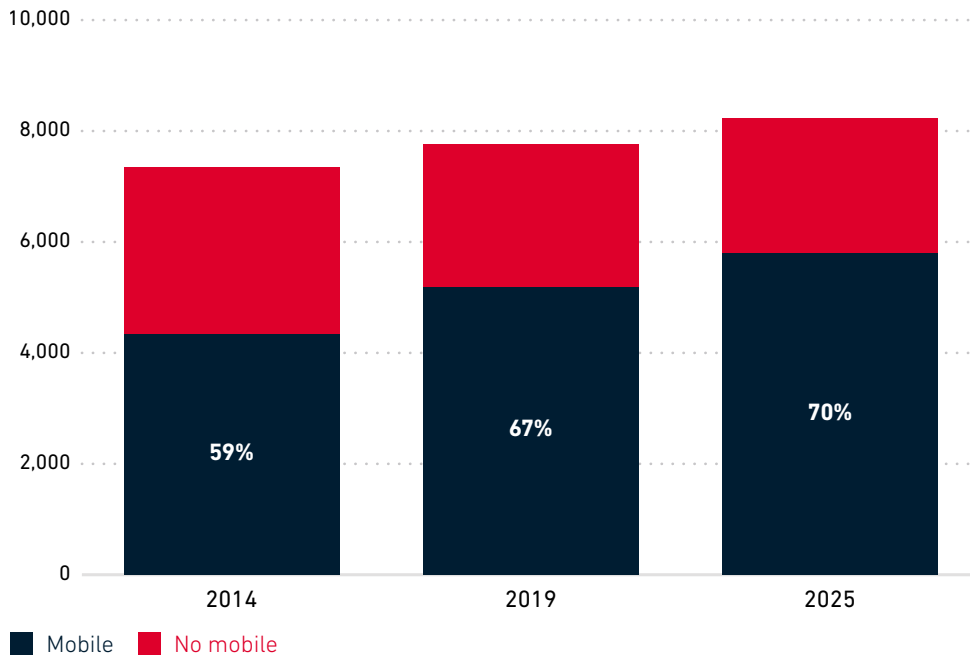
Mobile reaches two thirds of the global population; further gains hard to win

- Mobile phone usage stands at 5.2 billion individuals worldwide, 67% of the population.
- Growth has cooled over the past five years, something that will continue as China, India and other fast-growing countries such as Nigeria reach saturation in their urban populations.

- Rural Africa and the Indian sub-continent are the final frontiers but also the hardest to reach. An expected 30% of the world will remain unconnected in 2025.

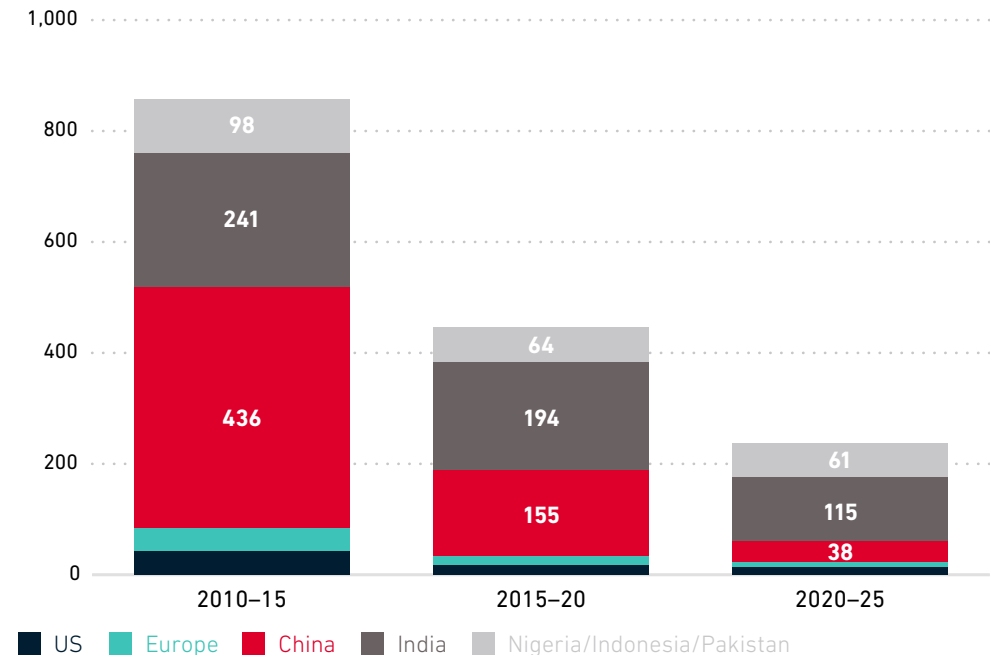
5 billion people with an active mobile

Population, million



Even the growth markets are starting to cool

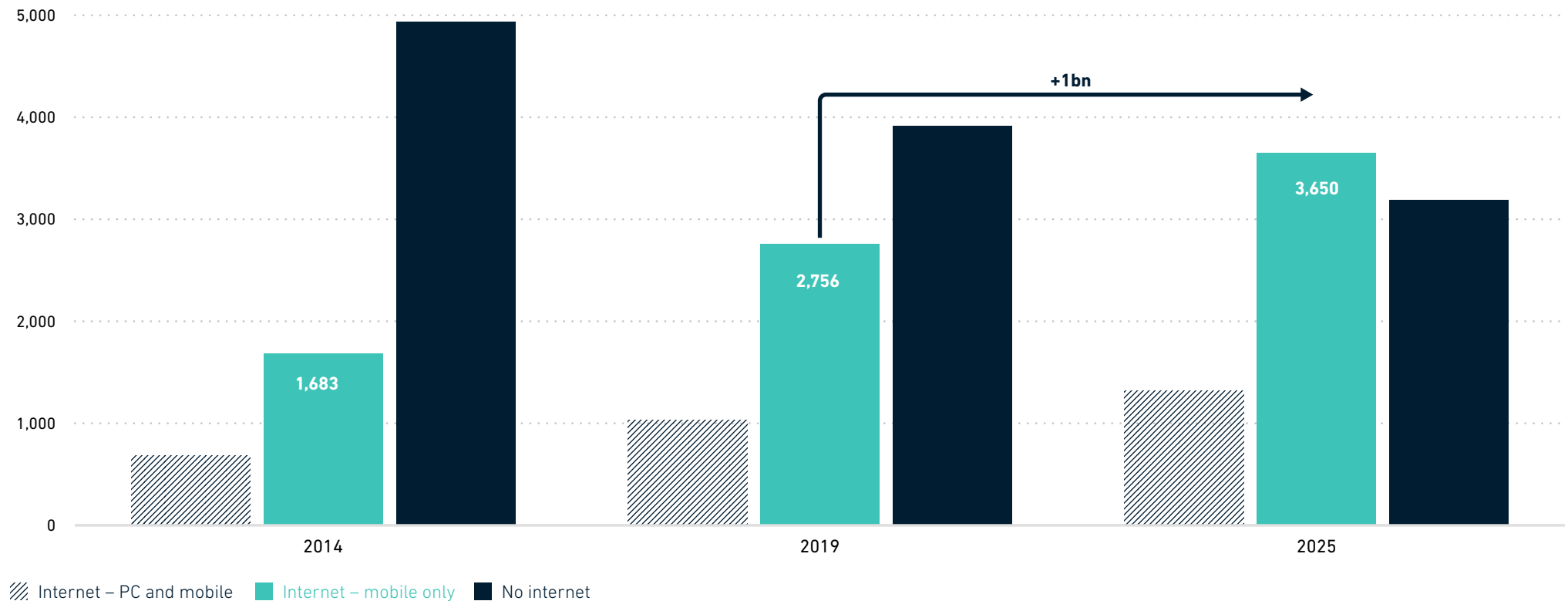
Net growth in mobile subscribers, million



The next billion are the mobile-only generation...

- Most of the growing base of mobile internet users (largely from the fast growing markets) are mobile-only with no PC access.
- This means a huge expansion of the app and digital content economy to non-English speaking markets.
- Streaming is at the forefront of this trend, with Netflix's recent launch of a stripped back, mobile-only tariff in India a sign of things to come.

Global population, million



PC-only users not shown because they represent a very small share of the population (54 million in 2019)

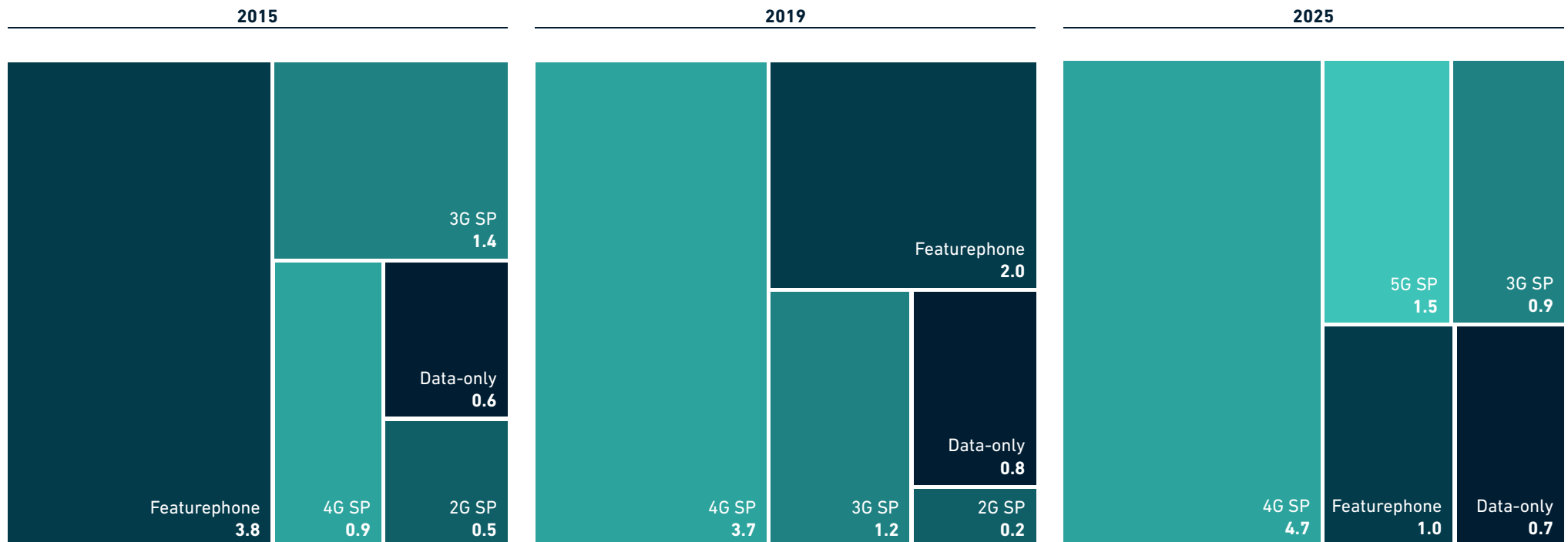
Source GSMA Intelligence

...Powered by rising smartphone penetration

- Smartphone penetration has reached 65% worldwide, reflecting falling device costs and cellular data prices.
- The upward trend will continue as Android manufacturers permeate the legacy 2G and 3G base. By 2025, we expect adoption to reach 80%.
- Most smartphones will run on LTE, with the 1.5 billion 5G smartphones clustered in early-adopter countries, of which the US and China are the biggest.

Installed base on mobile operator networks

Billions



SP = Smartphone. Data-only devices include cellular tablets, dongles and modems.

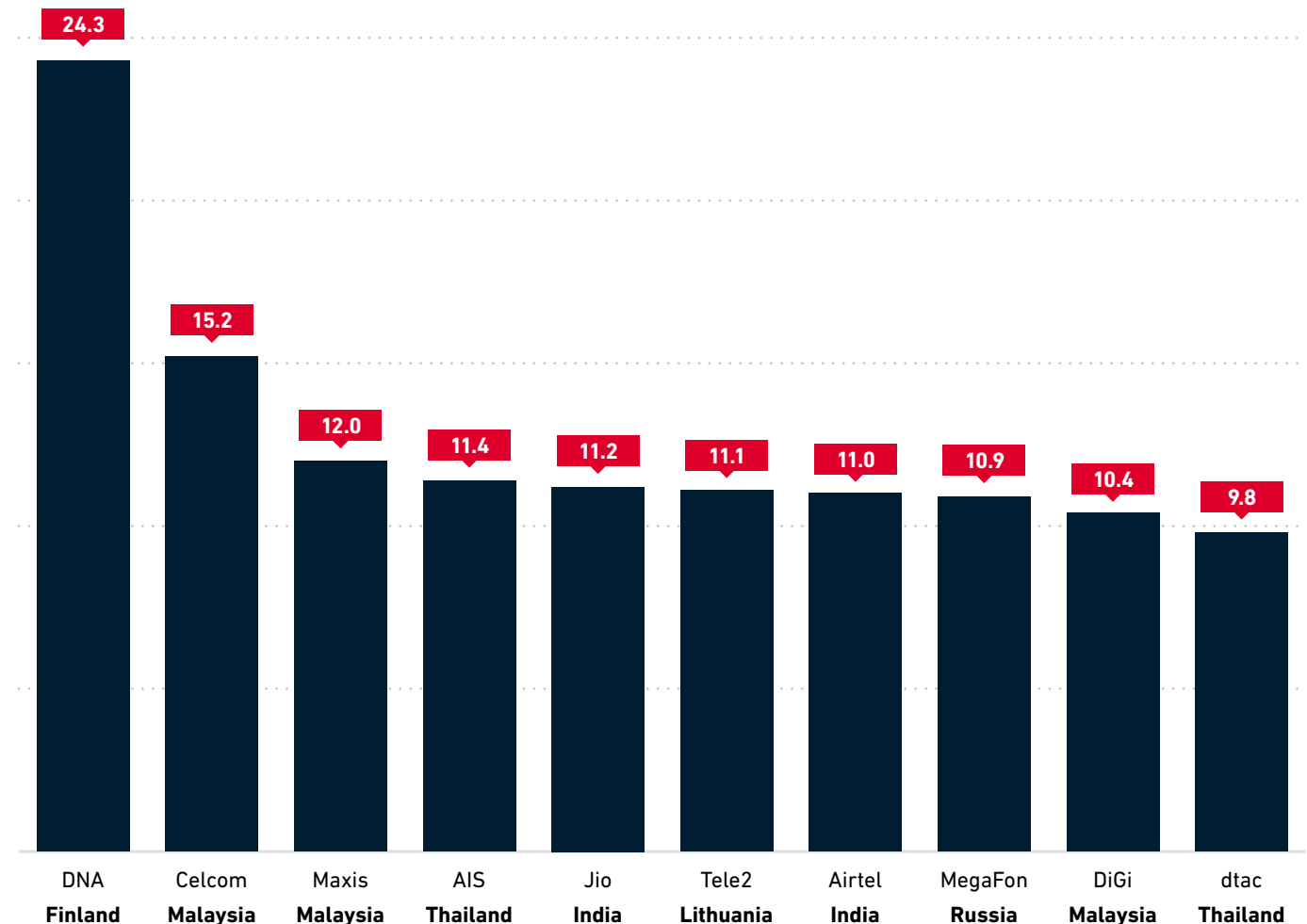
Source GSMA Intelligence

Mass migration to 4G is triggering a data explosion

- Lost in the current 5G hype is the mass migration of customers to 4G in Asia, Latin America and parts of Eastern Europe.
- Across a range of operators in countries including Malaysia, India and Thailand, average monthly data usage has surpassed 10 GB.
- This is significantly higher than was seen during the US and European wave of 4G take-up during 2011-14. Even now, customers of H3G UK (well known for unlimited tariffs) average around 7 GB.
- India can partly be explained by Jio's launch and subsequent response by competitors with very low 4G prices.
- There is huge pent-up demand for mobile data that is only in its early stages of being felt, presenting opportunities (price premiums) and risks (traffic overload) to operators.

Biggest users of mobile data: not the usual suspects

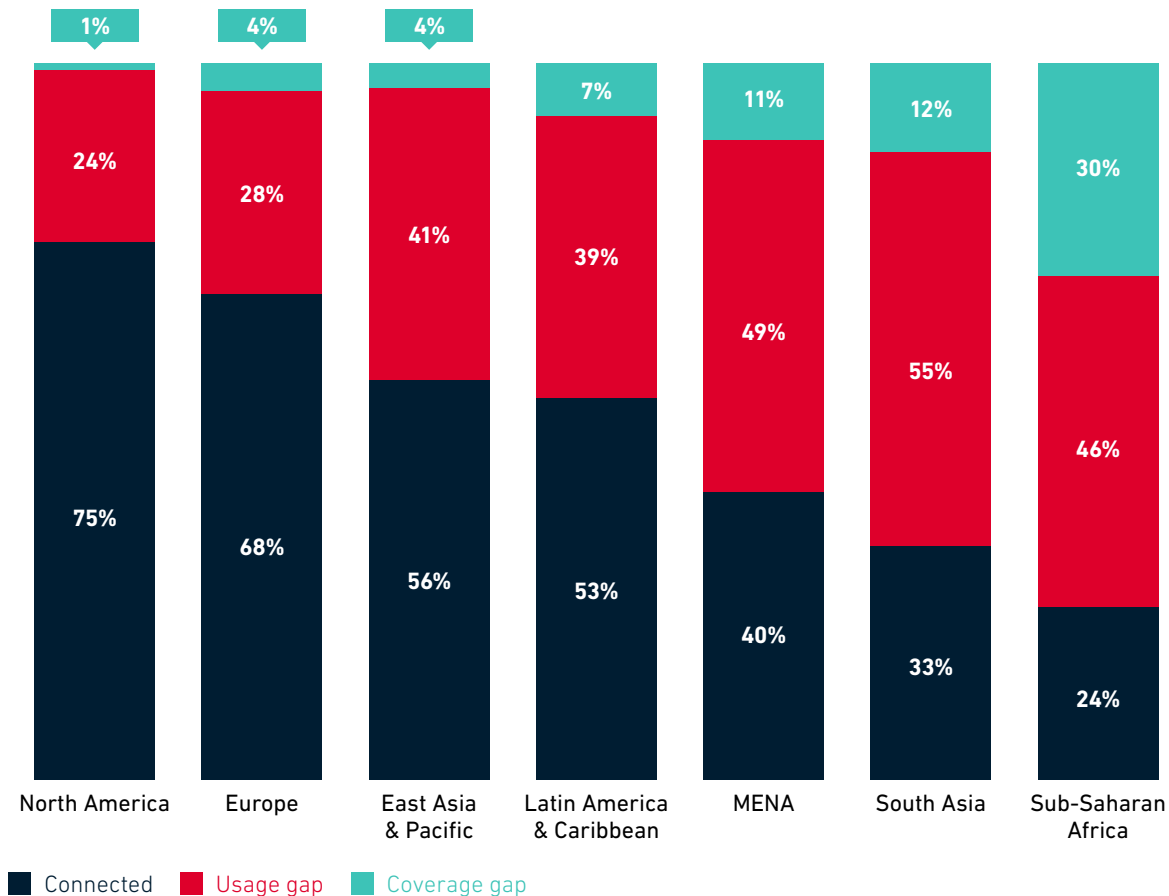
GB per customer per month, based on operators who have reported data traffic figures



Internet penetration has passed 50%, but still 50% to go

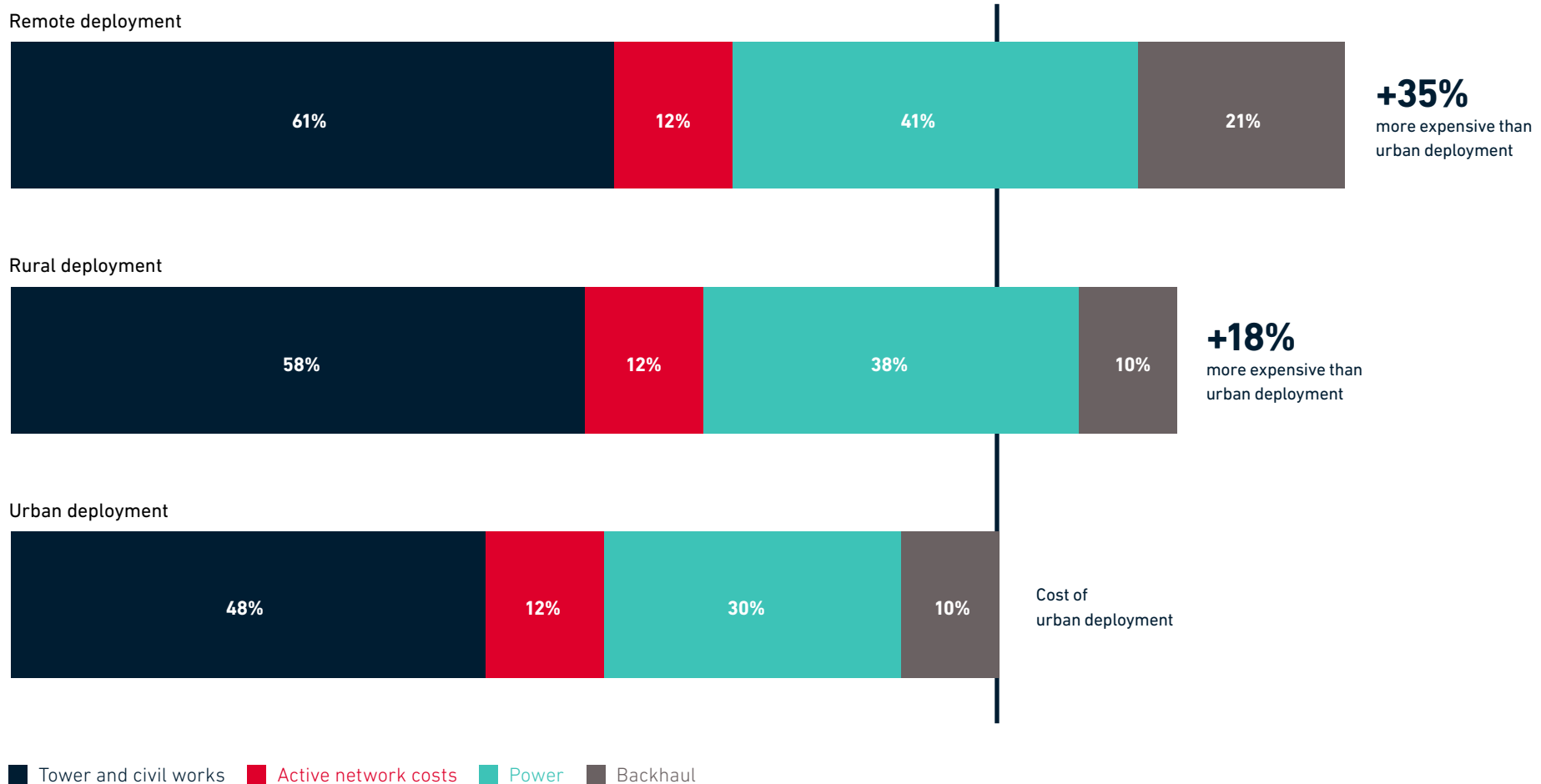
State of mobile internet connectivity, by region

Share of total population, 2018



- While more than two thirds of the population are connected to the internet in North America and Europe, access levels remain below a third in Africa, India and much of the sub-continent.
- High populations magnify the effect. India alone accounts for 860 million of the unconnected globally. Pakistan and Bangladesh are further reservoirs.
- Network coverage remains a challenge but one that has mitigated. Some 750 million people live outside of a viable 3G or 4G signal but this was 1.8 billion only five years ago. Organic expansion and network sharing have extended mobile coverage to rural locales.
- The bigger obstacle is relevance and understanding how to use the mobile internet (digital literacy). We quantify these barriers under 'usage gap'. Note that this problem also exists in developed markets for older demographics.

Covering not-spots is an economic, not technical, challenge

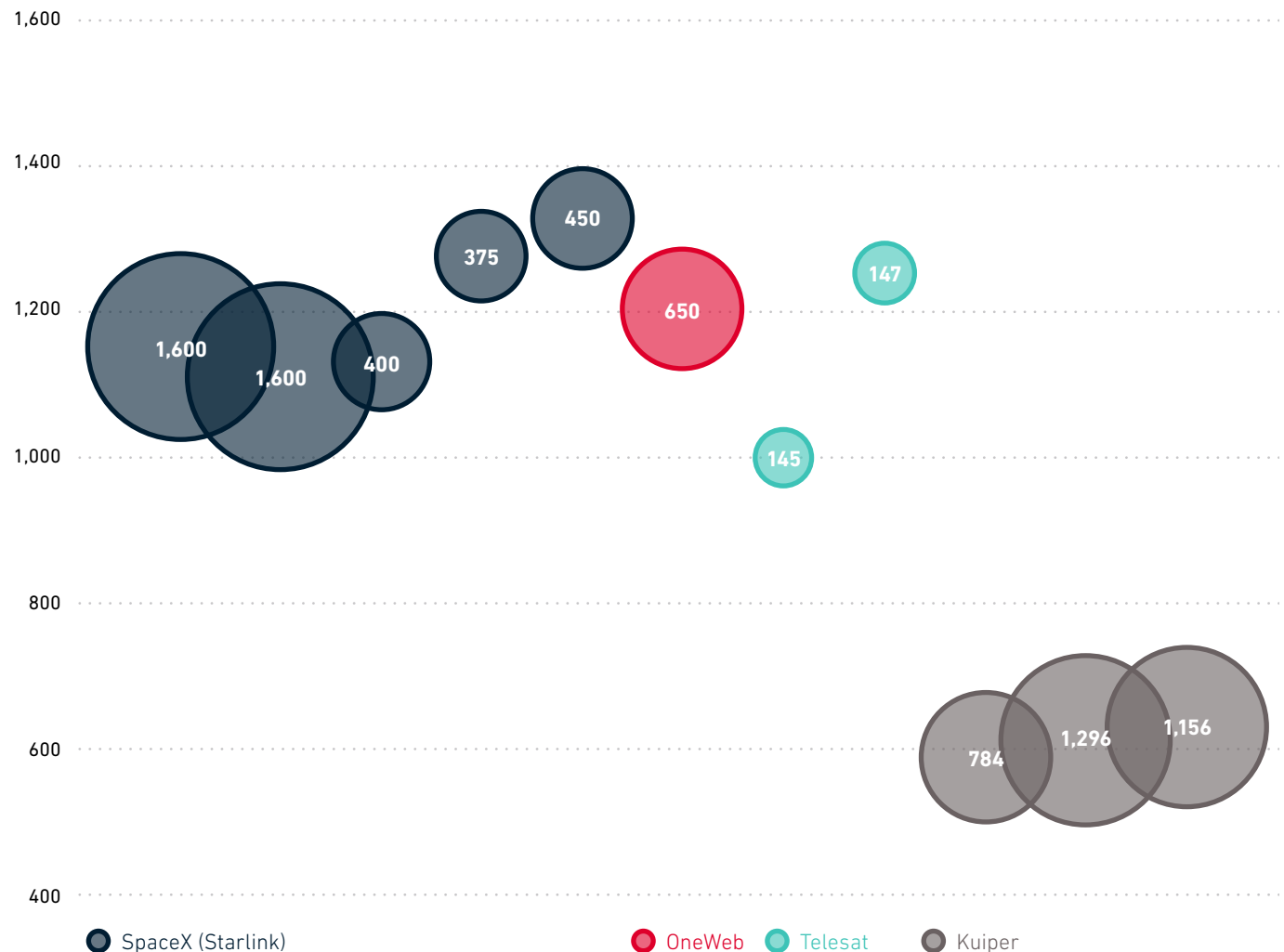


Satellite's revival could change things

- SpaceX, OneWeb and now Amazon (via Project Kuiper) represent a new class of satellite operators seeking to extend internet coverage to areas out of reach of terrestrial signals.
- The model is based on high density deployments at much lower altitudes than traditional geostationary vehicles, enabling faster speeds and lower latencies.
- If initial deployment plans move to completion, SpaceX, OneWeb and Kuiper would have 8,300 satellites in orbit by 2027 - four times the total currently in orbit for any purpose.
- Translating deployments to end-user connections would probably rely on partnerships with mobile operators to overcome technical difficulties (few handsets have the radios to connect with satellites) and the lack of sales and distribution infrastructure.
- While hype still abounds, cold hard economics and demonstrable operator interest in signing wholesale agreements give credence to this being a genuine aerial network model.

Planned constellations in low Earth orbit (LEO)

Altitude (km)

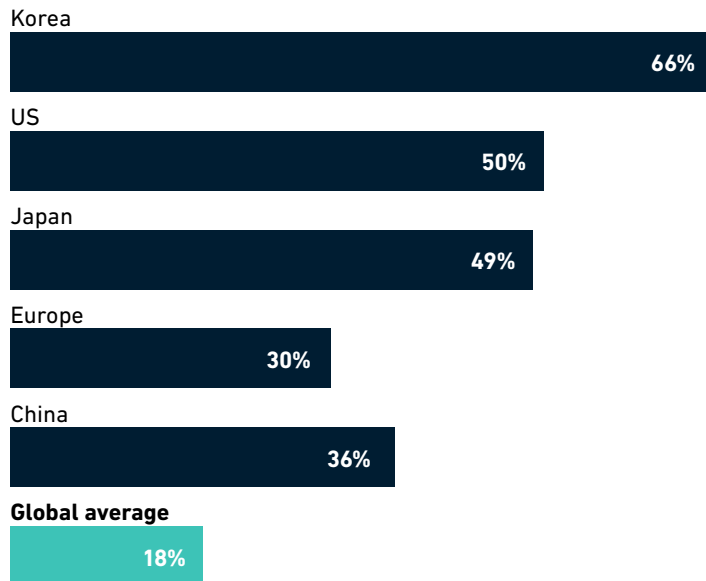


The 5G decade has arrived: incremental opportunity or game changer?

- Globally, we forecast consumer 5G take-up to reach 18% of the base by 2025, though this will be heavily skewed to a few early-adopter countries.
- This would make 5G adoption slower than 4G on a comparable basis but equally efficient as a share of the addressable market.
- The extent to which 5G drives new revenue growth, however, will come from selling into enterprises (covered in the 5G section).

Forecast 5G penetration in 2025

Percentage of total connections



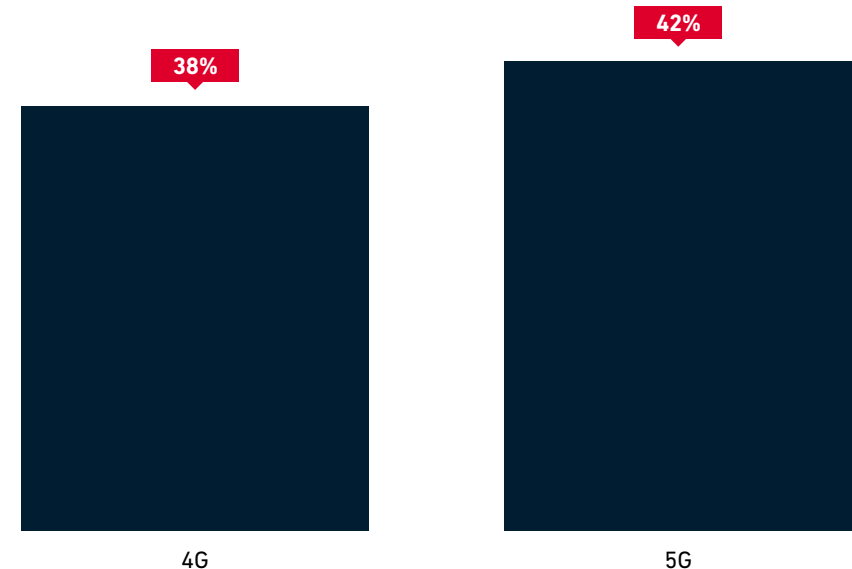
Connections

Connections



Equal conversion rates?*

Percentage of population, seven years post launch



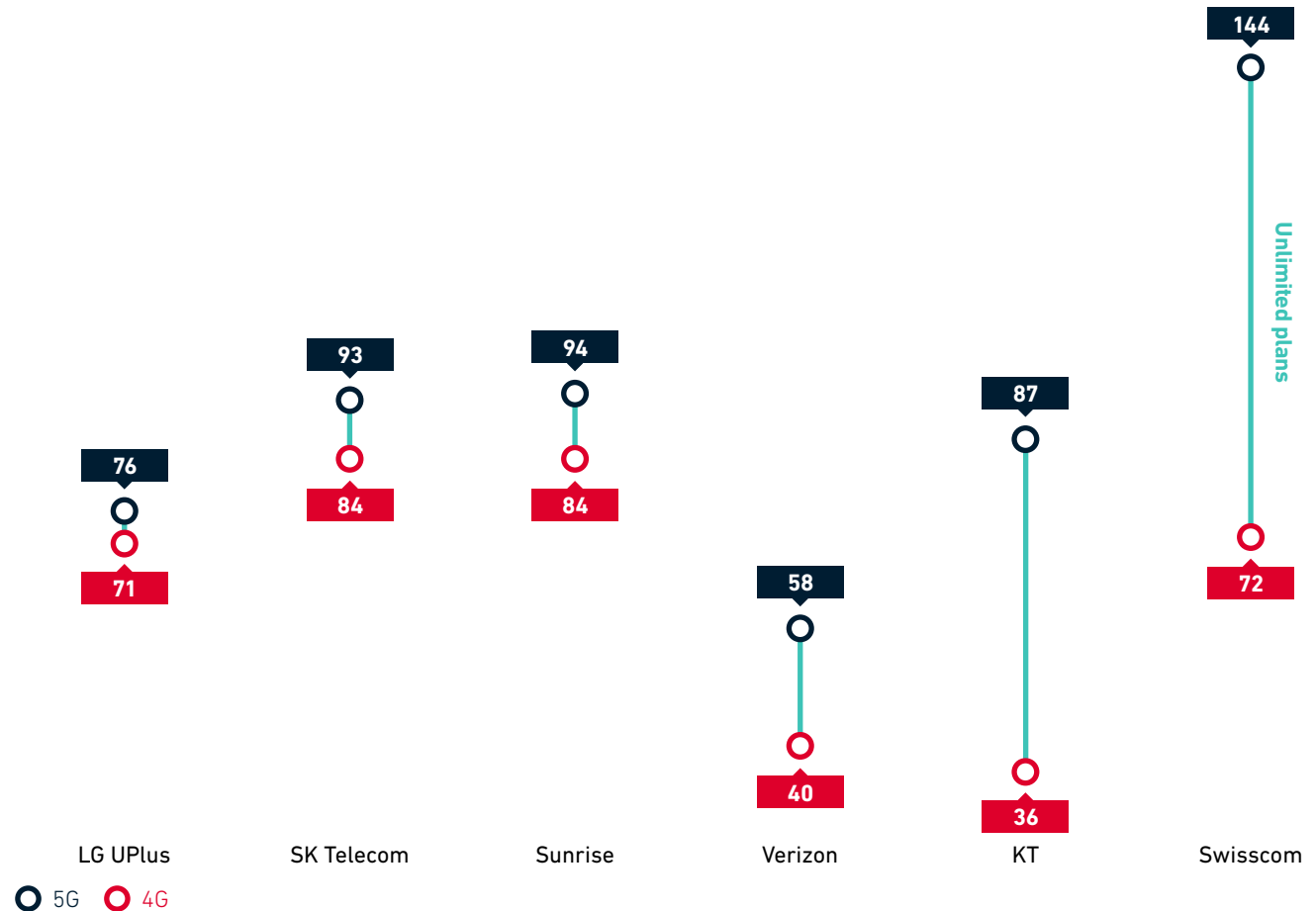
*Conversion rate = take-up as a share of population covered
Figures are standardised seven years post the first commercial launch. 4G = 2016, 5G = 2025

Will consumers pay more for just more speed?

