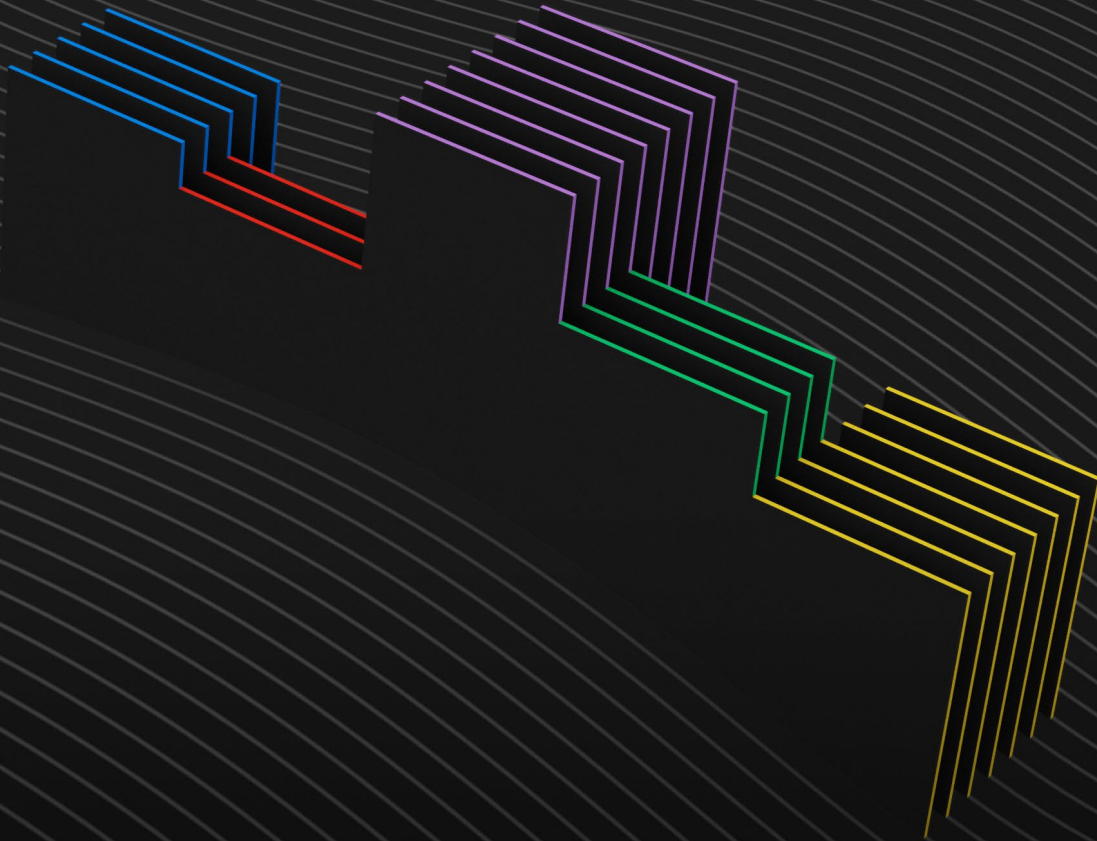




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Ericsson Mobility Report



November 2019

Subscriptions

Strong 5G subscription momentum as ecosystem rapidly develops

Mobile data traffic

Driven by constantly increasing video content, mobile data traffic continues to surge

Co-written articles

Insights from SK Telecom and MTN Group illustrate strong mobile industry progress

Letter from the publisher

5G momentum continues

5G goes from strength to strength as networks are built out across the world. A big uptake of 5G subscriptions has taken place in South Korea, with around 3 million subscribers recorded in just a few months. Globally, we estimate 5G subscriptions for the end of 2019 will reach 13 million.

In perspective, what has happened in 2019 doesn't determine the success of 5G but rather indicates what is to come. When looking at the development in this industry over the last few years it is truly astonishing to see the progress. The 5G specifications were accelerated in 3GPP, leading to device and infrastructure vendors taking on the challenge to deliver 5G earlier than expected. It is encouraging to see that 5G now has broad support from almost all device makers, and a very strong ecosystem.

Together with SK Telecom we take a closer look at the deployment strategies used to capture early benefits of 5G. We also examine communications service provider tariff plans and how they are evolving. So far, a majority of the launch markets are charging a premium averaging almost 20 percent for 5G subscriptions.

Today most of the investments, traffic and subscriptions are in 2G, 3G or 4G networks. Modernizing existing networks, improving network performance and increasing user experience continue to be at the core of every service provider's day-to-day business. Together with MTN, we explore how this is achieved in two African markets.

By 2025, we expect 5G to have 2.6 billion subscriptions covering up to 65 percent of the world's population and generating 45 percent of the world's total mobile data traffic.

I hope you find the report engaging and useful!

Publisher

Fredrik Jejdling

Executive Vice President and Head of Business Area Networks

Key contributors

Executive Editor:	Patrik Cerwall
Project Manager:	Anette Lundvall
Editors:	Peter Jonsson, Stephen Carson
Forecasts:	Richard Möller
Authors:	Peter Jonsson, Stephen Carson, Greger Blennerud, Jason Kyohun Shim, Brian Arendse, Ahmad Hussein, Per Lindberg, Kati Öhman
Co-authors:	Navindran Naidoo, Pieter Van der Westhuizen, Emmanuel Lartey: MTN Group (South Africa) Jonghun Lee, Chiyong Choi: SK Telecom (South Korea)

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We describe how in Ghana and Rwanda, MTN Group is leveraging network performance and customer loyalty to address growth opportunities.

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With SK Telecom, we look into their cluster-based 5G deployment strategy, focusing on customer experience.

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We show how increasing performance levels of 4G and introducing 5G are driving innovation in mobile service packaging.

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Mobile subscriptions Q3 2019

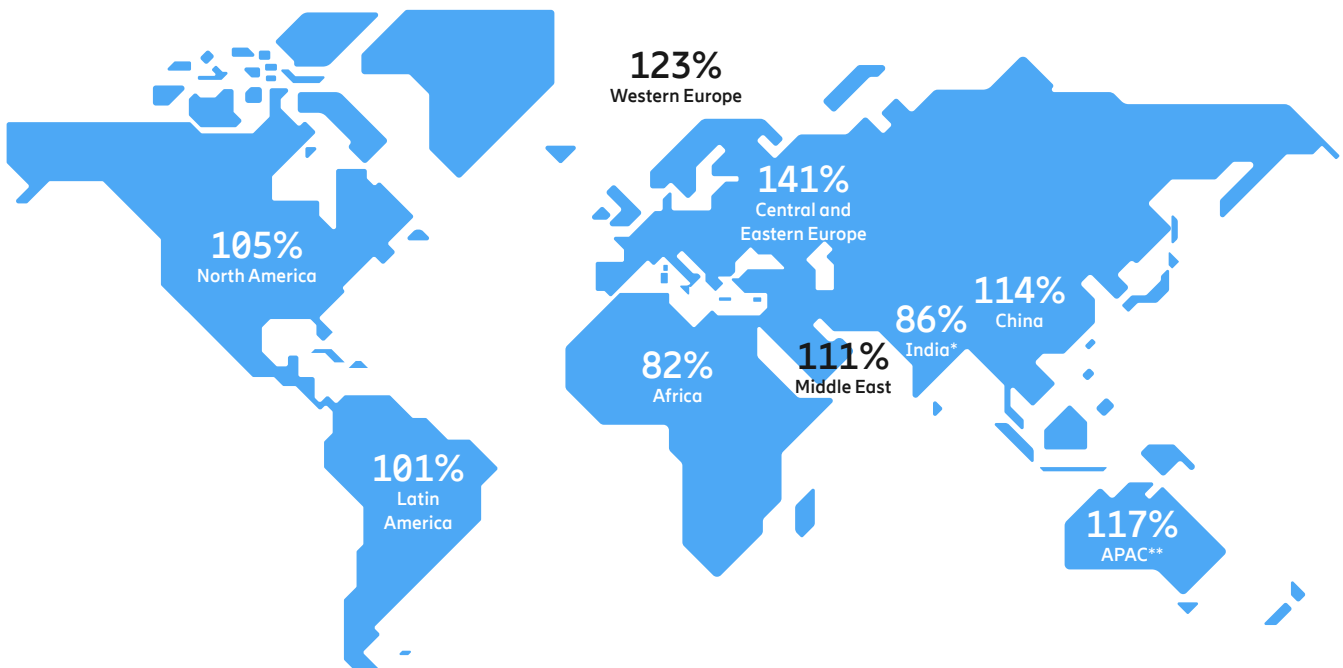
The total number of mobile subscriptions was around 8 billion in Q3 2019, with 61 million subscriptions added during the quarter.

The number of mobile subscriptions grew at 3 percent year-on-year and currently totals around 8 billion. High subscription growth continues from previous quarters in China, which had the most net additions during the quarter (+14 million), followed by Indonesia (+9 million) and the Philippines (+8 million).

The number of mobile broadband subscriptions¹ grew 10 percent year-on-year, increasing by 120 million in Q3 2019. The total is now 6.2 billion or 77 percent of mobile subscriptions. The number of 4G (LTE) subscriptions increased by 190 million during the quarter to reach a total of 4.2 billion, or 52 percent of all mobile subscriptions. 3G (WCDMA/HSPA) subscriptions declined by 50 million and 2G (GSM/EDGE-only) subscriptions declined by 70 million. Other technologies² declined by around 10 million.

Subscriptions associated with smartphones account for more than 70 percent of all mobile phone subscriptions. Mobile subscriptions exceed the population in many countries, which is largely due to inactive subscriptions, multiple device ownership and use of different subscriptions for different types of calls. As a result, the number of mobile subscribers is lower than the number of mobile subscriptions. Today, there are around 5.9 billion subscribers globally compared to 8 billion subscriptions. Global mobile subscription penetration is at 104 percent.

Figure 1: Subscription penetration Q3 2019 (percent of population)



¹ Mobile broadband includes radio access technologies HSPA (3G), LTE (4G), 5G, CDMA2000 EV-DO, TD-SCDMA and Mobile WiMAX

² Mainly CDMA2000 EV-DO, TD-SCDMA and Mobile WiMAX

* India region includes India, Nepal and Bhutan

** Excluding China and India

Figure 2: Total and net additions for mobile subscriptions Q3 2019 (million)

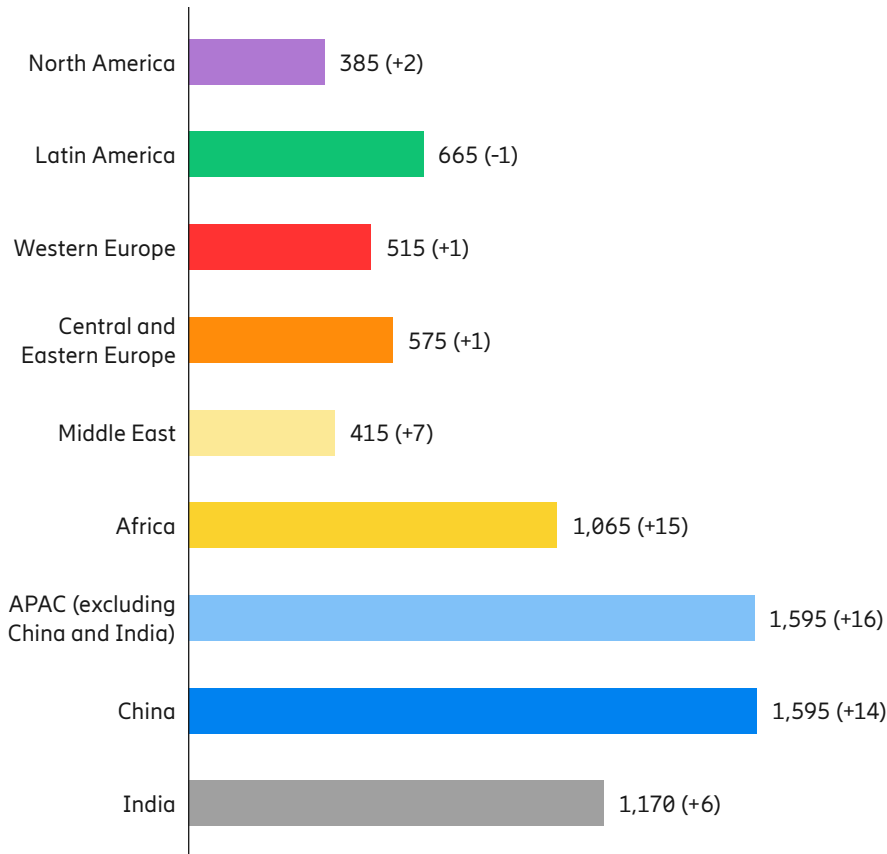
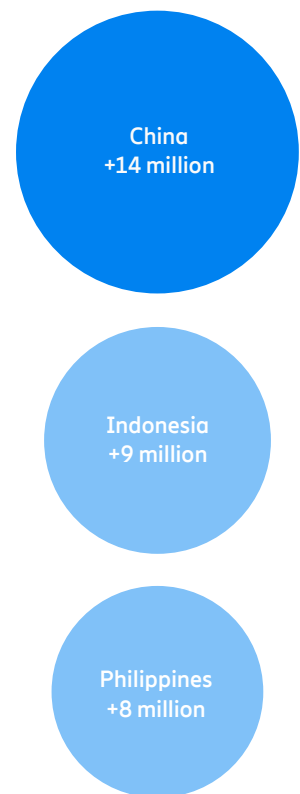


Figure 3: Top countries by net additions Q3 2019



6.2bn
 There are now 6.2 billion mobile broadband subscriptions.

61m
 During the quarter, 61 million subscriptions were added.

52%
 A total of 52 percent of all mobile subscriptions are now for LTE.

Mobile subscriptions outlook

A total of 13 million 5G subscriptions are expected by the end of 2019.

During the third quarter of 2019, service providers continued to switch on 5G and more 5G devices became available. Around 50 service providers¹ around the world have announced commercial 5G service launches.

A big uptake of 5G subscriptions² has taken place in South Korea, where all service providers launched commercial 5G services at the beginning of April. The initial focus for all three has been enhanced mobile broadband targeted at consumers, with immersive experiences based on virtual reality (VR), augmented reality (AR) and high-quality streaming. On a global level, 5G network deployments are expected to ramp up during 2020, building the foundation for massive adoption of 5G subscriptions. Over the next six years, 5G subscription uptake is expected to

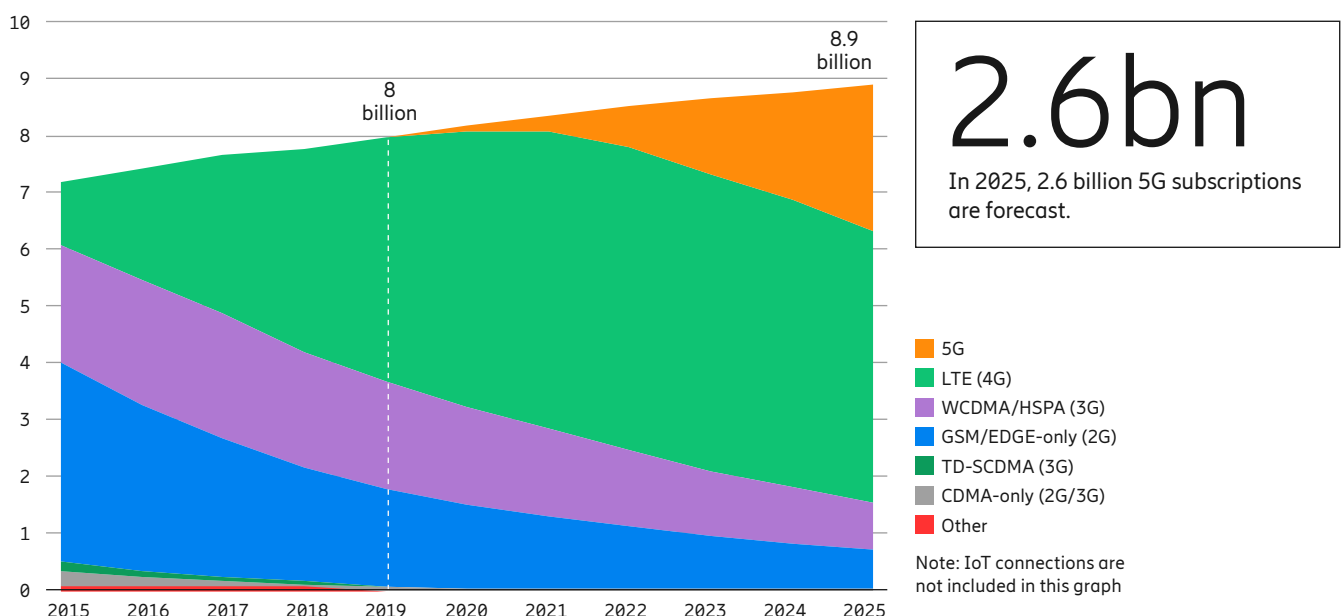
be significantly faster than that of LTE, following its launch back in 2009. Key factors are the earlier engagement of China in 5G compared to LTE, for which the country was not one of the early markets to launch, as well as the earlier availability of devices.

With the continued momentum for 5G, we predict 13 million 5G subscriptions by the end of this year. A big share of these subscriptions is expected to be in China. All three of the main service providers launched commercial 5G services in Q4 2019. Sign-up of customers started even before launch, with more than 10 million 5G users registered in October 2019. In 2025 we forecast 2.6 billion 5G subscriptions globally, accounting for 29 percent of all mobile subscriptions at that time.

LTE will remain the dominant mobile access technology by subscription during the forecast period. It is projected to peak in 2022 at 5.4 billion subscriptions and decline to around 4.8 billion subscriptions by the end of 2025 as LTE subscriptions migrate to 5G.

We anticipate a slower decline for 2G (GSM/EDGE-only) subscriptions than previously estimated, particularly in the Middle East and Africa region. In part, this is due to the longer life-cycles of 2G feature phones and the relatively higher cost of smartphones.

