GSMA

The 6 GHz IMT Ecosystem
Demand Drives Scale

June 2024



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GSMA

The GSMA represents the interests of mobile operators worldwide, uniting more than 750 operators with nearly 400 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and internet companies, as well as organisations in adjacent industry sectors. The GSMA also produces the industry-leading MWC events held annually in Barcelona, Los Angeles and Shanghai, as well as the Mobile 360 Series of regional conferences.

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GSMA Intelligence

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.

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Executive summary



6 GHz market development

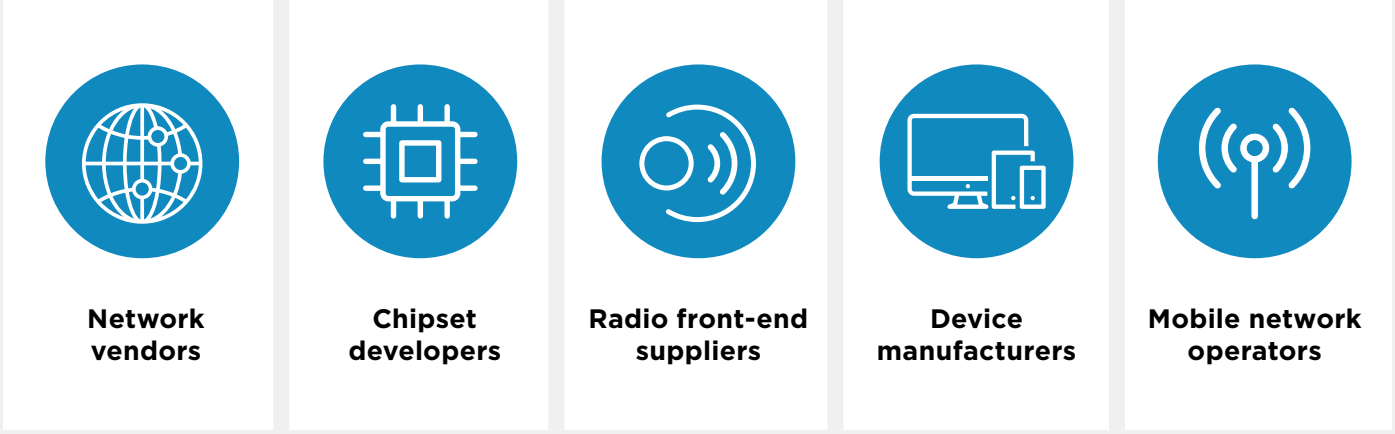
The definition of spectrum is vital to the mobile ecosystem. Harmonised spectrum enables the delivery of scale for networks and devices. In addition, the right spectrum management drives mobile development, delivering new technology generations and realising the $5.7 trillion total economic value of the mobile industry in 2023.[1]

Discussions and decisions by governments on the usage of the 6 GHz band (5.925-7.125 GHz) are well-developed and have been widely harmonised by the World Radiocommunication Conference 2023 (WRC-23). Some countries will use the whole band for unlicensed technologies, but the majority plan a balanced approach, assigning the lower band (5.925-6.425 GHz) to unlicensed while using the upper part (6.425-7.125 GHz) for full-power, macro-cell licensed mobile.

Against this backdrop, the role of 6 GHz mobile ecosystem development is a topic which cannot be ignored as 6 GHz spectrum management decisions are being made. The harmonisation of 6 GHz that was made at WRC-23 has justified robust 6 GHz mobile device and network infrastructure ecosystems development and has already accelerated trial and prototype equipment.

To further understand 6 GHz market readiness, GSMA Intelligence embarked on a detailed cross-sectional evaluation of the future prospects and market readiness for a 6 GHz mobile ecosystem.

6 GHz Ecosystem



The evaluation was based on a series of interviews, including executives and product strategy decision makers at major mobile network infrastructure vendors and mobile device component suppliers known to be considering and planning for the development of 6 GHz IMT solutions. Network infrastructure and radio vendors representing more than 90% of the global market were also included, as were major SoC and radio front-end suppliers which support the market's major smartphone and mobile device makers.

Input from operators (including a survey of spectrum experts and subject matter experts from approximately 20 leading operators from across the globe) and lessons learned from the introduction of other new spectrum bands – including regulatory and technical processes – were used as a basis for the analysis.

1. https://www.gsma.com/mobileeconomy/

6 GHz development principles

The research found that the outlook for the 6 GHz IMT ecosystem is robust, with the market aligned on the following principles:

Technical barriers

There are no technical barriers to developing, and commercialising, 6 GHz IMT solutions. Device and infrastructure solutions can operate in the band, just like any other.

Ecosystem readiness

Key players in device component and network infrastructure ecosystems are ready to develop 6 GHz IMT products in line with customer demand.

