ericsson.com/
mobility-report

Ericsson Mobility Report

November 2018

Letter from the publisher

The power of 5G

So here we are with a new "G" after years of research, standardization and trials. The telecom industry as well as many other industries are looking with great anticipation at what 5G might bring. In this edition of the Ericsson Mobility Report, we continue to broaden our perspective and deepen our analysis to provide insights into an industry going through a pivotal change.

For communications service providers, a successful mobile broadband business is the base for addressing all the new opportunities that lie ahead. 5G is a key component of this, as new spectrum and the promise of lower cost per gigabyte delivered will be key drivers of 5G deployment.

As 5G hits the market, the mobile ecosystem is larger and more widespread and extensive than ever. Momentum is building in many markets as service providers accelerate their plans for 5G rollout. In 2024, we project that 5G will reach 40 percent population coverage and 1.5 billion subscriptions, making it the fastest generation ever to be rolled out on a global scale. This is driven by new, innovative solutions that reuse existing infrastructure and available spectrum.

In parallel to the 5G rollout, cellular IoT is passing new milestones on its way to becoming the technology of choice for wide-area IoT applications. Boosted by a strong uptake in North East Asia, cellular IoT connections are set to pass the 4 billion mark by 2024.

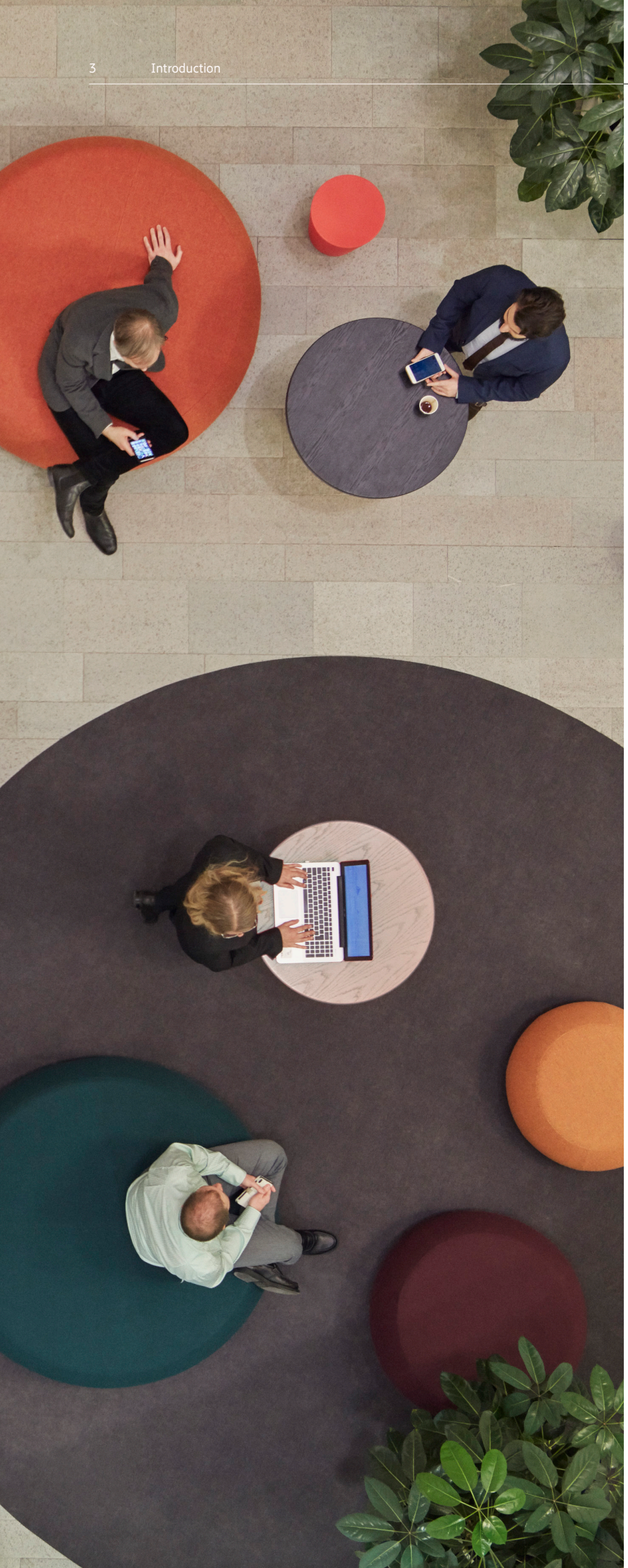
As 5G arrives I am sure it will be the starting point for fundamental changes. Imagine the power of an industry with 6 billion subscribers and the potential for innovation with 5G in their hands.

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
Articles:	Peter Jonsson, Stephen Carson, Per Lindberg, Kati Öhman, Ida Sorlie, Ricardo Queirós, Frank Muller, Lisa Englund, Mats Arvedson, Anders Carlsson



Contents

Forecasts

Articles

Find out more
Scan the QR code or visit
www.ericsson.com/mobility-report

The content of this document is based on a number of theoretical dependencies and assumptions and Ericsson shall not be bound by or liable for any statement, representation, undertaking or omission made in this document. Furthermore Ericsson may at any time change the contents of this document at its sole discretion and shall not be liable for the consequences of such changes.

Mobile subscriptions Q3 2018

The total number of mobile subscriptions was around 7.9 billion in Q3 2018, with 120 million new subscriptions added during the quarter.

The number of mobile subscriptions grew at 3 percent year-on-year and currently totals 7.9 billion. China had the most net additions during the quarter (+37 million), followed by India (+31 million) and Indonesia (+13 million). The high subscription growth in China continues from Q1 and Q2, and is likely the result of intense competition among communications service providers.

The number of mobile broadband subscriptions[1] is growing at 15 percent year-on-year, increasing by 240 million in Q3 2018. The total is now 5.7 billion.

The number of LTE subscriptions increased by 200 million during the quarter to reach a total of 3.3 billion. The net addition for WCDMA/HSPA was around 60 million subscriptions.

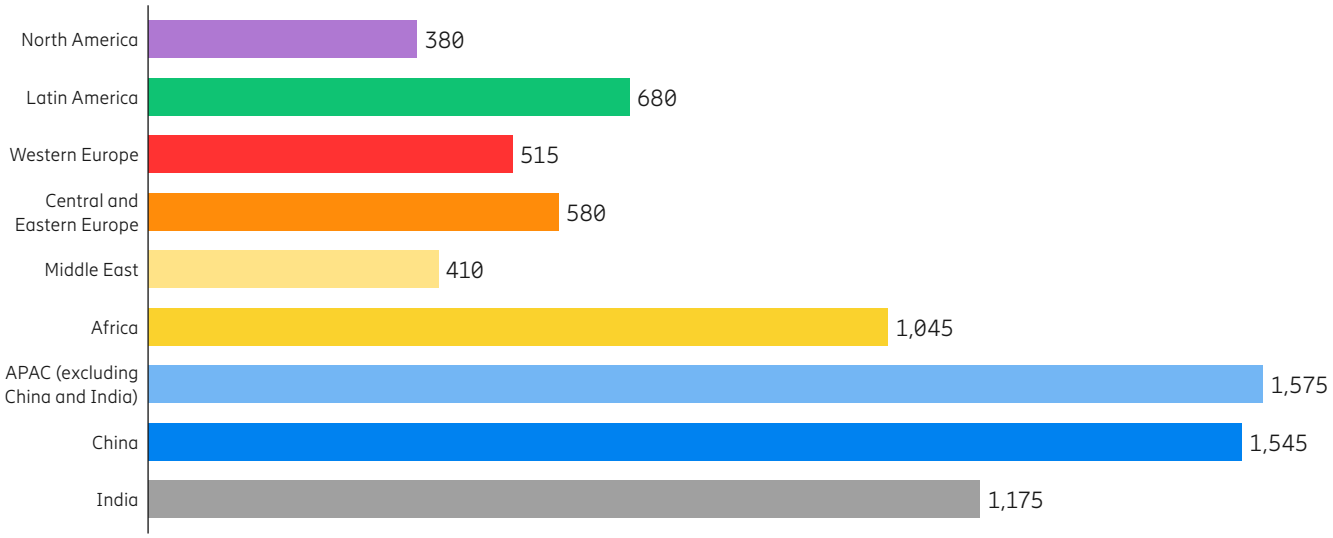
Over the same period, GSM/EDGE-only subscriptions declined by 110 million. Other technologies declined by around 30 million.

Subscriptions associated with smartphones now account for more than 60 percent of all mobile phone subscriptions. Around 360 million smartphones were sold in Q3, which equates to 86 percent of all mobile phones sold in the quarter.

5.7bn

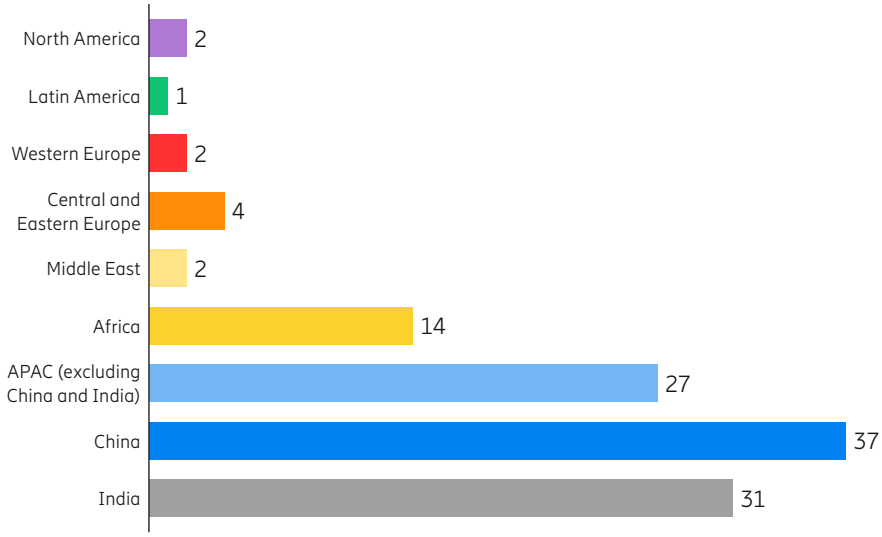
There are now 5.7 billion mobile broadband subscriptions.

Mobile subscriptions Q3 2018 (million)



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

New mobile subscriptions Q3 2018 (million)



120m

There were 120 million new mobile subscriptions globally in Q3 2018.

Top countries by net additions Q3 2018

1	China	+37 million
2	India	+31 million
3	Indonesia	+13 million

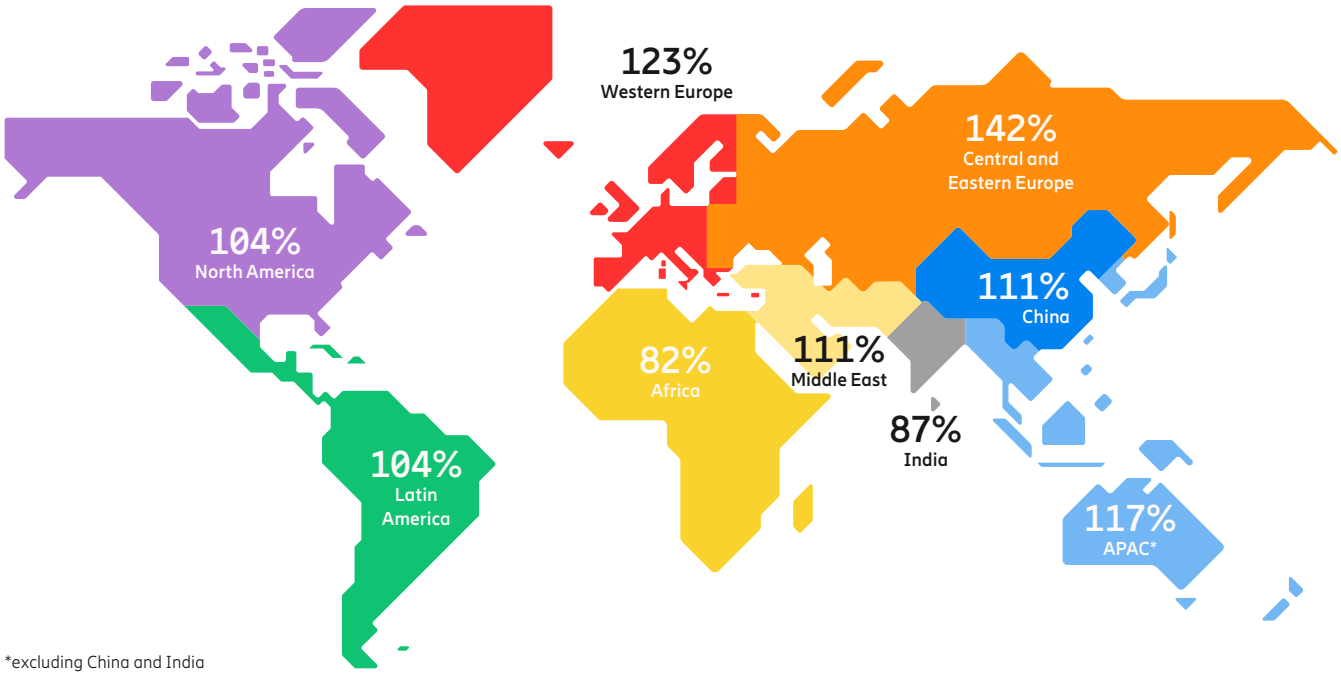
The number of mobile subscriptions exceeds the population in many countries, which is largely due to inactive subscriptions, multiple device ownership or optimization of subscriptions for different types of calls.

As a result, the number of mobile subscribers is lower than the number of mobile subscriptions. Today, there are around 5.6 billion subscribers globally compared to 7.9 billion subscriptions.

