Cisco Systems, Inc. Comments
July 2024

Response to ACMA Consultation on Future use of the upper 6 GHz band Options Paper

Introduction

Cisco Systems, Inc. hereby files comments in response to the Australian Communications and Media Authority (ACMA) Options Paper on *Future use of the upper 6 GHz band* issued in June 2024. Cisco appreciates the ACMA in having opened up the much-needed spectrum in the lower 6 GHz range for low power indoor (LPI) and very low power (VLP) devices. We look forward to ACMA taking the next step as soon as possible of making the upper part of the 6 GHz band similarly available, allowing for the entire 5925-7125 MHz band to be made available to class-licensed uses to sustain and grow the economic activity that Wi-Fi has historically supported. We also welcome discussions on the introduction of Automated Frequency Coordination (AFC) to allow Standard Power devices to be used in the full 6 GHz band.

Cisco is a global provider of Internet Protocol (IP)-based networking solutions with a strong presence in Australia. Among Cisco's many products are Wi-Fi network solutions for enterprise, enterprise networking solutions generally, and telecommunications service provider networking solutions. While we support our telecommunications service providers' goals for more spectrum in other bands, we believe that the upper 6 GHz band is better suited for Wi-Fi operations. Australia urgently needs more Wi-Fi spectrum to enable the technology to keep pace with improvements in complementary technologies such as 5G, and to ensure that Wi-Fi does not become a bottleneck in Australia's digital infrastructure. The upper 6 GHz band will help address this issue.

Need for Full 6 GHz Band (5925-7125 MHz) for Class-Licensed Use

Cisco appreciates that ACMA has laid out four options for consideration in the Options Paper for the upper 6 GHz band. We believe that Option 2 – introduce arrangements to enable RLAN access to all of the upper 6 GHz band via a variation to the LIPD Class License – is the approach that would be most beneficial to Australia.

Cisco has outlined the case for allocating the full 6 GHz band for class-licensed use in our previous submissions. This includes the need to alleviate the congestion experienced in current Wi-Fi networks that are primarily deployed in the 2.4 and 5 GHz band. While the additional spectrum in the lower 500 MHz of the 6 GHz is welcomed, to experience a significant performance boost in Wi-Fi networks in Australia, more spectrum is required. We wish to reiterate three points specifically on the need for:

- wider channels than the current 20 MHz and 40 MHz in use today;
- at least seven non-interfering 80 and 160 MHz channels to support dense deployments;
- and, support for higher power and outdoor Wi-Fi deployments in the 6 GHz band.

Need for Wider Channels

> The wider channels reflected in the latest Wi-Fi standards – Wi-Fi 6E, Wi-Fi 7 and beyond – utilizing the full 6 GHz band, are pivotal for enabling low latency applications such as AR/VR streaming, which are essential for various sectors

including collaborative design, telehealth, social gaming, and specialized training for military and heavy equipment and machinery. The wider spectrum allows for high-quality experiences with minimal latency, crucial for these immersive technologies.

Current deployments of Wi-Fi networks, typically based on 40 MHz channels, are limited in latency and throughput. In such networks, Wi-Fi speeds experienced by users typically hit a speed limit of 574 Mbps[1], even when the underlying network, e.g., a fiber or even a 5G connection, can reach and exceed speeds of 1 Gbps. In contrast, where 160 MHz channels are used, speeds of 2.4 Gbps can be expected[2]. As such, even with additional spectrum allocated for class-licensed use, unless wider Wi-Fi channels are deployed, the user will not experience an improvement in network performance.

AR/VR companies like Zero Latency[3], a Cisco customer, face challenges due to limited Wi-Fi spectrum. In dense environments, the lower part of the 6 GHz band can only support a limited number of users due to co-channel interference, significantly impacting the user experience. The compromise would be in terms of cost, quality and performance that could be achieved with only 500 MHz versus 1200 MHz. For instance, in Zero Latency's VR arenas, only four 80 MHz channels can be used, limiting the space to eight users at a time[4]. This is only feasible at the moment because there are no neighbouring 6 GHz networks. The 5 GHz band, previously in use, proved inadequate, being limited to 40 MHz channels due to congestion and external interference, affecting over 92% of VR sessions.

