Boeing Australia Holdings

RESPONSE TO THE ACMA DRAFT FIVE-YEAR SPECTRUM OUTLOOK 2024-2029

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Response to the Australian Communications and Media Authority's Draft Five-Year Spectrum Outlook 2024-2029

Boeing Australia Holdings appreciates the opportunity to respond to the Australian Communication and Media Authority's (ACMA) draft Five Year Spectrum Outlook 2024-2029 consultation paper (draft FYSO).

Our response focuses on key radiofrequency bands of interest to the Boeing Company's Australian, Asia-Pacific and global operations.

About Boeing Australia Holdings

Boeing has the broadest portfolio in Australian aerospace, with over 4800 employees and an extensive supply chain supporting our advanced manufacturing of commercial aircraft composite components, defence systems design and development, modeling and simulation, research and development, support and training, and uncrewed systems.

Boeing Australia subsidiaries include:

- Boeing Defence Australia is Australia's leading defence aerospace enterprise, supporting some of the largest and most complex programs for the Commonwealth of Australia, the Australian Defence Force – including the Royal Australian Air Force, Australian Army and Royal Australian Navy - and commercial customers.
- Boeing Aerostructures is Australia's only manufacturer of high-end aero-structure components, providing customers with a complete solution to aircraft component manufacture – from developing the most aerodynamic and efficient design, to rigorous testing processes.
- Boeing Distribution Australia is a leading solutions provider of aftermarket supply-chain management services for the aerospace, defence and marine industries, serving more than 500 customers in Australia.
- Insitu Pacific specialises in the design, development, and manufacture of high-performance and low-cost unmanned aerial systems for commercial and military applications.
- Wisk Aero, a leading advanced air mobility company and developer of the first all-electric, self-flying air taxi bringing the future of flight to Australia.

Our spectrum interests are many including aeronautical, unmanned systems, defence, space, fixed and mobile satellite services, radiolocation, maritime, 5G, IoT and machine-to-machine applications.

We offer the following comments of direct interest to Boeing Australia based on radiofrequency bands discussed in the draft FYSO.

1.5 GHz (1 427-1 518 MHz) - Preliminary replanning

Current and future use

This high demand frequency band is globally allocated on a primary basis to fixed and mobile services with parts of the band allocated to space operations (Earth-to-space), broadcasting and broadcasting-satellite services.

IMT/5G identifications for the mobile service have been introduced across the frequency ranges 1 427-1 452 MHz and 1 492-1 518 MHz in Regions 1 (RR footnote **5.341A** and **5.341C** respectively) and in the entire frequency range 1 427-1 518 MHz in Region 2 (RR footnote No. **5.341B**). The IMT/5G arrangements via the footnotes does 'not establish priority in the Radio Regulations' over other allocated services in the frequency bands.

Protection of the mobile-satellite service (MSS) in the adjacent frequency band

The adjacent 1 518-1 559 MHz frequency range is heavily utilised globally by a wide variety of satellite services (with the accompanying 1 626.5-1 660.5 MHz Earth to space link).

This section of L band includes some of the lowest radio frequencies available for satellite services.[1] The frequency range is highly suited for satellite communications, in part due to a longer wavelength, thereby less affected by atmospheric attenuation in comparison to higher frequencies. L band supports exceptionally high link availability, stable operations in the harshest of weather conditions, and facilitates increasingly higher speed broadband communications to users anywhere around the world.

At WRC-19 a revision of Resolution **223** '*Additional frequency bands identified for International Mobile Telecommunications*' instructed the ITU-R to conduct compatibility studies to develop technical measures to ensure coexistence between MSS in the frequency band 1 518-1 525 MHz and IMT in the frequency band 1 492–1 518 MHz.
Consequently ITU-R in 2023 approved Recommendation M.2159 on *Technical and regulatory measures to provide compatibility between IMT and MSS, with respect to MSS operations in the frequency band 1 518-1 525 MHz for administrations wishing to implement IMT in the frequency band 1 492–1 518 MHz.*

ACMA has used these supporting studies to progress the review of arrangements for MSS in the extended MSS L band first. ACMA notes 'the review of arrangements for terrestrial (non-satellite) services in the broader 1 427–1 535 MHz frequency range would be progressed separately and was proposed for consideration in the 2024–25 financial year.'

Aeronautical use of the frequency band

The 1 429-1 518 MHz frequency band is used nationally and in other countries increasingly for flight testing and aircraft control and non-payload communications (CNPC). The Australian Radiofrequency Spectrum Plan 2021 (ARSP) footnote AUS3 identifies use of the frequency band 'by the aeronautical mobile service for telemetry has priority over other uses by the mobile service.'

[1] L band generally considered to be radio frequencies from 1-2 GHz.