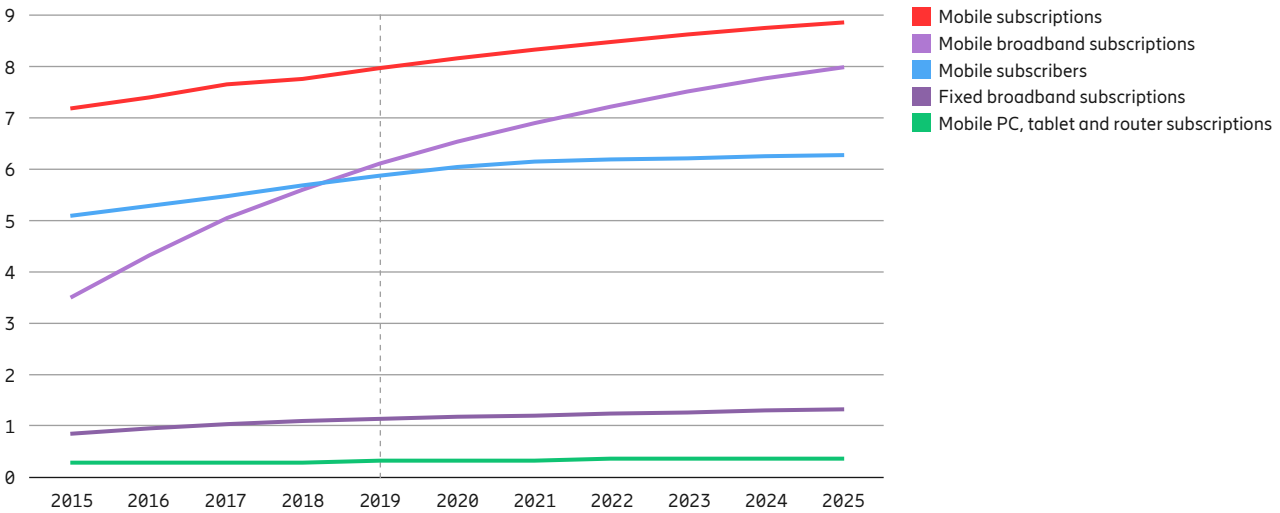
Figure 4: Mobile subscriptions by technology (billion)



¹Ericsson and GSA, November 2019

²A 5G subscription is counted as such when associated with a device that supports New Radio (NR), as specified in 3GPP Release 15, and is connected to a 5G-enabled network

Figure 5: Subscriptions and subscribers (billion)



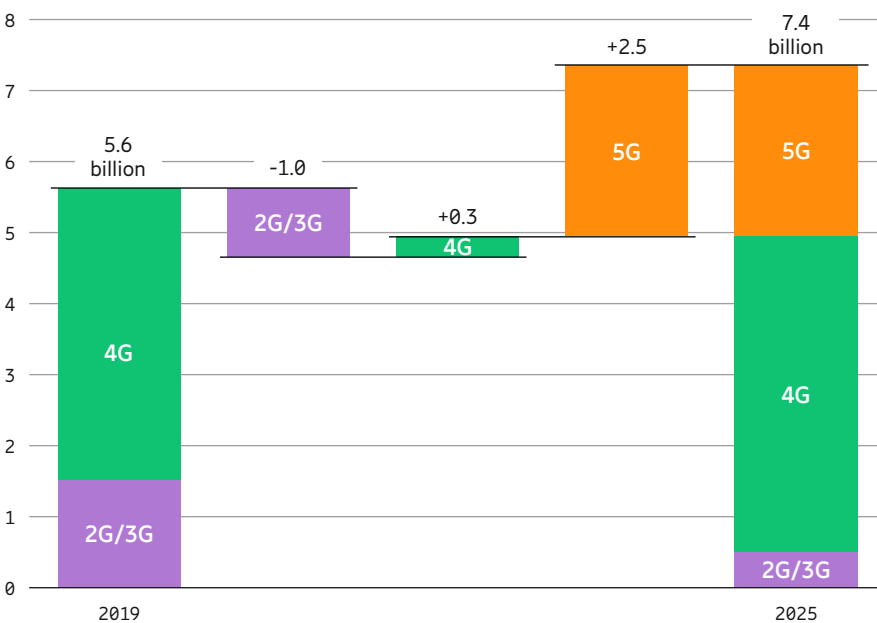
In 2025, 90 percent of subscriptions are projected to be for mobile broadband
 We estimate that there will be 8.9 billion mobile subscriptions by the end of 2025, out of which around 90 percent will be for mobile broadband. This is a slightly lower share than previously forecast, due to a slower decline for 2G (GSM/EDGE-only) subscriptions in the Middle East and Africa region. The number of unique mobile subscribers is projected to reach 6.3 billion by the end of the forecast period.
 Smartphone penetration continues to rise. Subscriptions associated with smartphones account for around 70 percent of all mobile phone subscriptions. It is estimated there will

be 5.6 billion smartphone subscriptions by the end of 2019. The number of smartphone subscriptions is forecast to reach 7.4 billion in 2025, or 83 percent of all mobile subscriptions.
 Subscriptions for fixed broadband are expected to show limited growth of around 2 percent per year through 2025.³ Subscriptions for mobile PCs, tablets and routers are expected to show moderate growth, reaching around 330 million in 2025.

8bn

In 2025, there will be 8 billion mobile broadband subscriptions.

Figure 6: Smartphone subscriptions by technology (billion)



³ The number of fixed broadband users is at least three times the number of fixed broadband connections due to shared subscriptions in households, enterprises and public access spots. It is the opposite for mobile phones, where subscription numbers exceed user numbers. FWA subscriptions are not part of the fixed broadband subscription estimate

5G device outlook

Second-generation chipsets will support 5G ramp-up.

Interoperability testing of second-generation silicon is now underway in laboratories. With this generation, vendors are working to surpass first-generation launches with more integrated designs, reduced power consumption, and more frequencies and network operation modes. There has been considerable talk about cellular access cutting the cables for Industry 4.0. Commercial-grade 5G modules for industrial use cases are expected with the launch of second-generation chipsets.

In 2020, we expect growth in the number of fixed wireless devices, with many vendors and models enabling 5G-connected households.

Entering the volume market

Annual shipments of 5G devices are projected to reach 13 million units by the end of 2019. 5G has clearly outpaced LTE in the number of devices launched during its initial roll-out period.

However, 2020 will be a different numbers game. 5G device volumes in 2020 are projected to reach 160 million units, with China expected to massively deploy 5G coverage. In addition, all major vendors will have released a 5G-capable device and a number of vendors are expected to have addressed mid-tier smartphone segments.

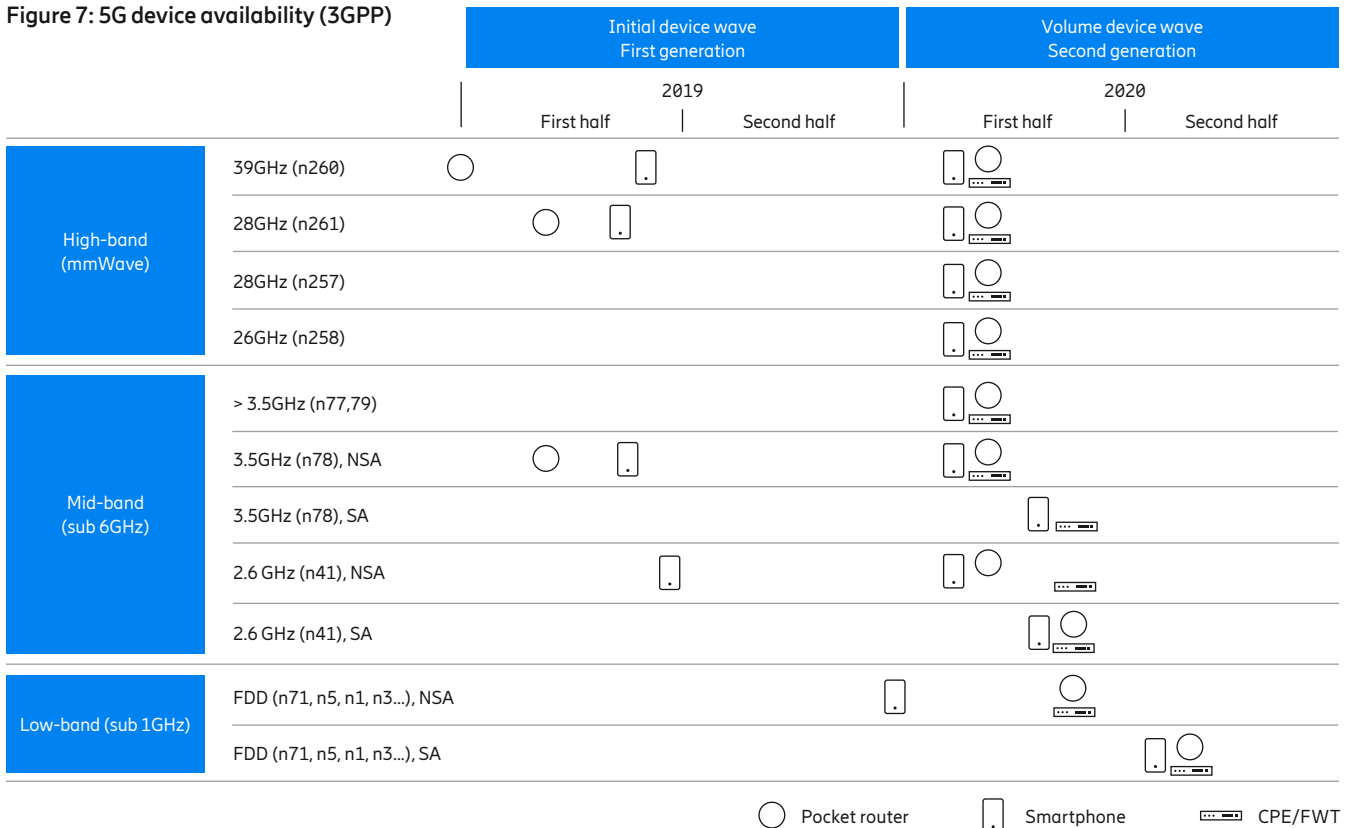
SA/NSA/FDD/TDD all in play and co-existing

In 2020, a typical 5G smartphone will be a very smart device. As many 5G networks are being launched using 5G non-standalone (NSA), this mode will be supported on most new devices along with 5G standalone (SA) mode. In both modes, phones will support:

- 5G carrier aggregation
- spectrum sharing
- low-band FDD and mmWave frequencies (as well as mid-band)

In short, 5G is expected to gain scale in 2020, enabled by coverage roll-out and availability of devices. Unlike previous cellular radio access technologies, it appears 5G will not be constrained by a lack of user equipment.

Figure 7: 5G device availability (3GPP)



Voice and communication services trends and outlook

VoLTE is the foundation for enabling globally interoperable voice and communication services on 4G and 5G devices, providing high-quality services to consumers and business users.

Service providers continue to evolve their voice networks to VoLTE-based services. These have now been launched in more than 200 networks in over 90 countries.¹ VoLTE services are being deployed using cloud technologies, to enable cost-efficient network operations, easier capacity scaling and faster service deployment.

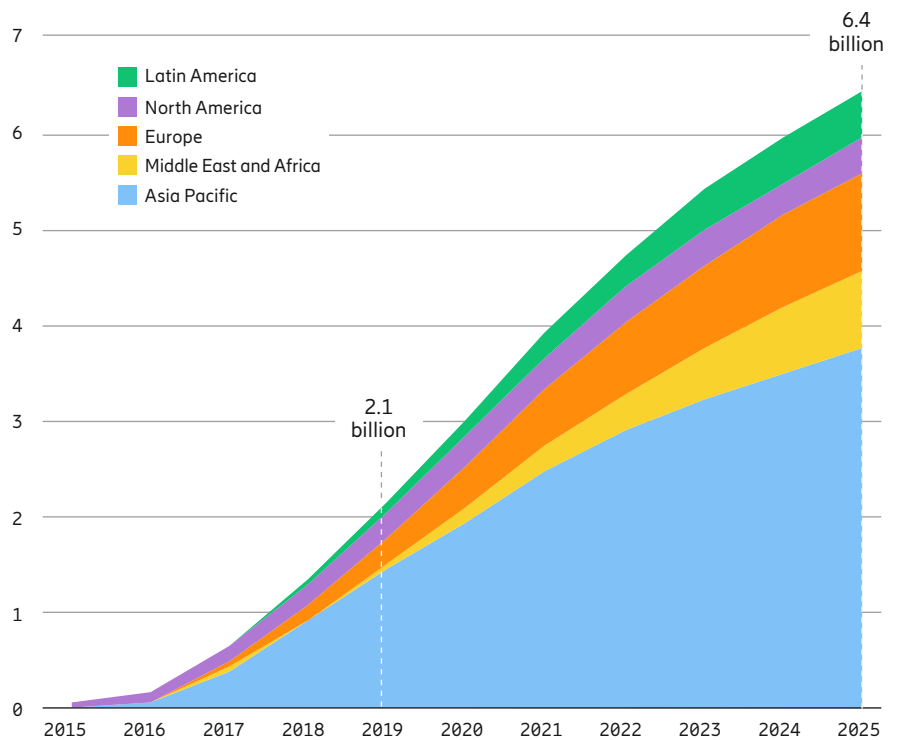
VoLTE subscriptions, estimated at 2.1 billion at the end of 2019, are projected to reach 6.4 billion by the end of 2025, and to account for more than 85 percent of combined LTE and 5G subscriptions. VoLTE will also be the foundation for enabling 5G voice calls, SMS and new types of communication services on various 5G devices. This will be deployed stepwise in 4G and 5G networks, using LTE-NR dual connectivity, Evolved Packet System fallback and voice over NR.

New use case uptake and device availability

There are more than 2,500 VoLTE-enabled device models.² The latest models also include the most recent high-definition voice codec Enhanced Voice Services (EVS). This provides improved audio and music quality within calls on VoLTE-capable devices, including 5G smartphones, as well as better call reliability across LTE and Wi-Fi. More than 165 EVS-capable device models are available, and EVS has been deployed by 20 service providers.³

The first service providers have now launched voice calling capabilities on smart speakers using the same mobile phone number as on a smartphone. This builds on the VoLTE multi-device network capabilities, where several devices can be tied to the same phone number, such as phones, cellular smart watches, smart speakers and other devices. There are now

Figure 8: VoLTE subscriptions by region (billion)



more than 80 service provider networks with cellular smartwatches enabled with voice services.

Video calling over LTE (ViLTE) is now provided in around 20 networks, and there are 395 device models⁴ available.

Other services based on VoLTE include additional phone lines on the same phone, group numbers, different types of enterprise collaboration services in combination with mobile HD voice, and voice in IoT devices. 5G-related service innovations for consumers, enterprises and industries are being explored, including combinations with AR and VR, and interactive calling.

2.1bn

VoLTE subscriptions are expected to reach 2.1 billion by the end of 2019.

¹ GSA (Oct 2019)

² GSA (Oct 2019), supporting different regions and frequencies

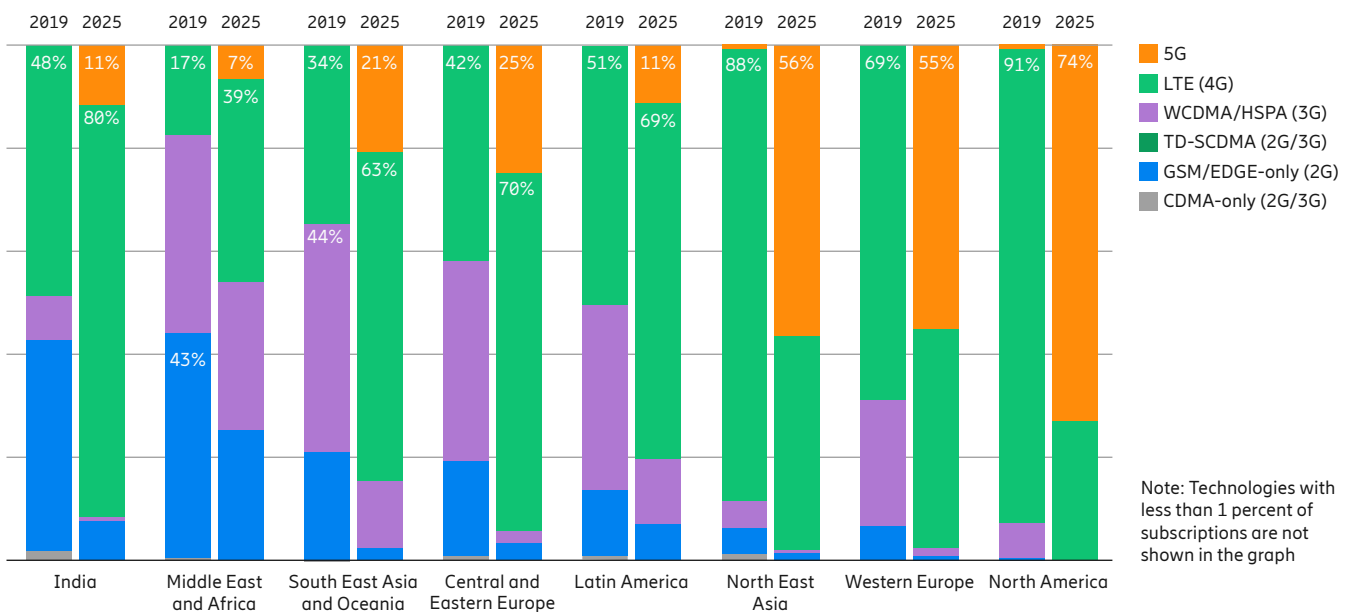
³ GSA (Oct 2019)

⁴ GSA (Oct 2019)

Regional subscriptions outlook

Mobile broadband subscriptions make up 77 percent of all mobile subscriptions.

Figure 9: Mobile subscriptions by region and technology (percent)



In the **India** region, LTE subscriptions are forecast to increase by 150 million during 2019 and pass GSM/EDGE as the dominant technology. Mobile broadband¹ technologies will account for 57 percent of mobile subscriptions at the end of the year, and the share of smartphone subscriptions is expected to have increased from 48 percent to 54 percent.

