



**WORKING PAPER**

**ASSEMBLY — 41ST SESSION**

**TECHNICAL COMMISSION**

**Agenda Item 30: Aviation Safety and Air Navigation Policy**

**30.3 Relevant Outcomes of the High-level Conference on COVID-19, Safety Stream (HLCC 2021)**

**SAFEGUARDING MEASURES TO PROTECT RADIO ALTIMETER FROM POTENTIAL HARMFUL INTERFERENCE**

(Presented by Saudi Arabia on behalf of the Arab Civil Aviation Organization (ACAO) States<sup>1</sup>)

**EXECUTIVE SUMMARY**

The on-going deployment of mobile/fixed communications 5G networks, at national, regional, and global levels, is concentrated in the frequency band 3-5 GHz as it offers additional International Mobile Telecommunications (IMT) services including higher data rates required by various applications. As the new cellular broadband technologies (5G) rollout plans are using frequency bands that are around and close to the radio altimeter frequency band 4.2-4.4 GHz, the aviation community has formally recognized and expressed safety concerns arising from the potentially harmful interference to radio altimeters. Based on the available information on 5G/Radio Altimeter analysis and compatibility studies, several Contracting States have already implemented interim technical, regulatory, operational mitigations, and safeguarding measures to protect radio altimeters during aircraft operations.

**Action:** The Assembly is invited to:

- a) note the information provided in this paper;
- b) request ICAO to develop comprehensive guidance material on safeguarding measures to protect radio altimeters from harmful interference and to work closely with ITU to review the relevant recommendations and criteria related to the protection of aeronautical frequency bands; and
- c) review and update the Assembly Resolution A38-6 “Support of the ICAO policy on radio frequency spectrum matters” considering the information provided in this paper.

<i>Strategic Objectives:</i>	This working paper relates to the Safety and Air Navigation Capacity and Efficiency Strategic Objectives.
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<sup>1</sup> Member States of the Arab Civil Aviation Organization (ACAO): Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syrian Arab Republic, Tunisia, United Arab Emirates, and Yemen.

<i>Financial implications:</i>	The ICAO activities referred to in this paper can be undertaken within the resources available in the 2023-2025 Regular Programme Budget and/or from extra budgetary contributions.
<i>References:</i>	Doc 10160, <i>High-Level Conference on COVID-19 (Montréal, 12 to 22 October 2021). Report</i> Doc 10140, <i>Assembly Resolutions in Force (as of 4 October 2019)</i> Doc 10115, <i>Report of the Thirteenth Air Navigation Conference (AN-Conf/13)</i>

## 1. INTRODUCTION

1.1 The band 4.2-4.4 GHz is allocated to the aeronautical radionavigation service (ARNS) and is reserved exclusively for radio altimeters installed onboard aircraft and for the associated transponders on the ground by International Telecommunications Union (ITU) Radio Regulations (RR)<sup>2</sup>, Article 5 – Frequency Allocations, footnote No. 5.438. The radio regulations allow use of 5G in the frequency range 3400 – 4200 MHz.

1.2 The radio altimeter is a mandatory safety-critical aircraft system used to determine an aircraft’s height above Earth surface (e.g., terrain and obstacles) with a high degree of accuracy and integrity during the approach, landing, and climb phases of aircraft operations. It plays a crucial role in providing situational awareness to the flight crew and is considered an essential component of aeronautical safety-of-life during aircraft operations. The system is installed on all types of commercial and general aviation aircraft including helicopters and the height measurements are typically used by aircraft systems at or below 2500ft altitude Above Ground Level (AGL) to enable safety-related flight operations and navigation functions.

1.3 The radio altimeter system is also providing height information to other onboard safety-critical systems and functions such as terrain awareness and warning system, ground proximity warning system, aircraft collision avoidance, wind shear detection, automatic flight guidance and control systems including functions for automatic approach and landing.

