The State of 5G 2024

Introducing the GSMA Intelligence 5G Connectivity Index

GSMA Intelligence

GSMA

GSMA Intelligence

The GSMA is a global organisation unifying the mobile ecosystem to discover, develop and deliver innovation foundational to positive business environments and societal change. Our vision is to unlock the full power of connectivity so that people, industry and society thrive. Representing mobile operators and organisations across the mobile ecosystem and adjacent industries, the GSMA delivers for its members across three broad pillars: Connectivity for Good, Industry Services and Solutions, and Outreach. This activity includes advancing policy, tackling today's biggest societal challenges, underpinning the technology and interoperability that make mobile work, and providing the world's largest platform to convene the mobile ecosystem at the MWC and M360 series of events.

We invite you to find out more at gsma.com

Follow the GSMA: @GSMA

GSMA Intelligence is the definitive source of global mobile operator data, analysis and forecasts, and publisher of authoritative industry reports and research. Our data covers every operator group, network and MVNO in every country worldwide – from Afghanistan to Zimbabwe. It is the most accurate and complete set of industry metrics available, comprising tens of millions of individual data points, updated daily.

GSMA Intelligence is relied on by leading operators, vendors, regulators, financial institutions and third-party industry players, to support strategic decision-making and long-term investment planning. The data is used as an industry reference point and is frequently cited by the media and by the industry itself.

Our team of analysts and experts produce regular thought-leading research reports across a range of industry topics.

gsmaintelligence.com

info@gsmaintelligence.com

Authors
Francisco Amaya, Economist, GSMA Intelligence
Kalvin Bahia, Principal Economist, GSMA Intelligence

Published February 2024

Contents

Executive summary

The number of 5G connections worldwide surpassed 1.5 billion at the end of 2023, four years after the arrival of the technology, making it the fastest-growing mobile broadband technology to date. However, despite this progress, a new digital divide is starting to emerge between high-income and low- and middle-income countries (LMICs). Furthermore, even in countries with 5G, the technology has not yet realised its full potential in terms of digital transformation, economic impact and commercial value. This highlights the imperative for strategic interventions, enabling policies and targeted investments to ensure the evolution of 5G everywhere.

Against this backdrop, GSMA Intelligence has launched the 5G Connectivity Index (5GI) to help enable increased coverage, adoption, usage and market development.[1] The 5GI provides a comprehensive assessment of 5G in 39 markets, offering valuable insights for informed decision-making and investment by the mobile ecosystem and policymakers. It is constructed around two categories, 5G infrastructure and 5G services, which are divided into six pillars, which are in turn made up of 17 indicators.

1 The 5GI is available at the following link: https://gsmaintelligence.com/5g-index. The webtool provides overall index scores as well as the underlying score for each indicator and a market comparison tool.

Figure i

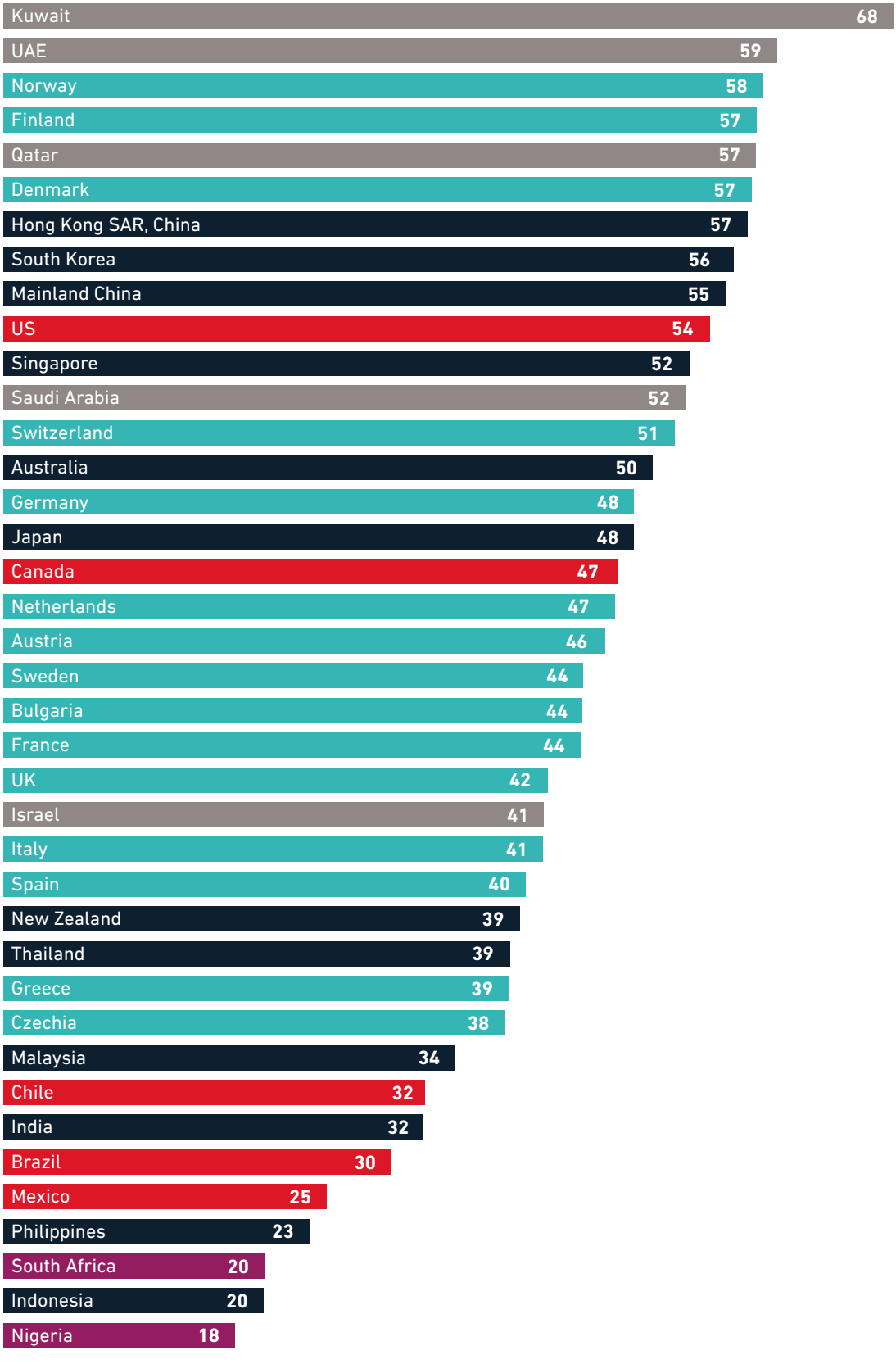
5G Connectivity Index structure: categories, pillars and indicators

* 5G coverage is a combination of two sub-indicators: 5G population coverage and 5G availability.
** 5G data affordability is a combination of the monthly affordability across three different baskets of data allowances for 5G (20, 50 and 100 GB).
Source: GSMA Intelligence

The results of the first edition of the index are presented in Figure ii. Leading the way are developed economies in the Gulf, Scandinavia and Asia Pacific. These have achieved high scores for spectrum, coverage, network experience, affordability, adoption and device shipments. However, 5G fixed wireless access adoption, data usage and revenue growth remain key areas for improvement. The countries that perform less well on the 5GI are mostly LMICs in Sub-Saharan Africa, Latin America and Asia Pacific. Their lower scores are primarily attributable to the network, affordability and adoption pillars.

Figure ii

5G Connectivity Index results by market, 2023



Source: GSMA Intelligence

While the 5GI highlights a number of variations in 5G development by region, some general insights can be drawn:

- Consumer experience on 5G networks outperforms that of 4G in all assessed markets, with average 5G download speeds reaching around 230 Mbps by the end of 2023, a more than fivefold increase compared to 4G. In some markets, 5G speeds are more than 10 times greater than 4G. The assignment of new spectrum bands, especially in the 3.5 GHz range, has played an instrumental role in improving user experience.
- There has been significant progress in providing affordable 5G data plans and devices. More than 30 markets in the index allow consumers to access 5G data plans of 100 GB per month for less than 2% of monthly income per capita, and in the majority of markets, 5G unit prices per gigabyte are cheaper than those of 4G, allowing consumers to access higher data allowances. New smartphone shipments in high-income countries are mostly sold for over $500, while in emerging markets almost two thirds are below $250, highlighting the growing importance of lower-cost 5G handsets.
- 5G fixed wireless access (FWA) has been one of the early 5G success stories in several markets, having reached more than 5% adoption among households in Kuwait, Saudia Arabia, the UAE, Austria, the US, Germany and Australia. This represents an important use case for operators aiming to drive revenue growth, serve new market segments and better utilise network assets. It also provides high-speed fixed broadband connectivity to underserved households and can help close the digital divide between and within countries. However, in the majority of countries, 5G FWA adoption remains low and so there is significant room for growth.
- Lastly, the index shows that 5G is an evolutionary process and is currently still in the early stages. Despite the continued growth in mobile data consumption, most of the more data-intensive 5G use cases (e.g. AR and VR) remain nascent, including for consumers. Furthermore, in most markets, including those with higher 5G consumer adoption, the business-to-business (B2B) segment that operators expect to drive much of the revenue growth for 5G has not yet achieved scale. The majority of operators are yet to deploy 5G standalone (SA) networks, which is a prerequisite for unlocking the full potential of 5G. However, the deployment and densification of 5G is a challenge for operators, given the high levels of investment needed and the fact that in many markets, returns have been flat or otherwise declining.

The deployment of 5G SA and 5G-Advanced represents the next stage of 5G's evolution to support new market demands before the development and launch of 6G towards the end of the decade. In terms of the 5GI, these technologies should drive significant improvements in the indicators that currently score poorly, particularly in the market development pillar (given the potential commercial opportunities from the B2B segment), as well as the network and experience pillars (given the infrastructure upgrades that are required). However, realising these opportunities will be dependent on wide ecosystem support, overcoming investment constraints and establishing a path to the monetisation of 5G use cases. All of this will require an enabling policy framework that incentivises investment, fosters innovation and collaboration, promotes dynamic competition and supports the timely access to the right amount of affordable spectrum in low, mid- and high bands.

The 5GI is therefore being introduced at a key point in the evolution of 5G. Going forward, it will provide the mobile ecosystem and policymakers with a comprehensive assessment of 5G development over time and enable them to target investments and resources where they are most needed.

