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# Ericsson Mobility Report

November 2024

# Letter from the publisher

## An industry poised for the next wave of mobile

An exciting future awaits as communications service providers are gearing up for a mobile industry transformation. Leading service providers are deploying and upgrading 5G standalone (SA) networks as part of their journey to enabling service differentiation and exploring new performance-based business models. Already, such deployments have enabled those service providers to introduce new differentiated service offerings and tap into growth opportunities beyond traditional best-effort services.

The innovation journey has already started. In this edition of the Ericsson Mobility Report, we take a closer look at two leading service providers that are currently leveraging network slicing capabilities within commercial networks to address a wider range of use cases that benefit from differentiated connectivity services.

On the forecast side, we see continued mobile network traffic growth but at a slower rate. Despite the deceleration, mobile network data traffic is expected to nearly triple by 2030 compared to current levels. A shift to high-performing and programmable networks, enabled by openness and cloud, will allow service providers to create and charge for offerings based on value delivered, and not only on volume of data.

To fully realize the potential of 5G, it is essential to continue deploying 5G SA and to further densify mid-band sites. Although some 320 service providers have launched commercial 5G services, less than 20 percent of these are 5G SA launches and deployments. Additionally, only around 30 percent of all sites globally, outside of mainland China, have been upgraded to 5G mid-band.

In this edition, we also explore how the increasing use of generative AI in mobile devices, which enables at-scale, hyper-personalized content creation, may impact mobile data traffic volumes and characteristics going forward.

This edition also investigates the application of cellular technology for bringing predictable and reliable connectivity to the digital airspace, unlocking new possibilities for mission-critical communications, drone operations and management such as beyond visual line of sight flights.

I trust that you will find this report engaging, and that it offers valuable insights as we navigate the evolving landscape of 5G.

**Fredrik Jejdling**
Executive Vice President and
Head of Business Area Networks

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**Forecasts**



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# Forecasts

5G subscriptions are growing, with one-quarter of all mobile subscriptions projected to be 5G by the end of 2024. This momentum is set to continue through the forecast period, with 5G expected to overtake 4G as the dominant mobile access technology by subscription for the first time in 2027. Although 5G population coverage is growing globally, 5G mid-band is only deployed in around 30 percent of all sites globally outside of mainland China; further densification of mid-band sites and deployments of 5G standalone (SA) are required to harness the full potential of 5G.

6.3bn

**Global 5G subscriptions will reach around 6.3 billion in 2030, equaling 67 percent of total mobile subscriptions.**

80%

**5G is expected to carry 80 percent of the total mobile data traffic by the end of 2030.**

6G

**Following on from the launches of 5G SA and 5G Advanced, 6G is expected to arrive during 2030.**

40%

**By the end of 2024, 5G mid-band population coverage outside of mainland China is expected to reach 40 percent.**

# 5G subscriptions to overtake 4G in 2027

During the third quarter of 2024, around 160 million 5G subscriptions were added to reach a total of 2.1 billion.

5G subscription uptake continues to be strong. 5G is now expected to become the dominant mobile access technology by subscription in 2027. This exceeds earlier predictions that it would overtake 4G in 2028, driven partly by growth in China and India. Global 5G subscriptions are forecast to reach 6.3 billion and make up 67 percent of all mobile subscriptions in 2030. At the same time, 5G standalone (SA) subscriptions are projected to account for around 3.6 billion out of these 6.3 billion. It is projected that the Gulf Cooperation Council (GCC) will have the highest 5G penetration in 2030 at 93 percent, followed closely by Western Europe at 92 percent and North America at 91 percent.

**One-quarter of all mobile subscriptions expected to be 5G at the end of 2024**

At the end of 2024, North America is set to have the highest 5G subscription penetration globally at 71 percent, followed by North East Asia at 51 percent, the GCC countries at 47 percent and Western Europe at 41 percent.

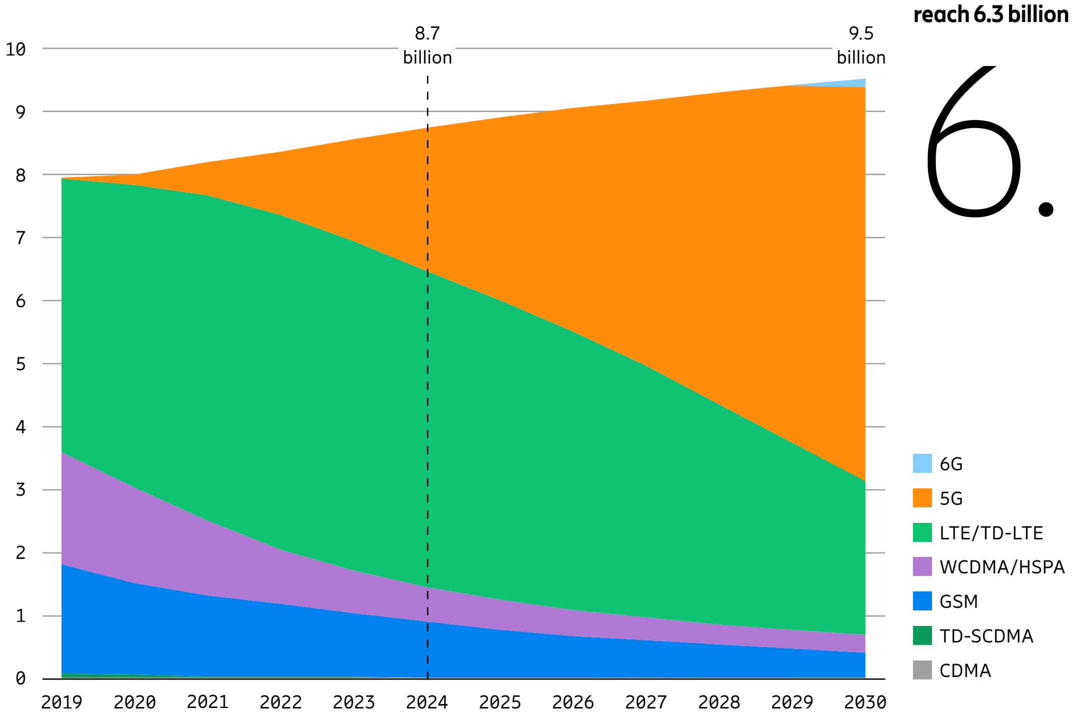
5G subscriptions increased by 163 million during the third quarter to total 2.1 billion. Looking toward the end of the year, 5G subscriptions are expected to reach close to 2.3 billion, accounting for more than 25 percent of all mobile subscriptions. 4G subscriptions continue to decline as subscribers migrate to 5G.

During the third quarter, the number of 4G subscriptions fell by 69 million, to total just below 5.1 billion. 3G subscriptions declined by 31 million during the quarter, while 2G subscriptions dropped by 34 million.

2G and 3G network sunsetting continues around the world. The timeline for this transition varies based on the country and service provider, but the phase-out of 3G networks on a global level is anticipated to happen more quickly than for 2G in the coming years.

Around 320 service providers have now launched commercial 5G services, and more than 60 have deployed or launched 5G SA.[1]

**Figure 1: Mobile subscriptions by technology (billion)**




**5G subscriptions are forecast to reach 6.3 billion by the end of 2030.**

6.3bn

[1] GSA and Ericsson (November 2024).

# GenAI is steering the future of smartphones

The number of smartphones sold is increasing, with positive year-on-year[1] numbers expected following a three-year decline. Generative AI (GenAI) is driving growth in the high-end segments, with new growth anticipated in the low-end domain due to attractive models.

AI is now integrated into various device form factors, including smartphones, laptops, watches and Fixed Wireless Access (FWA) products. A prominent topic is AI services and their potential to enhance user experiences. In the initial phase of GenAI, AI assistants are device-based and tied to original equipment manufacturers (OEMs). In the future, one AI assistant may become available across devices, instead of users requiring different AI assistants for different devices.

GenAI introduces new functionality to devices, with performance now measured not only in terms of bitrate and talk time but also in tera operations per second (TOPS). In a like-for-like scenario, the chip with the higher TOPS specification should complete AI tasks faster. The latest chipsets provide 30 TOPS, enabling new AI-based device services and, with high market interest, potentially triggering interest in renewing devices.

As AI is still in its early stages, the impact of GenAI on communication and traffic patterns remains uncertain (see page 19 for more information on GenAI's impact on traffic).

Most AI use cases could currently run either on-device or on a default enhanced mobile broadband (eMBB) subscription. However, as AI becomes more interactive with the cloud, time-sensitive payload comes into play and GenAI network slices could become a reality. Slicing triggered by using quality on demand (QoD) network APIs is expected in 2025.

**Exploring RedCap's potential**

With the widening adoption of 5G standalone (SA), reduced capability (RedCap) technology is coming into focus. RedCap offers more affordable 5G devices such as USB dongles, surveillance cameras, routers and wearables. It also plays a role in AI-powered cameras, contributing to early use cases in the market. RedCap has now taken the step from technology enablement on modules toward device implementation.

AR glasses are expected to resemble regular glasses and offer 5G connectivity through a companion device. However, integrated RedCap technology is also a possibility for future AR glasses.

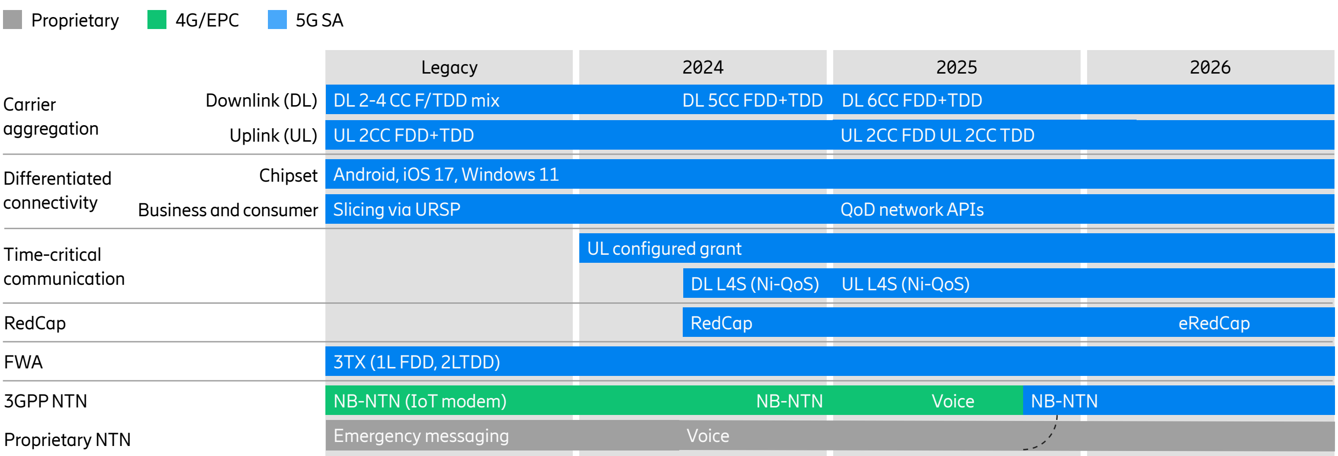
**An expanding ecosystem**

Harmony Next, a new operating system, is emerging and is now fully separated from Android. It is initially being marketed to the Chinese-speaking population and is not expected to extend beyond single-OEM support.

The foldable smartphone segment has seen increased competition, diversifying the vendor landscape. The trifold form factor, currently a trend among Chinese OEMs, may expand to other markets. Applications suitable for foldable devices, such as live-interpreter AI applications, are becoming available.

Non-terrestrial network (NTN) services are evolving beyond emergency SMS to include messaging and voice calls. Voice calls will also be part of the discussion surrounding narrowband NTN (NB-NTN) in the coming years. The first smartphones with 3GPP NB-NTN are either in the market or announced, with wider adoption expected in 2025. Discussions on migration towards 5G NTN are ongoing, with indications pointing to the end of this decade for widespread adoption.

**Figure 2: 5G SA technology area readiness on device**



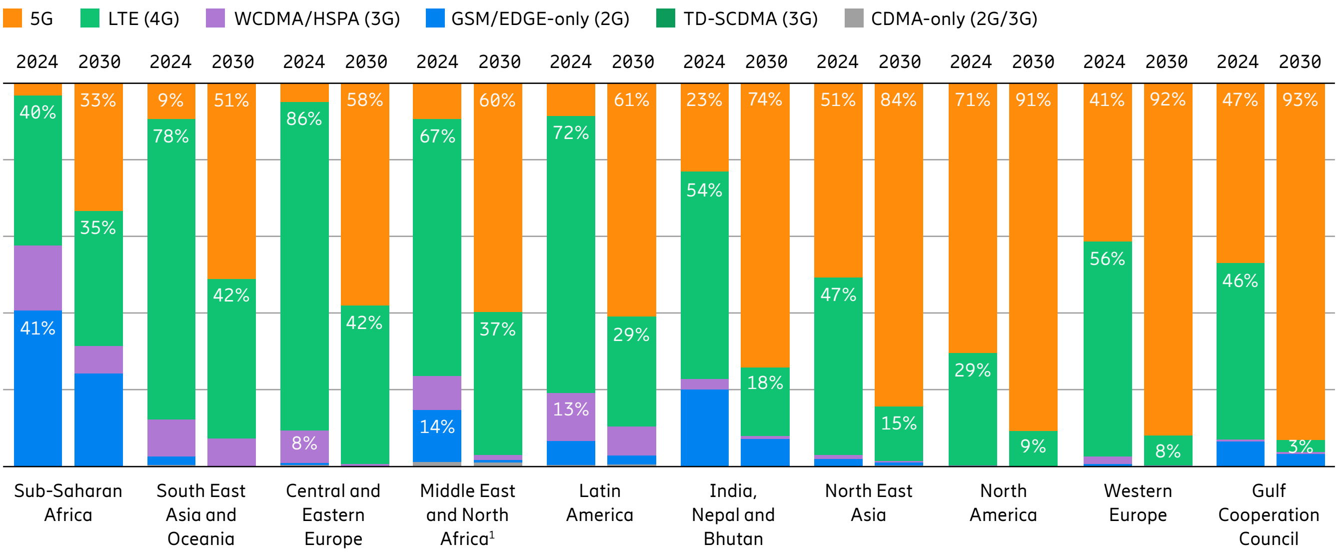

Note: The graph illustrates the availability of network functionality, as well as supporting devices. Readiness means more than one infrastructure and device vendor is ready.

[1] Counterpoint (Q2 2024).

# 5G subscriptions on the rise across regions

In India, 5G subscription penetration is expected to have doubled during 2024, reaching a penetration of 23 percent at the end of the year.

**Figure 3: Mobile subscriptions by region and technology (percent)**




**Sub-Saharan Africa**
Sub-Saharan Africa's economy is expected to grow between 3 and 5 percent over the next five years.[2] Despite macroeconomic challenges such as inflation, high debt and limited international financing, the telecom sector is expanding due to a young population, affordable smartphones and rising demand for mobile data and advanced services.

Mobile subscriptions are forecast to increase at an annual rate of 4 percent until 2030. The move to 4G and 5G networks will cause 2G and 3G subscriptions to decline. 4G subscriptions will represent 35 percent of total mobile subscriptions by the end of 2030. The strongest growth will occur in 5G, with subscriptions rising by 59 percent annually, representing 33 percent of total subscriptions by the end of the decade. This is both due to handset evolution and network rollouts in urban areas.

Service providers continue their diversification into financial technology, particularly mobile money services, and Fixed Wireless Access (FWA). The number of smartphones is expected to rise from 540 million in 2024 to 880 million by 2030, further driving demand for data-intensive services. While opportunities in the sector are substantial, significant infrastructure investments and supportive regulatory frameworks will be necessary for the telecom industry to play a central role in the region's digital transformation by 2030.

**Middle East and North Africa**
The region's telecom industry continues to be resilient, despite broader economic headwinds. While geopolitical risks persist, and some currencies continue to face devaluation, ongoing economic diversification efforts are contributing to greater stability.

Mobile subscriptions in the region are projected to grow 2 percent annually from 2024 to 2030, to total 830 million. Smartphone penetration is increasing at 5 percent annually, largely driven by device affordability and network expansion. This trend is reshaping the region's digital landscape as more consumers gain access to advanced services such as mobile financial solutions and e-health. 5G FWA will complement fixed broadband with diverse use cases, expanding home and enterprise access options.

2G and 3G subscriptions are expected to decline, as service providers are looking into sunsetting these networks to reallocate spectrum for 4G and 5G. By 2030, 4G will account for 37 percent of total subscriptions, while 5G will see the most significant growth and account for 60 percent of total subscriptions.

[1] All Middle East and North Africa figures include GCC countries.
[2] IMF, "Regional Economic Outlook: Sub-Saharan Africa" (April 2024).

The expanding availability of 5G networks, coupled with growing consumer demand and more affordable devices, is expected to transform the region's telecom industry over the next decade.

**Gulf Cooperation Council (GCC)**
The region is characterized by high mobile penetration, urbanization and strong consumer purchasing power. The region's economic outlook remains favorable, driven largely by sectors such as tourism, technology and renewable energy.

In the telecom industry, a key trend is the transformation of service providers from traditional telcos to technology companies. This transition is being fueled by the rollout of 5G, enabling the introduction of advanced services, including AI and cloud solutions and services, factory automation and content delivery. Network slicing will be critical in delivering these services. High-performance networks, APIs and the app developer community are expected to drive growth.

Up to 2030, overall mobile subscriptions in the GCC countries are forecast to grow at an annual rate of 3 percent, reaching 95 million. However, subscriptions for earlier network generations will decline as users shift to 5G. By the end of the decade, 93 percent of all subscriptions are expected to be 5G, with 88 million users adopting this technology.

**South East Asia and Oceania**
The 5G landscape in the region is evolving and 5G subscriptions are predicted to reach around 680 million in 2030. In Australia, Malaysia, Singapore and Thailand, growth in the 5G subscriber base is driven by increased network coverage, greater awareness of 5G, the growing affordability of 5G devices and the continued focus by service providers on promotional plans. In the Philippines, although 5G coverage has expanded, adoption remains slow due to limited data consumption and penetration. In October 2024, 5G was launched commercially in Vietnam.

Mature 5G markets such as Australia and Singapore continue to leverage advanced 5G capabilities to deliver new services and use cases. Customized 5G services for businesses are arriving in Australia, as service providers conduct trials and offer tailored connectivity solutions.

Spectrum re-farming remains a challenge across South East Asia and Oceania, particularly with reliance on 2G and 3G networks for voice services. Service providers are facing the issue of subscriber fallback from 5G to 4G, reducing data usage and delaying spectrum optimization. These challenges are shaping 5G deployment strategies in the region.

**Central and Eastern Europe**
Technology adoption and subscription uptake have historically been slower here than in Western Europe. 5G deployment varies by country, partly due to slower spectrum allocation processes. However, the number of 5G subscriptions is expected to have doubled during the year to reach 27 million by the end of 2024.

4G is currently the dominant technology, expected to account for 86 percent of all subscriptions at the end of 2024, but will decline after a peak in 2025 as subscribers migrate to 5G.

**Latin America**
4G is still the dominant technology in the region, although it has started to decline slightly as subscribers migrate to 5G. At the end of 2024, it is estimated that 4G will account for 72 percent of all subscriptions.

5G spectrum auctions continue to advance across Latin America. In 2023, Colombia, Uruguay and Argentina successfully concluded their auctions. Costa Rica is making significant progress in its 5G auction process, to be ended in January 2025. Meanwhile, Paraguay has announced its 5G license award will be finalized in early 2025. In Mexico, 5G auctions have been delayed until the end of 2025.

5G subscription uptake has been slow due to macroeconomic difficulties in the region. However, during 2024 the number of 5G subscriptions is estimated to have doubled, reaching around 63 million at the end of the year. By the end of 2030, 5G is expected to account for 61 percent of all mobile subscriptions.