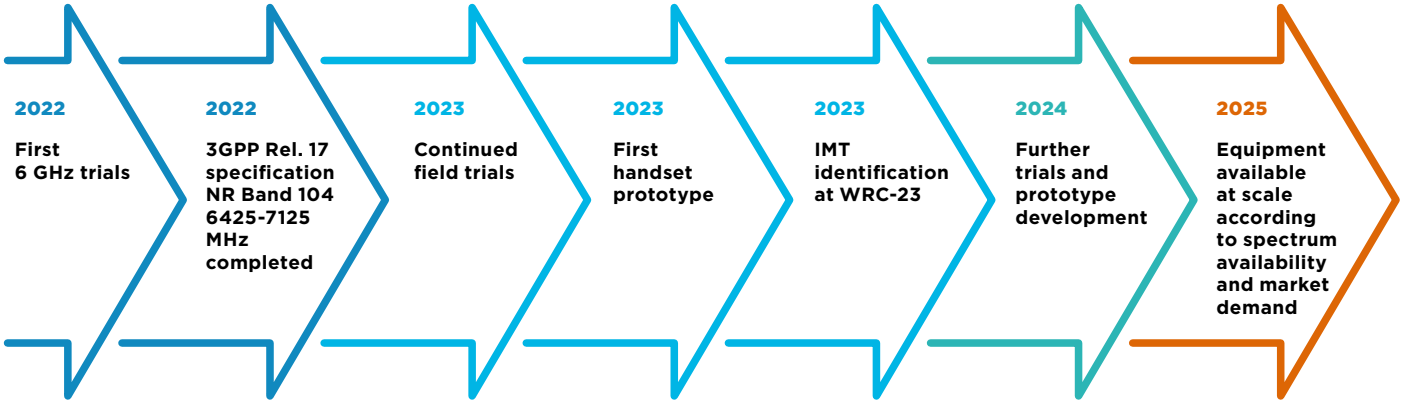
Development triggers

The main trigger for the commencement of product development will be operator demand, already driven by WRC-23 and national regulatory decisions.

Development timeline

From the start of development, ecosystem players expect that they could have solutions ready in 6 to 12 months.

6 GHz timeline



Government action to deliver 6 GHz to market:

1. Identify 6 GHz to mobile/IMT in national table of allocations
2. Publish roadmap and conditions, after consultation with industry, of spectrum assignment

1. The 6 GHz range



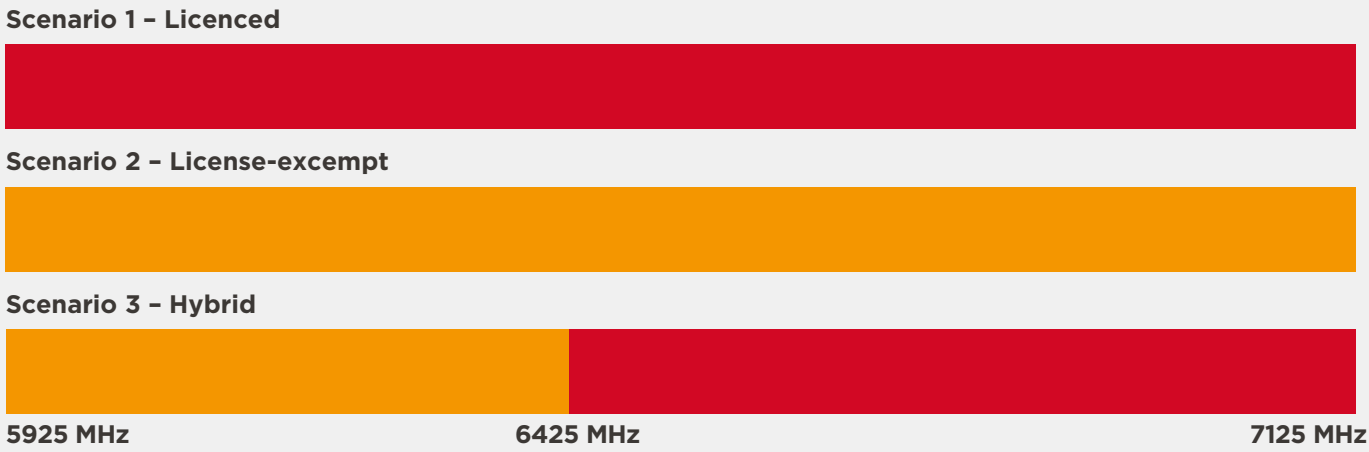


Options for 6 GHz

The implications of 6 GHz decisions are immense. In part, this is because the 6 GHz band represents the largest remaining single block of mid-band spectrum for licensed mobile services in the foreseeable future. Also, rising consumer demand for all mobile use cases makes this a concern for all mobile operators.

The 6 GHz band has generally been considered for licensed 5G, licence-exempt or a hybrid approach allowing for the needs of both licensed and licence- exempt technologies.

