



ICAO

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

OUTCOME OF FSMP WG/13 ON RADIO ALTIMETER ISSUES

(Presented by the Secretariat)

SUMMARY

This flimsy presents the outcome of the Thirteenth Working Group Meeting of the Frequency Spectrum Management Panel (FSMP-WG/13) on Radio Altimeter issues for information and reference by the meeting.

1. INTRODUCTION

1.1 The Thirteenth Working Group Meeting of the Frequency Spectrum Management Panel (FSMP-WG/13) was held on 21 – 25 February 2022 via Video Teleconference.

1.2 The Meeting agenda, papers, presentations and report can be found here: [Meetings - FSMP WG/13 \(21-25 February 2022\) \(icao.int\)](#)

2. DISCUSSION

2.1 The FSMP-WG/13 meeting's agenda mainly covered ICAO WRC-23 Position, Development of (planned) Material for ITU-R Studies on various WRC-23 AIs, and Radio Altimeter issues.

2.2 Under its **Agenda Item 4 - Radio Altimeter issues**, some papers were discussed, including:

- b) Report from correspondence group on radio altimeters (CG-RA) *IP03*
- a) National efforts to implement broadband mobile near 4200-4400 MHz
 - Mitigation measures *WP03, WP16, IP02, IP04*
 - Safety Cases/Compatibility Analyses

2.3 *IP03* 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. The report generated considerable discussion and the meeting appreciated the information and agreed that the work of the CG-RA should continue.

2.4 *WP03* provided information on efforts in France to ensure compatibility of 5G with radio altimeters (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 (AI13-01)

2.5 *WPI6* 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 such as the European PT-1 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;
- the meeting asked that 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; (AI13-02)
- the 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. (AI13-03)

2.6 *IP02* provided the results of trials to measure interference path loss (IPL) between a radio altimeter receiver and a 5G emitter for a medium sized helicopter. The measurements were carried out based on RTCA DO-307A procedures with the 5G emitter assumed to operate across the frequency range 3.5 GHz–4.7 GHz to cover both the 4.2-4.4 GHz band used for radio altimeters and Wireless Avionics Intra-Communication (WAIC), and the sub-6 5G mobile communication bands in Japan (3.5–4.1 GHz, 4.5–4.7 GHz). The transmitting antenna was tested both inside and outside the cabin, resulting in minimum IPL values of 49.2 dB and 55.1 dB, respectively. The minimum IPL are obtained when the transmitting antenna and the receiving antenna are in line-of-sight conditions, and when the 5G is operating inside the 4.2-4.4 GHz band. When the 5G is operating outside of that band, an addition attenuation (up to approximately 13 dB) is measured. The meeting greatly appreciated the information and asked to be kept informed if additional measurements are made.

2.7 *IP04* contained informal briefing material, as developed for use by the ICAO Secretariat in January 2022, to further supplement the information provided in State Letter 21/22 regarding compatibility between 5G and radio altimeters. The meeting appreciated having the reference material.

2.8 FSMP-WG/13 *IP/03* is the best overall fact finding reference available today, while *IP/04* is more of a simplified “executive level” briefing style text, they are provided in **Appendix A** and **Appendix B** respectively for easy reference.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) note the outcome of FSMP-WG/13 on Radio Altimeter issues highlighted in this paper including the information contained in **Appendix A** and **Appendix B**; and
- b) discuss any relevant matter as appropriate.



International Civil Aviation Organization

FSMP-WG/13 IP/03
2022-02-14

INFORMATION PAPER

FREQUENCY SPECTRUM MANAGEMENT PANEL (FSMP)

Thirteenth Working Group meeting

Web Meeting, 21 – 25 February 2022

**Agenda Item 3c : National efforts to implement broadband mobile near 4200-4400 MHz
- Report from correspondence group on radio altimeters (CG-RA)**

Update of the CG-RA Report FSMP-WG/12 IP08

(Presented by Christian Fleury)

SUMMARY

In June 2020, ICAO secretary brought to the attention of FSMP members, a Liaison Statement informing ECC about the issue of potential interference to aeronautical Radio Altimeters operating in the frequency band 4200 - 4400 MHz, caused by IMT systems currently operating or planned to operate in the frequency band 3400 - 3800 MHz in Europe. This Liaison Statement explained that there is no specific limit of unwanted emissions from IMT base stations within the frequency band 4200-4400 MHz.

The recent RTCA Report SC-239 raised another risk from MFCN (5G in the band 3.7-3.98 GHz) into some radio altimeters.

This IP compiles all the information on the subject since the publication of the RTCA Report.

1. INTRODUCTION

The aim of this information paper is to give a “full” picture of the issue and provide some guidance examples that could minimise the impact on Radio-Altitude for all stakeholders.

A presentation [published by Honeywell](#) provides an overview of operation, design, and performance of Radar Altimeters.¹

1.1 History

1.1.1 WRC15

Aviation used the analyses contained in working papers [14](#)² & [17](#)³ to the 29th meeting of the Aeronautical Communication Panel, Working Group-F to help defend against late proposals to implement IMT in frequency bands near 4000-4200 MHz in response to WRC-15 agenda item 1.1. After that successful effort, aviation recognized the need for additional information on radio altimeters, and a [job card](#)⁴ was instituted for FSMP to develop minimal SARPS for those systems, including receiver selectivity limits. Data was collected under the auspices of the WAIC standardization work that would form the basis for those altimeter SARPS. Results were briefed to FSMP starting in January 2019.

1.1.2 February 2020

The United States Federal Communications Commission (FCC) approves a final Report and Order allocating 3.7-3.98 GHz to ‘Flexible Use Licensees’ that will include 5G services.⁵ This includes limits of up to 85 dBm EIRP from 5G towers and with minimal restrictions on antenna placement or their respective beams with respect to aircraft.⁶ The FCC decision concluded the power and emission limits set for the 3.7 GHz Service and the spectral separation of 220 megahertz should offer all due protection to services in the 4.2-4.4 GHz band. However, it did agree that further analysis is warranted on why there may even be a potential for some interference given the measure it had put in place and encouraged an industry multi-stakeholder group to assess the issue. The FCC also expected the aviation industry to take account of the RF environment that is evolving below the 3980 MHz band edge starting in Dec 2021 and take appropriate action, if necessary, to ensure protection of such devices. Under this direction, RTCA SC-239 took the initiative formed a multi-stakeholder group to do the analysis.⁷

1.1.3 June 2020

ICAO secretary brought to the attention of FSMP members, a [Liaison Statement informing ECC](#)⁸ about the issue of potential interference to aeronautical Radio Altimeters operating in the frequency band 4200 - 4400 MHz, caused by IMT systems currently operating or planned to operate in the frequency band 3400 - 3800

¹ <https://avsi.aero/wp-content/uploads/2021/12/Radar-Altitude-Overview-of-Design-and-Performance.pdf>

² <https://www.icao.int/safety/acp/ACPWGF/ACP-WG-F-30/ACP-WGF30->

WP14%20Radio%20Altitude%20Adjacent%20Bands%20Compatibility%20Study%20with%20IMT-FINAL%20Rev1.docx

³ https://www.icao.int/safety/acp/ACPWGF/ACP-WG-F-30/ACP-WGF30-WP17_radio%20altimeter%20analysis.doc

⁴ https://www.icao.int/safety/FSMP/Documents/Job%20Cards/FSMP_JobCard.07.01.pdf

⁵ <https://www.fcc.gov/ecfs/filing/0303046335999>, paragraphs 390-395, dated 28 Feb 2020

⁶ The FCC does have generic limits on tower and antenna placement in its CFR 14 - Part 17 rules that apply to all services.

