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

**C-BAND 5G MOBILE SERVICE AND ITS COEXISTENCE WITH AERONAUTICAL
RADIONAVIGATION SERVICES IN BRAZIL**

(Presented by Brazil)

EXECUTIVE SUMMARY

This paper presents an overview of the discussions and actions taken to ensure the safe operation of Aeronautical Radionavigation services, mainly radio altimeter operations, in the context of the Brazilian C-Band 5G mobile service environment.

*Strategic
Objectives:*

*Financial
implications:*

References:

1. INTRODUCTION

1.1 The introduction of 5G mobile services in frequency bands near the 4,2-4,4 GHz band raised concerns about potential interference to radio altimeters. Studies such as RTCA Inc Paper No. 258-20/SC239-006¹ evidenced this new technology's potential for interference.

1.2 The Federal Agency responsible for telecommunications regulation in Brazil, ANATEL, auctioned the C-Band 5G mobile service in November 2021, which encompasses the 3,3-3,7 GHz frequency band. The operations started in July 2022.

1.3 The Brazilian National Civil Aviation Agency (ANAC) has been working together with ANATEL, having also interacted on this matter with civil aviation and telecommunications authorities of other countries, in addition to aircraft manufacturers and air operators.

1.4 This work led to some actions taken by ANATEL and ANAC to mitigate the potential of interference from the Brazilian 5G environment, in order to ensure safe coexistence between aeronautical radio navigation services and the 5G Mobile Service in C Band.

1.5 ANAC is continuing this work and following 5G deployment in Brazil and the evolution of studies and discussions of this topic worldwide.

2. DISCUSSION

2.1 The aviation community has raised concerns about potential interference with radio altimeters since standards for these systems did not consider frequency bands and power levels such as the ones considered and in use worldwide for 5G. Several studies concluded that some radio altimeters can suffer interference from 5G mobile systems implemented near the frequency band used by radio altimeters.

2.2 The radio altimeter is an aircraft system used to measure an aircraft's height above terrain. This information is used for several critical aircraft functions such as terrain awareness, aircraft collision avoidance, wind shear detection, flight controls, and functions to land an aircraft on commercial civil aircraft automatically. If not properly mitigated, a harmful interference to these functions during flight may pose a safety risk to passengers, crew, and people on the ground.

2.3 Considering this scenario and the long time it takes to develop new standards and deploy radio altimeters tolerant to C-Band 5G, it was necessary to assess the 5G environment in Brazil and its potential for interference with radio altimeters.

2.4 ANAC has been working with ANATEL to address the frequency bands and power levels of the Brazilian environment, which is different from most of the studies available for this issue. The interaction with aviation and telecommunications authorities of other countries, in addition to aircraft manufacturers and air operators, was fundamental to understanding these studies and to adapting them to our parameters. The data received in cooperation with other civil aviation and telecommunication authorities were fundamental to enable this work.

¹ RTCA, "Assessment of C-Band Mobile Telecommunications Interference on Low Range Radar Altimeter Operations," RTCA Paper No. 258-20/SC239-006 (rel. Sept. 18, 2020). Available from: https://www.rtca.org/wp-content/uploads/2020/10/SC-239-5G-Interference-Assessment-Report_274-20-PMC-2073_accepted_changes.pdf

2.5 The work focused in identifying the worst-case scenarios for the potential of interference from 5G to radio altimeters, using a free-space path loss propagation model, considered parameters and data such as:

- a) aircraft height above ground level;
- b) 5G base station position and height;
- c) radio altimeter antenna gain;
- d) C-Band 5G base station antenna gain;
- e) interference breakpoint at the radio altimeter receiver input;
- f) margins to account the variability of test results to define interference breakpoint at the radio altimeter receiver input;
- g) safety margin of 6dB, according to ICAO recommendations²;
- h) cable loss from radio altimeter receiver circuit.

2.6 The most critical scenarios identified were related to an aircraft approaching to land, considering reasonable worst-case conditions for: positions and geometries of the base station antenna, aircraft angle of attack in an approach to land, radio altimeter antenna radiation diagrams, base station antenna radiation diagrams, and the effects of the relative position of base station antenna to aircraft radio altimeter antenna.

2.7 These studies and discussions led to the preliminary conclusions that it is necessary to limit the angle of C-Band 5G base station antenna main lobe elevation up to the horizon (zero degrees of effective elevation). A power level limitation near airport runways was also identified as necessary.

2.8 With this, ANATEL Act n. 9064³, as of 28 June 2022, defined a precautionary zone composed of a rectangle of 2100 meters from each end of the runway and 910 meters of each side of the approach line, for the airport runways allowed to perform precision approaches. It was defined a limitation of C-Band 5G base station antenna main lobe elevation up to the horizon and power level limitations of 67 dBm/100 MHz for 3,3-3,6 GHz and 65 dBm/100 MHz for 3,6-3,7 GHz frequency ranges for the rectangle's area, based on calculations and analysis performed.

2.9 ANAC also issued the Operational Safety Alert (ASO) 0003-0/2022⁴ on 5 July 2022, providing alert information to the civil aviation community (mainly owners, aircraft operators and crews) about the start of 5G signal operation in Brazil.

² ICAO Doc 9718, "Handbook on Radio Frequency Spectrum Requirements for Civil Aviation, Volume I: ICAO spectrum strategy, policy statements, and related information" – Second Edition, Released 2018. Available from: [https://www.icao.int/safety/FSMP/Documents/Doc9718/Doc9718_Vol_I_2nd_ed_\(2018\)corr1.pdf](https://www.icao.int/safety/FSMP/Documents/Doc9718/Doc9718_Vol_I_2nd_ed_(2018)corr1.pdf)

³ ANATEL Act n. 9064, issued on June 28th of 2022, available at: https://sei.anatel.gov.br/sei/publicacoes/controlador_publicacoes.php?acao=publicacao_visualizar&id_documento=9850633&id_orgao_publicacao=0

⁴ ASO – Operational Safety Alert 0003-0/2022, issued on July 05th of 2022, available at: https://www.gov.br/anac/pt-br/assuntos/seguranca-operacional/informacoes-de-seguranca-operacional/aso/ASO_00030_2022ENG.pdf

3. CONCLUSION

3.1 The rapid changes to the C-Band frequency spectrum can pose a risk of interference to existing radio altimeter-equipped aircraft. Therefore maintaining continuous coordination between aviation and telecommunication authorities is essential.

3.2 ANAC considers the mitigations defined in ANATEL Act n. 9064 and ASO 0003-0/2022 are sufficient to address the potential of interference from C-Band 5G to radio altimeters in Brazil. As the deployment of 5G evolves and new studies are being developed, additional mitigations can be necessary or some of the measures in force can be lifted.

3.3 Since aviation is global, the next steps on this issue should leverage from a close interface among states in order to find out an approach that is shown to be safe and reasonable, taking into account both aviation and telecommunication industries' needs and constraints.

3.4 ICAO coordination with the International Telecommunication Union (ITU) could generate some guidance to be used by all states. Limitations for the Brazilian 5G environment were generated due to a collaboration work with many entities, which certainly would be facilitated if ICAO had issued some guidance on how to approach the issue.

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