



| ICAO

INTERNATIONAL CIVIL AVIATION ORGANIZATION

A UN SPECIALIZED AGENCY

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International
Civil Aviation
OrganizationOrganisation
de l'aviation civile
internationaleOrganización
de Aviación Civil
InternacionalМеждународная
организация
гражданской
авиацииمنظمة الطيران
المدني الدولي国际民用
航空组织

State Letter issued in March last year

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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 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/JP/FSMP-WG11-IP07_RTCA_Report.docx



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Problem Statement issued by IATA and IFALPA



Problem statement - 5G interference with radio (radar) altimeter frequency band

Reference

Problem statement and industry response to the ICAO FLTOPSP/7 information paper IP03 "5G frequency interference" and agenda item 5.4 "5G interference"

Introduction

Radio (radar) altimeters (RA), operating at 4.2-4.4 GHz, are the only sensors onboard a civil aircraft which provide a direct measurement of the clearance height of the aircraft over the terrain or other obstacles (i.e. the Above Ground Level - AGL - information).

The RA systems' input is required and used by many aircraft systems when AGL is below 2500 ft. Any failures or interruptions of these sensors can therefore lead to incidents with catastrophic outcome, potentially resulting in multiple fatalities. The radar altimeters also play a crucial role in providing situational awareness to the flight crew. The measurements from the radar altimeters are also used by Automatic Flight Guidance and Control Systems (AFGCS) during instrument approaches, and to control the display of information from other systems, such as Predictive Wind Shear (PWS), the Engine-Indicating and Crew-Alerting System (EICAS), and Electronic Centralized Aircraft Monitoring (ECAM) systems, to the flight crew.

There is a major risk that 5G telecommunications systems in the adjacent frequency bands to radio altimeters, including 3.7-3.98 GHz, will cause harmful interference to radio altimeters on all types of civil aircraft—including commercial transport airplanes; business, regional, and general aviation airplanes; and both transport and general aviation helicopters. If there is no proper mitigation, this risk has the potential for broad impacts to aviation operations in the United States as well as in other regions where the 5G network is being implemented close to the 4.2-4.4 GHz frequency band.

An example listed further below shows, that the identified risk has materialized during certain airline operations impacted by similar interference.

List of potential equipment failures

Interference to RA operations can affect



Some history: The ITU Radio Regulations in 1947

Bands adjacent to the Radio Altimeter band already allocated to the Mobile service.

However in practice, until recently, with the advent of Satellite links and until recently, these bands were mainly used for Satellite Downlink

2 700-2 900 (200)	Aero- nautical radio- navigation ¹⁰⁸⁾			
2 900-3 300 (400)	Radio- navigation ¹⁰⁹⁾ ¹¹⁰⁾			
3 300-3 900 (600)		3 300-3 900 (600) a) Fixed b) Mobile c) Radio- navigation	3 300-3 500 (200) Amateur 3 500-3 900 (400) a) Fixed b) Mobile	3 300-3 900 (600) a) Amateur b) Fixed c) Mobile d) Radio- navigation
3 900-4 200 (300)	a) Fixed b) Mobile			
4 200-4 400 (200)	Aero- nautical radio- navigation ¹¹¹⁾			
4 400-5 000 (600)	a) Fixed b) Mobile			
5 000-5 250 (250)	Aero- nautical radio- navigation			



Present:
The ITU Radio Regulations as a result of the latest WRC (rev 2020)

Allocation to services		
Region 1	Region 2	Region 3
3 600-4 200 FIXED FIXED-SATELLITE (space-to-Earth) Mobile	3 600-3 700 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile 5.434 Radiolocation 5.433	3 600-3 700 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile Radiolocation 5.435
	3 700-4 200 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile	
4 200-4 400	AERONAUTICAL MOBILE (R) 5.436 AERONAUTICAL RADIONAVIGATION 5.438 5.437 5.439 5.440	
4 400-4 500	FIXED MOBILE 5.440A	
4 500-4 800	FIXED FIXED-SATELLITE (space-to-Earth) 5.441 MOBILE 5.440A	

Not much change.

Fixed Satellite Service allocations added in 1970s approx.