⁷ <https://www.fcc.gov/ecfs/filing/104202099224796>, dated 20 Apr 2020

⁸ https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG10/WP/FSMP-WG10-WP13-Annex%20%20-%20ECC_PTI_66th_meeting%20-%20ICAO%20Input%20on%20Radioaltimeters%20vs%205G.docx

MHz in Europe. This Liaison Statement mainly focused on the fact that there is no specific limit of unwanted emissions from IMT base stations within the frequency band 4200-4400 MHz.

1.1.4 October 2020

RTCA published Report [SC-239](#)⁹ on the “Assessment of C-Band Mobile Telecommunications Interference Impact on Low Range Radar Altimeter Operations” highlighted the following issues with the operation of mobile/fixed communications network using 5G technology in the frequency band 3.7-3.98 GHz.¹⁰

- That “5G base stations present a risk of harmful interference to radar altimeters across all aircraft types, with far-reaching consequences and impacts to aviation operations”
- That fundamental emission (3,7 - 3.98 GHz signals) from 5G Base Station using active antenna systems could cause harmful interference to Usage Category 1 (Commercial Air transport Aircraft) in certain circumstances. Noting that fundamental emission creates effects on Radio-Altitude like blocking, saturation, intermodulation....
- For Usage category 2 (Regional Business Aviation and General Aviation) and Usage Category 3 (Helicopter) every 5G base station configuration will result in harmful interference, from both fundamental and spurious emissions, being present in virtually all operating scenarios and geometries
- That 5G User Equipment (UE) operating on the ground are not expected to cause harmful interference to radio altimeters
- That 5G UE operating on board Usage Category 2 & 3 aircraft could cause harmful interference to radar altimeters.

1.1.5 November 2020

In France, 5G was authorised and the first base stations were activated. Considering the RTCA SC-239 report, [France has taken immediate action](#)¹¹ to mitigate possible interference with radio altimeters.

1.1.6 Documents published on the subject in 2021

1.1.6.1 CEPT PT1

ECC PT1 #67 January 2021 ECC

There were 3 contributions on the subject:

Airbus [ECC PT1\(21\)022](#)¹² The airframer wanted to make the PT1 aware of the radio altimeter issue, of the existence of the RTCA report SC-239 and of the planned tests.

⁹ https://www.rtca.org/wp-content/uploads/2020/10/SC-239-5G-Interference-Assessment-Report_274-20-PMC-2073_accepted_changes.pdf

¹⁰ US 5G operators and manufacturers were openly invited to participate in the group, but voluntarily withdraw after the first few meetings without explanation. 5G parameters were instead provided via another forum that allowed for some data exchange on 5G and radar altimeter parameters (see RTCA report Appendix B - TWG-3 Information Exchange). Representatives of 5G operators did provide feedback to the final draft report during the public comment process and disagreed with the conclusions made (see RTCA report Appendix C – Public Comments), but were unable to provide any technical information to support their opinion. However, they did provide a correction to the 5G base station parameters they had originally provided (see RTCA report Appendix D – Additional Analysis).

¹¹ <https://portal.icao.int/FMG/Documents/FMG%20CM%202021%20-%20RAFT19/FMGCM2021%20RAFT19%20IP07.pdf>

¹² https://cept.org/Documents/ecc-pt1/62425/ecc-pt1-21-022_airbus-radio-altimeters-interference-from-5gmfcn-in-34-38-ghz

France [ECC PT1\(21\)006](#) ¹³Protection of radio altimeters from MFCN in 3.4-3.8 GHz.

France invites ECC/PT1 to study, as a matter of urgency and taking into account the safety aspect, the risk of interference from 5G in the 3.5 GHz band into radio altimeters. France also presented immediate measures for the protection of radio altimeters .

Bouygues Telecom, Orange [ECC PT1\(21\)027](#)¹⁴

C-band 5G networks have been deployed in different parts of the world, and there was no interference case reported. The source of problem suggested by the RTCA report was Radio-Altitude receiver out of band blocking (...) There is no evidence this RTCA report represents the real situation in Europe or elsewhere (...) If some Radio-Altitude models have receiver blocking problems, a replacement or repair plan must be set up as an urgent matter.

PT1 agreed on a new work Item ([PT1_40](#)¹⁵): “Compatibility between MFCN operating in frequency band 3400-3800 MHz and Radio Altimeters operating in the frequency band 4200-4400 MHz”

The scope of this work item is the following: *Assessment of susceptibility of deployed receivers operating in 4200-4400 MHz, while taking into account any civil aviation initiatives on Radio-Altitude receivers, in order to study the following compatibility scenarios:*

- 1) *Unwanted emissions from MFCN operating in 3400-3800 MHz into 4200-4400 MHz radio altimeters band*
- 2) *Impact of blocking of radio altimeters from 3400-3800 MHz MFCN in-band emissions*

ECC PT1 #68 April 2021 - There were 3 contributions on the subject:

GSA [ECC PT1\(21\)122](#) ¹⁶MFCN characteristics for WI on Radio Altimeters. *GSA invites ECC PT1 to take the MFCN characteristics (as in Annex) into account for the studies of radio altimeters while noting that final information will be provided for the September meeting of ECC PT1.*

France [ECC PT1\(21\)117](#) ¹⁷WI 5G radio altimeters. *France invites ECC PT1 to consider the attached draft skeleton for an ECC report on “Compatibility between MFCN operating in 3400-3800 MHz and Radio Altimeters (RA) operating in 4200-4400 MHz”.* This proposal was accepted by ECC PT1.

Eurocontrol [ECC PT1\(21\)115](#) ¹⁸EUROCONTROL ICAO State Letter on Potential safety concerns regarding interference to radio altimeters. *Eurocontrol invites Administration to consider as a priority, public and aviation safety when deciding how to enable MFCN (5G) services in radio frequency bands near the bands used by radio altimeters.*

ECC PT1 #69 September 2021 - There were 3 contributions on the subject:

¹³ https://cept.org/Documents/ecc-pt1/62166/ecc-pt1-21-006_france-protection-of-radio-altimeters-from-mfcn-in-34-38-ghz

¹⁴ https://cept.org/Documents/ecc-pt1/62432/ecc-pt1-21-027_bouygues-telecom-orange-mfcn-and-radio-altimeters-co-existence

¹⁵ http://eccwp.cept.org/WI_Detail.aspx?wiid=775

¹⁶ https://cept.org/Documents/ecc-pt1/64077/ecc-pt1-21-122_gsa-mfcn-characteristics-for-wi-on-radio-altimeters

¹⁷ https://cept.org/Documents/ecc-pt1/64066/ecc-pt1-21-117_france-wi-5g-radioaltimeters

¹⁸ https://cept.org/Documents/ecc-pt1/64064/ecc-pt1-21-115_eurocontrol-icao-state-letter-on-potential-safety-concerns-regarding-interference-to-radio-altimeters

France [ECC PT1\(21\)192](#)¹⁹ *Outcome from preliminary trial on one type of radio altimeter fitted on helicopter.*

GSA [ECC PT1\(21\)188](#)²⁰ *MFCN characteristics for WI on Radio Altimeters* .