As the transformation toward more advanced technologies continues in India, LTE is forecast to represent 80 percent of mobile subscriptions by the end of 2025. 5G subscriptions are expected to become available in 2022 and will represent 11 percent of mobile subscriptions at the end of 2025.

The **Middle East and Africa** comprises over 70 countries and is a diverse region. It varies from advanced markets with 100 percent mobile broadband

subscription penetration, to emerging markets, where around 40 percent of mobile subscriptions are for mobile broadband. At the end of 2019, around 25 percent of mobile subscriptions are expected to be for LTE in the Middle East and North Africa, while in Sub-Saharan Africa, LTE will account for around 11 percent of subscriptions. The region is anticipated to evolve over the forecast period, and by 2025, 82 percent of subscriptions in the Middle East and North Africa are expected to be for mobile broadband, while in Sub-Saharan Africa mobile broadband subscriptions will increase to reach around 70 percent of mobile subscriptions. Driving factors behind this shift include a young and growing population with increasing digital skills, as well as more affordable smartphones.

150m

In India, LTE subscriptions are set to increase by 150 million during 2019.

¹ Mobile broadband includes radio access technologies HSPA (3G), LTE (4G), 5G, CDMA2000 EV-DO, TD-SCDMA and Mobile WiMAX

In the Middle East and North Africa, commercial 5G deployments with leading service providers have taken place during 2019, and significant volumes are expected in 2021. In Sub-Saharan Africa, 5G subscriptions in discernible volumes are expected from 2022. For the region as a whole, around 120 million 5G subscriptions are forecast for the end of 2025, with 90 million subscriptions in the Middle East and North Africa, representing around 10 percent of total mobile subscriptions.

South East Asia and Oceania has already seen the launch of 5G networks for both mobile broadband and fixed wireless access in Australia. Multiple 5G trials have also been carried out in several other countries in the region, with some markets in South East Asia waiting for spectrum allocations in order to launch 5G.

Though today WCDMA/HSPA is still the region's dominant technology, by 2025 it is expected that 4G (LTE) will have become the main mobile technology, with 63 percent of the total number of subscriptions. At the same time, 5G subscriptions are expected to make up 21 percent of all subscriptions. During the forecast period, smartphone subscriptions are projected to grow 5 percent annually, surpassing 1 billion in 2025.

In **Central and Eastern Europe**, 2019 is the year that has seen LTE become the dominant technology, forecast to account for 42 percent of all subscriptions at the end of the year. 2019 is also the year we have seen 5G networks commercially launched in Latvia and Romania. In 2025 LTE will remain the dominant technology and is expected to account for 70 percent of mobile subscriptions, while 5G subscriptions are forecast to make up 25 percent. During the forecast period there will continue to be a significant decline

in WCDMA/HSPA, from 38 to 2 percent of all subscriptions, as users migrate to LTE and 5G. Further spectrum auctions in the 700MHz and 3.4–3.8GHz bands are planned during 2020, which will support the continued deployment of 5G in the region.

In **Latin America**, LTE remains the dominant radio access technology during the forecast period, accounting for 51 percent of subscriptions at the end of 2019 and 69 percent in 2025. A steady decline in WCDMA/HSPA is forecast as users migrate to LTE and 5G, falling from 36 to 13 percent. The first 5G network deployments will be possible toward the end of 2019 in the region, with Argentina, Brazil, Chile, Colombia and Mexico anticipated to be the first countries in the region to deploy 5G. The subscription uptake is forecast to commence in 2020 and, by the end of 2025, 5G is set to make up 11 percent of mobile subscriptions.

North America, North East Asia and Western Europe have high shares of mobile broadband subscriptions. Countries within these regions have developed economies, enabling a high adoption rate of information and communications technology.

In **North America**, 5G commercialization is moving at a rapid pace. Service providers have already launched commercial 5G services, both for fixed wireless access and mobile. North America's LTE penetration is currently 91 percent, which is the highest share globally. By the end of 2025, we anticipate close to 320 million 5G subscriptions in the region, accounting for 74 percent of mobile subscriptions.

In **North East Asia**, the share of LTE subscriptions is high, expected to reach 88 percent at the end of 2019, with China alone having close to 1.4 billion LTE subscriptions. In South Korea, 5G

74%

74 percent of North American mobile subscriptions are expected to be for 5G in 2025.

subscriptions are increasing rapidly following the launch of commercial services in April 2019. In China, 5G commercial licenses were issued to four service providers earlier this year and commercial services were launched in the beginning of Q4 2019. In Japan, service providers are expected to launch commercial 5G services in 2020. By the end of the forecast period, the region's 5G subscription penetration is projected to reach 56 percent.

In **Western Europe**, LTE is the dominant access technology, accounting for 69 percent of all subscriptions. Over the forecast period 5G is predicted to become the dominant technology, reaching 55 percent of all subscriptions, with LTE declining to 42 percent and WCDMA/HSPA reducing to only 2 percent of subscriptions in 2025. The first commercial launch in the region was in April 2019, and now around 20 service providers have launched 5G services across the region.

Further spectrum auctions in the 700MHz and 3.4–3.8GHz bands are planned during 2020, which will accelerate the deployment and coverage of 5G in the region.

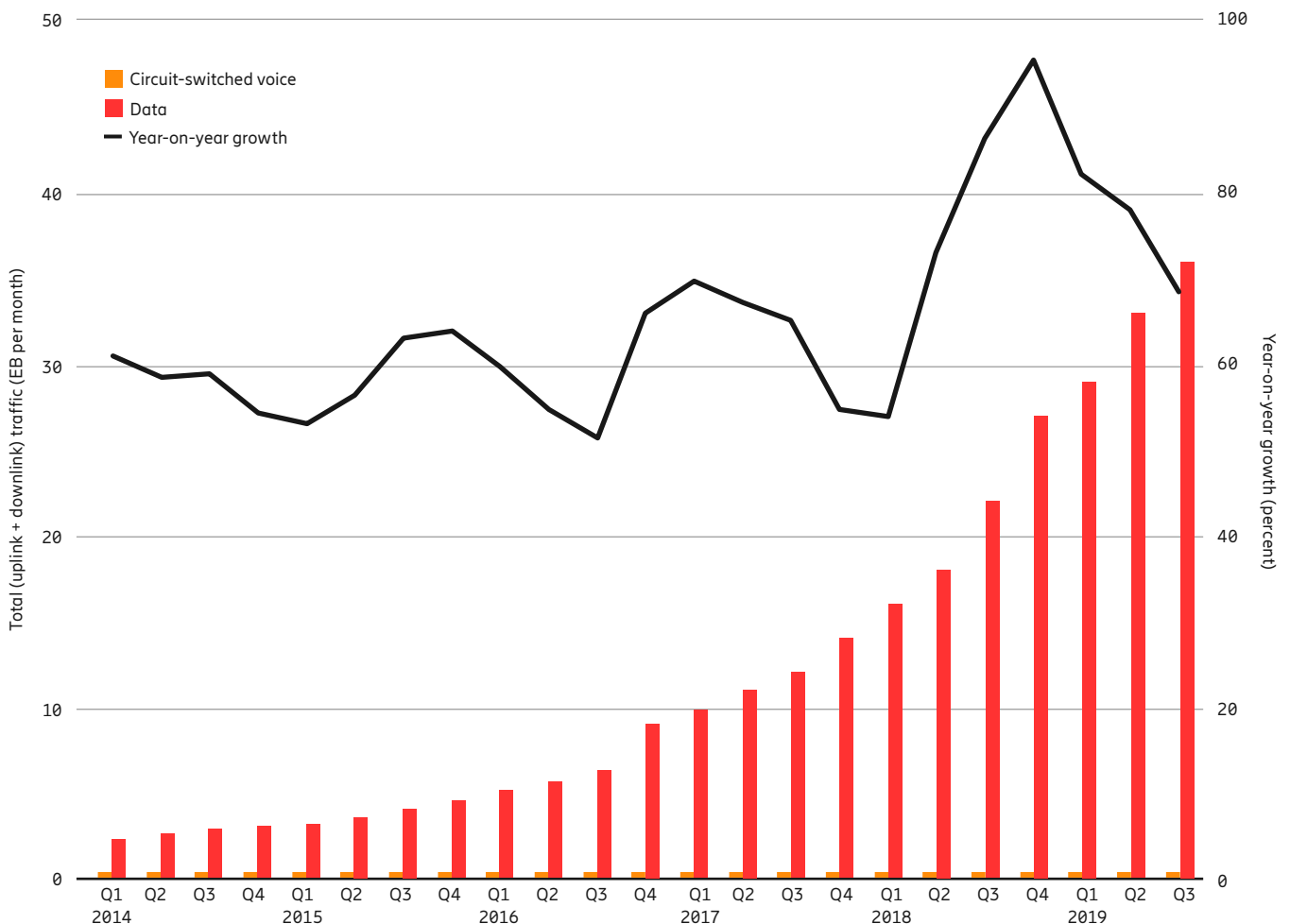
Mobile traffic Q3 2019

Mobile data traffic grew 68 percent between Q3 2018 and Q3 2019.

In Q3 2019, mobile data traffic grew 68 percent year-on-year. The high growth rate continues to be influenced by the increased number of smartphone subscriptions in India and increased data traffic per smartphone per month in China. The quarter-on-quarter growth for Q3 2019 was 12 percent.

In general, traffic¹ growth is being driven by both the rising number of smartphone subscriptions and an increasing average data volume per subscription, fueled primarily by more viewing of video content. The graph below shows total global monthly data and voice traffic from Q1 2014 to Q3 2019, along with the year-on-year percentage change for mobile data traffic.

Figure 10: Global mobile data traffic and year-on-year growth (EB per month)



¹ Traffic does not include DVB-H, Wi-Fi or Mobile WiMAX. VoIP is included in data traffic

Mobile traffic by application category

Mobile traffic is expected to grow by 27 percent annually between 2019 and 2025. Continuing recent trends, most of this will come from video traffic.

Video traffic in mobile networks is forecast to grow by around 30 percent annually through 2025 to account for three-quarters of mobile data traffic, from slightly more than 60 percent in 2019.

The video traffic growth is driven by the increase of embedded video in many online applications, growth of video-on-demand (VoD) streaming services in terms of both subscribers and viewing time per subscriber, and the evolution toward higher screen resolutions on smart devices. All of these factors have been influenced by the increasing penetration of video-capable smart devices.

Social network traffic is also expected to rise 20 percent annually over the next 6 years. However, its relative share of traffic will decline from 10 percent in 2019 to around 8 percent in 2025, because of the stronger growth of video.¹

Immersive formats contribute to traffic growth

Users are increasingly streaming and sharing video. The most common resolution for video streamed over cellular networks has been estimated to be around 480p (varying from network to network). With smartphones and networks improving constantly, streaming HD (720p) and Full HD (1080p) video are becoming more common. More immersive media formats and applications are expected to become a significant factor contributing to mobile data traffic growth, as 5G networks will provide the performance needed for a good user experience. For example, watching an e-streaming sports event in multi-view could consume about 7GB per hour, while a high-quality AR/VR stream with a media (bit) rate of 25Mbps would consume as much as 12GB per hour.

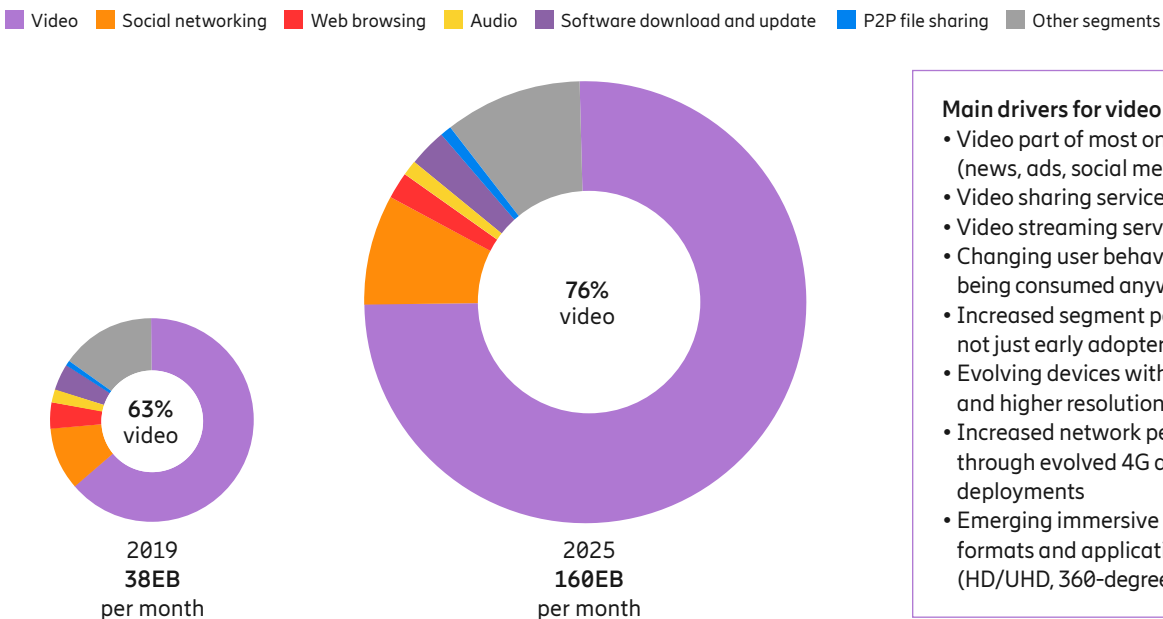
Calculate the traffic impact of different application categories

www.ericsson.com/mobility-report/mobility-calculator

Explore the relationship between the usage of various app types and monthly data traffic per subscription. Fill in app usage figures and benchmark the resulting data consumption against six pre-set data consumption profiles.



Figure 11: Mobile traffic by application category per month (percent)



Main drivers for video traffic growth

- Video part of most online content (news, ads, social media, etc.)
- Video sharing services
- Video streaming services
- Changing user behavior – video being consumed anywhere, any time
- Increased segment penetration, not just early adopters
- Evolving devices with larger screens and higher resolutions
- Increased network performance through evolved 4G and 5G deployments
- Emerging immersive media formats and applications (HD/UHD, 360-degree video, AR, VR)

¹Traffic from embedded video in web browsing and social media is included in the application category "Video"

Mobile data traffic outlook

In 2025, 5G networks will carry nearly half of the world's mobile data traffic.

Global total mobile data traffic is expected to reach around 38 exabytes per month by the end of the year, and is projected to grow by a factor of 4 to reach 160 exabytes per month in 2025. It represents the mobile data that over 6 billion people will consume using smartphones, laptops and a multitude of new devices 6 years from now.

Smartphones continue to be at the epicenter of this development as they generate most of the mobile data traffic – more than 90 percent today and 95 percent projected in 2025.

Populous markets that are early with 5G are likely to lead traffic growth over the forecast period. By 2025, we expect that 45 percent of total mobile data traffic will be carried by 5G networks.¹

Large variations in traffic growth across regions

Traffic growth can be very volatile between years and can also vary significantly between countries, depending on local market dynamics. In the US, the traffic growth rate declined slightly during 2018 but recovered to previously expected growth rates during 2019. In China, 2018 was a year of record traffic growth. India's traffic growth continued its trajectory and it remains the region with the highest usage per smartphone and month.

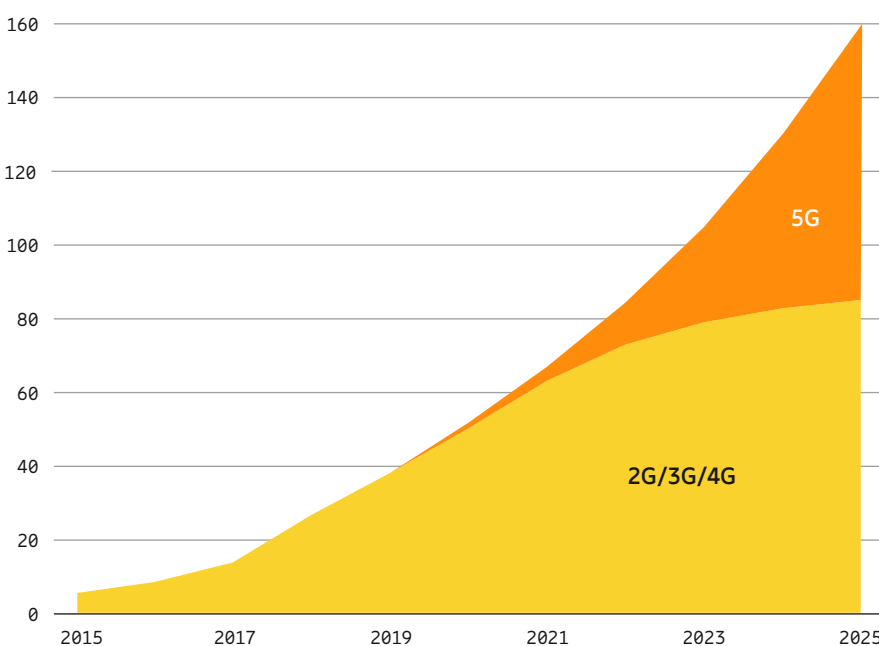
Globally, the increase in mobile data traffic per smartphone can be attributed to three main drivers: improved device capabilities, an increase in data-intensive content and more affordable data plans.

By 2025, 500 million additional smartphone users are expected in India

In the India region, the average monthly mobile data usage per smartphone has seen an extraordinary increase in recent years, becoming the highest in the world. A key factor has been the rapid adoption of 4G, boosted by a disruptive entrant in the market in 2016. Low prices for mobile broadband services,² affordable smartphones and people's changing video viewing habits have continued to drive monthly usage growth in the region. Only 4 percent of households have fixed broadband, making smartphones the only way to access the internet³ in many cases.