104%

Global subscription penetration is at 104 percent in Q3 2018.

Subscription penetration Q3 2018 (percent of population)



*excluding China and India

Mobile subscriptions outlook

5G has now been commercially launched.

There is strong momentum in the global 5G market. In the United States, one of the major communications service providers launched a 5G home internet service at the beginning of October, and all four of the country's major service providers have publicly announced that they will begin providing 5G services between late 2018 and mid-2019. Other markets expecting significant 5G subscription volumes early include South Korea, Japan and China. In Europe, some spectrum auctions have already been held, and others will take place over the next few years. The first commercial 5G subscriptions in the region are expected in 2019.

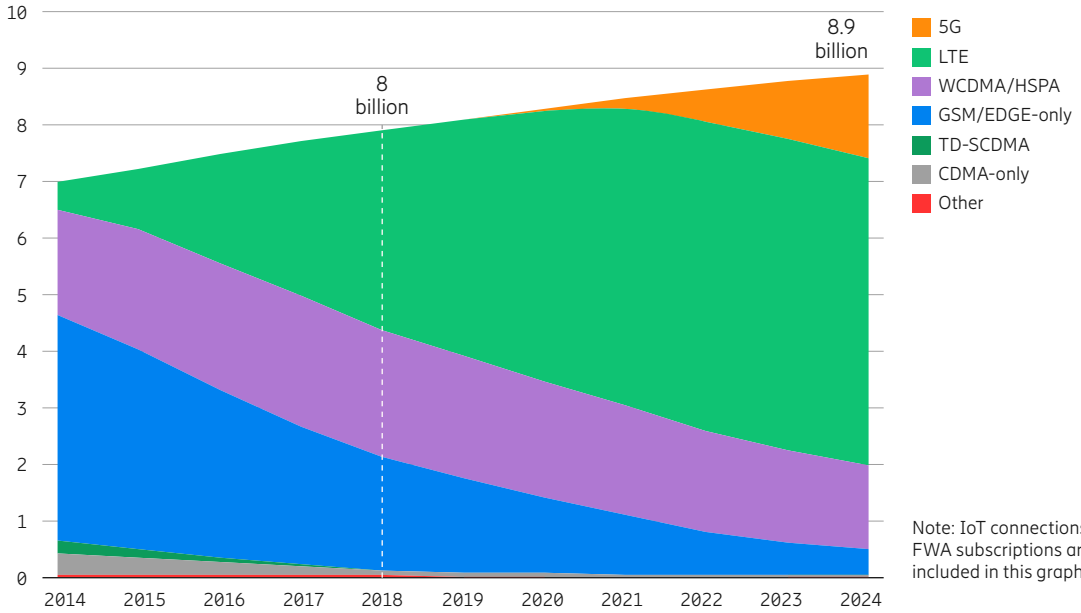
On a global level, major 5G network deployments are anticipated from 2020, and by the end of 2024 we project 1.5 billion 5G subscriptions for enhanced mobile broadband. This will account for close to 17 percent of all mobile subscriptions at that time. With global mobile data traffic forecast to increase more than 5 times between 2018 and 2024, key drivers for 5G deployment include increased network capacity and decreased cost per byte. 5G subscription uptake is expected to be faster than for LTE, which in turn is the mobile communication technology with the fastest subscription uptake so far.

LTE has been the dominant mobile access technology since the end of 2017. The number of LTE subscriptions continues to grow strongly and is forecast to reach 5.4 billion by the end of 2024, when it will make up more than 60 percent of all mobile subscriptions. The number of WCDMA/HSPA subscriptions has declined slightly during 2018, though the technology is still estimated to account for close to 17 percent of all subscriptions in 2024.

Cellular IoT connections and fixed wireless access (FWA) subscriptions supporting new use cases will come on top of the mobile subscriptions shown in the graph below.

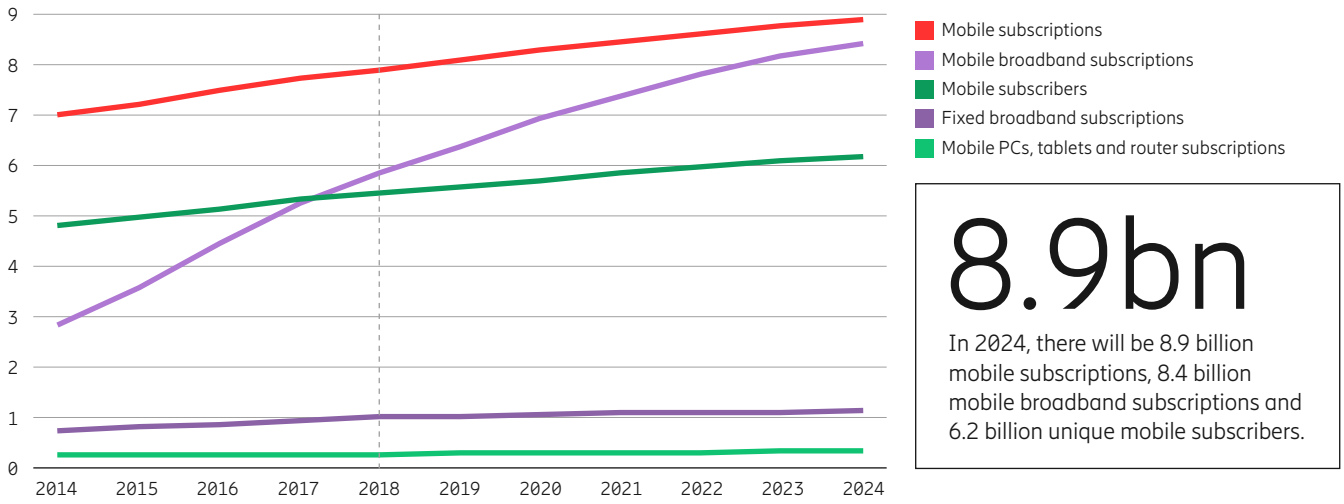
A 5G subscription is counted as such when associated with a device that supports New Radio (NR) as specified in 3GPP Release 15, and connected to a 5G-enabled network.

Mobile subscriptions by technology (billion)



Note: IoT connections and FWA subscriptions are not included in this graph

Subscriptions and subscribers (billion)



8.9bn

In 2024, there will be 8.9 billion mobile subscriptions, 8.4 billion mobile broadband subscriptions and 6.2 billion unique mobile subscribers.

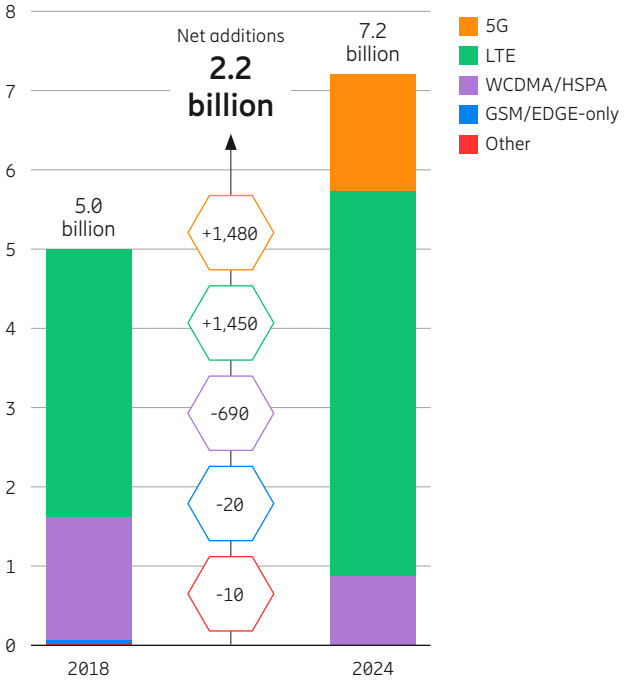
Close to 95 percent of all subscriptions will be for mobile broadband by the end of 2024.

We forecast that there will be 8.9 billion mobile subscriptions by the end of 2024. Mobile broadband subscriptions will reach 8.4 billion, accounting for close to 95 percent of all mobile subscriptions. The number of unique mobile subscribers is estimated to reach 6.2 billion by the end of the forecast period.

Mobile broadband will complement fixed broadband in some segments and will be the dominant mode of access in others.[1] Subscriptions for PCs and tablets with mobile capabilities are expected to show moderate growth, reaching 330 million in 2024.

Smartphone penetration continues to rise. At the end of 2018, there will be 5 billion smartphone subscriptions, 99 percent of which will be for 3G and 4G. The number of smartphone subscriptions is forecast to reach 7.2 billion in 2024, when practically all will be for mobile broadband.

Smartphone subscriptions by technology (billion)



[1] 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. This is the opposite to the situation for mobile phones, where subscription numbers exceed user numbers

IoT connections outlook

The number of cellular IoT connections is expected to reach 4.1 billion in 2024 – increasing with an annual growth rate of 27 percent.

There is an emerging trend toward communications service providers deploying one IoT network that supports both Cat-M1 and NB-IoT technologies. This enables them to address the diverse and evolving requirements across a wide range of use cases in different verticals, such as utilities, smart cities, logistics, agriculture, manufacturing and wearables.

Massive IoT cellular technologies such as NB-IoT and Cat-M1 are taking off and driving growth in the number of cellular IoT connections worldwide. Of the 4.1 billion cellular IoT connections forecast for 2024, North East Asia is anticipated to account for 2.7 billion – a figure reflecting both the ambitions and size of the cellular IoT market in this region.

These complementary technologies support diverse low-power wide-area (LPWA) use cases over the same underlying LTE network. The table to the right shows the IoT connections forecast, where the cellular IoT connections category is part of the wide-area IoT segment.

More advanced IoT use cases emerging

As the IoT application market is widening, more advanced use cases requiring enhanced network capabilities are emerging. Examples of such capabilities are support for optimized voice quality, more accurate device positioning and support for device mobility at high speed.

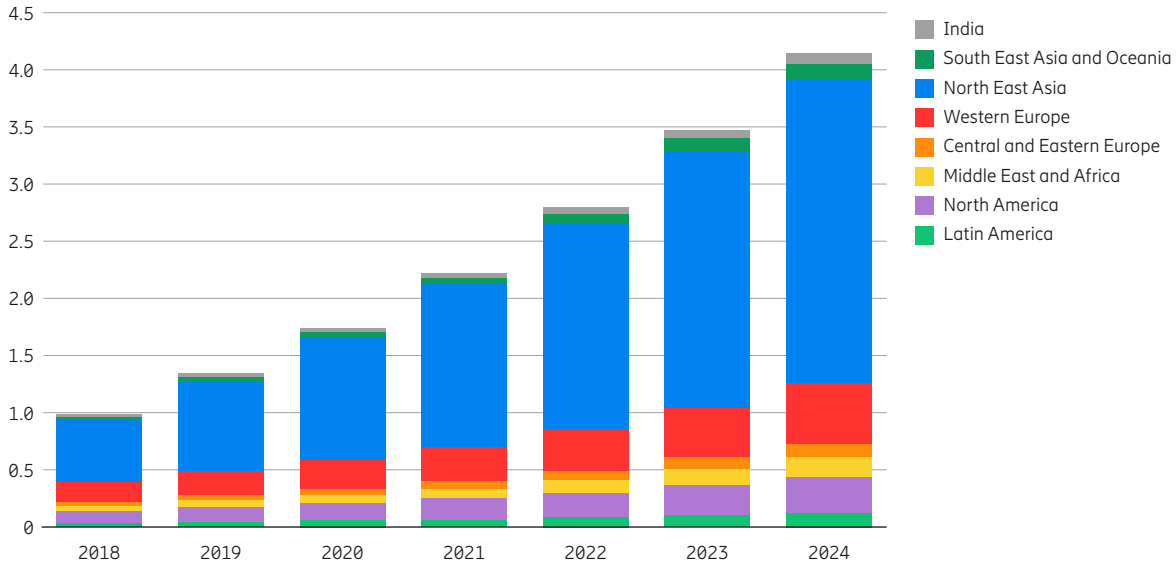
Service providers have announced the deployment of 85 cellular IoT networks worldwide using Cat-M1 and/or NB-IoT.[1] In both Europe and Asia, deployments of Cat-M1 have commenced, while NB-IoT is now also being deployed in North America, in addition to the ongoing deployment of Cat-M1 technology. Both technologies are being deployed to complement each other across regions worldwide.

Large-scale deployments, and the resulting high-volume chipsets, are expected to continue to reduce chipset prices. This is leading to further acceleration of the growth in cellular IoT connections.

IoT connections (billion)

IoT	2018	2024	CAGR
Wide-area IoT	1.1	4.5	27%
Cellular IoT[2]	1.0	4.1	27%
Short-range IoT	7.5	17.8	15%
Total	**8.6**	**22.3**	**17%**

Cellular IoT connections per region (billion)



[1] GSA (October 2018)
[2] These figures are also included in the figures for wide-area IoT

IoT traffic characteristics

Since 2013, the number of cellular connected devices has grown at a compounded annual rate of 33 percent. Over the same period, traffic per connected device has grown much faster due to an increasing share of devices generating higher traffic volumes. However, cellular IoT traffic still represents a very small portion of total mobile traffic in service providers' networks.

Most of today's cellular IoT applications generate relatively small data traffic volumes in mobile networks. The installed base of IoT devices is a distribution of 2G, 3G and LTE technology. A majority of these are 2G devices, due to the long life cycles of sensors and applications with basic requirements. This distribution is expected to change as a broader range of use cases evolve over time, along with the continued deployment of supporting LTE-based IoT technologies and future capabilities of 5G networks.

