



ICAO

MIDANPIRG/23 & RASG-MID/13

CAIRO - EGYPT

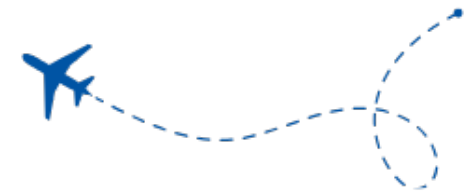
14-18 JUNE 2026

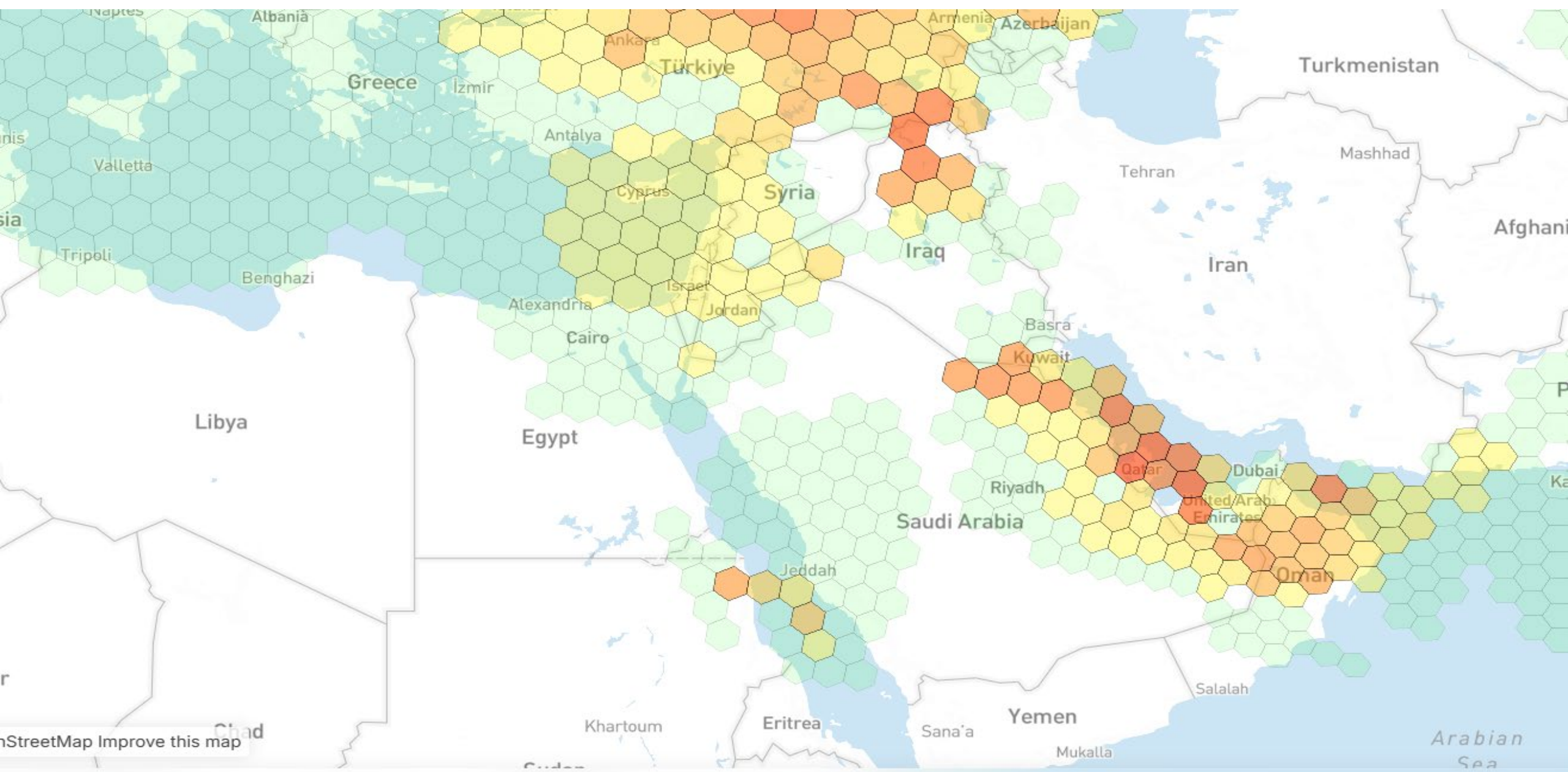


Global Navigation Satellite Systems Radio Frequency Interference (GNSS RFI)

