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Ericsson Mobility Report

Business Review edition

Letter from the publisher

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The road from opportunity to revenue

Welcome to the first Business Review edition of the Ericsson Mobility Report.

In many of my recent interactions with communications service providers, sustainability and revenue growth have been the common themes. In this report we have analyzed a number of current trends within our industry and explored ways in which service providers are turning 5G opportunities into revenues.

Around 230 5G networks are in commercial service today. And – with a growing 5G subscription base that has surpassed 1 billion – business fundamentals of the industry remain solid, despite macroeconomic and geopolitical challenges, as consumers prioritize mobile services.

We can see early indications of revenue growth in advanced 5G markets with extensive coverage build-out and differentiated service offerings. Enhanced mobile broadband offers the fastest revenue opportunities for 5G, as it is an extension of service providers' existing business, relying on the same business models and processes. Many service providers are updating their charging models and shifting customers to new, 5G-adapted subscriptions. The mobile broadband business will continue to comprise a significant part of service providers' revenue in the foreseeable future, but it is not expected to drive long-term growth on its own.

Fixed Wireless Access (FWA) is one of the major early 5G use cases, particularly in regions with unserved or underserved broadband markets. The growth potential provided by FWA is especially attractive as it leverages mobile broadband assets to a large degree.

Beyond the consumer business, there are growing 5G opportunities in enterprise and public sector applications across the world. 5G enables significant value for enterprises as private networks and wireless wide-area networks are now being deployed.

A very important aspect of 5G is that it also brings cost advantages and helps service providers to handle the data growth needed to drive future revenue. Upgrading existing 4G sites to 5G has the potential to realize increases of up to 10 times in capacity and to reduce energy consumption by more than 30 percent, offering the possibility to grow revenue and reduce costs while addressing sustainability.

We hope you find the insights in this report engaging and useful.

Fredrik Jejdling

Executive Vice President and Head of Business Area Networks

5G revenue growth opportunities

The 5G revenue growth opportunities for service providers can be divided into three main areas: core connectivity, current adjacencies and future innovations spanning consumer to enterprise and public sector customers. In core connectivity, the major business areas being addressed are:

- Mobile broadband differentiated customer experience in local markets
- 5G FWA opportunities being leveraged successfully across all geographies
- Mission-critical networks being deployed in many markets
- Wide-area IoT as an upsell to consumers and enterprises

Within current adjacencies the following are also showing traction:

- Mobile cloud gaming gaining momentum and interest
- Private networks moving from trials to starting commercial use of 5G
- Wireless wide-area network deployments going from a fallback to a primary solution with 5G
- Network API exposure as an emerging business building on communications platform as a service (CPaaS)
- 5G for indoor and venues to deliver the capacity and performance needed as demand increases

On the horizon, plenty of new opportunities are appearing that require innovative business models, which open up possibilities for service providers to take on new roles in the value chain.

This Business Review edition of the Ericsson Mobility Report addresses some, but not all, of the core and adjacent connectivity opportunities, and explores the fundamental drivers and trends behind the activity seen in the market.





5G driving revenue growth in top 20 markets

In the top 20 5G markets, there has been a positive revenue growth trend since the beginning of 2020 that correlates well with the increasing 5G subscription penetration in these markets.

Key insights

- Tiered pricing models are key for service providers, both for effectively addressing the individual needs of each customer and for continuing to drive long-term revenue growth.
- The top 20 5G markets have seen a significant network performance boost following the introduction of 5G services.
- After a period of slow or no growth, wireless service revenue curves are again pointing upwards in these leading markets. This correlates to 5G subscription penetration growth.

The demand for mobile data is strong and is continuing to grow. Over the past 5 years, global data consumption has increased by over 50 percent per year,¹ or by more than 8 times over the entire period. This is an indicator of the importance that mobile services play in people's lives. The data growth rate in the top 20 5G markets largely follows the average global growth rate. This means that the top 20 5G markets, which already have very high data consumption, are able to continue with the same growth rate as markets with lower consumption.²

5G is also adding network capacity and thereby creating the foundation for further data consumption growth. This capacity also forms the basis for monetization of growing consumer demand through larger data packages. While data volume has been the traditional basis for charging for mobile services, the shift to 5G also opens up new ways to measure, drive and capture consumer value.

Network performance is key for future monetization

Figure 2 depicts the network performance development, in terms of downlink throughput, for the top 20 5G markets as well as the global average. In the top 20 5G markets, the average downlink throughput has increased by 4.3 times over the past 5 years. This is 32 percent more than other markets on a global level, showing the positive impact 5G has had on network performance and user experience. The most significant network performance improvement in the top 20 5G markets



Figure 2: Network performance

The "top 20 5G markets"³ referred to in this article have been selected on the basis of 5G subscription penetration, in order to identify highly developed 5G markets. These markets represent 85 percent of all 5G subscriptions globally.

All of the top 20 5G markets have 5G penetration of more than 15 percent, with average penetration of above 20 percent. The most mature market even reaches a 5G subscription penetration close to 40 percent – an impressive figure when compared to the global average of around 10 percent.

Analysis of the 5G impact on consumer data consumption and user experience has also been done for these markets.

Source: Based on analysis by Ericsson of Ookid® Speedlest Intelligence® data for Q1 2017–Q2 2022

¹CAGR, 2017–2022, Ericsson Mobility Report (November 2022).

² Ericsson, The 5G consumer business case (2018).

³Markets categorized as "Top 20 5G markets": Australia, Bahrain, China, Denmark, Finland, Hong Kong, Ireland, Japan, Kuwait, Monaco, Norway, Qatar, Saudi Arabia, Singapore, South Korea, Switzerland, Taiwan, the UAE, the UK and the US. Data analysis covers 52 service providers across these 20 markets.

happened in 2020, following the introduction of 5G services. As the top 20 5G markets started to benefit from the capabilities of 5G, the 2 curves started to diverge.

5G is providing a network performance boost

The network performance contribution from 5G can be seen in Figure 3. It shows how, in the top 20 5G markets, the median downlink throughput of 5G is 5.8 times higher than the throughput of 4G (187 Mbps vs. 32 Mbps) in Q3 2022. This performance boost is what service providers could offer to consumers as an immediate benefit of upgrading to 5G.

The fact that the top 20 5G markets have twice the 5G penetration compared to the global market average, as well as almost 6 times better performance of 5G in these networks, explains their lead when it comes to overall network performance.

The impressive network performance levels of 5G when the new generation was first introduced in 2019 have gradually decreased over time, as the traffic and the utilization rate of the 5G networks have increased. As usage of 5G has matured in these leading markets, performance levels have now stabilized at around 200 Mbps for median downlink throughput.

Monetizing the network performance boost in steps

An increasing number of service providers are exploring speed tiering as a way to monetize the significant performance boost offered by 5G. This allows 5G performance to be offered as a "ladder", enabling an incremental upgrade path for consumers, while also creating a gradual monetization model for service providers. Incremental pricing models are key for service providers, both for effectively addressing the individual needs of each customer and for continuing to drive long-term revenue growth.

Service providers in leading markets have been successful in realizing the potential of 5G.

Figure 3: 4G vs. 5G network performance – top 20 5G markets



Source: Based on analysis by Ericsson of Ookla® Speedtest Intelligence® data for Q2 2019–Q3 2022.

Wireless service revenue development in leading 5G markets

An examination of how service providers convert their business propositions into business results reveals that revenue curves are again pointing upwards, after a period of slow or no growth. While network investments have been substantial in the initial phase of 5G, with yearly capex levels of the top 20 5G markets increasing by around 30 percent between 2017 and 2022, there are now signs of positive returns on those investments.⁴ As can be seen in Figure 4, there has been a positive growth trend in the top 20 5G markets since around Q1 2020, which correlates closely in time with increased levels of 5G subscription penetration. Average revenue growth over the past 2 years has been 6.5 percent, or 3.2 percent annually. This follows a period of flat or even declining revenue development. This points firstly to the positive impact 5G has had upon the markets, and secondly to the way in which service providers in leading markets have been successful in converting the potential of 5G into consumer value and revenue growth.

Figure 4: Revenue vs. subscription penetration – top 20 5G markets



Source: Ericsson analysis of Strategy Analytics data, Q3 2022.

⁴ Ericsson analysis of Strategy Analytics data, Q3 2022.

5G is driving a positive trend-shift

Looking at the average revenue per user (ARPU) trend, as depicted in Figure 5,⁵ there are positive signs of stabilization and even growth after a period of decline. This trend shift, starting in the beginning of 2020, is likely the result of consumers gradually migrating to high-value 5G plans. The fact that around 80 percent of consumers in the top 20 5G markets still have not shifted to 5G subscriptions highlights the strong potential for continued growth of both ARPU and revenue.

It is as yet early days for 5G, but analysis of the top 20 5G markets reveals clear indications that leading markets are able to turn customer demand for 5G services into revenue growth. To continue successfully addressing the 5G opportunities, there are some key learnings from the leading markets to consider:

- monetize 5G through the increased consumer value provided by new technology: larger data buckets, higher speeds and better user experience
- offer flexibility, breadth of choice and tiered value propositions, allowing for personalization and incremental growth
- with the above mechanisms in place, fuel the demand for 5G connectivity through innovative and advanced digital services: packaging of differentiated 5G services and 5G-rich content

The complexity of analyzing ARPU

ARPU is a popular indicator of how a market develops. However, an increasing ARPU does not always have to be good for business, while a declining ARPU does not always have to be bad.

Here are some factors that would have a diluting (seemingly negative) impact on ARPU, but which can in fact contribute to higher revenues and better business for the service provider:

- increased uptake of so-called "long-tail" customers, or first-time users, who typically spend less on mobile subscriptions (resulting in a shift of customer mix)
- increased uptake of secondary subscriptions, used either on the customers' own devices or by someone within the same "account" or family
- increased uptake of IoT subscriptions, typically offered as an add-on to the base subscription, for an incremental fee

Overall revenue trends depend on a combination of both ARPU development and customer base development. If the ARPU decreases, but the number of subscribers increases (for instance, as a result of changing customer mix), then the impact on total revenues could very well be positive. Meanwhile, if ARPU grows but the number of subscribers decreases (for instance, as a result of higher prices), then the impact upon total revenue could very well be negative.

To take into account such factors, some service providers have started to measure average revenue per account (ARPA) as a better metric of how consumer value is captured.

As mobile subscription penetration is now above 100 percent (global average: 106 percent,⁶ top 20 markets: 158 percent⁷) and keeps increasing, ARPU cannot be expected to increase.

As explained by the factors above, additional subscriptions and fees will continue to contribute to increasing service revenues, but that growth is not always reflected in the ARPU measurement.

Figure 5: ARPU vs. subscription penetration – top 20 5G markets



Source: Ericsson analysis of Strategy Analytics data, Q3 2022.

