International Civil Aviation Organization

SIXTH MEETING OF SPECTRUM REVIEW WORKING GROUP (SRWG/6)

Video Teleconference, 1 – 3 March 2022

Agenda Item 2: Review outcomes of relevant meetings
Agenda Item 7: State and regional updates

POTENTIAL IMPACTS FROM 5G IMPLEMENTATION ON AIRCRAFT RADIO ALTIMETERS – OUTCOMES IN RELEVANT MEETINGS AND REGIONAL UPDATES

(Presented by the Secretariat and Chairperson)

SUMMARY

This paper presents the discussion in APAC after SRWG/5 about 5G implementation and potential impacts on aircraft radio altimeters, and relevant regional updates.

1. INTRODUCTION

1.1 The concerns about potential interference to radio altimeters onboard aircraft due to implementation of new cellular broadband technologies, such as 5G, in the frequency bands close to the radio altimeter's frequencies of operation have been identified in several ICAO global meetings.

1.2 This paper summarized the discussions in APAC Region on the topic since SRWG/5. Information on forums of discussions is given below.

1.3 The 12th Meeting of Frequency Spectrum Management Panel Working Group (FSMP WG/12) held from 4 to 15 October 2021 discussed various issues related to radio altimeters, including the status of testing, national efforts to implement broadband mobile near 4.2-4.4GHz and outcome from the correspondence group on radio altimeters. The report and papers of FSMP/12 are available at:
https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG12/Report/

1.4 The 25th Meeting of CNS SG (CNS SG/25) held from 18 to 22 October 2021 reviewed the outcomes of SRWG/5 and made further elaborations on the issue, including the State Letter issued by ICAO Headquarters on 25 March 2021 to address potential safety concerns regarding interference to radio altimeters. The report and papers of CNS SG/25 are available at:
https://www.icao.int/APAC/Meetings/Pages/2021-CNS-SG-25.aspx

1.5 The 11th Meeting of Regional Aviation Safety Group – Asia and Pacific (RASG-APAC/11) held from 25 to 26 November 2021 reviewed the potential impacts from 5G Implementation on Aircraft Radio Altimeters shared by certain APAC States. The report and papers of RASG-APAC/11 are available at:
https://www.icao.int/APAC/Meetings/Pages/2021-RASG-APAC11.aspx

2. DISCUSSION

2.1 The concerns about potential interference to radio altimeters onboard aircraft due to the implementation of new cellular broadband technologies, including 5G, in the frequency bands close to the radio altimeter's frequencies of operation have been identified in several ICAO global meetings.

2.2 On 25 March 2021, ICAO Headquarters issued a state letter with the **Subject**: *Potential safety concerns regarding interference to radio altimeters (Ref.: SP 74/1-21/22),* the Member States and Administrations are encouraged to consider as a priority, public and aviation safety when deciding how to enable cellular broadband/5G services in radio frequency bands near the bands used by radio altimeters. The State Letter is provided in **Appendix** to this paper.

2.3 FSMP WG/12 discussed the status of testing from Japan and from the aviation industry, national efforts to implement broadband mobile near 4200-4400 MHz, and the outcome from the Correspondence Group on Radio Altimeters (CG-RA) of FSMP WG.

2.4 Japan reported in FSMP WG/12 via IP/07 on their tests on 5G impacts on pulsed radio altimeters. The tests, performed on two units of the same radio altimeter model, showed considerable variation in interference susceptibility performance between the two. The altimeter is for rotary craft and regional aircraft which would be considered "usage category 2 & 3" under the RTCA report classification. It was noted that susceptibility to an interference signal that was lower in frequency than the altimeter band compared to a similar one higher in frequency may simply be an artifact of that specific altimeter design.

2.5 ICCAIA reported in FSMP WG/12 via WP/17 regarding the updates on activities ongoing by industry to assess the compatibility of new cellular systems supporting 5G or similar OFDM based communication systems in the C-band adjacent to radio altimeters. Four topics were addressed:

(a) a compilation of known 5G spectrum allocations being used to develop standard requirements for radio altimeters robust to future adjacent band interference;

(b) flight test results reported from Europe were reviewed against expected results based on radio altimeter tested threshold levels;

(c) the need for global safety zones to ensure compatibility for existing altimeters was reiterated with some more detailed guidance and a notional schedule; and

(d) updates to the FSMP job card tasks related to Radio Altimeter adjacent band compatibility were discussed for panel consideration.

