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15 July 2024

The Manager
Spectrum Planning Section
Australian Communications and Media Authority
PO Box 78
Belconnen ACT 2616

Future use of the upper 6 GHz band – Options Paper

Dear Sir/Madam,

The GSMA appreciates the opportunity to respond to this consultation by the Australian Communications and Media Authority (ACMA) on the Future use of the upper 6 GHz band.

The GSMA is a global organisation uniting more than 750 operators and almost 400 companies in the broader mobile ecosystem and related industries. Our vision is to unlock the full power of connectivity so that people, industry and society thrive.

Our submission is attached below. Should you have any further query, please do not hesitate to contact me at [redacted].

Yours sincerely,

[redacted]

Jeanette Whyte
Head of Public Policy, APAC
GSMA

Future use of the upper 6 GHz band – GSMA submission

Contents

1. Introduction

Australia is among the most advanced countries globally in terms of mobile connectivity, evidenced by the widespread availability and adoption of high-quality mobile services supported by the scale of its 5G rollout. As of Q1 2024, the market penetration of 5G services stands at 62% of the population and Australia is one if the higher-scoring countries on the GSMA Intelligence 5G Connectivity Index.[1]

In the 5G era, mid-band frequencies are particularly crucial as they offer the dual advantages of wide, contiguous bandwidths and good propagation, enabling the sustainable expansion of capacity for wide-area mobile networks. The use of mid-band spectrum for mobile will drive an increase of more than $610 billion in global GDP in 2030, producing almost 65% of the overall socio-economic value generated by 5G.

At the ITU's World Radiocommunication Conference 2023 (WRC-23), the upper 6 GHz (6.425-7.125 GHz) was identified for mobile use by countries in each of the three ITU Regions. Conditions for its use have been agreed in the ITU's Radio Regulations, providing the foundation standard power deployments for 5G and its future evolution.

For the mobile industry, the certainty of future spectrum availability is a critical aspect of ensuring the continued evolution and expansion of mobile services. Clarity on the future plans for the upper 6 GHz in Australia will help encourage the long-term investments needed to meet growing demand and increase innovation. In this regard, the GSMA welcomes this consultation by the ACMA on the future use of the upper 6 GHz band.

The rest of our submission is structured as follows. We first examine the demand outlook for mobile services and the necessary spectrum requirements. We then discuss the importance of upper 6 GHz for mobile and latest developments relating to IMT ecosystem in 6 GHz This

[1] https://data.gsmaintelligence.com/5g-index

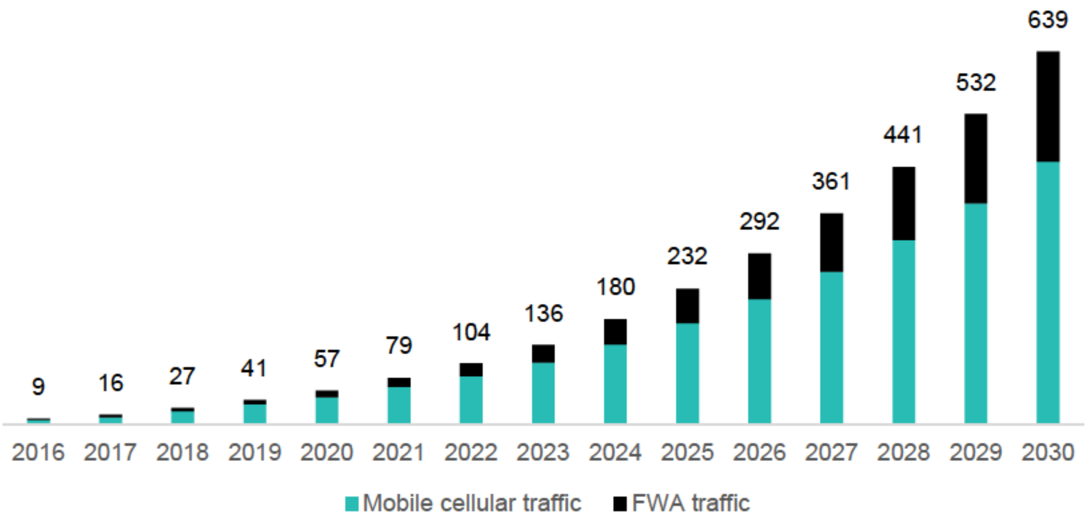
is followed by our views on the ACMA's proposed replanning options for the upper 6 GHz band.

2. Mobile traffic and use cases continue to grow

Mobile data traffic has experienced massive growth globally over the past decade, driven by the increasing adoption of smartphones, rising data usage and growing consumption of high-bandwidth applications such as video streaming and gaming. Between 2019 and 2023, global mobile data traffic, including fixed wireless access, grew more than threefold, from 41 exabytes (EB) to 136 EB per month. Average monthly data traffic per mobile connection grew from 4.4 GB in 2019 to 12.8 GB in 2023.[2]

Mobile data traffic in absolute terms has increased significantly year-on-year and 2023 represents the highest ever growth in traffic. This is forecast to continue rising through to the end of the decade as shown in Figure 1. There will also be significant growth in 5G FWA. Taking FWA into account the global traffic volume would be more than 40% by 2030. Overall global traffic for mobile and FWA is projected to reach more than 639 EB per month by 2030, while average monthly data per mobile connection would be nearly 50 GB.[3]

Figure 1: Global mobile cellular and FWA traffic (EB/month)



Source: GSMA Intelligence, Ericsson

The commercialisation of 5G continues to gather pace around the world. As of Q1 2024, there are more than 1.7 billion 5G connections globally, around a fifth of the total connections. This figure is forecast to grow three-fold to some 5.5 billion by 2030. Today in Australia, almost half of total connections are on 5G. This is projected to exceed 90% by 2030.[4]

As 5G evolves into 5G-Advanced and mobile networks become even more versatile across the rest of the decade, enhanced connectivity, IoT, data analytics and insight will drive efficiency gains and innovations across every aspect of industry and society. The four main

[2] Source: GSMA Intelligence
[3] Source: GSMA Intelligence
[4] Source: GSMA Intelligence

5G use cases as described in Figure 2, namely enhanced mobile broadband (eMBB), fixed wireless access (FWA), ultra-reliable, low-latency communication (URLLC) and massive IoT (MIoT), will drive 5G adoption, usage and mobile traffic growth across the period to 2030.

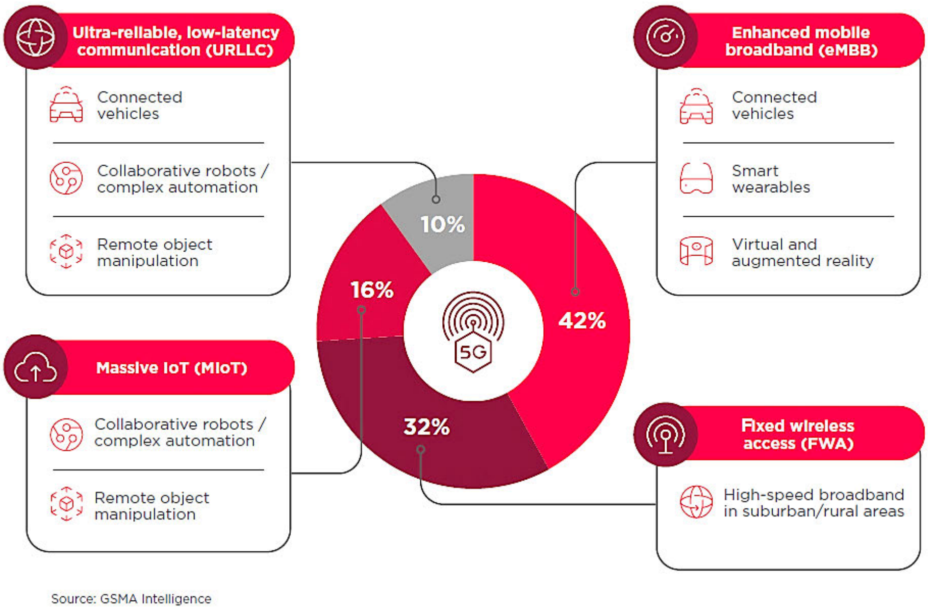
Figure 2: 5G use case description and associated applications

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

Figure 3 shows the different types of use cases and the capacity that mid-band spectrum will support. Over the period to 2030 eMBB and FWA will be the largest use cases While MIoT and URLLC associated applications are still at a relatively early development stage, a variety of applications across different industries and economy sectors are emerging.

Figure 3: Mid-band capacity division among 5G use cases, 2020-2030



As 5G technology matures, its full range capabilities enabled by the rollout of standalone cloud-native core networks and mobile edge computing, will provide enterprises and organisations with the ultra-reliable connectivity required to automate critical operations and the reduced latency to support the real-time image recognition and other AI-based applications.

