International Civil Aviation Organization
CAR/SAM Regional Planning and Implementation Group (GREPECAS)

WORKING PAPER

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Fourth GREPECAS–RASG-PA Joint Meeting and
Twenty-second Meeting of the CAR/SAM Regional Planning and Implementation Group (GREPECAS/22)
Virtual Phase (Asynchronous, 16 September to 11 October 2024)
In-Person Phase (Lima, Peru, 20 to 22 November 2024)

Agenda Item 5: CAR/SAM Air Navigation Services (ANS) Implementation

5.2 Communications, Navigation, Surveillance (CNS)

NAVIGATION INFRASTRUCTURE AND CONTINGENCY PLANNING

(Presented by Brazil)

EXECUTIVE SUMMARY

The paper presents a growing concern highlighted in the 14th ICAO Air Navigation Conference about interference with the Global Navigation Satellite System (GNSS), such as jamming and spoofing, and the significant risks this poses to civil aviation safety. Brazil has reported GNSS interference events at Guarulhos Airport (SBGR), affecting RNAV procedures and resulting in cancellations and delays. To mitigate these risks, the Department of Airspace Control (DECEA) is implementing a network of DME aids, whose project scope aims to provide a complementary ground infrastructure/backup to GNSS, with the use of DME/DME/Inertial, supporting RNAV1 operations in the TMA with the highest flow and RNAV5 operations, in a large portion of the continental upper airways. In addition, DECEA is preparing a national plan for the maintenance and implementation of conventional air navigation aids, such as DVOR, according to the guidelines of the GANP, in order to provide a minimum structure of conventional contingency. The conference also recommended that States develop regional procedures for reporting GNSS interference and reinforced the need to discuss mitigation measures and the creation of a regional forum or ad-hoc group to assess the problem in detail.

Action:	a) Share your experiences of GNSS interference, if any. b) Discuss ways to mitigate/eliminate aviation risks arising from RFI in GNSS. c) Discuss the possibility of setting up a specific regional forum or ad-hoc group for the detailed assessment of the problem.
Strategic Objectives:	• Safety • Air Navigation Capacity and Efficiency
References:	• Doc 9849 Global Navigation Satellite System (GNSS) Manual • ICAO letter "E3/5-24/54, of 30 April 2024 • AN-Conf/14-WP/212 of 30 August 2024

1. Introduction

1.1 The 14th ICAO Air Navigation Conference, held from August 26 to September 6, 2024, emphasized the need to improve the resilience of navigation systems, especially with regard to systems dependent on GNSS (Global Navigation Satellite System). The conference also called on ICAO to develop global guidelines for air traffic contingency management, including during the recovery phase after any signal interference in collaboration with States and industry.

1.2 In this vein, the Committee highlighted the need for robust mitigating measures, emphasizing the importance of maintaining a sufficient network of conventional navigational aids to ensure operational safety in the event of GNSS failures.

1.3 Brazil has experienced recent events of interference in GNSS signals at Guarulhos International Airport (SBGR), located in the city of São Paulo, which made the SID RNAV 1 RWY 10 procedure unavailable, resulting in cancellations and delays, as will be described in the following section.

1.4 In this context, the Department of Airspace Control (DECEA) has already been developing technical/operational analyses for the optimized provision of a ground infrastructure of DME aids that, in association with the inertial sensor of the capable aircraft, will be able to support the RNAV1 operations in the TMA and the RNAV5 operations in a large portion of the continental upper airways.

1.5 In addition, guided by the ASBU Block "NAVS-B0/4 – Navigation Minimal Operating Networks (Nav. MON)", of the GANP, a national plan for the maintenance/implementation of conventional air navigation aids, such as the DVOR, is being prepared.

1.6 It is essential to highlight at this forum that the Conference also recommended that States develop regional GNSS RFI reporting procedures through planning and implementation groups, in line with the existing guidance material contained in the GNSS Manual (Doc 9849) to raise awareness of geographic areas of GNSS interference and to use this information in the context of contingency operations planning.

2. Discussion

2.1. The most modern aircraft have accurate and reliable positioning systems, requiring the support of an infrastructure resulting from the appropriate combination of GNSS navigation information, onboard autonomous navigation systems and conventional terrestrial navigation aids.

2.2. Although most aircraft are capable of avionics capable of enabling air navigation with GNSS, these signals in space are vulnerable to interference, including environmental effects such as those caused by space weather.

2.3. On 29/08/2024 and 03/09/2024, Guarulhos International Airport (SBGR), located in the city of São Paulo, the busiest in the country, suffered local interference in the GNSS signal, preventing the use by some aircraft of the SID RNAV 1 RWY 10, causing some cancellations and delays in some scheduled flights.

