International Civil Aviation Organization

WORKING PAPER

A41-WP/561
TE/209
13/9/22
(Information paper)
English only

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)

MANAGING CHANGES TO SPECTRUM USE FOR SAFE COEXISTENCE

(Presented by the United States)

EXECUTIVE SUMMARY

The radio frequency spectrum is a natural resource with finite capacity and constantly increasing demands. Internationally, the aviation industry relies on the use of spectrum for a variety of technologies that ensure safe, efficient and cost-effective air travel. Similarly, innovation by the telecommunications industry is critical for economic and societal advances throughout the world, requiring States charged with making spectrum decisions to balance these needs.

The United States believes that increased and sustained cooperation, coordination, and communication among regulatory entities, consistent with their respective roles and authorities, will be conducive to promoting spectrum coexistence.

Strategic Objectives:	This information paper relates to the Safety and Air Navigation Capacity and Efficiency Strategic Objectives.
Financial implications:	This paper contains no significant financial implications.
References:	

1. INTRODUCTION

1.1 Background

1.1.1 The United States (U.S.) Government agencies responsible for managing non-federal and federal spectrum, the Federal Communications Commission (FCC) and the National Telecommunications and Information Administration (NTIA), have a long history of assessing the impact of proposed spectrum reallocations. In addition, the U.S. Federal Aviation Administration (FAA) has experience assessing the spectrum needs of military and civil aviation.

1.1.2 In February 2021, the FCC awarded licenses to 21 wireless providers, targeting the 3.7-3.98 GHz portion of the radio frequency spectrum. During the five years prior to this decision, the aviation industry raised multiple concerns about potential interference with thousands of installed radio altimeters and the potential degradation of flight safety. Based on its own internal analysis, the FCC adopted several technical requirements on 3.7-3.98 GHz licensees that it concluded addressed those concerns. However, concerns about flight safety due to interference remained for some in the aviation industry.

1.2 Role of Radio Altimeters

1.2.1 Radio (or radar) altimeters are installed on thousands of civil aircraft worldwide. They are the only high precision sensors that directly measure the relative height of the aircraft above terrain and other obstacles. (Other types of altimeters, such as those using GPS or barometric techniques, report absolute altitude above mean sea level.) Operating in the protected 4.2-4.4 GHz aeronautical band, radio altimeters provide critical information to a number of aircraft systems, including terrain awareness and warning systems (TAWS), traffic-alert and collision avoidance systems (TCAS), wind shear detection systems, flight control systems, and auto-land systems. The measurements obtained by radio altimeters also are used by electronic centralized aircraft monitoring (ECAM) systems and engine-indicating and crew alerting systems (EICAS), among others. Failure of these sensors can lead to potentially catastrophic results.

1.2.2 In December 2021, the FAA issued two Airworthiness Directives (AD) prohibiting certain aircraft operations due to potential interference to radio altimeters from 5G C-Band wireless systems in the 3.7-3.98 GHz frequency spectrum. The ADs were based on testing conducted through the Radio Technical Commission for Aeronautics (RTCA) and information provided by equipment manufacturers, including the numbers and types of susceptible radio altimeters. Aircraft system-level effects were evaluated by aircraft manufacturers and reviewed through FAA analysis. FAA AD 2021-23-12 and 2021-23-13 are published on the FAA's Dynamic Regulatory System website (www.drs.faa.gov).

1.2.3 After issuing the AD, the FAA continued to collect data and perform various analysis and modelling of the 5G C-Band environment, including susceptibility testing of radio altimeters to C-Band interference. Data includes in-flight radio frequency measurements via FAA flight evaluations and laboratory testing by aircraft and equipment manufacturers. Additional testing is being conducted by NTIA, the U.S. Department of Defense, and others.

1.3 5G C-Band Implementation in the United States

1.3.1 In January 2022, two of the 21 FCC licensees began deploying 5G C-Band networks operating in the 3.7-3.8 GHz range in 76 markets across the United States that included non-rural areas with critical airports serving domestic and international operators. The network implementation has been accompanied by extensive and ongoing collaboration that led to a combination of FAA-mandated restrictions to airline operations and voluntary technical mitigations by the two wireless companies. The restrictions to airlines operations are described in the series of FAA ADs that prohibit certain operations in the presence of 5G C-Band emissions without an FAA-approved alternative method of compliance. The voluntary 5G technical mitigations include decreased power settings for both fundamental and spurious emissions as well as restrictions on antenna angles.