IoT traffic volume is limited but increasing

To date, IoT has been characterized by a very large number of connections, small data volumes and, in some cases, stringent requirements on energy consumption. Typical uses are sensor, monitor or control data IoT applications. In many markets, ultra-low-end IoT applications with limited demands on throughput, such as sensors and monitoring, were the first services to be built on NB-IoT technology. Data traffic generated by such devices is generally low; the typical data packet for a sensor-based service is about 100–150 bytes, with a payload comprised of a device ID, time stamp and reported data values. NB-IoT technology is capable of supporting data rates of 227Kbps in uplink and 250Kbps in downlink.

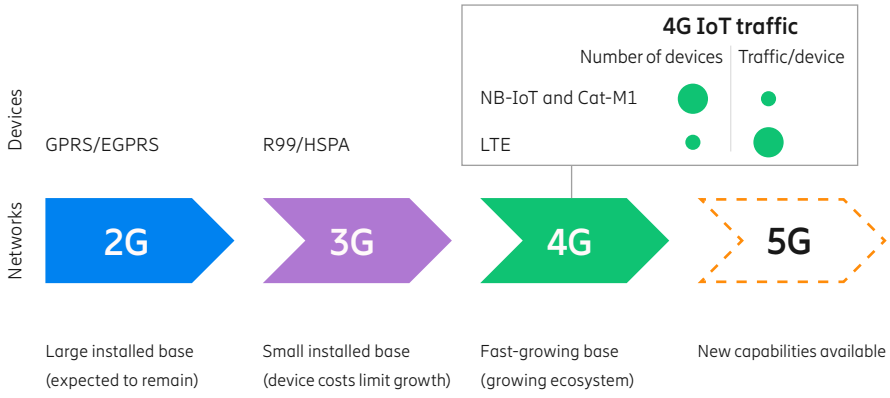
Cat-M1 is a second technology designed and standardized for massive IoT applications and is capable of supporting data rates up to 1Mbps in both the uplink and downlink.

The traffic volume generated by massive IoT applications is a function of message size, message interval and number of devices deployed per square kilometer.

Beyond massive deployments of devices generating limited data volumes, there is an evolving range of IoT applications that have stringent requirements on availability, delay and reliability. Applications include traffic safety, automated vehicles, drones and industrial automation. These can generate many times more data traffic than massive IoT applications, depending on the specific use case. They could be based on LTE devices where, for example, an LTE Cat 4 device supports data rates of 150Mbps in downlink and 50Mbps in uplink; or have use case requirements that only future 5G network capabilities can meet. NB-IoT and Cat-M1 will continue to coexist with the introduction of 5G networks.

The diagram below illustrates that, as new enabling IoT technologies are deployed, both the number of connections and the traffic per connection over cellular networks will drive increasing traffic volumes.

Evolution of cellular networks supporting IoT traffic growth



5G device outlook

The state of the device market is always a good indicator of the expectations for a new technology generation.

The third quarter of 2018 has been remarkable: a number of device vendors revealed their 5G ambitions, capturing the attention of the tech-savvy with their 5G smartphone designs. Recently, it has become apparent that 5G anticipation is much greater than that experienced in the lead-up to LTE. Key suppliers of cellular chipsets are spending significant resources on developing their 5G offerings.

Clearly 5G is at the front of everyone's mind – but it should also be remembered that this is just the beginning of a major technology shift, with many challenges ahead.

Frequency diversity

Not every market has the same access to spectrum. While millimeter wave (mmWave) spectrum bands are an important topic in North America, other markets will concentrate on sub-6GHz spectrum in different forms and variants. This means chipset and infrastructure vendors need to work on three non-standalone 5G variants almost concurrently: TDD for mmWave, TDD for mid-band and FDD for low band. Standalone 5G is also starting to emerge. Compared to the introduction of LTE, the scope of 5G technical variants is much wider.

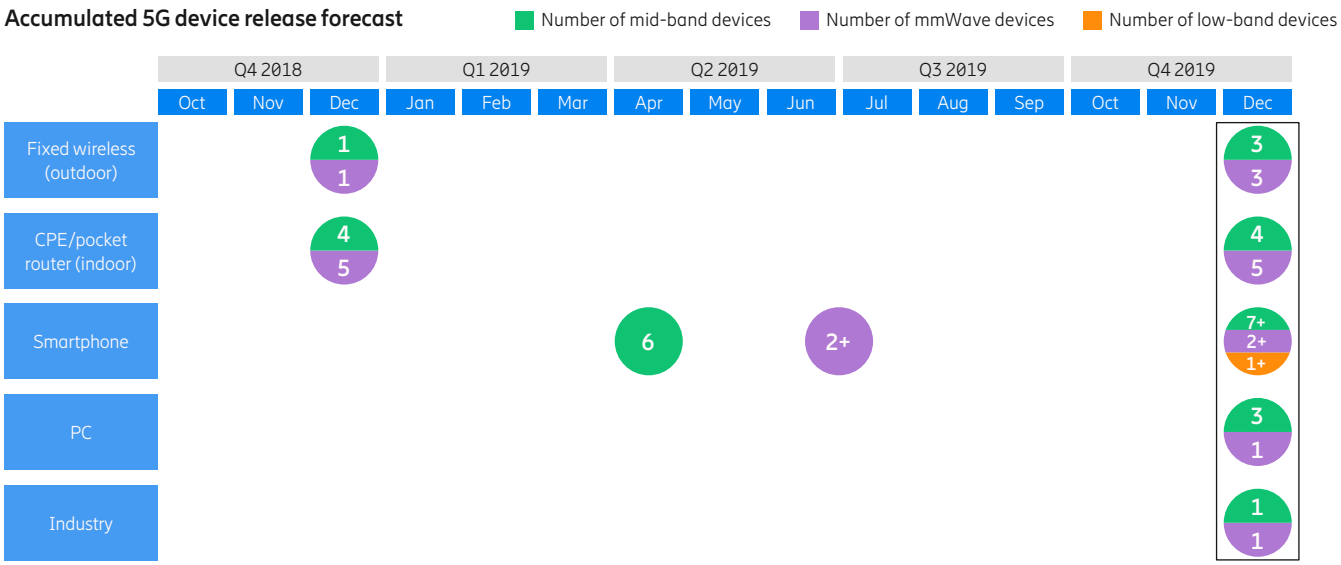
Despite the complexities, device and infrastructure vendors are now continuously announcing products for mmWave, mid-band and low-band variants. More than 20 devices were announced in October 2018 alone. The figure below illustrates our projected timing for commercial 5G device offerings.

There are strong indications that indoor customer-provided equipment (CPE) and pocket routers for mid-band will be available by the end of the year. For smartphones we forecast a strong lineup for Q2 2019. At this point it is difficult to accurately predict release timing or number of vendors, but second-generation chipsets are expected by the end of 2019, which will enable more 5G-capable devices with enhanced architectures and lower power consumption. Modules for laptops and industrial applications are expected within the same time frame.

The situation for mmWave looks very similar to that for mid-band, with the caveat that mmWave can be seen as more challenging as this frequency domain has not been used in small form-factor cellular devices before. Power consumption, antenna technology and Additional Maximum Power Reduction (A-MPR) are all more challenging for mmWave compared to mid- and low-band devices.

In summary, 5G will take off in 2019 and 2020 will be the year in which 5G enters the mass market. At this point in time, third-generation chipsets will have been introduced and a large number of devices will be available.

Accumulated 5G device release forecast



Accumulated 5G devices available December 2019

Voice over LTE outlook

At the end of 2018, VoLTE subscriptions will be close to 1.4 billion, with operators introducing a wide range of new voice service use cases.

Evolution of voice services to IP, cloud and 5G

Communications service providers continue to evolve their voice services and build IP-based communication service networks based on VoLTE. It has now been launched in more than 155 networks in over 75 countries, across all regions.[1]

VoLTE is now being deployed using cloud/NFV technologies in order to support more cost-efficient network operations, enabling faster scaling of capacity as well as faster deployment of new services.

The building of globally connected VoLTE services has started, with more than 20 service providers having signed VoLTE roaming agreements and over 10 holding voice interconnect agreements nationally or internationally.[2]

The number of VoLTE subscriptions is projected to reach 6 billion by the end of 2024, accounting for around 90 percent of combined LTE and 5G subscriptions. VoLTE technology will be the foundation for enabling 5G voice calls on different types of 5G devices.

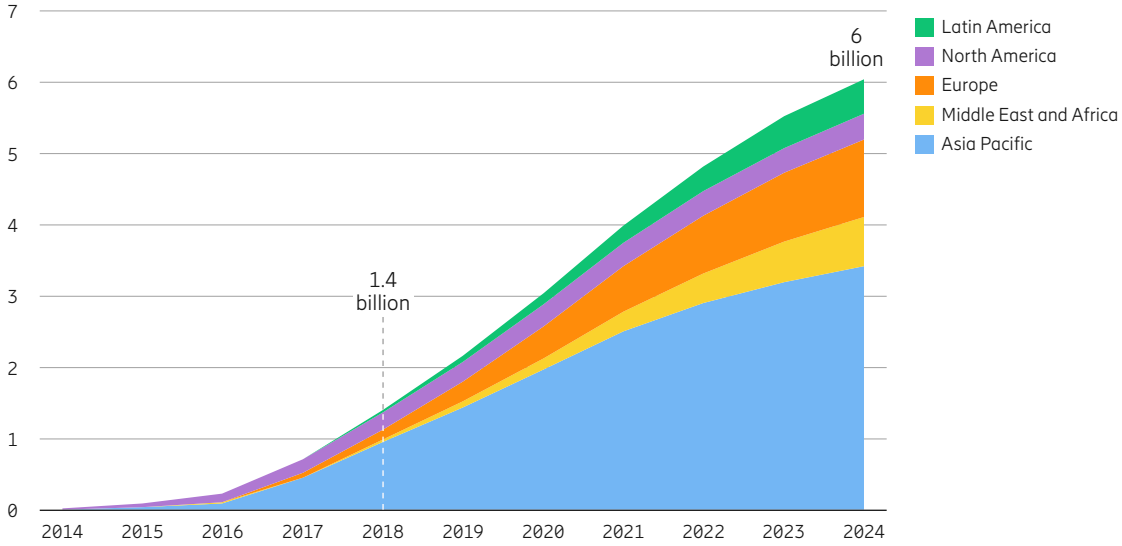
New use case uptake and device availability

There are more than 1,800 VoLTE-enabled device models.[3] The usage of next-generation 3GPP standardized voice codec Enhanced Voice Services (EVS), also known as HD voice+,[4] is starting to pick up. HD voice+ provides improved audio and music quality within calls on VoLTE-capable devices, as well as better call reliability across LTE and Wi-Fi. More than 150 HD voice+ enabled devices are available, and over 15 service providers have deployed the service.[5]

Cellular smartwatches with VoLTE-based voice calls enabled have gained market traction, with more than 50 service provider launches during the last year. Video calling over LTE (ViLTE) has been launched by over 20 service providers, and there are more than 220 device models[6] available.

Other VoLTE-based services include Wi-Fi calling, voice in IoT devices, multi-device (devices such as phones, smartwatches and smart speakers sharing a phone number) and multi-persona (a single phone using several phone numbers), while combinations with, for example, augmented and virtual reality in 5G are being explored.

VoLTE subscriptions by region (billion)

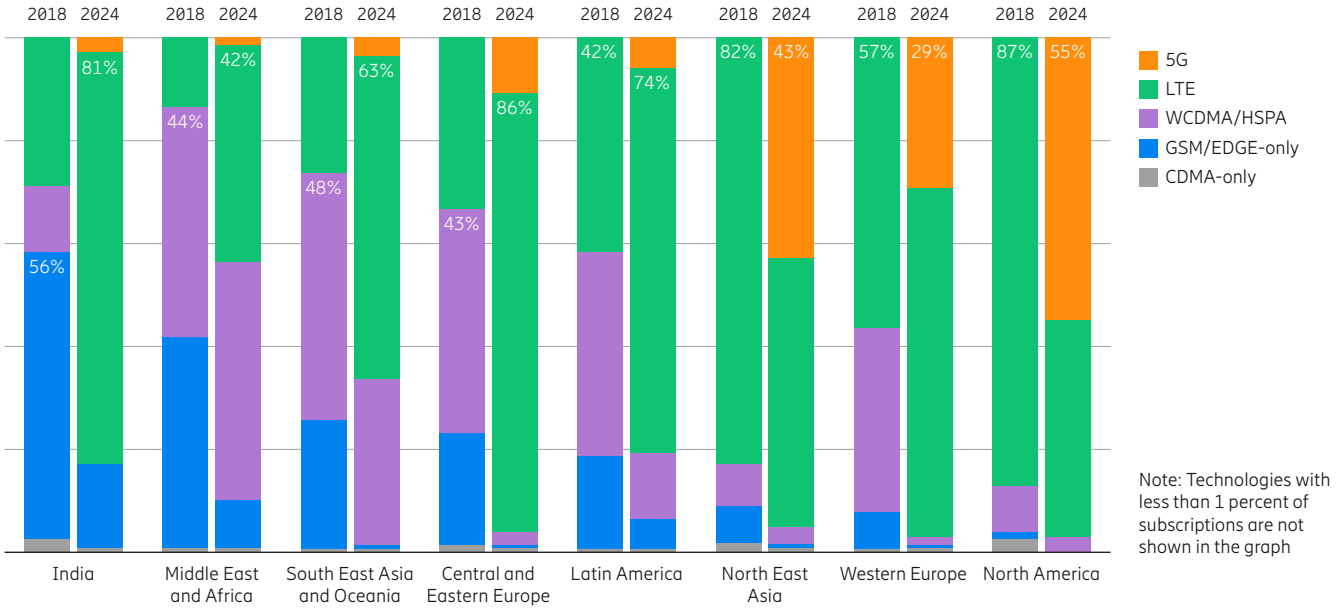


[1] GSMA (October 2018)
[2] Ericsson and GSMA (October 2018)
[3] GSA (August 2018), supporting different regions and frequencies
[4] GSMA trademark
[5] GSA (September 2018)
[6] GSA (August 2018)

Regional subscriptions outlook

Mobile broadband[1] drives subscription growth across all regions.