Boeing Australia is committed to development of aircraft communications in the frequency band.
Any future determinations in this frequency band should, as a priority, retain and protect the identification for flight testing as indicated in the ARSP footnote AUS3.

The Department of Defence noted in their submission to the 2023 FYSO;

> 'There is a growing demand for AMS access in this band directly by Defence as well as for defence industry for testing systems with larger spectrum bandwidth requirements … Defence is still concerned about potential implications on the AMS from future LTE and MSS systems if these services are going to be considered under the future scope.'

For 1.5 GHz (1 427-1 518 MHz) preliminary replanning Boeing Australia proposes:

- Under any future planning decisions, the need to retain the priority status of aeronautical mobile service for telemetry over other uses by the mobile service in accordance with ARSP footnote AUS3.
- Explore the options to accommodate UAS CNPC and general payload communications in the frequency band.
- Support a discussion paper to further this issue while recogniing the points noted above.

3.3 GHz (3 300-3 400 MHz) - Monitoring

In the RR Article **5** Table of Frequency Allocations the 3.3 GHz frequency band is globally allocated to radiolocation services (RLS) on a primary basis.
While there are IMT identifications afforded to some countries via footnotes to the Table of Frequency Allocations, these applications specifically cannot claim protection from, or cause interference to, RLS allocated in the frequency band, a condition of the footnote identification.
The mobile service is co-primary with RLS in Region 2 but not listed in Region 1 or 3 as a primary or secondary service, excluding any country footnote identifications for IMT.
The 2023 ITU World Radiocommunication Conference identified the frequency band for IMT in Region 2.

In Australia ARSP footnote AUS101A applies and stipulates the primary RLS is 'designated to be used principally for the purposes of defence and national security and the Department of Defence is normally consulted in considering non-defence use of this service,' and as also noted by ACMA in the draft FYSO. The other allocated services, amateur, fixed and mobile are all secondary to RLS.

The potential expansion of IMT/5G into in this frequency band poses significant interference potential to Defence global radar operations. In the Defence Department's submission to the 2023 FYSO it noted

> 'this reallocation will impact a growing number of Defence radar capabilities including non-itinerant systems … It is also of vital interest to take into account Australia's long term investment into developing globally unique Defence assets before repurposing the 3 300-3 400 MHz frequency band.'

Boeing Defence Australia is committed to providing equipment and services for the Department of Defence for radiolocation operations in this frequency band.

For Australia there is no solid case to identify IMT in this frequency range for the foreseeable future. Especially while 3.4-4.0 GHz is currently under implementation in Australia for IMT/5G/WBB in 5G mid-band spectrum (1-6 GHz) and parts of the spectrum having been auctioned last year.

Boeing Australia proposes:

- Retain the current ACMA position 'monitor' for this frequency band.
- As this is a priority Defence frequency band ensure DoD is consulted on all future considerations.

3.4-4 GHz band – Implementation

While the frequency band is in advanced reallocation for the introduction or extension of WBB/5G services, Boeing Australia reiterates the importance of mitigation measures to protect the safe operation of aircraft radio altimeters in the nearby frequency range of 4 200-4 400 MHz from 5G macro base station transmissions.

Radio altimeters are essential components of an aircraft for safe operation. The radio altimeter is the only sensor onboard an aircraft providing a direct measurement of aircraft clearance over terrain and other obstacles. A radio altimeter is used during all phases of flight, but significantly during precision approaches to landing, determining aircraft proximity to the ground, and collision avoidance systems. A failure in this sensor can lead to catastrophic results.

Studies conducted internationally have analysed the impact of 5G systems in the frequency range 3 400-4 200 MHz. The studies have led to the USA, France, Canada, India the UK and Japan introducing various mitigation measures to protect radio altimeters from interference from 5G transmissions. Each country has different 5G rollouts and consequently different mitigation measures to protect radio altimeters, i.e. one size does not fit all. For Australia the C Band 5G allocated frequency ranges and power levels are susceptible to cause interference to the operation of group 2 and 3 radio altimeters (predominately used on civil aviation aircraft in Australia).