- ⁵Blended ARPU, all subscription types.
- ⁶Ericsson Mobility Report (November 2022).
- ⁷ Strategy Analytics (Q2 2022).

Consumer Key insights

Speed tiers represent a step toward a quality- and value-oriented pricing focus



Many service providers are moving toward content aggregation, removing most of the risks

associated with traditional bundling



Advanced 5G features will be key to unlocking cloud gaming on-the-go





FWA is currently the largest 5G use case after mobile broadband in terms of uptake

It is expected that 5G end-user devices models with new form factors will soon appear at scale, making it possible for service providers to monetize 5G in new ways



The role of 5G in driving mobile service packaging innovation

Connectivity is at the core of the service provider business, and fundamental to our daily lives and smartphone use. Proactive packaging changes and updates are paying off for service providers.

Key insights

- Speed tiers represent a step towards a quality- and value-oriented pricing focus.
- Unlimited offers allow data usage to grow indefinitely without revenue gains for the service provider.
- Some service providers have introduced yearly price adjustments in their subscription contract terms.

The majority of the world's most popular apps, social media sites and music or video streaming services depend on connectivity that works anywhere and anytime. In Q3 2022 mobile networks carried 108 EB of traffic per month, growing at a rate of around 40 percent per year. As usage increases, service providers keep building network capacity and improving performance – for example, with the introduction of 5G – which benefits everyone.

The November 2022 update of an Ericsson study of consumer retail packages offered by 310 mobile service providers in 139 countries showed that, although the various types of service packaging remain largely the same globally, consumers are being offered increased variety in most markets. To gain further insights into service packaging, Ericsson interviewed 10 service providers, looking at their experiences within a few of these packaging principles.

Does a premium service command a premium price?

Typically, between 30 and 35 percent of service providers have been charging a premium for 5G over 4G. From a marketing or economics perspective, it makes sense to have a higher price tag for a product that adds value over similar products. It sends a signal to the consumer that there is value worth considering.

However, in the 6 months between the 2 latest iterations of the study, the number of service providers charging a premium for 5G has dropped to 25 percent. However, there may be hidden price increases amongst the other 75 percent of service providers, since it has become common to completely replace 4G offerings with 5G. The strategy of service providers has shifted toward moving as many subscribers as possible over to 5G, as it is the most efficient network in place. The next steps will involve sunsetting older technologies, freeing up assets like spectrum, site space and service resources, and focusing on the most efficient systems.

The bucket model vs. unlimited data

Since the introduction of smartphones, the prevailing pricing model has been to charge for mobile data usage through "buckets of gigabytes". Nearly all (306 out of 310) service providers offer data buckets as the base model, targeting most or all of their subscribers.

This model has sometimes been criticized for being difficult for consumers to understand but has nevertheless become widely accepted worldwide. Over time, consumers learn about their usage patterns and data allowance, how this relates to the package they have and when it might be time to upgrade. The model provides a simple yet clear correlation between consumer data usage and the revenues benefitting the service provider.

Provided the buckets are reasonably sized and generally match usage, there will be a natural movement from smaller to larger buckets within the customer base. Not all markets show this pattern, however; in some places, bucket sizes are much larger than actual usage. For example, in some of these markets, the smallest buckets available may offer as much as 50 or 100 GB per month, although the average usage could be well below 15 GB.

One service provider in Latin America mentioned that only 3 percent of its subscribers at the lowest tier actually reach their quota. As a result, there is very little natural movement from one tier to another since users never end up running out of data. Another consequence is poor segmentation and a price spiral where more and more data is offered with almost no price increase over time.

Around 45 percent of service providers in the survey offer true unlimited data packages to their smartphone users. In the vast majority of cases, these packages are the top-tier offers in monthly bill plans. The key selling point of unlimited data is that users do not have to worry about what they use or how much they spend. But it is very much a one-size-fits-all model without any inherent differentiation. Therefore service providers are required to combine this model with additional elements for effective segmentation. Unlike the bucket model, there is no clear means of connecting revenue growth to increased usage.

In fact, the most obvious argument against unlimited offerings is that they allow data usage to grow indefinitely without additional revenue gains for the service provider. One service provider who had abandoned unlimited plans mentioned that, as differentiation is key to its position as a challenger, it needed to look for other methods that would serve it better and not risk driving it towards commoditization. In the early years of 5G, many service providers began adding boundary conditions to their unlimited offerings. These conditions were in addition to some of the more "traditional" fair-use policies and were intended to limit extreme usage or what might be considered "abuse". They typically targeted very specific scenarios like connecting surveillance cameras or other IoT devices, or tethering computers and sharing data widely amongst multiple users when the subscription was intended for personal use. These actions are indications of some of the risks associated with unlimited data plans, especially when performance allows huge amounts of data to be generated in a short amount of time. However, in the latest iteration of the study, a slight reduction in the use of such policies can be observed, coinciding with the introduction of speed tiers.

The reasoning may be that speed in itself, at least in the lower tiers, is a limiting factor as to how much data can be generated. This remains to be seen, however, and may actually be something of a false safeguard, as even a 10 Mbps connection can theoretically generate up to 3,300 GB a month.

Speed as a differentiator

A segmentation model that seems to be growing in popularity is the use of speed tiers. Between April and October 2022 alone, the percentage of 5G service providers using speed as a differentiator grew from 18 to 24 percent. Unlike fixed networks, there is a lot of variation in the theme. Around 74 percent use it in some combination with the bucket model, and around 45 percent use a hybrid version (speed in combination with both buckets and unlimited data tiers).

The simplest version is one where each higher-speed tier also commands a higher price. Speed is never marketed with a guarantee towards consumers: Rather, it is presented as an "up to" promise. In many markets, especially in Western Europe where speed tiers are most widely used, the tiers are well separated with a hundred or a few hundred megabits per second. However, service providers in a number of markets have chosen to use what might be considered low speeds in relation to 5G capabilities. An argument brought forward in the interviews is that consumers may not need more than 10 or perhaps 50 Mbps for the services they use today. The ease with which these speeds can be delivered ensures that service providers are not overselling, and are well placed to deliver future increases and price tiers.

Most service providers who do not use speed tiers today mentioned the inability to guarantee performance as the key reason for not implementing this offering. Some regard speed tiers as irrelevant, as speeds are already much higher than what consumers actually need on a smartphone. At the same time, most concede that perception of value is key and that speed can be an emotional motivator for consumers to pay more.

A number of service providers are using the combination of speed, buckets and unlimited plans to allow consumers a choice between data usage and speed. One perspective on speed tiers brought up by a few of the interviewees was that in order to avoid commoditization, they felt a need to combine these with other value items, or sweeteners.

At a given price point, the consumer may be offered the highest 5G speed coupled with only a limited amount of data. Alternatively, at the same price they can get unlimited data, but speed of only 5 or 10 Mbps.

Interestingly, this variant has been brought up in some discussions with service providers looking to move away from unlimited offerings. Given that consumers are used to having unlimited packages as the default offering, removing unlimited offers might present a challenge. Therefore service providers are looking for some form of soft introduction of the bucket model. Speed is considered the "equalizer" between the bucket and the unlimited offer, both set at the same price. Starting with the lowest tier offers, the unlimited alternative is gradually given less and less attention and value.

Looking ahead

The most commonly used and popular packaging principles among service providers are quite basic, yet effective in monetizing connectivity. In an increasing number of markets, these packaging principles are being adjusted, developed and complemented with other packaging. These include variations on the bucket theme with family and device share plans, and discount schemes during the night or other times of low network traffic. Triple- and guad-play offerings have seen an increased rate of growth in the past 6–12 months, likely due to more mobile-only service providers starting to offer FWA combined with media service packages.

There is a desire for stability in the market and, in some cases, disruptions have pushed all players into a reactive mode which is not necessarily good for that market. Some of the service providers interviewed voiced concerns about short-sighted plans and campaigns that sometimes have no other effect than driving down prices for all, effectively reducing the market space and the long-term ability to invest and grow.

The current macroeconomic environment seems to have triggered some specific changes that may have a positive long-term effect on industry revenues.

One aspect of this is that service providers have confidence in a return to long-term contracts, which may have a stabilizing effect on the market. Another, more significant, impact may come from the yearly price adjustments (a few percent increase) which many service providers are writing into subscribers' contracts. It is interesting that service providers are now venturing to increase prices like this, and if it becomes commonplace, it may benefit the industry as a whole, clearing the path for more stable behavior. It is significant that connectivity is regarded as one of the last things consumers abandon during tough times.

Speed can be an emotional motivator for consumers to pay more.

The theme of monetizing 5G has been very clear in discussions with service providers. Much of what is happening today simply builds upon previous technologies. Speed tiers, however, indicate a move towards a auality- and value-oriented pricing focus. In addition, new services have already launched, like cloud gaming and AR on smartphones, which are promising and are being looked at by many service providers. With the right business models in place, revenues from connectivity can continue to grow. Adding new capabilities like 5G standalone (SA) and network slicing will further strengthen the case for service providers, as flexibility in pricing and packaging may be enhanced significantly, especially if more offerings related to quality of experience and tied to specific services become a reality.

5G and opportunities for compelling new services

Service providers benefit from service bundling as well as connectivity revenue from the most popular applications.

Key insights

- Many service providers are moving towards content aggregation, removing most of the risks associated with traditional bundling.
- Connectivity still represents the core value for service providers.
- Service-based connectivity packages are a step towards value-based pricing.

Mobile networks have evolved and now deliver capabilities beyond what most individual services require. However, the low latency and vastly improved throughput in 5G networks are expected to lead to new, exciting services being developed in the future. This is especially the case in moving imagery, and can already be seen in gaming and VR or AR.

Low latency allows for moving some or all of compute or rendering capabilities into the cloud, which in turn allows for cheaper, lighter devices and longer battery life. This is especially evident when looking at the XR device ecosystem, which will potentially benefit through earlier availability of such devices.

Consumers place new services high on their list of expectations from 5G, and also say they are willing to pay for these services.¹ Many of the highly attractive services come with a monthly fee, like music or video streaming services and cloud gaming or some of the AR and VR applications already available. The question is, in what ways can service providers benefit from such services?

Services enrich the business

It is common to add "sweeteners" or "value items" to the service offerings as a way to differentiate and create additional value. Service providers may add roaming data, virus protection or device insurance to the plan, but the more popular items used when bundling with smartphone subscriptions today are third-party video or music streaming services.

Of all service providers offering 5G, around 45 percent have been bundling third-party services. Earlier, they would sign exclusive agreements with a streaming provider to differentiate and attract more subscribers than their competitors. Today, the streaming market is mature and such agreements are commonplace, so this is seldom an option.

Traditional bundling is now a way to attract users to specific packages, typically towards premium subscriptions. The data bucket model has connectivity itself as a major part of value differentiation, but for the unlimited model, the value items have that role entirely.

