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Response to the ACMA’s Apparatus licences in the 3.4-4.0 GHz band in remote Australia - consultation

Boeing Australia Holdings (Boeing Australia) appreciates the opportunity to respond to the ACMA’s ‘Apparatus licences in the 3.4-4.0 GHz band in remote Australia Licensing, allocation process, technical framework and pricing arrangements’ – consultation paper.

Our submission focuses only on the ‘technical framework’ of the consultation package and specifically in relation to 5G wireless broadband (WBB) coexistence issues with radio altimeters allocated and operating in the frequency range 4.2-4.4 GHz.

Boeing Australia’s other substantive interest in the general reallocation of 3.4-4.0 GHz is the ongoing viability of the fixed-satellite service across the frequency band.
In this consultation specific to the new apparatus licences for 3.4-4.0 GHz in remote Australia, FSS is not a part of the consultation. Boeing Australia notes the proposed framework for apparatus licensed FSS earth stations in remote areas in the frequency band remains the same, except for the inclusion of previously agreed elements in a new draft Radiocommunications Assignment and Licensing Instruction (RALI) MS 47. These elements are simply an extension of the existing 3.4 GHz spectrum licensing technical framework coordination requirements of WBB with FSS applied to the realigned frequency ranges. Additionally in remote areas in the 3.7–3.8 GHz frequency range, introduced local area WBB services are on a shared basis with existing FSS and new apparatus licensed FSS will be issued on a coordinated, shared basis with local area WBB licences.

The main focus of the consultation is on provisioning area-wide apparatus licences (AWL) in remote parts of Australia in the frequency range 3.4-4.0 GHz to accommodate the introduction of 5G/ WBB, ACMA has invited comments on the following:

1. Do you have any comments, and supporting additional information, on the proposed technical framework, including the revised AWL LCD, draft RALI MS 47, and updated RALI FX3 and FX19?

2. Do you have any comments on the other issues referred to in the technical framework that have not been resolved in the TLG, such as WBB coexistence with radio altimeters?

Background to radio altimeter interference issues with 5G/WBB in mid-band spectrum

Radio altimeters are essential components in an aircraft for safe operation.
The radio altimeter is the only sensor on-board an aircraft providing a direct measurement of aircraft clearance over the terrain and other obstacles. A radio altimeter is used during all phases of a 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 for the crew on board, passengers, and people on the ground.

Studies conducted internationally have analysed the impact of 5G systems in the frequency range 3.4-4.2 GHz. In the United States the Radio Technical Commission for Aeronautics (RTCA) and the FAA, the European Union Safety Agency (EASA), French, Czech Republic and Canadian spectrum regulators have provided guidance on radio altimeter interference in this mid-band spectrum. The studies have led to the USA, France, Czech Republic, Canada and Japan introducing various mitigation measures to protect radio altimeters from interference from 5G/IMT transmissions.

Aviation regulators in many countries, including CASA in Australia, have issued airworthiness directions or advisory bulletins referencing the potential interference from 5G/WBB into aircraft radio altimeter operations and for the purpose of raising awareness with pilots and airline operators.[1]

Coexistence with radio altimeters

The 'AWL coexistence with radio altimeter' section on page 9 of the consultation paper makes fleeting reference to the problem of interference to radio altimeters from WBB operations 3.4-4.0 GHz.
It states 'the issue of compatibility of WBB services with radio altimeters in the adjacent 4.2-4.4 GHz band was explored within the TLG.'

The TLG was the industry 'Technical Liaison Group' providing background detail to ACMA prior to the consultation. As part of the TLG the Australian aviation industry formed a 'Radio Altimeter Co-ordination Group' (RA-CG) to liaise with the ACMA and other stakeholders on the issue of radio altimeter interference.[2]

Boeing Australia was a member of the RA-CG and supports the views and recommendations of the group to the TLG.

The summary view of the RA-CG to the TLG states:

> the protection of RA's from interference caused by WBB services should be of paramount importance. Members of the RA-CG believe there is sufficient evidence to indicate that WBB interference may adversely impact RA's. We therefore strongly support the case for technical restrictions on WBB deployments near airports, other landing locations (such as heliports), and areas where risk to aviation activity is identified.

[1] The latest CASA Airworthiness Bulletin No34-020. 7 'Potential 5G Interference of Radio Altimeter Systems' was released 4 March 2022.
[2] Membership of the RA-CG includes representatives from: Civil Aviation Safety Authority, Airservices Australia, Department of Defence, NSW Police, Qantas Airways, Virgin Australia, Boeing Australia, Sydney Airport Corporation Limited, Australian Airline Pilots Associations and the Australian Airports Association.

The consultation paper cites two ‘approaches’ for possible interference mitigation options.