Norway [ECC PT1\(21\)184](#)²¹ - *Results of the preliminary test of compatibility between MFCN operating in 3400-3800 MHz and Radio Altimeters operating in 4200-4400 MHz.*

ECC PT1 #70 January 2022 - There were 7 contributions on the subject:

EUROCAE and RTCA [ECC PT1\(22\)017](#) LS response to ECC on radio altimeters parameters.

EASA and Eurocontrol [ECC PT1\(22\)020](#) Input to ECC Report on MFCN-RA compatibility

France [ECC PT1\(22\)041](#) ECC Report on Compatibility between MFCN operating in 3400-3800 MHz and Radio Altimeters (RA) operating in 4200-4400 MHz.

France [ECC PT1\(22\)048](#) Preliminary outcome of second de-risking trial on the second type of radio altimeter fitted on helicopter of the French gendarmerie.

GSA [ECC PT1\(22\)058](#) Comments on altimeter characteristics for coexistence

FAA [ECC PT1\(22\)INFO01](#) request for radio altimeter parameters

ECC [ECC PT1\(22\)INFO02](#) LS to aviation bodies and DGs of Commission

1.1.7 ICAO

1.1.7.1 ICAO FSMP

1.1.7.2 FSMP WG11 – March 2021

There were 3 contributions on the subject

- [FSMP-WG11-WP27 Mobile vs Radalt REv.1](#) UK Deployment of Mobile Systems in the Frequency Range 3.6-4.2 GHz and the Theoretical Impact on Radio Altimeters
- [FSMP-WG11-WP30 5G Japan](#): The compatibility study between 5G base stations and radio altimeters in Japan and update of the result of measurement campaign.
- [FSMP-WG11-WP19 ICCAIA Working Paper on radio altimeters](#) to Encourage ICAO and Panel Member Participation in Country Regulatory Activities that Could Cause Interference to Radio Altimeters

¹⁹ https://cept.org/Documents/ecc-pt1/65970/ecc-pt1-21-192_france-radioaltimeter

²⁰ https://cept.org/Documents/ecc-pt1/65959/ecc-pt1-21-188_gsa-mfcn-characteristics-for-wi-on-radio-altimeters

²¹ https://cept.org/Documents/ecc-pt1/65941/ecc-pt1-21-184_norway-results-of-the-preliminary-test-of-compatibility-between-mfcn-operating-in-3400-3800-mhz-and-radio-altimeters-operating-in-4200-4400-mhz

- Elements for a proposed State Letter on possible interference to radio altimeters were drafted (see Section 2.2)

1.1.7.3 FSMP WG12 – October 2021

There were several contributions on the subject

- [FSMP-WG12-WP17 ICCAIA 5GLRRA Input](#) ICCAIA presents “*an updates on Industry Assessment of 5G Cellular Compatibility with Radio Altimeters*» and asks to provide feedback for a new update.
- [FSMP-WG12-IP05 Status on replanning the 3700–4200 MHz band in Australia](#). Australia presents the current status of activity in Australia to address the potential impact of deployment of wireless broadband services in the 3.4-4.0 GHz band on Aviation safety.
- [FSMP-WG12-IP07 Interference Susceptibility Evaluations of Pulsed Radio Altimeters Due to 5G Mobile Base Station Signal_rev1](#) Enri (JAPAN) presents laboratory tests on “*Interference Susceptibility Evaluations of Pulsed Radio Altimeters Due to 5G Mobile Base Station Signal*” on two Honeywell RT300
- [FSMP-WG12-IP12 - Brazil 5G Auction](#) provides information on 5G auction in Brazil and technical parameters.

1.1.7.4 ICAO High Level Conference On COVID-19 (HLCC 2021)

One [paper](#)²² co-signed by Air Transport Association (IATA), the International Business Aviation Council (IBAC), the International Coordinating Council of Aerospace Industries Associations (ICCAIA), the International Federation of Air Line Pilots’ Associations (IFALPA) and RTCA will be presented on “Safety concerns regarding interference to aircraft radio altimeters”. This Working Paper asking that States *mitigate the risk of 5G implementation to safety-critical radio altimeter functions*.

1.2 Information and Frequencies bands used for 5G around 4.2-4.4GHz worldwide.

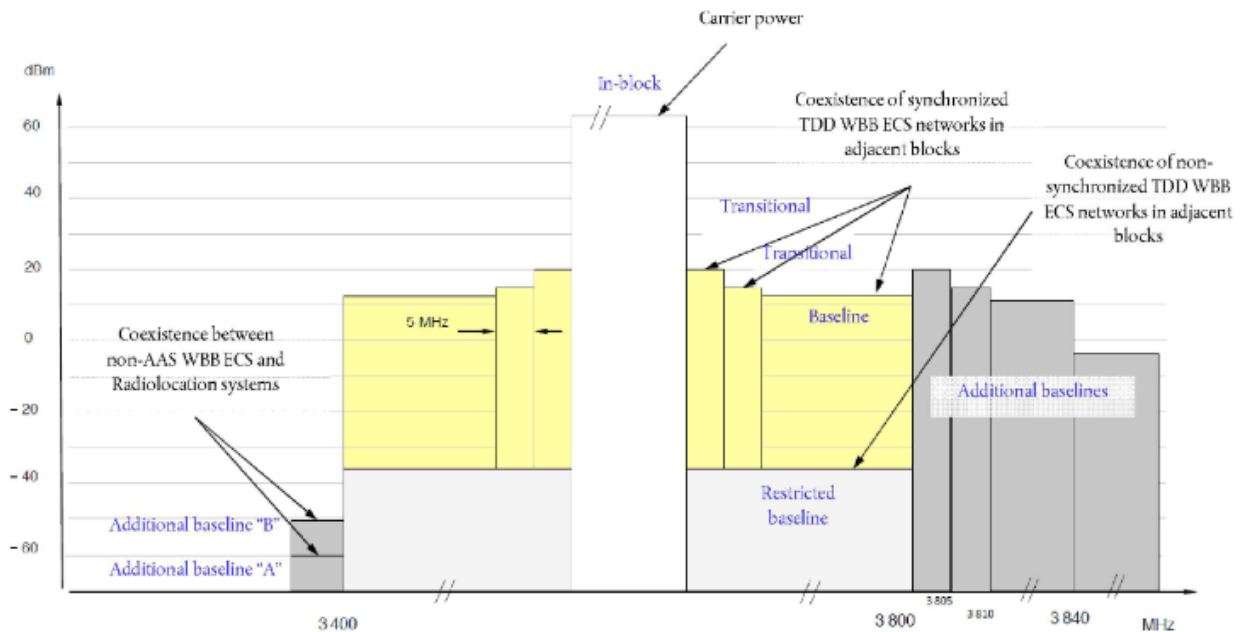
1.2.1 European Union law

Commission Implementing Decision ([EU](#)) 2019/235²³ of 24 January 2019 on amending Decision 2008/411/EC as regards an update of relevant technical conditions applicable to the 3400-3800 MHz frequency band.