- For most of the last 30 years mobile operators have relied on a simple tenet: charge more for more.
- This holds true whether ‘more’ is data, speeds, content or anything else.
- However, because of the oligopolistic nature of the sector, premiums are eventually competed away, meaning the effect on revenue growth is temporary.
- 5G is no different. Indications from early launches (notably South Korea) are that pricing will be set 10–20% higher than LTE.
- Latency gains are a potential game-changer for things like VR and AR, but the immaturity of the content ecosystem means it will be two to three years until these new services become available on a mass-market level.

Average monthly tariff

\$



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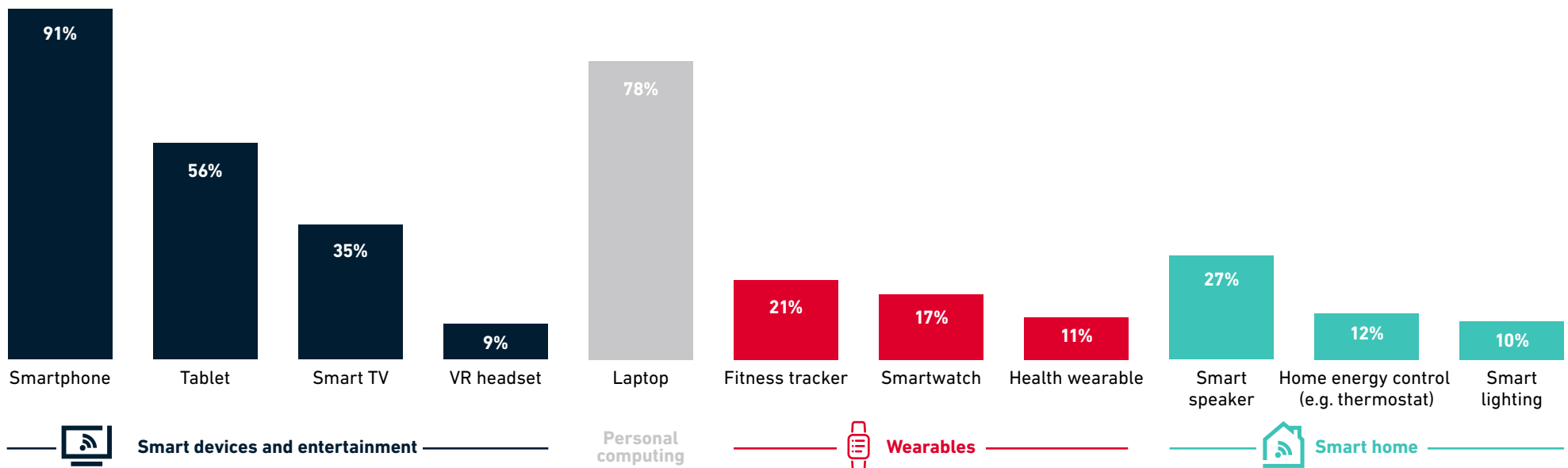
Following PCs and smartphones, a third wave is upon us

Smartphones still the centre of gravity amid huge variety of devices

- Smartphone ubiquity means it remains the primary internet access point for most of the world. In the US and Europe, 90%+ of the population have a smartphone, with 50-60% of online hours now spent on mobile devices.
- The extension of smart devices into the home has already happened, though for the most part take-up remains niche beyond smart TVs.
- Smart speakers are the exception; in the US, ownership increased 10ppts to 27% in 2019. This reflects the speaker being a strategic control point for Amazon, Google and Apple to entrench their ecosystems in the home.

Which devices do you own?

US consumers (2019)

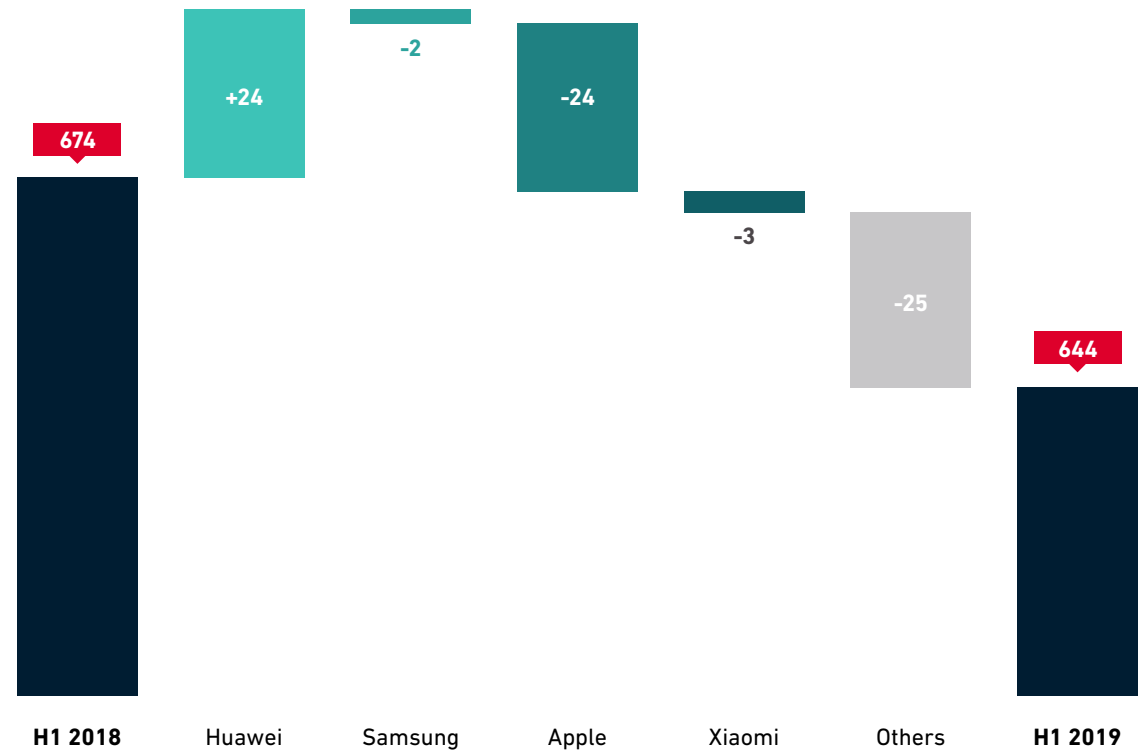


With smartphone sales in decline, can 5G reignite the flame?

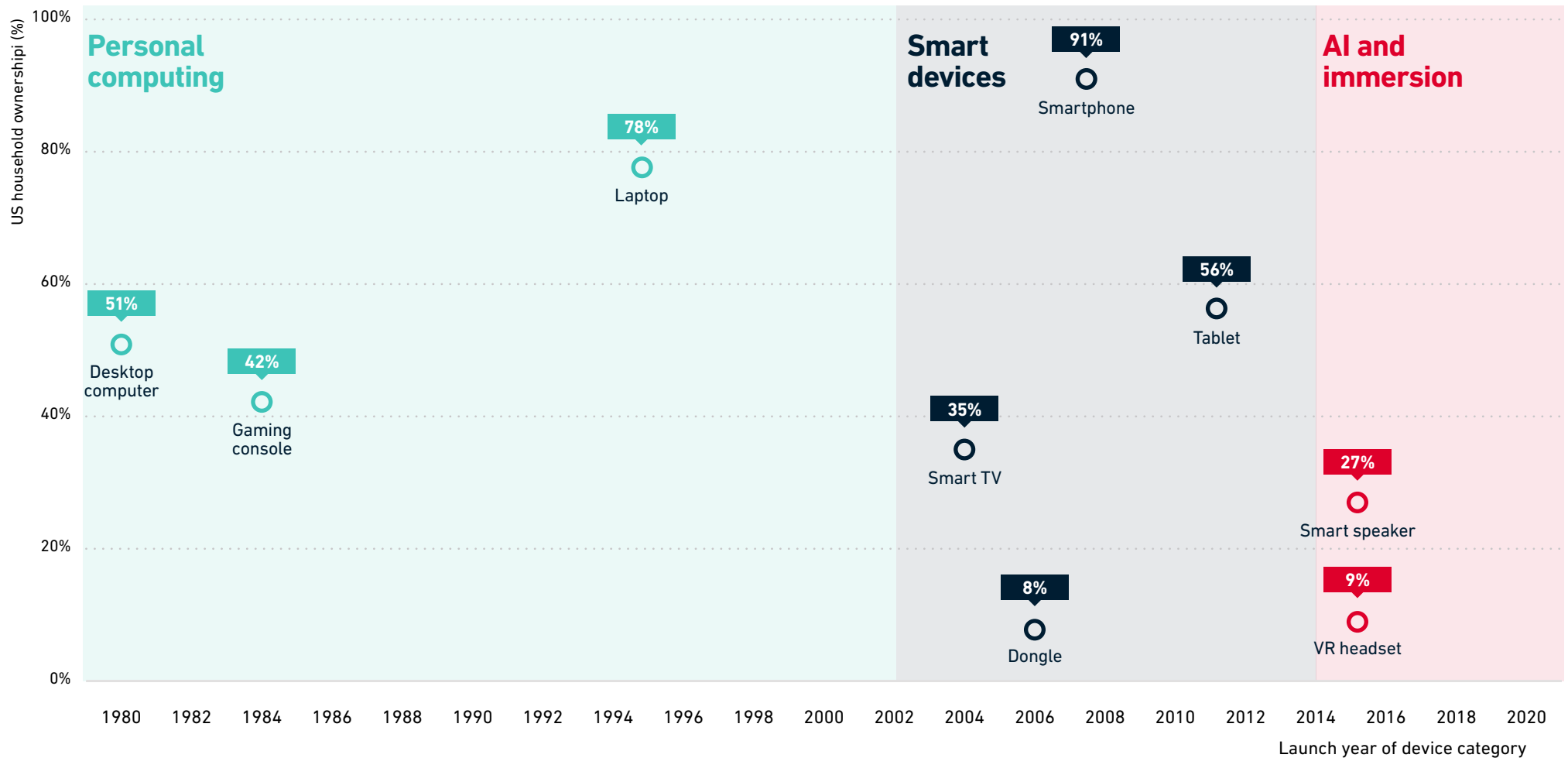
- The languishing performance of Apple over the last two years reflects a wider malaise in the smartphone market.
- People used to upgrade every two years to the latest new device. However, the pulling back of carrier subsidies, disposable income pressures and general stagnation in smartphone design have caused consumers to delay upgrading, with replacement rates now at three to four years.
- As a result, global smartphone sales are in decline. In H1 2019, the drop was 4%.
- China had been bucking the trend but even it has felt the slowdown; of the major global OEMs, only Huawei grew unit sales in H1 compared to the prior year.
- 5G provides marketing firepower but is unlikely to reignite sales unit growth in the near term until use cases beyond faster speeds (such as AR/VR) materialise.

Smartphone growth has all but run out

Shipments, million



Device innovation cycles are shortening as third wave sets in

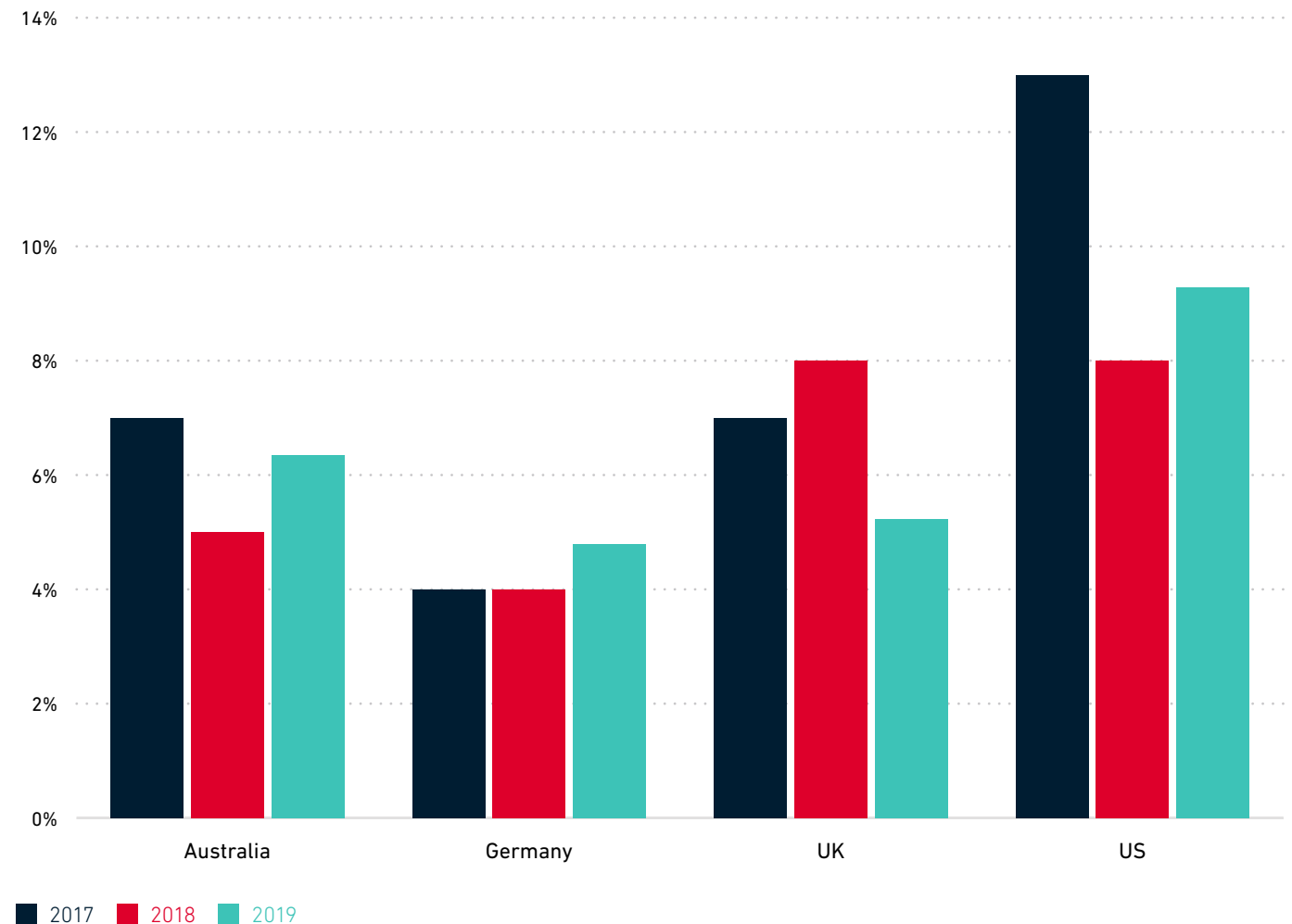


VR continues to flatline

- VR continues to suffer from post-hype realities.
- Headset ownership has failed to grow from its initial promise, with household ownership around 5% in Europe and 10% in the US.
- Expensive, clunky hardware and continued challenges with dizziness have not helped, but limited content libraries beyond gaming and lack of edge infrastructure are also to blame.
- Sports leagues and broadcasters are among those who continue to see VR as a means of boosting viewer interest. The challenge will be to convince pay-TV customers to pay more for VR broadcasts when they are already being pulled in the opposite direction towards cheaper and more flexible streaming packages.

VR headset ownership

Percentage of households



New platform wars on the horizon

- The dominance of Apple and Google in the smartphone era has long been entrenched. Android's 85% overstates Google's true reach because of forked versions in China. The reality is clear though: attempts at a 'third option', be it Windows Phone or others, failed
- As this reach has allowed Apple and Google to build huge ecosystems – effectively digital economies – around their platforms, a natural question is whether history will repeat itself in new device categories.
- In VR, Oculus and Sony are leaders (at least in the US). Microsoft is a sleeper; it does not make VR devices but it has opened APIs to others such as Acer and Dell. In any case, it is focused on the long game of achieving mixed reality, which would in effect make VR obsolete. Apple is not a factor (for now).
- The smart speaker market is a higher stakes game because the platform is only as good as the AI. Amazon's position with Echo devices is a worrying sign for competitors. There is a clear strategy of vertically integrating its e-commerce and Prime business, and it is well ahead in third-party apps that work with Alexa.

Market shares

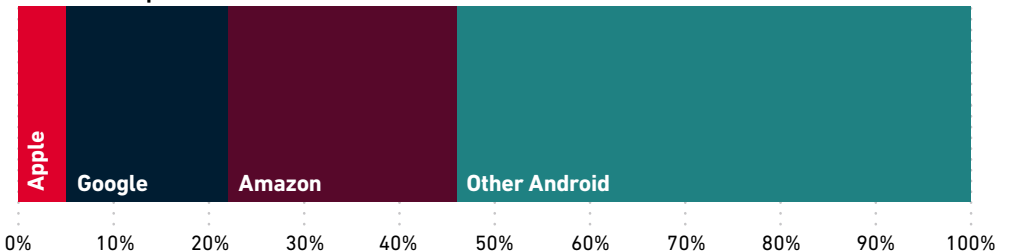
Smartphones



VR headsets



Smart speakers



Smartphones Q1 2018; smart speakers and VR headsets 2019

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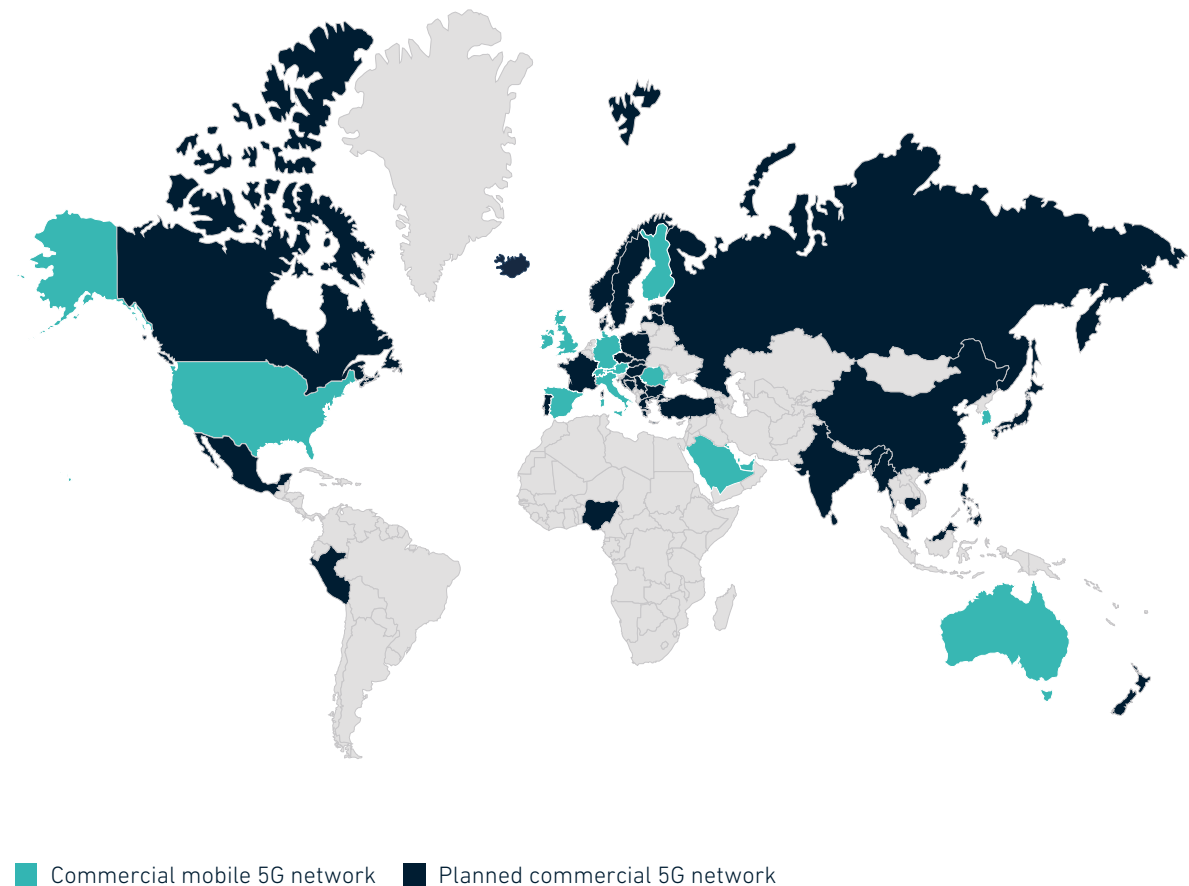
Regional outlooks

Implications of the 5G era

2019 is Year Zero for commercial 5G

- 33 operators across 18 countries – representing 8% of the global mobile connections base (excluding cellular IoT) – had launched commercial 5G mobile services as of early October 2019. Another 77 operators have announced plans to launch the technology, including China, where 5G will go live in October 2019.
- While initial deployments will be limited to urban centres, the pace at which 5G network coverage extends to national scale depends on the country.
- Korea (86% by 2021) and Japan (66%) will be among the world leaders, aided by willing operators, tech-savvy consumers and a heavily urbanised distribution.
- The US (79%) is also at the high end, although this is driven by competitive dynamics, with the recent T-Mobile/Sprint approval a further accelerant.
- By contrast, European telcos will play the long game. We forecast 5G coverage to be only 40% by 2021, reflecting a cautious investment sentiment and remaining headroom for LTE.

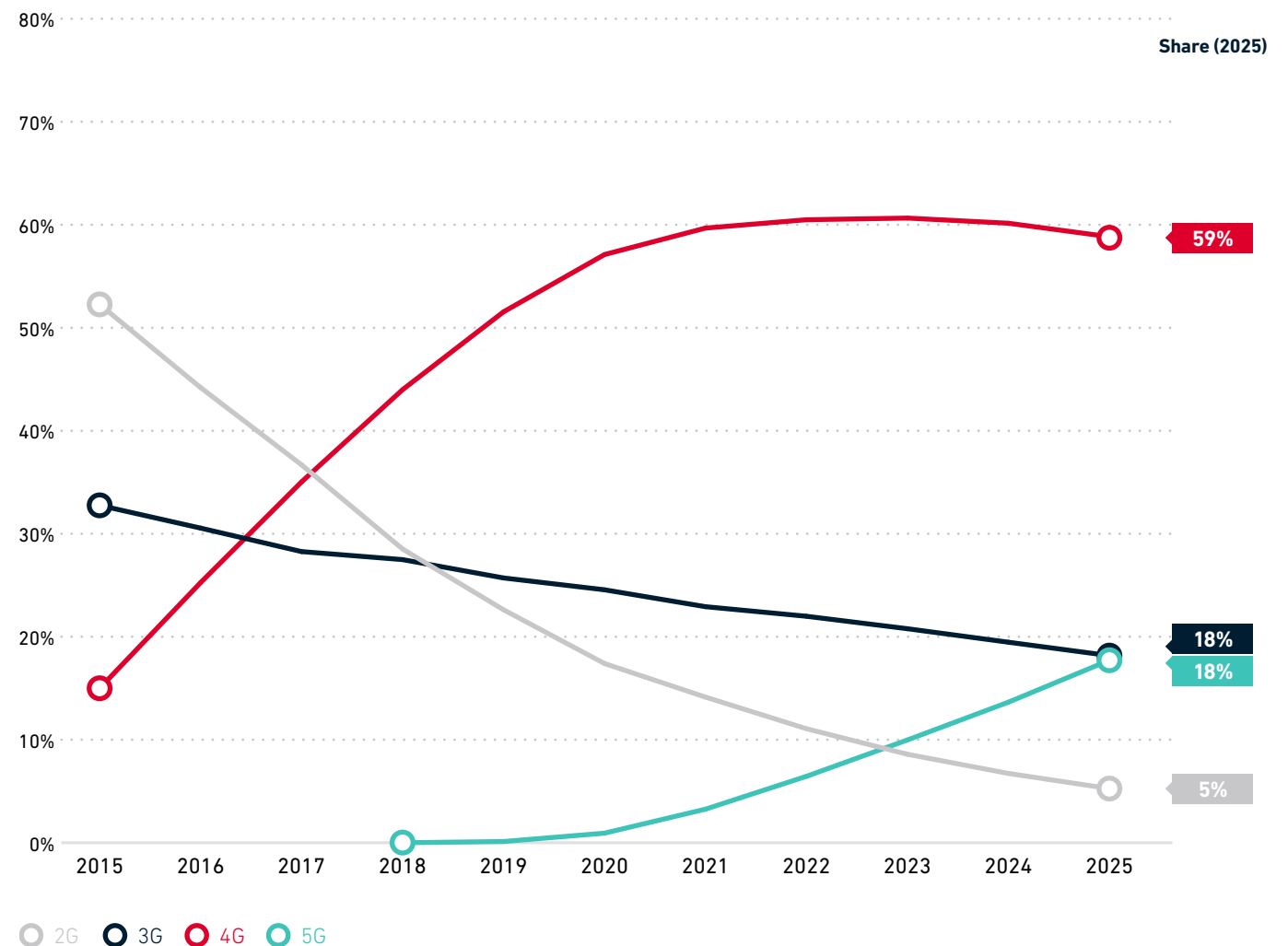
Confirmed operator launch plans



The 2020s will still belong to 4G

- Our forecasts for 5G take-up show a gradual S curve that begins to ascend post-2021. Take-up will reach 1.4 billion connections (18% of the base) by 2025, though this will be heavily driven by the US, China, Korea and Japan.
- Paradoxically, the 2020s still belong to 4G, at least in volume terms. India, Africa and swathes of Southeast Asia are in the midst of mass migration to LTE and low-end Android smartphones.
- As a result, around 60% of mobile connections will be running on LTE by 2025. Most operators have plans to shut down their GSM networks, which means 2G will all but disappear.

Global mobile connections by network generation



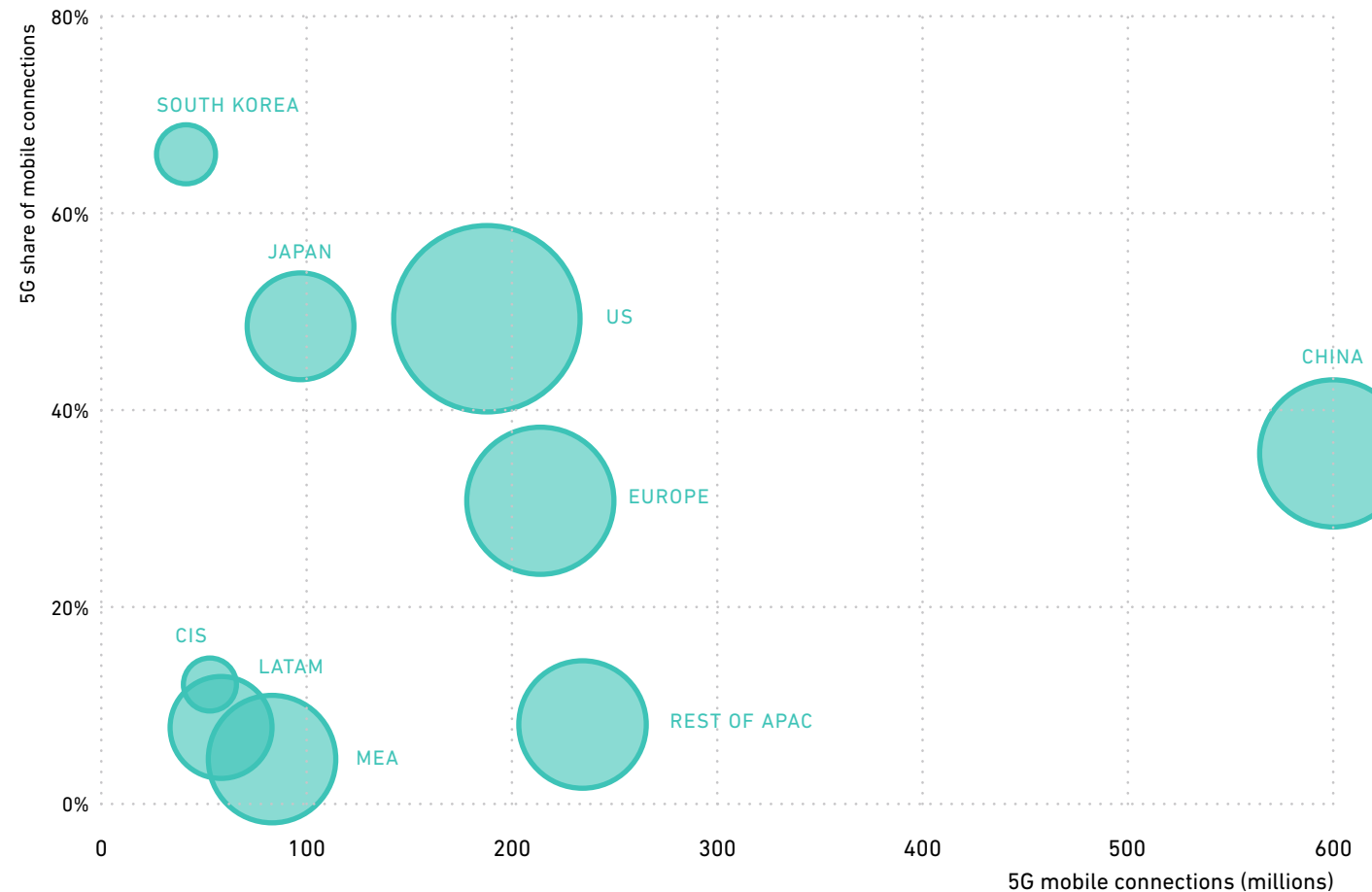
US, China, Japan and Korea will be the 5G pacesetters

Five economies will account for more than 70% of the global 5G connections base by 2025.

- **China:** the single largest 5G market, will have nearly half a billion users by 2025. The government has made it a national priority as part of the broader digital transformation of the economy.
- **The US, Japan and South Korea** will have the fastest migration to 5G, going from early adoption to lead technology in the period to 2025. High-income consumers in these countries will likely be a benchmark for new use cases.
- **Europe** will lag behind (around 30% adoption by 2025), with operators still looking to recoup 4G investments.