Mobile subscriptions by region and technology (percent)



Note: Technologies with less than 1 percent of subscriptions are not shown in the graph

In **India**, GSM/EDGE-only has remained the dominant technology during 2018, accounting for around 56 percent of total mobile subscriptions at the end of this year. However, the country has experienced strong growth in the number of LTE subscriptions over the last couple of years, and at the end of 2018 LTE will account for close to 30 percent of all mobile subscriptions.

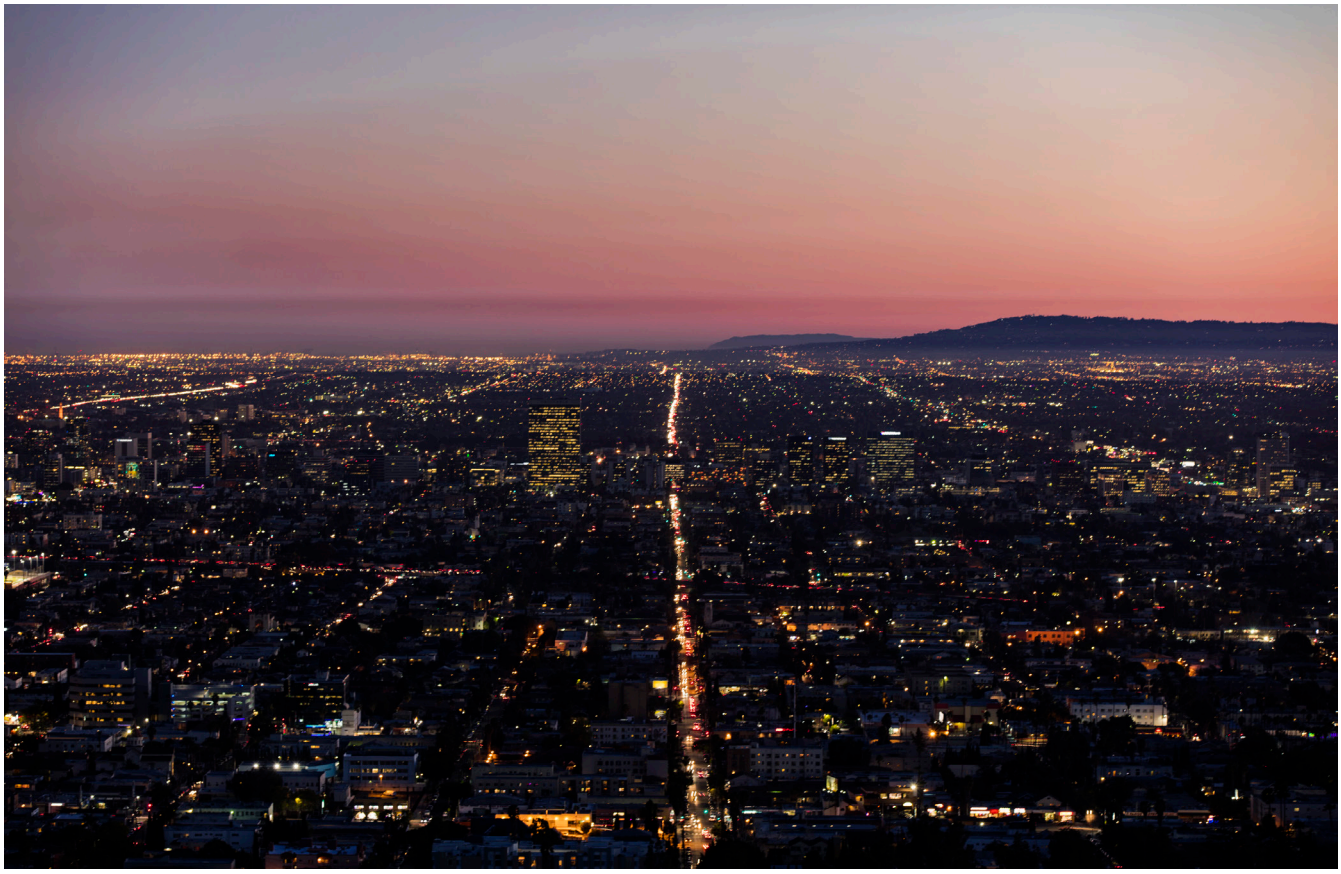
As the transformation toward more advanced technologies continues in India, LTE is forecast to represent 81 percent of all mobile subscriptions at the end of 2024. 5G subscriptions are expected to become available in 2022.

The **Middle East and Africa** comprises over 70 countries and is a diverse region. It varies from advanced markets which have mobile broadband subscription penetration of 100 percent, and emerging markets where around 40 percent of mobile subscriptions are for mobile broadband. At the end of 2018, more than 20 percent of all mobile subscriptions will be for LTE in the Middle East and North Africa, while in Sub-Saharan Africa, LTE will account for just over 7 percent of subscriptions. The region is anticipated to evolve over the forecast period and, by 2024, 90 percent of subscriptions are expected to be for mobile broadband. Driving factors behind this shift include a young and growing population with increasing digital skills, as well as more affordable smartphones. In the Middle East and North Africa, we anticipate commercial 5G deployments with leading communications service providers by 2019, and significant volumes in 2021. In Sub-Saharan Africa, 5G subscriptions in discernible volumes are expected from 2022.

74%

Globally, mobile broadband subscriptions now make up 74 percent of all mobile subscriptions.

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



A connected world: mobile broadband subscription levels globally are rising

South East Asia and Oceania includes developed markets with some of the most advanced networks in the world, as well as developing economies that have only recently launched LTE. WCDMA/HSPA is still the dominant technology, at 48 percent of all subscriptions. However, LTE subscriptions grew by 70 percent during 2018, taking a share of 26 percent. This transformation is expected to continue over the forecast period and, in 2024, LTE is projected to account for 63 percent of all mobile subscriptions in the region. 5G subscriptions are expected to become available in 2021.

In **Central and Eastern Europe**, the transition from WCDMA/HSPA to LTE is continuing. LTE is forecast to become the dominant technology in 2019 and to account for around 86 percent of all mobile subscriptions in 2024. The first 5G subscriptions are expected in 2019, and will make up close to 10 percent of total subscriptions in 2024.

In **Latin America**, LTE became the dominant radio access technology in 2018, accounting for 42 percent of all subscriptions – just above WCDMA/HSPA, with a share of 39 percent. The distribution of technology is expected to change dramatically over the forecast period, with LTE projected to represent three-quarters of all subscriptions in 2024. The first 5G deployments will be possible in the 3.5GHz band during 2019. Argentina, Brazil, Chile, Colombia and Mexico are anticipated to be the first countries in the region to deploy 5G, with increased subscription uptake forecast from 2020.

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, and the region is the first to launch commercial 5G services. In the United States, one of the four major service providers deployed a 5G fixed wireless internet service at the beginning of October 2018, and another has announced plans to deploy 5G based on the 3GPP 5G standard by the end of 2018. The other two major service providers are expected to launch 5G services in early 2019. LTE penetration is currently 87 percent in North America, which is the highest share globally. By the end of 2024, we anticipate more than 250 million 5G subscriptions in the region, accounting for over 55 percent of all mobile subscriptions.

In **North East Asia**, the share of LTE subscriptions is high at 82 percent.

55%

55 percent of mobile subscriptions in North America are expected to be for 5G in 2024.

China alone will have more than 1.3 billion LTE subscriptions at the end of 2018. 5G is expected to be deployed early in South Korea, Japan and China and, by the end of the forecast period, 5G subscription penetration is projected to exceed 43 percent in North East Asia.

In **Western Europe**, LTE is the dominant access technology, accounting for 57 percent of all subscriptions. WCDMA/HSPA continues to decline and will represent only 2 percent of subscriptions in 2024. The region is preparing for 5G, with many operators planning commercial launches during 2019. By the end of 2024, 5G is forecast to account for around 30 percent of all mobile subscriptions.

Mobile traffic Q3 2018

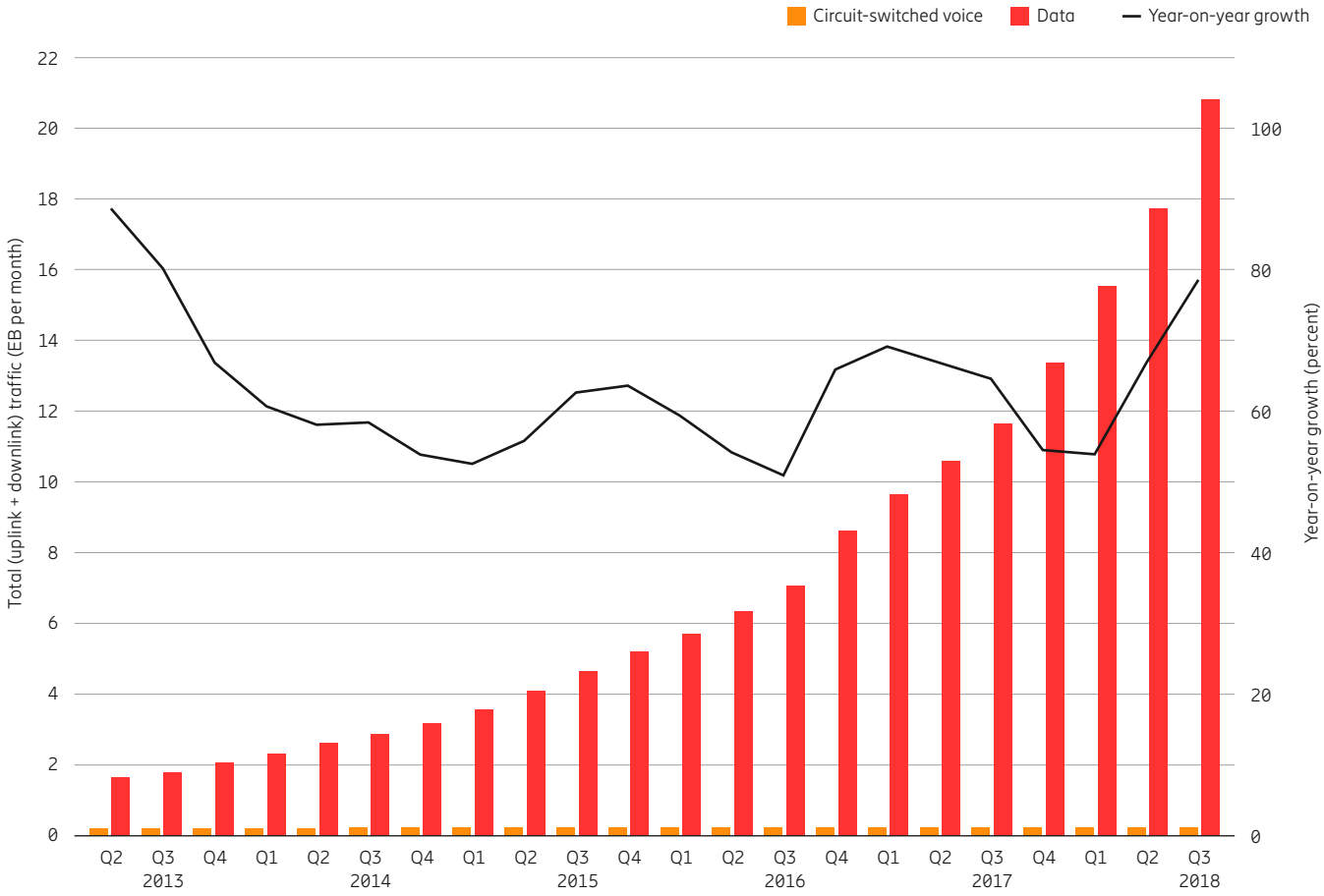
Increased mobile data traffic in North East Asia drives the global year-on-year growth rate to 79 percent.

Traffic[1] growth is 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 Q2 2013 to Q3 2018, along with the year-on-year percentage change for mobile data traffic.

In Q3 2018, mobile data traffic grew close to 79 percent year-on-year, which is the highest growth rate since 2013.

The increased mobile data traffic per smartphone in North East Asia this year, mainly in China, has pushed up the global traffic significantly. The global traffic growth rate has been influenced by individual regions before, for example by North America in 2015 and by India in 2016.

The quarter-on-quarter growth was around 17 percent.



Source: Ericsson traffic measurements (Q3 2018)

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

Mobile traffic by application category

Mobile video traffic continues to grow, driven by increased viewing time, online embedded video and streaming services, plus the evolution toward higher resolutions.

Video traffic in mobile networks is forecast to grow by around 35 percent annually through 2024 to account for 74 percent of all mobile data traffic. Traffic from social networking is also expected to rise – increasing by 24 percent annually over the next 6 years. However, its relative share of traffic will decline from 11 percent in 2018 to around 8 percent in 2024, because of the stronger growth of video.[1]

Video is everywhere

Increasing video usage is the main driver behind the growth in mobile data traffic. Users spend increasing amounts of time both streaming and sharing video. This trend is expected to continue, as video is increasingly embedded in all types of online content. In addition, emerging media formats and applications, such as streaming high-quality video and augmented/virtual reality, will continue to drive traffic growth while enhancing the user experience.