1.4 As radio altimeters are considered an essential component of aeronautical safety-of-life during aircraft operations, ITU has defined, in February 2014, protection criteria<sup>3</sup> known as “ITU-R M.2059-0: Operational and technical characteristics and protection criteria of radio altimeters utilizing the band 4 200-4 400 MHz” to safeguard radio altimeter system from harmful interference during aircraft operations. This document identifies three primary electromagnetic interference coupling mechanisms between radio altimeters and interfering signals from other transmitters that may be source of harmful interference with deleterious effects including receiver desensitization, overload/blocking, false altitude reports, and general failure, depending on the duration and characterization of the interference.

<sup>2</sup> *ITU Radio Regulations (RR) is an International Treaty, elaborated and revised by administrations and membership, during World Radio Conferences (WRC); RR has a binding nature for ITU Member States.*

<sup>3</sup> <https://www.itu.int/rec/R-REC-M.2059/en>

## 2. DISCUSSION

### 2.1 Deployment of 5G network & Safety concerns

2.1.1 The on-going deployment of mobile/fixed communications 5G networks, at national, regional, and global levels, is concentrated in the frequency band 3-5 GHz as it offers additional International Mobile Telecommunications (IMT) services including higher data rates required by various applications. The frequency spectrum management and allocation are under the responsibility of each State telecommunication regulator.

2.1.2 As the new cellular broadband technologies (5G) rollout plans are using frequency bands that are around and close to the radio altimeter frequency band 4.2-4.4 GHz, the aviation community has formally recognized and expressed safety concerns arising from the potentially harmful interference to radio altimeters.

2.1.3 Within ICAO, the Frequency Spectrum Management Panel (FMSP) has received and reviewed studies and submissions from several States and specialized organizations regarding the potential risk of interference to radio altimeters with the deployment of new cellular broadband technologies (5G). These Studies and submissions indicate that:

- a) there is potential risk for harmful interference to radio altimeters if high powered 5G base/ground stations are deployed near the frequency band used by the radio altimeters and at distances close to aerodromes;
- b) the radio altimeters used in helicopters, general aviation and business aircraft appear to be more vulnerable to interference, and radio altimeters installed onboard commercial aircraft appear to be less susceptible to potential interference from cellular broadband technologies (5G); and
- c) the risk of interference to a Radio Altimeter depends on many parameters such as: the frequency band used, power of the 5G base station, the type of antenna, the location of the 5G base station, the antenna setting i.e., tilts, the rate of use of a base station...etc. There are also significant differences in the deployment characteristics of 5G base stations from one State to another.

2.1.4 Based on a proposal from FSMP, ICAO issued a State Letter expressing potential safety concerns regarding interference to radio altimeters (ICAO SL 21/22 “Potential safety concerns regarding interference to radio altimeters”, published on 25 March 2021). This letter encourages administrations to consider as a priority, public and aviation safety when deciding how to enable cellular broadband/5G services in radio frequency bands near that used by radio altimeters. The FSMP continues to work on the subject and expects additional contributions from States, and specialized international organizations.

2.1.5 In October 2021, the ICAO High-Level Conference on COVID-19 (HLCC) adopted recommendation 5/5 as risk mitigation strategy to protect the radio altimeters from potential harmful interferences that may be caused by cellular broadband/5G services.

## 2.2 Short & long terms safeguarding measures

2.2.1 Based on the available information on 5G/Radio Altimeter analysis and compatibility studies, several ICAO Contracting States have already implemented interim technical, regulatory, and operational mitigations associated with the deployment of cellular broadband/5G services to protect radio altimeters from harmful interference. With this respect, safety notices, bulletins or circulars have been issued to aircraft operators highlighting the safety measures that must be implemented to reduce and mitigate potential risk of interference from 5G networks deployed around aerodromes. These measures include mainly the following:

- a) the aircraft operators must take the required actions to ensure that all Portable Electronic Devices (PEDs) must be in a non-transmitting mode during taxiing, take-off, and landing;
- b) the aircraft operators should ensure their flight crew are aware of the possible implications of radio altimeter malfunctions particularly during Precision Instrument Approaches in Low Visibility Operations; and
- c) the flight crew must advise the air traffic service units of any disturbance to the radio altimeter and report the occurrence to the civil aviation authority using safety reporting procedures.

