Hewlett Packard Enterprise

15 July 2024

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

Re: Future use of the upper 6 GHz band Options paper

Hewlett Packard Enterprise (HPE) appreciates the opportunity to provide comments in response to the Australian Communications and Media Authority (ACMA) consultation on the Future use of the upper 6 GHz band Options.

HPE is a global edge-to-cloud company that brings together wired, Wi-Fi and cellular technologies for private networking in enterprise, industrial and public sectors. As an industry recognized enterprise and wireless LAN infrastructure Leader, HPE Aruba Networking (Hewlett Packard Enterprise's Intelligent Edge business unit) has been named a leader in the 2024 Gartner Magic Quadrant for Enterprise wired and wireless LAN Infrastructure for the 18th consecutive time. We have been a significant provider of WLAN equipment to Australian enterprises and service providers for nearly two decades. Our customers span various sectors, including central government and local councils, education, energy, and hospitality.

Please find on the following pages HPE's comments on ACMA's consultation. Should you have any questions, please do not hesitate to contact the HPE signatory below.

Sincerely,

[redacted]

Xin Tang
APJ Wireless Policy Lead
[redacted]

[redacted]

Carlos Gómez Gallego
VP, Aruba CTO for APJ
[redacted]

Hewlett Packard Enterprise

## Questions for comment

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

HPE supports Option 2: "Introducing arrangements to enable RLAN access to some or all of the upper 6 GHz band through a variation to the LIPD Class Licence." We assert that this option is the only one capable of delivering socioeconomic benefits to Australia, both in the immediate future and over the long term.

**We have already seen demand from our Australia customers on accessing the entire 6GHz band.**

HPE serves a diverse range of customers, including utilities, universities, hospitality, medical facilities, and sports venues. With the increased demand for wireless traffic in enterprise networks and improvements in fibre speed, our customers are increasingly identifying Wi-Fi as the bottleneck in their network performance. Addressing this bottleneck is crucial for maintaining and enhancing operational efficiency across various sectors.

Since 2014 – when gigabit capable Wi-Fi 5 (802.11ac) access points that default to using 80 MHz or even 160 MHz channels became available, the vast majority of enterprise customers still have to use narrower 40 MHz or even 20 MHz bandwidths due to the limited amount of spectrum available. For instance, Australian university campuses typically deploy their networks in this constrained manner.

The reason for this behaviour is that a shared licence-exempt band requires multiple channels in order to distribute load and reduce Co-Channel interference (CCI). As shown in Figure 1, having more channels in a Wi-Fi network can increase the distance for APs using the same channel, which leads to a reduced CCI. Both practical experience and academic research over the last 20 years demonstrates that uncoordinated RLANs, such as Wi-Fi, require no fewer than about seven to nine non-overlapping radio channels to absorb current demand levels. For large venue environments with extreme loading levels such as stadiums, arenas, university lecture halls, and airports, research and years of experience have proven that having 20 or more independent channels enables RLANs to operate successfully and carry unprecedented levels of traffic.

