



**Fifth GREPECAS–RASG-PA Joint Meeting (GREPECAS-RASG-PA/5) and  
 Twenty-Third Meeting of the CAR/SAM Regional Planning and Implementation Group  
 (GREPECAS/23)**

Virtual Phase (Asynchronous, 19 January to 17 February 2026)  
 In-Person Phase (Mexico City, Mexico, 4 to 6 March 2026)

**Agenda Item 8: CAR/SAM Air Navigation Implementation**

**GNSS RADIOFREQUENCY INTERFERENCE AND MINIMUM OPERATING NETWORK**

(Presented by IATA)

<b>EXECUTIVE SUMMARY</b>	
<p>This working paper presents information on GNSS radio frequency interference and proposes the development of a Regional Guidance Material to harmonize GNSS Interference Mitigation and the implementation of a Minimum Operational Network by CAR/SAM States.</p>	
<b>Action:</b>	<p>The meeting is invited to:</p> <ul style="list-style-type: none"> <li>a) Take note of the information provided in this working paper.</li> <li>b) Include in the GREPECAS work programme and projects the development of a guidance material aimed at the States and ANSPs of the CAR/SAM Regions, with the purpose of supporting the Mitigation of GNSS Interferences and the Implementation of the Minimum Operational Network. This material should consider as primary inputs the initiatives currently underway within the framework of the NACC/WG and SAM/IG, as well as the technical material, best practices, and lessons learned already published by Brazil, EUROCONTROL, and other relevant bodies.</li> </ul>
<i>Strategic Objectives 2026-2050:</i>	<ul style="list-style-type: none"> <li>• Every flight is safe and secure</li> <li>• Aviation is environmentally sustainable</li> <li>• Aviation delivers seamless, accessible, and reliable mobility for all</li> <li>• No country left behind</li> <li>• The International Civil Aviation Convention and Other Treaties, Laws and Regulations Address All Challenges</li> <li>• The Economic Development of Air Transport Assures the Delivery of Economic Prosperity and Societal Well-Being for All</li> </ul>
<i>References:</i>	<ul style="list-style-type: none"> <li>• ICAO DOC 10209 - AN-Conf/14</li> <li>• NACC/10 Meeting Report</li> </ul>

	<ul style="list-style-type: none"> <li>• SAM/IG/33 Meeting Report</li> <li>• IATA GNSS RFI Safety Assessment</li> <li>• Brazil - PCA 100-5 - Plano de Implementação da Rede Operacional Mínima (MON) em resposta à falha do GNSS</li> <li>• EUROCONTROL - Minimum Operating Network Concept and Design Criteria</li> <li>• EUROCONTROL - European MON Technical and Economic Assessment</li> <li>• FAA - SAFO 24002</li> <li>• EASA SIB No.: 2022-02R3</li> </ul>
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## 1. Introduction

1.1 The Global Navigation Satellite System (GNSS), consisting of the USA's Global Positioning System GPS, Russia's GLONASS, China's BeiDou, and Europe's Galileo, includes ground infrastructure and satellite constellations that provide position, navigation, and timing (PNT) information supporting aircraft and air traffic management operations.

1.2 Satellite navigation signals are weak and can be compromised by Radio Frequency Interference (RFI), including intentional or unintentional signal interference, jamming, and/or spoofing. The effects of RFI vary. Signal jamming and/or spoofing can seriously impact aircraft navigation systems, resulting in non-normal avionic system behaviour.

1.3 Airspace users rely on the normal functioning of aircraft systems, including automated monitoring, caution, and warning sub-systems. Avionics such as Flight Management Systems (FMS) require GNSS for navigation and timing. GNSS position is also used by the Terrain Avoidance Warning System (TAWS) or Enhanced Ground Proximity Warning Systems (EGPWS). Therefore, interference-free GNSS PNT service is essential for flight safety.

1.4 Several safety alerts were issued since 2023, including [FAA SAFO 24002](#) and [EASA SIB No.: 2022-02R3](#). IATA developed a comprehensive Safety Risk Analysis (SRA), which is attached as **Appendix A** to this working paper. This SRA could also be obtained at

[IATA GNSS Interference RFI SRA](#).