1 Introduction

Background and context

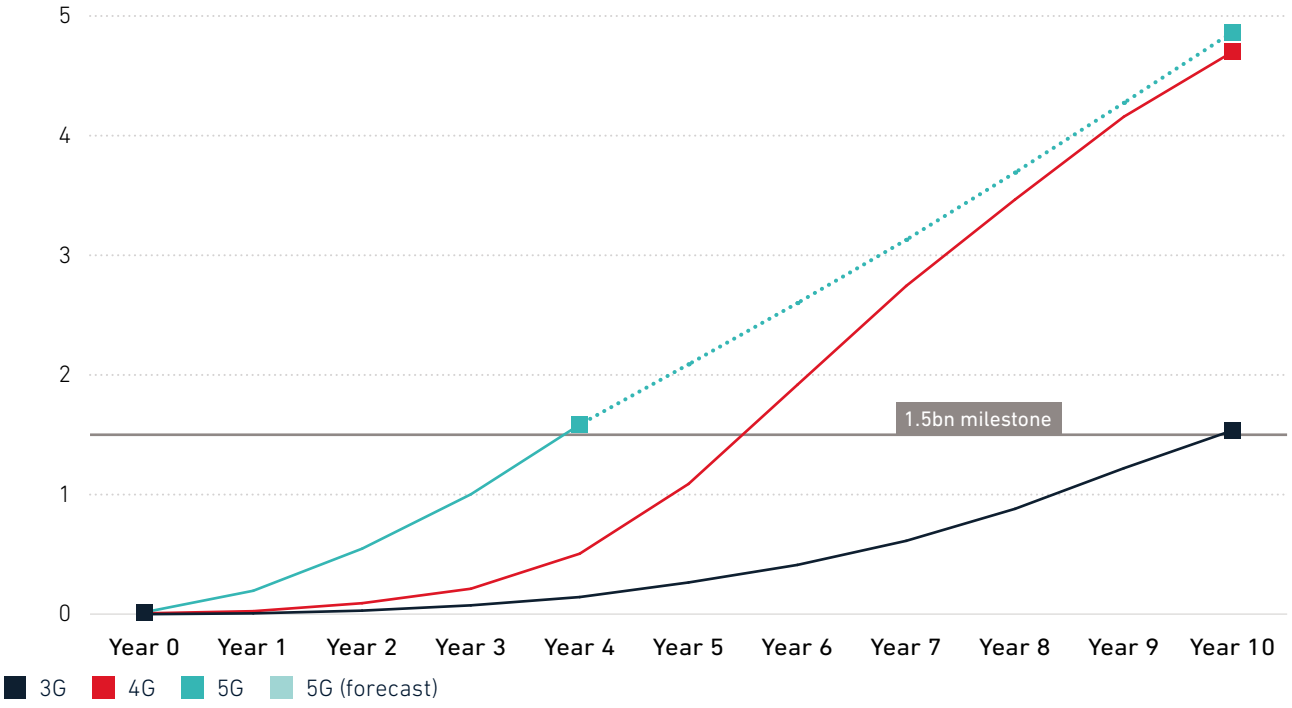
The arrival of 5G technology has enabled faster broadband speeds and lower latencies than any previous generation of mobile technology. By delivering a step-change in consumer connectivity and enterprise applications, 5G has the potential to become a key pillar for intelligent connectivity, supporting economic growth, transforming businesses and delivering new innovative services. Following the launch of the technology in 2019, the number of 5G connections worldwide surpassed 1.5 billion at the end of 2023, making it the fastest-growing mobile technology to date. It took 10 years for 3G to reach the same milestone and more than five years for 4G (see Figure 1).

Going forward, 5G is expected to continue to grow, as shown in Figure 2. Having surpassed 2G and 3G in terms of number of connections in 2023, it is expected to become the dominant global technology by 2028. The number of connections on legacy networks (2G and 3G) will continue to decline in the coming years as users migrate to 4G and 5G, resulting in more network shutdowns.

Figure 1

Number of 3G, 4G and 5G connections globally since launch

Billion

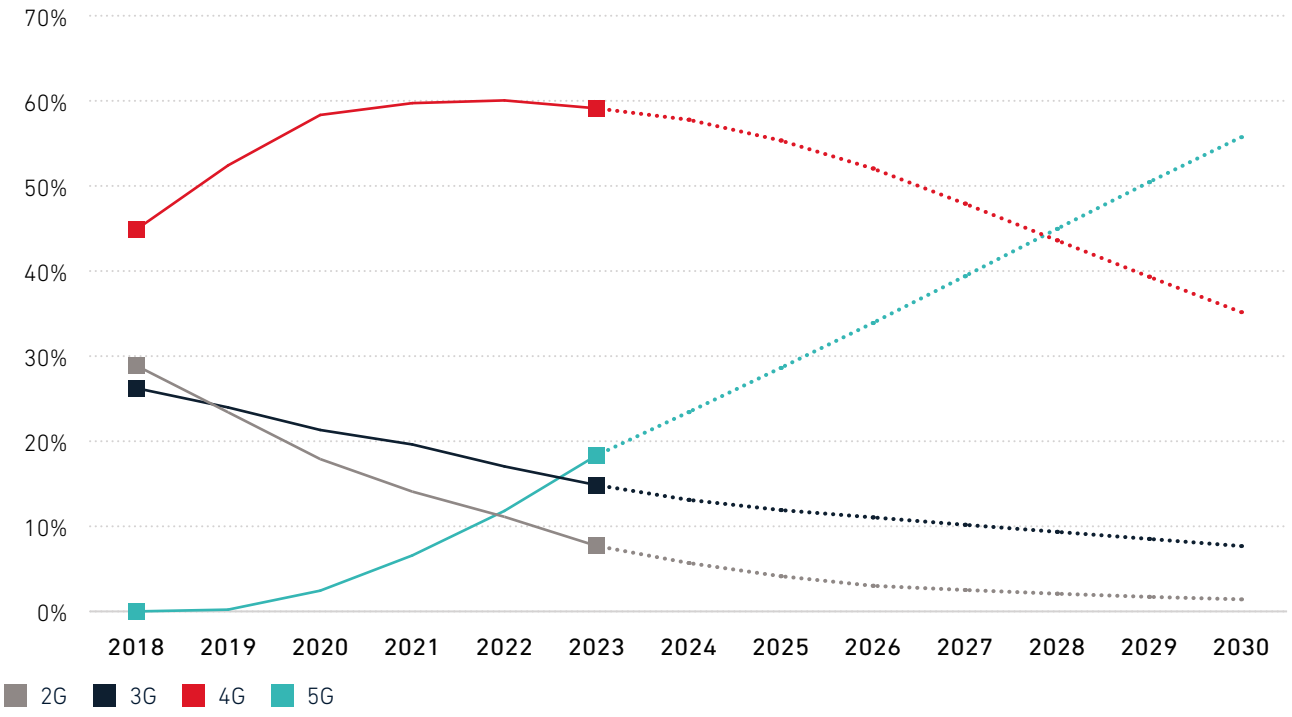


Source: GSMA Intelligence

Figure 2

Evolution and forecast of mobile connections by technology

Percentage of connections



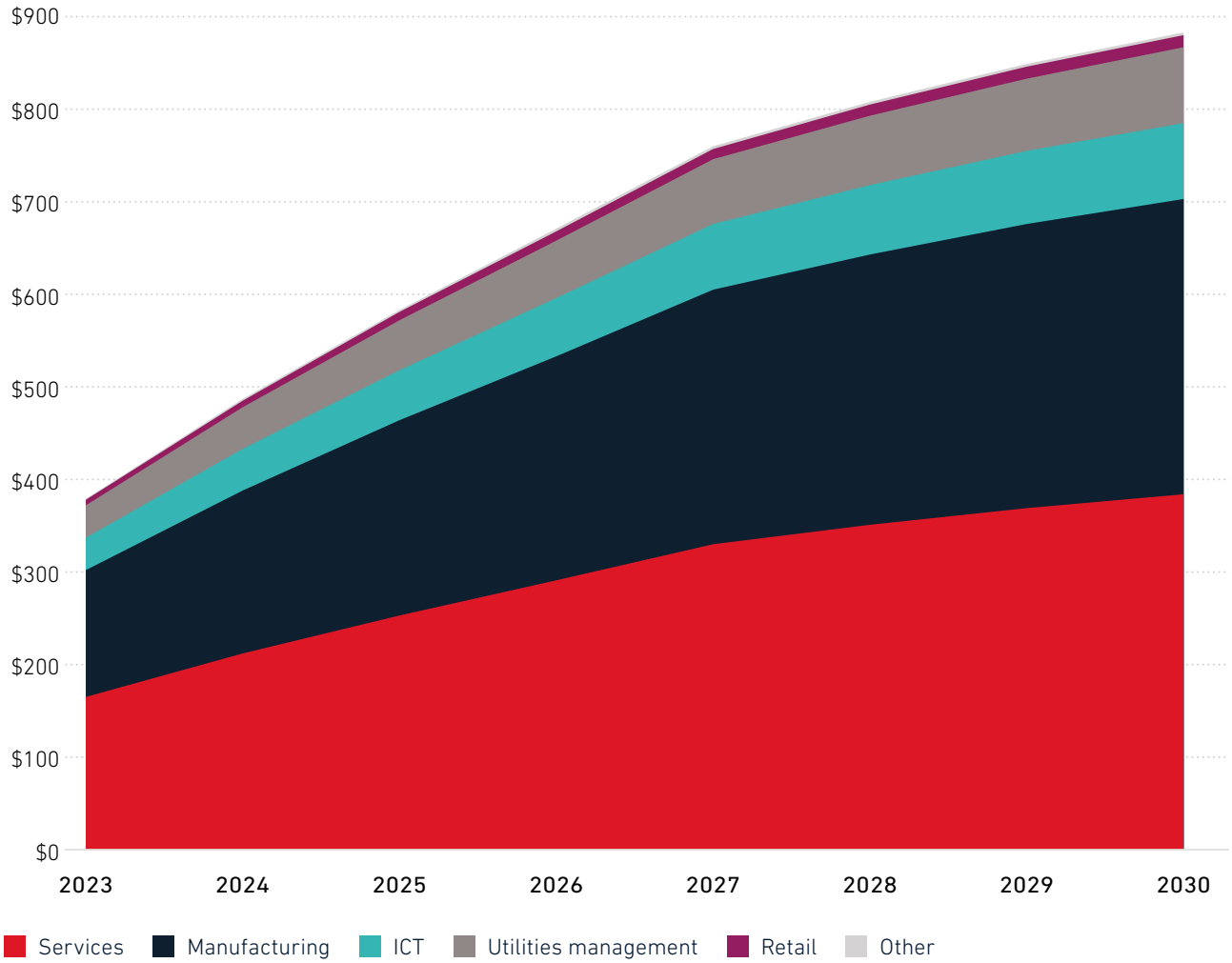
Source: GSMA Intelligence

As 5G technology becomes embedded in consumer and enterprise applications, it will drive wider economic growth – it is projected to contribute almost $900 billion to the global economy by 2030. Developed regions at the forefront of this digital transformation, including in Asia Pacific, North America and Europe, are set to experience robust growth in the period to 2030. The primary beneficiaries are expected to be the manufacturing, service and public administration industries, which will jointly contribute 60% of the total economic impact, driven by applications such as smart factories, smart cities and smart grids.

Figure 3

Annual global 5G contribution by industry

Billion



Source: GSMA Intelligence

A salient characteristic of 5G is its versatility, with the technology having driven increased adoption across a variety of business sectors. Industries ranging from power companies and manufacturers to transport operators and food producers are able to use 5G for mission-critical applications. The shift to 5G not only enhances operational flexibility but also contributes to cost reductions and productivity improvements.

Moreover, 5G has the potential to close the digital divide by extending high-speed broadband to communities previously beyond the reach of fixed networks. 5G technology also has the ability to support an extensive array of static and mobile IoT devices, which have a diverse range of speed, bandwidth and quality-of-service requirements. Table 1 sets out some of the primary 5G use cases and applications.