Private 5G networks can offer wireless, secure, reliable, low-latency, time-sensitive abilities for device-to-device and device-to-applications services along with access to the authorised public mobile devices inside the private networks.[5] Across many parts of the Asia Pacific region, including Australia, there is growing evidence of 5G's potential to transform businesses and industries. These industry use cases range from customised connectivity solutions at major transportation hubs such as airports and rail stations, to industrial processes and advanced manufacturing applications, including process automation and control, sensors' data aggregation, asset management, automated robotics and inspections.[6]

3. Mid-band spectrum is at the core of 5G

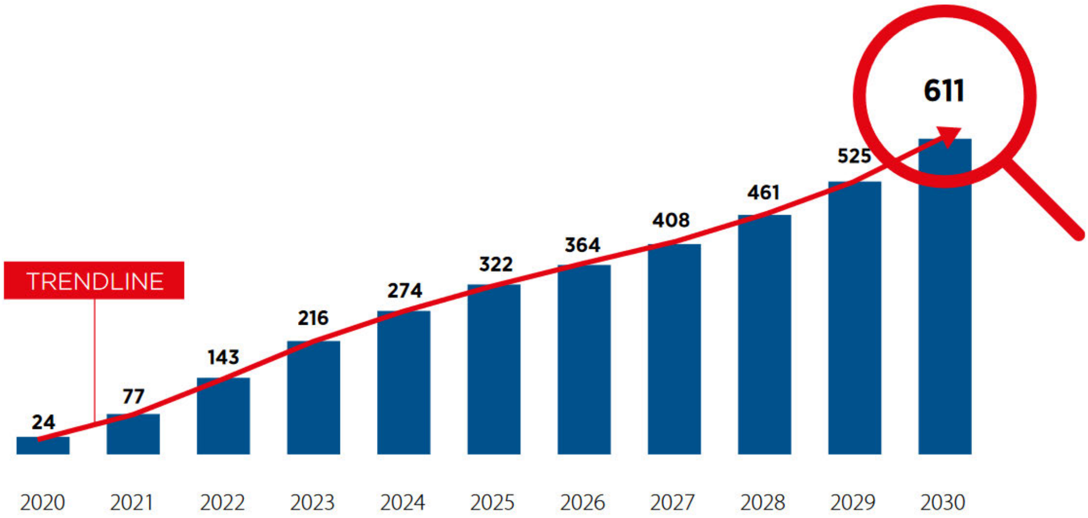
While 5G can be deployed across a variety of spectrum resources from sub-1 GHz to mmWave bands, mid-band frequencies in the 1-7 GHz range[7] are especially crucial because these offer the balance of capacity and coverage that enabling mobile networks to offer

[5] GSMA. Private 5G Industrial Networks: an analysis of use cases and deployment, June 2023.
[6] GSMA. How 5G is transforming APAC. Ten case studies highlighting the utility and versatility of 5G technologies, September 2023. https://www.gsma.com/about-us/regions/asia-pacific/gsma_resources/how-5g-transform-apac/
[7] Mid-band spectrum includes lower mid-bands (i.e. 1500 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2600 MHz) and upper mid-bands (i.e. 3.3–4.2 GHz, 4.5–5.0 GHz and 5.925–7.125 GHz).

reliable performance that meet the ITU IMT-2020 requirements[8] across densely populated urban areas. Analysis shows that an average of 2 GHz of mid-band spectrum will be required to fulfil the ITU requirements for 5G of 100 Mbps downlink and 50 Mbps uplink.[9]

The central role of mid-band spectrum is reflected in its contribution to productivity and economic growth. By 2030, more than half of the mobile connections globally will be 5G and this will contribute some US$960 billion to global GDP, or around 0.7% of the total.[10] Of this mid-band 5G will account for some $610 billion (63%) of the total 5G benefit to global GDP, as illustrated in Figure 4. These benefits would only be possible if governments and regulators make sufficient mid-band spectrum available so that operators are able to meet the growth in demand. If no additional mid-band spectrum is allocated for IMT, up to 40% of the expected 5G benefits could be lost.

Figure 4: Annual impact of 5G mid-band on global GDP, US$ billion



Source: GSMA Intelligence

The versatility of mid-bands for mobile connectivity is reflected by their wide deployment globally. To date, mid-band spectrum has been the most commonly used to launch 5G networks. Of the 295 operators globally that had launched 5G services by the end of Q1 2024, 186 operators have deployed their 5G networks using 3.5 GHz, representing 63% of total 5G launches.[11]

It is well recognised that majority of mobile traffic is delivered to users indoors with estimates ranging around 70-90%[12]. Most of this indoor mobile traffic is addressed through mid-bands

[8] ITU. Minimum requirements related to technical performance for IMT-2020 radio interface(s). Report ITU-R M.2410-0 , November 2017. https://www.itu.int/pub/R-REP-M.2410-2017

[9] GSMA and Coleago Consulting. Estimating the mid-band spectrum needs in the 2025-2030 time frame, July 2021. https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2021/07/Estimating-Mid-Band-Spectrum-Needs.pdf

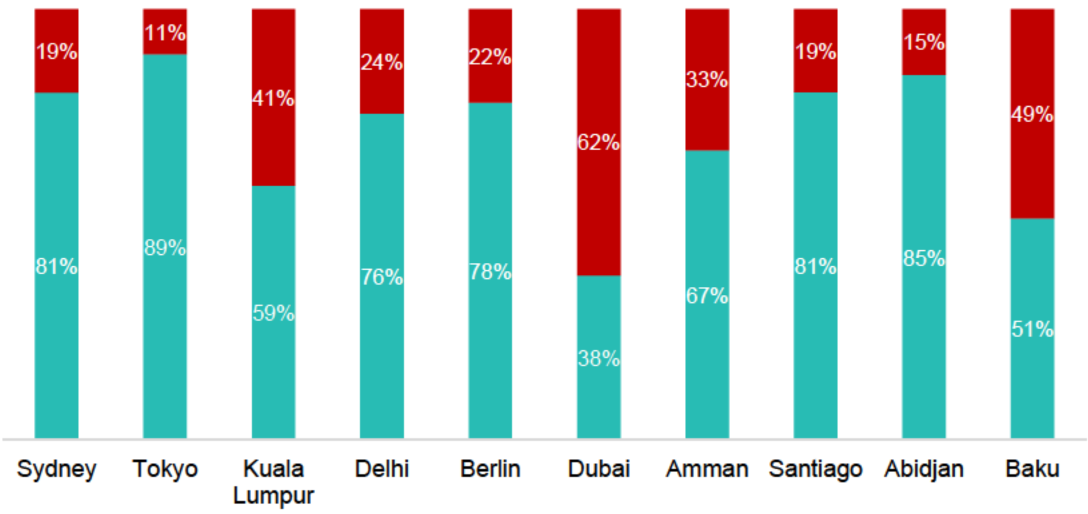
[10] GSMA. The Socio-Economic Benefits of Mid-Band 5G Services, February 2022. https://www.gsma.com/connectivity-for-good/spectrum/gsma_resources/mid-band-5g-spectrum-benefits/

[11] GSMA Intelligence. Spectrum Navigator Q1 2024.

[12] For example, see Ericsson, Planning indoor 5G coverage; Cisco, 5G Thriving indoors; Huawei, Better Indoor coverage, Better 5G networks

as evidenced by the proportion of indoor mobile coverage scans for selected cities around the world as shown in Figure 5 below.

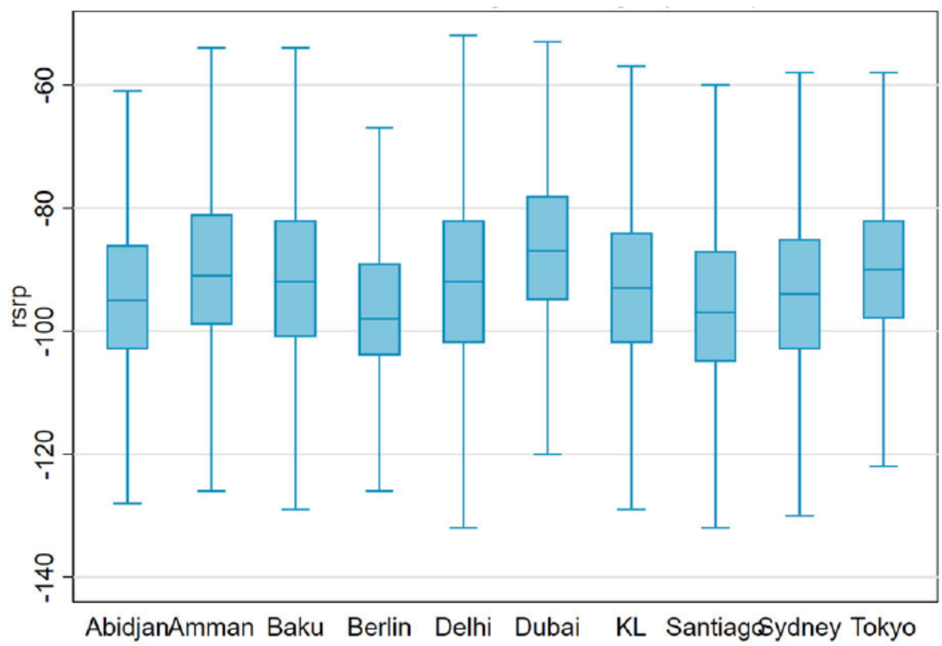
Figure 5: Majority of mobile traffic is indoors



Source: GSMA Intelligence analysis, based on Speedtest Intelligence data provided by Ookla

Analysis of indoor signal strength shows mid-bands delivering good quality coverage. As shown in Figure 6, the majority of indoor mid-band scans for selected cities have a Reference Signal Received Power (RSRP) of at least -100dBm, which is above the typical signal strengths used to determine whether coverage is available by regulators..

