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AMTA
Australian Mobile Telecommunications Association

AMTA Submission

Australian Communications & Media Authority

Future use of the upper 6 GHz band Options Paper

About AMTA

The Australian Mobile Telecommunications Association (AMTA) is the peak industry body representing Australia's mobile telecommunications industry. Its mission is to promote an environmentally, socially and economically responsible, successful and sustainable mobile telecommunications industry in Australia, with members including the mobile network operators and service providers, handset manufacturers, network equipment suppliers, retail outlets and other suppliers to the industry. For more details about AMTA, see http://www.amta.org.au.

Introduction and preferred replanning option

AMTA welcome the Options Paper as a sensible step towards providing greater clarity around the future use of this important upper mid-band spectrum, which mobile network operators (MNOs) will need to deliver high-capacity services in the future. We support the ACMA's approach to gathering material to inform its planning decisions, including whether to progress the band to the implementation stage in the near future.

The ACMA's planning for the future use of the upper 6 GHz band ("U6") must promote the long-term public interest to be derived from the use of this spectrum. AMTA notes the ACMA's desired planning outcomes for U6 and submit that there is clear evidence that introducing arrangements for wide-area wireless broadband (WA WBB) services will *"…optimise the use of the upper 6 GHz band"*, while continuing to enable co-existence with existing adjacent-band services.

In this regard, **Option 3** is the only option which achieves this, and in this response, we present the evidence to support our view that the ACMA should re-allocate the entire U6 (6425-7125 MHz)—which aligns with 3GPP band n104—for spectrum-licensing. Noting that any incumbent fixed point-to-point (PTP) links would need to be cleared from areas re-allocated for spectrum licensing, a balance would need to be struck between maximizing the public benefit derived from the use of U6, with the costs and disruption of clearing the band of fixed PTP links. At least initially, we believe that this balance can be achieved by re-allocating metropolitan ("metro") areas of the eight (8) State & Territory capital cities, with a potential future expansion to include other major regional centres.

Mobile networks

Services delivered over mobile networks

Over the past 30 years, cellular communications have brought unprecedented benefits to humankind. 2G and 3G unleashed the potential of human mobility and connectivity. 4G gave us greater access to information and social engagement. 5G has now linked us to the wealth of data from machines and sensors.

Initially, U6 will likely be used for 5G-Advanced which will enhance capacity and performance of city-wide 5G networks. MNOs will look to enhance user experiences and stave off network congestion while providing the services users have already come to expect, e.g. high levels of video streaming consumption, along with new and emerging applications like augmented- and virtual-reality (AR/VR) and tactile internet—mostly pertaining to the enhanced mobile broadband (eMBB) use case. Figure 1 below is an example of how, even within a single ‘generation’, mobile network technology is constantly evolving.

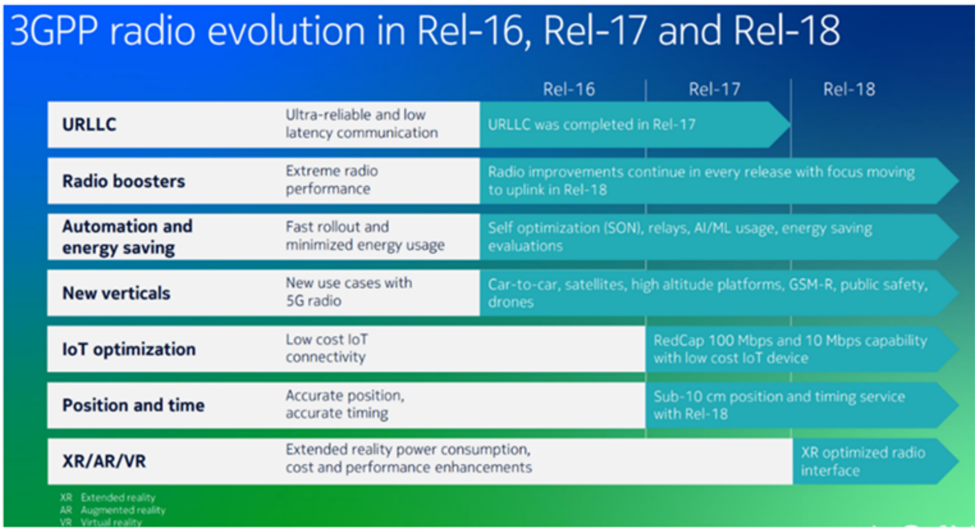

Figure 1—3GPP radio evolution of 5G NR.

Beyond initial deployments in support of 5G-Advanced, we consider that U6 will likely also provide a long-term spectrum home for 6G. 6G will be a technology evolution building on the existing 5G and 4G technologies, and is aimed to connect the digital, physical, and human worlds. In terms of standardisation, 6G performance aligns with the requirements of the ITU’s IMT-2030 framework, which expects the eMBB use case to be expanded to Immersive Communication to provide rich and interactive video experience to users.

U6 will become critical in meeting forecasted growth in mobile traffic and is also required to ensure smooth technology evolution to 5G-Advanced and 6G. Demand for data will extend beyond 5G and come from new use cases, including critical technologies such as quantum computing, autonomous systems and robotics, Artificial Intelligence (AI) and advanced manufacturing. “Mature” 5G and then eventually 6G networks and services will need to deliver a fibre-like experience with 100 Mbps downlink as well as low latency, catering for higher traffic densities.

In the 6G era, networking will move beyond mere connectivity. 6G will fuse the digital, physical and human worlds, opening the door to extrasensory experiences. Intelligent knowledge systems will be combined with robust computation capabilities, merging the roles of network, application and processor.

The industrial metaverse, spatial computing, AI-generated content and ubiquitous XR are hungry for capacity, require unbending reliability and brook no compromises in latency. The mobile industry is creating 6G to meet those relentless demands.

As demonstrated later in our response, mobile data traffic demands are growing and are expected to grow at a rate in the order of 20% per annum. For networks to support the increasing demands of the future, they will need to be more cognitive and automated utilizing AI and machine-learning (ML), as well as address the transformative needs and operating models of organizations and consumers.

WA WBB use of spectrum delivers unrivalled public benefit

The public benefits of WA WBB services to Australia are well-documented and undeniable. Mobile networks enable access to essential services and are national critical infrastructure. Mobile networks and services have and will continue to deliver unrivalled public benefit with their wide-area coverage and large customer bases enabling economies of scale and cost-effective national deployment.

Australian mobile networks supply essential communications services across the country, providing access to emergency, education, banking, health, social, commercial and government services. There were 28.7 million prepaid and postpaid mobile plans across Australia in December 2022, up 1.4 million from the previous year[1].

Mobile networks are a critical component of Australia's digital infrastructure and underpin the realisation of key Government policy objectives for an inclusive, secure and prosperous Australia. Mobile networks and services provide billions of dollars in uplift to the Australian economy and will continue to do so given the right investment environment. PwC has forecast the cumulative impact for 5G for Australia at **$110 billion over the period 2023-2030**.

In 2022, Deloitte Access Economics forecast that the cumulative benefit of 5G to the Australian economy over eight years through to 2030 would be **$94 billion**, *if* Australia is able to maintain its place in third position globally for the adoption of 5G technology. If, however, Australia was to chart the course predicted by the GSMA in terms of global ranking for 5G

[1] ACMA, 2023, Trends and developments in telecommunications 2022-23, p.5, where the ACMA notes that "there were 39.6 million mobile services in operation…2.8 million more than June 2022. It includes prepaid and postpaid mobile plans, mobile broadband services and machine-to-machine connections"

adoption, then it would only realise $67 billion; a shortfall of some $27 billion. AMTA notes that two years into the eight-year window, Australia has fallen to eighth place as at Q1 2024.

MNOs require the right spectrum to enable the cost-effective deployment of critical infrastructure essential to Australia's digital future. Mid-band spectrum provides a balance between delivering coverage and capacity; U6 represents a natural progression from existing mid-band spectrum in the range 3.4-4.0 GHz to support the cost-effective deployment of higher-capacity 5G-Advanced, and then 6G, networks.

In order to meet the growing traffic demands and realise the broader public benefits of WA WBB services for the long term, MNOs need mid-band spectrum of sufficient quantity and quality to deploy networks and deliver sufficient bandwidth at a competitive price. This is particularly so given accelerating uptake of 5G services and the future use cases contemplated by 5G-Advanced and then 6G (IMT-2030) services.

WA WBB in U6 provides greater benefits than RLAN

AMTA submit that when considered in this context, the merit of arrangements to support WA WBB use of U6 is clear. By contrast, the public interest to be served by making arrangements for use of U6 by radio local area networks (RLAN) is not clear, and certainly not urgent, particularly so soon after the recent variations to the *Radiocommunications (Low Interference Potential Devices) Class Licence 2015* ("LIPD Class Licence") to enable RLAN use of the lower 6 GHz band ("L6").

WA WBB deliver superior publicly-beneficial outcomes to RLAN on numerous metrics, including in relation to, *inter alia*:

- coverage and mobility;
- performance and reliability;
- quality of service (QoS);
- capacity and scalability;
- security; and
- efficient spectrum use.

The advanced features that will be deliverable via future mobile technologies lend greater support to the need for arrangements for future use of WA WBB in U6. In the circumstances, and for reasons detailed further below, AMTA urge the ACMA to carefully consider whether the risk of foreclosing WA WBB to this crucial spectrum is really outweighed by the RLAN sector's relatively unsubstantiated claims that they face an imminent spectrum shortfall to meet an impending "Gigabit connectivity target" via Wi-Fi.