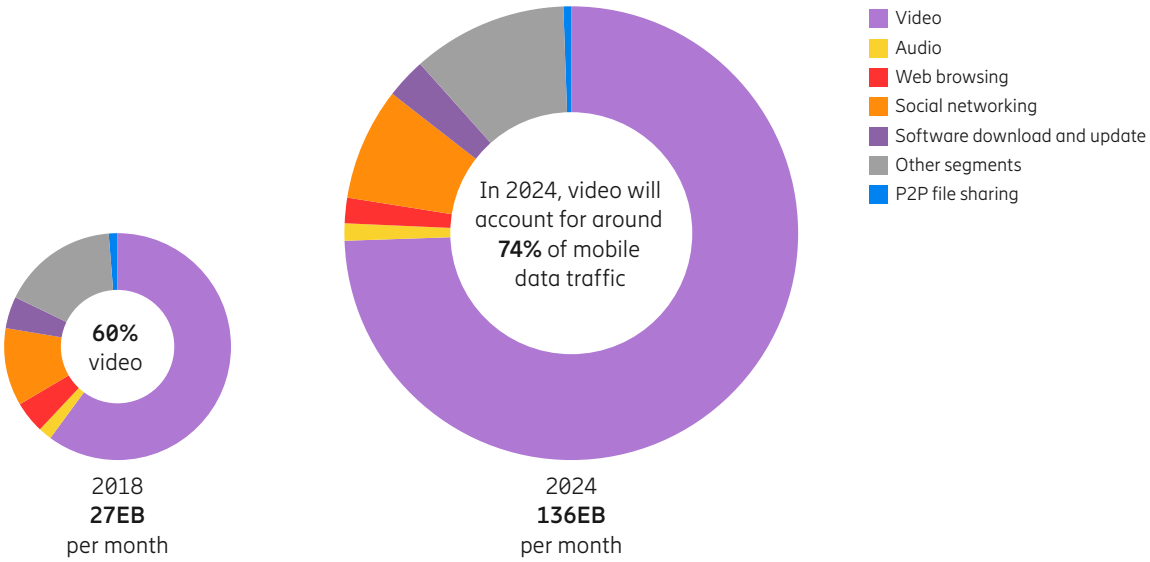
Main drivers for video traffic growth

- 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 deployments
- Emerging immersive media formats and applications (HD/UHD, 360-degree video, AR, VR)

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 traffic per subscription. Fill in your app usage figures and benchmark the resulting data consumption against six pre-set data consumption profiles.

Mobile data traffic by application category per month (percent)



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

Mobile data traffic outlook

In 2024, 5G networks will carry 25 percent of global mobile data traffic.

Monthly mobile data traffic per smartphone continues to increase in all regions, driven by improved device capabilities and more affordable data plans, as well as an increase in data-intensive content.

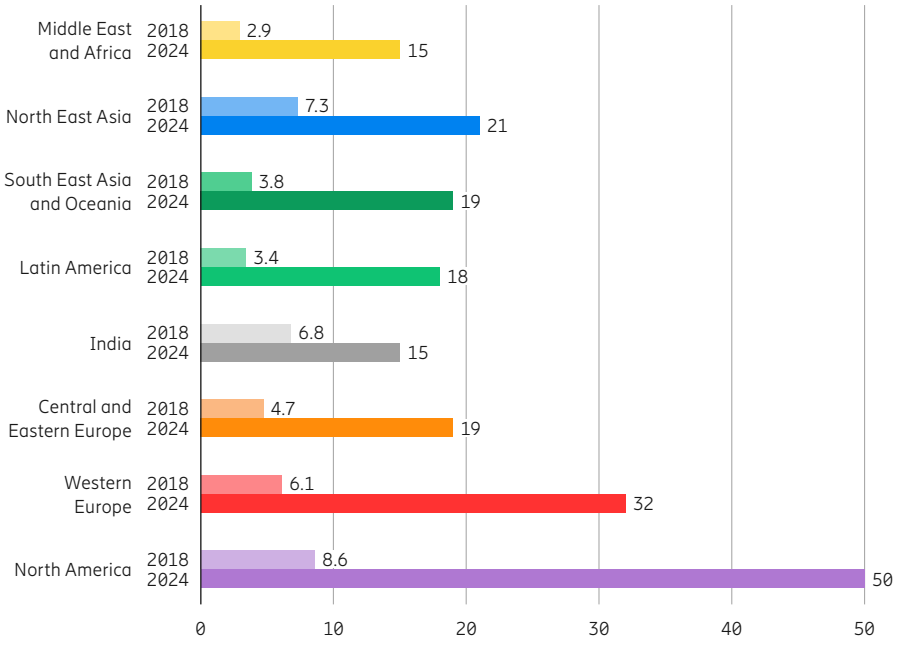
North America has the highest monthly usage, reaching 8.6 gigabytes (GB) at the end of this year, and is set to reach 50GB by the end of 2024. In North East Asia, traffic per smartphone has grown strongly during 2018 – increasing by around 140 percent year-on-year. The region now has the second-highest monthly usage at 7.3GB and is projected to reach 21GB at the end of the forecast period. Attractive data plans as well as innovative mobile apps and content are driving growth in China.

Total mobile data traffic is expected to be five times higher

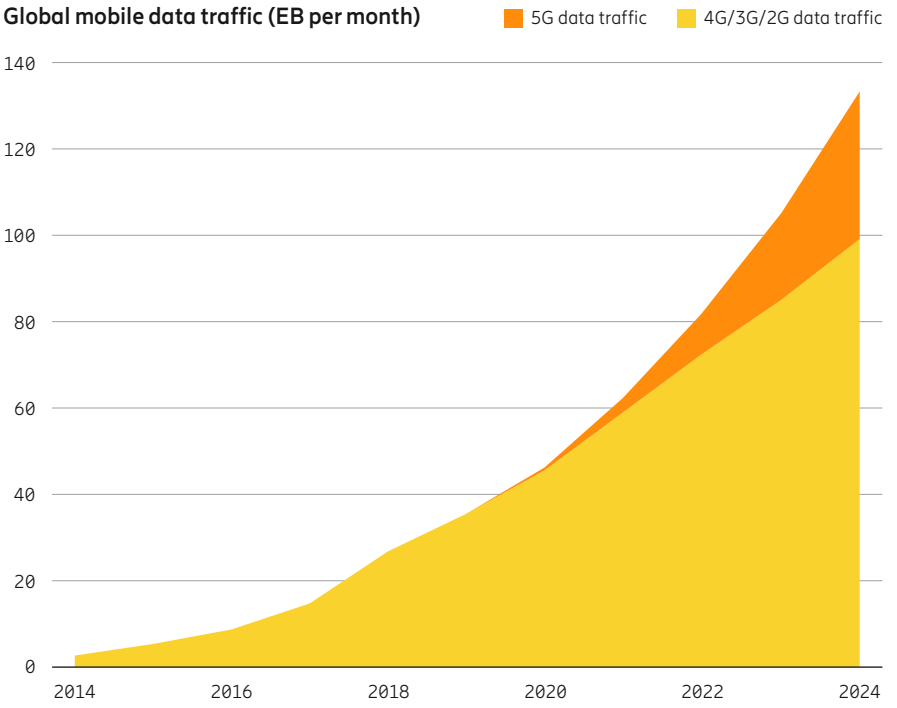
Close to 90 percent of total mobile data traffic is generated by smartphones today – a figure which is projected to reach 95 percent at the end of 2024. As monthly usage per smartphone continues to increase, total mobile data traffic is predicted to rise at a compound annual growth rate (CAGR) of 31 percent over the forecast period, reaching 136 exabytes (EB) per month by the end of 2024. It is expected that 25 percent of mobile data traffic worldwide will be carried by 5G networks at that time. This is 1.3 times more than the total traffic today.

Currently, the 5G traffic forecast does not include traffic generated by fixed wireless access (FWA) services. However, as FWA is one of the early use cases planned for 5G in some regions, it could have a significant impact on the forecast figures, depending on market uptake of the service.

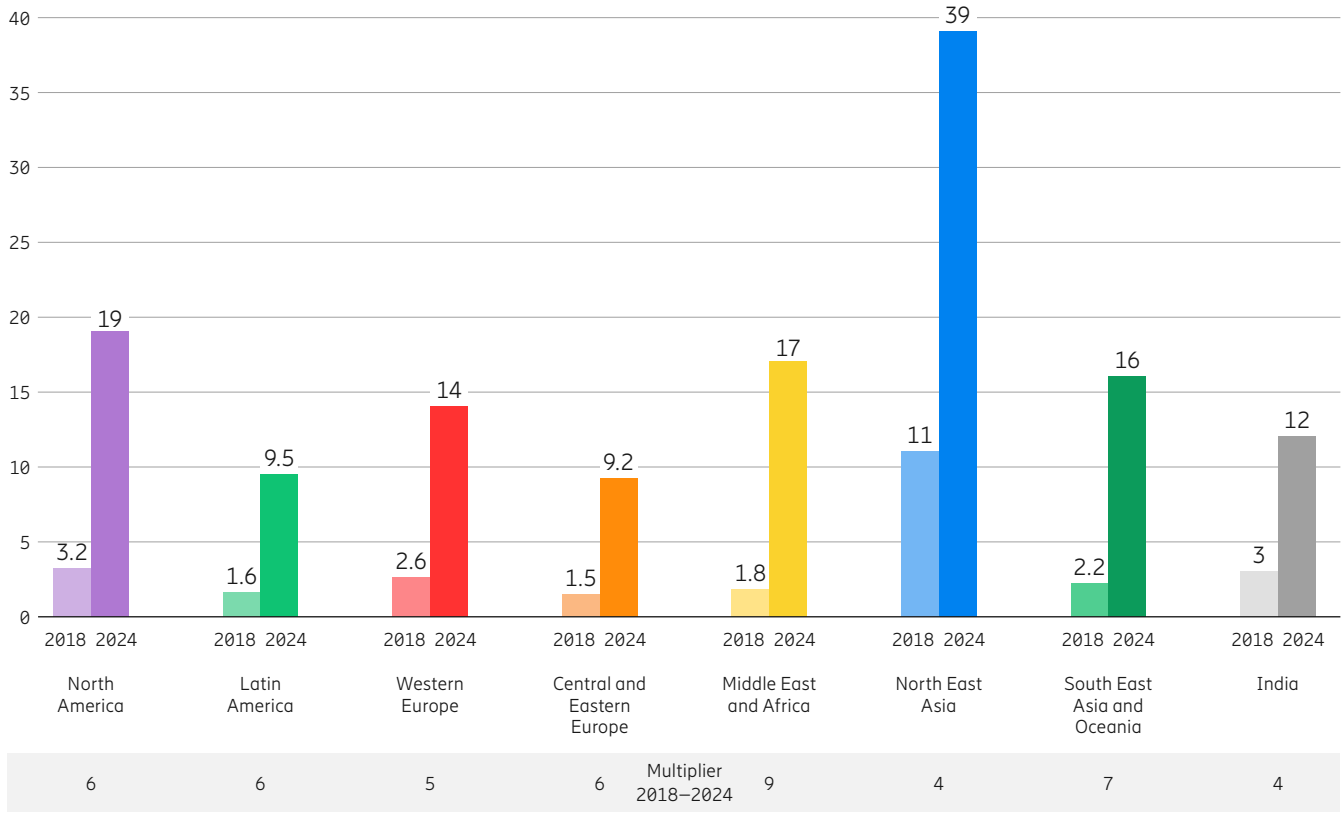
Mobile data traffic per active smartphone (GB per month)



Global mobile data traffic (EB per month)



Regional mobile data traffic (EB per month)



North East Asia's monthly mobile data traffic is set to reach 39EB in 2024

North East Asia is the world's most populous region and, as such, has the largest share of global mobile data traffic – close to 30 percent at the end of 2018. In 2024, total mobile data traffic in the region is forecast to reach 39EB per month. The rapid growth in mobile broadband subscriptions is expected to continue. China is set to add around 170 million mobile broadband subscriptions by the end of 2024, which – together with the increased usage per smartphone – will drive total data traffic up to 29EB per month in the country.

In the Middle East and Africa, total mobile data traffic is expected to grow by nine times during the forecast period – representing the highest growth rate globally. Smartphone subscriptions are projected to double, increasing penetration from 45 percent to 70 percent. In 2024, total monthly mobile data traffic is projected to reach 17EB in the region.

North America and Western Europe have a larger share of the total traffic volume than subscription numbers imply. This is due to well built-out LTE networks and high penetration of high-end user devices, complemented with affordable packages offering large volumes of data. With increased consumption of broadband-intensive services, such as video, and new applications like virtual reality and augmented reality, in 2024 total mobile data traffic is expected to exceed 19EB per month in North America and 14EB per month in Western Europe.

There will be nine times more mobile data traffic in the Middle East and Africa in 2024.

Network coverage

5G is projected to cover more than 40 percent of the world's population in 2024.

Communications service providers have been focused on providing sufficient radio signal for the world's inhabitants, which is defined as population coverage (as opposed to geographical coverage). Today, mobile networks cover around 95 percent of the world's population and this figure continues to grow.

There is continued momentum toward the build-out of LTE networks, driven by the demand for internet access and video streaming as well as a variety of other apps. In terms of population coverage, LTE is currently at over 60 percent and is forecast to reach around 90 percent in 2024.

