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South American Regional Office
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Agenda item 4: Report on GESEA activities and deliverables and Subgroups

IMPLEMENTATION OF A MINIMUM OPERATIONAL NETWORK FOR THE CONTINUITY OF ATS SERVICES IN THE EVENT OF GNSS DEGRADATION OR FAILURE.

(Submitted by Brazil)

SUMMARY

This working paper therefore seeks to share with the States of the SAM Region the progress achieved by Brazil, promote the exchange of operational experiences, and encourage regional coordination regarding ATS contingency planning for GNSS degradation or failure.

This working paper presents the actions being developed by Brazil to establish an Air Traffic Services Contingency Plan for scenarios involving GNSS degradation or unavailability.

Within the GADHOC CONTPLAN framework, the Brazilian Department of Airspace Control (DECEA) is developing integrated regulatory, operational, and technological measures to preserve flight safety and maintain a minimum level of ATS continuity during GNSS failures.

The initiative is centered on the implementation of a Minimum Operational Network (MON), supported by ground-based navigation aids, aircraft inertial capabilities, conventional procedures, tactical vectoring, and ATFM measures. The work also includes a specific GNSS contingency regulation, a Contingency Route Playbook, standardized reporting procedures, defined responsibilities for ANSPs and aircraft operators, recurrent training, and simulation activities.

Brazil is also integrating MON routes into the Digital Airspace System Analysis (DASA), enabling the identification of contingency routes by origin, destination, and flight level, with future capabilities for displaying navigation coverage, NOTAM information, infrastructure outages, coverage gaps, and capacity impacts.

This paper aims to share Brazil's progress with the SAM Region, encourage the exchange of operational experience, and strengthen regional coordination on GNSS contingency planning.

References:

- ICAO Annex 10 – Aeronautical Telecommunications
- ICAO Annex 11 – Air Traffic Services
- ICAO Doc 4444 – Procedures for Air Navigation Services — Air Traffic Management
- ICAO Doc 9750 – Global Air Navigation Plan (GANP)
- ICAO Doc 9971 – Manual on Collaborative Air Traffic Flow Management
- ICAO Doc 10039 – Manual on System-Wide Information Management Implementation
- Brazilian Airspace Control Department – PCA 100-5, Minimum Operational Network Implementation Plan
- Brazilian Airspace Control Department – CIRCEA 100-128 - ATS Contingency Plan

ICAO Strategic Objectives:	Promote operational resilience and contingency preparedness.

1 Introduction

1.1 Performance-based navigation and the increasing use of satellite systems have brought significant benefits to the capacity, predictability, and efficiency of air operations. However, this evolution has also increased the reliance of air navigation service providers and operators on the availability and integrity of GNSS signals.

1.2 The degradation or unavailability of such signals can affect aircraft navigation capabilities, the execution of RNAV routes, departure and arrival procedures, instrument approaches, and—depending on the characteristics of the event—the capacity of control sectors.

1.3 In response to this challenge, Brazil initiated a project within the framework of the ATS Contingency Plans Ad Hoc Group (GADHOC CONTPLAN) aimed at establishing measures to preserve operational safety and maintain a minimum level of continuity for ATS services.

1.4 The project is structured around the implementation of a Minimum Operational Network (MON), the development of regulatory and operational procedures, the use of digital tools, and the coordinated participation of ATS units, the Air Navigation Management Center, the Aeronautical Cartography Institute, and air operators.

2 Analysis

2.1 The main component of the Brazilian project is the implementation of a Minimum Operational Network (MON), designed to support operations considered essential during periods of GNSS degradation or unavailability.

2.2 The MON shall encompass selected routes and approach control areas, utilizing combinations of DME/DME, DME/DME/IRU, and inertial navigation sensors for RNAV 5 operations. During departure, arrival, and approach phases, conventional procedures, omnidirectional departures, RNAV procedures supported by ground-based infrastructure, and ILS or VOR/DME approaches may be used.

2.3 Initial development focuses on identifying aerodromes of operational interest and establishing city pairs that can remain connected during a contingency. To this end, consideration is given to aerodromes located in state capitals, major scheduled air transport airports, military airbases, and other aerodromes designated as strategic by DECEA.

2.4 The implementation of MON does not imply the preservation of existing operational capacity under normal conditions. In areas with insufficient DME/DME coverage, or where aircraft lack adequate inertial capability, it may be necessary to apply radar vectoring, separation standards compatible with declared navigation capabilities, and flow management measures.

2.5 Brazil is conducting specific studies on ground-based system coverage, particularly regarding lower airspace routes and regions with infrastructure limitations. These studies are intended to identify viable routes, coverage gaps, and sectors where a reduction in operational capacity will be necessary.

2.6 Aircraft operators participate directly in the development of the plan by providing information on inertial system autonomy, the capability to receive signals from various GNSS constellations, limitations related to equipment configuration, and applicable procedures in the event of signal loss or recovery.

2.7 Studies have shown that aircraft capabilities are not uniform. Therefore, the use of MON must take into account the characteristics of each fleet, the airworthiness status of the equipment, the flight phase, and the navigation capability declared by the pilot.