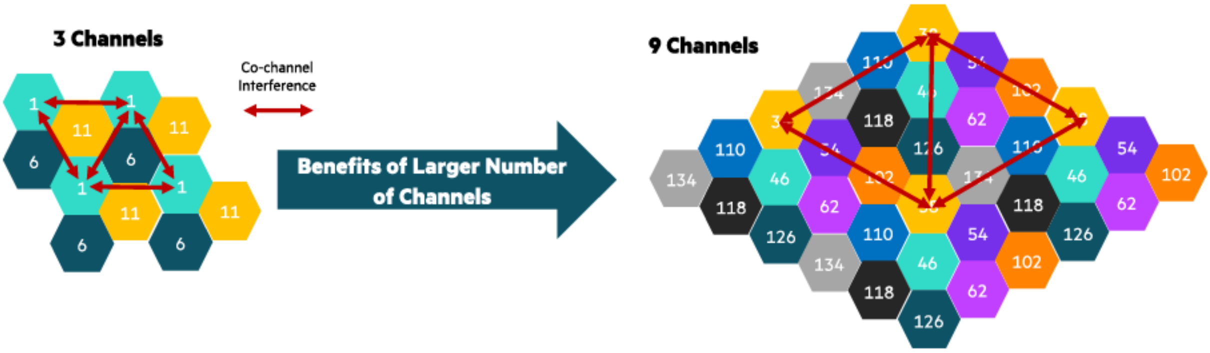


Figure 1 CCI decreases with available channel count

The LIPD class licence updated in 2022 enabled the lower 500 MHz in the 6 GHz band, which helped ease the spectrum congestion in the 5 GHz band. However, having just six 80 MHz channels and three 160 MHz channels means majority of enterprise network administrators still have to stick with the narrow band 40 MHz channel. This sacrifices higher data rates, limiting peak performance to under 600 Mbps for a typical device in optimal RF conditions for 40 MHz. For typical user equipment with 2x2 MIMO capability, 40 MHz will only be able to deliver a maximum of 574 Mbps even at a very good RF environment. Gigabit speeds are not possible with less than 80 MHz channel widths in Wi-Fi.

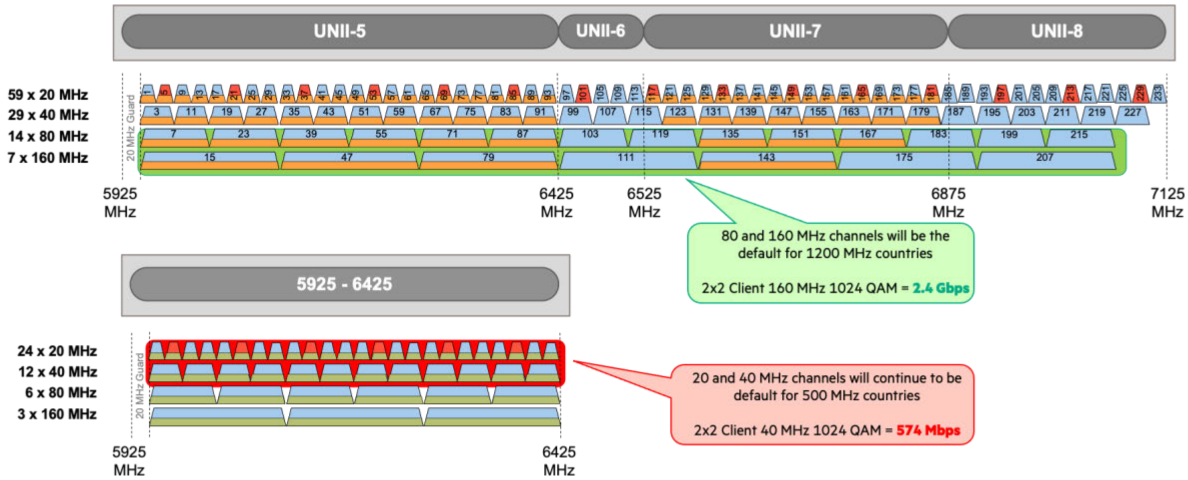


Figure 2 only the full 1.2GHz spectrum will be able to deliver gigabit throughput

The uncertainty regarding whether Australia will include the upper 6GHz band in LIPD class licence has delayed many enterprise users to invest in upgrading their Wi-Fi network to the latest Wi-Fi 6E or 7. If the ACMA decides to use option 1 "maintain existing arrangements, with potential reconsideration at a later date", it could cause further investment delays, resulting in significant opportunity costs for the Australia industry. In countries that have opened the full 1200 MHz, like US and Canada, we have observed  strong growth in Wi-Fi 6E adoption over the past two years. With full 1200 MHz spectrum available, many customers will default to multi-gigabit capable 160 MHz channels because seven channels is enough for most Wi-Fi operations, with some backing down to 80 MHz only in high CCI environments.

