



The Mobile Economy North America 2018



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Executive Summary



North America is the benchmark for migration to next-generation services

By the end of 2017, the number of unique mobile subscribers in North America exceeded 300 million, accounting for 84% of the population. By 2025, there will be 328 million subscribers across the region, or 86% of the population. With many subscribers owning more than one connected device, there were 374 million mobile connections across North America in 2017; this will grow to around 420 million by 2025 (109% penetration). In addition, licensed cellular IoT will be a major driver of connections growth in North America, reaching 515 million by 2025, up from just under 100 million in 2017. This will bring the total number of connections in North America to 933 million by 2025.

High subscriber penetration coupled with historically high consumer spend on mobile services means the mobile market in North America was worth \$260 billion in revenues in 2017. The US is the largest market worldwide in terms of revenue – about 40% greater than China, bigger than the entire European mobile market, and larger than CIS, Latin America, MENA and Sub-Saharan Africa combined.

The region is a benchmark for rapid migration to next-generation devices and networks. North America has the highest levels of mobile internet penetration, mobile broadband and smartphone adoption globally, and the second highest subscriber penetration rate (behind Europe). This is primarily driven by the US, which is in the top 10 markets worldwide by smartphone and 4G adoption.



North America will lead the way on 5G: nearly 50% adoption by 2025

4G currently accounts for three quarters of total connections across North America, and will continue to grow, reaching around 80% of total connections in 2019 – by which time, 5G will start to make an impact.

AT&T, T-Mobile and Verizon have all announced plans to launch 5G in selected major cities across the US by the end of 2018. Following these launches (and with Canada expected to launch in 2020), 5G adoption will likely grow as fast as 4G did in North America, reaching 100 million connections in late 2022. By 2025, 5G will become the leading mobile network technology in North America with more than 200 million mobile connections, accounting for around half of total mobile connections. 5G adoption in North America will occur faster than in any other region in the world.

Between 2018 and 2020, mobile operators will invest \$122 billion in capex in North America, mostly driven by network maintenance and early 5G rollouts that are likely to require densification through small cell deployments, new antennas and transmission upgrades. Subsequent expansion of 5G to a larger footprint – beyond the currently expected reach of around 70% and 52% of the population in the US and Canada respectively by the end of the decade – could require further incremental capex, above the \$42 billion expected in 2020.



Mobile contribution to North America's economy will reach \$1.1 trillion by 2022

In 2017, mobile technologies and services generated 4% of GDP in North America, a contribution that amounted to approximately \$830 billion of economic value added. In the period to 2022, this will increase to \$1.14 trillion (4.9% of GDP), largely driven by strong growth in productivity impacts brought about by the continued adoption of IoT technology and the increased digitisation of industry and services across North America.

The mobile ecosystem supported nearly 2.5 million jobs in the region in 2017. This includes workers directly employed by mobile operators and the ecosystem, and jobs that are indirectly supported in the rest of the economy. The sector also makes an important direct contribution to the funding of the public sector, with \$114 billion raised in 2017 in the form of general taxation, including sales taxes, corporate taxes and employment taxes. An additional \$19 billion was raised in 2017 by the US government through the auction of the 600 MHz band spectrum licences.



New opportunities sought to offset challenging future for traditional mobile services

2017 was a challenging year for mobile operator revenues, primarily due to intense competition leading to the introduction of unlimited price plans across the US. The last quarter of 2017 showed signs of recovery though, spurred by tax reform in the US and increased device prices (including migration to unsubsidised price plans). Despite some uncertainty in the future outlook (including questions around some M&A deals and the escalating trade dispute between the US and other major economies), the recovery is expected to continue through 2018 and into 2019 as mobile operators pursue new incremental revenue opportunities to offset the decline in traditional mobile revenues. These include the following:

1) Media and content

Global M&A deals involving telecoms and media companies recorded a historic high of more than \$320 billion in the first half of 2018, six times higher than for the same period last year. Much of the growth is driven by internet players (such as Netflix and Amazon) becoming serious competitors to the more established telecoms and media companies, and also by demand from consumers.

Mobile operators are therefore beginning to invest in content and media capabilities to tap into this new wave of growth. Examples include Oath, the new umbrella company for Verizon's digital content subdivisions that include previous acquisitions AOL and Yahoo; and AT&T's acquisition of TimeWarner in June 2018. If successful, these strategies can serve as models for other large mobile operators looking to diversify into content and advertising verticals, while also finally proving the value of moving beyond offering connectivity only.

2) Network innovation

Mobile operators in the US agree that the provision of enhanced mobile broadband to the consumer market will be the core proposition in early 5G deployments, with massive IoT and ultra-reliable, low-latency communications gaining scale at a later stage (for example, in autonomous vehicles, industrial and vehicular automation, remote medical surgery, and advanced AR and VR).

5G-based fixed wireless is an additional use case in the US, offering a potentially lower cost and faster means – compared to FTTH – of expanding high-speed services to households and businesses, bringing the opportunity to gain market share and incremental revenue.

However, the largest opportunity for incremental revenue in the 5G era is from services targeted at the enterprise sector in key industry verticals such as automotive, transportation, media, industrial manufacturing, logistics, energy, utilities, healthcare, agriculture and smart cities.

To ensure they can meet the capacity, coverage and efficiency demands of future 5G services, mobile operators in the US are investing in their networks to achieve the highest performance at the lowest cost per bit, using advancements such as network function virtualisation (NFV) and software-defined networking (SDN) to maximise network efficiency.



3) IoT

The number of IoT connections in North America will almost triple between 2018 and 2025, reaching 5.9 billion. Consumer IoT currently accounts for the majority of connections, but by 2025 will be overtaken by industrial IoT, driven by strong adoption across enterprises in verticals such as smart buildings, utilities, manufacturing and smart cities.

IoT revenue in North America will increase at an average annual rate of 21% to 2025 to reach \$337 billion, a three-fold increase on 2018. North America currently accounts for 35% of global IoT revenue, being home to IoT heavyweights – including Google, Amazon and GE – and a vibrant start-up ecosystem.

Applications, platforms and services account for the majority of IoT revenue in North America, as mobile operators have been deploying different strategies and business models to move beyond offering connectivity only. Their role in the value chain could vary from simply providing enablers that other companies use to build a solution, to becoming an overall aggregator and/or end-to-end solution provider.

4) Grassroots innovation and VC funding

2018 looks set to be a record year for global venture-capital (VC) funding, both in North America and worldwide. The US is still the largest single market worldwide, accounting for more than a third of global financing. This continued growth in funding confirms its role as the heart of tech innovation and digital transformation, and is providing valuable support to growth and developments across the wider mobile ecosystem.

Given the need for rapid innovation to evolve and meet future demand, there is a changing dynamic within mobile operators to pivot their business models and tap into this growing startup ecosystem. Examples include Orange Silicon Valley (OSV), AT&T Foundry and the Verizon Innovation Program, which work with companies of all sizes to bring their solutions to market. Top areas of innovation include IoT, entertainment/media and AI/machine learning.

North America

Unique mobile subscribers

2017

303m

84% PENETRATION RATE
(% of population)

86%

CAGR 2017-25

328m

2025

1.0%
↑



SIM connections

Excluding licensed cellular IoT

2017

374m

103% PENETRATION RATE
(% of population)

109%

419m

2025

1.4%
↑

CAGR 2017-25



4G 5G

Smartphone connections will increase from 80% of total in 2017 to

91%

by 2025

4G connections accounted for a total of

70%

in 2017

5G connections will account for

49%

of total connections by 2025

Excluding licensed cellular IoT

IoT connections

5.9bn

2025



Operator total revenues



\$260bn

2017

→ 2025

\$311bn

North America accounts for

24%

of global operator revenues

Operator capex of **\$122 billion** for the period 2018-2020



Mobile industry contribution to GDP

4.0%

\$833bn

2017

4.9%

\$1.1tn

2022

Public funding

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



2017

\$114bn

Employment



Jobs directly supported by the mobile ecosystem

2017

1.1m

plus an additional

1.3m

indirect jobs

01

Industry overview

1.1

328 million subscribers in North America by 2025

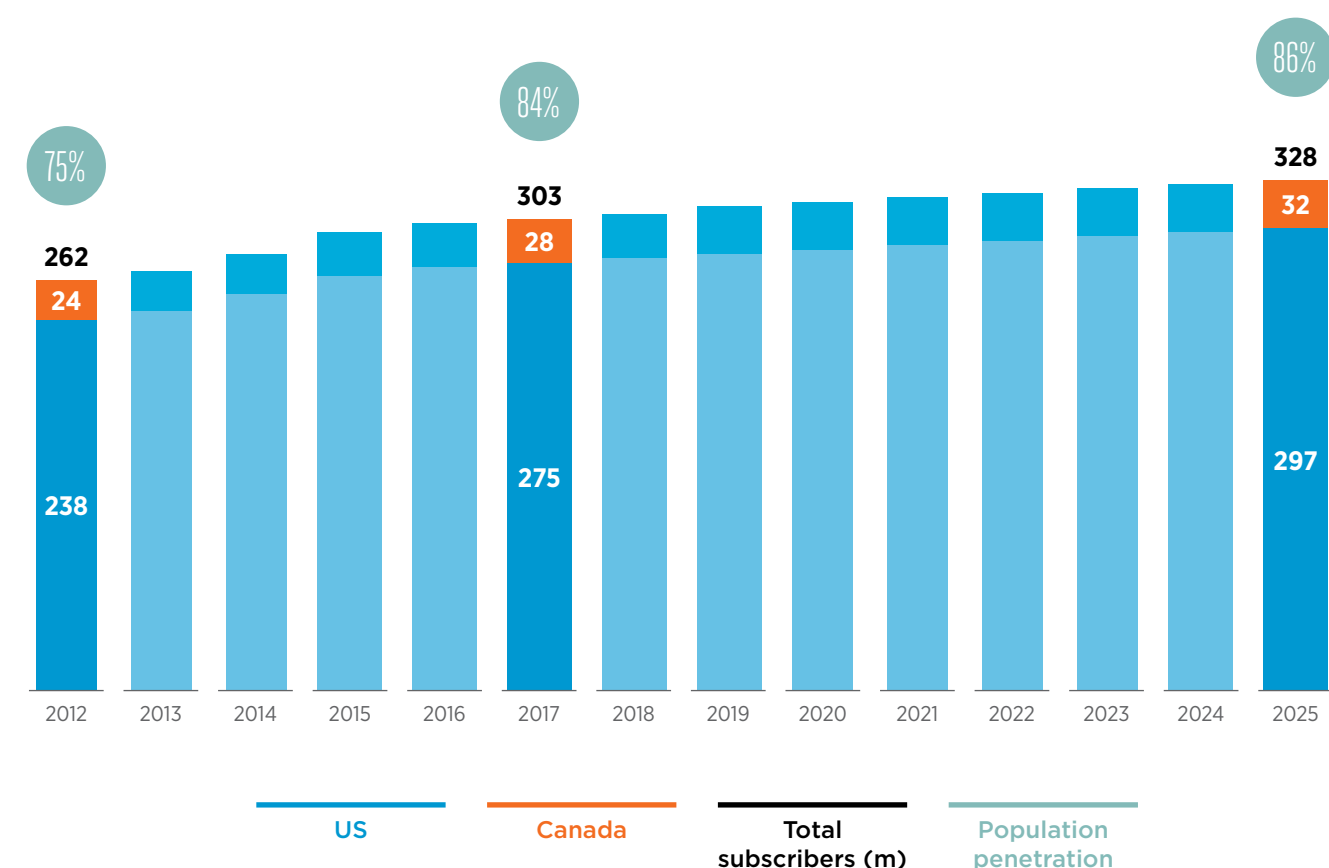
By the end of 2017, the number of unique subscribers¹ in North America exceeded 300 million, with the US accounting for 91% of the regional subscriber market and Canada the remaining 9%.² At this point, 84% of the population subscribed to mobile services, up from 82% in 2015 and 75% in 2012. As one of the most developed and penetrated regions in the world, further subscriber growth will be minimal (limited mostly to the under 18 and over 65 year-olds): by 2025, there will be 328 million subscribers across the region, or 86% of the population.

With an average 1.3 SIM cards per subscriber, there were 374 million mobile connections³ across North America in 2017, equating to connections penetration of 103%. This will grow to around 420 million by 2025 (109% penetration). In addition, licensed cellular IoT⁴ will be a major driver of connections growth in North America, reaching 515 million by 2025, up from just under 100 million in 2017. This will bring the total number of connections in North America to 933 million by 2025.

Figure 1

Source: GSMA Intelligence

Unique subscribers in North America



1. Total unique users who have subscribed to mobile services at the end of the period, excluding M2M. Subscribers differ from connections such that a unique user can have multiple connections.
2. North America includes Bermuda, Greenland, and Saint Pierre and Miquelon. These countries have just under 100,000 mobile subscribers in total (2017). Note that Mexico is included in the scope of our Mobile Economy Latin America report.
3. Total unique SIM cards (or phone numbers, where SIM cards are not used), excluding licensed cellular IoT, that have been registered on the mobile network at the end of the period. Connections differ from subscribers such that a unique subscriber can have multiple connections.
4. Total unique SIM cards that have been registered on the mobile network at the end of the period enabling mobile data transmission between two or more machines. Licensed cellular IoT excludes computing devices in consumer electronics such as e-readers, smartphones, dongles and tablets.

With high subscriber penetration and historically high consumer spend on mobile services, the mobile market in North America was worth \$260 billion in revenues in 2017. The US is the largest market worldwide in terms of revenue (at \$240 billion in 2017) – about 40% greater than China, bigger than the entire European mobile market, and larger than CIS, Latin America, MENA and Sub-Saharan Africa combined.