Total traffic is projected to triple, reaching 22EB per month in 2025. This comes from two factors: high growth in the number of smartphone users and an increase in average usage per smartphone. A total of 500 million additional smartphone users are expected in India by 2025. Even if the traffic per existing smartphone user continues to grow significantly over time, the increase in the average traffic per smartphone is expected to moderate as more consumers in India acquire smartphones. In addition, the mass-market adoption of advanced use cases fueled by 5G is expected later in India than in other regions. Nevertheless, the average monthly traffic per smartphone is expected to increase to around 24GB in 2025.

Figure 12: Global mobile data traffic (EB per month)



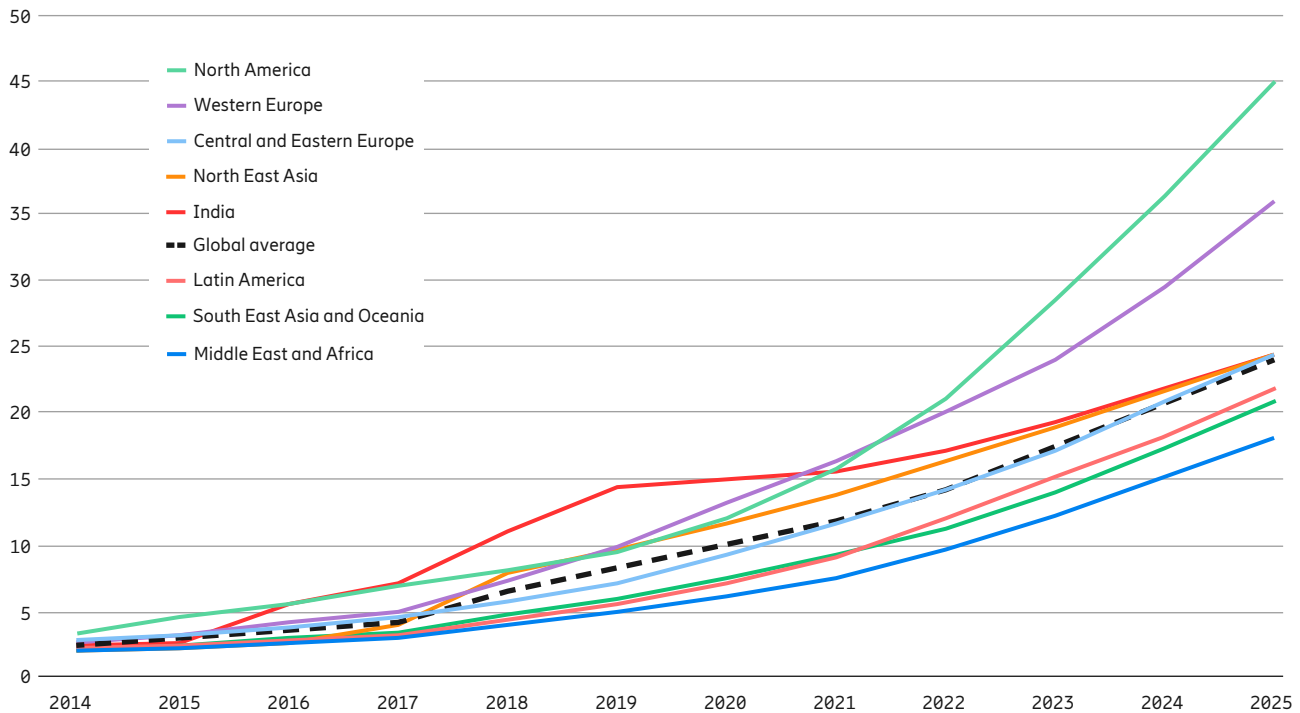
¹ Our traffic forecast does not include traffic generated by fixed wireless access (FWA) services, as it is not yet possible to estimate this traffic.

However, as FWA is one of the early use cases planned for 5G in some regions, it could significantly impact the overall traffic, depending on market uptake

² www.cable.co.uk/mobiles/worldwide-data-pricing

³ GlobalData, India Telecom Operators Country Intelligence Report (2019)

Figure 13: Mobile data traffic per smartphone (GB per month)



In North America, future monthly GB growth depends on 5G services adoption

The monthly average usage of mobile data in North America is expected to reach 45GB per smartphone by 2025. The major service providers have all launched 5G, initially focused on building capacity in the high- and mid-band spectrum. On top of that, we expect 5G in low-band, increased penetration of 5G devices, and early 5G adopters to drive traffic growth. But even if there is strong traffic growth today, the adoption of immersive consumer services using VR and AR is expected to lead to big increases in traffic per smartphone toward the end of the period. By 2025 the penetration of 5G subscriptions is set to be the highest of all regions at 74 percent.

The **Western Europe** traffic growth rate follows a similar pattern to that expected in North America. However, the more fragmented market situation is expected to lead to later mass-market adoption of 5G and therefore a somewhat lower traffic per smartphone in 2025 than North America.

North East Asia traffic growth rate reaches an all-time high

Attractive data plans, as well as innovative mobile apps and content, have pushed up monthly mobile data usage in North East Asia, particularly in China. The rapid growth in smartphone subscriptions is expected to continue, with China alone set to add around 170 million smartphone subscriptions between 2019 and 2025, further driving data traffic growth. With 5G set to capture a lot of early adopters, we continue to expect high growth numbers in **North East Asia**. In South Korea, 5G mobile data traffic per subscriber exceeded 25GB per month in August.

The **Middle East and Africa** region is expected to have the highest growth rate during the forecast period, increasing total mobile data traffic by a factor of 7 between 2019 and 2025. The average data per smartphone is expected to reach 18GB per user per month in 2025 in the Middle East and Africa region – as Sub-Saharan Africa is expected to reach on average 7GB.

South East Asia and Latin America

are expected to follow similar trends over the next six years on a regional level, while the individual countries can show very different growth rates for traffic per smartphone. Traffic growth is driven by coverage build-out and continued adoption of 4G, linked to a rise in smartphone subscriptions and increases in average data usage per smartphone. The data traffic per smartphone is expected to reach 21GB and 22GB per month respectively in **South East Asia** and **Latin America**.

In **Central and Eastern Europe**, growth is also fueled by 4G adoption but the region has a somewhat higher traffic per subscriber starting point. Over the forecast period, the monthly traffic per smartphone is expected to increase from 6GB to 24GB per month.

It is important to bear in mind that there are significant variations in monthly data consumption within regions, with individual countries and service providers having considerably higher monthly consumption than any regional averages.

Network coverage

5G has the potential to cover up to 65 percent of the world’s population in 2025.

Momentum continues in the build-out of 4G (LTE) networks. Global 4G population coverage was around 75 percent at the end of 2018 and is forecast to reach over 90 percent in 2025.

4G networks are also evolving to deliver increased network capacity and faster data speeds. There are currently 777 commercial 4G networks deployed. Of these, 311 have been upgraded to LTE-Advanced, and 36 Gigabit LTE networks have been commercially launched.

Increasing 5G commercial launches and deployment momentum

To date, there have been around 50 5G commercial launches across the world. Most have focused on larger cities, creating some initial 5G coverage. In some cases, a rapid build-out has resulted in high population coverage. In South Korea, service providers have committed to building 5G networks that will cover 93 percent of the population by the end of 2019. Similarly, 5G population coverage in Switzerland is expected to reach around 90 percent at the end of the year.

5G is expected to be the fastest-deployed mobile communication technology in history.

Technology advancements enabling rapid 5G population coverage build-out
5G coverage build-out can be divided into three broad categories:¹

1. Radio deployments in new bands in the sub-6GHz range
2. Deployments in millimeter wave frequency bands
3. Deployments in existing LTE bands

Looking at the first two categories combined, 5G population coverage is forecast to reach 55 percent in 2025.

For the third category, a significant proportion of 4G networks are already prepared for 5G and can be upgraded to support 5G services in existing LTE bands by utilizing spectrum sharing. Given this option, an estimated additional 10 percentage points of population coverage is achievable, creating a potential of up to 65 percent 5G population coverage in 2025.

Figure 15: World population coverage by technology²

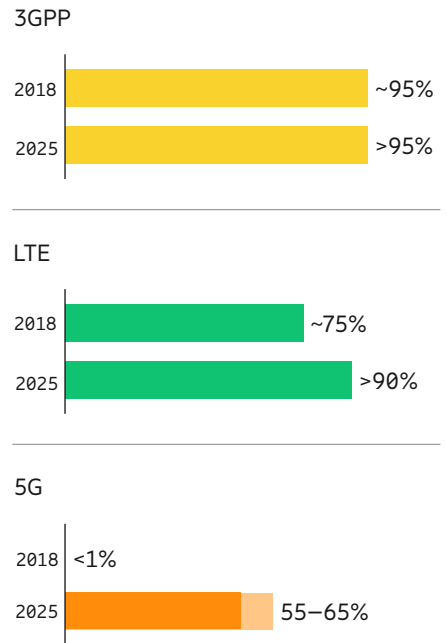
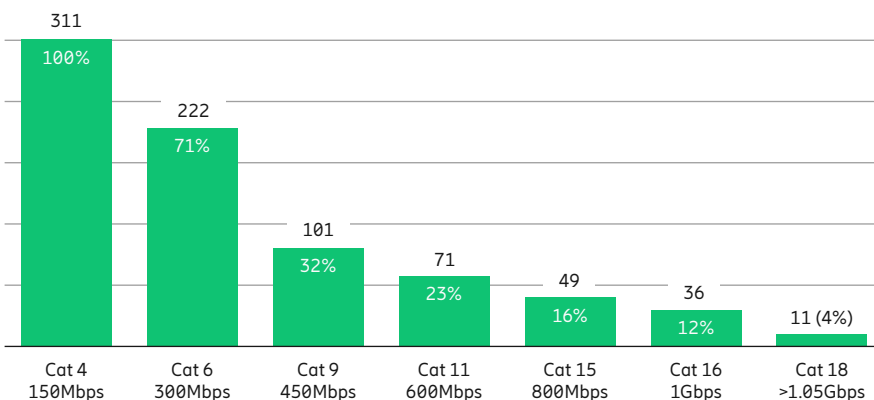


Figure 14: Percentage and number of LTE-Advanced networks supporting various categories of devices



Source: Ericsson and GSA (Oct 2019)

¹ The coverage area for the three categories may overlap in some areas but the calculated numbers refer to the combined coverage area predicted

² The figures refer to coverage of each technology. The ability to utilize the technology is subject to factors such as access to devices and subscriptions

IoT connections outlook

NB-IoT and Cat-M technologies are projected to account for more than 50 percent of cellular IoT connections in 2025.

The Massive IoT technologies NB-IoT and Cat-M¹ continue to be rolled out around the world. 2G and 3G connectivity still enable the majority of IoT applications, but during 2019 the number of Massive IoT connections are estimated to have increased by a factor of 3, reaching close to 100 million at the end of the year.

Massive IoT primarily consists of wide-area use cases, connecting massive numbers of low-complexity, low-cost devices with long battery life and relatively low throughput. NB-IoT and Cat-M technologies complement each other, and many service providers are deploying both technologies. Out of the 114 service providers² identified as having launched at least one of the NB-IoT or LTE-M technologies, close to 25 percent have launched both technologies. At the end of 2025, NB-IoT and Cat-M are projected to account for 52 percent of all cellular IoT connections. Broadband IoT mainly includes wide-area use cases that require

higher throughput, lower latency and larger data volumes than Massive IoT technologies can support. LTE is already supporting many use cases in this segment. By the end of 2025, 28 percent of cellular IoT connections will be broadband IoT, with 4G connecting the majority.

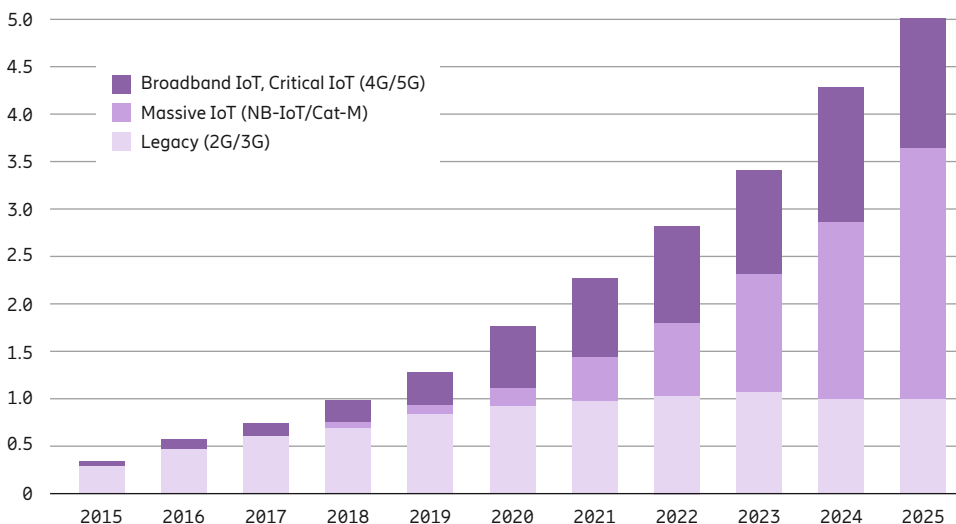
Critical IoT includes both wide-area and local-area use cases that have requirements for extremely low latency and ultra-high reliability. The first modules supporting Critical IoT use cases are expected to be deployed in 2020. Only a small fraction of total cellular IoT connections will be Critical IoT in 2025.

North East Asia is leading the global adoption of cellular IoT. At the end of 2019, it is estimated that the region will account for 60 percent of all cellular IoT connections, a figure set to increase to 68 percent in 2025. This reflects both the ambition and size of the cellular IoT market in this region.

Figure 17: IoT connections (billion)

IoT	2019	2025	CAGR
Wide-area IoT	1.4	5.4	24%
Cellular IoT ³	1.3	5.0	25%
Short-range IoT	9.3	19.5	13%
Total	10.8	24.9	15%

Figure 16: Cellular IoT connections by segment and technology (billion)



¹ Cat-M includes both Cat-M1 and Cat-M2. Only Cat-M1 is being supported today

² GSA, Oct 2019

³ These figures are also included in the figures for wide-area IoT

Automotive IoT

Mobile networks provide reliable and secure cellular connectivity, meeting different use case requirements of automotive and transport applications.

Connected vehicles and road infrastructure are part of a broader IoT ecosystem that is continuously evolving. The automotive industry is expected to be among the top four industries in terms of the 5G-enabled opportunity for service providers in 2030.¹

The connectivity needs of the automotive and transport ecosystem are diverse and complex, requiring a common network solution, rather than several single-segment solutions. Vehicles can be seen as multipurpose devices in which several connectivity-dependent use cases are executed simultaneously. Deployment of 5G NR, interworking with existing 4G (LTE) networks, can satisfy the connectivity needs for those use cases.

Mixed deployment of 4G and 5G technology

Simulation of a 4G/5G network in a dense urban environment shows that coverage and capacity requirements for automotive services with distinctly different network requirements can be satisfied with a mixed deployment of 4G and 5G technology. Three automotive services with different requirements on user data throughput, latency and resource utilization were applied to the simulated scenario: in-vehicle infotainment (mobile broadband), remote driving (delay-critical), and HD maps and telematics transfer (lower than best effort). The evaluated results show all three services can be supported by the network. The results also show network capacity can be increased at the cost of relaxed delay requirements, such as for services with lower than best effort requirements.

Enabling a full range of automotive services

An array of automotive and road transport services requires cellular connectivity, with many already in commercial operation. These services can be classified into eight groups and mapped against the three cellular IoT technology segments – massive IoT, broadband IoT and Critical IoT – based on their connectivity requirements.

Massive IoT is suitable for low data rate use cases that can be supported with narrow bandwidth modems. These use cases can be found in logistics, telematics, fleet management and connecting parts of road infrastructure.

Broadband IoT is vital for most automotive use cases that require high data rates and low latency, such as infotainment, telematics, fleet management, sensor sharing, basic safety and advanced driver assistance systems (ADAS).

Critical IoT enables ultra-reliable and/or ultra-low latency communication and can provide some very advanced services, such as remote driving of automated commercial vehicles on specific routes.

4G (LTE) networks already support massive IoT (NB-IoT/Cat-M) and broadband IoT. 5G networks will boost broadband IoT performance and support ultra-reliable low-latency communication (URLLC) with critical IoT – enabling the full range of existing and emerging automotive applications. This horizontal approach of supporting all services through a common cellular network is much faster and more cost-efficient than deploying dedicated systems for different services.²

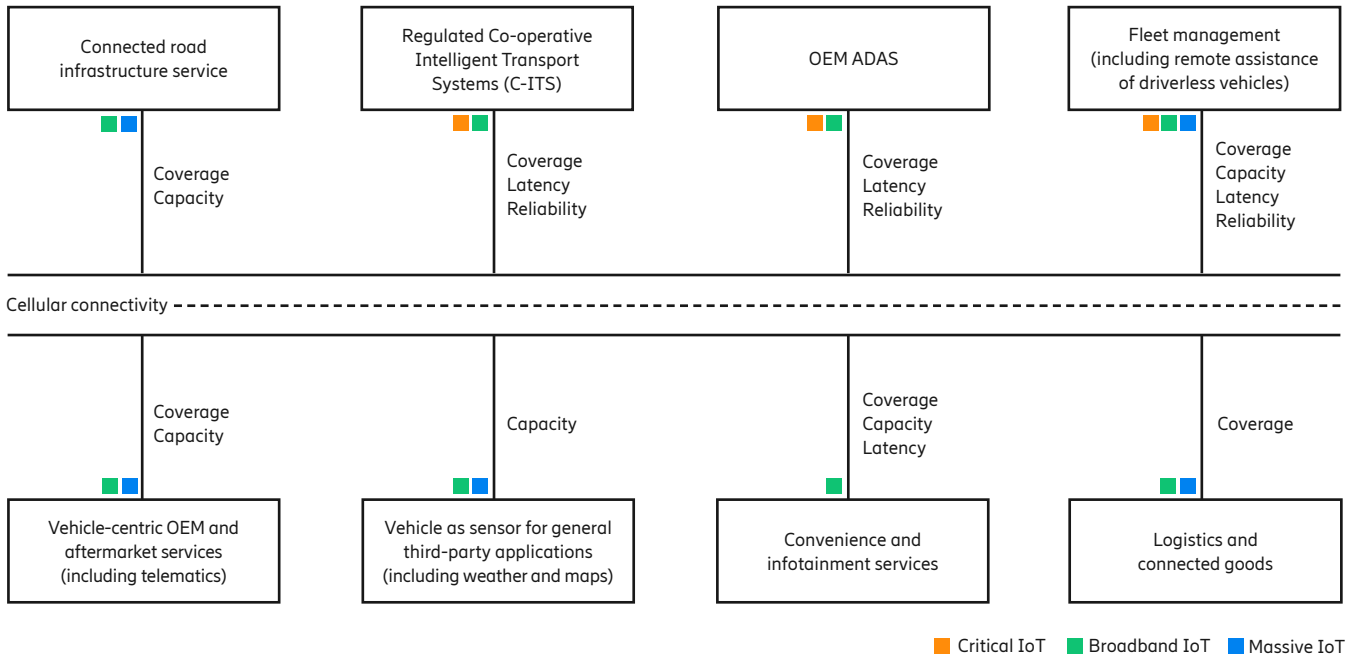
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The automotive industry is expected to be among the top four industries for 5G-enabled service provider opportunity in 2030.