5G mobile connections: 2025 view

Bubble size corresponds to forecast mobile revenue in 2025

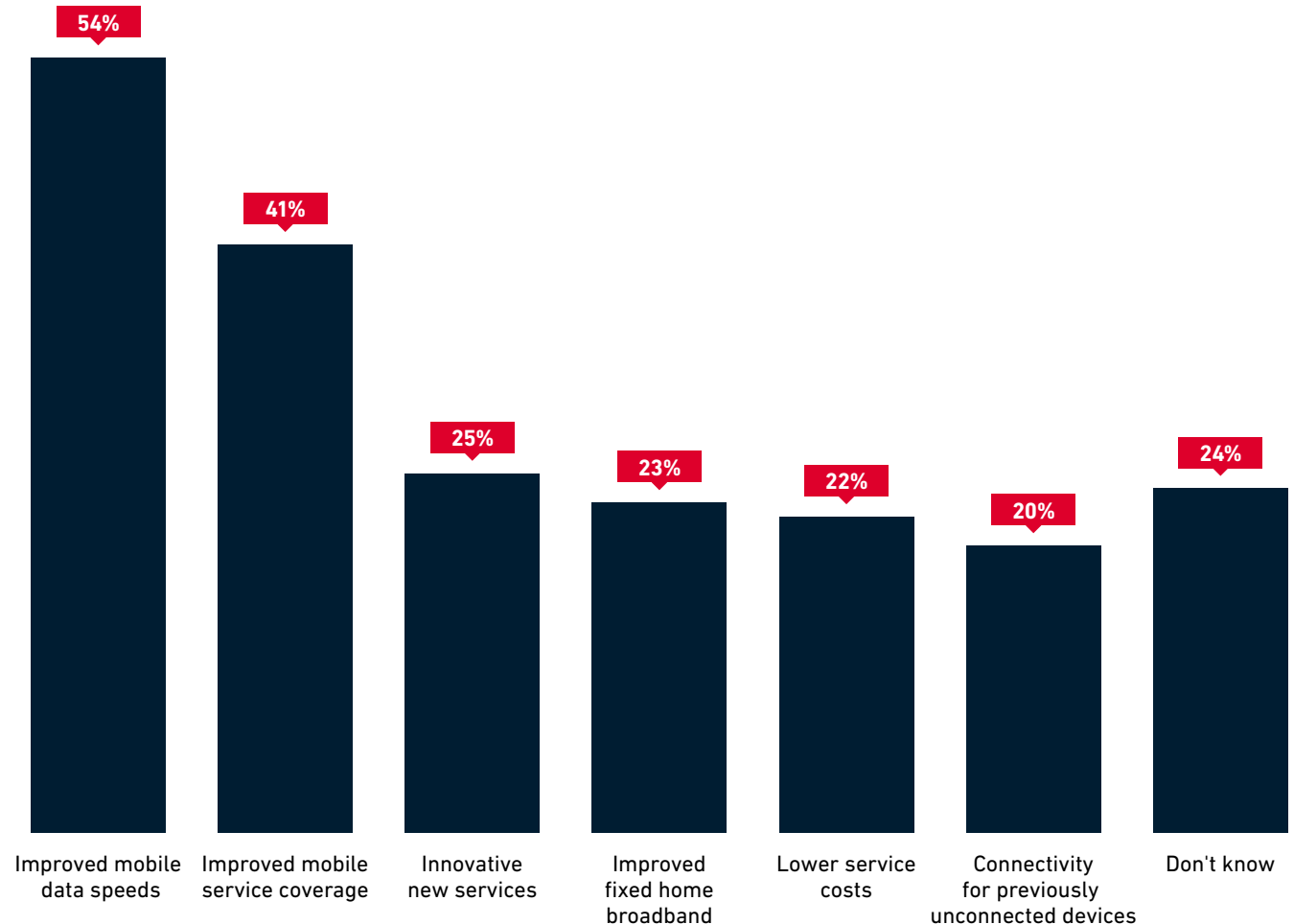


5G for consumers: in search of a killer app

- Most consumers in developed markets see 5G as a new network generation that will improve mobile data speeds – at least for now.
- In this scenario, any mobile ARPU uplift will likely be temporary (witness the 4G era) before being competed away.
- The incremental opportunity is in immersive entertainment including gaming, VR/AR, e-sports and live events.
- However, we are still a few years away from mainstream adoption. The technology (low latency, AR/VR devices, content and applications) is still in its infancy, while the business model and monetisation routes are still in the experimental phase.

What do consumers expect from 5G?

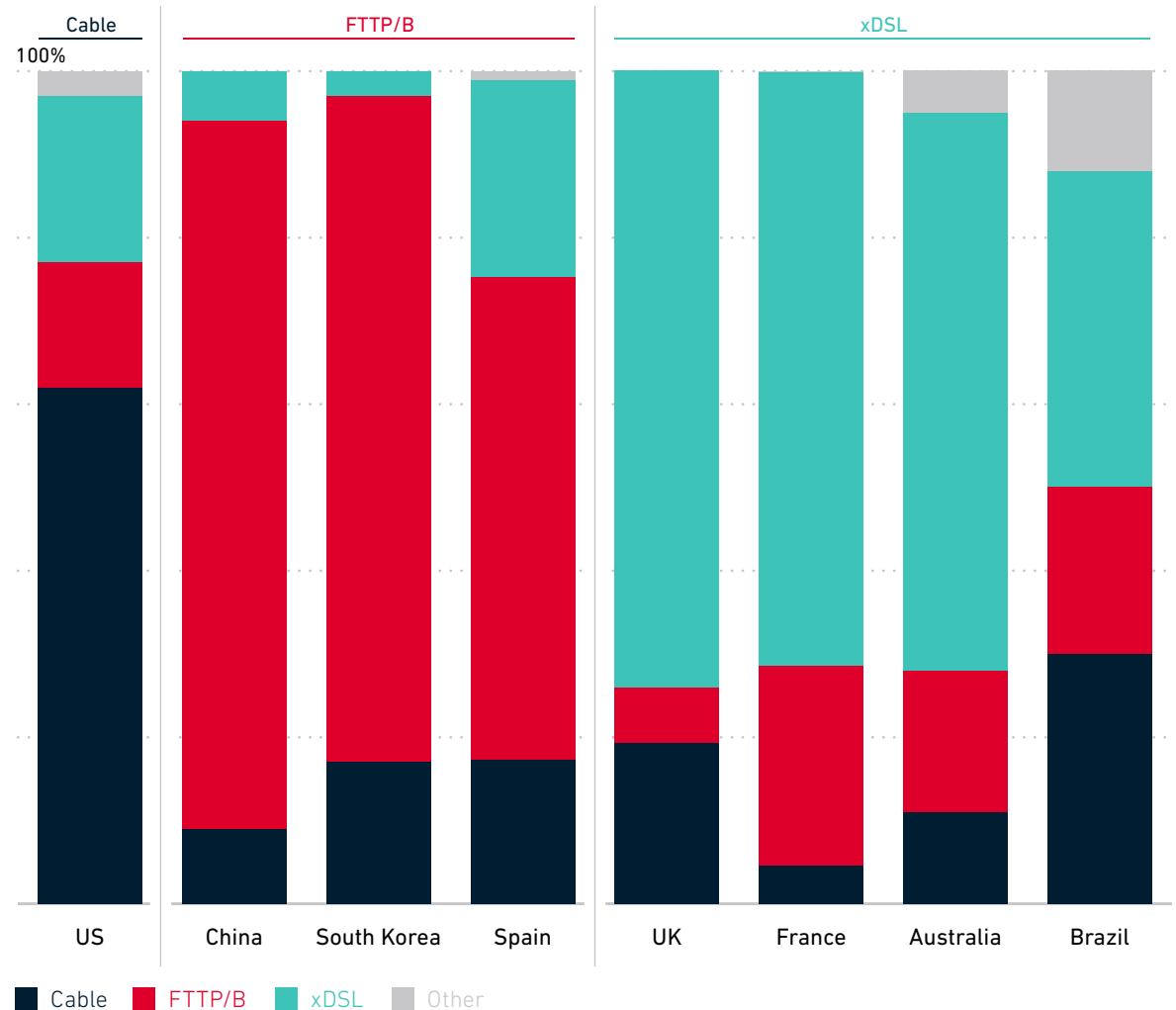
15,000 respondents from 16 developed countries around the world. Respondents could select multiple answers.



Growing interest in 5G for home broadband

- 5G as a last-mile option for home broadband has garnered increasing interest as a cheaper alternative to fibre.
- The US plays a pivotal role, with Verizon having launched and T-Mobile waiting in the wings. On the face of it, this presents a sizeable addressable market, especially when considering that around 20 million households in the US lack high-speed broadband.
- However, competing head on with cable and FTTH is challenging. mmWave (the likely carrier for FWA) has weak signal propagation, requiring a very high density of small cells. Sufficient spectrum bandwidth is also needed to deliver competitive speed, which must be weighed against wireless data demands.
- None of these are insurmountable problems but they underline the challenge in establishing a viable alternative to fibre, which remains the gold standard in data transmission and commands the greatest pricing power.
- A smattering of telcos in other countries have similarly announced plans to offer FWA, mostly in Europe and the Middle East. Only Vodafone Qatar has a live service. At \$96 per month for 100 Mbps, this is a premium product and unlikely to be replicated elsewhere.

Percentage of fixed broadband connections by technology

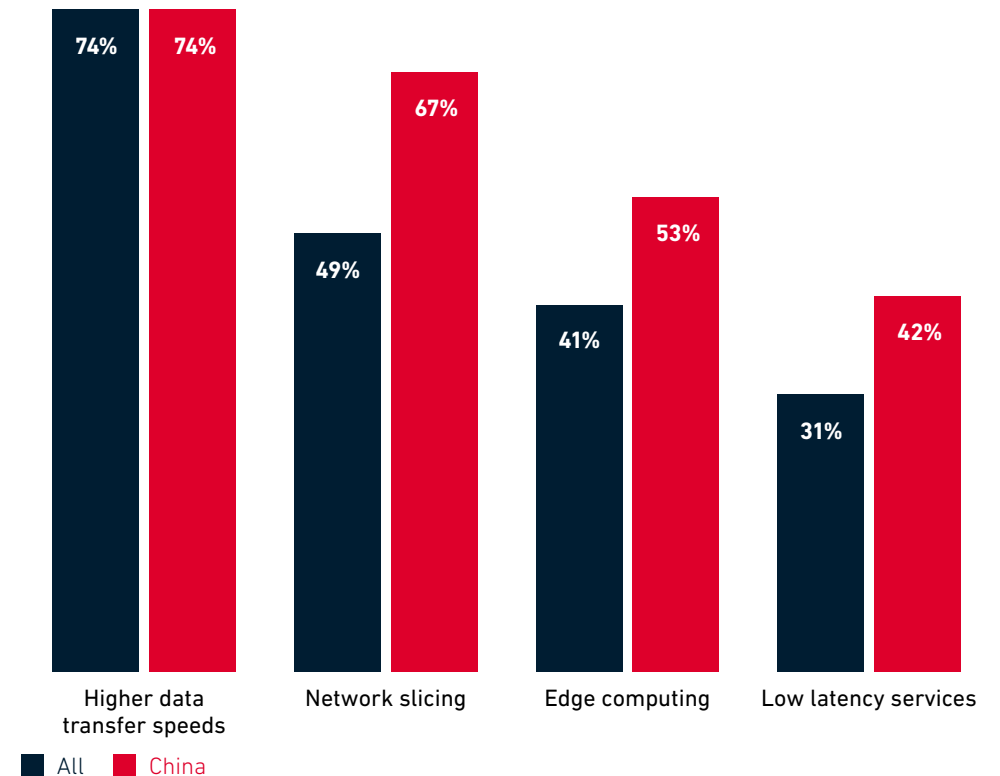


Enterprise verticals are the real opportunity, where China is racing in front

- Companies in a range of verticals (manufacturing, power generation, aerospace) are evaluating options for digitising product assembly and general operations management.
- This presents an opportunity for operators that can offer 5G with complementary infrastructure for low latency service (mostly data centres close to the edge) and analytics.
- However, our enterprise survey indicates that while a majority recognise the speed gains from 5G, other improvements are not widely appreciated. Many simply say “4G is still good enough”.
- To a certain extent this reflects the fact that 5G is young. The greater point is that enterprise digitisation is a pond being waded into by multiple sectors including telcos, cloud, SaaS and systems integrators. Ford’s manufacturing plant upgrade, for example, is just as fair game for Amazon as it is for Verizon – or perhaps a combination of both.
- The challenge will be to move the conversation away from technology and towards a consultative mentality that solves problems.
- China is a clear exception. Early partnerships and trials from the mobile operators have paid dividends, evidenced by widespread industrial sector intent to utilise 5G.

Which of the following 5G capabilities would make it compelling for your organisation to use 5G for future IoT deployments?

N=2271. Multiple answers possible.



Smart manufacturing: nearing the autonomous factory

- Manufacturing companies are adopting robots, AI, sensors and a range of industrial IoT solutions to automate and monitor production.
- In many cases this depends on low-latency connectivity to satisfy precision thresholds and real-time analytics.
- 5G theoretical standards are for sub-1 ms roundtrip, which is attractive when combined with the option of a network slice offering a guaranteed quality of service to factory owners. Achieving that latency will likely require edge computing infrastructure where cloud servers sit in close proximity to (or even inside) factories.
- Globally, smart manufacturing IoT connections will grow seven-fold between 2018 and 2025 to almost 1 billion connections. China is the single largest driver, helped by investment and political will to forge its position as a global leader in the industrial economy.
- The ultimate goal would be an autonomously controlled factory. The Changing Precision Technology Company in China (which automated 90% of its production line) and more recently a satellite facility in Florida jointly owned by OneWeb and Airbus have provided an early template for such a design.

5G uses cases in smart manufacturing



Robots and robotics

- 5G increasingly complements Wi-Fi in factories
- Real-time AI-powered robot collaboration and integration
- Cloud-based wireless robotics



Remote real-time or near-real-time manufacturing

- Live remote monitoring and reconfiguration of robots and processes
- Remote quality inspection



Labour augmentation

- 5G and AI power industrial AR, enabling workforce training and augmenting human skills
- High precision simulations of human-machine interaction in various manufacturing situations



Connected operational intelligence and analytics

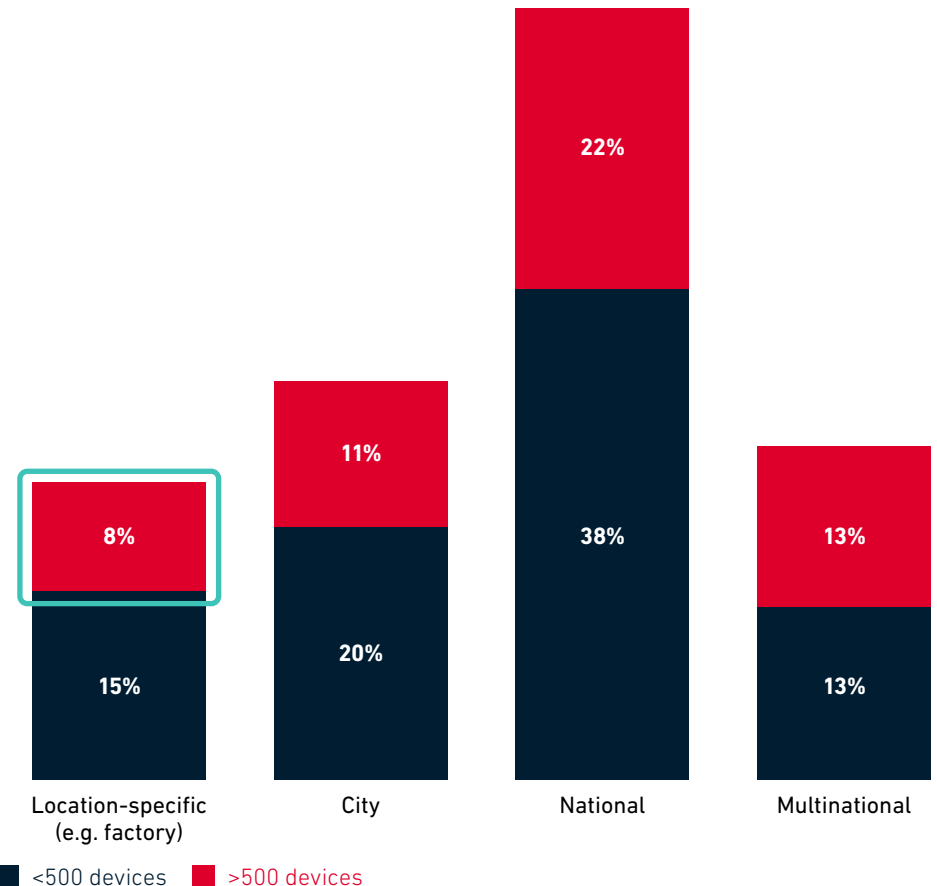
- 5G coupled with AI enables real-time data gathering to inform immediate manufacturing decisions
- AI-based analytics in various areas (i.e. processes, inefficiencies, predictive maintenance for robots)

Private networks re-emerge as an enticing enterprise option

- Private networks exist to service the connectivity requirements of a specific company or organisation without dependence on or reference to a national mobile grid.
- While not a new concept as such (some already run LTE), these have re-emerged as an enticing option for enterprises, particularly factories, wanting high-grade connectivity using 5G.
- The addressable market is still limited. Only 8% of enterprises planning large-scale IoT deployments also require location-specific coverage. Most have wider coverage footprint goals, which would make private networks uneconomical.
- However, the nascent movement towards reserving spectrum for enterprise – as opposed to operator – use will likely fuel demand over the coming years. The US FCC recently gave approval to CBRS spectrum, while Germany carved out spectrum in its 5G allocations.
- Enterprises therefore have multiple options at their disposal from direct builds to commissioned networks. In the case of the latter, operators are one option but they will need to step up given fierce competition from global cloud companies such as AWS and Microsoft.

Scale of planned enterprise IoT deployments

Note: respondent companies could enter multiple responses



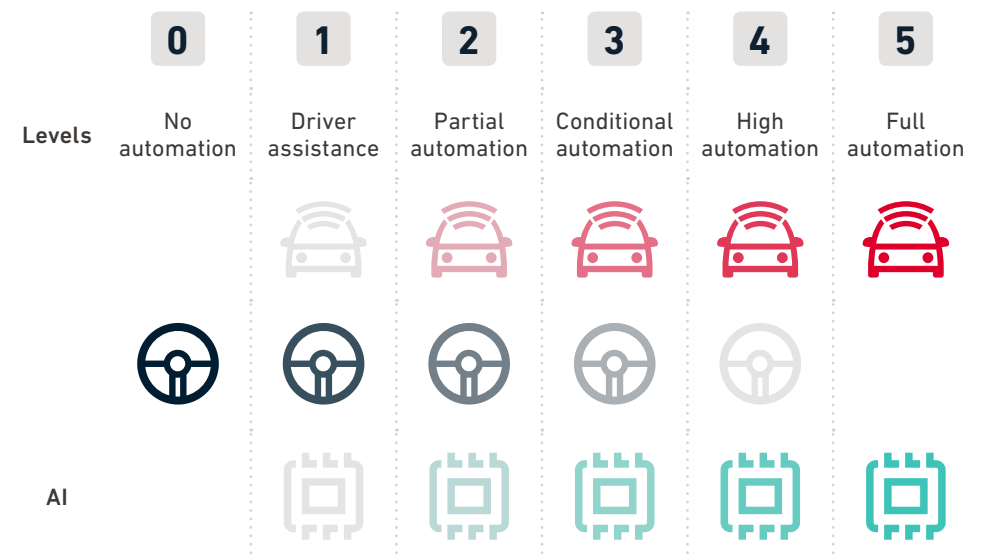
Base: all enterprises planning a future IoT deployment

Source GSMA Intelligence IoT Enterprise Survey

Autonomous driving: 5G will be in the car, even if it's not driving it

- Automakers and automotive tech players aim to bring commercially available level 4 and 5 autonomous cars to the roads over the next five years (Waymo was first in 2019). Mobility-as-a-service (ride hailing) in selected driving areas is the key use case over the next five to 10 years.
- The rate of progress depends heavily on two factors: AI and regulation. Advances in deep learning, computer vision, real-time recognition of the surrounding environment and AI-based computing infrastructure are required to process the huge amounts of data gathered by a level 4/5 car in real time and turn this into actual decisions.
- The operator role is most likely in helping the car communicate with its surroundings, not the actual driving given the risk of signal loss. LTE networks are enabling early C-V2X pilots and launches; 5G will enhance C-V2X and support larger scale deployments.
- Wi-Fi is a competing alternative but has the drawback of higher costs for successive equipment upgrades. The rejection of the Wi-Fi standard in autonomous vehicles by the European Commission in July 2019 provides an open window for cellular.

Levels of vehicle autonomy



Level 4: The car is in full control for the entire trip under certain conditions, with human backup driver.

Level 5: The car has no steering wheel, pedals or driver

5G-V2X plays a key role in supporting autonomous driving

Vehicle-to-Vehicle (V2V)



e.g. emergency vehicle approaching

Vehicle-to-Pedestrian (V2P)



e.g. pedestrian on walkway ahead

Vehicle-to-Network (V2N)



e.g. traffic queue five kilometres ahead

Vehicle-to-Infrastructure (V2I)



e.g. traffic signal ahead turning red

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View from the top

Future of devices

Implications of the 5G era

Media and content

Financial performance

Regional outlooks

Enterprise IoT and Industry 4.0

Act now or lose later

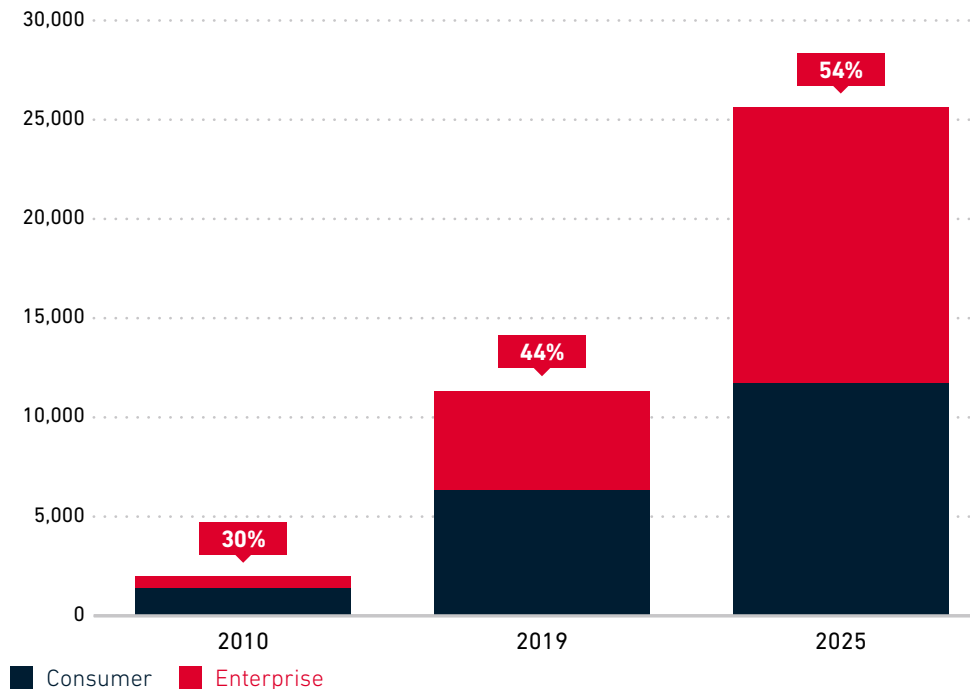
IoT value continues to move up the stack to platforms

- Industrial sectors of the economy are the driver of IoT, which will account for more than 50% of the installed base by 2025.
- With automation comes the need for companies to implement sophisticated controls and analytics. For this reason, most of the value gain for telcos and cloud firms

supplying into enterprise clients will be in the application/ platform layer. The deflationary nature of connectivity means it will shrink from 20% to 5% of total revenue, making it a no-man’s land for operators without a broader service package.

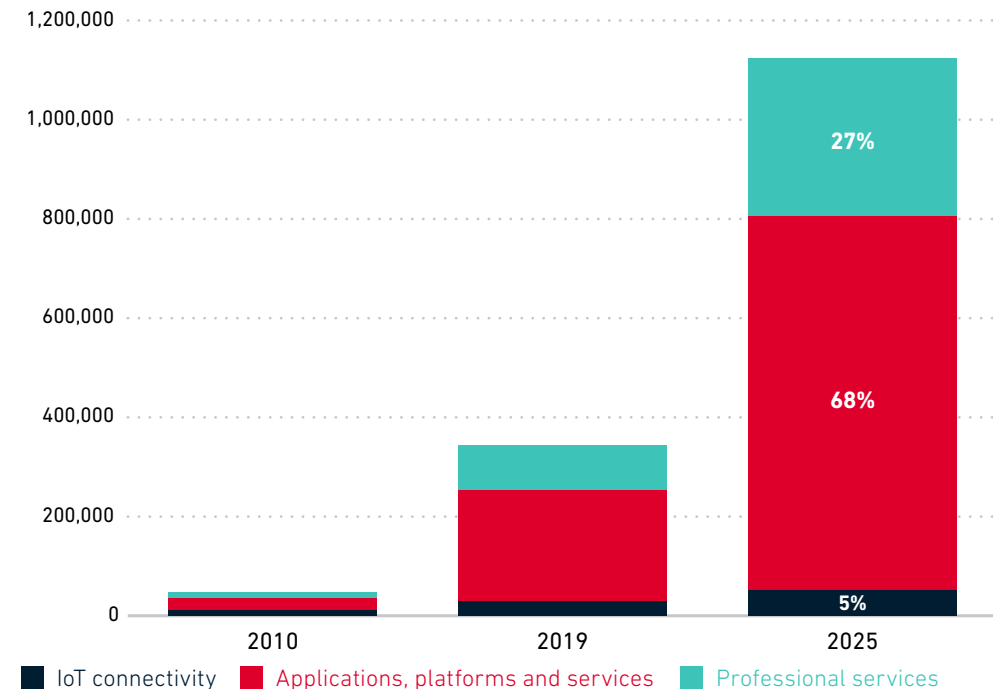
Enterprise/industrial will account for over half of IoT connections by 2025

IoT connections (m)



Incremental value is in platforms and services

IoT revenue (\$m)



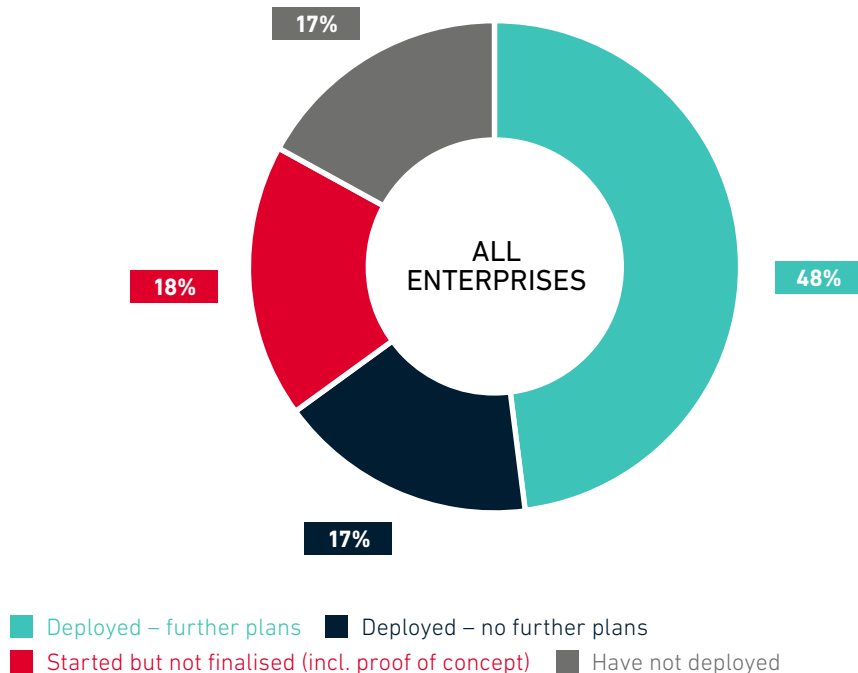
In enterprise IoT, small is big

- Almost two thirds of companies with over 20 employees had deployed an IoT solution by Q4 2018; 75% are planning expansions or upgrades.
- The vast majority of IoT rollouts are small scale, with 74% numbering fewer than 500 connected devices. This reflects the fact that smaller enterprises tend to deploy fewer devices.

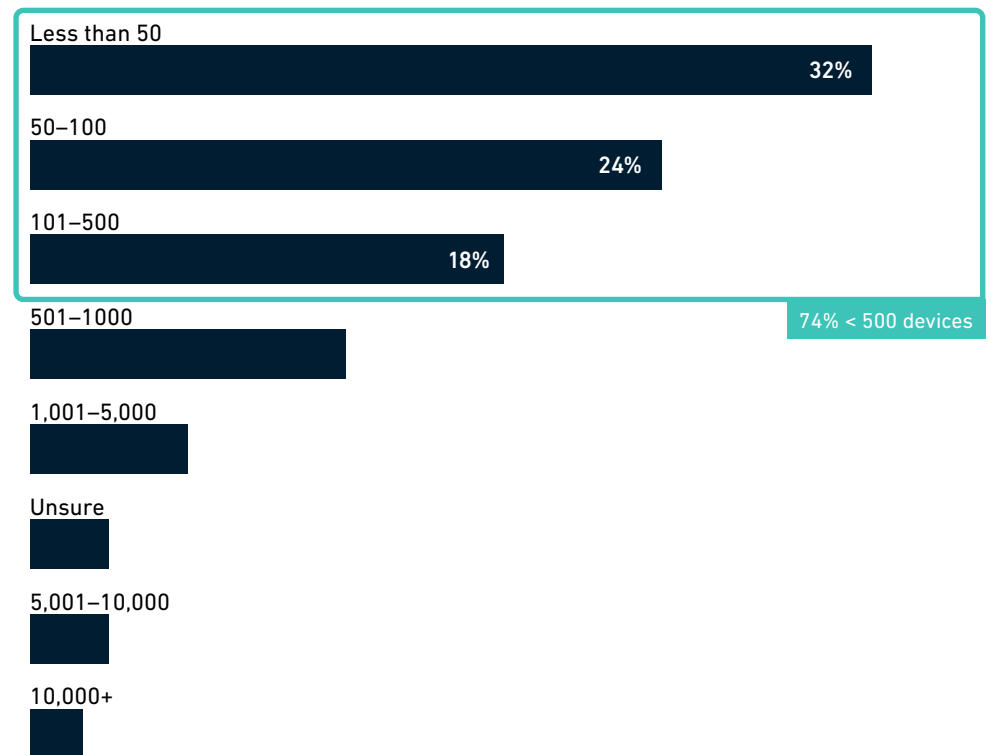
As larger groups and conglomerates bring their IT upgrades to fruition, the average deployment size will increase.

- This presents a trade-off for telcos and other suppliers in that electing to pursue only large contracts at present may be good for margins but risks losing future business as today's SMEs expand in future.

Two thirds of companies have adopted IoT



Current IoT deployment size – small is big



IoT has a magnifying effect on economic productivity

- Increased productivity is one of the key drivers of IoT adoption. The Chingyang autonomous factory in China is just one example of a broader shift underway, with a 90% shift to robots equating to a 250% productivity uplift.
- The reason this shift hasn't really been noticed is that most companies claim savings are relatively small (under 5% of cost base).
- However, many small savings add up to a big effect on the wider economy. We estimate IoT adoption will add \$370 billion per annum to the global economy by 2025 (0.34% of GDP).

