



ICAO

*International Civil Aviation Organization***TENTH MEETING OF SPECTRUM REVIEW  
WORKING GROUP (SRWG/10)**

Bangkok, Thailand, 04 – 06 February 2026

**Agenda Item 6:** Frequency Interference in the Region

## 6.2 GNSS interference

**REVIEW OF THE LIST OF RECOMMENDATIONS FROM THE RADIO NAVIGATION  
SYMPOSIUM**

(Presented by Secretariat)

**SUMMARY**

The paper presents the key outcomes of the ICAO APAC Radio Navigation Symposium, which was held in New Delhi, India, from 07-09 April 2025 and request meeting to update list of recommendaitons resulted as an outcomes of discussion in the symposium.

**1. INTRODUCTION**

1.1 The **ICAO APAC Radio Navigation Symposium** was held in New Delhi, India, from 07-09 April 2025. The theme of the Symposium was ***GNSS RFI: Collectively Bridging Gaps and Shaping the Path Forward***. The Symposium aimed to provide a collaborative platform for exchanging experiences and insights on GNSS RFI, analyzing its impact and challenges, and facilitating in-depth discussion on mitigation measures and future development to build a resilient aviation system. The Symposium developed recommended actions to guide future efforts in managing GNSS RFI. It also addressed the USOAP Radio navigation flight inspection requirements and the latest developments.

1.2 The Symposium was attended by **157** participants from **10** Member States/Administrations, **6** International Organizations and **5** International Industries. The report and other documents of the Symposium can be accessed at the ICAO APAC Meeting webpage:

<https://www.icao.int/APAC/meetingdocs?fid=555>

1.3 This paper presents the list of recommendations resulting from the Radio Navigation Symposium for the SRWG/10 Meeting review.

**2. DISCUSSION**

2.1 The summary of the key presentations of the Symposium is given in the following paragraphs.

**Day 1: 7 April 2025**

2.2 Day 1 was divided into three sessions. The first Session, *Setting the Scene*, explored global developments in radio navigation, updates from the ICAO APAC Region, and GNSS vulnerabilities,

providing a foundation for understanding current challenges and their implications for the aviation industry.

2.3 The session included three presentations delivered by the ICAO Secretariat team and the ICAO HQ Navigation System Panel (NSP) vice-chair. Ms. Muna Alnadaf shared details about ICAO provisions, relevant global developments and initiatives, and ongoing NSP activities. Dr. Soniya Nibhani, ICAO APAC Office, shared updates on activities done in the ICAO APAC Office on relevant topics. She introduced the ICAO APAC Office structure, its role and responsibilities, and the challenges faced by APAC States/Administrations in handling matters related to GNSS RFI and other navigation issues. Key issues raised in past ICAO APAC meetings under the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) and respective actions taken by the ICAO APAC Office were shared with the participants. The third presentation by Mr. Gerhard Berz, Eurocontrol, provided background information on GNSS vulnerabilities, their impact on both airborne and ground systems, and trends in spoofing incidents.

2.4 The second and third sessions included a panel discussion on the operational and safety impacts of RFI on GNSS-dependent systems, addressed the consequences of flight operation and air navigation service, and highlighted best practices, ongoing efforts, and recommended actions.

2.5 During the second session, the Symposium was apprised of the impact of the GNSS RFI and the associated challenges in India, Japan, Malaysia, the Philippines, and the ROK. It was noted that States have implemented the reporting procedures and form as outlined in the GNSS Manual. However, the main challenges include the lack of real-time monitoring and reporting, ineffective management of reported incidents, insufficient awareness of GNSS RFI issues, and the proliferation and online sale of jamming devices.

2.6 In the third session, under a panel discussion on the industry's perspective, Indigo and Thai Airways shared their airline viewpoints, and IATA shared APAC Airlines' outlooks on GNSS RFI challenges, impact, best practices and recommendations. Boeing presented recommended best Practices in the case of GNSS Interference from an aircraft manufacturer's view, while Eurocontrol presented GNSS RF Interference and Mitigation from an international organization perspective.