Table 1

5G use cases: description and associated applications

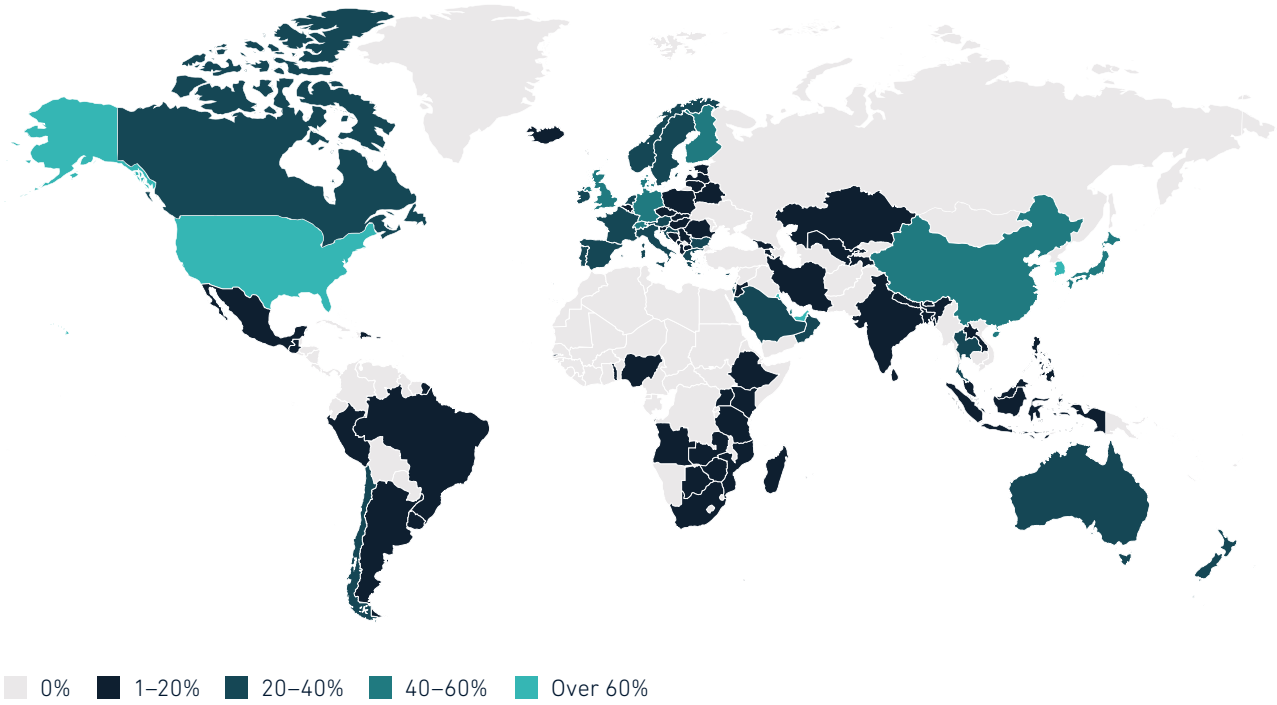
Use case	Description	Business need	Vertical
Fixed wireless access	5G allows network operators to deliver ultra-high-speed broadband to suburban and lower-density areas, supporting home and business applications where fibre is prohibitively expensive to lay and maintain. This will allow more communities to be connected to the internet via an ultra-fast, reliable connection, bringing applications such as telemedicine and remote education to more people. 5G FWA can therefore provide the benefits of fibre-like connectivity to rural communities.	• Alternative to fibre connection • Provides high-speed fixed connectivity in areas where it is not currently accessible	Education, healthcare, public administration, utilities
Enhanced mobile broadband	5G provides the capacity to handle growing data traffic and grants operators an opportunity to develop new and improved services to consumers. This will enable a new range of applications, including reliable mobile internet services for mass gatherings and sports events (where current mobile technology is often stretched to its limits) and AR/VR applications that improve the customer experience e.g. in retail, by supporting or replacing traditional showrooms.	• Immersive experience (AR/VR) • Allows 4K/8K streaming on capable devices • Increased service capacity	Retail, public administration, arts and events
Ultra-reliable low-latency communication	Low latency and high reliability will enable new applications in manufacturing, logistics, health and transportation. These include autonomous driving, connected robotic applications, AR/VR, drones and remote surgical/medical operations.	• Autonomous driving • Safety-critical applications • Remote manufacturing • Remote healthcare	Manufacturing, utilities, oil and gas, transport, healthcare
Massive IoT	5G will be able to facilitate a large network of IoT devices, supporting the creation of smart cities, smart infrastructure and, in the utility sector, smart grids capable of self-identifying issues on networks. In the agricultural sector, for example, farmers will benefit from the potential of a vast collection of sensors located in fields that are able to identify with pinpoint precision which areas need water, have disease or require pest management.	• Remote control of crop conditions • Advanced manufacturing • Smart cities	Agriculture, utilities, manufacturing, public administration

Source: GSMA Intelligence

Despite the promising outlook, however, another digital divide is starting to emerge. More than 100 countries and territories had not launched 5G networks at the end of 2023, of which more than 80% are LMICs.[2] While ambitious targets have been set by policymakers and industry leaders for 5G deployment, penetration remains low in many markets (see Figure 4). Based on the latest forecasts, by 2030 it is expected that 5G penetration in LMICs will be around 55%, compared to 120% for high-income countries.[3] This highlights the imperative for strategic interventions, enabling policies and targeted investments to address the barriers to 5G development.

Figure 4

5G market penetration globally, 2023



Source: GSMA Intelligence

2 Based on the most recent income classifications by the World Bank.
3 Sourced from GSMA Intelligence. 5G penetration is calculated as the number of 5G connections as a percentage of total population. Connections differ from subscribers in that a unique subscriber can have multiple connections. Penetration can therefore be greater than 100%.

Introducing the GSMA Intelligence 5G Connectivity Index

Given the importance and potential transformative impacts of 5G, GSMA Intelligence has launched the 5G Connectivity Index (5GI) to help enable increased 5G network coverage, adoption and market development. The objectives of the 5GI are as follows:

1. **Understanding the 5G landscape:** The index offers a complete view of 5G development in the selected markets, tracking indicators for coverage, network performance, affordability, adoption and market development. This facilitates comparative analysis and offers valuable insights for informed decision-making.
2. **Tailoring priorities for 5G deployment:** The 5GI aims to tailor 5G connectivity, network and economic priorities based on local market context and digital development, aligning strategies with specific national needs.
3. **Guidance for policymakers:** The 5GI provides a data-driven approach for decision-making, ensuring decisions on 5G expansion are grounded in empirical evidence. Policymakers can develop guidelines from the 5GI, ensuring focused efforts to drive increased 5G market development.
4. **Promoting universal access:** The index encourages universal access to advanced mobile connectivity, highlighting the disparities in 5G deployment to bridge the digital divide. An important aspect of the 5GI is establishing ambitious aspirational targets, providing a clear roadmap for markets to achieve their 5G and broader connectivity goals.

2

The 5G Connectivity Index

Index framework

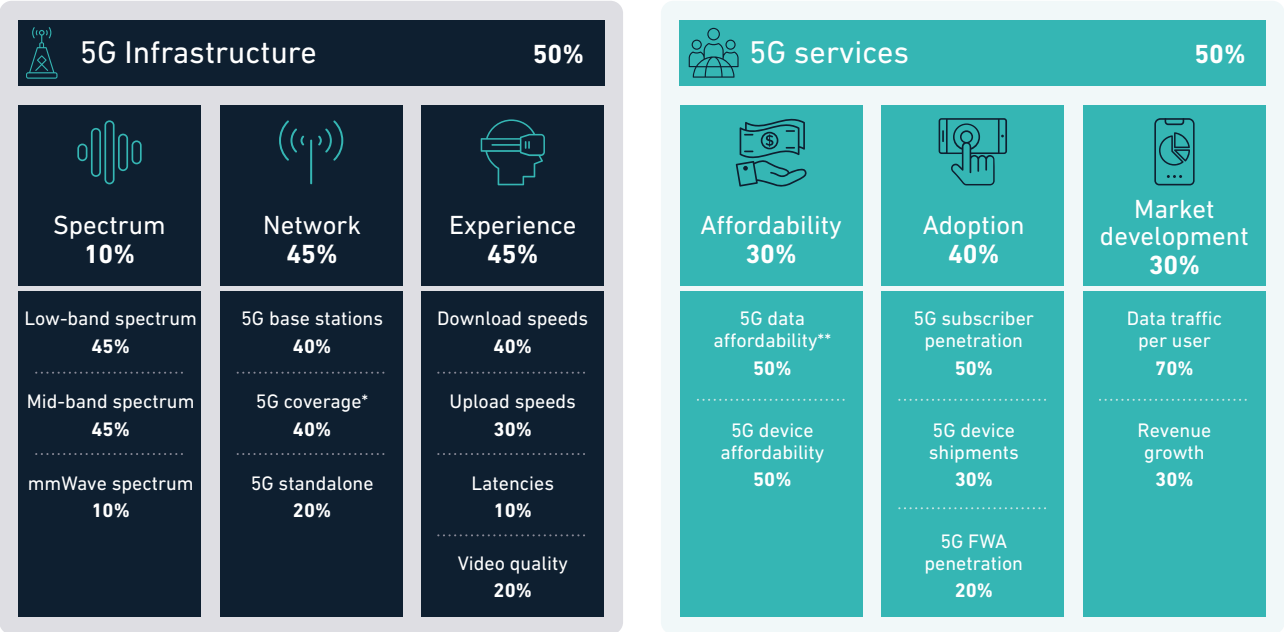
The 5GI is constructed around two categories, 5G infrastructure and 5G services, which are divided into six pillars, which are in turn made up of 17 indicators. Figure 5 presents the 5GI structure, as well as the weights assigned to each index layer. Details of the 17 indicators that are used to construct the index are provided in Table 2.

The 5GI combines enablers and outcomes to provide a comprehensive measure of 5G development in each market. Enablers, such as network infrastructure or spectrum, contribute to desired outcomes such as higher adoption and market development. The indicators in the index therefore measure either an enabler of 5G connectivity or the adoption or usage of 5G by consumers or enterprises.[4] This combination offers a holistic assessment of 5G, aiding governments and organisations in decision-making, investment and strategic planning.