6 GHz policy scenario analysis



The specific use of this spectrum carries clear cost-benefit implications. GSMA Intelligence research studied 24 countries[2] and made two core findings:

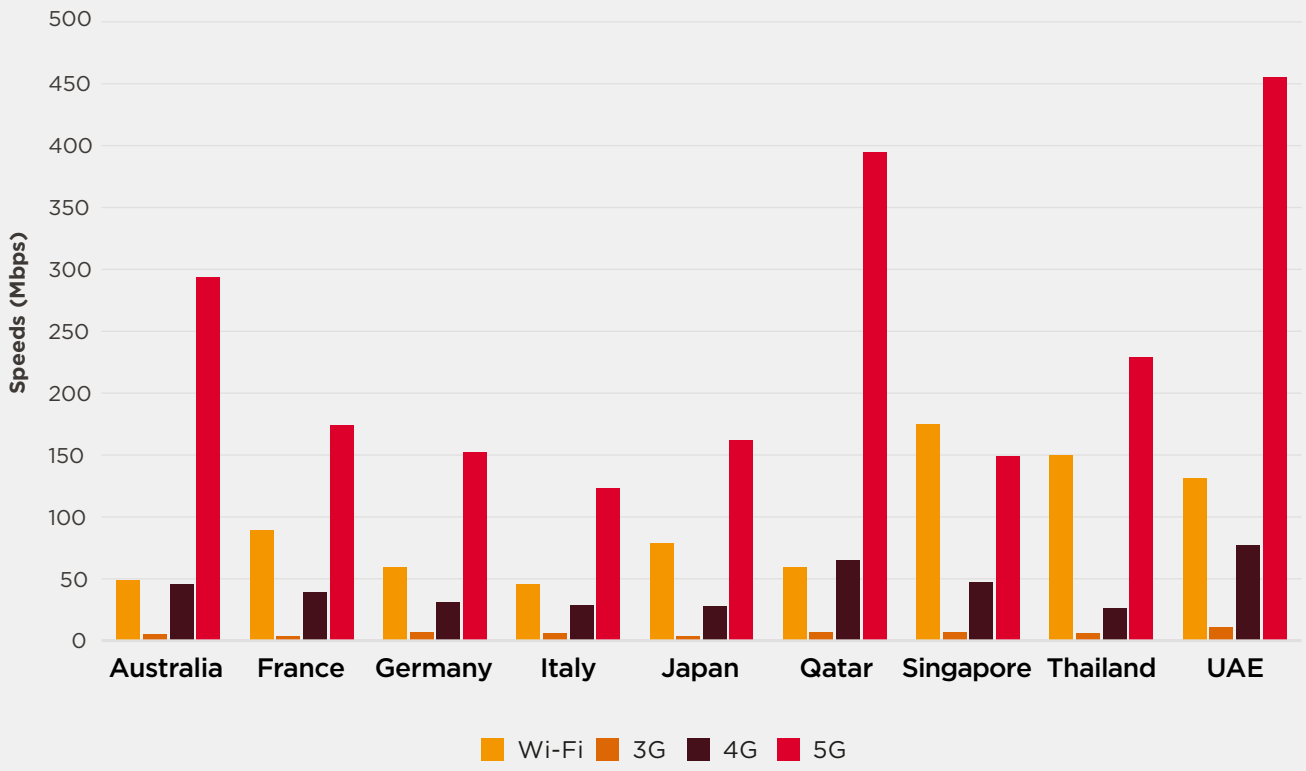
1. For all countries studied, the most benefit to society comes from assigning between 700-1200 MHz of 6 GHz spectrum to licensed 5G

2. For all countries studied, there is never a scenario where the allocation of the full 6 GHz band to unlicensed use generates the greatest benefit to society.

In addition to the amount of available spectrum, the study found that the optimal assignment policy largely depends on the infrastructure to deliver fixed fibre/cable broadband services in each market, along with the speeds that fixed broadband can offer consumers.

Consumers use more data on 5G relative to 4G, and there is evidence that less traffic is carried over Wi-Fi as mobile network speeds rise, and data allowances increase along with mobile network capacity. In 5G markets, consumers often get significantly better speeds than on 4G and Wi-Fi. Analysis of 5G users across several markets also show that consumers use more data than on 4G and, in some cases, less Wi-Fi.[3]

Speed comparison – download speeds for 3G, 4G, 5G and Wi-Fi (2021)



Source: GSMA Intelligence analysis, based on Speedtest Intelligence® data provided by Ookla®
Data is provided for the nine countries with 5G adoption greater than 2% at the end of 2021.

In order for both technologies to thrive, policy makers need to find the right balance in order to maximise socio-economic benefits.