Our concerns have been previously documented in various submissions to the ACMA through the replanning process of these frequency bands including our 'Response to the ACMA's Proposed spectrum re-allocation declaration for the 3.4 GHz and 3.7 GHz bands - consultation paper.'[2] Boeing Australia commends the ACMA in adopting temporary and permanent mitigation measures across the frequency range 3 700-4 200 MHz.
Nonetheless, we remain concerned about the ongoing protection required from 5G base station operations in 3 400-3 700 MHz. Studies show 5G base station interference to radio altimeters only marginally reduces at frequencies further from the radio altimeter range of 4 200-4 400 MHz.
Australia currently has 5G base stations increasingly operative in the 3 400-3 700 MHz frequency range. Many countries have mitigation measures in place in this frequency range. The ECC are now conducting studies to determine the extent of the interference to radio altimeters from 5G macro base station transmissions.[3]

[2] ACMA consultation Draft allocation and technical instruments for the 3.4/3.7 GHz bands auction
[3] https://eccwp.cept.org/WI_Detail.aspx?wiid=775

Meanwhile, the aviation industry is actively addressing the problem by developing new technical standards for radio altimeter equipment designed to reject spurious and unwanted emissions from 5G transmissions. This is a process that will take time as technical standards are still under development and equipment is then to be manufactured and eventually installed in aircraft.

In the near term the risk of harmful interference from new 5G/WBB/IMT to radio altimeters is not the responsibility solely of the aviation industry. To avoid unacceptable outcomes from an incident where radio altimeters are negatively affected by 5G transmissions, the mobile service industry and spectrum regulators need to cooperate with the aviation industry to support and monitor appropriate interim mitigation measures to prevent interference to aircraft radio altimeters operating in the frequency band 4 200-4 400 MHz.

Boeing Australia proposes:

- ACMA should expand the current mitigation measures proposed for 3 700-4 000 MHz to 5G commercial services in the frequency range 3 400-3 700 MHz consistent with what has happened in other jurisdictions.

- The regulator and telecommunication companies should work cooperatively with the aviation industry on this mutual problem to establish and monitor agreeable and appropriate temporary mitigation measures to protect safe air travel in Australia from potential interference to critical aircraft radio altimeter operations from new and expanding 5G services.

4.0 GHz (4 400–4 990 MHz) - Monitoring

The frequency band is allocated globally on a co-primary basis to the fixed and mobile services also with a primary allocation to fixed-satellite services in the frequency range 4 500-4 800 MHz.

For the frequency range 4 400-4 800 MHz in Australia, ARSP footnote AUS101 states it is 'principally for the purposes of defence and national security.' Also, RR footnote No. **5.440A** identifies the entire frequency band in Region 2 and Australia for aeronautical mobile telemetry for flight testing by aircraft stations and RR No. **5.442** identifies in Australia, the frequency band 4 825–4 835 MHz is also allocated to the aeronautical mobile service, limited to aeronautical mobile telemetry for flight testing by aircraft stations. It is essential to commercial and defence aviation that any future planning preserves the integrity and intent of the footnotes.
Furthermore, in the domestic preparations for WRC-19, in reviewing existing Radio Regulations Table of Frequency Allocations footnotes that include Australia's name, it was noted for footnote Nos. **5.440A** and **5.442**, that the frequency bands are 'used by fixed and mobile stations operated by the Department of Defence, including for aeronautical mobile telemetry for flight testing by aircraft stations. Hence, this footnote(s) should be retained.' At WRC-23 the intention similarly was 'retain Australia's name where included in footnotes at previous conferences.'

ACMA has noted in the draft FYSO 'there is some interest domestically from mobile network operators as well as from wireless internet service providers and other fixed wireless access operators in pursuing this band for WBB in Australia.' Boeing Australia agrees with the ACMA further observation that there is no widespread support for use of the frequency band for 5G/WBB applications from regional communication bodies such as CEPT, CITEL and APT.

Boeing Australia opposes a move to accommodate 5G/IMT/WBB in this frequency band given its proximity to the aviation radio altimeter safety of life allocation at 4 200-4 400 MHz. This mirrors the same problem described above for the 3 400-4 200 MHz frequency range.

Radio altimeters are an essential component of a commercial and military aircraft enabling precision approach, landing, ground proximity and collision avoidance functions to work properly. Studies have identified potentially serious inference into radio altimeter systems from the operation of 5G macro base stations near the frequency band. Until this matter is resolved, it is in the critical interest of public safety this frequency band not be considered for identification of IMT/5G/6G.

In previous FYSO's the Department of Defence noted in relation to frequency bands 4 400-4 500 MHz and 4 800-4 990 MHz Defence platforms could be directly affected due to possible radio frequency interference by the IMT in these frequency bands. The frequency ranges are part of the harmonised Five Eyes and NATO spectrum used extensively by defence. Such use is not compatible with 5G/IMT applications in the same frequency range.

Boeing Australia and subsidiaries have defence contracts in place and are reliant on this frequency band remaining 'principally for the purpose of Defence.'