¹ 5G for business: a 2030 market compass: www.ericsson.com/en/5g/forms/5gforbusiness-2019-report

² For further reading see "Driving transformation in the automotive and road transport ecosystem with 5G", Ericsson Technology Review (#13, 2019): www.ericsson.com/4a61e3/assets/local/publications/ericsson-technology-review/docs/2019/etr-transforming-transportation-with-5g.pdf

Figure 18: Automotive and road transport services that require cellular connectivity



Connected road infrastructure services, such as physical traffic guidance systems, parking management and dynamic traffic signs, are operated by cities and road authorities to monitor traffic and control its flow. Each service group contains multiple use cases, and requirements can be diverse within a group.

The ongoing roll-out of 5G provides a cost-efficient and feature-rich foundation for a horizontal multi-service network. The time-to-market for 5G networks and services is faster than for earlier generations, and connectivity capabilities can be tailored to different services using mechanisms that enable both separated QoS treatment and separated charging. This functionality contributes to making 5G instrumental in helping to maximize the safety, efficiency and sustainability of road transportation.

Regulated Cooperative-Intelligent Transport Systems (C-ITS) focus on government-regulated services for road safety and traffic efficiency. Traffic efficiency use cases have relaxed latency requirements, while safety-related data often requires reliable low-latency communication. A benefit of regulation is to encourage cross-OEM cooperation in standardized (regulated) information exchange. Regulated C-ITS services may also use dedicated ITS spectrum in certain regions; for example, for direct short-range communication using 3GPP PC5 or IEEE 802.11p technologies.

OEM ADAS aim to increase road safety by focusing on the driver and their driving behavior. They rely primarily on vehicle sensor information and are typically not collaborative across vehicle brands. ADAS services can also benefit from data provided by traffic authorities, such as traffic light information. They are expected to evolve to support the driverless vehicles of the future.

Fleet management services are aimed at vehicle fleet owners, such as logistics or car-sharing companies. The communication service is primarily used to monitor vehicle locations and the vehicle/driver status. If the fleet consists of driverless vehicles, fleet management also includes communication support for operations monitoring and remote assistance, which can imply full remote driving.

Vehicle-centric OEMs and aftermarket services focus on vehicle performance and usage. They make it possible for the OEM to collect vehicle diagnostics data that enables it to monitor and adjust the vehicle and give advice to the driver for improved driving efficiency. Other examples of services in this category include vehicle tracking and remote and predictive maintenance.

Vehicle-as-a-sensor for general third-party use cases involve the installation of sensors in the vehicle to provide information. Solutions aimed at achieving driving improvements (such as ADAS or automated driving) are reused to provide anonymized data to other parties to monitor city infrastructure and road status, maintain street maps or give accurate and up-to-date weather information.

Convenience and infotainment services deliver content such as traffic news and audio entertainment for drivers, and gaming and video entertainment for passengers.

Logistics and connected goods services have the primary focus of tracking transported objects (commodities, merchandise goods, cargo and so on) during the production and transport cycle of the object.

A strategy for differentiating the 5G user experience

Applying a 5G cluster-based deployment strategy, focusing on the customer experience.

SK Telecom has completed the first phase of its 5G deployment, focused on an initial coverage build-out primarily in major metropolitan areas, along major traffic and commuter routes as well as other densely populated areas. The second phase continues the 5G coverage build-out with mid-band,¹ complemented by deployments in the millimeter wave band² to meet expected capacity needs and increase network speeds in selected densely populated areas. When 4G was commercialized in 2011, it took SK Telecom about 11 months to build out nationwide network coverage.³ A 5G population coverage of around 90 percent is expected to be achieved by the end of 2020.

To drive further uptake of 5G services, SK Telecom has identified areas with large numbers of potential customers that could be provided with a variety of high-quality services supported by a dense 5G network.

Identifying and selecting such areas is a key part of SK Telecom's cluster-based 5G deployment strategy. This strategy is centered around providing a premium 5G network experience and innovative services to customers in selected geographical locations. The goal is to drive uptake of 5G subscriptions by providing differentiated mobile broadband services at these locations, as well as to stimulate the development of new 5G services for consumers, enterprises and industries.

In these locations, 5G network capacity will be built out to enable high-volume data traffic and include localized services and benefits tailored to the area's specific characteristics. The objective of these 5G clusters is specifically to enhance customer value, showing the features and benefits of 5G-enabled services, and to make it obvious that these services bring new experiences



This article was written in cooperation with SK Telecom, a market-leading communications service provider in South Korea creating value in diverse ICT-related markets, including mobile services, media, security and commerce.

compared to 4G. As the 5G ecosystem is still under development, consumers will be the main target group initially, while industry and enterprise opportunities will be addressed on an "on-demand" basis to drive industrial innovation.

¹ 3.5GHz (mid-band)

² 28GHz (millimeter wave band)

³ Reaching 99 percent population coverage

70
 SK Telecom has identified more than 70 specific areas for its cluster-based 5G deployment strategy in 2019.

Cluster area selection criteria

Target areas for the 5G cluster-based deployment are selected using floating population data, to identify where many potential customers are expected to need 5G services and to stimulate the development of new services. Initial main target areas are high population or office areas, with people in the 20–40 age group, as well as areas with high seasonal populations. The size of a cluster area varies depending on its characteristics. For example, Haeundae Beach, a popular beach area in Busan, South Korea, is roughly 1.5km long and 30–50 meters wide, and can have up to 500,000 visitors daily. It can be covered by 15 5G cells, while covering the Olympic Park would require about 50 5G cells.

Examples of cluster areas are as follows:

- The League of Legends (LoL) Park, an eSports stadium in the center of Seoul, receives more than 120,000 visitors per year. Various augmented and virtual reality (AR/VR) services linked to watching e-sports and supporting the gaming culture are provided in the stadium. For example, LoL Park visitors can view messages from other fans in AR when pointing their smartphones in a specific location inside the stadium, and VR live broadcasting and playbacks are available during games.
- The Olympic Park, with more than 400,000 visitors per month, provides localized AR/VR services to visitors. An aim is to reduce entry barriers when introducing new types of 5G services, as customers have gained user experience from existing AR/VR-based services.
- The Ikseon-dong region of Seoul, a trendy area with many popular cafes, restaurants and handicraft shops, receives more than 80,000 visitors per month. Providing services, such as customer-centric discount coupons or promotion of discounts and events at local shops, cafes and restaurants, serves to stimulate the local economy of small and medium-sized enterprises.

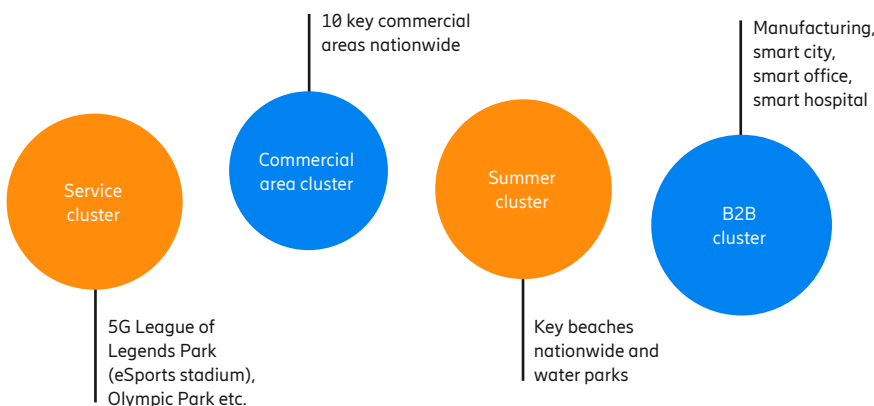
Other selection criteria include potential areas with an expected demand for business-to-business (B2B) services using 5G in the future, such as mobile game development clusters where 5G networks with low-latency capabilities can be used by the gaming industry. During 2019, more than 70 cluster areas have been selected, addressing mainly consumers, to stimulate innovation and uptake of new 5G services. Greater cluster expansion will follow, along with development of further 5G-based B2B-specific solutions during 2020.

Build 5G networks with precision to optimize performance

SK Telecom deployments include a combination of different radio and antenna configurations to meet the specific performance needs of each site and optimize the total cost of ownership. These range from 4T4R radios, through 32T32R to variants of mid-band Massive MIMO 64T64R.

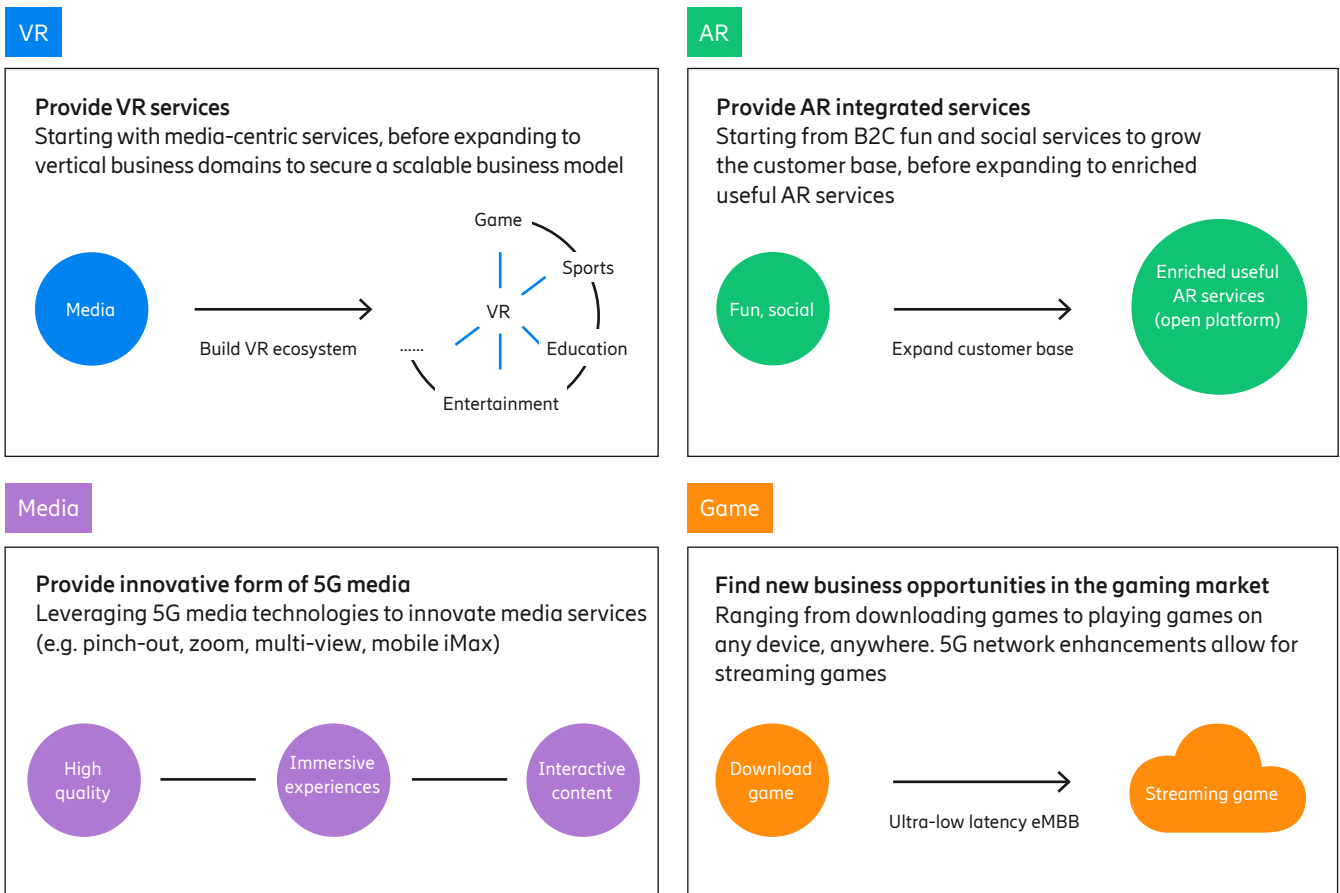
As part of its strategy to provide the best possible customer experience, SK Telecom has deployed 4G–5G new radio (NR) dual connectivity technology, which allows a mobile device to exchange data with a 5G NR base station and a 4G base station simultaneously. SK Telecom has been able to reach typical speeds of between 1.5 and 1.8 gigabits per second (Gbps), with top rates of up to 2.7Gbps by combining 5G⁴ and 4G⁵ carriers. Deploying 5G in the millimeter wave band (28GHz) will enable peak rates of up to 7.2Gbps. Software upgrades to improve and optimize network performance are first implemented in the cluster areas. Drive tests⁶ conducted in cluster areas show four to five times higher average download speeds on the 5G network using dual connectivity compared to 4G alone.

Figure 19: SK Telecom’s 5G cluster area selection



⁴ Utilizing 100MHz bandwidth on 3.5GHz
⁵ Utilizing 75MHz bandwidth on 850MHz, 1.8GHz, 2.1GHz and 2.6GHz
⁶ SK Telecom (September 2019)

Figure 20: SK Telecom’s four 5G service areas strategy



SK Telecom’s go-to-market services strategy for 5G

SK Telecom has the ambition of becoming a full-service provider by developing content and services specifically designed and optimized for 5G networks.

Initially, it is targeting the enhanced mobile broadband opportunity of immersive consumer experiences based on VR, AR and ultra-high definition (UHD) streaming services. Services such as streamed cloud gaming (ultra-low-latency gaming) are implemented. VR content is available with 3D animation and six degrees of freedom functionality. AR content displays superimposed information (sounds, image and text) on real-world objects, often by using a smartphone’s camera. VR and AR are both part of rapidly evolving device ecosystems which include smartphones, headsets, glasses and displays.

SK Telecom is focusing on providing services to consumers through an over-the-top (OTT) multimedia services platform⁷ that enables users to watch high-quality streaming content in UHD (2K, 4K and 8K) formats, as well as VR- and AR- based services. Two key attributes of 5G networks enabling these services are reductions in latency

and support for more symmetrical uplink/downlink throughput. Some multimedia content produced includes multi-view and pinch-zoom features to enhance and differentiate the 5G media experience compared to watching regular TV or video content. For example, SK Telecom’s Social VR service enables multiple users to experience sports events and movies together in a virtual environment as if they were in the same physical location. As the VR ecosystem is built, these types of media services will be expanded to additional vertical domains to secure a scalable business model. In a similar fashion, fun and engaging AR services are provided to expand the customer base and will be followed by further service expansion through own and third-party provisioning of utility-based AR services, such as information-, commerce- and zone-based services.

New business opportunities in the game streaming market will emerge with the introduction of ultra-low-latency capabilities in the 5G networks.

5G drives an increase in average mobile data consumption

South Korea’s monthly mobile data traffic was at around 550 petabytes in August.⁸ The share of traffic carried by 5G networks was 67 petabytes, equal to about 12 percent of the total mobile data traffic. It is noteworthy that the 5G traffic comes on top of continued 4G traffic growth, which continues to grow at a similar rate as prior to the 5G network launches. Total mobile data traffic figures from the top 30 websites in South Korea show that the share of video traffic⁹ has been stable at around 50 percent since 2015.

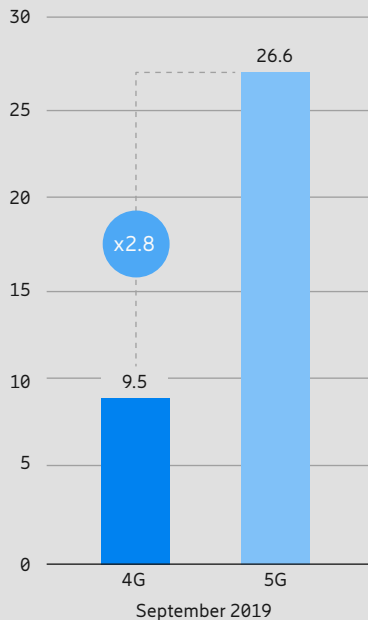
A 5G subscriber’s average monthly data consumption was 26.6GB/month versus 9.5GB/month for a 4G subscriber in September, i.e. almost 3 times higher than that of 4G subscribers.

⁷ Named “Wavve”

⁸ Ministry of Science and ICT, South Korea

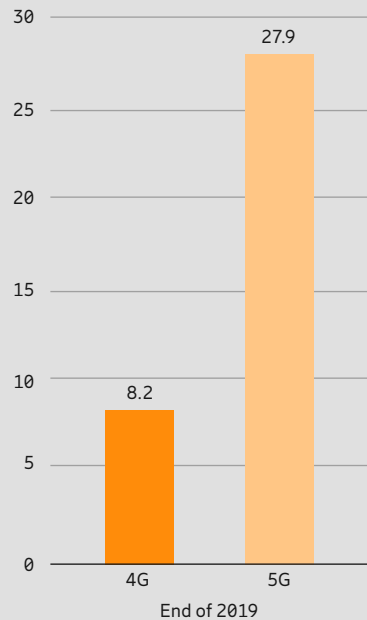
⁹ YouTube, Wavve, Facebook video, Sports video, etc.

