



WORKING PAPER

ASSEMBLY — 41ST SESSION

TECHNICAL COMMISSION

Agenda Item 31: Aviation Safety and Air Navigation Standardization

GNSS INTERFERENCE

(Presented by the United Arab Emirates)

EXECUTIVE SUMMARY

The utilization of global navigation satellite system (GNSS) in air traffic management (ATM) operations and flights have resulted in significant efficiency and safety benefits. GNSS has proven its benefits however, given its 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 issue of GNSS jamming and/or possible spoofing has intensified in geographical areas surrounding conflict zone and other areas. With on-going worldwide deployments of performance-based navigation (PBN) and automatic dependent surveillance — broadcast (ADS-B), harmful interference to GNSS will adversely impact ATM and air traffic control (ATC) operations.

Action: The Assembly is invited to:

- a) request ICAO to bring to attention of States 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 planning and implementation regional groups (PIRGs) and regional aviation safety groups (RASGs).

<i>Strategic Objectives:</i>	This working paper relates to the Safety and Economic Development Strategic Objectives.
<i>Financial implications:</i>	
<i>References:</i>	Doc 10115, <i>Report of the Thirteenth Air Navigation Conference (AN-Conf/13)</i> Doc 10007, <i>Report of the Twelfth Air Navigation Conference (AN-Conf/12)</i> Doc 9849, <i>Global Navigation Satellite System (GNSS) Manual</i>

1. INTRODUCTION

1.1 The global navigation satellite system (GNSS) includes satellite configurations, infrastructures and augmentations, which provide position and timing information for air traffic management systems and aircrafts. GNSS configurations, which are recognized by ICAO include the United States. global positioning system (GPS), the Russian GLONASS, the European Galileo and the Chinese BeiDou.

1.2 The utilization of GNSS in ATM operations and flights have resulted in significant efficiency and safety benefits. The GNSS benefit aviation by enabling aircraft to fly direct from departure to destination using the most fuel-efficient routes and to navigate complicated terrain at low altitude.

1.3 GNSS has proven its benefits however, given its 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 as recognized by the Twelfth Air Navigation Conference (AN-Conf/12). The potential sources of GNSS vulnerabilities are:

- a) intentional interference;
- b) unintentional interference;
- c) space weather e.g. solar flares; and
- d) others.

2. JAMMING AND/OR SPOOFING

2.1 The issue of GNSS jamming and/or possible spoofing has intensified in geographical areas surrounding conflict zone and other areas. Under the present conditions, it is not possible to predict GNSS outages and their effects. The magnitude of the issues generated by such outage would depend upon the extent of the area concerned, on the duration and on the phase of flight of the affected aircraft.

2.2 The following non-exhaustive list includes some potential issues that a degradation of GNSS signal could generate:

- a) loss of ability to use GNSS for waypoint navigation;
- b) loss of area navigation (RNAV) approach capability;
- c) inability to conduct or maintain required navigation performance (RNP) operations, including RNP and RNP authorization required (AR) approaches;
- d) triggering of terrain warnings, possibly with pull up commands;
- e) inconsistent aircraft position on the navigation display;
- f) loss of automatic dependent surveillance-broadcast (ADS-B), wind shear, terrain and surface functionalities;

- g) failure or degradation of ATM/ANS/CNS and aircraft systems which use GNSS as a time reference; and
- h) potential airspace infringements and/or route deviations due to GNSS degradation.

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.

4. IMPACTS OF GNSS INTERFERENCE ON ATM OPERATIONS AND FLIGHTS

4.1 GNSS is the essential source of aircraft position data driving the aircraft navigation system and is imperative for the safety and efficiency of the flight. GNSS provides aircraft position input to pilot navigation display, an important element during reduced visibility conditions.

4.2 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 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.

4.3 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.

5. SAFEGUARDING OF GNSS THROUGH EFFECTIVE SPECTRUM MANAGEMENT AND REGULATIONS

5.1 As radio frequency spectrum is a very limited resource with high demand, 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.

5.2 AN-Conf/12 recommended that States provide effective spectrum management and protection of GNSS frequencies to reduce unintentional interference or degradation of GNSS performance. The following ICAO Air Navigation Conference (AN-Conf/13) 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.

5.3 ICAO has continued through several State letters and electronic bulletins, the essential role of States in ensuring protection of GNSS signals from interference, which can be achieved through

cooperation of aviation and telecommunication authorities in the establishment and enforcement of appropriate regulations governing the use of the radio spectrum.

6. GNSS RADIO FREQUENCY INTERFERENCE (RFI) MITIGATION PLAN

6.1 ICAO has developed a GNSS RFI mitigation plan as a part of the GNSS Manual (Doc 9849). The mitigation plan describes a list of preventive and reactive measures aimed at mitigating the interference risk as far as practicable.

6.2 The framework recommended by the mitigation plan includes a continuous three-step process of:

- a) monitoring threats
- b) assessing risks
- c) deploying mitigation measures.

6.3 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.

6.4 While retaining conventional navigation aids may provide temporary mitigation against loss of GNSS, this is not a long term solution. In many States, the conventional ground infrastructure has been or is planned to be phased out in line with the global transition to PBN. The industry should endeavour to develop and implement long term technological solutions that mitigate interference to the GNSS systems.

7. SUMMARY

7.1 GNSS has generated a great deal of safety, efficiency and capacity benefits and is a necessary element of daily flight and ATM operations. Adequate mitigations of harmful interference to GNSS will safeguard that these benefits remain, and will serve in preventing disruption of flights, resulting in better promptness of the global aviation industry.

7.2 The UAE commends ICAO for its on-going efforts on this issue, including the establishment of the GNSS RFI mitigation plan, and reiterates a strong concern regarding on-going harmful interference to GNSS. The UAE would respectfully invite the Assembly to urge States to adopt and implement measures to manage and reduce the impacts of such anomalies.

8. CONCLUSION

8.1 The UAE would respectfully invite the Assembly to urge States to adopt and implement measures to manage and reduce the impacts of such anomalies.