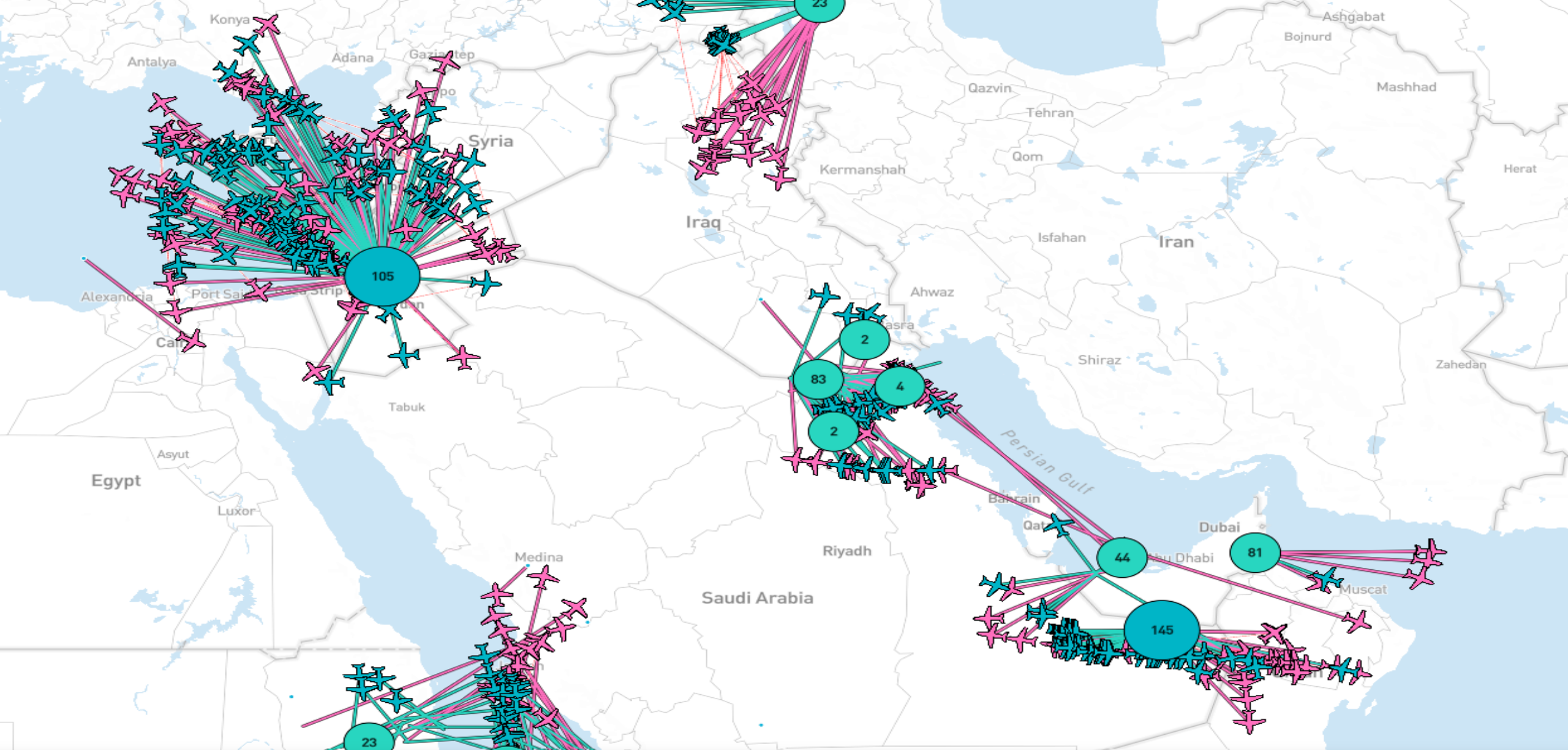
Muna Alnadaf

Technical Officer CNS / ICAO HQ
Secretary of the Navigation Systems Panel





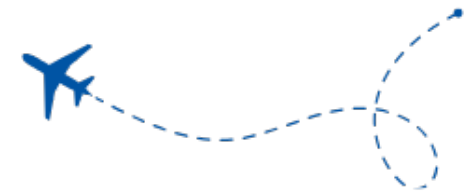
Jamming Map



Spoofting Map

Online GNSS Jamming & Spoofing Monitoring Tools

- GPSJAM: [GPSJAM GPS/GNSS Interference Map](#)
- Live GPS Spoofing and Jamming Tracker Map: [Real-time GPS Spoofing & Jamming Detection | GPSwise](#)
- Flightradar24 GPS jamming map: [GPS jamming & interference map | Flightradar24](#)