**India, Nepal and Bhutan**
5G adoption in India is growing rapidly, given the 5G coverage of over 90 percent and the availability of affordable 5G services. 5G subscriptions are projected to reach over 270 million by the end of 2024, accounting for 23 percent of the total mobile subscriptions in the region. 5G subscriptions are expected to reach around 970 million by the end of 2030, accounting for 74 percent of mobile subscriptions. Enhanced mobile broadband and FWA have emerged as the initial 5G use cases. Increased availability of 5G FWA customer premises equipment (CPE) is likely to spur the growth of 5G FWA connections. 4G continues to be the dominant subscription type, contributing 54 percent of the total mobile subscriptions currently. Based on the strong 5G uptake, 4G subscriptions are forecast to decline from 640 million in 2024 to 240 million in 2030.

**North East Asia**
The region has the second-highest 5G subscription penetration, with an anticipated 51 percent by the end of 2024. AI is a hot topic, with service providers across the region increasing investments in this area. In mainland China, the commercial deployment of 5G Advanced has begun. Initial functionalities include reduced capability (RedCap) and high-order carrier aggregation, to support forthcoming use cases encompassing 5G and AI, the low-altitude digital airspace segment (drones) and XR. In Japan, service providers are focusing on 5G performance, and there is positive momentum for 5G standalone (SA) penetration and coverage. Conversely, in South Korea, certain service providers are deferring the evolution to 5G SA while they evaluate use cases. In Taiwan, commercial 5G SA is expected within 1–2 years.

**Western Europe**
Although penetration is behind other developed markets, 5G subscription growth is strong, rising from 143 million in 2023 to an estimated 226 million by the end of 2024. This equals a region-wide penetration of 41 percent, however, it varies between countries. Markets such as the UK and Finland, which launched 5G early, have already achieved high penetration relative to other markets. 4G is expected to decline in favor of 5G subscriptions going forward. 5G subscriptions are anticipated to reach around 520 million at the end of 2030, representing 92 percent penetration at that time, in line with other leading 5G markets.

**North America**
Network investments in North America stabilized in 2024, after the 2023 slow-down. During 2024, 5G adoption has continued to grow strongly, and 316 million subscriptions are expected at the year's end. By 2030, around 436 million 5G subscriptions are anticipated, accounting for 91 percent of mobile subscriptions. Leading service providers in the US project continued growth for FWA. Mid-band 5G network coverage has now reached a point where consumer, enterprise and government innovations across the broader tech ecosystem can accelerate.

**In North America, 5G will account for 71 percent of all mobile subscriptions at the end of 2024.**

71%

# Quarterly mobile network data traffic update

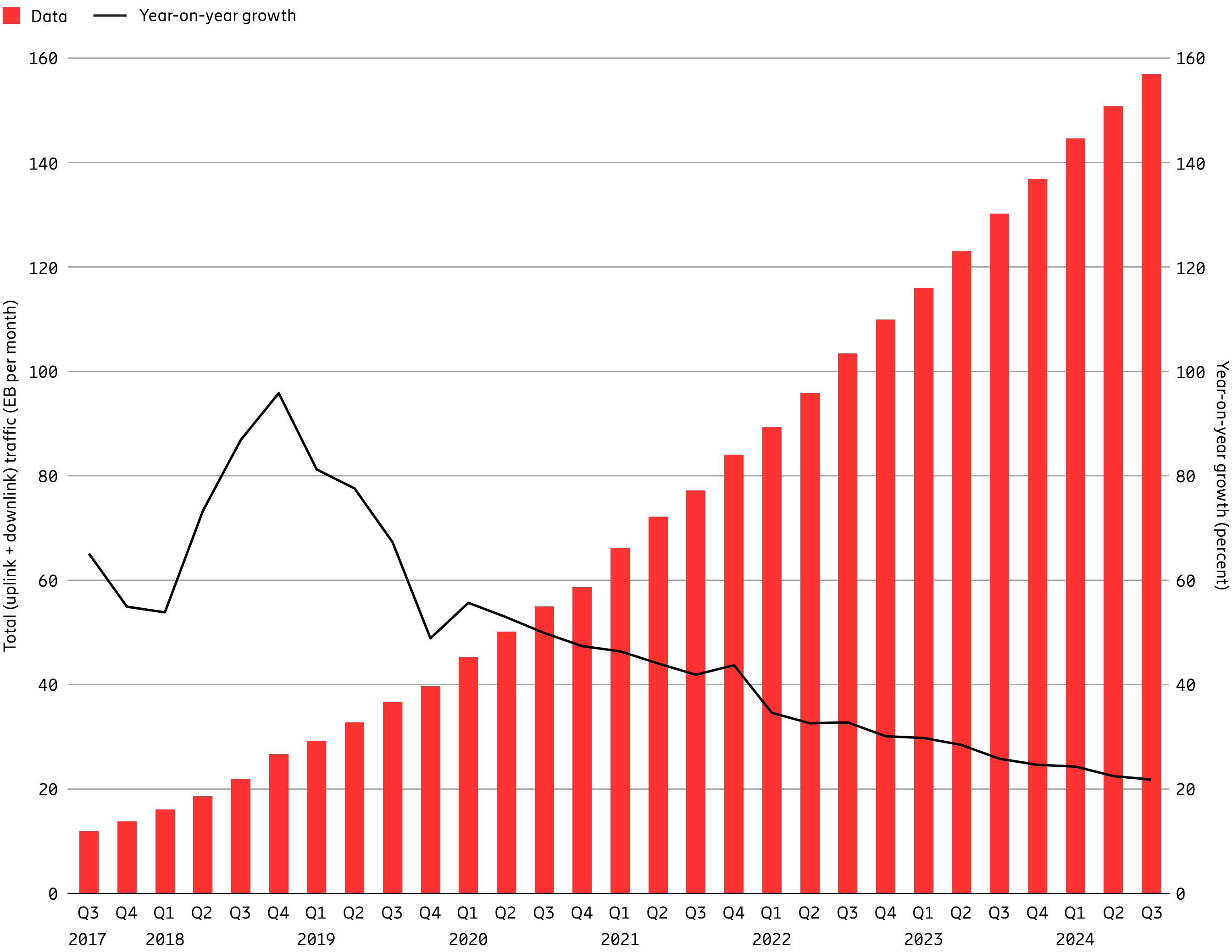
Mobile network data traffic grew 21 percent between Q3 2023 and Q3 2024.

The quarter-on-quarter mobile network data traffic growth between Q2 2024 and Q3 2024 was around 4 percent. Total monthly global mobile network data traffic reached 157 EB.

Mobile data traffic growth is being driven by both rising smartphone subscriptions and increasing average data volume per subscription, fueled primarily by increased viewing of video content. At the end of 2024, video traffic is anticipated to account for 74 percent of all mobile data traffic.

Figure 4 shows the total global monthly network data traffic from Q3 2017 to Q3 2024, along with year-on-year percentage growth for mobile network data traffic.

**Figure 4: Global mobile network data traffic and year-on-year growth**




Note: Mobile network data traffic also includes traffic generated by Fixed Wireless Access services.

# 5G will carry 80 percent of mobile data traffic globally in 2030

Mobile data traffic continues to grow globally, fueled by subscriber migration to later mobile technology generations.

Since Q2 2024, the market has experienced a continued reduction in the mobile network data traffic growth rate. The year-on-year growth rate for mobile network data traffic is expected to continue to decline, from 21 percent in 2024 to 16 percent in 2030. This means a CAGR of 19 percent over the full forecast period.

Total global mobile data traffic – excluding traffic generated by Fixed Wireless Access (FWA) – is expected to grow by a factor of around 2.5 to reach 303 EB per month in 2030. When FWA is included, total mobile network data traffic is anticipated to grow by a factor of around three, rising to 473 EB per month by the end of the forecast period.

5G's share of mobile data traffic will reach an estimated 34 percent by the end of 2024, an increase from 25 percent at the end of 2023. This share is forecast to grow to 80 percent in 2030.

**Factors impacting the forecast**

Mobile data traffic growth between years can be highly volatile and vary significantly between regions, markets and service providers, depending on local market dynamics. Some factors that could further change the forecast for 2030 for mobile data traffic include:

- global macroeconomic changes (inflation and interest rates)
- the pace of subscriber migration to later generations in India, Latin America, South East Asia and Africa
- smartphone shipment development
- the uptake rate for new consumer applications (such as XR), new advanced devices and AI-enabled tools
- changes to the split between FWA and mobile data traffic when FWA connections grow
- continued improvements in the performance of deployed networks

**Figure 5: Global mobile network data traffic (EB per month)**

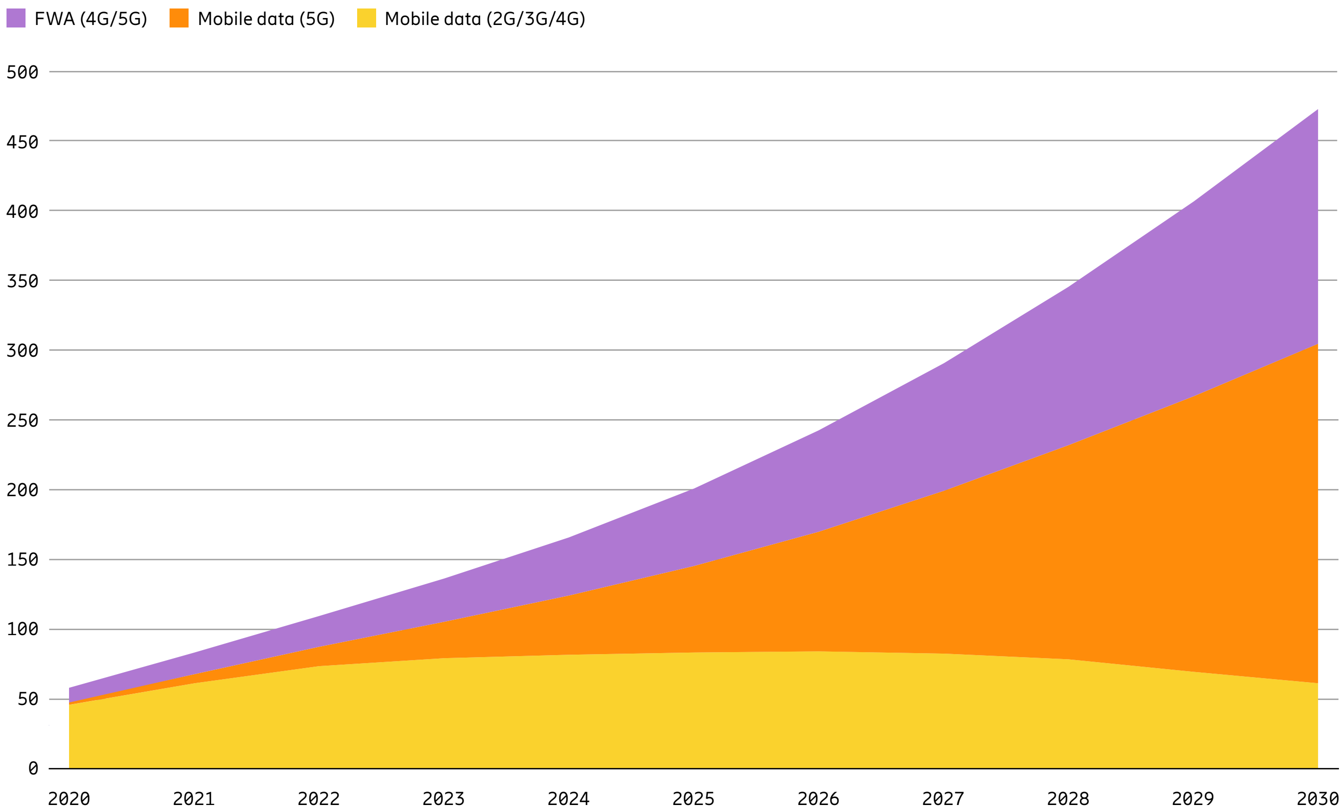
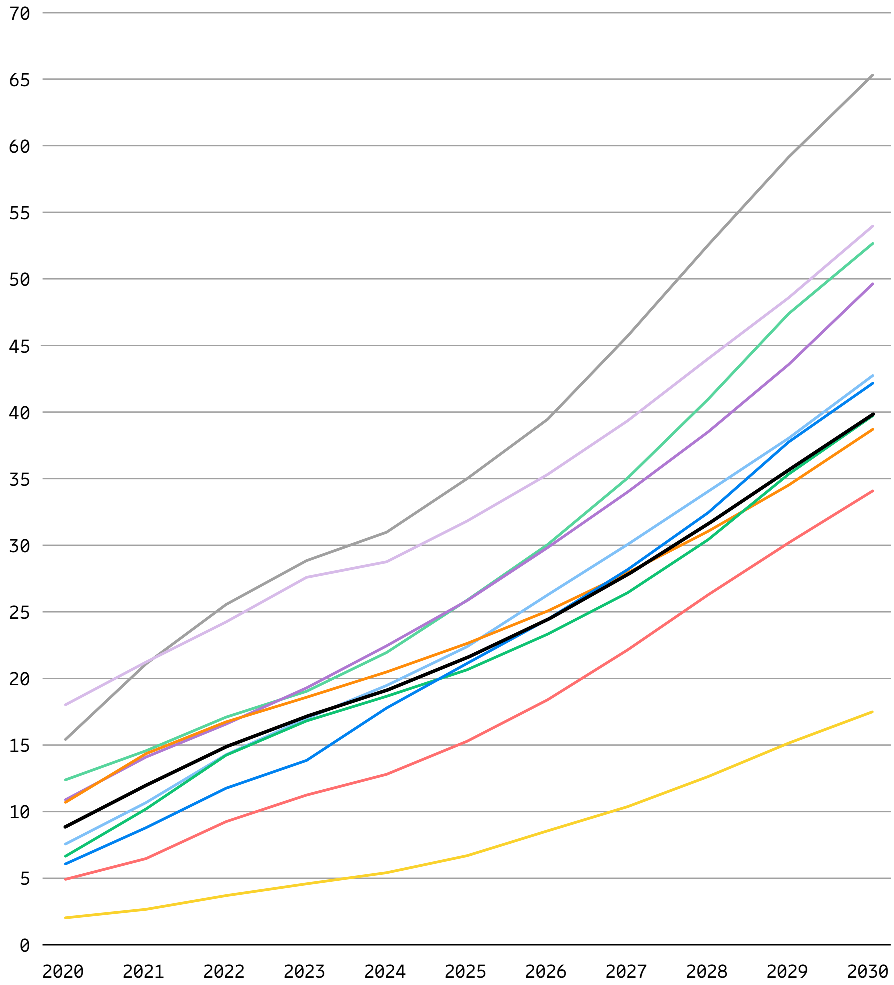


**Figure 6: Mobile data traffic per active smartphone[1] (GB per month)**




| Regions | 2024 | 2030 | CAGR 2024–2030 |
|---|---|---|---|
| India, Nepal and Bhutan | 32 | 66 | 13% |
| Gulf Cooperation Council | 29 | 54 | 11% |
| North America | 22 | 52 | 16% |
| Western Europe | 23 | 49 | 14% |
| Central and Eastern Europe | 20 | 42 | 14% |
| Middle East and North Africa[2] | 19 | 43 | 15% |
| South East Asia and Oceania | 19 | 39 | 13% |
| Global average | 19 | 40 | 13% |
| North East Asia | 21 | 38 | 11% |
| Latin America | 13 | 34 | 18% |
| Sub-Saharan Africa | 5.4 | 17 | 21% |

As seen in the last couple of years, the macroeconomic situation can change significantly with global inflation, interest rates and other factors. This can have a big impact on consumer willingness to pay for mobile services, thereby affecting mobile data usage.

Several large regions such as India, Latin America, South East Asia and Africa are expected to significantly migrate their subscriber base to later generations of mobile technologies in the coming years. Globally, it is expected that there will be an addition of 1.3 billion mobile broadband subscriptions during the forecast period. The future traffic patterns of these users will depend on network capabilities, tariff plans and available services.

Predicted traffic growth up to 2030 includes an assumption that an initial uptake of XR-type services, including AR, VR and mixed reality (MR), will happen in the latter part of the forecast period. However, if adoption is accelerated, data traffic could significantly surpass our current traffic outlook at the end of the forecast period.

With continued strong FWA uptake in parts of the world where fixed broadband connections have been limited, it is likely that household-based traffic will move from smartphones to FWA – especially for streaming services. This could then impact the GB per smartphone numbers in those regions.

Globally, the growth in mobile data traffic per smartphone can be attributed to three main drivers: improved device capabilities, an increase in data-intensive content and growth in data consumption due to continued improvements in the performance of deployed networks.

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

**5G will account for 34 percent of mobile data traffic by the end of 2024.**

34%

[1] Traffic per active smartphone refers to all traffic generated by that device, regardless of number of subscriptions attached.
[2] All Middle East and North Africa figures include the Gulf Cooperation Council countries.

# 5G mid-band population coverage growing

5G mid-band coverage in Europe has increased from around 30 percent at the end of 2023 and is expected to reach 45 percent by the end of 2024. Despite this progress, further coverage enhancements are required to deliver the full 5G experience.

There are currently 831 4G networks deployed worldwide, with 346 upgraded to LTE-Advanced and 161 Gigabit enabled.[1] 4G population coverage, outside of mainland China, is set to surpass 85 percent globally at the end of 2024 and is projected to reach over 95 percent in 2030.

The build-out of 5G continues, with around 320 networks launched worldwide. Global 5G population coverage is expected to reach 55 percent at the end of 2024. Outside mainland China it is projected to increase from 45 percent in 2024 to about 85 percent in 2030.

5G mid-band combines high capacity with good coverage and is available in most markets, making it an ideal choice for delivering the full 5G experience. Combined with a low-band frequency division duplex (FDD) 5G carrier, it can provide full coverage and mobility.

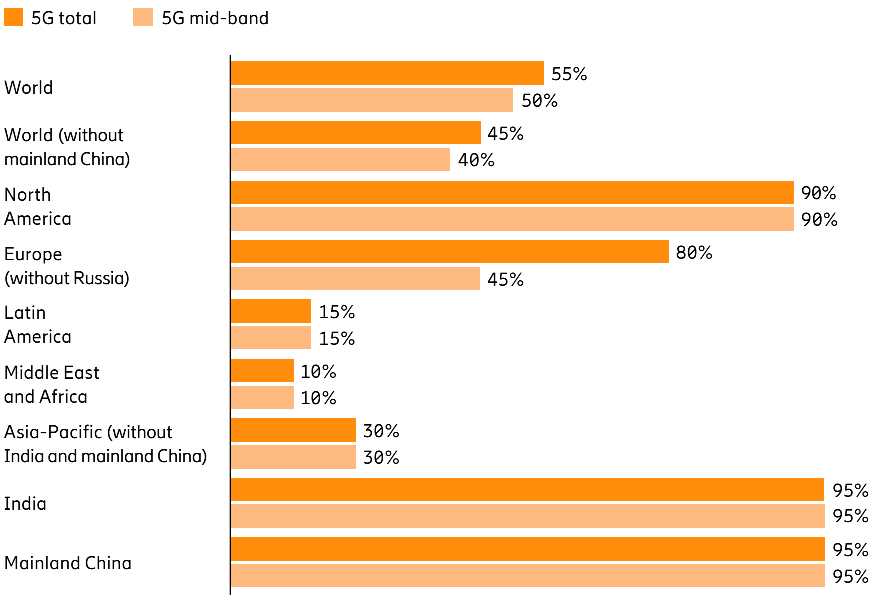
**Large regional variations in 5G coverage**

By the end of 2024, 5G mid-band population coverage outside of mainland China is expected to reach 40 percent, but coverage varies between regions. The Middle East and Africa as well as Latin America are the two regions with the lowest total and mid-band coverage, and are expected to reach around 10 and 15 percent coverage respectively by the end of 2024. The Asia-Pacific region, outside of China and India, is expected to reach 30 percent total and mid-band coverage by the end of 2024. Europe is predicted to reach total 5G population coverage of 80 percent by the end of 2024. During 2024, mid-band coverage in Europe significantly increased from around 30 percent at the end of 2023 and is predicted to reach 45 percent by the end of the year. Despite this, Europe has yet to make further coverage deployments in mid-band to reach similar coverage to North America and India.

