International Civil Aviation Organization

A40-WP/188[1]
TE/74
5/8/19

WORKING PAPER

ASSEMBLY — 40TH SESSION

TECHNICAL COMMISSION

Agenda Item 30: Other issues to be considered by the Technical Commission

AN URGENT NEED TO ADDRESS HARMFUL INTERFERENCES TO GNSS

(Presented by the International Federation of Air Traffic Controllers' Association (IFATCA), the International Federation of Air Line Pilots' Associations (IFALPA) and the International Air Transport Association (IATA))

EXECUTIVE SUMMARY

The global navigation satellite system (GNSS) provides essential position and timing information supporting flight and air traffic management (ATM) operations. A significant number of reports have been received on harmful interference to GNSS. Under their obligations to ICAO, the International Telecommunication Union (ITU) and the international aviation community, States are invited to adopt and implement measures to manage and reduce the operational impact from harmful interference to GNSS, as it can adversely affect the safety and efficiency of aircraft and ATM operations.

Action: The Assembly is invited to:

a) to implement appropriate mitigation measures as contained in the *Global Navigation Satellite System (GNSS) Manual* (Doc 9849) as a matter of high priority and to report progress and any difficulties to ICAO;
b) to recognize the unintended impact of harmful interference to civil flight operations and to exercise caution to the maximum extent possible to protect the safety of civil aircraft during military exercises and operations;
c) to establish and ensure appropriate frequency regulations are in place and maintained to protect allocated GNSS frequencies from harmful interference in line with ITU Radio Regulations;
d) to ensure that contingency procedures are established in coordination with air navigation service providers and airspace users and that essential conventional navigation infrastructure, such as Instrument Landing System (ILS), are retained when operationally beneficial; and
e) to support the multi-disciplinary development of alternative positioning, navigation and timing (APNT) strategy and solutions to complement the use of GNSS in aviation in coordination with ICAO and airspace users.

Strategic Objectives:	This working paper relates to the Safety and Economic Development of Air Transport Strategic Objectives.

[1] Arabic, Chinese, English, French, Russian and Spanish versions provided by IATA.

Financial implications:	Failure to mitigate effectively the harmful interference to GNSS would prevent the full continuation of safety and efficiency benefits of GNSS-based services. The cost impact of implementing the mitigation measures being suggested by ICAO would be minimal for all stakeholders as compared to the cost of accidents or significant disruption of flight and ATM operations.
References:	Annex 10 — *Aeronautical Telecommunications,* Volume I — *Radio Navigation Aids* Doc 9849: *Global Navigation Satellite System (GNSS) Manual* Doc 10007, *Report of the Twelfth Air Navigation Conference (AN-Conf/12),* Recommendations 6/7, 6/8 Doc 10022, *Assembly Resolutions in Force (as of 4 October 2013),* Resolution A37-11 Doc 10115, *Report of the Thirteenth Air Navigation Conference (AN-Conf/13),* Recommendations 2.2/1 Assembly/39-WP/118 – *Impact to Flight & ATM Operations from Harmful Interference to GNSS* *Radio Regulations, Edition of 2016,* International Telecommunication Union

1. INTRODUCTION

1.1 The global navigation satellite system (GNSS) includes satellite constellations, infrastructures and augmentations which provide position and timing information for aircraft and air traffic management systems. GNSS constellations which are recognized by ICAO include the US. Global Positioning System (GPS), the Russian GLONASS, the European Galileo and the Chinese BeiDou.

1.2 Flight and ATM operations utilizing GNSS have resulted in substantial efficiency and safety benefits. On safety, GNSS is a main technical enabler for approach with vertical guidance in line with *Assembly Resolution A37/11* effectively mitigating the risk of controlled-flight into terrain (CFIT). For efficiency, GNSS contributes to the United Nations' Sustainable Development Goals by making it possible for aircraft to navigate and fly enhanced, more efficient air routes. Regarding capacity, GNSS is also the primary technology supporting performance-based navigation (PBN) operations which enhance airspace capacity through enabling safe reductions of aircraft separation minima.

1.3 With its proven benefits, GNSS has its vulnerabilities. AN-Conf/12 in 2012 recognized that very low strength of GNSS signals received from satellites makes GNSS vulnerable to interference and other effects that have the potential to affect multiple aircraft over a wide area. The sources of GNSS vulnerabilities include unintentional interference, intentional interference, effects of the ionosphere, solar activity (space weather) and others.

