Ericsson submission to the ACMA's Future use of the upper 6 GHz band options paper

July 2024

Executive Summary

- Ericsson welcomes the opportunity to provide a response to the Australian Communications and Media Authority's (**ACMA's**) Future use of the upper 6 GHz band – Options paper (**Options Paper**).
- In summary Ericsson:
  - Recommends the ACMA progress with Option 3 to support IMT use for Wide Area Wireless Broadband (**WA WBB**) in Metropolitan areas.
  - Considers geographic segmentation is the best solution to protect incumbent services.
  - Recommends that outside metropolitan areas, fixed links are only retained in areas where no viable alternative exists.
- We reiterate recommendations Ericsson made to the ACMA's Exploring RLAN use in the 5 and 6 GHz bands options paper[1]. Specifically, that:

  "*an allocation of 5925-6425 MHZ for R-LAN and 6425-7125 MHz for IMT would result in a balanced approach*."
- Multiple studies have identified the need for additional IMT spectrum to address capacity constraints of actual and forecast growth of wireless broadband traffic and new use cases arising from 5G advanced.
- The only mid-band spectrum with the quantity of spectrum required to meet future demand for IMT growth, is the upper 6GHz band.
- To ensure successful co-existence between proposed IMT and existing services, Ericsson:
  - Supports the use of technical frameworks that address potential interference from WA WBB to Fixed Satellite Service (**FSS**) downlink.
  - Agrees that fixed point to point allocations need to be cleared in areas where WA WBB will be used and propose that this is undertaken in high population areas only, for the lowest impact to existing services.
  - Supports the retention of fixed point to point links only in areas where no viable alternative exists for outside of metropolitan areas.
  - Notes the deployment of IMT base-stations complying with the limits on e.i.r.p spectral density (e.i.r.p mask agreed at WRC-23, ITU-R RES 220) is sufficient for the protection and operation of the FSS Space-station receivers. 3GPP[2] has already started developing technical specification for BS RF emission and relevant conformance testing and is expected to be completed by December 2024.
  - Has performed tests which show RLAN interference into Fixed links can be problematic.

[1] https://www.acma.gov.au/consultations/2021-04/rlan-use-5-ghz-and-6-ghz-bands-consultation-122021

[2] RP-240829 - NR base station (BS) RF requirement evolution for FR1/FR2 and testing

- Agrees with the ACMA's view that **WA WBB** and RLAN geographic separation will not work.

- Hybrid RLAN / IMT sharing options - other than lower 6 GHz band for RLAN and upper 6 GHz for IMT - are not viable at this stage.

The need for additional spectrum for IMT

- Globally, 5G networks are becoming the backbone of digitalised economies and societies and a key component of prosperous, sustainable, and inclusive growth. 5G is on a trajectory to become critical infrastructure for all industries and public services.
- 5G is an enabling industrial infrastructure for new technology adoption and, when fully engaged, will drive an economy-wide productivity leap.
- Australia's deployed 5G infrastructure is a strategic asset to mitigate Australia's productivity challenge.
- Increasing economy wide 5G enabled digitalisation is a perfect fit for the Treasurer's recognition that:

  "*Productivity flows from investing in our people and their ability to adapt and adopt new technology*".[3]
- 5G is the fastest-adopted technology in the history of the mobile industry.
- Continued strong uptake of 5G shows that demand for high-performance connectivity remains resilient. For example, the latest Ericsson Mobility Report[4] found:
  - 320 operators have deployed 5G, with 2,300 5G devices available, and 140 operators investing in 5G Stand Alone (**5G SA**).[5]
  - At the end of 2023, 5G population coverage outside mainland China reached 40% globally and is expected to reach 80% in 2029.
  - Between Q1 2023 and Q1 2024 there was a 25% growth in mobile data traffic.
  - At the end of Q1, 2024, there were 1.7bn 5G subscriptions, forecast to reach 5.6bn by 2029. **Figure 1** below shows actual and forecast mobile subscriptions per technology type.
  - Mobile data traffic expected to grow around three times between 2023 and 2029, with 5G's share forecast to grow to 75% in 2029.
- It is essential that Australia anticipates and prepares for the strong forecast growth in demand for mobile data traffic by identifying and releasing sufficient spectrum for 5G's evolution across low, mid, and high spectrum bands.