The risks to spectrum utility of seeking to accommodate too wide a range of use cases are clearly demonstrated by the ACMA's approach to the 3.4-4.0 GHz range, which has resulted in inefficient fragmentation of important mid-band spectrum. This sub-optimal outcome lends greater weight to the need to ensure sufficient arrangements are made for WA WBB in the future use of U6.

Responses to Issues for Comment

Question 1

What are your views on the 4 broad planning options identified for the upper 6 GHz band?

The only option which maximises the public benefit derived from the use of the spectrum is **Option 3**: described by the ACMA as *"[introduction of] arrangements to enable WA WBB access to some or all of the Upper 6 GHz band, using apparatus and/or spectrum licensing"*. From here on in in this response, by Option 3 we mean: allocation of the entire U6—6425-7125 MHz (i.e. 3GPP band n104)—to WA WBB. As such, Option 3 means that the upper edge of spectrum made available for RLAN stays at 6425 MHz (as is currently the case). It also means that the bottom 20 MHz of the 7.2 GHz Television Outside Broadcasting (TOB) services band (7105-7125 MHz) would be re-purposed for WA WBB, although we recognise that this coexistence issue can be considered in further detail as part of a subsequent planning process

If the ACMA cannot support Option 3, we would err on the side of caution and recommend that Option 1 would be preferable to either Option 2 or 4, at least for the time being. It would be much better for the ACMA to pause and allow international developments (e.g. device ecosystem development) and domestic developments (e.g. higher penetration of WiFi-6 devices to be able to confirm real-world compatibility with fixed links) to play out before allocating so much of U6 for RLAN, *especially* via class-licensing arrangements. With such arrangements, once these devices begin to proliferate at a large scale, it would be very difficult to correct course and reconsider.

As explained further below, even if the ACMA were to decide that allocating U6 spectrum for RLAN represented the optimal use of the band—which we argue is definitely <u>not</u> the case—there certainly isn't any urgent need to do so.

We justify our preference for Option 3, which will result in all of the band being allocated for WA WBB—and <u>none</u> of the band being allocated for RLAN—in the following sub-sections.

WA WBB allocation to be spectrum-licensed

Before proceeding with the technical justifications, to be clear, it is our view that any licensing arrangements to support WA WBB Option 3 should be ***spectrum-licensing*** arrangements. This is the most appropriate licensing approach to provide the certainty and exclusivity needed for MNOs to invest in the dense deployment of a network across a wide area. The only (perceived) benefits to an apparatus-licensing approach (e.g. using Area Wide Licences (AWL)) would be:

a) ability to divide a broad geographical area allocated to WA WBB into smaller areas, with a view to allow a greater number of licensees with more localised coverage requirements, i.e. diversity of users and use cases; and/or

b) allow continued operation of incumbent apparatus-licensed services over a longer period of time, i.e. no re-allocation period end date to vacate by.

However, in terms of 'benefit' (a), support for multiple licensees within a metro area necessitates "dead zones" over urban or suburban populations, which represents inefficient spectrum allocation, which in turn goes against desirable planning outcome #1.

With respect to 'benefit' (b), there is more flexibility with an AWL in terms of allowing it to overlap an incumbent apparatus-licensed service (or punch a hole out of the AWL where the incumbent service is located). However, subsequent coordination requirements—with a view to protecting, or avoiding interference from, the apparatus-licensed service—are likely to render significant portions of an area licensed to WA WBB unusable anyway. This obviously degrades the value (and efficiency of) the WA WBB spectrum allocation.

Option 3 maximises the public benefit derived from the use of the Upper 6 GHz band

Allocating all of the Upper 6 GHz band to WA WBB maximises the public benefit that can be derived from the use of this band. A key resource backing this assertion is a detailed cost-benefit analysis conducted by GSMA Intelligence—*The socioeconomic benefits of the 6 GHz band: Considering licensed and unlicensed options*[2]—which studied 24 countries (and so we refer to it as "the GSMA-i multi-country study"), *including Australia*. The research considered three scenarios, reflecting:

1. No 'unlicensed'[3] spectrum in U6 and 1200 MHz licensed for 5G;
2. 1200 MHz unlicensed spectrum spanning entire U6 and no allocation for 5G; and
3. Unlicensed spectrum in the Lower 6 GHz band ("L6") and 700 MHz licensed for 5G in U6.

The analysis observed that the greatest socio-economic benefit comes from allocating at least 700 MHz of 6 GHz spectrum to licensed 5G. Across the 24 countries, there was never a case where allocating 1200 MHz for unlicensed use delivered the greatest benefits.

For Australia, the GSMA predicted that the greatest benefits would come from 1200 MHz for licensed 5G.However, since Australia has already allocated L6 to RLAN, Scenario 1 is no longer possible. Between Scenarios 2 and 3, there is always greater public benefit with supporting Scenario 3, and in fact there is *no additional benefit* derived from Scenario 2 for the 1 Gbps fixed-line speed case, and if high-band (i.e. 60 GHz) offload is possible, there is *no additional benefit* derived from Scenario 2 for the 1 or 5 Gbps fixed-line speed cases.

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[2] GSMA Intelligence, June 2022, *The socioeconomic benefits of the 6 GHz band: Considering licensed and unlicensed options*, available at: https://data.gsmaintelligence.com/api-web/v2/research-file-download?id=72941571&file=160622-The-socioeconomic-benefits-of-the-6-GHz-band.pdf

[3] In Australia, all radiocommunications transmissions must be licensed; 'unlicensed' operation is what is referred to in Australia as "class-licensed" operation.

As discussed later in this submission, the lowest fixed-line speed considered of 1 Gbps corresponds to the highest line speeds currently available in Australia, which have low adoption. What this means is that where (a) the fixed-line speed is 1 Gbps or less, or (b) the fixed-line speed is 5 Gbps or less *and* offload to high-band unlicensed systems is possible, the existing RLAN spectrum (including L6) is sufficient to satisfy the Wi-Fi capacity demands in the house-dwelling settings[4].

As discussed later in this document, this is corroborated by observations by Analysys Mason, as well as AMTA's own observations of a study commissioned by the Wi-Fi Alliance itself.

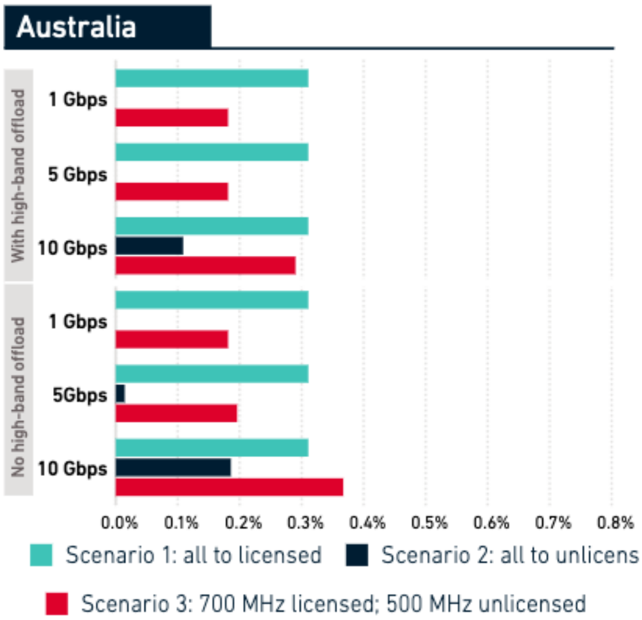

Figure 2—socio-economic benefits derived from use of U6 for different amounts allocated to unlicensed and licensed services[2]

The socio-economic benefits that are predicted to be missed out on under Scenario 2 may help to explain criticism of the adoption of a full 1200 MHz for RLAN in the USA, including by the CTIA which estimates economic losses of up to $200 billion flowing from this decision[5]. It also means that the US Government needs to look elsewhere for mid-band spectrum for IMT—including 3.1-3.45 GHz and 7.125-8.4 GHz[6]. The US think tank, Centre for Strategic and International Studies (CSIS) considers the mid-band spectrum shortage for licensed commercial 5G use a threat to the US economy and national security[7].

[4] In three types of households with 3, 6 or 11 connected devices in use and each device requiring a data rate of 100 Mbps.
[5] CTIA, 2024, *Advancing U.S. Wireless Excellence: The Case for Global Spectrum Harmonization*, available at: https://www.ctia.org/news/advancing-u-s-wireless-excellence-the-case-for-global-spectrum-harmonization
[6] NTIA, March 2024, National Spectrum Strategy Implementation Plan, available at: https://www.ntia.gov/sites/default/files/publications/national-spectrum-strategy-implementation-plan.pdf
[7] CSIS, 2023, The National Security Benefits of Reallocating Federal Spectrum for 5G, available at: https://www.csis.org/analysis/national-security-benefits-reallocating-federal-spectrum-5g

Spectrum demand for mobile

Mobile data traffic continues to grow

The demand for mobile broadband continues to grow, with mobile network data traffic having grown globally by 28% between Q4 2022 and Q4 2023[8]. Globally, 5G reached 1 billion subscriptions at the end of 2022—achieving 30% population coverage—further increasing to 1.6 billion by end of 2023[8].