GNSS RFI Regional Monitoring Network (Near-real-time monitoring) can provide:

- detection of interference events
- Operational alerts delivered to ATC and airlines supporting rapid response and mitigation
- Regional coordination across FIR boundaries to enhance collaborative situational awareness
- Trend analysis (hotspots, time-of-day patterns) to support risk management

MIDANPIRG 20/47 Decision, that requested the ICAO MID Office to collaborate with ACAO to assess the feasibility of establishing a Regional GNSS RFI monitoring System and report the outcome to the CNS SG/13 and MIDANPIRG/21 meetings (WP44 will provide further details)

ICAO GNSS RFI Roadmap



ICAO GNSS RFI Roadmap

Medium Term

To enhance 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

2027 -
2029

Long Term

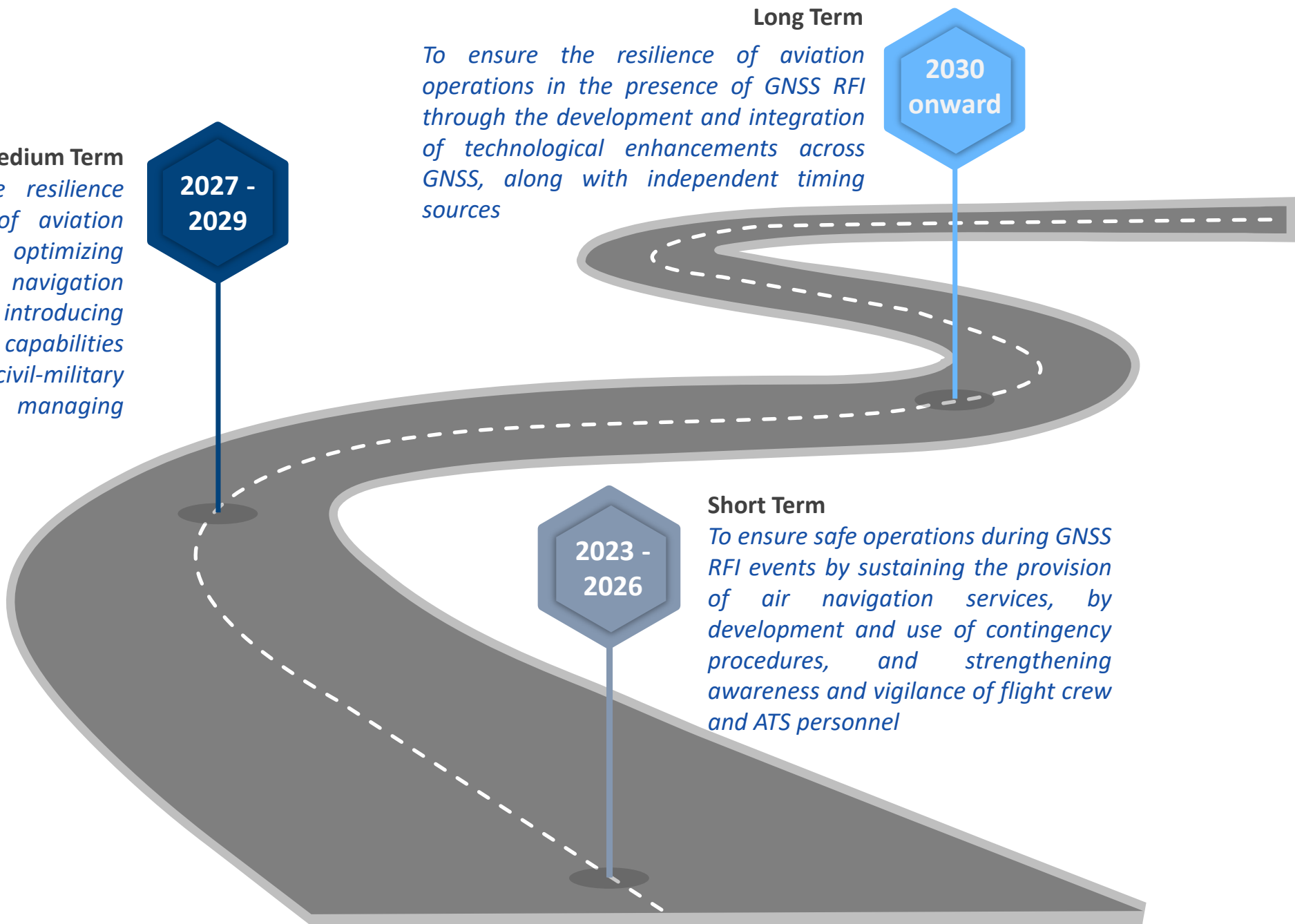
To ensure the resilience of aviation operations in the presence of GNSS RFI through the development and integration of technological enhancements across GNSS, along with independent timing sources