Boeing Australia is opposed to the introduction of 5G/IMT/WBB in Australia in this frequency range through the course of this five-year outlook and proposes:

- Retention of the planning status of 'monitoring' for this frequency band recognising the importance of protection of safety of life aeronautical radio altimeters in the adjacent 4 200-4 400 MHz frequency band.
- ACMA ensure the spectrum regulatory protection of the current arrangements in the frequency band in the interest of defence and national security use.
- Ensuring the retention of RR footnotes No. **5.440A** and **5.442**, and
- the need to retain access to part of the frequency range allocated via footnotes to the RR Table of Frequency Allocations to aeronautical mobile telemetry for flight testing by aircraft stations.

Noting part of the frequency range is a consideration of WRC-27 agenda item 1.7 discussed below.

5 030–5 091 MHz RPAS - Initial investigation

At WRC-12, the 5 030–5 091 MHz frequency band was identified in the Radio Regulations for use by line-of-sight (LoS) and beyond line-of-sight (BLoS) remotely piloted aircraft systems (RPAS) control and non-payload communication (CNPC) links. It is only recently that spectrum regulators, notably ACMA have moved to free up access to this frequency band to accommodate RPAS communications.

RPAS operating in non-controlled airspace predominately use low interference potential device (LIPD) class licence for both CNPC and payload communications.
While LIPD access is useful for smaller RPAS and hobbyists' drones, the inherent low power constraints and congestion of the LIPD radio frequencies are a disadvantage to medium to large RPAS running business and security operations at times in environments that require reliable safety-critical control links. These constraints have been acknowledged by ACMA in a positive response where arrangements were

put in place to facilitate temporary access to part of the frequency band (i.e. 5 055–5 065 MHz) for LoS RPAS CNPC links. ACMA states these interim arrangements will be in place until international arrangements are sufficiently mature including progress of a draft new ITU-R Recommendation that specifies terrestrial air-ground links characteristics operating in the aeronautical mobile radiocommunication service in the band.[4] ACMA then proposes to release an 'options paper outlining proposals for more permanent arrangements.' This assumes widening access to the entire frequency range.

The frequency band needs to be protected for future requirements for UAS and in the event that demand exceeds the current 10 MHz access ACMA should move expeditiously to free up more of the frequency band.

Boeing Australia acknowledges and agrees that ACMA is only responsible for the spectrum aspects of RPAS regulation in Australia whereas air safety and operational regulatory provisions are the mandate of the Civil Aviation and Safety Authority and Airservices Australia, and any arrangements in the frequency band are to be developed in consultation with those agencies and ICAO standards and practices.

It is important to note the frequency band 5 030-5 091 MHz only provides a small amount of internationally harmonised spectrum for RPAS CNPC. There is a pressing need for much more spectrum to be available, for both CNPC and payload applications for medium to large RPAS, this is discussed under 'Drone spectrum regulation' below.

While it is recognised no current satellite access is available for payload operations in 5 030-5 091 MHz to support the aeronautical mobile-satellite (R) service, given the rapid developments across the satellite industry especially non-GSO constellations it is possible a viable service could become available especially if supported by access to the frequency band for RPAS. For Australia's vast airspace this is perhaps the best option for countrywide and intercontinental UAS operations. Rather than seeing regulation follow technological advancements Boeing Australia encourages ACMA to take a lead in developing regulations that can be applied for future BLoS radiocommunications for UAS especially in this globally allocated frequency band.

Boeing Australia commends the ACMA for introducing arrangements for interim access to the frequency band for RPAS CNPC.

Boeing Australia proposes the ACMA:

- Support ITU-R efforts to develop international radiocommunication regulations for both terrestrial and satellite RPAS communications in this and other frequency ranges at ITU-R Study Group fora, and

- consider and facilitate access as soon as possible to the entire 5 030-5 091 MHz frequency range dependent on developing user demand.

[4] Preliminary draft new Recommendation ITU-R M.[CNPC_CHAR_5GHz] - *Characteristics and protection criteria of terrestrial and satellite unmanned aircraft system control and non-payload communications links operating in the aeronautical mobile (route) service and aeronautical mobile satellite (R) service in the band 5 030-5 091 MHz*

13 GHz (12.75–13.25 GHz) - Monitoring

The frequency band is allocated on primary basis to the fixed service, fixed-satellite service (Earth-to-space) and mobile service, and on a secondary basis to the space research (deep space) (space-to-Earth) service in all three ITU Regions.

At the 2023 ITU World Radiocommunication Conference (WRC-23) the frequency band was approved for use of earth stations in motion (ESIM) on aircraft and vessels with the GSO FSS subject to strict regulatory conditions as stipulated in Resolution **121 (WRC-23)**[5].

ESIM support in-flight broadband connectivity and in part addresses the growing demand for Internet-based applications on aircraft and vessels

As these applications are intended to operate globally, including across Australia, harmonised spectrum for ESIM facilitate the service on aircraft registered outside of Australia entering our air space.
ESIM Internet high-speed broadband connectivity to aircraft directly benefits aviation industry operations and passengers flying domestically across the vast land mass of Australia.