2.7 The panel emphasized the need for States to be better prepared by adopting proactive measures rather than reactive ones, as mitigating GNSS RFI has become a critical risk management activity for States and airlines. Moreover, the panel encouraged States and Air Navigation Services Providers (ANSPs) to re-evaluate GBNA infrastructure under their control and follow AN-Conf/14 *Recommendation 2.2/2 – Addressing global navigation satellite system interference and contingency planning* (a) States 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.

## **Day 2: 8 April 2025**

2.8 Day 2 discussion was divided into three sessions under two agenda items. The first two sessions focused on the agenda item *Mitigating GNSS Interference: Current Measures and Gaps to Address*, while the third on the agenda item *Risks Beyond GNSS: Lessons and Broader Threats to Satellite-Based Systems*.

2.9 Two panels were organized under the agenda *Mitigating GNSS Interference: Current Measures and Gaps to Address* to provide a comprehensive overview of existing mitigation strategies, identify gaps, and offer insights into what more needs to be done to address emerging challenges posed by GNSS RFI in terms of technological, procedural, and human-centric aspects of mitigation.

2.10 The first session focused on technological aspects of mitigation under which industries, including Aireon, Collines Airspace and Thales, shared information about innovative technical developments such as innovation embedded in the new nav aids and surveillance systems, GNSS interference monitoring using space-based ADS-B and building resilient GNSS Systems. In addition, Saudi

Arabia shared its experience with GNSS Performance Monitoring in Saudi Arabia, and the USA shared details about PNT and Innovation.

2.11 The Symposium noted that new features are being developed for DME, referred to as Enhanced DME (eDME), within the framework of the SESAR project. These enhancements are expected to contribute to more efficient spectrum utilization and enable an increase in the number of available DME channels.

2.12 Furthermore, the discussion emphasized the importance of a robust and resilient time source for both airborne and ground systems to support aviation safety and security. It was recommended that aviation systems adopt independent clocks or oscillators as the primary means to ensure secure and reliable time and frequency synchronization.

2.13 The Symposium was apprised of the Collins GNSS receiver roadmap and noted the ongoing efforts to enhance airborne GNSS resiliency by leveraging advancements in both GNSS sensor technology and antenna techniques.

2.14 During the second session, a panel discussion on procedural and human-centric aspects of mitigation was conducted under which ITU shared ITU regulations and actions to protect the RNSS from harmful interference and IFATSEA shared ATSEP's Role in Detecting, Diagnosing, and Mitigating GNSS RFI for a Human-Centric ATM System.

2.15 The Symposium emphasized that harmonized communication between ATC and pilots, through standardized radiotelephony (RT) phraseology and well-defined contingency procedures, can significantly enhance safety. In support of this, it was recommended that recommendations for improvements in RT phraseology be submitted to the relevant ICAO experts group for consideration and further evaluation.

2.16 The last panel on day 2 focused on the agenda item Risks Beyond GNSS: Lessons and Broader Threats to Satellite-Based Systems. This panel discussion explored lessons learned from the challenges faced by GNSS and examined the risks posed to other satellite-based systems that share similar vulnerabilities. Panellists debated what lessons can be applied to safeguard the resilience of other satellite-based systems and what collaborative efforts and proactive steps were necessary to mitigate the growing threats to these vital technologies.

2.17 This panel considered a total of four presentations. Singapore presented ADS-B spoofing and mitigating measures due to GNSS RFI. At the same time, Thales informed about Space-based Surveillance used for delivering a real-time, continuous and safety-certified ATC surveillance data flow whenever the areas. Aireon presented Space-based Surveillance and its experience based on the first 6 years of Global ATC operations and evolution into Satellite Time Difference of Arrival (TDA) to mitigate GNSS interferences, and Japan shared its experience on research activities for investigating onboard electronic magnetic compatibility issues in current radio environments.

### **Day 3: 9 April 2025**

2.18 On the last day, an expert panel deliberated on Key Takeaways, Recommendations, and the Path Forward. The expert panel, composed of five members from Singapore, ICAO, IATA, USA and Collins airspace, reflected on the insights shared during the first two days, considering the major themes and challenges. Panellists provided a synthesis of the most important takeaways related to radio regulatory topics, flight deck, ATC operations, service provision aspects, short-term C-PNT development, and long-term C-PNT Development. This session offered a collaborative opportunity to chart a path forward, ensuring that the momentum generated throughout the Symposium was translated into recommended action. The list of key recommendations discussed during the Symposium can be accessed by [this link](#).