1.3.2 The FAA has worked with the wireless companies to exchange information about planned antenna locations and operating characteristics. This has enabled the FAA to assess potential

impacts to airline operations around specific airports and provide guidance to providers on a monthly basis as the networks continue to expand.

1.3.3 The aviation and wireless technical communities also continue to exchange and evaluate data about the performance of radio altimeters themselves. Such data is useful in identifying which radio altimeters fail to perform in the presence of wireless transmissions that are several hundred megahertz away and therefore require new filters or other retrofits to be able to perform adequately. This data has provided manufacturers and Original Equipment Manufacturers with criteria that enabled them to design modifications intended to protect radio altimeters from the authorized emissions from 5G C-Band when operating within their designated limits.

1.3.4 The current two wireless providers have agreed to maintain operational mitigations until July 1, 2023, to allow airlines to modify radio altimeters by installing radio frequency filters. After July 1, 2023, the two wireless providers, along with the additional 19 licensees, will begin deploying base stations utilizing the complete C-Band allocation of 3.7-3.98 GHz. This means that radio altimeters could be subjected to radio frequency emissions from 5G base stations with no power reductions or other mitigations such as antenna angle adjustments or operational limits for conducted spurious emissions.

1.3.5 The primary focus of the aviation and wireless industries to date has been on collaboration to enable the successful co-existence of wireless deployments with commercial transport category airplane operations and air commerce. Radio altimeters in helicopters and general aviation airplanes without filters or improvements may also be susceptible to malfunction in the presence of high power 5G C-Band emissions. The operating environment of most helicopter and general aviation operations (e.g., away from primary airports) presents a different set of challenges to address potential interference concerns. Mitigations are more challenging to implement for these operations due to the variety of operational uses. For example, emergency medical helicopter operations frequently occur outside traditional aviation/airport infrastructure. The FAA has implemented other mitigations for those operations, including requiring the use of alternate means of relative height-finding so that those operators do not depend solely on radio altimeters. Aviation interests across all transport, helicopter, and general aviation operations continue to evaluate less-severe hazards such as nuisance alerts, e.g. TAWS, TCAS, etc., that may desensitize flight crews and pilots to these last-layer-of-defense safety systems.

1.3.6 The 19 additional network providers authorized to operate in the 3.8-3.98 GHz range in 2023 will expand the markets to 406 areas. Because these providers are able to enter the market at the authorized 62 dBm/MHz non-rural power level and 65 dBm/MHz rural power level, the FAA views expeditious retrofits to radio altimeters as a priority.

2. FUTURE FOCUS

2.1 Lessons Learned

2.1.1 From its first assessment of the potential impact of the planned 3-7-3.98 GHz spectrum repurposing in 2015, the FAA has evaluated the many activities and communications that attempted to address aviation concerns in advance of the spectrum auction. From the FAA’s viewpoint, the key lessons are:

a) existing processes, roles and responsibilities, and coordination between spectrum and other regulators should be reviewed, revised and/or updated to reflect increasingly rapid evolutions in technology;

b) regular collaboration and outreach between the regulatory bodies as stakeholders – rather than as interested parties – should be established and maintained;

c) organizations responsible for developing industry standards should assess how and when they define the need for new or updated standards, ensure transparency as to their data inputs and methodologies, and be proactive in correcting any inadequacies. In addition, industry representation from all affected industries should participate. Organizations should also improve product delivery timeframes; and

d) affected industries – aviation, wireless, or otherwise – must engage with one another early and consistently to learn about respective operating environments, and constraints.

2.1.2 Civil aviation authorities can learn from their counterparts. For example, although 5G C-Band is being implemented around the world, disparities exist in terms of frequency, power, and authorized locations, as well as differences in aviation needs, users, and equipment. Regular dialogue and information exchange between authorities and industries can help to ensure awareness of operational differences, safety approaches, commonalities, etc.

2.2 Beyond 5G in the C-Band

2.2.1 As the FAA continues its work with the aviation and wireless communities to mitigate any potential impacts of 5G C-Band between 3.7-3.98 GHz in the United States, it is also planning for the continued evolution of wireless technologies. While this evolution is still years away, there is a clear desire to ensure that any technological advances are widely understood ahead of time. Lessons learned from 5G C-Band will facilitate any future work on next generation aviation and wireless technologies. The FAA acknowledges the role that ICAO and other United Nations bodies play in this regard and welcomes the opportunity for ongoing dialogue and planning.

3. CONCLUSION

3.1 The Assembly is invited to note the information provided in this paper and visit the FAA's 5G and Aviation Safety website (www.faa.gov/5g) for more detailed information.

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