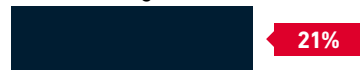
Cost savings attributable to IoT deployments

% of respondents

0-5% saving



6-15% saving



16-20% saving



21-30% saving



31-40% saving



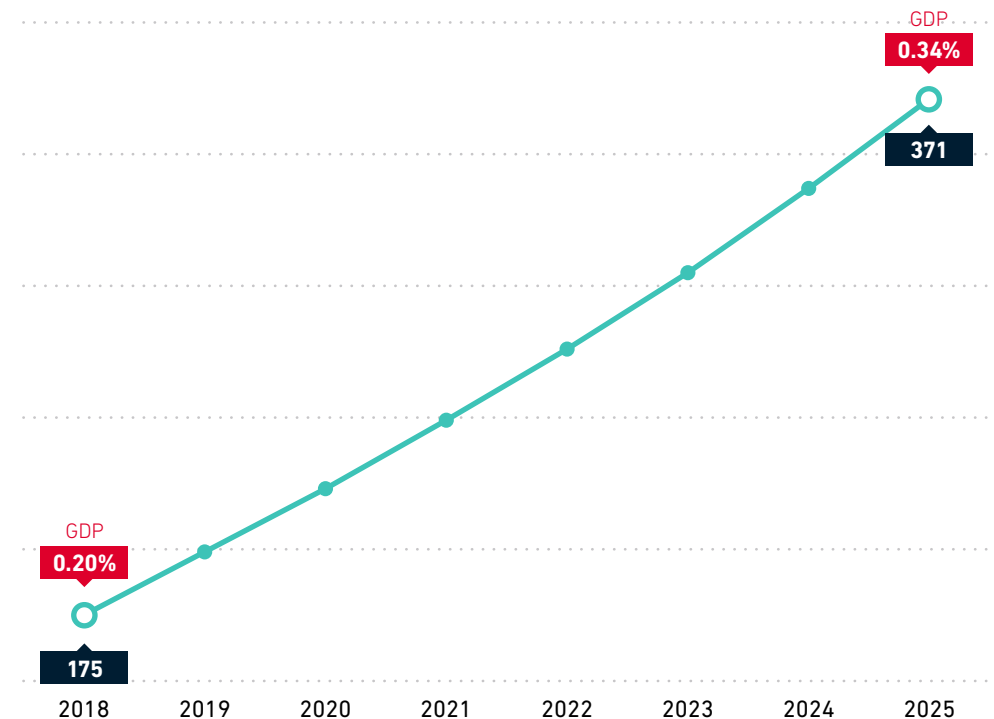
41-50% saving



Source GSMA Intelligence IoT Enterprise Survey Q4 2018

IoT economic impact on business productivity

\$ billion



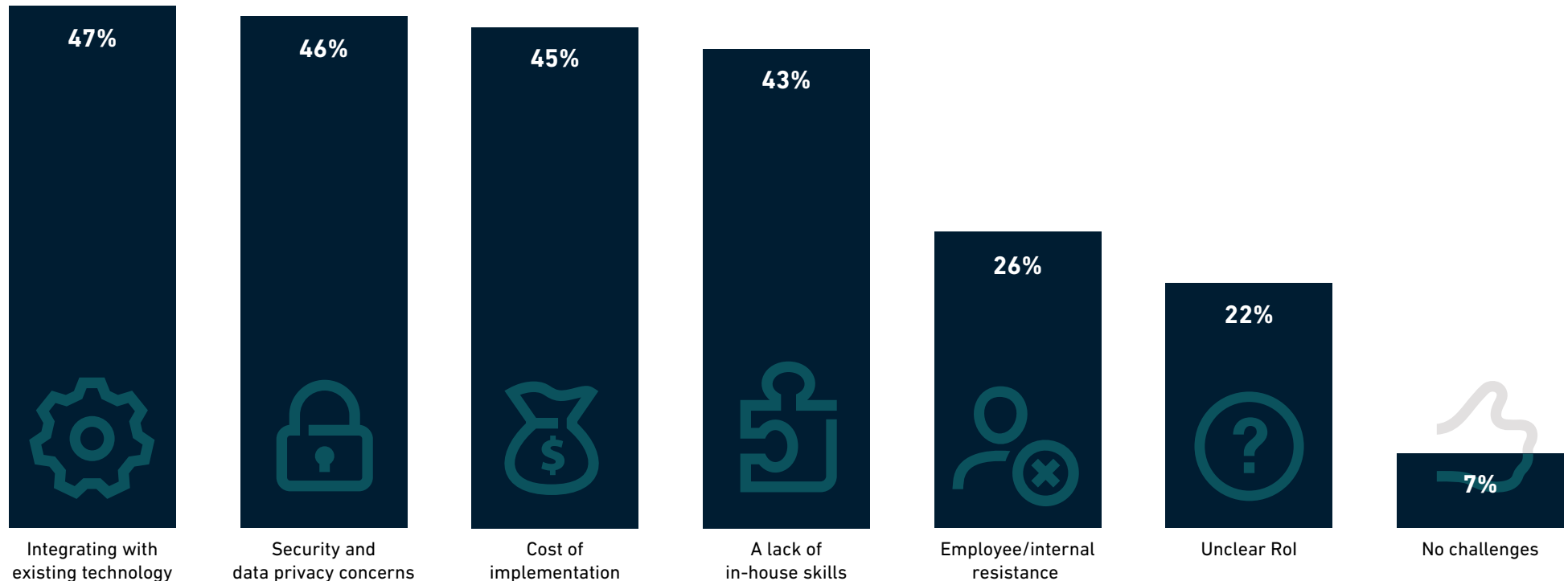
Source GSMA Intelligence

Integration and security persist as challenges

- Nearly 50% of companies point to security and data privacy concerns as key challenges to IoT deployments. Integration and implementation costs are also prevalent issues.
- A key route in for operators would be to offer managed security services as part of a broader IoT contract, relieving enterprises of the skills gap and costs to do so directly. Deutsche Telekom's security operation centre (tailored to automotive clients) and Telefonica's ElevenPaths are early examples.

Challenges organisations face in deploying IoT solutions

Percentage of respondents

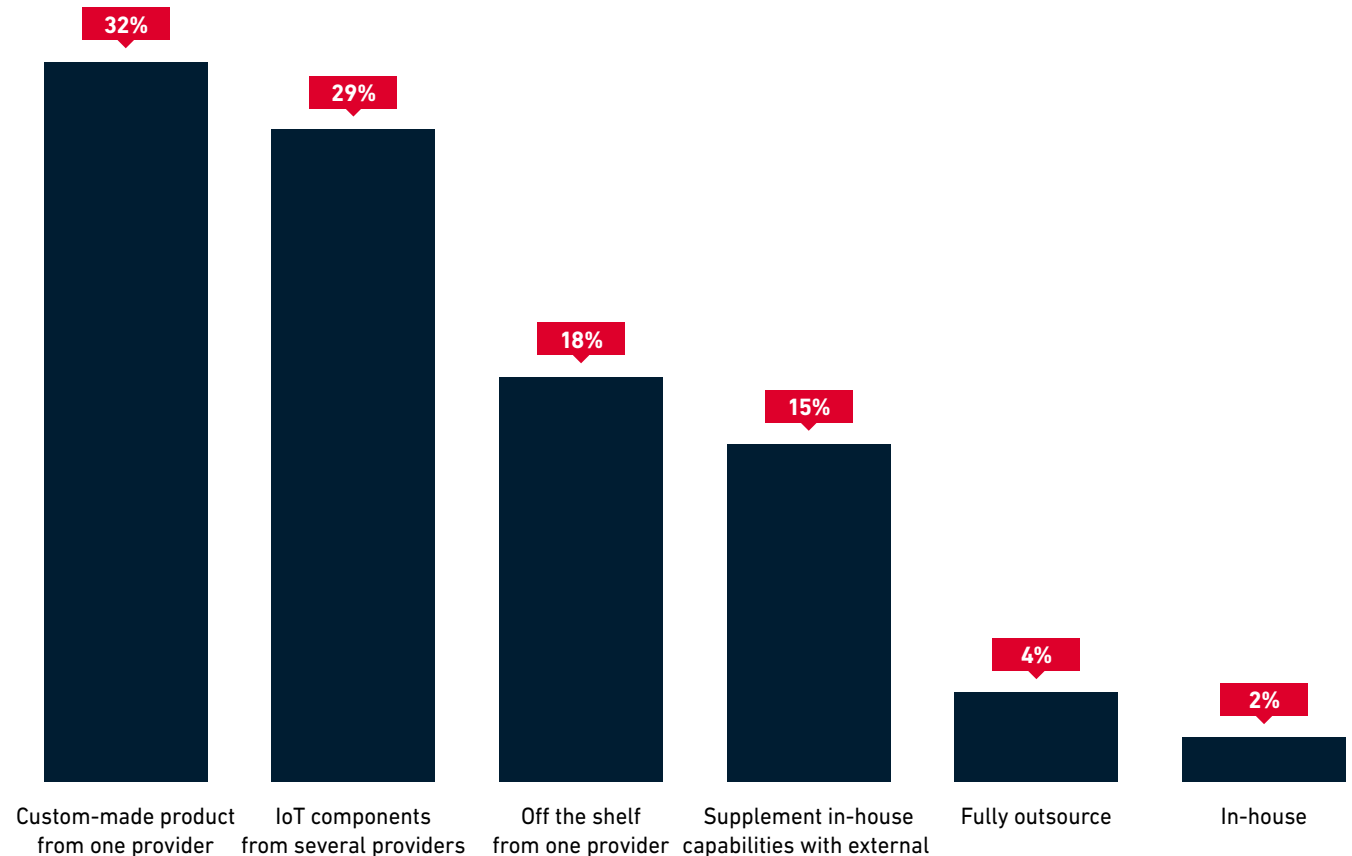


Sourcing patterns suggest no single type of provider preferred

- Integration complexities have fuelled demand for custom-made solutions rather than risking misfits from standard off-the-shelf products.
- Customised solutions are more expensive and ultimately not conducive to scale or common standards, which affects everyone in the long run.
- The diverse nature of the IoT value chain means the use of multiple vendors is likely to be the norm. That puts the onus on the lead contractor (be that an IBM/Red Hat or Accenture) to simplify the overall package for end customers.
- It also accentuates the need to work across company and industry lines. Operator tie-ups with public cloud vendors are gathering momentum, with AT&T/AWS, Telefonica/Azure and DT/Google notable examples signed in 2019.

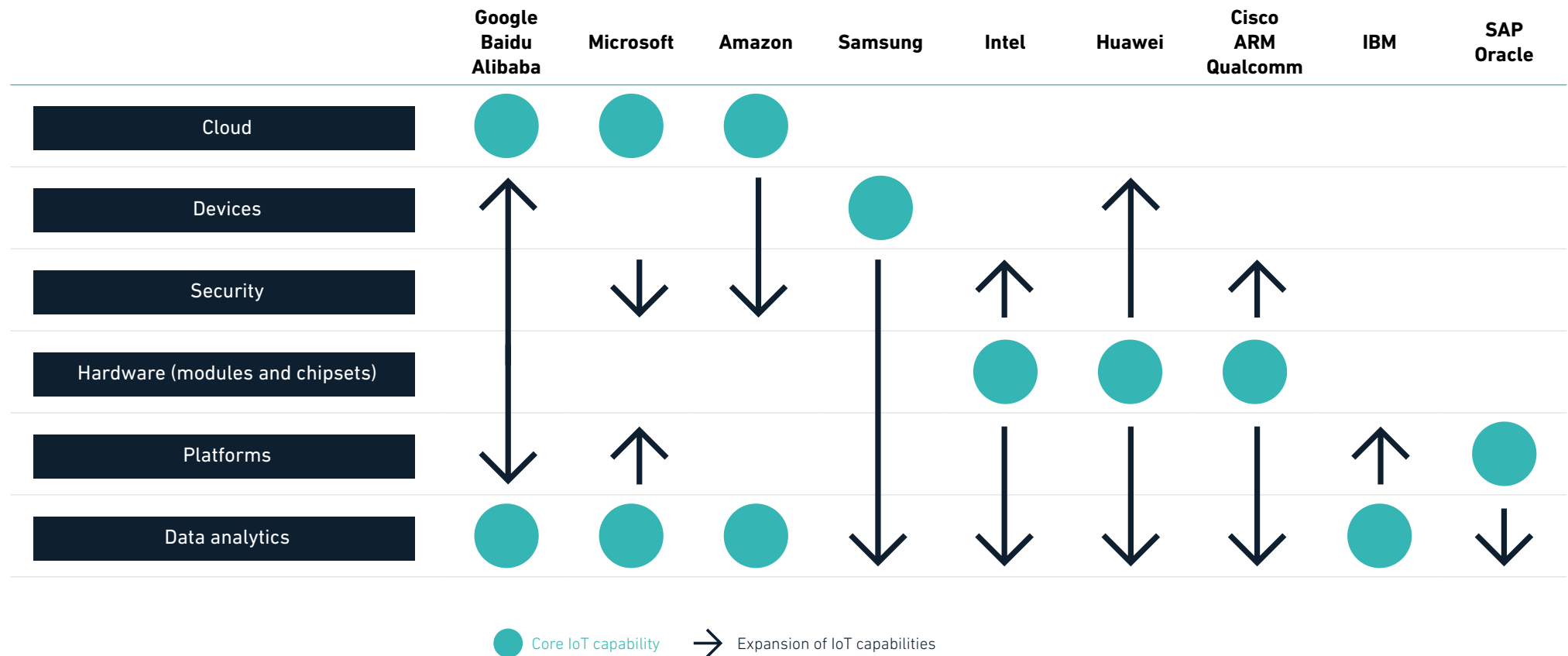
Sourcing IoT solutions – enterprises' preferred approach

Percentage of respondents



All roads now go through a security offering

- The boundaries between traditional technology and IT players are blurring as new business models in IoT emerge around data, analytics and services. Companies are moving up and down the IoT value stack to expand beyond their “core” to offer a more holistic service offering



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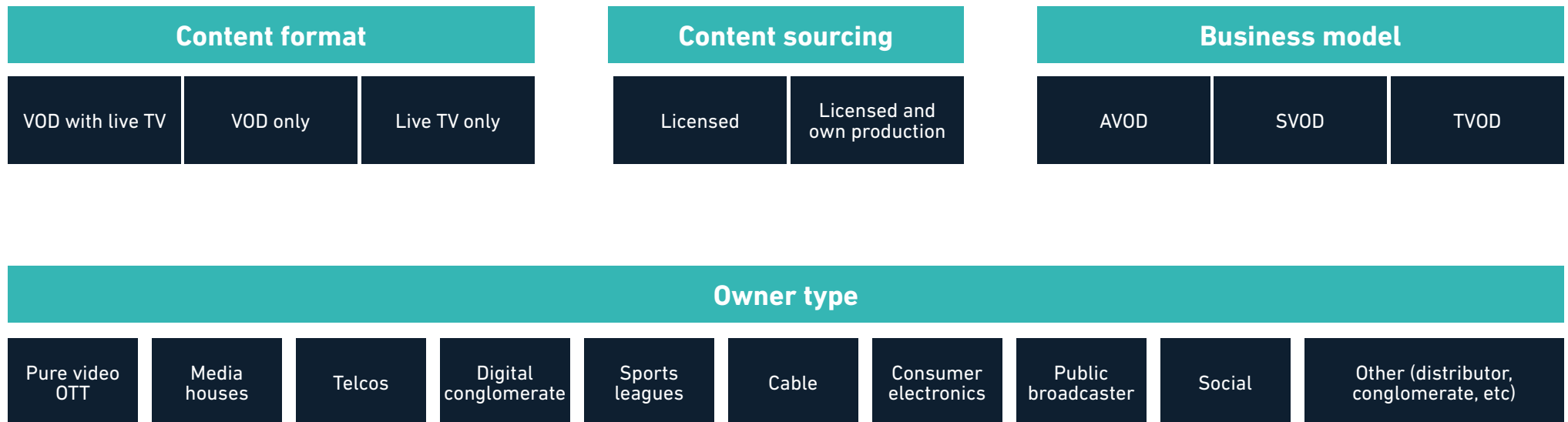
Regional outlooks

Media and content

Streaming growth,
defending pay TV,
the value of local

Streaming is a diverse movement with no one-size-fits-all model

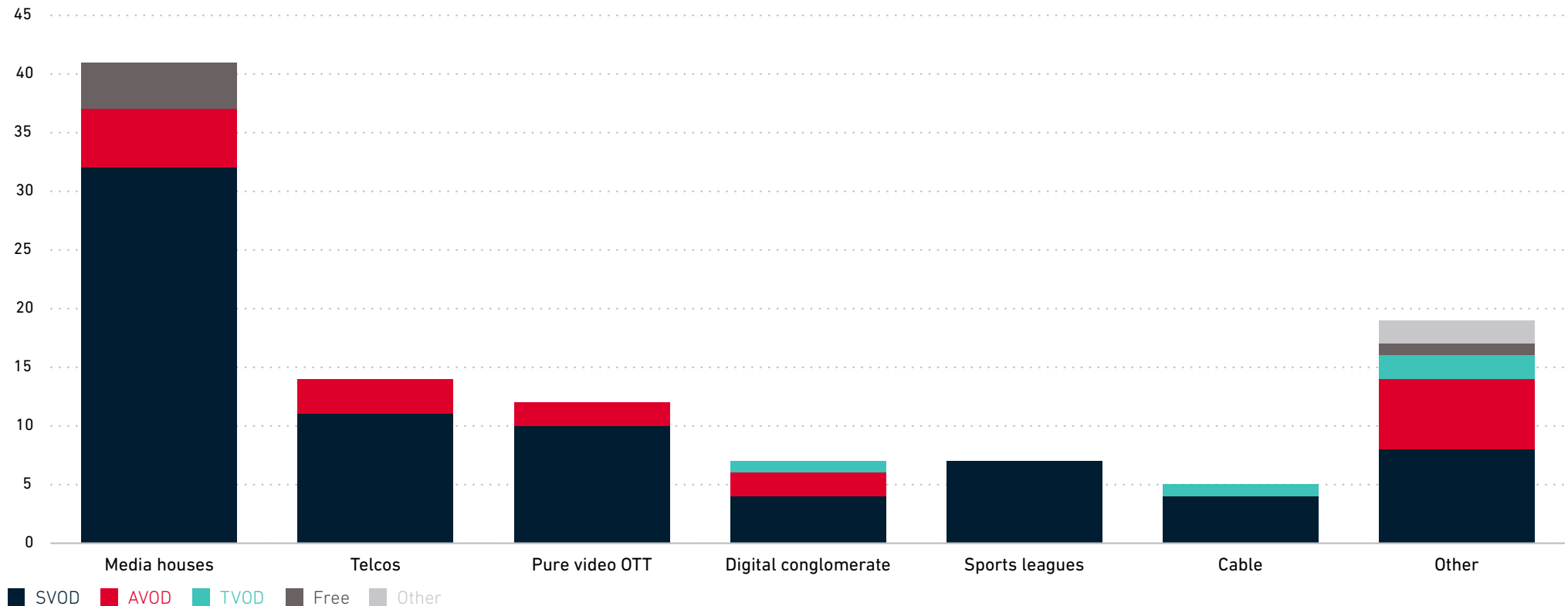
- Most people associate streaming with Netflix or Amazon. While these two companies dominate, in reality consumers now have a choice of options including VoD, live TV or both within a service.
- Monetisation models (e.g. subscription versus ad-funded) and the method of content sourcing (e.g. original versus licensed) are other pertinent parameters.



Who *isn't* involved?

- The US is a microcosm for market structures in other countries, with a limited number of global services controlling the majority of viewership, complemented by a long tail of niche providers (105 in total).
- Media and entertainment groups have the largest footprint, though a range of others from telcos to sports leagues are also active.
- Ad-funded models (AVOD) are rare given the audience scale required. YouTube and Facebook Watch have minimal meaningful competition.

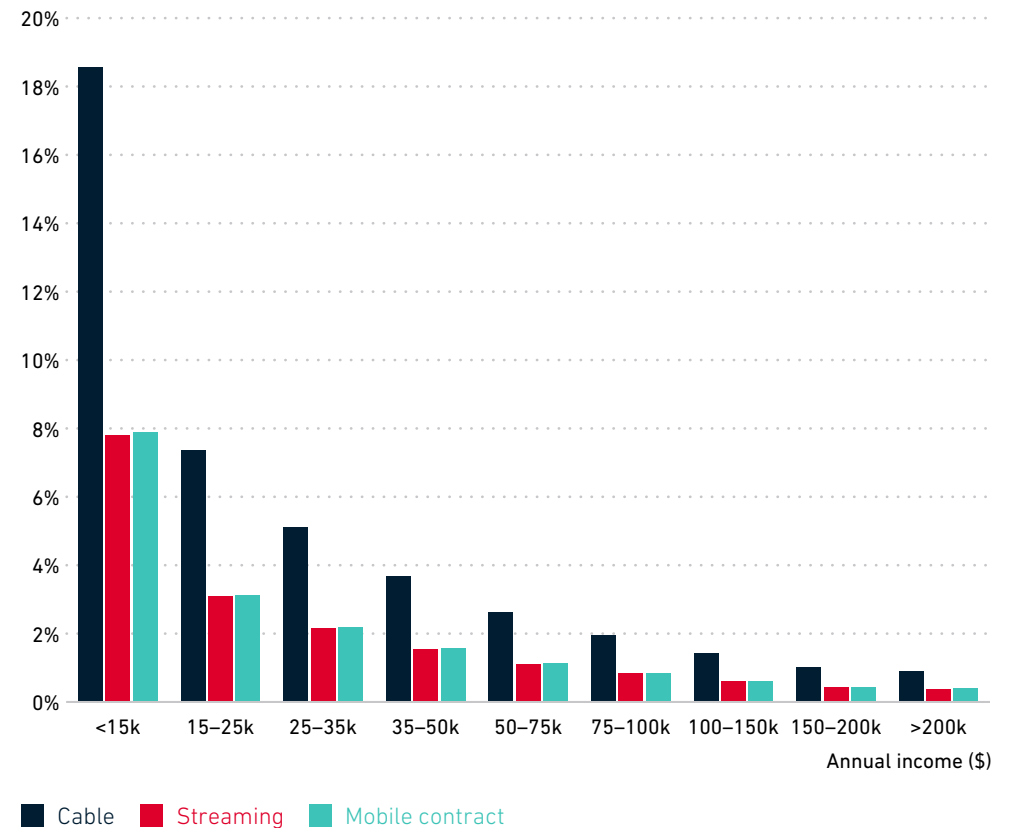
Sectors with video streaming platforms in the US



D2C is the flavour of the month, but how much can the market bear?

- Consumer popularity combined with a raft of new entrants in the streaming space has prompted the question as to how many platforms can survive.
- Pricing is still cheap enough to facilitate multiple competitors. Even in the unlikely scenario of a household subscribing to Netflix, Amazon Prime, Hulu and Disney+, it would pay less than half of an average pay-TV package. The bigger factor is access to content production.
- The US market is expected to consolidate the number of Netflix-style standalone SVOD services as rights inflation and licensing friction create higher barriers to entry. Amazon, YouTube and Facebook have little overlap, while Apple is the unknown entity as an in-between alternative with no obvious USP.
- Beyond the market leaders, a long tail of services will likely continue as complements to a broader business (such as HBO Go).
- The long-term outlook is towards a super-aggregator model. This could involve a hybrid build/buy approach (Netflix), pure aggregation (Amazon Channels), bundling discounts (Sky Ultimate On Demand) or a reorientation of media consumption on social networks (principally Facebook).

Cable, streaming bundle and mobile contract prices as % of household income in the US



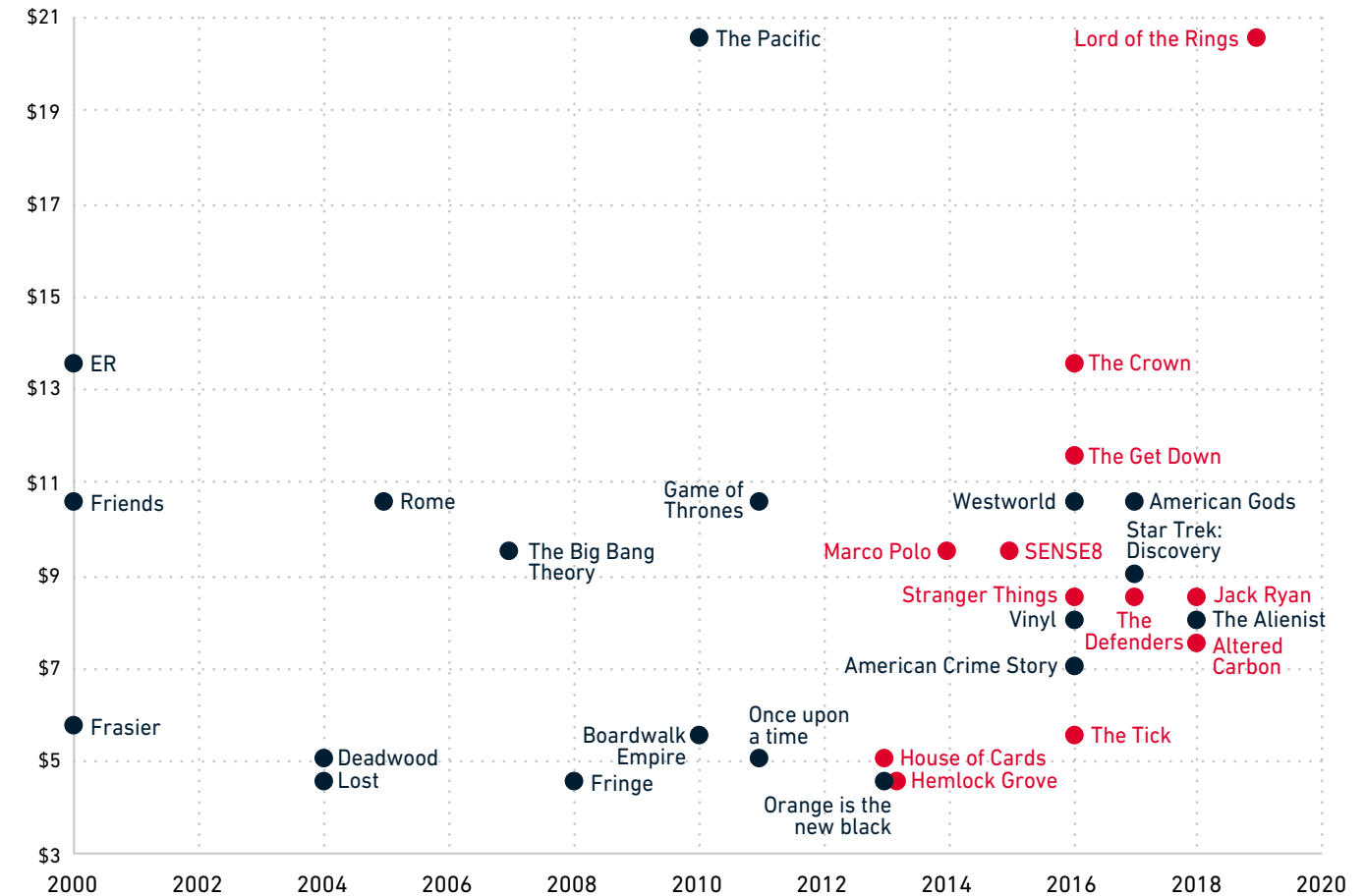
The streaming bundle includes Netflix, Amazon Prime, Hulu and Disney+. The monthly average cable bill figure used is \$107.

Content spend wars will drive consolidation

- Netflix and Amazon have had an indelible impact on content spend, with production budgets across the sector steadily rising since 2012.
- Part of this comes from more expensive shows (such as *The Crown*) and part from simply producing more of them to satisfy consumers' insatiable appetites.
- The plethora of niche offerings available has so far limited content spend as a barrier to entry for new platforms but this is not sustainable.
- Expect consolidation to a small number of high spending groups.

The world's most expensive TV shows

Cost per episode (\$m)

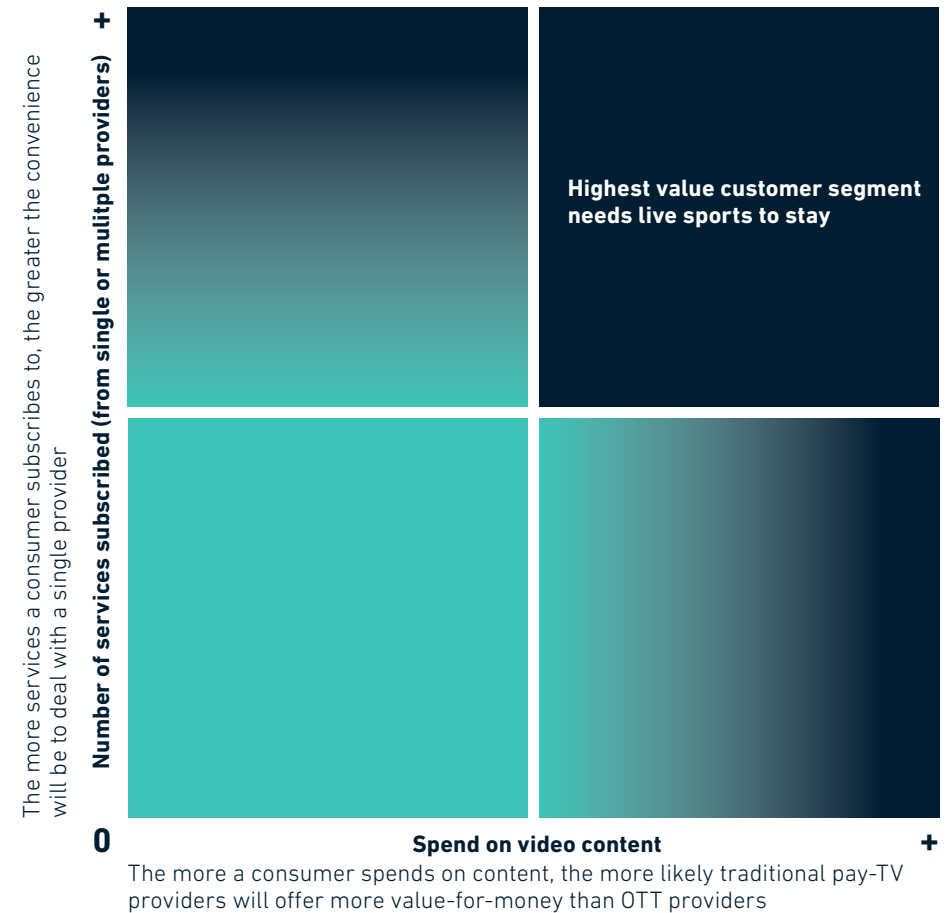


● OTTs (Netflix, Amazon) ● Networks (ABC, CBS, FOX, FX, HBO, NBC, Starz, TNT)

Pay TV's longevity depends on live sports

- The rise of streaming is undoubtedly a major part of the cord-cutting phenomenon that has eroded the legacy pay-TV base, especially in the US. However, the rate of loss has slowed, with the faithful largely made up of over 45s who are willing to pay the premium for a full-service TV package.
- Given the expansive libraries built up by Netflix, Amazon and Disney (to say nothing of others such as HBO) across multiple content segments, live sports is the last remaining bastion of defence for pay TV.
- In this sense, top-tier broadcasting rights are not only a cost of doing business; in many cases they are existential (would Sky Sports exist without English Premier League football?)
- The dilemma for sports leagues is how to protect their main revenue source (rights) while appealing to new audience segments that are primarily young, digital savvy and cable 'nevers'.
- So far, Amazon and Facebook have only dipped their toes in the water, but the long-term balance will shift in OTT's favour as rights packages are 'carved out' for digital-only distribution.
- Pay-TV providers aren't going anywhere but the long-term revenue growth picture is weak.

Preferred pay-TV provider, based on consumer profile



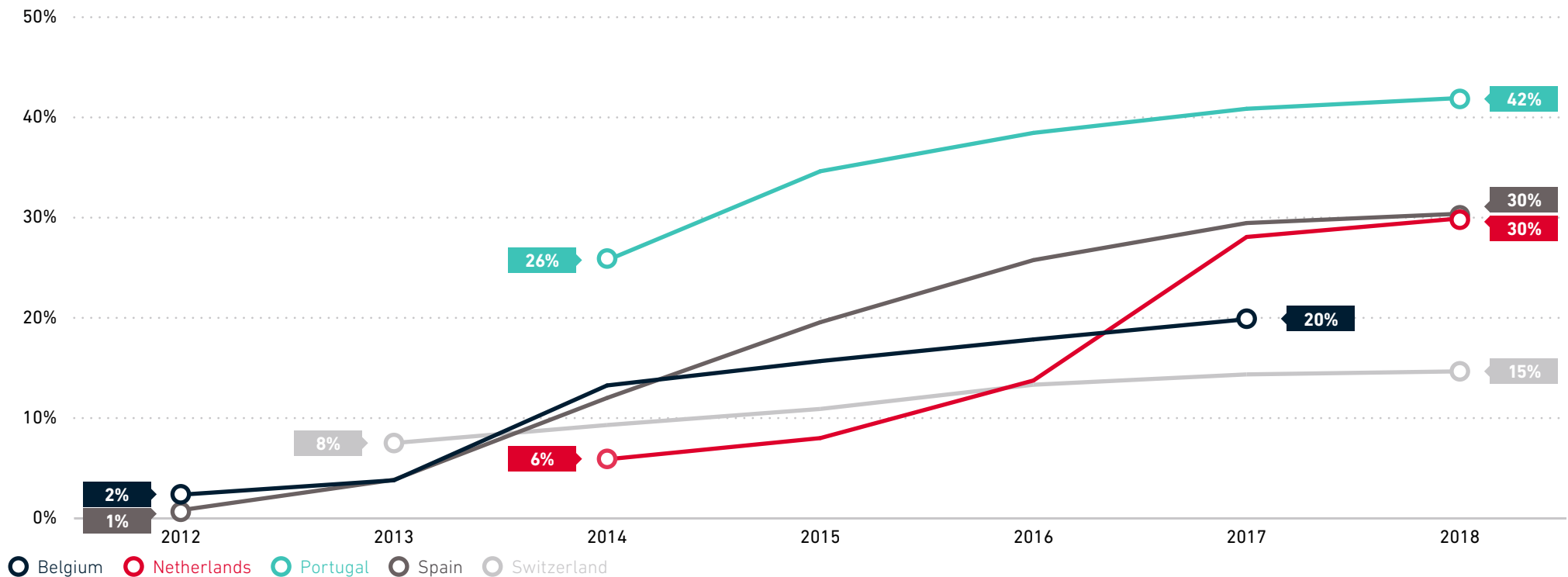
Preferred pay-TV provider: ■ OTT provider ■ Traditional pay-TV provider

For telcos, the coveted quad play has peaked

- Triple- and quad-play (which adds mobile) penetration rates appear to have plateaued around 30% in Western Europe, the region that has shown most customer affinity for such propositions. Other markets such as Australia and the US have lower penetration rates, in part because convergence has taken longer to be adopted as a strategy for telcos.
- The ready-made supply of streaming options is partly to blame, but more significantly operators have pulled back on discounts to drive take-up. Without a price incentive, consumers are loath to go through the hassle of cancelling subscriptions to put everything into one bundle.

