



International Civil Aviation Organization

**MIDANPIRG Communication, Navigation and Surveillance Sub-Group
(CNS SG/15)**

(Doha, Qatar, 11 – 14 May 2026)

Agenda Item 3: Navigation Issues

ICAO GNSS RADIO FREQUENCY INTERFERENCE (GNSS RFI) ROADMAP

(Presented by the Secretariat)

SUMMARY

This paper presents the ICAO GNSS RFI roadmap, along with outcomes from the 14th Air Navigation Conference and the 42nd Session of the Assembly relevant to GNSS RFI. It calls on States to take action in line with AN-CONF/14 Recommendation 2.2/2 and Resolution A42-8/C.

Action by the meeting is at paragraph 3.

REFERENCES

- ICAO 14th Air Navigation Conference (AN-CONF/14)
- 42nd Session of ICAO Assembly
- Online ICAO GNSS RFI Roadmap

1. INTRODUCTION

1.1 Global navigation satellite systems (GNSS) is a crucial enabler for modern aviation services and technologies.

1.2 The GNSS provide highly precise positioning, navigation, and timing (PNT) which enable accurate location tracking and flight guidance. Additionally, GNSS provides accurate time synchronization for avionics, communication networks and operational systems, facilitating seamless communications and coordination between pilots, controllers and ground services, significantly enhancing safety and efficiency of flight operations and air traffic management.

1.3 The 14th Air Navigation Conference was held from 26 August to 6 September 2024, at ICAO HQ in Montreal.

1.4 The ICAO Council requested Secretariat, through C-DEC 234/11, to prepare a roadmap outlining short-, medium- and long-term actions to address GNSS RFI, including immediate mitigation measures and long-term strategies to build an air transport system resilient to such interference.

1.5 The ICAO GNSS RFI Roadmap has been prepared and presented to the 42nd Session of ICAO Assembly, which was held from 23 September to 3 October 2025, at ICAO, Montreal, Canada.

2. DISCUSSION

2.1 The AN-Conf/14 expressed voiced significant concerns with the recent escalation of GNSS jamming and spoofing, and the significant safety risk it poses to civil aviation operations. The Conference agreed on the following recommendations:

Recommendation 2.2/2 – Addressing global navigation satellite system interference and contingency planning

That States:

a) ensure that effective global navigation satellite system radio frequency interference mitigation measures are implemented, based on measures developed by ICAO and industry, including the need to maintain a sufficient network of conventional navigation aids to ensure operational safety as well as sufficient airspace capacity during times of global navigation satellite system interference;

b) through the mechanism of the planning and implementation regional groups, develop regional global navigation satellite system reporting mechanisms to raise operational awareness of affected geographical areas, to the extent feasible, as described in the Global Navigation Satellite System (GNSS) Manual (Doc 9849);

c) work with industry to identify means to make aircraft systems more resilient to radio frequency interference events, and to provide guidance on detecting global navigation satellite system jamming or spoofing and maintaining safe and efficient aircraft operation in case of global navigation satellite system anomalies; and

d) review aircraft minimum equipage lists to ensure compatibility with States' implemented minimum operational networks.

2.2 The GNSS RFI can have a serious impact on operational safety, potentially contributing to three global high-risk categories of occurrence (G-HRC): a mid-air collision (MAC), a controlled flight into terrain (CFIT), and a loss of control in-flight (LOC-I). In addition, it is likely to result in a significant operational and financial impact, including flight rerouting, delays, cancellations and increased workload for both controllers and pilots.

2.3 Recognizing the significant risks and potential consequences of GNSS RFI on aviation safety and security, ICAO has outlined a roadmap set of short, medium, and long-term actions.

2.4 The roadmap is structured around three progressive objectives. For the short-term, which span from 2023 to 2026, the roadmap focuses on ensuring safe operations during GNSS RFI events by sustaining the provision of air navigation services, by development and use of contingency procedures, and strengthening awareness and vigilance of flight crew and ATS personnel.

2.5 The Short-term actions and activities includes:

2.5.1 Conduct of Regional Workshops and Symposia to enhance awareness and facilitate the exchange of best practices and lessons learned across regions. In this regard, the meeting may wish to note that a Workshop on PBN/GNSS (27-29 September 2026, Cairo, Egypt) has been scheduled for the MID Region.

2.5.2 NOTAM codes and recommended phraseology have been developed to ensure global harmonization of terminology, thereby assisting pilots in interpretation and pre-flight preparation. Relevant ICAO provisions are currently being updated (PANS-ABC, AIS Manual)

2.5.3 GNSS RFI iPack which emerged in response to frequent requests from States for additional provisions and guidance material. While ICAO, other international organizations, and several States have already developed substantial resources, the iPack was initiated to consolidate and complement these efforts. It aims to provide tailored, on-site expert assistance to states, thereby strengthening implementation support.

2.5.4 Enhance reporting mechanism with ITU (refer to WP.8)

2.5.5 Inter-Agency UN Collaboration: ICAO, International Telecommunication Union (ITU) and International Maritime Organization (IMO) issued a joint statement to UN Member States to protect GNSS from harmful interference. The joint Statement is at *Appendix A*.