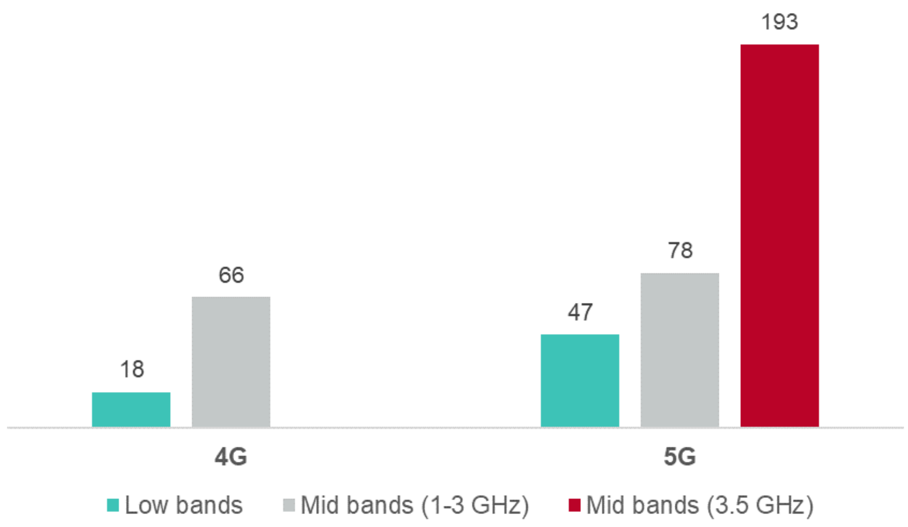
Figure 6: Mid-bands indoor signal strength



Source: GSMA Intelligence analysis, based on Speedtest Intelligence data provided by Ookla

When considering download speeds, mid-bands provide significant advantages over low bands – for example, in Sydney as illustrated in Figure 7 below, Ookla measurements show mid-band performance on 4G and 5G around 4 times faster compared to low-bands. This is unsurprising given the additional frequencies and wider channels that are available in mid-bands, but it highlights their importance in providing the quality of service that consumers expect. While low-bands are critical to provide coverage in rural and remote areas, as well as providing deep indoor coverage in urban areas, majority of traffic in urban areas (both indoor and outdoor) is supported by mid-band spectrum, which also provides much faster speeds.

Figure 7: Median download speeds by spectrum bands, Sydney



Source: GSMA Intelligence analysis, based on Speedtest Intelligence data provided by Ookla

4. Upper 6 GHz is essential to expanding mid-band capacity

Mid-band spectrum is necessary to meet the continued growth in mobile data traffic in an efficient way and to facilitate the new use cases for 5G. The need for mid-band spectrum will continue to strengthen across the rest of the decade. By 2030, an average of 2 GHz in mid-bands will be needed to deliver mobile services at a performance consistent with the ITU's IMT-2020 requirements. [13]

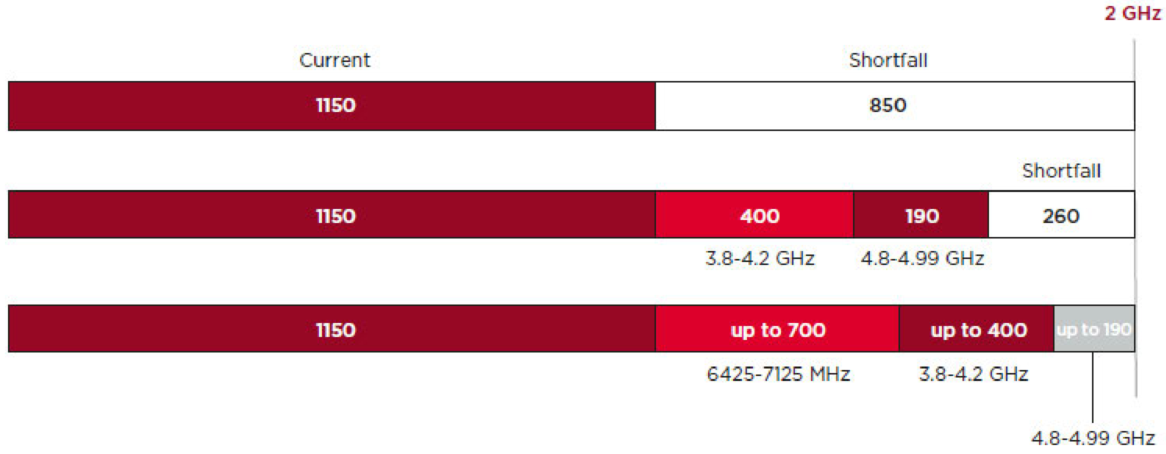
Today, around 650-750 MHz of mobile spectrum is typically available in the 1-3 GHz range. In more advanced 5G markets, 400-500 MHz of 3.5 GHz spectrum usually supports city-wide 5G, giving a total of around 1150 MHz as indicated in Figure 8.[14] In many countries however, the amount of mid-band assignments are lower. For example, in Australia there is currently around 840 MHz of mid-band spectrum assigned to mobile operators[15] – a significant shortfall to the 2 GHz required.

The upper 6 GHz band is essential to bridge this gap. As 5G evolves into 5G-Advanced and network quality continues to improve throughout the decade, traffic volume and new use cases will follow as discussed above. By 2030 over 90% of mobile connections in Australia

[13] GSMA. Vision 2030: Insights for Mid-band Spectrum Needs. July 2021.
[14] GSMA. The Maths of Mid-band Spectrum, 20 July 2022.
[15] Comprising 1800 MHz, 2.1 GHz, 2.3 GHz, 2.6 GHz and 3.5 GHz, noting there regional differences across Australia.

will be on 5G and that is when demand and the economic impact on businesses, economies, and livelihoods will be at its highest.

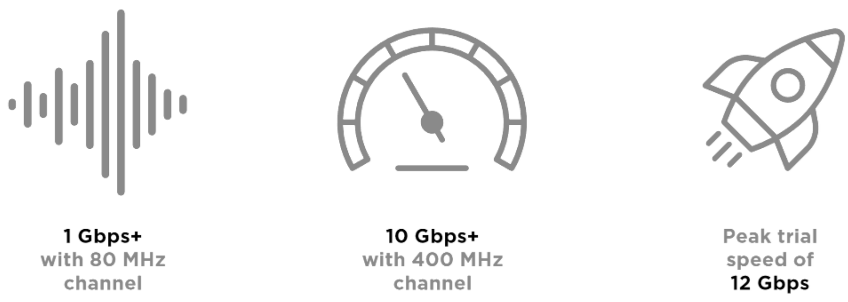
Figure 8: Options to address mid-band spectrum needs by 2030



Source: GSMA

Since 3GPP completed the technical specifications of 5G NR band 104 for the upper 6 GHz band as part of 3GPP Release 17 in June 2022, numerous trials based on 5G equipment using 6 GHz have been carried out across the world. Peak speeds of 12 Gbps have been achieved, while the first prototype handset using 6 GHz was tested in late 2023. The headline results of some of the trials are shown below with further details in Appendix A. This marks a huge upward curve in technology development over the 5 years since the first consideration of the band for public communications infrastructure.

Figure 9: Benefits of 6 GHz – key results from trials and field tests

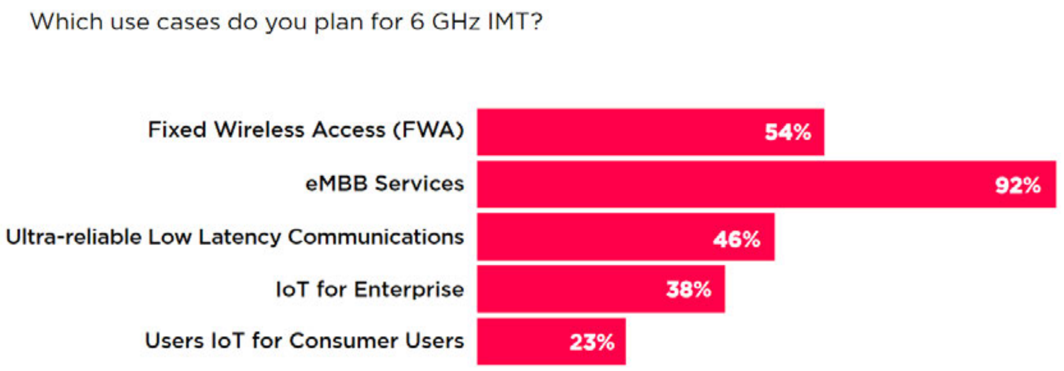


Source: GSMA

Additionally, trials have also demonstrated the potential for 6 GHz to provide a new capacity layer that will be able to make use of existing network grids. Making use of 3.5 GHz network grids for 6 GHz in future network evolution will allow operators to expand network capacity for future mobile evolution in a practical, cost-effective and environmentally-friendly way, while also supporting the mobile industry’s goal to reach net-zero by 2050.

Findings from GSMA's operator survey[16] indicates strong demand for access to the 6 GHz band for IMT. eMBB services have been the primary use case for 5G launches to date. This holds true for 6 GHz as well – 92% of operators say eMBB is a planned 6 GHz IMT use case, followed by FWA (54% of operators).