High spend on mobile services has also boosted North America’s revenue contribution to the global mobile market. While the region accounts for between 6% and 10% in key global metrics such as subscribers, smartphones and 4G connections, its contribution to global mobile revenue is just under 25%. This figure will remain steady over the short to medium term, largely due to the emergence of 5G, which will scale rapidly in North America and account for 16% of global 5G connections by 2025.

Table 1 Source: GSMA Intelligence

North America’s contribution to the global mobile industry

	2017	2025
Revenue	24%	24%
4G connections	10%	4%
5G connections	-	16%
Smartphone connections	7%	5%
Subscribers	6%	6%

1.2 US and Canada are global leaders in mobile

The US and Canada are notable examples of fast migration to next-generation devices and networks. Both were among the first few countries in the world to reach 50% smartphone adoption – doing so in 2012 – and 50% 4G adoption three years later.

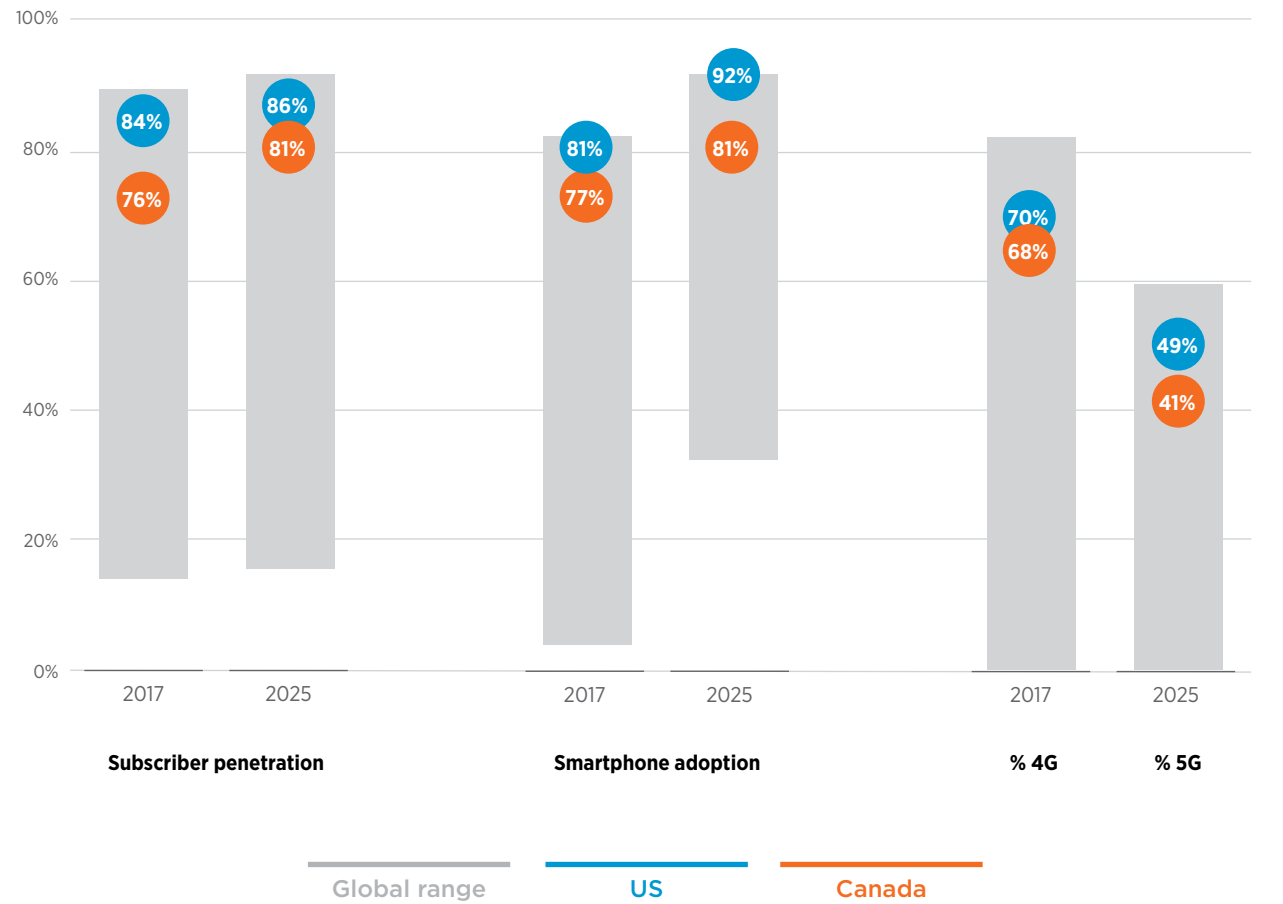
The North America region as a whole has the highest levels of mobile internet penetration, mobile broadband and smartphone adoption globally, and the second highest subscriber penetration rate (behind Europe). This is primarily driven by the US, which is in the top 10 markets worldwide in terms of smartphone and 4G adoption. Its ranking

is expected to improve further over the next few years: by 2025 the US will have the highest smartphone adoption and the fourth highest 5G adoption⁵ globally (at 92% and 49% of connections respectively). Canada meanwhile is in the top 5% of countries in terms of 4G adoption, and in the top 10% for smartphone adoption.

This fast adoption of new mobile technologies is being driven by several supply- and demand-side factors, including rapid tech rollouts and a highly engaged customer base.

Figure 2 Source: GSMA Intelligence

US and Canada are global leaders in mobile



Note: Only includes countries with a population of over 10 million

5. Behind Macao (69% of total connections), South Korea (59%) and Australia (54%)

1.2.1

4G is everywhere, and 5G is coming soon

Rollout of 4G networks was extremely rapid across North America: 4G coverage reached 90% of the population in the US in just three years (2010–2012) and in Canada in four (2011–2014). Practically 100% of the population in both countries currently have access to 4G services.

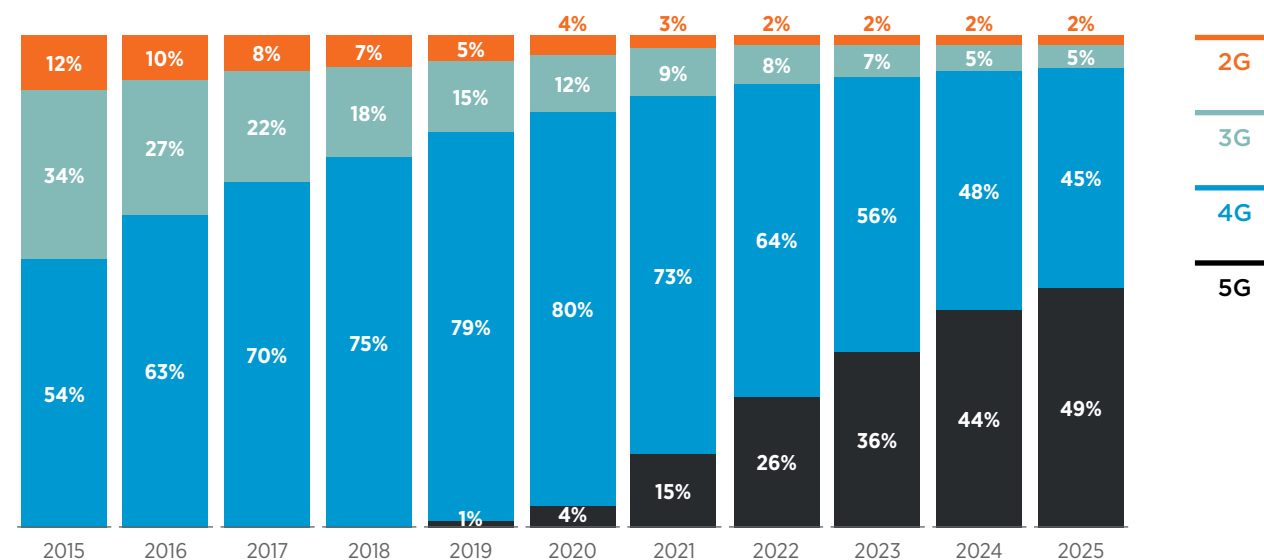
4G became the dominant technology across North America in terms of share of connections in 2015, and currently accounts for three quarters of total connections. 4G will continue to grow – reaching around 80% of total connections in 2019 – by which time, 5G will start to make an impact.

Figure 3

Source: GSMA Intelligence

Rapid technology migration in North America

Percentage of connections



The accelerated schedule agreed to by 3GPP in 2017 has seen some operators around the globe – including in the US – bring forward their 5G commercial launch plans: AT&T⁶, T-Mobile⁷ and Verizon⁸ have all announced plans to launch 5G in selected major cities across the country by the end of 2018. Following these launches (and with Canada expected to launch in 2020), 5G adoption will likely grow as fast as 4G did in North America, reaching 100 million connections in late 2022. By 2025, 5G

will become the leading mobile network technology in North America with more than 200 million mobile connections, accounting for around half of total mobile connections.⁹

5G adoption in North America will occur faster than in any other region in the world: 49% and 41% of connections will be on 5G networks in the US and Canada respectively by 2025, compared to around 30% in Europe and in key Asian markets (China, Japan and South Korea in aggregate).

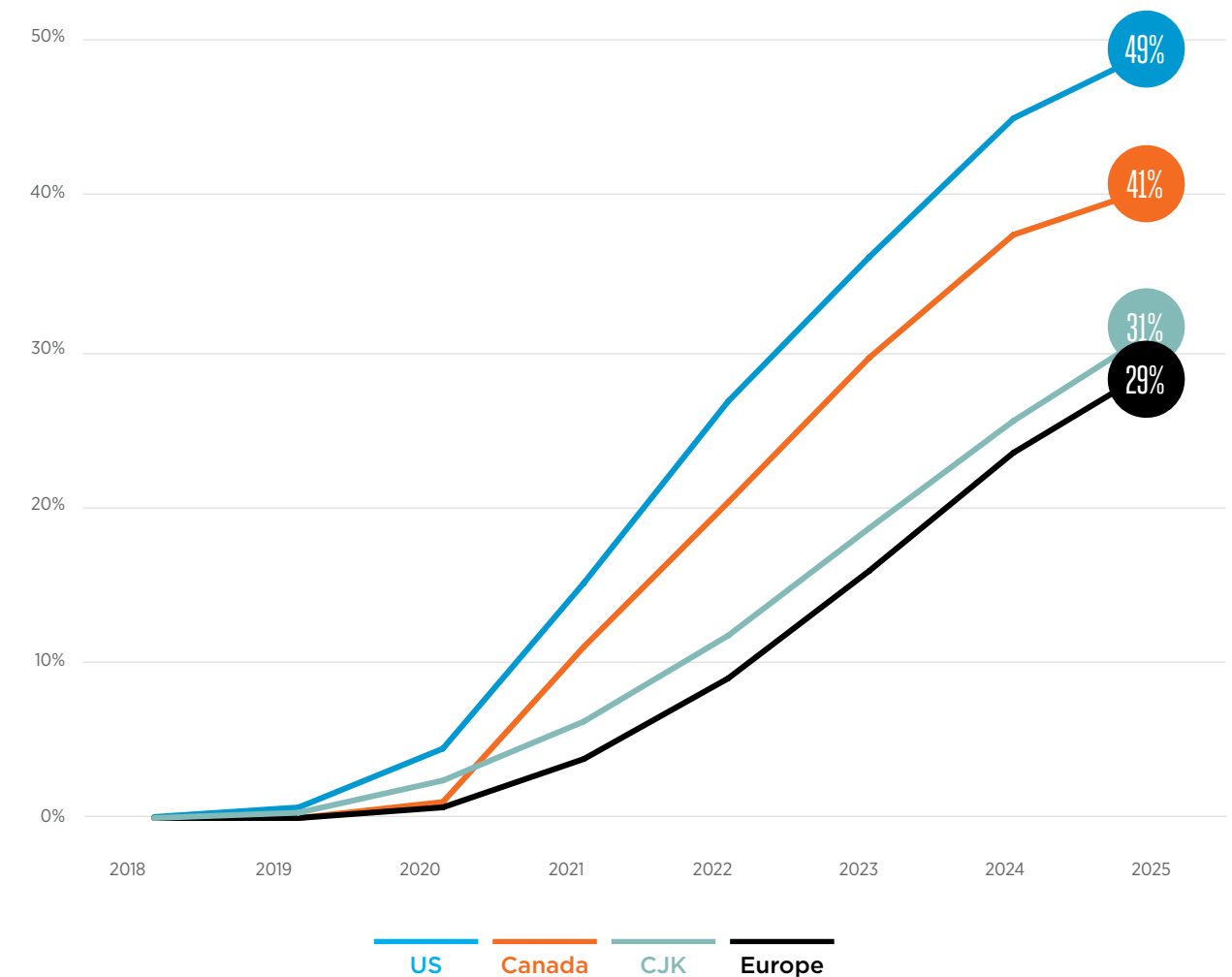
6. "AT&T Drives Path to Nationwide Mobile 5G With Multi-Gigabit Speeds", AT&T, February 2018
 7. "T-Mobile Building Out 5G in 30 Cities This Year ...and That's Just the Start", T-Mobile, February 2018
 8. "Verizon to launch 5G residential broadband services in up to 5 markets in 2018", Verizon, November 2017
 9. This forecast does not include 5G-based fixed wireless connections

Figure 4

Source: GSMA Intelligence

5G adoption in key markets

Percentage of connections



Note: Excludes sub-1 GHz spectrum coverage

5G smartphones take a step closer

In July 2018, Qualcomm announced its 5G mmWave and sub-6 GHz radio frequency modules,¹⁰ overcoming one of the major barriers to 5G adoption – enabling the technology on mobile devices. The QTM052 mmWave antenna module and QPM56xx sub-6 GHz module families pair with the previously announced Snapdragon X50 5G modem to create a complete connectivity solution in a compact footprint suited for integration in mobile devices.

