



International Civil Aviation Organization

ICAO

**Twenty Sixth Meeting of the Communications/
Navigation and Surveillance Sub-group (CNS SG/26) of
APANPIRG**

Video Tele-Conference, 5 – 9 September 2022

Agenda Item 5: Aeronautical Mobile Communications Service and Aeronautical electromagnetic spectrum utilization

5.3 Other issues related to aeronautical communications service and aeronautical radio spectrum management, especially on 5G implementation and potential impacts to aircraft radio altimeters

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

(Presented by the Secretariat)

SUMMARY

This paper presents the discussion in APAC after CNS SG/25 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 after CNS SG/25. Information on forums of discussions is given below.

1.3 The Thirty-second Meeting of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG/32) was held from *1 to 3 December 2021* via video teleconference. The Meeting was attended by 278 participants from 28 Member States, 2 Special Administrative Regions of China, and 8 International Organizations (AAPA, ACI, CANSO, IATA, ICAO, IFALPA, IFATCA and PASO). APANPIRG/32 meeting report, working papers, information papers, and other resources can be accessed at <https://www.icao.int/APAC/Meetings/Pages/2021-APANPIRG32.aspx>.

1.4 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>

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1.5 The Sixth Meeting of the Spectrum Review Working Group (SRWG/6) of APANPIRG was held via video tele-conferencing from 1-3 March 2022. The meeting was attended by 74 participants from 16 States/Administrations and 2 International Organizations. The meeting considered Fifteen (15) Working Papers, Three (3) Information Papers and Three (3) Flimsies under Ten (10) Agenda Items. The working papers, information papers, flimsies, meeting report, and other resources of SRWG/6 are available at <https://www.icao.int/APAC/Meetings/Pages/2022-SRWG6.aspx>

1.6 The 13th and 14th Meetings of Frequency Spectrum Management Panel Working Group (FSMP WG/13 and FSMP WG/14) held respectively on 21-25 February and 25-29 April 2022 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 WG/13 and FSMP WG/14 are available at <https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG13/> and <https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG14/> respectively.

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 ICAO Headquarters issued a state letter with the **Subject: Potential safety concerns regarding interference to radio altimeters (Ref.: SP 74/1-21/22)**, dated 25 March 2021, 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 A** to this paper.

Discussion in APANPIRG/32

2.3 APANPIRG/32 reviewed the outcome from CNS SG/25 that SRWG/5 developed an action item to take necessary follow up action at the regional level, to support CAAs working with State's spectrum regulators to avoid the future safety issues on radio altimeter due to 5G implementation. Furthermore, ICAO issued a state letter on *Potential safety concerns regarding interference to radio altimeters* (Ref.: SP 74/1-21/22), the Member States and Administrations were 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. Member States were invited to report to ICAO APAC Regional Office in a timely manner once the interference to radio altimeters by these broadband technologies happens. Outcomes from CNS SG/25 on this issue were also shared to RASG-APAC/11 to alert the potential impact on flight safety.

2.4 The meeting agreed that Member States would keep an eye on monitoring the impact of 5G on radio altimeters in their States/Administrations regarding 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 the CNS section of the ICAO APAC Regional Office for the coordination with RASG-APAC and ICAO headquarter.

Discussion in RASG-APAC/11

2.5 The outcome from CNS SG/25 on the topic was shared to RASG-APAC/11 through WP/17 and the meeting noted the content of the paper. 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 CNS section of the ICAO APAC Office for further coordination with RASG-APAC and ICAO Headquarters.

2.6 The Meeting noted the WP/18 presented by Singapore, co-sponsored by Bangladesh, Fiji, Indonesia, New Zealand and Thailand, on the efforts to bring about greater awareness in managing the risk posed by the potential interference to aircraft radio altimeter by 5G. The Meeting also noted the paper WP/19 presented by Hong Kong, China. Hong Kong, China has brought 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.