2.6 CG-RA updated in FSMP WG/12 via IP/08 (revision 1) on their activities. The IP highlighted the different 5G implementations on-going in different States, as well as the testing and flight trials that have been undertaken. In particular, a presentation was made about a French trial in which a helicopter with a usage category 1 altimeter was flown in the vicinity of a 5G base station and the co-pilot monitored the radio altimeter for abnormal activity. Under the conditions of that trial, no abnormal activity was noted. The meeting discussed the trial and provided suggestions for follow-on work. It was also suggested that for any trials, any caveats or conditions should be repeated in the "conclusions" section to preclude readers from getting wrong impressions.

2.7 Australia reported in FSMP WG/12 via IP/05 that after the Australian radio regulator (ACMA) released the "Replanning the 3700-4200 MHz band - Outcomes Paper" in January 2021, they established a technical liaison group (TLG) to provide advice on the development of changes to the

spectrum or apparatus license technical framework. As a result, the aviation sector in Australia formed a coordination group comprised of airlines, defence department, CASA, Air Services, and altimeter manufacturers and developed and an aviation position for the TLG. That position is currently under review by ACMA. In discussion, it was revealed that the reflection coefficient used in the early ACMA studies was taken from a document on trials in one part of the country using an L-Band radar. The TLG is considering the use of a different reflection coefficient for future studies. The TLG is supposed to complete its work by the end of the year and 5G operations in the bands of interest have not yet begun. Australia also presented in CNS SG/25 IP/12 on the status of activity in Australia to address the potential impact of deployment of wireless broadband services in the 3.4 to 4.0 GHz band on Aviation safety.

2.8 Hong Kong China shared their experience in CNS SG/25 that the established mechanism in handling potential interference to radio altimeters caused by 5G implementation. They have notified relevant aircraft operators through the issuance of "Flight Operations Notice" in April 2021 and has requested their vigilance on the possible interference on radio altimeter during any phase of flight, and report any relevant anomalies to the Civil Aviation Department of Hong Kong China. Moreover, a working group, with members of CAD, Airport Authority Hong Kong and Office of the Communications Authority, has been established to keep in view of the situation as well as to coordinate the implementation of 5G at the Hong Kong International Airport.

2.9 To bring up the discussion on the issue during CNS SG/25, the ICAO Secretariat presented IP/06 on *5G Implementation and Potential Impacts on Aircraft Radio Altimeters summarizing* the discussion from SRWG/5 and the background in APAC.

2.10 Subsequently, the ICAO Secretariat presented the summary of outcomes from CNS SG/25 Meeting as WP/17 in RASG-APAC/11 about 5G implementation and potential impacts on aircraft radio altimeters. Member States would monitor the impact of 5G on radio altimeters in their States/Administrations with reference to the safety and frequency spectrum issues. CAA and airworthiness office may collect all relevant information and past issues reported, if any, and inform RASG-APAC in case of any significant concern. The issues related to frequency spectrum may be brought to the attention of the CNS section of the ICAO APAC Office for further coordination with RASG-APAC and ICAO Headquarters. The message was also reviewed and noted in APANPIRG/32.

2.11 Singapore, co-sponsored by Bangladesh, Fiji, Indonesia, New Zealand and Thailand, presented in RASG-APAC/11 via WP/18 on their efforts to bring about greater awareness in managing the risk posed by the potential interference to aircraft radio altimeter by 5G. In addition, Hong Kong, China presented in RASG-APAC/11 via WP/19 on their effort to bring the potential risk to the attention of the local industry and taken proactive actions with relevant parties, including collecting suspected occurrences from airline operators. A Working Group consisting of subject matter experts (SME) from multiple domains was established to study and closely monitor the global development of the issue..