**A prosperous Wi-Fi 6E/7 device ecosystem can provide immediate benefits to Australian society.**

Since the FCC authorised unlicensed device using the 6 GHz band, a robust 6 GHz Wi-Fi ecosystem has developed in the past four years. To date, over 45 billion devices have been deployed globally, with 800 million of them supporting 6 GHz. Almost all the latest generations of mobile phones, tablets, laptops, access points, and routers now feature 6 GHz Wi-Fi capability. These advancements offer substantial benefits that would positively impact the Australian economy and society today.

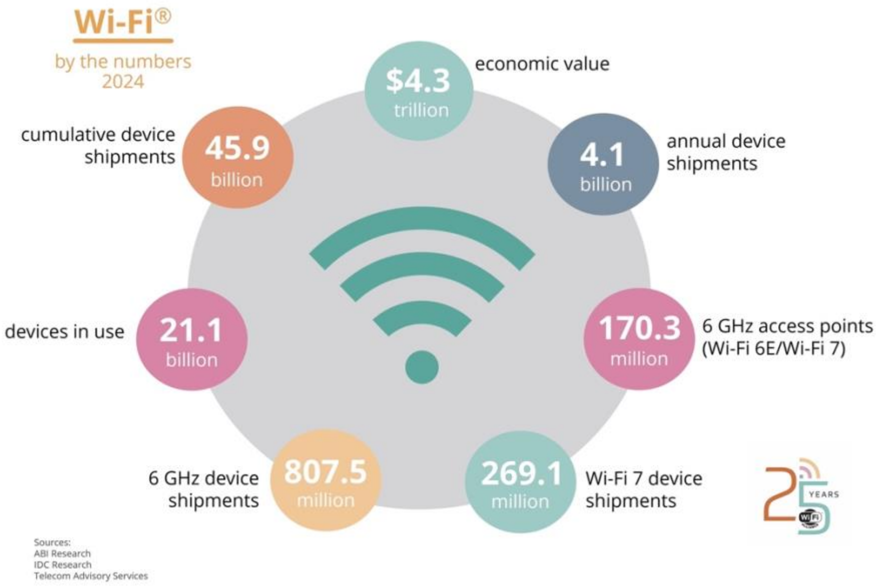


Figure 3 Wi-Fi by the numbers 2024[1]

**HPE thinks option 3 provides little benefit to Australia. The reasons are listed below:**

a. <u>The majority of internet traffic will carried by Wi-Fi plus fibre. Limiting spectrum available for Wi-Fi will strand Australia's investment in fibre infrastructure.</u>

Thanks to enormous government investment, Australia boasts world-class fibre infrastructure. Fibre has become the cornerstone of internet access in Australia, as evidenced by the Internet Activity Report published by the Australian Competition and Consumer Commission. The report highlights that over 87% of internet traffic in Australia is carried over fixed networks[2]. These fixed networks terminate at premises, where broadband connections are distributed via Wi-Fi.

With the NBN gradually upgrading its fibre network to support speeds of 10G, 50G, and even 100G[3], limiting the spectrum available for Wi-Fi risks stranding Australia's substantial investment in fibre infrastructure. Fibre networks are designed to deliver high-speed, reliable internet connectivity, and Wi-Fi plays a crucial role in extending this connectivity to end-user devices across homes, businesses, and public spaces. By constraining Wi-Fi spectrum options, Australia may undermine the full potential of its fibre network capabilities, potentially delaying the realization of economic and societal benefits associated with advanced internet connectivity.

b. <u>Australia has sufficient WA WBB spectrum. Adding the upper 6 GHz band offers marginal gains and doesn't address indoor traffic demand.</u>