As at January 2024, the GSA noted over 300 operators in 113 countries have launched commercial 3GPP-compatible 5G services[9]. There are at least 1964 commercially-available devices, including an increase of 39% from Dec 2022 in phones alone[10].

5G is increasingly doing the heavy lifting in terms of carrying mobile traffic; the latest Ericsson Mobility Report updates that by 2029, 5G networks will carry 76% of the world's mobile data traffic and cover 85% of the world's population. Mobile data traffic per smartphone is expected to grow with an 18% compound annual growth rate[8]. The Nokia Global Network Traffic 2030 Report projects that end-user data traffic demand will increase at a compounded annual growth rate (CAGR) of 22-25% from 2022 through 2030. Global network traffic demand is expected to reach between 2443 to 3109 exabytes (EB) per month in 2030[11].

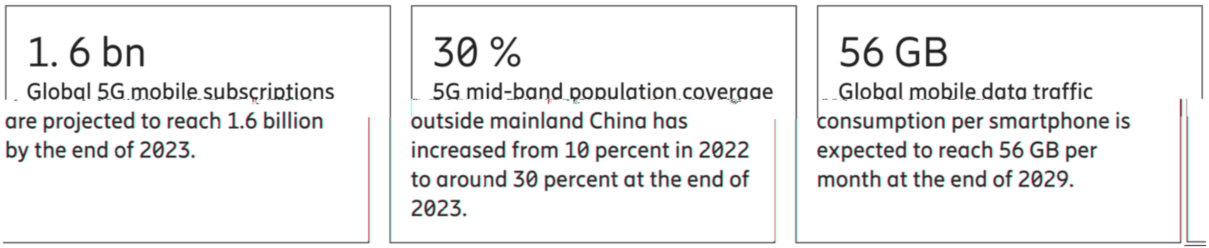

Figure 3—Ericsson snapshot of the latest 5G market statistics[8]

Australia is currently performing well on the world stage in terms of deployment of 5G. Economic modelling by Deloitte Access Economics showing that 5G will **increase** Australia's Gross Domestic Product (GDP) by **$67 billion (in 2022 dollars) by 2030**. Further, accelerating 5G adoption could add an uplift of $27 billion to the current forecast[12]. Delivering these economic benefits requires ongoing support for 5G investment.

[8] *Ericsson Mobility Report November 2023*, available at: https://www.ericsson.com/en/reports-and-papers/mobility-report
[9] GSA, January 2024, *Public Networks and Operators*, available at: https://gsacom.com/paper/public-networks-and-operators-january-2024/
[10] GSA, January 2024, *5G Ecosystem January 2024 Summary*, available at: https://gsacom.com/paper/5g-ecosystem-january-2024-summary/
[11] Nokia, 2023, *Global Network Traffic 2030 Report*, available at: https://onestore.nokia.com/asset/213660
[12] Deloitte Access Economics, March 2022, *5G Unleashed*, available at: https://amta.org.au/wp-content/uploads/2022/03/5G-Unleashed-Final-Report_combined-v2.pdf

Importance of mid-band spectrum

It is widely recognised that mid-band spectrum provides an ideal balance between providing coverage (due to more favourable propagation than at mmWave) and capacity (with much wider bandwidths than are available at low bands). The propagation characteristics in these bands also allow for outdoor-to-indoor coverage (a challenge at mmWave) and beamforming antenna arrays are more feasible (compared to low-band due to array dimensions).

As per the GSMA's report on *The Socio-Economic Benefits of Mid-Band 5G Services*[13], mid-band spectrum 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**, which adds further weight to the view that mid-band is the "heavy-lifter" of 5G spectrum.

Data traffic growth translated to spectrum demand

However, this estimate depends on adequate mid-band spectrum being available. According to the GSMA, an average of 2 GHz of mid-band spectrum will be required to address the continuing growth in mobile data traffic[14]. The GSMA have considered a baseline of 1150 MHz of existing mid-band allocations, including 400-500 MHz of 3.5 GHz spectrum, based on which a shortfall of 850 MHz has been flagged. The shortfall, along with a couple of options of how that shortfall could be addressed, are shown in Figure 4 below, including an expectation that much of the shortfall would be made up using 3.8-4.2 GHz (up to 400 MHz).

U6 is the main spectrum target to satisfy demand

However, in Australia, there was a less-than-optimal outcome for WA WBB in the 3.3-4.2 GHz range and there is continued opposition from Defence to spectrum within the range 4.4-5.0 GHz being used for IMT (expressed in WRC preparatory processes). As a result, U6 has emerged as the Australian mobile industry's last hope for making up even so much as a significant percentage of the 2 GHz mid-band spectrum requirement. The other mid-band spectrum options (mainly in the 4 GHz range) simply represent too much risk and uncertainty at this stage.

The criticality of U6 to the mobile industry is global: in a June 2024 joint statement by GSMA and over 30 MNOs ("the June 2024 joint statement"), the signatories confirm that *"[U6] represents the largest remaining single block of mid-band spectrum that can be allocated to licensed mobile services in the foreseeable future"*[15].

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[13] GSMA, *The Socio-Economic Benefits of Mid-Band 5G Services*, available at: https://www.gsma.com/spectrum/resources/mid-band-5g-spectrum-benefits/

[14] GSMA, July 2022, *The Maths of Mid-Band Spectrum*, available at: https://www.gsma.com/connectivity-for-good/spectrum/the-maths-of-mid-band/

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

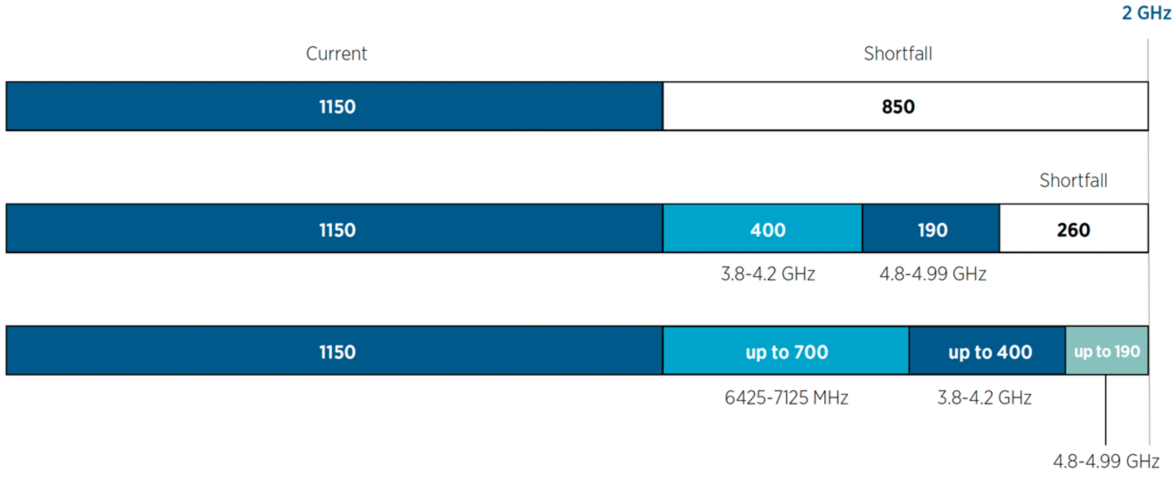

Figure 4—mobile industry vision on how to reach the 2 GHz target in 2022[14]

The 2 GHz mid-band spectrum estimate was based on a July 2021 study by Coleago Consulting which sought to determine the quantum of spectrum needed to satisfy the ITU requirements for IMT-2020, i.e. 100 Mbps downlink and 50 Mbps uplink[16]. Later that year, AMTA also engaged Coleago[17] to validate the need for significant additional mid-band spectrum in the Australian context. Coleago found that an additional 427 to 727 MHz would be required in Sydney and Melbourne (adjusted here to take into account the subsequent 3.7 GHz auction). Using Option 3 to allocate the full 700 MHz between 6425 and 7125 MHz would almost entirely satisfy this demand.

Therefore, it's clear that the mobile industry has performed considerable research to quantify its claims for additional spectrum, and that U6 is the most suitable (if not the last available) option to address that demand.

We also note that in the GSMA's June 2024 joint statement, the mobile industry has called on governments and regulators to make U6 available for licensed, macro-cell mobile. This will ensure a spectrum roadmap is delivered for mobile operators, who will then have the necessary certainty to put orders into their suppliers. This will in turn give the vendors the certainty to continue large-scale manufacture of equipment and vendors. This sequential process is clearly outlined in the GSMA's paper *The 6 GHz IMT Ecosystem: Demand Drives Scale*[18].

In this paper, we see industry's confidence that there are no technical barriers to developing and commercialising 6 GHz IMT solutions, and that trials and prototypes have already

[16] Coleago Consulting, July 2021, *Estimating the mid-band spectrum needs in the 2025-2030 time frame*
[17] Coleago, Nov 2021, *Demand for mid-band spectrum in Australia*, available here: https://amta.org.au/wp-content/uploads/2021/12/Coleago-Report-Demand-for-mid-bands-spectrum-in-Australia.pdf
[18] GSMA, June 2024, *The 6 GHz IMT Ecosystem: Demand Drives Scale*, available at: https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2024/06/The-6GHz-IMT-Ecosystem-Demand-Drives-Scale.pdf

demonstrated 6 GHz macro-cell capabilities. As such, ecosystem players are confident that they can have solutions ready in 6 to 12 months from the start of development[18].