[3] https://ministers.treasury.gov.au/ministers/jim-chalmers-2022/speeches/address-jobs-and-skills-summit-parliament-house-canberra

[4] Explore the Ericsson Mobility Report June 2024

[5] 5G | Technology | Reports & Trends | GSA.com

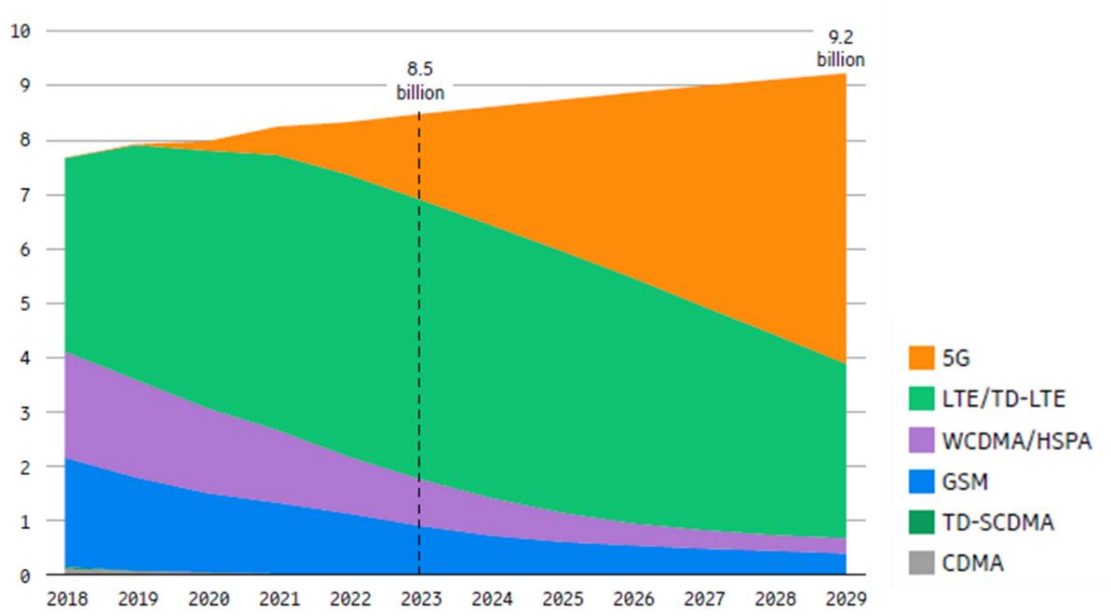
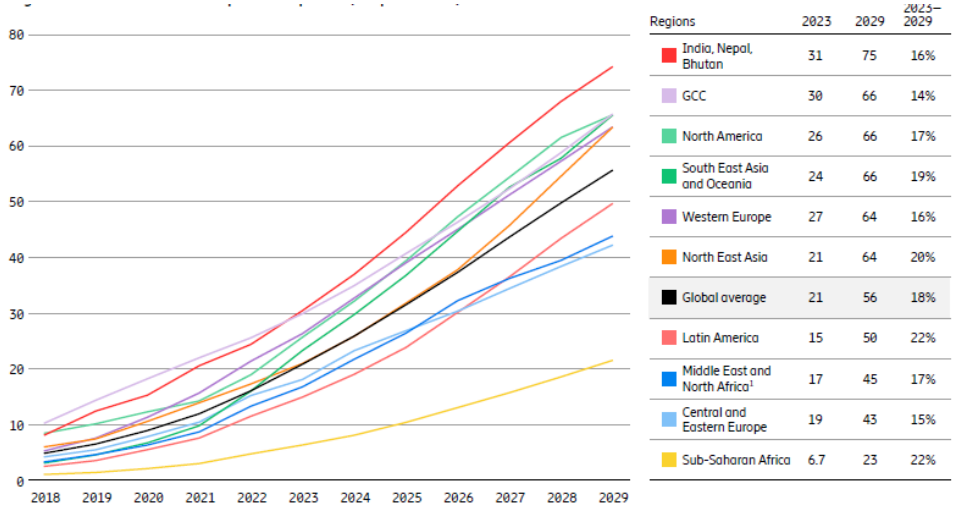


Fig. 1 – Mobile subscriptions by technology (millions)

- The Ericsson Mobility Report also shows a continued increase in data traffic per smartphone through to 2029.