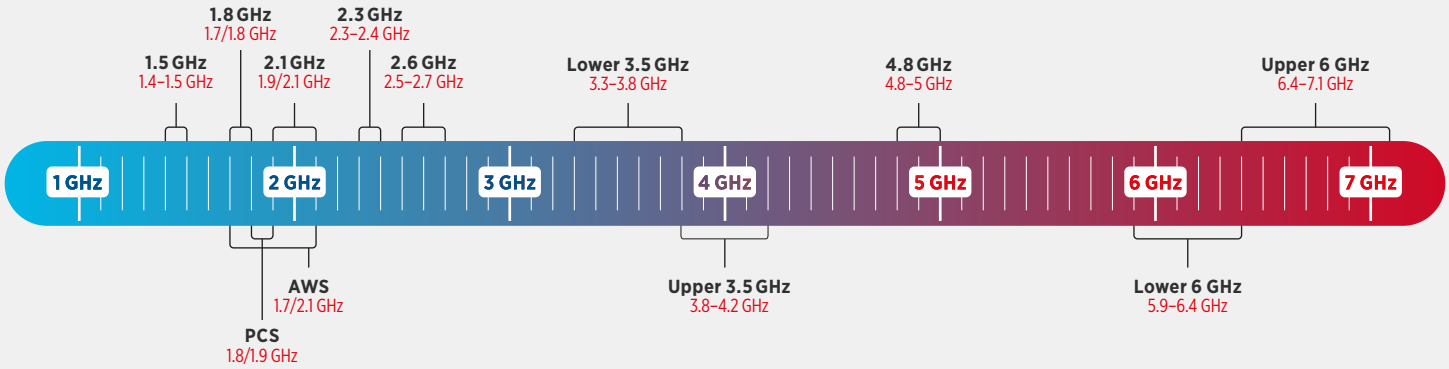
2. The Socio Economic Benefits of the 6 GHz Band, GSMA Intelligence, 2022
3. For example, Ericsson (2021) shows that 5G users spend more time on a range of uses (including cloud gaming, streaming music and video and using AR/VR) and that one in five users upgrading to 5G have decreased Wi-Fi usage at home and other locations.



Gauging the 6 GHz IMT opportunity

5G networks bring substantial improvements over 4G networks, including higher connection speeds, greater capacity and lower latency. With this increased performance, 5G networks can also enable new use cases and applications that positively impact many industry sectors and the economy as a whole.

Lower and upper mid-band spectrum



Source: GSMA Intelligence

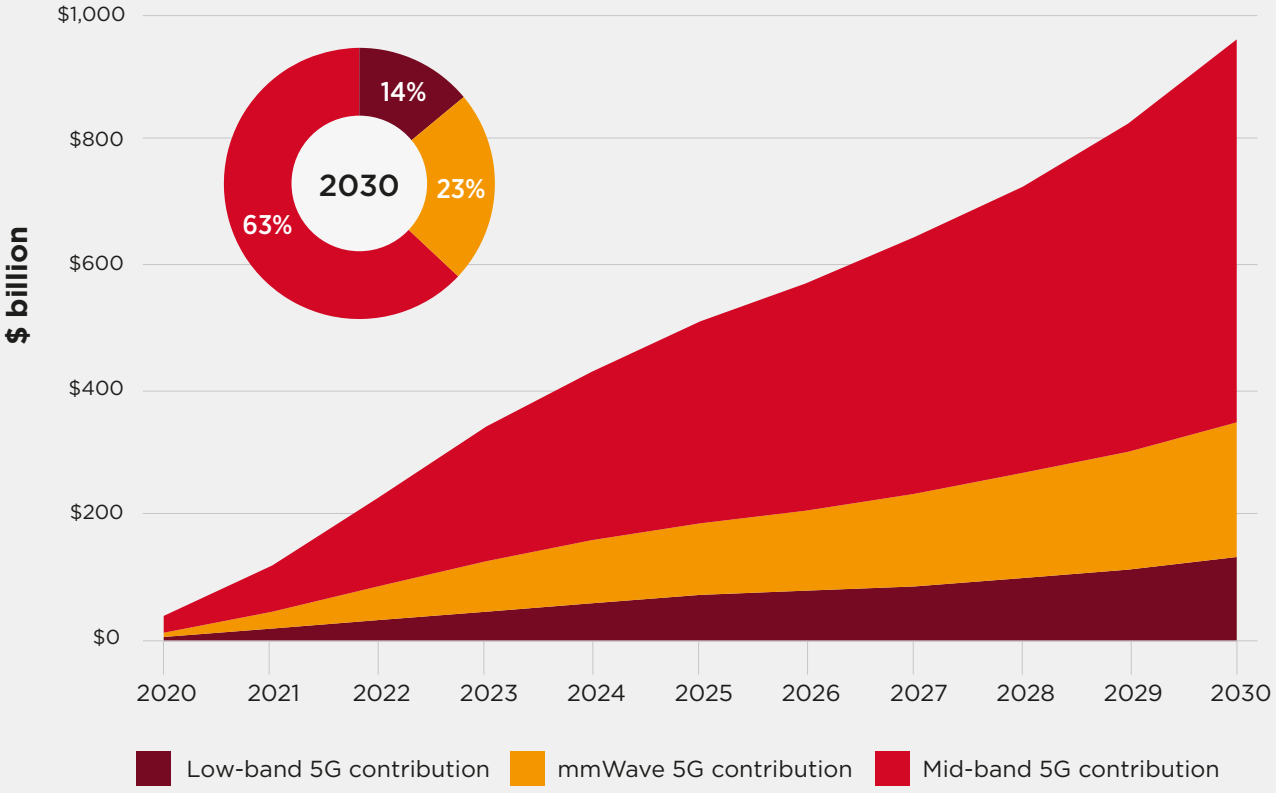
5G requires spectrum in low, mid- and high bands to realise its full potential. The increases in bandwidth and capacity that numerous 5G applicationsrequire mean that mid-band frequencies provide an important role and allow capacity for city-wide coverage. Mid-band is therefore at the heart of 5G and the need for mid-band spectrum will only grow. An average of 2 GHz mid- band spectrum is needed per country to deliver the ITU's IMT-2020 (5G) requirements.[4]