Consideration of spectral efficiency and densification

One counter-argument often made is that what exists is a demand for *capacity*, not necessarily demand for *spectrum*, and that this demand for capacity also needs to be addressed by technological advancements (i.e. spectral efficiency) and network densification, not just adding spectrum.

We note that the mobile industry already undertakes these measures, and MNOs have a strong incentive to utilise their spectrum in an efficient manner because they face a pricing signal. In other words, MNOs already work very hard to get the most out of their very expensive spectrum.

This has a flow-on effect to the equipment developers and vendors, eager to respond to their customers' needs (already confirmed in the case of U6[18]). As a result, the mobile industry is highly adept at improving spectral efficiency, with a new 'G' (generation) every decade providing approx. 2-4 times improvement in bps/Hz spectral efficiency.

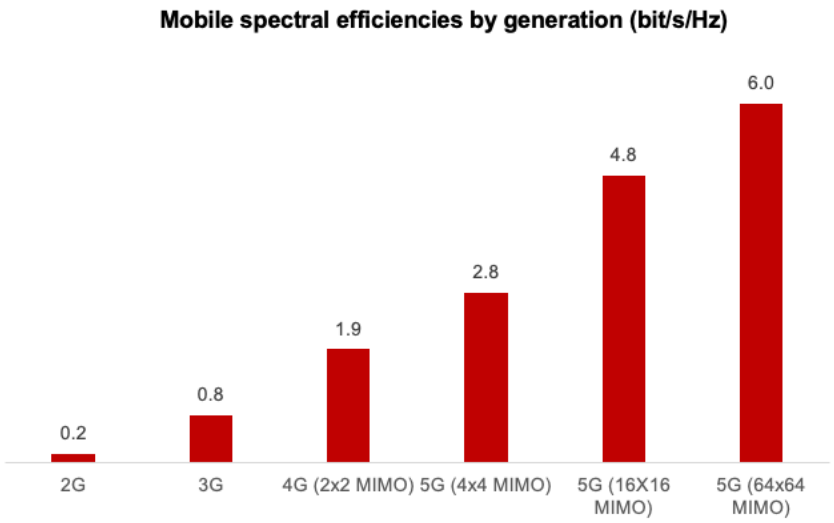

Figure 5—Mobile spectral efficiencies by generation (bps/Hz)

With respect to network densification, as described in the Licensed 6 GHz Opportunity White Paper[19]: *"While in principle it is possible to mitigate the demand for spectrum by building additional sites (network densification), this is practically and economically unfeasible for network operators. The GSMA spectrum needs evaluation* [[16]] *estimates that if there is a deficit of 800-1000 MHz in the required mid-bands spectrum, the total cost of network*

[19] Licensed 6 GHz Opportunity, June 2022, Whitepaper: *6 GHz opportunity: licensed spectrum for mobile networks*, available at: https://6ghzopportunity.com/wp-content/uploads/2022/06/22-06-09-Licensed-6-GHz-opportunity-v2.pdf

ownership will be 3-5x higher over a ten-year period, and the carbon footprint 1.8-2.9x greater, both as a result of the extreme densification needed to deliver the target performance levels. It is worth noting that the study does not address the practical restrictions in acquiring the additional sites required within an already dense network grid, nor the technical challenges including harmful interference management and mobility management, nor the economic feasibility in terms of both CAPEX and OPEX resulting from such extreme densification."

A June 2023 report by Analysys Mason demonstrates that the carbon footprint of future 5G mobile networks is expected to be lower if additional mid-band spectrum is made available to meet future capacity targets, by avoiding a significant densification of macro sites and outdoor small cells[20]. In fact, the analysis also makes the observation that the availability of U6 would not translate into any reduction in the overall carbon emissions if used for Wi-Fi, given the future fixed broadband connectivity targets of aggregated throughput exceeding 1 Gbps per premises can be met using spectrum bands already available for Wi-Fi (2.4 GHz, 5 GHz and L6).

It's worth noting that the mobile industry is also flagging that re-use of existing 3.5 GHz network grids for U6 is feasible, verified by technological trials[19]. This will help to overcome practical and regulatory barriers associated with deployment, while also minimising deployment costs and increasing energy-efficiency (noting the mobile industry's goal to reach net-zero by 2050).

RLAN proponents have also shown that the majority of traffic is fixed (as opposed to mobile) to bolster its claims that RLAN needs more spectrum. However, this is not a like-for-like comparison; Wi-Fi use is indoor and re-use is possible over short distances, so the spectrum requirements for Wi-Fi are to support a few households/families. On the other hand, a WBB cell will serve hundreds of people. Furthermore, not all the fixed traffic is delivered to the final user device by Wi-Fi. For example, in many situations it will be delivered via Ethernet cable, and is most advantageous to do so.

Spectrum demand for RLAN/Wi-Fi

With respect to WiFi spectrum demand, we address the following points in the subsequent sub-sections:

I. We challenge the WiFi Alliance's headline claim that *"up to ten 160 MHz channels are necessary for optimal WiFi performance in delivering gigabit connectivity in high user density environments"*.
II. We highlight inefficiencies of WiFi which that sector should address before rushing for U6 spectrum.
III. Data rates that could be delivered by WiFi are limited by the fixed broadband (FBB) connection.

[20] Analysys Mason, June 2023, *Impact of additional mid-band spectrum on the carbon footprint of 5G mobile networks: the case of the upper 6GHz band*, available at: https://www.analysysmason.com/consulting/reports/5g-mid-band-carbon-impact/

IV. We challenge the WiFi Alliance’s claims that there is no alternative spectrum.
V. We also challenge some comparisons made by RLAN proponents that we believe are not “like-for-like”.
VI. Lastly, it should be clear that WiFi does not have a monopoly on indoor data consumption: the majority of mobile data is actually consumed indoors.

I. WiFi spectrum demand

In its presentation to the ACMA’s February 2024 Tune Up on the Upper 6 GHz band (“the Tune Up”), the Wi-Fi Alliance stated that *“up to ten 160 MHz channels are necessary for optimal Wi-Fi performance in delivering gigabit connectivity in high user density environments”*.

We understand that this headline is based on a commissioned study by Plum Consulting on *Wi-Fi Spectrum Requirements*, latest version dated 18 March 2024[21] (“the Plum Report”). The report very clearly explains each aspect of this claim:

- *“ten 160 MHz channels”* consists of three channels in the 5 GHz range and seven channels in the 6 GHz range. This is in turn based on what “other countries” (i.e. outside of Europe, e.g. the US) have available for Wi-Fi.
- The *“gigabit connectivity”* is based on the EU’s Gigabit policy objectives[22].
- The *“high user density environment”* is modelled as an apartment building with:
- ten apartments (each 10mx10m) on each floor; and
- only one AP with a gigabit fibre connection
- *“are necessary”* means the minimum number of channels with which at least 1 Gbps is delivered across 99-100% of the building’s floorspace.

However, other observations can be drawn from the study results which are not reflected in the headline statement:

- 1 Gbps can still be achieved with 80 MHz channels in over 60% of the floorspace; and
- Very high data rates (e.g. 600 Mbps[23]) could still be achieved with 80 MHz channels for 99-100% of the floorspace.

Other comments on the study assumptions:

- Tenants should be able to have some choice as to modem placement to increase signal strength where most needed (e.g. workspace).
- Tenants could deploy additional modems or repeaters to improve signal throughout the apartment (acknowledging that this could conceivably increase the unwanted signal in adjacent apartments).

[21] Plum Consulting, March 2024, *Wi-Fi Spectrum Requirements*, available at: https://www.wi-fi.org/system/files/Plum%20%28Mar%202024%29%20-%20Wi-Fi%20Spectrum%20Requirements.pdf
[22] European Commission, *Digital Decade Policy Programme 2030*, available at: https://digital-strategy.ec.europa.eu/en/library/digital-decade-policy-programme-2030
[23] Which would satisfy the first two household types in GSMA-i’s multi-country study, with 3 and 6 connected devices in use and each requiring a data rate of 100 Mbps.

- Assumes Gigabit fibre-to-the-home (FTTH), not necessarily available everywhere and which may be the limiting factor (rather than amount of WiFi spectrum).

It's also worth comparing the European assumptions about available WiFi spectrum (without U6 channels) with what is available in Australia. In the Australian context, we have available:

- 5150-5350 MHz: 1 x 160 MHz channel; 2 x 80 MHz channels
- 5470-5600 MHz: 0 x 160 MHz channel; 1 x 80 MHz channel
- 5650-5725 MHz: 0 x 160 MHz channel; 1 x 80 MHz channel
- 5725-5850 MHz: 0 x 160 MHz channel; 1 x 80 MHz channel
- 5925-6425 MHz: 3 x 160 MHz channel; 6 x 80 MHz channels

This is even less 5 GHz spectrum than what the EU case focused on in the Plum study: only 1 x 160 MHz channel in the 5 GHz range. So the ACMA's Options would provide between 4 (minimum for Option 3) and 8 (maximum for Option 2) 160 MHz channels.