Regions	2023	2029	2023–2029
India, Nepal, Bhutan	31	75	16%
GCC	30	66	14%
North America	26	66	17%
South East Asia and Oceania	24	66	19%
Western Europe	27	64	16%
North East Asia	21	64	20%
Global average	21	56	18%
Latin America	15	50	22%
Middle East and North Africa[1]	17	45	17%
Central and Eastern Europe	19	43	15%
Sub-Saharan Africa	6.7	23	22%

Fig. 2 – Mobile data traffic per smartphone (GB per month)

- A recent Ericsson ConsumerLab poll on AR/XR[6] reinforces the need for spectrum to support new use cases. For example:
  - Consumers combining smartphones and AR devices will double in the next five years.
  - Consumers are hungry for on-the-go AR devices and willing to pay 20 per cent more for portability.

[6] Ericsson ConsumerLab polls XR early adopters on expectations

- As AR technology advances in adapting to geospatial surroundings, the range of XR experiences will become more diverse and demanding on 5G.

- A recent GSMA report:[7]
  - estimated that mobile operators will require around 2,000 MHz spectrum in mid-bands, to meet the 5G mobile data traffic growth in the period 2025-2030 in a cost-effective manner.
  - indicated that a spectrum deficit in mid-bands would significantly increase 5G infrastructure investments. For example, an 800-1000 MHz shortfall in required mid-band spectrum would result in 3-5 times increase in the total cost of network investments over a ten-year period. Added to this are the practical difficulties and time it would take to acquire a large number of new sites.
- In 2021, Coleago consulting released a report estimating IMT mid-band spectrum needs in the 2025–2030 time frame in Australia[8]. The analysis showed IMT mid-band spectrum needs an additional:
  - 587 – 827 MHz for Melbourne
  - 527 – 757 MHz for Sydney
  - 387 – 577 MHz for Brisbane
- The increase in data per smartphone, the number of subscriptions, and new use cases, demonstrate a need for additional spectrum to ensure there is enough capacity in IMT networks.
- Coleago's analysis shows a vast amount of spectrum will be required between 2025 and 2030 which can only be addressed by access to the upper 6GHz band.
- The Wi-Fi Alliance presented at the ACMA upper 6 GHz tune up meeting in February 2024, and noted that the 6 GHz band does not penetrate well from outdoor to indoor. However, test results presented in the "6 GHz opportunity: licensed spectrum for mobile networks – whitepaper June 2022[9]" shows this is not the case. It found that 6 GHz has similar penetration to the 3.5 GHz band. The November 2023 Upper 6 GHz band industry position paper also explains how 6 GHz can deliver performance that is comparable to the 3.5 GHz band.[10]

[7] GSMA 5G Mid-Band Spectrum Needs

[8] https://amta.org.au/wp-content/uploads/2021/12/Coleago-Report-Demand-for-mid-bands-spectrum-in-Australia.pdf

[9] https://6ghzopportunity.com/wp-content/uploads/2022/06/22-06-09-Licensed-6-GHz-opportunity-v2.pdf

[10] https://6ghzopportunity.com/news/

Options paper planning options

Question 1.

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

> ***Option 1:***
Maintain existing arrangements, with potential reconsideration at a later date.

Ericsson recommends Option 1 be applied to non-Metropolitan areas to protect existing incumbent services, only in scenarios where no viable alternative to fixed links exists and until further investigation of alternate scenarios is explored. For example:

- IMT use under an area wide licence (AWL).
- IMT use under an apparatus fixed licence.
- RLAN interference into fixed links under a class licence. (see coexistence section)

> ***Option 2:***
Introduce arrangements to enable RLAN access to some or all of the upper 6 GHz band, via a variation to the LIPD Class Licence. There would be no introduction of arrangements introduced for WA WBB.

- Option 2 would bring the lowest socioeconomic value of using the 6 GHz band, according to GSMA Intelligence studies[11.] and would create capacity constraints on existing IMT networks before 2030.
- There is no other mid-band spectrum available with the equivalent bandwidth to the upper6 GHz band. Not allocating the upper 6GHz band for IMT would impact future use for 6G beyond 2030. RLAN under a LIPD class licence does not provide the certainty of known low or no interference spectrum that an apparatus licence can offer through a technical framework developed by an approved provider who has assessed the impact to existing deployed services.
- For edge use cases proposed by the Wi-Fi industry, that require very high bandwidths, Area Wide licences in the 26 / 28 GHz range are available for deterministic applications, as well as RLAN in 24 GHz and WiGig in the 60 GHz range for opportunistic spectrum access.