4 Details about data selection criteria are included in 5G Connectivity Index methodology, GSMA Intelligence, 2024

Figure 5

5G Connectivity Index structure and weightings: categories, pillars and indicators



* 5G coverage is a combination of two sub-indicators: 5G population coverage and 5G availability.
** 5G data affordability is a combination of the monthly affordability across three different baskets of data allowances for 5G (20, 50 and 100 GB).
Source: GSMA Intelligence

Table 2

5G Index categories, pillars and indicators

Category	Pillar	Indicator	Description	Source
5G infrastructure	Spectrum	Low-band spectrum	Amount of spectrum in bands below 1 GHz assigned to mobile network operators	GSMA Intelligence
		Mid-band spectrum	Amount of spectrum in bands in 1–7 GHz assigned to mobile network operators	GSMA Intelligence
		mmWave spectrum	Amount of spectrum in bands above 24 GHz assigned to mobile network operators	GSMA Intelligence
	Network	5G base stations	Number of 5G base stations deployed per 100,000 people	GSMA Intelligence
		5G coverage (a)	Coverage and availability of 5G networks	Ookla Speedtest Intelligence® and GSMA Intelligence
		5G standalone	Proportion of 5G connections with operators that have deployed a 5G standalone network	GSMA Intelligence
	Experience	Download speeds	Median download speed for mobile users	Ookla Speedtest Intelligence
		Upload speeds	Median upload speed for mobile users	Ookla Speedtest Intelligence
		Latencies	Median latency for mobile users	Ookla Speedtest Intelligence
		Video quality	Weighted sum of multiple video quality metrics	Ookla Speedtest Intelligence

Category	Pillar	Indicator	Description	Source
5G services	Affordability	5G data affordability (b)	Monthly affordability of 5G data plans (based on 20 GB, 50 GB and 100 GB mobile 5G data plans)	Tarifica
		5G device affordability	Monthly affordability of the cheapest available 5G device	Tarifica
	Adoption	5G subscriber penetration	5G connections at the end of the period, expressed as a percentage share of the total population	GSMA Intelligence
		5G device shipments	Proportion of new device sales that are 5G-enabled	Counterpoint Research
		5G FWA penetration	5G fixed wireless access (FWA) connections as percentage of total households	GSMA Intelligence
	Market Development	Data traffic per user	Monthly data traffic per connection	GSMA Intelligence
		Revenue growth	The average percentage growth in mobile operator revenues since the launch of 5G networks in the market	GSMA Intelligence

a) The indicators for 5G coverage entail a combination of two additional sub-indicators: 5G population coverage (representing the proportion of the population covered by a 5G network, sourced from GSMA Intelligence) and 5G availability (reflecting the proportion of users on 5G-capable devices who spend the majority of their time on 5G, sourced from Ookla Speedtest Intelligence).
b) The indicators for 5G data affordability entail a combination of three additional sub-indicators: monthly affordability of the cheapest 20, 50 and 100 GB mobile 5G data plan (initially expressed as a percentage of monthly GDP per capita, sourced from Tarifica).
Source: GSMA Intelligence

In order to ensure comparability across indicators, they are normalised using the 'minimum-maximisation' method, which transforms all indicators to lie within a range between 0 to 100, with a higher score always representing stronger performance.

The 5GI web dashboard provides overall index scores, including the underlying score for each indicator and a market comparison tool.[5] The first version of the 5GI covers 39 markets and, going forward, some indicators will be updated on a quarterly basis, with the remainder updated annually. Over time, more markets will be added to the index as they begin their 5G journey. Full details of the methodology used to construct the index, including data treatment, normalisation, weighting and aggregation, are also provided on the web tool.[6]

The rest of this section provides key insights from the first version of the 5GI, with all analysis reflecting data as of Q4 2023.[7]

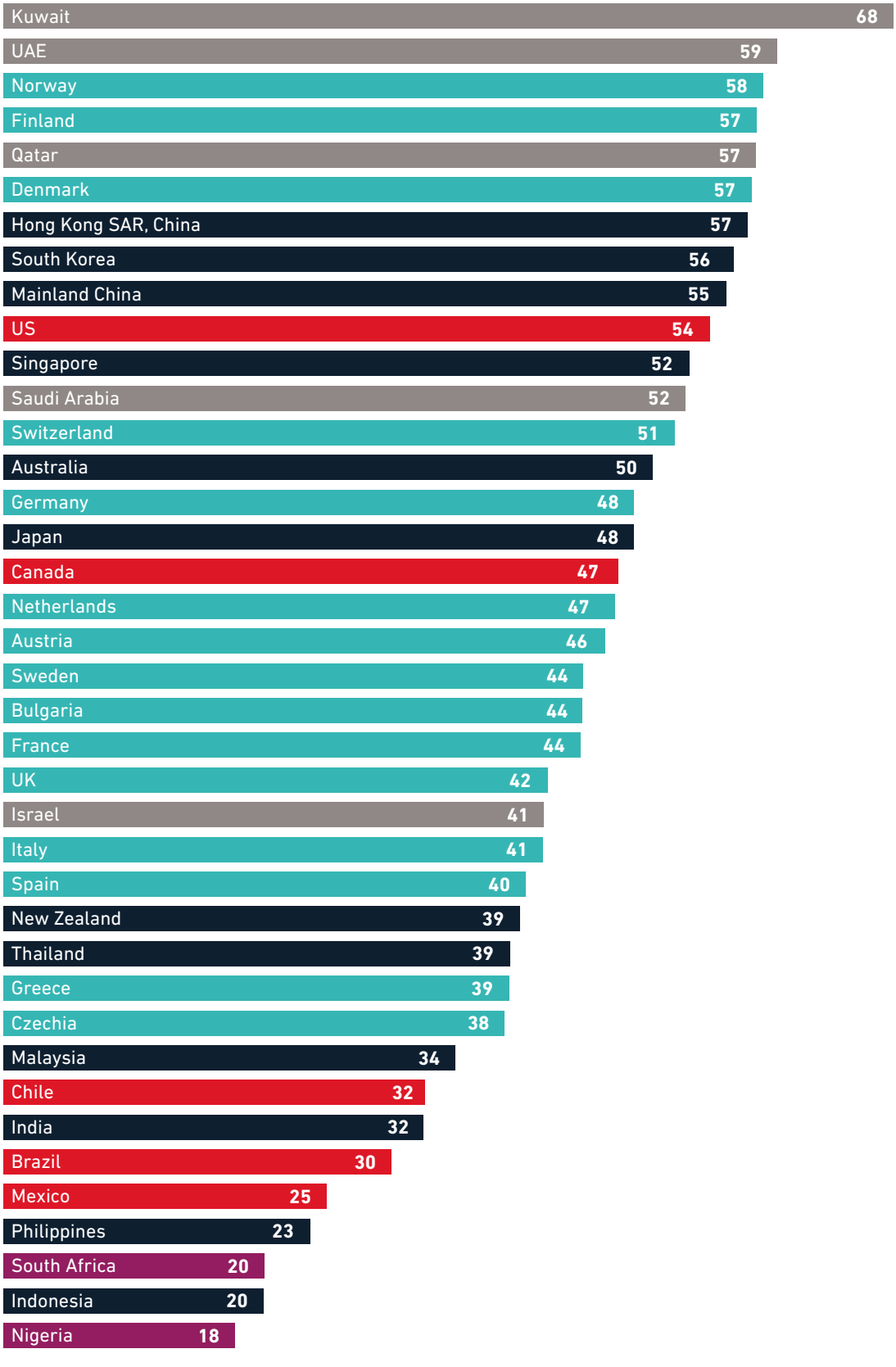
5G Connectivity Index scores

Figure 6 presents the results of the 5GI scores by market. The highest performers are primarily comprised of developed markets in the Gulf, Scandinavia and Asia Pacific. These markets exhibit relatively advanced levels of both demand and supply factors for 5G services. On average, Asia Pacific markets slightly outperform their European counterparts, while African and Latin American markets lag behind. This regional variation underscores the need to address uneven levels of 5G development worldwide. The majority of low- and middle-income markets (LMICs) record the lowest scores, emphasising the urgency to address the emerging digital divide.

5 Available at the following link: https://gsmaintelligence.com/5g-index
6 5G Connectivity Index Methodology, GSMA Intelligence, 2024
7 It is possible that, going forward, certain data will be retroactively updated. Therefore, the results presented in this report may differ slightly from the data on the 5GI website in the future.

Figure 6

5G Connectivity Index results by market, 2023



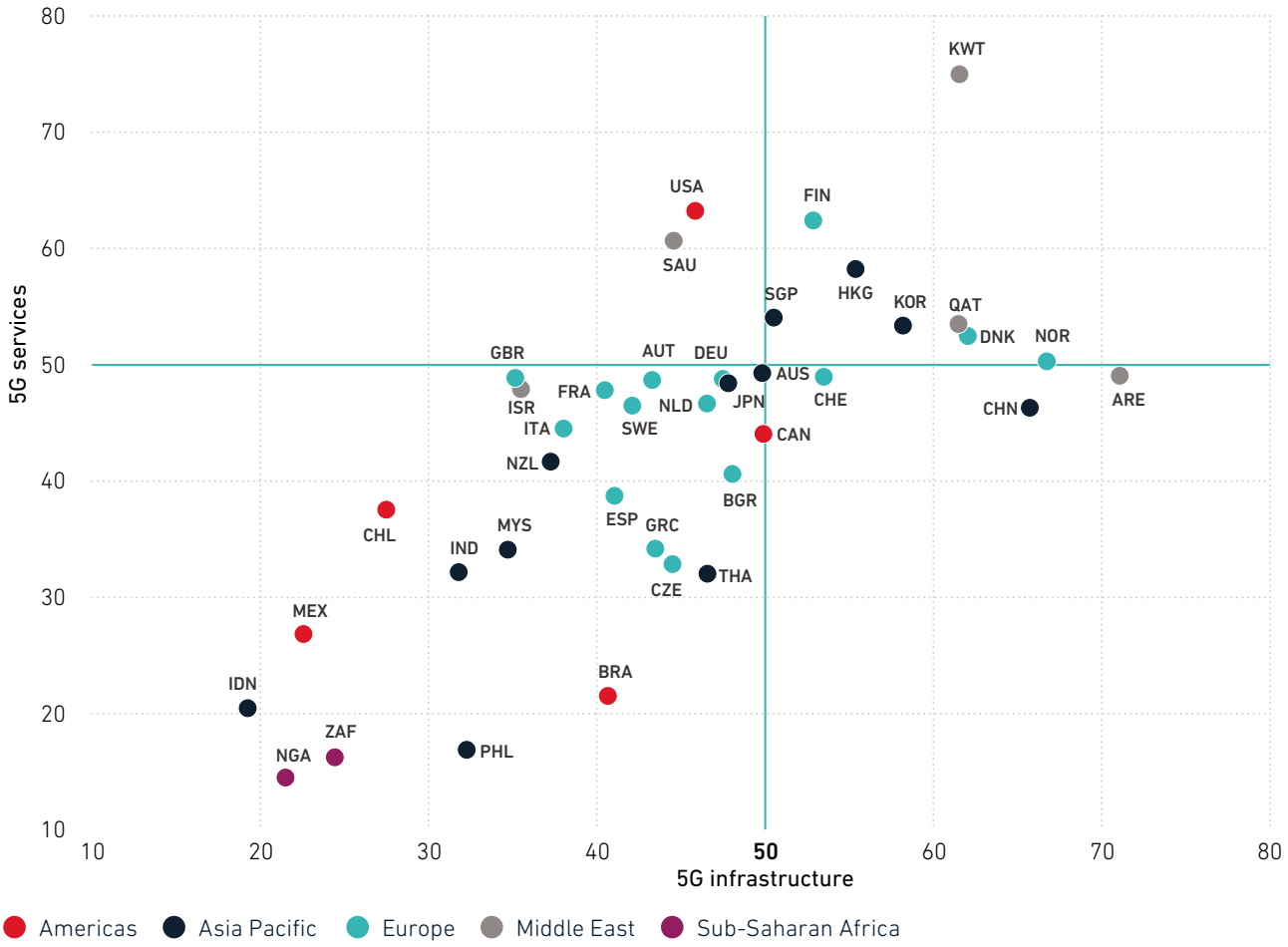
Source: GSMA Intelligence

Despite the notable achievements of the leading markets, only Kuwait scores above 60 (and it still has significant room to increase its score, notably on the spectrum pillar and the revenue growth indicator). Additionally, a further 12 markets score above 50, which is the midpoint of the index scale and is also above the average score of the sample (44). Six markets score below 30, with the remainder scoring between 30 and 50. This can be attributed to the fact that the majority of analysed markets require improvement in at least one of the two 5GI categories. As shown in Figure 7, only eight markets (Kuwait, Norway, Finland, Qatar, Denmark, Hong Kong SAR, South Korea and Singapore) achieve a score higher than 50 for both categories.