In terms of 80 MHz channels, there are 5 x 80 MHz channels in the 5 GHz range, and so the ACMA's Options would provide between 11 (minimum) and 19 (maximum). We have put together the following table to put the Plum Report's results for 160 MHz and 80 MHz channels, side-by-side:

Table 2: Plum Report results: percentage of floor space at which the target bit rate is achieved

MHz in U6 for Wi-Fi	# channels across 5 & 6 GHz ranges (160 MHz / 80 MHz)	Target bit rate: 1000 Mbps		Target bit rate: 600 Mbps	
		160 MHz channels	80 MHz channels	160 MHz channels	80 MHz channels
0	4 / 11	Unknown	61%	Unknown	99-100%
160	5 / 13	52%	68%	56%	99-100%
320	6 / 15	71%	> 68%	75%	99-100%
480	7 / 17	> 71%	< 99%	> 75%	99-100%
640	8 / 19	< 87%	99%	< 88%	99-100%

The comparison above shows that, no matter how much additional spectrum is allocated to WiFi in U6, the higher-reuse based on 80 MHz channels always yields better coverage than the reuse based on 160 MHz channels, thanks to the greater availability of 80 MHz channels in the 5 GHz range. As such, the ACMA should abandon its starting assumption that 160 MHz channels are required, and fall back to consideration of **the 80 MHz channel raster**.

Furthermore, acknowledging that 1 Gbps is a nominal target in the EU's Digital Decade Policy objective, it should also be recognised that the same EU Policy also includes a requirement that *“all populated areas are covered by wireless networks with performance at least equivalent to that of 5G”*.

Lastly, even if 1 Gbps is not able to be delivered to the entire floorspace of every apartment, user experience will not be poor; it’s still possible to provide *very high* bit rates (e.g. 600 Mbps) to 99-100% of the apartment building floorspace, while assigning the entire U6 to WA WBB. **This surely presents a win-win scenario for the ACMA where the public benefit derived from the use of spectrum is maximised.**

II. WiFi inefficiencies

We believe that WiFi deployments need to be used far more efficiently than is currently the case—including due to a significant proportion of legacy Wi-Fi equipment (i.e. Wi-Fi 4) and inefficient deployments indoors which vary greatly case-by-case.

There is also the inherent technological design which—according to the Plum Report and the DSA/Cisco Tune Up presentation—require a frequency reuse factor of at least seven (7); mobile networks employ a frequency-reuse factor of **one**.

The reality is that WiFi is not the most efficient method of delivering capacity to users. On one hand, MNOs provide an inter-network, end-to-end solution, providing a seamless experience as the user moves from premises to premises, with infrastructure upgrades and a UE ecosystem which is also upgraded regularly.

However, the same cannot be said for WiFi. While the technology itself is capable of delivering very high bit rates—and has evolved to increase spectral efficiency over time—the throughput experienced by the user is highly dependent on many other factors like bands and channels used, number of access points, backhaul between access points, number of devices, number of antennas, frequency re-use, access point channels and whether the use is complemented by use of unlicensed mm-wave at 60 GHz, as well as the fixed broadband (FBB) connection (discussed below).

Therefore, a user connected to a mobile network will be able to rely on their connection as they move around, for example, between retail or hospitality premises, while the Wi-Fi connection will vary significantly at each premises.

Unlike MNOs, **Wi-Fi users do not have the incentive to deploy as efficiently as possible**, due to the lack of a price signal, and in many cases may also lack the know-how and/or resources to ensure efficient deployment. The message from the mobile industry is that **inefficient spectrum use should not be compensated for with the allocation of more spectrum to that use.**

III. WiFi data rates limited by FBB connection

As highlighted by the 6 GHz Opportunity White Paper[19]: *"while 5G NR mobile networks are end-to-end communication solutions, Wi-Fi RLANs only offer "last few metres" connectivity, with their most popular use being within residential premises. As such, the performance of Wi-Fi is ultimately constrained by the speed of the fixed broadband (FBB) connectivity supplied to the Wi-Fi access points. For this reason, in deciding the amount of additional spectrum assigned for Wi-Fi, policy makers should account for FBB penetration and speeds."*

The WiFi Alliance's spectrum requirements estimates are based on *"gigabit fibre connectivity to every apartment"*[21]. However, even in its major cities, Australia's fixed broadband (FBB) speeds seem to be well below this, even in major cities this is less than 300 Mbps *peak* and for the fastest provider[24]. Average speeds are lower at about 50-100 Mbps depending on the source[19,25]. A recent ACMA report[26] notes that the most popular NBN speed plan at the moment is 50 Mbps (62% market share), and while there was a slight 3% increase for 100 Mbps plans over 2023, the proportion of 250+ Mbps plans decreased by 2%.

Overseas, the European Commission's recent white paper on Europe's digital infrastructure identifies limited fibre coverage (56% of all EU households), and notes a lack of demand for 1 Gbps broadband, with the majority of markets still persisting with 100 Mbps plans.

As such, even if 1 Gbps FTTH connections eventually became the norm, **there is no urgency** to support this just yet.

IV. No alternative spectrum

In its Tune Up presentation, the Wi-Fi Alliance stated that *"[U6] band is uniquely suited to support current and future generations of Wi-Fi — **there is no alternative spectrum**"*. We understand that this view is based on current standardised bands. However, the Wi-Fi industry, via the IEEE, could conceivably work to standardise other bands to address future demand. For example, one of the WiFi industry's claims in terms of the relative benefits of WiFi (relative to IMT) is that it causes minimal impact to existing services via technologies like Automatic Frequency Coordination (AFC). If AFC works well in practice, then there could be potentially several other spectrum bands available to address future WiFi growth, particularly where the primary or incumbent use is only itinerant. For example, in Defence bands like 3.3-3.4 GHz and/or 4.4-5.0 GHz, or in bands currently used by TOB services. Opportunistic and low-cost WiFi systems would be much better suited to share spectrum with a primary, itinerant use than IMT networks which (a) operate constantly and intensely and (b) requiring massive capital and operational costs and therefore a high degree of certainty.

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[24] Opensignal, June 2023, Australia, June 2023, *Fixed Broadband Experience*, available at: https://www.opensignal.com/2023/06/09/australia-june-2023-fixed-broadband-experience
[25] Statista, July 2022, *Average internet speeds for mobile and fixed broadband in Australia in July 2022*, available at: https://www.statista.com/statistics/1126515/australia-mobile-and-fixed-broadband-internet-speed/
[26] ACMA, December 2023, *Trends and Developments in Telecommunications 2022-23*, available at: https://www.acma.gov.au/sites/default/files/2023-12/Trends%20and%20developments%20in%20telecommunications%202022-23_0.pdf

Lastly, one of the points repeatedly made by the RLAN proponents (and others) is that the mobile industry has 2.4 GHz of spectrum in the 26 GHz band which it should make use of before looking for more spectrum in other bands. As (fortunately) recognised by the ACMA at the Tune Up, spectrum across low-, mid- and high-band spectrum is not substitutable. mmWave is presenting major technical challenges in terms of propagation for outdoor coverage, particularly in urban environments, which may take many years of technological developments to overcome. In addition, unlicensed applications also have vast amounts of mmWave spectrum of their own, most notably in the 60 GHz range (57-64 GHz) as well as at 24 GHz[27]. Furthermore, mmWave frequencies should be suitable for the short-range Wi-Fi use cases being considered (i.e. coverage inside houses and apartments), and may even assist in reducing unwanted signals from adjacent apartments due to higher building penetration losses. The offload to mmWave spectrum was considered in GSMA's multi-country study and showed that it reduces the need for additional mid-band spectrum for unlicensed Wi-Fi. As such, we would argue that—noting the availability of mmWave spectrum for unlicensed applications and the recent allocation of 500 MHz in L6—there is no justification for depriving the mobile sector of the much-needed mid-band spectrum when there is sufficient spectrum for delivery of high-speed Wi-Fi. Certainly the mobile industry's mmWave spectrum holdings shouldn't have any bearing on the ACMA's decision-making processes around U6.

V. Erroneous comparisons

RLAN proponents often point out the amount of spectrum that is already allocated to WA WBB in various bands to argue that WA WBB does not need U6 as well. Amounts of spectrum held by one service or another does not paint the full picture. In the Plum Report, they are claiming a need for one 160 MHz channel to serve one apartment, while a WA WBB base station needs to serve hundreds of indoor and outdoor users simultaneously. The mobile network users have a greater variety of requirements—for example, ranging from enhanced mobile broadband (eMBB) to narrowband-IoT—in turn necessitating an appropriate balance of low-, mid- and high-band spectrum. Furthermore, the pricing signal mentioned earlier will deter MNOs from having excess spectrum supply that they don't make use of; Wi-Fi users have no such incentive.

Another comparison shown by RLAN proponents is that the majority of data traffic is over fixed-line/FBB networks. However, this doesn't mean that the same proportion of traffic is being carried over Wi-Fi, since devices can be connected via Ethernet cable. In many cases it would actually be important to connect the device via Ethernet cable, which improves throughput and security compared to connecting via Wi-Fi.

[27] *Radiocommunications (Low Interference Potential Devices) Class Licence 2015*, available at: https://www.legislation.gov.au/F2015L01438/latest/text

Question 2

If we decide to divide the band into different RLAN and WA WBB segments, should the WA WBB segment:
a. be a multiple of 100 MHz? This would align with the largest 3GPP channel size (noting that the ability for WA WBB operators to deploy one or more 100 MHz channels will depend on the outcome of the assignment process)
b. align with the 160/320 MHz wi-fi channel raster? This would maximise the number of the larger wi-fi channels available (by avoiding options that would split these channels).

