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INTERNATIONAL CIVIL AVIATION ORGANIZATION

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Speaker Bio

A former Engineer-Officer in the Tunisian Air Force, he transitioned to civil aviation in 2007, developing expertise in airport planning, airside operations, and aerodrome certification.

He has led aerodrome capacity-building initiatives for ICAO, the United Nations, and the African Union, and oversaw certification and master planning for Tunisia's international airports. Since 2010, he has served as an instructor at the Tunisian Air Force Academy, and since 2016 with ACI, sharing his knowledge on aerodrome planning and safety.

In addition to his AGA role, he coordinates ICAO activities in the Middle East on CNS, cybersecurity, innovation, and the CAPSCA programme, combining technical expertise with strategic leadership in international aviation.

Mohamed Iheb HAMDI
Regional Officer, AGA
ICAO MID

MID REGION Approach on the Management of the GNSS Radio Frequency Interference (RFI)

Eng. Mohamed Iheb Hamdi

ICAO MID Regional Officer for Aerodromes and Ground Aids (RO-AGA)

& MID Region CNS and Cybersecurity Focal Point

Joint ICAO EUR/NAT and MID GNSS RFI Workshop
(Doha, Qatar, 18-20 November 2025)

GNSS Vulnerabilities and Resilience: Outcomes of the ICAO Assembly A42

Agenda Item 24: Aviation Safety and Air Navigation Priority Initiatives.

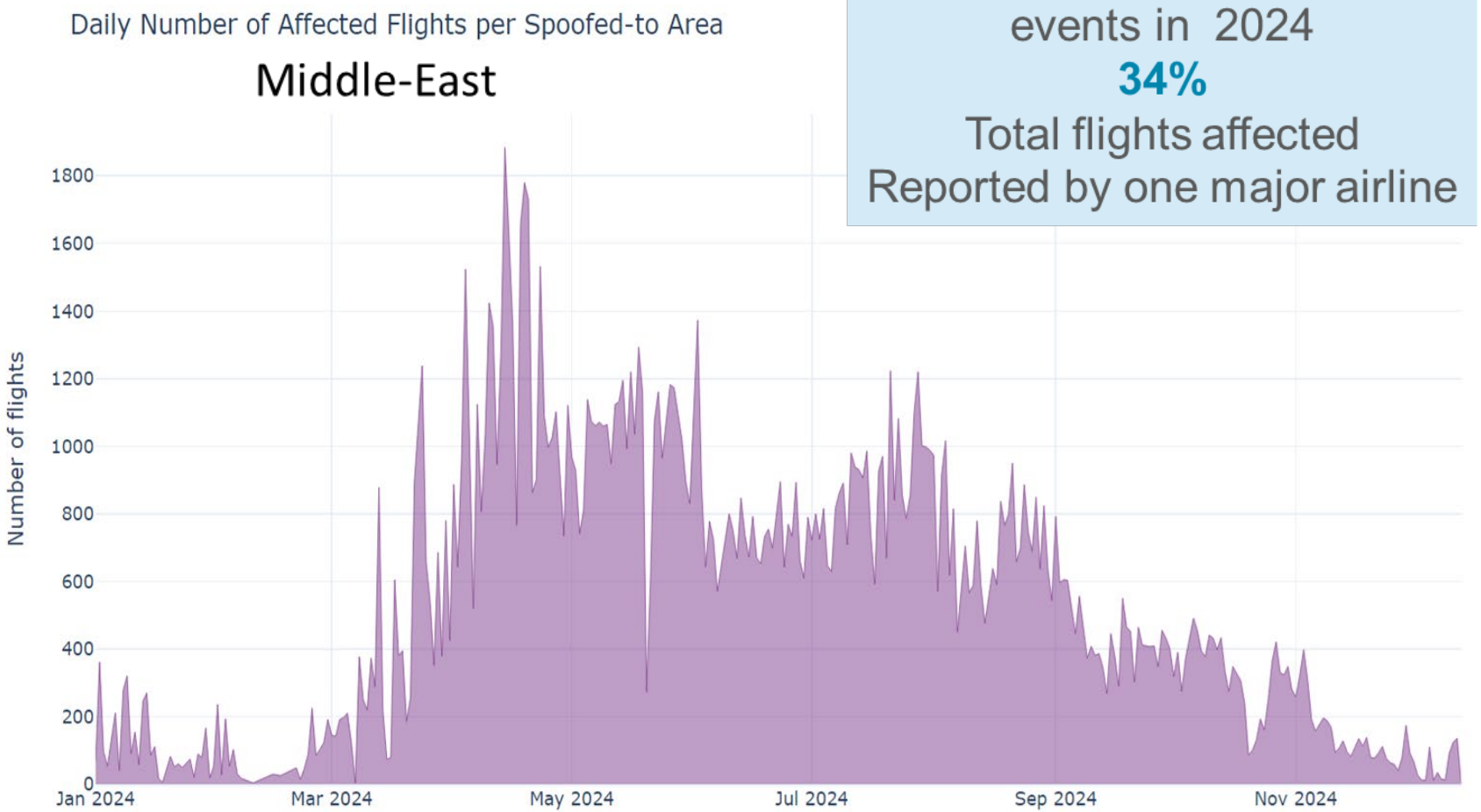
- reflects the Assembly's recognition that GNSS interference (RFI) has become a major global safety risk and must be addressed through a coordinated, multi-layered ICAO strategy.