Figure 10: Planned use cases for 6 GHz



Source: GSMA

5. 6 GHz IMT ecosystem is ready for commercialisation

WRC-23 marked a significant milestone in the evolution of mobile communications. The upper 6 GHz band was identified for IMT throughout the EMEA / CIS region, and in some countries from APAC and the Americas, with harmonised conditions for its use. Some 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.

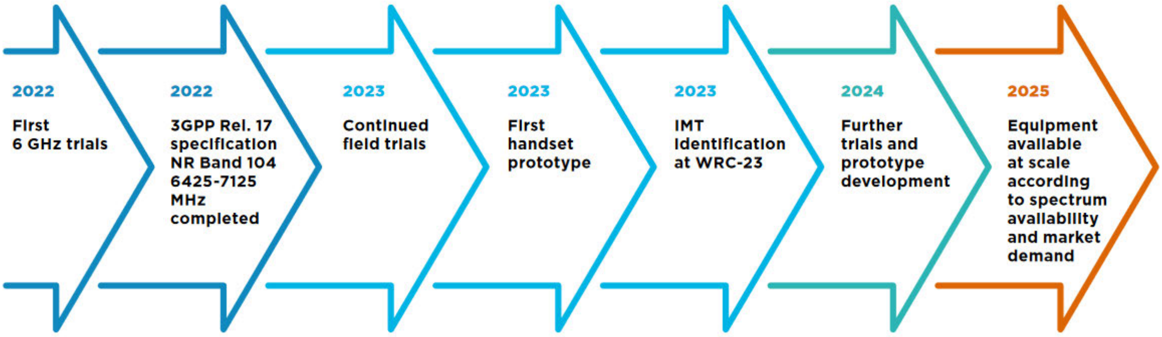
The timeline for the mobile ecosystem in the upper 6 GHz is a key consideration for operators, regulators, and solution providers. This depends on several factors, namely

- **Regulatory approval** – The 6 GHz band already has a mobile allocation in the ITU Radio Regulations and WRC-23 has laid out the conditions for its use by IMT technologies globally. National regulators are now placing the band in their national frequency allocation tables and incorporating it into their spectrum planning processes.
- **Device and infrastructure availability** – Successful trials have been conducted for the upper 6 GHz band while radio component and network infrastructure providers 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
- **Operator demand** – GSMA's operator survey has indicated strong demand for this band in line with growing mid-band spectrum requirements with expected demand emerging with scale in the 2025-2030 timeframe.

Taking the above into account, the potential timeline for the commercialisation of the 6 GHz IMT ecosystem is as follows.

[16] GSMA. The 6 GHz IMT Ecosystem. Demand Drives Scale. June 2024. https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2024/06/The-6GHz-IMT-Ecosystem-Demand-Drives-Scale.pdf

Figure 11: The 6 GHz mobile ecosystem timeline



Source: GSMA

In a recent industry statement[17], the GSMA along with stakeholders across the mobile value chain called for collaboration between governments and industry to support the full development of 6 GHz for mobile, to ensure a spectrum roadmap is delivered for mobile operators, and to put in place clear timelines for equipment and handsets to be ready at scale. The statement co-signed by 36 companies including Optus, Telstra and TPG.

6. The case for mobile in upper 6 GHz is clear

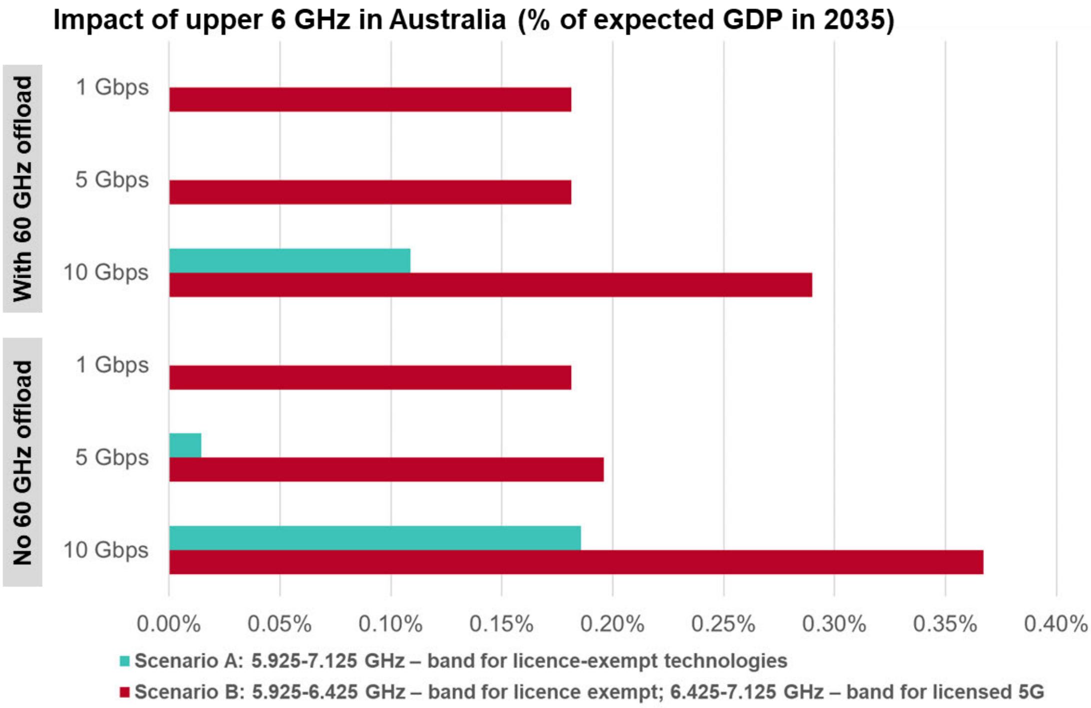
There are competing claims for access to the upper 6 GHz band by IMT and RLANs/Wi-Fi. In the preceding sections we have set out the case for licensed mobile use. Decisions on the allocation and future use of this band has significant implications on the socio-economic benefits that 5G can deliver. Thus, it is essential for policymakers and regulators to carefully consider the implications of the allocation of this band.

A detailed economic impact assessment by GSMA Intelligence[18] of the different allocation scenarios of the 6 GHz band across 24 countries, including Australia, found that optimal socio-economic benefits are achieved from the allocation of at least 700 MHz, namely the whole of upper 6 GHz band, for licensed 5G use. Even in countries with extensive fibre broadband penetration, the allocation of an additional 500 MHz of spectrum for unlicensed use in the lower 6 GHz band (5.925-6.425 GHz), representing roughly a doubling of the current supply of licence-exempt spectrum, will be sufficient to address expected Wi-Fi demand.

The benefits of additional licence-exempt spectrum for Wi-Fi are tied to the capability of fixed line connectivity speeds. Figure 12 below shows the potential economic benefits of upper 6 GHz spectrum in Australia as a percentage of GDP in 2035 for a range of theoretical FTTP download speeds (1, 5 and 10 Gbps). Noting that Australia has already made available the lower 6 GHz for RLANs, results are shown for two scenarios – Scenario A in which the whole of upper 6 GHz is also made available for licence-exempt use, and Scenario B in which the upper 6 GHz is assigned to licensed mobile use.

[17] GSMA. 6 GHz statement, June 2024. https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2024/06/6-GHz-Statement-Shanghai-FINAL.pdf
[18] GSMA Intelligence. The socioeconomic benefits of the 6 GHz band: considering licensed and unlicensed options, June 2022.

Figure 12: Impact of licensed 5G vs licence-exempt use of upper 6 GHz in Australia



Source: GSMA Intelligence

The results clearly demonstrate that licensed 5G mobile is the optimal use of the upper 6 GHz band. Even in cases with fixed broadband speeds of 10 Gbps, assigning the upper 6 GHz for licensed 5G, instead of licence-exempt use (RLANs/Wi-Fi), delivers at least a two-fold benefit in terms of GDP impact by 2035. Allowing licence-exempt technologies in the entire 6 GHz band will never be the most beneficial option.

7. GSMA views on planning options for upper 6 GHz

The ACMA has set out four broad planning options for the upper 6 GHz band and the desired planning outcomes in the Options Paper as follows. Below we provide on views on each of them.

Planning options • **Option 1:** Maintain existing arrangements, with potential reconsideration at a later date. • **Option 2:** Introduce arrangements to enable RLAN access to some or all of the upper 6 GHz band, via a variation to the LIPD Class Licence. There would be no arrangements introduced for WA WBB. • **Option 3:** Introduce arrangements to enable WA WBB access to some or all of the upper 6 GHz band, under apparatus and/or spectrum licensing. There would be no arrangements introduced for RLANs. • **Option 4:** Introduce arrangements to enable both RLAN and WA WBB access to different frequency segments within the upper 6 GHz band, using the respective authorisation arrangements in options 2 and 3.
Desired outcomes 1. Optimise the efficiency and utility of the upper 6 GHz band by introducing arrangements for RLAN and/or WA WBB services. 2. Maintain regulatory arrangements to the extent possible for existing services within the upper 6 GHz band when optimising its utility. 3. Ensure coexistence with other services in the upper 6 GHz band. 4. Maintain coexistence with adjacent band services

Views on Option 1

In light of the evidence and analysis provided in the sections above, Option 1 would be inappropriate as this fails to meet the key desired planning outcome to optimise the efficiency and utility of the upper 6 GHz band.