4. Coleago Consulting, "Estimating the mid-band spectrum needs in the 2025-2030 time frame", July 2021

Annual impact of 5G on GDP, by band, 2020-2030

A recent study by GSMA Intelligence concludes that mid-band spectrum will drive more than $610 billion in global GDP in 2030, producing almost 65% of the overall socio-economic value generated by 5G.[5] However, this can only happen if sufficient spectrum resources are assigned to mobile operators to provide the capacity and performance needed to support growing mobile data traffic and advanced 5G use cases. On the flip side, up to 40% of the expected benefits of mid-band 5G could be lost if no additional mid-band spectrum is assigned to mobile services in the near future, according to the analysis.

Annual impact of 5G on GDP, by band, 2020-2030



Source: GSMA Intelligence

The future availability of mid-band spectrum is part of the discussions of the World Radiocommunication Conference 2023 (WRC-23). The range of spectrum bands that could offer such supplementary mid-band spectrum for 5G services in the medium term is limited.

Therefore, the 6 GHz range is seen by the mobile industry as the principal target for 5G expansion and the main means of meeting the 2 GHz goal.

5. https://www.gsma.com/spectrum/wp-content/uploads/2022/02/mid-band-5G-spectrum-benefits.pdf

2. The 6 GHz ecosystem



The road to market readiness

Economy of scale has been a hallmark of the mobile industry, where global networks, network infrastructure, and device ecosystem scale have resulted in services connecting more than 5.6 billion users. Global 5G connections have scaled in line with the diversity of devices and will account for 56% of all connections by 2030. Therefore, an important consideration in any spectrum assignment decision is ecosystem support for the band and whether sufficient network infrastructure and device solutions are available to support the target services and use cases.

The development of the 6 GHz mobile ecosystem must be understood as decisions on the band are finalised and timelines for assignment laid out.

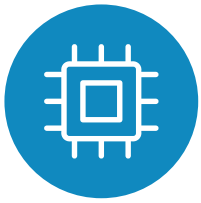
Its ecosystem development outlook is crucial to decisions enabling licensed mobile in the 6 GHz band, and vice-versa.

To understand the extent of ecosystem development for licensed mobile usage of the 6 GHz band, GSMA Intelligence engaged in detailed interviews with key ecosystem players across the network infrastructure and device component sectors. This analysis included the core sectors which are integral to the development of 6 GHz IMT solutions.

6 GHz Ecosystem



Network vendors



Chipset developers



Radio front-end suppliers



Device manufacturers



Mobile network operators



6 GHz development principles

The research found that the outlook for the 6 GHz IMT ecosystem is robust, with the market aligned on the following principles:

Technical barriers

There are no technical barriers to developing, and commercialising, 6 GHz IMT solutions. Device and infrastructure trials have shown the capabilities of the band.

Ecosystem readiness

Key players in device component and network infrastructure ecosystems are ready to develop commercial 6 GHz IMT products in line with customer demand.

Development triggers

The main trigger for the commencement of product development will be operator demand, driven by the positive WRC-23 decisions and national regulatory decisions.

Development timeline

Trials and prototypes have now demonstrated 6 GHz macro-cell capabilities. Commercialisation of these products at scale is now the next step.



Trials and market progress

6 GHz spectrum is the largest remaining contiguous block of mid-band spectrum that can be allocated to licensed mobile in most markets. Harmonisation of 6 GHz spectrum could therefore provide more bandwidth and improve network performance.

At the same time, the broad contiguous channels offered by the 6 GHz range could reduce the need for network densification.

6 GHz trials have provided some critical information as to its use. First among these is its feasibility as a band that can be used to provide very high-speed coverage for future mobile evolution. Trial data showed:



1 Gbps+ with 80 MHz channel



10 Gbps+ with 400 MHz channel



Peak trial speed of 12 Gbps

On top of these speeds, the trials showed continued promise of 6 GHz as a new spectrum layer that will be able to use existing network grids. Making use of 3.5 GHz network grids for 6 GHz in future network evolution will allow less-dense, lower-carbon networks.

Developments for 6 GHz

- **Standards momentum.** 3GPP completed technical specifications of 5G NR band 104 as part of 3GPP Release 17 for the upper part of the 6 GHz band for licensed 5G services in June 2022. This provides a standardised basis for production of 6 GHz 5G equipment and devices.
- **Co-existence.** Co-existence parameters between mobile and other users of the band has now been fully laid out by the decisions of WRC-23 in all regions of the world.
- **Administrations in all three ITU Regions supported the 6 GHz band at WRC-23.** These represented an addressable market of 60% of the global population and pave a solid foundation for ecosystem development



6 GHz IMT ecosystem drivers and challenges

GSMA Intelligence engaged with major ecosystem players across the mobile network infrastructure and device component sectors to understand whether and when network infrastructure and device solutions will be available for the 6 GHz band.