2.2.2 Regarding the deployment of cellular broadband/5G network, several civil aviation authorities have coordinated with national spectrum regulators, and mobile/fixed communications 5G network providers to identify appropriate mitigations and safeguarding measures that should be implemented to protect radio altimeters from harmful interference. The measures have defined protection zones around the aerodromes considering the location of 5G base stations, as well as details on deployment characteristics and parameters (e.g. antenna type, height and setting, the frequency band used, power of the 5G base station...etc..). Typically, the protection zones include:

- a) **Safety zone:** rectangular area around the runway where 5G base stations are not authorized to transmit and defined to protect the Radio altimeters during approach for landing where the aircraft is at or below 200 ft. The dimensions of the area depend on the 5G base station maximum radiated power; and
- b) **Precaution/Buffer Zone:** rectangular area contiguous to the safety zone and centered around the runway centerline imposing restriction on 5G base station transmission radiated power with specific setting of antenna radiation pattern, i.e., low radiated power transmission around aerodromes with a downward beam tilt angle of each 5G transmitting antenna. The dimension of this area is defined based on the clearance distance required between the location of the 5G base station and the path of an aircraft flying nearby giving assurance that the attenuation of radiated energy has no impact on radio altimeters. In general, 1000 ft is the reference height/altitude of an aircraft used for the calculation of the clearance distance.

2.2.3 In addition, many States have conducted assessment and test flights around the aerodromes to proactively ascertain the actual levels of 5G base station transmissions and its potential impact on radio altimeters performance.

2.2.4 Regarding the long-term solutions, ICAO and Standards Developing Organizations are working on the development of new Minimum Operational Performance Standards (MOPS) and SARPs for the Radio Altimeter and interference resilience.

2.2.5 Even with new MOPS and SARPs for the Radio Altimeter and viable technical solutions, the retrofit of current radio altimeters installations, would take many years to properly validate, and deploy across all affected civil aircraft operating in the world. Therefore, it is crucial to adopt measures and mitigations to protect the performance of radio altimeters during aircraft operations.

2.2.6 ICAO is conducting several activities related to 5G/Radio Altimeter analysis and compatibility and the material is shared through ICAO FSMP website: <https://www.icao.int/safety/FSMP/Pages/default.aspx>. The outcome of these activities can be further complemented by additional technical studies and consolidated into a comprehensive guidance material.

### 3. CONCLUSION

3.1 The growth in demand for cellular broadband/5G providing additional International Mobile Telecommunications (IMT) services is introduced using the frequency band 3-5 GHz. The deployment of mobile/fixed communications networks in this band may impact nearby aeronautical frequency bands, including the Radio Altimeter frequency band 4.2-4.4GHz.

3.2 Although, ITU has defined protection criteria for radio altimeter band, the dramatic change in the RF environment and the significant differences between States in implementing cellular broadband/5G technologies were not considered and these criteria should be reviewed considering the evolution and evolution of wireless technology. With this respect, the Assembly may consider requesting ICAO to work closely with ITU to review the relevant radio regulation, recommendations and criteria related to the protection of aeronautical frequency bands, including the Radio Altimeter frequency band 4.2-4.4GHz.

3.3 Until the development of new standards for the Radio Altimeter and interference resilience, there is a need to protect radio altimeters as they are considered an essential component of aeronautical safety-of-life during aircraft operations. Therefore, the Assembly may invite ICAO to develop comprehensive guidance material on safeguarding measures to protect radio altimeters from harmful interference and to update the Assembly Resolution A38-6 “Support of the ICAO policy on radio frequency spectrum matters” considering the on-going deployment of mobile/fixed communications 5G networks in the band 3-5 GHz that may impact nearby aeronautical frequency bands, including the Radio Altimeter frequency band 4.2-4.4GHz.

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