Quad-play penetration in selected European markets

Percentage of households



Source GSMA Intelligence based on data reported by companies and regulators

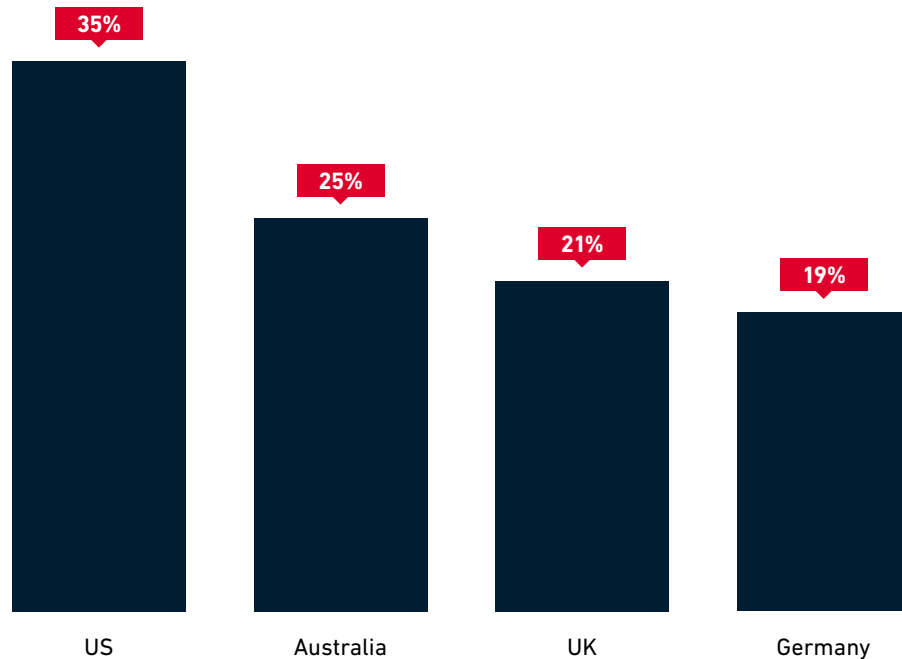
Partnering offers more flexibility

- Video streaming has become a key part of what people do on their smartphones. YouTube forged the path but the trend now is towards paid-for subscriptions. Over a third of mobile owners in the US have one, with other leading markets at around 25%.

- For telcos, the huge audience and content price inflation favour a licensing approach. Netflix remains king with 70% market share of mobile viewers in leading countries. Amazon is the global no.2, while Hulu is still popular in the US. YouTube's paid-for option (Premium) has yet to crack the mass market.

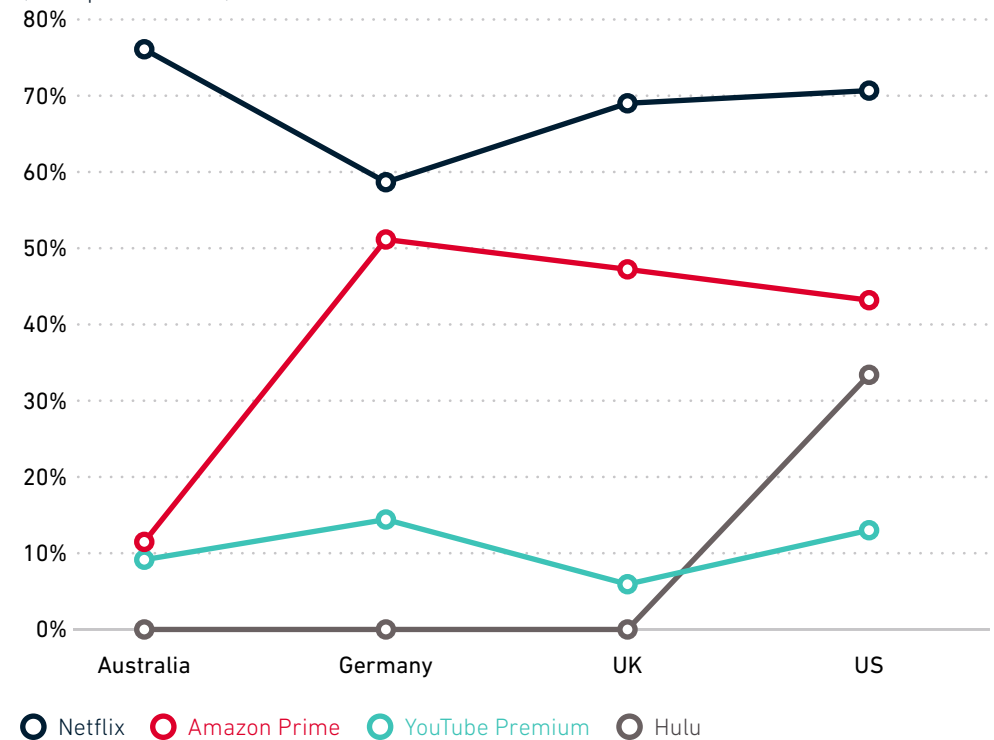
Subscribe to paid-for streaming services on mobile

Percentage of mobile phone owners that have a paid-for streaming subscription, 2019



Market share of streaming platforms

Share of paid-for streaming mobile users that subscribe to given platform (multiple answers)



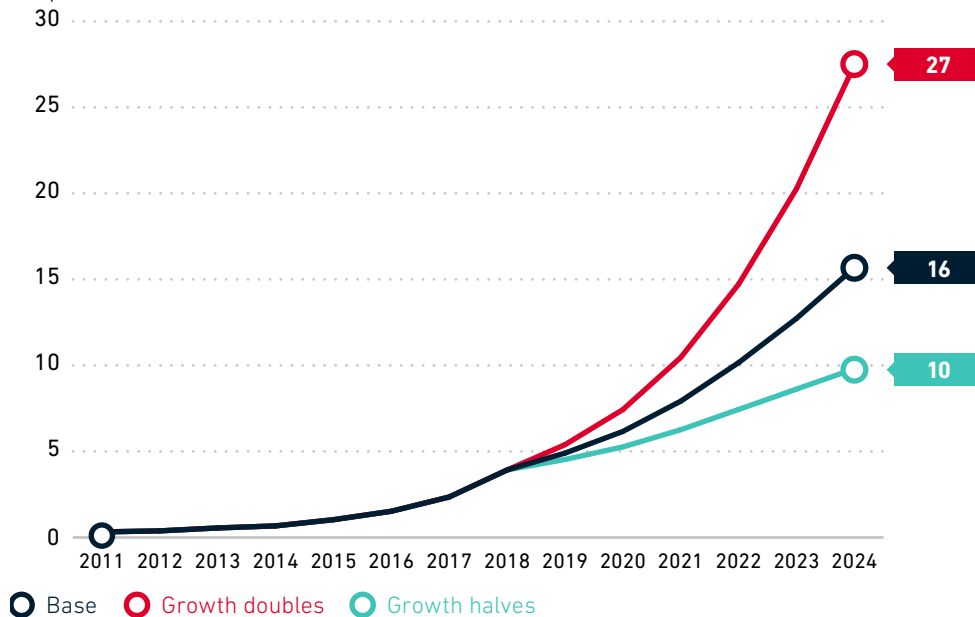
Absorbing video-driven traffic will be a key challenge in 5G

- Video has been the biggest driver of mobile data traffic growth in the smartphone era. This trend is expected to continue in the coming years as higher definition video streams on mobile devices.
- Based on Ericsson’s mobile data projections and GSMA Intelligence’s modelling for video usage on smartphones, mobile networks could carry four to eight times more data by 2025 than at the start of 2019.
- This presents clear capacity risks, particularly at peak hours. Additional 5G spectrum and refarming LTE holdings will need to complement network densification and multiple offload outlets (Wi-Fi and fixed) to cope.

Scenarios for mobile data traffic (2019–2024)

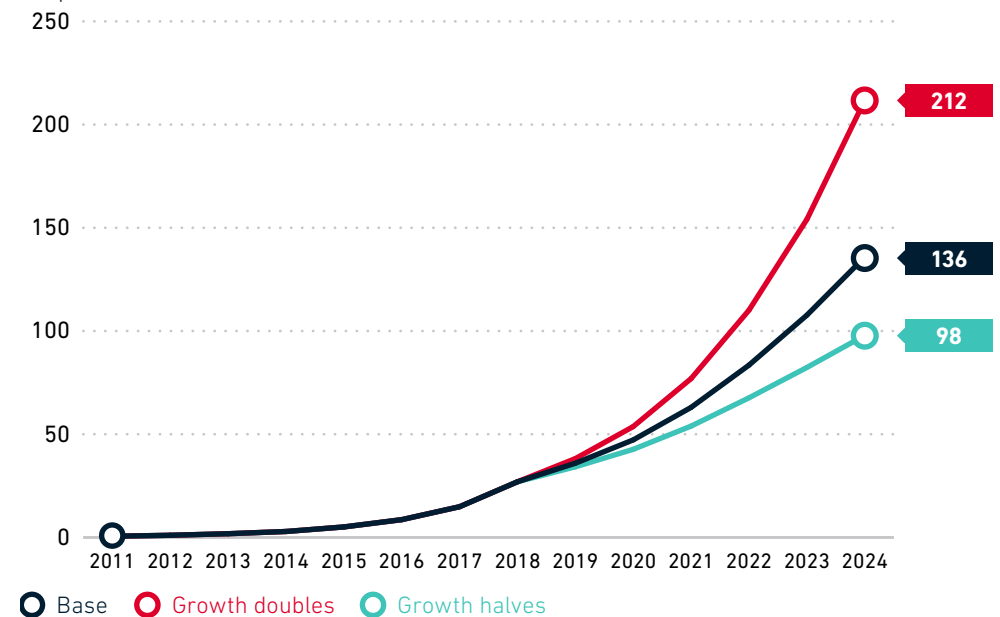
Mobile video data usage per smartphone connection

GB per month



Global mobile data usage

EB per month



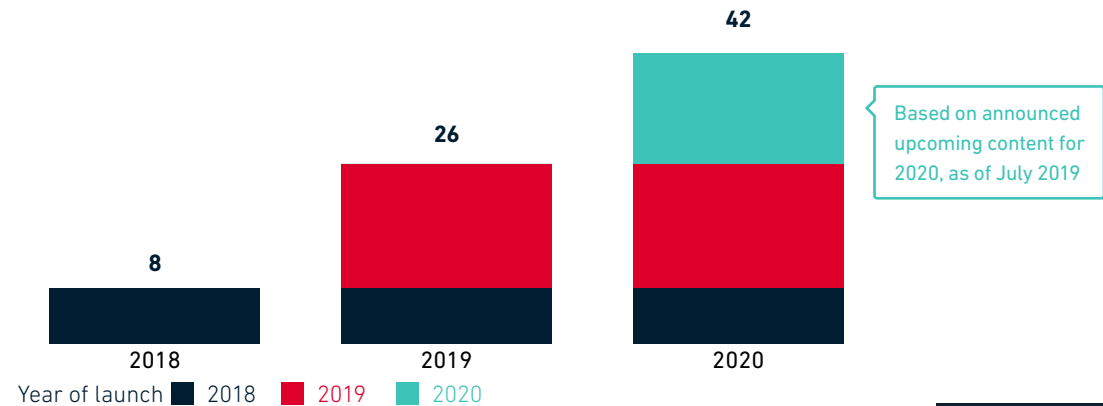
Source Ericsson, GSMA Intelligence. The base case is based on Ericsson data.

The increasing power of 'local' in non-English-speaking countries

- US content has helped streaming services such as Netflix establish a global presence. The next challenge for these services, which rely on subscriber scale, is to maintain high subscriber growth in their international markets.
- To tackle this challenge, local content will be a key if expensive tool. Netflix, for example, has more than doubled over the last year the number of originals it produces in the important Indian market.
- Distribution and pricing will also be key in cracking international markets. Adding subscribers in countries with low household disposable incomes, outside of their currently limited higher earning customer base, will require both pricing flexibility and creativity from the streaming services.
- Netflix again provides a good example of such an initiative through its recent launch of a much cheaper (by two thirds compared to the prior cheapest tariff), SD-only and mobile-only tariff in India. This latest tariff helps close the gap between spending on a discretionary service such as Netflix and an essential service such as mobile.

Netflix's original content for India

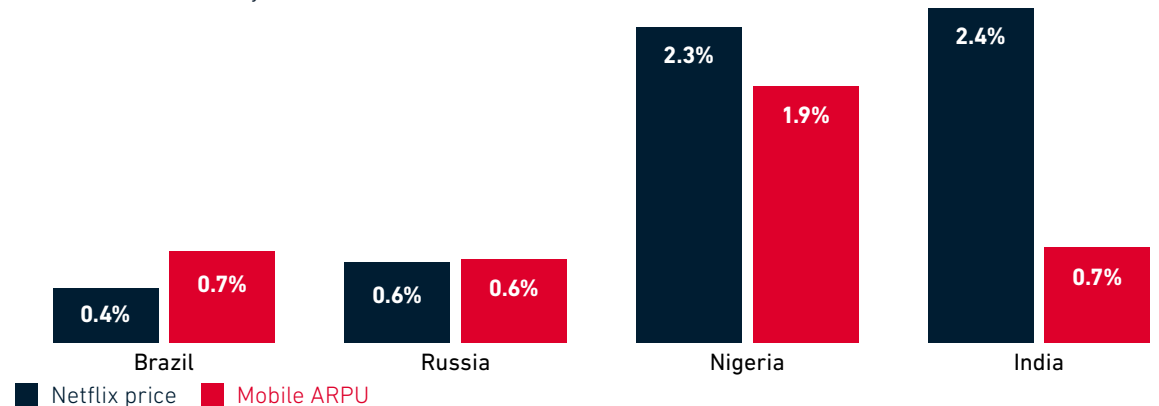
Library available per year split by year of content launch



Source Netflix, IMDb

Netflix versus mobile tariffs

As a share of monthly household income



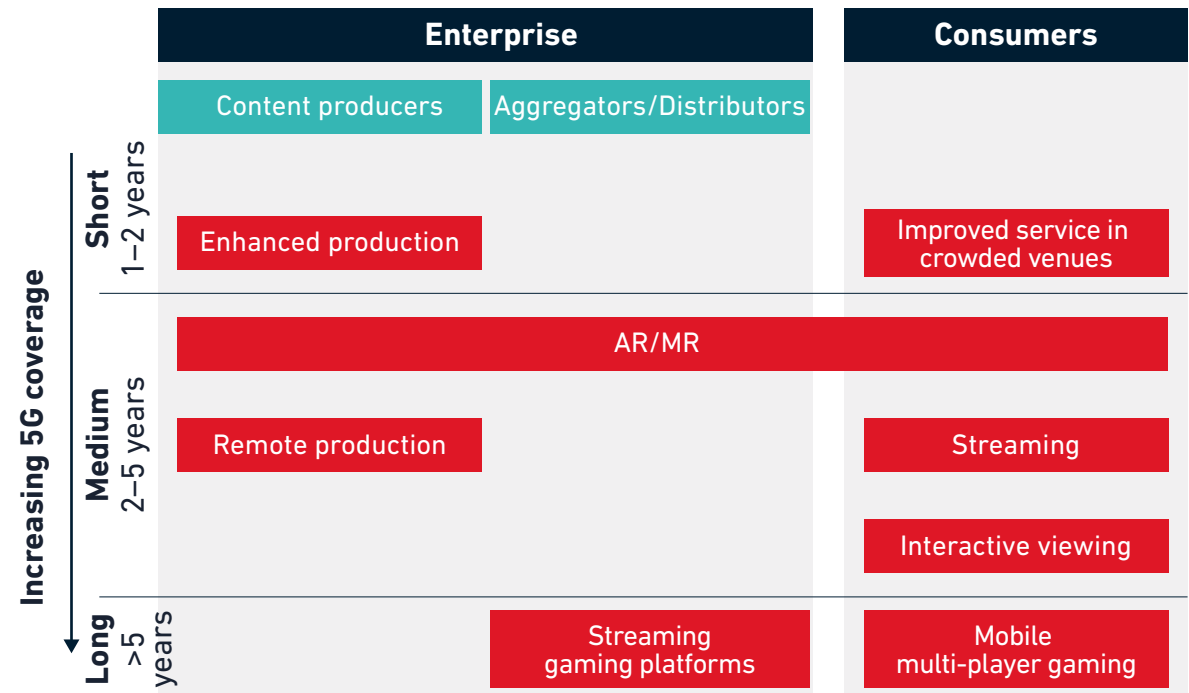
Source GSMA Intelligence, World Bank. Household income is based on World Bank GNI per capita with two earning people assumed in a household

How 5G changes the media landscape

- The media sector has two broad groups: content producers (such as production studios) and aggregators/distributors (such as broadcasters, OTT players and telcos).
- Broadcasters will be able to monetise richer content or offer it for free as a differentiator. Enhanced production can provide a new range of camera angles and event-related data. Investment will be required in user interfaces to allow users to access the new interactive features.
- Some telcos have already moved into live sports rights (BT, Telefonica, Verizon), though this has proven difficult to generate a return on. Selling 5G access wholesale to broadcasters (or to stadium operators to enhance the fan experience) makes more sense.
- Consumer apps using AR are a little further out, although glasses technology has advanced significantly and is likely to move faster still once 5G comes online with increased edge compute infrastructure.

5G's impact on the media value chain

Note: coverage timeline is indicative and will vary by country



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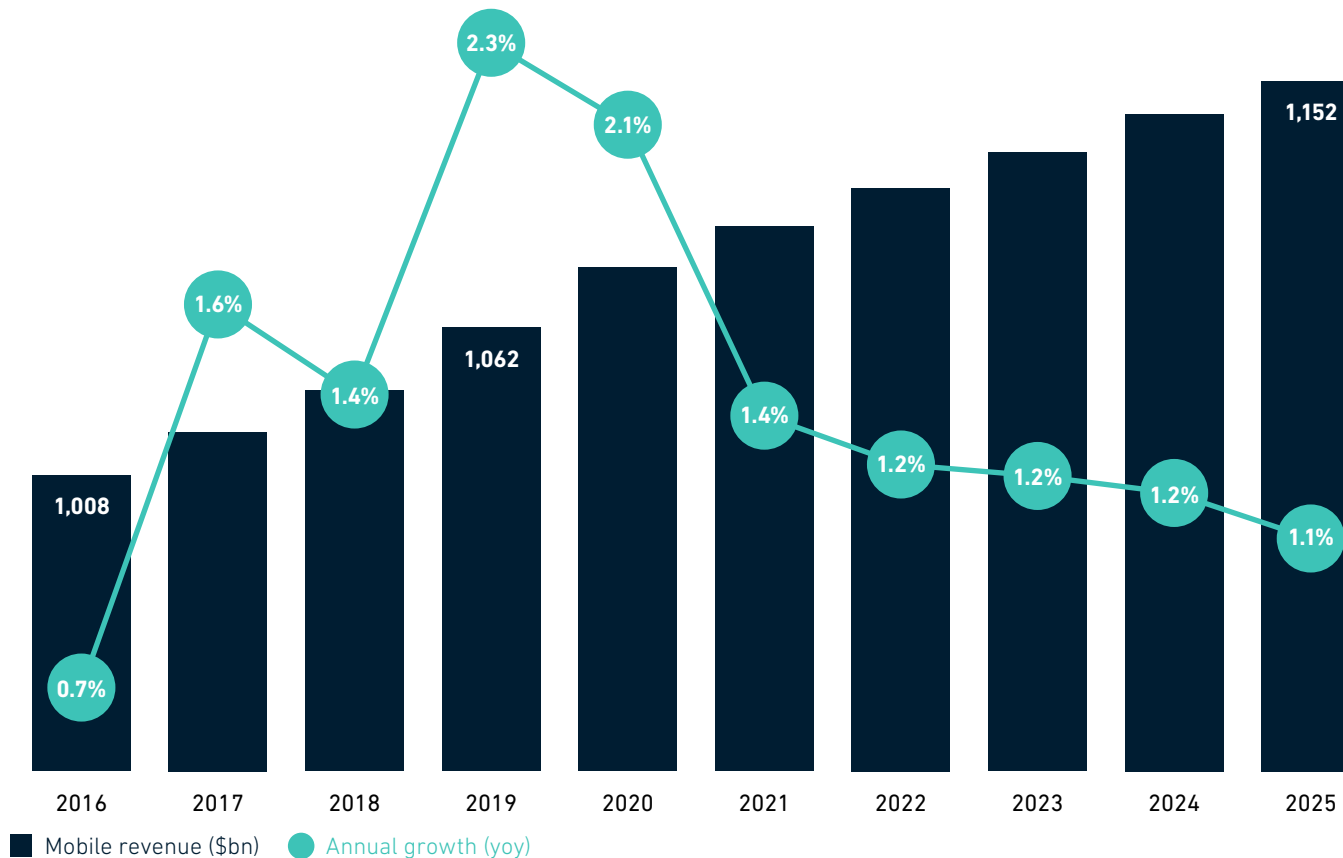
Regional outlooks

Financial performance

Telco growth prospects
and investment
projections

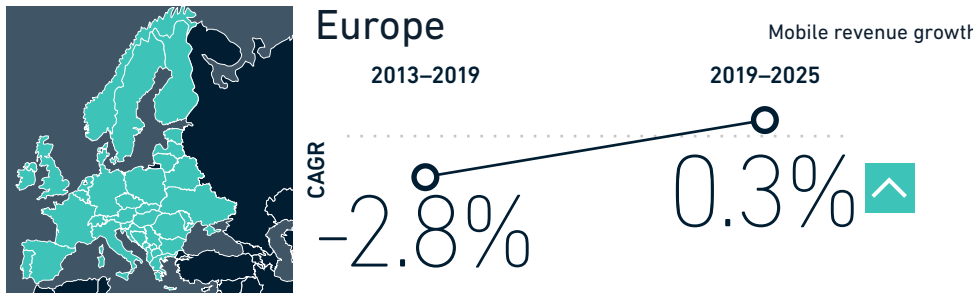
Global mobile revenue outlook remains stable, with potential 5G upside

Total global mobile revenue growth



- Total mobile revenues reached \$1.04 trillion in 2018, up 1.4% year-on-year. Following a further pick-up in 2019, growth will slow steadily to around 1% (real terms) growth to 2025.
- The recent uplift in growth reflects a stabilisation of pricing trends, including in Europe and India following consolidation moves, while data growth in emerging markets remains strong.
- Growth to 2025 includes a modest uplift from 5G launches and IoT services. Further upside depends on growing revenues in enterprise IoT segments and new 5G services that consumers are willing to pay more for.

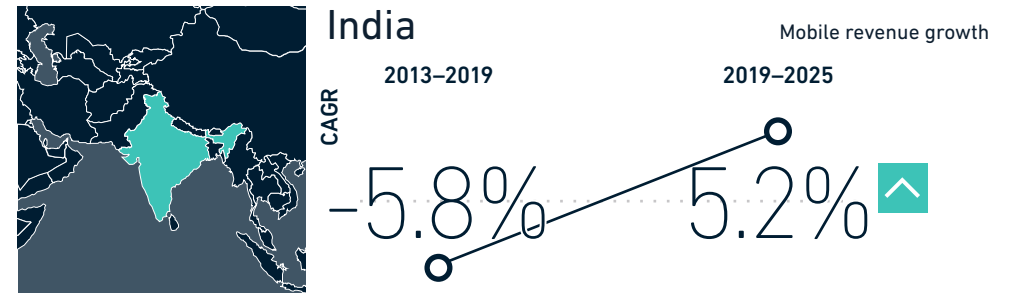
Europe and India: restabilising of operating environment



Key drivers

Competitive pressures are easing in Europe following recent consolidation moves and signs that price declines are slowing. Initial 5G launches are generally priced at a premium to 4G – a positive at least in the short term.

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

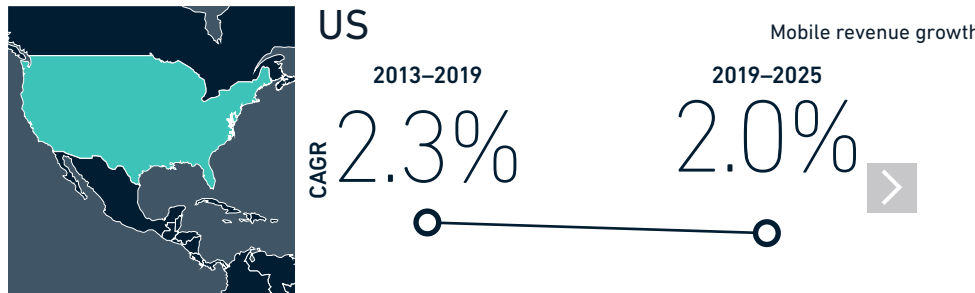


Key drivers

The Indian market is stabilising; Reliance Jio has reached critical mass (around 30% revenue share). Recent consolidation moves have transformed a once highly fragmented market, with three private sector players and one state-owned player.

We forecast an ARPU inflection point from Q4 2019, as competitive pressures ease and the full impact of mergers is felt. Growing 4G adoption is expected to drive higher data usage and improve the pricing power of operators, with data pricing already among the lowest in the world.

US and China: oiling the machines



Key drivers

Revenue trends are already improving in the US despite the still challenging dynamics around unlimited data plans. There are signs of ARPU improvement as users upgrade to premium plans/ additional features such as content bundles. The recently approved T-Mobile/ Sprint merger should help stabilise competitive pressure. New entrant Dish is unlikely to be a major disruptor, constrained by its MVNO terms and the need to deploy its own 5G network.

Further out, new revenue streams particularly around IoT (where connections are seeing strong growth) and 5G adoption (typically priced at a small premium to LTE) offer potential upside to existing forecasts.



Key drivers

A number of regulatory measures have affected revenue trends over the last year (such as the abolition of roaming in July 2018). Results in recent quarters show signs that mobile data growth is losing some of its momentum as a growth driver, with ongoing competitive pressures also a factor.

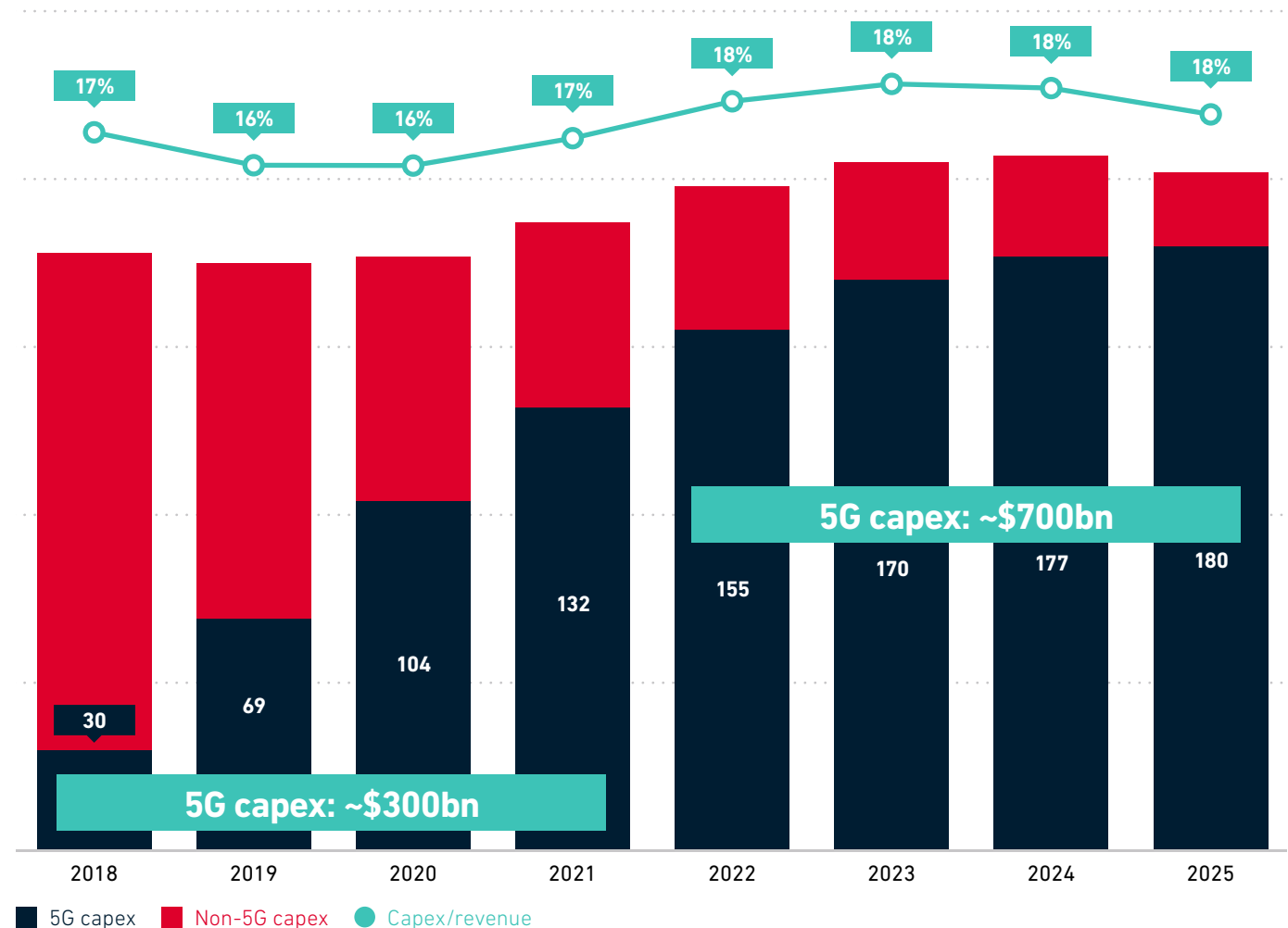
Full commercial launches of 5G in China are scheduled for the third quarter of 2019, with more widespread deployment expected over the course of 2020. At this stage, our forecasts include little uplift from 5G or new services. The issue of a 5G licence to China Broadcasting Network creates some medium-term uncertainties, depending on spectrum allocation and financial backing.

Operators will invest up to \$1 trillion in 5G networks

- Much of the 5G network investment to 2025 (\$700 billion) will be back-loaded, reflecting more targeted rollouts compared to 4G.
 - It will take longer to reach a given level of population coverage (40% in seven years versus five years for 4G).
 - The overall 5G network investment cycle will likely be longer than 4G.
 - Capex will grow post-2020 as we move into the 5G era, although capex/sales will remain in line with previous network investment cycles.
 - 4G and 5G networks will coexist and remain complementary into the 2030s.

Global mobile capex

\$ billion. Mobile capex excludes spectrum acquisitions.