1.5 One of the current initiatives to mitigate the effects of GNSS RFI is the planning and implementation of a Minimum Operating Network (MON). In accordance with definition of EUROCONTROL - [MON Concept and Design Criteria](#). ), MON objective is to improve the cost-effectiveness of the CNS infrastructure through optimization, including the decommissioning of communications, navigation and surveillance assets, while providing an adequate level of resilience and maintaining an acceptable level of safety and security. The mentioned document also provides design criteria for the development of such a CNS MON.

1.6 Also, in accordance with EUROCONTROL, the term MON has traditionally been associated with the minimum navigation infrastructure that allows aircraft to revert to conventional navigation procedures after a loss of GNSS service. The approach developed on the Eurocontrol MON Concept and Design Criteria document aims to extend the MON concept to CNS, and to consider not only the minimum infrastructure required to support the reversion infrastructure enabling aircraft to continue operations in a seamless manner, but also contingency procedures.

1.7 The 14<sup>th</sup> ICAO Air Navigation Conference (AN-CONF/14) agreed on the importance of maintaining a sufficient network of VOR, DME and ILS, to ensure safety, as well as adequate airspace capacity during times of interference with GNSS. In considering the need to gradually eliminate traditional

navigation systems, the conference concurs that such elimination should consider the need to effectively mitigate RFIs with GNSS, and that aircraft minimum equipment lists should be updated to reflect this requirement.

1.8 The AN-CONF/14 formulated the Recommendation 2.2/2 – Interference with the Global Navigation Satellite System and Contingency, which refers to international efforts to address interference with Global Navigation Satellite Systems (GNSS) and the need for contingency planning to ensure safety and continuity in air navigation operations. This recommendation urges States and ICAO to take several initiatives to face this essential issue to the present and future of air navigation.

- 1.9 Related to MON, the recommendation 2.2/2 of the AN-CONF/14 requires the following:
- a) States - Ensure that effective measures are implemented to mitigate radio frequency interference in the Global Navigation Satellite System (GNSS), based on measures developed by ICAO and the industry, including the need to maintain a sufficient network of navigation aids and adequate airspace capacity during periods of GNSS interference.
  - b) States - Review aircraft minimum equipment lists to ensure compatibility with the States' minimum operational networks.
  - c) ICAO - Develop a standardized implementation assistance package to support and guide States in effectively implementing measures to mitigate radio frequency interference in the Global Navigation Satellite System, including the optimization and rationalization of conventional navigation aids, in accordance with their local conditions, to ensure the continuity of air navigation services.
  - d) ICAO - Formulate recommendations for globally harmonized aircraft minimum equipment lists so that airspace users can utilize the existing navigation infrastructure according to the available air traffic services.

## **2. Minimum Operating Network in CAR/SAM Regions**

2.1 According to EASA Safety Information Bulletin Operations – ATM/ANS SIB No. 2022-02R3 - GNSS RFI has become a significant safety risk, particularly in geographical areas surrounding conflict zones and the eastern Mediterranean, Middle East, Baltic Sea, and Arctic area, where RFI can increase pilots' and air traffic controllers' workload.

2.2 GNSS RFI is not limited to the affected flight information regions (FIR) highlighted by EASA's safety bulletin. IATA FDX indicates it has become a safety risk in other geographical areas.

2.3 The chart below illustrates the trend of GNSS outages over the recent past. The projected GPS signal losses per 1000 flights in 2025 indicates a significant increase compared to 2023 and 2024 globally.



2.6 The current version of IATA's SRA does not incorporate the GNSS interferences recorded in the Maiquetía FIR or in the adjacent airspace. Nevertheless, the numerous reports from airspace users and from ANSPs in the interface area between the CAR and SAM Regions further highlight the need for all stakeholders (States, ANSPs, and airlines) to adopt the necessary measures to strengthen the resilience of global air navigation. It is important to note that GNSS interferences are no longer sporadic events but have become a persistent condition that urgently requires attention and coordinated action.

2.7 [IATA GNSS RFI SRA](#) made a series of recommendations for Airlines, ANSPs, States ICAO and IATA. In relation to the MON, the following recommendations were made:

- a) ANSP - In coordination with airlines and other airspace users, periodically reassess the national CNS rationalization plan, ensuring a minimum operating network (MON) for operational resilience.
- b) States - Consider operational risks associated with GNSS RFI during the rationalization of conventional navigation and surveillance infrastructure and incorporate inputs from airspace users while developing a CNS MON.
- c) States - Ensure that contingency procedures are established in coordination with air navigation service providers and airspace users and that essential conventional navigation infrastructure, particularly Instrument Landing System (ILS), is retained and fully operational.
- d) ICAO - Develop a standardized implementation package to assist and guide States in implementing effective global navigation satellite system radio frequency interference mitigation measures, including optimization and rationalization of conventional navigation aids commensurate with their local conditions, to ensure continuity in the provision of air navigation services.