Wi-Fi remains the preferred technology for AR/VR due to its cost-effectiveness and lower power requirements. Beyond gaming, sectors like defence and real estate also benefit from AR/VR for training and visualization purposes, as demonstrated by Zero Latency's work with the Australian Defence Force and in architectural design.

The need for wider channels is not just about enabling AR/VR but also about supporting a wide range of future applications and technologies. Making the full 6 GHz band available is crucial for maximizing the innovation potential of Australia, benefiting not only large organizations but also the vibrant community of AR/VR startups and companies.

[1] Based on 2x2 client at 40 MHz 1024 QAM = 574 Mbps
[2] Based on 2x2 client at 160 MHz 1024 QAM = 2.4 Gbps
[3] https://zerolatencyvr.com/
[4] A cap of 8 players is placed on Zero Latency's gaming platform with only the lower 6 GHz band available. However, based on Zero Latency's projection, 16 players would be a requirement to achieve a viable business case. Without the full 6 GHz band, to support more users with only 500 MHz, the user experience would be significantly compromised with the need to use narrower channels. The streaming bandwidth for each user will drop from 50 Mbps to 30 Mbps with the use of 40 MHz instead of 80 MHz channels. This places serious limitations on Zero Latency's innovative potential.

Need for Seven 160 MHz Non-interfering Channels

For nearly two decades, the Wi-Fi industry has been leveraging the 5 GHz spectrum to innovate and meet the growing demands of various government and enterprise applications. As the volume of data and number of use cases grew, the industry learned to deploy dense Wi-Fi networks across a range of different environments, from offices and classrooms, to convention centres and stadiums, and shopping centres and airports. High density designs must provide coverage across the site, while minimising co-channel interference and maintaining an acceptable level of performance. Despite Wi-Fi 5 supporting wider channels, most networks continued using 40 MHz channels due to the 5 GHz band's inability to support wider channels at typical access point densities.

Recognizing that technological advancements alone could not meet future demands, which include denser deployments and more data-heavy applications like AR/VR, the industry looked towards Wi-Fi 6. This new generation aimed not only for incremental improvements but also to utilize contiguous spectrum that supports wide channels. The 6 GHz band was chosen for its compatibility with existing 5 GHz equipment and its ability to coexist with licensed services.

Cisco's experience in the US, shows that Wi-Fi in the 6 GHz band allows for networks designed with frequency reuse 7 channel plans, using 80 or 160 MHz wide channels. This design minimizes packet collisions and supports up to fourteen 80 MHz channels or seven 160 MHz channels, enabling gigabit throughput with low latency—a necessity for current and future applications.

Today's government and enterprise networks require these advanced capabilities, especially for broadband access where users tend to cluster in specific areas, necessitating multiple access points for coverage. The challenges will intensify with the deployment of AR/VR and robotics, which place greater demands on the network.

While the addition of the lower 500 MHz of the 6 GHz band is beneficial for current needs, the full 6 GHz band is crucial for supporting emerging technologies that require 80 and 160 MHz channels and have stricter latency requirements, such as AR/VR applications that need latencies approaching 10 ms. Access to the full 6 GHz band is essential not just for enhancing today's Wi-Fi experience but also for enabling and supporting the next generation of applications.

To support 160 MHz channel sizes as a default for dense deployments such as hospitals, schools, auditoriums, stadiums and other public areas, there will be a need for 7 non-overlapping channels. Should the upper 100 MHz of the 6 GHz band be made available for WA WBB, it would not be possible to configure a network with seven 160 MHz channels without the full 1200 MHz in the 6 GHz band. In such a scenario, 80 MHz channels would likely be the default configuration for such environments, thus limiting the full potential of technologies such as Wi-Fi 6E, Wi-Fi 7 and beyond. If only the original lower 500 MHz in the 6 GHz band was available

(i.e., no additional spectrum was made available for RLAN in the upper 700 MHz), we would be further limited to using only 40 MHz channels as there would not even be seven 80 MHz channels available.