2030
onward

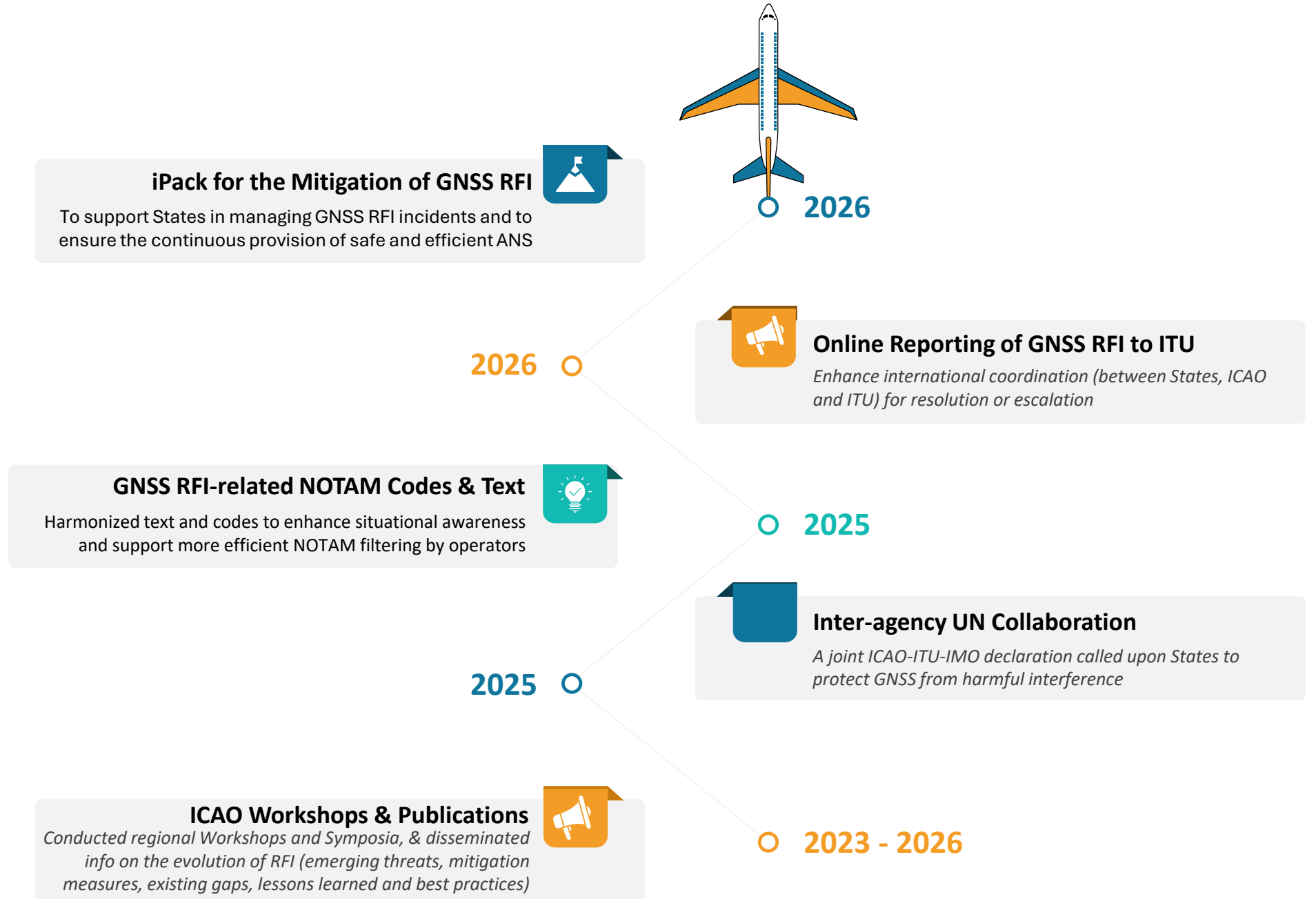
Short Term

To ensure 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

2023 -
2026



Short-Term



GNSS Manual Update (Doc 9849)