The infrastructure and device component communities were aligned on several key points:

No technical barriers to 6 GHz IMT

There are no significant technical barriers to 6 GHz IMT solutions and services. On-going lab and field trials confirm this view

3.5 GHz grid reuse

Simulations and trials indicate that 6 GHz IMT could effectively expand network capacity using the same infrastructure of 3.5 GHz mobile services, enabling cost-effective deployment.

Demand triggers exist

1. Operator demand is a pivotal trigger for economy of scale.
2. 3GPP standardisation momentum is a significant milestone in shaping up the scale of the 6 GHz IMT ecosystem.
3. Decisions taken at WRC-23 require adoption by individual national regulators

3. Quantifying operator demand



Quantifying operator demand

To better understand operator demand, GSMA Intelligence surveyed spectrum strategy experts from a global sample of the industry's top mobile operators. We focussed on a number of key questions, including:

- The importance of access to 6 GHz spectrum for IMT networks.
- How likely operators are to deploy the spectrum.
- Planned 6 GHz IMT use cases.
- Impacts in case the 6 GHz band is not available for IMT services.

Timescale

The timely availability of 6 GHz spectrum will be a crucial factor and assignments need to be made according to market demand.

Some of the earliest adopter markets expected to show demand soon after ecosystem availability in the second half of the decade. Many markets will require the spectrum later, towards 2030.

Also, the majority of operators responded that 6 GHz spectrum would be required in the 2025-2030 timeframe with the highest portion considering 2027-2030 as likely to be the demand point.

Over what timescale would you require access to 6 GHz frequencies for IMT?

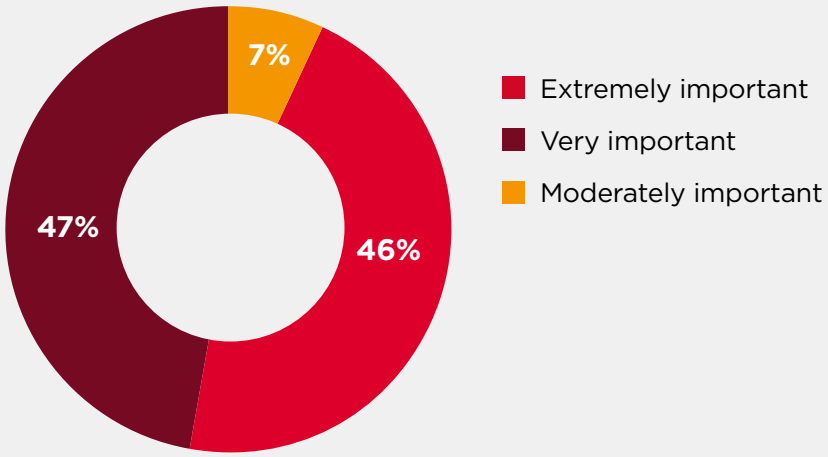




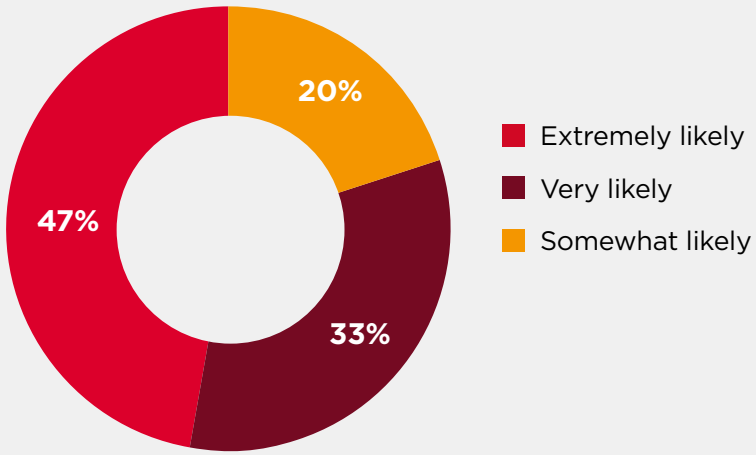
Importance of 6 GHz

The survey shows how critical 6 GHz is to the future of their IMT networks: 93% of those surveyed identify it as very or extremely important. It should not be surprising, then, that 80% of the surveyed operators feel it is very or extremely likely that they will deploy the band for IMT services.

How important is 6 GHz spectrum to the future quality and capabilities of your IMT networks?



How likely are you to deploy 6 GHz IMT in your networks?