Need for Higher Power Levels and Outdoor Support

Under the current technical regulations for Wi-Fi equipment operating in the 6 GHz channel, access points are required to operate in indoor-only scenarios with the LPI configuration. However, there are many deployment scenarios where LPI access points cannot provide the needed coverage.

For enterprises, indoor higher (standard) power deployments will greatly assist in the coverage of large structures such as lecture theatres, shopping centres, warehouses, factories, concert halls, convention centres and arenas. Standard Power will be necessary to support external antennas to provide the necessary coverage that may be, for example, at the edge of a large building or on the other side of one or two internal walls. High ceilings and large open environments can make it challenging to provide the necessary coverage with standard integrated omni-directional antennas.

Moreover, many businesses and consumers also rely on Wi-Fi for outdoor operations. People expect seamless Wi-Fi connections wherever they go. Thus, Wi-Fi is used outdoors in mobile vehicles (e.g., airplanes, cruise ships), often connected to mobile wireless or satellite backhaul. Wi-Fi is also frequently used for outdoor use cases like municipal Wi-Fi, campus networks, sports venues, industrial sites, and broadband services. University environments, in particular, require pervasive, high bandwidth and high-density coverage across their campuses, with seamless access across both indoor and outdoor.

The US FCC recognized the importance of outdoor Wi-Fi in its rules governing the 6 GHz band by allocating more than 800 MHz of the 1200 MHz in the 6 GHz band to Standard Power operations, which may take place outdoors in coordination with an Automated Frequency Coordination (AFC) database. In the United States, now that the FCC Standard Power rules for the 6 GHz band have been finalized, Cisco plans to take advantage of the outdoor Wi-Fi opportunity with state-of-the-art devices and services focusing on industrial and campus Wi-Fi uses.[5] As a recent blog stated, "[s]mooth operations require reliable wireless connectivity at the factory, into the warehouse, and across loading docks and ports. Machines need reliable, high bandwidth connectivity as businesses increase automation and connect more assets like autonomous robots and AGVs [Automated Guided Vehicles]."[6]

[5] *See* Vikas Butaney, "Cisco announces first outdoor Wi-Fi 6E ready access point and enhancements for industrial remote operations," (24 May 2022), *available at* https://blogs.cisco.com/internet-of-things/cisco-extends-industrial-iot-portfolio-to-bring-reliable-wireless-connectivity-and-enable-remote-operations-anywhere.

[6] *Id.*

Outdoor Wi-Fi can also help bridge the digital divide. Cisco is currently working with network engineers and students at the University of Illinois Chicago to extend campus Wi-Fi service to the surrounding majority-Latino neighbourhood, which significantly lags behind nearby communities in terms of broadband access.[7] This student-led project is taking advantage of the school's planned Wi-Fi 6 upgrade effort "to provide point-to-multipoint and point-to-point Wi-Fi mesh solutions to extend the school's backbone wireless capabilities, leveraging the location of specific buildings in the Pilsen neighborhood."[8]

Supporting Customer Needs

Cisco has many years of experience in deploying large scale Wi-Fi networks for our customers in Australia and around the world. The deployment of advanced Wi-Fi technology has proven to be transformative for institutions worldwide, as evidenced by the experiences such as that of Baldwin Wallace University (BW) and Renown Health, both of which partnered with Cisco to overhaul their wireless networks.

BW[9], a private university in Ohio, faced network congestion issues that led to dropped connections and slow performance, affecting academic and administrative operations. To resolve this, Cisco upgraded BW's network to Wi-Fi 6E LPI devices utilizing the 6 GHz band, resulting in fast Internet speeds and the elimination of help desk requests related to network problems.