Interviews with service providers² reveal that the most effective way of selling bundles is through campaigns and short-term offers, where content services are offered free for a few months. Once that time has passed, consumers typically choose to keep services which they value.

In the past year, the impact of global inflation has led to several service providers discontinuing traditional hard bundles completely. Interviews with service providers have shown that hard bundles have become associated with issues such as price changes and tough contract terms from content owners, deterring some service providers from introducing bundles or leading to a decision to discontinue them.

Some also mentioned that the attraction of individual services may change over time.

For example, a new series from a video streaming service provider may become immensely popular and as a result that streaming platform gets a sudden rise in interest. Later, when all the episodes have been aired, people may want to move to another service.

Many service providers are now starting to act as content aggregators, whereby they offer a much larger variety of services to their consumers. These services are offered as flexible bundles added to a plan without being tied to the base price of that plan. This structure also allows for selling across all customer segments, regardless of tiers. It may even be offered to all consumers in the market as an "over the top" service. Besides the most commonly offered third-party streaming services, there may be magazine subscriptions, news services or training programs. The most proactive content aggregators offer the ability to add and remove service subscriptions on a monthly basis, without the bundle affecting or being affected by the base plan. There are several benefits with this model:

- 1. Consumers have full flexibility of choice from most or all services in a single place and on one bill.
- Service providers receive a share of the monthly fee from each of the included services.
- 3. Consumers with many services will be less likely to churn.
- Services drive traffic and many subscribers may need to upgrade their base subscription to higher data tiers at some point.
- 5. Streamlining processes using APIs can reduce cost and effort while speeding up the onboarding task significantly.
- 6. The risks associated with hard bundles are more or less eliminated as the price of the content service is not linked to the price of the connection.

¹Ericsson Consumer & IndustryLab, 5G: The next wave

² Interviews with 10 service providers from November 2022 to January 2023.

Figure 6: Service providers' new role as content aggregator



Content provider subscriptions

Service and connectivity hand in hand

The use of service-based connectivity offerings has increased recently and, as the name suggests, they provide connectivity to be used only for a specific type of service, such as video streaming.

Service providers often call this type of connectivity "passes" or "packs" and they are usually named by the service they are intended for, like "video pass" or "music pack". These passes are added on top of the base plan and the most common variants provide either gigabytes to be used only for a specific purpose, for example video streaming, or for allowing completely unlimited video streaming, in both cases without consuming from the base bucket. There are also those which sell "buckets of hours" which may be easier for consumers to relate to as it correlates with their usage patterns. The segmenting factor for such packages becomes the monthly number of hours of video, music or perhaps cloud gaming.

Nearly 40 percent of service providers have some type of service-based connectivity targeting traffic-intense video or music streaming services. Interviews reveal that service providers are very happy with this type of packaging, and there is high interest in using them for new and demanding services like cloud gaming.

The basic reasoning behind service-based connectivity is that it:

- connects usage and revenue, as the packs can be designed with price tiers in relation to specific factors such as time spent or data used
- provides an alternative to unlimited data with the ability to use popular services as much as consumers need, without worrying about running out of base subscription data or incurring high costs
- 3. allows for more of a value-based pricing principle within each individual service category

- creates a connectivity-related revenue stream for services that the service provider does not even need to own
- 5. allows for a more granular segmentation of the market, which in turn allows for attractive pricing compared to, for example, unlimited.

Customer awareness is key

Some new services like cloud gaming and VR/AR may generate many times more traffic than streaming video. Revenue will come from these services through retail partnerships, similar to what exists with video and music streaming providers. However, the load on the network from these services is higher and often there are costs involved from investments in platforms and servers. A business model such as service-based connectivity, which also allows for monetization of the connectivity for these services may, therefore, prove to be crucial.

There is however a risk that consumers may be unaware that such options exist. This applies to both aggregation bundles and service-based connectivity passes. They are not necessarily part of the standard subscription and therefore need to be selected and added by the subscriber themselves. However, as mentioned already, promotions and campaigns are effective ways of raising consumer awareness.

Another way to resolve this, starting to be used by some service providers, is to integrate this type of packaging into the customer journey. This is done by placing it into the process of buying the basic SIM card subscription. This starts with the selection of a data plan or bucket, ending up at a menu where the customer gets to select their entertainment services and/or the connectivity passes to go along with these. All is added up to the final price, taking into account any potential discounts that may be accrued.

Connectivity still represents the core value

Without connectivity, it would be impossible to enjoy all the services and apps used on an almost daily basis. Service providers are in the fortunate position of being able to aggregate content and offer a wide variety of subscription services in a digital marketplace. This marketplace may even become a valuable asset in itself, providing visibility for content providers while being simple, flexible and easy to use for consumers.

For the content providers, it is undoubtedly beneficial to be part of these ecosystems, which is why they are willing to share revenue with service providers. Meanwhile, for the service provider, it is important to also have models, like service-based connectivity, which allow for monetization of the core of their business, namely connectivity. Although it may be some time until networks are fully upgraded to 5G SA, with slicing, as networks evolve, there is potential for service providers to take even further steps towards more flexible and advanced packaging. This might be more closely mapped towards the value of both the services themselves and the experience provided by the connectivity they are relying upon.

Many service providers are now starting to act as content aggregators.

Figure 7: Integrating service-based connectivity into the customer journey



Add-on packs



5G opportunities in the cloud gaming market

Cloud gaming has been around for a number of years but only started to gain popularity among consumers in 2019–2020.

Key insights

- Meeting latency requirements in a loaded network is only possible with 5G.
- Advanced 5G features will be key to unlocking cloud gaming on-the-go.
- Targeted gaming packs will tie together connectivity usage and revenue.
- Market adoption is the most important challenge and becoming associated with gaming is one of the ways service providers can drive growth.

The growth rate of the cloud gaming market is now very high. According to Newzoo, it was estimated to be worth around USD 2.4 billion at the end of 2022. This number is expected to reach in excess of USD 8.2 billion by 2025. There are currently an estimated 32 million users, which is expected to grow to 87 million in 2 years' time.¹

Cloud gaming is one of the more obvious consumer cases for 5G, as it takes advantage of key characteristics like throughput and latency. The customer group is expected to respond positively to messages around gaming experiences free from "lag" (the gaming equivalent to high latency). Research conducted by Ericsson during the first half of 2022 showed that 35 service providers had launched cloud gaming together with a platform partner. As part of the research, interviews were conducted with 10 of these service providers to understand the challenges and opportunities of introducing cloud gaming to the market.²

Figure 8: Launches of cloud gaming by service providers with platform partners



Source: Summarized from public information.

¹Newzoo, "Cloud Gaming Revenues to Hit \$2.4 Billion in 2022" (October 2022). ²Ericsson desktop research covering 200+ service providers with 5G. Ericsson research covering interviews with 10 service providers with cloud gaming offerings.

Cloud gaming in a nutshell

Cloud gaming comes with numerous advantages over conventional gaming. Some of the most attractive features of cloud gaming include:

No storage required for games

Many new and popular titles require around a 100 GB of storage, if not more. In addition, updates can often be as large as the first install, which requires either a very high bandwidth or waiting an hour or more before being able to play. As gamers increase their game libraries, they may also need to spend money on upgrading their storage.

No waiting for games to load

Cloud gaming services remove the need to store game files on devices, as they are already loaded and ready on a server.

Insights into the cloud gaming market from service providers

Interviews with service providers have given some interesting insights into the challenges and opportunities that they see in this space. Their comments were grouped into five different categories, and each scored according to weight, or number of mentions. Of the five areas, two are related to the platform or network. These two seem to be of least concern for service providers, which is likely due to the fact that the network is the one area they have most control over. Furthermore, the cloud gaming platform and its ecosystem are also largely under the control of service providers via their selected partners.

The platforms available for cloud gaming have been maturing in terms of both devices they work on and the number of games available in gaming libraries. Unless it is an original equipment manufacturer (OEM) type of setup, there is not much that service providers can do with regards to features and functionality. For the most part, this is a strategic concern when selecting a platform partner.

When playing a game locally on a PC, there is some latency between moving the mouse and seeing the resulting movement on screen. This relates to the types of mouse, game engine and screen being used, and is called "system latency". Generally it is considered to be low enough to give an experience without any perceptible lag. Cloud gaming, however, replaces the mouse connection and the HDMI cable with an internet connection and cloud platform software, each of which increases latency. Network latency is the component which

No waiting for updates

The servers used for cloud gaming are always updated with all the patches and latest drivers.

No need for high-end hardware

Gamers do not need high-end devices to play their favorite games on cloud gaming services. It will be possible to play the latest and most demanding games on nearly any device without the need for costly hardware upgrades.

Play anywhere, at any time

A console or desktop PC is not very portable, and a gaming laptop cannot be pulled out on the subway or a bus. Cloud gaming services give gamers the independence to play on their most portable device, namely the smartphone.

will make the greatest impact on the mobile cloud gaming experience. According to the platform providers, requirements on the network range from 40 to 80 ms or better. Although the lowest possible latency is desirable, stable latency with as little variation as possible can sometimes be even more important. Sudden motion freeze, or jumpy and jerky motion, is nearly impossible to manage as a player and will be very frustrating. Besides latency, there is also a significant requirement regarding throughput, where cloud gaming on a smartphone may start out requiring 15 Mbps (for 720 p and 60 fps).

As pointed out by several service providers, 15 Mbps is often achieved in a mature 4G network, serving at least one or a few concurrent users. Capacity to serve multiple players may not be there, however, and meeting latency requirements in a loaded network is only possible with 5G.

In the end, all these challenges can be addressed in various ways. Network latency is affected by the distance between the end user and the server location and can be resolved by siting distributed servers closer to the users. Moving servers inside a service provider's network provides as much control over traffic as possible. Upgrading the mobile network with 5G and higher frequency bands improves on latency and moving on with 5G SA and network slicing will further enhance the experience. Advanced features like Low Latency Low Loss Scalable Throughput (L4S)³ will improve management of the data flow and provide an optimal user experience with the lowest possible latency, and without disturbing variations.

Gaming on all devices

Games designed to run on a PC can typically only be played on a PC. With cloud gaming it is possible to use any device and operating system for which the service is available. Most of these services support cross-platform gaming, and the progress is synced with the account, not the device. This means a gamer can start playing on their smartphone on their way home, and then continue playing where they left off on a PC or console.

There is one clear downside to mobile cloud gaming, however, and that is increased latency compared to running a game locally on a device. 5G is a solution to this problem.

Some of the service providers interviewed identified these steps as key to unlocking cloud gaming on-the-go.

Figure 9: Cloud gaming: Top challenges highlighted in interviews with service providers



Driving behavioral changes in consumers Fragmented market with few references

Difficult to monetize

- Technology and features still lacking
 - Balancing coverage, capacity and performance

Upgrading the mobile network with 5G improves on latency.