2.6 The Medium-Term spans from 2027 to 2029 and focuses on enhancing the resilience and efficiency of aviation operations by optimizing ground radio navigation infrastructure, introducing RFI detection capabilities and improving civil-military coordination in managing GNSS RFI.

2.7 The Med-Term activities include:

2.7.1 development of further guidance material for GNSS Spoofing to be included in the new Edition of the GNSS Manual (ICAO Doc 9849)

2.7.2 development of guidance material to support PBN operations in case of GNSS RFI disruption by updating the PBN Manual (ICAO DOC 9613)

2.7.3 development of provisions for Resilient navigation operational network (NAV RON)- as explained in WP/7 of this meeting

2.7.4 development of provisions for on-board GNSS RFI detection capability.

2.8 The long-term actions focus on ensuring the resilience of aviation operations in the presence of GNSS RFI through the development and integration of technological enhancements across GNSS, along with independent timing sources, and it spans from 2030 onward. Long-term includes:

2.8.1 Complementary PNT (C-PNT) is anticipated to be a key solution for GNSS RFI. It will enable aircraft to integrate and cross-check data from multiple independent sources, including ground-based infrastructure (NAV RON), space-based systems (GNSS), and onboard capabilities such as inertial navigation systems.

2.8.2 Signal Authentication for GNSS core constellations, like GPS and GALILEO, and augmentation system (SBAS). Authentication allows aircraft receiver to verify the authenticity of signal received and whether it was generated by a spoofer.

2.8.3 Dual Frequency Multi Constellations (DFMC GNSS), the roadmap timeline refers to implementation milestones. ICAO completed DFMC GNSS in Amendment 93 of Annex 10, Vol I; however, its implementation in aircraft avionics is expected after 2032.

2.9 The updated assembly resolution 42-8/c “Ensuring the resilience of ICAO CNS/ATM Systems and Services” introduced mainly the following:

- a) Included operative clause on NAV RON “.... . *Encourages States to ensure that ~~sufficient~~ resilient terrestrial CNS capabilities remain available*”
- b) New Operative clause to secure industry and standardization organization support to ICAO roadmap “*Encouraged standardization bodies and industry to collaborate with ICAO in advancing PNT solutions that align with ICAO initiatives;*”

- c) Updated the operative clause on the requirement for protection from harmful interference “*Urges States to apply necessary measures to avoid the commercialization/ proliferation, purchase, possession, and the use of illegal transmitters such as jammers*”

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) encourage States to participate actively in the upcoming ICAO PBN/GNSS Workshop;
- b) discuss means to implement State mandates in accordance with AN-CONF/14 Recommendation 2.2/2 and A42-8/c; and
- c) review the ICAO GNSS RFI roadmap and identify any actions needed to reflect it at the regional level.



JOINT STATEMENT

by

**The Secretary General of the International Telecommunication
Union,**

**The Secretary General of the International Civil Aviation
Organization,**

**The Secretary General of the International Maritime
Organization**

regarding

**PROTECTION OF THE RADIO NAVIGATION SATELLITE
SERVICE FROM HARMFUL INTERFERENCE**

The Joint Statement (“Statement”) is made by the International Telecommunication Union (“ITU”), with its Headquarters at Place des Nations, 1211 Geneva 20, Switzerland, represented by its Secretary-General; the International Civil Aviation Organization (“ICAO”) , with its headquarters at 999 Boulevard Robert-Bourassa Boulevard, Montreal, Canada, represented by its Secretary-General; the International Maritime Organization (“IMO”), with its headquarters at 4 Albert Embankment, London, United Kingdom, represented by its Secretary-General (referred to collectively as the “Signatories”, and each, a “Signatory”).

WHEREAS, ITU is the United Nations specialized agency for information and communications technologies, responsible for, *inter alia*, coordinating efforts to eliminate harmful interference between radio stations of different countries and to improve the use made of the radio-frequency spectrum for radiocommunication services and of satellite orbits;

WHEREAS, ICAO, a specialized agency of the United Nations, was created to promote the safe and orderly development of international civil aviation throughout the world, and to establish Standards and Recommended Practices (SARPs) necessary for the safety, efficiency and regularity of international civil aviation.

WHEREAS, IMO is the United Nations specialized agency responsible for the safety and security of shipping and the prevention of marine and atmospheric pollution by ships. As an international regulatory body for the safety of maritime navigation, IMO recognizes radionavigation systems capable, in accordance with IMO’s requirements, of providing adequate position, velocity and timing information to ships.