2.19 The last session of this day was dedicated to the agenda item *Radio Navigation Flight inspection*. The panel discussed the critical role of Radio Navigation Flight Inspection in ensuring the

safety of air navigation services. It highlighted the ICAO USOAP audit requirements and addressed the latest developments, including the use of UAS-based flight inspection and relevant ICAO provisions.

2.20 A total of four presentations were discussed under this panel. Japan shared flight inspection using drones in Japan and details of ILS drone propeller modulation. Indonesia shared about flight inspection in Indonesia, while the NSP vice chair shared details of ICAO provisions for flight inspection.

2.21 The Symposium was informed of recently developed guidance material aimed at reducing flight inspection volume, with a particular focus on minimizing the number of inspection runs for ILS procedures. Furthermore, it was noted that ongoing efforts will include a new chapter on GNSS RFI and flight inspection capabilities for geolocating interference sources in the ICAO doc 8071, Vol II.

### **Q&A Sessions**

2.22 Dedicated Q&A sessions were conducted at regular intervals based on available time. In addition, a link to Slido was provided for asking questions. A total of **122 questions** were asked using Slido, and most of them were answered during the Symposium. For some questions, the answers were added to the Slido for the participant's reference.

### **Key Outcomes of the Symposium**

2.23 The final list of recommendations resulting from the Symposium was published using Electronic Bulletin (EB2025/20) (**Appendix A**) on 28 July 2025, including a link to the Symposium's webpage, for information and awareness of Member States. The List of Recommendations is also provided in **Appendix B**.

### **Closing of the Session**

2.24 The Symposium recommended organizing such sessions in the future and ensuring that all APAC member States/Administrations participate and contribute in such sessions so that comprehensive regional requirements can be formulated to address GNSS RFI issues in the region.

2.25 In closing, the ICAO Secretariat expressed sincere appreciation and gratitude to the Ministry of Civil Aviation, India, for the excellent organization and smooth conduct of the Symposium. Appreciation was also extended to all participants and panelists for their valuable contributions and active engagement throughout the event. The Secretariat requested continued collaboration and information sharing among States to support ongoing efforts in mitigating GNSS interference and enhancing regional aviation safety and resilience.

## **3. ACTION BY THE MEETING**

3.1 The Meeting is invited to:

- a) note the outcome of the ICAO APAC Radio Navigation Symposium;
- b) review the list of recommendations;
- c) take any necessary follow-up actions; and
- d) discuss any relevant matter as appropriate

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International Civil Aviation Organization

## ELECTRONIC BULLETIN

For information only

EB 2025/20

28 July 2025

### RECENT REGIONAL RADIO NAVIGATION WORKSHOPS AND SYMPOSIA TO PURSUE INCREASED RESILIENCE TO GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) RADIO FREQUENCY INTERFERENCE (RFI)

1. To address growing concerns about the impact and potential consequences of GNSS RFI and its detrimental effect on aviation safety, ICAO has been actively engaging its Regions through radio navigation workshops and symposia to develop timely and effective mitigation strategies.
2. The ICAO Asia Pacific (APAC) Radio Navigation Symposium was held from 7 to 9 April 2025, in New Delhi, India, under the theme “GNSS RFI: Collectively Bridging Gaps and Shaping the Path Forward”. This Symposium examined existing and potential mitigation strategies with the objective to identify gaps and offer insights into actions required to address the evolving challenges posed by GNSS RFI in terms of technological, procedural, and human-centric aspects of mitigation.
3. The Symposium further echoed the discussions of the ACAO/ICAO Radio Navigation Workshop, held in Rabat, Morocco, from 24 to 26 February 2025 as well as the recommendations made by the EUR/MID Radio Navigation Symposium held in Antalya, Türkiye, from 6 to 8 February 2024 (State letter 24/54 refers).
4. The Symposium reaffirmed the significance of the recent International Telecommunication Union (ITU), ICAO and International Maritime Organization (IMO) Joint Statement on the Protection of the Radio Navigation Satellite Service (RNSS) from Harmful Interference. For information and awareness of Member States, information on the ICAO APAC Radio Navigation Symposium can be accessed at: [icao.int/APAC/Meetings/Pages/Radio-Navigation-Symposium.aspx](https://www.icao.int/APAC/Meetings/Pages/Radio-Navigation-Symposium.aspx).
5. The ITU, ICAO and IMO Joint Statement on the Protection of the RNSS from harmful interference can be accessed at: [ITU, ICAO and IMO Joint Statement](#)

