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TECHNICAL COMMISSION

Agenda Item 36: Aviation Safety and Air Navigation Implementation Support

IMPACT TO FLIGHT & ATM OPERATIONS FROM HARMFUL INTERFERENCE TO GNSS

(Presented by International Air Transport Association – IATA,
International Council of Aircraft Owner and Pilot Associations – IAOPA,
the International Business Aviation Council – IBAC,
the International Federation of Air Line Pilots' Associations – IFALPA, and
the International Federation of Air Traffic Controllers' Associations - IFATCA)

EXECUTIVE SUMMARY

The Global Navigation Satellite System (GNSS) provides position and timing information supporting several important flight and air traffic management (ATM) operations. In line with ICAO Assembly Resolution A37-11, GNSS has become an important navigation infrastructure supporting high-priority ICAO initiatives such as performance-based navigation (PBN). Additionally, some business aircraft are using GNSS as a reference source for aircraft flight control and stability systems.

In 2016 alone, a significant number of reports have been received from airlines and airspace users regarding the interference to GNSS and its impact to flight operations. Under their obligations to ICAO, the International Telecommunication Union (ITU) and the international aviation community, States are invited to adopt and implement an appropriate set of mitigation measures being suggested by ICAO to manage and reduce the operational impacts of harmful interference to GNSS, as it can adversely affect aircraft safety and ATM efficiency.

Action: The Assembly is invited to:

a) request ICAO to bring to attention of States, ICAO Planning and Implementation Regional Groups (PIRGs) and Regional Aviation Safety Groups (RASGs) the operational impact from harmful interference to GNSS; and
b) urge ICAO Member States to implement appropriate mitigation measures as suggested in ICAO the *Global Navigation Satellite System (GNSS) Manual* (Doc 9849)and to report progress and any difficulties to appropriate PIRGs and RASGs.

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

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

Financial implications:	Failure to mitigate effectively the harmful interference to GNSS would prevent the full fruition of the potential safety and efficiency benefits of GNSS-based services. The cost impact of implementation of mitigation measures being suggested by ICAO would be minimal for all stakeholders. The implementation would also reduce the need for a costly investment for an alternative position, navigation and timing system.
References:	Annex 10 — *Aeronautical Telecommunications,* Volume I — *Radio Navigation Aids* 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 9849: *Global Navigation Satellite System (GNSS) Manual* Memorandum of Cooperation between ICAO and ITU for *Providing a Framework for Enhanced Cooperation Regarding the Protection of the Global Navigation Satellite System from Harmful Interference with a Potential Impact on Aviation Safety* https://www.itu.int/dms_pub/itu-r/oth/0a/0e/R0A0E0000A40001PDFE.pdf

1. INTRODUCTION

1.1 The Global Navigation Satellite System (GNSS) includes navigation satellite infrastructures and constellations which provide position and timing information supporting aircraft and air traffic management operations. GNSS satellite constellations which are currently recognized by the International Civil Aviation Organization (ICAO) include the US. Global Positioning System (GPS), the Russian GLONASS, the European Galileo and the Chinese BeiDou.

1.2 The ICAO Global Air Navigation Plan has identified the implementation of performance-based navigation (PBN) as a global air navigation priority and GNSS is globally recognized as a main enabler to PBN operations. ICAO Assembly Resolution A37-11 also urges States to implement PBN approaches with vertical guidance (APV), which rely on functioning GNSS, to all instrument runway ends. As the approach is a critical phase of flight, a harmful interference to GNSS will interrupt the flight operation and can potentially impact its safety.

1.3 Radio frequency spectrum allocated for GNSS signals is globally harmonized and legally protected under the Radio Regulation established under the International Telecommunication Union (ITU). As the specialized United Nations agency responsible for matters related to radio communications, the ITU, through its Radio Regulations, aims to ensure the availability and protection from harmful interference of the radio frequencies allocated to safety of life services, such as GNSS. 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.

1.4 The 2012 ICAO High-level Conference on Aviation Security (HLCAS) recognized the significance of this issue, and recommended ICAO to intensify efforts to develop guidelines on the prevention and appropriate response to emerging aviation security threats such as GNSS jamming, blocking and spoofing.

1.5 In accordance with Recommendation 6/7 from the Twelfth Air Navigation Conference (AN-Conf/12), ICAO should continue technical evaluation of known threats to GNSS and make the information available to States. ICAO should compile and publish more detailed guidance for States to use in the assessment of GNSS vulnerabilities, and develop a formal mechanism with the ITU and other

appropriate United Nations bodies to address specific cases of harmful interference to GNSS reported by States to ICAO. In line with this Recommendation, ICAO has established a Memorandum of Understanding with the ITU to provide a framework of enhanced cooperation regarding the protection of the GNSS from harmful interference with a potential impact of aviation safety.

1.6 The concern over harmful interference to GNSS has also been reemphasized 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 global navigation satellite system (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.