Taking into account that IMT has more flexibility with respect to channelling, we agree that it's sensible to set the top of the domestic RLAN allocation to align with the WiFi channel raster, which is based on fixed, pre-defined channels.

That said, for the reasons presented earlier, we strongly recommend that the ACMA: (a) set that boundary at 6425 MHz, and (b) abandon its focus on 160 MHz channels, and instead fall back to basing its considerations on the 80 MHz WiFi channel raster.

We wish to clarify that we oppose both Options 2 and 4, so the RLAN/WA WBB split upon which the question is based is an unacceptable outcome for us, as explained in the response to Question 1.

Question 3

Of the segmentation options based on wi-fi channels (schemes 1–3 in this paper), what is the preferred option and why?

As mentioned in our response to Q2 above, we agree that alignment of the top of the WiFi allocation with the WiFi channel raster is reasonable, but we challenge that this should be based on the 80 MHz channel raster (not 160 or 320 MHz channel rasters).

The 7-frequency reuse illustrated by the Dynamic Spectrum Alliance (DSA)/Cisco at the ACMA's February 2024 Tune Up could be satisfied by 7 x 80 MHz channels; they don't necessarily need to be 7 x 160 MHz channels.

If we count the 5 x 80 MHz channels in the 5 GHz range and the 6 x 80 MHz channels in the Lower 6 GHz band, then there are already more than enough channels to satisfy this 7-frequency reuse scheme, which in turn justifies our preference for an Option 3 approach whereby the entire U6 band is allocated to WA WBB.

For obvious reasons, the schemes are in descending preference for the mobile industry—from 1 to 3. However, as explained in responses to the previous questions, we oppose Option 4 (and any of the schemes under it) and would rather the ACMA fall-back to Option 1 before proceeding with any RLAN allocation in U6.

Question 4

Is it appropriate to limit our consideration of hybrid options for accommodating multiple services to frequency segmentation only? For example, should geographic segmentation or less traditional sharing models be considered when determining models for enabling access to the upper 6 GHz band by both WA WBB and RLAN services?

Notwithstanding our support for Option 3 and opposition to Option 4, for the purposes of responding to this question on technical matters, we agree with the ACMA's focus on frequency segmentation. We note that even Option 3 adopts the same frequency segmentation concept, just with the frequency boundary being fixed at 6425 MHz (instead of some other value higher in the band).

Non-traditional sharing models

In our view, any co-frequency, same-area sharing between WA WBB and RLAN is likely to degrade the performance of any WA WBB that could be deployed—be in due to increased noise, the need to contend for access with RLAN, limited indoor coverage and/or base station power reduction—which reduces the value and utility of the band for WA WBB. We consider this outcome to be an inefficient use of this valuable spectrum and that the potential benefits that could have been derived from the use of the band will be wasted. We ask the ACMA to exercise caution when considering untested and unverified non-traditional approaches.

At a technical level, the less traditional sharing models are not feasible in the same area, to a large degree because of the intense usage by WA WBB networks in city areas, and the fact that most mobile data (70-80%) is actually consumed indoors[28]. At this point it's worth noting that WiFi does not have a monopoly on indoor connectivity.

This last point alone means that indoor/outdoor separation is simply not a valid solution. This is in addition to the fact that there will be many locations where the building penetration loss (BPL) may be insufficient to avoid co-channel interference, for example, on footpaths and public spaces close to buildings and/or areas exposed via openings such as doors and windows.

[28] GSMA, 11 March 2024, Optus boosts indoor 5G coverage, available at: https://www.gsma.com/solutions-and-impact/technologies/networks/latest-news/optus-boosts-indoor-5g-coverage/

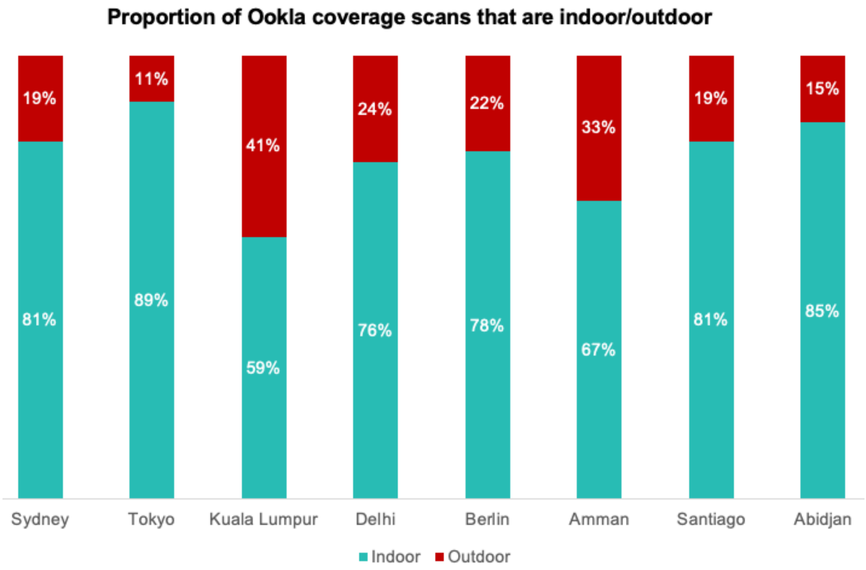

Figure 6—proportion of coverage scans that are indoor or outdoor from crowd-sourced data[29]

BS power reduction only degrade the capacity able to be delivered by mobile networks in U6, diminishing the value and the utility of the band for use by IMT. Noting the previous point that the majority of mobile data is actually consumed indoors, outdoor-to-indoor coverage may be particularly impacted. Furthermore, it will also remove an MNO's ability to re-use its 3.4-3.8 GHz network infrastructure, a key benefit which will improve energy efficiency[18,30].

In terms of the database-assisted models, e.g. Automated Frequency Coordination (AFC), these are designed to enable sharing of opportunistic unlicensed systems like Wi-Fi with fixed point to point links or some FSS earth stations. These systems intend to take advantage of the fact that in any particular location, it will either not be illuminated by a fixed link or earth station antenna, or if it is, the fixed link or earth station channel will only occupy a narrow (and generally, pre-defined and static) part of the broader frequency band allocated for these uses. In other words, the unlicensed system makes use of gaps of unused spectrum at any particular geographical location. Unlike those incumbent services, WA WBB networks *fully utilise* their licensed spectrum *all the time*, meaning there won't be any gaps in the band where a WA WBB network isn't operating, certainly not any long enough to be useful for delivery of Gigabit connectivity to users in their apartments. In city areas, the dense network rollout means that there won't be any geographical 'holes' in which WiFi can operate either, at least not in any meaningful location of high demand.

This is a limitation even at the conceptual level; beyond that there are additional practical challenges, noting that while this concept has been discussed for many years, there have

[29] GSMA Intelligence analysis of data provided by Ookla

[30] TelecomTV, June 2024, *Nokia and Telia complete successful outdoor trial in 6 GHz range with massive MIMO radio*, available at: https://www.telecomtv.com/content/5g/nokia-and-telia-complete-successful-outdoor-trial-in-6-ghz-range-with-massive-mimo-radio-50522/

been limited implementations. In Australia, the ACMA has been stating that it’s open to dynamic spectrum sharing for the past (at least) five years via its Five-Year Spectrum Outlook (FYSO). To date, no progress has been made.

Geographical segmentation

While we believe that the ACMA should have due regard to the geographical areas that could/would be allocated to WA WBB under Option 3, we believe this is separate to geographical segmentation of WA WBB and Wi-Fi. We agree with the ACMA’s observation that both services are most likely interested in the same (high demand, metro) areas to satisfy the respective claimed capacity requirements, and that as such, allocating more spectrum in regional areas than metro areas for either service is not likely to be helpful to that service. Ultimately, the ACMA has to determine what the optimal use is in the highest demand areas while also taking into account the impact on other services, and then allocate the band to that optimal use. What happens in lower-demand areas is then consequential.

Conceivably, the ACMA could allocate high demand/metro areas to WA WBB and then allow class-licensed operation of Wi-Fi devices outside these areas. However, AMTA is opposed to such geographical segmentation, since it would be very difficult to enforce. If the ACMA were to allow the proliferation of large numbers of Wi-Fi devices in regional/remote areas, it would not readily be able to restrict people moving their devices into metro areas.

Coexistence with other services

We acknowledge and provide further commentary on, the following existing uses of U6 and adjacent bands:

- Fixed-satellite service (FSS) uplinks (Earth-to-space)
- FSS downlinks (space-to-Earth)
- Fixed point to point (PTP) links
- Television Outside Broadcasting (TOB) services

Applicable to multiple services

We support the ACMA's creation of Embargo 81 which will help to preserve the current state-of-play so that the environment isn't shifting during the planning process.

We do not necessarily agree with the ACMA's view—with respect to *"concerns from industry groups and other regulators that [the increase in aggregate interference from a growing number of devices] might lead to unacceptable interference to other services in the longer term"*—that *"international and domestic experience does not support this hypothesis under current VLP/LPI-based RLAN deployment models"*. We believe this conclusion is premature because use of the lower 6 GHz band is low compared to 2.4 and 5 GHz bands, even in countries that have made the lower 6 GHz band unlicensed. Figure 4 below shows analysis by GSMA Intelligence on Wi-Fi scans taken by Ookla revealing less than 1% were made on the 6 GHz band (with the exception of Tokyo). As such, the fact that administrations having put in place licensing arrangements to support Wi-Fi 6 in the lower 6 GHz band, does not extend to the actual widespread and high-density operation of these devices that would support a conclusion that there is no interference in practice.