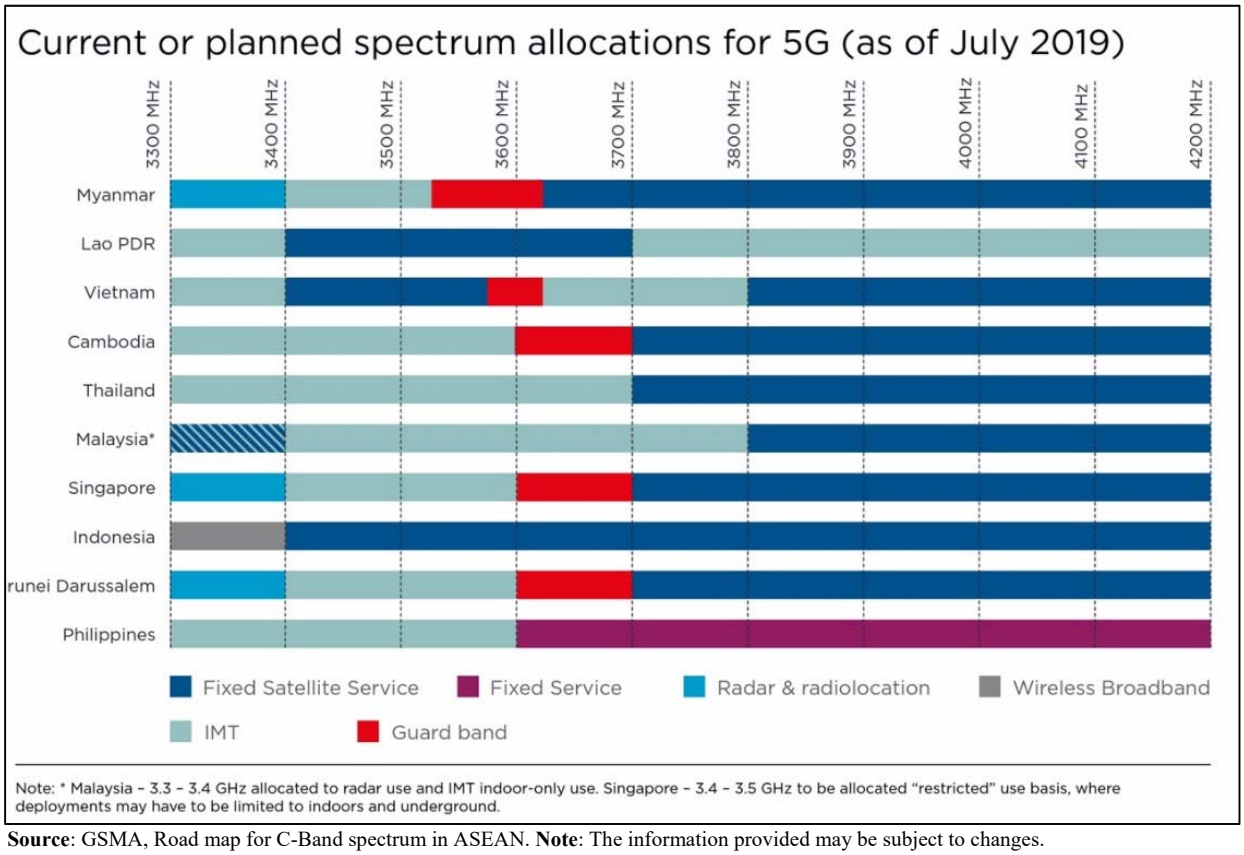
2.12 The RASG-APAC/11 urged States/Administrations to strengthen collaboration and sharing of information, as well as take an early action with their industry stakeholders and relevant authorities to prevent any potential safety risk to the aviation safety system. As 5G implementation is a global issue, the RASG-APAC Chair suggested the ICAO Regional Office to refer the subject to the relevant ICAO Panels and Expert groups (e.g. ICAO Airworthiness Panel and/or ICAO Frequency Spectrum Management Panel) to conduct further studies to assess the potential impacts from 5G implementation on aircraft radio altimeters and address this global issue. As such, the meeting formulated one Conclusion and one Decision as follows:

Conclusion RASG-APAC 11/3 — Potential Interference to Aircraft Radio Altimeter by 5G Telecommunications System – WP/17, WP-18 & WP-19	
That, the ICAO Regional Office to refer the subject to the relevant ICAO Panels and Expert groups to conduct further studies to assess the potential impacts from 5G implementation on aircraft radio altimeters and address this global issue.	Expected impact: ☒ Ops/Technical ☒ Achievement of global and regional aviation safety priorities and targets ☐ Enhancement of USOAP effective implementation ☐ Monitoring and administration ☐ Capacity Building and Sharing of Information ☐ Inter-regional ☐ Political / Global ☐ Economic ☐ Environmental
Why: To collaborate to prevent any potential safety risk to the aviation safety system from 5G Interference.	Follow-up: ☐Required from States
When: 26-Nov-2021	Status: Open
Who: ☒Sub groups ☒APAC States ☐ICAO APAC RO ☐ICAO HQ ☒Other: Industry	