The forthcoming update to the GNSS Manual will include the following enhancements:

- guidance on monitoring and mitigation techniques
 - effects of spoofing on navigation and timing capabilities
 - possible effects of GNSS RFI on other aircraft capabilities
 - alternative and complimentary conventional navigation capabilities
 - Revising terminology and reorganizing content to better address current, global impacts and a wider audience of stakeholders affected by GNSS RFI
 - Updating and correcting content to reflect the current threat environment
-
- Manual updates are expected to be completed by November 2026.

GNSS RFI-related NOTAMs

1) NOTAM QCodes:

- New NOTAM Code for Spoofing (LO) –PANS ABC need to be updated (2029)
- Associate jamming code (LF) with GNSS

2) Recommended Item E Text for Jamming: GNSS MAY BE UNRELIABLE WITHIN ...

3) Recommended item E text for GNSS Spoofing: GNSS MAY BE MISLEADING WITHIN ...

Update of relevant ICAO provisions is currently in progress





Complete

ICAO Outreach



International Civil Aviation Organization
Organisation de l'Aviation civile internationale
Organización de Aviación Civil Internacional
Международная организация гражданской авиации
منظمة الطيران المدني الدولي
国际民航组织

Tel.: +1 514-315-1872
Ref.: E 3/5-24/54
30 April 2024


Subject: Aviation safety concerns regarding interference to the Global Navigation Satellite System (GNSS)

Action required: a) disseminate guidance material; and b) implement recommendations, as applicable

Sir/Madam,

- I have the honour to bring to your attention the concerning escalation of jamming spoofing activities targeting the global navigation satellite system (GNSS), which have been increasing recently in various regions globally. GNSS, as one of the main enablers for performance-based navigation (PBN), provides navigation guidance for all phases of flight, from enroute through to precise approach. By providing accurate position and timing information, GNSS enables several systems critical to the safety of flight.
- Since 2003, the International Civil Aviation Organization (ICAO) has been actively developing recommendations and guidance concerning GNSS Radio Frequency Interference (RFI), in particular to recall ICAO Assembly Resolution A41-8, Appendix C: *Ensuring the resilience of CNS/ATM systems*, which serves as the latest ICAO policy on GNSS resilience.
- To bring attention to the critical issue of GNSS interference, and to foster discussions on management of GNSS vulnerabilities and potential mitigation measures against GNSS RFI, ICAO recently convened the ICAO EUR/MID Radio Navigation Symposium from 6 to 8 February 2024 in Antalya, Turkey. One important outcome of this symposium is the attached list of recommendations regarding Stakeholders' continued efforts towards ensuring safe, reliable, and resilient air navigation.
- I would like to take this opportunity to refer to recent safety-related publications by the European Union Aviation Safety Agency (EASA), *Safety Information Bulletin No. 2022-02R2* and

ICAO SL on the recommendations from ICAO EUR/MID Radio NAV Symposium, Antalya, 2024



International Civil Aviation Organization
ELECTRONIC BULLETIN
For information only

EB 2024/27 18 December 2024

REPORT OF THE OPSGROUP GPS SPOOFING WORKGROUP


- On 4 November 2024, the Council of the International Civil Aviation Organization (ICAO) was briefed on a report providing the outcomes of an impact assessment on Global Positioning System (GPS) Spoofing, developed by a Working Group of the OPSGROUP. Membership of the OPSGROUP consists primarily of pilots, flight dispatchers, cabin crew and controllers. The report provides comprehensive information on the recent increase in GPS Spoofing incidents, their operational impact and various safety concerns.
- On 5 November 2024, the Council in its 77th meeting of the 233rd session reiterated its serious concerns regarding the impact of interference to the Global Navigation Satellite Systems (GNSS) on the safety and security of air navigation systems, particularly as such occurrences are expected to increase, posing an ever-growing safety hazard to global flight operations. Consequently, the Council has requested (C-DEC 233/7) that the attached report be circulated amongst Member States and relevant industry stakeholders.
- The Report of the OPSGROUP GPS Spoofing Workgroup, which was published on 4 September 2024, includes detailed analysis of the technical background, impacts to aircraft handling and operation, best practices for flight crew, and a series of safety concerns and recommendations for industry attention.
- The Report of the OPSGROUP is herewith attached for information and awareness of Member States and industry stakeholders.