2.4. To mitigate the issue, an OMNI SID procedure (OMNI 10L/10R 28L/28R) was used until the GNSS signal was available again, above 3,000ft.

2.5. It is also important to highlight the use of the SATDIS tool (RAIM - Receiver Autonomous Integrity Monitoring) by Brazil, through the Air Navigation Management Center (CGNA), whose purpose is to

inform the perspective of GPS degradation, based on the availability information of the satellite constellation used for navigation.

2.6. CGNA monitors RAIM availability daily for a period of 72 hours in advance. If any of the 130 airports registered in the tool's database is expected to be unavailable, NOTAM is published informing the days, times and airports that will have an impact on RNAV/PBN operations. Due to its use, it was possible to certify that the interruptions of the GPS signals at Guarulhos airport were not due to the deficiency of the geometry of the satellite constellation. Thus, it remained to investigate whether the cause was local interference.

2.7. Radio monitoring missions were carried out on 29 August 2024 using a laboratory aircraft of the Special Flight Inspection Group (GEIV), with the purpose of monitoring, detecting, locating and identifying the interfering source in the Aeronautical Services and no interference was detected. However, with the return of interference on 3 September 2024, a new flight was executed, this time delimiting the geographical areas that could contain the possible interfering sources.

2.8. Based on this mapping, the National Telecommunications Agency (ANATEL), the Brazilian regulatory agency responsible for authorizing the use, management and inspection of the radio frequency spectrum, carried out interventions that culminated in the reestablishment of normal airport operations on 4 September 2024, guaranteed after another GEIV flight.

2.9. Therefore, against this backdrop, DECEA is making efforts to conduct technical/operational assessments in order to pursue the internalization of the measures recommended in the ICAO communication "E3/5-24/54 (30 April 2024)", issued after the EUR/MID Symposium on Radio Navigation (6-8 February 2024 in Antalya – Turkey), related to the ongoing efforts of stakeholders to ensure safety, reliability and resilience of air navigation.

2.10. Through the SIRIUS Brazil Program, resources are being invested to expand the DME (Radio Telemetry Equipment) aid network, whose association of DME/DME systems has the potential to support air navigation in a complementary way to GNSS, mitigating the risks arising from dependence on this system.

2.11. The entire strategy for operationalizing the use of this system is being planned considering the use of the inertial sensor of the capable aircraft, given the technical limitations of providing exclusive DME/DME coverage.

2.12. The scope of the project aims to provide a complementary terrestrial infrastructure/backup to GNSS, with the use of DME/DME/Inertial, supporting RNAV1 operations in the TMA and RNAV5 operations, in a large portion of the continental upper airways.

2.13. As this network of grants has undergone changes over the years, it will be important to reassess the current provision so that efficient planning of new deployments can be conducted.

2.14. Considering this reassessment, a national plan for the maintenance/implementation of conventional air navigation aids, such as DVOR, is also underway, following the guidelines of the ASBU Block "NAVS-B0/4 – Navigation Minimal Operating Networks (Nav. MON)", of the GANP, which aims to allow the rationalization of conventional terrestrial infrastructure by defining minimum aid networks, with the intention of providing a minimum structure of conventional contingency.

3. Conclusions

3.1. During the 14th Air Navigation Conference, one of the topics addressed the effects of radio frequency interference on GNSS, Brazil expressed support for the proposals and shares the concerns expressed with the recent escalation of GNSS jamming and spoofing and the consequent significant security risk that this represents for civil aviation operations.

3.2. In accordance with the recommendations listed in the ICAO communication "E3/5-24/54, DECEA has invested in the expansion of the DME aid network, aiming to provide complementary ground infrastructure/backup to GNSS for PBN navigation (relying on the use of the aircraft's inertial sensor), in order to provide safe air navigation and serving the areas of greatest movement.

3.3. In addition, the elaboration of a national plan for the maintenance/implementation of conventional air navigation aids, such as the DVOR, is underway in order to plan the provision of a minimum contingency structure, to maintain safe operations in the event of failures of satellite navigation systems.

3.4. Finally, as guidelines were issued for the States to develop regional GNSS RFI reporting procedures through planning and implementation groups, it is opportune to discuss the topic for the CAR/SAM regions, in order to structure regional contingency plans.

4. Suggested Actions

4.1. The audience is invited to:

a) Share your experiences of GNSS interference, if any.
b) Discuss ways to mitigate/eliminate aviation risks arising from RFI in GNSS.
c) Discuss the possibility of setting up a specific regional forum or ad-hoc group for the detailed assessment of the problem.

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