A provisional agenda item has been developed for WRC-31 to study ESIM usage in the frequency band communicating with non-geostationary satellites in the FSS.

Boeing Australia supports:

- Australia's engagement in any preliminary studies in ITU-R Study Group 4 in support of provisional agenda item WRC-31 2.3, and
- retaining planning status as 'monitoring.'

40 GHz (37–43.5 GHz) - Monitoring

The Radio Regulations have a range of primary services in different sections of this frequency range including space research, fixed, mobile, mobile satellite and fixed-satellite services.
In Australia, 37-37.5 GHz is designated to be used principally for defence and national security, as provisioned in ARSP footnote AUS101A.[6]

The frequency band 37-43.5 GHz is identified globally for IMT/5G via RR footnote No. **5.550B**.
The footnote indicates various FSS allocations that need to be protected from IMT transmissions.
With 5G/IMT/WBB mmWave spectrum available in Australia in the frequency ranges 25.1-27.5 GHz and 27-29.5 GHz, there is no pressing need to consider 40 GHz for more IMT mmWave spectrum.
It remains questionable how useful mmWave 5G spectrum is considering the Republic of Korea Ministry of

[5] Resolution **121 (WRC-23)** *Use of the frequency band 12.75-13.25 GHz by earth stations in motion on aircraft and vessels communicating with geostationary space stations in the fixed-satellite service*

[6] ARSP footnote AUS101A – 'The Department of Defence is normally consulted in considering non-defence use of this service'

Science and IT revoked mmWave licences in their country as operators did not utilise their access to the frequency bands.[7]

The Australian Mobile Telecommunications Association in their 2023 FYSO submission said 'the 40 GHz band, is not a short-term priority for industry.'

The frequency band accommodates the high-density fixed satellite service (HDFSS), for very high data throughput on satellite systems that supports backhaul capabilities for broadband connectivity for aircraft and vessels. The FSS gateway stations also utilise these frequency bands for feeder links.

FSS operators have previously sought more planning certainty from the regulator and ACMA responded with an 'interim licensing process or licence applications for gateway satellite earth stations in these bands' (40 GHz, 46 GHz and 47 GHz). ACMA also notes they will undertake 'a comprehensive review of the bands to determine long-term arrangements.'

Boeing Australia proposes the ACMA:

- Consider progressing the planning stage to 'initial investigation' in light of satellite applications being developed and currently deployed and the ACMA intention to undertake 'a comprehensive review' thereby providing additional planning certainty for primary allocated services.

46 GHz (45.5–47 GHz) - Monitoring

The 46 GHz frequency band has primary allocations in the Radio Regulations for mobile, mobile-satellite, radionavigation and radionavigation-satellite services in Australia.
However, as the ACMA notes, apart from some radio astronomy observations, 'in Australia, there are currently no formal arrangements for any services in the band.'
ARSP footnote AUS62, indicates that parts of the band might be used in the future for defence.

With 5G/IMT/WBB mmWave spectrum available in Australia in the frequency ranges 25.1-27.5 GHz and 27-29.5 GHz, there is no pressing need to consider 46 GHz for more 5G/IMT mmWave spectrum.
The Australian Mobile Telecommunications Association in their 2023 FYSO submission said 'mmWave spectrum, such as the 40 GHz band, is not a short-term priority for industry.'

FSS operators have previously sought more planning certainty from the regulator and ACMA responded with an 'interim licensing process or licence applications for gateway satellite earth stations in these bands' (40 GHz, 46 GHz and 47 GHz). ACMA also notes they will undertake 'a comprehensive review of the bands to determine long-term arrangements.'

Boeing Australia proposes the ACMA:

- Consider progressing the planning stage to 'initial investigation' in light of satellite applications being developed and the ACMA intention to undertake 'a comprehensive review' thereby providing additional planning certainty for future services. Considering there are currently no compatibility issues with other services there is great potential to maximize the utility of this spectrum.

[7] Korean govt falls for 5G fallacy over 28GHz | Light Reading

47 GHz (47.2–48.2 GHz) - Monitoring

This frequency band has primary allocations for fixed, mobile and fixed-satellite services in Australia, although according to the ACMA there are currently no formal arrangements for any services in the frequency band in Australia.

These higher frequency bands (Q/V band) represent greenfield opportunities for new satellite technologies including next generation high and very high throughput satellites, and ubiquitous broadband. Most major satellite operators have systems under development and some operational satellites have a Q/V band capability built in.