While Option 1 does not foreclose potential use of the band for mobile in future, a lack of clarity on future roadmap for mid-band supply in Australia puts at risk the ability of network operators to support the continued growth of 5G, new mobile-enabled innovations and the development of the next generation of mobile technologies.

Views on Option 2

Option 2 would have significant negative consequences to the long-term prospects for 5G and beyond in Australia. The upper 6 GHz band represents the largest remaining single block of mid-band spectrum that can be allocated to licensed mobile services over the next decade. Without this, Australian operators would be hampered in their ability to keep up with demand at time when 5G adoption and demand are reaching their peak.

As highlighted in Section 3 above, some 40% of the socio-economic benefits from 5G by 2030 could be lost if spectrum for mobile services is constrained to today’s levels. A similar impact is likely in Australia.

Conversely, with Australia having made available 500 MHz in the lower 6 GHz band for RLAN/Wi-Fi, further expansion of licence-exempt spectrum is unwarranted and would be sub-optimal in terms of securing maximum public benefit from the upper 6 GHz band as illustrated in Figure 12 above. These figures show that there is more benefit from using the upper 6 GHz for licensed mobile because RLAN capacity is not expected to be constrained during period to 2035, while mobile capacity will be in that period.

It is important for policymakers and regulators to understand the efficiency of spectrum utilisation by different spectrum users and whether incentives exist for them to optimise use of scarce spectrum resources.

Mobile operators have a strong incentive to utilise spectrum efficiently because they face a pricing signal on their spectrum use – whether they purchase spectrum in an auction and/or pay renewal or annual fees (or have a license obligation). With growing demand, mobile operators are incentivised to improve spectral efficiency through technology upgrades and migration, and also to re-use spectrum where possible by densifying networks and deploying additional mobile sites.

While Wi-Fi spectral efficiencies have evolved by generation, user speeds are highly variable, contingent on various factors including bands and channels used, number of access points, backhaul between access points, number of devices (or STAs), antennas per access point and per STA, frequency re-use, access point channels and use of unlicensed mmWave in 57-71 GHz range. Unlike for mobile, Wi-Fi users do not face a pricing signal, and there is less incentive to deploy as efficiently as possible.

Additionally, there remains a large proportion of legacy Wi-Fi technologies. Wi-Fi scans for a selection of major cities taken from Q1 2024 show that Wi-Fi 4 usage range from 22% in Santiago, Chile, up to 78% in Abidjan, Ivory Coast (see Figures B4-B6 in Appendix B for more detail on Wi-Fi use). This means Wi-Fi performance could be significantly enhanced by simply upgrading users to the latest technology, as well as deploying them more efficiently indoors. See Appendix B for further discussion on spectrum utilisation by mobile and Wi-Fi.

In the case of the upper 6 GHz band where spectrum allocation decisions are made outside of a market-based mechanism, it is crucial that policymakers incentivise the efficient use of spectrum and avoid assigning spectrum to compensate for inefficient use. Thus, the GSMA is of the view that Option 2 does not merit further consideration by the ACMA.

Views on Option 3

The upper 6 GHz spectrum band is vital to the mobile industry as discussed above and because of this received widespread support at WRC-23. Given the reasons and evidence set out in this submission, the GSMA firmly believes that only Option 3 can deliver optimal public benefit in terms of socio-economic impact and efficiency of spectrum utilisation in the upper 6 GHz band. This can ensure that affordable mobile capacity is available to drive industrial and economic competitiveness in the sustainable, digitalised markets of the future.

The GSMA and the mobile industry[19] firmly believe that:

- 6 GHz capacity is required to meet increasing customer demand at speeds outlined in the ITU's vision for 5G, as well as future evolution
- Mobile networks are already densified, but 6 GHz can enable the growth of sustainable mobile capacity on existing macro-cell sites.
- Timely availability of 6 GHz, at reasonable conditions and price, will drive cost-efficient network deployment, help lower the broadband usage gap and support digital inclusion.

[19] GSMA Statement. Commercialising the 6 GHz IMT Ecosystem, June 2024. https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2024/06/6-GHz-Statement-Shanghai-FINAL.pdf

- Mobile networks will need, on average, 2 GHz of mid-band spectrum per country by 2030. This is challenging to achieve without 6 GHz.
- The 6 GHz band at 6.425-7.125 GHz should be made available for licensed, macro-cell mobile

With regard to coexistence between IMT and existing users in the upper 6 GHz band, extensive studies and discussions have taken place during the WRC-23 cycle to address the concerns of various stakeholders. For the protection of FSS uplinks, harmonised conditions in the form of an EIRP mask on IMT base stations were agreed at WRC-23[20] and conformance specifications are due to be finalised by 3GPP later this year.

For FSS downlinks, it is noted that the number of assignments for earth station receivers are small and detailed coordination can be undertaken to ensure protection while allowing flexibility for wide-area mobile deployment.

For fixed links including TV outside broadcast (TOB), the relocation of these users is likely to be needed to ensure that mobile operators can deploy their networks efficiently in the band. This process, as mentioned by the ACMA, will require time and consultation with affected users and potential new users. In this regard, the ACMA's embargo on new apparatus licences in the upper 6 GHz band is a prudent first step.

Views on Option 4

The GSMA recognises the need to use spectrum efficiently, including in particular the valuable mid-band spectrum in the upper 6 GHz band. We appreciate ACMA's desire to explore various forms of traditional and non-traditional sharing which might potentially help to enable more efficient use of spectrum. We believe, however, that there are a number of difficult challenges associated with sharing of the upper 6 GHz band between licensed mobile and Wi-Fi.

Co-channel operation of mobile networks and Wi-Fi at the same place and time are likely to result in extensive harmful interference and severe degradation in the performance of both types of radio systems. Licensed mobile operates in clean, contiguous spectrum with user terminals moving throughout any coverage area in unknown locations while unlicensed terminal locations are, by their nature, also not fixed.

Firstly, with regard to frequency segmentation, we note that this approach retains mutually exclusive allocations for Wi-Fi and licensed mobile meaning any increment to Wi-Fi would reduce the bandwidth available for mobile. As highlighted in the economic impact study by GSMA Intelligence, the optimal allocation and greatest public benefit is achieved by using the whole upper 6 GHz spectrum for licensed mobile with the lower 6 GHz band for unlicensed Wi-Fi, thus allowing for sufficient new spectrum assignments for both technologies to develop. Any frequency segmentation option that results in constrained mobile spectrum and reduced economic/GDP impact should be avoided.

With regard to geographic segmentation, the main challenge is that mobile and Wi-Fi demand are likely to peak in similar areas (i.e. in dense urban clusters) and segmentation of by geographic area or location is unlikely to meet the needs of both uses. We agree with ACMA's view that this is not a viable planning option for the upper 6 GHz band.

[20] ITU. Final Acts WRC-23. Resolution 220, resolves 2.

As for non-traditional sharing, the ACMA have identified different mechanisms, namely including indoor/outdoor separation, reduced WA WBB base station power, database-assisted coordination and spectrum sensing. The practicalities involved in implementing any of the above options are highly complex.[21]

In the case of an indoor/outdoor separation, there are serious doubts whether it would work more generally in practice. There will be many locations where there will be much less isolation between indoors and outdoors, e.g. where there are openings such as doors and windows and/or where the building penetration loss is lower, and in such cases interference between mobile and Wi-Fi will occur. The signal/penetration loss between indoors and outdoors will vary greatly between different buildings and locations within them. More importantly, as discussed in Section 3, the majority of mobile use is indoors and dependent on mid-bands. As recent trials have shown, 6 GHz outdoor cells can provide indoor coverage at high data rates.

In the case of reduced mobile base station power, such an approach will degrade performance to the extent that it diminishes the value of the band for operators and results in limited use for mobile, particularly given that majority of mobile use is indoors and supported by mid-bands. Reducing power will result in denser network grids as it means that the proposed re-use of 3.5 GHz base stations will not be possible. Such densification will have a high economic and carbon emissions cost. The other impact of reduced power levels would be lower quality service and lower speeds. This would result in loss of productivity and the economic benefits of mobile as well as its potential enabling effect on carbon emissions reductions in other sectors.[22] Moreover, the indoor signal strength from mobile networks may not be reduced and will therefore not enable the sharing between mobile and Wi-Fi that is envisaged under this scenario. Any approach that reduces power levels of mobile base stations should be avoided.

While spectrum sensing mechanisms and database sharing solutions have been discussed for many years, successful implementations have been limited. There are a number of challenges that would need to be overcome, e.g. how to accurately predict interference (both in-band and adjacent) so as to avoid interference from one service to another without leaving a substantial ‘buffer zone’ between areas that are used by the two services. It is also currently unclear as to what the costs of these solutions would be, as well as their impact on mobile and Wi-Fi deployments in the upper 6 GHz band.

Such non-traditional sharing frameworks would only work if licensed mobile use was prioritised over Wi-Fi. For the above reasons, we believe non-traditional sharing is extremely challenging, and we are concerned about the practicality and complexities that this may involve, and the effectiveness of any solution. In any case, as mentioned above, the spectrum needs of RLAN and licensed mobile are likely to be higher in the same areas.