Issued under the authority of the Secretary General



## ICAO APAC RADIO NAVIGATION SYMPOSIUM

GNSS RFI: Collectively Bridging Gaps and Shaping the Path Forward

7<sup>th</sup> – 9<sup>th</sup> April 2025 New Delhi, India



### List of Recommendations

*The ICAO APAC Radio Navigation Symposium reviewed existing Global Navigation Satellite System (GNSS) Radio Frequency Interference (RFI) mitigation strategies with the objective of identifying gaps and offering insights into actions required to address the evolving challenges posed by GNSS RFI in terms of technological, procedural, and human-centric aspects of mitigation.*

*The Symposium reaffirmed the significance of the [ICAO/ITU/IMO Joint Statement on the Protection of Radio Navigation Satellite Service \(RNSS\) from Harmful Interference](#) and outlined a set of recommended actions and best practices to achieve the following objectives:*

#### **Objective 1: Minimize GNSS RFI occurrence through effective regulatory measures and enforcement.**

##### 1.1 States should:

- 1.1.1 ensure sufficient aviation representation in delegations of States to ITU WRC-27 preparatory meetings, to progress future improvements to ITU Resolution 676 and to ensure that future WRC updates of Radio Regulations do not adversely impact GNSS;
- 1.1.2 improve coordination with the military by facilitating the sharing of information on GNSS RFI testing and any relevant activities such as Counter-UAS operations;
- 1.1.3 possess the necessary technical capabilities to detect GNSS RFI, conduct Radio Frequency (RF) measurements, and geolocate the source of the GNSS RFI; and
- 1.1.4 utilise the ITU Radio Regulations (RR) escalation procedure (RR Article 15) to ensure proper resolution for incidents of GNSS RFI with cross-border impact that cannot be solved nationally or internationally through routine procedures;
- 1.1.5 States should also consider submitting reports to the respective ICAO Regional Office, which can then forward those reports to the ITU Satellite Interference Reporting and Resolution System (SIRRS) for further action.

1.2 Radio regulatory authorities of States need to step up enforcement against GNSS jamming transmitters (GPS Jammers) while educating the public about their illegality, without unintentionally exposing system vulnerabilities. Law enforcement should monitor and act against online marketplaces selling such devices. Additionally, making the ownership of GPS jammers illegal will help authorities confiscate them more effectively and strengthen regulatory control.

1.3 All stakeholders need to contribute to the development of further ICAO guidance to strengthen the link between air operator reports, air navigation services provider (ANSP) confirmation, and spectrum regulator engagement. The coordination and reporting processes must be efficient and simplified to ensure timely and effective management.

## **Objective 2: Support Air Crews in Operational Risk Reduction and Management**

2.1 ICAO should consider the necessity of standardized radiotelephony phraseologies for specific scenarios. Establishing clear, standardized communications in these situations could greatly benefit both pilots and air traffic controllers, ensuring accurate and efficient responses.

2.2 Airlines and aircraft manufacturers should:

2.2.1 integrate GNSS RFI factors into fuel and alternate planning to ensure contingency measures are in place for potential navigation disruptions, including refining dispatch decisions based on aircraft equipment and ensuring the aircraft's capabilities match the expected interference conditions;

2.2.2 ensure pilots maintain proficiency in conventional navigation methods, supporting operational resilience in GNSS-degraded environments. This includes:

2.2.2.1 providing training to ensure pilots can operate effectively using conventional procedures, enabling them to fly without reliance on GNSS when necessary.

2.2.2.2 encouraging position cross-checking using VOR radials for situational awareness; and

2.2.2.3 ensure a full Inertial Reference System (IRS) alignment before departure if the aircraft experienced GNSS RFI during the previous flight, as indicated in the aircraft journey log.