> ***Option 3:***
Introduce arrangements to enable WA WBB access to some or all of the upper 6 GHz band, using apparatus and/or spectrum licensing. There would be no arrangements introduced for RLANs.

- Considering the significant large forecast socioeconomic benefits that 5G will deliver, the advanced state of development of the 5G ecosystem, and recent decisions at WRC-23, Ericsson recommends the ACMA identify 6425-7125 MHz band for IMT. Such a decision will benefit consumers and industries with advanced 5G services, full mobility and large economies of scale that will be achieved in the 6 GHz band over coming years.

[11] GSMA Intelligence "The socioeconomic benefits of the 6 GHz band", June 2022

- A GSMA study 12 evaluated the cost-benefit of the different options for utilizing the 6 GHz band, whether for licensed (5G NR) or unlicensed use (RLAN). Figure 3 below shows the conclusion of the study that the largest socioeconomic benefit of the 6 GHz band is achieved when the entire band is allocated to licensed use (5G NR). The unlicensed (e.g. RLAN) use of the whole 6 GHz band was found not to be the most beneficial allocation in any of the considered scenarios analyzed.

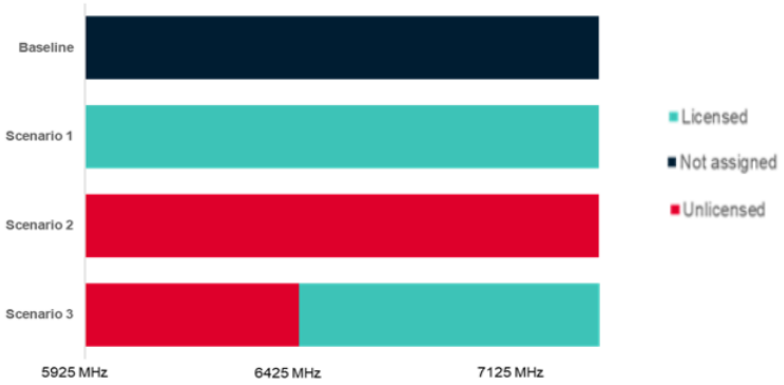


Figure 3 *– Socioeconomic benefit of 5G NR versus unlicensed use in the 6 GHz Band*

- Spectrum Licensing is considered most appropriate for WA WBB networks in highly populated areas (eg. metropolitan areas) due its efficiency and lower interference scenarios between spectrum holders.
- In non-metropolitan areas, WA-WBB use of Apparatus-fixed, or Area wide licensing, is better suited to protect incumbent users through use of the appropriate technical frameworks.

> ***Option 4:***
Introduce arrangements to enable both RLAN and WA WBB access to different frequency segments within the upper 6 GHz band, using the respective authorisation arrangements in options 2 and 3.

- Ericsson does not support Option 4. With over 1 GHz of spectrum available to RLAN/Wi-Fi, across the 2.4, 5 and lower 6 GHz bands, no justifiable reason has been provided to increase the RLAN bandwidth beyond the lower 6 GHz range. RLAN is an inefficient spectrum user and should not be afforded further spectrum to compensate for this.
- For WA WBB however, multiple studies have demonstrated the growth of IMT data usage and new use cases from 5G advanced. Ericsson has consistently advocated to the ACMA that strong forecast demand for **WA WBB** spectrum can be satisfied via maximizing IMT access to the upper 6 GHz spectrum.

[12] GSMA Intelligence "The socioeconomic benefits of the 6 GHz band", June 2022

Question 2.

If we decide to divide the band into different RLAN and WA WBB segments, should the WA WBB segment:

a) be planned based on multiples of 100 MHz? This would align with the largest WA WBB 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).

- Ericsson recommends the ACMA consider identifying the 6425-7125 MHz band for IMT and that spectrum could be planned in multiple blocks of 100 MHz each.
- 100 MHz channels are a sweet spot that maximizes both bandwidth and power spectral density. If demand for WA WBB spectrum is sufficient however, the upper 6 GHz could be partitioned into multiple 100 MHz channels plus a few 50 MHz channels providing for more suitable options for potential spectrum holders who have lower bandwidth needs.

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?