Enclosure:
GPS-Spoofing-Final-Report-OPSGROUP-WG-0024 (English only)

Issued under the authority of the Secretary General

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Dissemination of OPSGroup Report, December 2024



International Civil Aviation Organization
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EB 2025/20 28 July 2025

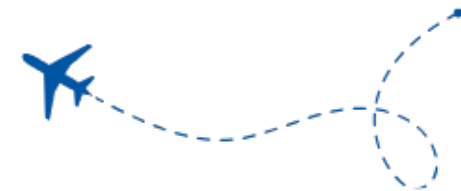
RECENT REGIONAL RADIO NAVIGATION WORKSHOPS AND SYMPOSIA TO PURSUE INCREASED RESILIENCE TO GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) RADIO FREQUENCY INTERFERENCE (RFI)

- 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.
- 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 Forging Steps 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.
- The Symposium further extended the discussions of the ACAS/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, Turkey, from 6 to 8 February 2024 (State letter 24/54 refers).
- 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: www.icao.int/APAC/Meetings/Pages/Radio-NAV-Symposium.aspx.
- 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](https://www.itu.int/ITU-T/Workshops-Symposia/2024/02/24-26-2024-ITU-ICAO-IMO-Joint-Statement).

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ICAO Electronic Bulletin on recommended actions from ICAO APAC Radio NAV Symposium, New Delhi, July 2025





ICAO Outreach

Plan for 2026

- ICAO SAM Radio Navigation Workshop
2-4 September 2026
- ICAO MID PBN/GNSS Workshop
28-30 September 2026
- Air Navigation World – CNS 2026
12-15 October 2026



ICAO EUR/MID Radio Navigation Symposium
(6-8 Feb 2024, Antalya, Türkiye)



ICAO/ACAO Radio Navigation Workshop
(24-26 Feb 2025, Rabat, Morocco)

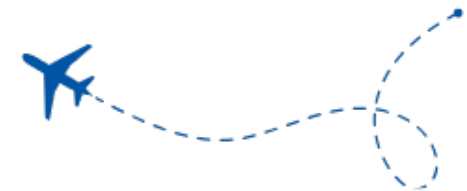


ICAO APAC Radio Navigation Symposium
(7-9 April 2025, New Delhi, India)



ICAO NACC Radio Navigation Workshop
(2-4 September 2025, Mexico City, Mexico)

Global event on GNSS resilience is planned Q1 2027



Reporting GNSS RFI to ITU



Space Services Department

YOU ARE HERE ITU > HOME > ITU-R > SPACE SERVICES > SIRRS

SHARE    

SIRRS

Satellite Interference Reporting and Resolution System


- As per Resolutin 55 (Rev. WRC-23) Reports of Harmful Interference affecting Space Services are to be submitted by SIRRS -

This online application has been developed by the Radiocommunication Bureau in response to Resolution 186 of ITU Plenipotentiary Conference 2014 with the aim to facilitate Administrations and space stakeholders to report a case of harmful interference affecting space services, to request assistance from the BR, to be informed in case a radio station under your jurisdiction is causing harmful interference to space services of other Administrations, and to exchange all necessary information among the concened parties involved in the case.

In order to be able to use the system, a user account must be open as indicated below:

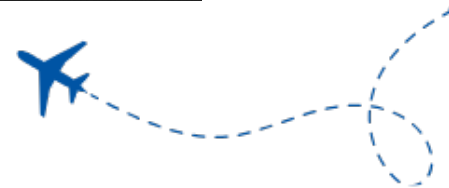

Reporting

(ITU Registered Users)

 LOGIN [I forgot my password...](#)

References:

[Short Video to Use SIRRS](#)





In-Progress

Implementation Package (iPack) for GNSS RFI Mitigation



Raise Awareness

Educate stakeholders on effects of GNSS RFI on CNS/ATM systems, aviation operations, and GNSS-based services through comprehensive training materials and workshops



Risk Mitigation Framework

Provide methodologies for threat monitoring, risk assessment, and implementation of mitigation measures tailored to specific operational environments