India has made large-scale mid-band deployments and is expected to reach around 95 percent population coverage by the end of 2024. Meanwhile, North American service providers have deployed 5G across low-, mid- and high-band frequencies, and total and mid-band coverage are both now expected to reach around 90 percent.

Despite these coverage advancements, only around 30 percent of sites globally outside of mainland China have been upgraded to 5G mid-band.

Figure 7: World population and mid-band coverage split by region (end of 2024)

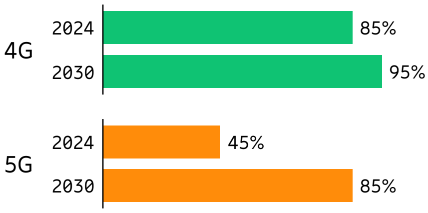



Note: The figures in these graphs are rounded and refer to the coverage of each technology. The ability to utilize the technology is subject to factors such as access to devices and subscriptions.

**Globally, 5G population coverage outside of mainland China is set to reach around 85 percent at the end of 2030.**

85%

Figure 8: World population coverage outside mainland China, by technology




[1] Ericsson and GSA (Nov 2024).

# Continued global FWA momentum

The number of Fixed Wireless Access (FWA) service providers offering speed-based tariff plans has risen to 43 percent, compared to 30 percent a year ago, indicating the market's momentum.

During the last year, FWA has grown solidly in terms of the:
- proportion of service providers offering it over 5G
- share of service providers with speed-based tariff plans
- number of connections and the traffic volume per connection

**Continued global FWA momentum**
An updated Ericsson study[1] of retail packages offered by mobile service providers reveals that 79 percent have an FWA offering. There are 131 service providers offering FWA services over 5G, representing 54 percent of all FWA service providers.

Figure 9: Global FWA service provider adoption 2021–2024

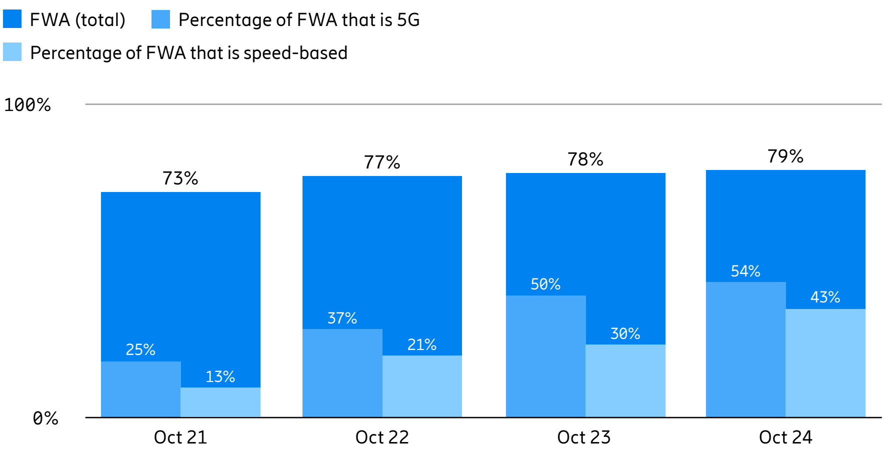
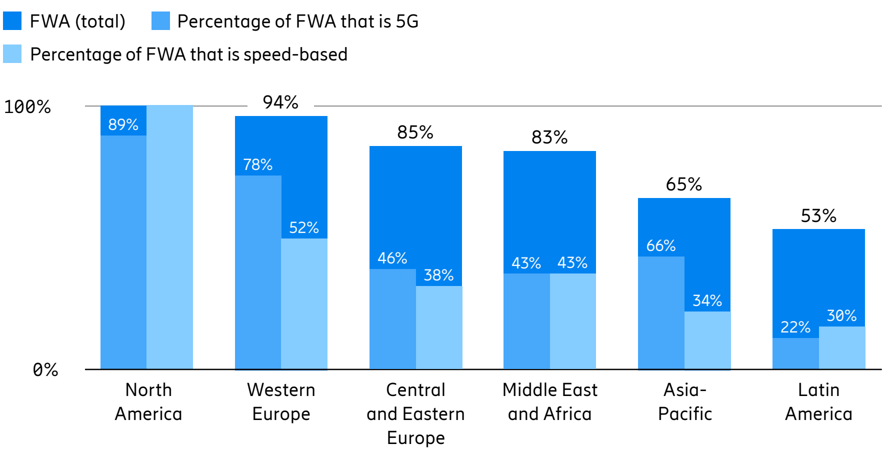



Figure 10: Regional FWA service provider adoption 2024



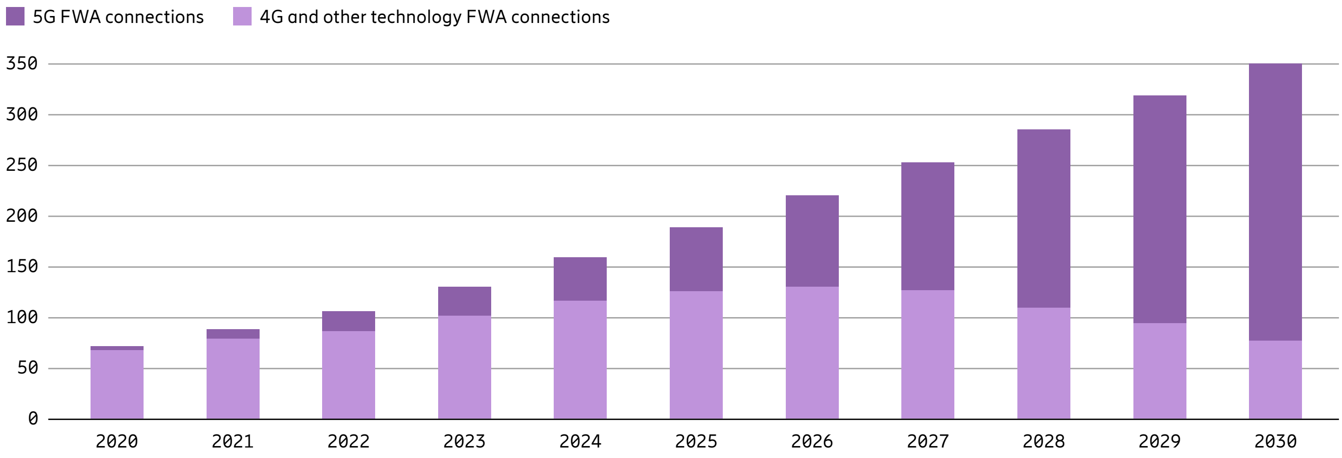

[1] 310 service providers, representing around 90 percent of global mobile revenues.

**Speed-based tariff plans are becoming more widely available**
Speed-based tariff plans are commonly offered for fixed broadband services, such as those delivered over fiber or cable. Consumers understand this type of plan well, enabling service providers to monetize FWA as a broadband alternative. Speed-based tariff plans are now offered by 43 percent of FWA service providers, up from 30 percent a year ago. The remaining 57 percent subscribe to volume-based tariff plans (buckets of GB per month).

**Regional variations**
There are large regional variations in the proportion of service providers adopting FWA:
- FWA adoption is widespread globally. In four out of six regions, 83 percent or more service providers are offering FWA.
- In the past year, Western Europe experienced substantial growth in speed-based offerings and has the second-highest service provider FWA adoption globally, rising from 32 to 52 percent.
- Similar to Western Europe, the Middle East and Africa region has seen solid growth in the proportion of mobile service providers offering speed-based plans, growing from 23 to 43 percent.

**FWA service provider advancements**
- In the past 12 months, Europe has accounted for 73 percent of all new 5G FWA launches globally.
- Currently, 94 percent of service providers in the Gulf Cooperation Council region offer 5G FWA services.
- In the US, two service providers originally set a goal to achieve a combined 11–13 million 5G FWA connections by 2025. After reaching this target ahead of schedule, they have now revised their goal to 20–21 million connections by 2028.

Figure 11: FWA connections (millions)




- The market in India is rapidly accelerating, with 5G FWA connections reaching nearly 3 million in just over a year since launch.
- An increasing number of service providers are launching FWA based on 5G standalone (SA), driven by several key factors:
  – efficiency – improved spectrum management and coverage
  – performance – enhanced speeds, advanced features and superior user experiences
  – differentiation – introduction of premium FWA and reduced capability (RedCap) offerings

**CPE choices support a speed-based strategy**

FWA customer premises equipment (CPE) shipments are expected to increase by 23 percent during 2024 to reach 37 million units.[2]

The Ericsson study, which examines 131 global mobile service providers offering 5G FWA services, provides insights into the types of CPE they offer. Among the 51 service providers with a best-effort offering, 88 percent only offer indoor CPE units, while 12 percent provide outdoor or flexi self-install CPE options (that can be placed indoors or outdoors). In contrast, for the 80 service providers with speed-based offerings, the percentage of indoor-only CPE drops to 60 percent, with a significantly higher portion, at around 40 percent, offering outdoor or self-install options.

**350 million FWA connections by 2030**

Global FWA connections are expected to grow from 160 million by the end of 2024 to 350 million by the end of 2030. This would represent 19 percent of all fixed broadband connections. Of the 350 million projected connections, close to 80 percent are expected to be over 5G. 4G FWA connections are predicted to peak in 2026, compared to earlier estimates of 2024.

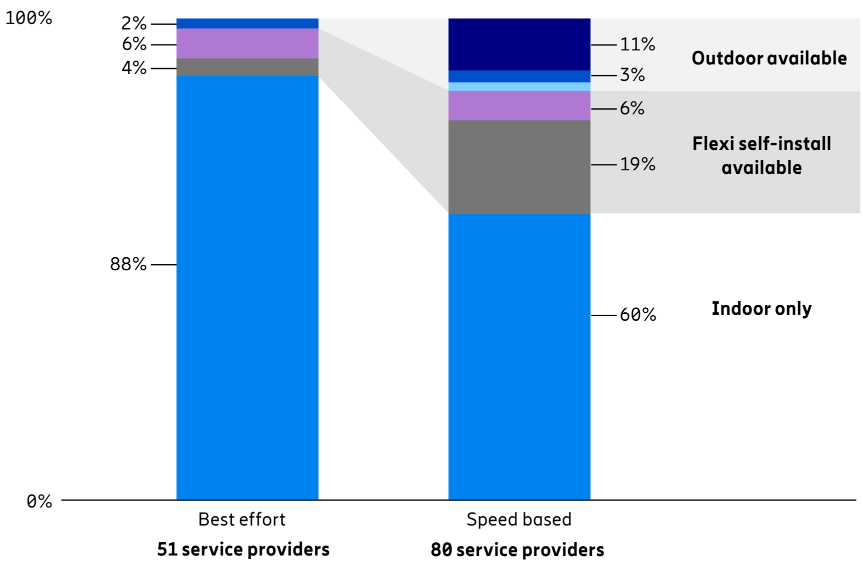
**Almost half of global FWA connections to be in Asia-Pacific by 2030**

Higher volumes of 5G FWA in populous, high-growth countries can drive economies of scale for the overall 5G FWA ecosystem, resulting in even more affordable CPE. Asia-Pacific's share of global FWA connections is expected to increase from 40 percent in 2024 to 48 percent by 2030.

**FWA impact on global mobile network data traffic**

As a result of the change in the 4G/5G FWA connection mix during the forecast period, the predicted FWA traffic up to 2030 has been slightly reduced. At the end of 2024, FWA data traffic is expected to represent 25 percent of global mobile data traffic and is projected to grow by a factor of more than 4 to reach around 170 EB per month by the end of 2030. This will represent 36 percent of total mobile network data traffic.

Figure 12: 5G FWA CPE form factor by service-provider offering




**During the last year, 73 percent of 5G FWA launches occurred in Europe.**


[2] Ericsson and GSA, FWA Forum CPE Survey (September 2024).

# Articles

The innovations promised by 5G are not only possible, they are becoming reality. In our articles we explore how the power of network slicing and 5G standalone (SA) is already enabling advanced concepts, services and capabilities, including Fixed Wireless Access (FWA), RedCap, differentiated connectivity and a digital airspace. In this edition we also look forward, exploring the effect of generative AI (GenAI) on network traffic and even looking further ahead toward the arrival of 6G.

**Network slicing is still in the experimental stage for many service providers, but T-Mobile in the US has taken the leap from pilots to real-world applications.**

**Using 5G SA to power Own Lane FWA, Finnish service provider Elisa is continuing to improve its customers' satisfaction in their network performance.**

**Saudi Telecom Company (stc) is expanding its 5G coverage in line with national goals, with a multi-NR carrier strategy playing a key role.**

**5G offers the opportunity to create a digital airspace that enables seamless communications in the skies, fueling innovation in manned and unmanned aviation.**

**GenAI has the potential to transform how digital content is created and enjoyed. It is particularly important to understand how this could change traffic volumes and characteristics.**

**Although use-stage electricity consumption rises 2–3 percent yearly in the ICT sector, a growing share of renewable energy means that greenhouse gas emissions have fallen.**

# Unlocking the capabilities of 5G SA

5G standalone (SA) subscriptions are forecast to reach 3.6 billion by the end of 2030, accounting for nearly 60 percent of 5G subscriptions.

Leading service providers are deploying 5G SA networks as part of their journey to enabling service differentiation and performance-based business models. More than 60 service providers deployed or launched public 5G SA networks on mid- and low-band spectrum by the end of September 2024.[1] North America, China, South East Asia and Australia had early, major deployments during 2020–2022, but deployments are now also ongoing in Latin America, the Gulf Cooperation Council countries and South Africa. In Europe, commercial launches have taken place in more than 10 countries, including Germany, the UK, Italy and Spain. However, 5G SA coverage is still scattered in most markets that have launched commercial networks (Figure 13).

Early 5G SA network deployments provide a substantial competitive advantage for service providers that leverage its full benefits and potential. The 5G SA core is flexible and programmable, allowing services to be designed based on customers' requirements, with assured quality of service (QoS), security and adaptability. 5G SA benefits include faster connection times (lower latency) and programmability for more agile creation of services and network slices. A deployed 5G SA network is also a prerequisite for 5G IoT use cases based on reduced capability (RedCap) technology.

### 5G SA subscriptions to reach 1.2 billion in 2024[2]

The proportion of 5G SA devices among all announced 5G devices is increasing, reaching approximately 70 percent by the end of June 2024.[3] Smartphones make up 60 percent of the announced, but not launched, 5G devices with stated 5G SA support, with a growing number featuring a default SA-enabled setting.

By the end of 2024, there will be an estimated 1.2 billion 5G SA mobile subscriptions worldwide, with the majority – around 1.1 billion – in China and India.

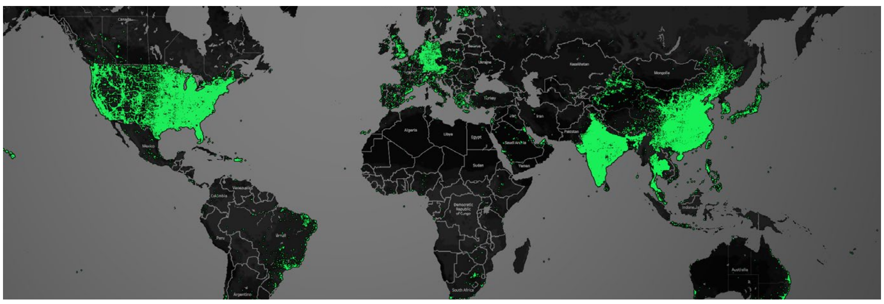
By 2030, the global number of 5G SA subscriptions is projected to reach approximately 3.6 billion.

## Key drivers for service providers to deploy 5G SA

**Business drivers:**
- the opportunity to become a service creator, moving beyond being a connectivity provider
- a prerequisite to introduce new offerings based on differentiated connectivity
- address a wider range of potential business opportunities (enterprise, consumers, government and society)
- support and accelerate enterprise transformation and industry digitalization to offer higher reliability for critical applications
- enhance customer mobile broadband experience, such as faster network responsiveness due to lower handover interruption time, lower latency and higher bitrates

**Network technology and operational drivers:**
- no dependency on LTE; 5G SA offloads the 4G networks, ensuring user experience and efficient use of network assets
- build a more powerful and programmable network for new use cases, only possible with 5G SA
- improved efficiency – minimize energy usage and dependency on LTE
- introduce automated end-to-end network slicing, supporting high reliability, time-sensitive applications or those requiring guaranteed minimum bandwidth
- greater speed and agility to bring new services to market through cloud-native, service-based architecture

**Figure 13: 5G SA deployment and trials – indicative coverage**



Source: Based on analysis by Ericsson of Ookla® Speedtest Intelligence® data for January 2022 to October 2024. Note: Samples include iOS and Android smartphones connecting to a 5G SA network. Sample density varies across markets, reflecting differences between markets with more extensive commercially launched 5G SA or markets with mainly trials/tests.

[1] GSA, September 2024.
[2] The 5G SA forecast is an Ericsson estimate. A 5G SA subscription is counted as such when associated with an SA-capable device (with SA enabled) in a commercially launched 5G SA network.
[3] GSA, September 2024.

# 6G: Co-creating a cyber-physical world

Early deployments of 6G are expected in 2030, and the 6G journey is already well underway.

## Key insights

- The first commercial 6G deployments are expected in 2030.
- Long term, the network capabilities of 6G will enable the promise of the cyber-physical world, making it possible to freely move between the connected physical world and the physical world's programmable digital representation.
- The journey begins with 5G standalone (SA) and 5G Advanced. 6G scales up these capabilities and brings entirely new ones to enhance existing use cases and allow for the innovation of completely new use cases.

Multiple waves of 5G deployments and upgrades are still yet to take place in many parts of the world. However, the ICT industry, academia and standardization bodies have already begun to discuss and invest in new technologies to power the next generation of wireless possibilities beyond 5G and 5G Advanced: 6G.

**The cyber-physical world**

In the long term, 6G's capabilities will make it possible to realize the vision of moving freely in the "cyber-physical world," building a critical bridge between the connected physical world of senses, actions and experiences, and the physical world's programmable digital representation. The 6G cyber-physical world includes AR/VR as well as today's digital twins, but goes further, providing a much closer link to reality. It will be possible to project digital objects onto physical objects that are represented digitally, allowing them to seamlessly coexist as "mixed reality" that enhances the real world. For example, holographic calls where a person is digitally represented within a physical environment could be possible.

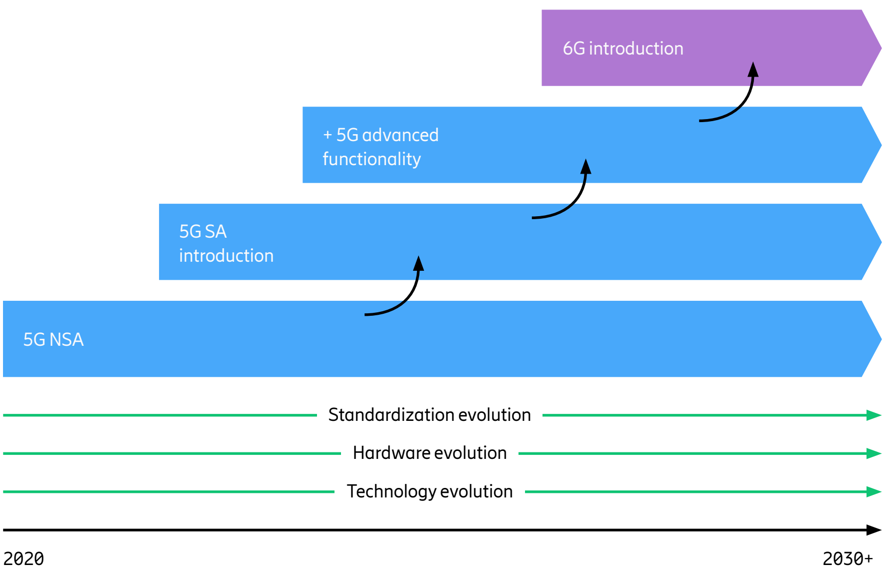
Countless sensors will be embedded in the physical world to send data that will update the digital representation in real time. Meanwhile, functions programmed in the digital representation will be carried out by actuators in the physical world. The purpose of the 6G network is to provide intelligence, ever-present connectivity and full synchronization to this emerging reality. This network is built on the foundation of a trustworthy system that is always available, reliable, performs as expected and recovers quickly when facing disturbances or attacks.