2.7 States/Administrations and industry are encouraged to share their experience, take an early action to bring up the subject to the attention of their industry stakeholders, provide feedback to aircraft manufacturers to support their further studies, and keep relevant contributory bodies of ICAO RASG-APAC informed. The Meeting noted Hong Kong, China’s proactive efforts. 4.7.3 On discussions of WP/17, WP/18 and WP/19, the Meeting 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. Australia, China, Indonesia and United States endorsed the Working Papers. The Meeting adopted the following Conclusion and 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: <input checked="" type="checkbox"/> Ops/Technical <input checked="" type="checkbox"/> Achievement of global and regional aviation safety priorities and targets <input type="checkbox"/> Enhancement of USOAP effective implementation <input type="checkbox"/> Monitoring and administration <input type="checkbox"/> Capacity Building and Sharing of Information <input type="checkbox"/> Inter-regional <input type="checkbox"/> Political / Global <input type="checkbox"/> Economic <input type="checkbox"/> Environmental
Why: To collaborate to prevent any potential safety risk to the aviation safety system from 5G Interference.	Follow-up: <input type="checkbox"/> Required from States

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When: 26-Nov-2021	Status: Open
Who: <input checked="" type="checkbox"/> Sub groups <input checked="" type="checkbox"/> APAC States <input type="checkbox"/> ICAO APAC RO <input type="checkbox"/> ICAO HQ <input checked="" type="checkbox"/> Other: Industry	

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

Discussion in FSMP WG/13 and FSMP WG/14

2.8 Under FSMP WG, the Correspondence group on radio altimeters (CG-RA) was formed to discuss on various issues and follow-ups regarding the issue of “5G” broadband mobile terrestrial interference to radar altimeters. Since this issue is of global interest, in order to catalogue the different implementations in various countries, the CG-RA has been compiling that information. [IP03 of FSMP WG/13](#) and [IP01rev3 of FSMP WG/14](#) provided the report of the chairman of the correspondence group –radio altimeters (CG-RA), and it included a comprehensive listing of 5G implementation activities in different countries including APAC countries. Resources to online forums for valuable discussions on the topic are also introduced in these papers.

2.9 FSMP WG/13 WP/03 *National Efforts on Coexistence with Radio Altimeters within France* provided information on efforts in France to ensure compatibility of 5G with RAs. This included a report on testing of an RA on a helicopter and on plans to develop a 5G roadmap to inform development of MOPS for next-generation RAs. The paper generated considerable discussion, in particular on the concept of what is “good enough” rejection of adjacent-band signals for a receiver. The discussion resulted in an action item to national spectrum regulators that were contributors to the work of the FSMP to provide examples of standards/systems for adjacent-band signal rejection that could be provided to the next FSMP meeting.

2.10 FSMP WG/13 WP/16 *ICAO Material to Support Safe Co-existence between 5G and Radio Altimeters* discussed recent lessons-learned concerning the deployment of 5G telecommunication networks and outlined the need for ICAO material to assist States in mitigating any potential risks to flight safety by 5G deployments, and to support safe co-existence between 5G and radio altimeters. The paper generated considerable discussion including the following:

- groups could be utilized to bring aviation and wireless proponents together, and as a result the meeting was encouraged to participate in such groups to the extent possible;
- a dedicated site on the FSMP website be defined to place important reference material such as complete studies submitted to State regulators, or material explaining RA operation;
- CG-RA was tasked with developing an “Information for States” document that contained material such as explaining the 5G/RA issue and providing guidance as to where additional information can be found.