1.4 The concern over harmful interference to GNSS has also been documented by *AN-Conf/12 Recommendation 6/8* where, in planning for mitigation of GNSS vulnerabilities, States were recommended to:

a) assess the likelihood and effects of global navigation satellite system vulnerabilities in their airspace and apply, as necessary, recognized and available mitigation methods;

b) provide effective spectrum management and protection of GNSS frequencies to reduce the likelihood of unintentional interference or degradation of GNSS performance;

c) report to ICAO cases of harmful interference to global navigation satellite system that may have an impact on international civil aviation operations; and

d) develop and enforce a strong regulatory framework governing the use of global navigation satellite system repeaters, pseudolites, spoofers and jammers.

1.5 The 2012 ICAO High-level Conference on Aviation Security also recognized the significance of this issue and recommended that ICAO intensify efforts to develop guidelines on the prevention and appropriate response to aviation security threats such as GNSS jamming and spoofing.

2. IMPACTS ON FLIGHT AND ATM OPERATIONS

2.1 GNSS is the main source of aircraft position information driving the aircraft navigation system and is important for safety and efficiency of flight. GNSS provides aircraft position input to pilot navigation display (ND), an important function during reduced visibility conditions.

2.2 *GNSS beyond Navigation*: In addition to aircraft navigation, GNSS is a main component of various essential communication, navigation and surveillance (CNS) and flight safety/control systems. GNSS is used to provide timing signal to some satellite communications avionics which are essential for operations in oceanic and remote airspaces. It is the sole aircraft position source to automatic dependent surveillance – broadcast (ADS-B). Some business aircraft are using GNSS as a reference source for aircraft flight control and stability systems. Particularly noteworthy, GNSS is a necessary component of an aircraft terrain awareness and warning system (TAWS) - a mandatory aircraft safety system implemented to alert pilots of upcoming terrain.

2.3 *GNSS in ATM/ATC Operations:* With on-going worldwide deployments of ADS-B, harmful interference to GNSS will adversely impact ATM and air traffic control (ATC) operations. Once GNSS signals are compromised, a degradation or complete interruption of ADS-B surveillance service will consequentially occur as ADS-B requires aircraft position input from GNSS.

2.4 Since the last ICAO Assembly, IATA has received from various airlines and airspace users an increasing number of reports of harmful interference to GNSS. During one recent incident, it was reported that a passenger aircraft flew off course during a period of GNSS jamming and nearly crashed into a mountain. Fortunately, an alert RADAR controller intervened, and the accident was averted.

3. SOURCES OF HARMFUL INTERFERENCE TO GNSS

3.1 Unintentional interference to GNSS signals can arise from several sources. A non-exhaustive list would include very high frequency (VHF) communications, television signals, certain RADARs, mobile satellite communications, military systems, microwave links, GNSS repeaters and certain systems on-board aircraft.

3.2 However, more concerning cases of recent harmful interference to GNSS being reported are likely caused by intentional interference sources, such as “GNSS jammers or spoofers”. Some equipment being used in some military operations and activities has been reported to interfere with specific GNSS signals and have the coverage radius of more than 300 NM. While some of these military activities were well coordinated with relevant aviation authorities, there have been a significant number of cases where the coordination was less successful - resulting in civil flight operations being interrupted without airspace users being appropriately notified.

3.3 The airline industry welcomes the efforts by some States and air navigation services providers (ANSPs) in informing airspace users regarding the use of GNSS jammers during military operations and exercises. Nevertheless, States are strongly urged to recognize the unintended impact of such interference and to exercise caution in order to minimize their effect on civil aviation. Recognizing the importance of national security needs, IATA stands ready to support coordination efforts with States.

4. GNSS RADIO FREQUENCY INTERFERENCE (RFI) MITIGATION PLAN

4.1 ICAO has developed a GNSS RFI mitigation plan as a part of the *GNSS Manual* (ICAO Doc 9849). The mitigation plan describes a list of preventive and reactive measures aimed at mitigating the interference risk as far as practicable. The framework recommended by the mitigation plan includes a continuous three-step process of 1) monitoring threats; 2) assessing risks; and 3) deploying mitigation measures. The plan also explains the need to inform airmen in the event of GNSS outages and the necessity to train airspace users and air traffic controllers to be able to recognize interference events and to react appropriately.