Figure 21: South Korea's mobile data traffic per subscriber (GB per month)



Source: Ministry of Science and ICT, South Korea
Note: All three service providers subscribers included

Figure 22: SK Telecom's forecast mobile data traffic per subscriber (GB per month)



Source: SK Telecom forecast
Note: Only SK Telecom subscribers included

25%

By the end of 2019, 25 percent of total mobile data may be carried over SK Telecom's 5G network.

25 percent of total mobile data traffic may be carried over the 5G network by the end of 2019

It took SK Telecom 8 months to reach 1 million 4G subscribers after commercial launch in 2011. In comparison, it took just 4.5 months from commercial 5G launch to reach 1 million 5G subscribers, beating an early forecast¹⁰ of reaching this figure by the end of 2019. The average monthly data consumption of those early 5G adopters switching from a 4G device increased from 20.4GB (4G) to 33.7GB (5G) – a usage growth rate of 65 percent, where increased consumption of immersive content is the main contributing factor. As these are early adopters, with typically high consumption of data and services, the average data consumption figure is expected to decrease slightly in the near term as further market segments become 5G subscribers.

SK Telecom forecasts that the average monthly data usage for its subscriber base on 5G will be 27.9GB compared to 8.2GB for 4G subscribers by the end of 2019. In one possible scenario,¹¹ SK Telecom could reach 2.2 million 5G subscribers by the end of 2019, meaning that almost 25 percent of total mobile traffic will be carried over the 5G network.

Immersive formats contribute to traffic growth

Currently, SK Telecom does not offer any "5G-only" services. Many of the services mentioned in this article are already available to 4G customers, but are much better when experienced over 5G, as the more immersive formats demand higher bandwidths. This is governed by the media (bit) rate of different content types. The data transfer rate (bandwidth) of the network required for a good customer experience can be twice the media (bit) rate.

Immersive formats drive traffic growth. For example, high-quality AR/VR content with a media (bit) rate of 25Mbps would consume about 12GB per hour, while watching an e-streaming sports event in multi-view¹² would consume about 7GB per hour. High-quality VR is currently predominant, typically viewed with a Head Mounted Display (HMD) device, while most current AR services do not drive data consumption, as they are about downloading small-sized objects in advance via an app rather than based on real-time streaming. Present AR services are mostly proof-of-concept services, paving the way for more advanced AR services in the future.

Building clusters to address new 5G service revenue opportunities

SK Telecom customers are accustomed to a well built-out and high-capacity 4G network, and have high expectations of services provided over 5G. To build 5G network coverage and capacity providing ubiquitous access to a wide range of applications and services will take a few years, where 3.5GHz 5G NR deployments will continue to play a key role in SK Telecom's 5G deployment strategy. However, with a cluster-based 5G deployment strategy, customers can have an early experience of the benefits and value of innovative 5G media services provided over a high-quality 5G network. The cluster-based 5G deployment strategy is not only a strategy to deploy a network, but a strategy to provide various new services and benefits to customers in the cluster – creating new business growth opportunities.

During 2019, SK Telecom will build 70 clusters in which they will provide differentiated 5G-specific services. This will be expanded to 200 clusters in 2020, with the aim of continuing to drive further uptake of 5G services among consumers, industries and enterprises.

¹⁰ SK Telecom 5G subscriber forecast (April 2019)

¹¹ Scenario assumptions: 27.2 million SK Telecom subscribers, comprising 25 million 4G subscribers and 2.2 million 5G subscribers, by the end of 2019

¹² Media rate 15Mbps

Network performance as a lever for business growth

Leveraging network performance and customer loyalty to address growth opportunities in Sub-Saharan Africa.

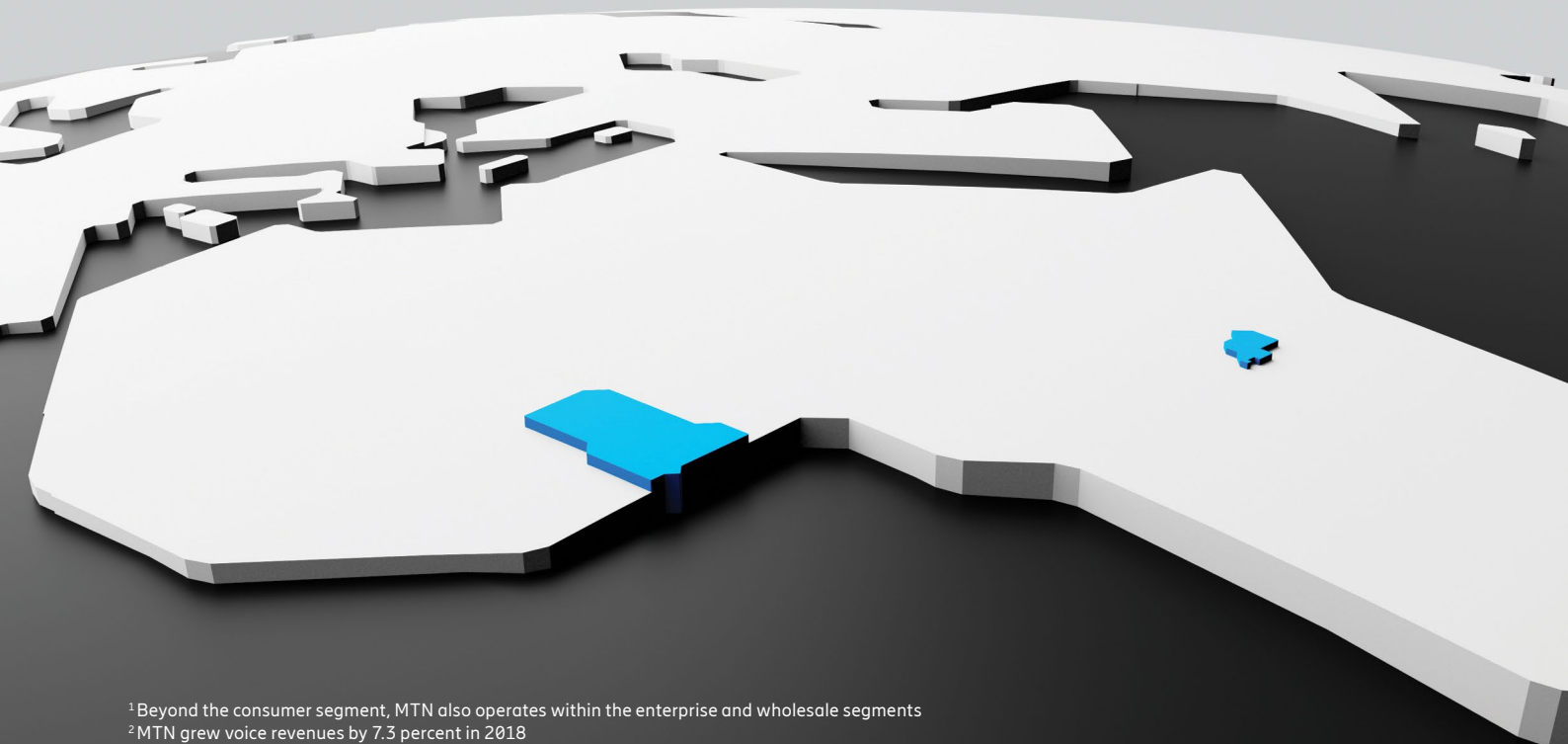
Of the global population, 13 percent lives in Sub-Saharan Africa, which is served by less than 2 percent of the mobile base stations installed worldwide. Mobile data penetration is relatively low, with data usage, smartphone penetration and 4G population coverage all only around 30 percent. However, there is increasing demand for digital services and financial inclusion, including in rural low-income areas.

Operating in 21 markets across the Middle East and Africa, MTN is pursuing 6 distinct growth opportunities, 4 of which target the consumer segment.¹ Voice is still a significant business, presently generating almost three times more revenue than data does for MTN. However, the data revenue market is projected to increase at a compound annual growth rate (CAGR) of

20 percent in MTN markets over the coming 3 years, while the voice revenue market is expected to decline at a rate of 2 percent over the same period. Nevertheless, MTN continues to protect and increase² its voice business, while pursuing data revenues to drive growth.³ Another ambition is to increase revenues from new digital services (mobile music, advanced messaging, mobile advertising and local content). However, from its small base, an expected 50 percent CAGR will bring the market size in 2021 to only about one-tenth of that for data and voice respectively. The fourth opportunity is financial services (mobile money, banking and insurance). MTN considers data to be its core medium-term growth driver and is deploying 3G and 4G network technologies to provide sufficient data coverage in rural areas to meet increasing demand.



This article was written in cooperation with MTN, a leading emerging market communications service provider, offering a range of communications services to customers across Africa and the Middle East – one of the world's fastest-growing regions for mobile telecommunications.



¹Beyond the consumer segment, MTN also operates within the enterprise and wholesale segments

²MTN grew voice revenues by 7.3 percent in 2018

³MTN grew data revenues by 22 percent in 2018

In the Sub-Saharan Africa region, mobile broadband subscription penetration of the population is approximately 30 percent, but – with a young and fast-growing population – it is forecast to reach over 50 percent by the end of 2025. With customers still early in the data adoption journey, MTN is focused on realizing its belief that everyone deserves the benefits of a modern connected life, and contributing to the UN’s Sustainable Development Goals,⁴ which include reducing poverty, improving health and wellbeing, and stimulating economic growth.

50%

Mobile broadband subscription penetration in Sub-Saharan Africa is expected to exceed 50 percent by the end of 2025.

Strategy to connect the unconnected
 MTN applies a “connect the unconnected” strategy, named CHASE.⁵ It includes initiatives to build sufficient data coverage in rural low-income areas, to make data-enabled devices accessible and affordable, to promote mobile money solutions for those without banking opportunities, and to expand awareness and availability of digital services.

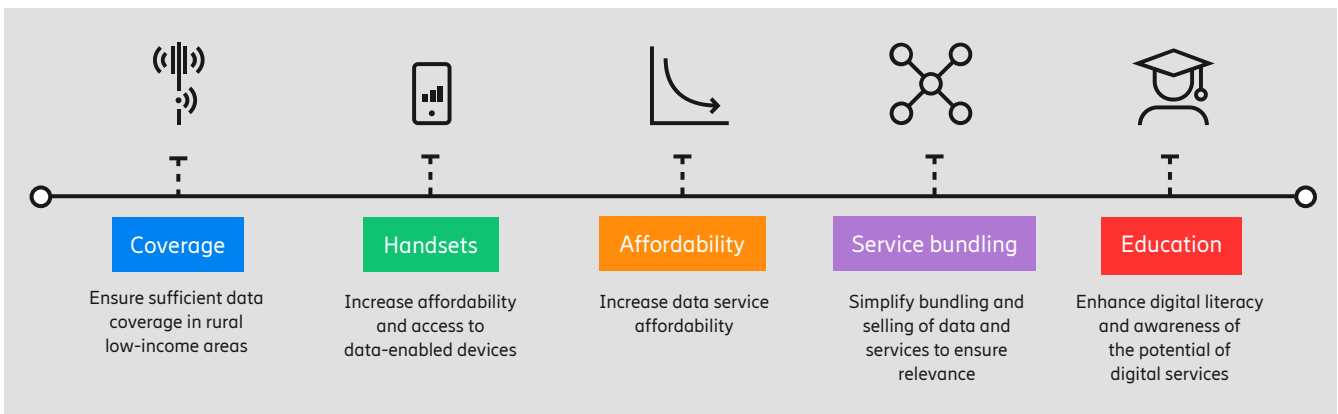
A cornerstone of MTN’s operational strategy⁶ is to achieve best network performance in its markets by 2022. Initiatives include employing rural coverage solutions to increase 3G and 4G population coverage, plus steps to improve network quality and user experience to become a leader in network Net Promoter Score (NPS).⁷ These initiatives support an overall objective of providing best customer experience in markets where MTN is present.

Customer experience program: a structured approach

MTN’s objective of improving overall customer experience is built into the entire group’s processes. In addition, there is dedicated management and governance directing central and local expertise in a program to identify network quality issues and implement appropriate improvements – reusing best practices across the different markets, including forward-looking services and recommendations for constant performance improvements.

Important measures when improving network quality are moving subscribers to the highest possible network layer, activation of key software features, removal of inconsistencies and alignment of parameters supporting selected network improvements.

Figure 23: MTN’s “connect the unconnected” strategy – CHASE



⁴ Supporting the UN Sustainable Development Goals 1, 3, 7, 8, 9 and 17

⁵ Coverage, Handsets, Affordability, Service bundling, Education (CHASE)

⁶ Named BRIGHT: www.mtn-investor.com/mtn_ar2017/our-bright-strategy.php

⁷ NPS is a measure of the likelihood that a customer would recommend a company’s product or service.

A sample of customers is surveyed and scored between 0 and 10 then classified into three categories: promoters, passives and detractors. Then, the percentage of detractors is subtracted from the percentage of promoters. The NPS is separated into various factors, one of which is network performance

Figure 24: MTN Rwanda – voice 3G

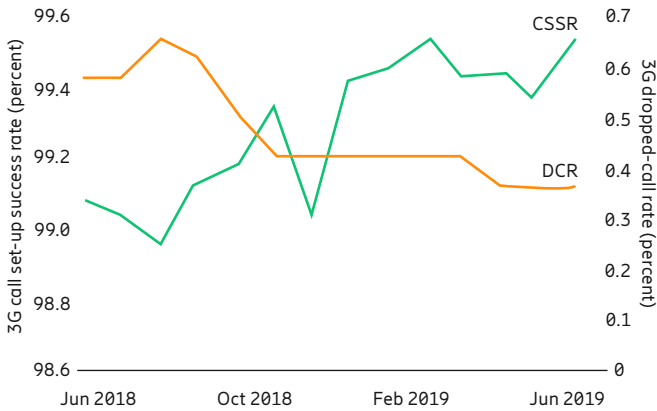
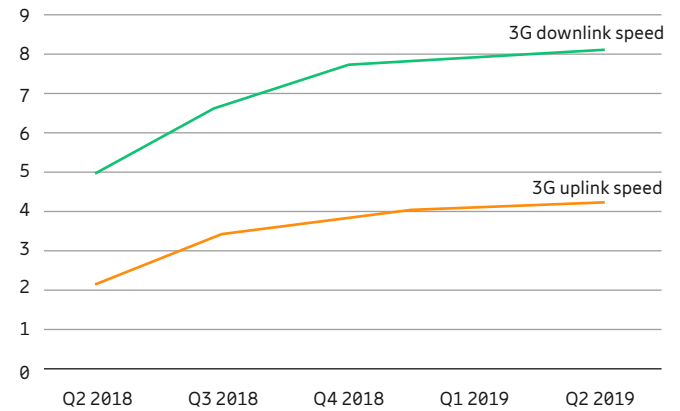


Figure 25: MTN Rwanda – data 3G (Mbps)



MTN applies this methodology in several markets across the Sub-Saharan region. Two examples are Rwanda and Ghana, which illustrate different aspects of the strategy.

Network improvements in Rwanda

Rwanda is a country in central Africa, with a young, mostly rural population of nearly 13 million. It is very densely populated, with an average of 460 people per square kilometer. Over 80 percent of inhabitants live in rural areas.

The mobile internet user penetration is around 40 percent in Rwanda, indicating strong growth potential for mobile broadband, addressable by expanding 3G/4G network coverage into rural and other previously under-served areas. The 3G/4G subscription uptake is forecast to be high, driven by more affordable data plans. Monthly average revenue per user (ARPU) was USD 2.24 in Q2 2019.⁸

Rwanda currently has a single 4G wholesale network with national roaming. Consequently, MTN's focus is to extend and improve its 3G coverage. It does this through aligning network and handset planning, and focusing on voice

stability and data growth. Economically, expanding rural coverage requires cost optimization through prioritized capex planning and opex optimization.

MTN Rwanda's 2G network carries one of the highest average loads of data traffic per site and voice traffic per subscriber in the region. In 2018, there was high growth in smartphone usage and average data consumption in the MTN Rwanda network, driven by significantly improved 3G coverage and a growing customer base with 3G/4G devices. UTMS 900MHz technology was deployed to enhance internet coverage, cater for data traffic growth and improve data speeds across the countrywide network.⁹

During 2019, MTN rolled out more capacity and additional sites on its 3G network to drive efficiency and better customer experience. Steps included adding software features and parameter settings to improve voice accessibility, call set-up time, and 3G data uplink coverage and capacity.

From Q2 2018 to Q2 2019, MTN Rwanda's network improvements led to positive developments across the board, with all key network indicators improving, including call set-up success rates and

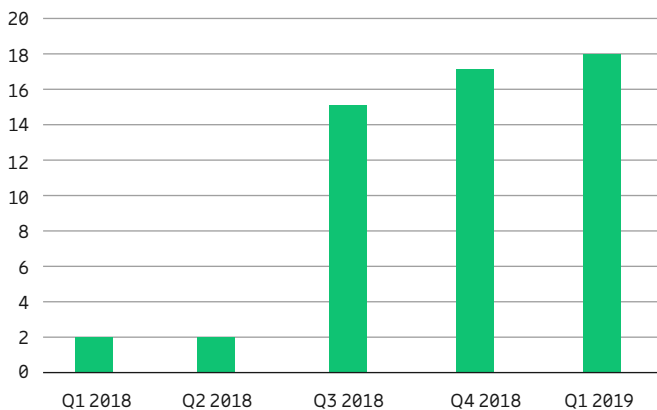
dropped-call rates. The network KPIs and data from performance monitor (PM) counters, combined with improving median uplink and downlink speeds gathered from drive tests, are correlated with the network NPS data. Recent root cause analysis of the network NPS data indicates the positive contribution of a good, reliable, strong and fast internet connection.

The network improvements and customer satisfaction increases are reflected in solid business performance for MTN Rwanda.¹⁰ This includes a market share increase of 11 percentage points to 54 percent at the end of the first half of 2019, compared with the first half of 2018, as subscribers grew by 23 percent – with revenue and EBITDA up 27 percent and 24 percent respectively over the same period.