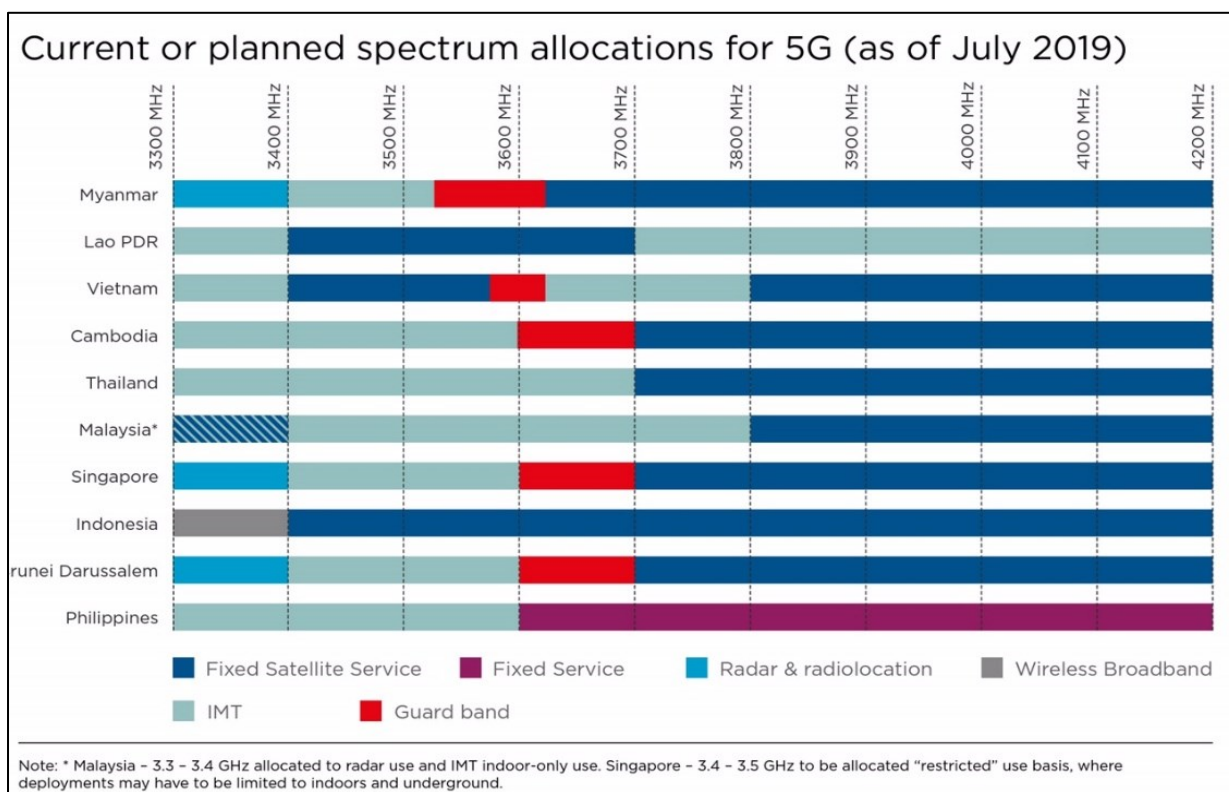
2.11 FSMP WG/13 IP/02 *Radio Altimeter Interference Path Loss Measurements of Helicopter* provided the results of trials by Japan to measure interference path loss (IPL) between a radio altimeter receiver and a 5G emitter for a medium sized helicopter.

2.12 FSMP WG/13 IP/04 *Briefing material on the Radio Altimeter and 5G rollout issues* contained informal briefing material, as developed by the Secretariat, to further supplement the information provided in State Letter 21/22 regarding compatibility between 5G and radio altimeters.

Discussion in other bodies

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.

Fig.1 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

Fig.2 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 a reminder of agreement 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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Tel.: +1 514-954-8219 ext. 7130

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 altimeter¹ 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 mitigated², 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 altimeters³. 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

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 devised⁴.

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-](https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG11/WP/FSMP-WG11-WP27_Mobile%20vs%20Radalt%20REv.1.docx)

[WP27_Mobile%20vs%20Radalt%20REv.1.docx](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-](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)

[IP03_5G%20vs%20RA%20Actions%20taken%20in%20France%20to%20mitigate%20interference_r1.doc](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.