Renown Health[10], a healthcare provider in Nevada, required a robust network to support an increasing number of devices, including a growing array of Internet of Things (IoT) devices critical for healthcare operations. The network, which had grown from supporting 2,000 devices in 2000 to 14,000 in 2023, was updated with Cisco's LPI access points using the 6 GHz band. This upgrade tripled network speeds and allowed for a 700% increase in IoT devices, with a significant 94% reduction in troubleshooting time, enabling a small team to manage the network effectively.

Both BW's and Renown Health's experiences highlight the transformative effects of Wi-Fi 6E LPI technology. For BW, the upgrade meant seamless academic and business processes without connectivity issues. For Renown Health, reliable wireless connectivity is crucial for patient care, as it ensures essential checks and documentation, such as the refrigeration of samples and medication, are maintained without interruption.

[7] Erika Gimbel, "How University Wi-Fi Networks Better Digital Equity in Surrounding Communities," EdTech (1 September 2023), *available at* https://edtechmagazine.com/higher/article/2023/09/how-university-wi-fi-networks-better-digital-equity-surrounding-communities.
[8] *Id.*
[9] https://www.cisco.com/c/en/us/about/case-studies-customer-success-stories/baldwin-wallace-university.html#~the-story
[10] https://www.ciscolive.com/c/dam/r/ciscolive/global-event/docs/2023/pdf/CSSOPS-1070.pdf

Experience in Australia

In working with customers in Australia, we have faced similar situations where large venues and large campuses require a significant improvement in their wireless connectivity.

Public Venues

The Sydney Opera House is one of the most well-known tourist destinations in the world, regularly seeing more than 10 million visitors each year, with events such as New Year's Eve and Australia Day each bringing approximately one and a half million spectators. As most of those visitors are overseas tourists, guest Wi-Fi is highly desirable. During peak periods, the 4G and 5G networks are also overwhelmed, making demand for better localised Wi-Fi coverage even more critical.

Wi-Fi bandwidth in 5 GHz is already impacted by cruise ships from the neighbouring Overseas Passenger Terminal and associated Dynamic Frequency Selection (DFS) RADAR events. The unique requirements of the site mean that Standard Power is necessary to allow for the use of 6 GHz, not just for the outdoor areas but also indoors, as nearly every Wi-Fi access point is currently deployed with external antennas.

Given the high demand, venues such as the Sydney Opera House will consume whatever spectrum they can access. Because of that demand, notwithstanding the high desirability of providing Wi-Fi for visitors, they currently find that they need to disable guest Wi-Fi at peak events to ensure connectivity for their critical internal services. As such, providing the full 1200 MHz of the 6 GHz band together with Standard Power will ensure that the Opera House can support not just future requirements, but even peak periods today.

Universities

Australian universities are another example where we regularly see very high demand for Wi-Fi. It is common for universities to see significant challenges in high density areas such as libraries and lecture theatres.

Deakin University provides an excellent example as previously shared at the ACMA "tune-up". As can be seen in Figure 1, a significant number of access points are required to support the density of students. Deakin recently migrated to Wi-Fi 6E, and we are already seeing 6 GHz adoption at around 10% of connected clients. Other universities report similar numbers. We fully expect this to increase considerably as staff devices are refreshed through the year, and students upgrade their devices. Student adoption of new technologies is cyclical, with new cohorts at the start of the year arriving with the latest devices. As such, we expect to see Wi-Fi 7 devices early next year as well, adding to the mix of 6 GHz capable clients. Much like the Sydney Opera House, Australian universities must support these high-density requirements in outdoor campus locations as well.