2. IMPACT TO FLIGHT AND ATM OPERATIONS FROM HARMFUL INTERFERENCE TO GNSS AND DEVELOPMENT OF AN APPROPRIATE MITIGATION PLAN

2.1 The aircraft GNSS receiver is an important equipment for safety and efficiency of flight operation and is also the main source of position information which drives the aircraft navigation system. The GNSS receiver is the primary equipment supporting required navigation performance (RNP) operations and provides position input to aircraft Navigation Display (ND), ground-proximity warning system (GPWS) and automatic dependent surveillance (ADS). Additionally, some business aircraft are using GNSS as a reference source for aircraft flight control and stability systems.

2.2 On-going reports of harmful interference to GNSS have been received from various airlines and airspace users. Within the second quarter of 2016 alone, IATA and IFALPA together have received more than fifty reports relating to harmful interference to GNSS. These reported cases were mostly geographically concentrated on the areas with on-going military activities and political tensions. Based on the information in these reports, the impacts on airline flight operations, as also discussed by the ICAO Navigation Systems Panel (NSP), include:

- loss of on-board GNSS functionality;
  - [GPS-L INVALID] and/or [GPS-R INVALID] messages appear;
- decrease in navigation performance leading to RNP alert;
  - through increasing aircraft horizontal error, Actual Navigation Performance (ANP) decreases beyond RNP requirement. - [NAV UNABLE RNP] message appears;
  - in some aircraft, aircraft navigation reverted to IRU or DME/DME after GNSS loss;
- impact on Navigation Display;

  - a large “map shift” was observed;
- impact on GPWS;
  - [TERR POS] and [EICAS TERRAIN POSITION] messages appear;
  - in certain cases, “Terrain Terrain, Pull-Up Pull-Up” aural alerts occur;
- loss of auto-land and ADS reporting capabilities.

2.3 Noting the on-going worldwide deployments of automatic dependent surveillance – broadcast (ADS-B), harmful interference to GNSS will also adversely impact ATM operations. A degradation or complete interruption of ADS-B surveillance services will automatically occur as a consequence of GNSS signals being interfered. This adverse impact to ATM operations can be quite significant, especially in the area where ADS-B is deployed as the sole mean of ATM surveillance.

2.4 Unintentional interference to GNSS signals can arise from several sources, operating in the same frequency bands as GNSS or in other bands. A non-exhaustive list would include mobile and fixed very high frequency (VHF) communications, television signals, certain radars, mobile satellite communications, military systems, microwave links, GNSS repeaters, and systems on-board aircraft.

2.5 However, more concerning cases of recent harmful interference to GNSS as reported by airlines and pilots are likely caused by intentional interference sources, such as “GNSS jammers.” These jammers, which are being used during some military operations and testing, have been reported to interfere with specific GNSS signals and have their coverage area, in some cases, of more than 300 NM from the assumed interference source. While some of these military activities were well coordinated with relevant aviation authorities, there have been a significant number of reported cases where the coordination might not properly take place - resulting in civil flight operations being interrupted without airspace users being appropriately notified.

2.6 While the aviation industries and professional communities welcome 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, States are strongly urged to recognize the unintended impacts of the harmful interference to GNSS on civil flight operations, and to exercise extreme cautions to minimize the impacts on flight and ATM operations and to protect the safety of civil aircraft.

2.7 Additionally, the recent proliferation of personal privacy jamming devices, designed for consumer uses such as to defeat vehicle-tracking systems, is becoming a rising concern. While ownership and use of such devices are legally prohibited in some States, this prohibition or other effective regulations - along with their regular enforcements - have not been consistently applied globally.

2.8 In line with AN-Conf/12 Recommendation 6/7, the ICAO NSP is now proposing a GNSS Radio Frequency Interference (RFI) Mitigation Plan to advise States on how to address this interference issue and to mitigate its associated risks and impacts on flight and ATM operations. The Mitigation Plan is scheduled to be published by early 2017 in the *Global Navigation Satellite System (GNSS) Manual* (Doc 9849).

2.9 The aim of the Mitigation Plan is to ensure the implementation of a list of measures which give confidence that the interference risk is reduced as far as practicable – permitting the full operational benefits provided by GNSS. The mitigation 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 Mitigation Plan then suggests preventive and reactive measures which States

can choose to apply, both strategically during GNSS implementation planning and tactically during day-to-day operations. The Mitigation Plan also explains the need to inform airmen in the events of GNSS outages and the necessity to train airspace users and air traffic controllers to be able to recognize RFI events and to react appropriately.

3. CONCLUSION

3.1 IATA, IAOPA, IBAC, IFALPA and IFATCA, on behalf of the global communities of airlines, aircraft owners, business aviation, pilots and air traffic controllers, express a strong concern on the operational impacts of harmful interference to GNSS and commend ICAO for its on-going effort in developing the GNSS RFI mitigation plan. We invite ICAO and its member States to timely and effectively implement relevant mitigation measures as soon as possible as a matter of high priority.

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