2.8 Operators are also developing internal procedures and checklists for their flight dispatchers, engineering departments, and pilots-in-command to ensure compatibility between company-specific procedures and the provisions to be established in DECEA regulations.

2.9 Another component of the project consists of improving the collection, standardization and centralization of GNSS degradation reports. Brazil developed a model form intended to record, among other data, the identification of the aircraft, the date and time of the event, the origin and destination of the flight, the affected route segment and the estimated period of unavailability.

2.10 The incorporation of this functionality to the Integrated Air Traffic Flow Management System - SIATFM is being studied, allowing the CGNA to consolidate the reports received from the ATS units and air operators. The data obtained will serve to identify recurring areas, evaluate operational impacts and support the review of MON routes.

2.11 To formalize procedures, the GADHOC CONTPLAN is developing a specific CIRCEA regarding GNSS contingency. The regulation will define the responsibilities of ATS units, the CGNA, aircraft operators, and other stakeholders involved.

2.12 Aspects under consideration include the issuance of NOTAMs based on the level of degradation, the tactical assessment of reported events, the use of the GNSS Contingency Route Playbook, the use of radar vectoring, the application of separation standards compatible with aircraft navigation capabilities, and the inclusion of GNSS degradation scenarios in recurrent training programs.

2.13 The regulation will also mandate that aircraft immediately report any signal loss or reduction in navigation capability and that operators have processes in place to strategically assess the use of the MON when degradation has been previously announced via NOTAM.

2.14 The GNSS Contingency Routes Playbook will serve as the operational tool for disseminating the routes and procedures available during the activation of the MON.

2.15 Brazil plans to integrate this Playbook into the Digital Airspace System Analysis (DASA) tool and the AISWEB interface. The development must enable users to select the departure aerodrome, destination, and flight level to identify available MON routes.

2.16 At a later stage, the tool may incorporate information regarding ground-based system coverage, outages published via NOTAM, coverage gaps, and potential impacts on ATS sector capacity.

2.17 The response to a GNSS contingency may also require air traffic flow management measures. Depending on the extent of the affected area and available capacity, rerouting, level restrictions, additional separation, demand regulation, and other measures coordinated by the CGNA and flow management units may be applied.

2.18 When the unavailability is known prior to departure, it is the responsibility of operators to evaluate modifying the routes filed in the flight plans. When the loss occurs in flight, tactical coordination, rerouting, and vectoring may be used, subject to aircraft capability and the conditions of the ATS units involved.

2.19 The effectiveness of the plan will depend on the preparedness of operational personnel. For this reason, Brazil plans to develop simulated scenarios of GNSS degradation and incorporate them into recurrent training programs for controllers, flow managers, and other involved professionals.

2.20 The exercises must enable the verification of coordination among ATS units, the CGNA, and aircraft operators, as well as the validation of routes, declared capacities, reporting procedures, and flow management measures.

2.21 The Atlantic FIR presents unique characteristics due to the limited availability of ground-based navigation infrastructure and the use of oceanic routes. In this area, a loss of GNSS capability may require the application of separation standards compatible with the remaining navigation accuracy and the adoption of specific coordination measures with adjacent FIRs.

2.22 Brazil is also analysing the South Atlantic contingency route structure and proposed amendments to SAT DOC 002, with the aim of improving operational continuity in the EUR/SAM corridor and strengthening coordination with adjacent air navigation service providers.

3. Current status of the work

3.1 The work carried out to date has made it possible to:

a) establish the initial operational concept for the MON;

b) identify the ground-based navigation resources and onboard capabilities that will support operations;

c) begin surveying the aerodromes and city pairs of operational interest;

d) develop a form for reporting GNSS degradation;

e) initiate the drafting of the CIRCEA document for the GNSS Contingency Plan;

f) define initial responsibilities for ATS units and aircraft operators;

g) begin developing the GNSS Contingency Route Playbook; and

h) establish requirements for integrating MON routes into the DASA system.

4. Opportunities of Regional Cooperation

4.1 Although the project is initially focused on Brazilian airspace, GNSS degradation events can affect international routes and require coordination between adjacent FIRs.

4.2 The exchange of information between SAM States can contribute to the identification of recurring interference areas, the harmonization of notification procedures, the definition of cross-border contingency routes, and the conduct of regional exercises.

4.3 The experience acquired by Brazil in the development of the MON, the specific regulations, and the digital tools can be shared with interested States, respecting the operational and infrastructure characteristics of each air navigation service provider.

5. **The Meeting is invited to:**

a) take note of the actions Brazil is undertaking to implement an ATS contingency plan for GNSS degradation or failure;

b) share information on GNSS degradation events identified in the airspace of SAM States;

c) consider adopting standardized formats for reporting and collecting information related to GNSS degradation;

d) analyze the ground infrastructure, conventional procedures, and airborne capabilities available to maintain a minimum operational network;

e) to promote the exchange of experiences on regulations, training and coordination procedures applicable to GNSS contingencies; and

f) evaluate, within the relevant regional groups, the advisability of developing coordinated exercises and cross-border contingency routes.

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