GNSS Vulnerabilities and Resilience: Outcomes of the ICAO Assembly A42

Identified Risks

- The Commission **reviewed A42-WP/34** (presented by the ICAO Council), highlighting:
  - Rising global occurrences of **GNSS radio frequency interference (RFI)**.
  - **Safety implications**, since GNSS RFI has contributed to three global high-risk categories of occurrence.
- ICAO proposed a **roadmap** with:
  - Short-term mitigation (incident reporting, monitoring).
  - Long-term resilience (alternative navigation and time sources).
- **States and stakeholders were urged** to support ICAO's ongoing work, including the validation and deployment of an **iPack for GNSS RFI mitigation**.
- **Reporting procedure:** States should now report unresolved GNSS interference incidents to their **accredited ICAO Regional Office**, in addition to following **ITU Radio Regulations** channels.

GNSS RFI: MID REGION APPROACH



15000+
events in 2024
34%
Total flights affected
Reported by one major airline

Ref: ICCAIA (Airbus) – skai data services
EUR/MID WRC-27 (World Radiocommunication Conference 2027) Workshop (Paris, France, 06-07 October 2025)

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Standardization and Technological Mitigation

- The Commission reviewed **industry and State contributions** (A42-WP/108, A42-WP/204):
  - Need for ICAO to **standardize RFI mitigation solutions** such as:
    - **Complementary Position, Navigation and Timing (C-PNT)**,
    - **Signal authentication** for core constellations and augmentations,
    - **Performance standards** for time synchronization across airborne and ground systems.
- ICAO was asked to **coordinate with standards-making organizations** and **encourage industry** to accelerate implementation of these solutions.

General Industry Approach to GNSS Interference

Short Term	Medium Term	Longer Term
• Update technical information regarding expected aircraft effects and recommended procedures • (Automatically) Report and analyze GNSS interference events • Continued airworthiness assessments – aircraft and operational impacts • Promote awareness of GNSS spoofing areas • Update Surveillance systems (e.g. Terrain avoidance systems) • Address Data-Link availability issues	• Update navigation systems to detect, report and reliably recover from spoofing • Study & standardize mitigation technologies (e.g.): ✓ Adaptive GNSS antenna systems, i.e. Controlled Reception Patten Antennas (CRPA) ✓ Signal authentication methods (cryptographic)	• Deploy more advanced mitigation technologies ✓ Introduce GNSS signal authentication ✓ Adaptive Antennas • Robust time reference that is independent from GNSS for applications requiring time synchronization (e.g. Datalink) • Complementary P.N.T. development to support PBN operations without GNSS

Work at **ICAO** with IATA, Airframe Manufacturers, Air Navigation Service Providers, Air Traffic Controllers, Airlines Pilots Associations on **technical and operational recommendations**

Ref: ICCAIA
EUR/MID WRC-27 (World Radiocommunication Conference 2027) Workshop (Paris, France, 06-07 October 2025)

Operational Monitoring and Reporting

- A new concept, **Digital Operational Reporting Information Service (DORIS)**, is being developed to replace NOTAMs for:
  - Real-time reporting and dissemination of GNSS interference events.
- ICAO noted that **existing phraseology** in PANS-ATM (Doc 4444) is not exhaustive; pilots and controllers should use **plain language** if necessary.
- Work is underway to **update phraseology and reporting standards**.
- ICAO supported a **multi-layered approach**, emphasizing real-time monitoring, adaptable mitigation, and a comprehensive **CNS/ATM resilience review framework**.

GNSS Vulnerabilities and Resilience: Outcomes of the ICAO Assembly A42

Ground-Based Resilience and Regional Coordination

- The Commission emphasized the **need for resilient ground-based infrastructure** to complement GNSS:
  - States should integrate **conventional CNS systems (e.g., DME/VOR/ILS)** into resilience strategies.
  - ICAO expert groups are developing **provisions for the Resilient Navigation Operational Network (NAV RON)** to optimize existing infrastructure and define a "**sufficient NAV network**".
  - Capacity-building will support States in implementing these resilient networks.