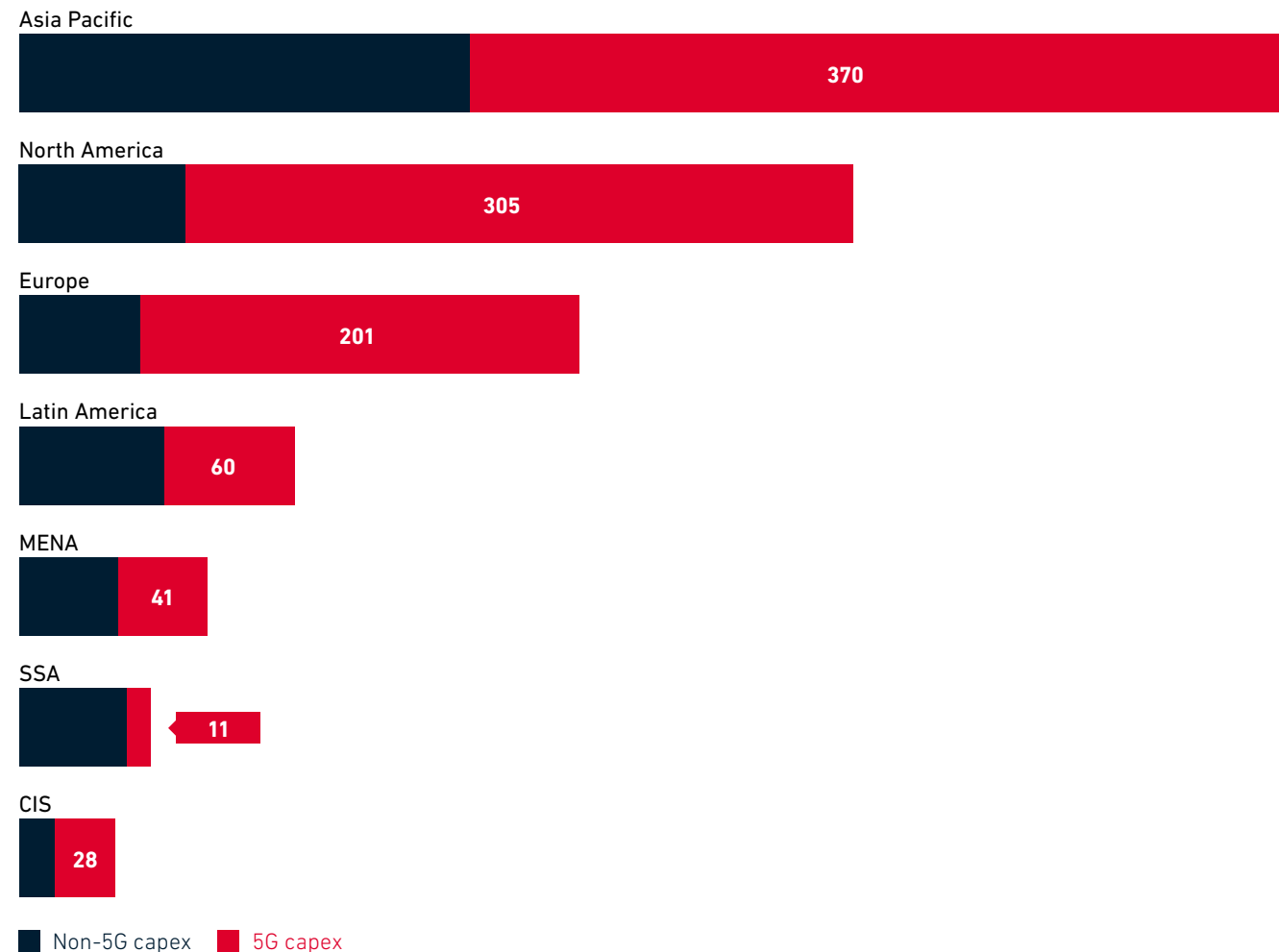
5G investment will happen in three broad waves

Looking out to 2025, 5G network investment can be divided into three main waves:

- **Wave 1: Early deployments 2018-2020** - China, US, South Korea and Japan dominate.
- **Wave 2: Ramp-up 2021-2023** - Europe accelerates, more than doubling its 5G capex (nearly \$100 billion in this phase).
- **Wave 3: Wider spread in 2024 and beyond** - 5G in Latin America, MENA, CIS and part of Africa.

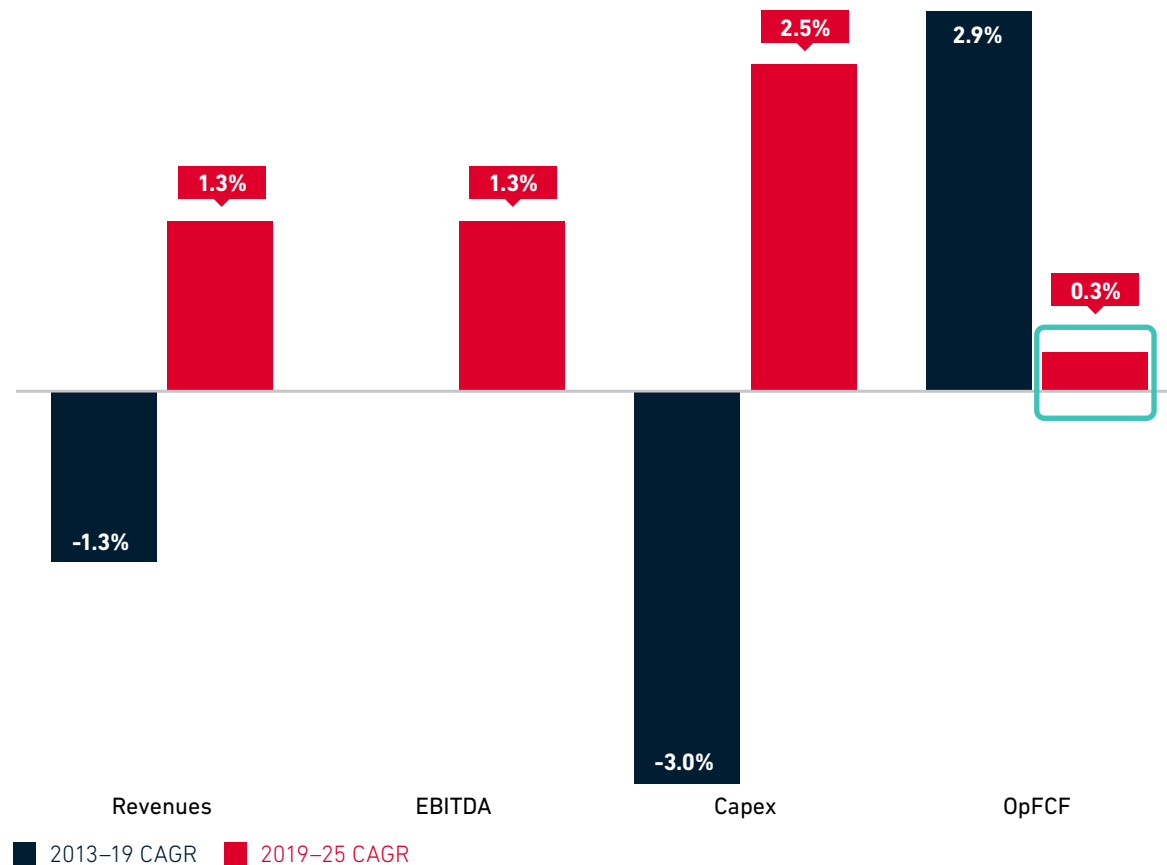
Capex by region

\$ billion, cumulative 2018-2025



Without new revenue growth, cashflow pressures will return

Outlook for telco key financial indicators

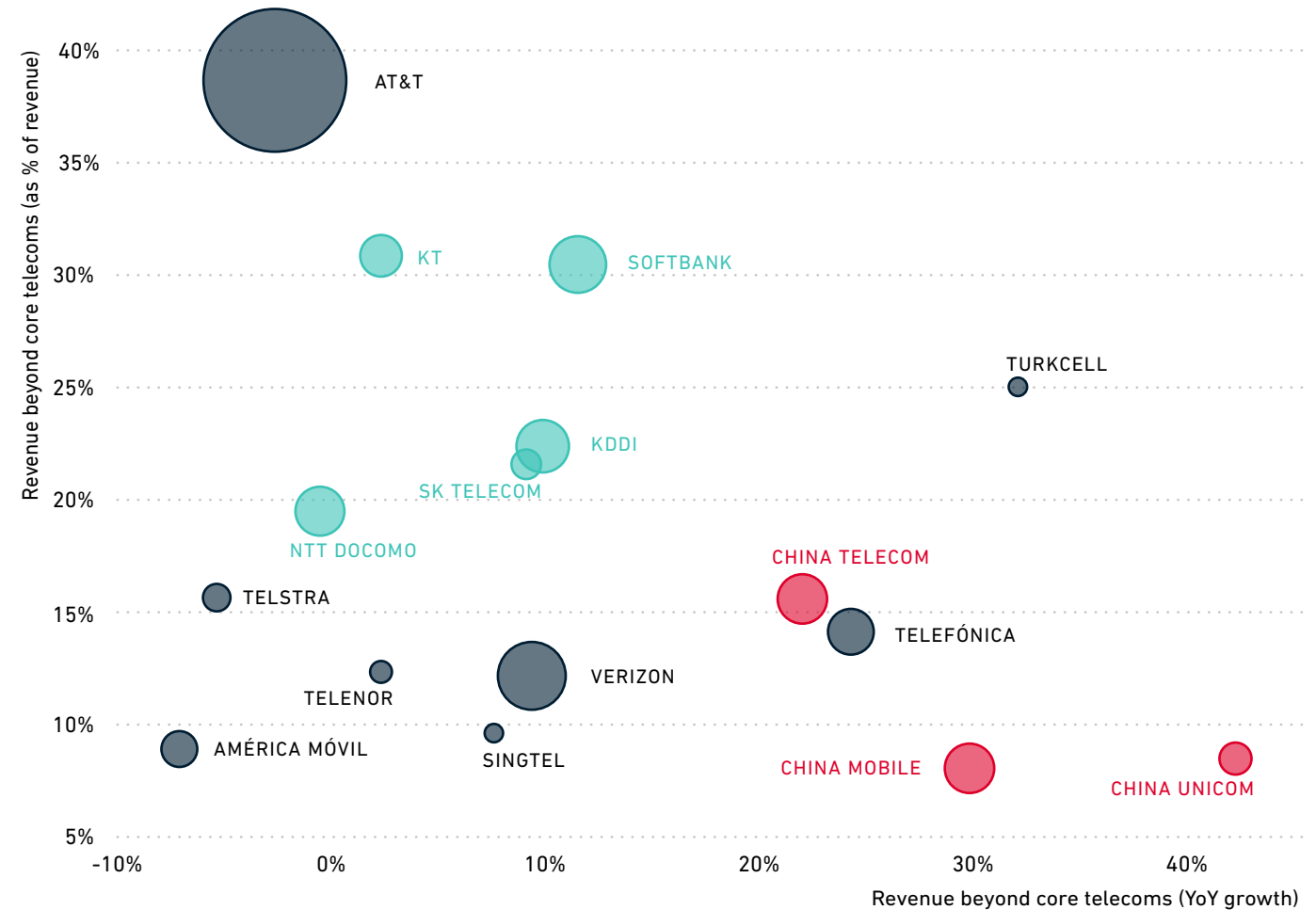


- In response to years of low revenue growth, operators have cut costs to preserve margins – and their dividends.
- The free cash that ultimately funds these has also benefitted from a relative lull in capex in 2017/2018, but this will reverse over the next five years as operators invest in 5G networks.
- The priority now is to establish meaningful revenues from new business areas to repay infrastructure investments, reduce the pressure to cut costs and ultimately revive the overall sector.
- Our current projection is for a modest increase in growth (1.3% per year out to 2025), reflecting LTE upgrades in emerging markets and 5G adoption in the US, China, Japan and Korea.
- Using 5G to sell into enterprises could deliver a step change to this outlook and is something that will be closely monitored.

The search continues for growth beyond connectivity

- Pay TV, standalone video streaming, advertising, IoT and enterprise services are the most common efforts among telcos, depending on country.
- The challenge is to build something big enough to move the overall dial. AT&T's purchase of Time Warner was a flagship moment but, given the high cost, an exception rather than the rule.
- For the largest operators, pay TV and non-connectivity services average 10-20% of total revenue. IoT, in gestation for 10 years, is at most 2% for the leaders (Vodafone and the Chinese operators).
- Using 5G and new edge infrastructure should help realise new enterprise IoT business, but the current figures underscore the scale of the challenge.

Revenue beyond core telecoms services, 2018*



Annual figures based on fiscal year reporting periods. For AT&T: 12 months to June 2019 (to reflect 100% of Warner Media, fully consolidated since Q3 2018). For SoftBank: SoftBank Corp. plus Yahoo Japan. * Bubble size reflects 2018 non-telecoms services revenue

GLOBAL MOBILE TRENDS
REGIONAL OUTLOOK



Europe

At a crossroads

US and Canada

China

India

Sub-Saharan Africa

Middle East and North Africa

Latin America



Smartphones

	2018	2025
Connections	489 million	570 million
Adoption rate	73%	83%



Unique subscribers

	2018	2025
Total	468 million	482 million
Penetration rate	86%	88%



Connections by technology

	2018	2025
2G	16%	1%
3G	34%	7%
4G	50%	61%
5G	—	31%



Operator total revenues

	2018	2025
	\$169 billion	\$173 billion
CAGR	0.3%	



Capex

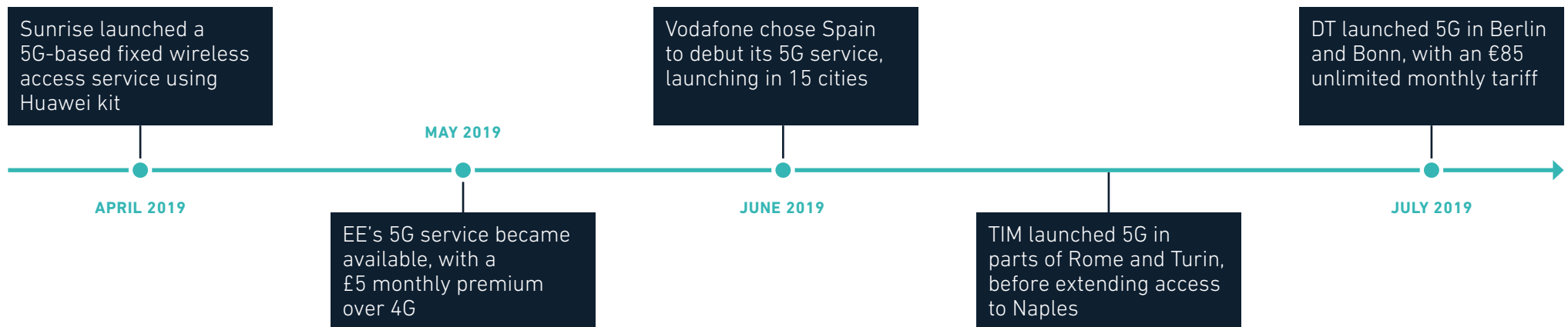
	2018	2025
	\$28 billion	\$34 billion
CAGR	2.8%	

Region's pioneers aim to keep pace with global 5G leaders

- A number of operators, including EE, Swisscom and Vodafone, have now launched mobile 5G services in Europe, typically beginning with larger urban centres such as London and Madrid. Adoption is at a nascent stage and is forecast to reach 30% of connections by 2025.
- Despite concerns around the financial burden on operators and the lack of 'killer' use cases, the 5G investment race has begun. Capex in Europe will accelerate in the post-2020 period, with 5G accounting for around 80% of total network investment between 2019 and 2025.
- Several operators are establishing or expanding network sharing agreements to expedite 5G rollout in a cost-effective way, with tower sales also in play.

Commercial 5G launches in Europe

to July 2019

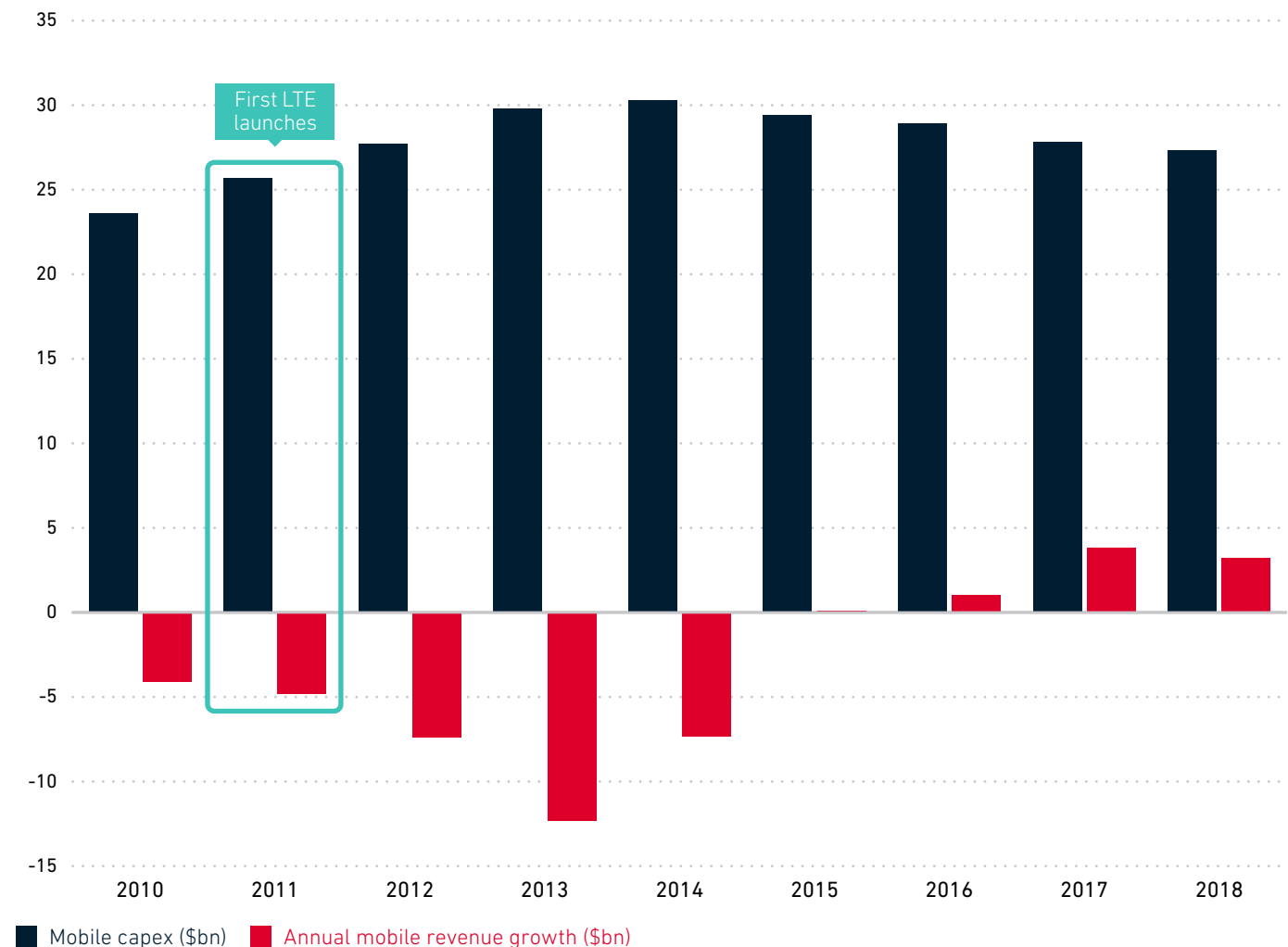


Still lots of 4G investment to recoup

- As consumer 5G becomes a reality, European mobile remains a competitive, low-growth environment, requiring operators to be measured and targeted in their investments to manage the capex/revenue ratio.
- European operators spent \$250 billion between 2010 and 2018 on 4G networks. While this was a cost of doing business, mobile revenues experienced a net decline of \$27 billion over the period.
- With some operators now waiving premiums for unlimited 5G tariffs, we forecast only a modest upward revenue trend to 2025.
- A significant potential benefit of 5G's enhanced capabilities is the opportunities for telcos across verticals, including healthcare, manufacturing and smart cities.
- In the Nordics, for example, operators, vendors and private firms have partnered to explore new industrial automation use cases underpinned by 5G networks.

Operators are still looking to recoup LTE investments

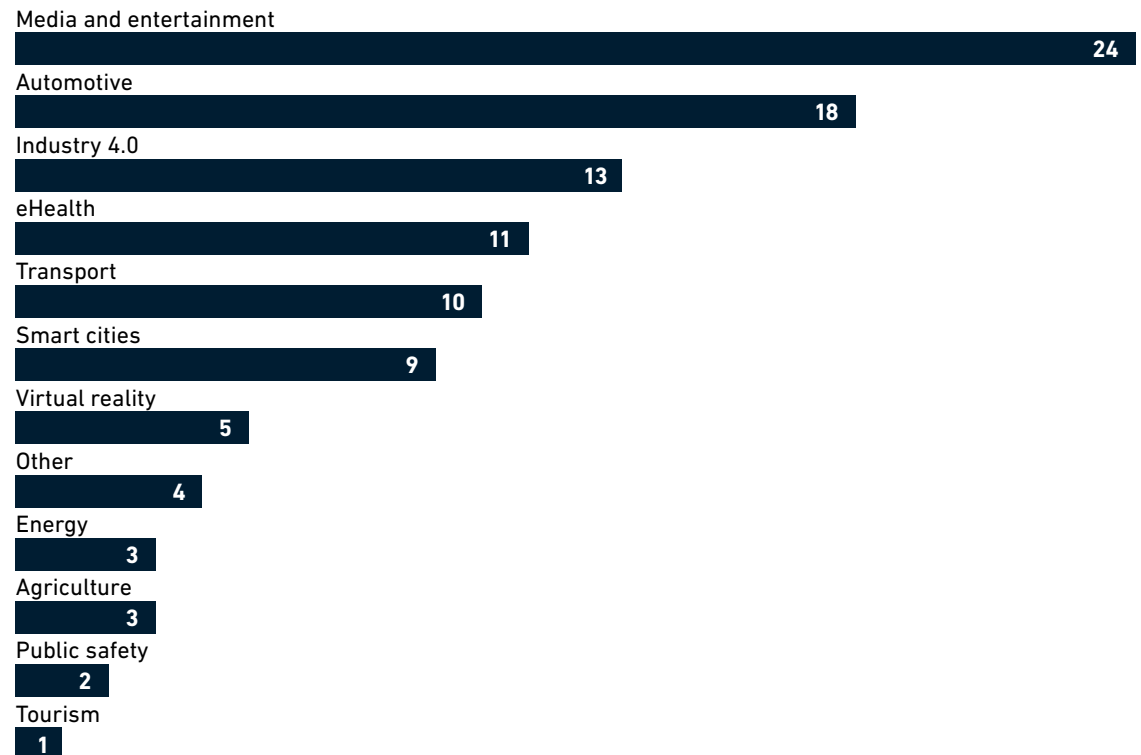
\$ billion. Note: Figures exclude spectrum auctions and licence fees.



Europe is seeking to re-establish lost technological leadership

- The European Commission is eager to spearhead the development of 5G and further industrial transformation, for example through the 5G Action Plan and Digital Europe project.
- The broader objective is to regain technological leadership ceded to the US and China over the last 10 years. However, business sentiment remains challenged by a combination of low growth, political uncertainty and stubbornly punitive regulation.
- Particularly on the enterprise side of 5G, policy making will need to become far more accommodative of new business models – such as those using slicing.
- Spectrum is the other crucial factor. Assignments of new spectrum earmarked for 5G are accelerating across the region, most often in the valuable 700 MHz and 3.5–3.7 GHz bands. However, pricing remains high in some countries (witness Italy) – good for government coffers but bad for long-term investment.

Media & entertainment and automotive represent over 40% of all vertical 5G trials in the EU



Spain has seen the most 5G trials, with the EU Top 5 accounting for 60% of the 153 conducted by the end of H1 2019.

GLOBAL MOBILE TRENDS
REGIONAL OUTLOOK



Europe

US and Canada

A new landscape just as 5G launches

China

India

Sub-Saharan Africa

Middle East and North Africa

Latin America



Smartphones

	2018	2025
Connections	326 million	394 million
Adoption rate	82%	90%



Unique subscribers

	2018	2025
Total	321 million	345 million
Penetration rate	83%	85%



Connections by technology

	2018	2025
2G	7%	2%
3G	19%	7%
4G	74%	45%
5G	—	46%



Operator total revenues

	2018	2025
	\$272 billion	\$317 billion
CAGR	2.2%	



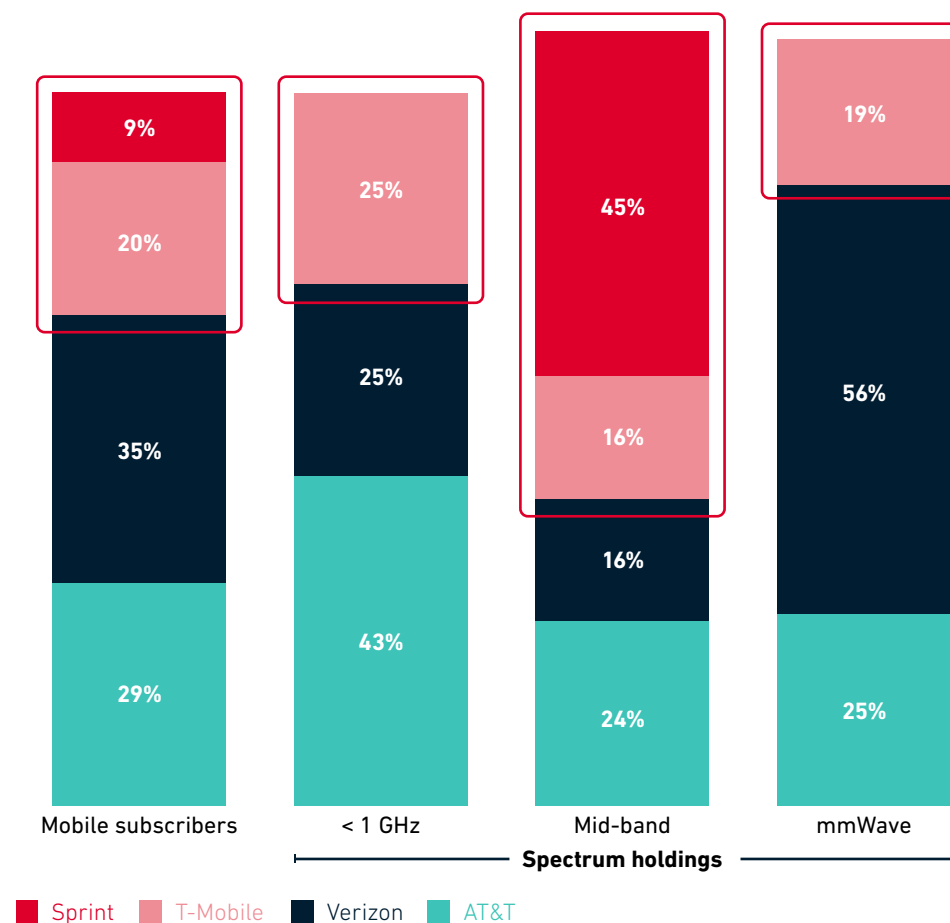
Capex

	2018	2025
	\$31 billion	\$51 billion
CAGR	7.4%	

New T-Mobile: a child born of 5G

- The recent merger approval of T-Mobile and Sprint will reshape US telecoms into a 30/30/30 market, with all to play for in 5G.
- For Sprint, the merger was a necessity for long-term survival, while T-Mobile's free cash flow margin of around 15% was still only half those of AT&T and Verizon. Without consolidation, T-Mobile would have taken many years to reach the scale of its rivals.
- Superior network coverage has always been at the heart of AT&T's and Verizon's marketing strategies. However, T-Mobile now has the subscriber scale – and spectrum – to threaten both.
- The merger also carries a number of remedies to ensure Dish can be a viable fourth national player. To finance its independent 5G network, Dish is likely to need an anchor tenant(s), either MVNOs or US tech giants (like Amazon) seeking to leverage new applications enabled by 5G.
- Interestingly, the DoJ has also required the new entity to support eSIM smartphones on its network, which will provide further competitive pressure given that consumers can more easily switch providers.

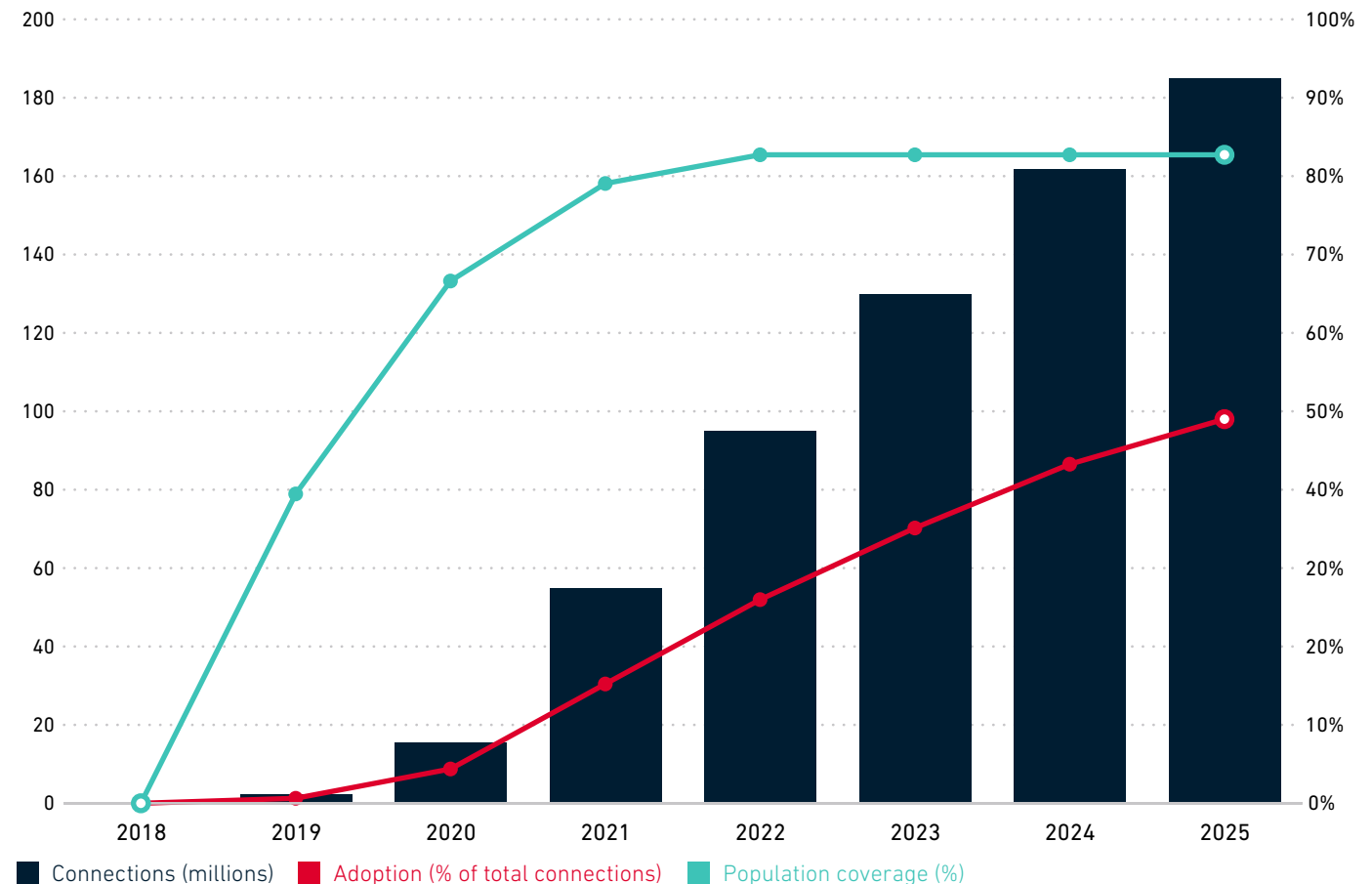
The US becomes a 30/30/30 market



5G adoption will be gradual, with an initial focus on mmWave deployments

- With mmWave's weak signal propagation, 5G deployments in the US have been limited so far to pockets of urban areas requiring additional capacity and faster speeds. To work at scale, mmWave needs a very high density of small cells, which will take significant amounts of capex and time.
- US 5G adoption will accelerate in 2020 and beyond, as operators expand coverage using sub-6 GHz bands. As well as refarming existing spectrum for 5G, new techniques such as dynamic spectrum allocation should help balance 4G and 5G bandwidth.
- Intensified competition could stimulate adoption beyond current forecasts. Our expectation is that most operators will price 5G at a small premium to LTE, but this could change if T-Mobile seeks to amplify its disruptor image post-merger.