- Approach A: the established guard band of 200 MHz and no other restrictions.
- Approach B: a range of mitigation measures to apply above 3 700 MHz derived from ACMA and overseas technical studies and mitigation provisions implemented by overseas regulators. This includes exclusion and restricted zones around airports and pfd and power restrictions elsewhere.

This information is detailed in proposed draft new RALI MS 47.

There is no comment from the ACMA as to how it determined mitigation measures might apply above 3 700 MHz, but do not apply below that frequency.

Draft RALI MS 47

The draft RALI MS 47 details the ACMA’s proposed frequency coordination and apparatus area-wide licensing (AWL) provisions and ‘approaches’ in the 3.4-4.0 GHz frequency band.

Section 4.6 [Compatibility with radio altimeters] is a provisional inclusion noting that the ‘draft clauses for comment and do not yet represent a formed ACMA view.’ Section 4.6 is the only text in the draft RALI in square brackets which assumes it can be deleted.

Sections 4.6.1 ‘Definitions’ and 4.6.2 ’Registration requirements’ are, in part, based on overseas mitigation measures, notably that of France (that has allocated 5G in the frequency band 3 490-3 800 MHz). The ‘registration requirements’ reflect the TLG Approach B, as mentioned above. Boeing Australia welcomes the provisional inclusion of options for mitigation, notably consideration of exclusion and restricted zones around airports which provides strong protection from interference to aircraft radio altimeters. Nonetheless, more work, especially with the aviation industry, is needed to agree technical detail and mitigation measures to be put in place on an interim basis to address possible interference to radio altimeters relevant to Australia’s specific WBB infrastructure.

It also needs to be determined if interim mitigation measures below 3 700 MHz are warranted in Australia noting such measures have already been introduced in Canada and France that have 5G operational in 3.5 GHz.

ACMA ‘Updated wireless broadband and radio altimeter compatibility study’

This ACMA study is Appendix D of the TLG ‘Review of 3 700-4 200 MHz, 3.4 GHz bands spectrum and apparatus licence technical frameworks.’ The study has been through a number of iterations.

The study, according to the consultation paper, is part of the basis of the draft RALI MS 47 ’Registration requirements’ that include various mitigation options for WBB in 3 700-4 000 MHz. While Boeing Australia appreciates the initiative of the ACMA to undertake the study, we do have some concerns with the methodology and assumptions.

Comments on the study are shown at the Attachment of this submission.

Key points of concerns with the study include:

- The study claims that ''For AAS it would take an increase of 1.5 dB over currently operating power to have a fail rate over 0.1% of test points, which is considered an acceptably small amount.'

  This -> 0.1% is fail rate not acceptable for safety of life service.

- The effect of interference to the operation of radio altimeters on helicopters is not considered.
- The study path modelled is an ideal path, while an actual aircraft would fly within a region around the ideal path and could be susceptible to interference in the scenario modelled.
- The study uses ITU-R altimeter Recommendation values instead of newer RTCA or AVSI testing data.

The study does not draw any conclusions. Boeing Australia suggests, should the ACMA wish to persevere with the study, the comments provided in the attachment to this submission could assist with any future revision.

We are aware that the ACMA is of the view that there is no radio altimeter interference from 5G/WBB below 3 700 MHz on the basis that there have been no reports of interference in the presently operating 3.575-3.7 GHz 5G services across Australia.
This position is disputed as lack of interference reports can be explained in a number of ways including:

- The first 5G service started in May 2019 and is still being progressively rolled out.[3]
- During the rollout of 5G in Australia the country was mostly under lockdown conditions due to the COVID-19 pandemic. As a consequence air traffic was at all-time lows during this period.
- Awareness of the problem has been better socialised in only the last six months. This is through the airlines, manufacturers and airline safety regulators highlighting the potential problem and establishing industry reporting avenues to assess potential interferences.
- Radio altimeters can malfunction for a number of reasons and often only for short durations. Some incidents may not have been reported in the past and dismissed as an atmospheric or operational anomaly.

[3] Telstra claims a 75% population coverage the other MNOs much less 5G coverage maps: Where is 5G available in Australia? | WhistleOut.

Summary

The AWL's, subject of this consultation, are largely confined to remote areas of Australia where non-segregated airspace would be much less than more populated areas. Nonetheless, the need to protect aircraft fitted with radio altimeters is essential. This applies in this instance to emergency and rescue aircraft and larger commuter planes using remote destinations. This consultation is expected to form the basis of future AWLs and spectrum licensing across 3.4-4.0 GHz in more populous locations to accommodate a variety of applications including 5G, WBB and use of these applications by private companies (industry verticals) and government.