Among the 31 markets with a score below 50 in at least one of the categories, five markets achieve scores above 50 on the overall index. These markets show relative strength in specific dimensions. However, the majority of markets score below 50 in both categories, meaning that most markets have room for improvement in both 5GI categories. This emphasises the important role of the 5GI going forward to provide a benchmark for markets to track their 5G progress.

Figure 7

Score results by 5GI categories (5G services and 5G infrastructure)

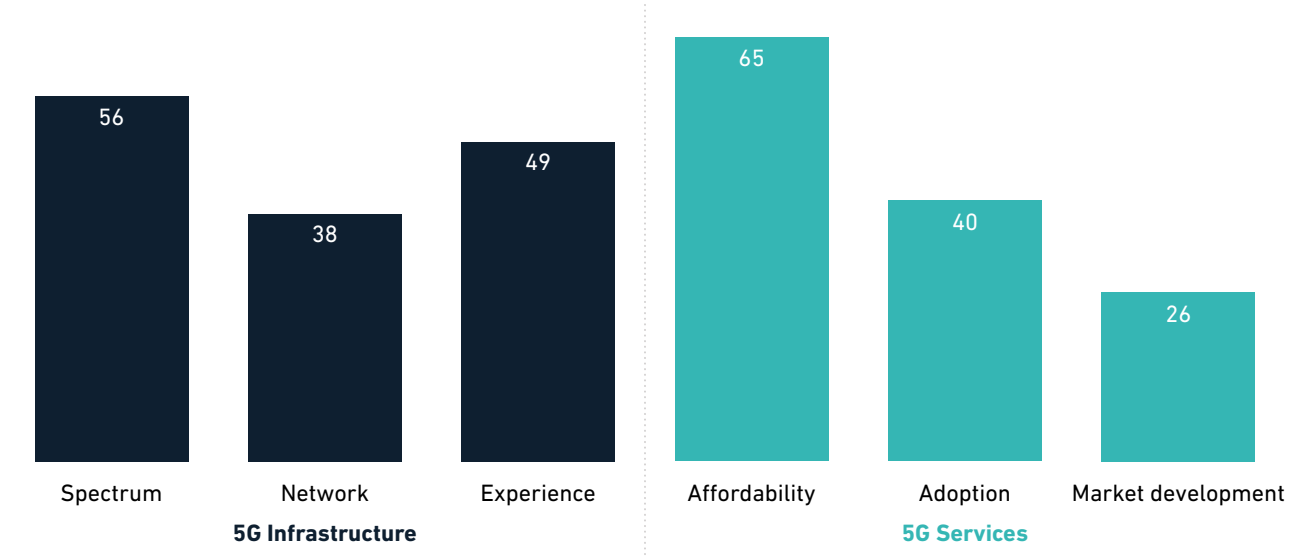


Source: GSMA Intelligence

As shown in Figure 8, market development ranks as the lowest-scoring pillar of the 5GI, followed by network and adoption. Across all markets, there is comparatively stronger performance in spectrum, experience and affordability. These variations highlight the evolving nature of 5G development, stressing the ongoing need to address specific barriers.

Figure 8

Average scores by pillar



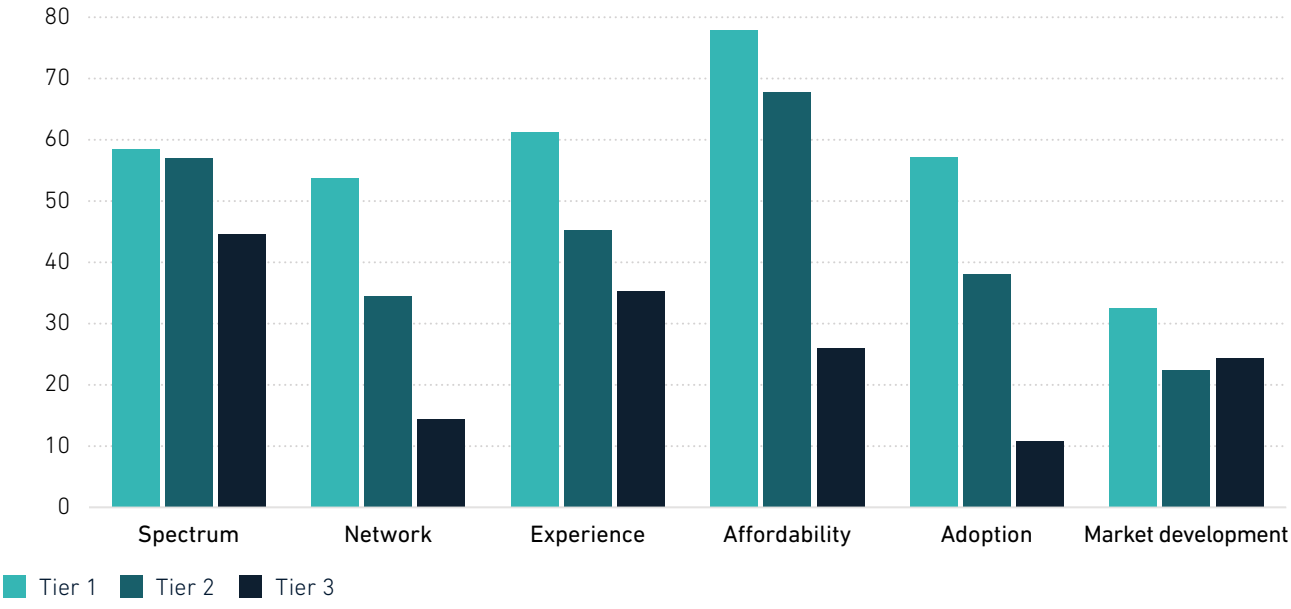
Source: GSMA Intelligence

Cluster analysis

Based on the scores in the first 5GI, we can group the 39 markets into three tiers. The first tier includes markets that score higher than 50 overall. The second tier consists of markets scoring between 30 and 50, which contains the majority. The third tier includes markets scoring lower than 30. Figure 9 shows the average pillar score based on each tier.

Figure 9

Average pillar score by tier



Source: GSMA Intelligence

Tier 1 (scores above 50)

The 13 markets with a 5GI score higher than 50 (mostly in the Gulf and Asia Pacific) generally attribute their performance to the 5G infrastructure category. With the exception of two markets (the US and Saudi Arabia), all of them score above 50 in 5G infrastructure. Most show strong spectrum and network scores, particularly in 5G coverage, which may account for their strong performance in the indicators of the experience pillar, such as download speeds, upload speeds and latencies. An area that requires improvement in 5G infrastructure is the deployment of 5G base stations and 5G standalone (SA) networks; with the exception of mainland China, none of the markets in Tier 1 score more than 50 in both of these indicators.

From the perspective of 5G services, the Tier 1 group performs very well on affordability, with nine markets achieving a score greater than 75. The adoption pillar also shows relatively good performance, with high scores for 5G penetration and 5G device shipments. However, similar to most markets analysed in this first edition of the 5GI, 5G FWA adoption and market development (comprising the data traffic per user and revenue growth indicators) are the main areas for improvement. As an example, for data traffic per user, only four markets score higher than 50, while for revenue growth, all of them score lower than 40.

Tier 2 (scores between 30 and 50)

A second group of 20 markets, primarily in Europe and Asia Pacific, have scores between 30 and 50. In the 5G infrastructure category, similar to the Tier 1 markets, most of the Tier 2 markets have relatively high scores for spectrum assignments. However, compared to the leading markets, this group lags behind in the network and experience pillars, which underscores the need to improve on indicators such as the deployment of 5G base stations (with 14 of them scoring lower than 20 points), expanding 5G coverage and advancing the deployment of 5G SA networks (though some markets score exceptionally well for 5G SA, notably Australia, Japan, Thailand and Canada). In the experience pillar, the primary area requiring improvement is download speeds, as 15 out of the 20 markets score lower than 30 points.

In 5G services, similar to Tier 1, this group also shows stronger results in terms of affordability and in the 5G device shipments indicator, which means there is a growing 5G device ecosystem. However, specific efforts are needed to address the 5G connectivity gap, driven by low penetration rates and limited 5G FWA adoption. Additionally, advancements in the data traffic per user and revenue growth indicators are crucial for market development.

Tier 3 (scores below 30)

Finally, a group of six markets, primarily LMICs in Sub-Saharan Africa, Latin America and Asia Pacific, score lower than 30 points in the 5GI. In the 5G infrastructure category, with the exception of Brazil (which performs relatively well in this specific category, scoring 41, similar to the average score for countries identified in Tier 2 for this category), all other markets score less than 33. This highlights the need for improvement in all infrastructure indicators, particularly 5G base station deployment, which is by far the weakest indicator for Tier 3 markets. This is also linked to poorer performance in the experience pillar. 5G coverage is also critical to achieving wider access to 5G, and since most markets in this group have coverage scores lower than 35, improving this aspect will be an important priority for 5G deployment.

Unlike with Tier 1 and 2, in the 5G services category, affordability is also an area that needs improvement. All markets in Tier 3 fall within the lowest 10 scores for the affordability pillar. This underscores the importance of affordable 5G data and devices, particularly for lower-income populations, as this directly impacts the usage gap in 5G penetration. 5G penetration being low is linked to the low scores for 5G device shipments, as the development of the ecosystem is still in its early stages. On the positive side, many Tier 3 markets have better scores on revenue growth than Tier 2 and even some Tier 1 markets, though this is likely to be explained by the fact that many have only launched 5G recently and much of the revenue growth will still be driven by 4G and connecting new broadband users.

3 Unleashing the full benefits of 5G

The 5GI enables a comprehensive assessment of the aspects of 5G that require focused attention and development. While these vary by country, we can draw some general insights from the first edition of the index.