2.2.3 clarify and streamline GNSS RFI reporting, potentially through Electronic Flight Bags (EFB) integration, to facilitate timely incident reporting; and

2.3 The symposium acknowledged IATA's initiative in providing the Turbulence Aware platform to support airline information sharing and encouraged the development of similar initiatives for GNSS RFI information exchange.

**Objective 3: Ensure effective support to flight crews while maintaining safety**

3.1 States should:

- 3.1.1 prioritize suitable staffing levels, sector workload planning, and continuous monitoring of compliance with clearances to ensure effective air traffic management;
- 3.1.2 ensure ATC readiness to provide radar vectors when requested navigational assistance in a surveillance environment, clock checks, and clearly define circumstances under which ATC may refuse vectoring;
- 3.1.3 ensure comprehensive ATCO training and awareness programs focusing on response to abnormal situations and clearance deviations, equipping controllers with the necessary skills to handle unexpected events effectively; and
- 3.1.4 identify critical areas for Terrain Awareness and Warning System (TAWS) climb and deconfliction advisories, ensuring controllers provide timely and accurate guidance to pilots.

**Objective 4: Ensure suitable CNS capabilities are available as required**

4.1 States should:

- 4.1.1 ensure timely and effective communication regarding GNSS RFI incidents. A warning could be issued via NOTAM, Aeronautical Information Publication (AIP), and/or Automatic Terminal Information Service (ATIS) as appropriate;
- 4.1.2 ensure ATSEP personnel receive training/awareness program on GNSS RFI detection, mitigation, and reporting. Simulation exercises and collaborative awareness programs could be implemented to enhance response capabilities and operational resilience;
- 4.1.3 establish a Resilient Operational Network (RON) by ensuring availability of sufficient navigation infrastructure to support continuous Performance Based Navigation (PBN) operations and by facilitating positional awareness through maintenance of a VOR/DME Network for reliable cross-checking; and
- 4.1.5 implement GNSS jamming and spoofing monitoring using ADS-B Out (ground-based or space-based) or Wide Area Multilateration (WAM).

**Objective 5: Strengthen capabilities to maintain PBN and optimize operational efficiency by leveraging current technology**

5.1 Aircraft and avionics manufacturers should:

- 5.1.1 avoid cross-contamination of aircraft/avionics sensors due to GNSS RFI;
- 5.1.2 augment GNSS time with precision time sources to improve resilience and mitigate disruptions;

5.1.3 enhance GNSS robustness with rapidly deployable Multi-Mode Receivers (MMR) and strategic system upgrades; and

5.1.4 enable advanced RNP operations using DME through improvements to multi-DME navigation and clarifying the DME interrogator scanning and selection criteria.

5.2 States should:

5.2.1 implement spoofing monitors in surveillance trackers while conducting a comprehensive ADS-B to SSR/WAM comparison; and

5.2.2 optimise DME transponder network planning and coverage.

**Objective 6: Achieve Robust Positioning, Navigation, and Timing (PNT) through long-term C-PNT development**

6.1 States should:

6.1.1 conduct a comprehensive cyber risk assessment for all CNS/ATM systems, particularly space-based systems, and implement adequate mitigation measures; and

6.1.2 enhance GNSS resilience and improve cybersecurity defenses through standardization and implementation of advanced technical improvements such as authentication mechanisms, improved Controlled Reception Pattern Antennas (CRPA) for robust interference mitigation and enhanced signal reception, GNSS RFI detection systems and downlink enhancements to identify and counter GNSS RFI in real time and ensure secure and reliable data transmission across GNSS networks.

6.2 ICAO should:

6.2.1 enhance L-Band spectrum utilization through standardization of enhanced DME (eDME) and assess other candidate PNT solutions;

6.2.2 establish a balanced CNS evolution roadmap, whereas ground, air, and space capabilities should work collaboratively within a unified framework that prioritizes spectrum efficiency as the fundamental driver; and

6.2.3 emphasize the core objective of the Integrated Communication, Navigation, Surveillance and Spectrum (CNSS), transforming common mode weaknesses into strengths through smart integration while maintaining independence across ground, air, and space systems.