Overcoming cloud gaming monetization challenges

The top three challenges highlighted by service providers in the interviews are the most difficult to address, as they are perceived to be further away from their control.

The two challenges that nearly all mentioned are related to the fact that cloud gaming is a relatively new phenomenon and therefore not yet well known amongst consumers. While there are many players looking into the possibilities, there is no clear "winner" or "best practice" to show how it should be done.

The challenges mentioned by service providers in relation to the ability to monetize cloud gaming were not about lack of business models or that any of the models used would not work. The challenges were mainly associated with the risks and costs of setting up a cloud gaming solution. Platform providers have designed the complete solution to work on a well-performing network, independently of the service provider. As a result, the partnerships they shape are somewhat generic and inflexible.

In a shared marketing and sales effort where the service provider usually acts as a retailer of the cloud gaming subscriptions, a smaller (typically 10 to 30 percent) share of the monthly fee can be gained. Additionally, the service provider can benefit from being associated with the cloud gaming provider, increasing its reach into the target customer group. Similarly, the platform provider will benefit from the broader reach of the service provider.

The distance between server and gamer plays an important role in the experience. If the server is placed inside the service provider's network, it can create a near-optimal situation. However, this would typically mean investing in and owning the servers built by the platform provider. In a balanced partnership, the platform provider and the service provider would share the associated risks and costs. Based on what the interviewed service providers are saying, this does not seem to be the case at all. In fact the general view is that the platform providers charge far too much for the servers, moving nearly all of the risk over to the service provider. To resolve this, one service provider decided to build the servers itself, based on specifications from the platform provider. This had a clear and positive impact on its business case which made the decision a much easier one.

Besides receiving revenue from retailing the platform solution, one key element which some pointed towards was related to connectivity. They all spoke about finding a model which would allow them to get some return from the usage of the connectivity, whilst still allowing gamers to play as much as they want. Looking at the 35 service providers which have launched cloud gaming, 1 in 5 have some form of targeted connectivity package for gaming, whether it is a game pass, selling hours of gaming connectivity or complete zero rating of all gaming traffic.

On top of basic connectivity, the next step mentioned by some service providers will come with 5G SA and is expected to involve more experience-based pricing. This makes it possible to deliver a much higher quality of experience to those who really require it, for a price.

The fragmented cloud gaming market

Cloud gaming is growing and interest in the concept is extremely high with investments being made by several large players like Microsoft, Nvidia and Amazon, as well as numerous smaller players. The most common business model is based on a subscription giving users access to a library of games, for as long as they keep paying. There may be multiple tiers which differentiate with regards to performance (resolution and frame rates) or via the game library itself where only the most expensive subscription provides access to all the top titles.

Most of the service providers have selected to partner with one of the market leaders (Nvidia, Microsoft or Blacknut). Others have chosen one of the smaller players, often allowing for significant adaptation with regards to branding, price models, tools and even game selection.



Figure 10: How streamed cloud gaming works





Becoming associated with gaming is a way service providers can drive market adoption.

Nvidia and Microsoft target somewhat different customer segments and use different business models. All in all, this results in a rather scattered market and several service providers feel there is a lack of direction.

Driving behavioral change

The most important challenge, which everyone points towards, is the issue of limited cloud gaming awareness. The interviews clearly show that the challenges most, or all, service providers agree upon are related to getting consumers to accept, adopt and even discover this new way of playing games.

Both casual and more hardcore gamers need to be educated about the possibilities. However, unlike selling physical gaming hardware like a PC or a console, the proposition of hardware in the cloud, or a "virtual PC", is difficult to understand and therefore communicate.

Several indicated that the business model involving access to games through a monthly subscription represents another challenge. Considering the success of video streaming services, this might seem counterintuitive. But, unlike a movie you watch once or twice, games are typically played over extended periods, sometimes for years. Being forced into paying a subscription "forever" in order to be able to retain ownership of a game is therefore seen as a drawback. The possible benefit to be communicated is access to a library of hundreds or even thousands of games, although most gamers typically only play a handful of games, even over an extended period of time.

Although cloud gaming has been growing rapidly, creating awareness takes time and effort and here service providers together with their platform partners will have to work together.

The web pages of a service provider are an obvious go-to place when looking for any type of connectivity for a smartphone or a home. For gaming, however, there is no clear association and without making the proposition very visible, most consumers will likely miss the fact that it even exists. One service provider in the Netherlands market has successfully integrated the proposition into the customer journey, which is proving to be very effective. It offers consumers a selection of entertainment alternatives, including cloud gaming, together with the SIM card subscription. Bundling of cloud gaming with premium packages is another tool that some are using. In addition, the inclusion of free trial periods is something many mention as an effective way of creating awareness and driving change, almost regardless of the service in question.

Becoming associated with gaming is yet another way service providers can drive market adoption. A few of them have created a separate gaming or esport brand to address the most active gamers. Being an active sponsor at esport events or even being the host for them can be part of this.

According to some service providers, between 15 and 20 percent of cloud gaming usage is in the mobile network. Simplifying and speeding up access when playing can have a huge impact on usage. As one service provider explained, their simple "click to play" setup resulted in literally turning usage upside down, resulting in up to a 4:1 ratio in, mobile vs. home use. This proves one of the key benefits of cloud gaming in which the game is already loaded and ready to run, with all the latest patches and drivers working.

Realizing the 5G FWA growth opportunity

There is a very large unserved market in broadband for both households and enterprises worldwide, with more than a billion addressable connections.

Key insights

- With 5G efficiencies, FWA has an expanding addressable market worldwide, with great potential to deliver broadband in unserved and underserved areas.
- FWA is currently the largest 5G use case after mobile broadband in terms of uptake.
- The growing volumes of FWA connections worldwide are helping to reduce the cost of CPE, which in turn further drives uptake.

As one of the largest 5G use cases, monetization of FWA has already begun, and attention has shifted to momentum, opportunities, positioning and profitability.

FWA global momentum

Estimated service provider revenues from Fixed Wireless Access (FWA) worldwide of USD 27 billion in 2022 are projected to reach USD 67 billion by 2028, a CAGR of 16 percent. The growth potential from FWA is especially attractive as it leverages mobile broadband assets to a large degree.

High-speed mobile broadband coverage of 4G and 5G has opened up opportunities for service providers to deliver broadband services to homes and small and medium-sized enterprises (SMEs) via FWA. Research data from 139 countries show that more than three-quarters of service providers are now offering FWA services. Nearly one-third are offering it over 5G, compared to one-fifth a year ago. 5G FWA has been launched on all continents. Key findings are as follows:

- The uptake in North America is particularly strong, with accelerating connection growth over 2022.
- Many service providers are launching 5G FWA in Europe, with strong market uptake in Italy, Austria and the Nordic countries.
- There is strong momentum in the Middle East, particularly in Kuwait, Oman and Saudi Arabia.
- In Australia and Japan, strong connection growth is being captured by all service providers.
- Emerging market launches have begun following spectrum awards, including several populous markets such as Mexico, Nigeria and South Africa.

FWA opportunities

The potential revenue growth from FWA is from a combination of six typical market opportunities, broadly divided into the unserved and the underserved.

The unserved:

- Connecting unconnected homes (~1 billion households without fixed broadband globally) and businesses in emerging markets as well as rural areas of more developed markets.
- Secondary homes, as many people want broadband connectivity for leisure and/or work. As an example, Norway has some 400,000 cottages and Sweden just over 600,000 secondary homes (around 12 percent of permanent homes).

The underserved:

FWA is in many cases an alternative to wired broadband.

- Cable: FWA is an alternative for cable subscribers when there is no other choice of fixed broadband provider, with lower cost and/or higher speeds.
- Fiber: FWA can be viable where there is only one fiber provider and consumers want choice.
- DSL replacement for service providers delivering broadband over copper-based local loops to provide higher speeds and reduced network operation costs.
- The SME opportunity is typically for connectivity solutions, primarily addressing premises with fewer than 100 employees. Some service providers include value-added services on top of connectivity solutions, including security, SD-WAN and IT services (such as Microsoft 365). For larger enterprises, Wireless WAN solutions offer even more complementary opportunities.¹

Speed-based tariff plans offer enhanced FWA monetization FWA is typically offered with either a volume-based or a speed-based tariff structure.

In a volume-based case, the household customer premises equipment (CPE) is usually an indoor wireless device with 4G or 5G connectivity, and a Wi-Fi router (or LAN cabling) within the home. The device and subscription may be nomadic, meaning the subscriber can move the device to a different location, and as long as the subscription is valid, it will continue to work. The subscription normally reuses mobile broadband paradigms, possibly with higher data allowances to cater for a household's needs.

For a speed-based offering, the household CPE is ideally a 4G/5G device mounted on the exterior of the home. Typically, it includes an advanced antenna arrangement to improve performance, connected to a Wi-Fi router within the home. It is normally managed according to the fixed broadband paradigm, enabling remote configuration and fault management from a customer service center over standard protocols.

The price plan is in line with fixed broadband offerings. In terms of positioning, speed-based offerings can have higher prices than volume-based offerings, with price levels in line with fixed broadband offerings available in the market.

Moreover, speed-based FWA connections are usually marketed to verified locations, where the network capacity and performance are dimensioned to deliver on the agreed service levels. Finally, subscription agreements are generally only valid in the subscribed location.

5G FWA is being launched across all continents and is the most popular 5G use case after mobile broadband.

Monetization strategies

As with fixed broadband, segmentation of the FWA market is critical to target a broad variety of market opportunities. As a result, service providers use a mix of offerings with different price and speed tiers to target different segments. Such speed-based tiers are achieved primarily by using a combination of technologies (including 4G and 5G) and CPE alternatives (including indoor and outdoor).

Figure 11 depicts offerings from service providers in four different countries, categorized by relative ARPU and speed. Relative ARPU is based on the ratio of FWA tariffs to the equivalent mobile broadband ARPU to adjust for local market conditions and exchange rates. Entry-level offers are based on 4G using indoor CPE, where speeds in these examples are between 5 and 20 Mbps and prices range from 1 to 2.3 times mobile broadband ARPU levels. High-end offerings are based on 5G using outdoor CPE, with speed tiers from 100 to 500 Mbps and tariffs ranging from 3 to 5 times the mobile broadband ARPU levels.

Price positioning

Price positioning is driven primarily by the local broadband market dynamics and the home broadband pricing itself is mainly related to advertised download speeds. Higher speeds command higher prices across all available technologies, whether fiber, cable, xDSL or FWA. The variety of speed-based tariff plans enables service providers to address different customer needs and segments, at a variety of price points. Service providers generally use xDSL and 4G FWA to target download speeds below 100 Mbps, while fiber and 5G FWA are used to target speed tiers of 100 Mbps and above.