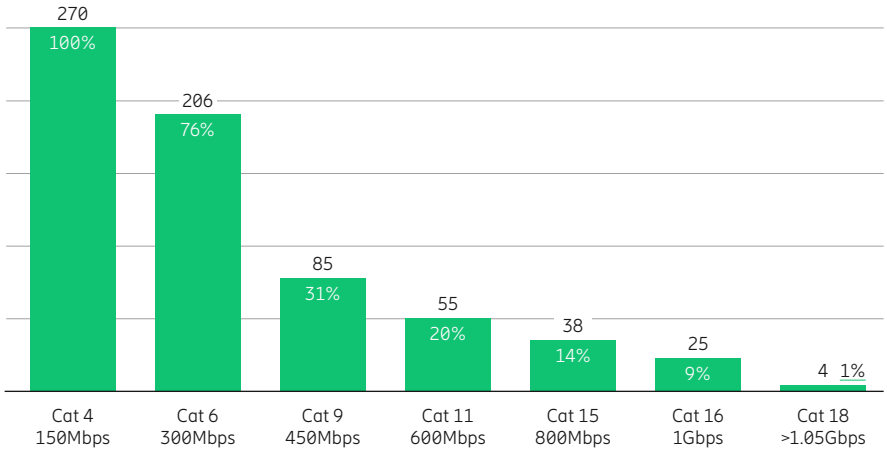
LTE networks are also evolving to deliver increased network capacity and faster data speeds. There are currently 679 commercial LTE networks deployed in 208 countries. Of these, 270 have been upgraded to LTE-Advanced, and 25 gigabit LTE networks have been commercially launched.

Gigabit networks will lead to higher peak rates, increased network capacity and faster average end-user data speeds.

25

A total of 25 gigabit LTE networks have been commercially launched.

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



Source: Ericsson and GSA (October 2018)

Provisioning of sufficient radio signal is key for population coverage

2019 will be the year that 5G takes off

5G networks are currently being deployed in several regions worldwide and commercial launches are already taking place. One of the first 5G use cases will be fixed wireless access, as devices with form factors suitable for customer premises equipment will be early to the market, and will not have the stringent size, weight and power consumption requirements that come with smartphones.

As 5G smartphones become available during 2019, several service providers are expected to commercially launch 5G. In North America and North East Asia, significant 5G subscription volumes are expected early.

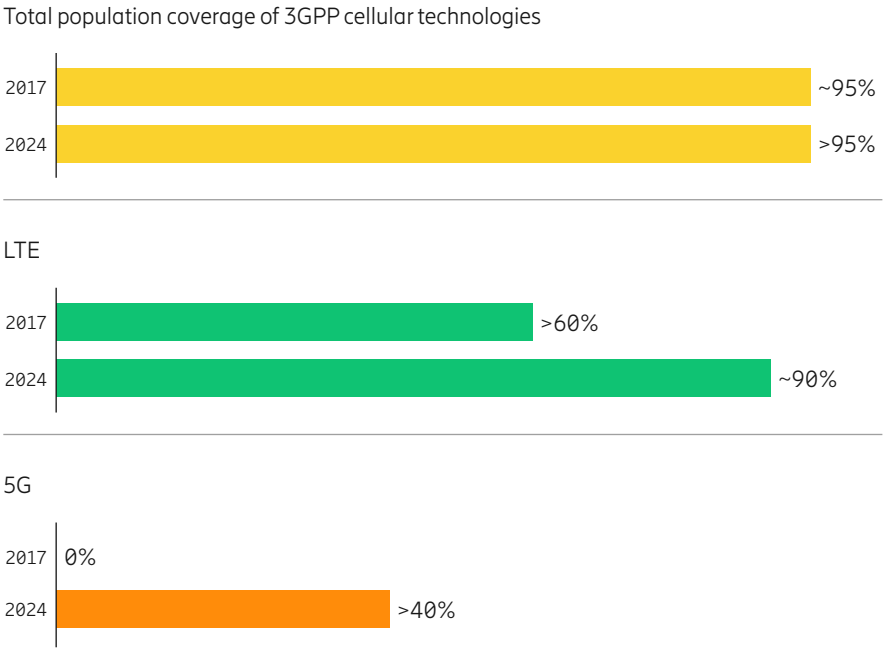
5G population coverage build-out is expected to be faster than LTE

In terms of build-out and subscription uptake, LTE has been the fastest-deployed mobile communication technology to date. Initial LTE build-out was led by Western Europe, North America, Japan and South Korea. With the exception of Western Europe, these areas, along with China, are expected to also lead the 5G population coverage build-out.

5G coverage build-out can be divided into three broad categories: radio deployments in new bands in the sub-6GHz range, deployments in millimeter wave frequency bands and deployments in existing LTE bands. Deployments in existing LTE bands can be rapidly upgraded to support 5G services in many networks by installing new software; for example, spectrum sharing between LTE and 5G in low to mid-bands.

More than 40 percent of the world's population is forecast to be covered by 5G in 2024.

World population coverage by technology[1]



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

Making fixed wireless access a reality

5G networks are now being built out, with performance and capacity gains available to be tapped by new use cases. One of the first will be fixed wireless access (FWA).

Around half of all households in the world – over 1 billion – do not have a fixed broadband connection. Given the current speed and capacity of cellular networks with LTE and its evolution to 5G, there are opportunities for operators to deliver broadband services to homes and small and medium-sized enterprises economically using FWA.

Devices with form factors suitable for FWA customer premises equipment (CPE), and without the stringent requirements on size, weight and power consumption that come with smartphones, will be among the first to reach the market.

For FWA to be a viable alternative to fixed broadband, including xDSL, cable and fiber-optic access technologies, it must be able to be dimensioned with comparable capacity and performance. While 5G will make this possible, there is also a range of markets to be addressed with LTE technology on the way to 5G.

In order to explore these opportunities, some questions need to be answered: can a mobile network handle FWA traffic and support the "unlimited data" model common to fixed broadband? And can it accommodate the anticipated growth in mobile broadband and FWA, in terms of both subscriptions and traffic per subscription over time?

Fixed-style subscriptions, mobile-style dimensioning

The paradigms for fixed and mobile broadband are different, in both subscription offerings and dimensioning.

Subscription offerings

Fixed broadband tariffs are commonly structured around a maximum data rate and include unlimited data traffic. The user traffic is often managed so that it does not exceed the maximum data rate for the subscription.

The mobile broadband subscription paradigm is dominated by monthly data traffic limits ("buckets"), and additional monetization is achieved through top-ups and upgrades to larger data buckets. For mobile broadband, the network normally transmits the maximum rate that the system resources and mobile device can handle.

FWA inherits the subscription paradigms of fixed broadband rather than those of mobile broadband; households will pay for FWA based on data rate and should not be concerned about traffic generated.

Last-hop dimensioning

With FWA, the last hop is wireless, so all the characteristics of a wireless network apply. Unlike fiber, but similarly to xDSL loop length, connection quality will vary across households. And, unlike fixed broadband overall, the last hop is point-to-multipoint radio and therefore shared, which means that speeds will degrade with increasing cell load. All these characteristics must be considered when dimensioning an FWA network.

~50%

Around half of all households in the world – over 1 billion – are yet to have a fixed broadband connection.

Focus on busy hour

FWA inherits dimensioning properties from mobile broadband, as the data rate which users experience varies with the position of the household relative to the radio base station, and generally decreases with the load of the shared radio resource.

First, households are situated at varying distances from a radio base station site, which results in different experienced data rates.

Second, the data rate differs during busy hour (when large numbers of users are active), compared to late at night or early in the morning (when there are fewer active users in the cell).

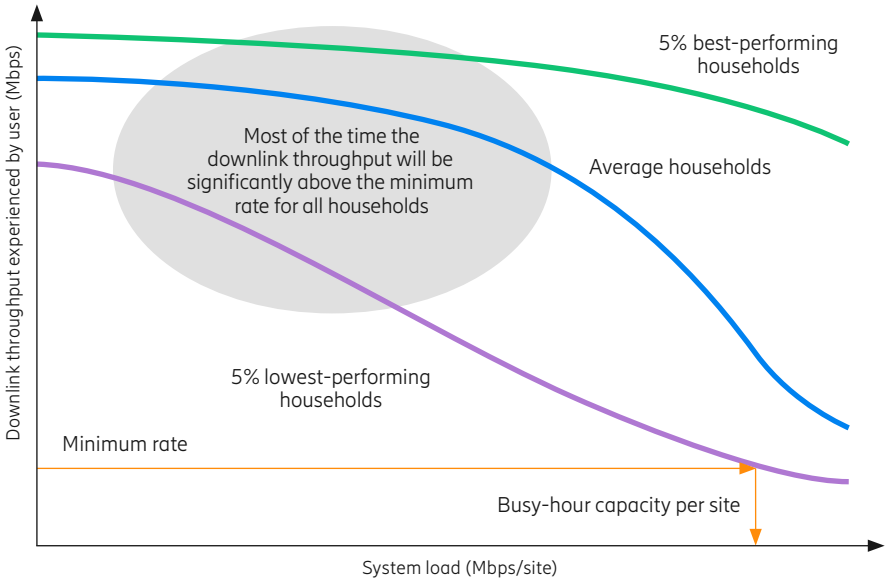
The figure below illustrates this combined behavior, showing how downlink data rates vary between households and decrease with load for users in different locations.

- The best-performing 5 percent of households (see the green line in the graph below) are in good geographic positions, with limited degradation even at high cell load.
- The average households (see blue line) have significant degradation at high cell load.
- The lowest-performing 5 percent of households (see purple line) are in difficult positions, with performance decreasing to critical levels during periods of high cell load.

The network should be dimensioned to maintain a given user experience under high load periods. This can be defined as the minimum data rate that a household could experience during busy hour.

It can, for example, be set to allow a standard-definition (SD) television stream, or multiple streams of SD or high-definition (HD) quality, depending on the addressed FWA segment. The minimum data throughput rate could be from 2Mbps up to 30Mbps, depending on the addressed segment. As the cell load increases and reaches busy hour, the lowest-performing 5 percent of households will finally reach the minimum rate, and the cell load at this point is defined as the capacity per site (as illustrated in the figure below). The minimum rate is only experienced by the lowest-performing 5 percent of households, during busy hour – and is sufficient to deliver all of the services described in the subscription agreement.

Varying downlink data rates for households



Analyzing FWA opportunities

FWA opportunities can look very different around the world, based on subscriber needs and expectations and availability of alternatives. An operator considering an FWA launch in a particular area should assess factors including the following:

External factors

- density of households in the target area
- availability and uptake of fixed broadband alternatives (xDSL, cable and fiber-optic access)
- service demand, including telephony, web access and television/video
- government subsidies

Internal factors

- LTE radio access network and infrastructure, including synergies between mobile broadband and FWA
- plans and/or activities to build out 5G coverage for other use cases
- availability of additional spectrum needed

The assessment should include market segmentation and targeting, creating a map of feasible coverage areas with subscription offerings constructed and priced around the resulting target segments.

As an operator's network evolves from LTE through various stages of LTE-Advanced to 5G New Radio (NR), the cost of a delivered gigabyte declines and the amount of capacity increases – allowing the operator to address more opportunities.

FWA and mobile broadband

All the FWA opportunities outlined are included on the basis that they are dimensioned on top of an existing LTE or 5G mobile network built out primarily to serve mobile broadband subscribers. As well as the advantages of serving an additional customer segment, there are a number of technical synergies to be captured beyond the administrative efficiencies of common billing and support systems. These include network trunking effects, spectrum sharing gains, and combining businesses with different or offset busy hours, all of which improve capacity utilization.

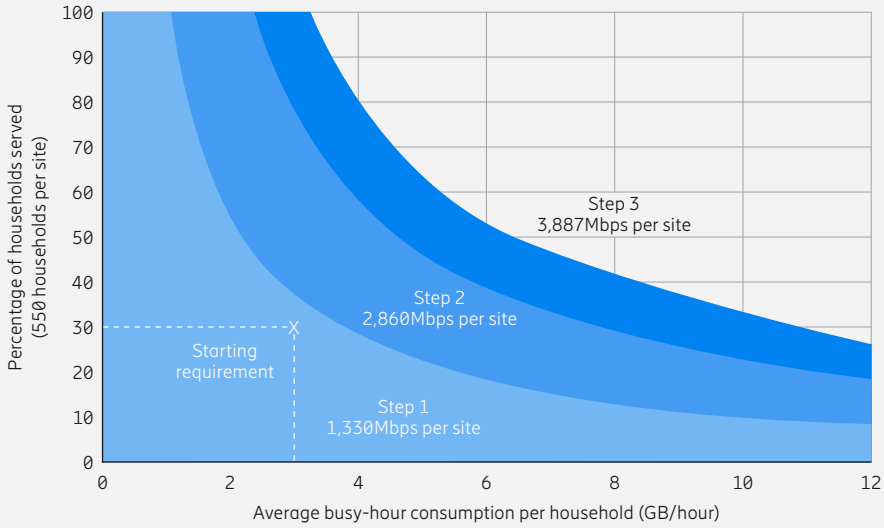
A clear path to expansion

With the performance and capacity gains from enhanced mobile broadband and the evolution to 5G, FWA will be a feasible opportunity for communications service providers to deploy in many places. Previous experience from FWA and fixed broadband has shown that an "unlimited" traffic paradigm does not result in infinite demand and network congestion, but is manageable with a combination of performance-based service offerings and average consumption patterns.

Furthermore, analysis of a demanding example described here, the American suburb case, illustrates a clear path to capacity expansion by following a procedure of "utilize, add and densify". First, network assets already in place should be fully utilized, including radio sites, spare capacity in deployed spectrum and associated radio, baseband and transport equipment. Next, spectrum and radio network capabilities should be added, such as higher-order modulation, advanced antenna systems and beamforming, increased sectorization and 5G NR access as needed. Finally, densify with the addition of macro and small cells when necessary.

Case study: An American suburb

Trade-off between households served and average busy-hour consumption



The curves on the graph depict the results of capacity simulations for each deployment step and show a set of trade-offs between the percentage of households served (y-axis) and gigabytes consumed per household during busy hour (x-axis).

The situation

The case depicts a suburban area in North America with LTE mobile broadband coverage, along with an initial 5G build-out using mid-range spectrum. On average, the area has 1,000 households per square kilometer and is covered with radio base stations that have an inter-site distance of 2,000 meters. Some fixed broadband offerings are available in the area, but there is little or no access to fiber to the home (FTTH). FWA is deployed on the sites to compete directly with fixed broadband by meeting the need for higher-rate offerings and capacity. Services to be offered include IPTV (allowing two 4K UHD video streams, or a combination of multiple SDTV and HDTV streams), internet access and IP telephony (also known as "triple play").