18%

Network NPS improved from 2 percent to 18 percent in Rwanda.

Figure 26: MTN Rwanda network NPS (percent)



⁸ MTN reported USD 2.15 ARPU in Rwanda for Q1 2019

⁹ 3G population coverage reached more than 90 percent at the end of 2018

¹⁰ www.mtn.com/investors/financial-reporting/integrated-reports/

Figure 27: MTN Ghana – voice 3G

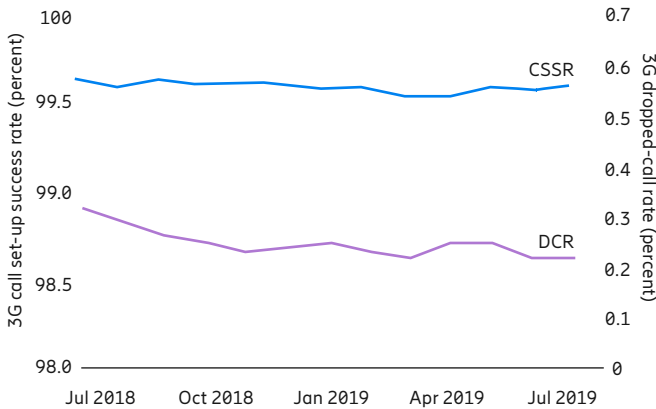
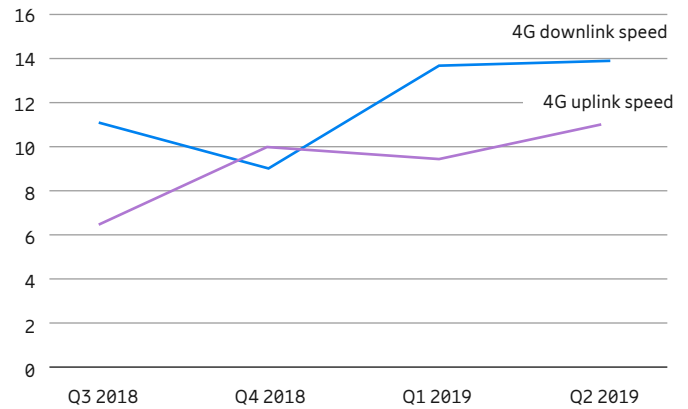


Figure 28: MTN Ghana – data 4G (Mbps)



Network improvements in Ghana

Ghana, in West Africa, is a nation of 30 million inhabitants with a moderate population density of 130 people per square kilometer.

The mobile internet user penetration is around 30 percent, ARPU is over USD 4 per month, and service revenues are increasing at more than 20 percent per year.

MTN Ghana network improvements during 2018–2019 have included expanding and densifying 3G and 4G, as well as optimizing each access layer in turn, steered by KPIs covering availability, retainability, quality and traffic volume.

The 4G share of devices is rapidly increasing, driving data traffic volumes, with over two-thirds of the total data traffic volume coming from 4G devices. The number of 4G devices is projected to outnumber that of 3G devices by early 2020.

With low voice tariffs, average voice traffic per device in the network is very high. Around half of voice traffic comes from 2G devices, while the 2G network carries two-thirds of voice traffic.

From Q2 2018 to Q2 2019, the MTN Ghana network improvements also led to better KPIs, including call set-up success rates and dropped-call rates.

As in Rwanda, Ghana’s KPIs were tracked along with data from PM counters, and matched with improving median uplink and downlink speeds gathered from drive tests to be correlated with network NPS data. Recent root cause analysis of these scores highlighted the positive contribution of good coverage and data speeds.

The network and customer satisfaction improvements translated into positive business results.¹¹ Comparing MTN Ghana’s first half of 2019 with the first half of 2018, voice revenue was up 13 percent, and data revenue¹² increased by 26 percent. Overall, in constant currency, revenues increased 19 percent and EBITDA increased 24 percent over the same time period.

Leveraging network performance to address growth opportunities

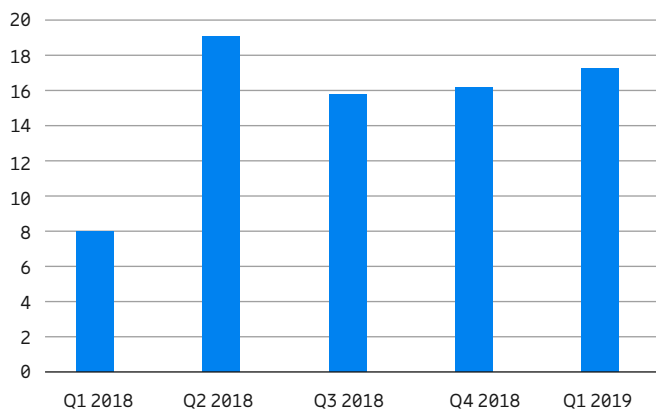
The effects of network improvements on customer loyalty are measured monthly through NPS, then disaggregated into major root causes, including network performance. NPS benchmarking illustrates how user-experience improvements translate into loyalty. The network NPS is further separated into detailed root causes to analyze contributing factors. It has substantially evolved over the

past year, allowing greater precision in assessing network improvements, and is a major component in gauging performance throughout the MTN group.

All network improvements are carried out within the context of actively lifting users to the highest network technology possible, to optimize the cost per erlang (voice) and gigabyte (data) served. Integral to this is the smart capex concept which involves ranking and prioritizing radio sites identified for improvements. The goal of smart capex is to achieve the greatest return from budgeted network investments.

From network KPIs and NPS benchmarking to business performance, both Rwanda and Ghana’s networks are improving user experience and results, while expanding further into rural areas and offering services to connect the unconnected. While much attention worldwide is focused on initial 5G roll-outs, for many regions the reality is continued demand for expanding 2G, 3G and 4G network coverage and capacity. The insight from these countries is that customer satisfaction and commercial success are not mutually exclusive but require regular and consistent processes to expand and optimize network services.

Figure 29: MTN Ghana network NPS (percent)



17%

Network NPS improved from 8 percent to 17 percent in Ghana.

¹¹ www.mtn.com/investors/financial-reporting/integrated-reports/

¹² Data revenues include internet access through mobile and fixed wireless access

Mobile service packaging trends

Increasing performance levels of 4G and the introduction of 5G are driving innovation in mobile service packaging.

Buckets of data are the basis of offerings from nearly every service provider. The amount of data traffic in packages has increased and – in most markets – voice and text messaging are included in the package. Recently, service providers have been creating packages that cater for the usage of specific services or devices in various combinations.

A recurring question is how 5G will open opportunities to increase revenues. A recent survey¹ indicated consumers were willing to pay more for the performance improvements 5G will bring. However, they also expected a range of new services, as well as new ways of paying for them. During August 2019, Ericsson updated

a desktop study of 264 service providers to determine what type of packages they offered to consumers.²

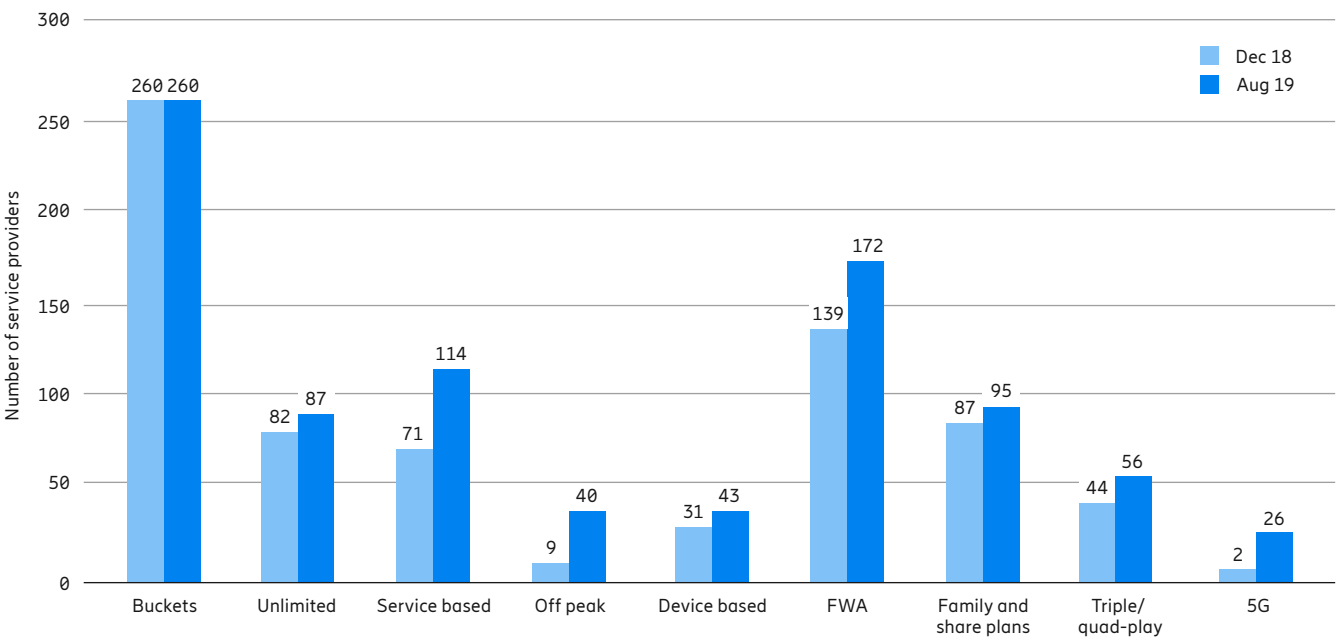
The “bucket model”, which provides the consumer with a data allowance in gigabytes per month, is a key component of the overwhelming majority of tariff plans – 260 out of 264 service providers are using this model as the core feature of their offers. A slight increase in the number of service providers offering an option with unlimited data packages could be seen. These packages are generally provided as premium alternatives in a range of offerings commonly starting with small buckets. Only four service providers were found to offer solely unlimited packages.

The main benefit of the bucket model is that it forms a connection between data traffic growth and mobile revenues. The model can generate revenue from both a growing number of subscribers and a continuous increase in average data traffic per subscriber.

260

Out of 264 service providers, 260 were found to be using the bucket model as the base of their offers.

Figure 30: Service providers typically offer various combinations of these components of service packages



¹Ericsson ConsumerLab, 5G consumer potential (May 2019)

²“Mobile service packaging towards 5G”: www.ericsson.com/en/networks/trending/insights-and-reports/mobile-service-packaging-towards-5g



Unlimited has limits

A total of 31 percent of service providers are providing packages that offer unlimited data traffic. Mostly it is used to attract premium customer segments. However, four of them are solely providing unlimited data packages. In order to differentiate between packages and segment the market, they use speed tiers. This unlimited model faces a number of challenges. Firstly, it restricts options for growing revenue per user as traffic increases. A second challenge has been reaching lower market segments due to the packages' typically high prices. In addition, although speed tiers generally work well, they lose effectivity at higher speeds as it becomes increasingly difficult to discern differences on a smartphone with currently available applications. Service providers try to mitigate these shortcomings by bundling extras to motivate customers to upgrade to higher tier packages. These typically include roaming data and/or services such as cloud storage and video/TV subscriptions. To cater for lower segments, service providers have introduced low-priced

packages with speeds limited to around 1Mbps. However, in the study update, one service provider that previously offered solely unlimited had reintroduced data buckets to attract lower segments. The new packages offered 0.5–2.0GB per month, at a 40–60 percent discount to unlimited packages providing similar speeds.

Future of 5G offerings

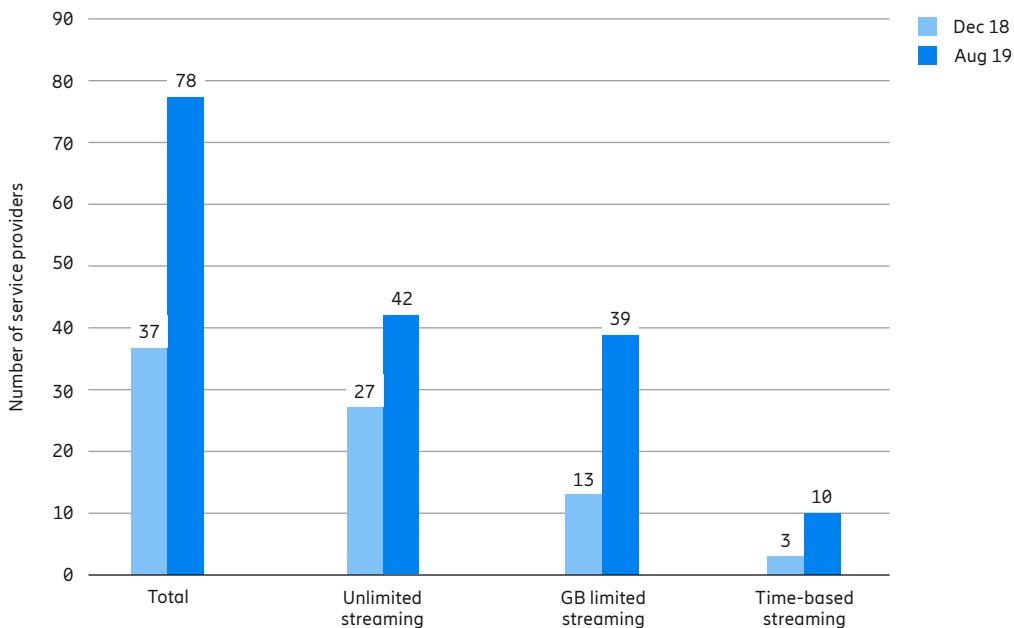
An area of particular interest is offerings related to 5G services and consumer IoT. At the time of the second study in August 2019, 181 service providers indicated that they expected to have commercial 5G services available in coming years. A total of 21 had already launched services for smartphones and another 5 were offering 5G services for fixed wireless access (FWA). Additionally, 16 service providers indicated they would be launching 5G services during 2019.

In the consumer survey conducted earlier in 2019, we found consumers were willing to pay an average of 20 percent more for 5G than they were paying for their current mobile service. The introduction of 5G also provides an opportunity for service

providers to start packaging their services in new ways. A few have been preparing for 5G by partnering with other ecosystem players in gaming, entertainment and sports, as well as consumer hardware. The aim is to launch services which take advantage of 5G's low latency and high capacity capabilities.

Many service providers are creating packages aimed at capturing extra value when launching 5G. One option involves the bundling of specific services, although many are simply pricing 5G packages higher than their 4G alternatives. Of the 21 service providers that had already launched 5G targeting smartphones, 16 had priced 5G packages higher than their nearest available 4G option. On average they were around 18 percent more expensive, a mark-up of between 6 and 50 percent from the closest 4G option.

Figure 31: Number of service providers offering service-based packages specifically targeting video/music streaming



Note: As some service providers utilize more than one method of packaging, the numbers illustrated above exceed the total

Service-based offers: a big change

The most significant changes since the previous study were in offering variants of service-based packages. This model targets a specific application or group of applications, providing services such as social media, music or video streaming. At the time of the study, 114 service providers, around 43 percent, had such variants. An increasing proportion of those with such packaging were specifically focused on data-intensive applications, such as streaming media. This group has increased by 110 percent, to 78, since the initial study. Ways these service-based packages are constituted include either offering unlimited streaming or imposing a limit to how much streaming will be allowed.

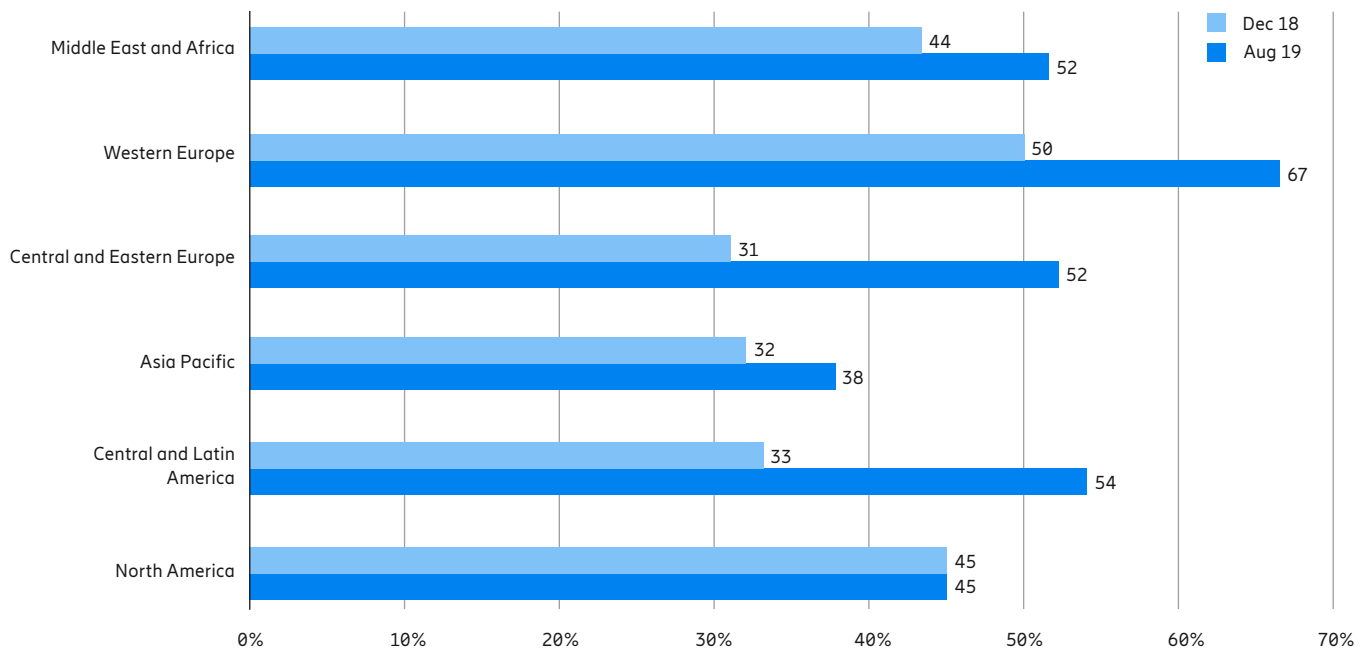
While there was an increase in the number of service providers offering unlimited streaming, the largest increase was observed in those offering packages with clear differentiation and segmentation through the use of either data or time limitations. The most common practice is to use gigabytes as the limiting factor, with 39 out of the 114 offering packages with a number of gigabytes dedicated to a set of streaming services. However, there were 10 service providers offering packages delimited by time instead of data traffic – an increase from only 3 in the previous study. Most of these allow for a limited number of hours of continuous streaming, starting from when the package is bought. But a few were found to sell varying sized “buckets of hours”, allowing users to stream the purchased amount of time spread out across the month. We expect to see further experimentation with models using time, as it is easier for consumers to relate to time than to gigabytes.