Figure 11: FWA solutions addressing a variety of speed and price tiers



Service providers' market positioning also influences home broadband pricing. Service providers that are market leaders or hold a strong incumbent position typically command a price premium over new entrants and challengers – driven by brand perception and market performance. As a result, challengers' pricing tends to be pitched at a lower level (for example, with a lower tariff or more data for the same price), and this applies across technologies and speed tiers.

Home broadband pricing is also affected by competition at local level, in contrast to mobile broadband, where prices are set at a regional or national level. Home broadband competition is set at the address level, which defines the availability of speed tiers and alternatives. As a result, national list prices can be adjusted to the local competitive environment through discounts (such as tariff reductions) and incentives (such as free installation or a period of free service).

Figure 12 illustrates these competitive dynamics in a European market, comparing 4G FWA, 5G FWA and fiber tariff plans across various speed levels. Both the incumbent and the challenger are converged service providers, and the incumbent holds the price premium position. Figure 12 clearly shows that the challenger's services are priced lower than those of the incumbent. It also shows how 4G FWA and 5G FWA complement each other to address multiple segments. 5G FWA pricing follows fiber pricing between 100 and 200 Mbps, with 5G FWA priced above fiber in higher-speed tiers to monetize high-speed tariff plans in locations that do not have fiber available.

Figure 12: Price positioning in the fixed broadband market - example



Optimizing profitability through choice of CPE

FWA profitability is affected by CPE choices determining premises and network costs as well as revenue drivers.

Premises costs relate to the direct costs of connecting a home or other type of premises. They include the cost for the CPE, where indoor CPE tends to cost less than outdoor CPE as it includes less expensive antenna components. Installation cost is another parameter, with indoor CPE having an advantage as there are no associated costs, or only minor ones such as eventual call center support for self-installation. While outdoor CPE often comes with a self-installation app, users might prefer professional installation.

Network cost includes all costs related to FWA for a RAN site (and proportion of other elements such as packet core). Outdoor CPE, with its higher spectral efficiency compared to indoor CPE, enables two to three times more FWA connections per site. As a result, unitary network cost per CPE can be two to three times lower for outdoor CPE than indoor CPE. Some service providers mitigate the drawbacks of indoor CPE by adding external antennas, including upgrades to external antennas at a later stage for high-end and cell edge users.

Time to market (TTM) is the first revenue driver, as it impacts uptake of customers. Speed of deployment is a key differentiator for FWA, with CPE choices also affecting that parameter. Indoor CPE would generally enable a faster TTM as there is no need for onsite installation. Another parameter is related to customer lifetime value, where outdoor CPE is generally correlated with longer customer contracts and lower churn compared to indoor CPE. Finally, outdoor CPE is associated with larger cells reaching more households, providing faster and more predictable broadband speeds than indoor CPE and therefore commanding higher prices.

Finding the right mix of indoor and outdoor CPE

Outdoor CPE allows better spectral efficiency compared to indoor CPE. While it may be an absolute necessity to have outdoor CPE for homes in some locations, there are other places, such as those close to a base station, where indoor CPE can be quite sufficient.

In cost-sensitive cases (like low-ARPU areas) or where TTM is crucial, it makes sense to deploy indoor units, which are typically cheaper and faster to deploy. For example, if the available spectrum is large, a first approach could be to provide indoor CPE to most homes, with an option to replace them later with outdoor units as required.

On the other hand, if the number of potential customers in an area is large relative to the available spectrum, it might be worth identifying customers who would benefit the most from outdoor CPE during the sales process. The improved spectral efficiency of outdoor CPE typically boosts range, which in turn increases coverage and the potential customer base, and drives up the proportion of outdoor CPE.

In one case study, when the 20 percent worst-located connections from a radio signal strength perspective were assigned outdoor CPE, the average number of connections per cell could be increased by around 60 percent, while the capacity doubled when only outdoor CPE was used. Even though results are dependent on individual case parameters, this example indicates the effects of mixing indoor and outdoor units.

FWA – a future-proof technology

FWA has emerged as the most popular 5G use case after mobile broadband, with leading service providers scaling and monetizing the 5G connectivity opportunity. Its competitiveness is based on three scale advantages:

- FWA leverages 5G's multi-use case network scale, enabling service providers to make shared investments to monetize multiple use cases, spreading risks and lowering initial upfront investments to new use cases.
- FWA leverages the scale of the global 5G device ecosystem, reaching 1 billion connections in 2022 (2 years faster than 4G measured from its launch), enabling affordable devices and a broad device ecosystem.
- 3. 5G FWA leverages the scale of the 3GPP innovation ecosystem, bringing billions of dollars of R&D investment and new spectrum to higher capacity and performance of devices and networks.

To highlight the third point, one of the latest 3GPP innovations has been the millimeter wave extended range functionality, enabling FWA connectivity at gigabit speeds over 11 km.

In summary, 5G service providers are well positioned to serve the more than 1 billion premises that currently lack fast and reliable broadband, closing the digital divide and empowering consumers and enterprises.

Figure 13: CPE choices impacting profitability in three areas

Premises cost Network cost Revenue drivers (= CPE cost + CPE installation) (= Network capex / homes connected) TTM, ARPU, lifetime value and coverage
CPE cost Chipset, antennaCPE installationIncremental capex per siteTTMARPULifetime valueCoverageChipset, antennaCall centerRadio, baseband, transmissionInstallationDependentAverageLarger cellsand routerand transportationby connectionsmultipliedspeed-baseddurationhouseholdsand SMEs with outdoor CPE
Indoor CPE (external antenna) (multiple offerings)
Outdoor CPE (self-installation)

5G devices with new form factors likely to grow fast

Only 3 percent of 5G end-user device models announced so far are designed in a new form factor, such as drones, wearable devices or robots. But with the current uptake rate it is likely that they will soon appear at scale.

Key insights

- It is expected that 5G end-user device models with new form factors will soon appear at scale, making it possible for service providers to monetize 5G in new ways.
- Only 3 percent of announced 5G end-user device models can be categorized as application-specific devices with a different form factor than the typical communication devices (such as phones, customer premises equipment (CPE) and tablets).

A review of device model growth over time reveals a clear correlation between device availability and service uptake. 5G subscription uptake is almost two years ahead of 4G subscription uptake at a similar time after the first network was launched. The number of 5G device models announced since the launch of 5G shows a similar uptake trend to that for 4G devices at the time. This is what could be expected, and one could debate which is the chicken and which is the eaa in this case. Did the availability of networks drive the development of new models in the market? Or did the availability of devices drive service providers to launch 5G, and hence drive subscription uptake?

Regardless, devices and networks both need to be available at scale to drive

Figure 14: Number of available application-specific end-user device models



substantial subscription uptake. The same can be seen for Fixed Wireless Access (FWA), where a steep increase in available CPE from many vendors drives growth in FWA connections across markets.

The Global mobile Suppliers Association (GSA) tracks newly announced device models on a monthly basis. In its latest data,¹ smartphones, PCs, tablets and various routers and CPE account for 97 percent of all announced 5G end-user devices (over 1,600 models).² Of the remaining end-user devices, only 3 percent can be categorized as an application-specific (or use-case specific) device.³

This means that only around 50 such device models have been announced (not all being commercially available yet). It also indicates that many of these new types of 5G devices, which are targeting consumer and/or enterprise use cases, are hard to find in many markets as they have yet to be released for all available 5G spectrum bands.

It is worth remembering that after 4G was launched the growth of devices in this segment did not really take off until 2018 (see Figure 14), nearly a decade after 4G was launched, but over 1,200 application-specific devices have now been announced globally. Asset trackers, cameras, smart watches and vehicle on-board units are each all available in over 100 different models. There are also many new types of smartphone accessories connected via Bluetooth or similar, that can already benefit from either a 4G or 5G connection. New types of 5G end-user devices are expected to soon appear at scale, making it possible for service providers to take advantage of new form factors to address new consumer and enterprise use cases.

¹GSA GAMBoD data (December 2022).

²This figure excludes 5G modules. Only end-user devices are considered.

³ Includes camera, vehicle on-board unit, encoder, drone, wearable device, robot, television, kiosk terminal/vending machine, and other niche devices.

The number of 5G device models announced since the launch of 5G shows a similar uptake trend as for 4G devices at the time.

There are already clear signs of a coming uptake of 5G services in several industries:
The industrial gateway ecosystem is in place and enables the industry to connect most industrial devices, machines and tools.

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- Industrial ruggedized 5G handsets have been launched and more are planned for 2023.
- Mobile devices such as autonomous mobile robots (AMRs), drones and XR devices are already being connected by modules to a gateway. This is expected to accelerate in the coming years.

As innovation in 5G is picks up the pace, not only on the consumer side but also for enterprises, new application-specific devices will increase in number, possibly also in areas not yet considered.

Figure 15: 5G end-user device models announced



Enterprise and public sector

Key insights



For a service provider or reseller, monetizing private networks starts with establishing credibility in new industries Harmonizing the exposure of APIs in 5G networks together with other service providers will attract developers to innovate at scale





Service providers are expanding into managed services for Wireless WAN and this is rapidly becoming the desired networking business model for enterprises that want to streamline their IT operations

Opening 5G networks to app developers

Evolving CPaaS markets to expose 5G network capabilities through APIs opens up new opportunities to monetize networks.

Key insights

- As 5G networks are built out globally, the opportunity for exposing 5G capabilities to developers is increasing.
- Harmonizing the exposure of APIs in 5G networks together with other service providers will attract developers to innovate at scale.
- This will also open up opportunities for service providers to monetize by deploying new pricing plans.

Opening up 5G networks to application developers brings new possibilities to drive innovation. The communications platform as a service (CPaaS) market is growing at 28 percent annually since 2021 and is projected to reach USD 22 billion by 2025.¹ CPaaS is essentially a collection of tools for the easy integration of features, such as SMS, chat or video calls, into various software. It provides the back-end communications infrastructure, presented as a service that is then integrated into a developer's own app offerings through application programming interfaces (APIs) and software development kits (SDKs).

Today CPaaS technology offers various opportunities:²

 Healthcare providers and government agencies can use CPaaS for automating reminders and managing appointments, while transport and logistic companies can easily send status alerts for deliveries through SMS.

- The travel and hospitality industries can integrate CPaaS with existing applications to offer contact-free services such as in-app calling and messaging.
- Online learning providers, including schools and colleges, can use CPaaS to access features like video calling, screen sharing and call recording.

In the current CPaaS value stack, service providers play an important role in providing SMS and voice minutes that are converted into programmable components for developers.

However, service providers can claim a stronger role at low investment levels, by offering advanced network services through current LTE deployments and/or existing 5G investments.

5G to transform exposure capabilities

As 5G networks are built out globally, the opportunity for exposing 5G capabilities to developers is increasing. By 2028, it is expected that 85 percent of the world's population will have 5G coverage.