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[1] Value of Wi-Fi https://www.wi-fi.org/discover-wi-fi/value-wi-fi
[2] ACCC Internet Activity Report, for the period ending 30 June 2023 https://www.accc.gov.au/system/files/internet-activity-report-june-2023.pdf
[3] Australia's NBN trials multiple PON technologies over a live fiber network

The ongoing planning activities in the 700/800 MHz, 1800 MHz, 3.4 - 4.2 GHz, and 26/28 GHz bands will provide Mobile Network Operators (MNOs) with sufficient spectrum to deploy their networks. Specifically focusing on mid-band licensed IMT allocation, Australia already enjoys access to more spectrum than many comparable countries. As noted by the ACMA, a primary justification for allocating the upper 6GHz spectrum for WA WBB is to provide additional capacity in dense urban areas to complement the already substantial mid-band spectrum available for WA WBB. However, most of that data traffic is consumed indoor. Relying on outdoor Macro base stations to provide the required quality of service indoor is impractical due to high-frequency propagation loss, building entry loss, and the limited power of user equipment. This issue has already been observed from the Perth Convention and Exhibition Centre (PCEC)'s experience with WA WBB deployed at even lower frequencies.

From Brett Miell – Director of Technology and Digital Innovation, PCEC

*"PCEC implemented a Wi-Fi 6E network in 2023 to provide a best of breed solution, to deliver an first-class experience to the Australian and International event customer. The network equipment selected used only flagship technologies to meet the requirements of next generation customer devices.*

*User expectations for connectivity are only increasing, venues such as the PCEC often have low coverage for 5G services due to building interference (loss), opening the full 6GHz band would provide that last hop benefit making the greatest impact to the customer's experience."*

c. Allocating spectrum without a supporting device ecosystem provides no value and imposes significant costs on consumers and industries.

For spectrum allocation to effectively benefit consumers and industries, it must be accompanied by a robust ecosystem of devices that can utilize the allocated frequencies. Without such devices, the spectrum remains underutilized, leading to wasted resources and missed opportunities for innovation and economic growth. Currently, there is no commercial IMT devices operate in the 6 GHz band. The ongoing policy debate on spectrum access and technical study on hybrid sharing in Europe create significant investment uncertainty for IMT device manufactures.

In the absence of IMT devices operating in the 6 GHz band, allocating spectrum to WA WBB provide no benefit to Australia social economy. Instead, restricting access for other services and Wi-Fi to this band imposes a substantial opportunity cost. Even MNOs themselves express uncertainty about acquiring spectrum in the 6 GHz band, as evidenced by the recent consultation held by the Hong Kong Communications Authority (HKCA). In the response to HKCA's proposed spectrum auction for upper 6 GHz band, all four major MNOs expressed concerns that the auction is premature due to the lack of ecosystem and available equipment in this band[4].

[4] Joint Statement of the Communications Authority and the Secretary for Commerce and Economic Development Arrangements for Assignment of the Spectrum in the 6/7 GHz Band for the Provision of Public Mobile Services and the Related Spectrum Utilisation Fee.

As described by ACMA, introducing WA WBB is likely to require the clearance of co-channel point-to-point links in areas allocated for WA WBB, which could be a costly and lengthy process without clear policy benefits. This challenge is similarly reflected in HKCA's development arrangement for the 6/7 GHz band, where the HK authority arranged to relocate users of fixed links and outside broadcasting links operating in the frequency ranges from 6425 MHz to 7125 MHz to make spectrum available for public mobile services.

**Frequency segments between WBB and RLAN in Option 4 will restrict Wi-Fi use for innovative applications and outdoor deployments.**

Frequency segments between WBB and RLAN in Option 4 can compromise the quality of enterprise and public venue Wi-Fi networks that require dense deployment. As demonstrated in our analysis above, splitting the spectrum would reduce the number of available 160MHz channels, crucial for supporting future applications requiring very high through put and extra low latency.