Bespoke national solutions or national requirements on products should always be avoided to ensure that Australian consumers can benefit from global ecosystems and economies of scale.

[21] See for example ongoing CEPT work in ECC PT1 and Ofcom (2023), Hybrid sharing: enabling both licensed mobile and Wi-Fi users to access the upper 6 GHz band – Summary of responses and next steps
[22] GSMA. Spectrum: the climate connection, May 2023. h https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2023/05/Spectrum_Climate_Connection.pdf

We agree with ACMA that introducing arrangements that carry a high level of uncertainty can materially affect spectrum value, especially for allocations intended to support wide-area deployments. Further consideration of non-traditional sharing is not warranted at this point.

8. Summary and conclusions

Australia has made a strong start to the 5G era. However, as 5G demand continues to increase across the rest of this decade, mobile operators need clarity on future spectrum supply in order to plan for the next phase of 5G technology evolution and support continued innovation.

Mid-bands are core to meeting rising mobile traffic and supporting new use cases. The upper 6 GHz band is the largest remaining single block of mid-band spectrum that can be allocated to licensed mobile services in the timeframe to 2030. Without this, Australian operators would be hampered in their ability to keep up with demand at time when 5G adoption and demand are reaching their peak. Thus it is imperative that the ACMA take appropriate steps towards making available this band for licensed mobile use.

Spectrum policymakers are facing an important decision as they look to decide the optimal approach for managing spectrum in the 6.425–7.125 GHz band amid competing claims by IMT and RLANs/Wi-Fi. It is crucial that ACMA pursue policies that generate the most economic and social value for the country. Our assessment of the socio-economic benefits of the different options for the 6 GHz shows that assigning the full upper 6 GHz band for licensed mobile delivers this desired outcome.

Evidence on how Wi-Fi is currently utilised strongly suggests that Wi-Fi has sufficient spectrum in the 2.4 GHz, 5 GHz and lower 6 GHz frequencies (as well as unlicensed high bands) to meet future traffic demand if used efficiently. It is important that policymakers look to incentivise the efficient use of spectrum and avoid assigning spectrum to compensate for inefficient use.

In light of the above, it is clear that Option 3 is the optimal choice. Option 2 does not merit further consideration as this would have significant detriment to the long term development of 5G and future evolution of mobile. As for Option 4, aside from frequency segmentation, other forms of sharing including geographic sharing and non-traditional mechanisms are highly complex and carry a high level of uncertainty which would adversely the utility of the upper 6 GHz band. Any frequency segmentation scheme in the upper 6 GHz band should be avoided as this would reduce the amount of bandwidth available for mobile and lower overall public benefit. Therefore, GSMA recommends Option 3 as the way forward for Australia.

Appendix A. Upper 6 GHz trials for IMT

Several recent field trials and test involving the upper 6 GHz band provide evidence on the ability of the upper 6 GHz band to provide an effective coverage and capacity layer for IMT. Further details on these trials are provided below.

A1. Chulalongkorn University (February 2023) [23]

Chulalongkorn University, Thailand, conducted a field test of upper 6 GHz to study the data transmission quality for 5G Outdoor to Outdoor (O2O) and Outdoor to Indoor (O2I) deployment scenarios using the upper 6 GHz band. Using a channel bandwidth of 80 MHz, the test achieved average throughputs of 1100 Mbps (O2O) and 550 Mbps (O2I). This trial demonstrates that upper 6 GHz is able to offer good macro base station coverage performance, making it a suitable band for nation-wide IMT deployment.

A2. Du, e& (August 2023)[24]

UAE operators du and e& completed a successful 5G-Advanced trial project involving the upper 6 GHz band. Using 400 MHz bandwidth, the trial achieved a throughput of 10 Gbps. The TDRA which confirmed the results, noted that the increase in data speed will support many future projects at the UAE level, especially those that require highly sophisticated technologies (e.g. nanotech) and high internet speeds, such as remote diagnostics in healthcare, or autonomous (self-driving) vehicle projects in transportation, as well as help in the management of some industrial installations.[25]

A3. Deutsche Telekom (August 2023)[26]

German operator Deutsche Telekom completed a trial which achieved a data rate of ~12 Gbps. To achieve this speed, two 5G data streams – from upper 6 GHz and 3.7 GHz spectrum – were combined. The results highlight the capacity expansion benefits of 5G deployment using carrier aggregation of 3.5 GHz and upper 6 GHz mid-band spectrum and the ability of such a deployment to achieve reasonable indoor coverage.

A4. Maxis, Universiti Malaya (September 2023)[27]

This upper 6 GHz trial conducted by Malaysian operator Maxis and Universiti Malaya achieved a peak throughout of 1.28 Gbps with 80 MHz bandwidth using a prototype Active Antenna Unit and a prototype mobile device. The test results showed good indoor penetration and the ability to achieve speeds of over 300 Mbps at locations more than 400m away from the mobile site, as well as potential for improvements in mobile signal propagation with more advanced antenna technology.

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[23] More information at https://www.chula.ac.th/en/news/118185/
[24] More information at https://www.eand.com/en/news/29-aug-etisalat-by-eand-5G-advanced-network-speed-trials.html and https://www.du.ae/about/media-centre/newsdetail/du-breaks-new-ground-in-5g-advanced-trial
[25] More information at https://www.chula.ac.th/en/news/118185/https://tdra.gov.ae/en/media/press-release/2023/tdra-announces-successful-completion-of-phase-ii-of-advanced-5g-trials
[26] More information at https://www.telekom.com/en/media/media-information/archive/world-record-12-gigabits-per-second-in-mobile-communications-1048610 and https://api.cept.org/documents/ecc-pt1/81398/ecc-pt1-24-032_%C2%ADdt_6-ghz-trial
[27] More information at https://www.maxis.com.my/en/about-maxis/newsroom/2023/september/setting-the-right-path-to-meet-growing-data-consumption/

A5. Vodafone Spain (October 2023)[28]

Vodafone announced a successful test of the upper 6 GHz band in Spain which achieved download speeds of up to 5 Gbps and on average 2 Gbps across various indoor locations. It was noted that 75% of all mobile traffic originates from users at home, in the office, or in enclosed public places such as cafes, bars, shops, and gyms, and the ability of upper 6 GHz to serve indoor users will ensure consumers and businesses receive even faster access and more reliable 5G services over the next 5-10 years.

A6. Ericsson, MediaTek (November 2023)[29]

Ericsson and MediaTek successfully carried out an interoperability test involving 5G NR data calls over upper 6 GHz band. This was performed with a MediaTek prototype test device and an Ericsson base station. The test was the first 5G NR data call on the 3GPP-defined n104 band (6.425-7.125 GHz) and highlights the efforts by telecom vendors, service providers, and device/chipset makers to build a global ecosystem for IMT in the upper 6 GHz band.

A7. Telefonica Germany (November 2023)[30]

Telefónica Germany tested 5G in the upper 6 GHz band using an existing site in Stuttgart, with results that show the good propagation characteristics of the band in real environments, and its large potential value for both indoor and outdoor coverage.

The tests achieved peak download speeds of 3 Gbps using just a 100 MHz bandwidth in the upper 6 GHz base station. Even at the outdoor cell edge, 500 meters away from the roof-top site, 0.5 Gbps were obtained. Throughout the cell coverage the averaged download speed outdoor was almost 2 Gbps. Indoor coverage was also tested at 200 meters distance from the site obtaining very high download speeds of 1.7 Gbps.

The test shows the indoor coverage reach of 6 GHz in mobile networks, providing high download speeds that make indoor use of Wi-Fi very difficult in the same frequency and location as 5G. This suggests any power restrictions intended to reduce indoor penetration and accommodate Wi-Fi would result in impaired services, affecting the capacity and performance of the band and should be carefully analysed.

A8. Nokia, Telia (June 2024)[31]

Nokia and Telia successfully completed a field pilot in the upper 6 GHz spectrum band that will add crucial capacity and coverage to existing macro cell sites in dense urban environments for next-generation 5G-Advanced and 6G networks.

During the trial, Nokia used a 128TRX Massive MIMO radio based on its AirScale Habrok platform and a test terminal from MediaTek with integrated antennas. The pilot examined whether the uplink coverage on the new, higher frequency is compatible with the existing inter-site distances. The companies tested the upper part of the band (n104) and used a 3.5

[28] More information at https://www.vodafone.com/news/technology/vodafone-tests-reveal-6ghz-spectrum-to-avoid-5g-capacity-crunch
[29] More information at https://www.ericsson.com/en/news/2023/11/ericsson-and-mediatek-demo-on-6-ghz-licensed-5g-band
[30] https://www.telefonica.com/en/communication-room/blog/6ghz-will-bring-high-benefits-for-society-with-the-right-rules/
[31] https://www.nokia.com/about-us/news/releases/2024/06/04/nokia-and-telia-complete-successful-outdoor-trial-in-6-ghz-range-with-massive-mimo-radio/

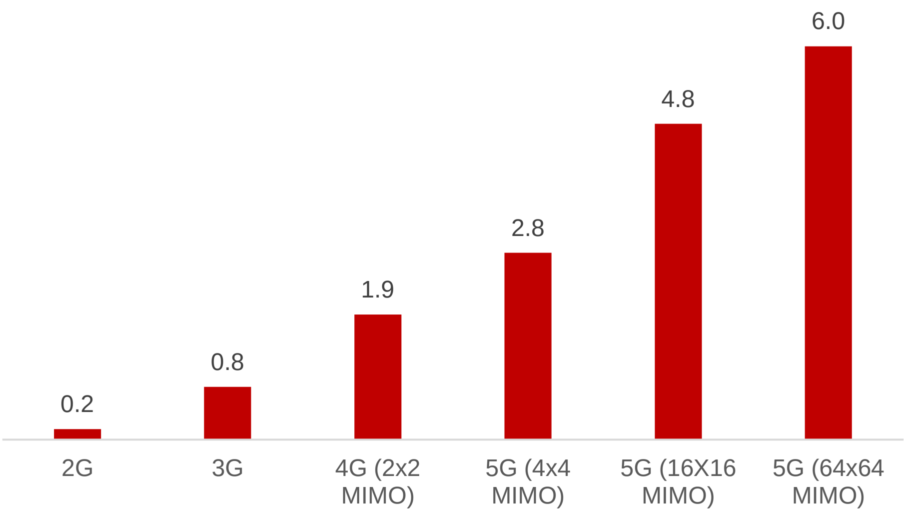
GHz massive MIMO cell of the same RF-bandwidth across various distances to replicate different real-world scenarios.