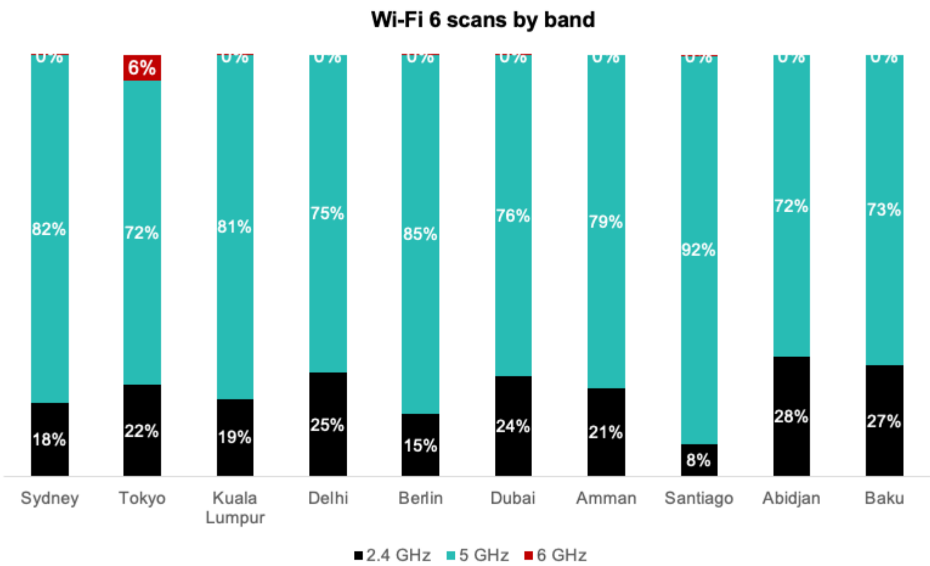

Figure 7—proportion of scans by Wi-Fi band from crowd-sourced data[31]

[31] GSMA Intelligence analysis of data provided by Ookla

As stated earlier, we caution the ACMA with respect to untested and unverified non-traditional approaches. We note that more traditional registration and coordination requirements have served the industry well over the past few decades; primarily to avoid interference but also to help trace interference if and when it does occur. Relying on unregistered devices to be operated by the user under the correct conditions (e.g. remaining indoors, correctly sensing an incumbent higher-priority system) is fraught with risk.

FSS uplinks

WA WBB into FSS

In terms of coexistence between IMT transmitters and FSS space station receivers, this has been the subject of significant study in the 4-year study cycle for the World Radiocommunication Conference of 2023 (WRC-23), which resulted in the development of expected EIRP masks now enshrined in Resolution **220 (WRC-23)**. IMT equipment vendors developed the expected EIRP mask approach and both Nokia and Huawei generated their respective masks, which were presented alongside another proposal from Russia, and another from the satellite lobby, in the Conference Preparatory Meeting's Report (CPM Report[32]) to WRC-23. In the final lead up to the Conference, the UK and France presented a mask which is similar to the Huawei mask but 3.5 dB more stringent than the Huawei mask (except for the range 0-5 degrees above the horizontal plane, where it is 4.5 dB more stringent). As such, the final regulatory measure adopted in the Radio Regulations (RR) represents a conservative approach to ensuring protection of space station receivers.

FSS into WA WBB

There is also the question of the interference that FSS earth station transmitters may cause to WA WBB receivers, or the spectrum denial caused to the FSS to avoid this interference. We acknowledge that wherever WA WBB is spectrum-licensed, FSS earth station transmitters would not be able to be (or remain) licensed; be it for established gateway facilities or for short-term deployments (e.g. for distribution of broadcasting content).

With respect to the former, this has been an ongoing discussion for at least ten years, since the beginning of the allocation process for the 3.6 GHz band and earlier. Terrestrial services used to provide connectivity to users have to be located where the users are, and therefore the highest demand is where the highest population is. The same does not apply to satellite gateways; the gateway could be located anywhere provided that it has an appropriate backhaul link (ideally fibre). Moving further away from cities may increase costs associated with longer backhaul and human resourcing, but it is a financial—not technical—issue. The ACMA had (for a brief period of time) an earth station siting policy in place which encouraged earth stations to be located outside major population centres. This was later abandoned and replaced with the earth station protection zone (ESPZ) approach—introduced in 2018 with

[32] ITU, 2023, *Report of the CPM on technical, operational and regulatory/procedural matters to be considered by World Radiocommunication Conference 2023*

Embargo 72, and intended to incentivise earth station facilities to be located in certain regional/remote areas where there would be far fewer regulatory constraints. To date (i.e. 6 years later), these have not been used, although there has been a notable increase in earth station assignments in other regional and remote areas, such as Alice Springs, Broken Hill and Kalgoorlie, and especially the Mingenew satellite park. As eventually happened with the C-band downlink—in multiple piece-meal iterations—the gateways at Landsdale WA, Lockridge WA, Belrose NSW and Ningi QLD will either have to retire/remove frequencies in the extended C-band range—and apply appropriate filtering—or facilities should be relocated to other regional/remote locations.

In the latter case of short-term deployments, we come back to a genuine scenario of needing to be where the action is, for example special events or sporting events which are typically in highly-populated areas also. However, licensing records show that these are almost always in the ‘standard’ C-band uplink below 6425 MHz; none were identified in the ‘extended’ and ‘planned’ C-band ranges above 6425-7025 MHz[33].

This is in line with international observations summarised in 6 GHz opportunity: licensed spectrum for mobile networks[19], which notes that:

- reduced use of the extended C-band downlink in 3400-3700 MHz (due to terrestrial 5G deployment worldwide) has translated into limited use of the extended C-band uplink in 6425-6725 MHz also; and
- there are very few satellites with uplink capacity in the extended and planned bands and the capacity in these bands represents a very small percentage of total commercial satellite capacity leased, with demand in these bands on a declining trend.

Conclusions on coexistence with FSS

- Coexistence with the FSS is feasible in terms of the impact to space station reception, and international regulatory measures have been put in place to support co-channel operation of both services;
- While coexistence between IMT networks and FSS earth station transmitters is not possible in the same spectrum space on the surface of the Earth, we believe that the impact of restricting FSS earth station transmitters from U6 (the ‘extended’ and ‘planned’ C-band ranges) is of limited impact to the satellite industry;
- Adjacent-band coexistence between IMT networks and FSS earth station transmitters in the same geographical area on the surface of the Earth will be possible via detailed case-by-case coordination, but further planning work is needed to determine the appropriate out-of-band emission and receiver selectivity requirements to allow services to coexist.

[33] In the past six years, the licences which we identified as supporting such services were held by Telstra Broadcast Services, Gravity Media, Multi-Link Holland, Sydney Teleport Services and IP Uplinks; these were all in the ‘standard’ C-band range 5925-6425 MHz.

FSS downlinks

In the band 6700-7075 MHz, there is an FSS "space-to-Earth" (downlink) allocation which, in accordance with ITU RR No. 5.458B, is limited to feeder links for non-geostationary-satellite (NGSO) systems of the mobile-satellite service (MSS). For this purpose, Pivotel has three gateways located at Dubbo, Mt Isa and Meekatharra. These earth stations can easily be protected via the imposition of coordination requirements which will prevent WA WBB base stations from being deployed too close to the earth stations.

There is also the OmniSpace gateway facility at Ningi QLD, with earth station licences within the range ~7010-7075 MHz. Further work would need to confirm the spectrum denial caused by the OmniSpace earth station to a future metro WA WBB network in Brisbane—and whether this would be greater than that cause by any remaining fixed PTP transmitters in the surrounding area—but it's likely that these services would need to cease or be relocated to a more regional/remote location.

Fixed PTP links

We acknowledge that, with over 3000 individual links, the 6.7 GHz microwave fixed link band presents the biggest challenge in terms of coexistence between proposed WA WBB networks and existing services. It is an issue that requires careful consideration to balance the maximisation of the public benefit derived from using U6 by allocating the band to WA WBB (on one hand), with the costs of re-allocating fixed PTP links (on the other hand).

Preliminary identification of potentially affected fixed links

We note that in terms of licensees, AMTA members Optus, Telstra and TPG hold 1143 of those licences, who have a strong interest in the band being allocated to WA WBB, while NBN Co holds another 1132 of those licences.

That leaves approx. 760 links held by various telecommunications service providers and companies in the energy and rail sectors, along with State Government entities and mining companies.

Of particular interest is that most of the 6.7 GHz links are located **outside** of the 'metro' areas which typically refer to the five mainland State capital cities of Brisbane, Sydney, Melbourne, Adelaide and Perth, along with the adjoining population centres of Gold Coast, Wollongong, Central Coast, Newcastle and Geelong.

Using the ACMA's Fee Density Areas, we note that the numbers of sites/links licences within the High-Density Areas (HDA) and Medium-Density Areas (MDA) are relatively low, as shown in the table below. Note that the number of sites is not exactly half the number of licences because for some links, one site is within the HDA/MDA, and the other is not.