RLAN technology serves not only as a critical last-mile connection for devices to broadband networks but also for point-to-point backhaul connections or mesh networks, reducing the need for costly rolling cable to connect core networks. For example, the John Holland Group faces the challenge of establishing connectivity in even the most remote locations across Australia quickly and efficiently[5]. They utilize outdoor Wi-Fi systems to provide connectivity in these remote construction areas, ensuring that the right applications have access to the appropriate bandwidth and that critical infrastructure data is kept secure.

From Kier Morrison – General Manager IT, John Holland Group

*"John Holland have use cases of needing to create a wireless solution on large worksites located on remote areas or areas where traditional mobile coverage is lacking. These worksites need access to the JH's corporate and internet network on the open spaces where they have their IoT deployments are located like scanners, sensors, automation systems all of which require real-time data transmission. Work staff such as surveyors and design engineers also need fast and reliable access to network when on the field while accessing bandwidth-intensive application. Building a robust and high performance Wi-Fi network based on the 6 GHz band spectrum will help John Holland in providing resilient and extended coverage to these challenging outdoor environments.*

*The same will also be true for confined worksite like tunnels that spans several kilometres. A Wi-Fi network built on 6GHz spectrum will improve signal coverage on these areas with reduced interference and better channel availability while providing higher throughput and bandwidth."*

Currently, Australia offers only four available 80 MHz channels for outdoor Wi-Fi use, with three requiring Dynamic Frequency Selection (DFS) and EIRP (Equivalent Isotopically Radiated Power) masks. This limited spectrum availability severely

[5] Building Australia's next generation infrastructure John Holland brings connectivity to the most remote construction projects.

constrains the feasibility of deploying functional outdoor Wi-Fi systems, posing a future risk for companies like John Holland Group that rely on fast and reliable connectivity.

6 GHz Wi-Fi is designed with Automatic Frequency Coordination (AFC) to protect incumbent services, such as Fixed Service (FS). AFC ensures that Wi-Fi APs do not operate on channels that could interfere with FS receivers. In areas with dense FS utilization, this protection mechanism may result in very limited or no available channels for Wi-Fi deployment.

Figure 4 illustrates a sample AFC calculation for available channels for an outdoor Wi-Fi AP in San Francisco. Each coloured shape represents a calculated protection zone in front of an FS receiver applicable to the Wi-Fi AP. In this scenario, the resulting spectrum availability shows that only four 80 MHz channels and one 160 MHz channel are feasible at this location. Similar constraints are typical in major cities worldwide, and availability can be even more restricted in cities with flat terrain.

If the ACMA decides to allow Wi-Fi only to access a certain portion of the 6 GHz band, it could exacerbate spectrum availability issues for outdoor deployments. This restriction has the potential to render the 6 GHz band unusable for outdoor Wi-Fi operations, particularly in densely populated urban areas where spectrum congestion is already a significant concern.