With 5G/IMT/WBB mmWave spectrum available in Australia in the frequency ranges 25.1-27.5 GHz and 27-29.5 GHz, there is no pressing need to consider 47 GHz for more 5G mmWave spectrum.
The Australian Mobile Telecommunications Association in their 2023 FYSO submission said 'mmWave spectrum, such as the 40 GHz band, is not a short-term priority for industry.'

Sections of the frequency band, i.e. 47.2-50.2 GHz and 50.4-51.4 GHz (Earth-to-space), are the subject of WRC-27 agenda item 1.1 to harmonise the band for earth stations in motion (ESIM) on aircraft and vessels with the GSO and non-GSO space stations of the FSS.

Boeing Australia proposes the ACMA:

- Consider progressing the planning stage to 'initial investigation' in light of satellite applications being developed and the ACMA intention to undertake 'a comprehensive review' thereby providing additional planning certainty for future services. Considering there are currently no compatibility issues with other services there is great potential to maximize the utility of this spectrum.

- Support the WRC-27 agenda item 1.1 to harmonise the parts of the frequency band for ESIM on aircraft and vessels with GSO and non-GSO space stations of the FSS, and

- support the existing allocation of primary services specifically retaining and protecting the utility of the FSS primary allocation in the frequency band.

Bands being studied under WRC-27 agenda items 1.7

WRC-27 agenda item 1.7 will undertake sharing and compatibility studies and develop technical conditions for the possible use of IMT in the frequency bands 4 400-4 800 MHz, 7 125–8 400 MHz (or parts thereof), and 14.8–15.35 GHz.[8]
These frequency bands, either in part or in full, are used for defence purposes in Australia.

The 4 400-4 800 MHz frequency band

This frequency band is immediately adjacent to the primary safety of life aeronautical radionavigation service (ARNS) frequency band of 4 200-4 400 MHz reserved exclusively for radio altimeters installed onboard aircraft. The radio altimeter is a mandatory safety-critical aircraft system.
This frequency range was studied for IMT compatibility at WRC-15 under agenda item 1.1.
The overwhelming consensus was services allocated in the frequency band were not compatible with ubiquitous IMT deployment. This is particularly relevant to IMT/ FSS compatibility. Studies on compatibility of radio altimeters in the frequency range 4 200-4 400 MHz with IMT were not conducted for WRC-15.
The issue of radio altimeter incompatibility arose after WRC-15 when 3GPP specifications of the n78 frequency range (3 300-4 200 MHz) were approved and released in 2018. After the standards were released aviation industry quickly undertook studies showing serious incompatibility of 5G base stations transmissions with radio altimeters.[9]

Below the ARNS frequency band Australia has introduced permanent and temporary mitigation measures to prevent operation of ubiquitous 5G services interfering with the safe operation of aircraft radio altimeters across the frequency range 3 700-4 200 MHz.
The same problem applies above the ARNS frequency band and this proposal includes no buffer zone (guard band) similar to that in the Australian provisions for 3 700-4 200 MHz.

In domestic preparatory work for WRC-23 the Australian Mobile Telecommunications Association stated regarding this frequency band … 'we're not suggesting that Australia should support this band.'

Defence in their 2023 FYSO submission noted the frequency band is '

> part of harmonised Five Eyes and NATO spectrum used by aeronautical mobile services (AMS), fixed line-of-sight and non-line-of-sight for data, command, control and telemetry as well as for Navy fleet wide communications including mesh networks all of which are currently used by Defence in Australian territory today through either legacy systems or newly acquired systems across major Defence capability projects. AMS use also extends to command and control of weaponised systems. Due to the very complex spectrum environment including weaponised systems, either sharing or replacement of equipment will simply not be possible. It is worth noting that these bands are the few remaining frequency segments below 6 GHz available to Defence and it is vital to preserve these bands for defence purposes.'

[8] Most of the agenda item bands are Region specific - 4 400-4 800 MH, in Region 1 and Region 3; 7 125-8 400 MHz in Region 2 and Region 3; 7 125-7 250 MHz and 7 750-8 400 MHz in Region 1; and 14.8-15.35 GHz globally.

[9] See RTCA paper *Assessment of C-Band Mobile Telecommunications Interference Impact on Low Range Radar Altimeter Operations*, and Airline Pilots Association, Int'l Aircraft Operations and Radar Altimeter Interference from 5G

The 7 125-8 400 MHz and 14.8-15.35 GHz frequency bands

This is a core Defence satellite communications band with worldwide operational footprint and significant harmonisation interests making it entirely unsuitable for IMT identification.

Defence Spectrum Office at WRC-23 noted opposition to these bands being studied as it 'directly affects three core Defence bands and Region 3 has the worst outcome of any region wrt Defence interests.'

Background to the WRC-27 agenda item

This agenda item was decreed through closed discussions at the dying stages of WRC-23. The potential negative consequence for aviation and defence from outcomes that may identify IMT/5G/6G in these frequency ranges is considerable.