Decision RASG-APAC 11/6 — Potential Interference to Aircraft Radio Altimeter by 5G Telecommunications System – WP/17, WP-18 & WP-19	
a) That, States/Administrations share with their telecommunications authorities on possible potential 5G interference with aircraft radio altimeter for 5G installations near airports; b) That, States/Administrations and industry liaise with States of Design and aircraft manufacturers to mitigate the potential interference of 5G networks on aircraft radio altimeters; c) That, States/Administrations and industry provide feedback to RASG-APAC and APANPIRG, and its sub-groups on reports of interference from 5G networks	Expected impact: ☒ Ops/Technical ☒ Achievement of global and regional aviation safety priorities and targets ☐ Enhancement of USOAP effective implementation ☐ Monitoring and administration ☐ Capacity Building and Sharing of Information ☐ Inter-regional ☐ Political / Global ☐ Economic ☐ Environmental
Why: To collaborate to prevent any potential safety risk to the aviation safety system from 5G Interference	Follow-up: ☐Required from States
When: 26-Nov-2021	Status: Open
Who: ☒Sub groups ☒APAC States ☒ICAO APAC RO ☐ICAO HQ ☒Other: Industry	

2.13 Besides the discussion in various meetings aforementioned, it is worth noting that FAA issued Statements on 5G since December 2021 regarding the implementation of 5G, which described that certain Airworthiness Directives, Safety Alert for Operators (SAFO) and Special Airworthiness Information Bulletin (SAIB). Documents issue, further information and updates could be found at https://www.faa.gov/newsroom/faa-statements-5g. It is understood that their telecommunications providers agreed to voluntarily delay their 5G implementation and adopt proposed mitigations to work out and find a solution that will provide confidence that 5G C-Band and aviation will safely coexist.

2.14 Within the Association of Southeast Asian Nations (ASEAN), based on the latest studies conducted by Global System for Mobile Communications Association (GSMA), that can be found at https://www.gsma.com/spectrum/wp-content/uploads/2019/08/GSMA_Roadmap-for-C-band-spectrum-in-ASEAN_WEB.pdf, the current plans for 5G spectrum allocation are focused mainly on the 3 300 – 3 800 MHz range. The probability of the entire 3 300 – 4 200 MHz band, as desired by the industry, being made available for 5G is unlikely in the near term. This is due to the heavy use by Fixed Satellite Services (FSS) and other services in part of the band. However, in the long term, sharing maybe possible but on a limited area basis. The timeframe for the availability of these frequencies for 5G varies from member countries, this is shown below.



Source: GSMA, Road map for C-Band spectrum in ASEAN. **Note**: The information provided may be subject to changes.

Planned Spectrum Allocation for 5G

Indicative timeline for availability of 3.5 GHz band in ASEAN (as of July 2019)

Country	C-band incumbent service	Estimated availability of 3.5 GHz for IMT/5G
Myanmar	Vacant and FSS	Now – 3.4 – 3.52 GHz
Lao PDR	Vacant and FSS	Now – above 3.7 GHz depending on IMT demand
Philippines	IMT and FS	Now – 3.3 – 3.6 GHz. 240 MHz assigned and 5G services launched.
Brunei Darussalam	IMT and FSS (VSATs)	2020/21 – 3.4 – 3.6 GHz depending on IMT demand
Cambodia	IMT and FSS	2020/21 – 3.3 – 3.7 GHz following refarming of BWA licences
Singapore	FSS	2021/22 – 3.4 – 3.6 GHz following migration of TVROs
Vietnam	FSS (ubiquitous – VSATs)	2022/23 – 3.3 – 3.4 GHz and 3.62 – 3.8 GHz
Malaysia	FSS (ubiquitous – VSATs)	2022/23 – 3.4 – 3.8 GHz
Thailand	FSS (ubiquitous – TVROs)	Post-2023 – 3.4 – 3.7 GHz, depending on expiry of satellite licences
Indonesia	FSS (ubiquitous – VSATs)	Post-2023 – Specific frequencies unclear at present.