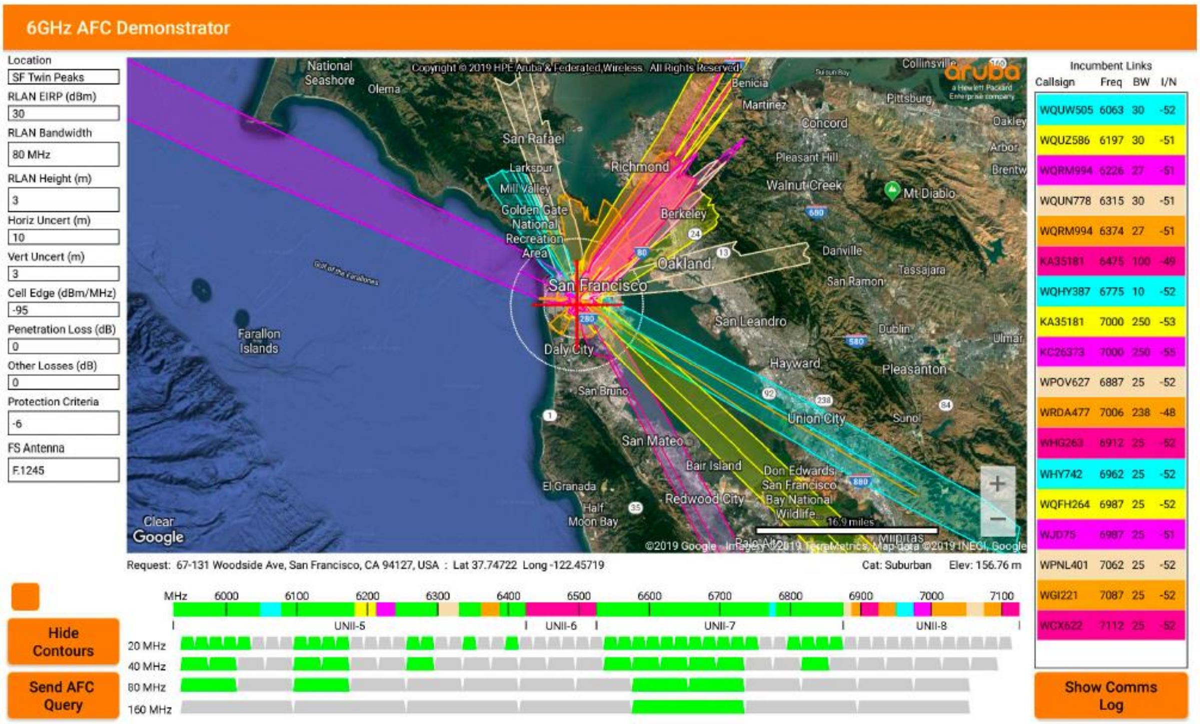


Figure 4 AFC Calculated Spectrum Availability for 6 GHz RLAN in San Francisco

It should be noted that the spectrum splitting methods proposed in option 4 will not only directly eliminate the Wi-Fi channels that overlap with the allocated WBB spectrum. Due to the asynchronous operation of Wi-Fi and cellular systems for their downlink and uplink transmissions, as illustrated in Figure 5, the presence of high-power cellular transmissions below 7125 MHz can cause strong Adjacent Channel Interference (ACS) to Wi-Fi reception.

Compounding the ACS issue is the fact that nearly all 6 GHz Wi-Fi devices are equipped with a frontend filter that stops at 7125 MHz, providing no additional rejection of blockers by the RX frontend filter. Consider scenarios where indoor cellular base stations are co-located with Wi-Fi APs, or where nearby user devices use Wi-Fi for downlink and cellular for uplink respectively. In such cases, the adjacent channel blocker from cellular emissions can be more than 80 dB stronger than the Wi-Fi received signal, potentially saturating the Wi-Fi receiver.

This presents a significant risk of deteriorating Wi-Fi performance in channels with frequencies close to high-power emissions, potentially rendering those channels unusable.