This means that smartphones compatible with both the shorter-range but higher-capacity mmWave and the more reliable but slower sub-6 GHz spectrum bands will be commercially available in the first half of 2019, paving the way for faster consumer adoption of 5G services.

10. "Qualcomm Delivers Breakthrough 5G NR mmWave and Sub-6 GHz RF Modules for Mobile Devices", Qualcomm, July 2018

1.2.2
Rise of the digital consumer

The transformation of mobile customers from ‘connected’ (those connected to cellular networks) to ‘digital’ (those consuming digital services and content on a regular basis, with heavy data usage) has been fast in the US and Canada, driven by nationwide 4G network coverage, high consumer adoption of smartphones, and a growing range of digital services and content available to consumers.

Mobile users in the US and Canada have high propensity to adopt new mobile technologies and digital services & content at an early stage, and show strong levels of mobile engagement across both established and emerging use cases.

Most smartphone owners in North America use their phones on a regular basis to access internet communications services, social networks, entertainment content, e-commerce, health and financial services. In the US in particular, smartphone owners tend to use their device for more services and with more frequency than the developed world on average. Key insights include the following:

- Apart from a few exceptions, engagement among smartphone owners in the US is consistently higher than the developed world average across all mobile activities.
- The widest difference between the US and the developed world is in financial services, with

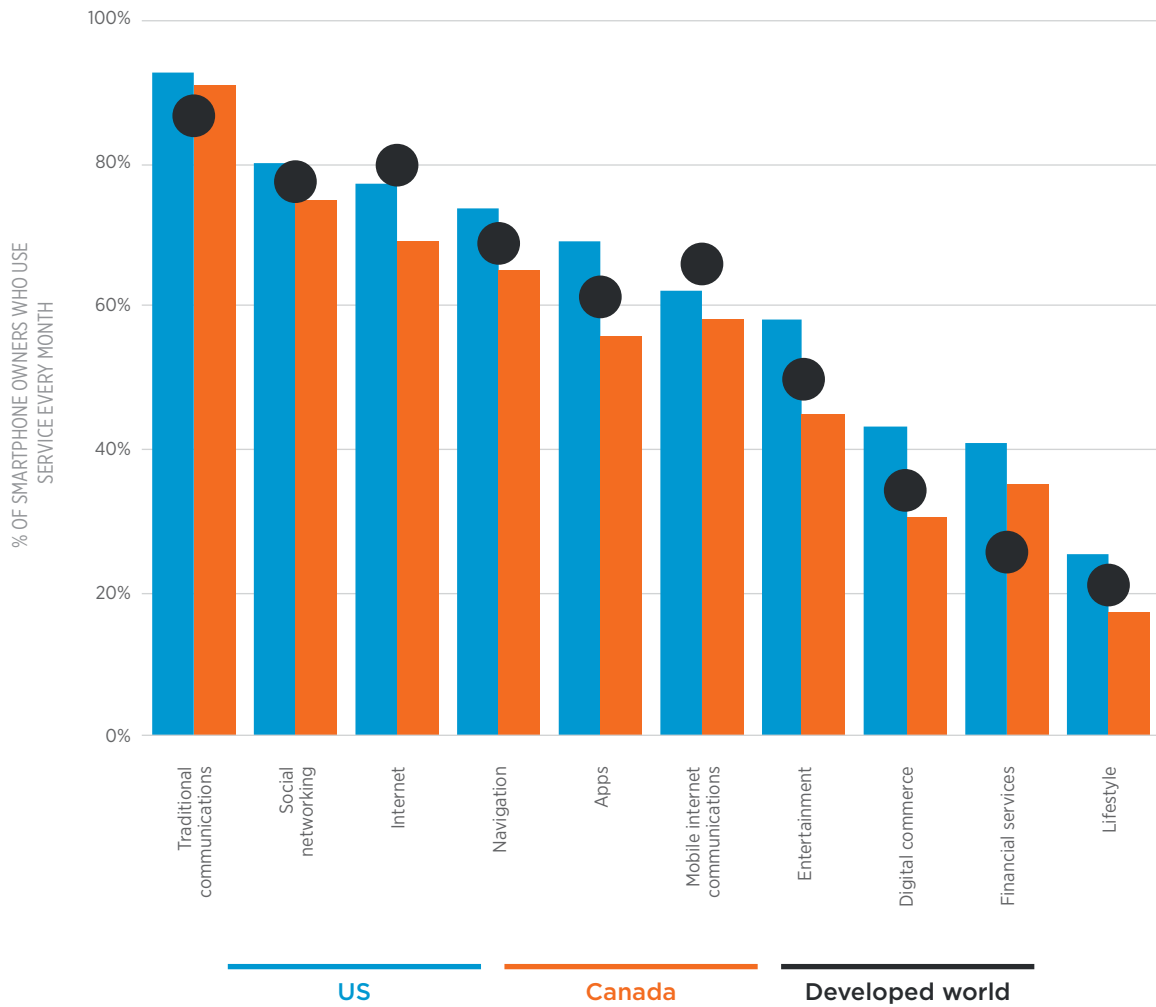
a particularly high proportion of smartphone owners using their devices to access online banking services or to prove their identity when accessing or purchasing online services.

- Digital commerce and entertainment are also areas of particularly high engagement in the US, reflecting the rapid and continued growth of internet-based services such as Amazon Prime and Netflix. In April 2018, Amazon announced it had exceeded 100 million paid Prime members globally, with estimates placing as many as 80% of these in the US. Meanwhile, Netflix reported it had 56 million paid subscribers in the US in June 2018, after adding more than 5.6 million over the last year alone.
- Smartphone owners in the US browse the internet on their devices slightly less frequently than the developed world average, most likely due to the widespread availability of high-speed fibre broadband across the country (and therefore a reduced need to use a phone for this purpose). It is a similar case with mobile internet communications services, which are more popular in some countries in the Middle East and Europe.
- In Canada, more smartphone owners make use of digital financial services than on average across the developed world, although they tend to do so less frequently.

Figure 5

Source: GSMA Intelligence Consumer Survey 2017

Smartphone engagement in North America



High mobile consumer engagement, particularly in digital content delivered through video (e.g. movies, games, advertising) has driven fast growth in mobile data traffic. In the US, 61% and 55% of smartphone owners respectively watch online video (e.g. YouTube, embedded video and live streaming) and stream music on their devices every month.¹¹

Looking forward, many of today's digital consumers will become tomorrow's augmented consumers in the 5G era; they will increasingly adopt or consume

a range of new technologies, including those expected to benefit from the faster speeds and/or lower latencies promised by 5G networks such as advanced video, AR, VR, tech solutions for smart cities, and autonomous cars. Mobile data traffic will therefore continue to grow across North America, reaching almost 20 EB per month by 2023.¹² By this time, a mobile subscriber in the region will on average consume almost 60 GB of data per month – a sevenfold increase on 2017.

Figure 6

Source: Ericsson, GSMA Intelligence

Mobile data in North America to continue to grow rapidly

Mobile data traffic
(GB per subscriber per month)

8.3

2017

7x

59
2023

11. GSMA Intelligence Consumer Survey 2017
12. Ericsson

1.3

Financials: muted revenue outlook, while capex sees calm before the 5G storm

1.3.1

New opportunities sought to offset challenging future for traditional mobile services

2017 was a challenging year for mobile operator revenues, primarily due to intense competition leading to the introduction of unlimited price plans across the US. Q4 2017 showed signs of recovery though, spurred by tax reform in the US and increased device prices (including migration to unsubsidised price plans). The 2.5% growth compared to Q4 2016 meant that total revenue growth across North America remained relatively flat for the year.

The first half of 2018 saw this recovery continue. In Q2 2018, Verizon reported annual total revenue growth of 5.5%, driven by customer migration to higher value plans and increases in average connections per account, while T-Mobile reported a record high in service revenues in Q2 2018, up 6.5% annually. AT&T posted annual growth of 0.6% in Q2 2018 on a comparative basis¹³ in its Consumer Mobility segment, citing the continued to shift to unlimited plans and the migration of subscribers to the Business Solutions segment (which allows individual subscribers to purchase wireless services through employer-sponsored plans for a reduced price). This is, however, a marked improvement on the 5% annual decline reported for 2017.

The recovery is expected to continue through the rest of the year and into 2019 as mobile operators aggressively pursue new incremental revenue opportunities in content, IoT and 5G to offset the enduring decline in traditional mobile revenues. However, there is some uncertainty in the future outlook based on a number of factors:

- The \$26 billion merger of Sprint and T-Mobile has been agreed, but the deal is yet to receive final regulatory approval. Capitalising on the strengths of both companies (i.e. Sprint with spectrum and T-Mobile with marketing), a combined company should be able to compete much better going forward (with 107 million connections in total versus Verizon's 122 million and AT&T's 102 million¹⁴).
- AT&T's \$85 billion acquisition of Time Warner has gone ahead, but the Department of Justice is appealing the ruling. In addition, questions remain over how it extracts value from the merger. AT&T included WarnerMedia – the new name for Time Warner and encompassing HBO, Turner and Warner Bros. – in its Q2 2018 results, with the division's revenues growing by 7% compared to Q2¹⁵ (though only 16 days' worth of ownership were represented in the quarter).
- The escalating trade dispute between the US and other major economies, which includes tariffs and border taxes charged on foreign imports, is a source of uncertainty in the US. While tariffs can protect domestic jobs, they can also lead to raised prices for consumers and a slowdown in innovation, which could result in stagnation of the mobile industry and the wider economy.

With this in mind, total mobile revenues in North America are expected to grow modestly over the next few years, with an average annual growth rate of just over 2% between 2017 and 2025. By 2024, annual revenues in the sector are forecast to surpass \$300 billion across the region, reaching £311 billion in 2025.