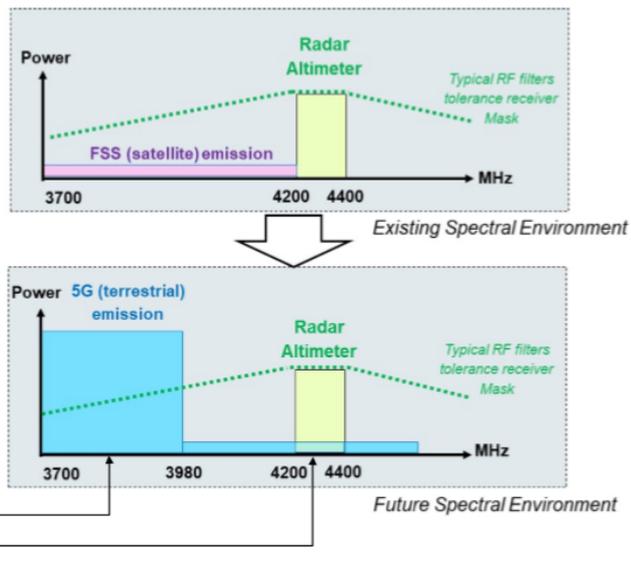
Mobile bands below 3700 MHz identified for IMT in 2007/2012, through country footnotes.

Current rollout of 5G not related to the ITU WRC-23 agenda



On-going Long-Term Actions

RA receivers have not been designed to support such level of terrestrial interferences in its adjacent and nearby bands (previously allocated to satellites) while being compliant with applicable regulations at time of certification



- New RTCA/EUROCAE MOPS expected end of 2022.
- ICAO FSMP task agreed in 2016 to include the new equipment standards into the ICAO Annexes and to assist with coordination with ITU for appropriate legal protections for future radio altimeters. This task will be progressed and finalized asap, dependent on the work being performed within RTCA/EUROCAE.



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ASSEMBLY 41ST SESSION (27 SEP TO 7 OCT 2022) WPS RELATED TO SPECTRUM



[Assembly 41st Session \(icao.int\)](https://www.icao.int)



Item 30: Aviation Safety and Air Navigation Policy

***Spectrum
(WRC and 5G/Radio Altimeter):
A hot topic related to CNS!***

WPs related to Spectrum and 5G.

A41-WP/80 TE/11	STRENGTHENING PROTECTIONS FOR AVIATION SAFETY SYSTEMS FROM HARMFUL INTERFERENCE	
A41-WP/227 TE/78	SAFEGUARDING MEASURES TO PROTECT RADIO ALTIMETER FROM POTENTIAL HARMFUL INTERFERENCE	
A41-WP/266 TE/99	COLOMBIAN CIVIL AVIATION AUTHORITY'S ENDORSEMENT OF THE ICAO POSITION ON RELATED MATTERS TO BE CONSIDERED AT THE WORLD RADIOCOMMUNICATION CONFERENCE (2023) (WRC-23) OF THE INTERNATIONAL TELECOMMUNICATION UNION (ITU)	

Also, Information papers provided by Brazil (A41-WP/536), Oman (A41-WP/410) and United States (A41-WP/561) were noted



A41 Outcome related to ICAO policy on radio frequency spectrum matter

The Technical Commission

- Requested ICAO and its Member States to continue taking necessary measures and efforts to ensure that radio altimeters and other aeronautical systems are free from harmful interference, including implementation of mitigation measures, sharing of best practices, as well as development of relevant provisions and guidance.
- Recognizing the criticality of radio frequency spectrum, encouraged States and regions to actively participate in spectrum defense activities and to endorse the ICAO position for the ITU WRC-23. (State letter E 3/5-21/37).

A41 adopted Resolution 30/2: Support of the ICAO policy on radio frequency spectrum matters, which enhances Assembly Resolution A38-6 adding the following statement in the new resolution.

2. Urges Member States to consider, as a priority, public and aviation safety when deciding how to enable new or additional services, and to consult with aviation safety regulators, subject matter experts and airspace users, to provide all necessary considerations and to establish regulatory measures to ensure that incumbent aviation systems and services are free from harmful interference.