	Number of sites	Number of licences
Australia-wide	6076	3038
HDA	253	155
MDA	92	71
HDA & MDA	**343**	**226**
Proportion of all in Aus.	**5.6%**	**7.4%**

Only 7.4% of all 6.7 GHz licences have at least one site within HDA or MDA.

Eighty-eight of these licences are held by Telstra, Optus or Vodafone; leaving only 138 licences with at least one site in HDA or MDA (4.5%), of which the majority (95/138) are held by NBN. A total of 11 licensees (incl. NBN Co but excluding the MNOs) have licences in HDA or MDA, compared to 45 licensees with links in this band nationwide.

Notably, **Canberra** which is in the Low-Density Area, only has two Digital Distribution Australia (DDA) links terminating in that city, and no others. **Darwin**—in which no 3.4-4.0 GHz spectrum is available due to defence activities—could also benefit greatly from 3GPP band n104 mid-band 5G if the 14 fixed links in that city were able to be migrated (mostly held by Telstra & Optus, 8 by NBN Co and one by the NT Government). **Hobart** only has Telstra, Optus and NBN Co links near the city.

Therefore, we consider that, while still challenging, it's feasible to allocate U6 for WA WBB via spectrum licensing in **all eight State & Territory capital cities** with a relatively modest clearance of 6.7 GHz fixed links from these cities. This will:

a) minimise the number of licensees impacted (11 including NBN Co but excluding the three major telcos);
b) minimise the number of link licences impacted (just 4.5% of all 6.7 GHz fixed links in Australia);
c) maintain utility of the 6.7 GHz band for existing (and in some areas, future) fixed links in the rural and regional areas where they are most needed due to lack of fibre backhaul.

From now until 2030, further deployment of fibre backhaul throughout Australia, along with alternative backhaul options such as satellite in higher spectrum bands, may allow a future re-assessment as to the need for microwave fixed link backhaul to other regional population centres and potentially allow future re-planning activities in those cities and towns.

Exactly which links are impacted needs further work, as the count of links with at least one site within HDA/MDA is a preliminary check. However, from the CBD of the relevant capital city, the nearest sites—for which the licence is not counted (i.e. both the licence's sites are outside HDA/MDA) and the antenna doesn't point away from the HDA/MDA—are at least ~110-120 km away in the case of the HDAs, and in the order of 45-70 km in the case of the typically smaller MDAs. These distances often exceed the 68 km separation distance derived for main lobe interference in the sharing studies as part of WRC-23 Agenda item 1.2, so it may indeed be a valid starting point.

Fixed links allow for precise coordination

The other aspect which greatly facilitates coexistence with fixed links is that, unlike some other services, they don't need to be protected down to the noise floor, which can often cause very large areas of spectrum denial. Rather, the interference threshold is calculated for each link on a case-by-case basis as the difference between: (a) the fixed link's planned wanted received signal level and (b) the protection ratio (or minimum wanted-to-unwanted signal ratio requirement) which is typically 60-70 dB for co-channel signals, and which is adjusted for the link's path length and other atmospheric factors which affect the link's fade margin.

So, as an example, for a 20 km link planned to receive a typical wanted signal level of -30 dBm, the 70 dB protection ratio may be adjusted to 55 dB, and the maximum unwanted signal level would therefore be -85 dBm, making protection more easily achievable than I/N -6dB in many cases.

Furthermore, their fixed, highly-directional antennas, significantly limit the area of potential interference or spectrum denial to other services to a relatively small range of azimuth angles.

Option 4 not any better for fixed links than Option 3

Finally, it's worth pointing out that, in terms of impact to fixed PTP links, Option 4 does not present any lower impact compared Option 3 (at least for Schemes 1 or 2). This is because, even if the first few channels were unaffected—due to being below the frequency boundary (between the RLAN and WA WBB allocations)—the corresponding paired channels above 6770 MHz would still be in spectrum allocated to WA WBB. As such, the entire 6.7 GHz fixed link band becomes unavailable in any areas allocated to WA WBB, regardless of whether 700, 540 or 380 MHz is allocated to WA WBB.

Spectrum sharing with Wi-Fi is not risk-free

We recognise that outdoor IMT base stations naturally present a higher interference potential to fixed link receivers relative to very low power (VLP) or low power indoor (LPI) Wi-Fi devices. That is why it's acknowledged that licensing arrangements for WA WBB and fixed PTP links would have to be segregated in different geographical areas. On the other hand, the ACMA's assumption appears to be that Wi-Fi devices can operate across the same geographical areas where fixed PTP links operate, and that the risk of interference is sufficiently limited by the VLP and LPI conditions.

Furthermore, as we challenged earlier, the ACMA has concluded that, because the LIPD Class Licence authorises operation of unlicensed devices in the Lower 6 GHz band, this means that unlicensed devices and fixed PTP links can coexist effectively without harmful interference. As mentioned earlier, we don't believe that the operation of 6 GHz devices is widespread enough to arrive at such a conclusion.

Moreover, evidence is gathering that fixed PTP links might not be all that safe from ubiquitously-deployed Wi-Fi devices.

- In document SE19(23)024[34], the Swedish regulator PTS carried out field measurements to study the impact of RLAN on a real fixed radio link in the 6 GHz band. The authors note: *"the measurements carried out show that the FS performance can be affected by an RLAN even without any active payload traffic, i.e. beacon only, if the signal strength of the interfering signal is high enough. When the RLAN also carries payload data, the FS performance can be affected even more. The difference in FS receiver threshold degradation in case of RLAN with/without payload traffic was only 4 dB"*.

- The Electric Power Research Institute (EPRI) also carried out field tests[35] and concluded that *"indoor locations along the FS centerline at distances up to 5.6 mi (9 km) with unobstructed visibility and low building entry loss provide opportunities to be a source of harmful interference from RLAN devices"*.

- CEPT ECC Report 302[36] also highlighted potential interference scenarios which could impact fixed services unless certain mitigations are applied, such as indoor usage, power limits, and ensuring minimum separation distances are satisfied.

As such, while RLAN devices operating under VLP and LPI conditions certainly pose a lower interference risk compared to a full-power WA WBB base station—*for a particular configuration (e.g. separation distance, pointing angles etc)*—the fact that the former will be uncoordinated and the latter will be coordinated, needs to be factored in.

The Swedish field tests outlined above indicate that even if an RLAN were being 'polite' and not transmitting traffic, it still has the potential to cause interference, while some of the other conditions are difficult to enforce in practice (e.g. an indoor-only requirement).

This challenges the assumption that WA WBB is the option that impacts existing services while RLAN is the "no impact" option. WA WBB may have a higher-magnitude impact due to

[34] Swedish contribution to CEPT ECC Group SE19, 14 June 2023, Doc. SE19(23)024, RLAN impact on a real 6 GHz radio link, available at: https://cept.org/ecc/groups/ecc/wg-se/se-19/client/meeting-documents/file-history?fid=79299
[35] EPRI, June 2021, Unlicensed use in the 6 GHz band: Columbus, Georgia field interference test results, available at: https://www.epri.com/research/products/000000003002022241
[36] CEPT ECC Report 302, available at: https://docdb.cept.org/document/10170

the higher-power operation and need for exclusive spectrum licensing arrangements, however it is a predictable, controlled impact.

TOB services

Television Broadcasting Services (TOB) operate in the “7.2 GHz band” defined in RALI FX 3, starting at 7100 MHz, but with the lower edge of the first channel starting at 7105 MHz. Like WA WBB, TOB services have the highest demand within the most highly-populated cities, and it is unlikely that both services could operate co-channel in the same geographical area.

As such, a WA WBB allocation extending up to 7125 MHz would likely require the clearance of (at least) the lowest three (3) 8 MHz channels, currently allocated to Nine Network. We note that there are ten (10) “shared general” channels in 7345-7425 MHz.

These are not used except for the very largest annual sporting events in Australia: the Formula One Grand Prix, the Australian Open Tennis, and SailGP. The AFL did hold a Victoria-wide licence from March 2020 to March 2024 but this has since expired. NEP also held a Sydney/Wollongong-wide licence in September 2022; presumably for the UCI Road World Championships in Wollongong that month.

Given the low utilisation of these ten channels—totalling 80 MHz in 7345-7425 MHz—throughout most of the year except for the very largest sporting events, we believe that any TOB channels having to clear the band to make way for very highly-utilised and high-benefit WA WBB networks, could reasonably be accommodated within these nominally shared channels.

We also note that the part of the 7.2 GHz band above 7250 MHz is allocated to the FSS (space-to-Earth), which is in turn designated for use by the Australian Defence Force and the Department of Defence—i.e. the Military Sat-Com downlink. Since both TOB and Mil-Sat-Com are itinerant uses, they are much better suited to sharing spectrum with each other than sharing with WA WBB. As such—though perhaps not ideal due to the need to coordinate with Defence—greater utilisation of the range 7250-7425 MHz can be made by the TOB operators for the sake of the greater public benefits that WA WBB will provide below 7125 MHz.

It is also important to consider the adjacent-band compatibility between WA WBB and TOB. As part of this, the ACMA should take 3GPP specifications into account, including the n104 band edge (7125 MHz) and the out-of-band emissions specified by 3GPP. As we’ve prosecuted in multiple previous consultation responses, it is very important for band edges and unwanted emission limits to align with 3GPP to avoid vendors having to create bespoke solutions for Australia; a relatively small market which significantly drives up the development, manufacturing and deployment costs.

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