13. Excluding the impact of new US accounting standards that include new revenue recognition rules (ASC 606)

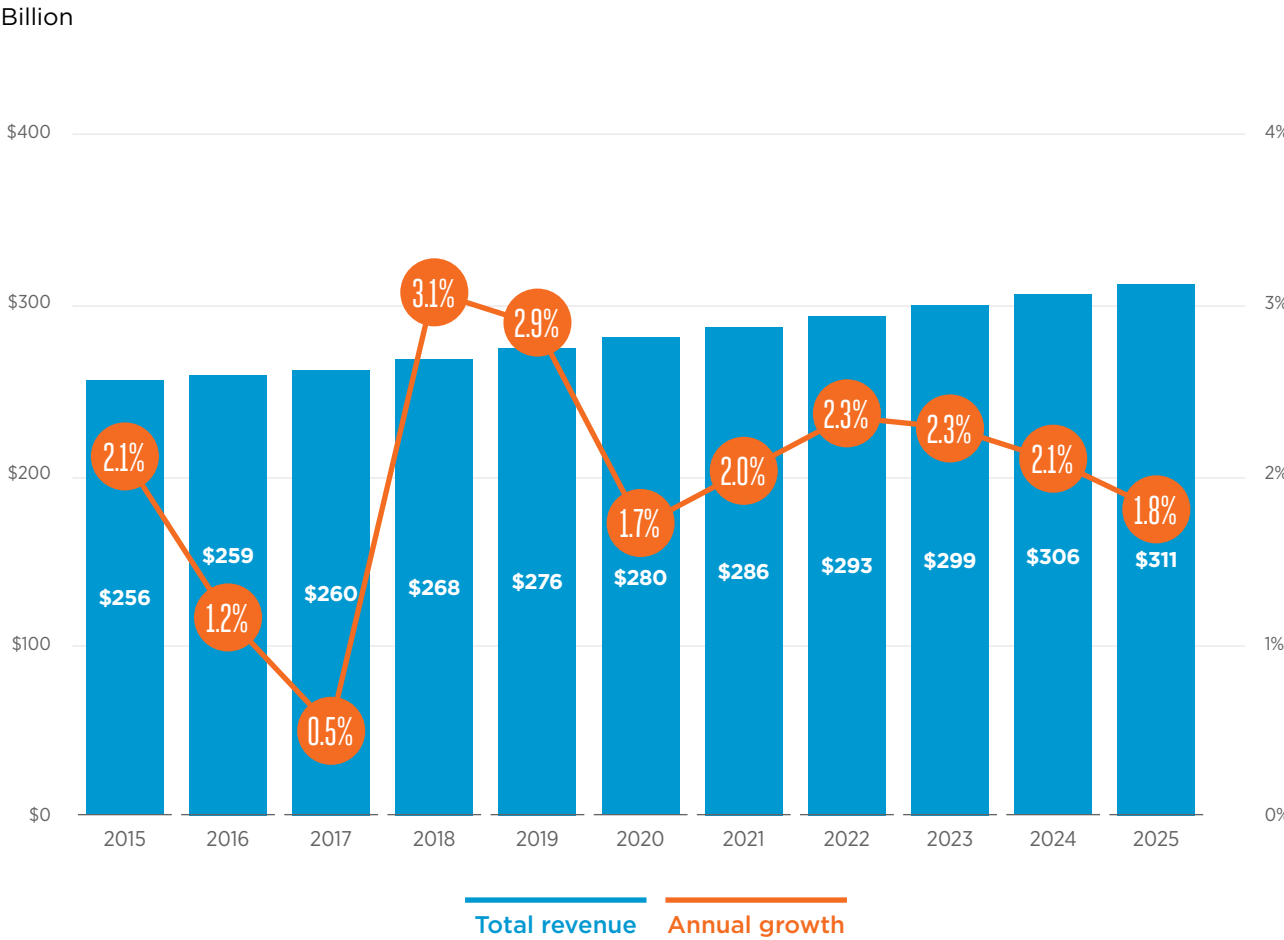
14. As of Q2 2018

15. HBO and Warner Bros. recorded double-digit annual growth, while Turner ad revenue grew by 3%



Figure 7 Source: GSMA Intelligence

North America mobile revenue outlook



1.3.2

Capex peaked in 2017 as mobile operators prepare for 5G

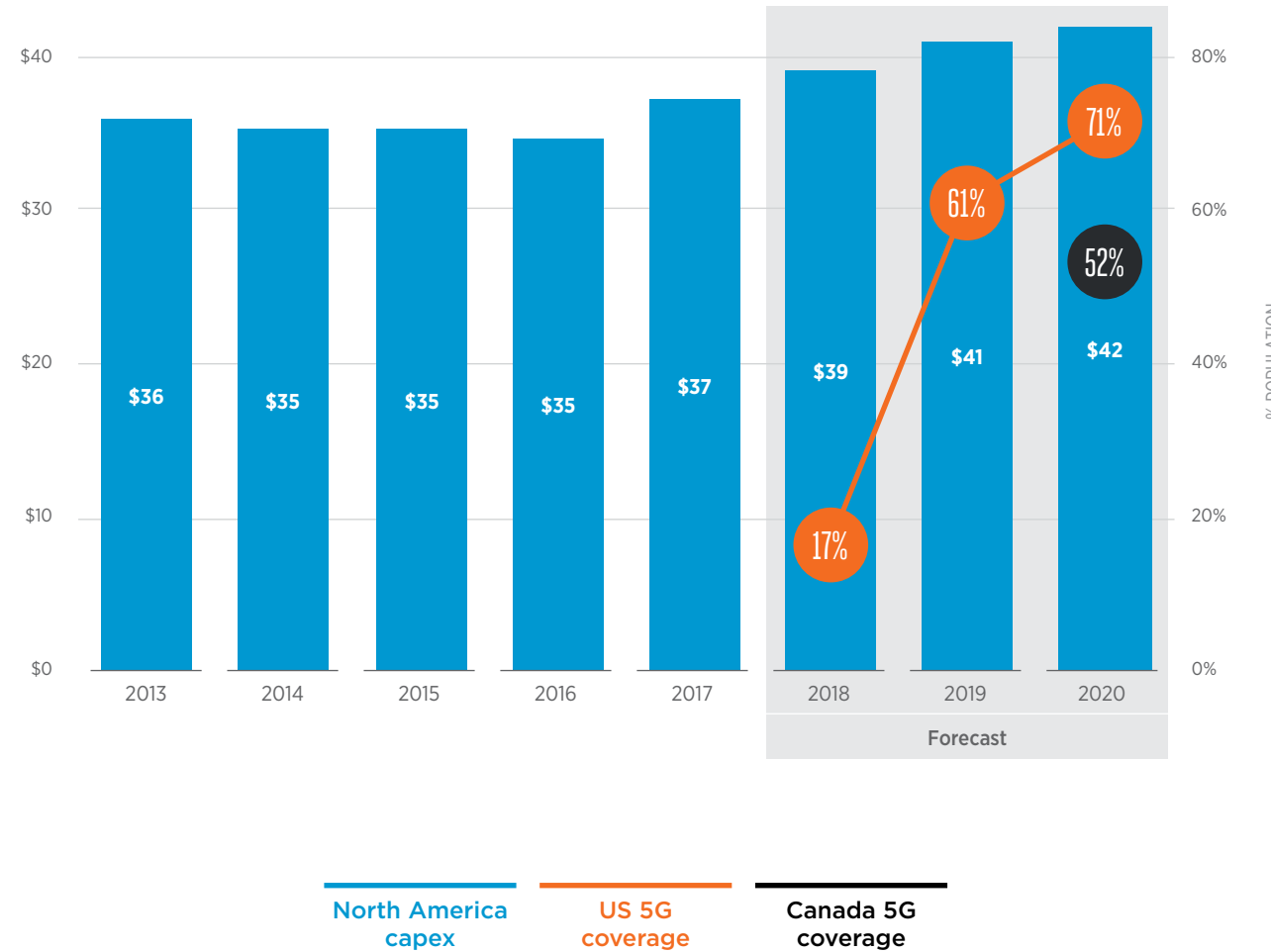
Between 2014 and 2017, mobile operators in North America invested \$143 billion in both spectrum and network equipment. Investments peaked in 2017. The year saw the highest level of capex on record in the region, surpassing the amount invested during the years of rapid 4G rollout, as mobile operators accelerated network upgrades in preparation for 5G. Between 2018 and 2020 a further \$122 billion will be invested, mostly driven by network maintenance

and early 5G rollouts that are likely to require densification through small cell deployments, new antennas and transmission upgrades. Subsequent expansion of 5G to a larger footprint – beyond the currently expected reach of around 70% and 52% of the population in the US and Canada respectively by the end of the decade – could require further incremental capex, above the \$42 billion expected in 2020.

Figure 8 Source: GSMA Intelligence

North America capex and coverage outlook

Billion



Note: Coverage forecast excludes sub-1 GHz spectrum

02

Mobile contributing to economic growth

The mobile ecosystem makes a significant direct contribution to the economy in North America, generating an economic value of \$255 billion (or 1.2% of GDP). This constitutes more than 30% of the total GDP contribution of the mobile ecosystem in North America, which amounted to \$833 billion in 2017. This overall impact includes the direct impact of the mobile ecosystem as well as the indirect impact and the increase in productivity brought about by the use of mobile technologies.

2.1

The direct economic contribution of the mobile ecosystem

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

including employee compensation, business operating surplus and taxes.

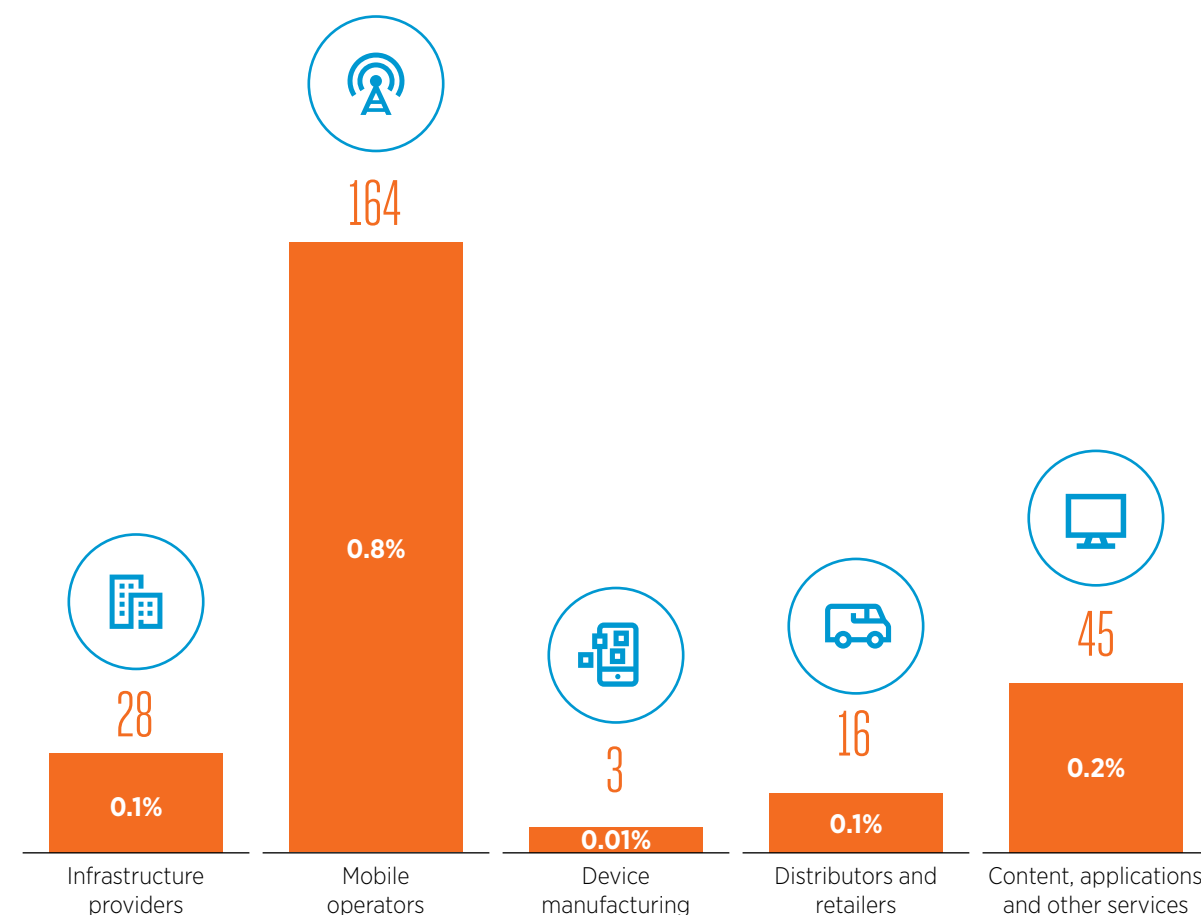
In 2017, the total value added generated by the mobile ecosystem in North America was around \$255 billion (or 1.2% of GDP), with mobile network operators accounting for the majority of this with \$164 billion (or 0.8% of GDP).

Figure 9

Source: GSMA Intelligence

Direct contribution of the mobile ecosystem to GDP

\$ billion, % 2017 GDP



2.2

Indirect and productivity impacts of mobile technology

In addition to their direct economic contribution, firms in the mobile ecosystem purchase inputs from their providers in the supply chain. For example, handset manufacturers purchase inputs from microchip providers, and content providers require services from the IT sector. Furthermore, some of the profits and earnings generated by the ecosystem are spent on other goods and services, stimulating economic activity in those sectors.

We estimate that in 2017, this additional economic activity generated a further \$160 billion in value add (or 0.8% of GDP) in North America.

The use of mobile technology also drives improvements in productivity and efficiency for workers and firms. For many years, workers in North America have been using mobile voice and messaging services to communicate more efficiently and effectively. They also use mobile

data and internet-based services extensively through 3G and 4G networks. Now, advanced mobile applications and IoT solutions are allowing the digitisation of services and improvement of industrial processes. As these technologies become increasingly adopted, we expect them to drive significant benefits via cost savings and efficiency gains in areas such as manufacturing, logistics and retail. Productivity impacts from IoT and M2M alone contributed \$70 billion to the North American economy in 2017. In total, we estimate the overall productivity impact from using mobile technology and services was worth around \$415 billion in 2017 (or 2% of GDP) in North America.

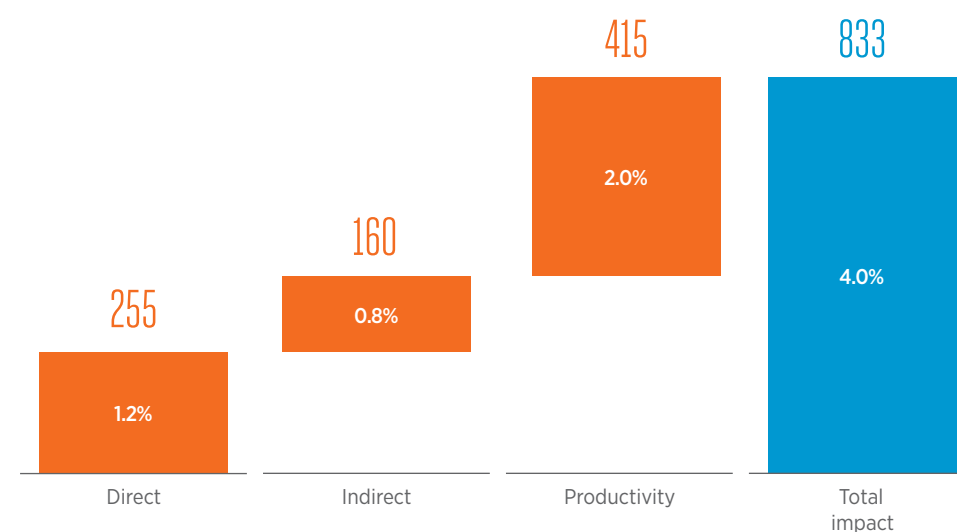
Overall, taking into account the direct, indirect and productivity impacts, in 2017 the mobile industry made a total contribution of \$833 billion to the North American economies in value added terms, equivalent to 4% of the region's total GDP.

Figure 10

Source: GSMA Intelligence

Total contribution to GDP

\$ billion, % 2017 GDP



Note: totals may not add up due to rounding.