Field tests confirmed the macro-grid-readiness of the upper 6 GHz spectrum used with Massive MIMO. It showed that massive capacity can be added in urban areas, where there is higher demand for TDD broadband, and high throughput can be achieved in suburban or rural areas. This offers operators an evolution path to 5G-Advanced and 6G, in the future.

Appendix B. Mobile and Wi-Fi spectrum utilisation

Almost all governments and policymakers have an objective of ensuring that spectrum is used efficiently.[32] With each technology cycle, mobile has made more efficient use of spectrum, as shown in Figure B1, with the spectral efficiencies of 5G more than 7 times greater than that of 3G. Operators also have an incentive to utilise spectrum efficiently because in almost all countries, they face a pricing signal to do so – whether they purchase spectrum in an auction and/or pay renewal or annual fees (or have a license obligation). This means that in addition to improving spectral efficiencies, they also re-use spectrum where possible by densifying networks.

Figure B1: Mobile spectral efficiencies by generation (bit/s/Hz)



Source: GSMA Intelligence

By contrast, where a spectrum user does not face a pricing signal, there is less incentive to deploy it as efficiently as possible. Figure B2 shows how Wi-Fi spectral efficiencies have evolved by generation, with the spectral efficiencies of Wi-Fi 6 around 2 times greater than that of Wi-Fi 4. However, these headline rates are rarely achieved due to co-channel and non-co-channel interference, especially in dense urban apartment buildings. Given this challenge, several studies have sought to assess actual Wi-Fi spectrum needs to deliver certain speed requirements, for example 1 Gbit/s, in dense urban apartment blocks. This includes analysis by Qualcomm (2016 and 2023)[33], Analysys Mason and Huawei[34] and Plum Consulting.[35] More recently, Comtel published the results of a series of field tests on Wi-Fi connectivity in a high-density urban residential environment, with the aim of evaluating the

[32] For example, Decision No 676/2002/EC of the European Parliament and of the Council, Article 1 states, "*The aim of this Decision is to establish a policy and legal framework in the Community in order to ensure the coordination of policy approaches and, where appropriate, harmonised conditions with regard to the availability and efficient use of the radio spectrum necessary for the establishment and functioning of the internal market in Community policy areas such as electronic communications, transport and research and development (R & D)*".
[33] Qualcomm (2016), A Quantification of 5 GHz Unlicensed Band Spectrum Needs and Qualcomm (2023), Presentation for the UK Spectrum Policy Forum On Future Demand for Unlicensed Spectrum
[34] Analysys Mason (2023), Impact of additional mid-band spectrum on the carbon footprint of 5G mobile networks: the case of the upper 6GHz band
[35] Plum Consulting (2024), Wi-Fi Spectrum Requirements

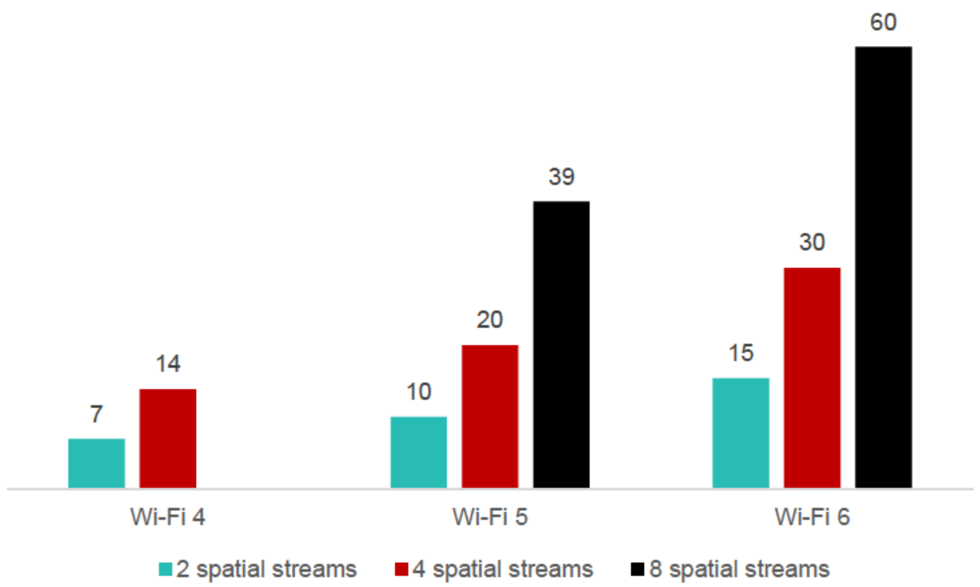
ability of Wi-Fi access points to effectively handle high traffic volumes while subjected to significant interference.[36]

The results of these studies vary considerably based on the assumptions and inputs regarding:

- The frequency bands and channels used
- The number of access points
- Backhaul between access points (Ethernet or WLAN)
- Number of devices (or STAs)
- Number of antenna per access point and per STA
- Coverage
- Frequency re-use
- Access Point channels
- Use of unlicensed mmWave in the 57–71 GHz range

Figure B3 shows the range of spectral efficiencies implied from each study, based on the spectrum required to deliver 1 Gbit/s. The lower range typically assume one access point, 99% coverage, minimal frequency re-use, no utilisation of mmWave and that STAs will have 2 antenna even in the long-term. The upper range adjusts one or two of these assumptions, for example 2-4 access points, 90% coverage, greater frequency re-use or assuming STAs will have 4 antenna in the long-term. This is important because when deciding how to assign spectrum outside of a market-based mechanism, policymakers should incentivise the efficient use of spectrum and avoid assigning spectrum to compensate for inefficient use.

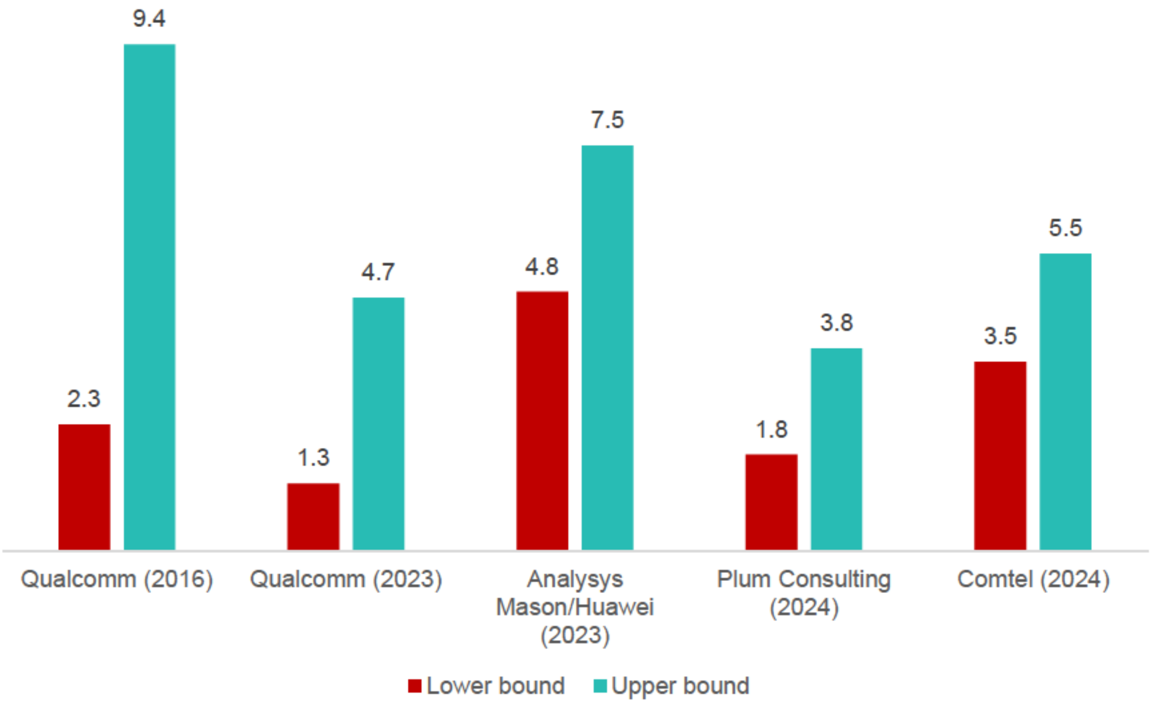
Figure B2: Wi-Fi spectral efficiencies by generation (bit/s/Hz)



