61ST CONFERENCE OF DIRECTORS GENERAL OF CIVIL AVIATION ASIA AND PACIFIC REGION

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AGENDA ITEM 4: AIR NAVIGATION

MITIGATING GNSS INTERFERENCE RISKS IN ASIA-PACIFIC: ENSURING RESILIENT AIR NAVIGATION SYSTEMS

(Presented by Bangladesh)

DISCUSSION PAPER

SUMMARY

The Global Navigation Satellite System (GNSS) has become an essential technical enabler supporting improved services to meet the Global Air Navigation Plan (GANP) objectives by supporting positioning, navigation, and timing applications and has become critical for aviation operations. However, since GNSS signals from satellites are very weak at the receiver antenna, reports of radio frequency interferences (jamming and spoofing) are gradually becoming significant global issues. The APAC region is no exception to this growing threat. The resultant increasing risk of GNSS jamming and spoofing against civil aviation has been identified as an urgent priority both globally and regionally. In order to enhance GNSS resilience across the region and globally Bangladesh proposes concerted efforts among the CAAs and the ICAO.

MITIGATING GNSS INTERFERENCE RISKS IN ASIA-PACIFIC: ENSURING RESILIENT AIR NAVIGATION SYSTEMS INTRODUCTION

1. INTRODUCTION

1.1 The 59th APAC DGCA Conference (Cebu, October 2024) acknowledged that GNSS Radio Frequency Interference (RFI) and spoofing events jeopardize the safety and resiliency of airspace operations. The 60th DGCA Conference (Sendai, July-August 2025) further discussed GNSS RFI mitigation, with Thailand proposing the establishment of an APAC GNSS Interference Coordination Task Force.

1.2 The 61st APAC DGCA Conference, to be hosted by Malaysia in Kuala Lumpur in 2026 under the theme "Smart Skies: AI for Safe, Secure, Sustainable and Efficient Aviation", presents a pivotal opportunity to consolidate regional efforts and build a comprehensive framework for GNSS RFI mitigation. This paper builds on the momentum generated by the ICAO APAC Radio Navigation Symposium (New Delhi, April 2025), the 42nd ICAO Assembly and the outcomes of the DGCA/60 to propose concrete actions for enhancing GNSS resilience across the region.

1.3 GNSS RFI has been identified by ICAO as a contributing factor to three Global High-Risk Categories of Occurrences e.g. a) Controlled Flight Into Terrain (CFIT), b) Mid-Air Collision (MAC), and c) Loss of Control In-Flight (LOC-I). The upcoming Asia Pacific Regional Aviation Safety Plan (AP-RASP) 2026-2028 will also recognize these threats posed by GNSS RFI on CFIT and MAC for the APAC region.

1.4 Bangladesh wishes to acknowledge the previous published DPs on this issue. With the advent of the emergence of the new technologies and various mitigation measures applied individually by States, Bangladesh wishes to present a unified and harmonized solution to this persisting Global High-Risk Categories of Occurrences drawing the coconscious of the APAC States.

2. DISCUSSION

2.1 While GNSS supports a vast array of critical aviation functions such as Flight Management Systems (FMS), Automatic Flight Control Systems (AFCS), and Data Link Communication Systems, technologies like Automatic Dependent Surveillance-Broadcast (ADS-B) Out depend on GNSS to provide accurate location data to ANSPs for ATM purposes. GNSS is applied to both precision and non-precision approaches, contributing to fuel savings and more efficient air traffic management.

2.2 But the GNSS has its own inbuilt vulnerabilities, mainly in the weakness of GNSS signals at the receiver antenna. This renders GNSS receivers susceptible to two primary forms of interferences. These primary forms of interferences are known as:

a) **Jamming:** The deliberate or unintentional emission of radio interference that prevents receivers from acquiring or tracking GNSS signals, resulting in the loss of valid Position, Navigation and Timing (PNT) information, and

b) **Spoofing:** The transmission of counterfeit satellite signals that mislead GNSS receivers, causing erroneous PNT data that may be undetected by the aircraft systems.

2.3 These interferences pose a significant and growing threat to aviation safety and efficiency. The fundamental vulnerability of weak satellite signals, combined with the proliferation of jamming devices and the emergence of sophisticated spoofing techniques, requires a coordinated, multi-layered response. Attention is drawn to the following sets of degradations:

a) Terrain Awareness and Warning Systems (TAWS) Degradation**:** Spoofing-induced corruption of Positioning, Navigation and Timing (PNT) data compromises the integrity of Terrain Awareness and Warning Systems (TAWS), causing spurious PULL UP alerts or total system failure signals, which can lead to crew losing confidence and disregarding genuine alerts. On the other hand, jamming causes an immediate loss of PNT data and GNSS-dependent Systems (TAWS, ACAS, ADS-B).

b) RNP Degradation: Spoofing or jamming degrades Required Navigation Performance (RNP) accuracy, causing the Actual Navigation Performance (ANP) to exceed the deviation in low visibility or in complex terrain situations violating the obstacle clearances, leading directly to CFIT risk.

c) TCAS Degradation**:** Spoofing supplies corrupted position data to the Flight Management System, generating major position errors for TCAS leading to spurious Resolution Advisories (RAs) or a dangerous inhibition of genuine collision alerts. In addition, jamming corrupts the time source, leading to ranging errors and inaccurate calculation of threat proximity.

d) ATC Surveillance Degradation: GNSS RF interferences severely degrade ADS-B and ADS-C data, and Controller Pilot Data Link Communication (CPDLC). As such ATC is forced to use procedural separation, increasing separation minima and MAC risk.

