



International Civil Aviation Organization

MIDANPIRG Communication, Navigation and Surveillance Sub-Group

Thirteenth Meeting (CNS SG/13)  
(Jeddah, Saudi Arabia, 20 – 23 October 2024)

**Agenda Item 6: ASBU Threads/ Elements related to CNS**

**DEVELOPMENT OF A REGIONAL NAVIGATION MINIMAL OPERATING NETWORK**

*(Presented by Saudi Arabia)*

**SUMMARY**

Under the GANP, the ASBU element NAVS-B0/4, titled “Navigation Minimal Operating Networks (Nav. MON),” allows the rationalization of the ground-based conventional infrastructure through the definition of minimal networks of ground navigation infrastructure needed to provide the required level of ANS service for both normal and contingency operations.

This paper proposes setting up a MON Action Group to develop a proposal for a Regional Navigational Minimum Operational Network to support the navigation service for the MID region's normal and contingency/reversion operations. A proposal for a decision is provided in §3.2 of this WP.

Action by the meeting is under paragraph 4 of this WP.

<i>Referen ce(s)</i>	A41-8: Consolidated statement of continuing ICAO policies and practices related to a global air traffic management (ATM) system and (CNS/ATM) systems, Appendix C ICAO Doc 9750, Global Air Navigation Plan, 7th Edition ICAO Doc 9849, Global Navigation Satellite System (GNSS) Manual MIDANPIRG/21 and RASG-MID/11 Report (RASG-MID Conclusion 11/3) ICAO AN-Conf/14-WP/212 <sup>1</sup> ICAO AN-Conf/14-WP/213 ICAO AN-Conf/14-WP/194, Saudi National Air Navigation Plan (SNAP)
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**1. INTRODUCTION**

1.1 Under the GANP, the ASBU element NAVS-B0/4 titled “Navigation Minimal Operating Networks (Nav. MON)” allows the rationalization of the ground-based conventional infrastructure through the definition of minimal networks of ground navaids infrastructure needed to provide the required level of ANS service for both normal and contingency operations. This element requires airspace users' and aircraft operators' consultations and agreements to optimize the ground navigational networks. ICAO recommends to re-visit this element with the introduction of new navigation capabilities.

1.2 The MIDANPIRG/21 and RASG-MID/11 meeting adopted RASG-MID Conclusion 11/3, which invites:

- ICAO, with the support of States and IATA to establish a regionally determined minimum operational network (MON) of conventional navigation aids for use in case of GNSS interference /Spoofing; and
- States to maintain adequate infrastructure to enable aircraft operators to use conventional navigation

aids as appropriate during GNSS RFI or Spoofing.

1.3 This conclusion aims to maintain a regionally agreed-upon navigational aids infrastructure as a reversionary means for navigation service during GNSS interference or unavailability.

## 2. DISCUSSION

### *Global strategy for rationalization of conventional radio navigation aids*

- 2.1. The ICAO Annex 10, Volume I (Attachment B, §3.6 bullet (i) refers) stipulates that rationalization should be part of a national or regional strategy on terrestrial navigation aids. The Changes in radio navigation facility provision require associated efforts in airspace planning, procedure design, consideration of regulatory aspects, and broad consultation with impacted airspace users.
- 2.2. Moreover, Attachment H of ICAO Annex 10, Volume I defines a global “Strategy for rationalization of conventional radio navigation aids and evolution toward supporting performance-based navigation”. This attachment provides guidance to the States for rationalizing and reversion of the terrestrial Navaid infrastructure. The recommendations of this high-level strategy are based on specific operational considerations for each type of Navaid to support PBN operations and conventional procedures.
- 2.3. The Navigation infrastructure and contingency planning were the subject of extensive discussion at the Air Navigation Conference AN-Conf/14 held in ICAO HQ from 26 August to 6 September 2024. The Conference reviewed WPs on rationalizing existing navigation infrastructure and the need for contingency planning, particularly concerning GNSS RFI and outages.
- 2.4. The Conference agreed on maintaining a sufficient network of conventional navigation aids supported by VOR, DME, and ILS facilities to ensure operational safety and sufficient airspace capacity during GNSS interference or unavailability.
- 2.5. Recognizing challenges faced by States and the benefits of innovation in the aviation system, particularly in the areas of communications, navigation, and surveillance (CNS), the Conference agreed that ICAO should consider including optimization of utilizing legacy systems in the development of the CNS technology roadmap, leveraging the CNS minimum operation network concept in a globally harmonized manner.
- 2.6. Regarding the need to phase out legacy navigation systems, the Conference agreed that removing such systems should consider the need for effective GNSS RFI mitigation and that aircraft minimum equipage lists would need to be updated to reflect this requirement. The following recommendations were adopted by the conference:

### ***Proposed recommendations:***

#### Addressing global navigation satellite system interference and contingency planning

- 2.7. The meeting may wish to recommend the following:

*That States:*

- a) *ensure that effective global navigation satellite system radio frequency interference mitigation measures are implemented, based on measures developed by ICAO and industry, including the need to maintain a sufficient network of conventional navigation aids to ensure operational safety as well as sufficient airspace capacity during times of global navigation satellite system interference;*

- b) *review aircraft minimum equipage lists to ensure compatibility with States' implemented minimum operational networks.*

*that ICAO:*

- c) *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;*

### ***Phasing out and/or optimizing the use of legacy systems***

2.8. The meeting may wish to recommend the following:

*That States:*

- a) *adopt a phased implementation plan for transitioning to modern communications, navigation and surveillance, and air traffic management systems while maintaining a minimum operation network for the provision of resilient air navigation services;*

*that ICAO:*

- b) *develop a global framework to guide Member States in phasing out and/or optimizing the use of legacy systems, ensuring consistency and interoperability;*
- c) *consider including a methodology to optimize the utilization of legacy systems in the communications, navigation, and surveillance technology roadmap, leveraging the communications, navigation, and surveillance minimum operation network concept in a globally harmonized manner;*

### ***Development of a Minimum Operational Network (MON) serving Jeddah FIR***

2.9. Under the implementation of the National Transformation Program (NTP) aiming to develop the necessary infrastructure and services for the achievement of the Kingdom of Saudi Arabia's Vision 2030 goals, the General Authority of Civil Aviation (GACA) took the initiative to set a National Air Navigation Plan known as Saudi National Air Navigation Plan (SNAP). This plan is a strategic document that addresses and bridges gaps in the KSA's air navigation infrastructure and services, tackles the upcoming air navigation challenges, and sets initiatives with a roadmap for ANS modernization over the forthcoming 15 Years.

2.10. 2.2The SNAP is developed based on the Assembly resolution A41-6, the Global Air Navigation Plan (GANP, Doc 9750), and the Performance-Based Approach (PBA) as described in the ICAO Doc 9883. It is structured into five layers and divided into 27 Projects, grouped into 6 Initiatives<sup>2</sup>The initiative related to Flight trajectory optimization has three projects related to Time-based Operations, Air traffic flow management, and Performance-Based Navigation (PBN). One of the key operational improvements under this initiative is rationalizing the ground navigational aids infrastructure based on the ICAO ASBU element NAVS B0/4 concept. The rationalization aims to identify the minimum operational network (MON), i.e., a list of ground NAVAIDs to be retained into operation to support PBN operations within Jeddah FIR and ensure resilience against GNSS RFI.

2.11. Under the development of SNAP initiatives for the modernization of airspace, Saudi Air Navigation Services (ANSP provider) is deploying a three-year wide-scale project to implement PBN for all phases of flight within Jeddah FIR. This project includes assessing the current ground navigational aids infrastructure coverage and the DME facilities supporting PBN applications for en-route and terminal

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operations. This assessment will allow SANS to identify:

- The DME/DME coverage that can provide redundant and reversionary capability to GNSS for RNAV applications;
- Opportunities to optimize the DME network through its redistribution and relocation to provide DME/DME coverage as low as possible without requiring additional DME facilities;
- VOR and DVOR facilities that can be decommissioned with a focus on those co-located with DME stations;
- DME facilities can be subject to cross-border use with adjacent ANSPs;
- The need to deploy new DME stations.