2.3

Employment and public funding contribution

In 2017 mobile operators and the ecosystem provided direct employment to approximately 1.1 million people in North America. In addition to this, economic activity in the ecosystem generates jobs in other sectors. Firms that provide goods and services as production inputs for the mobile ecosystem (for example microchips or transport services) will employ more individuals as a result of the demand

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

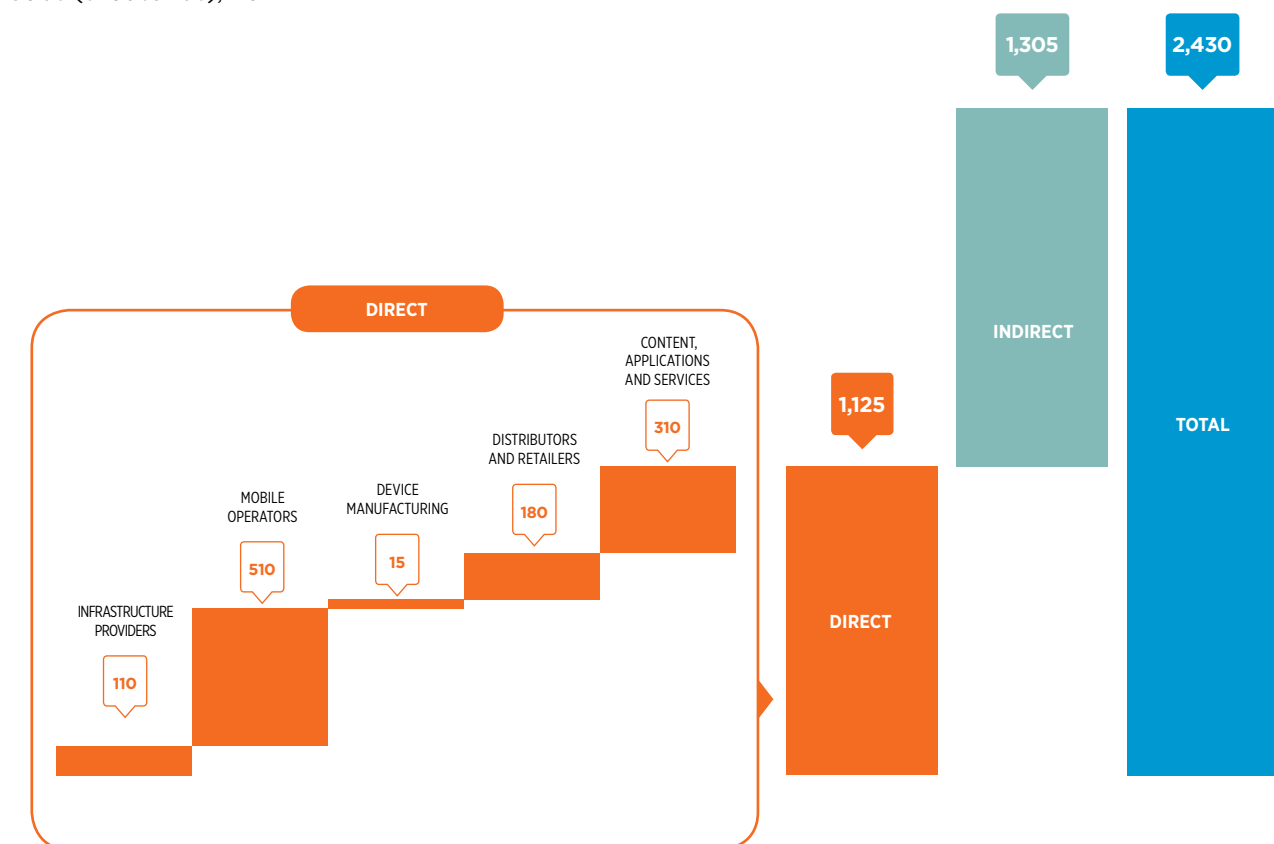
We estimate that in 2017, more than 1.3 million jobs were indirectly supported in this way, bringing the total impact (direct and indirect) of the mobile industry in North America to around 2.4 million jobs.

Figure 11

Source: GSMA Intelligence

Employment impact

Jobs (thousands), 2017



Note: totals may not add up due to rounding.

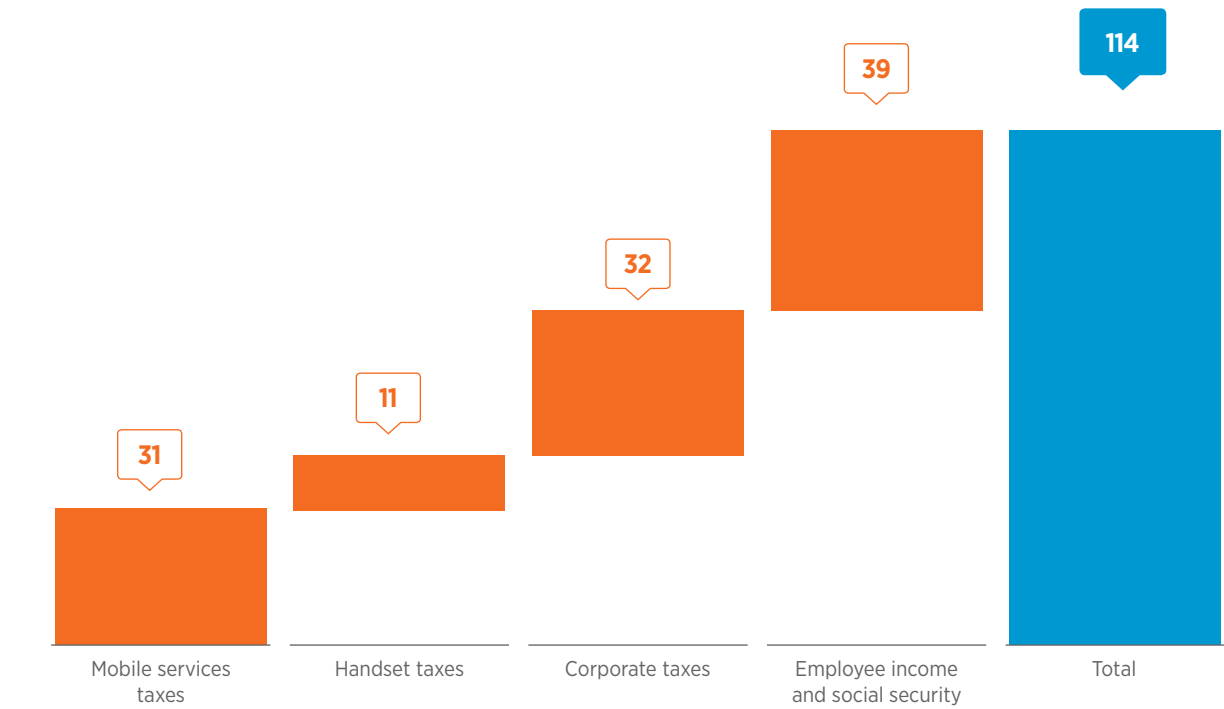
The mobile ecosystem also makes a significant contribution to the funding of public sector activity in the region through taxation. This includes sales and value added taxes, corporation tax, income tax and social security from firms and employees. We estimate that the ecosystem made a tax contribution to the public finances of the US and Canadian governments of \$114 billion in 2017.

This figure does not include the significant contribution made by the mobile industry in purchasing spectrum licences and other regulatory payments. In 2017, the US government raised an additional \$19 billion in net proceeds from the auction of the 600 MHz band. Additionally, the mobile industry in the US makes a contribution to the Universal Service Fund. A recent report¹⁶ estimated that mobile consumers in the US paid in excess of \$5 billion in 2017 through their mobile bills to fund universal service.

Figure 12 Source: GSMA Intelligence

Contribution to public funding by the mobile industry

2017 \$ billion



Note: totals may not add up due to rounding.

2.4 Five-year outlook

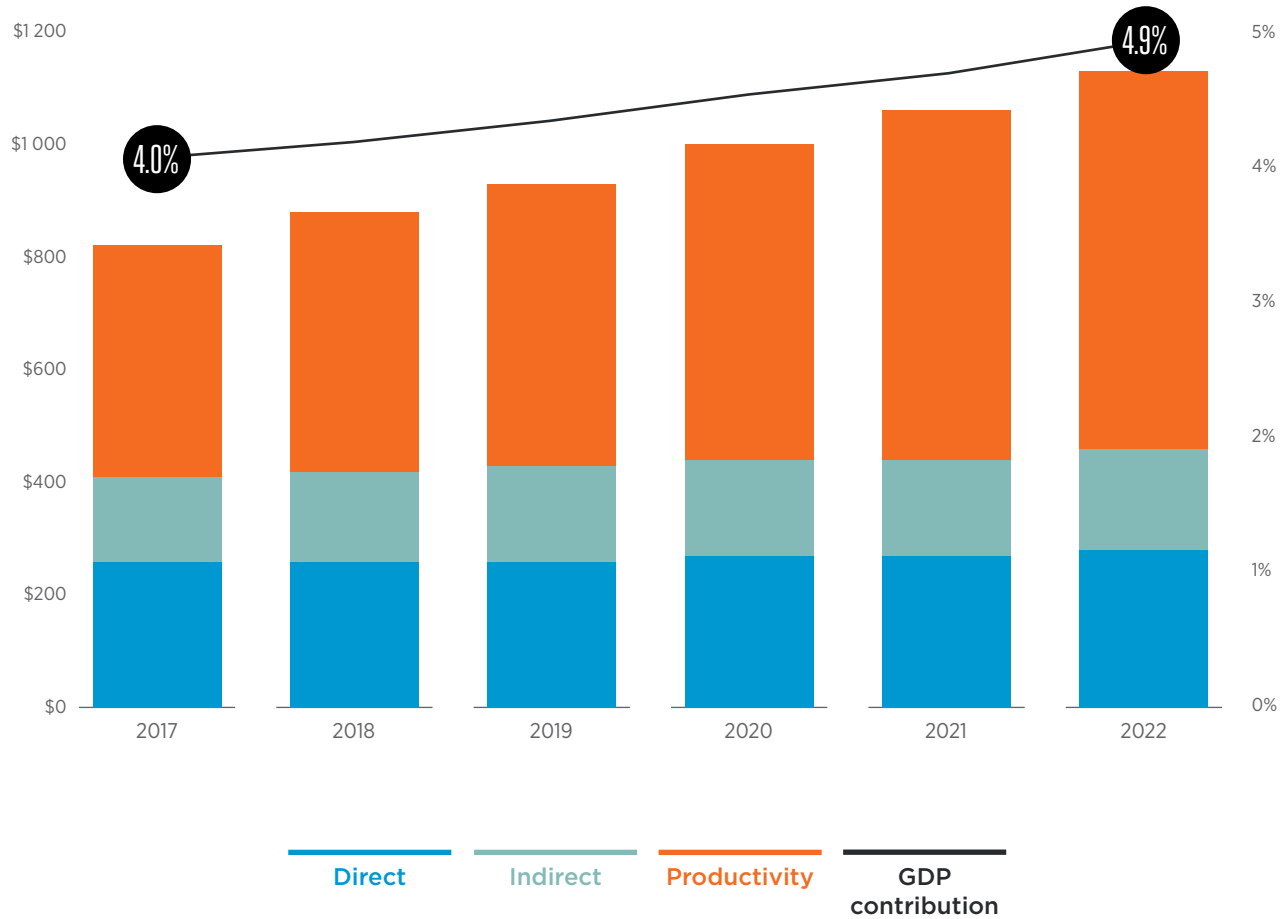
Going forward, we expect the economic contribution of the mobile industry in North America will continue to grow. In value-added terms, we estimate that the ecosystem will generate in excess of \$1.1 trillion by 2022, representing at that time 4.9% of GDP. This is an increase in the contribution both in

absolute and relative terms compared to the rest of the economy. The majority of this increase is due to improved productivity driven by continued adoption of IoT technology and the increased digitisation of industry and services.

Figure 13 Source: GSMA Intelligence

Contribution of the mobile industry in North America: outlook to 2022

\$ billion, % GDP

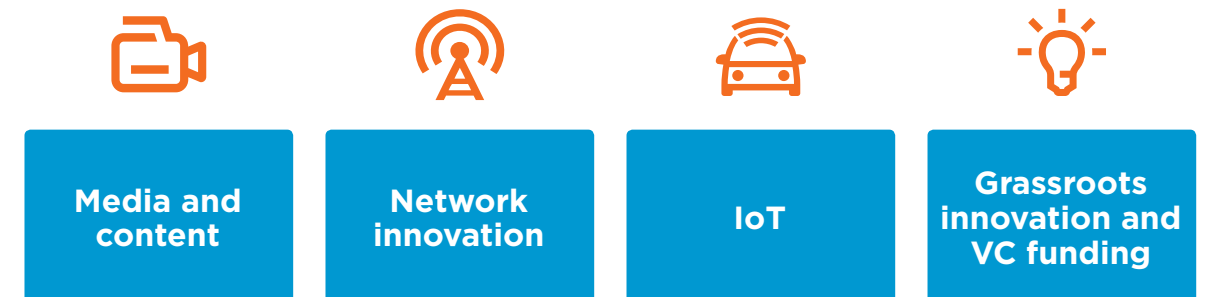


16. Wireless Taxes and Fees in 2017, Tax Foundation, 2017

03

Evolution of the North American mobile ecosystem

Mobile operators in North America, as in most of the developed world, increasingly need to innovate and evolve to future-proof themselves against the challenges facing traditional mobile communication. To this end, there are four key opportunities and areas of investment for North American mobile operators in the near to medium term:



3.1

Mobile operators seeking content capabilities

Global M&A deals involving telecoms and media companies recorded a historic high of more than \$320 billion in the first half of 2018, six times higher than in the same period last year.¹⁷ The explosion in M&A in the sector highlights both the importance of scale and the ongoing impact of technology in disrupting the traditional telecoms and media industries.

Much of the growth is driven by internet players (for example, Netflix and Amazon) becoming serious competitors to the more established telecoms and media companies, and also by demand from consumers: in the US, a third of smartphone owners pay for on-demand content (TV, movies, music etc.) on their devices each month.¹⁸ Mobile operators are therefore beginning to invest in content and media capabilities to tap into this new wave of growth.