Some APIs will be essential to enabling new services, such as mobile XR, private 5G network apps and IoT low-latency apps, which service providers can monetize with different types of business models such as resell of enhanced APIs or through subscriptions.

But service providers will need to adjust their approach, making 5G networks easy to consume by others, such as application developers. This is a fundamental change, orientated in harmonizing the exposure of APIs in 5G networks together with other service providers in order to attract developers to innovate at scale.

The potential for 5G APIs is promising, as new capabilities become available to developers worldwide. These APIs will allow service providers to charge for new services, such as enhancing QoS and performance for mobile gaming, reliable drone management through low-latency video and location services – and superior authentication and security for financial transactions.

5G SA with network slicing gives service providers opportunities to provide traffic differentiation where different types of applications can be treated individually based on their needs. This will also open up opportunities to monetize by deploying new pricing plans, moving from the traditional approaches based on minutes, data use and subscriptions, to models with premium and segmented experiences which are consumed dynamically as they are needed through APIs. Moreover, service providers will be able to provide specialized services, giving application service providers (ASPs) the technical support needed for each type of service.

Figure 16: Examples of use cases enabled by advanced network APIs



¹IDC and Gartner, CPaaS 2021 metrics.

²Vonage, What is CPaaS (Communications Platform as a Service): A Brief Overview.

5G and private networks transforming enterprises

5G connectivity and edge compute are fundamental to enterprise transformation programs already underway, and to the related use cases for digitalization, automation and worker augmentation.

Key insights

- Allocation of industry spectrum for enterprise use has increased demand for private networks. Industry spectrum also brings new opportunities for resellers, yet service providers remain relevant and deploy many private networks.
- For a service provider or reseller, monetizing private networks starts with establishing credibility in new industries. This can be fast-tracked by building ecosystem partnerships in target segments, adapting sales models for resell of connectivity networks, and offering more than connectivity.
- As enterprise transformation programs get underway, the resulting use cases demand the performance of 5G and private networks.

Drivers of transformation vary. They include macroeconomic outlook; new technology capabilities; remote working in COVID-19 times; supply chain volatility; or simply to scale up.

While motivations may differ, many enterprises are implementing high-value digitalization and transformation programs. These tap into the vast data their business generates to gain new insights and capabilities, and enable automation or remote operations, empower workers and promote their safety.

Industry spectrum drives momentum for 5G and private networks

Where industry spectrum has been allocated for enterprise use,¹ demand for private networks has gained momentum over 60 percent of the enterprises deploying private networks by Q3 2022 were located in the US, Germany, France, the UK and Japan, according to the latest GSA report on private networks.² It is no coincidence that these are leading manufacturing markets. Governments and regulators keen to promote national manufacturing competitiveness have taken allocated spectrum for industry and funded 5G projects. While this brings new opportunities for distributors, resellers and system integrators, service providers remain relevant and provide many of the networks deployed in these markets. Service providers' licensed spectrum is a valuable asset for 5G use cases. Spectrum is the primary parameter of network capability, so service providers can support the



advanced 5G use cases by dedicating spectrum capacity for enterprise use. As most industrial sites are located outside densely populated areas there will be sufficient spectrum capacity.

How service providers add value to enterprises with private networks

For service providers introducing 5G private networks, monetization paths are depicted in Figure 17. Value potential grows as the offering expands in content and commitment, requiring more capabilities. Monetizing private networks effectively will mean:

- building partnerships and ecosystems in target segments
- adapting the sales, delivery and support models for resell, for example of private networks
- extending the offering beyond connectivity for upsell, and developing credible expertise
- engaging a wider set of enterprise customer stakeholders, beyond IT
- applying a consultative sales approach, with value calculators

The stakes are high for enterprises and so is the value

This is a compelling, and demanding, sales engagement for service providers, resellers and system integrators. It reaches new enterprise stakeholders and covers strategy, technology and business case, touching ecosystems outside of ICT.

Some enterprises are building the foundations by putting in place 5G connectivity platforms and edge compute capability that will support their ambitions. Others may be experimenting with pilot use cases, many of which require the capabilities of 5G.

Figure 17: Monetization paths

¹Ericsson, 5G spectrum for local industrial networks (April 2022).

²GSA, Private Mobile Networks Summary Report (December 2022).

When upselling beyond connectivity, gaining early credibility is key in technology, in industry verticals or in systems integration.

Ecosystem bundling: Partnerships to extend connectivity sales reach

Partnering and ecosystem engagement can improve brand recognition in new industries or new areas of expertise. It can bring exposure to new customer stakeholders and decision makers, for example within the Operational Technology (OT) field where service providers are less familiar. Advantages include:

- Becoming intrinsic to ecosystems: Engaging with key industry ecosystems builds relevance and leverages the credibility and sales reach of others. This may be co-selling, in which partners sell alongside one another.
- Strengthening commercial relationships: Leveraging partners who may embed or reference service provider offerings in their solutions, monetized by, for example, reselling the service or generating sales fees.

New business models: Resell connectivity networks

Telecom services are often provided as a shared network where the service provider retains asset ownership. With private networks, the asset ownership is often transferred to the enterprise as a resell, with purchases made through distributors and resellers. Those who resell will expect networks to be pre-integrated as a complete end-to-end offering, for an efficient sales process.

An alternative monetization approach is to offer nomadic private networks as-a-service, for broadcasters' use with 5G cameras at sports or entertainment events on-demand, utilizing spectrum which does not conflict with the visitor smartphone traffic. For the service provider, this new offering generates recurrent revenue.

Upsell: Extend the offering beyond connectivity

As an enterprise expands, a customer request for more coverage can evolve to a review of future traffic profiles and use cases, a dialogue with a wider set of stakeholders, and a potential upsell of private networks, devices, system integration services and more.

Taking on new roles can extend the offering beyond connectivity; the target value chain position depends on the service provider strategy and existing capabilities. For the service provider upselling beyond connectivity, gaining early credibility is key – in technology, in industry verticals or in systems integration. Examples are provided in Figure 18.

Figure 18: Three areas in which to gain credibility when upselling beyond connectivity



For which use cases do enterprises turn to 5G private networks?

Manufacturers already deploy sensors across the factory site, so when it comes to 5G the focus is often on automation use cases. These enable, for example, AGVs/AMRs to function as mobile transporters within the factory, fork-lift trucks to be remotely controlled and torque tools to become wireless for the safety and agility of workers.

For critical infrastructure industries (such as power plants, mines, steel mills, recycling plants and wind farms) good reliable coverage, often in remote locations, is essential. Predictive maintenance is a leading use case, with sensors introduced to detect equipment problems early and rectify proactively, preempting expensive outages. This use case alone may be sufficient motivation for introducing 5G and private networks. Another use case augments field workers with new tablets or AR-based applications, to enable real-time access to specialists in shared centers of excellence. This can greatly empower workers in remote and isolated locations.

For these use cases and more, 5G brings essential new capabilities to the enterprise communications landscape:

- Coverage and economics: While enterprises may have Wi-Fi, cables and land mobile radio, they turn to cellular first for "must-have" reliable coverage and capacity throughout the site. Furthermore, Wi-Fi hotspots may not scale economically compared with the power output and wider coverage of cellular radio base stations, especially for outdoors.
- Mobility and security: 5G will naturally support the need for high speed and cell handovers which come with AGVs/AMRs, drones and unmanned haulage vehicles. For some, security is the prime need when going wireless.
- Consistent latency: For equipment running industrial automation protocols (for example a port crane using the Profinet protocol) which now adds wireless mobility, it is essential the network provides consistent low latency, without the spikes that Wi-Fi may bring. A remote-control operator requires the controls to respond in less than 75 ms (round-trip) for a credible user experience. Longer than this can cause frustration, operator nausea and service disruption.



"No Ordinary Port": Port of Tyne and BT's surveillance and smart solutions

BT has developed expertise and offerings for surveillance and smart solutions, leveraging its 30-year track record supporting UK national security and critical infrastructure.

The offerings leverage smart camera technologies, IoT sensors and video analytics, for situation awareness in tracking and management of things. This covers physical security, identification, inspection and integrity checking, safety zones and rapid and redeployable response capability, for example drones and vehicles.

BT sources best-of-breed technology with open standards, with the right network, and develops additional functionality with in-house BT Research teams and ecosystem partners such as Cradlepoint. BT delivers business outcomes to customers, with a collaborative partnership engagement, such as Port of Tyne.

Port of Tyne is one of the most innovative, progressive and efficient deep-sea ports in the UK, linking the north of the country to the rest of the world. The vibrant and sustainable Port of Tyne contributes to the growth of the economy, with a focus on renewables including the Tyne Clean Energy Park.

To evolve its port capabilities Port of Tyne engaged BT, which introduced its smart surveillance offerings and private networks.

5G works begin at the Port of Tyne³

The Port deploys cameras across the site for various use cases, such as: • container inspection from

ship-to-shore cranes, recording the condition of cargo containers as unloaded from inbound ships, for example to retain a record for any damage/insurance claims

- ship turnaround is a key performance parameter, and cameras together with analytics insights identify improvement areas, as well as track and optimize operations across the site
- development of command and control for remote operations of vehicles, such as drones

Throughout the engagement a joint partnership approach has been taken to ensure that innovation, collaboration and digitalization comes to life for the Port of Tyne: "No Ordinary Port".

An agreement was announced between BT and Port of Tyne in June 2022, for a 5G private network.



A 5G private network agreement between Port of Tyne and BT is evolving port capabilities. Photo: Image courtesy of BT <u>³Port of Tyne blog, "5G works begin at the Port of Tyne" (July 18 2022).</u>

The value of 5G WWAN lies in layers

From FWA to in-vehicle access, there is deep value in simplified integration between cellular and the latest security and performance technologies.

Key insights

- 5G is more valuable to enterprises — providing flexibility and simplicity — when sold in a full solution that meets many networking needs instead of just one.
- Service providers are expanding into managed services for Wireless WAN (WWAN) and this is rapidly becoming the desired networking business model for enterprises that want to streamline their IT operations.
- The ability to deploy and trust 5G WWAN for primary connectivity is beneficial for companies that have already opened, or plan to open, locations in a wide variety of settings.

To fully visualize the potential value of 5G WWAN for service providers, it is necessary to look beyond Fixed Wireless Access (FWA), high-performance in-vehicle connections and large-scale IoT. The bigger picture of 5G enterprise value lies in layers – namely layers of use cases, enhancements, integration and management options that make WWAN a robust opportunity for enterprises to scale and for service providers to enable.

Enabling the network experience that each enterprise needs

The value of 5G for enterprise customers is maximized when sold as a full solution that meets all of their networking needs instead of just one. A layered approach enhances customers' flexibility, and simplifies deployments and management.

Operator-provided managed services

Service providers are expanding into managed services for WWAN and this is rapidly becoming the desired networking business model for enterprises that want to streamline their IT operations.