US operators will use low and mid-band spectrum to accelerate 5G coverage

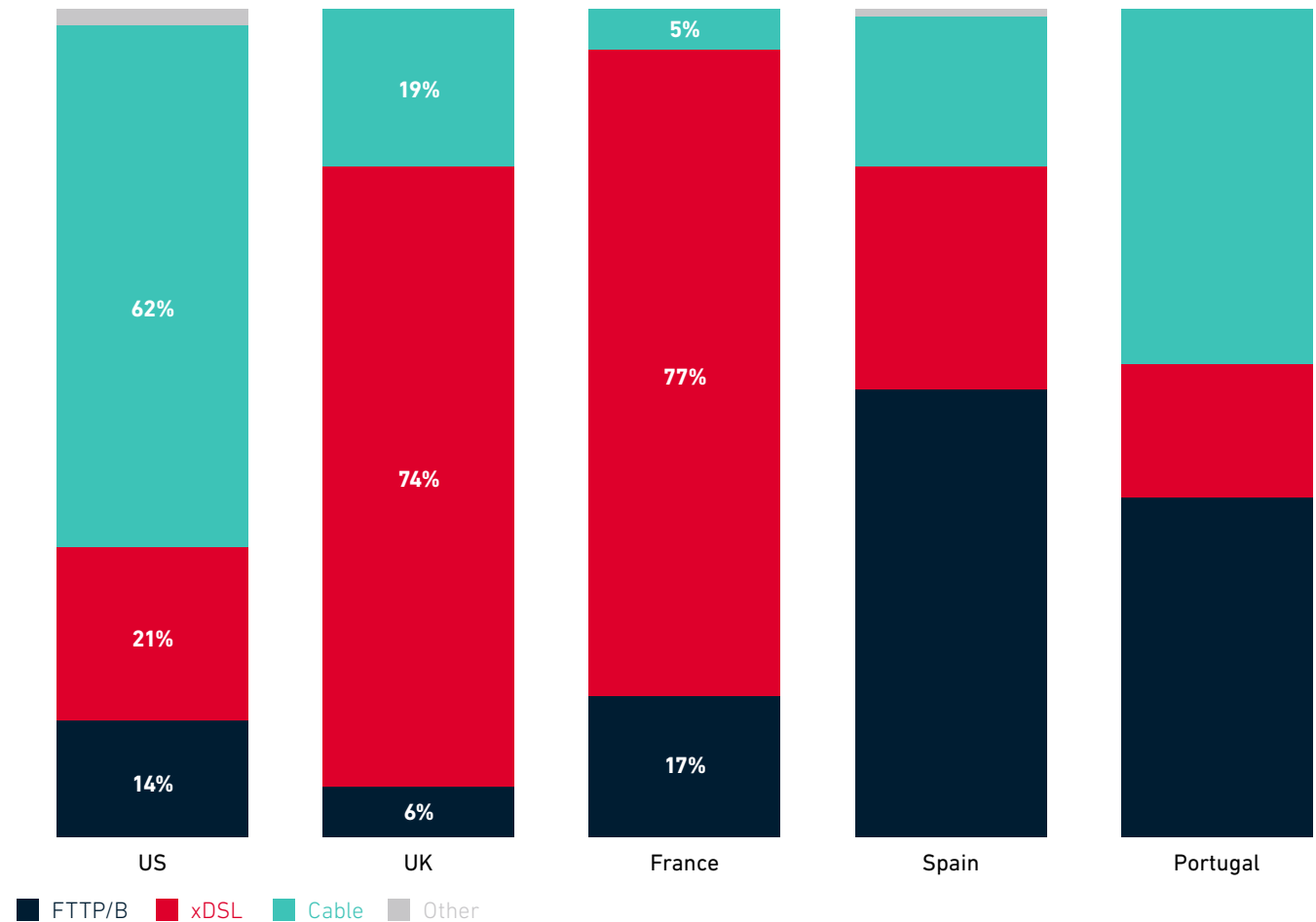


5G-based fixed wireless faces challenging economics

- In October 2018, Verizon became the first operator in the world to commercially launch 5G as a last-mile technology to provide fixed wireless access (FWA). Its strategy is to target households on DSL seeking to upgrade or to win customers away from Comcast, Charter and AT&T.
- Whereas Verizon’s FWA rollout will use mmWave, T-Mobile’s FWA strategy relies on 2.5 GHz spectrum. This reduces the need to deploy additional small cells, helping improve the FWA business case, particularly in rural areas.
- The challenge for US operators when deploying FWA is to devote sufficient spectrum bandwidth to deliver speeds that would rival cable/fibre – the gold standard. We expect a minimal FWA impact.

5G FWA will be offered as a competitive alternative to cable in the US

Percentage of fixed broadband connections (Q4 2018), residential and business



GLOBAL MOBILE TRENDS
REGIONAL OUTLOOK



Europe

US and Canada

China

Coveting global leadership

India

Sub-Saharan Africa

Middle East and North Africa

Latin America



Smartphones

	2018	2025
Connections	1.09 billion	1.51 billion
Adoption rate	69%	88%



Unique subscribers

	2018	2025
Total	1.17 billion	1.24 billion
Penetration rate	81%	85%



Connections by technology

	2018	2025
2G	16%	0%
3G	7%	0%
4G	76%	64%
5G	—	36%



Operator total revenues

	2018	2025
	\$182 billion	\$194 billion
CAGR	0.9%	



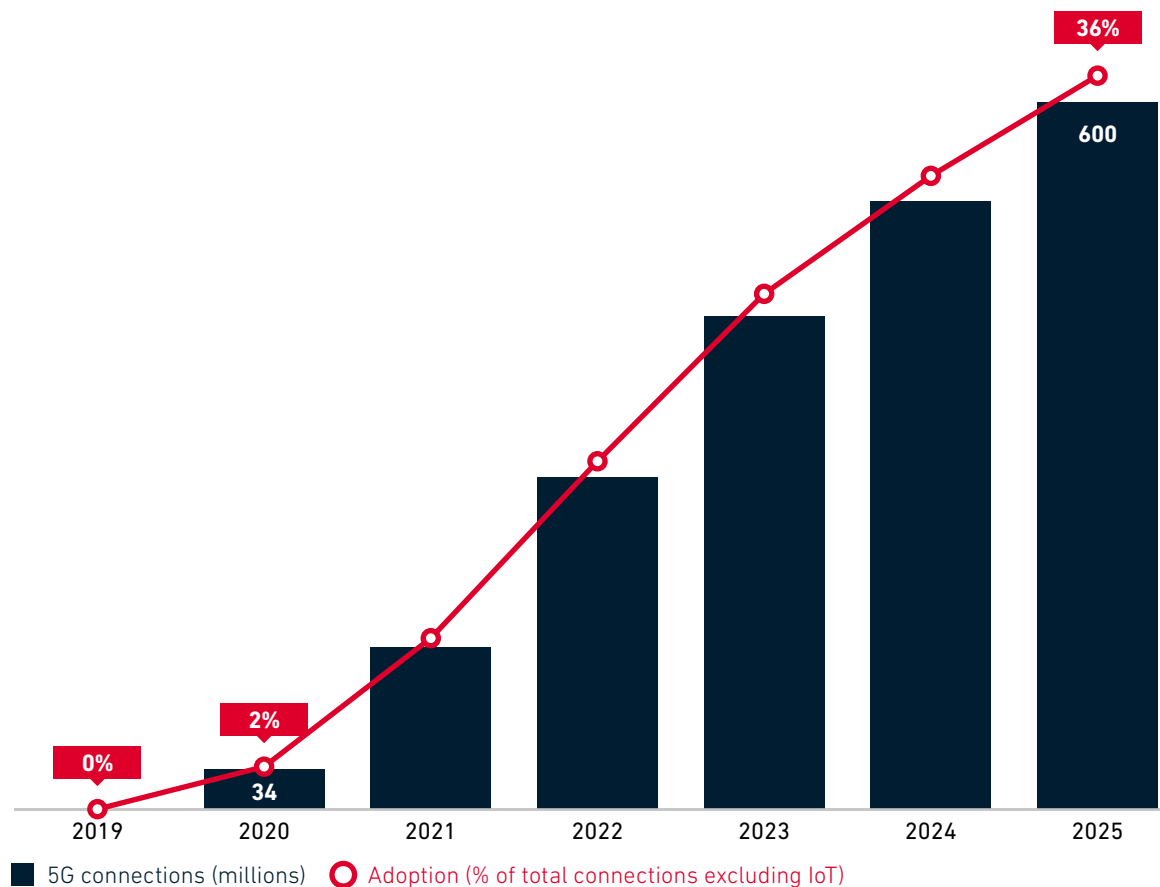
Capex

	2018	2025
	\$34 billion	\$34 billion
CAGR	0.1%	

Full steam ahead for 5G

- Following the award of commercial licences, the three incumbent operators are moving ahead with 5G deployments. China Mobile plans to launch 5G in 50 cities by the end of 2019.
- One of the major distinguishing factors between Chinese operators and those in the rest of the world is an intention to deploy brand new standalone 5G networks. The high cost underlines China's seriousness about paying whatever it takes for the gold standard.
- The issuance of a 5G licence to China Broadcasting Network creates some medium-term competitive uncertainties, depending on spectrum allocation and financial backing.
- China will account for by far the largest number of 5G connections in 2025, greater than North America and Europe combined. China is forecast to reach 600 million 5G connections by the end of 2025, equivalent to 36% of total connections.

5G in China

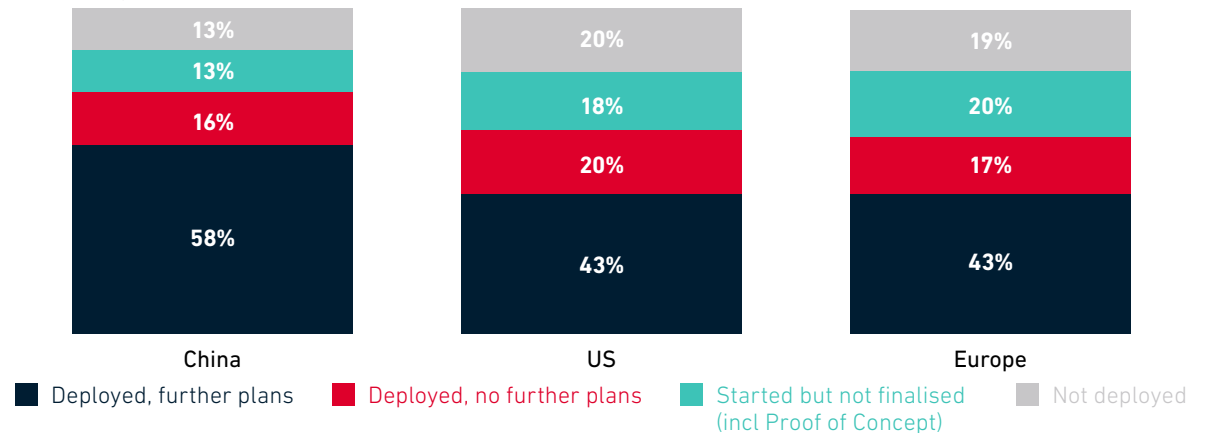


China at the forefront of IoT deployments, but where is the money?

- China has the highest rate of enterprise IoT deployments globally. Around three quarters of Chinese companies have already deployed IoT, of which 80% plan to deploy more in the future
- That the gulf exists in every vertical is testament to the political will – and investment – for China to cement its position as a global leader in advanced technology and manufacturing.
- Installing adequate security is a particular challenge. Paradoxically, because devices are so cheap, security represents a higher share of the total cost of ownership. Conforming to stringent regulations is also a factor.
- Enterprise demand has made IoT a priority for the Chinese mobile operators. IoT revenues have only reached 0.5–1% of group revenues. IoT is still too small to drive overall growth. However, the demand pipeline and infrastructure readiness mean operators should grow enterprise revenues significantly in the coming five years.

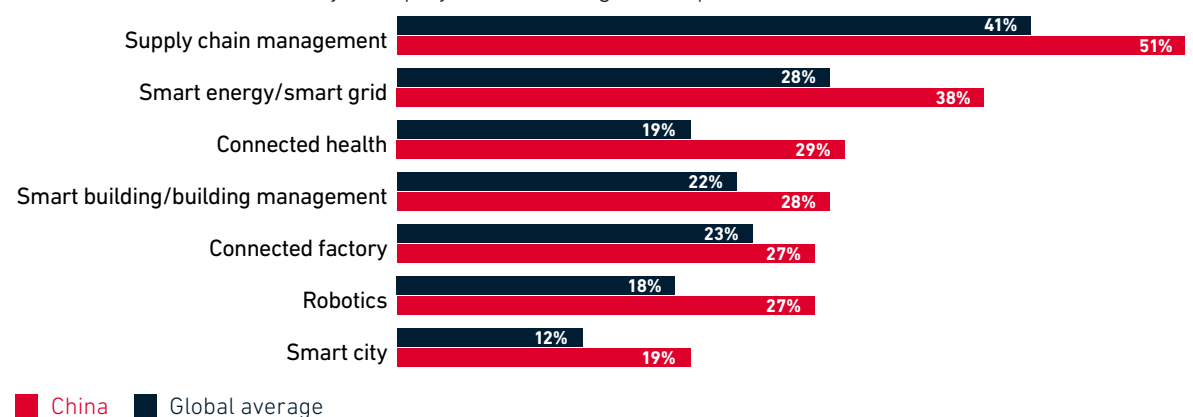
Chinese enterprises are surging ahead with IoT

Percentage of respondents



Certain use cases are particularly popular in China

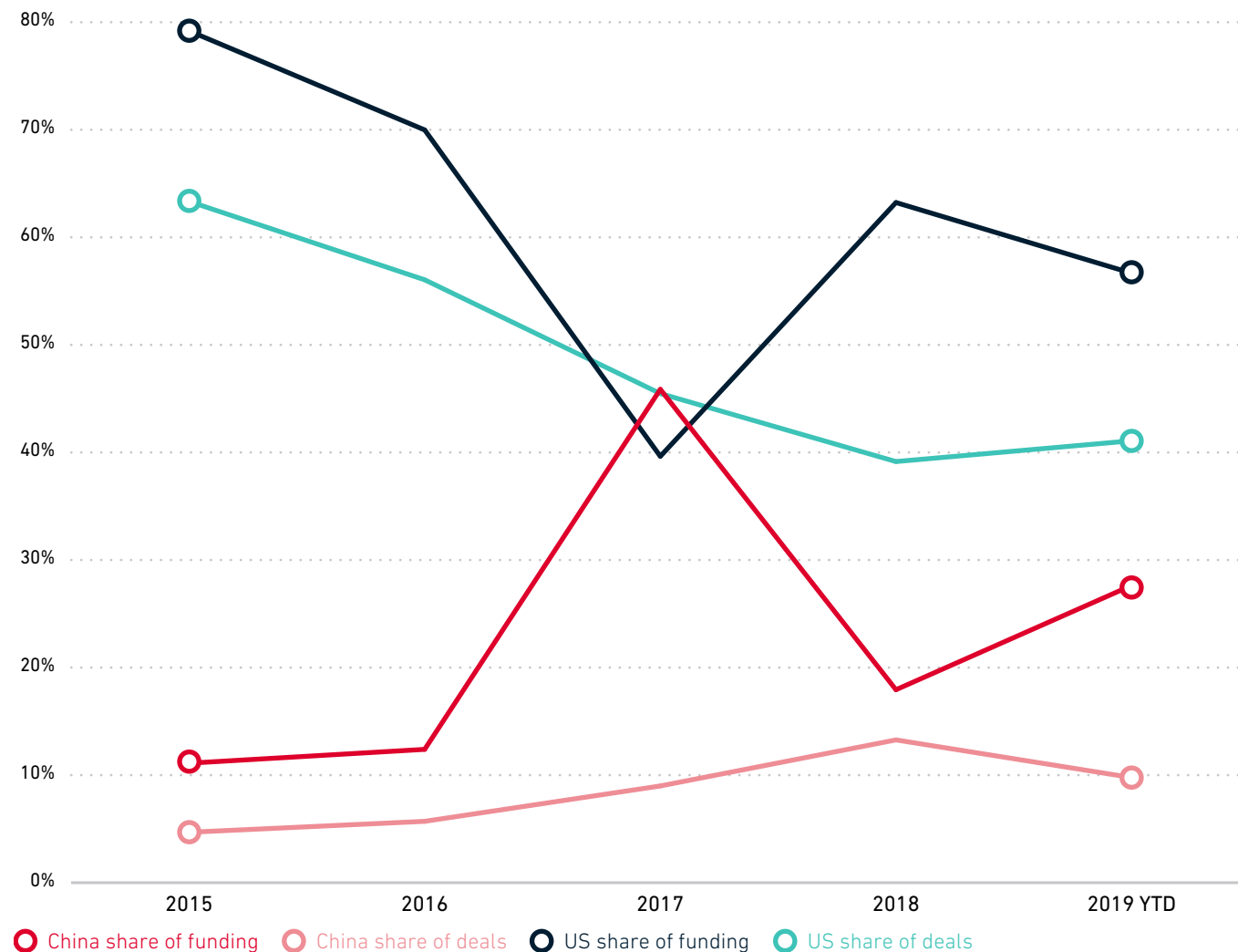
Q. Which IoT solutions have you deployed? Percentage of respondents



A flourishing ecosystem asserts China's AI dominance

- In July 2017, China's government announced its intention to become the world leader in AI by 2030, investing heavily in research and private industry.
- All major players, including the operators and tech giants, are committed to driving AI forward.
- Investment in start-ups has also flooded in: in 2017, China overtook the US as the global leader in AI funding, accounting for just under half of total capital raised.
- From a telco perspective, operators are using AI for network optimisation and maintenance. However, as the technology develops, it will likely expand into other areas such as billing, customer support and advertising, eventually reaching the holy grail of a fully autonomous network.

China's AI peak: missed opportunity, or a sign of things to come?



GLOBAL MOBILE TRENDS
REGIONAL OUTLOOK



Europe

US and Canada

China

India

Mobile internet growth

Sub-Saharan Africa

Middle East and North Africa

Latin America



Smartphones

	2018	2025
Connections	613 million	1,015 million
Adoption rate	57%	84%



Unique subscribers

	2018	2025
Total	747 million	914 million
Penetration rate	55%	63%



Connections by technology

	2018	2025
2G	45%	8%
3G	16%	5%
4G	39%	80%
5G	—	7%



Operator total revenues

	2018	2025
	\$21 billion	\$27 billion
CAGR		4.9%



Capex

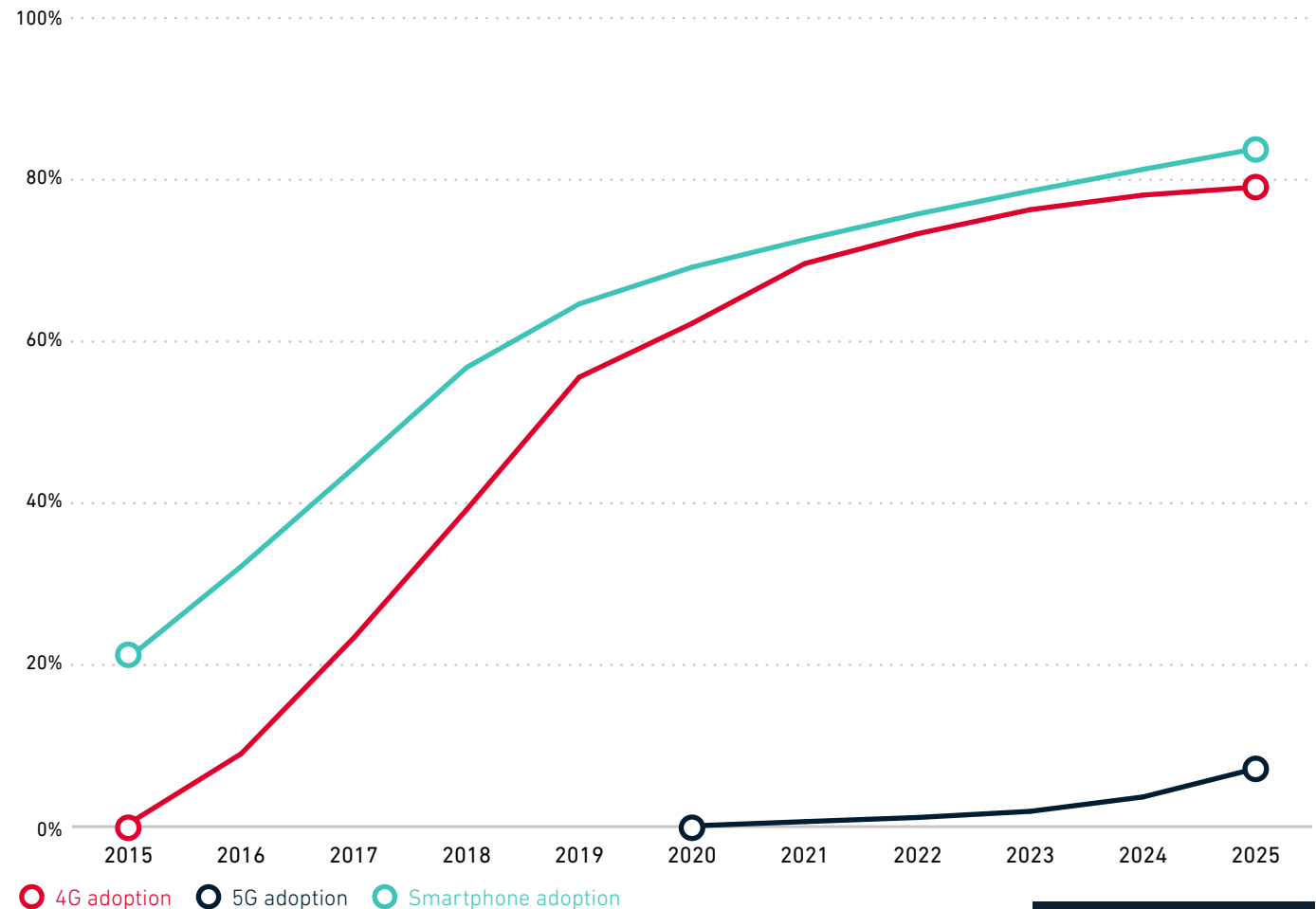
	2018	2025
	\$7.2 billion	\$5.5 billion
CAGR		-3.7%

India is poised to become the second largest smartphone market by 2025

- The entry of Reliance Jio triggered a rapid acceleration of 4G adoption, driven by zero-premium 4G tariff plans, cheap 4G featurephones (under \$30) and increased handset availability from regional vendors.
- Extrapolating forward, India will be the world's second largest smartphone market with an installed base of over 1 billion devices by 2025.
- The Indian government is targeting the commercial launch of 5G services in 2020, with spectrum auctions due in late 2019. However, adoption is expected to be slow at only 7% of the mobile base by 2025.

5G adoption is expected to have a slow start in India

Percentage of connections



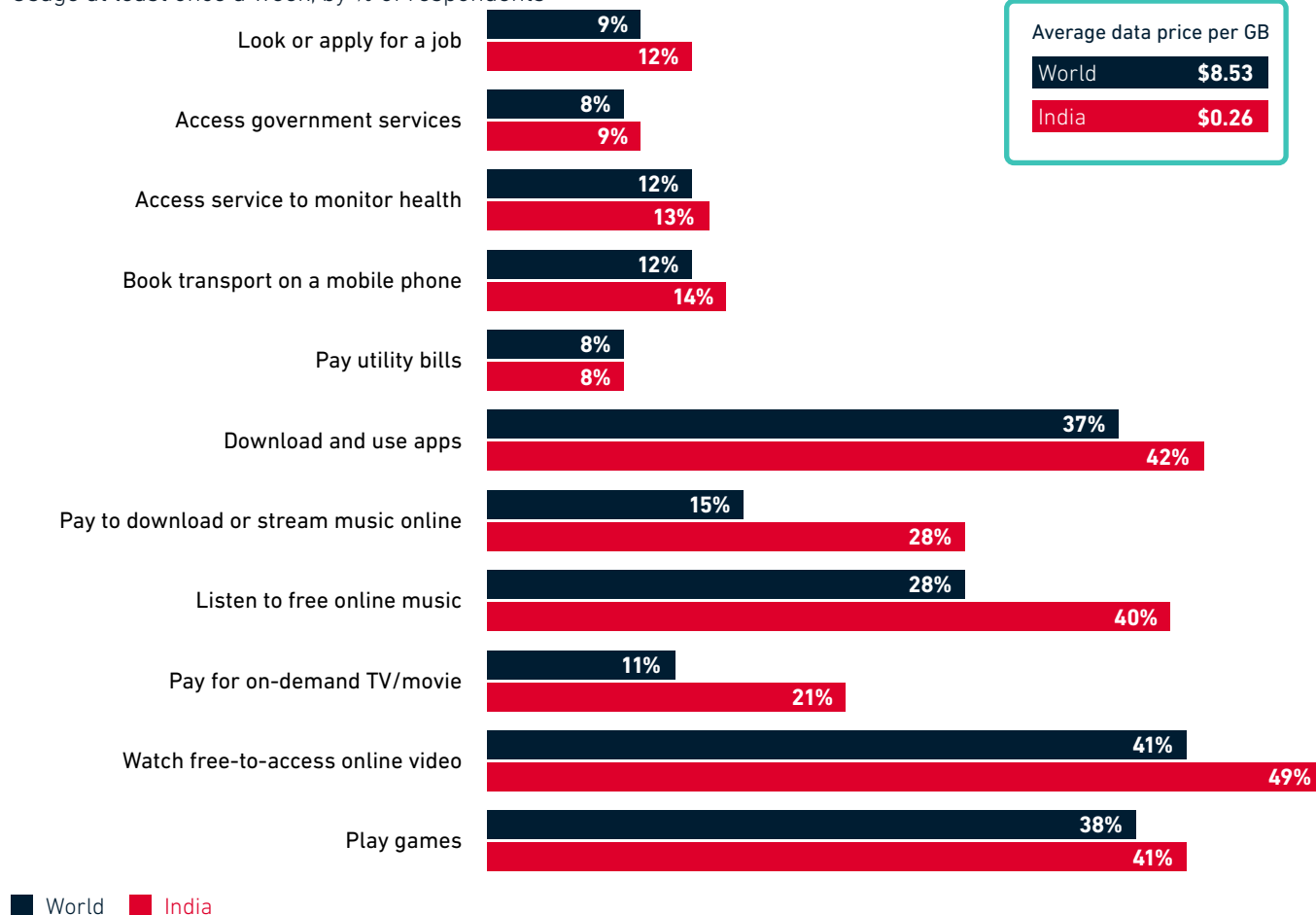
Cheap data has fuelled an internet binge

- India has some of the cheapest mobile data pricing in the world, driving high levels of data consumption.
- An average user in India now spends more than 17 hours per week on social media, higher than in the US and China.
- The government’s flagship biometric passport (Aadhaar*) has also helped drive public service access from smartphones.

* Aadhaar is a 12-digit unique identification number issued by the Indian government to every individual resident of India. It is instrumental in electronic verification to enable digital services

Comparison of smartphone usage between India and the world

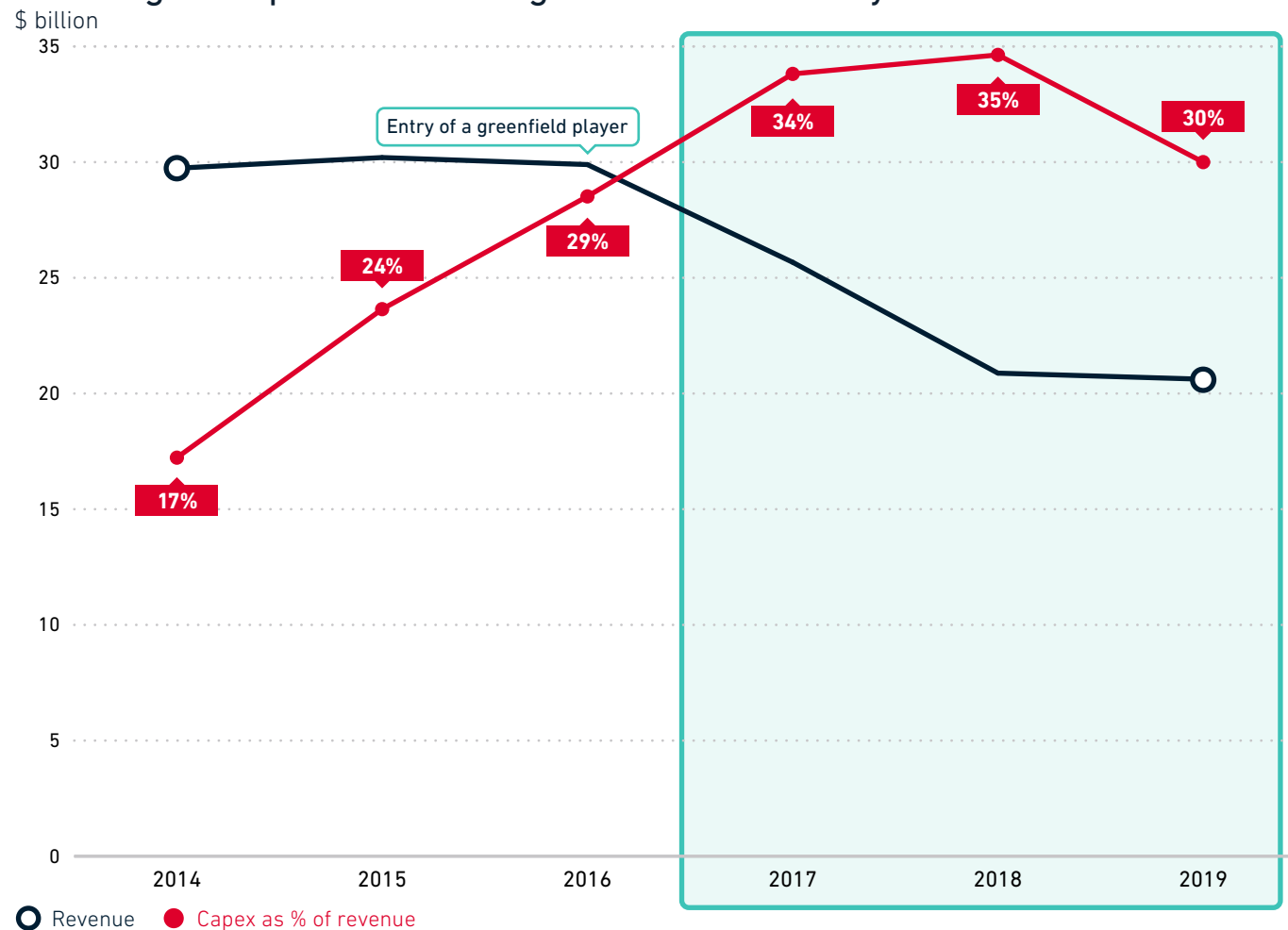
Usage at least once a week, by % of respondents



Consolidation has improved the sector's financial health but challenges remain

- Recent consolidation moves have transformed the Indian market from one of the world's most highly fragmented to a four-player market (three private sector players and one state-owned).
- There are signs of pricing stabilisation and a potential ARPU inflexion. But even if growth improves, revenues by 2025 are still likely to be below the level of 2016.

Ultra-high competition challenges the sustainability of network investments



GLOBAL MOBILE TRENDS
REGIONAL OUTLOOK



Europe

US and Canada

China

India

Sub-Saharan Africa

The power of local

Middle East and North Africa

Latin America



Smartphones

	2018	2025
Connections	301 million	689 million
Adoption rate	39%	66%



Unique subscribers

	2018	2025
Total	456 million	623 million
Penetration rate	44%	50%



Connections by technology

	2018	2025
2G	53%	12%
3G	40%	62%
4G	7%	23%
5G	—	3%



Operator total revenues

	2018	2025
	\$42.1 billion	\$50.9 billion
CAGR	2.8%	



Capex

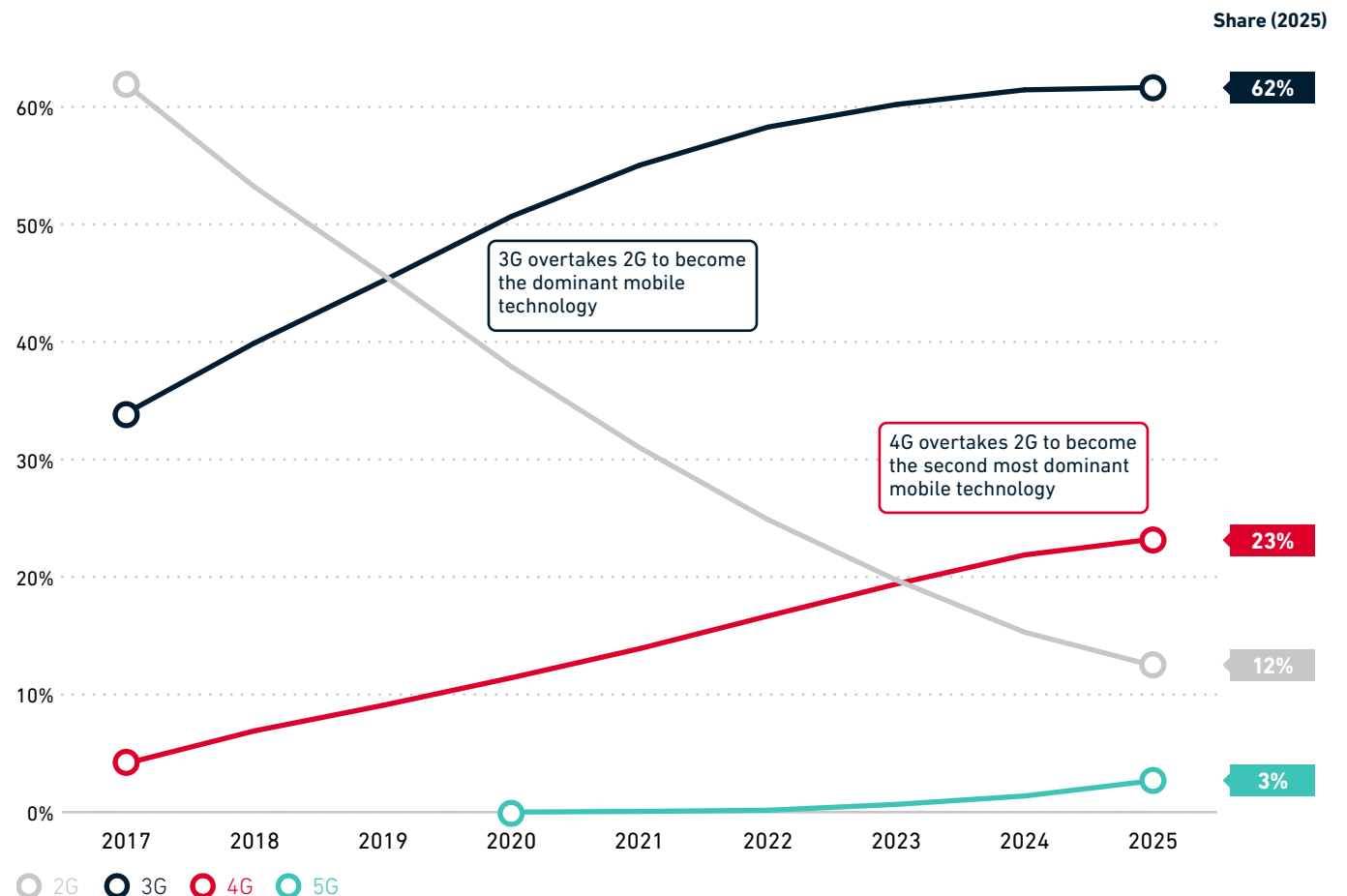
	2018	2025
	\$8.0 billion	\$11.1 billion
CAGR	4.8%	

Rising MBB adoption is driving a shift in engagement to data-centric services

- By the end of 2019, mobile broadband (MBB) connections (3G and above) will for the first time account for the majority of total mobile connections.
- This is an important inflection point for the region, and reflects a growing shift in the way consumers use digital platforms.
- Data-centric services, particularly music and video streaming, will drive a four-fold increase in data consumption by 2024.
- 5G is at the exploratory phase. For consumers, there is no real need, with LTE still in its infancy. However, telco-enterprise trials to establish proof points suggest its use could well come into sectors such as mining, utilities and transport in the coming three years.