²² https://www.icao.int/Meetings/HLCC2021/Documents/WP/EN/SAF/wp_030_en.pdf

²³ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019D0235>

Example of base station BEM elements and power limits

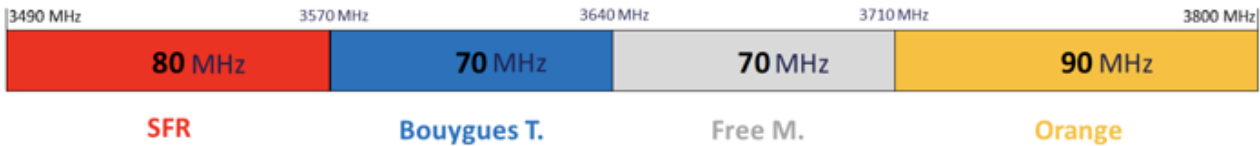


Definition of Block Edge Mask (BEM) elements

BEM element	Definition
In-block	Refers to a block for which the BEM is derived.
Baseline	Spectrum within 3 400-3 800 MHz used for WBB ECS, with the exception of the block assigned to the operator and the corresponding transitional regions.
Transitional region	Spectrum within 0 to 10 MHz below and 0 to 10 MHz above the block assigned to the operator. Transitional regions do not apply to TDD blocks assigned to other operators, unless networks are synchronised. The transitional restricted regions do not apply below 3 400 MHz or above 3 800 MHz.
Additional baseline	Spectrum below 3 400 MHz and above 3 800 MHz.
Restricted baseline	Spectrum used for WBB ECS by networks unsynchronised or semi-synchronised with the operator's block in question.

No Power limitation In-block assigned to the operator for non-AAS and AAS base stations

1.2.2 France

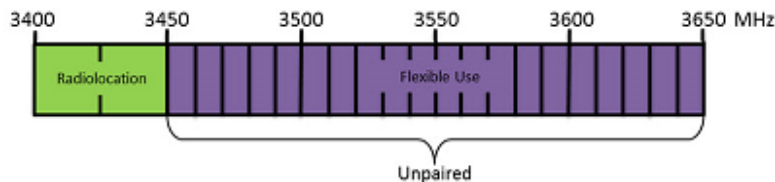


24

The power spectral density (PSD) of the base stations varies according to the operators between 62.44dBm/5MHz to 67.34 dBm/5MHz.

1.2.3 Canada

This figure below shows the proposed 3500 MHz band plan, which includes the frequency range of 3400 to 3650 MHz. The frequency range of 3400 to 3450 MHz is allocated for radiolocation. The frequency range of 3450 to 3650 MHz is divided into 20 unpaired blocks of 10 MHz each and allocated for fixed and mobile (flexible use).



1.2.4 USA

The USA has allocated 3.7-3.98 GHz to services including 5G in Feb 2020 in 20 MHz license blocks that can be aggregated by the same operator up to 100 MHz. The FCC limited the power to 65 dBm/MHz maximum EIRP for rural areas, and 62 dBm/MHz in urban areas, though no limits were placed on antenna positioning or direction. 5G operators won the subsequent auction in Dec 2020 for over \$80 bn USD with additional money going to the SATCOM operators fund satellite migration and ground station filtering. Given the need to migrate existing SATCOM users over time, the first 100 MHz (3.7-3.8 GHz) was planned for implementation in Dec 2021, and the remaining 3.80-3.98 GHz in Dec 2023. Licensees are also only in certain Partial Economic Areas (PEAs) in the US, not nationwide.

1.3 Worldwide actions

1.3.1 Japan

At the last FSMP, Japan presented measures for the deployment of 5G base stations around runway. These measures were put in place a long time before the French mitigation measures were implemented. Both measures are similar.

Apart from the fact that Japan uses a different frequency band than Europe (closer to the radio altimeter frequency band), in time when Japan implemented these mitigation measures, AAS antennas were not allowed. The maximum EIRP (macro cells 68dBm or small cells 48dBm) was therefore much lower than EIRP (with AAS antennas) allowed in Europe and in the U.S. For these reasons, Japan requires smaller separation distances while being closer to the radio altimeter frequency band.

1.3.2 New Zealand

²⁴ <https://www.arcep.fr/la-regulation/grands-dossiers-reseaux-mobiles/la-5g/frequences-5g-procedure-dattribu-tion-de-la-bande-34-38-ghz-en-metropole.html>

In November 17th 2020, CAA published a safety message that require to “Do not use 5G devices inflight if you have a radar altimeter”.

1.3.3 United Arab Emirate

United Arab Emirate also published a [SafetyAlert](#)²⁵ at the attention of United Arab Emirate Aircraft Operator, informing them about the likelihood of 5G interferences on aircraft system. This safety alert also recommends to monitor and report any 5G interference events.

1.3.4 France

France published a [Safety info leaflet](#)²⁶ while mitigation measures are still in place around CAT III runway. Extensive tests were planned but the mobile operator involved left the table after few weeks of preparation. This test is still on hold.

1.1 France conducted and provided the preliminary outcome of de-risking trials, performed by test pilots, on two type of radio altimeter one fitted on an AS350 helicopter of the French gendarmerie. ([ECC PT1\(22\)048](#)) and an other fitted on an EC 135 helicopter also of French gendarmerie ([ECC PT1\(21\)192](#)). It has been observed that there was no unexpected behaviour of the type of radio altimeters fitted onboard helicopters of the French gendarmerie during the retained trial, which gives reasonable level of confidence on the resilience of these type of radio altimeters.

This two de-risking trials on radio altimeters embedded on helicopters of the French gendarmerie lead France to consider that all the different types of radio altimeters used by helicopters of the French gendarmerie and civil protection in France are now covered where the emissions characteristics of 5G base stations are similar. Indeed, the tests were performed with a base station whose 5G antenna tilt was negative. Therefore, although the tests provide a representative scenario, the absence of unexpected behaviour cannot alone guarantee that the radio altimeter will remain free from harmful interference from 5G NR emissions in all configurations. It has also to be noted that, subject to confirmation by the radio altimeter manufacturers, the two types of radio altimeters fitting helicopters of the French gendarmerie are in conformity with the blocking level of CAT-1 radio altimeters as assumed in the RTCA report. Therefore, the results of these trials cannot be used to address the cases of other type of radio altimeters much more sensitive to interferences and which have been considered under the CAT-3 of the RTCA report.

Additional trials may be envisaged with other types of radio altimeters.

France also started consultation with mobile operator in order to define the roadmap of 5G in order to have the deployment perspective of 5G in order to have baseline for future MOPS for radio altimeter offering resilience to IMT 5G and other applications. Indeed, France considers that it is the highest priority task to conduct in close cooperation with all the stakeholders within ECC PT1.

1.3.5 Australia

The Australian spectrum regulator (the ACMA) has formed a technical liaison group (TLG) to review/develop spectrum and apparatus licence technical frameworks for the 3400-4000 MHz band. Public consultation on the proposed rules that are informed by the TLG are expected in March / April 2022. The Australian Civil Aviation Safety Authority (CASA) published an [Airworthiness Bulletin](#)²⁷ asking to report any Radio-

²⁵ <https://www.gcaa.gov.au/en/epublication/admin/Library%20Pdf/Safety%20Alerts/SAFETY%20ALERT%202021-03%20-%20REQUIREMENTS%20TO%20MITIGATE%205G%20INTERFERENCE%20OPERATIONAL%20RISKS%20-%20ISSUE%2001.pdf>

²⁶ https://www.ecologie.gouv.fr/sites/default/files/Safety_Info_Leaflet_2021_01_5G_interferences.pdf

²⁷ <https://www.casa.gov.au/files/awb-34-020-issue-3-potential-interference-radio-altimeter-systems>

Altimeter interference that occurs below 2500 feet.