The most talked about deal in the telecoms sector in the US this year was AT&T's \$85.4 billion acquisition of Time Warner completed in June 2018, part of AT&T's ongoing strategy to transform into a vertically integrated media company of the future. By combining AT&T's direct-to-consumer distribution strengths with the content and creative abilities of Warner Bros., HBO and Turner, the aim is to offer customers a differentiated, high-quality, mobile-first entertainment experience.

This does however put AT&T's new B2C content play in direct competition with market leaders Netflix and Amazon. Netflix has more than 55 million subscribers in the US¹⁹, while Amazon's US audience for all video programming on Prime, including movies and TV shows it licenses from other companies, was about 26 million customers in 2017.²⁰ Penetrating this market will not be easy: finding the right business model for the new content capabilities is essential to maximise the incremental revenue opportunity compared to the legacy model.

The major opportunity for AT&T therefore, and most likely the main focus and justification for the acquisition of Time Warner, seems to be advertising: specifically, with the gain of the Turner assets AT&T could potentially unlock a significant uplift in targeted advertising revenues. AT&T has already demonstrated an ability to generate a cost per mille (CPM²¹) rate of around \$30 through its use of customer data, while Turner has been limited in its targeted advertising capabilities and has a much lower CPM rate of around \$7.50. If AT&T can apply its customer data – and therefore its CPM rate – to Turner's ad inventory, it could create an additional \$16.9 billion in advertising revenues (Figure 14). Further, some AT&T execs have discussed the possibility of achieving CPM rates of \$35–40, which would have substantial additional upside.²²

17. "Global M&A hits historic high with media deal wave", Reuters, June 2018

18. GSMA Intelligence Consumer Survey 2017

19. Netflix Q1 2018 results

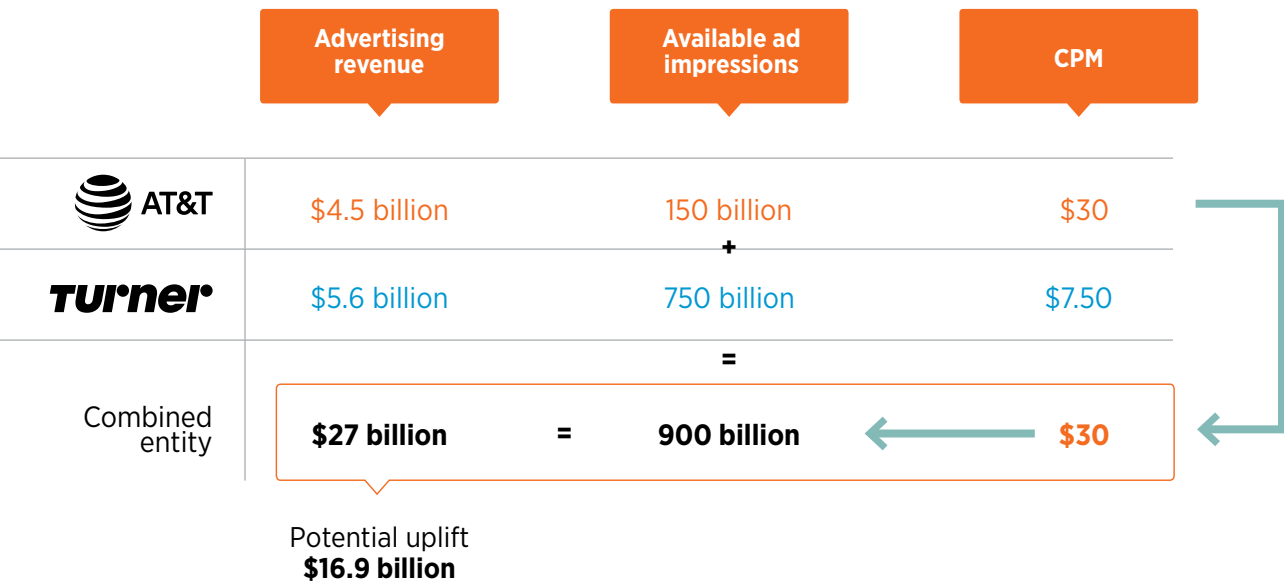
20. Reuters

21. The cost an advertiser pays for 1,000 views or clicks of an advertisement

22. In reality, these upside numbers would be down-weighted since AT&T will only have customer data on around two-thirds of US consumers

Figure 14 Source: GSMA

AT&T’s new ad revenue potential



- Other potential benefits of the acquisition include:
- significantly lower content costs
 - lower customer acquisition marketing costs
 - uplift to legacy business
 - healthy content revenue growth
 - ability to sell content to other providers and businesses.

AT&T’s massive investments on both the content and advertising fronts look to be the industry’s first significant challenge to Google and Facebook’s advertising dominance, with potential to capture as much as 10% of total US ad spend in the medium term. Net ad revenues are projected to reach an all-time high of around \$200 billion in the US in 2018, 5.5% growth from 2017, and for the first time around half of this is expected to be through digital formats (including search, video, display and social, of which mobile accounts for almost 60%).²³

Meanwhile, in June 2017, Verizon launched Oath, the new umbrella company of its digital content subdivisions that include previous acquisitions AOL and Yahoo. Oath could be a way for Verizon to present its family of digital content services to advertisers and other partners as a single entity. Since Verizon is a home internet provider and the largest mobile operator in the US (with 35 million fixed and 116 million mobile connections in Q2 2018), its access to subscriber data could help provide a significant boost to the Yahoo/AOL advertising business. In Q2 2018, Verizon reported Oath revenues of \$1.9 billion. However, in July 2018, Verizon announced it was not going to compete with other content providers (such as AT&T and Comcast) in terms of creating or owning content, instead focusing its efforts on content distribution and delivery of 5G services.

Assuming the ability to execute on these strategies, AT&T and Verizon can serve as models for other large mobile operators looking to diversify into content and advertising verticals, while also finally proving the value of moving beyond just connectivity provision.

3.2 Networks evolving to meet future demand

The US will be one of the first countries to launch 5G commercial services, as was the case for 4G. Mobile 5G services based on industry standards are expected to launch in late 2018 by AT&T and Verizon, with AT&T targeting 12 markets for this phase. The first 5G devices are anticipated to work as mobile

hotspots while waiting for early 5G devices to be ready in 2019. All four mobile operators in the US – AT&T, Sprint, T-Mobile and Verizon – will provide mobile 5G services by 2019; this represents a major milestone for the US mobile industry.

3.2.1 5G use cases: opportunities in fixed wireless and mobile consumer/enterprise

The majority of mobile operators around the world, including those in the US, indicate that the provision of enhanced mobile broadband to the consumer market will be the core proposition in early 5G deployments, with massive IoT and ultra-reliable, low-latency communications gaining scale at a later stage. Ultra-reliable and low-latency communications may be utilised in a number of emerging or future areas such as autonomous vehicles, industrial and vehicular automation, remote medical surgery, and advanced AR and VR.

In the US, mobile operators agree that innovative and segmented consumer propositions targeting an enhanced mobile/video customer experience will help drive 5G consumer adoption at launch while awaiting greater scale in IoT and developments in

AI and automation. This includes entertainment content delivered through advanced video capabilities, AR/VR devices and applications for gaming and immersive TV, and multi-device subscriptions that include IoT services (e.g. connected cars).

Meanwhile, 5G-based fixed wireless is an additional use case in the US, offering a potentially lower cost and faster means – compared to FTTH – of expanding high-speed services to households and businesses, bringing the opportunity to gain market share and incremental revenue. To this end, Verizon has indicated that it will launch 5G-based fixed wireless services in three to five US markets in the second half of 2018.

23. “Digital advertising soon to grab 50% of all ad dollars”, MAGNA, March 2018

Figure 15 Source: GSMA CEO 5G Survey (October 2016), ITU, 3GPP and major vendors

Priority use cases in early 5G deployments

Question: What will be your highest priority use case in early 5G deployment?

Percentages add to 100% of respondents globally.



Enhanced Mobile Broadband

- Ultra-fast internet (gigabytes in a second)
- Enhanced video (4K, 8K, 3D, 360-degree video, ultra HD live streaming on mobile)
- Early AR and VR
- Work and play in the cloud



Additional use case in the US - fixed wireless
(launch in the second half of 2018)



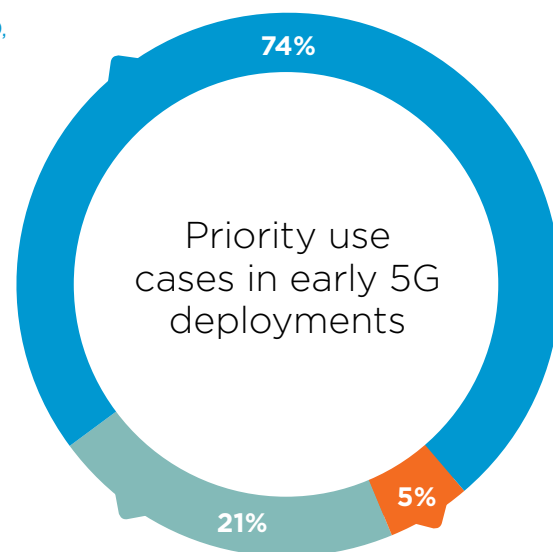
Ultra-Reliable, Low-Latency Communications

- Advanced AR and VR
- Connected and autonomous vehicles
- Industrial and vehicular automation
- Mission critical broadband (e.g. emergency services)



Massive Internet of Things

- Smart cities
- Smart buildings
- Multiple vertical industries



The largest opportunity for incremental revenue in the 5G era is from services targeted at the enterprise sector, with more than two-thirds of global mobile operators indicating this will be their most important source of new revenue. There is also broad agreement from operators across the

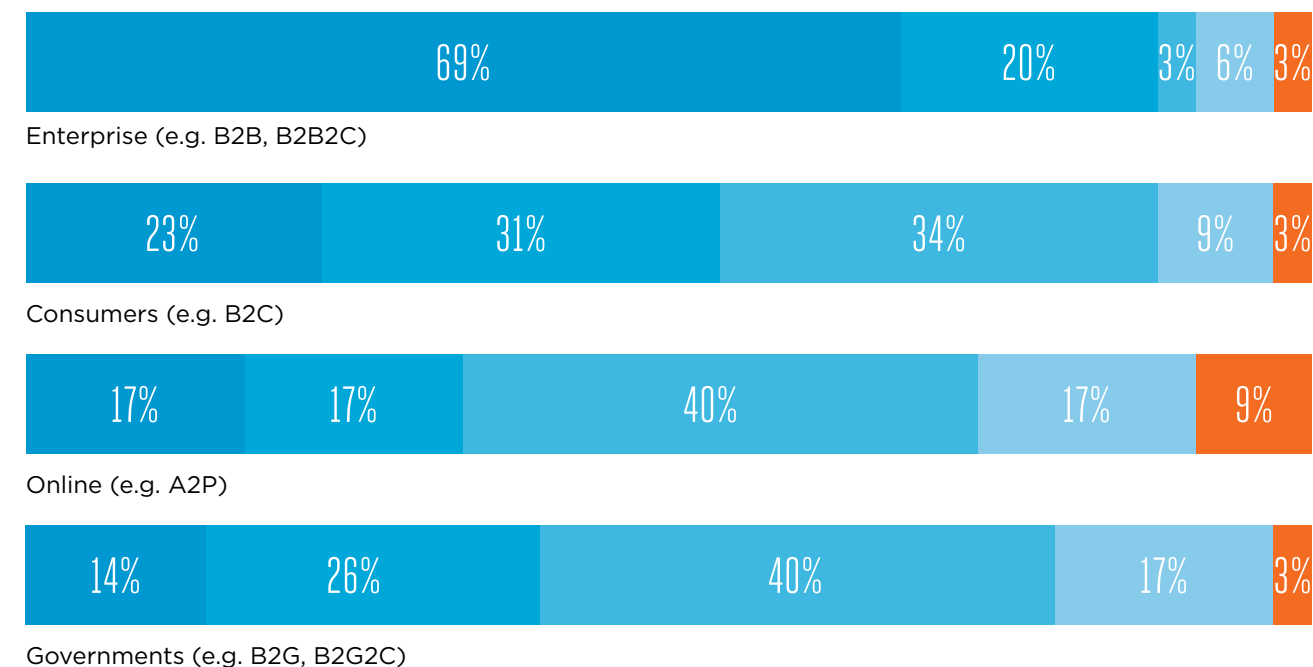
US, China, Japan, South Korea and Europe on the key industry verticals where 5G can deliver greatest value, including automotive, transportation, media, industrial manufacturing, logistics, energy, utilities, healthcare, agriculture and smart cities.

Figure 16 Source: GSMA CEO 5G Survey (October 2016)

Sources of new operator revenues for 5G

Question: Where will new operator revenues in 5G come from?

Global results



Most important

2

3

4

Least important

While the potential is clear, long-term monetisation may require greater maturity of the 5G ecosystem – particularly for the more innovative and mission-critical services, such as autonomous vehicles and certain smart city applications. Industry-wide collaboration and innovation centres, where companies from across different sectors can experiment with the 5G ecosystem to develop new

products and services, are key in the 5G era. To this end, mobile operators are working with other tech players and industrial companies to bridge ICT and vertical industries, and establish new solutions that can be initially tested and implemented on 4G networks with a view to exploiting enhanced 5G capabilities in the future.

