International Civil Aviation Organization

MIDANPIRG Communication, Navigation and Surveillance Sub-Group

Fourteenth Meeting (CNS SG/14)
(Abu Dhabi, UAE, 19 – 23 October 2025)

Agenda Item 3: CNS Planning and Implementation Framework in the MID Region

MITIGATING GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) VULNERABILITIES

(Presented by Sultanate of Oman)

SUMMARY

This paper presents the significant importance to address the GNSS Vulnerabilities at the international, regional, and national levels. Furthermore, this Working paper underscores the need to review and update ICAO MID Doc. 011 "Guidance on GNSS implementation in the MID Region. Additionally, this paper presents the recent activities taken by CAA of Oman regarding GNSS Vulnerabilities.

Action by the meeting is at paragraph 3.

REFERENCES

- ICAO Annex 10, V I
- Doc 9849 "Global Navigation Satellite System (GNSS) Manual"
- Report of MIDANPIRG/22 & RASG-MID/12 (Doha, Qatar, 4 – 8 May 2025)
- Recommendations from the ICAO EUR/MID Radio Navigation Symposium (6 to 8 February 2024)

1. INTRODUCTION

1.1 GNSS supports positioning, navigation and timing (PNT) applications. GNSS is the foundation of Performance Based Navigation (PBN), Automatic Dependent Surveillance – Broadcast (ADS-B) and Automatic Dependent Surveillance – Contract (ADS-C). GNSS also provides a common time reference used to synchronize systems, avionics, communication networks and operations, and supports a wide range of non-aviation applications.

1.2 GNSS signals from satellites are very weak at the receiver antenna, and so GNSS signals are vulnerable to radio frequency interference. ICAO Global Navigation Satellite System (GNSS) Manual (Doc 9849) includes the mitigation strategy.

1.3 The increasing frequency and geographic spread of GNSS RFI, particularly in the MID Region experiencing geopolitical instability, has introduced a significant threat to the reliability and integrity of satellite-based services.

2. DISCUSSION

2.1 Dependence on GNSS is increasing, as GNSS is used for an ever-expanding range of safety, security, business and policy critical applications. GNSS functionality is being embedded into many parts of critical infrastructures. Aviation is now dependent on uninterrupted access to GNSS positioning, navigation and timing (PNT) services. Aviation relies heavily on GNSS for area navigation and precision approach. Aircraft avionics such as the Flight Management Systems (FMS) require GNSS timing for a large number of onboard functions including Terrain Avoidance Warning System (TAWS) or Enhanced Ground Proximity Warning Systems (EGPWS). Onboard avionics are highly integrated into commercial aircraft and are very dependent on GNSS timing data. At the same time, GNSS vulnerabilities are being exposed and threats to denial of GNSS services are increasing.

2.2 GNSS Vulnerability has been identified as a safety issue and one of the main challenges impeding the implementation of PBN in the MID Region.

2.3 With the increasing dependence on GNSS, it is important that GNSS vulnerabilities be properly addressed.

2.4 There are several types of threat that can interfere with a GNSS receiver's ability to receive and process GNSS signals, giving rise to inaccurate readings, or no reading at all, such as radio frequency interference, space weather induced ionospheric interference, solar storm, jamming and spoofing. The disruption of GNSS, either performance degradation in terms of accuracy, availability and integrity or a complete shutdown of the system, has a big consequence in critical infrastructure.

2.5 To bring attention to the critical issue of GNSS interference, and to foster discussions on the management of GNSS vulnerabilities and potential mitigation measures against GNSS RFI, ICAO recently convened the ICAO EUR/MID Regional Navigation Symposium from 6 to 8 February 2024 in Antalya, Turkey. One important outcome of this symposium is the list of recommendations regarding Stakeholders' continued efforts towards ensuring safe, reliable, and resilient air navigation.

2.6 At the regional level, ICAO MID Regional Office has endorsed the following decisions/conclusions during the last MIDANPIRG 22/RASG 12 (Doha, Qatar, 4 – 8 May 2025), as follows:

i. PIRG/RASG DECISION 3: That, the amended RASG-MID Safety Advisory 14 (RSA-14) is endorsed.

ii. PIRG/RASG CONCLUSION 2: CONSOLIDATED REGIONAL APPROACH TO GNSS RFI MANAGEMENT.

2.7 At the regional level, ICAO MID Regional Office has published ICAO MIDANPIRG Doc. 011 titled "GUIDANCE ON GNSS IMPLEMENTATION IN THE MID REGION", edition December, 2018. This guidance includes some mitigation strategies to GNSS vulnerabilities in Part III: GNSS Vulnerabilities.

2.8 At the national level, Civil Aviation Authority of Oman has published Civil Aviation Safety Bulleting No. 2024-01 on 13th August 2024 regarding GNSS Outage and alternatives leading to Navigation-Surveillance Degradation. This Safety Bulletin is applicable to all stakeholders to be aware of the potential safety and capacity impacts of GNSS interference, jamming, and spoofing. Furthermore, this safety bulleting provides guidance, information and recommendation to the relevant stakeholders. The Safety Bulletin is available on the link: https://www.caa.gov.om/upload/files/CASB%202024-01%20GNSS%20Jamming%20or%20Spoofing%20Issue%202%20Rev.0%20130824%20(2).pdf.

2.9 Recommendation: revise and update ICAO MID Doc. 011 “GUIDANCE ON GNSS IMPLEMENTATION IN THE MID REGION” to consider the following:

i. Latest amendment of ICAO Annex 10, Volume I;

ii. Latest revision of RASG-MID Safety Advisory 14 (RSA-14);

iii. Recommendations from the ICAO EUR/MID Radio Navigation Symposium (6 to 8 February 2024); and

iv. Latest update to Global Air Navigation Plan.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information mentioned in this Working Paper;

b) urge Member States to prioritize and expedite the implementation of the actions stipulated in PIRG/RASG CONCLUSION 2 regarding CONSOLIDATED REGIONAL APPROACH TO GNSS RFI MANAGEMENT; and

c) review and update, as appropriate, ICAO MID Doc. 011 “GUIDANCE ON GNSS IMPLEMENTATION IN THE MID REGION”, as highlighted in 2.9.

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