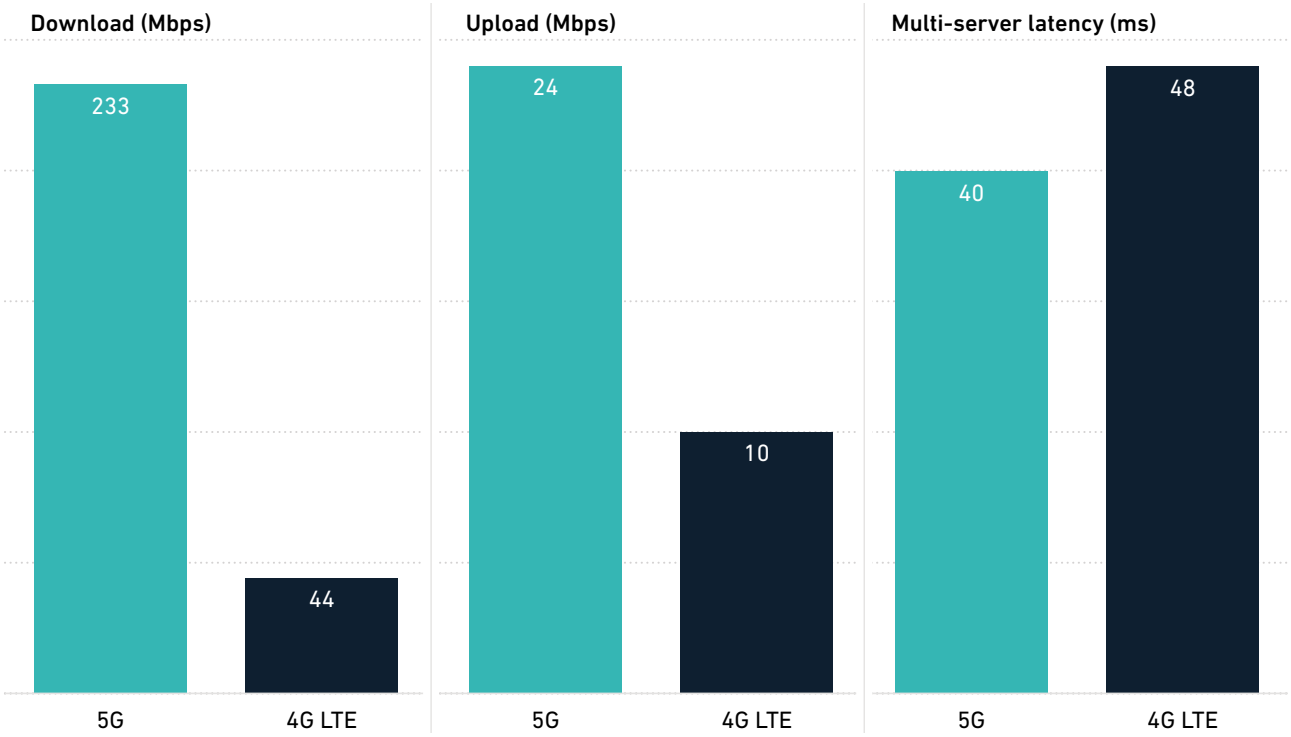
5G is already providing an enhanced user experience, in part due to the assignment of key spectrum bands

In all of the markets covered by the first 5GI, the consumer experience on 5G networks is noticeably outperforming that of 4G networks. By the end of 2023, average 5G download speeds had reached approximately 230 Mbps, more than a fivefold increase from the 44 Mbps observed in 4G. Across the 39 markets covered, average 5G download speeds were 2–19 times greater than 4G download speeds. Moreover, average 5G upload speeds are more than two times greater than 4G, and 5G average latency is 16% lower than that of 4G (see Figure 10).

Sustaining this level of user experience will be important for the mobile ecosystem, especially with more users transitioning to 5G. This migration will lead to higher demand and potential congestion on the network, which underscores the need to maintain and enhance network capacity.

Figure 10

Average download speeds, upload speeds and latency for 4G and 5G, Q4 2023



Note: Data is based on the 39 markets in the 5GI.
Source: GSMA Intelligence analysis of data provided by Ookla Speedtest Intelligence

An instrumental factor contributing to the improved user experience is the assignment of new spectrum bands since the introduction of 5G, especially in the 3.5 GHz range, which is to date the most widely used 5G frequency band. Figure 11 shows that 5G speeds are higher when consumers are connected using 3.5 GHz range spectrum. It also highlights the step-change in performance when utilising high bands in the mmWave frequencies, with users experiencing gigabit speeds (though it should be noted the analysis of high bands is based on a much smaller sample of three markets, as the ecosystem for mmWave 5G networks remains more limited than for mid-bands).[8] Given the cost savings that mmWave deployments can drive,[9] as well as consumer demand going forward,[10] new mmWave spectrum assignments and network deployments should lead to growing adoption in the coming years.

Operators in 36 out of the 39 markets analysed in the 5GI have been assigned spectrum in the 3.5 GHz range. Those that have assigned more than 300 MHz of 3.5 GHz range spectrum have achieved speeds that are more than 60% higher than those that have assigned less than 300 MHz. Furthermore, the outcome of the ITU's World Radiocommunication Conference 2023, where countries agreed on the harmonisation of mid-band spectrum in the 3.5 GHz and 6 GHz ranges (in addition to new low-band spectrum), means that consumers' 5G experience should continue to improve.[11]

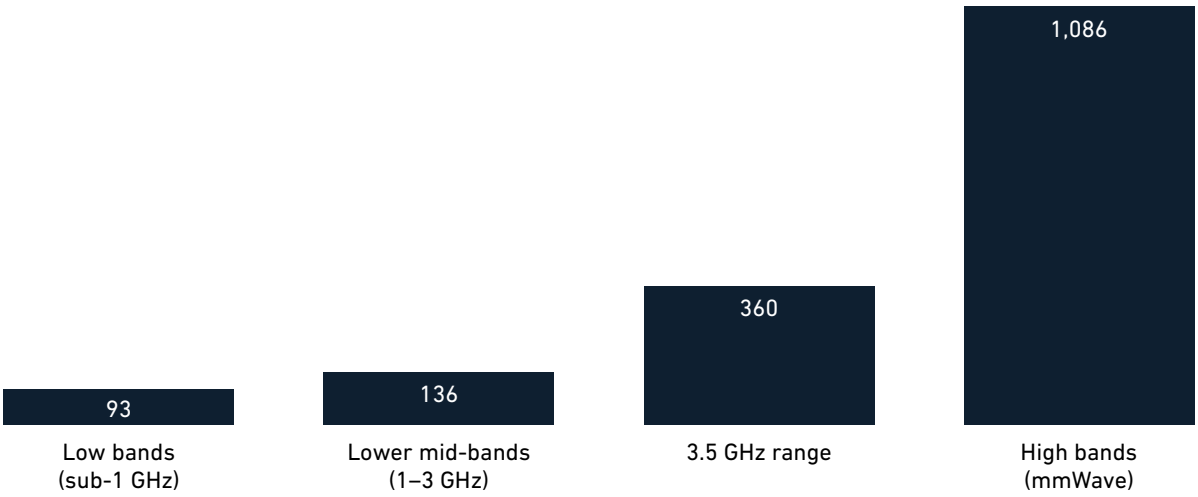
Additionally, in 35 markets, operators are leveraging 600 or 700 MHz spectrum frequencies to extend coverage indoors and in rural areas. This strategic use of spectrum bands plays a pivotal role in ensuring more extensive and reliable 5G network coverage, further enhancing connectivity for users across diverse geographies. A previous GSMA study showed that markets where operators are utilising the 600 or 700 MHz bands for 5G have significantly higher levels of 5G coverage, as well as better 5G availability and indoor quality of service. In terms of coverage, for example, the average 5G network population coverage reached 73% for countries using the 600 or 700 MHz frequencies, while this figure was 46% for countries not using these frequencies.[12]

8 For example, see "mmWave Clocks Gigabit Speeds in the U.S. but Lacks Maturity Elsewhere". Ookla, February 2023
9 For example, see The economics of mmWave 5G, GSMA Intelligence, 2021 and The 5G FWA opportunity: series highlights, GSMA Intelligence 2022
10 For example, see Consumer 5G: how much users would pay for mmWave, GSMA Intelligence, 2023
11 "For the benefit of billions: the impact of WRC-23 decisions on spectrum policy in 2024", GSMA, January 2024
12 See Socio-Economic Benefits of 5G: The importance of low-band spectrum, GSMA, 2023

Figure 11

Average 5G download speed by frequency band, Q4 2023

Mbps



Note: Data for low bands, lower mid-bands and 3.5 GHz range is based on the average download speed across the 39 markets in the 5GI for Q4 2023. Analysis of high bands is only based on data for the US, Japan and Australia.
Source: GSMA Intelligence analysis of data provided by Ookla Speedtest Intelligence

5G is becoming more affordable, especially in emerging markets

There have been notable strides in the mobile ecosystem towards offering more affordable data plans and devices.[13] Considering the affordability target that is used by the ITU (which sets countries the objective to achieve entry-level broadband subscription costs at less than 2% of monthly income),[14] the majority of the 39 markets in the 5GI exhibit affordability levels below 2% of monthly income when considering the cost of the cheapest 5G mobile plan. This performance is impressive given that the ITU target applies to entry-level plans with up to 2 GB of monthly data allowance, whereas the 5GI monitors monthly plans of 20, 50 and 100 GB.

Of the 39 markets in the 5GI, only four have affordability levels above 2% of monthly income for a 20 GB plan, while eight markets have affordability above 2% for a 100 GB plan. These comparisons highlight the varying degrees of affordability across markets and the progress that operators have made in achieving affordable 5G services in most of the 39 markets.

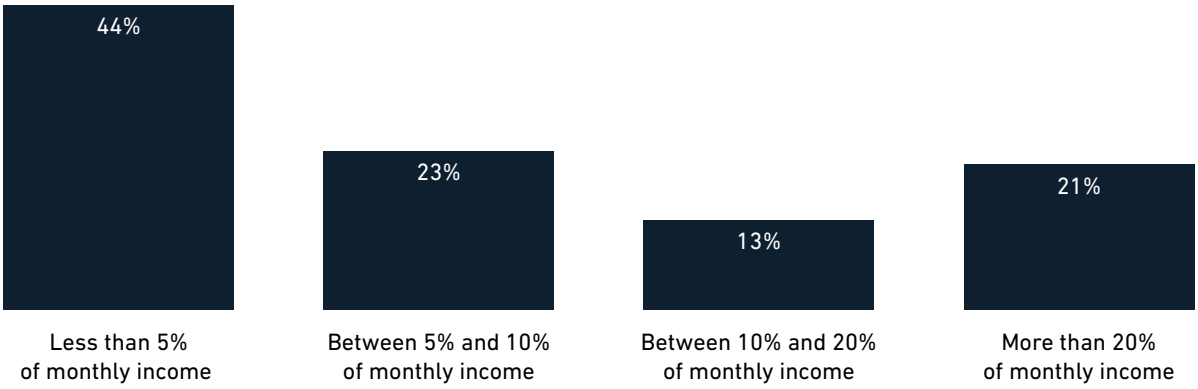
An analysis of mobile tariffs offered in the 39 markets at the end of 2023 also shows that the transition from 4G to 5G has proven to be cost effective for consumers, with significantly lower prices per gigabyte and an improved overall service. In 31 of the 39 markets, the median price per gigabyte for 5G plans is lower than that of non-5G plans, with most having a 5G unit price that is less than half that of 4G.[15] This trend underscores a further positive shift in affordability, allowing consumers to access higher data capacities at lower unit prices.