Source: GSMA, Road map for C-Band spectrum in ASEAN. **Note**: The information provided may be subject to changes

Potential timescales for availability 3.5 GHz band for 5G

2.15 Further information related to the use of certain frequency bands for IMT-2020 (5G) in Asia-Pacific countries can be found from the following survey studies as APT Reports (most recent versions) related to this, those reports can be downloaded directly from the following list:

1) APT Report on Information of Mobile Operator's Frequencies, Technologies and License Durations in Asia Pacific Countries

2) APT Report on Current status and future plan of implementation and deployment of IMT-2020 (5G) in Asia-Pacific region

3) APT Report on Studies on implementation aspects of IMT-2020 in the frequency bands below 6 GHz in Asia-Pacific region

4) APT Report on Survey on Regulatory Information for Implementation of IMT Network in the Asia-Pacific region

2.16 CNS Section of ICAO APAC Regional Office has received ZERO report on such interference in radio altimeter from the Member States or IATA so far. As agreed in CNS SG/25, Member States would keep an eye on monitoring the impact of 5G on radio altimeters in their States/Administration with reference to the safety and frequency spectrum issues. In parallel, it was advised that Member States CAA and airworthiness office may collect all relevant information and past issues reported, if any, and inform RASG-APAC in case of any significant concern. The issues related to frequency spectrum may be

brought to the attention of CNS section of the ICAO APAC Office for further coordination with RASG-APAC and ICAO Headquarters.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;

b) report to the relevant contributory bodies of the ICAO RASG-APAC in a timely manner for events on interference to radio altimeters;

c) report issues related to frequency spectrum to the CNS section of the ICAO APAC Office for further coordination with concerned parties; and

d) discuss any relevant matter as appropriate.

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25 March 2021

Ref.: SP 74/1-21/22

Subject: Potential safety concerns regarding interference to radio altimeters

Action required: As indicated in paragraph 5

Sir/Madam,

1. I have the honour to bring your attention to an ongoing initiative by the International Civil Aviation Organization (ICAO) to ensure continued public and aviation safety.

2. During recent meetings of ICAO experts, concerns about interference to radio altimeters on-board aircraft have been raised. A number of administrations are currently considering or have already begun deploying new cellular broadband technologies (such as 5G) in the frequency bands close to the radio altimeter's frequencies of operation (4.2-4.4 GHz), a critical aviation safety system. The international aviation industry has noted with concern that these broadband technologies may cause harmful interference to radio altimeters.

3. The radio altimeter[1] is a mandated critical aircraft safety system used to determine an aircraft's height above terrain. Its information is essential to enable several safety related flight operations and navigation functions on all commercial aircraft as well as a wide range of other civil aircraft. Such functions and systems include terrain awareness, aircraft collision avoidance, wind shear detection, flight controls, and functions to automatically land an aircraft. If not properly mitigated[2], harmful interference to the function of the radio altimeter during any phase of flight may pose a serious safety risk to passengers, crew and people on the ground.

4. ICAO has received studies from several States and organizations regarding the interference potential to radio altimeters[3]. These studies generally conclude that some radio altimeters will be impacted

[1] In some aviation publications it is also known as the radar altimeter or Low Range Radar Altimeter.
[2] General guidance on Interference Protection Considerations can be found in Chapter 9 of the *Handbook on Radio Frequency Spectrum Requirements for Civil Aviation – ICAO spectrum strategy, policy statements and related information* (Doc 9718, Volume I)
[3] Report by RTCA – https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG11/IP/FSMP-WG11-IP07_RTCA_Report.docx

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if high power cellular systems are implemented near the frequency band used by radio altimeters. Several States have already implemented temporary technical, regulatory and operational mitigations on new 5G systems in order to protect radio altimeters while more permanent solutions are being devised[4].

5. I encourage you and your Administration to consider as a priority, public and aviation safety when deciding how to enable cellular broadband/5G services in radio frequency bands near the bands used by radio altimeters.

Accept, Sir/Madam, the assurances of my highest consideration.

Fang Liu
Secretary General

[3] Report of Australian national study (*IP03 WG/10 meeting – ACMA options consultation meeting*) – https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG11/WP/FSMP-WG11-WP13_Status%20on%20replanning%20the%203700-4200%20MHz%20band%20in%20Australia.doc

[3] Report of Japanese national study and mitigations - https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG11/WP/FSMP-WG11-WP30_5GJapan.docx

[3] Report of UK CAA study – https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG11/WP/FSMP-WG11-WP27_Mobile%20vs%20Radalt%20REv.1.docx

[3] Report of French national mitigations - https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG11/IP/FSMP-WG11-IP03_5G%20vs%20RA%20Actions%20taken%20in%20France%20to%20mitigate%20interference_r1.doc

[4] For example, ICAO has been informed of longer-term work being initiated by several aviation standard-making organizations to update radio altimeter standards. Part of that update will include improved tolerance of interference.