Service providers can expedite their ability to satisfy demand for managed services by onboarding a partner to handle day-to-day services while building their own internal infrastructure and eventually moving to fully internal operations.

Partner-provided managed services

The understandable hype surrounding 5G is not lost on channel resellers, many of whom will be motivated to exploit this latest cellular generation to provide custom services beyond traditional hardware deployments and network management.

Channel partners are agile enough to offer a wide range of options, including site surveys, consultation and break/fix services. Such innovation makes it easier for partners and operators alike to bring on new enterprise customers looking to scale up for years to come.



Figure 19: WWAN layered solutions

*Service provider or channel provided managed services

High-value use cases for 5G WWAN continue to emerge as enterprises envisage what is possible.

Technology integrations

Network operators can offer more value to businesses by providing network hardware that easily integrates with the latest, most in-demand software technologies. Cellular router vendors ideally either provision these technologies themselves or have cloud-delivered integrations with best-in-class vendors. In-demand features include:

• zero trust network access (ZTNA) security service, which removes default access and utilizes an adaptive verification policy to protect information

- intrusion detection systems (IDS) and intrusion prevention systems (IPS), which identify and stop prospective data security breaches
- IoT monitoring systems, such as AWS Greengrass and Microsoft Azure IoT Central, which provide remote visibility into analytics for data from sensors and other devices
- SD-WAN traffic steering, which classifies traffic and matches application requirements with network characteristics, conditions and behaviors¹
- network slicing, which enables a service provider to provision a set of logical networks over shared infrastructure, with each designed to serve a defined business purpose and comprising all the required network resources, configured and connected end-to-end²

Network slicing is poised to become a high-value service differentiator, as operators that provide dedicated slices can uniquely impact their customers' quality of service and data security for a variety of custom use cases.

High-value use cases for 5G WWAN continue to emerge as enterprises envisage what is possible with the significantly higher performance and lower latency of 5G. Meanwhile, network operators can prepare for this wave of innovation by better aligning what they offer with what many different types of collaborators can provide within WAN deployment, optimization, security, management and beyond.

Layered solutions make it easier for enterprises to unlock the power of cellular broadband in a range of settings, including:

- at fixed sites
- in remote locations
- in vehicles
- in residential properties where employees are working from home



¹OONUG, "SD-WAN Traffic Steering Moves Enterprise Apps Across Clouds" (May 9 2019).
²Ericsson, Network slicing early use cases.

Real-world use cases

What is the real-world result of offering high-performance cellular broadband as part of a larger solution that can include layers of data security, optimization and management features? A key outcome will be that 4G LTE use cases, already proven critical in many industries, will become more feasible, ideal and common for a far greater number of enterprises. For example:

Day-1 connectivity for fixed and temporary sites

Residential FWA has everyone buzzing, but businesses have been leveraging FWA for years. One of the most common use cases is day-1 connectivity.

Often companies can't afford to delay opening their new distributed locations while waiting for wired access to be installed. In these situations, they use cellular-enabled wireless routers to enable on-site connectivity immediately. Once wired access is available – sometimes many months after opening day – the organization can change the WAN configuration according to each location's needs.

The continued rollout of 5G has made day-1 cellular solutions more flexible – and thus attractive to – businesses than ever before. 4G was considered by many to be essential for failover in small to mid-sized spaces but not ideal for primary connectivity 5G is expanding those WWAN use cases, as businesses are seeing that ultra-high download speeds and ultra-low latency make cellular broadband a viable primary connection for small to mid-sized offices and stores, and can handle failovers for all applications at large sites.

Whether 5G backs up wired, wired backs up 5G, or one 5G carrier backs up another 5G carrier, the setup can be altered from anywhere through a cloud management platform.

Remote locations

In remote and rural places where fiber would take too long to provide or isn't even available, FWA offers high performance and cost-effectiveness that addresses companies' geographical networking challenges. The ability to deploy and trust 5G WWAN for primary connectivity is a boon for companies that have already opened, or plan to open, locations in a wide variety of settings.

Remote work from anywhere

Remote work has changed not only many facets of staff management and business communication, but also enterprise networking. Businesses are dealing with a greatly expanded and more complex network edge, necessitating solutions that help IT teams balance their data security and network control needs with the connectivity demands of off-site employees using data-intensive apps. Many companies now send cloud-managed, 5G/4G-enabled solutions home with at least a portion of their employees. Using enterprise-grade solutions for remote work enables a "branch of 1" at each staff member's house, with the ability for the IT team to implement and maintain the same level of security and connection performance – critical for high-bandwidth applications, including teleconferencing – that is available at headquarters.

Vehicle fleets

Cellular broadband has long been the ubiquitous connection choice for vehicle fleets. Solutions that support dual-modem 4G LTE, provide Wi-Fi and can be managed centrally have made connected technologies an essential component of fleet management.

However, the steep increase of different technologies within these vehicles – for law enforcement, fire services, ambulances, public transportation, schools, private motorcoaches and more – has left organizations and their fleet managers anxiously awaiting 5G to better accommodate their newly robust performance needs. Now that 5G solutions for vehicles have arrived, organizations can better plan for the next wave of connected technologies for both operations and customer service.



Glossary

3GPP: 3rd Generation Partnership Project	HSPA: High speed packet access	xDSL: x Digital subscriber line
4G: 4th generation mobile networks (LTE, LTE-A)	IDS/IPS: Intrusion detection systems / intrusion protection systems	XR: Extended reality. An umbrella category for virtual or combined real/virtual
4K: In video, a horizontal display resolution of approximately 4,000 pixels. A resolution of 3840 × 2160 (4K UHD) is	L4S: IETF standardization targeting Low queuing Latency, Low Loss, and Scalable throughput)	VR and MR ZTNA: Zero trust network access
used in television and consumer media. In the movie projection industry,	LTE: Long-Term Evolution	
	MB: Megabyte, 10 ⁶ bytes	
5G: 5th generation mobile networks (IMT-2020)	Mbps: Megabits per second	
AGV: Driverless Automated Guided Vehicles	Mobile broadband: Mobile data service using radio access technologies including	
AMR: Driverless autonomous mobile robots	Mobile WiMAX and TD-SCDMA	
API: Application programming interface	Mobile PC: Defined as laptop or desktop PC devices with built-in cellular modem	
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	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)	
ARPU: Average revenue per user	NR: New Radio as defined	
CAGR: Compound annual growth rate	by SGFF Release 15	
CDMA: Code-division multiple access	OT: Operational Technology, for monitoring and control of industrial and manufacturing equipment	
CPaaS: Communications platform as a service	p (as in 720p): Progressive scanning	
CPE: Customer premises equipment	SA: Standalone	
DL: Downlink	SDK: Software Development Kit	
EB: Exabyte, 10 ¹⁸ bytes	SD-WAN: software defined	
fps: Frames per second		
FWA: Fixed Wireless Access	Sunsetting: The process of closing down older mobile technologies	
GB: Gigabyte, 10 ⁹ bytes	TD-SCDMA: Time division-synchronous	
Gbps: Gigabits per second		
GHz: Gigahertz, 10 ⁹ hertz (unit of frequency)	Triple/Quad Play: Typically offering Mobile and fixed services in combination with media content (three or four services combined)	
GSA: Global mobile Suppliers Association		
GSM: Global System for Mobile Communications	VR: Virtual reality	
GSMA: GSM Association	WCDMA: Wideband code-division multiple access	

Key figures

Key figures are from Ericsson Mobility Report, November 2022. The figures for 2022 are estimates from November 2022.

Global key figures

Global key ligales			Forecast	CAGR*	
Mobile subscriptions	2021	2022	2028	2022–2028	Unit
Worldwide mobile subscriptions	8,210	8,390	9,230	2%	million
 Smartphone subscriptions 	6,260	6,600	7,790	3%	million
 Mobile PC, tablet and mobile 					
router subscriptions	390	410	680	9%	million
 Mobile broadband subscriptions 	6,780	7,120	8,590	3%	million
 Mobile subscriptions, GSM/EDGE-only 	1,290	1,130	470	-14%	million
 Mobile subscriptions, WCDMA/HSPA 	1,320	1,040	180	-25%	million
 Mobile subscriptions, LTE 	5,030	5,160	3,580	-6%	million
Mobile subscriptions, 5G	548	1,050	4,970	30%	million
 Fixed wireless access connections 	88	107	300	19%	million
Fixed broadband connections	1,360	1,450	1,800	4%	million
Mobile data traffic					
Data traffic per smartphone	12	15	46	21%	GB/month
Data traffic per mobile PC	17	20	31	7%	GB/month
Data traffic per tablet	9.6	11	27	16%	GB/month
Total data traffic**					
Mobile data traffic	68	90	324	24%	EB/month
• Smartphones	65	87	314	24%	EB/month
 Mobile PCs and routers 	0.6	0.9	3.1	23%	EB/month
• Tablets	2.2	2.5	6.7	18%	EB/month
Fixed wireless access	17	25	128	32%	EB/month
Total mobile network traffic	85	115	452	26%	EB/month
Total fixed data traffic	220	270	600	14%	EB/month

Regional key figures

r tegreriar teg rigaree			Forecast	CAGR*	
Mobile subscriptions	2021	2022	2028	2022-2028	Unit
North America	390	400	460	2%	million
Latin America	690	710	790	2%	million
Western Europe	540	550	560	0%	million
Central and Eastern Europe	570	570	570	0%	million
North East Asia	2,120	2,170	2,300	1%	million
China ¹	1,660	1,700	1,750	1%	million
South East Asia and Oceania	1,150	1,170	1,290	2%	million
India, Nepal and Bhutan	1,140	1,160	1,290	2%	million
Middle East and North Africa	750	760	880	2%	million
Gulf Cooperation Council (GCC) ²	76	77	83	1%	million
Sub-Saharan Africa	850	890	1,100	4%	million

			Forecast	CAGR*	
Smartphone subscriptions	2021	2022	2028	2022-2028	Unit
North America	310	320	330	1%	million
Latin America	540	570	670	3%	million
Western Europe	430	440	440	0%	million
Central and Eastern Europe	410	420	430	0%	million
North East Asia	1,920	1,990	2,160	1%	million
China ¹	1,520	1,570	1,660	1%	million
South East Asia and Oceania	860	910	1,120	3%	million
India, Nepal and Bhutan	800	890	1,210	5%	million
Middle East and North Africa	630	680	760	2%	million
GCC ²	63	65	73	2%	million
Sub-Saharan Africa	350	380	710	11%	million