Dimensioning

As this case is demanding in terms of both capacity and performance, we include a description of its dimensioning and spectrum utilization based on simulations.

To reliably support the demands described above, a service provider must offer fiber-like speeds of 100–1,000+Mbps with a minimum data rate of 30Mbps and capacity to serve busy-hour usage per household of 3GB/h. Assuming 10 percent of total traffic occurs during busy hour, this corresponds to average monthly traffic of 900GB per household.

In order to deliver traffic with the expected performance, coverage can be densified so that, on average, a base station covers 550 households. With a projected 30 percent service uptake rate, the initial deployment will need to be dimensioned to serve 165 households per site. Households in the lowest-performing 5 percent should experience a downlink data rate of at least 30Mbps during busy hour.

Step 1

The initial deployment consists of:

- undeployed band 10MHz FDD in sub-3GHz bands for LTE
- 40MHz TDD LTE in new 3.5GHz band (radios with 8 Tx/Rx including Multi-User MIMO)
- 400MHz TDD NR in millimeter wave (mmWave) band (Massive MIMO radio)
- selective densification on utility/light poles (5 poles per macro site)
- deployment of all 4 bands above 1GHz on the macro sites
- outdoor CPE focus to maximize performance and indoor CPE as complement

Step 1 is calculated to have throughput capacity of 1,330Mbps per site, allowing average busy-hour traffic of 3.6GB/h per household, which provides some headroom over the projected actual busy-hour consumption of 3GB/h.

The lightest blue region on the graph above represents Step 1. The "X" indicates the starting requirements: 30 percent of households within the coverage area and average busy-hour consumption of 3GB/h.

Dimensioning can evolve to handle increased capacity requirements – either additional connected households or higher usage per household. The following is an outline of how additional capacity can be provided.

Step 2

Add 60MHz of TDD spectrum (new band), such as 3.7–4.2GHz, and increase bandwidth from 400 to 600MHz in the mmWave band

The mid-blue region of the figure indicates the capacity achieved in Step 2. The network could, for example, serve 30 percent of households with average busy-hour consumption of around 8GB/h. Alternatively, the higher capacity could be used to serve a higher percentage of households with unchanged average busy-hour consumption (or any combination between those points along the curve). Radio units supporting 5G NR are needed to handle the new sub-6GHz band.

Step 3

Deploy an additional 40MHz of TDD spectrum, such as 3.7–4.2GHz, and increase bandwidth from 600 to 800MHz in the mmWave band

The dark blue region in the graph shows what can be achieved in the third step. This configuration would enable the operator to serve 30 percent of households with an average busy-hour consumption of above 10GB/h, or alternatively serve 100 percent of the households with over 3.5GB/h or any combination of consumption and uptake along the curve in between.

Beyond this, additional ways to increase capacity are to exploit MU-MIMO in the mmWave band and/or to densify further with more sites.

Streaming video – from megabits to gigabytes

Smartphone traffic per subscription will continue to grow, driven by increasing video quality and immersive formats.

By the end of 2024, it is estimated that a smartphone will consume more than 21GB of data per month on average – nearly 4 times the amount consumed in 2018. In addition to this increased usage, the number of smartphone subscriptions is set to increase by 45 percent, reaching a total of 7.2 billion.

New video-watching behaviors drive data consumption

Video currently stands out as the most significant traffic type consumed by smartphone users, at a current average of 60 percent of total traffic. The importance of video will only increase; by the end of 2024, it is projected to account for 74 percent of traffic.

The increase in video data traffic per smartphone user has three main drivers: increased viewing time, more video content embedded in news media and social networking, and an evolution to higher resolutions and more demanding formats.

Today, most mobile video is streamed at low-definition and standard-definition formats 360p and 480p respectively. This is due to restrictions introduced by both content and communications service providers, as well as customers selecting formats with lower bitrates to get the most out of their data bucket. But user behaviors are shifting as network capabilities expand and are projected to change more dramatically as 5G services are made available. The streaming of high-definition (HD) video in 720p and 1080p resolutions is increasing, and the average resolution of a YouTube video in some LTE networks is already up to 720p.

21GB

At the end of 2024, average data consumption per smartphone is projected to be 21GB per month.

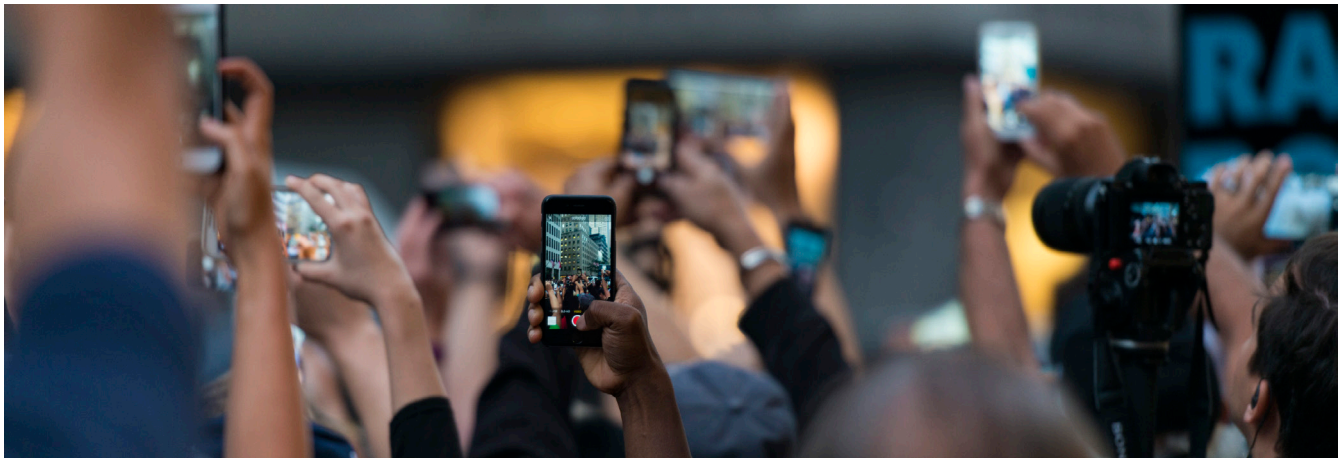
Evolution of the average smartphone user's data consumption

Traffic category	World average data consumption (GB per month)	
	2018	2024
Downloads	0.6	1.2
Messaging	0.5	0.9
App traffic	1.0	2.1
Audio streaming	0.1	0.4
Video streaming	3.4	16.3
Total	**5.6**	**21**

Further explore the relationship between the usage of various app types and monthly traffic per subscription with Ericsson's Mobility Calculator:

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

Video data traffic per smartphone user is increasing fast



New immersive formats are on the horizon

Shifting behaviors

User behaviors are shifting, with low- and standard-definition video formats being overtaken by HD and Full HD formats. Higher resolutions and complex formats – including 4K, 8K, virtual reality (VR) and augmented reality (AR) – are now on the horizon but have not generated a significant amount of traffic to date. Use cases driving large-scale streaming of 4K, 8K or VR to smartphones have not yet emerged. AR has many potential applications. Industrial manufacturing and maintenance, sports events, architecture, navigation and tourism are just a few of the areas where AR is expected to have a big impact. Traffic generated by AR will depend on many factors, and will vary across a wide spectrum from very little to extreme. For illustrative purposes we use 25Mbps in the graph below.

Two key factors in enabling new immersive formats to go mainstream will be reductions in latency and support for more symmetrical uplink/downlink throughput – both of which are attributes of 5G. The graph below compares the amount of monthly traffic generated over an incremental five minutes per day of video viewing at each resolution/format. It should be noted that AR applications will have a wide range of bitrates dependent on many factors beyond quality, including the form and amount of augmentation.

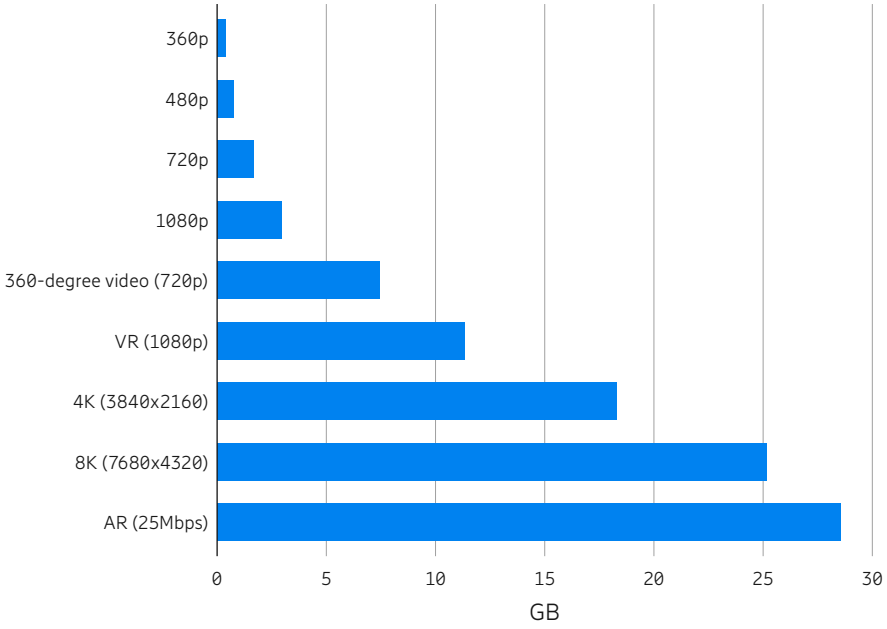
Video traffic and throughput

There is a difference between data traffic (consumption) and the network performance needed to deliver a good user experience. Traffic is the product of the bitrate (media data plus signaling overheads) through time. Required performance is related to adaptive streaming mechanisms, and is a function of the selection of media quality and the avoidance of stalls and re-buffering.

There is no definitive "media rate" for any given resolution. The bitrates used to calculate the traffic in the graph below are for comparison purposes and take a wide range of variables into consideration – including container, codec, profile, audio coding, overheads and, not least, content. In addition, AR is a special case, as the bitrate is dependent on a further range of factors, including the amount of data sent in the uplink.

Given the rate of change in both mobile technology and video media streaming, we expect a continued high growth rate in smartphone traffic on mobile broadband networks over our forecast horizon through 2024.

Monthly traffic generated by five minutes of streaming per day



Developing the smart wireless manufacturing market

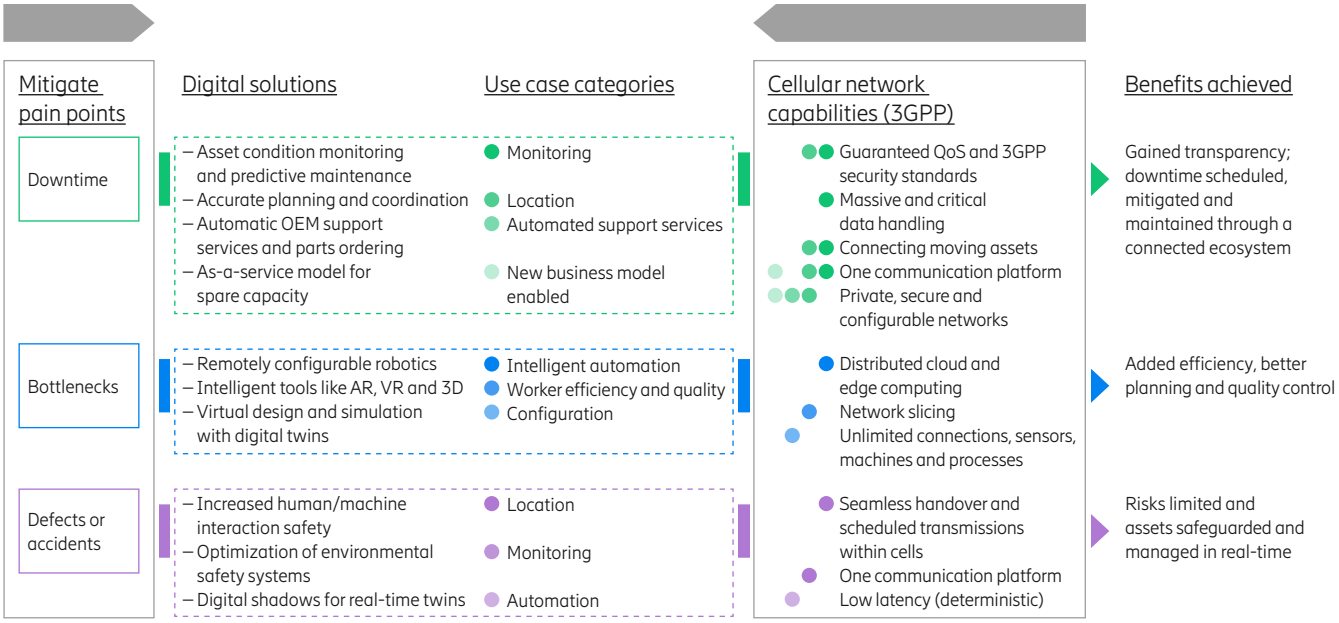
Combining cellular networks with Industrial IoT (IIoT) will make manufacturing more effective and flexible – challenging the traditional connectivity paradigm.