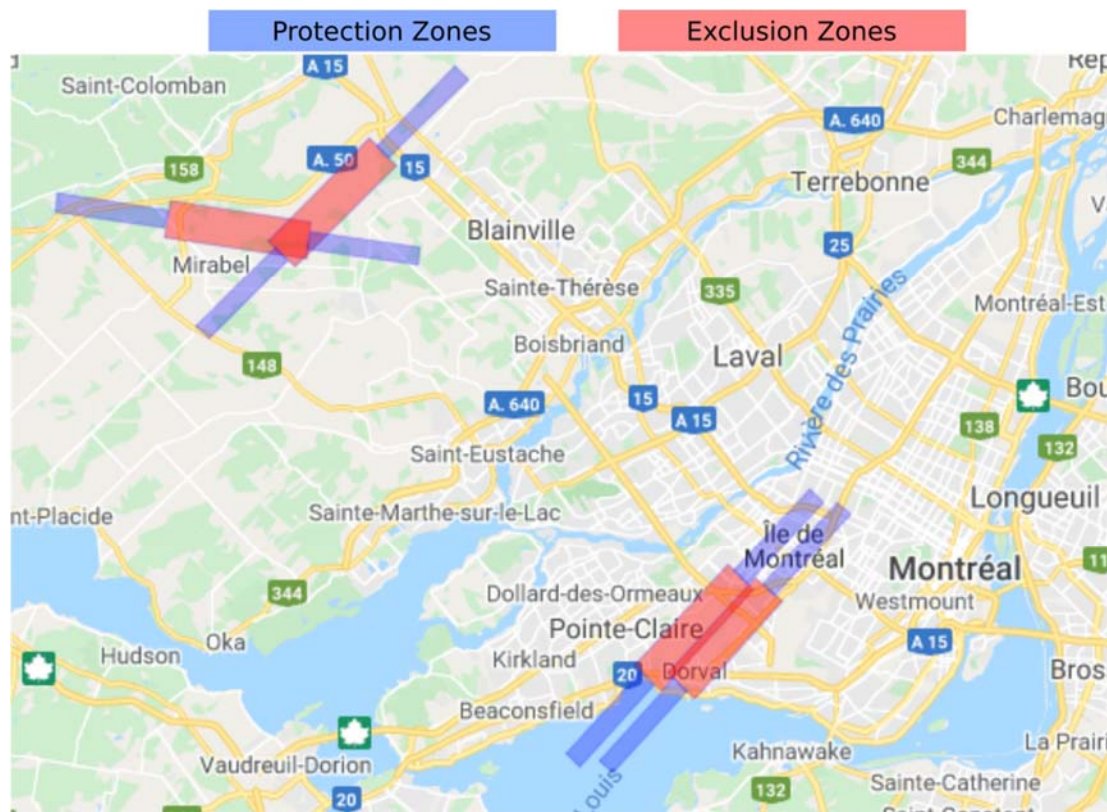
In late December 2021 CASA issued an [exclusion](#) from the Operation of Airworthiness Directives FAA AD 2021-23-12 and FAA AD 2021-23-13. This Exclusion applies to any Australian registered aircraft when it is operated outside the airspace of the United States of America.

1.3.6 Canada

Canada published a [Civil Aviation Safety Alert](#)²⁸ on “Potential Interference of Radio Altimeter Systems”. It recommends switching off all 5G passenger/flight crew devices and in case of interference, to report the event to the Air Traffic Service as soon as possible.

On August 6, 2021, Innovation, Science and Economic Development Canada (ISED) initiated a [Consultation](#)²⁹ on Amendments to SRSP-520, Technical Requirements for Fixed and/or Mobile Systems, Including Flexible Use Broadband Systems, in the Band 3450-3650 MHz (the Consultation). (ISED) invites further comments and extending the deadline to October 15, 2021.

In October 2021, the Canadian government³⁰ decided to take mitigation measures (similar to Japan and France) by defining exclusion zones and protection zones around airports.



Montreal example

²⁸ <https://tc.canada.ca/sites/default/files/2021-06/CASA-ASAC-2021-08.pdf>

²⁹ <https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11736.html>

³⁰ <https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11726.html>

In October 2021 [ISED's decision](#)³¹ on use of the 3450-3650 MHz band published imposes mitigation techniques, including nationwide 5G antenna down pointing and airport exclusion zones, to protect radio altimeters.

1.3.7 Thailand

CAA Thailand issue the document "Continued Airworthiness Notification" to Thailand's Aircraft Operators to provide recommendations on the issue. The document could be found in the attachment or could be reached by this address with reference number [CAAT-CAN-2021-02](#)³²

CAA Thailand issue an official letter to NBTC-Thailand's Spectrum Regulator to raise their awareness on the potential interference from 5G to Radio altimeter issue. As of now, Thailand is in the auction process on the C-band spectrum (3 400 - 3 700 MHz) while still have a discussion of the suitable guard band between IMT and FSS.

1.3.8 Sultanate of Oman

Sultanate of Oman published an [Aeronautical Information Circular \(AIC\)](#)³³. The purpose of this Civil Aviation Safety Alert is to raise awareness of the potential risk of 5G interference and to recommend precautionary operational measures before confirmation of impact of 5G radio waves on radio altimeters.

1.3.9 Czech Republic

November 2021, Czech Republic in their [Safety Brief](#)³⁴ inform that "Prague Airport respects the safety zones and precaution zones specified by the French Civil Aviation Authority DGAC and keeps them free of any 5G transmitters. And kindly asked to the pilots to report any radio altimeter issues.

1.3.10 USA

The United States Federal Aviation Administration (FAA) on 23 December 2021 issued a [Special Airworthiness Information Bulletin \(SAIB\) on the Risk of Potential Adverse Effects on Radio Altimeters](#) and also two Airworthiness Directives (ADs): [Airworthiness Directive on altimeter interference and airplanes](#), and an [Airworthiness Directive on altimeter interference and helicopters](#). The FAA has also facilitated data sharing between avionics manufacturers and wireless companies, and recent dialogue has helped to establish information sharing between aviation and telecommunications sectors and newly agreed measures to reduce the risk of disruption, but these issues are ongoing and will not be resolved overnight.³⁵

2. DISCUSSION

The problem of radio altimeters is not specific to 5G but rather to high field susceptibility. We can take the example given by [ATR in its presentation to the FSMP](#)³⁶. But of course, since 5G is being deployed massively and globally around the radio altimeter frequency band 4.2-4.4 GHz, it makes 5G the main part of the problem.

³¹ <https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11747.html>

³² <https://www.caat.or.th/en/archives/56597>

³³ <https://www.caa.gov.om/upload/files/AIC%2004-21.pdf>

³⁴ <https://www.prg.aero/sites/default/files/obsah/O->

[letisti/O%20spole%C4%8Dnosti/Bezpecnost%20na%20letisti/Safety/Safety%20Brief/SAFETY%20BRIEF%20LKPR%2093%20Interference%20of%205G%20networks%20with%20radio%20altimeters.pdf](#)

³⁵ <https://www.faa.gov/5g>

³⁶ https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG11/IP/FSMP-WG11-IP06_RA_interference.pdf

The mid-band frequencies ranges discussed here have become central to 5G operators plans to rollout new technologies, balancing capacity and coverage. The priority the 5G operators place in this spectrum range is reflected by the multiple billions offered in different national auctions. This is contrasted by radar altimeters being a highly sensitive system, needed to achieve the necessary performance and accuracy, reacting to a dramatic change in the RF environment. Radar altimeters are deployed on most aircraft for many essential air safety functions of modern aircraft given its capability and years of interference free performance. Therefore, both industries are highly invested in the outcome, but also use different standards and metrics to assess the risk of interference. Combined with the significant sums of money and political interests, this creates a source of friction that appears difficult to solve.