Adoption by technology in Sub-Saharan Africa

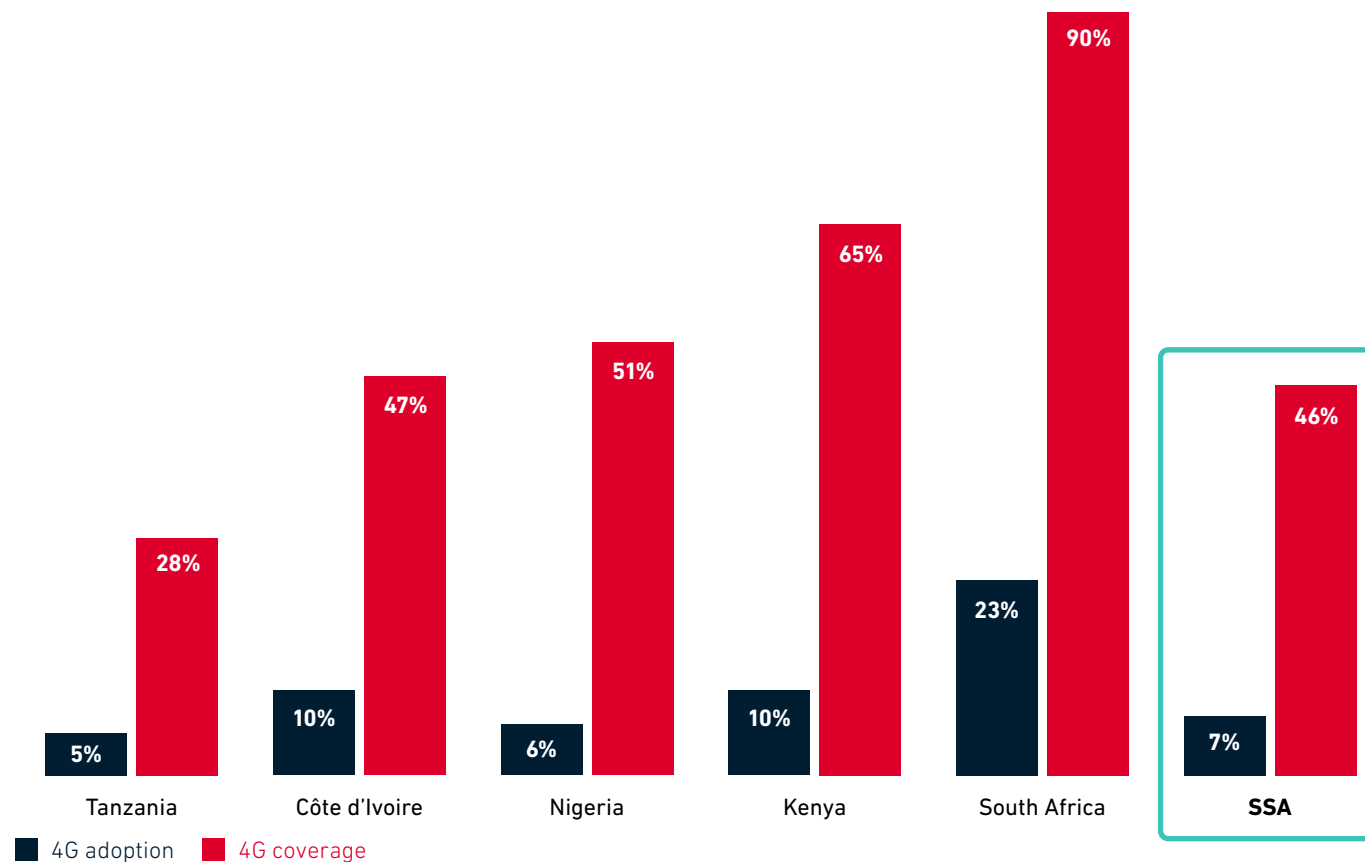
Percentage of connections
70%



Gap between 4G coverage and adoption underscores device affordability challenge

- Smartphone affordability is the main limiting factor for 4G adoption, with the average selling price of devices still above \$100.
- Several initiatives, such as the KaiOS smart featurephone, have brought 3G-enabled devices to sub-\$30 price points, but there is a need to replicate similar initiatives or implement alternative financing solutions for 4G devices to drive adoption.
- The PAYG financing model has been used to considerable success in the distribution of solar equipment for off-grid home energy solutions. Replicating the same model for smartphone distribution could create a unique opportunity to drive mass adoption.

4G coverage versus 4G adoption, June 2019



Operators will play a central role in the impending digital disruption of the media and entertainment sector

- Rising smartphone adoption, a youthful consumer base and sluggish adoption of digital distribution channels by traditional broadcasters and content producers are driving the digital disruption of the media content space.
- Operators will lead this trend, building on existing customer relationships, brand power and digital channels.
- But they need to find sustainable sources for locally relevant content amid the challenge of monetising media content in predominantly prepaid and low-income markets, and growing competition from local and global OTT players.

Examples of operator activities in the media content space

May 2019: Vodacom launches mobile gaming platform, PlayInc

April 2019: Vodacom launches music streaming app My Muze

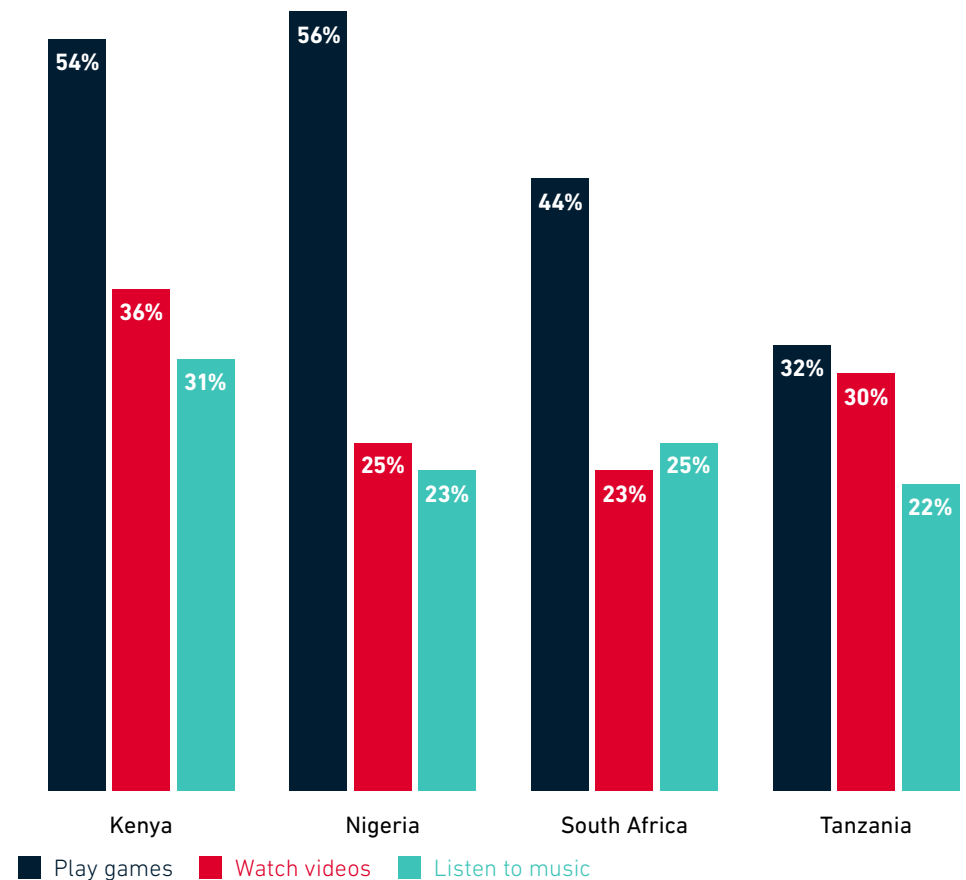
December 2018: MTN launches its streaming service Music Time

November 2018: MTN acquires music streaming business Simfy Africa

February 2018: Safaricom launches music streaming service Songa

Millennial smartphone behaviour on smartphones

Percentage of respondents engaging in activity weekly



Source: GSMA Intelligence Consumer Insights Survey

GLOBAL MOBILE TRENDS
REGIONAL OUTLOOK



Europe

US and Canada

China

India

Sub-Saharan Africa

Middle East & North Africa

A region of contrasts

Latin America



Smartphones

	2018	2025
Connections	344 million	589 million
Adoption rate	54%	75%



Unique subscribers

	2018	2025
Total	383 million	458 million
Penetration rate	64%	69%



Connections by technology

	2018	2025
2G	34%	8%
3G	40%	32%
4G	26%	53%
5G	—	7%



Operator total revenues

	2018	2025
	\$64.6 billion	\$75.5 billion
CAGR		2.3%



Capex

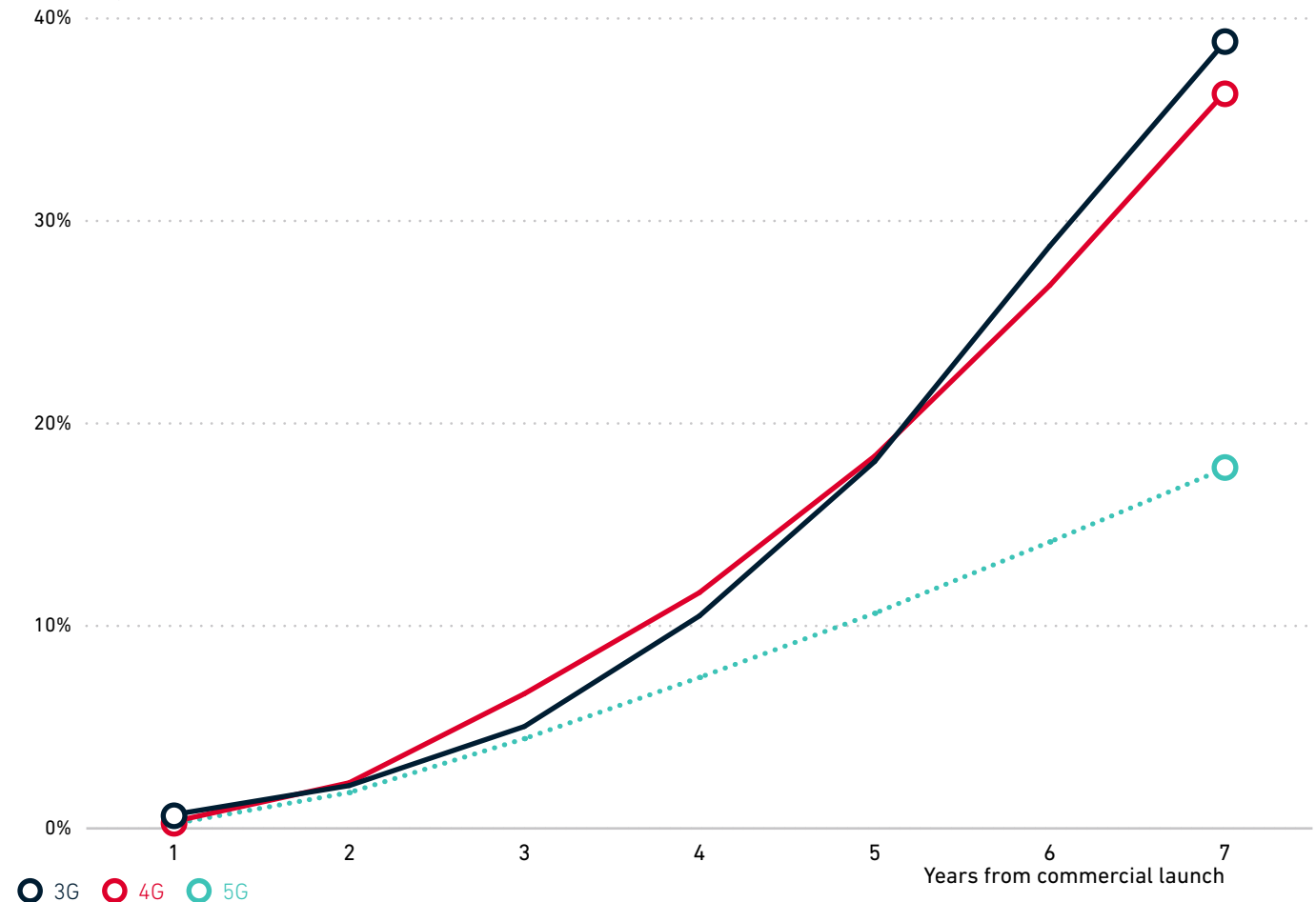
	2018	2025
	\$11.3 billion	\$11.2 billion
CAGR		-0.13%

5G debuts in GCC Arab States but take-up will be slower compared to 4G

- GCC Arab States are leading the transition to 5G in MENA, with commercial launches in all six countries in the bloc by the end of 2019.
- However, 5G adoption in these countries will be muted in the early phases of deployment with limited devices and network coverage.
- 5G is a long-term prospect in most non-GCC markets where structural and regulatory hurdles, such as limited fibre connectivity for backhaul, could hold back investments in the near term.

Average tech adoption rate for GCC* states

Percentage of total connections



● 3G ● 4G ● 5G

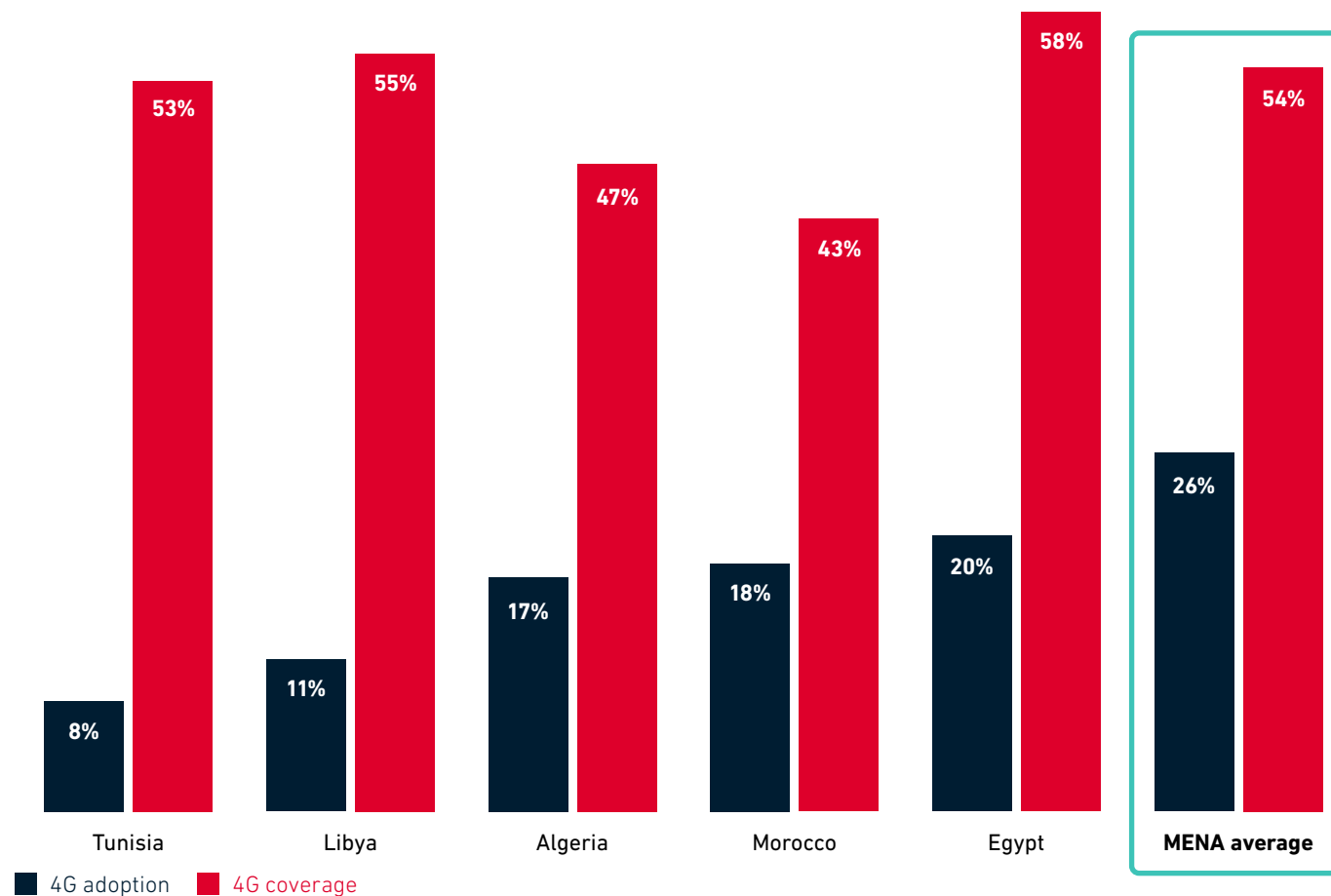
*Bahrain, Kuwait, Oman, Qatar, KSA, UAE

Source GSMA Intelligence

North Africa: 4G still has plenty of room for growth

- North Africa was late to the 4G party, but this is changing with new network launches and rapid coverage expansion.
- Operators sorely need the pricing uplift following intense competition. All but two of the countries in the region – Libya and Morocco – now record sub-\$5 ARPU levels.




4G adoption and coverage



Smart cities to drive IoT growth opportunities in MENA

- The MENA IoT market is valued at \$16 billion, with around 400 million IoT connections across the region.
- Smart city projects are gaining momentum in the region, and IoT connectivity and applications will play a crucial role in enabling solutions that can drive efficiency, productivity and safety across different sectors, such as utilities, healthcare and transport.
- Recent developments suggest a growing focus on IoT opportunities among operators, many of whom are looking for new growth areas amid increasing saturation in the mobile market.

Total IoT revenue share

Total IoT revenue share	Example developments
 Connectivity 19%	Turkcell and Huawei are working together to connect transport, water meters and parking spaces using NB-IoT and cloud computing.
 Professional services 35%	Etisalat and du have created separate health business units, which include digital health applications such as teleconsulting and apps for psychiatric assessment.
 Applications, platforms and services 46%	Zain Kuwait launched its smart home brand Zain life in March 2018 which includes smart smoke detectors, motion sensors, cameras, door/window detectors and control hubs.

GLOBAL MOBILE TRENDS
REGIONAL OUTLOOK



Europe

US and Canada

China

India

Sub-Saharan Africa

Middle East and North Africa

Latin America
Smartphones almost ubiquitous but challenging macro environment remains



Smartphones

	2018	2025
Connections	427 million	578 million
Adoption rate	66%	79%



Unique subscribers

	2018	2025
Total	420 million	489 million
Penetration rate	67%	73%



Connections by technology

	2018	2025
2G	23%	5%
3G	36%	20%
4G	41%	67%
5G	—	8%



Operator total revenues

	2018	2025
	\$69.6 billion	\$77.7 billion
CAGR		1.6%



Capex

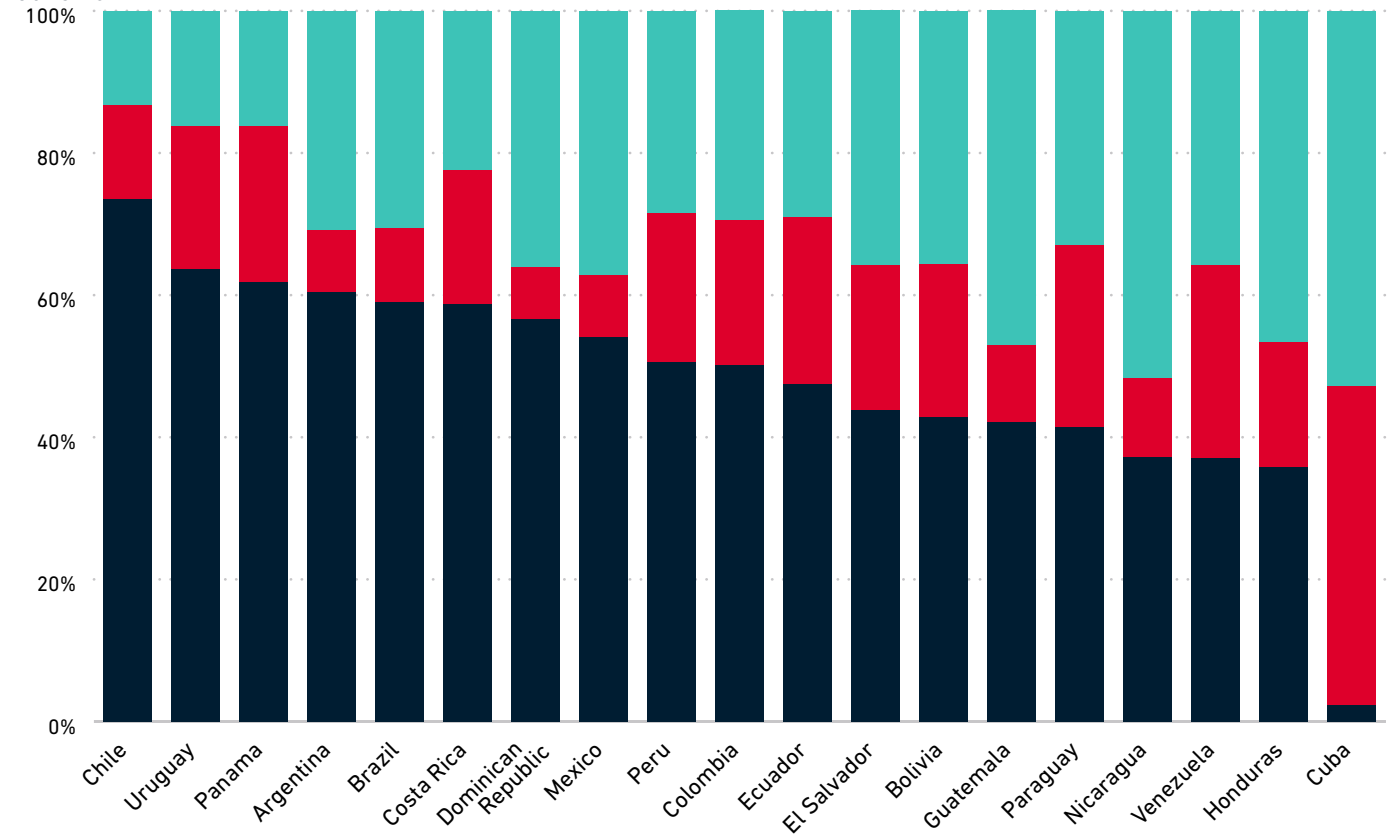
	2018	2025
	\$14.1 billion	\$14.2 billion
CAGR		0.04%

Affordability levels impacting mobile internet adoption

- Almost two-thirds of the region's population will be mobile internet users by 2025, up from just over half in 2018.
- However, mobile internet penetration among individual countries remains varied, with affordability the primary barrier.
- For example, the challenging macroeconomic climate in Venezuela over the last few years has significantly affected affordability of a wide range of services, not just mobile.
- In Honduras, where only 36% of the population subscribe to mobile internet, the main adoption barriers are mobile tariffs and handset pricing, with the lowest device costs representing 2% of GDP per capita.

Mobile adoption in Latin America

June 2019



Mobile subscribers

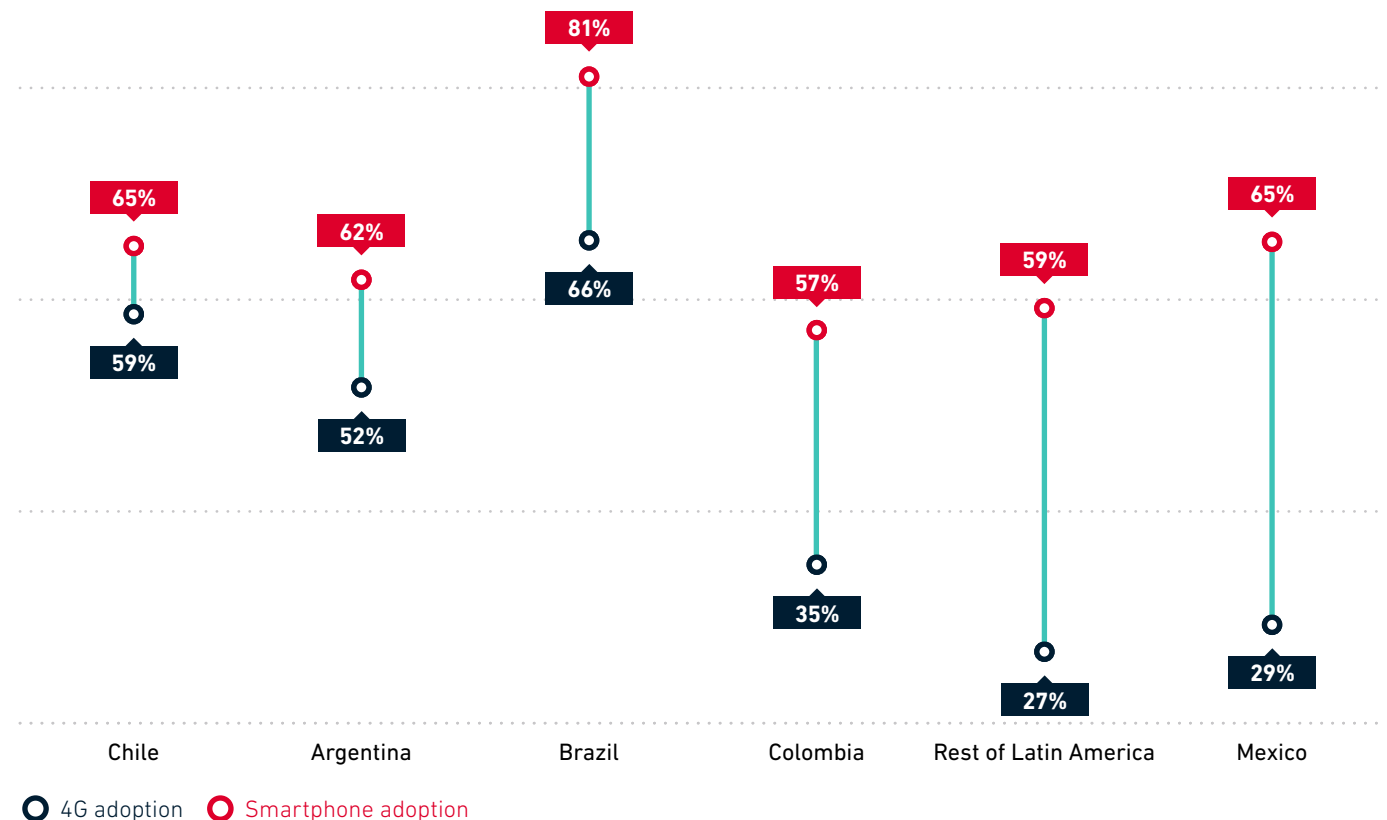


Migrating the base to 4G is the priority

- Raising 4G adoption continues to be the priority of operators in Latin America. This is for good reason; since 2010, \$600 billion has been invested in mobile networks.
- Smartphones are almost ubiquitous now, although many are still lower end and not optimised for LTE. High device costs, in part fuelled by import duties, remain a barrier to adoption.
- Brazil, Argentina and Chile have had most success transitioning customers up the ladder. Other markets are, however, well behind, with Mexico at only 30%.
- 5G trials are underway though launches are not expected until 2020. We therefore forecast tepid adoption of 8% by 2025.

4G should eventually reach parity with smartphones – just not yet

Data as of June 2019

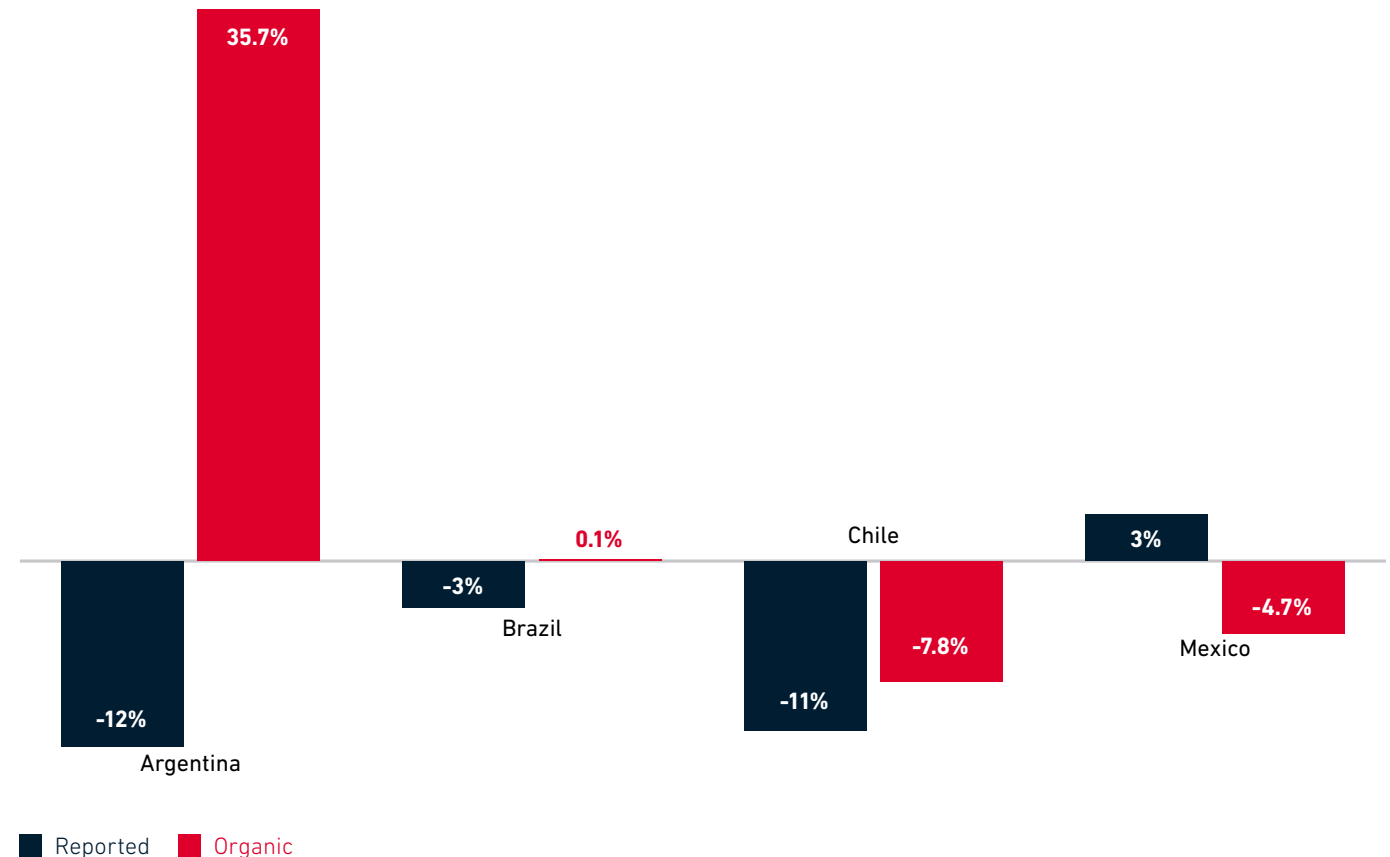


Macro impacts persist

- With continuing hyperinflation, currency devaluation and political crises, the overall macroeconomic outlook for the region remains volatile.
- Telefónica is a case in point. Organic growth is variable (Argentina is outperforming, Chile and Mexico are underperforming) but the FX depreciations have severely hit revenues when converted back into euros.
- These macro factors have a direct impact on foreign investment and capex costs in the region (as already seen in Q4 2018 in Brazil) which will make it more expensive to roll out new network infrastructure – either for LTE upgrades or 5G.

Telefónica mobile service revenue growth: up and down

% change YoY Q2 2019



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