Regional key figures

Regional Rey figures			Forecast	CAGR*	
LTE subscriptions	2021	2022	2028	2022-2028	Unit
North America	290	250	40	-26%	million
Latin America	460	520	290	-9%	million
Western Europe	450	450	70	-27%	million
Central and Eastern Europe	360	420	320	-5%	million
North East Asia	1,590	1,350	560	-14%	million
China ¹	1,210	980	390	-14%	million
South East Asia and Oceania	560	650	590	-2%	million
India, Nepal and Bhutan	780	840	570	-6%	million
Middle East and North Africa	360	430	550	4%	million
GCC ²	61	55	8	-28%	million
Sub-Saharan Africa	181	260	600	15%	million
			Foregat		
5G subscriptions	2021	2022	2028	2022-2028	Unit
North America	70	1/1	/20	2022 2020	million
	5	141	420	20%	million
Western Europa		67	400	11%	million
Central and Eastern Europe	1	05	240	41% N/A	million
North East Asia	108	729	1 710	15%	million
Ching ¹	357	644	1 / 00	1/1%	million
Courth East Asia and Ossania	10	20	1,400	14/8	million
South East Asia and Oceania	10	29	620	N/A	million
India, Nepal and Bhutan	0	31	690	N/A	million
Middle East and North Africa	10	24	270	N/A	million
GCC ²	6	15	71	30%	million
Sub-Saharan Africa	3	7	150	N/A	million
			Forecast	CAGR*	
D 1 1 10 1 1	2024	2022	2020	2022 2020	
Data traffic per smartphone	2021	2022	2028	2022-2028	Unit
Data traffic per smartphone North America	2021 14	2022 17	2028 55	2022–2028 21%	Unit GB/month
Data traffic per smartphone North America Latin America	2021 14 7.7	2022 17 10.5	2028 55 41	2022–2028 21% 25%	Unit GB/month GB/month
Data traffic per smartphone North America Latin America Western Europe Casteria and Eastern Europe	2021 14 7.7 15	2022 17 10.5 19	2028 55 41 52	2022–2028 21% 25% 18%	Unit GB/month GB/month GB/month
Data traffic per smartphone North America Latin America Western Europe Central and Eastern Europe	2021 14 7.7 15 9.9	2022 17 10.5 19 13	2028 55 41 52 35	2022–2028 21% 25% 18% 18%	Unit GB/month GB/month GB/month GB/month
Data traffic per smartphoneNorth AmericaLatin AmericaWestern EuropeCentral and Eastern EuropeNorth East AsiaChinal	2021 14 7.7 15 9.9 14	2022 17 10.5 19 13 17 10	2028 55 41 52 35 55	2022–2028 21% 25% 18% 18% 21%	Unit GB/month GB/month GB/month GB/month
Data traffic per smartphone North America Latin America Western Europe Central and Eastern Europe North East Asia China ¹ South East Asia	2021 14 7.7 15 9.9 14 15	2022 17 10.5 19 13 17 18 125	2028 55 41 52 35 55 47	2022–2028 21% 25% 18% 28% 21% 18% 21%	Unit GB/month GB/month GB/month GB/month GB/month
Data traffic per smartphone North America Latin America Western Europe Central and Eastern Europe North East Asia China ¹ South East Asia and Oceania India Nased and Phyton	2021 14 7.7 15 9.9 14 15 9.1 20	2022 17 10.5 19 13 17 18 12.5 25	2028 55 41 52 35 55 47 54	2022–2028 21% 25% 18% 21% 18% 21% 18% 28%	Unit GB/month GB/month GB/month GB/month GB/month GB/month
Data traffic per smartphoneNorth AmericaLatin AmericaWestern EuropeCentral and Eastern EuropeNorth East AsiaChina1South East Asia and OceaniaIndia, Nepal and BhutanMiddle East and North Africa	2021 14 7.7 15 9.9 14 15 9.1 20 7.8	2022 17 10.5 19 13 17 18 12.5 25 11	2028 55 41 52 35 55 47 54 54 54	2022–2028 21% 25% 18% 21% 21% 18% 28% 14%	Unit GB/month GB/month GB/month GB/month GB/month GB/month GB/month
Data traffic per smartphoneNorth AmericaLatin AmericaWestern EuropeCentral and Eastern EuropeNorth East AsiaChina1South East Asia and OceaniaIndia, Nepal and BhutanMiddle East and North Africa	2021 14 7.7 15 9.9 14 15 9.1 20 7.8 22	2022 17 10.5 19 13 17 18 12.5 25 11 25	2028 55 41 52 35 55 47 54 54 54 38	2022-2028 21% 25% 18% 21% 21% 18% 28% 14% 24%	Unit GB/month GB/month GB/month GB/month GB/month GB/month GB/month
Data traffic per smartphoneNorth AmericaLatin AmericaWestern EuropeCentral and Eastern EuropeNorth East AsiaChina ¹ South East Asia and OceaniaIndia, Nepal and BhutanMiddle East and North AfricaGCC ² Sub Scharge Africa	2021 14 7.7 15 9.9 14 15 9.1 20 7.8 22 22	2022 17 10.5 19 13 17 18 12.5 25 11 25 4.4	2028 55 41 52 35 55 47 54 54 54 38 53	2022–2028 21% 25% 18% 21% 18% 21% 18% 28% 14% 24% 13% 24%	Unit GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month
Data traffic per smartphoneNorth AmericaLatin AmericaWestern EuropeCentral and Eastern EuropeNorth East AsiaChina1South East Asia and OceaniaIndia, Nepal and BhutanMiddle East and North AfricaGCC2Sub-Saharan Africa	2021 14 7.7 15 9.9 14 15 9.1 20 7.8 22 3.3	2022 17 10.5 19 13 17 18 12.5 25 11 25 4.6	2028 55 41 52 35 55 47 54 54 54 54 38 53 18	2022–2028 21% 25% 18% 28% 21% 18% 28% 14% 24% 13% 26%	Unit GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month
Data traffic per smartphoneNorth AmericaLatin AmericaWestern EuropeCentral and Eastern EuropeNorth East AsiaChina1South East Asia and OceaniaIndia, Nepal and BhutanMiddle East and North AfricaGCC2Sub-Saharan Africa	2021 14 7.7 15 9.9 14 15 9.1 20 7.8 22 3.3	2022 17 10.5 19 13 17 18 12.5 25 11 25 4.6	2028 55 41 52 35 55 47 54 54 54 38 53 18 Forecast	2022–2028 21% 25% 18% 21% 18% 21% 18% 28% 14% 24% 13% 26% CAGR*	Unit GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month
Data traffic per smartphoneNorth AmericaLatin AmericaWestern EuropeCentral and Eastern EuropeNorth East AsiaChina1South East Asia and OceaniaIndia, Nepal and BhutanMiddle East and North AfricaGCC2Sub-Saharan AfricaMobile data traffic	2021 14 7.7 15 9.9 14 15 9.1 20 7.8 22 3.3 2021	2022 17 10.5 19 13 17 18 12.5 25 11 25 4.6 2022	2028 55 41 52 35 55 47 54 54 54 38 53 18 Forecast 2028	2022–2028 21% 25% 18% 21% 18% 28% 14% 28% 14% 24% 13% 26% CAGR* 2022–2028	Unit GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month
Data traffic per smartphoneNorth AmericaLatin AmericaWestern EuropeCentral and Eastern EuropeNorth East AsiaChina ¹ South East Asia and OceaniaIndia, Nepal and BhutanMiddle East and North AfricaGCC ² Sub-Saharan AfricaMobile data trafficNorth America	2021 14 7.7 15 9.9 14 15 9.1 20 7.8 22 3.3 2021 4.8	2022 17 10.5 19 13 17 18 12.5 25 11 25 4.6 2022 6.0	2028 55 41 52 35 55 47 54 54 54 54 54 38 53 18 Forecast 2028 21	2022–2028 21% 25% 18% 21% 18% 28% 14% 24% 13% 26% CAGR* 2022–2028 23%	Unit GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month
Data traffic per smartphoneNorth AmericaLatin AmericaWestern EuropeCentral and Eastern EuropeNorth East AsiaChina1South East Asia and OceaniaIndia, Nepal and BhutanMiddle East and North AfricaGCC2Sub-Saharan AfricaMobile data trafficNorth AmericaLatin America	2021 14 7.7 15 9.9 14 15 9.1 20 7.8 22 3.3 2021 4.8 3.7	2022 17 10.5 19 13 17 18 12.5 25 11 25 4.6 2022 6.0 5.3	2028 55 41 52 35 55 47 54 54 54 54 54 38 53 18 Forecast 2028 21 24	2022–2028 21% 25% 18% 28% 21% 18% 28% 14% 24% 13% 26% CAGR* 2022–2028 23% 28%	Unit GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month BB/month EB/month
Data traffic per smartphoneNorth AmericaLatin AmericaWestern EuropeCentral and Eastern EuropeNorth East AsiaChina1South East Asia and OceaniaIndia, Nepal and BhutanMiddle East and North AfricaGCC2Sub-Saharan AfricaMobile data trafficNorth AmericaLatin AmericaWestern Europe	2021 14 7.7 15 9.9 14 15 9.1 20 7.8 22 3.3 2021 4.8 3.7 6.1	2022 17 10.5 19 13 17 18 12.5 25 11 25 4.6 2022 6.0 5.3 7.8	2028 55 41 52 35 55 47 54 54 54 54 54 53 18 Forecast 2028 21 24 22	2022–2028 21% 25% 18% 28% 21% 18% 28% 14% 24% 13% 26% CAGR* 2022–2028 23% 28% 19%	Unit GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month EB/month EB/month
Data traffic per smartphoneNorth AmericaLatin AmericaWestern EuropeCentral and Eastern EuropeNorth East AsiaChina1South East Asia and OceaniaIndia, Nepal and BhutanMiddle East and North AfricaGCC2Sub-Saharan AfricaMobile data trafficNorth AmericaLatin AmericaWestern EuropeCentral and Eastern EuropeCentral and Eastern Europe	2021 14 7.7 15 9.9 14 15 9.1 20 7.8 22 3.3 2021 4.8 3.7 6.1 3.3	2022 17 10.5 19 13 17 18 12.5 25 11 25 4.6 2022 6.0 5.3 7.8 4.3	2028 55 41 52 35 55 47 54 54 54 54 54 38 53 18 Forecast 2028 21 24 24 22 12	2022–2028 21% 25% 18% 28% 21% 18% 28% 28% 14% 24% 13% 26% CAGR* 2022–2028 23% 28% 19% 18%	Unit GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month GB/month EB/month EB/month EB/month EB/month
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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 enables communications service providers and enterprises to capture the full value of connectivity. The company's portfolio spans the following business areas: Networks, Cloud Software and Services, Enterprise Wireless Solutions, Global Communications Platform, and Technologies and New Businesses. It is designed to help our customers go digital, increase efficiency and find new revenue streams. Ericsson's innovation investments have delivered the benefits of mobility and mobile broadband to billions of people globally. Ericsson stock is listed on Nasdaq Stockholm and on Nasdaq New York.

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