*These texts extracted
from the draft report*



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- **ICAO State Letter 21/22:**
<https://www.icao.int/MID/Documents/2021/FM%20WG2/74-1e.pdf>
the SL includes several useful links, including Report by RTCA and reports of several national studies and mitigations.
- **A41 Assembly:** <https://www.icao.int/Meetings/a41/Pages/default.aspx>
- **A better presentation on the actual Radio Altimeter and its use:**
<https://www.icao.int/NACC/Documents/Meetings/2018/RPG/RPGITUWRC2019-P08.pdf>

- **Frequency Spectrum Management Panel, Working Group/12 (4-15 October 2021)**
 1. **WP/17** “ICCAIA updates on Industry Assessment of 5G Cellular Compatibility with Radio Altimeters”
https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG12/WP/FSMP-WG12-WP17_ICCAIA_5GLRRA%20Input.docx
 2. **IP/03** “Status on replanning the 3700-4200 MHz band in Australia”
https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG12/IP/FSMP-WG12-IP05_Status%20on%20replanning%20the%203700-4200%20MHz%20band%20in%20Australia.docx
 3. **IP/07**, ENRI Japan, “*Interference Susceptibility Evaluations of Pulsed Radio Altimeters Due to 5G Mobile Base Station Signal*”
https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG12/IP/FSMP-WG12-IP07_Interference%20Susceptibility%20Evaluations%20of%20Pulsed%20Radio%20Altimeters%20Due%20to%205G%20Mobile%20Base%20Station%20Signal_rev1.pptx
- **IP/12** “Brazil 5G auction”
<https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG12/IP/FSMP-WG12-IP12%20-%20Brazil%205G%20Auction.pdf>

- **Frequency Spectrum Management Panel, Working Group/15 (22 Aug -1 Sep 2022)**
 1. **IP/08** “National efforts to implement broadband mobile near 4200-4400 MHz - Report from correspondence group on radio altimeters (CG-RA) “
https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG15/IP/FSMP-WG15-IP08_CG-RA%20Report%20August%202022%20V1.0.docx



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The activities related to Radio Altimeter/5G in the MID Region

Muna Alnadaf

RO/CNS - ICAO MID Office



01

Introduction



02

Radio Altimeter Action Group



03

**Safeguarding measures adopted by
MID states**



04

**Coordination between PIRG &
RASG**

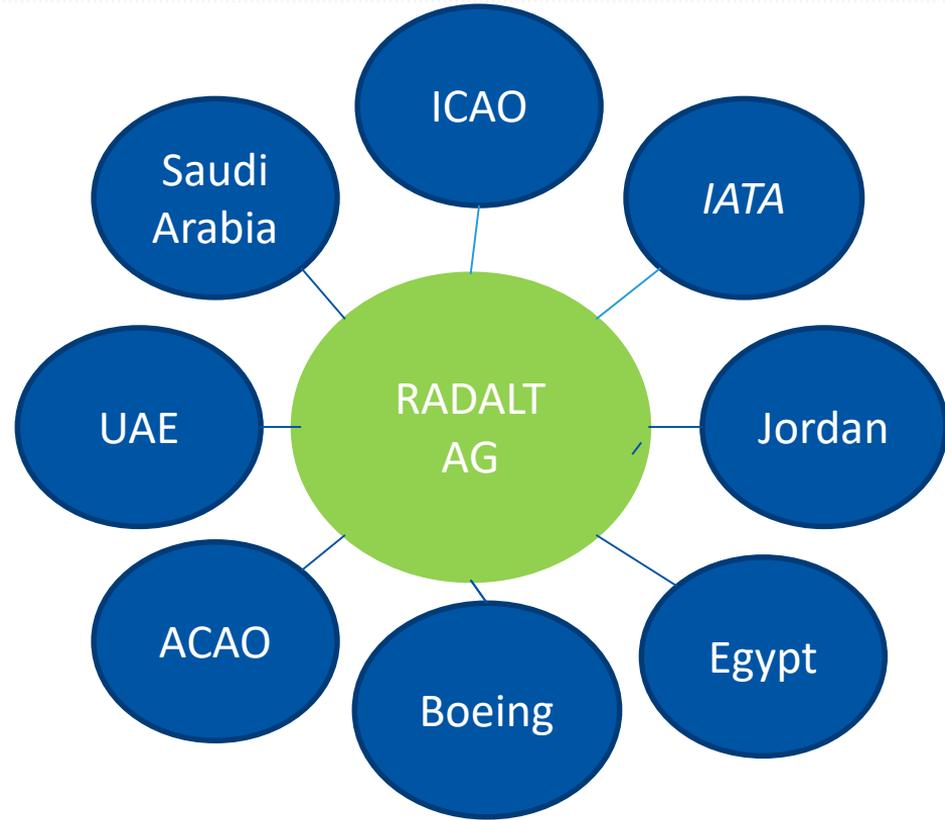


MIDANPIRG/19 meeting (14-17 February 2022, Saudi Arabia):