2.8 Based on recommendation 2.2/2 of the AN-CONF/14, ICAO should elaborate an assistance package to support and guide States to mitigate GNSS RFI, including the optimization and rationalization of conventional navigation aids, in accordance with their **local conditions**. These local conditions should consider, among other aspects, volume/complexity of air traffic and GNSS RFI threat level in CAR/SAM Regions and in the States.

2.9 It is important to reiterate that the MON requires the rationalization of the CNS equipment network and indicates that it will be necessary to implement more ground equipment, for example, DMEs, and maintain equipment that could be removed if GNSS RFI were not an issue, such as, for example, some VORs, ILSs, and radars. Likewise, said rationalization indicates that unnecessary equipment, such as NDBs, should be removed, and that VORs and ILSs should not be considered at the same airport, if a DMEs network is implemented that allows RNAV 1 applications for STARs and SIDs.

2.10 In this sense, it is highly recommended that the implementation of the National MON be regionally harmonized via the development of a corresponding Guidance Material based documentation already developed by Eurocontrol ([MON Concept and Design Criteria](#)) and Brazil ([PCA-100-5](#)).

### **3. Initiatives in the Regional Implementation Groups – NACC/WG and SAM/IG**

3.1 IATA has presented a working paper similar to this one at the NACC/WG/10 and SAM/IG/33 meetings, which has contributed—along with working papers submitted by States and by the Secretariat—to planning the actions required to mitigate GNSS interference and to develop a minimum operational network that ensures the resilience of air navigation in the CAR/SAM regions.

3.2 The NACC/WG/10 meeting is developing a Concept of Operations (CONOPS) for navigation aid systems in the CAR Region, with the aim of responding to increasing air traffic demand and

the obsolescence of conventional radio navigation aids. Deficiencies have been identified, including environmental vulnerability, lack of spare parts, high inspection costs, and shortages of technical personnel. The project proposes a harmonized regional approach that combines conventional aids (VOR/DME, ILS/LOC, DME/DME) with GNSS-based systems (satellite-based augmentation system/SBAS and ground-based augmentation system/GBAS), while also establishing a Minimum Operational Network (MON) as a resilient backup to GNSS. This initiative will provide criteria for the rationalization and modernization of navigation infrastructures, ensuring operational continuity, efficiency, and safety.

3.3 Similarly, the SAM/IG has established the following actions in line with the mitigation of GNSS interferences and the development of the Minimum Operational Network (MON):

- Action S33/05 – The Interop Task Force (GT Interop) must implement a regional GNSS resilience framework that integrates the definition of a Minimum Operational Network (MON), protocols for interference detection and reporting, and inter-institutional coordination mechanisms. This should be based on the experiences of the States and aligned with the priorities of Project RLA/06/901 and the guidance provided by the GANP.
- Action S33/06 – The Interop Task Force (GT Interop) must develop Regional Guidance Material for the planning and implementation of harmonized Minimum Operational Networks (MON) within the SAM Region, taking as reference the EUROCONTROL guidelines and Brazil’s experience. Progress will be monitored by reporting updates at the next SAM/IG meeting.

3.4 The initiatives of NACC/WG and SAM/IG to mitigate GNSS interferences and implement the Minimum Operational Network need to be harmonized and strengthened through the GREPECAS work program and projects. Such harmonization should be achieved by means of guidance material for the CAR/SAM Regions, based on the initiatives already under development in both regions and on material published by Brazil and EUROCONTROL.

#### 4. Suggested actions

The meeting is invited to:

- a) Take note of the information provided in this working paper.
- b) Include in the GREPECAS work programme and projects the development of a guidance material aimed at the States and ANSPs of the CAR/SAM Regions, with the purpose of supporting the Mitigation of GNSS Interferences and the Implementation of the Minimum Operational Network. This material should consider as primary inputs the initiatives currently underway within the framework of the NACC/WG and SAM/IG, as well as the technical material, best practices, and lessons learned already published by Brazil, EUROCONTROL, and other relevant bodies.

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