### ***Development of a Regional Minimum Operational Network (MON)***

- 2.12. As PBN operations are expanding in the MID region, the ground-based infrastructure, including facilities and conventional instrument flight procedures, may be reduced. Consequently, this infrastructure may be rationalized, maintaining the necessary safety backup capability. With the increased GNSS RFI observed recently, MID States should consider operational risks while planning to rationalize ground-based navigation and engage airspace users to develop a ground navigational aids rationalization plan as recommended by ICAO.
- 2.13. The Nav aids infrastructure enables navigation operations by providing the appropriate signal-in-space. The supported navigation operations can be conventional or PBN. For each type of application, several performance requirements are defined for the signal-in-space, usually expressed in terms of Accuracy, Continuity, Availability, and Integrity as specified in ICAO Annex 10 Volume I. Various factors and drivers influence ground navigational aids in infrastructure management and planning. These factors include operational usage, equipment life cycle, siting and coverage, maintenance (qualifications of technicians and spare parts), the conduct of flight inspections, and its effectiveness in supporting PBN applications.
- 2.14. The development of a regional Navigational Minimum Operational Network is a complex undertaking that requires the involvement of SMEs from all MID States and all stakeholders. The main activities that should be conducted can be summarized as follows:
- a) Collect information on the ground Nav aids infrastructure used within the MID Region. A Request for Information (RFI) or questionnaire should be sent to each State to collect and update the available information on ground Nav aids infrastructure and their performance;
  - b) Establish a comprehensive inventory of the existing Nav aids, with their characteristics (type, manufacturer, lifetime, ..etc.) and the operating parameters (e.g. frequency/channel, coordinates, DOC max. range and height, DME antenna height, etc..) as published in the MID-States AIPs;
  - c) Identify all operational needs associated with each ground Nav aid (ATS routes and Instrument Flight Procedures (IFPs) supported);
  - d) Identify ground Nav aids facilities that can serve cross-border operational usage;
  - e) Consolidate all information into a comprehensive record of the existing navigation infrastructure and the operational usage of each facility and identify Nav aids with issues (e.g, facilities at the end of the lifecycle, repetitive failures, limited coverage, maintenance issues);
  - f) Assess the current state of ground Nav aids considering the information provided;
  - g) Define the targeted navigation service level for normal and contingency/reversion operations in the MID region. The expected type of service (e.g. DME/DME, VOR/DME) and the navigation applications (e.g., RNAV 5, RNAV 1, RNP 1, Conventional) should be determined
  - h) Define the infrastructure-specific performance criteria as accuracy with appropriate availability, continuity, and integrity considering the targeted level of navigation service;
  - i) Map existing ground Nav aids infrastructure against the infrastructure-specific performance criteria and the targeted level of navigation service;
  - j) Identify the Nav aid facilities that can be relocated or decommissioned.

k) Draft a summary report on the regional Navigational Minimum Operational Network that will support the navigation service for the MID region's normal and contingency/reversion operations.

3.1. Developing a Navigational Minimum Operational Network for the MID region is a collaborative effort that should involve all MID States and stakeholders. A comprehensive work plan should be established and can start with collecting information and data on Navaid facilities' characteristics, operating parameters, and current operational usage. The targeted navigation service level for normal and contingency/reversion operations in the MID region is a critical factor in identifying the ground navaids infrastructure.

3.2. Considering the above and the need for the development of a regional Navigational Minimum Operational Network for the MID region, it is proposed to set an Action Group and adopt the following decision:

**DRAFT DECISION 13/X: MON/NAV ACTION GROUP**

*That,*

- a) *MON Action Group be established to develop a proposal for a Regional Navigational Minimum Operational Network to support the navigation service for the MID region's normal and contingency/reversion operations;*
- b) *the terms of reference of the MON Action Group be developed during the first meeting of the Action Group; and*
- c) *States support the MON Action Group through:*
  - i. *assignment of Subject matter experts to contribute to the work of the Action Group; and*
  - ii. *sharing states' experience and provision of required data for developing the Navigational Minimum Operational Network.*

4.1. The meeting is invited to:

- a) note the information provided in this WP; and
- b) agree to the proposal to set up a MON Action Group to develop a proposal for a Regional Navigational Minimum Operational Network to support the navigation service for the MID region's normal and contingency/reversion operations.

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