Future networks will be a fundamental component for the functioning of virtually all parts of life, including society and industry, fulfilling the communication needs of humans and intelligent machines. As accelerating automatization and digitalization continue to simplify people's lives, the emerging cyber-physical world will continuously improve efficiency and support the sustainable use of resources through digitalization.

**Growing from 5G to 6G**

The cyber-physical world will not fully materialize over the course of a day, but instead, we will see a gradual progression from the first deployments of 6G around 2030. There is not yet a detailed roadmap for 6G, but based on several years of research, pre-standardization work has now begun. Research into new technology areas for 6G will then continue in parallel with the evolution of 5G. Learnings from live 5G networks and interactions with the user ecosystems will continuously feed into the research, standardization and development of 6G. The capturing of the technology evolutions, alongside advancements in hardware capabilities into how the 6G standards evolve, is critical to delivering both enhanced and new network capabilities, while ensuring cost-efficient and sustainable solutions. It is expected that 6G will be built on the foundations of 5G SA and 5G Advanced.

**Figure 14: Factors driving the path to, and evolution of, 6G**



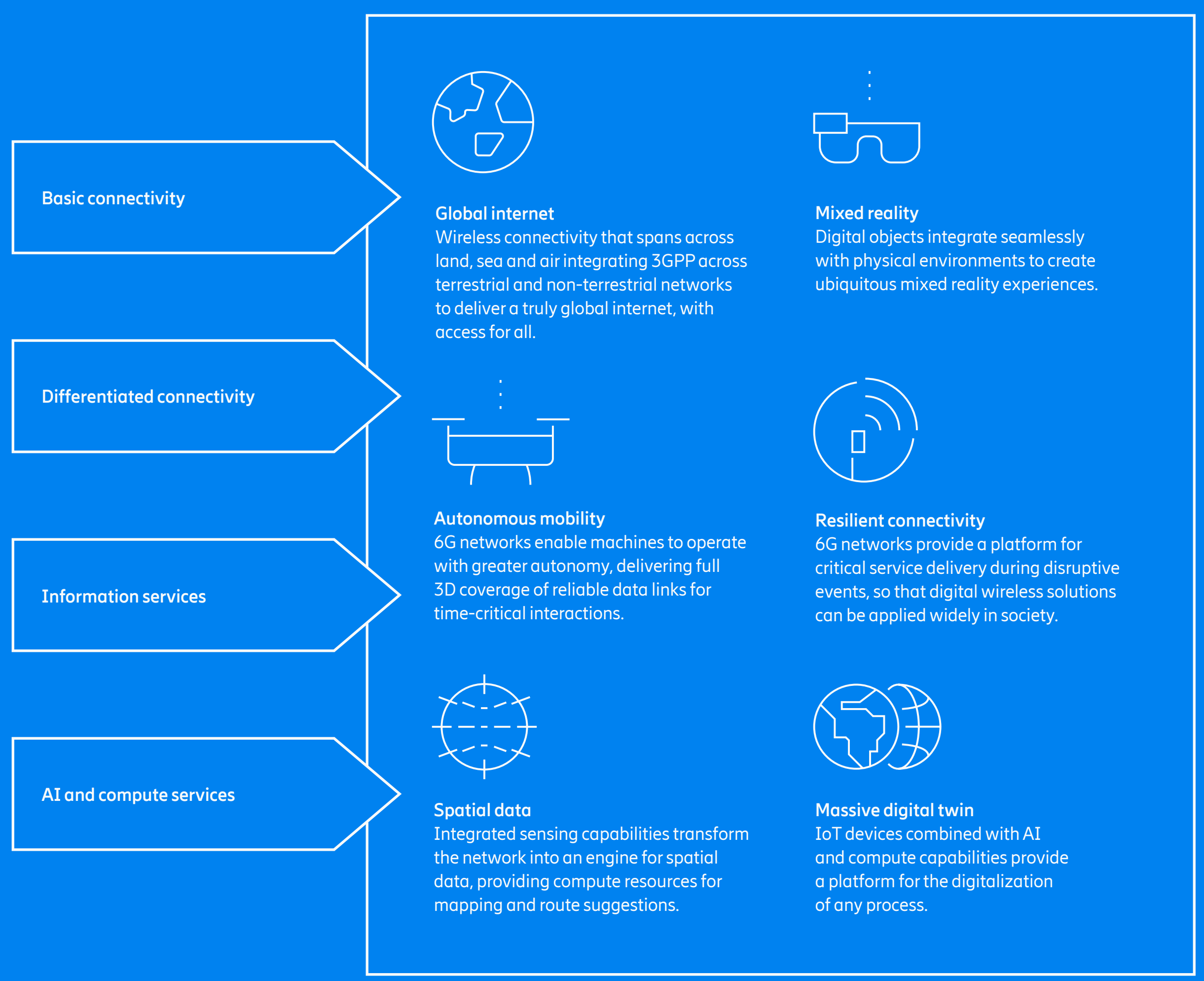
The 6G Radio Access Network (RAN) should connect to an evolved form of the 5G Core network.[1] 5G SA architecture is flexible and can easily be extended to handle new 6G features. Building upon the well-established baseline of the 5G Core network enables a cost-efficient introduction of the 6G RAN and other 6G features. It is expected that deployments will commence in 2030 with a smooth migration to 6G, utilizing the evolved 5G Core and highly efficient Multi-RAT spectrum sharing (MRSS) for existing spectrum in combination with new spectrum bands. More new capabilities will be added as 6G standards evolve.

**6G capabilities and use cases**
To serve as the platform for a vast range of new and evolving services, the capabilities of wireless access networks need to be enhanced and extended in various dimensions. This includes enhancing classic capabilities, such as achievable data rates, latency and energy performance. Alongside these, entirely new capabilities are expected within 6G, including services offering functionality beyond communication, such as AI and compute services, as well as information services such as integrated sensing and communication.

These new concepts are already under development, enabling 6G to support cyber-physical interactions with basic connectivity, differentiated connectivity, spatial and timing data, and AI and compute services.

**A multi-purpose platform**
The core elements of 6G will form one seamless system, with all the capabilities necessary to empower the vision of ever-present intelligent communication connecting a cyber-physical world. With a foundation of trustworthy systems and a highly efficient cloud compute with built-in AI capacities, the networks of the future will deliver global connectivity as well as services beyond connectivity for upcoming applications. This will make 6G the information backbone of society, leading to the creation of a fully digitalized and programmable physical world.[2] Network APIs are critical to realizing the cyber-physical world, as they allow developers to easily access valuable network capabilities and insights. These can then be used to enhance existing applications and develop new ones. This has begun already with 5G network capabilities such as differentiated connectivity, location-secure authentication and network insights, but will continue to evolve and accelerate with entirely new 6G network capabilities.

**Figure 15: Cyber-physical interactions**




[1] Ericsson, "6G network architecture – a proposal for early alignment" (October 2023).
[2] Ericsson Technology Review, "Beyond bit-pipes – new opportunities on the 6G platform" (July 2024).

# Impact of GenAI on mobile network traffic

Generative AI (GenAI) may significantly impact future mobile network traffic, particularly through increased video consumption and changing uplink requirements.

## Key insights

- GenAI enables at-scale, hyper-personalized content creation, driving potential mobile traffic growth beyond baseline predictions.
- Increased use of GenAI-driven video assistants and immersive interactions may increase both uplink and downlink traffic.
- The compression capabilities of GenAI will likely be used in closed ecosystem applications but are unlikely to impact general consumer traffic anytime soon.

GenAI refers to advanced machine-learning models that understand text, audio and video context based on patterns learned from vast datasets. This allows it to create new information that is often indistinguishable from human-generated content. Understanding context also allows it to segment provided content and therefore represent it through more efficient encoding.

It is particularly important for service providers to understand how GenAI will change traffic volumes or characteristics with respect to previous mobile broadband and extended reality (XR) predictions.

**Understanding GenAI**

Users today engage with different forms of content, including audio through headphones, text and video through smartphones and 3D objects, as well as volumetric environments, through immersive XR devices. Each is being impacted by GenAI capabilities, where these fundamental approaches have emerged: Generative adversarial networks (GANs), diffusion models, transformers and hybrids thereof.

Transformers – powering large language models (LLMs), such as the GenAI chatbots that exist today – are neural network architectures originally designed for sequential data, like text, using a mechanism called self-attention to capture dependencies in the data. They are increasingly used for multimedia tasks, including audio, image and video generation. They are highly effective at capturing "long-range dependencies" and are particularly powerful for "multimodal tasks," such as text-to-image generation.

These techniques collectively form the backbone of GenAI, pushing the boundaries of what machines can create in terms of images, videos, 3D objects and more. Of importance to mobile networks is insight into where these models will likely be executed, as summarized in Figure 16.

**Introduction to semantic compression**

GenAI models are also able to represent content more efficiently as they can understand context. Imagine you have a high-resolution safety camera, recording millions of pixels of detailed information capturing a person operating a machine. Rather than try to understand each pixel, an alternative approach is to describe the features in the photo, for example the color of the hair or the handling of the machine.

Referred to as latent space, the exact pixel details are lost, but the essential characteristics that define an entity's appearance are preserved in compact data representations. Generative models have extremely capable inference properties which allow them to synthetically render the entity based on these representations, thus reducing bandwidth requirements.

This can help improve the user experience by enabling new applications that may not otherwise have been possible in constrained situations, by providing a higher resolution, or by reducing the amount of bandwidth needed per stream.

The required processing capabilities and standards to do this at scale for consumers could still be at least a decade away. However, it could be used in a proprietary form in closed ecosystems or volumetric/avatar content representations and synthetic regeneration. General adoption and scale of semantic compression, however, remains uncertain. This technology is expected to be a part of the overall evolution of video compression technologies.

**Figure 16: GenAI model complexity and execution location**

| Model Type | Training complexity | Inference complexity |
|---|---|---|
| GANs | Complex: Unstable and non-convergent, requires careful tuning; likely executed in the cloud. | Moderate: Once trained, inference is relatively fast; executed in the cloud and on the smartphone. |
| Diffusion models | Complex: Computationally expensive and time consuming; likely executed in the cloud only. | Complex: Inference requires multiple steps; likely executed on cloud, except for low-complexity Gaussian Splatting. |
| Transformers | Complex: Requires massive datasets and high compute power; likely executed in the cloud only. | Low/moderate: Requires compute and activation memory; large models in the cloud, smaller on device. |
| Hybrid | Complex: While it can be optimized, training typically is complex; executed in the cloud only. | Low/moderate: Good at balancing speed and quality; executed in cloud and on device. |

**Trends in consumer interactions with GenAI**

Users will increasingly consume and produce GenAI content, as well as interact with multimodal GenAI models using their smartphones or XR devices. Initially, such interactions will mostly be consumer initiated; however, toward the end of the decade, we will likely observe an increase of AI-based assistants acting on behalf of consumers.

AI-based assistants use AI agents, systems which use GenAI to autonomously achieve specific goals. They can help with healthcare, education, understanding and reacting to users' environments and more. While intelligent voice-based assistants are commonplace today, advances in GenAI are starting to enable video-based assistants.

Most of the traffic increase will be due to video-based GenAI interactions, where three areas are emerging:

- First, the legacy way of using the smartphone screen where users will spend more time with hyper-personalized content. For instance, educational or entertainment materials are catered to a specific person, significantly increasing engagement and retention rates.
- Second, using the smartphone camera to look around and ask a video LLM questions about the immersive environment – for example, pointing the camera to a broken car engine and receiving step-by-step instructions on how to repair it.
- Third, using smart glasses or XR devices to engage with the environment – either on an as-required basis initiated by the user, or via an always-on AI agent monitoring the immersive environment. For instance, your AI assistant could use a video LLM via smart glasses to recognize the food on your plate and calculate the nutritional value. Wide use of such assistants could imply growth in the uplink traffic from current levels.

Many other interactions between consumers and GenAI models will emerge, similar to the text-based interactions today with GenAI chatbots. However, these modes of engagement are not expected to increase traffic significantly and are therefore not further considered here. Outside the consumer segment, we expect increased traffic from AI agents interacting with drones and droids.

**Impact on mobile network traffic**

By evaluating these factors, we can gain valuable insights into potential traffic patterns. The actual effects will depend on several variables, such as consumer interest and industry uptake, which will only become apparent over the coming years. Consequently, this is a qualitative analysis that aims to offer insights into possible future developments in traffic volume.

In terms of the location of GenAI workloads, they will mostly be executed in the cloud in real time or pre-rendered to generate hyper-personalized content that users can consume when needed. Some of the medium-complexity GenAI workloads that are being executed in the cloud today will likely migrate to the smartphone, enabled by low-complexity LLMs. Complex real-time engagements, however, will likely be orchestrated in a federate fashion: simple sub-tasks are completed on smartphones, more complex but privacy protected tasks in a private (edge) cloud and highly complex tasks by the large LLMs in the cloud.

As a result, the uplink versus downlink requirements will change toward the end of the decade. Due to hyper-personalized content, further increase of downlink traffic over the baseline increase may occur. A significant increase in uplink traffic due to consumer or AI assistant-initiated video streams may also occur if GenAI-enabled devices reach mass market volumes.

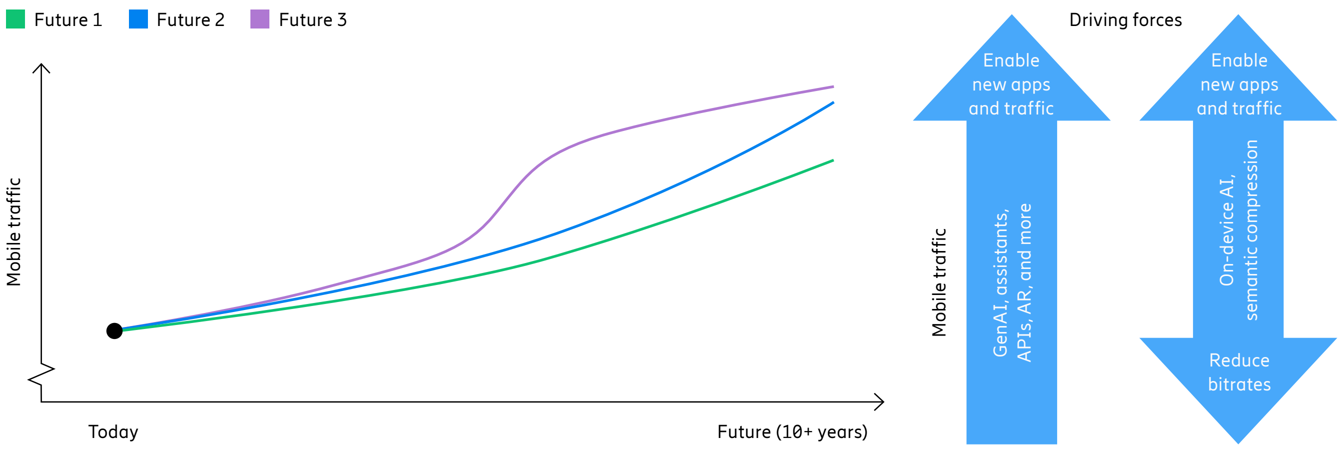
For instance, using smart glasses with an AI-based video assistant for just one hour a day would increase traffic substantially.

As discussed above, the projected rate increase is potentially offset per flow by emerging GenAI capabilities, such as semantic compression, on-device AI-based upscaling or on-device search enabled by up-to-date LLMs. With such sophisticated GenAI capabilities in smartphones, however, very high compute, memory and battery requirements would be needed. Uptake would therefore depend on the industry roadmaps for both device hardware and embedded GenAI model software.

These and other GenAI capabilities are, however, likely to drive entirely new applications, scale up existing ones and improve user experience. As a result, GenAI is likely to cause an overall traffic increase due to the enablement of hyper-personalized content as well as the new applications. Illustrated in Figure 17, three potential future traffic trends could emerge:

- Future #1: Despite general traffic growth in developed markets showing recent signs of slowing down, the adoption of GenAI at scale may be a reason we will see a continued traffic increase.
- Future #2: Accelerated consumer uptake of GenAI will cause a steady increase of traffic in addition to the baseline increase.
- Future #3: GenAI consumer uptake will explode – possibly aligned with the launch of AR glasses. This will force the industry to consider more efficient video compression technologies, including potential introduction of semantic compression – at least for parts of GenAI traffic – as viable alternatives to deal with this. This and general traffic saturation may cause traffic to stabilize.

**Figure 17: A conceptual illustration of different mobile traffic growth impacts due to GenAI**



# T-Mobile takes network slicing from pilots to real-world scenarios

Network slicing has advanced to the extent that leading service providers are currently leveraging its capabilities within commercial networks. This allows them to address a wide range of use cases that benefit from differentiated connectivity.

## Key insights

- Network slicing is in the early stages of commercialization, where successful pilots are being converted into commercial offerings with the potential to scale.
- Network slices do not need to be custom-made for each unique purpose, and service providers can start with a few of the most important types of slices.
- Network slicing represents an important stage beyond best-effort connectivity, on the road to enabling capabilities that can be enhanced through network APIs.

This article was written in cooperation with T-Mobile, a leading US service provider that deployed a nationwide 5G SA network in 2020. It currently operates the SA network on multiple spectrum bands to unlock a wide range of use cases by providing differentiated connectivity. T-Mobile is the only major service provider in the US operating a nationwide 5G SA network, with low-band population coverage reaching 330 million people and mid-band population coverage reaching over 300 million people.

5G standalone (SA) architecture is the foundation for network slicing and is widely deployed by T-Mobile in the US. Network slicing empowers service providers to optimize network resources to meet the diverse needs of a wide range of services. By transforming the physical network into multiple logical networks on a shared infrastructure, service providers can create tailored network slices designed to serve specific business purposes. These slices contain customized network resources and configurations that can either be allocated individually or shared among multiple enterprise customers based on their requirements. Network slices can be optimized for characteristics such as latency, bandwidth, reliability and security. This flexibility allows service providers to address specific customer demands and emerging vertical markets.

Network slices do not have to be custom-made for each unique purpose, and service providers can start with a few of the most important types of slices. Prior to introducing guaranteed performance levels, which are costly from a resource-allocation perspective, service providers can unlock new business models by ensuring that prioritizations between different types of slices are maintained for different use cases. A large share of the existing best-effort connectivity will remain as it is, and network slicing will focus on securing the required characteristics for the most valuable business- and mission-critical applications.

### The value of 5G network slicing

As the role of mobile networks evolves, from mainly supporting consumer-grade services to include facilitating business- and mission-critical services, it becomes imperative that all services are adequately supported. This can be likened to how essential societal infrastructure, such as roads and energy distribution systems, can accommodate the varying, distinct requirements of consumers, businesses and governments.

A state-of-the-art mobile network features a high-performance infrastructure. Network performance encompasses more than just the "speed" metrics at which traffic is delivered to users. It also includes peak rates for data transmission to and from users, low latency from the cloud to users and precise positioning capabilities. When these individual capabilities are combined and integrated into a network slice, they have the potential to enhance connectivity experiences for specific use cases.

The main benefits of 5G network slicing for business and government customers are that it:

- leverages the widespread coverage of existing 5G networks, without the need to build a dedicated single purpose network
- ensures that business- and mission-critical services can take full advantage of one multi-purpose infrastructure
- accelerates digital transformation with applications that have access to more network capabilities than previously exposed

For service providers, 5G network slicing offers:

- expanded value propositions from universal to differentiated connectivity
- new business models coupled to attributes other than downstream data traffic volumes
- engineered networks to support a mix of different connectivity needs

Network slices can be defined in many ways, and the initial challenge is to successfully turn pilots and proofs-of-concept into scalable solutions. Therefore, scalable solutions are required so that networks can manage the life cycle of a slice and the associated business models.