The WRC-23 preparatory and participatory process for, and at, the conference was seriously deficient in that Australia was ineffectual or not involved in discussion and the APT representing Region 3 had no position or voice in discussions that produced this agenda item.
In the past, Australia has often been a significant influencer in international radiocommunication fora and needs to regain that reputation. As Region representation is paramount to deciding intractable matters at WRCs, Australia needs to invest considerable effort and expertise into managing the APT preparatory process to bolster outcomes at the coming WRC and influence agenda items for future conferences.

An Australian position on WRC-23 agenda item 1.7

While ACMA proposes the way forward in this draft FYSO to 'continue to engage with stakeholders via the usual international preparatory process to develop Australian positions on WRC-27 agenda item 1.7,' Boeing Australia cautions that this is not sufficient.

The frequency bands are wholly unsuited for IMT in Australia and this should be established as the Australian position now as discussions in a preparatory process will be lengthy and time consuming while inevitably concluding the same outcome. ACMA often advocates that IMT identifications are summarily the decision of individual countries, especially so where Australia has no clear issue with neighbouring country radiocommunications in these frequency bands.

It would be beneficial to all Australian stakeholders to identify the position that IMT is not suitable in these frequency ranges and efforts accordingly can go into any ITU-R studies to this effect. This will provide planning certainty for stakeholders and direct efforts to investigate spectrum planning options in other radio frequency bands more suited to viable outcomes.

Boeing Australia proposes:

- The ACMA and Australia position this issue as 'no IMT identifications' in any of the frequency bands in Australia, and
- engage in ITU studies to protect the use of the frequency bands used for Defence purposes and aeronautical safety of operation in Australia.

Drone spectrum regulation

For consistency in this section we reference generically 'UAS' (unmanned aircraft systems) of medium to larger size aircraft for commercial, government and defence use.

The UAS industry is expanding rapidly worldwide, with Australia often at the forefront.
While aviation standards and technology developments that accompany UAS operations are the responsibility of other regulators, intergovernmental agencies and industry bodies, access to, and regulation of, spectrum in Australia is the responsibility of the ACMA.

As noted by the ACMA, UAS or 'drone spectrum' is well established for personal hobbyist use by individuals using unlicensed spectrum (LIPD class licence in Australia and ISM bands) to operate small aircraft over short distances.

Boeing Australia welcomes creative and world leading initiatives by the ACMA in spectrum access for the medium/large commercial and defence UAS industries. Notably arrangements for temporary access to a portion of the 5 030-5 091 MHz frequency band is a significant step forward. Nonetheless, aviation requires more formally identified spectrum for medium to large UAS operations than available across LIPD class license and the 030-5 091 MHz ARNS allocation.

ACMA notes ….

> 'we expect drones to transfer more and more to mobile (including 5G) networks over time, larger drones used for commercial or military purposes are increasingly requiring access to dedicated aeronautical spectrum.'

Boeing Australia agrees and welcomes access to 5G infrastructure that can facilitate multiple payload communications, however the safety of life CNPC aspects will not be adequately supported by access to the public mobile telecommunications system. Constraints include the more demanding medium/larger UAS requirements for flight coverage that may travel beyond mobile network range and issues of high reliability QoS for CNPC requirements. CNPC requires dedicated spectrum.

Existing aeronautical allocations in the Radio Regulations (notably 960-1 164 MHz) have been ruled out as the frequency bands are already heavily encumbered for critical aeronautical navigation purposes.
The quantum of spectrum required for future UAS operations is currently undefined and industry and government are encouraged to continue to work together in determine near and long-term requirements.

Boeing Australia supports ACMA collaboration with CASA, the Department of Infrastructure, Transport Regional Development, Communications and the Arts, and the Emerging Aviation Technologies sector to further refine future Australian UAS spectrum requirements, avenues for government support and necessary regulations. Noting that 'the Australian Government is working … to help the drone and Advanced Air Mobility (AAM) sector develop a more coordinated perspective of their future spectrum needs. This will inform the spectrum policy and regulatory frameworks in the future.'

Activities planned for 2024–25

ACMA notes ongoing collaboration with 'the Department on drone management and contribute to relevant government initiatives', including 'monitoring the current and future implications of spectrum and licensing requirements for drones alongside international developments in spectrum management'.