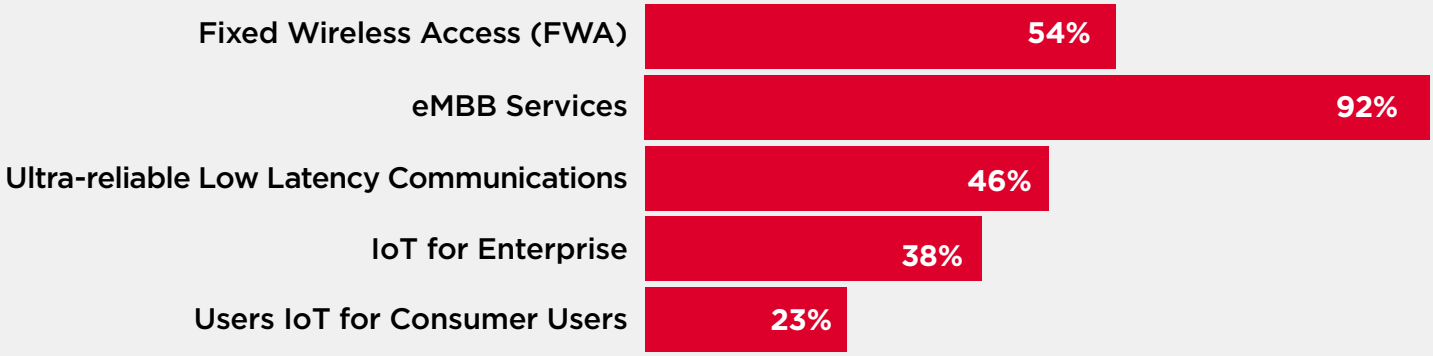
NB – the lower values 'slightly/not important' and 'very/extremely unlikely' received 0%.



Use cases

eMBB services have been the primary use case for 5G launches to date. This holds true for 6 GHz plans; 92% of operators say eMBB is a planned 6 GHz IMT use case. The second most popular use case, cited by 54% of operators, is Fixed Wireless Access (FWA). With FWA serving a role in diversifying operator revenues and helping to close the digital divide, the opportunities 6 GHz can enable are clear.

Which use cases do you plan for 6 GHz IMT?



4. 6 GHz IMT timeline outlook



While evaluating the prospects for a 6 GHz IMT ecosystem, the timeline for any ecosystem development is a key consideration for operators, regulators, and solution providers. Building on input from the industry, such a timeline can be estimated in a straightforward manner.

Factors influencing 6 GHz timeline



Regulatory approval



Device and infrastructure R&D



Operator demand

Regulatory approval

The upper 6 GHz band (6.425-7.125 GHz) was identified for IMT at WRC-23. National regulatory authorities are now placing the band in their national tables of allocation and considering the timeline for making the band available to mobile operators. The 6 GHz band already has a mobile allocation in the ITU Radio Regulations and the WRC-23 decision laid out the conditions for its use by IMT technologies everywhere in the world.

Device and infrastructure availability

Trials of 6 GHz network equipment occurred across the world before and after WRC-23, leading to the first prototype UE in October 2023. Component and infrastructure players have always indicated no difficulty in providing pre-production network equipment and handsets enabled for 6 GHz IMT between 6 and 12 months after receiving orders. With the scale provided by harmonised WRC-23 decisions added to in-country identification in China, vendors are already well-advanced towards the release of commercial products for this market.



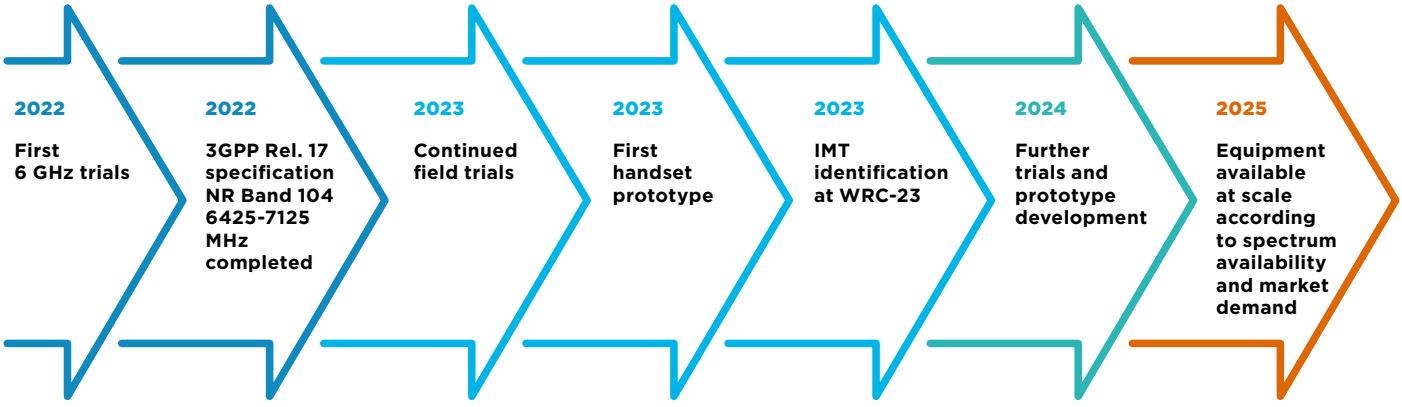
Operator demand

6 GHz is the last opportunity to obtain significant contiguous mid-band spectrum. Our operator survey has indicated strong demand for this band in line with prior studies of mid-band spectrum requirements.[6] This assumes that national regulators make cleared spectrum in the band available in a timely manner at reasonable prices.