### Network realization to support network slicing

Since network slicing was introduced as a concept, the ecosystem has matured in multiple steps through technology innovations in the core, RAN, orchestration and monetization domains.

5G SA adopters can take advantage of network slicing across these four domains:

- RAN slicing enables the sharing of radio resources and dynamically optimizes radio resource allocation, so they are occupied as long as needed. Slice-aware RAN quality of service (QoS) implementation enables the allocation of resources based on subscriber and service requirements.
- The core network enables the creation of slices with a dedicated or shared user plane, control plane and data layer network for supporting different service needs over one common infrastructure. It also controls traffic steering among the different network slices.
- Orchestration and automation enable the provision of new slices, adjustment of resources and optimization of network performance to meet customer needs, as the number of slices grows. Service assurance monitors the service performance to secure the service-level agreements.
- The monetization layer manages the contracts and service-level agreements, billing and charging for the different slices, as-well-as including exposure functions to enable monetization of network-slicing capabilities in the broader ecosystem.

On the subscriber side, user equipment route selection policy (URSP) technology can steer traffic on an application basis through defined, end-to-end slices in the network. It allows for multiple network slices on the same device, with traffic detection and steering capabilities. URSP is supported in devices and enabled on the network side via the core network.

**Use cases taking advantage of network slicing**

T-Mobile has leveraged network slices to explore a diverse range of business opportunities and obtained valuable experiences in many areas including:

- the value of embracing the 5G SA architecture as a foundation for network slicing
- the importance of collaborating extensively across the broader ecosystem to determine which slices are ready to move from pilots to commercial offerings
- the potential to improve well-established business services like video conferencing through increased reliability
- the business models that make sense for both application and connectivity providers and the beneficiaries of a specific type of network slice

These explorations have uncovered valuable insights on network slices coupled with specific use places, industries and use cases.

Figure 18: Four network slice use-case realizations

## Key network slicing use cases

Special events are a category of use-place solutions where network capacity at high-profile events can be boosted to support an influx of people over a shorter period. Temporary deployments of mobile cellular-on-wheels (COWs) augment the existing capacity in a limited area. A very high concentration of people and business-critical functions compete for the available network resources. At such events, T-Mobile has leveraged network slicing to support business-critical use cases such as connectivity for point-of-sale terminals and ticket screening. By speeding up these business processes and providing event organizers with a greater "peace of mind" with reliable connectivity (unlike Wi-Fi), visitors' overall satisfaction improves and revenues for on-site sales are increased.

T-Mobile offers a network slice optimized to support the emergency services. Connectivity requirements for first responders fall into the mission-critical category of services. First responders depend on smartphones, tablets and laptops during emergencies and need assurance that their traffic will get priority to be able to fulfill their missions. The network slice provides lower latency and faster 5G speeds more consistently, including the highest priority across all 5G frequency bands, even in times of extreme congestion. The growing use of video by many first responder roles also makes it necessary to set priorities between first responders that can provide the best information about developments at the scene of an emergency.

A slice for first responders helps ensure best-in-class connectivity during times of extreme congestion

Ensuring information security is crucial for organizations to safeguard sensitive data. Cybersecurity threats against businesses and organizations' digital infrastructure, applications and information can be addressed with technologies such as Secure Access Service Edge (SASE). 5G SA enables a service provider-managed SASE to be further security-enhanced, with network slicing providing extra network traffic isolation and QoS guarantee throughout the slice along with the SASE security functions. T-Mobile has implemented a SIM-based SASE solution in combination with a security slice dedicated to the SASE traffic that will provide an incremental layer of security and control for enterprise customers.

These examples illustrate the broad and multi-faceted potential of network slicing, and the possibilities to realize network slices at multiple levels.

### Unlocking value from network APIs

To stimulate innovation across the mobile ecosystem, T-Mobile has also allowed application developers to access network slices through network APIs that can be leveraged for specific service-level category requirements. These network slices can therefore target premium user experiences and business-critical parts of digital transformations where universal connectivity services may not be adequate. These connectivity innovations encompass both what to include in each slice and how developers can access richer network capabilities. Previously, application developers have had access to differentiated cloud services, for compute and storage capabilities, but relied on a single, universal type of connectivity service. The addition of access to differentiated connectivity is a new tool in the toolbox for application developers.

### Future possibilities and eco-system beneficiaries

Network slicing is in the early stages of the commercialization journey, with successful pilots being converted into commercial offerings with the potential to scale. Multiple stakeholders play key roles in advancing network slicing to the next level of maturity:

- Communications service providers understand the network slicing value proposition and can accelerate the pace of realization, with 5G SA as a required enabler.
- Enterprises can take advantage of different types of network slices for business-critical applications, to enhance their digital offerings and for applications that enhance internal efficiencies.
- Application developers, both for enterprise customer-facing applications and for enterprises' digital transformation purposes, can consider access to differentiated connectivity as a vital complement to differentiated cloud services.
- Regulators benefit from understanding the full potential of network slicing, in order to secure the innovation potential of network slicing applicable to multiple go-to-market models.
- Business model innovators can play a key role in refining network slicing models to ensure that network capabilities and value propositions are well-aligned.

After having pioneered the deployment of 5G and, subsequently, building on its foundation of a nationwide 5G SA network, T-Mobile is accelerating its ambitions of bringing differentiated connectivity to market with tools like network slicing. Network slicing represents an important stage beyond best effort connectivity on the road to capabilities that can be enhanced through network APIs.

# Differentiated connectivity is key for monetizing 5G

Leading service providers are utilizing their 5G standalone (SA) networks to provide differentiated connectivity services, allowing them to grow their revenue through premium network performance.

With applications demanding connections with characteristics such as predictable latency and throughput, service providers should ensure their networks are ready to meet these requirements. 5G SA is essential to achieve this, combined with technologies such as network slicing which allows applications to separate traffic streams with different requirements and map them toward correct performance in the network.

**Network preparation and dimensioning**
Service providers need to configure and dimension their networks based on the required performance. This involves understanding where the business potential for high-performance services is, and ensuring that network resources in those locations can meet demand.

One key metric in network dimensioning is the available bandwidth (MHz) per device.[1] This indicates the network's capacity to offer more differentiated connectivity services. Increasing MHz per device allows the network to host new apps that create additional value through predictable connectivity.

Service providers also need a set of available tools to configure their networks, such as traffic steering, resource partitioning, priority scheduling and rate adaptations. It is noteworthy that there is no single solution for achieving differentiated connectivity. Service providers can decide on the optimal configuration for their networks, as long as the statistical KPIs of the desired performance can be delivered.

**Performance classes and cost**
Wireless data transmission can be categorized into four distinct performance classes based on if the size of the data can be adjusted (fixed or adaptive) and how quickly data needs to arrive (immediately processed or buffered before use).

Significantly, there is a different level of cost associated with delivering data across these classes. Figure 19 shows the conceptual network capacity required to deliver streams of traffic via different performance classes. Generally, when it comes to supporting connections with higher requirements on latency, the effective load on the network to deliver the connection needs to be lower. This means that to support traffic in more demanding performance classes, the effective network capacity needs to be higher.

This increase in capacity has direct cost implications. More network resources must be allocated to maintain the characteristics required for premium connectivity services. Thus, service providers should factor in these increased costs when planning and managing their networks to offer differentiated connectivity services.

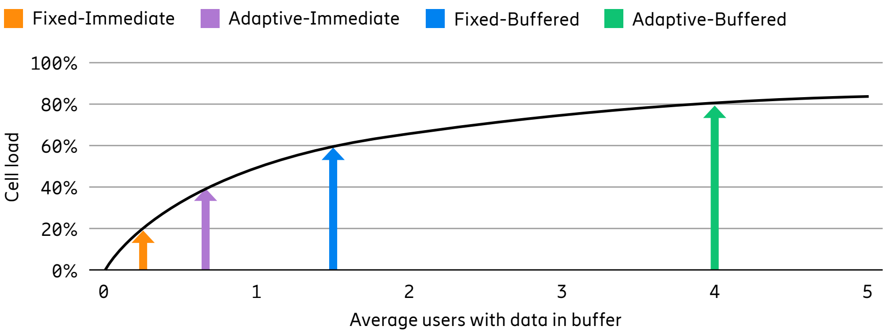
**From a vicious to a virtuous circle**
Currently, there is a vicious circle of lowering data prices and increasing data buckets (to virtually unlimited), because there is close to zero incremental network cost for service providers to support more users and data with best-effort connectivity.

The introduction of differentiated connectivity creates an opportunity to support and monetize the diverse needs of mobile users. This will foster increased possibilities for service providers to differentiate by further investments in networks for enhanced performance, coverage and availability tailored to users' needs.

To create a virtuous circle, service providers would need to adopt consumption-based models that reflect the cost of delivering data with specific performance. For instance, customers who need consistent low-latency, high-reliability connections, such as real-time video streaming or industrial automation, would pay a premium. This shift from unlimited best-effort data plans allows service providers to charge based on the value delivered, pricing higher-performance services according to network resources consumed.

By aligning pricing with performance, service providers can better manage network costs while still delivering tailored services. This model not only supports service providers in recovering investments in network upgrades and expansions, but also ensures that customers receive appropriate value based on performance.

**Figure 19: Dimensioning the network for different performance classes**




Note: Conceptual network capacity.

[1] This is defined as total deployed spectrum divided by total number of devices in the network.

# Premium FWA services enabled in Finland with 5G SA

Being a pioneer in 5G non-standalone (NSA), Elisa launched 5G standalone (SA) powered services in 2024. Customer satisfaction and network performance results are promising – 5G SA, with network slicing, has the potential to meet even the most demanding customer needs.

## Key insights

- 5G SA network slicing allows customers to enjoy guaranteed bandwidth and latency with Elisa's premium Own Lane 5G Fixed Wireless Access (FWA) service.
- With the Own Lane 5G FWA service, customers have perceived added value from a more reliable broadband connection with minimum guaranteed performance, especially during the peak evening hours.
- The 5G SA-based Own Lane FWA service has shown better performance compared to regular FWA (without dedicated slices and partitions), leading to increased customer satisfaction.

Elisa's 5G network covers more than 95 percent of the Finnish population, and as of October 2024, it extends to every municipality in the country. In June 2018, Elisa became one of the first service providers in the world to deploy a pre-commercial 5G network.

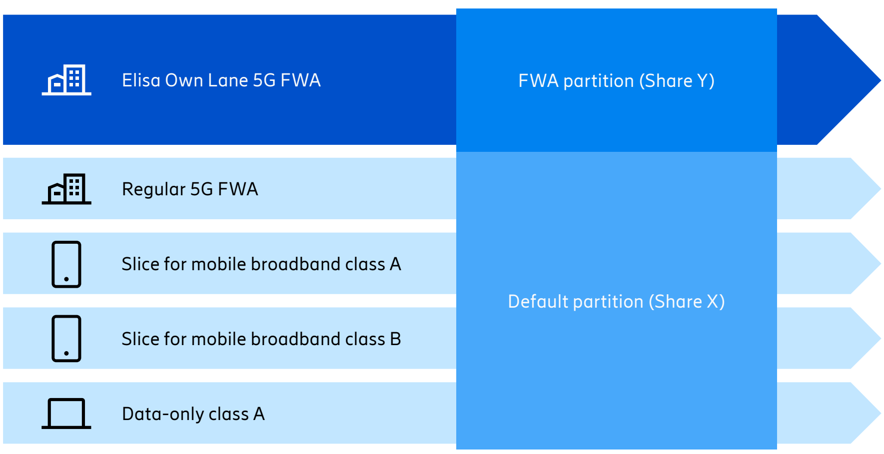
**Introducing 5G SA services, with network slicing as a key feature**
Elisa's 5G SA journey started in August 2020, when it was first in the Nordics to trial 5G SA connectivity services for voice and data. In June 2021, Elisa officially opened its 5G SA network in Finland. After deploying 5G SA technology in the network, it took a few years before 5G SA services and 5G SA-capable devices entered the Finnish market.

Meanwhile, one of the key questions asked within Elisa was: "How do we create added value for customers with the features enabled by 5G SA?" The question was researched across the company, with close collaboration between the technology and business teams. Discussions led to the same answer: The quality and reliability of the connectivity. The clear conclusion was to deploy a network slicing solution.

This article was written in cooperation with Elisa, a market-leading service provider that offers sustainable digital solutions for over 2.8 million consumer, corporate and public administration customers in its core markets of Finland and Estonia.

After an initial pilot in 2021, the first customer trials at scale were conducted during 2023. One of the earliest trialed services was FWA, powered by 5G SA. This service was designed to respond to customers' needs in home environments for heavy and demanding broadband use cases that require reliable connectivity such as remote working and online gaming. FWA based on network slicing met the needs and expectations of the most demanding customers regarding the need for high capacity, reliability and simultaneous usage of several services within a household, with a perceived network performance on par with a fixed network connection.

**Figure 20: Elisa's Own Lane 5G FWA (illustrative)**




**Own Lane FWA implementation**
Elisa's premium FWA service is called Omakaista (Own Lane). It is enabled by a 5G SA network that provides the toolbox of capabilities needed to provide a premium FWA service. The performance level of Own Lane 5G FWA is achieved with a specific network slice for FWA, together with radio resource partitioning and relative priority scheduling functionality.

**Qualitative customer feedback includes:**

"Quality and speed of the connection has been excellent so far."

"5G standalone connection is as fast and stable as promised! Also liked the quality of devices."

"The 5G Own Lane FWA service brought a new level of stability for our family's network usage."

"Playing online games is smooth." (The games don't crash as much as before.)

**Own Lane FWA based on a 5G SA slice**

Since the commercial launch of the 5G SA-based Own Lane FWA service in 2024, Elisa customers have greeted the new services with enthusiasm. The initial customer feedback has proven that they perceive the added value, especially during the peak hours. Typically, the busiest hours of network usage tend to take place in the late afternoon and early evening, when some household members are still working while others might be watching streaming services or playing online games. This can create local congestion in mobile networks and a bottleneck effect in the network. When customers started using the Own Lane 5G FWA service, with the ability to guarantee a certain bandwidth and connection speed, these problems were quickly resolved, resulting in better user experience and happier customers. Elisa's Own Lane 5G FWA service offers a maximum downlink speed of 1,000 Mbps with a guarantee of minimum 100 Mbps, as well as a promise of a typical speed of 500 Mbps.
The service is enabled by an outdoor receiver installed by a technician.

When examining the network performance of 5G SA and NSA services, it can be observed that Own Lane 5G FWA performs better and succeeds in maintaining higher speeds throughout the day. This aligns with customer feedback and highlights the potential of 5G SA-powered services.

Figure 21 demonstrates the development of network performance in one area in the Finnish capital region. While there are some fluctuations in performance for both Own Lane 5G FWA services and regular 5G FWA, the Own Lane services continue to deliver a better user experience, even during peak evening hours.

It is evident that demand for reliable and stable broadband connections continues to grow, and it can be expected that the customer 5G SA adoption rate will improve steadily in the near future.

**Deploying 5G SA is a natural part of 5G development**

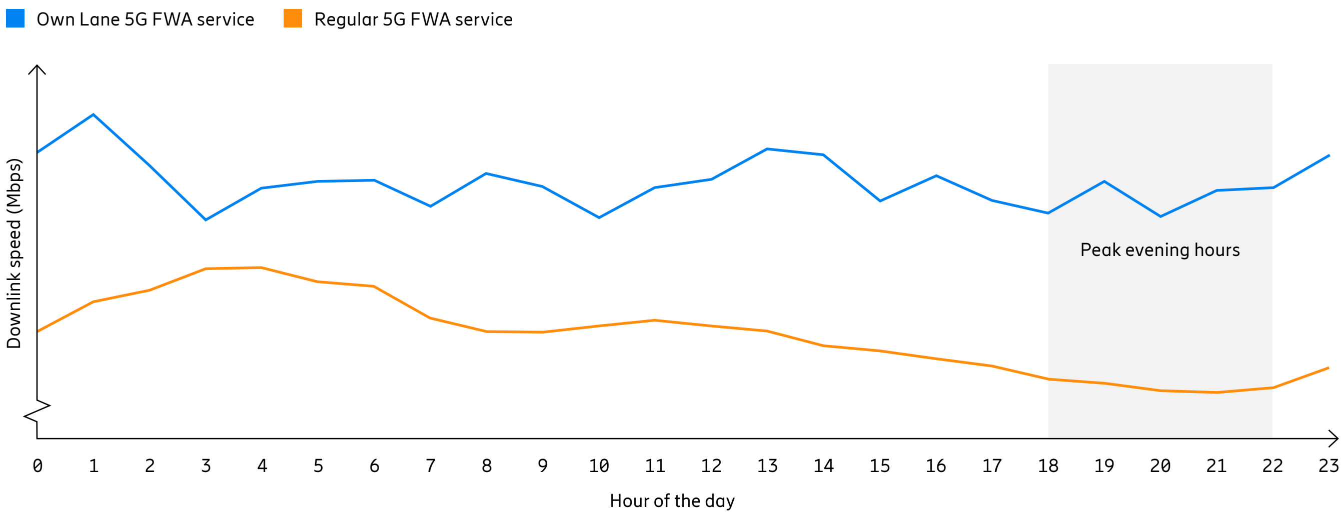
As 5G SA is an evolutionary step toward the full 5G experience, it is essential for service providers to guide their customers to 5G SA as early as possible.

In Finland, 5G NSA penetration is quite high due to early adoption of the technology, and many customers have 5G NSA-capable devices.
Although many of those devices can be upgraded with software updates, the transition will take a few years. The more that customers migrate to 5G SA-capable devices, the easier it will be to manage customer experience in a less complex landscape than today's mobile networks.
From a service evolution perspective, Elisa expects that making 5G SA network capabilities available will boost service development in the 5G SA ecosystem.
This is a traditional dilemma about which should come first: New services in order to tempt customers, or customers to draw the interest of application developers. Elisa has chosen to start with simple services, attracting customers who can then begin learning the benefits of 5G SA. While customers are using the services, the user experience can be fine-tuned, and service innovation often grows as users come up with new ideas.

For an enhanced customer experience, Elisa has deployed both mid-band and low-band spectrum for 5G SA. This has enabled early launch of services, as it was not necessary to wait until mid-band coverage reached rural areas.

Going forward, Elisa has extended its 5G SA network services beyond consumer offerings to enhance mobile working capabilities for companies and organizations with an Own Lane 5G FWA service for businesses. In the future, larger companies will get their own version of slicing as 5G SA mobile connections can be used as part of LAN or WAN solutions.

**Figure 21: Stable downlink speed in Own Lane 5G FWA service compared to regular 5G FWA service**



# Empowering enterprises with 5G

Secure, flexible and reliable connectivity is the foundation for enhancing operational efficiency in enterprises. 5G unlocks enterprise agility, enabling a more dynamic response to shifting market conditions.

Enterprises anticipate that digital transformation will yield concrete and measurable outcomes, particularly when it comes to operational efficiency. However, the business environments where these improvements must be realized are often challenging. Commonly cited obstacles include rising customer demands, supply chain constraints, insufficient operational insights and risks associated with competency, safety and security. In such scenarios, the selection of digitalization initiatives profoundly impacts the way enterprises operate, deliver value and foster new business opportunities.

An IDC survey (see Figure 22) of enterprise digital decision makers showed that improving operational efficiency was the top business outcome they expected to result from investments in connectivity technology as part of their digital transformation strategies. It was noted by 77 percent of the surveyed enterprises (that had invested in connectivity to drive operational efficiency) that key metrics improved by 11–50 percent.

This suggests that enterprise connectivity solutions, increasingly powered by 5G and coupled with AI automation and innovative applications, have the potential to contribute significantly to achieving increased operational efficiency.