These sentiments do not align with a more proactive Australian Government drone spectrum policy and does not build on the positive approach to drone spectrum management from two years ago.[10]
Advanced Air Mobility and RPAS innovation is strongly supported by industry and government in Australia and ACMA must continue to look for new opportunities to free up spectrum access for medium to large UAS CNPC communications noting recent developments in CASA and industry group AAUS.[11]

Going forward

The ITU-R have been developing regulatory conditions for use of fixed-satellite service networks for CNPC and payload communications of UAS over a long period of time.
Global CNPC use in FSS allocations most recently was a consideration of the ITU's World Radiocommunication Conference (WRC-23) last year in Dubai.[12]
Unfortunately, this work did not progress at the conference.
Boeing Australia is of the view that formally mandated ITU-R regulatory conditions are not essential in this instance for the use of FSS allocations for RPAS communications in Australia.

Nonetheless, the fundamental ITU-R technical work has largely been settled relevant aspects of the studies are valuable and mature and can be the basis to expand spectrum access for UAS in non-segregated airspace. In Australia (under Region 3 identification) this includes 12.2-12.5 GHz, 12.5-12.75 GHz, 14-14.7 GHz and 29.5-30 GHz frequency bands. Supplementing this work with coordination between likeminded countries supported by ICAO standards and practices is a viable way forward.

Boeing Australia encourages the ACMA to use the ITU-R technical work as a basis for developing appropriate regulatory conditions to facilitate FSS spectrum for this use. This is conditional on no constraints to the FSS and procedures in place for safe operation of UAS, the remit of other regulatory agencies, such as the Civil Aviation and Safety Authority and Airservices Australia and ICAO standards and practices.

The ACMA through technical and regulatory spectrum determinations can support flexibility, capacity and reliability considering the wide range of opportunities and uses that are emerging in this dynamic market. Continued and deeper engagement on these issues is particularly important and encouraged.

Boeing Australia proposes the ACMA:

- Explore with a view to support and instigate the use of FSS allocations (based on work in ITU-R) for CNPC and payload access to spectrum for medium to large RPAS in cohort with ICAO standards and practices.

- Continue to support trial licences to enable UAS access to viable frequencies outside of the LIPD/ISM bands.

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[10] https://www.drones.gov.au/policies-and-programs/policies/spectrum-policy

[11] For examples see a) CASA *The RPAS and AAM Strategic Regulatory Roadmap* and b) AAUS Release Vision Roadmap for AAM

[12] WRC-23 agenda item 1.8 'to consider, on the basis of ITU R studies in accordance with Resolution **171 (WRC-19)**, appropriate regulatory actions, with a view to reviewing and, if necessary, revising Resolution **155 (Rev.WRC-19)** and No. **5.484B** to accommodate the use of fixed-satellite service (FSS) networks by control and non-payload communications of unmanned aircraft systems'

- Continue to support government and industry consultation and cooperation on frequency bands that may accommodate medium/large UAS communications for both CNPC and general payload and other options suited to explore alternative radio frequency access.

Boeing Australia appreciates the opportunity to respond to the ACMA's forward spectrum planning in this submission.

Respectfully submitted

[redacted]

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[redacted]

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6 May 2024

List of abbreviations/glossary

Abbreviation	Definition
5G	Fifth generation mobile phone service
6G	Sixth generation mobile phone service (still in development)
AAM	Advanced Air Mobility
ACMA	Australian Communications and Media Authority (spectrum regulator)
APT	Asia-Pacific Telecommunity
ARNS	Aeronautical radionavigation service
ARSP	Australian Radiofrequency Spectrum Plan
AWG	Asia-Pacific Telecommunity Wireless Group
BLoS	beyond line-of-sight
CEPT	Conference of Postal and Telecommunications Administrations (Europe)
CITEL	Inter-American Telecommunication Commission
CNPC	control and non-payload communication
ESIM	earth stations in motion
FCC	Federal Communications Commission (USA)
FSS	fixed-satellite service
FWA	fixed wireless access
GHz	Gigahertz
GSO	geosynchronous orbit (of a satellite postioned above Earth)
ICAO	International Civil Aviation Organization
IMT	International mobile telecommunications
IoT	Internet of Things
ISM	Industrail scientific and medical
ITU	International Telecommunication Union
ITU-R	International Telecommunicatiuon Union - Radiocommunication Sector
LIPD	Low interfernce potential devices
LoS	line-of-sight
M2M	machine to machine
MHz	Megahertz
mmWave	Millimetre wave (spectrum roughly from 20-300 GHz)
MNO	Mobile network operator (e.g. Tesltra/Vodafone/Optus)
MS	mobile service
MSS	mobile-satellite service
NATO	North Atlantic Treaty Organization
NGSO	Non-geostationary satellite orbit (does not maintain a stationary position)
PFD	Power flux density
QoS	Quality of service
RLAN	Radio Local Area Network
RLS	Radiolocation service
RPAS	remotely piloted aircaft systems
RR	Radio Regulations
UAS	unmanned aircraft systems
WBB	wireless broadband
WRC	World Radiocommunication Conference


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