WHEREAS Article 45.1 of the ITU Constitution states: “*All stations, whatever their purpose, must be established and operated in such a manner as not to cause harmful interference to the radio services or communications of other Member States...*”

WHEREAS Article 47 of the ITU Constitution states: “*Member States agree to take the steps required to prevent the transmission or circulation of false or deceptive distress, urgency, safety or identification signals, and to collaborate in locating and identifying stations under their jurisdiction transmitting such signals.*”

WHEREAS Article 4.10 of the ITU Radio Regulations states: “*Member States recognize that the safety aspects of radionavigation and other safety services require special measures to ensure their freedom from harmful interference; it is necessary therefore to take this factor into account in the assignment and use of frequencies.*”

WHEREAS Article 15.1 of the ITU Radio Regulations states: “*All stations are forbidden to carry out unnecessary transmissions, or the transmission of superfluous signals, or the transmission of false or misleading signals, or the transmission of signals without identification...*”

WHEREAS Article 15.28 of the ITU Radio Regulations recognizes that “*frequencies used for the safety and regularity of flight...require absolute international protection and that the elimination of harmful interference to such transmissions is imperative, administrations undertake to act immediately when their attention is drawn to any such harmful interference.*”

WHEREAS ICAO Assembly Resolution A41-8/C “*urges States to ensure close collaboration between aviation authorities, military authorities, service providers, radio regulatory and spectrum enforcement authorities to put in place any special measures required to ensure that spectrum used*

by all CNS (Communication and Navigation Systems), and GNSS (Global Navigation Satellite System) in particular, is free from harmful interference.”

WHEREAS ICAO Assembly Resolution A41-8/C *“urges States to refrain from any form of jamming, or spoofing affecting civil aviation”; and “to coordinate and notify to the maximum extent possible in advance with the air navigation services provider (ANSP) responsible for the affected airspace in case of military or other State authorized security or defence-related operations or training, potentially causing any form of jamming, or spoofing affecting civil aviation.”*

WHEREAS ICAO Assembly Resolution A41-8/C *“urges States and operators, when assessing the interference risks associated with conflict zones, to consider that the use of satellite-based CNS systems can potentially be impacted beyond those zones.”*

WHEREAS regulation V/19.2.1.6 of the International Convention for the Safety of Life at Sea (SOLAS), 1974, requires that *“all ships, irrespective of size, shall have a receiver for a global navigation satellite system or a terrestrial radionavigation system, or other means, suitable for use at all times throughout the intended voyage to establish and update the ship’s position by automatic means.”*

WHEREAS ships and ports have come to rely on GNSS for a wide array of applications relating to position, velocity and precise universal and local time which are used for navigation purposes and, most importantly, on systems that are part of the Global Maritime Distress and Safety System (GMDSS).

WHEREAS the IMO’s Maritime Safety Committee, through MSC.1/Circ.1644, *“urged Member States to take actions necessary to minimize interference coming from their territory, as required under the ITU Radio Regulations; consider issuing warning notices or advisories to mariners specifying the time periods and areas impacted by any known interferences to minimize negative effects upon maritime operations; and consider enacting measures that prevent unauthorized transmissions on recognized satellite navigation system frequencies.”*

CONSIDERING ITU-R Resolution 676 (WRC-23) on *“Prevention and mitigation of harmful interference to the radionavigation-satellite service in the frequency bands 1 164 - 1 215 MHz and 1 559 - 1 610 MHz”.*

CONSIDERING Recommendation 2.2/2 of the 14th ICAO Air Navigation Conference (AN-Conf/14) on *“Addressing global navigation satellite system interference and contingency planning”.*

RECOGNIZING that the ITU Radio Regulations Board encouraged Administrations to implement the Recommendations issued by the ITU Radiocommunications Bureau to Members States in its Circular Letter CR/488 dated 8 July 2022 on *“Prevention of harmful interference to radionavigation-satellite service receivers”.*

NOTING with grave concern the increasing number of cases of harmful interference in the form of jamming and spoofing affecting the Radio Navigation Satellite Service (RNSS), which is critical for navigation of civil aircraft, maritime vessels, humanitarian assistance vehicles, as well as for time synchronization of telecommunication networks.

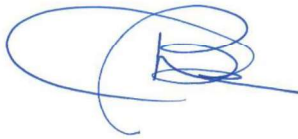
THEREFORE, ITU, ICAO, and IMO jointly and urgently call on their respective Member States to:

- a) protect the RNSS from transmissions that can adversely cause harmful interference degrading, interrupting or misleading signals used for civilian and humanitarian purposes;

- b) reinforce resilience of the systems which rely on RNSS for navigation, positioning and timing in relation to this type of interference;
- c) retain sufficient conventional navigation infrastructure for contingency support in case of RNSS outages and misleading signals, and develop mitigation techniques for loss of services;
- d) increase collaboration between radio regulatory, civil aviation, maritime, defense and enforcement authorities; and
- e) report cases of harmful interference affecting RNSS to the appropriate telecommunication, aeronautical and maritime authorities, and to the ITU Radiocommunications Bureau, to enable the monitoring of the situation.

For the International Telecommunication Union

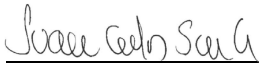
Ms. Doreen Bogdan Martin



Place: Geneva
Date: 17.03.2024

For the International Civil Aviation Organization

Mr. Juan Carlos Salazar



Place: Montreal
Date: 18/03/2025

For the International Maritime Organization

Mr. Arsenio Dominguez



A handwritten signature in black ink, consisting of a large, stylized 'A' followed by several vertical strokes and a final flourish.

Place: London

Date: 18/03/2025