2.1 Why C-band 5G networks have been deployed in different parts of the world, and there was no interference case reported?

This question is often asked, but the risk cannot be generalised. The risk of interference to a Radio Altimeter depends on many parameters such as:

- Maximum Effective Isotropic Radiated Power (E.I.R.P = power of the 5G base station (xxx) + antenna gain (yy))
 - Power of the 5G base station (xxx dBm) call TRP (True Radiated Power)
 - Antenna gain (yy dBi) depending on the type of antenna.
- the location of the Base station antenna
- the antenna tilts.
- The vertical scan (Scan angle)
- the rate of use of a base station
- The ground scattering and altitude
- the frequency band used.
- aggregated unwanted emission level

From one country to another, all these parameters are different even in CEPT countries.

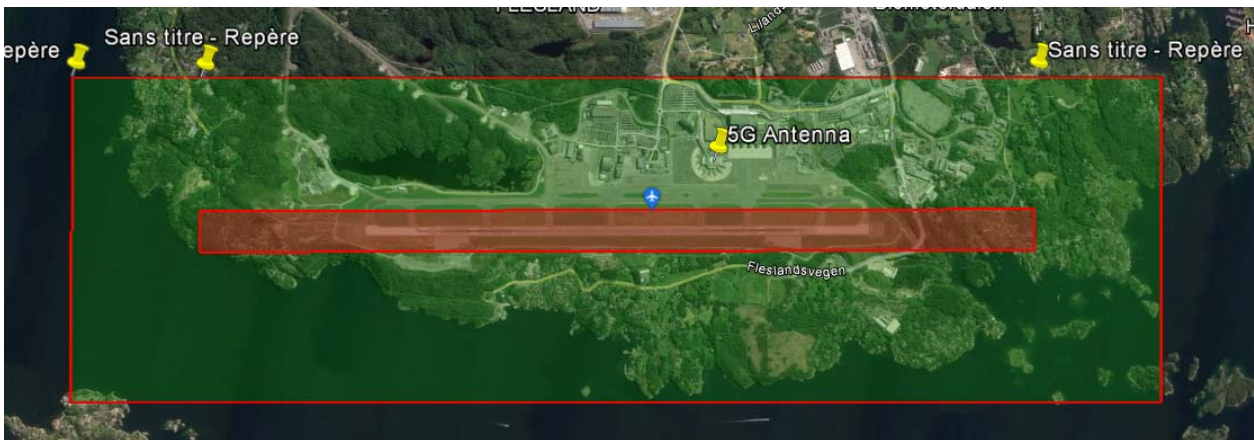
2.1.1 E.I.R.P

The tests carried out by Norway are interesting.

If we consider the power parameter (EIRP) as a parameter and estimate the "zone de sécurité" (safety zone) as defined in the French mitigation measures.

If we use the power of 60.68dBm EIRP from Norway: the "zone de securité" is in red (123m each part of the runway);

If we use the power of 78dBm EIRP from France: "zone de sécurité" is in green (910m each part of the runway).



As we can see, using an EIRP of 60.68dBm for the 5G Base station, the runway easements are sufficient to protect radio altimeters, using an EIRP of 75dBm for the 5G Base station: implementing 5G antenna on the air terminal would be problematic.

E.I.R.P is the main problem, but within the regulations, there is no limit of EIRP! Because there are not limit on the antenna Gain, only the TRP is limited ($E.I.R.P = TRP + \text{Antenna Gain}$). AAS antennas are a huge problem, because in theory there is no limit to the antenna gain and therefore no regulation on the limit to the EIRP. Without EIRP limits, we will never be able to develop standards that allow radio altimeters to be resilient!

2.1.2 Type of antennas used

Two different technology are available for 5G antennas with different antenna gain and therefore acts directly on E.I.R.P

- AAS antenna (*advanced antenna systems*) is the general term used to describe antenna using adaptive beamforming. Depending on the information available, the gain can exceed 25dBi
- Non AAS antennas are antennas with a fixed beam, usually 120° where the gain where the gain is constant around 15dBi.

2.1.3 Antenna tilt

In some countries, the tilt must always be below the horizon, and therefore the maximum gain towards the aircraft is lower (about 5dB) than the maximum gain of the antenna. But for example, in France, this constraint has been removed by a ministerial decision. Negative tilt is only imposed in the precautionary and safety zones around aerodromes with CAT III approaches (there is no CAT II in France).

The desire to use the 5G for the UTM will question the limitation of negative tilt in other countries.

2.1.4 The vertical scan (Scan angle)

The vertical scan of an AAS Antenna has the ability to steer the main beam of the AAS antenna upward toward an aircraft above the horizon. There are no restrictions on the vertical scan angle in the Telecommunication regulations. The main beam is steered above the horizon depending on User Equipment demand in the vicinity and network management policy of the operators and the antenna manufacturers.

RTCA report details the consequences on radio Altimeters in such cases (refer to §10.1.3). Also, high negative vertical scan angles can also create significant grating lobes upward.

2.1.5 The rate of use of a base station

The power radiated by a base station depends on the data traffic passing through it. According to the information available: in France, data transmitted in 5G represents less than 1.5% of mobile data. This can be explained by the price of 5G subscriptions, which is tending to fall. At the same time, the rate of 5G compatible phones that will be available for the population is going to increase, knowing that but the average renewal period for a phone is 2 years. This means that, within 2 years, most of the phones will be 5G capable and the 5G mobile data traffic will be higher.

2.1.6 The ground scattering and altitude.

The susceptibility of radio altimeters also depends on the ratio of the 5G signal to the radio altimeter return signal. The higher the ground scattering is, the more resistant the radio altimeter is. But this coefficient is not constant, it depends on the type of soil (sand, pure water or sea, agricultural land, vegetation...) and the soil moisture content. A very interesting [document](#)³⁷ produced by Honeywell (page 33 to 40) deals with this complex subject and helps to understand the issue.

The altitude of the aircraft increases the path loss of the Radio altimeter signal, and therefore makes its receiver more sensitive, but at the same time the altitude of the aircraft moves it away from the 5G base stations and increase 5G the path loss. Studies and simulations have shown that the most unfavourable altitude is around 200ft.

2.1.7 Aggregated unwanted emission level

RTCA report indicated that the conducted PSD (Power Spectral Density) of Spurious Emissions from a 5G Base Station is -20 dBm/MHz. It also indicates that the peak output PSD of this spurious level at the output of the antenna (eirp) corresponds to a conducted PSD through a single element of an AAS antenna. So the Peak Output PSD spurious (eirp) can reach -12.9 dBm/MHz. RTCA Report relies on data provided by Telecommunication community (as per Appendix B)

2.1.8 The frequency band used

The new uses of 5G worldwide are concentrated in the frequency band 3-5 GHz. A wide guard band does not make it safe, but it is part of the equation to protect radio altimeters. That is why the availability of data on the susceptibility for all type of Radio-Altimeter over the whole frequency band 3-5 GHz, will allow us to establish specific rules for each 5G frequency band.