Cellular network capabilities are evolving from the support of massive IoT to extreme low-latency IoT applications – meeting the requirements of IIoT. Currently, most use cases on manufacturing sites are based on wired connections. However, as the evolving cellular capabilities are challenging industrial ethernet solutions, cables will in many cases become redundant, introducing opportunities for more flexible production and expanded digital operations.[1]

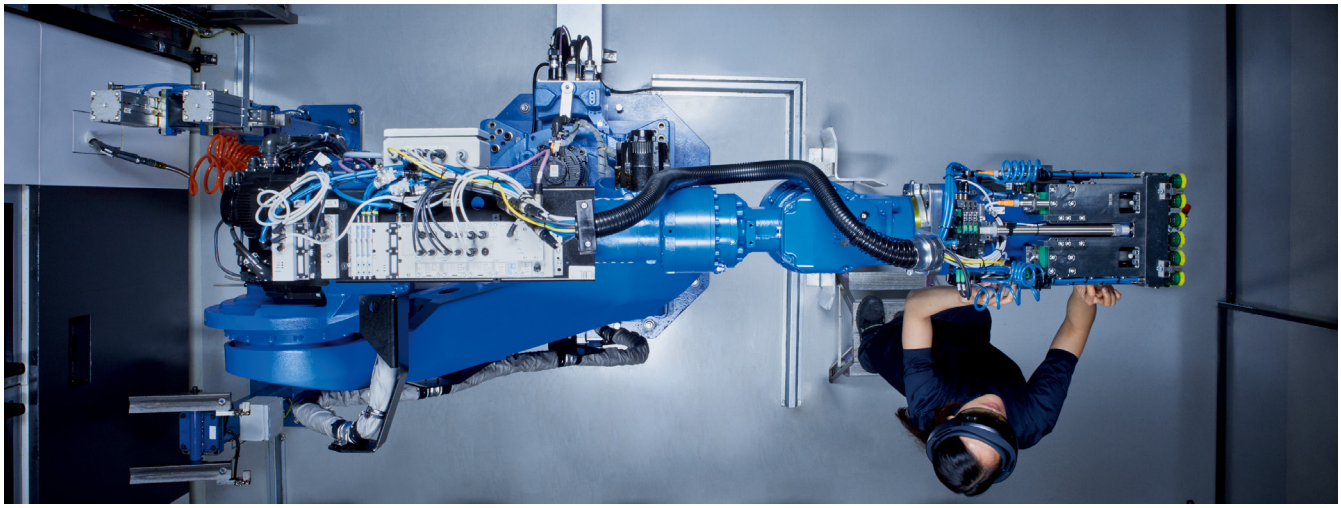
Introducing smart wireless manufacturing
Eventually the currently installed fixed network technologies will be incapable of effectively managing the use case requirements in advanced manufacturing. However, the ability of communications service and network technology providers to create a new market for smart wireless manufacturing depends on three fundamental aspects:

1. **Bridge the perceived value gap**
   To convey the value of cellular connectivity, a common language for use cases and network terminology needs to be established between industry players and the service and network technology providers.
2. **Address the right pain points**
   Identifying and mitigating classic manufacturing pain points with cellular capabilities will more than offset the switching costs, proving the new networks' practical and business value.
3. **Build horizontal and scalable solutions**
   Horizontal solutions that suit small-scale networks as well as highly diverse subsectors are needed in order to address cost, deployment and spectrum issues.

Bridging the gap between a factory's functional pain points and cellular capabilities



[1] Ericsson Mobility Report, "Realizing smart manufacturing through IoT" (June 2018)



Mapping manufacturers' needs to the value of cellular connectivity

A more holistic view of a manufacturing company's needs is required to chart and develop the market demand for smart wireless manufacturing. So far, conveying the value of cellular connectivity has focused on specific research and high-end production scenarios. One example from the metal cutting industry is real-time sensor monitoring of complex and hazardous milling processes that cannot be achieved with cables or other wireless technologies. Another use case is moving the intelligence of industrial robot controllers from physical robots to cloud-based applications, by way of a cellular network with edge computing capabilities that is deployed on-site.

The key challenge to position smart wireless manufacturing is that manufacturers do not generally identify connectivity as a pain point. The limitations of the legacy networks and how they will affect future operational ambitions are not sufficiently appreciated. However, a few digitally mature manufacturers are actively searching for wireless alternatives to support their digital transformation goals.

Linking pain points to capabilities

Manufacturers will gradually adopt supportive applications and concepts, from augmented reality to digital twins,[2] to address operational pain points. Cellular networks have superior capabilities in, for example, mobility, security, availability and reliability, to be able to support different manufacturing use cases. However, there is currently a disconnect between three perspectives among manufacturers: the understanding of cellular capabilities, how they enable different digital solutions, and finally how these solutions address manufacturers' actual pain points.

The figure on the previous page starts with the manufacturing perspective, illustrating the classic pain points experienced by a factory, then giving corresponding examples of digital solutions along with use case categories and the enabling cellular capabilities.[3]

To drive market engagement for cellular networks and their role in enabling smart wireless manufacturing, it is key to identify manufacturers' main areas of need in relation to cellular networks' strengths.

Focus areas to drive engagement:

- processes requiring mobility, such as shop floors with automated vehicles and assembly warehouses, which need secure and precise management as well as tracking of traffic, data flows and assets
- low-volume and high-variance manufacturing cases, where wireless machine line configuration is simple and flexible compared to cabled machine lines
- processes that cannot be monitored and controlled via cables but require wireless, real-time critical data transmission and a stable, deterministic network performance (bandwidth and latency) to operate
- processes susceptible to human error, or advanced manufacturing that requires tacit knowledge and skills transfer, where digital tools will be widespread to mitigate for errors and encourage faster learning
- processes where coordination of factories, resources and components is time-sensitive or crucial for the result (e.g. product quality and timely delivery)

From value chain to value network

The choice of connectivity will determine the quality and flexibility of a manufacturer's digital foundation, as well as the possibilities and ultimately the value it will bring to their operations. It affects which equipment and operations can be connected, how many assets and processes can run simultaneously, and how well it scales beyond one geographical site. Manufacturing companies that exploit the full value of using cellular networks' global, wide-area capabilities beyond a single manufacturing site will also explore increased internal and external collaboration, creating tighter value networks with partners and other stakeholders. With the expected growth in demand for digital twins and automated, customized, remote, and even mobile production, the need for enhanced wireless network capabilities will only increase.

The adoption of cellular networks for connectivity in the manufacturing industry is dependent on how well their enabling role in smart wireless manufacturing is described in an actual manufacturing context. For service and network technology providers to gain market traction in the industry, it is also important to build relationships with production equipment manufacturers in order to lower entry barriers into factories. Also, given the complexity of the factory environment,[4] consultancies and system integrators will be necessary channel partners to build the smart wireless manufacturing market.

[2] "Digital twin" refers to the virtual representation of a physical product, service or process, used to optimize the operation and maintenance of its physical counterpart

[3] A complete mapping of the solutions needed to address the pain points is substantial and complex. Accordingly, the mentioned actions and enablers are just some highlighted examples

[4] It is not unusual to have scores of different vendors with separate IIoT platforms in an average factory environment

Methodology

Forecast methodology
Ericsson makes forecasts on a regular basis to support internal decisions and planning, as well as market communication. 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 uses 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 operators 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 the key figures tables, 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 operator 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 (not yet standardized)

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 perceptual information

CAGR: Compound annual growth rate

Cat-M1: A 3GPP standardized low-power wide-area (LPWA) cellular technology for IoT connectivity. Cat-M1 is a solution that can be deployed on LTE, targeting a wide range of IoT applications from simple to rich content

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 through the media a signal passes

EB: Exabyte, 10^{18} bytes

EDGE: Enhanced Data Rates for Global Evolution

EPC: Evolved Packet Core

FDD: Frequency Division Duplex

GB: Gigabyte, 10^{9} bytes

Gbps: Gigabits per second

GHz: Gigahertz, 10^{9} hertz (unit of frequency)

GSA: Global mobile Suppliers Association

GSM: Global System for Mobile Communications

GSMA: GSM Association

HSPA: High Speed Packet Access

IMS: IP Multimedia Subsystem

IoT: Internet of Things

Kbps: Kilobits per second

LTE: Long-Term Evolution

MB: Megabyte, 10^{6} bytes

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

Mbps: Megabits per second

MHz: Megahertz, 10^{6} 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. NB-IoT is a narrowband solution that can be deployed on LTE, or as a standalone solution, targeting ultra-low-throughput IoT applications

NFV: Network Functions Virtualization

NR: New Radio as defined by 3GPP Release 15

OS: Operating System

PB: Petabyte, 10^{15} 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. This category also includes devices connected over fixed-line local area networks and powerline technologies

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. An end-to-end mobile system including IP Multimedia Subsystem (IMS), Evolved Packet Core (EPC), LTE RAN, Subscriber Data Management and OSS/BSS

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

Mobile subscriptions	2017	2018	Forecast 2024	CAGR** 2018–2024	Unit
Worldwide mobile subscriptions	7,720	7,980	8,920	2%	million
– Smartphone subscriptions	4,350	5,010	7,210	6%	million
– Mobile PC, tablet and mobile router subscriptions	250	260	330	4%	million
– Mobile broadband subscriptions	5,250	5,930	8,420	6%	million
– Mobile subscriptions, GSM/EDGE-only	2,410	2,000	470	-21%	million
– Mobile subscriptions, WCDMA/HSPA	2,330	2,270	1,480	-7%	million
– Mobile subscriptions, LTE	2,750	3,580	5,440	7%	million
– Mobile subscriptions, 5G			1,500		million
Mobile data traffic*					
– Data traffic per smartphone	3.4	5.6	21	24%	GB/month
– Data traffic per mobile PC	9.8	12	30	17%	GB/month
– Data traffic per tablet	4.6	5.8	14	16%	GB/month
Total data traffic***					
Total mobile data traffic	15	27	136	31%	EB/month
– Smartphones	13	24	128	32%	EB/month
– Mobile PCs and routers	1.7	2.1	5.2	17%	EB/month
– Tablets	0.5	0.7	2.0	20%	EB/month
Total fixed data traffic	80	100	280	18%	EB/month
Fixed broadband connections	930	990	1,120	2%	million

Regional key figures

Mobile subscriptions	2017	2018	Forecast 2024	CAGR** 2018–2024	Unit
North America	390	400	460	2%	million
Latin America	690	700	740	1%	million
Western Europe	510	520	540	1%	million
Central and Eastern Europe	580	580	590	0%	million
North East Asia	1,800	1,960	2,060	1%	million
China[1]	1,420	1,550	1,630	1%	million
South East Asia and Oceania	1,120	1,160	1,290	2%	million
India	1,200	1,200	1,420	3%	million
Middle East and Africa	1,410	1,450	1,810	4%	million
Sub-Saharan Africa[2]	680	710	940	5%	million

* Active devices
** 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

Smartphone subscriptions	2017	2018	Forecast 2024	CAGR** 2018–2024	Unit
North America	320	330	390	3%	million
Latin America	480	510	610	3%	million
Western Europe	380	390	480	4%	million
Central and Eastern Europe	310	340	540	8%	million
North East Asia	1,310	1,550	1,900	3%	million
China[1]	990	1,280	1,540	3%	million
South East Asia and Oceania	600	680	1,030	7%	million
India	420	560	1,000	10%	million
Middle East and Africa	560	640	1,260	12%	million
Sub-Saharan Africa[2]	280	340	690	13%	million
Mobile broadband subscriptions					
North America	380	390	460	3%	million
Latin America	510	570	690	3%	million
Western Europe	460	480	540	2%	million
Central and Eastern Europe	400	450	590	5%	million
North East Asia	1,610	1,820	2,050	2%	million
China[1]	1,270	1,460	1,630	2%	million
South East Asia and Oceania	740	860	1,290	7%	million
India	440	510	1,180	15%	million
Middle East and Africa	700	850	1,630	11%	million
Sub-Saharan Africa[2]	340	410	820	12%	million
LTE subscriptions					
North America	300	350	190	-9%	million
Latin America	210	290	550	11%	million
Western Europe	240	290	370	4%	million
Central and Eastern Europe	140	190	510	17%	million
North East Asia	1,290	1,600	1,090	-6%	million
China[1]	1,030	1,320	880	-6%	million
South East Asia and Oceania	200	300	820	18%	million
India	250	350	1,150	22%	million
Middle East and Africa	130	200	770	25%	million
Sub-Saharan Africa[2]	30	50	310	34%	million
Data traffic per smartphone*					
North America	6.6	8.6	50	34%	GB/month
Latin America	2.4	3.4	18	32%	GB/month
Western Europe	4.0	6.1	32	32%	GB/month
Central and Eastern Europe	3.6	4.7	19	26%	GB/month
North East Asia	3.0	7.3	21	19%	GB/month
China[1]	2.7	7.2	19	18%	GB/month
South East Asia and Oceania	2.7	3.8	19	31%	GB/month
India	5.4	6.8	15	14%	GB/month
Middle East and Africa	2.0	2.9	15	32%	GB/month
Sub-Saharan Africa[2]	1.4	1.8	9.0	31%	GB/month
Total mobile data traffic					
North America	2.5	3.2	19	35%	EB/month
Latin America	1.0	1.6	9.5	35%	EB/month
Western Europe	1.8	2.6	14	33%	EB/month
Central and Eastern Europe	1.1	1.5	9.2	35%	EB/month
North East Asia	4.2	11	39	23%	EB/month
China[1]	2.7	8.6	29	22%	EB/month
South East Asia and Oceania	1.4	2.2	16	39%	EB/month
India	1.8	3.0	12	26%	EB/month
Middle East and Africa	1.1	1.8	17	45%	EB/month
Sub-Saharan Africa[2]	0.36	0.54	5.2	46%	EB/month

[1] These figures are also included in the figures for North East Asia
[2] 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.

www.ericsson.com

Ericsson
SE-164 80 Stockholm, Sweden
Telephone +46 10 719 0000
www.ericsson.com

EAB-18:012366 Uen, Revision B