- Ericsson recommends the ACMA to allocate the upper part of 6 GHz (i.e., 6425-7125 MHz) for IMT use in metropolitan areas, which is **Option 3.** Option 3 would create the highest socioeconomic value according to the GSMA Intelligence studies.[13]
- Outside metropolitan areas, Ericsson supports the retention of fixed point to point links only in areas where no viable alternative exists to reallocate these services.
- In the context of RLAN and WA WBB sharing, Ericsson agrees that geographic segmentation is not a viable option. This is because Wi-Fi devices can be nomadic either by design or by use case. IMT requires deterministic spectrum which cannot be assured when RLAN devices are used under a LIPD class licence. For the RLAN LIPD class licence type proposed, there is no fixed location a Wi-Fi device must operate within, and enforcement of indoor only operation is not possible.

3GPP

- At its RAN#96 plenary meeting, 3GPP completed standardization work on the upper part of the 6 GHz band (i.e., 6425 to 7125 MHz), named band n104, for 5G New Radio (i.e., 5G on licensed spectrum). This was incorporated into Release 17. The 3GPP standardization body confirmed that the new n104 band will use a TDD configuration with channels between 20 to 100 MHz.
- This new standard allows the mobile industry to develop 5G systems and terminals that operate in the 6425 to 7125 MHz band, since the 3GPP approved the RF specifications of this band for both the network and user equipment, to provide a standard basis for the industrial chain to develop products for this spectrum.

[13]GSMA Intelligence "The socioeconomic benefits of the 6 GHz band", June 2022

- This standard provides certainty for governments to plan their strategies to authorize the use of IMT in the 6 GHz band, in coordination with their domestic mobile industry.
- When considering the technical framework for IMT in this band we make the following comments:
  - Ericsson recommends the ACMA's option 3 is chosen for the upper 6 GHz band which would allow IMT technology use.
  - Specifically, the entire upper 6 GHz band (6425 – 7125 MHz) should be allocated to WA-WBB, which aligns with 3GPP band n104.
  - Licence conditions should then follow on to reflect the same licence emissions requirements as detailed in 3GPP 38.104 standards.
  - When ACMA defines the technical framework for the upper 6 GHz band, Ericsson recommends following the conformance testing technical specifications which are detailed in 3GPP 38.141.
  - We specifically point out 3GPP 37.141 section 6.6, Table 6.6.1-1 for operating band unwanted emissions (OBUE) frequency range outside the operating band.
  - We strongly recommend adoption of the 3GPP OBUE to avoid a need to develop bespoke radios to be manufactured for the Australian market to meet spectrum licence conditions.

WRC-23 Outcomes 6GHz

The World Radiocommunication Conference 2023 (WRC-23) supported IMT (5G) services in the 6 GHz band. That is:

- In Region 1 (i.e., Europe, Africa, Arab, and CIS regions) [14], the 6425-7125 MHz band was identified for IMT.
- In Region 2, the 6425-7125 MHz band was identified for IMT in Brazil and Mexico [15], with the opportunity for other Administrations in the Americas to also join at World Radiocommunication Conference 2027 (WRC-27).
- In Region 3, Cambodia, Lao People's Democratic Republic, and the Maldives [16] identified the 6425-7025 MHz band for IMT, while the 7025 to 7125 MHz range was identified for the terrestrial component of IMT in the entire region (Asia Pacific).
- Many other Administrations in Region 3 expressed their interest in joining this footnote, which will be possible at the next World Radiocommunication Conference, WRC-27.
- The IMT identifications in all ITU regions include harmonized technical conditions to protect the existing Fixed Satellite services (Earth-space), while at the same time, allowing the deployment of macro IMT radio bases for greater efficiency in deployments, maximizing economies of scale in the upper 6 GHz band.
- All Administrations that identified the 6425-7125 MHz band for the IMT during WRC-23, and those which officially expressed interest in doing so, represent a total

[14] WRC-23 Final Acts, footnote 5.457E

[15] WRC-23 Final Acts, footnote 5.457F

[16] WRC-23 Final Acts, footnote 5.457D

combined population of more than 4.75 billion people, equivalent to 60% of the world's population.

Fig. 3 – IMT identifications and interest in 6425-7125 MHz band during WRC-23

IMT ecosystem readiness for the 6 GHz band

- With 60% of the world's population interested in IMT for the upper 6 GHz band, an ecosystem of 5G networks and devices will be generated with large economies of scale to benefit consumers.
- The identification of the 6 GHz band for IMT at WRC-23, and the early standardization of the band by the 3GPP, have been important milestones in the development of an ecosystem.
- Ericsson is also leading the development of this ecosystem and is working with partners to develop the full 3GPP n104 ecosystem in time for the expected release of the upper 6 GHz band for IMT use.