In terms of devices, although considerable attention has been placed on high-end premium 5G devices, 15 of the markets assessed in the index offer 5G devices priced at less than $250, adjusting for purchasing power parity. Similarly, after adjusting for monthly income, 26 out of the 39 markets exhibit relative income prices lower than 10% of monthly income, as shown in Figure 12. This highlights how 5G devices are becoming increasingly affordable relative to income.

13 The affordability analysis presented here is based on mobile pricing and device data sourced from Tarifica. Further details on the underlying data and indicators are provided in the 5G Connectivity Index methodology.
14 See Aspirational targets for 2030, ITU
15 Of these 31 markets, six have stopped distinguishing 4G and 5G mobile tariffs . Analysis of tariffs is based on standard plans (excluding youth or senior plans) and any tariff (postpaid or prepaid) intended for consumers (excluding business plans). For more details, refer to the 5G Connectivity Index methodology

Figure 12

Distribution of cheapest 5G device prices relative to monthly income, Q3–Q4 2023

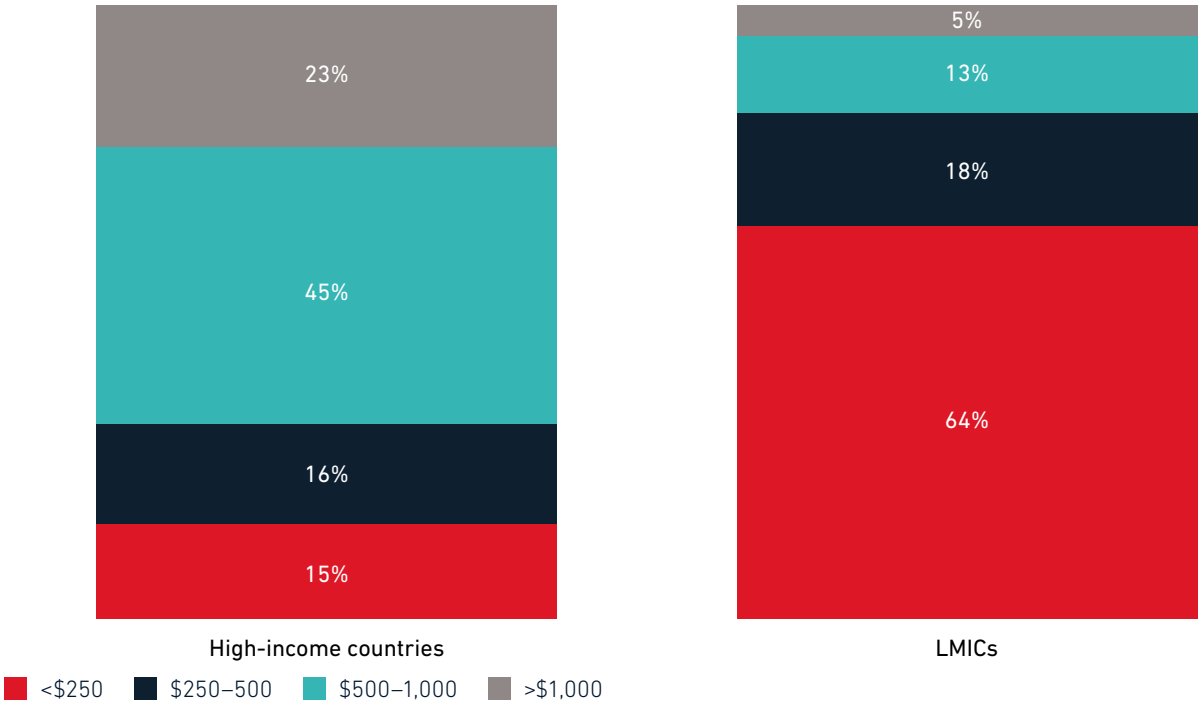


Note: Data is based on the 39 markets in the 5GI.
Source: GSMA Intelligence analysis of data provided by Tarifica

Figure 13 illustrates the distribution of 5G device shipments by price band. In high-income markets, the majority of devices are priced at $500 or above, whereas in LMICs almost two thirds fall below the $250 mark. Despite an overall decline in smartphone shipments due to cost-of-living crises and rising expenses over the past two years,[16] 5G device shipments have increased, with lower-cost devices driving growth in emerging markets and premium 5G smartphones sales increasing in high-income markets. Given the crucial role of device affordability in boosting 5G adoption, increasing the availability of affordable 5G devices will be essential.

Figure 13

Distribution of 5G device shipments by wholesale price, Q4 2022 – Q3 2023



Note: Data is based on the 39 markets in the 5GI. Prices refer to wholesale shipment prices.
Source: GSMA Intelligence analysis of data provided by Counterpoint Research

16 For example, see "2023 Global Smartphone Shipments to Hit Lowest Level in Almost a Decade", Counterpoint Research, November 2023

While this progress on data and device affordability is encouraging, it is important to note that the majority of markets in the first 5GI edition are high-income markets, and the average does not capture the affordability challenges faced by those at the bottom of the income distribution. For instance, considering all markets in the index, affordability of 5G devices and data plans for the poorest 20% is 2–8 times worse than the average affordability, and 3–28 times worse than for the richest 20%.

Efforts to enhance the affordability of 5G services and devices therefore remain a priority, particularly for segments of the population with lower income levels. This economic barrier poses a significant challenge to achieving widespread adoption and hampers efforts aimed at promoting digital inclusion.

5G deployments are not yet complete, especially 5G SA

Of the 39 markets in the 5GI, only four (South Korea, Norway, Hong Kong SAR and mainland China), have deployed more than 200 base stations per 100,000 people. A lack of base stations hinders the expansion and capacity of 5G networks, limiting the overall reach and accessibility of high-speed connectivity. The deployment and densification of 5G is a challenge for operators, given the high levels of investment needed and the fact that in many markets, returns have been flat or otherwise declining.

While the mobile ecosystem works to develop the use cases and additional value that 5G can bring, governments and regulatory bodies should focus on creating a supportive framework that incentivises investment, assigns sufficient and affordable spectrum and streamlines the deployment process. By fostering an environment that encourages investment and collaboration, policymakers can accelerate the deployment of 5G infrastructure, ensuring a faster and more efficient rollout.

The deployment of 5G SA networks also remains limited, with only five markets in the 5GI achieving nearly full adoption among operators and 17 markets having no operator 5G SA launches as of the end of 2023. This slow progress in deploying 5G SA technologies impedes the realisation of 5G's full impact, as SA networks offer enhanced capabilities compared to non-standalone configurations. 5G SA will be important in fulfilling 5G's potential, particularly in terms of extended slicing, low latency and massive IoT capabilities that are crucial for enterprise service requirements. Despite its critical role, 5G SA faces challenges in terms of deployment progress, including device support and inconsistent spectrum policy in some regions.[17]

To facilitate deployment, targeted strategies and supportive policy environments are essential to help reduce costs, incentivize investments, and promote the ecosystem. The expected role of 5G SA is reflected in the GSMA Intelligence Operator Survey 2022, which found 5G SA to be the most important 5G capability to drive success in operators' enterprise offerings.[18]

17 For example, see European Spectrum Policy for the Digital Decade – options for the new Radio spectrum policy programme, GSMA and ETNO, 2023
18 Operators in Focus: Enterprise Opportunity Survey Dashboard 2022, GSMA Intelligence, 2022

5G FWA has the potential to be a bigger success story

FWA networks have a long history, having predominantly leveraged 4G technology for commercial services. The emergence of 5G is transforming FWA into a more competitive solution compared to fibre-to-the-home (FTTH) and cable, offering speeds over 10 times those of 4G FWA. In addition to higher speeds, 5G FWA is benefiting from several market developments, including government mandates and/or incentives promoting the use of 5G FWA to reach rural areas, the sunsetting of legacy broadband technologies (notably xDSL), the rapid rise in the number and diversity of 5G FWA devices (indoors and outdoors) and the entry of new broadband players leveraging 5G FWA to compete against incumbent fixed broadband providers.[19] At the end of 2023, 123 operators in 62 markets worldwide had launched 5G FWA services, meaning that more than 40% of commercial 5G networks included a 5G FWA offering.

In some of the markets assessed in the index, 5G FWA has grown rapidly: it has reached more than 5% adoption among households in Kuwait, Saudia Arabia, the UAE, Austria, the US, Germany and Australia. This has made FWA one of the early 5G success stories. It is a particularly important use case for operators aiming to drive revenue growth, serve new market segments and better utilise network assets.

In the context of the 5GI, the indicator assessed is the adoption of 5G FWA as a share of households. Despite the initial growth in some markets, the results reveal considerable scope for improvement, with the majority of markets (30 out of 39) having lower than 5% adoption. Even if we only consider households that do not have FTTH or cable, 5G FWA adoption remains lower than 10% in 25 markets.

Therefore, despite experiencing the highest customer growth rate among all fixed broadband access technologies, 5G FWA is still in the early stages of development, representing approximately 1% of total fixed broadband connections as of Q4 2023. However, consumer interest in 5G FWA is high. According to the GSMA Intelligence Consumers in Focus Survey 2022, 5G FWA tops the list of most appealing 5G use cases for consumers, both in fast-growing markets, such as the US, and in markets where 5G FWA adoption has been slower. In this context, to extend meaningful connectivity to underserved areas, governments worldwide are actively seeking to expand the reach of high-speed broadband networks.[20]

5G market development is still in its early stages

Despite the continued growth in mobile data consumption, most of the more data-intensive 5G use cases remain nascent, including for consumers (e.g. AR and VR). As the adoption of these advanced use cases increases over time, data usage may accelerate. At the end of 2023, average monthly data usage per connection in the 39 markets covered in the 5GI stood at around 20 GB. However, this figure is expected to increase to more than 50 GB by the end of the decade, primarily driven by the widespread adoption of more data-intensive 5G-enabled services.

Revenue growth and 5G use cases

Since the introduction of 5G in each of the 39 markets, average service revenue[21] (in nominal terms) has increased in 30 of them,[22] though only four have experienced average annual growth of 5% or more.[23] External factors, particularly the Covid-19 pandemic and high inflation in 2022, have imposed constraints on the market for mobile operators and the ecosystem more generally.

19 For example, see 5G FWA on the rise: state of the market, new developments and outlook through to 2030, GSMA Intelligence, 2023; The 5G FWA opportunity: series highlights, GSMA Intelligence, 2022; and 5G FWA in action, GSMA Intelligence, 2022
20 For specific examples, see 5G FWA on the rise: state of the market, new developments and outlook through to 2030, GSMA Intelligence, 2023
21 Mobile recurring service revenues refer to the ongoing and regularly occurring income generated by mobile service providers from their subscribers.
22 When considering real price adjustments for inflation, the number of markets with positive average growth rates since the launch of 5G is reduced to 13.
23 It is important to note that the four countries with higher annual growth since 5G launch are Nigeria, India, Bulgaria and Mexico, where mobile service revenues are still primarily driven by 4G.