3.2.2

The move to software-based networks

To ensure they can meet the capacity, coverage and efficiency demands of future 5G services (and indeed some current 4G services), mobile operators in the US are investing in their networks to achieve the highest performance at the lowest cost per bit. Rather than meeting demand by buying and installing new hardware with every new generation of services – a costly and time-consuming business – mobile operators are increasingly using advancements such as network function virtualisation (NFV) and software-defined networking (SDN) to maximise network efficiency.

In early 2015, AT&T stated its plan to virtualise and software-control 75% of its core network functions by 2020, up from 55% in 2017. To achieve this, AT&T has developed its Open Network Automation Platform (ONAP), which is described as an operating system for the network cloud, as well as OpenROADM, its cross-vendor software interoperability initiative.

More recently, AT&T announced in March 2018 that it is replacing specialised, proprietary routers (running vendor-specific software) with 60,000 white box routers running open-source software in its cell towers over the next few years, allowing faster and cheaper network upgrades when required. This means AT&T's virtualisation efforts now extend across its entire network as it moves to upgrade to 5G network technology and transition to an edge computing paradigm.

AT&T's moves into open source are partly an effort by the operator to rally vendors and developers around the software by encouraging other operators to use its open source offerings. In January 2018, Verizon announced it too would join a range of other operators using ONAP, which brings together more than 50 of the largest network and cloud operators and technology providers from around the world (representing more than 60% of the world's mobile subscribers) to deliver a neutral automation platform for network, infrastructure and services.

3.2.3

Bringing security to the forefront

As mobile becomes the remote control for day-to-day life, mobile identity is key to making things simpler and more secure for consumers. In March 2018, the Mobile Authentication Taskforce – created to develop a next-generation identity verification system for mobile device users and comprising AT&T, Sprint, T-Mobile and Verizon – announced that its multi-factor ID confirmation solution will be available to consumers by the end of 2018.

Unlike two-factor authentication, which typically relies on a password plus a PIN code retrieved from a trusted device, the new multi-factor solution is expected to be simpler and more secure, using an encrypted, device-specific profile to confirm a user's identity. Much like modern credit card

transactions, a risk assessment engine with AI and advanced analytics will process each profile – which includes unique user details such as the phone's network-verified phone number, IP address, SIM card details and phone account type – confirming or denying identity.

The new cross-operator identity service is also interoperable with Mobile Connect, the GSMA-backed secure universal login solution that matches a user to their mobile phone, allowing them to log in to websites and applications quickly without the need to remember passwords and usernames. It will also allow mobile operators to improve the targeting of mobile advertising and acquire consent in a much simpler way.

3.2.4

Further regulatory developments are key to realising potential of 5G

Streamlining regulation as well as further developments in three main areas could influence the development of 5G over the next decade:

- **Spectrum** – US mobile operators believe there is a need for a regulatory framework that prioritises and supports the timely and sufficient availability of spectrum for 5G, both in the short term (2018–2019) and beyond. This applies to all frequency ranges (sub-1 GHz, 1–6 GHz and above 6 GHz), including the mmWave frequencies, as well as licensed and unlicensed bands. The FCC is currently focusing on getting the mmWave spectrum to auction.
- **Infrastructure** – US operators believe regulators must aim to reduce existing barriers to deploying infrastructure, particularly small cells, which are expected to be widely utilised in 5G networks. Moreover, policymakers should allow any infrastructure sharing arrangements to develop organically and commercially over time – if they are viable – rather than introduce rules that could slow the pace of deployment.

- **Economics** – While the long-term economics of 5G for the mobile industry are uncertain at this stage, in the US (and around the world), there is a shared view among operators that the investment needed to deploy 5G networks and deliver mobile connectivity for all use cases should be supported by a long-term policy environment that provides greater predictability, spurs effective competition among companies in the ecosystem, and encourages innovation. Pro-investment reforms – such as the US tax reform signed into law in late 2017 – will help fuel investments in US infrastructure and increase business activity in other major industries; this could in turn spur additional demand for services provided by US operators.

To make further progress with 5G, operators and other mobile players should continue to work closely, and collaborate with the US government and institutions at the federal, state and local levels. Ultimately, the way 5G is deployed, funded, regulated and commercialised will determine the development of the wider mobile ecosystem over the next decade.

3.3 Scaling IoT

The number of IoT connections²⁴ in North America will triple between 2017 and 2025, reaching 5.9 billion. Consumer IoT currently accounts for the majority of connections (63% or 1.2 billion) and

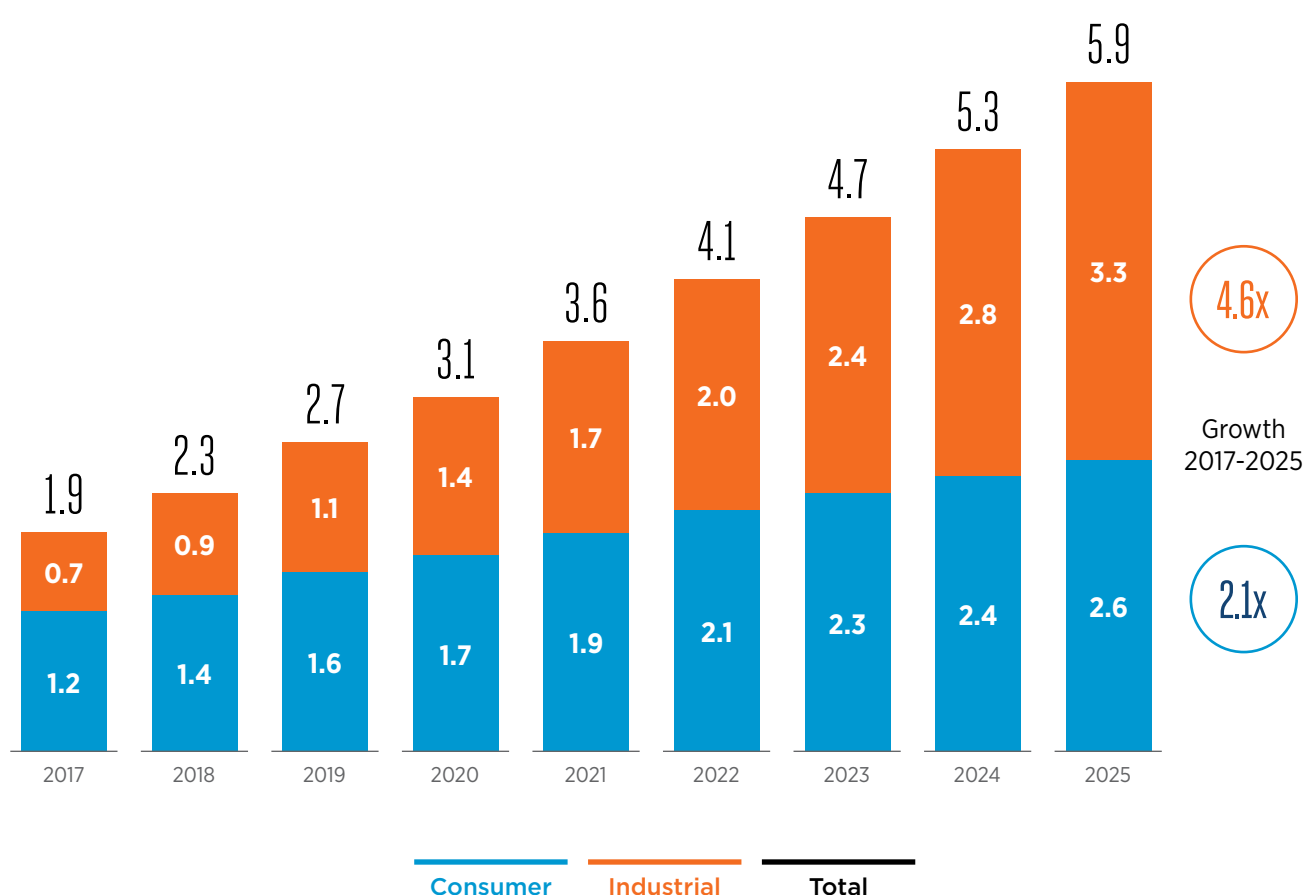
will almost double in size to 2.6 billion by 2025. This is mostly driven by increased adoption across consumer electronics, smart homes and smart vehicles.

Figure 17

Source: GSMA Intelligence

North America IoT connections

Billions



The US leads in terms of smart home adoption, with the highest smart home device ratio per household and the greatest consumer propensity to own devices across two or three use cases (security, energy and appliances).²⁵ It also boasts an active ecosystem of smart home solution providers, such as Vivint, which has recently implemented Google Assistant into its product range. Another smart home provider, Alarm.com, has recently announced a home-builder programme to help install devices into newly built homes.

Connected car is an opportunity mobile operators have been pursuing for a while now, and the majority of the largest US and Canadian operators already offer connected car platforms. AT&T is leading the pack, having connected more than 19.5 million cars to its network so far.

By 2025 however, industrial IoT will overtake consumer, driven by strong adoption across enterprises in verticals such as smart buildings, utilities, manufacturing and smart cities. For example:

- Siemens has recently acquired Building Robotics to increase its presence in smart buildings. The US-based company has designed a smartphone app that allows employees to register discomfort with office conditions; this communicates with a software platform that changes the lighting and HVAC conditions.
- New York State Electric and Gas Corporation announced in June 2018 that it plans to replace all electricity and gas meters with smart meters within the next five years. Smart grids became federal policy in 2007 as part of the Energy Independence and Security Act, and were funded by the Smart Grid Investment Grant (SGIG) programme, which provided funding to smart meter manufacturers. These types of incentives have resulted in North America taking the top spot in terms of smart meter deployments globally.
- BMW's South Carolina factory has implemented smart factory technology with the aim to reduce the cost of manufacturing vehicles. Meanwhile, Toyota's North Carolina factory is installing smart factory machinery to save on maintenance costs.
- The Canadian government has created a smart city challenge to generate ideas to improve

residents' lives using technology, offering prizes for the best proposals. Geotab, a telematics and smart city solution provider, in June 2018 launched a website, Intelligence and Smart City Datasets, which helps cities identify dangerous driving behaviour and other infrastructure challenges. Nokia plans to bring GE's smart city platform, CityIQ, to Canada and has collaborated with Smart City Capital to support smart city projects in the country.

Although the majority of IoT connections are short range (Wi-Fi, Zigbee etc.), the momentum behind licensed LPWA is growing. These networks serve the needs of low-data rate IoT devices traditionally served by 2G networks, which are being phased out across North America by 2020. AT&T closed its network in 2017, and the remaining big three US operators have announced that they will shut down 2G by 2020. In Canada, Telus and Bell are shutting their 2G networks by the end of 2018.

Narrowband IoT (NB-IoT) and LTE-M connections will increase almost 16-fold between 2018 and 2025, reaching 287 million connections. The four largest US operators have either deployed LTE-M and/or NB-IoT or are planning to do so within the next two years. As such, AT&T and Verizon already have live LTE-M networks, and T-Mobile is currently the only operator in North America to have a live NB-IoT network. T-Mobile trialled the network with the City of Las Vegas to identify smart city applications such as temperature, flood, humidity and environmental sensors and LED streetlights. Recently, it also announced its partner programme 'Connect', with the goal to increase commercialisation and development of IoT solutions. T-Mobile and Sprint have plans for LTE-M deployments while AT&T, Sprint and Verizon have plans for NB-IoT rollouts (with AT&T quoting customer demand for a lower cost solution for IoT as the main reason). Bell Canada is planning an LTE-M deployment and has piloted the use of LTE-M for a winery for measuring temperature and water levels.

IoT revenue²⁶ in North America will increase at an average annual rate of 21% between 2017 and 2025 to reach \$337 billion, 4.5 times its current figure of \$74 billion. North America currently accounts for 35% of global IoT revenue. The market is home to IoT heavyweights – including Google, Amazon and GE – and has a vibrant start-up ecosystem.

24. IoT connections include cellular and non-cellular connections. IoT comprises IP-enabled devices capable of two-way data transmission (excluding passive sensors and RFID tags). This includes connections using multiple communication methods such as cellular, short range and others. It excludes PCs, desktops, tablets, laptops, e-readers and smartphones.