Assembly Outcome: Resolution 24/3

A new **Assembly Resolution 24/3** was adopted, titled:

“Consolidated statement of continuing ICAO policies and practices related to a global air traffic management (ATM) system and CNS/ATM systems.”

Appendix C : Ensuring the resilience of ICAO CNS/ATM systems and services

GNSS Vulnerabilities and Resilience: Outcomes of the ICAO Assembly A42

Appendix C : Ensuring the resilience of ICAO CNS/ATM systems and services

Key directives include:

1. **Encourage States** to transition toward optimized, secure, and resilient CNS systems integrating both satellite- and ground-based infrastructures.
2. **Encourage industry and standards bodies** to develop onboard and ground interference detection and reporting capabilities.
3. **Maintain resilient terrestrial CNS** as backup for satellite services.
4. **Develop ICAO principles** for integration of ground, space, and onboard systems for **resilient PNT**.

GNSS Vulnerabilities and Resilience: Outcomes of the ICAO Assembly A42

Appendix C : Ensuring the resilience of ICAO CNS/ATM systems and services

Key directives include:

5. **Collaborate** with standards bodies to advance complementary PNT solutions.
6. **Establish a global CNS/ATM resilience review framework**.
7. **Urge States to:**
    - Prevent the use or sale of **illegal jammers or spoofers**;
    - Strengthen **civil-military coordination** on spectrum use;
    - **Avoid intentional jamming/spoofing** affecting civil aviation;
    - Notify **ANSPs** in advance of military operations potentially causing interference;
    - Assess **conflict-zone interference risks** beyond national borders.

GNSS Vulnerabilities and Resilience: Outcomes of the ICAO Assembly A42

Strategic Takeaways

- ICAO now treats **GNSS interference** as a **systemic safety and resilience priority**, not just a technical anomaly.
- The adopted approach is **multi-layered**, combining:
  - **Technical** (C-PNT, authentication, RON/DFMC),
  - **Operational** (real-time reporting, phraseology, DORIS),
  - **Regulatory** (standardization, State responsibility, ITU coordination),
  - **Strategic** (Assembly Resolution 24/3 under continuous monitoring by the Council).

MIDANPIRG/22 – RASG/12 CONCLUSION

PIRG/RASG Conclusion 2: Consolidated Regional Approach to GNSS RFI Management

That, a consolidated regional approach for the management of GNSS RFI be established with the following actions:

a) States be urged to:

- *i. Support the establishment of regional GNSS RFI monitoring and reporting mechanisms through the appropriate MID regional frameworks;*
- ***ii. maintain an adequate network of conventional navigation aids to ensure continuity of air navigation services in case of GNSS signal degradation;***
- *iii. strengthen civil-military coordination and ensure timely sharing of information related to intentional GNSS interference;*
- *iv. define reversion scenarios and associated contingency procedures to maintain safe and efficient operations in the event of GNSS unavailability.*

b) ICAO MID Office be requested to:

- *i. coordinate the development of the regional GNSS RFI management framework and potential reporting mechanism;*
- *ii. support States through regional capacity building and awareness activities on GNSS interference detection and mitigation;*

Action by the Meeting : Considering the PPT updates and the endorsed Conclusions

PIRG/RASG Conclusion 4: Capacity Building on GNSS RFI

That, ICAO, in collaboration with ICAO partners, organize a Regional Capacity Building event on GNSS Interference during 2025.

Current : Doha, Qatar from 18- 20 November 2025.

MIDANPIRG DECISION 22/20: MID NAV-MON ACTION GROUP

That,

a) NAV-MON Action Group be established to develop a proposal for a Regional Navigational Minimum Operational Network supporting the ANS operations;

b) the terms of reference of the NAV-MON Action Group be developed during the first meeting of the Action Group; and

c) States support the NAV-MON Action Group through the assignment of CNS and ANS Subject matter experts and sharing states' experience and provision of required data for developing the MID NAV-MON Network.

The Action Group established.

NAV-MON Action Group: The way forward

The Action Group was tasked to :

1. **Take note** of the ICAO Assembly A42 outcomes on GNSS vulnerabilities and resilience, including the introduction of the **Resilient Navigation Operational Network (NAV RON)** concept to strengthen CNS/ATM system robustness;

2. **Recognize** that **NAV RON** evolves from the **NAV MON** approach by integrating ground- and space-based systems to ensure service continuity in case of GNSS degradation;

3. **Encourage States** to maintain conventional navigation aids as part of the resilience strategy, and coordinate with national authorities to protect navigation spectrum; and

4. **Notify the need of support capacity-building** on GNSS RFI mitigation and **NAV RON** planning, and report progress to the next **MIDANPIRG Meeting**.

Thank You

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