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

STRENGTHENING GNSS RESILIENCE THROUGH MULTI-CONSTELLATION AND MULTI-SOURCE TIME SYNCHRONIZATION IN THE MID REGION

(Presented by UAE)

SUMMARY

This paper highlights the operational and safety risks arising from GNSS interference and spoofing, which affect both position and precise time synchronization across Communication, Navigation, and Surveillance (CNS) systems. It emphasizes the importance of adopting multi-constellation and multi-source time synchronization strategies to enhance the resilience and continuity of Air Navigation Services (ANS) in the MID Region.

The paper encourages States to implement multi-GNSS receivers, independent timing sources, and Complementary Positioning, Navigation and Timing (C-PNT) frameworks to ensure CNS service continuity during GNSS disruptions.

Action by the meeting is at paragraph 4.

REFERENCES

- ICAO Global Air Navigation Plan (GANP), 8th Edition (Doc 9750)
- ICAO Assembly 42nd Session Working Papers A42-WP/34, A42-WP/108 and A42-WP/204
- ICAO MID Region Air Navigation Plan (MID ANP), Vol. I, Part IV (CNS)
- MIDANPIRG/22-WP/49 – Outcomes of CNS/13 Meeting (GNSS RFI Mitigation and NAV-MON)
- ITU Radio Regulations on GNSS Interference and Spectrum Protection

1. INTRODUCTION

1.1 Air Navigation Services in the MID Region increasingly depend on GNSS for both position and precise timing data used across communications, navigation, and surveillance systems. While GNSS provides high accuracy and global coverage, recent events have shown that jamming and spoofing can simultaneously corrupt both position and timing signals, leading to widespread system degradation. When timing errors propagate through networked CNS elements, they can impact correlation, synchronization, and even safety-critical functions.

1.2 ICAO's 42nd Assembly encouraged States to strengthen CNS resilience through multi-layered PNT architectures, Complementary PNT (C-PNT) solutions, and timing assurance mechanisms to safeguard continuity of air navigation operations.

2. DISCUSSION

2.1 The increasing reliance on GNSS-disciplined clocks, such as Network Time Protocol (NTP) and Precision Time Protocol (PTP) servers, has made CNS networks vulnerable to timing corruption. Spoofed or denied GNSS signals can cause time offsets that lead to loss of correlation between radar and ADS-B tracks, multilateration (WAM) inaccuracies, mis-sequencing in communication recording, and message timestamp errors within SWIM and ATM data exchanges. Such cascading timing failures can result in degraded situational awareness and potential operational safety implications.

2.2 Adopting a multi-constellation approach—using GPS, Galileo, GLONASS, BeiDou, and NavIC concurrently—offers a practical and immediate enhancement to resilience. The use of multiple constellations improves availability and geometry, and provides redundancy in case one constellation experiences interference. Each constellation broadcasts an independent UTC-aligned reference, allowing fusion algorithms to validate and cross-check timing inputs before synchronization is distributed to the broader CNS network.

2.3 Beyond multi-GNSS adoption, a robust time architecture requires multi-source synchronization. This includes deploying alternative timing references such as terrestrial or fibre-based NTP/PTP networks, disciplined rubidium or cesium atomic clocks for extended holdover during GNSS outages, and a potential cross-validation among regional ANSP time servers to detect and isolate anomalies. The implementation of this layered timing model would ensure that CNS services—particularly surveillance correlation and data exchange—remain continuous even during prolonged GNSS disruption.

2.4 Regional coordination is key to achieving this resilience. Establishing a MID Region PNT Resilience Working Group under the CNS Sub-Group could facilitate the exchange of interference reports, clock stability data, and best practices for time assurance. This group could also collaborate with the NAV-MON Action Group, which is addressing GNSS continuity through ground-based navigation networks, ensuring alignment between navigation and timing resilience efforts.

2.5 By incorporating multi-constellation, multi-source, and cross-validation mechanisms, the MID Region can build a resilient, self-verifying timing infrastructure capable of maintaining CNS performance under adverse conditions. This approach complements ICAO's GANP PIA2 objectives and supports the region's ongoing initiatives on GNSS interference management and CNS modernization.

3. CONCLUSION

3.1 GNSS resilience requires protecting not only signal availability but also time integrity. Multi-constellation and multi-source synchronization strengthen the robustness of CNS infrastructure and minimize service degradation from spoofing or radio-frequency interference. Coordinated regional implementation and shared best practices will ensure that the MID Region remains aligned with ICAO's global C-PNT and CNS Resilience frameworks.

4. ACTION BY THE MEETING

4.1 The meeting is invited to:

a) note the information contained in this Paper;

b) recognize the importance of protecting both positional and temporal integrity within CNS systems;

c) encourage MID States to adopt multi-constellation GNSS receivers and integrate alternative timing sources such as atomic clocks and terrestrial networks; and

d) request the ICAO MID Office, in coordination with the CNS and NAV-MON Action Groups, to develop regional guidance on multi-constellation implementation and time assurance frameworks under the C-PNT initiative.

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