Internet of Things for consumers

Device-based offerings also showed a notable increase. We observed 43 service providers selling a device where mobile data traffic was generally included (i.e. not charged extra for). The focus of the offering is on the value provided by using the device. Many service providers in the updated study were targeting cars, using a device which plugs into the on-board diagnostics (OBDII) port in the car to offer vehicle location and in-car Wi-Fi, as well as various add-on services. However, the most common area was tracking devices for pets, bags or children. Some service providers offer safety devices for elderly people and a couple of them had surveillance equipment utilizing the mobile network rather than Wi-Fi connectivity.

As 4G keeps evolving and 5G is introduced there will be a growing number of services and IoT devices that can be used to complement traditional smartphone offerings.

Figure 32: Percentage of service providers offering FWA



FWA on the rise

Although FWA has been around since 3G was introduced, the number of service providers offering it has increased dramatically as LTE coverage has expanded. The evolution of LTE networks with increased network capacity and faster data speeds – and the advent of 5G – has seen FWA further emphasized by service providers. In just 6 months, the number of service providers that offer FWA has increased from 103 to 140, resulting in 1 out of 2 service providers having FWA. In Western Europe 2 out of 3 service providers offer FWA services. In addition, 32 are offering broadband services using a mobile battery-powered pocket router device. However, the number of service providers offering only these devices has decreased from 36, indicating a move toward focusing more on household broadband at fixed locations. It is not uncommon to bundle FWA with some form of media service, such as a TV package or video streaming services.

More choice for the consumer

Family and data-share plans have also increased, with 95 service providers offering this type of package, up from 87 in our earlier study. A key benefit of such packages, involving multiple users, is reduction in churn. The number of service providers offering night and weekend plans promoting usage during off-peak hours has risen dramatically from 9 to 40. In particular, the Middle East and Africa and Asia-Pacific regions have seen significant increases in this type of offering. The most popular packaging includes extra gigabytes to be used at night.

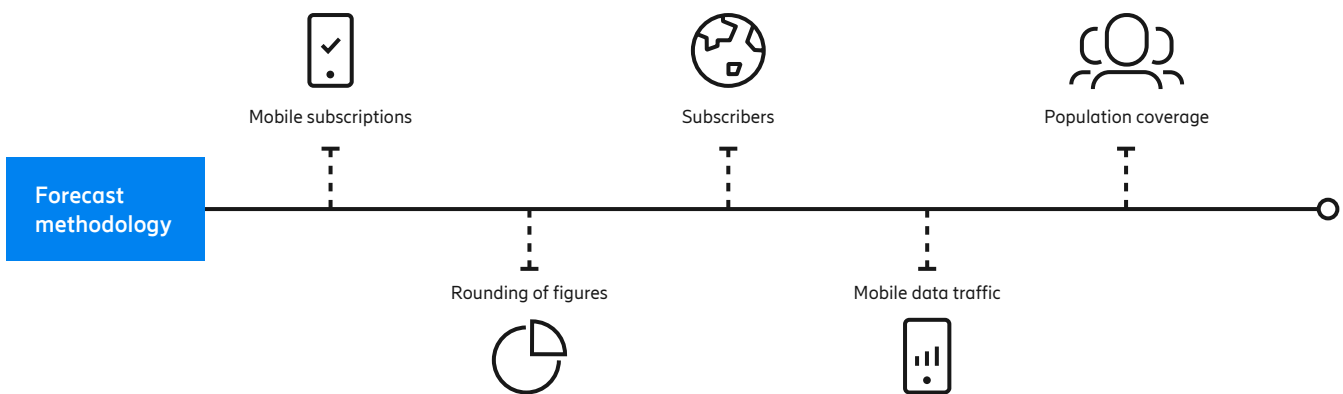
Many service providers are increasing the breadth of their offerings, providing more choice for consumers while exploring new forms of segmentation and differentiation in their search for fresh paths to revenue growth. This may complicate choices for consumers, and many service providers have streamlined

their offerings by limiting selections to a few per type. Additionally, most of the newly introduced elements are provided as add-ons, while buckets remain the basis of the offers. There is a slight increase in the use of unlimited packages as a top-tier option, but this has been overtaken by service-based offerings which are seeing a faster rate of increase.

5G offerings present a clear opportunity for service providers to try new ways of packaging in search of new revenues. FWA is already increasing rapidly due to improved 4G networks, and the introduction of 5G creates new opportunities.

In general, as service providers explore more possibilities for segmentation and differentiation, the increased breadth of offerings provides more choice for the consumer.

Methodology



Forecast methodology

Ericsson makes forecasts on a regular basis to support internal decisions and planning, as well as market communications. The forecast time horizon in the Mobility Report is six years and is moved forward one year in the November report each year. The subscription and traffic forecast baseline in this report is established using historical data from various sources, validated with Ericsson internal data, including measurements in customer networks. Future developments are estimated based on macroeconomic trends, user trends, market maturity and technological advances. Other sources include industry analyst reports, together with internal assumptions and analyses.

Historical data may be revised if the underlying data changes – for example, if service providers report updated subscription figures.

Mobile subscriptions

Mobile subscriptions include all mobile technologies. Subscriptions are defined by the most advanced technology that the mobile phone and network are capable of. Our mobile subscriptions by technology findings divide subscriptions according to the highest-enabled technology they can be used for. LTE subscriptions, in most cases, also include the possibility for the subscription to access 3G (WCDMA/HSPA) and 2G (GSM or CDMA in some markets) networks. A 5G subscription is counted as such when associated with a device that supports New Radio as specified in 3GPP Release 15, and connected to a 5G-enabled network. Mobile broadband includes radio

access technologies HSPA (3G), LTE (4G), 5G, CDMA2000 EV-DO, TD-SCDMA and Mobile WiMAX. WCDMA without HSPA and GPRS/EDGE are not included.

Rounding of figures

As figures are rounded, summing up data may result in slight differences from the actual totals. In tables with key figures, subscriptions have been rounded to the nearest 10th of a million. However, when used in highlights in the articles, subscriptions are usually expressed in full billions or to one decimal place. Compound annual growth rate (CAGR) is calculated on the underlying, unrounded numbers and is then rounded to the nearest full percentage figure. Traffic volumes are expressed in two or three significant figures.

Subscribers

There is a large difference between the numbers of subscriptions and subscribers. This is because many subscribers have several subscriptions. Reasons for this could include users lowering traffic costs by using optimized subscriptions for different types of calls, maximizing coverage and having different subscriptions for mobile PCs/tablets and mobile phones. In addition, it takes time before inactive subscriptions are removed from service provider databases. Consequently, subscription penetration can be above 100 percent, which is the case in many countries today. However, in some developing regions, it is common for several people to share one subscription, for example via a family- or community-shared phone.

Mobile data traffic

Ericsson regularly performs traffic measurements in over 100 live networks covering all major regions of the world. These measurements form a representative base for calculating worldwide total mobile traffic. More detailed measurements are made in a selected number of commercial WCDMA/HSPA and LTE networks with the purpose of understanding how mobile data traffic evolves. No subscriber data is included in these measurements.

Traffic refers to aggregated traffic in mobile access networks and does not include DVB-H, Wi-Fi or Mobile WiMAX traffic. VoIP is included in data traffic.

Population coverage

Population coverage is estimated using a database of regional population and territory distribution, based on population density. This is then combined with proprietary data on the installed base of radio base stations (RBS), together with estimated coverage per RBS for each of six population density categories (from metro to wilderness). Based on this, the portion of each area that is covered by a certain technology can be estimated, as well as the percentage of the population it represents. By aggregating these areas on a regional and global level, world population coverage per technology can be calculated.

Glossary

2G: 2nd generation mobile networks (GSM, CDMA 1x)

3G: 3rd generation mobile networks (WCDMA/HSPA, TD-SCDMA, CDMA EV-DO, Mobile WiMAX)

3GPP: 3rd Generation Partnership Project

4G: 4th generation mobile networks (LTE, LTE-A)

4K: In video, a horizontal display resolution of approximately 4,000 pixels. A resolution of 3840 × 2160 (4K UHD) is used in television and consumer media. In the movie projection industry, 4096 × 2160 (DCI 4K) is dominant

5G: 5th generation mobile networks

App: A software application that can be downloaded and run on a smartphone or tablet

AR: Augmented reality. An interactive experience of a real-world environment whereby the objects that reside in the real world are “augmented” by computer-generated information

CAGR: Compound annual growth rate

Cat-M1: A 3GPP standardized low-power wide-area (LPWA) cellular technology for IoT connectivity

CDMA: Code Division Multiple Access

dB: In radio transmission, a decibel is a logarithmic unit that can be used to sum up total signal gains or losses from a transmitter to a receiver

EB: Exabyte, 10¹⁸ bytes

EDGE: Enhanced Data Rates for Global Evolution

FDD: Frequency Division Duplex

GB: Gigabyte, 10⁹ bytes

Gbps: Gigabits per second

GHz: Gigahertz, 10⁹ hertz (unit of frequency)

GSA: Global mobile Suppliers Association

GSM: Global System for Mobile Communications

GSMA: GSM Association

HSPA: High Speed Packet Access

Kbps: Kilobits per second

LTE: Long-Term Evolution

MB: Megabyte, 10⁶ bytes

MBB: Mobile broadband (defined as CDMA2000 EV-DO, HSPA, LTE, Mobile WiMAX and TD-SCDMA)

Mbps: Megabits per second

MHz: Megahertz, 10⁶ hertz (unit of frequency)

MIMO: Multiple Input Multiple Output is the use of multiple transmitters and receivers (multiple antennas) on wireless devices for improved performance

mmWave: Millimeter waves are radio frequency waves in the extremely high frequency range (30–300GHz) with wavelengths between 10mm and 1mm. In a 5G context, millimeter waves refer to frequencies between 24 and 71GHz (the two frequency ranges 26GHz and 28GHz are included in millimeter range by convention)

Mobile PC: Defined as laptop or desktop PC devices with built-in cellular modem or external USB dongle

Mobile router: A device with a cellular network connection to the internet and Wi-Fi or Ethernet connection to one or several clients (such as PCs or tablets)

NB-IoT: A 3GPP standardized low-power wide-area (LPWA) cellular technology for IoT connectivity

NFV: Network Functions Virtualization

NR: New Radio as defined by 3GPP Release 15

OEM: Original Equipment Manufacturer

PB: Petabyte, 10¹⁵ bytes

Short-range IoT: Segment that largely consists of devices connected by unlicensed radio technologies, with a typical range of up to 100 meters, such as Wi-Fi, Bluetooth and Zigbee

Smartphone: Mobile phone with OS capable of downloading and running “apps”, e.g. iPhones, Android OS phones, Windows phones and also Symbian and Blackberry OS

TD-SCDMA: Time Division-Synchronous Code Division Multiple Access

TDD: Time Division Duplex

VoIP: Voice over IP (Internet Protocol)

VoLTE: Voice over LTE as defined by GSMA IR.92 specification

WCDMA: Wideband Code Division Multiple Access

Wide-area IoT: Segment made up of devices using cellular connections or unlicensed low-power technologies like Sigfox and LoRa

Global and regional key figures

Ericsson Mobility Visualizer

Explore actual and forecast data from the Mobility Report in our new interactive web application. It contains a range of data types, including mobile subscriptions, mobile broadband subscriptions, mobile data traffic, traffic per application type, VoLTE statistics, monthly data usage per device and an IoT connected device forecast. Data can be exported and charts generated for publication subject to the inclusion of an Ericsson source attribution.

Find out more

Scan the QR code, or visit
www.ericsson.com/mobility-report/mobility-visualizer



Global key figures

	2018	2019	Forecast 2025	CAGR* 2019–2025	Unit
Mobile subscriptions					
Worldwide mobile subscriptions	7,810	8,040	8,940	2%	million
• Smartphone subscriptions	5,020	5,550	7,400	5%	million
• Mobile PC, tablet and mobile router subscriptions	270	290	330	2%	million
• Mobile broadband subscriptions	5,630	6,160	8,060	5%	million
• Mobile subscriptions, GSM/EDGE-only	2,010	1,720	700	-14%	million
• Mobile subscriptions, WCDMA/HSPA	2,040	1,890	830	-13%	million
• Mobile subscriptions, LTE	3,600	4,340	4,790	2%	million
• Mobile subscriptions, 5G	-	13	2,600		million
Mobile data traffic					
• Data traffic per smartphone	5.5	7.2	24	22%	GB/month
• Data traffic per mobile PC	12.2	14.8	27	11%	GB/month
• Data traffic per tablet	5.6	6.9	16	15%	GB/month
Total data traffic**					
Total mobile data traffic	27	38	160	27%	EB/month
• Smartphones	24	35	150	28%	EB/month
• Mobile PCs and routers	2.1	2.7	7.5	18%	EB/month
• Tablets	0.7	0.8	2.7	22%	EB/month
Total fixed data traffic	110	140	400	20%	EB/month
Fixed broadband connections	1,060	1,110	1,300	3%	million

Regional key figures

	2018	2019	Forecast 2025	CAGR* 2019–2025	Unit
Mobile subscriptions					
North America	380	390	430	2%	million
Latin America	660	670	730	1%	million
Western Europe	520	520	540	1%	million
Central and Eastern Europe	580	580	590	0%	million
North East Asia	1,970	2,050	2,170	1%	million
China ¹	1,540	1,610	1,690	1%	million
South East Asia and Oceania	1,060	1,090	1,200	2%	million
India, Nepal and Bhutan	1,220	1,250	1,450	3%	million
Middle East and Africa	1,420	1,480	1,830	4%	million
Sub-Saharan Africa ²	700	750	960	4%	million

* CAGR is calculated on unrounded figures

** Figures are rounded (see methodology) and therefore summing up of rounded data may result in slight differences from the actual total

	2018	2019	Forecast 2025	CAGR* 2019–2025	Unit
Smartphone subscriptions					
North America	310	320	360	2%	million
Latin America	480	510	600	3%	million
Western Europe	390	390	490	4%	million
Central and Eastern Europe	330	350	500	6%	million
North East Asia	1,630	1,820	2,060	2%	million
China ¹	1,280	1,440	1,610	2%	million
South East Asia and Oceania	640	730	1,030	6%	million
India, Nepal and Bhutan	590	670	1,170	10%	million
Middle East and Africa	650	770	1,190	8%	million
Sub-Saharan Africa ²	320	380	670	10%	million
Mobile broadband subscriptions					
North America	380	390	430	2%	million
Latin America	540	580	680	3%	million
Western Europe	470	480	530	2%	million
Central and Eastern Europe	430	470	570	3%	million
North East Asia	1,690	1,820	1,970	1%	million
China ¹	1,400	1,520	1,660	1%	million
South East Asia and Oceania	770	860	1,160	5%	million
India, Nepal and Bhutan	620	720	1,340	11%	million
Middle East and Africa	740	840	1,370	9%	million
Sub-Saharan Africa ²	270	340	660	12%	million
LTE subscriptions					
North America	330	360	110	-17%	million
Latin America	280	340	500	7%	million
Western Europe	310	360	230	-7%	million
Central and Eastern Europe	190	250	410	9%	million
North East Asia	1,580	1,800	900	-11%	million
China ¹	1,230	1,420	750	-10%	million
South East Asia and Oceania	280	380	760	12%	million
India, Nepal and Bhutan	460	610	1,160	12%	million
Middle East and Africa	180	260	720	19%	million
Sub-Saharan Africa ²	50	90	280	22%	million
Data traffic per smartphone					
North America	7.0	8.5	45	32%	GB/month
Latin America	3.1	4.3	22	32%	GB/month
Western Europe	6.2	8.8	36	26%	GB/month
Central and Eastern Europe	4.5	6.1	24	26%	GB/month
North East Asia	6.9	8.7	24	18%	GB/month
China ¹	7.1	8.8	22	17%	GB/month
South East Asia and Oceania	3.6	4.9	21	28%	GB/month
India, Nepal and Bhutan	10.2	13.6	24	10%	GB/month
Middle East and Africa	2.7	3.7	18	29%	GB/month
Sub-Saharan Africa ²	0.9	1.3	6.9	33%	GB/month
Total mobile data traffic					
North America	2.5	3.3	17	31%	EB/month
Latin America	1.4	2.0	11.6	34%	EB/month
Western Europe	2.6	3.7	16	28%	EB/month
Central and Eastern Europe	1.2	1.7	9.5	33%	EB/month
North East Asia	10.5	15	47	21%	EB/month
China ¹	8.5	11.8	35	20%	EB/month
South East Asia and Oceania	2.3	3.5	20	34%	EB/month
India, Nepal and Bhutan	4.6	6.9	22	21%	EB/month
Middle East and Africa	1.7	2.6	18	38%	EB/month
Sub-Saharan Africa ²	0.25	0.40	4.2	48%	EB/month

¹ These figures are also included in the figures for North East Asia² These figures are also included in the figures for Middle East and Africa

Ericsson enables communications service providers to capture the full value of connectivity. The company's portfolio spans Networks, Digital Services, Managed Services, and Emerging Business and is designed to help our customers go digital, increase efficiency and find new revenue streams. Ericsson's investments in innovation have delivered the benefits of telephony and mobile broadband to billions of people around the world. The Ericsson stock is listed on Nasdaq Stockholm and on Nasdaq New York.

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