In the short to-medium term, operators have a clear view on the use cases and applications they expect 5G to support, including improved slicing, IoT capabilities and multi-access edge computing. These are also use cases that mobile network and device vendors continue to support. The priority now is to monetise these and drive commercial value, especially in the business-to-business (B2B) segment that operators expect to drive much of the revenue growth for 5G.

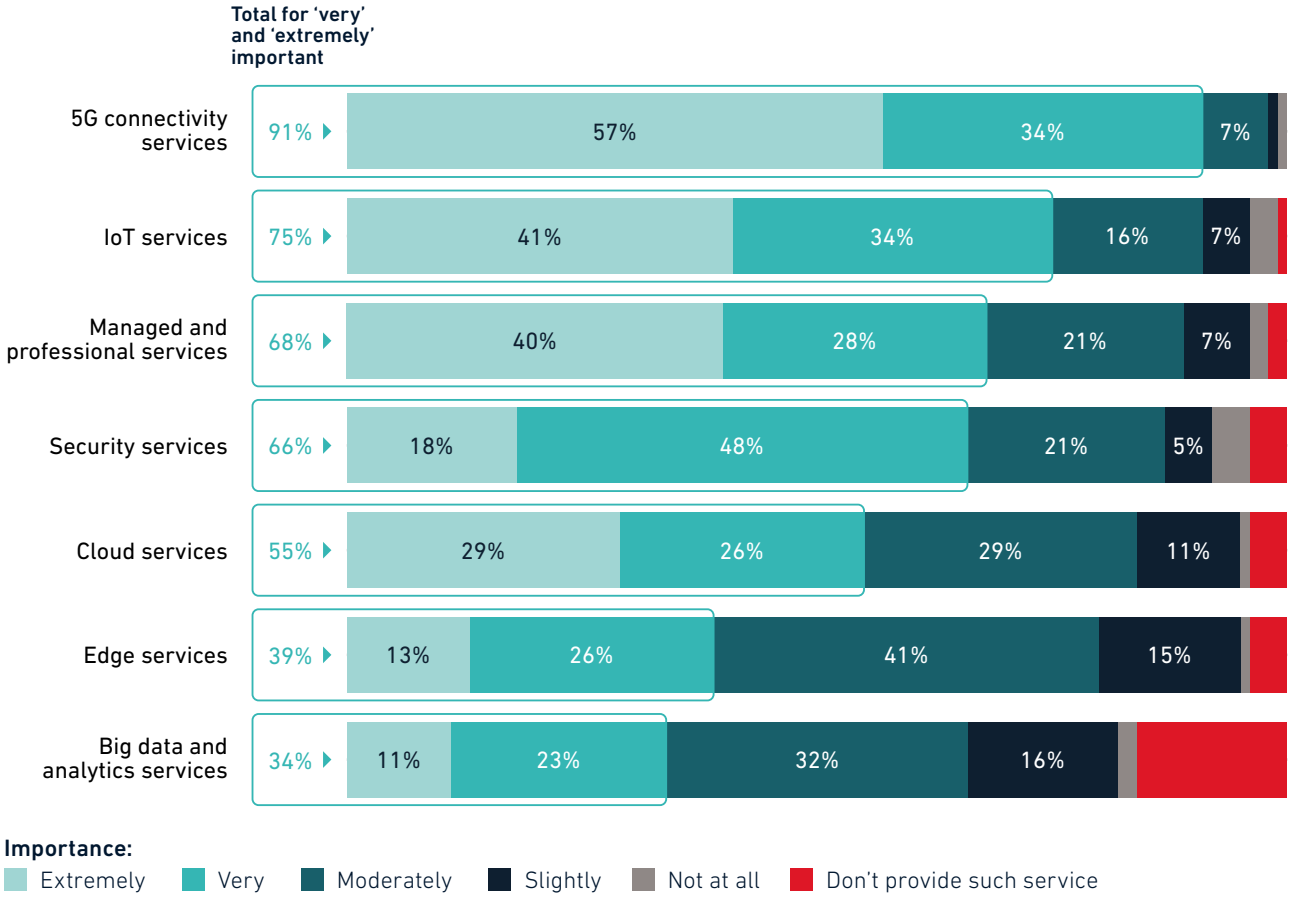
Estimates of B2B's contribution to total revenues varies across operators, ranging from 19% to 45%.[24] Operators are navigating a balance between short- and long-term expectations, acknowledging that B2B growth requires initial resource investments and the establishment of dedicated business units. The monetisation journey is therefore a multi-year endeavor that will extend into the 5G-Advanced era.[25]

Findings from a GSMA Intelligence survey[26] show that 5G connectivity services remain the primary use case for enterprise customers, followed by IoT (see Figure 14). The digital transformation of enterprises has resulted in increased demand for connected assets and operational intelligence, prompting operators to recognise the importance of IoT in the success of their enterprise strategies.[27] This is evident, for instance, in the substantial increase in the number of enterprise IoT connections, which reached more than 10 million at the end of 2023 (more than double compared to five years before).[28]

Figure 14

Enterprise services portfolio and priority rankings

Rank how important the following are to the success of your enterprise strategy (percentage of respondents)



Source: GSMA Intelligence Operators in Focus: Enterprise Opportunity Survey 2022

24 B2B drives operator revenue growth as digital transformation of verticals accelerates, GSMA Intelligence, 2023
25 For example, see 5G in the consumer market: the growth and monetisation story, GSMA Intelligence, 2022
26 Operator in Focus: Enterprise Opportunity Survey Dashboard 2022, GSMA Intelligence, 2022
27 Enterprise Opportunity 2022: operator strategies, plans and expectations, GSMA Intelligence, 2022
28 IoT Connections Forecast to 2030, GSMA Intelligence, 2023

Another expected key source for revenue growth in the enterprise segment is the deployment of 5G private networks. These provide businesses with significantly improved levels of speed, reliability and low-latency communications compared to 4G. Private network deployments using 5G are growing. Based on the GSMA Intelligence Operators in Focus Survey, at the end of 2022, 34% of operators stated they had launched or were testing private 5G networks. At the end of 2023, this proportion had almost doubled to 64%.

Despite regional variations, certain markets have made significant progress in the development of private wireless networks. In Europe, key contributors to private wireless activity include Germany, France, the UK, the Nordic countries and Spain. Notably, Germany and the UK have seen significant enterprise investment in 5G private wireless networks. While manufacturing, financial services and media exhibit the main use cases, larger deployments have been made in critical infrastructure projects such as construction, mining, airports, ports, healthcare clinics and hospitals.[29]

Turning to Asia, the Korean Ministry of Science and ICT reports that private 5G is operational in 48 locations, marking a substantial increase from 2022. The main use cases in South Korea involve shipbuilding, logistics, healthcare, manufacturing and energy. Meanwhile, in Mainland China, the three largest telecoms operators lead in the implementation of private networks, encompassing private 4G and 5G. For example, China Mobile has one of the largest B2B businesses ($18 billion in 2021),[30] while China Unicom's industry internet revenue has been steadily growing by around 30% in recent years, accounting for 20% of total revenues in 2022.[31] Progress with private networks and 5G is a key driver of B2B revenue growth for all operators in mainland China, with deployment cases including multi-access edge computing (MEC) nodes and ultra-low-latency IoT services.

However, despite the positive outlook for many operators, the market is still developing, with the majority stating that 5G private network customers are in the early stages of using them and, although they are seeing benefits, specific outcomes (e.g. financial returns) haven't been measured yet.[32]

5G-Advanced: a new era for mobile growth

Following the rapid growth of 5G technology, 5G-Advanced is becoming a key focus for the mobile ecosystem and will begin with the completion of 3GPP Release 18 standards, expected in the first half of 2024. It represents the next stage in 5G's evolution to support new market demands before the development and launch of 6G towards the end of the decade, as more than half of operators worldwide expect to launch 5G-Advanced by 2025.

5G-Advanced will build on the capabilities of 5G (including network slicing and edge computing) as well as developing new features, such as multicast services, new AI use cases and integration with non-terrestrial networks. It is expected to provide a broad range of new capabilities for enterprises, including extended reality, RedCap and passive IoT. In the context of the 5GI, the evolution of 5G-Advanced should drive significant improvements in the indicators that currently score low, particularly in the market development pillar (given the potential commercial opportunities from the B2B segment), as well as the network and experience pillars (given the infrastructure upgrades that are required). However, realising these opportunities will be dependent on wide ecosystem support, overcoming investment constraints and establishing a path to the monetisation of 5G-Advanced use cases.[33]

29 Global Mobile Trends 2024, GSMA Intelligence, 2024
30 Should China be seen as a global benchmark for enterprise 5G?, GSMA Intelligence, 2023
31 China Unicom: Scaling up private wireless networks in the largest and most innovative 5G B2B market, GSMA Intelligence, 2023
32 Global Mobile Trends 2024, GSMA Intelligence, 2024
33 A three-way showdown in 2023: 5G standalone, 5G-Advanced and 6G, GSMA Intelligence, 2023

4 Conclusion

The 5GI offers data-driven analysis for effective policymaking and investment decisions, tailored to local contexts. Despite the rapid expansion of 5G adoption, reaching 1.5 billion connections by the end of 2023, it still remains an evolutionary process, as highlighted by the initial of scores in the index.

On the positive side, operator investments and the assignment of new spectrum bands have led to high-performing 5G networks that offer significant quality-of-experience improvements to consumers and enterprises. Furthermore, affordability of both 5G data plans and devices continues to improve and enable consumer access, including in emerging markets.

Further investments are still needed, as many populations remain underserved, even in high-income markets, and 5G SA is still to be deployed by most operators. Without this, many of the 5G use cases that are expected to benefit consumers and businesses cannot be fully realised, which will in turn limit consumer and business 5G utilisation and therefore hinder the commercial value of 5G for operators and the wider ecosystem. It will also be important to continue to improve affordability, especially in lower-income markets, so that the digital divide does not widen.

Recommendations for policymakers

The 5GI will provide policymakers and the private sector with a comprehensive view of 5G development over time and enable them to target investments and resources where they are most needed. Based on the analysis from the first version of the 5GI, a number of recommendations can already be considered to accelerate the monetisation of 5G services, increase investment and encourage the widespread adoption and use of 5G:

- **Modernise regulation:** Adapt regulatory frameworks to the dynamic nature of 5G, fostering investment, innovation and collaboration. Enable small cell deployment, streamline backhaul deployment and harmonise power density limits.
- **Enhance investment in networks:** Mobilise increased investments from governments and the private sector to develop reliable and extensive 5G networks capable of meeting growing service demands.
- **Ensure cooperation between stakeholders:** Foster collaboration among vendors, regulators and operators to optimise the deployment of 5G networks, creating an environment conducive to shared goals and mutual benefits.
- **Promote effective spectrum management:** Implement transparent and well-coordinated spectrum assignment strategies to meet the rising demand for high-speed and reliable connectivity.
- **Advance toward affordable 5G services:** Actively work towards making 5G services more affordable, promoting accessible devices and affordable mobile plans to bridge the digital divide and ensure widespread accessibility.

gsmaintelligence.com

GSMA
Intelligence

gsmaintelligence.com