Operators and vendors with whom we spoke indicated demand and deployments for 6 GHz IMT emerging with scale in the 2025-2030 timeframe in their territories. Clear preference for licensed 6 GHz IMT has been expressed in some large markets to deliver the expected high number of 5G subscribers. This aligns with expected product availability worldwide in the 2024-2025 timeframe.

Taking all of these factors into account, a potential 6 GHz roadmap and timeline can be estimated:

6 GHz timeline



Government action to deliver 6 GHz to market:

1. Identify 6 GHz to mobile/IMT in national table of allocations
2. Publish roadmap and conditions, after consultation with industry, of spectrum assignment

6. Coleago Consulting, "Estimating the mid-band spectrum needs in the 2025-2030 time frame", July 2021

China case study

Since the awards of commercial 5G licences in 2019, China has become the largest 5G market globally both in scale of deployments and consumer take-ups. The awards of mid-band frequencies across the 2.6 GHz and 3.5 GHz bands for 5G have played important roles in tackling the significant coverage and capacity challenges. Looking at the next stage of 5G expansion.

China has put its focus on the 6 GHz band and adopted the upper 6 GHz band (6.425-7.125 GHz) for IMT at a national level in 2023, to satisfy the fast-rising demands for 5G. In parallel, China has also started the domestic coordination and preparation for the use of the 6 GHz band for IMT:

In January 2022, the MIIT issued a public consultation to amend the frequency planning and radio frequency management of fixed service/microwave communication systems with a proposal to remove such uses from the 6 GHz band.

In June 2022, the MIIT further issued the draft amendments to the "Regulations on Radio Frequency Allocation of the People's Republic of China" that confirmed the removal of fixed/microwave systems from the 6 GHz band, taking a significant step forward in the preparation of the band for IMT.

In July 2023, MIIT identified the upper 6 GHz band for IMT in its national table of frequency allocations.

China already has over 800 million 5G connections.



Brazil case study

Brazil originally supported unlicensed use of 6 GHz, but following on from successfully identifying the upper band for IMT at WRC-23, has moved away from that decision.

In 2021, Brazilian regulator Anatel announced plans to allow unlicensed technologies in the full 6 GHz band, following the support of unlicensed use in North America. The scale which Brazil brought led to the move being described at the time as 'global paradigm shift in wireless connectivity' by the unlicensed technologies community.

However, following this decision the regulator began to re-consider its position. In the run up to WRC-23 Anatel began to express an interest in keeping its options open on the band and allowing itself the flexibility to move towards licensed mobile in the future. During WRC-23 the change in Brazil's position saw the development of a footnote for the use of 6.425-7.125 GHz for countries in ITU Region 2 (the Americas). Brazil and Mexico both signed into this footnote during WRC-23, but importantly this provides the legal and technical conditions for other countries in the Americas to join at the next WRC in 2027.

Following on from WRC-23, in mid-2024 Brazil began a process of public consultation to mandate that WiFi equipment be retuned to the lower 500 MHz (5.925-6.425 GHz) of the band if it becomes available for IMT.



5. Recommendations for the 6 GHz IMT ecosystem



Fulfil mid-band requirements

Regulators must carefully consider 5G spectrum demands in the timeframe to 2030, when mobile usage is expected to grow significantly, and correspondingly make more mid-band spectrum available where required. With 2 GHz of mid-band spectrum per country required for mobile on average, the 6 GHz band represents the largest remaining single block of mid-band spectrum that can be assigned to licensed mobile services in the foreseeable future.

Study the economic benefits of 6 GHz uses

The decision between licensed or unlicensed use of the 6 GHz band needs to be carefully assessed and the economic impact clearly understood. GSMA Intelligence research has previously found that the unlicensed use across the 6 GHz band was never the most beneficial option in any of the 24 analysed countries. It is important for regulators to carry out a regulatory impact assessment of the 6 GHz band in order to come to an evidence-based decision.

Continue to build on the harmonisation of 6 GHz made at WRC-23

The 2023 World Radiocommunication Conference (WRC-23) identified the upper 6 GHz band (6.425-7.125 GHz) for IMT throughout the EMEA / CIS region, and in some countries from APAC and the Americas. 60% of the global population supported the band at WRC-23 and more countries are expected to join the 6 GHz harmonised footprint at the next WRC in 2027.

The harmonisation of the band across global markets has had a huge impact on the development of the 6 GHz ecosystem.

Provide clear roadmaps for affordable mid-band spectrum

Access to affordable spectrum is required in a timely manner. Investment in a new spectrum layer is significant and greater certainty for operators will allow them to undertake mid- and long-term investment planning before rolling out networks and deploying new services. The result is a faster rollout of new technologies and innovative use cases, to the benefit of consumers, businesses, and the broader economy.

Adoption of the 6 GHz band into national tables of frequency allocation and national spectrum roadmaps will help provide certainty for MNOs as they develop the networks of the future.

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