5. PROTECTION OF GNSS THROUGH EFFECTIVE SPECTRUM MANAGEMENT AND REGULATIONS

5.1 ICAO AN-Conf/12 recommends that States provide effective spectrum management and protection of GNSS frequencies to reduce the likelihood of unintentional interference or degradation of GNSS performance. The following ICAO Air Navigation Conference in 2018 also reemphasized this critical issue in *AN-Conf/13 Recommendation 2.2/1* recommending that States engage in the spectrum regulatory process to ensure the continued necessary access to and protection of safety-critical aeronautical communications, navigation, and surveillance (CNS) systems.

5.2 Through several State Letters and Electronic Bulletins, ICAO has continued to highlight the essential role of States in ensuring protection of GNSS signals from interference, which can be achieved through cooperation of national aviation and telecommunication authorities in the introduction and enforcement of appropriate regulations controlling the use of the radio spectrum.

5.3 Noting the importance of safety-of-life applications using GNSS, radio frequency spectrum allocations for GNSS signals are globally harmonized and legally protected under the Radio Regulation of the International Telecommunication Union (ITU). Article 4.10 of the Radio Regulations states that ITU member States recognize that the safety aspects of radio navigation and other safety services require special measures to ensure their freedom from harmful interference and that “it is necessary therefore to take this factor into account in the assignment and use of frequencies.”

5.4 As radio frequency spectrum is a very limited resource with competing demands and interests, it is essential that State aviation and telecommunication authorities work closely together to ensure that aviation and the travelling public are well served by effective spectrum management and State regulations. In coordination with ICAO, IATA will continue engaging in this important strategic topic at global, regional and national levels to provide a necessary foundation for sustainable air transport growth while balancing other societal demands and public interests.

6. ROLES OF CONVENTIONAL NAVIGATION AIDS AND PROGRESS FOR ALTERNATIVE POSITION, NAVIGATION AND TIMING (APNT) SOLUTIONS

6.1 *Need for Contingency Procedures and Infrastructures:* Whilst today many aircraft navigate primarily using GNSS in all phases of flight, some conventional navigation aids still play a

major role supporting flight operations, particularly when GNSS signals are compromised. Interruptions of GNSS services often result in operational disruptions and have recently led to cancellation of flights.

6.2 During critical operations like approach and landing, it is very important that alternative navigation aids are readily available to flight crews to continue the operations while maintaining the safety of flight. Lessons learned from interference cases at major airports, including those servicing capital cities, have shown that instrument landing system (ILS) will be preferred and often required by flight crews whenever they perceive that the performance of GNSS shown in the cockpit is in question.

6.3 From these lessons learned, ANSPs are therefore invited to assess carefully the possible impacts of harmful interference to GNSS in coordination with State safety regulators and airspace users while developing their rationalization strategy for conventional navigation aids. The *Strategy for Introduction and Application of Non-Visual Aids to Approach and Landing* attached to ICAO Annex 10 suggests the continuation of ILS operations at the highest level of service.

6.4 *Global Strategy for Future APNT:* In the longer term, acknowledging the fundamental limitations of satellite navigation systems (e.g., low strength signals) and the economic consequences of interrupted airline operations for the travelling public and the global supply chain, States are invited to provide more robust support for the development of a global strategy for Alternative Position, Navigation and Timing (APNT) solutions and infrastructures in coordination with ICAO and the aviation community as requested by *AN-Conf /12 Recommendation 6/7d*. This APNT strategy should aim to maintain flight safety and an acceptable level of efficiency of air navigation services to the maximum extent possible in the event of prolonged GNSS signal outages or interferences. Noting the ubiquitous use of GNSS in various CNS/ATM applications and increasing challenges in the global frequency spectrum environment, an integrated, multi-disciplinary CNS approach - taking into account frequency spectrum efficiency and existing and potential avionics capabilities - should be used when defining this APNT strategy.

7. CONCLUSION

7.1 GNSS has resulted in substantial safety, efficiency and capacity benefits and is a necessary cornerstone of daily flight and ATM operations. Effective mitigations of harmful interference to GNSS will ensure that these benefits continue, and will help prevent interruptions of flights - resulting in better punctuality of global trade and enhanced satisfaction of the travelling public.

7.2 IATA commends ICAO for its on-going efforts on this critical issue, including the establishment of the GNSS RFI mitigation plan, and reiterates a strong concern regarding on-going harmful interference to GNSS. On behalf of the global community of airlines, IATA respectfully invites the Assembly to urge States to adopt and implement measures to manage and reduce causes and impacts of the interference.

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