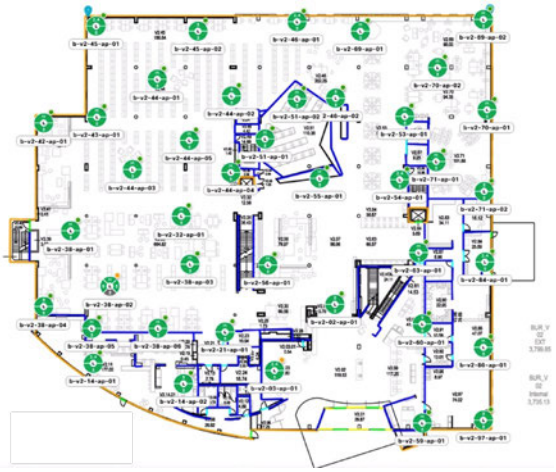

Figure 1: Deakin University Library Example

The bandwidth needs in these examples are considerable, suggesting the need for at least 80 MHz, and preferably, 160 MHz channels. A 7 channel frequency re-use pattern in 6 GHz is necessary to reduce co-channel interference and support networks capable of delivering multi-gigabit speeds and the low latency needed for immersive technologies.

The need for increased bandwidth is also driven by applications. Another Australian university, for example, currently runs a training program using AR with Microsoft HoloLens, allowing doctors to perform virtual surgery. With the current limitation of 40 MHz channels, they are restricted to a maximum of 6 headsets in a class environment, leaving others to simply watch the video rather than partake of the virtual experience. Increasing the channel widths to 80 and 160 MHz allows for more active AR and VR clients by providing not just increased throughput, but decreased latency.

Mining

We are also working with a large Australian mining company which has had similar issues as they try to roll out VR for training and inductions across sites in Queensland, South Australia and Western Australia. The solution works today where they can have the data loaded on VR headsets. However, future use cases will require the data to be streamed over Wi-Fi. The current limitations have led them to put those programs on hold as they need to enable the entire class with VR to be of value. For large numbers of users, such as in this example, 320 MHz channels would also be beneficial. While we would not be able to run 320 MHz channels across every access point in the environment with only a maximum of three channels, with access to the full 1200 MHz, it would at least be practical to use these wider channels in limited scenarios.

Despite being early days for this technology, we continue to see strong interest in AR and VR, and not just for educational and training scenarios. Head mounted wearables are also used by mining companies for remote safety, maintenance and operational work tasks. With such levels of early interest, we expect the bandwidth challenges to become more widespread as organisations increasingly look to adopt

the technology. Without more spectrum to support wider channels, Australia will not be able to fully benefit from these emerging technologies, despite the benefits they would provide.

As with other examples, the mining industry would also require Standard Power to support the external antennas and outdoor requirements specific to their environments and allow 6 GHz channels to be used.

Additional spectrum is not purely about supporting higher bandwidth and lower latency applications. There are many environments where we see multiple, parallel wireless networks in operation. The additional spectrum allows those networks to operate across different channels, minimising the interference they cause to each other. While this is quite common in high density, metropolitan environments, we also see it in a number of different vertical environments as well:

- In healthcare, for security requirements, hospitals will sometimes prefer to provide patient and visitor guest Wi-Fi over completely different wireless infrastructure from the internal hospital wireless network, resulting in two competing networks.
- There are similar challenges in mining. In both open pit and underground mines, the corporate IT networks are deployed on completely separate infrastructure to their mining operations OT network. Supporting the necessary channel separation, while still providing the required level of throughput, currently creates significant challenges and complexity. Given the current limitation of 500 MHz of available spectrum in the 6 GHz band, only 20 MHz channels can be enabled to ensure both networks can be operated effectively. As previously discussed, this will present future challenges as the emerging mixed reality solutions need to be deployed.

In summary, the advanced Wi-Fi deployments both in Australia and around the world demonstrate the importance of up-to-date wireless infrastructure in supporting the growing demands of users and IoT devices. These upgrades have not only addressed immediate connectivity challenges but have also prepared both institutions for future technological needs, enhancing operational efficiency and user experience.

Conclusion

Cisco appreciates the opportunity to provide the above input to the ACMA's consultation. This topic is important for the future of Australia, for connecting residents and accelerating the industry digitalisation of your economy. We would be happy to discuss or respond to any additional questions.

Contact Information

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