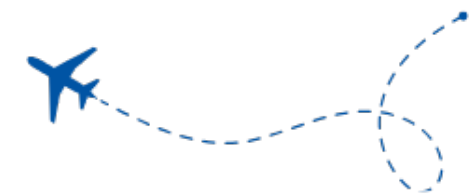
Expert Support

Deliver hands-on guidance to develop essential policies, procedures, and training requirements for managing GNSS RFI events



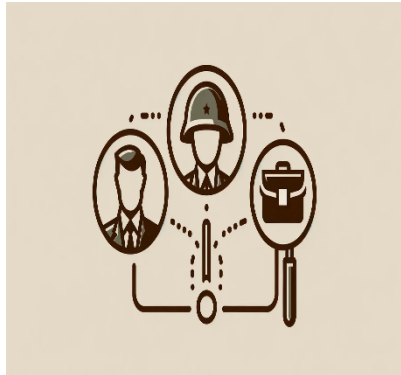
Infrastructure Assessment

Assist States in assessing conventional navigation infrastructure for a rationalized approach to maintaining necessary backup capabilities





**Resilient Navigation
Operational Network
(NAV RON)**



**New Guidance for Civil-
Military coordination**



**Update PBN Manual to
support PBN operations
in case of GNSS RFI**



**Onboard RFI detection
capability**

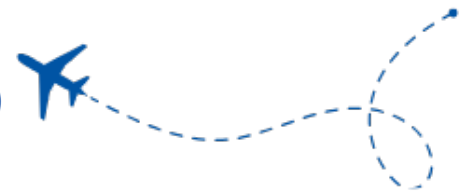
Medium-Term

2027-2029

Objective

To enhance 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

Inclusion of GNSS RFI in Security risk assessment and update relevant security guidance (2027)





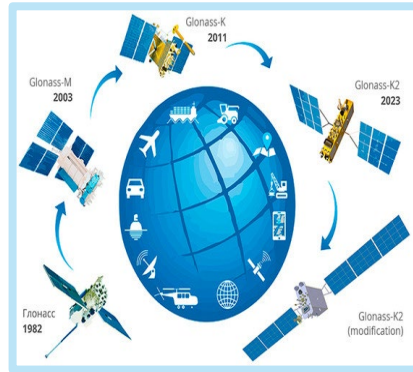
**Complementary Positioning,
Navigation and Timing
(C-PNT)**



**GNSS Signals Authentication
for augmentation systems
(SBAS Authentication)**



**GNSS Signals Authentication
for Core Constellations
(Galileo OSNMA)**



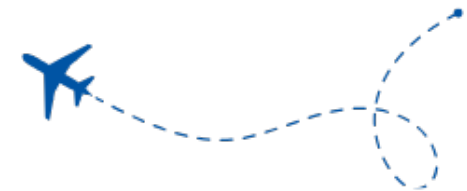
**Dual Frequency
Multiple Constellation
(DFMC GNSS)**

Long-Term

2030 onward

Objective

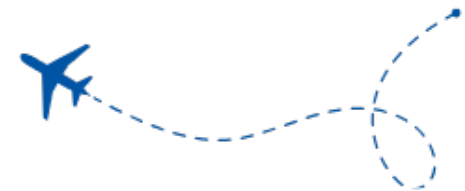
To ensure the resilience of air navigation in the presence of GNSS RFI through the development and integration of technological enhancements across GNSS, along with independent timing sources.





In conclusion, for the short term, conventional navigation infrastructure can serve as a backup, while iPack will support States facing implementation challenges by helping them deploy the necessary preventive and reactive mitigation measures.

No single solution is known to be effective in all GNSS RFI cases, therefore, the most robust approach is a combination of technical measures, including signal authentication for core constellations (GPS, Galileo), SBAS authentication, C-PNT, NAV RON, enhanced antenna types, and other complementary technologies.





For the MID Region, we need to focus on:

- 1- Continuous monitoring of risks, and evolving threats along with the sharing of experience and intelligence to enhance regional resilience;*
- 2- ensure implementing necessary mitigation measures including the conventional navigation network;*
- 3- exploring the establishment of a GNSS RFI regional monitoring network;*
- 4- enhancing reporting procedure by taking into consideration operational experience gained, pilot workload, reporting effectiveness and alignment with ITU-ICAO reporting procedure*

Thank You