2.2 Stakeholder organisation

2.2.1 ICAO

2.2.1.1 FSMP

³⁷ <https://avsi.aero/wp-content/uploads/2021/12/Radar-Altimeter-Overview-of-Design-and-Performance.pdf>

ICAO sent a state letter (drafted by FSMP) to raise awareness in the aviation community.

During FSMP WG11, a correspondence group on radio altimeters (CG-RA) was formed to collect information on a number of topics related to 5G/altimeter compatibility ([FSMP WG11 Report³⁸ Appendix H](#)).

2.2.1.2 Flight Operations Panel (FLTOSP)

During FLTOSP/8 an information paper 6 updated the position on interference by 5G communications in the aircraft radio altimeters (FLTOSP/7 Decision 5/2).

The panel were informed that the original statement had been presented to the frequency spectrum management panel (FSMP), and that the FSMP had requested any specific examples of interference to be shared with them.

Regarding updating of the industry standards for radio altimeters, the panel noted that work was underway with RTCA to develop more robust systems, but that this would be a long term fix as the new standards would not be completed until Q4 2022 and would then need to be adopted by equipment manufacturers to be implemented. Reports from the 5G industry suggested there was considerable interest in looking at improvements and mitigations to allow 5G development to continue without impacting on aircraft safety.



FLTOSP WG8 IP06
- 5G Interference.pdf

³⁸<https://www.icao.int/safety/FSMP/MeetingDocs/Forms/AllItems.aspx?RootFolder=%2fsafety%2fFSMP%2fMeetingDocs%2fFSMP%20WG11%2fReport&FolderCTID=0x012000556AC038F4589F4281B27ABB7E901CAE>

2.2.1.3 FMG Europe

The European FMG is following the issue and invites its members to express ICAO's concerns to their respective frequency regulator.

2.2.2 EASA

Following the CARI (Continuing Airworthiness Review Item) sent by EASA to all aviation stakeholders on the subject, the partial data received until now by EASA (initial deadline in February 2021) did not allow to conclude on a risk assessment for all possible combinations of radalt/aircraft models. Further data are still expected .

During ECC PT1 #68 Meeting (April 2021), EASA has taken the lead in the collection, compilation and anonymisation of radio altimeter data from the different manufacturers. These data are needed to be implemented into the draft ECC Report (CEPT PT1 SWG C TEMP 13 / ANNEX VIII-13) for conducting studies, and only EASA (within Europe) has the authority/legitimacy to request this data from manufacturers. EASA did not contribute nor participate in the following ECC PT1 #69 meeting (sept 2021).

2.2.3 EASA / EC DG MOVE / EUROCONTROL

On 25 February 2021, a joint workshop was hosted by EASA, the European Commission and EUROCONTROL for aviation stakeholders. Presentations were given by EASA, RTCA / EUROCAE, Airbus, Thales, DGAC and EUROCONTROL. The presentations were made available to all registered participants.

2.2.4 EUROCONTROL

On 2 October 2020, the EUROCONTROL Airport Operations Team was informed about the 5G and RADALT issue. The airports community was requested to be vigilant about 5G deployments near aerodromes and to ensure caution when deploying 5G infrastructure themselves.

On 23 February 2021, EUROCONTROL presented the potential for RFI to RADALT from 5G emissions to the 4th meeting of SAFOPS, which is part of the network manager working arrangements. It also published a safety bulletin with an information message to operators. The bulletin is to make sure that if events related to RADALT are reported, that they are made available to EVAIR, the EUROCONTROL Voluntary ATM Incident Reporting System, for further analysis. As of end September 2021, no such reports have been received.

On 12 March 2021, an action paper on Possible 5G Interference to Radio Altimeters was presented to the NDTECH meeting, the Network Directors of Technology Working Group (agenda item 4.6). The paper summarizes the issue and associated developments and calls for cooperation between airport operators, ANSP, aviation and radio regulatory authorities, military and all airspace user organizations to cooperate on the matter. It establishes three priorities for such activities, which are to 1) maintain safety, 2) limit the economic impact to the aviation industry and 3) engage with the 5G industry to facilitate 5G developments as far as possible while maintaining safety and a viable transition to operations with equipment built to improved RADALT standards. NDTECH continues to be informed on this matter through the “matters arising” agenda item.

2.2.5 CEPT PT1

At the beginning of the year 2021, when the issue was brought to the attention of PT1, there was a lot of tension. But since the ITM community has realised that the aeronautical community is not able to provide technical characteristics, they are more confident. Some of them asked to put the subject on hold, others said that if EASA doesn't react then there are no problems, and therefore the work item must be closed...

The ECC PT1 report on the Radio-Altitude topic was planned to be delivered for March 2022

Important involvement of the aviation industry at the PT1 meeting of 11-12 and 17-21 January 2022. Based on documents (cf. §1.1.5.1 CEPT PT1 /ECC PT1 #70 January 2022), the meeting agreed to establish a Correspondence Group (CG), chaired by Mr Alexander Deder (Germany), until the next ECC PT1 meeting (with the Terms of Reference in [ECC PT1\(22\)074 ANNEX VIII-28](#)). The CG convener should provide an update to ECC PT1 chairman on the progress of CG activity one week prior to the upcoming ECC meeting in order for PT1 chairman to inform ECC accordingly.

The CG continued developing the draft ECC Report on compatibility between MFCN operating in 3400-3800 MHz and Radio Altimeters operating in 4200-4400 MHz ([ECC PT1\(22\)074 ANNEX VIII-27](#)).

Material from relevant input documents was included in appropriate places into the working document but there was not sufficient time to discuss it, so it was inserted with square brackets and further considerations are required. Questions by the mobile industry were raised on whether received parameters for Radio-Altitude were the most appropriate and a list of [clarifying questions was drafted](#). ASRI kindly agreed to work on responses to these questions. Recognising that there is a range of Radio-Altitude performance, participants stressed the need to agree first on realistic assumptions and scenarios before starting any compatibility studies. It was also highlighted that assumptions should represent the CEPT situation.

During the discussions it was pointed out that there are still missing parameters required for the simulations. AVSI informed the meeting that additional parameters are intended to be published in March this year. It was highlighted that a reply to Eurocae/RTCA on received Radio-Altitude parameters and questions regarding 5G performance would be essential.

The draft ECC Report had been scheduled to be finalised for submission to ECC for approval for public consultation from this ECC PT1 meeting but this was the first time the group received information regarding radio altitude characteristics, therefore more time is needed to progress the work and an extension to the deadline by 3 additional ECC PT1 meetings to work item PT1_40 will be requested from ECC (draft report for public consultation to be approved at ECC PT1 #73 in January 2023 for submission to ECC #61 in March 2023; resolution of public consultation comments at ECC PT1 #74 in April/May 2023 and final approval at ECC #62 in June/July 2023).