- acknowledged the safety concerns and potential operational impacts of the 5G & Radio Altimeter interferences;
- updated the Frequency Management Working Group Terms of Reference to include tasks related to the issue of 5G & Radio Altimeter interferences;
- agreed to establish Radio Altimeter (RADALT) Action Group to develop guidance material to protect the aircraft operations from potential Radio Altimeter interference



RADALT AG established to develop guidance material to protect the aircraft operations from potential Radio Altimeter interference associated with the deployment of cellular broadband/5G ground infrastructure near the bands used by RADALT



Chapter 1 – Background on 5G and Frequency band allocation

Chapter 2 – Potential impact of 5G on Radio Altimeters during Aircraft operations

Chapter 3 – Short Term Safeguarding measures adopted at Regional and Global levels

Chapter 4 – Methodologies for defining safeguarding measures for Aerodromes and heliports



MID Dec XXXX

INTERNATIONAL CIVIL AVIATION ORGANIZATION

**Guidance on Safeguarding measures to protect
Radio Altimeter from potential harmful interference
from Cellular 5G Communications**

Edition 1.0-Rev.0 | November 2022

The document is under final review will be circulated next week



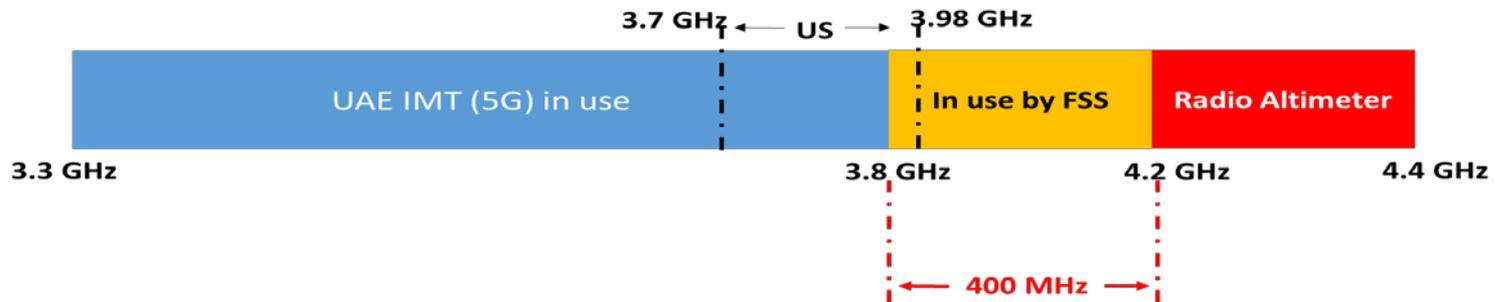
-  **01 Introduction**
-  **02 Radio Altimeter Action Group**
-  **03 Safeguarding measures adopted by MID states**
-  **04 Coordination between PIRG & RASG**

1) Oman

- a) Established Ad-hoc committee
- b) Issued a safety circular Aeronautical Information Circular (AIC), 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.
- c) Conducted awareness campaign for industry
- d) Monitoring the industry report/complaint due to interference if any. q Joint work and cooperation between TRA and CAA in any relevant update in this regard.

2) UAE

Telecommunications and Digital Government Regulatory Authority is responsible for managing radio spectrum in UAE. 5G allocations in UAE are in the band 3.3 – 3.8 GHz



The UAE plans to use the band 3.8 – 4.0 GHz for IMT only after completion of technical studies to protect RADALT in 4.2- 4.4 GHz and in the future may extend this use up to 4.2 GHz.

The General Civil Aviation Authority (GCAA – UAE) published a Safety Alert at the attention of United Arab Emirates Aircraft Operator, informing them about the likelihood of 5G interferences on aircraft systems. This safety alert also recommends monitoring and reporting any 5G interference events.

<https://www.gcaa.gov.ae/en/epublication/admin/Library Pdf/Safety Alerts/SAFETY ALERT 2021-03 - REQUIREMENTS TO MITIGATE 5G INTERFERENCE OPERATIONAL RISKS - ISSUE 01.pdf>



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MIDANPIRG DECISION 19/24: 5G SAFEGUARDING MEASURES

That, the CNS SG coordinate with the RASG-MID relevant subsidiary bodies the 5G Safeguarding measures around the aerodromes to protect RADALT from any interference

CNS SG/11 requested RASG relevant Subsidiary body to include the 5G interference with RADALT in the RASG ASRT report, edition 12 as one of the emerging risks that will require close coordination between regulators and providers of telecommunication services and adherence to recommendations set to ensure protection of radio altimeter equipment on board aircraft.”





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