Efficiency is enhanced through a wide range of successfully executed initiatives, which involve selecting and implementing the connectivity solutions that best meet specific needs. In this context, 5G – with its inherent capabilities providing low latency, high reliability and robust security – is effectively an enabler of enterprises' transformations to becoming more agile, intelligent and innovative.

Foundational technologies that utilize the benefits of 5G include wireless wide-area networks (WWAN), zero-trust security and software-defined wide-area networks (SD-WAN), private cellular networks and neutral-host networks. WWAN enables connectivity at the edge of public and private networks, connecting people, places and things via routers, adapters and gateways.

A zero-trust security model protects access to the enterprise network from the internet, cloud services and private applications with SD-WAN optimized performance. Private cellular networks provide indoor and outdoor coverage supporting the most business-critical applications, offering new levels of control, reliability and integration into existing local-area networks (LAN). Neutral-host networks extend public 5G coverage in public-facing enterprise environments.

**Agile and intelligent operations advance businesses**

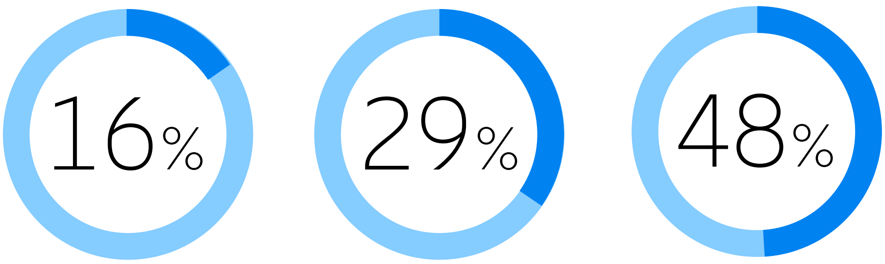
Enterprises strive to boost productivity, drive efficiency, gain situational awareness and improve safety across their operations. Increasing operational efficiencies is at the heart of what can be viewed as an "internal domain" of digital transformation within enterprises. This is coupled with an "external domain" that centers around business growth, differentiation and premium customer experiences.

The key elements of digital transformation are mobility, AI, cloud and enterprise security. However, deploying these technologies at scale is impossible without a robust network. This is where 5G becomes essential.

5G networks offer the predictable latency, reliability and security necessary to deploy these technologies at scale. These networks increase operational efficiencies and enable enterprises to bring new products and services to market faster. For example, AI-powered automation can streamline supply chain processes, while 5G-enabled IoT devices can provide real-time operational insights.

With the right connectivity solutions, enterprises can become more intelligent and reactive to changing market conditions.

**Figure 22: Results from Future Enterprise Connectivity Survey**




**16 percent of enterprises that invested in connectivity to drive operational efficiency saw a 6–10 percent improvement in related metrics.**

**29 percent saw an 11–20 percent improvement in related metrics.**

**48 percent saw a 21–50 percent improvement in related metrics.**

Source: IDC, 2024 Future Enterprise Connectivity Survey: Positive Market Sentiments Drive Increased Investment in Network, Mobile and Cloud Connectivity, doc #US52671524 (October 2024).

**5G-powered manufacturing**
It is increasingly important for manufacturers to access seamless, reliable wireless connectivity to reduce labor costs, boost productivity and track assets continuously, all while meeting sustainability goals. Traditional wired and Wi-Fi networks, however, are no longer sufficient to meet the growing need for speed, mobility, flexibility and security. As a result, manufacturers are turning to private 5G cellular networks.

Private 5G networks provide a host of advantages over traditional wireless networks, especially in challenging industrial environments, offering tangible benefits such as:

- **Faster decision making and productivity:** The ability to collect and process data more quickly enables manufacturers to make better decisions and optimize their operations in real time. Experiences from commercially deployed private 5G networks show that asset condition monitoring can lead to savings of up to 36 percent in maintenance and 51 percent reduction in downtime.
- **Improved communication for real-time applications:** Private 5G networks support applications like robotics and autonomous vehicles that require immediate feedback and action. Autonomous mobile robots (AMRs) can reduce labor costs by up to 46 percent and the 5G networks can increase AMR uptime by up to 49 percent.
- **Enhanced worker safety and communication:** Reliable connectivity improves safety protocols and ensures that critical communications can be transmitted without delay.
- **Security:** The use of dedicated spectrum and end-to-end encryption offers greater security than with Wi-Fi networks, making it easier to integrate with existing security infrastructures.

**Real-world applications in manufacturing**
Manufacturers worldwide are already reaping the benefits of 5G. For instance, a large global forklift manufacturer has transformed its production operations with private 5G and neutral-host solutions, improving efficiency and flexibility on the factory floor where Wi-Fi was suboptimal. At first, private 5G was used to connect scanners on the shop floor. However, over time this helped the company to prioritize the development of their overall digital transformation strategy, with 5G as the foundation for connectivity. Similarly, a large engine manufacturer in the US deployed a neutral-host and private 5G network to support advanced industrial operations across multiple facilities, with use cases ranging from automated guided vehicles (AGVs) to IoT and connecting workers. These examples highlight how 5G enables manufacturers to achieve greater agility and intelligence in their operations.

**Retail business growth with 5G**
Retailers are equally impacted by the need for seamless connectivity. From small stores to e-commerce hubs, the sector depends on connected devices, cloud applications and secure networks to manage customer interactions and business operations. Agile, reliable and secure network connectivity is no longer optional; it is a critical driver of success.

Traditionally, stores relied on wires for primary connectivity, but cellular-based solutions such as WWAN have proven to be more flexible, secure and reliable. These cellular solutions allow retailers to create robust primary, hybrid, or backup connectivity for fixed and temporary locations. In many cases, cellular is comparable to wired connectivity for speed and quality, making it an attractive option for retailers looking to enhance the customer experience.

**Real-world applications in retail**
Poor and unreliable connectivity can lead to loss of business. 5G ensures a robust network capable of managing high-traffic periods, supporting retailers' seamless business continuity. It provides swift data access and enables real-time, efficient operations. A US-based fast-food restaurant franchise has deployed 5G-based connectivity to streamline business operations, creating a more responsive and flexible customer experience. Using 5G, they were able to place stores in locations that their competitors weren't able to because of their reliance on fiber.

For big-box retailers, neutral-host networks bring another advantage: Seamless indoor coverage from all major carriers. This improves customer and worker experience while ensuring critical services, such as emergency communications, are always available. Many retailers are also expanding their services outside of traditional storefronts, with offerings like curbside pickup, where reliable connectivity is essential. Private cellular networks step in where Wi-Fi coverage may falter, ensuring that business-critical applications and devices can continue to operate smoothly.

Cases like these highlight how 5G can drive operational efficiency while enhancing business growth in the retail sector.

5G is the key to driving digital transformation in today's fast-paced business environment. Private networks, WWAN, and neutral-host solutions provide the flexibility and security necessary to meet modern challenges head on. By embracing 5G, enterprises can unlock new opportunities for innovation, growth, efficiency and agility, ensuring they stay competitive in an increasingly connected world.

**Figure 23: Economic value enabled by enterprise WAN solutions**

**Validated benefits of implementing an enterprise wireless WAN solution**

| | |
|---|---|
| 120 | WAN connectivity received an average of 120 days sooner than with wired |
| 2% | Revenue increased by 2 percent by enabling new locations |
| 46% | WAN admin tasks reduced by 46 percent |
| 60% | WAN downtime events reduced by 60 percent |

**Improved business agility:** Allows companies to enable locations faster and in scenarios that may be unserved by wired bandwidth

**Improved financials:** Benefits both sides of the financial equation, lowering costs while enabling new revenue

**Better business continuity:** Enterprises can improve their recoverability plans, both in routine events and disaster occurrences

Source: Enterprise Strategy Group Economic Validation Report, "Analyzing the Economic Benefits of Enterprise Cellular Solutions in Branch Locations" (September 2024).

# A multi-NR carrier strategy for best performance

stc Group is placing a strong emphasis on expanding its 5G mobile network coverage and capacity, bolstered by various enhancement techniques such as multi-New Radio (NR) carrier aggregation.

## Key insights

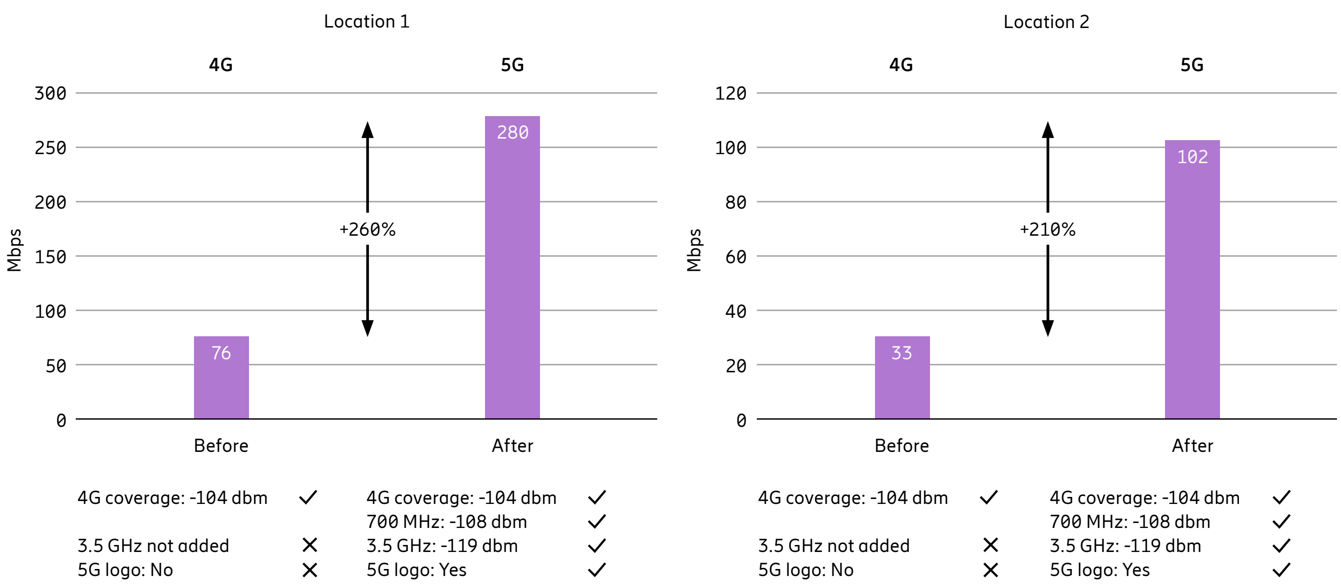
- A cornerstone of stc's strategy is to deliver superior network experiences to customers by maintaining national leadership in 5G coverage and speed.
- Adding frequency division duplex (FDD) and time division duplex (TDD) bands with a multi-carrier mobility strategy resulted in a 245 percent 5G traffic volume growth in one year in stc's network.
- Going forward, stc aims to deploy 5G standalone (SA) and transition it into a high performing and programmable network powered by 5G Advanced.

This article was written in collaboration with stc, a market-leading digital enabler in the KSA, providing innovative digital services and platforms to customers in the Middle East and North Africa region.

The Saudi Vision 2030 initiative, introduced in 2016, encompasses several digital programs. Among these are collaborations between service providers and the Government to build a solid telecommunications infrastructure as part of the National Transformation Program. Enhancing both the fixed and mobile network infrastructure is a priority, to attain median speeds in the Kingdom of Saudi Arabia (KSA) that will place it among the top 10 fastest countries in the world. To support this objective, stc is prioritizing expanding its 5G mobile network coverage and capacity, bolstered by various enhancement techniques such as multi-NR carrier aggregation.

**Leveraging carrier aggregation for improved 5G coverage and performance**
Selecting a well-defined business strategy that considers assets, market conditions, the competitive landscape and desired positioning is crucial for success in any business. A cornerstone of stc's strategy is to deliver superior network experiences to customers by maintaining national leadership in 5G coverage and speed. Aligned with the aims of the ambitious Saudi Vision 2030, stc is expanding 5G coverage and proactively increasing capacity to maintain performance leadership and accommodate the continuous traffic growth driven by enhanced mobile broadband (eMBB) and Fixed Wireless Access (FWA).

Figure 24: Coverage and downlink median speed improvements with 5G carrier aggregation



To provide a good 5G user experience, stc's strategy includes leveraging carrier aggregation as a cornerstone for improved 5G coverage and performance. This involves the addition of second, third and fourth[1] NR carriers throughout the network.

This strategy was initiated in 2020, as stc evaluated the impact of FDD/TDD carrier aggregation and its ability to expand 5G coverage and increase network capacity, while supporting higher peak rates. Improvements in coverage and median downlink speed due to 5G carrier aggregation are illustrated in Figure 24, which shows test measurements from two areas in Riyadh before and after the low-band (700 MHz) deployment and addition of carrier aggregation in Q4 2023. These areas had no 5G coverage before low-band was deployed and aggregated with mid-band (3,500 MHz). The deployment resulted in significantly improved median downlink speeds in both areas. Currently, the peak rate throughput is over 2 Gbps for an evolved non-standalone (NSA) dual connectivity (EN-DC)[2] user. The monthly 90 percentile of NR throughput measured is 750 Mbps in live network across the KSA and over 800 Mbps in the capital, Riyadh.

### The need for additional mid-band spectrum to meet service demand

Additional TDD spectrum was recognized by stc as being essential for further increasing the capacity of the mobile network in order to meet the rising demands of digital services, while enhancing the network experience and global speed ranking.

Testing commenced with an additional TDD-mid band carrier to enable third and fourth carrier aggregation as needed. Spectrum testing at 2,300 MHz was initiated, to evaluate the coverage gain on top of the 3,500 MHz (C-band) and throughput gains in TDD-TDD carrier aggregation. This was implemented across stc's network in 2022–2023.

### stc's RAN mobility strategy

The use of spectrum components, including 700 MHz (FDD), 3,500 MHz (TDD) and 2,300 MHz (TDD), were defined and a target of median 5G speed of 300 Mbps in deployed areas was set. The next step involved devising a Radio Access Network (RAN) mobility strategy to maximize the investment and optimize performance in both mobile and stationary (that is, FWA) modes. A clear strategy was essential to address these various challenges:

- stc has a high-performing 4G network, and did not want to utilize only the 700 MHz carrier (single layer) for 5G access, as the user experience might be perceived as worse than when connected to the 4G network (85 MHz FDD available).
- The 2,300 MHz device ecosystem is expanding but is not as extensive as the 700 MHz and 3,500 MHz ecosystems.
- Multiple devices in the network didn't support FDD/TDD carrier aggregation, which ensures they are served by TDD layers only.

Numerous scenarios were evaluated both theoretically and in practical field tests to determine the most effective strategy for achieving the objectives.

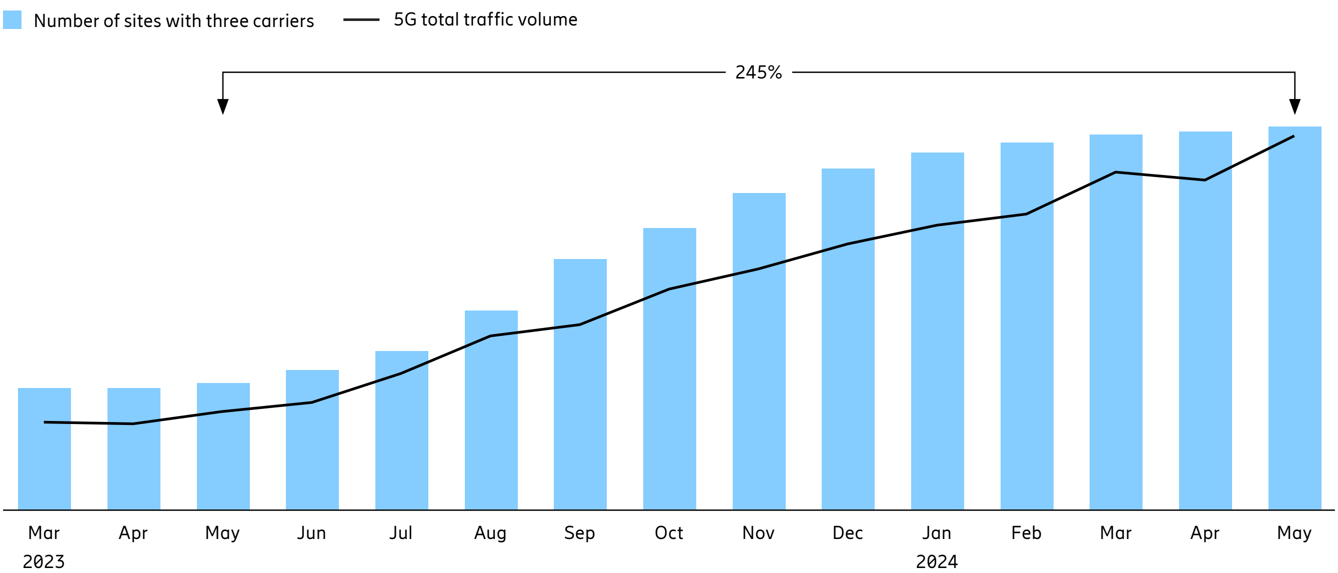
First was priority-based assignment, with 3,500 MHz having the highest priority, followed by 2,300 MHz and then 700 MHz. One major issue with priority-based assignment, despite having carrier aggregation available under all scenarios, was that utilization levels on 2,300 MHz were low due to low device penetration on that band. In addition, stc did not want users to be served only by low-band (700 MHz), but always served by low-band and mid-band carrier components aggregated for all service scenarios. Therefore, priority-based assignment alone was not optimal, prompting the need for a more effective approach. After conducting iterative field testing, the mobility strategy was finalized, incorporating advanced RAN and core network features such as capability-aware idle mode control, user and service-specific mobility and EN-DC-triggered handover during connected mode mobility.

### Separating FWA and mobile broadband layers

The mobility strategy involves separating FWA and mobile broadband layers, directing services toward specific layers to improve mobile experience and FWA coverage.

**FWA:** Within 5G mid-band coverage (2,300 MHz and 3,500 MHz) an FWA user will be served by 2,300 MHz as primary secondary cell (PSCell), as the coverage of 2,300 MHz is better indoors. When the router is outside of such coverage it will be served by low-band (700 MHz) as PSCell. The threshold is set for 700 MHz coverage to ensure 3,500 MHz as secondary cell (SCell) and avoid 700 MHz being the only NR layer.

**Figure 25: Multi-carrier aggregation strategy drives traffic growth**




[1] Fourth carrier dependent on coming Saudi Communications Authority (CST) auction results.
[2] EN-DC is a 5G feature that allows for simultaneous 4G LTE and 5G NR connectivity in a 5G NSA network. This enables 5G devices to connect to both 4G and 5G at the same time, improving coverage, speed and reliability.

**eMBB:** Within 5G mid-band coverage (2,300 MHz and 3,500 MHz) an eMBB user will be served by 3,500 MHz as PSCell. When the device is outside of such coverage it will be served by low-band (700 MHz) as PSCell. The threshold is set for 700 MHz coverage to ensure 3,500 MHz as SCell and avoid 700 MHz being the only NR layer.

In summary, stc only uses the NR 700 MHz layer as a coverage extension for 5G NR carrier aggregation with NR 2,300/3,500 MHz, and not full NR 700 MHz coverage, reducing the actual NR 700 MHz layer coverage to achieve that objective. This is to ensure that when the "5G icon" is visible on device screens, the subscriber has a better EN-DC performance than with LTE-only performance.

The new configuration of adding FDD and TDD bands with a multi-carrier mobility strategy has resulted in a 245 percent 5G traffic volume growth in one year in stc's network. This is about three times more traffic than would have been expected without three carrier deployments. This growth has mainly been driven by extended FWA coverage due to deployed 700 MHz and 2,300 MHz.

Alongside continued coverage extension of the terrestrial mobile network, stc is building an air-to-ground (A2G) network covering the main national air routes, providing airlines with reliable high-performance connectivity.