2.2.6 FAA (Federal Aviation Administration U.S.A)

See Section 1.3.10[TBC]

2.2.7 RTCA-EUROCAE

Following the US national regulator's decision to allow 5G services in the 3.7-3.98 GHz, additional study was encouraged given the questions raised by the aviation community. From this, RTCA created a public multi-stakeholder group under its SC-239 committee that conducted an extensive theoretical study of the simulated 5G interference, assessing it against radar altitude performance data from the major manufacturers in common and real-world scenarios. With the regulatory limits defined by the US national regulator for base stations and handsets, combined with data from the 5G interests, the [RTCA SC-239 Report](#)³⁹ found that all

³⁹ https://www.rtca.org/wp-content/uploads/2020/10/SC-239-5G-Interference-Assessment-Report_274-20-PMC-2073_accepted_changes.pdf

aircraft types and multiple operations received interference from both simulated fundamental and spurious 5G emissions. The RTCA Report concluded that “5G base stations present a risk of harmful interference to radar altimeters across all aircraft types, with far-reaching consequences and impacts to aviation operations”. Although they did not participate in the public RTCA work, 5G interests have challenged the findings stating it is overly conservative and there is no interference potential. Since publication of the RTCA Report, no decision has been yet made by the U.S national regulatory.

In December 2020, RTCA made an interesting [Youtube presentation of the Radio Alitmeter issue](#)⁴⁰.

RTCA and EUROCAE (SC-239/WG-119) have jointly initiated the drafting of new Mops for the Radio Altimeter, the completion of the work is scheduled for December 2022.

3. Conclusion

Radio altimeters were developed at a time when:

- mobile telecommunication industry didn't exist.
- coexistence with systems in adjacent frequency bands had little or no impact.

The increase demand for wireless technology to enable connectivity has come to surround of some aeronautical frequency bands, including the Radio Altimeter frequency band 4.2-4.4GHz. It was clearly never anticipated by the Radio altimeters industry in 1980s.

Although the aviation community is developing new standards as fast as possible, but States shall ensure the safety of life during this transitional period. The aeronautical community must make “the best effort” but can do it only if the limits of RF environment are perfectly known and stable for decades.

– END –

⁴⁰ <https://www.youtube.com/watch?v=OpYhjK2MDqM>



INFORMATION PAPER

FREQUENCY SPECTRUM MANAGEMENT PANEL (FSMP)

Thirteenth Working Group meeting

Web Meeting, 21– 25 February 2022

Agenda Item 4: Radio Altimeter Issues

Briefing material on the Radio Altimeter and 5G rollout issues

(Presented by the Secretariat)

SUMMARY

The recent and ongoing rollout of 5G in the frequency band below the Radio Altimeter band at 4200-4400 MHz and the potential associated interference issues to Radio Altimeters that 5G base stations may cause has resulted in questions being asked to the ICAO Secretariat, by Aeronautical Regulators and others.

This paper contains informal briefing material, as developed for use by the Secretariat in January 2022, further supplementing the information provided in State Letter 21/22 as attached hereto.

1. Briefing, Key Points

1.1 The allocation of radio frequency bands is beyond ICAO's mandate as the international standard setting body for aviation. ICAO is nonetheless working very closely with State regulators to better understand their positions, and has received information from several countries which are presently conducting studies into the 5G and Radio Altimeter interference issue ahead of deployment of their 5G networks.

1.2 ICAO has been concerned by the apparent lack of a consistent standardized approach between States as they proceed with the rollout of 5G. Frequency ranges slated for 5G use vary from country to country, including with respect to how close they come to the Radio Altimeter band. There is also a very substantive difference in the prescribed maximum radiated power of the 5G base stations from one country to another.

1.3 ICAO has shared these concerns with regulators and has asked them to prioritize the safety of the public when deciding how to enable cellular broadband/5G services in radio frequency bands near the bands used by radio altimeters.

1.4 Any questions about the current regulations pertaining to 5G issues in specific countries must be addressed directly to the applicable national authorities.

2. Technical Background

2.1 Radio Altimeters (RA) are a mandated critical aircraft safety system used to determine an aircraft's height above terrain. The technical performance of the RA, including receive mask and interference resilience, is currently not standardized by ICAO. There are currently no applicable industry standards either describing those characteristics.

2.2 The RA operate at 4200-4400 MHz, in a portion of a frequency range often designated as the "C-band". The frequency bands adjacent to the RA band, have traditionally been "quiet" until the recent 5G rollout in the C-band". The adjacent bands were previously mainly used for downlinks from geostationary satellites.

2.3 The information from the RA is an essential enabler for several safety related flight operations and navigation functions on all commercial aircraft as well as a wide range of other civil aircraft. Functions include terrain awareness, aircraft collision avoidance, wind shear detection and flight controls, functions to automatically land an aircraft including autothrottle and thrust reversers.

2.4 If not properly mitigated, harmful interference from 5G will pose a serious safety risk. Safety net systems subject to interference by 5G such as the ground proximity warning system will become unreliable. These systems were introduced to avoid accidents based on lessons learned from previous ones. The unreliability of these systems defeats their purpose and poses a serious safety risk. Additionally, if the mitigations taken will result in operation of RA being prohibited at certain airports, then this would infer the necessary shutdown of those airports during foul weather (i.e. Instrument Flight Rules) conditions, which in turn could lead to widespread disruptions.

2.5 Studies from several States and organizations indicate the potential for harmful interference to RA if high powered base stations are implemented near the frequency band used by the RA and at distances close to airports/runways.

2.6 Industry studies cataloging the interference susceptibility of various RA types are still ongoing. While some RA typically used in helicopters, general aviation and business aircraft appear to be more vulnerable to interference, other RA, more often found in commercial aircraft appear to be less susceptible to potential interference from 5G.

2.7 The 5G rollout strategies in different States are different in terms of key parameters such as how close the frequency band used is to the RA frequency band and the total transmitting power of the base stations. Hence the mitigatory strategies taken will need to be tailored to each specific situation.

2.8 The current situation in the US is not directly comparable to that of the current rollout taking place within some European and other States, in that the "typical" 5G base stations being rolled out in the US operate in a frequency band closer to the RA band and may transmit at power levels which are up to an order

of magnitude higher. The US FAA has issued a [Safety Alert for Operators](#) and Airworthiness Directives on the issue.

2.9 ICAO and industry standards are under development for the “future” RA, focusing especially on the interference environment. This however will be a longer-term solution.

2.10 To estimate the scope of potential RA replacements required, “one major air transport manufacturer representing approximately half of air transport sector, reports approximately 15,000 airplanes in service. There are three groups of altimeters operating on those airplanes, roughly representing three generations of RA equipment. All three groups were included in RA testing for the RTCA 2020 report. One group is represented by the RTCA 2020 report interference threshold and represents roughly 3000 airplanes. A second group performs somewhat better and is operating on 7000 airplanes. Finally, the third group is significantly more robust on the remaining 5000 airplanes. If only the most robust group of altimeters can meet the updated standard, then 10,000 aircraft will need to replace altimeters at an estimated cost of several billion dollars.” (Ref. 12th Meeting of the Frequency Spectrum Management Panel Working Group (FSMP WG/12), 4-15 Oct 2021, WP/17 – presented by the International Coordinating Council of Aerospace Industries Associations (ICCAIA)).

2.11 Several States have already implemented temporary technical, regulatory and operational mitigations on new 5G systems in order to protect the RA while more permanent solutions are being devised

Attachment:

[ICAO SL 21/22 “Potential safety concerns regarding interference to radio altimeters”, published 25 March 2021.](#)

— END —