25. Smart home: from niche to mainstream by 2025, GSMA Intelligence, 2018

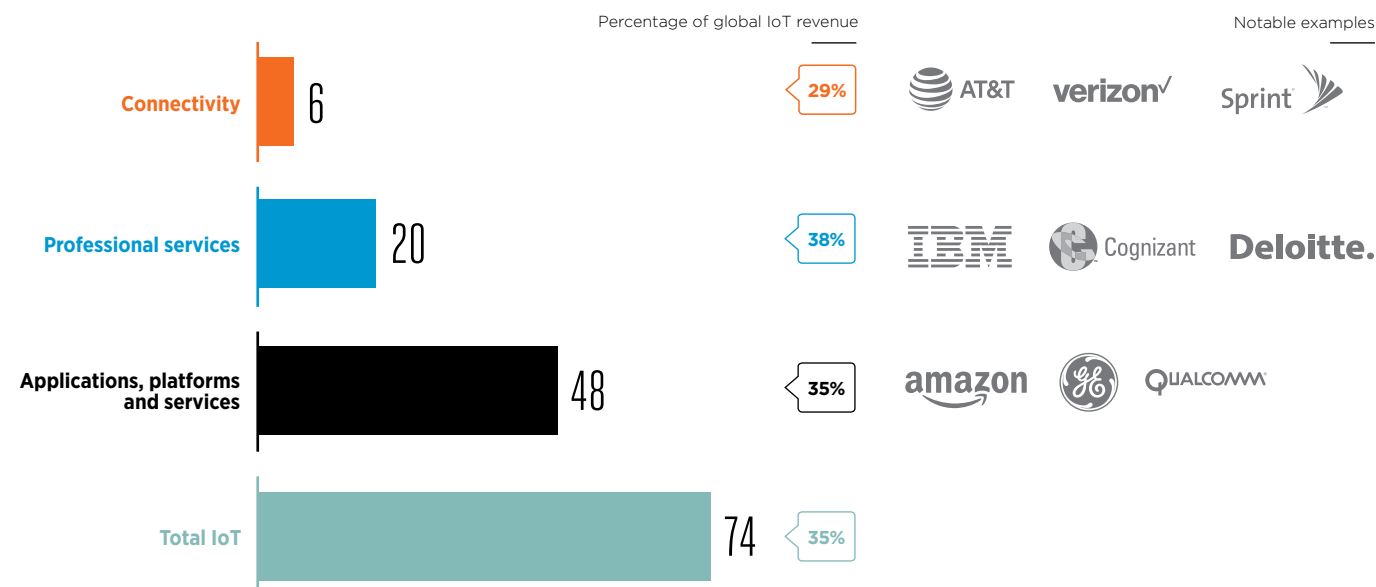
26. For GSMA Intelligence, IoT revenue excludes device and module chipset revenue, but includes revenue associated with provision of connectivity, applications, platforms and services, and professional services

Figure 18

Source: GSMA Intelligence

North America IoT revenue

2017, \$billion



In North America, applications, platforms and services account for the majority of IoT revenue (two-thirds of the total), as mobile operators have been deploying different strategies and business models to move beyond offering connectivity only (which accounts for only 8% of total North America IoT revenue). Their role in the value chain could vary from being the overall aggregator of the solution to simply providing enablers that other companies use to build a solution. For example, Sprint has launched IoT Factory, an online marketplace that provides pre-packaged IoT solutions targeting SMEs. This is reinforced by Sprint's strategic partnerships – myDevices and the Goldie Group.

Another route to market for mobile operators is to become an end-to-end solution provider. Verizon is a prime example, having spent \$5 billion in acquisitions (including Hughes Telematics, Telogis and Fleetmatics) resulting in the creation of Verizon Connect in March 2018, which offers a full suite of telematics solutions. The operator is also providing solutions to other verticals, such as utilities: It has collaborated with Hawaiian Electric to provide the cloud-based software platform Grid Wide Utility

Solutions for smart metering data management. Verizon reported IoT revenues (including telematics) of \$1.5 billion in 2017, a 52% annual increase.

Mobile operators have also been active in forging partnerships across the value chain, not only to address vertical-specific opportunities but also to offer horizontal enablers. To that end, AT&T and Tech Mahindra launched an open source AI platform, Acumos, in partnership with the Linux Foundation. The goal of the platform is to provide a marketplace for developers and business to access, use and build AI applications. Several mobile operators have decided to sell off their datacentre facilities to work closer with cloud service providers rather than trying to compete in this space. In June 2018, AT&T announced it would sell off 31 datacentres to Brookfield Infrastructure, which will continue to host AT&T services such as NetBond, its high-speed secure virtual private network. This comes after Verizon announced in May 2018 that it would choose AWS to host 1,000 business applications and database systems after selling off its datacentres to IBM in 2016.

3.4

A vibrant startup ecosystem supporting future innovation

2017 was a record year for global VC funding, with around \$380 billion invested via 35,000 deals. However, the first half of 2018 showed further growth which – if continued into the second half – would lead to an all-time annual record of financing, both in North America and worldwide.

In North America, private equity companies, VC firms and corporates have invested more than \$750 million since 2013 to finance start-ups and

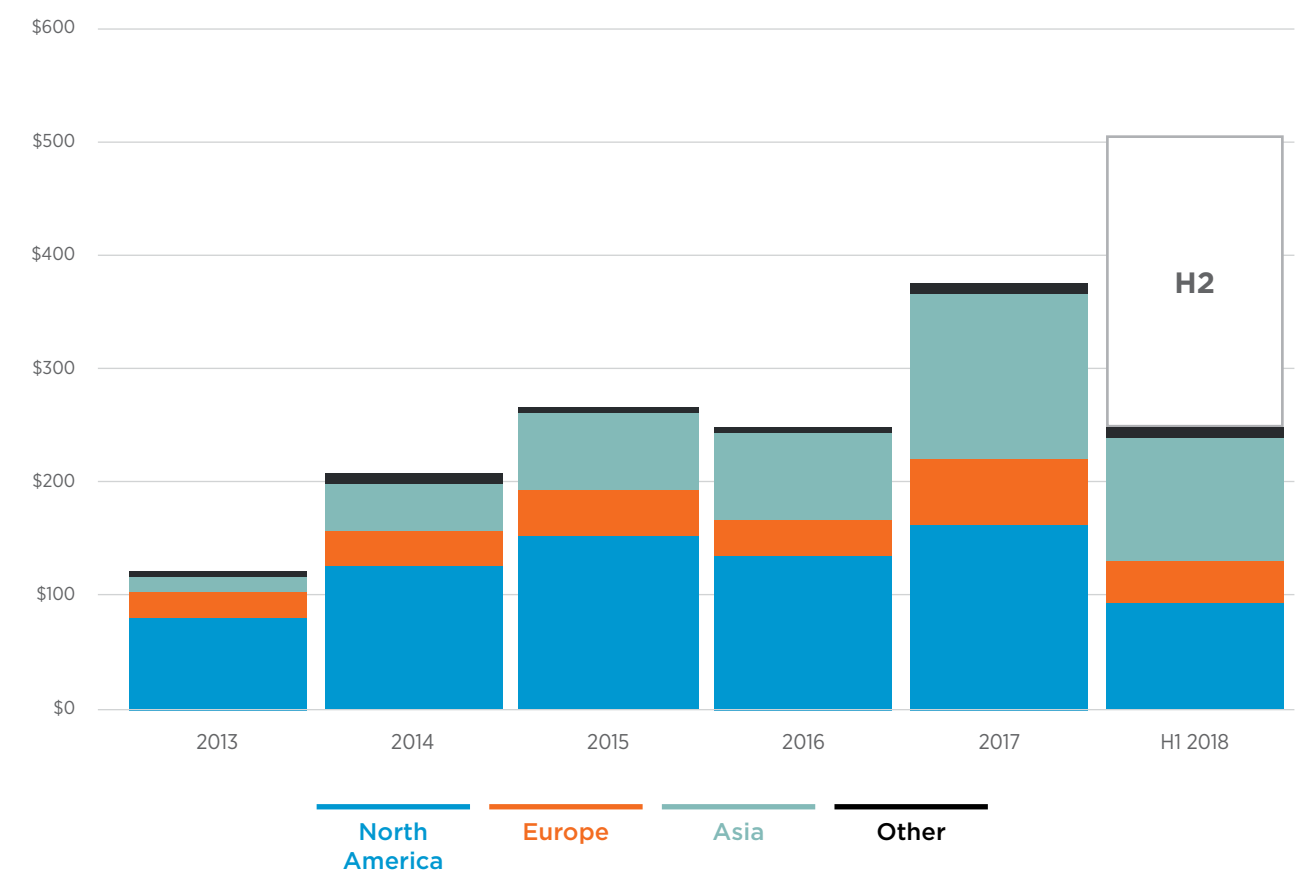
emerging companies, just under half of which has been in the internet and mobile sectors. The US is still the largest single market worldwide, accounting for over a third of global financing; this continued growth in funding confirms its role as the heart of tech innovation and digital transformation, and is providing valuable support to growth and developments in the wider mobile ecosystem.²⁷

Figure 19

Source: CB Insights, GSMA Intelligence

Global investor financing

Billion



Note: H2 2018 is an indicative estimate based on H1 2018. There has been little/no seasonality over the last few years

27. CB Insights

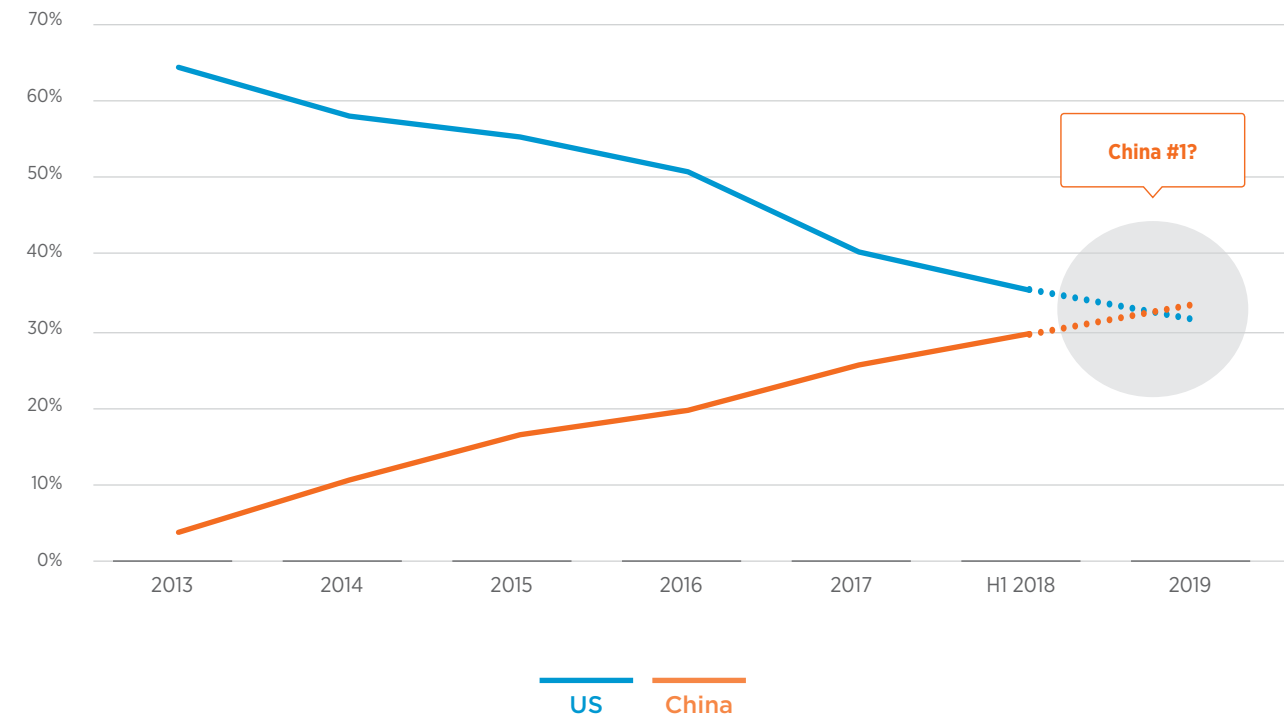
The US is, however, facing growing competition from other regions. Asia overtook North America in the first half of 2018 to be the largest regional recipient of VC funding, with China on the rise. In

the first half of 2018, China accounted for 30% of global funding, rapidly closing the gap on the US with 35%.²⁸ If this trajectory continues, China could become the global leader in the next 6–12 months.

Figure 20 Source: CB Insights, GSMA Intelligence

Will funding in China overtake the US soon?

Percentage of global funding



China overtakes the US as the global AI pacesetter

One particular area of growth for China has been in AI. VC funding in the AI sector worldwide reached \$17.5 billion in 2017, an annual increase of 162%. China accounted for more than 60% of this growth. The Chinese government is promoting a futuristic AI plan, encompassing everything from smart agriculture and intelligent logistics to military applications and new employment opportunities growing out of AI. Part of the resources are going to grassroots innovation, with the result that funding for Chinese AI startups increased 10-fold in 2017 compared to 2016. In fact, Chinese AI startups accounted for nearly half of total global AI funding in 2017, up from just over 10% in 2016, surpassing the US for the first time.²⁹ Interestingly, Sequoia Capital China is the number 1 investor in Chinese AI startups with 21 deals in the last year, more than its parent company, Sequoia Capital, completed in the US.











Given the need for rapid innovation to evolve and meet future demand, there is a changing dynamic within mobile operators to pivot their business models to tap into this growing startup ecosystem. For example, Orange Silicon Valley (OSV) engages with more than 500 new companies each year through its Orange Fab startup accelerator and the Orange Institute, actively participating in disruptive innovations such as AI, big data, cryptocurrency, cloud computing and IoT.

Similarly, the AT&T Foundry brings the expertise of AT&T innovators into a collaborative environment with industry technology providers, developers and startups to move ideas to market faster, while the Verizon Innovation Program, open to mid-stage innovators and start-ups, works with companies of all sizes to bring their non-traditional connected solutions to market.

Facilitating collaboration between mobile operators and innovators, GSMA 100 (part of the GSMA's innovation portfolio) are the world's most promising growth-stage companies, developed from mobile operators' desire to shorten the time to innovation discovery, by sharing common interests and market validation. The initiative leverages GSMA's reach into the mobile operator, investment and innovation ecosystems, offering new channels to speed business development, commercial partnerships and investment. Key areas of innovation within the initiative are shown in Table 2.

Table 2 Source: GSMA

Top 10 areas of innovation as ranked by GSMA 100 members

1		IoT/mobility/smart city
2		Entertainment & media (e.g. video, adtech, AR/VR)
3		Artificial intelligence & machine learning
4		Consumer experience
5		Security
6		Edge computing
7		5G
8		SDN/NFV
9		Energy efficiency
10		Backhaul

28. CB Insights
29. "Top AI trends to watch in 2018", CB Insights, February 2018

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