Boeing Australia recommends ACMA take into consideration the following in regard to potential radio altimeter interference from 5G/WBB transmissions in 3.4-4.0 GHz in Australia:

1. Define the 5G/WBB frequency range applicable to radio altimeter protection.
   ACMA suggests there is no interference from 5G/WBB base station transmissions to radio altimeters below 3 700 MHz.
   There is no qualification from the ACMA to support this view/assumption.
   Noting Canada and France have allocated 5G in 3.5 GHz (i.e. below 3 700 MHz) subject to interim mitigation measures.
2. Section 4.6 [Compatibility with radio altimeters] 4.6.2 'Registration requirements' of draft RALI MS 47 should be further refined, in consultation with the aviation industry, to arrive at agreed interim mitigation provisions and technical parameters including airport exclusion and protections zones relevant to 5G/WBB operations in Australia.
3. Boeing Australia proposes ACMA retain and further develop the current section 4.6 [Compatibility with radio altimeters] of the draft RALI MS 47 with a view to upgrade this provisional text to part of the RALI. This is subject to and conditional on the outcome of 1. above.
4. ACMA and mobile operators need to arrive at acceptable mitigation measures as early as practicable given the already operational 5G infrastructure in Australia at 3.5-3.7 GHz and the substantial increase in mid-band spectrum, from the current spectrum licence reallocation and new AWL for WBB.

Respectfully submitted

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ATTACHMENT

Boeing comments on ACMA Updated wireless broadband and radio altimeter study

The following comments relate to the Technical Liaison Group 'Review of 3700-4200 MHz, 3.4 GHz bands spectrum and apparatus licence technical frameworks' Appendix D 'Updated wireless broadband and radio altimeter study.'

While recognising the ACMA's comment in the study's executive summary that 'the results of the study are still highly dependent on the assumed parameters, both for radio altimeters and base stations,' Boeing, in the interest of accuracy, provide comments on the study.

- While the study uses current ITU-R WP 5D assumptions it is noted that AAS antenna patterns models can diverge from measured patterns in side lobes and grating lobes tending to underestimate the base station's power in those directions
    - A model where the AAS antenna pattern (or resulting e.i.r.p.) is bounded would be better.
    - Then how would e.i.r.p. bound vs direction be enforced?
- In the United States the FAA is currently protecting UC1 category altimeter operations (as defined by the RTCA SC-239 Report) with margin for tolerance across serial numbers and temperature as well as safety margin.
  The volume of protection is everywhere at and above obstacle surfaces (defined by local terrain and Terminal Area Procedures) via a pfd limit vs. height above ground level at and above all of the obstacle surfaces.
  The obstacle surface is a surface above which the airplane must fly in order to avoid obstacles (building, antennas, terrain, etc.).
  Currently, these operations are enabled by keeping 5G turned off completely within a safety zone defined by obstacle surfaces and a buffer zone around the safety zone that is a function of the minimum separation distance for UC1 altimeters.
  The safety zone extends 2 nautical miles from the runway threshold and has a 1.25 nautical mile width, centred on each runway.
  This arrangement is in place until July 2022 and subject to further review.
- An additional parametric analysis determining the signal strength in space in a uniform grid (varying distance away from the base station, and altitude relative to the base station) would provide information of regions near an antenna that may present a risk to altimeters.
- With one scenario studied, the result is inconclusive as it is unknown if an aircraft is expected to fly through a volume in space that presents a risk to the altimeter.
  The parametric analysis described above would better inform the formation of the approach scenarios.
    - The scenarios are also idealised in that turns or aircraft banking is not considered.
- Mechanical downtilt is useful, however over steering a beam electronically toward the ground presents the possibility of a severe grating lobe above the horizon.

    - A plot of the base station antenna pattern in the vertical plane would be useful
    - Can the base station tilt more than 10 degrees below the horizon?
      What if there is a UE below that?
    - Other propagation effects like ground bounce should be considered.

- No amount of threshold exceedance is acceptable
    - 'For AAS it would take an increase of 1.5 dB over currently operating power to have a fail rate over 0.1% of test points, which is considered an acceptably small amount.'
      -> 0.1% is not acceptable for safety of life service.
    - Path modelled is an ideal path, while an actual aircraft would fly within a region around the ideal path and could be susceptible to interference in the scenario modelled.
    - Hazards exist in all types of approaches not just ILS path or automated landings
        - Automated systems, thrust reversers, tail-striker protection, speed brake deployment, etc. may activate putting the aircraft into an unrecoverable situation.

- Distance and extended flight paths conclusion is not entirely correct.
  While base stations within a certain distance (800m) in this analysis dominate interference to altimeters, there are potentially other scenarios where varying terrain and certain base station pointing conditions could have an impact.

- Helicopters are not considered.

- The study uses ITU-R Altimeter Recommendation values instead of newer RTCA or AVSI testing data.
  The AVSI test data is available at https://avsi.aero/afe76s2-report/ this report is detailed on the site and Vol III's release is imminent.