Source: GSMA Intelligence calculations based on the MCS Index table

[36] See https://www.comtelitalia.it/indoor_connectivity_test_en/

Figure B3: Wi-Fi spectral efficiencies to deliver 1 Gbps (bit/s/Hz)



Source: GSMA Intelligence calculations based on the respective studies

Wi-Fi performance can be significantly improved by upgrading Wi-Fi 4 devices

A related point regarding the efficient deployment of unlicensed networks is whether they are utilising the most efficient technology. In the 10 cities considered in this study, Figure B4 shows a significant proportion of Wi-Fi scans were on Wi-Fi 4, ranging from 22% in Santiago to 78% in Abidjan.[37]

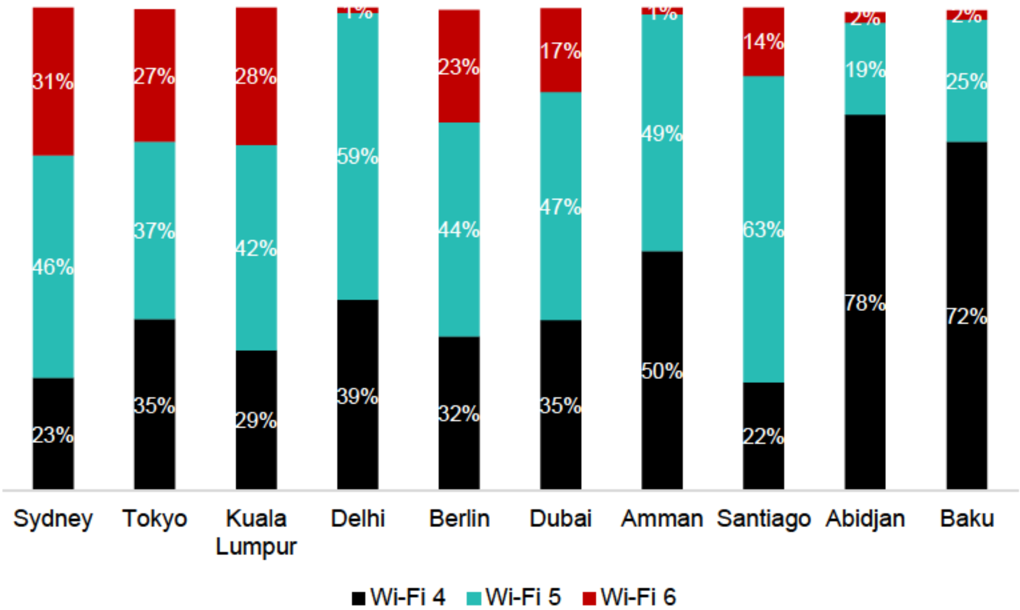
As demonstrated in Figure B5, the type of Wi-Fi technology has a significant impact on user experience – download speeds on Wi-Fi 6 were up to 15 times faster than Wi-Fi 4. This shows that Wi-Fi performance could be significantly enhanced by upgrading users to the latest technology, as well as more efficient deployments indoors. It is also worth emphasizing that the fast speeds observed on Wi-Fi 6 in this analysis have not been dependent on access to the lower 6 GHz band. Figure B6 shows that when looking at Wi-Fi scans, less than 1% have utilised the lower 6 GHz band, with the exception of Tokyo. This includes cities such as Berlin, Sydney and Santiago, where the lower 6 GHz band has been available to use for unlicensed RLAN technologies.

It is also important to note that Wi-Fi speeds will be constrained by the maximum speed of the underlying copper, fibre or cable connection. Around half or more fixed broadband subscriptions cannot deliver speeds greater than 100Mbps in Europe, Latin America and the Caribbean, South Asia, South Eastern Asia, Sub-Saharan Africa and MENA (outside of the

[37] This is further supported by analysis in other cities and countries, see for example https://www.ookla.com/articles/improve-wi-fi-in-the-home-q1-2023 and https://www.ookla.com/articles/gulf-fiber-wifi-standard-q2-2023

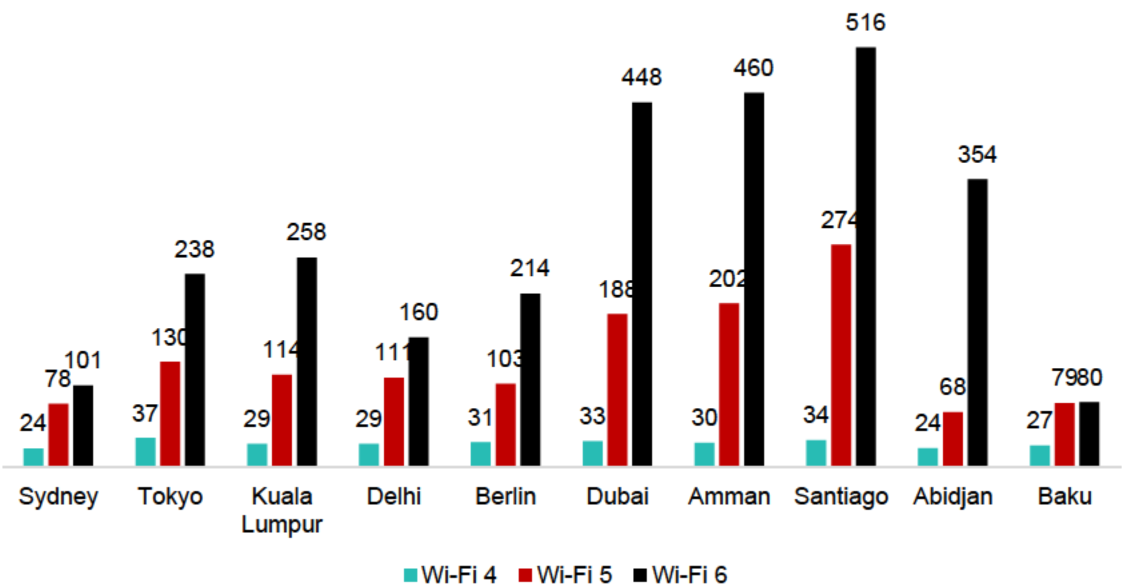
GCC).[38] In such cases, Wi-Fi and the amount of unlicensed spectrum will never be a capacity bottleneck.

Figure B4: Distribution of Wi-Fi scans based on technology



Source: GSMA Intelligence analysis, based on Speedtest Intelligence data provided by Ookla

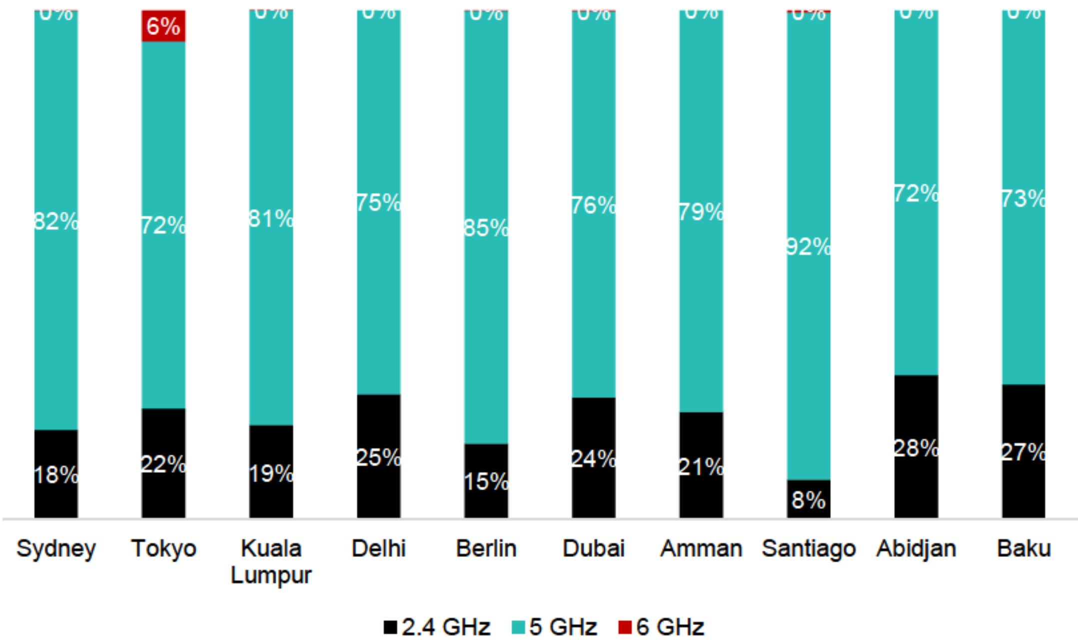
Figure B5: Median download speeds by Wi-Fi technology



Source: GSMA Intelligence analysis, based on Speedtest Intelligence data provided by Ookla

[38] GSMA Intelligence analysis of ITU data

Figure B6: Distribution of Wi-Fi scans by frequency



Source: GSMA Intelligence analysis, based on Speedtest Intelligence data provided by Ookla