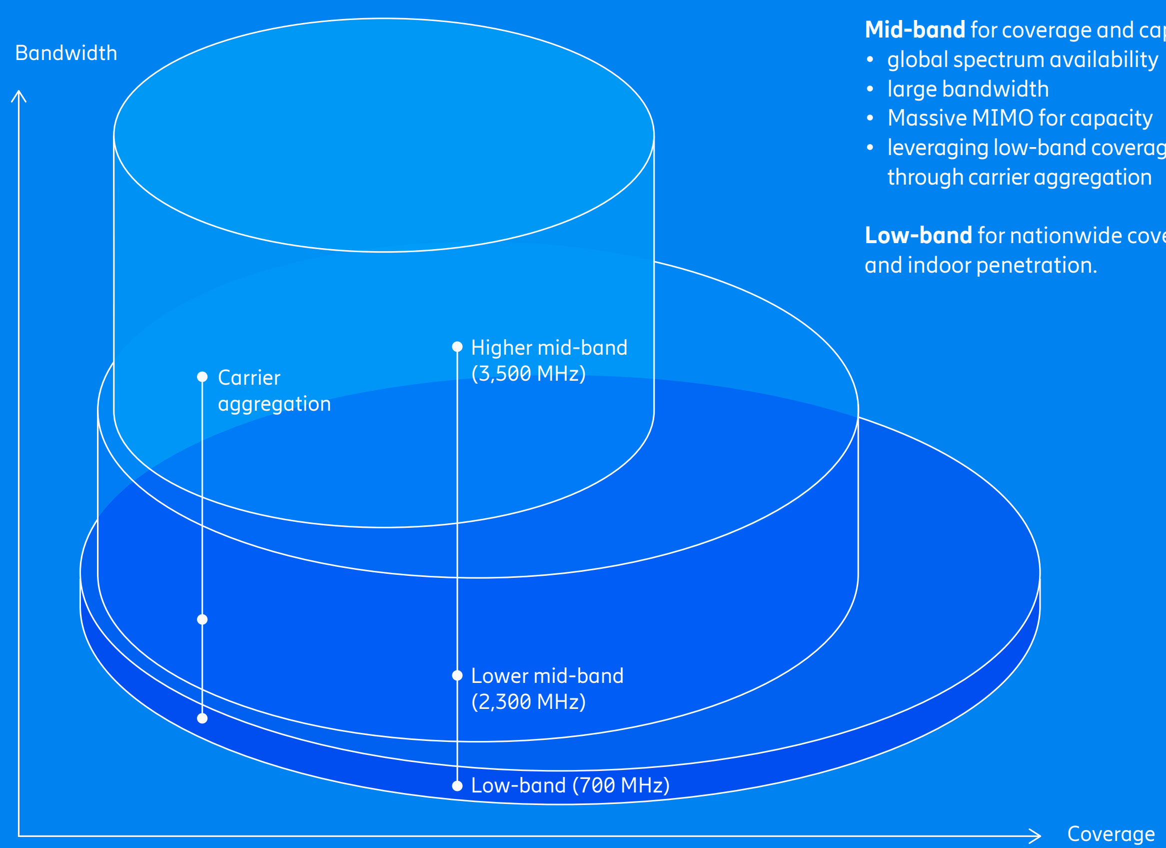
It has also acquired spectrum license (2,100 MHz) for non-terrestrial networks (NTN) to provide nationwide mobile communications via mobile satellite services (MSS).

The Communications and Information Technology Commission (CITC) in the KSA has updated the IMT regulatory document in furtherance of its national spectrum strategy, which aims to further unlock the potential of radio spectrum in the KSA by 2025. With additional spectrum expected in low/mid-band, an evolved mobility strategy will continue to play a fundamental role in getting the maximum performance out of precious spectrum assets.

## Multi-band NR carrier aggregation for best performance

stc is the largest digital enabler in the KSA, with around 27 million mobile subscriptions and 1.6 million 4G and 5G FWA subscriptions, representing a 55 percent market share. stc launched 5G commercial services in June 2019 and now has over 7.5 million 5G subscribers. Since commercial launch, 5G population coverage has reached 50 percent, with a target to have 5G coverage in all cities with a population of over 5,000, with a median speed of 100 Mbps, by 2029. The set countrywide median speed target is 300 Mbps by 2030. Going forward, stc aims to deploy 5G SA and transition it into a high-performing and programmable network powered by 5G Advanced. This will enable new service offerings based on SA network capabilities such as network slicing and differentiated connectivity.

**Figure 26: A coordinated multi-layer network for best performance**




**Mid-band** for coverage and capacity:
- global spectrum availability
- large bandwidth
- Massive MIMO for capacity
- leveraging low-band coverage through carrier aggregation

**Low-band** for nationwide coverage and indoor penetration.

# 5G RedCap – advancing IoT beyond 4G

A wide range of new IoT use case possibilities will emerge with 5G standalone (SA) networks and 5G reduced capability (RedCap) technology.

Cellular IoT connections are forecast to have a CAGR of around 11 percent through to 2030, surpassing 7 billion by that time. The number of Broadband and Critical IoT (4G/5G) connections is forecast to double, reaching 4.3 billion by 2030. This rise is fueled by growing demand for new use cases and the need to shift away from legacy technologies, and is expected to be further uplifted by the introduction of 5G RedCap devices. Globally, 2G and 3G networks continue to be shut down to refarm spectrum for use with 4G and 5G. By the end of 2023, 33 service providers had completed 3G switch-offs[1] and 24 had completed 2G switch-offs. In many markets, the phase-out of 3G networks is expected to be more rapid than for 2G in the upcoming years, as sunsetting 3G enables the reuse of spectrum to strengthen 4G and 5G user experiences. 2G networks, with their minimal use of spectrum, will continue to be utilized for voice and legacy IoT services for a longer duration.

### Unleashing the full potential of IoT with 5G RedCap

5G RedCap will cater to a wide range of use cases in industrial, enterprise and consumer applications, including smart wearables, medical devices, XR glasses, health monitors, video surveillance cameras, wireless industrial sensors, utility/smart grid applications and Fixed Wireless Access (FWA). 5G RedCap technology will unlock new business opportunities by harnessing the advanced network functionalities offered by 5G SA networks. These include time-critical communication, enhanced positioning, high reliability, improved uplink throughput and network slicing. The increasing availability of 5G RedCap devices with 4G as the fallback technology is expected to stimulate the migration to 5G-based offerings.

5G RedCap technology is currently in its early stages. However, while commercial services have been launched in two markets, more than 10 leading service providers worldwide are currently performing tests and trials, with many more exploring the technology.

### An evolving RedCap device landscape

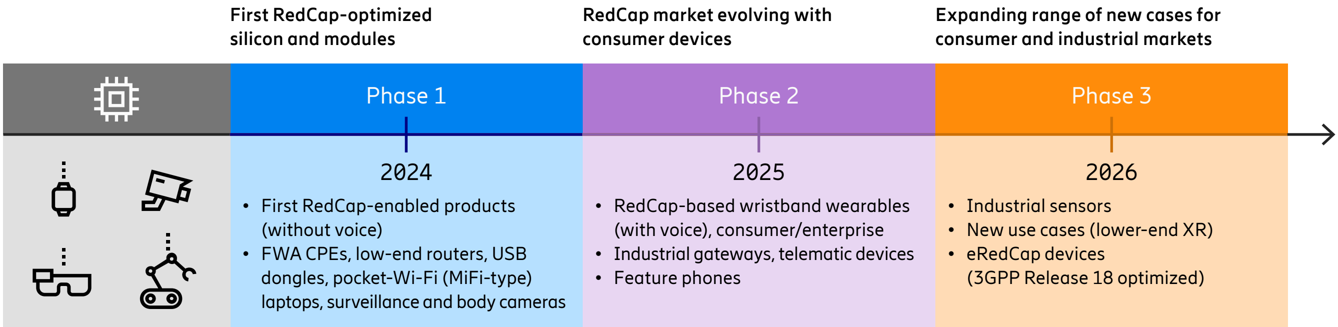
The RedCap device ecosystem is gaining momentum, with more module releases (both pre-commercial and commercial) that can be integrated into different devices.

The first RedCap products were released in 2024. Ongoing testing is currently underway for inspection and surveillance cameras, as well as low-cost routers and laptops equipped with RedCap technology. As we move into 2025, the RedCap market is set to expand into both the consumer and enterprise segments with the introduction of voice-enabled wearables, industrial gateways and telematic devices. Looking ahead to 2026, new devices are anticipated that cater to an expanding array of new use cases for consumer and industrial markets.

### Enhanced RedCap (eRedCap) broadens the addressable IoT market

eRedCap is being introduced with 3GPP's Release 18 and is designed for use cases that are currently being served by LTE Cat 1 and Cat 1 bis[2] technologies. eRedCap devices will feature a lower peak rate (10 Mbps versus 225 Mbps), and an optional reduced baseband bandwidth (5 MHz versus 20 MHz for data channel transmissions), enabling even lower power consumption and cost compared to RedCap. This could significantly expand the addressable market for 5G IoT devices, creating a substantial growth opportunity. eRedCap can be seen as a separate category, addressing use cases requiring reduced complexity and lower performance thresholds, while RedCap remains suited for mid-tier use cases.

**Figure 27: The evolving RedCap device landscape**




Note: The phases are based on Ericsson estimations.

[1] GSA, GAMBoD (September 2024).
[2] LTE Cat 1 bis is an evolved version of LTE Cat 1, providing the same capabilities with only a single antenna (instead of two), making them more compact and easier to design compared to LTE Cat 1 devices.

# Digital airspace: Enabling mission-critical communication in the skies

3GPP technologies like 5G enable vast opportunities in the skies, from saving lives to facilitating sustainable deliveries. To achieve this, an innovative approach is required that leverages existing infrastructure as well as purpose-built networks for the digital airspace.

## Key insights

- Advanced Air Mobility (AAM) is ushering in a tremendous transformation in aviation. Today, drones may be collecting data. Tomorrow, they will be moving goods and people.
- 3GPP technologies offer a wide range of benefits, for manned and unmanned aviation that are currently limited with existing communications technologies.
- Intelligence from telecom networks, via network APIs, can greatly enhance the operational safety of unmanned aerial vehicles, such as drones.

Mobile connectivity is ubiquitous, transforming the world around us. 3GPP network coverage now serves around 95 percent of the world's population. However, this coverage is essentially 2D, built to support users and services at ground level.

The digital airspace is about connectivity in the air, be that unmanned aerial vehicles (UAV) like drones and air taxis or helicopters and commercial airplanes. These are all operational at various altitudes ranging from ground level to over 3,000 m. For a safer, smarter and more sustainable digital airspace, high-performance 3D radio networks with predictable coverage and capabilities offer the best solution for enabling use cases in both manned and unmanned aviation.

### The need for transformative airspace connectivity

There are three prevalent conventional communications technologies in the aviation industry today, some of which have been in use for more than 50 years. These include very high frequency (VHF) radio for voice, automatic dependent surveillance broadcast (ADS-B) for positioning and satellite communication to bring basic data connectivity. Satellite comes at a very high cost in bandwidth and latency as well as service costs, although these dimensions have improved recently with the introduction of low Earth orbit (LEO) satellites.

To meet the requirement for predictable and reliable data communication, the industry has explored in recent years how 3GPP technology can bring these capabilities to the digital airspace. For example, secure connectivity and low latency mean it has the potential to unlock new possibilities for mission-critical communications, drone operations and management such as beyond visual line of sight (BVLOS) flights.

Large-scale drone utilization requires BVLOS. There are presently no air traffic management (ATM) communications where low-altitude drones operate, as ATM has a mandate to monitor controlled airspace and low altitude is mostly uncontrolled. However, drone operations are increasing, and are expected to be greater than manned aviation today, making airspace management essential. UAV traffic management (UTM) systems will need to be highly automated and built to handle large volumes of drone operations safely and provide a suite of services to drone operators, as well as to interwork with ATM systems.

Figure 28: Digital airspace segments

Low altitude (from ground to 300 m) communication used for use cases like drone inspection, in rail and utilities, transport and delivery.

Medium altitude (from 300 to 3,000 m) used for mission-critical operations like public safety operations and air taxi services.

High altitude (above 3,000 m) communication for commercial aircraft and defense. Reduced cost, higher capacity and availability enabled by 5G air-ground-air (AGA) networks and NTN.

Mobile networks are perfectly positioned to enable UTM systems toward large-scale BVLOS drone utilization –as well as many additional services, for example using SIM density data to plan routes that avoid highly populated areas.

Airspace is a scarce resource around airports and busy flight paths today, however the number of congested areas will grow as UAV operations increase. With sufficiently reliable data, automation and technical performance, airspace can be more efficiently utilized through shortening the intervals between passing aircraft, therefore increasing airspace capacity – for example, a two-minute interval compared with a three-minute interval increases capacity by one-third. 3GPP connectivity is a key enabler for the low-altitude unmanned segment as well as for mid-altitude air taxis and electric vertical take-off and landing (eVTOL), supporting the entire AAM field. 3GPP technologies shall not only provide secure and resilient connectivity to eVTOLs but also provide capabilities like precision landing at emerging vertiports where these eVTOLs will land.

**Opening up the digital airspace for mission-critical use cases**

From a communications perspective, the digital airspace can be split into three altitude levels that are each enabled and served in different ways. At a low altitude, below 300 m, applications will be for multiple drone use cases; the medium altitude, between 300–3,000 m, is predominantly for general aviation, defense and future applications for eVTOL and AAM; and high altitude, above 3,000 m, is predominantly for defense and commercial airlines.

At low altitudes, below 300 m, industries are increasingly considering drones for a wide range of mission-critical operations and enterprise applications such as:

- **Rail:** Drones can conduct rail-line surveys, monitor project progress and inspect rail infrastructure, helping identify issues early on and reduce costly manual inspections.
- **Utilities:** Drones can inspect power lines, wind turbines and solar panels, as well as monitor oil and gas pipelines instead of costly helicopters, helping identify and fix problems more quickly with lower costs and reduced risk of accidents.
- **Logistics:** Automated delivery of packages and goods using drones can make delivery quicker, more efficient and more sustainable, contributing to CO2 reductions and increasing societal inclusions.
- **Health care:** Drones can help save lives in time-critical situations, such as by quickly delivering defibrillators or transporting blood to hospitals, labs or into the field.
- **Public safety:** First responders like police and firefighting personnel can use drones for better situational awareness and real-time decision making.
- **Agriculture:** Drones equipped with sensors and cameras can monitor crop health, helping farmers optimize their use of pesticides, fertilizers and water to increase crop yields and contribute to wildlife protection or control.

## Learnings from Teracom's 3GPP commercial AGA network

The Swedish mobile operator, Teracom, delivers an aerial, nationwide 3GPP network to private and public national critical infrastructure enterprises.

Teracom's network design is based on an innovative design philosophy that utilizes existing high TV masts with varied heights of up to 300 m, and wide-area, high-capacity, 5G-ready 2.3 GHz spectrum, deployed across 160 sites nationwide.

The main deployment scenario is to enable maximum cell range for the air coverage, which has been verified successfully for data connectivity at a maximum range of 90 km in flying vehicles such as helicopters, airplanes and drones. Use cases tested ranged from blue-light missions and healthcare transport to various forms of situational awareness for critical communications, such as remote search and rescue using high-definition, real-time video and infrared heat cameras, as well as the continual monitoring of air quality, fire, smoke and weather developments based on live data feeds.

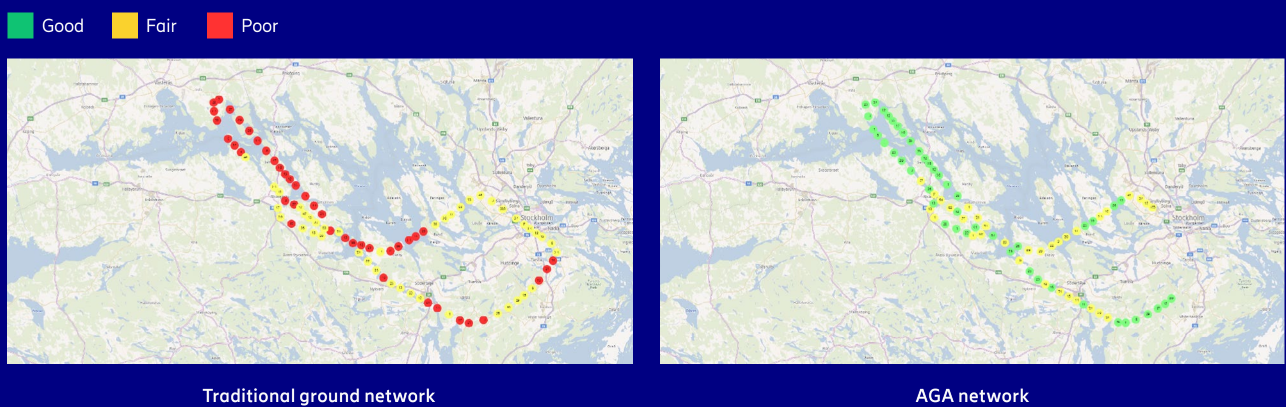
Actual flight tests have been conducted in the mid- to high-altitude segment, shown in Figure 29.

The benchmark ground network showed poor coverage, resulting from the fact that it was built for ground coverage and is therefore likely to experience poor cell edge-like performance at higher altitudes. However, the AGA network shows good coverage based on the Teracom network. A key difference that impacted performance was the number of handovers. These comprised 15 in 15 minutes, compared to just 3 handovers in the AGA network, indicating a more consistent set of performance characteristics.

The tests demonstrated that 3GPP technology, when dimensioned for the skies, can provide the required reliable and predictable connectivity in the mid- to high-altitude segment, putting them on a path toward future innovation and opening up a gateway for future UAV and AAM development.

TERACOM
SAMHÄLLSNÄT

**Figure 29: Flight tests comparing network performance**



In medium-altitude segments, where helicopters operate, digital connectivity brings new possibilities in mission-critical cases like air ambulances. At ground-level today, the emergence of connected ambulances is enabling real-time communication between patients, ambulance workers and remote medical experts – not only through voice, but through high-definition video and data sharing in emergency situations. By addressing this segment, the same level of connectivity and service can be brought to the most critical patients.

Advancements in electrification are revolutionizing design and enabling eVTOL aircraft to gain momentum. Analysis of industry trends suggests that piloted air taxis are likely to emerge in the next two to three years, with early trials having already begun.

The high-altitude segment is predominantly for commercial passenger aircraft and defense aviation. This segment can benefit from non-terrestrial networks (NTN), with 5G 3GPP technology integrated in satellites, which complement AGA 3GPP networks to drive a common solution and economies of scale through utilizing devices with the same chipsets. Transformation in this segment is evolving and new technologies are being adopted, while areas like in-flight entertainment and passenger connectivity will advance more quickly.

## Building a 3GPP network in thin air

How mission-critical mobile broadband solutions for the digital airspace are built will depend on the altitude above ground at which coverage is needed, as well as the industry use cases. It is important to consider horizontal and vertical aspects in relation to cell handovers and interference from neighboring cells. Use-case requirements on latency, data throughput and positioning accuracy must also be considered, as well as Doppler-effect compensation for air vehicles with relatively high speeds, such as commercial airlines. At low altitudes, communications service providers can generally leverage existing network infrastructure with some enhancements such as 5G massive multiple input, multiple output (M-MIMO) and beam forming to address interference. However, at altitudes above 300 m, interference issues and handover challenges become more of an issue, especially for high-speed use cases. This will require a dedicated 3GPP aerial network covering the skies.

The availability of radio-frequency spectrum resources is vital in enabling reliable communication with UAVs. Most drones today use unlicensed spectrum, which will not be sufficient going forward as new use cases emerge and the volume of drones increases. It is also important to note that the spectrum situation differs from country to country. Often, spectrum issues can be managed by utilizing communications service providers' existing spectrum, with their networks dimensioned to support UAVs.