Coexistence

Fixed-Satellite Service (FSS) uplinks (Earth-to-space). Potential interference from WA WBB

- Based on the coexistence studies to assess the aggregated interference from IMT base-stations to FSS space receivers, WRC-23 developed requirements for the e.i.r.p. spectral density emitted by an IMT base station to ensure protection for the FSS (Earth-to-space) in this band.
- During the conference, the studies expanded the cases that included deployment of IMT base-station deployments including the Region 3 countries. The conference also agreed that there is no further additional study needed for the protection of FSS space-stations' receivers operating in this band for administrations considering deploying IMT in the band 6425-7125 MHz.
- The deployment of IMT base-stations complying with the limits on e.i.r.p spectral density (e.i.r.p mask) is sufficient for the protection and safe operation of the FSS Space-station receiver.
- It is also important to note that the Earth-stations transmitting to space can potentially interfere with the operation of IMT base-stations based on the elevation angle and geographical location; hence, it is recommended to consider a regulatory technical framework to efficiently use this band.

FSS downlinks (space-to-Earth). Potential interference from WA WBB

- Ericsson agrees with the ACMA's approach of geographic separation through technical frameworks (if necessary).

Fixed (point-to-point). Potential interference from WA WBB

- Ericsson agrees that co-channel Fixed (point to point links) will require clearance in areas where WA WBB is allocated.
- IMT in the Upper 6 GHz band could be geographically segmented in major population areas which would not impact existing incumbent fixed (point to point) users in less dense regional and remote areas.
- For boundary areas between Fixed services and WA WBB services, separation through technical frameworks would apply.

Potential interference from RLANs to Fixed (point-to-point)

- Ericsson has provided radio equipment and design services for many of the existing Fixed, point to point links deployed for IMT network backhaul.
- We cannot see a mechanism to protect these links from RLAN interference, to be put forward by ACMA, as these devices would be implemented under a LIPD class licence.
- There is no policing to ensure RLAN LPI is inside a fixed premise with known location, which would provide the protection required to these existing fixed (point-to-point) backhaul links.
- The main manufacturers of IMT systems (Ericsson, Huawei, and Nokia) have carried out laboratory measurements that demonstrate that Wi-Fi systems can easily interfere with fixed microwave service links when they operate in the same spectrum band.
- Additionally, in May 2023, the Swedish Regulator PTS carried out a field test to evaluate the impact of RLAN (Wi-Fi 6E) on a deployed point-to-point microwave radio link (fixed service) operating in the lower band of 6 GHz (5925-6425 MHz)17,. It concluded that microwave systems suffered interference from a Wi-Fi Access Point located at a 3.8 km distance from the fixed service receiver, which degraded the performance of the fixed service even with low intensity RLAN traffic.
- The proliferation of RLAN devices in 6 GHz has not yet eventuated and therefore existing RLAN and Fixed (point to point) examples cannot be used as evidence that there is no interference concern.
- In practice, the interference generated by RLAN (Wi-Fi) devices operating in the 6 GHz band as unlicensed spectrum is almost impossible to coordinate due to its ubiquitous location. Also, given the dynamic and random nature of the use of RLAN devices, it is difficult to guarantee that a separation distance between Wi-Fi devices and the fixed link equipment to be protected (e.g., antennas of microwave links) will be achieved and will not change as no ACMA Approved Person will be engaged in the process of RLAN deployment.

[17] https://api.cept.org/documents/se-45/78519/se45-23-info006_info-document-on-rlan-vs-fs-field-measurements

Conclusion

- The upper frequency band in the 6 GHz range (i.e., 6425-7125 MHz) represents a unique opportunity to address the evolution of 5G in Australia, enabling efficient spectrum use and providing high-quality services to consumers and industries through the certainty of deterministic spectrum.
- Considering that the recent WRC-23 identified the 6425-7125 MHz band for IMT in all regions of the world, with a large potential for economies of scale (covering around 60% of the world's population), we recommend the ACMA consider identifying the 6425-7125 MHz band for IMT (5G), and thus achieve the mid-band spectrum needs detailed in this submission.
- To meet strong forecast demand, mobile network operators in Australia will require this spectrum for increasing subscriptions, increasing data usage per user and 5G Advanced use cases in the second half of this decade (2025 -2030).