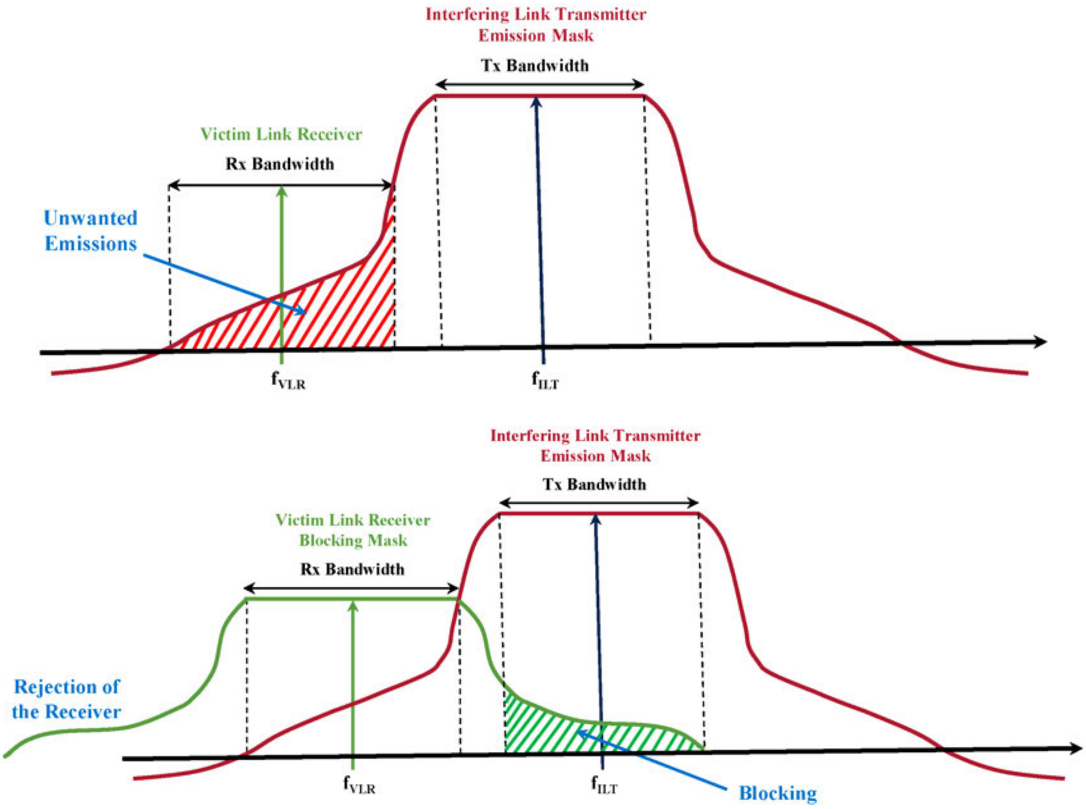


Figure 5 Illustration of interference due to unwanted emissions and receiver blocking

*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).*

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

For Question 2-3, based on our analysis above, we do not believe that the ACMA should proceed with any spectrum segmentation methods. We also want to emphasize that the 6 GHz band is the only spectrum supporting the current Wi-Fi 6E/7 and future Wi-Fi 8; there are no alternative spectrum bands for three generations of Wi-Fi expected in the next decades. In contrast, for WA WBB, as the ACMA outlined in its 5YSO, many spectrum bands in the low, mid, and high frequencies will either be re-farmed or implemented in the next 5 years. In addition to Australia's existing WA WBB spectrum portfolio, there are also 2255 MHz of spectrum across three mid-band frequency ranges being studied for a possible IMT identification under WRC-27 agenda item 1.7.

*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?*

In the last 15 years, the industry has invested significant effort in researching methods for sharing spectrum between 3GPP and IEEE technologies. This research has led to the development of several unlicensed 3GPP technologies like LTE-LAA and 5G-U. A fundamental principle for enabling these technologies to share frequencies without degrading their performance is using contention-based protocols for channel access and ensuring a proper energy detection threshold in both systems.

Given that most high-density Wi-Fi networks are deployed in urban areas and that licensed FWA plays a vital role in rural connectivity, geographic segmentation - allowing Wi-Fi in dense urban areas while reserving WA WBB for regional or remote areas seems an efficient way to use the spectrum. However, the reality is that Wi-Fi device manufacturers use a regulatory table to ensure their devices comply with the country's regulations. Implementing different regulatory settings for different geographic areas within a country can be both technically challenging and costly.

We can foresee that geographic segmentation will require Wi-Fi APs to have geolocation capabilities and report their locations to a central database. This database would need to include regulatory settings for different geolocations and be able to update its settings when the location changes. Such complex regulatory requirements could pose a significant technical hurdle for manufacturers, leading some to avoid implementing these features altogether.

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