## Emerging innovation within the low altitude segment

With the broad range of UAV use cases being explored within the AAM and eVTOL areas, the low- to mid-altitude segment is a hive of activity and innovation. 3GPP connectivity offers a wide range of benefits that are not possible with existing communications technologies, not least of which is enabling real-time data sharing and constant connectivity. This can be enhanced through network APIs that will enable dynamic control of quality of service, drone identification, drone location tracking, 3D-coverage maps and geographic SIM density, all of which will result in improved safety, efficiency and cost savings for the aviation industry. Positioning is a key area for ensuring UAV safety. 3D satellite positioning is subject to spoofing and blocking, so the network can play a key role here in validating the positions and, in case of issues, perform as a fallback solution. A ground-level-specific solution can provide positioning within 1 m accuracy, important for eVTOL aircraft take-off and landing zones. The macro network provides accuracy of around 10 m.

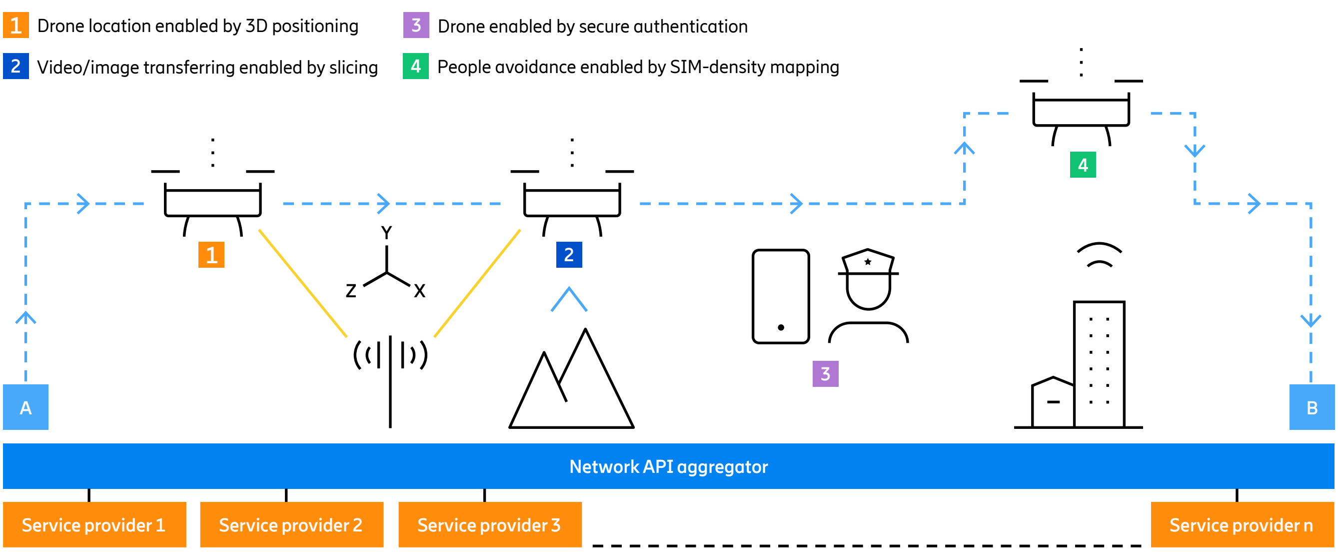
Standardized APIs aligned with CAMARA and GSMA Open gateway will create new opportunities for innovation and collaboration between the aviation and mobile network industries, as illustrated in Figure 30. This will lead to the development of new products and services that can further enhance the digital airspace ecosystem.

## Future of digital airspace

High-performing 3D radio networks with predictable coverage and capabilities will enable advanced automated drone applications and innovative advanced air mobility for a safer and more sustainable digital airspace.

With the continued developments of 5G Advanced, NTN and the introduction of 6G, the possibilities in the digital airspace will continue to expand. This will include the application of new capabilities like integrated sensing and communications, which will support immersive and awareness applications in the digital airspace. This capability will make it possible to perform RADAR-like functionality with the ability to detect objects without a SIM in the sky.

**Figure 30: Network APIs enabling safer skies**



# ICT's carbon footprint continuing to decrease

Electricity in the use stage of ICT continues to grow by about 2–3 percent per year, but the share of renewable energy has almost doubled in three years, leading to a slight decrease in greenhouse gas (GHG) emissions.

The ICT sector consists of three main parts: networks, data centers and user devices such as smartphones and computers. These parts consume electricity in the use stage, which leads to GHG emissions. For the full carbon footprint, the embodied GHG emissions related to materials, production and transport also need to be factored in.

**ICT sector development to 2023**

Data reported by 160 of the largest ICT companies shows an increase in electricity usage in 2023. Most of the increase is related to a few very large companies. Encouragingly, the same 160 companies show a slight decline in reported GHG emissions.

Total electricity consumption at use stage in the ICT sector was estimated to be about 1,000 TWh globally in 2023, up from about 940 TWh in 2020. However, the total estimated GHG emissions for the entire lifecycle has decreased to about 750 million metric tons (Mt) of carbon dioxide equivalents (CO2e) in 2023, from about 780 Mt of CO2e in 2020.[1,2] The decrease in reported emissions in 2023 compared to 2020 relates to both an increased share of renewables during operations and less fossil fuels in electricity production in general.

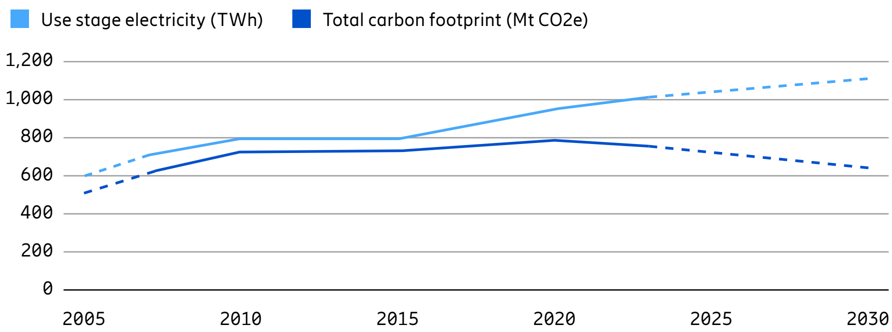
Since Ericsson's first ICT sector-wide study in 2007, the number of mobile and fixed subscriptions has increased about 2.5 times, smartphone subscriptions about 40 times, and total data traffic as much as 80 times. Still, the total carbon footprint has only increased 1.2 times.

The average GHG emissions per mobile and fixed subscription – including all networks, data centers, and user devices – has on average decreased, and is currently about 70 kg of CO2e per year.

**Looking forward to 2030**

In a forecast spanning until 2030, it is anticipated that electricity consumption will continue to rise gradually in all areas of ICT. The carbon footprint of the sector is forecast to decrease by 2030 as a result of an increased share of renewable energy, used by networks and data centers as well as generally in the global electricity grid, which will reduce GHG emissions from device usage and production. However, current trends do not point to reaching the global target of halving emissions by 2030, which means the ICT industry needs to continue its work to further reduce emissions.

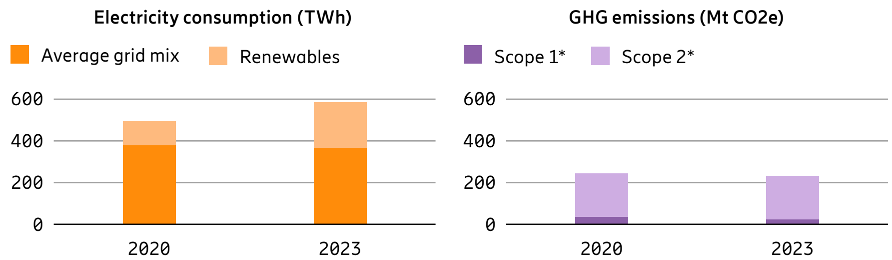
**Figure 31: ICT sector development 2007–2023 and forecast to 2030**




**ICT sector**

The ICT sector is defined here as including data centers, mobile and fixed networks, user devices such as PCs, monitors, phones, tablets, customer premises equipment (CPE) such as routers and modems. Payment terminals, surveillance cameras, smart meters, smart home devices and other Internet of Things (IoT) and machine-to machine (M2M) communication modules are also included.

**Figure 32: Reported data for 160 of the largest ICT companies in 2020 and 2023**




Note: These 160 companies cover about 75 percent of all mobile and fixed network subscriptions, 75 percent of ICT manufacturers revenues and over 90 percent of internet data traffic.

*Scope 1 emissions are direct GHG emissions from owned or controlled sources. Scope 2 emissions are indirect GHG emissions from the generation of purchased energy.

[1] ICT Sector Electricity Consumption and Greenhouse Gas Emissions – 2020 Outcome" (April 2024).
[2] Assessing embodied carbon emissions of communication user devices by combining approaches" (September 2023).

# Methodology

**Forecast methodology**
Ericsson makes forecasts on a regular basis to support internal decisions and planning, as well as market communications. The forecast time in the Ericsson Mobility Report is six years and this moves forward one year in the November report each year. The subscription and traffic forecast baseline 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 (4G) 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. FWA is defined as a connection that provides broadband access through mobile network enabled customer premises equipment (CPE). This includes both indoor (desktop and window-mounted) and outdoor (rooftop and wall-mounted) CPE. It does not include portable battery-based Wi-Fi routers or dongles.

**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 to two 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 network traffic**
Ericsson regularly performs traffic measurements in around 100 live networks covering all major regions of the world. These measurements form a representative base for calculating worldwide total mobile network traffic. Mobile network data traffic also includes traffic generated by FWA services. More detailed measurements are made in a select number of commercial networks with the purpose of understanding how mobile data traffic evolves. No subscriber data is included in these measurements. Please note that the Ericsson Mobility Report data traffic forecast, both global and regional, represents the estimated traffic volume in all networks over the duration of a month. Traffic (in terms of throughput) in high-traffic areas will be much higher than the average 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, world population coverage per technology can be calculated.

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**Ericsson Mobility Visualizer**
Explore actual and forecast data from the Ericsson Mobility Report in our 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
ericsson.com/mobility-visualizer

# Glossary

**2CC:** Two component carrier

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

**3CC:** Three component carrier

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

**3GPP:** 3rd Generation Partnership Project

**4CC:** Four component carrier

**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 (IMT-2020)

**AI:** Artificial intelligence

**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

**ARPU:** Average revenue per user

**CAGR:** Compound annual growth rate

**CAMARA:** An open-source project to develop APIs.

**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, $10^{18}$ bytes

**EN-DC:** EUTRA-NR Dual connectivity

**FDD:** Frequency division duplex

**FWA:** Fixed wireless access

**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

**IoT:** Internet of Things

**Kbps:** Kilobits per second

**LTE:** Long-Term Evolution

**MB:** Megabyte, $10^{6}$ bytes

**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 broadband:** Mobile data service using radio access technologies including 5G, LTE, HSPA, CDMA2000 EV-DO, Mobile WiMAX and TD-SCDMA

**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)

**MOCN:** Multi-operator core network

**MORAN:** Multi-operator Radio Access Network

**MR:** Mixed reality. Immersive technology in which elements from both the real world and a virtual environment are fully interactive with each other

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

**Net Zero:** Defined in ITU standards as a future state where all emissions that can be reduced are reduced, with like-for-like or permanent removals applied by carbon-removal technologies to balance the remaining emissions

**NR:** New Radio as defined by 3GPP Release 15

**NR-DC:** NR-NR Dual connectivity

**NSA 5G:** Non-standalone 5G is a 5G Radio Access Network (RAN) that operates on a legacy 4G/LTE core

**PB:** Petabyte, $10^{15}$ bytes

**RedCap:** Reduced capability

**SA:** Standalone

**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

**Sunsetting:** The process of closing down older mobile technologies

**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

**VR:** Virtual reality

**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

**XR:** Extended reality. An umbrella category for virtual or combined real/virtual environments, which includes AR, VR and MR

# Key figures

## Global key figures

| Mobile subscriptions | 2023 | 2024 | Forecast 2030 | CAGR* 2024–2030 | Unit |
|---|---|---|---|---|---|
| Worldwide mobile subscriptions | 8,510 | 8,700 | 9,470 | 1% | million |
| • Smartphone subscriptions | 6,930 | 7,160 | 8,330 | 3% | million |
| • Mobile PC, tablet and mobile router subscriptions | 260 | 290 | 530 | 10% | million |
| • Mobile broadband subscriptions | 7,410 | 7,740 | 9,070 | 3% | million |
| • Mobile subscriptions, GSM/EDGE-only | 1,010 | 870 | 390 | -13% | million |
| • Mobile subscriptions, WCDMA/HSPA | 680 | 550 | 280 | -11% | million |
| • Mobile subscriptions, LTE | 5,210 | 4,990 | 2,440 | -11% | million |
| • Mobile subscriptions, 5G | 1,603 | 2,270 | 6,350 | 19% | million |
| Mobile subscriptions, 5G standalone | 890 | 1,220 | 3,640 | 20% | million |
| • Fixed Wireless Access connections | 131 | 159 | 350 | 14% | million |
| **Fixed broadband connections** | **1,530** | **1,590** | **1,890** | **3%** | **million** |

| Mobile data traffic | | | | | |
|---|---|---|---|---|---|
| • Data traffic per smartphone | 17.2 | 19 | 40 | 13% | GB/month |
| • Data traffic per mobile PC | 22 | 24 | 36 | 7% | GB/month |
| • Data traffic per tablet | 14 | 16 | 38 | 16% | GB/month |

| Total data traffic** | | | | | |
|---|---|---|---|---|---|
| Mobile data traffic | 106 | 124 | 303 | 16% | EB/month |
| • Smartphones | 104 | 122 | 297 | 16% | EB/month |
| • Mobile PCs and routers | 0.9 | 1.1 | 2.7 | 15% | EB/month |
| • Tablets | 0.9 | 1.0 | 3.3 | 21% | EB/month |
| Fixed Wireless Access | 30 | 42 | 170 | 26% | EB/month |
| Total mobile network traffic | 137 | 166 | 473 | 19% | EB/month |
| Total fixed data traffic | 330 | 380 | 710 | 11% | EB/month |

## Regional key figures

| Mobile subscriptions | 2023 | 2024 | Forecast 2030 | CAGR* 2024–2030 | Unit |
|---|---|---|---|---|---|
| North America | 440 | 450 | 480 | 1% | million |
| Latin America | 720 | 730 | 800 | 1% | million |
| Western Europe | 550 | 550 | 570 | 0% | million |
| Central and Eastern Europe | 560 | 560 | 560 | 0% | million |
| North East Asia | 2,220 | 2,290 | 2,390 | 1% | million |
| China[1] | 1,740 | 1,800 | 1,880 | 1% | million |
| South East Asia and Oceania | 1,160 | 1,190 | 1,320 | 2% | million |
| India, Nepal and Bhutan | 1,180 | 1,180 | 1,310 | 2% | million |
| Middle East and North Africa | 730 | 740 | 830 | 2% | million |
| Gulf Cooperation Council (GCC)[2] | 77 | 81 | 95 | 3% | million |
| Sub-Saharan Africa | 950 | 1,000 | 1,250 | 4% | million |

| Smartphone subscriptions | 2023 | 2024 | Forecast 2030 | CAGR* 2024–2030 | Unit |
|---|---|---|---|---|---|
| North America | 380 | 390 | 400 | 0% | million |
| Latin America | 600 | 620 | 710 | 2% | million |
| Western Europe | 480 | 500 | 490 | 0% | million |
| Central and Eastern Europe | 460 | 490 | 520 | 1% | million |
| North East Asia | 2,080 | 2,160 | 2,280 | 1% | million |
| China[1] | 1,660 | 1,720 | 1,810 | 1% | million |
| South East Asia and Oceania | 970 | 1,010 | 1,190 | 3% | million |
| India, Nepal and Bhutan | 880 | 920 | 1,140 | 4% | million |
| Middle East and North Africa | 630 | 540 | 710 | 5% | million |
| GCC[2] | 66 | 70 | 84 | 3% | million |
| Sub-Saharan Africa | 460 | 540 | 880 | 9% | million |

# Regional key figures

| LTE subscriptions | 2023 | 2024 | Forecast 2030 | CAGR* 2024–2030 | Unit |
|---|---|---|---|---|---|
| North America | 170 | 130 | 40 | -16% | million |
| Latin America | 530 | 530 | 230 | -13% | million |
| Western Europe | 380 | 310 | 40 | -28% | million |
| Central and Eastern Europe | 460 | 480 | 230 | -11% | million |
| North East Asia | 1,230 | 1,070 | 350 | -17% | million |
| China[1] | 900 | 770 | 190 | -21% | million |
| South East Asia and Oceania | 910 | 930 | 550 | -8% | million |
| India, Nepal and Bhutan | 730 | 640 | 240 | -15% | million |
| Middle East and North Africa | 470 | 500 | 310 | -8% | million |
| GCC[2] | 46 | 38 | 3 | -36% | million |
| Sub-Saharan Africa | 329 | 400 | 440 | 2% | million |

| 5G subscriptions | 2023 | 2024 | Forecast 2030 | CAGR* 2024–2030 | Unit |
|---|---|---|---|---|---|
| North America | 257 | 316 | 440 | 6% | million |
| Latin America | 33 | 63 | 480 | N/A | million |
| Western Europe | 143 | 226 | 520 | 15% | million |
| Central and Eastern Europe | 14 | 27 | 330 | N/A | million |
| North East Asia | 914 | 1,158 | 2,020 | 10% | million |
| China[1] | 779 | 986 | 1,670 | 9% | million |
| South East Asia and Oceania | 61 | 112 | 680 | N/A | million |
| India, Nepal and Bhutan | 135 | 272 | 970 | N/A | million |
| Middle East and North Africa | 36 | 70 | 500 | N/A | million |
| GCC[2] | 26 | 38 | 88 | 15% | million |
| Sub-Saharan Africa | 11 | 26 | 420 | N/A | million |

| Data traffic per smartphone | 2023 | 2024 | Forecast 2030 | CAGR* 2024–2030 | Unit |
|---|---|---|---|---|---|
| North America | 19 | 22 | 52 | 16% | GB/month |
| Latin America | 11 | 13 | 34 | 18% | GB/month |
| Western Europe | 19 | 23 | 49 | 14% | GB/month |
| Central and Eastern Europe | 17 | 20 | 42 | 14% | GB/month |
| North East Asia | 19 | 21 | 38 | 11% | GB/month |
| China[1] | 19 | 21 | 38 | 10% | GB/month |
| South East Asia and Oceania | 17 | 19 | 39 | 13% | GB/month |
| India, Nepal and Bhutan | 29 | 32 | 66 | 13% | GB/month |
| Middle East and North Africa | 14 | 19 | 43 | 15% | GB/month |
| GCC[2] | 28 | 29 | 54 | 11% | GB/month |
| Sub-Saharan Africa | 4.7 | 5.4 | 17 | 21% | GB/month |

| Total mobile data traffic | 2023 | 2024 | Forecast 2030 | CAGR* 2024–2030 | Unit |
|---|---|---|---|---|---|
| North America | 7.4 | 8.8 | 22 | 16% | EB/month |
| Latin America | 5.8 | 6.8 | 21 | 20% | EB/month |
| Western Europe | 8.3 | 10 | 22 | 14% | EB/month |
| Central and Eastern Europe | 5.9 | 7.2 | 17 | 15% | EB/month |
| North East Asia | 33 | 38 | 76 | 12% | EB/month |
| China[1] | 29 | 33 | 63 | 12% | EB/month |
| South East Asia and Oceania | 15 | 17 | 43 | 16% | EB/month |
| India, Nepal and Bhutan | 21 | 24 | 63 | 17% | EB/month |
| Middle East and North Africa | 7.8 | 9.1 | 28 | 20% | EB/month |
| GCC[2] | 1.5 | 1.6 | 3.6 | 14% | EB/month |
| Sub-Saharan Africa | 1.9 | 2.5 | 13 | 31% | 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 North Africa.

* 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.

## About Ericsson

Ericsson's high-performing networks provide connectivity for billions of people every day. For nearly 150 years, we've been pioneers in creating technology for communication. We offer mobile communication and connectivity solutions for service providers and enterprises. Together with our customers and partners, we make the digital world of tomorrow a reality.

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