2.4 Economic and Operational Impact: GNSS RFI imposes significant operational and financial burdens, including flight rerouting, delays, cancellations, and increased workload for both pilots and air traffic controllers. The proliferation of GNSS RFI hotspots—many occurring in cross-border areas—may further complicate regional airspace management.

2.5 While mitigation of GNSS interferences is ongoing, there are considerable gaps in the existing processes of mitigations: In order to make the mitigations more effective we must understand the gaps that still remain present globally and within the region. The fragmentation of efforts, limited reporting of interferences, inadequate detection capabilities and the existing conventional navigation infrastructure, are the focus areas for future add-ons.

2.5.1 Fragmentation and Duplication: Discussions on GNSS RFI occur across multiple technical working groups and sub-groups (APANPIRG, RASG-APAC, RASCF), leading to confusion, repetition, and inconsistent approaches.

2.5.2 Limited Reporting: Despite the established reporting form, not a single incident report was shared with the ICAO APAC Office as of SRWG/9 (May 2025). Confusion regarding the reporting scope (limiting reports to cases with cross-border impact that cannot be solved nationally or internationally through routine procedures) has discouraged States from submitting data.

2.5.3 Insufficient Data for Analysis: Thailand has shared data and taken multiple actions, and Malaysia has been active in discussions in sharing GNSS RFI data. This types of limited data from member States without detailed information will hinder trend analysis and development of mitigation strategies.

2.5.4 Scope Limitations: The Ad Hoc group for GNSS and Data Link Disruption works with the operational procedures only and does not address technical considerations, system resilience, or cross-cutting safety-security aspects.

2.5.5 Inconsistent NOTAM Practices: The eighteen different Q-Codes being used worldwide for GNSS interference events render the filtering mechanisms ineffective. Different text is used in NOTAM Item E (e.g., "GPS Unreliable," "GPS Jamming," "GPS signal interference"), creating challenges for operators trying to identify relevant information. However, the conference may note that new Q-codes are being developed by the ICAO's Navigation Systems Panel (NSP), one for jamming (code "LF" associated with "GA" or "GW") and a new code specifically for spoofing.

2.5.6 Lack of Standardized Phraseology: While phraseology for GNSS interference is published in PANS-ATM (Doc 4444), given the multitude of varieties, it is not exhaustive, and pilots and ATS personnel are expected to use plain language when necessary.

2.6 **What We Have Now:**

2.6.1 The APAC region has established several mechanisms to address GNSS RFI. Following are the examples of work undertaken by the Regional Office.

a) APANPIRG CNS Sub-Group (SRWG): Discusses technical aspects of GNSS RFI, including spectrum protection and interference reporting.

b) Procedures for GNSS and Data Link Disruption Ad Hoc Group (established by ATM SG/12, September 2024): Focused on developing operational procedures for reporting GNSS and data link disruptions and mechanisms for sharing information among stakeholders.

c) RASG-APAC SEI Working Group: Addresses the safety implications of GNSS interferences, recognizing its implication in the CFIT and MAC risks.

d) ICAO APAC GNSS Interference Reporting Form: Circulated through State Letter T 8/5.10 - AP052/24(CNS) dated 23 April 2024**.**

2.7 **The Way Forward:**

2.7.1 The APAC region has established several mechanisms to address GNSS RFI. To name a few are the APANPIRG CNS Sub-Group (SRWG), Procedures for GNSS and Data Link Disruption Ad Hoc Group, RASG-APAC SEI Working Group, ICAO APAC GNSS Interference Reporting Form.

2.7.2 Thailand has highlighted in its proposal to DGCA/60 to form a task force dedicated to GNSS RFI forming more concrete solutions.

2.7.3 Reports of GNSS RFI events and mitigation measures are discussed in APANPIRG, while safety implications are addressed in RASG-APAC, and security perspectives in RASCF.

2.7.4 Singapore has similarly proposed a coordination group led by the CNS SG and SEI WG to coordinate action on GNSS RFI risks. The 12th PIRG-RASG Regional Coordination Meeting (November 2024) acknowledged that enhanced coordination was necessary.

3 CONCLUSIONS

3.1 This paper proposes that the APAC member States should consider:

a) ensuring sufficient aviation representation in delegations to ITU WRC-27 preparatory meetings to progress improvements to ITU Resolution 676 and ensure that future radio regulations updates do not adversely impact GNSS;

b) Improving coordination with the military by facilitating the sharing of information on RFI testing;

c) acquiring the necessary technical capabilities to detect GNSS RFI, conduct Radio Frequency measurements, and geolocate the source of the RFI;

d) utilizing the ITU RR15 escalation procedure for RFI incidents with cross-border impact that cannot be resolved nationally or internationally through routine procedures;

e) submitting reports to the respective ICAO Regional Office, which can forward them to the ITU Satellite Interference Reporting and Resolution System (SIRRS) for further action;

f) ensuring ATC readiness to provide radar vectors when requested, navigational assistance, clock checks, and clearly define circumstances under which ATC may refuse vectoring;

g) prioritizing ATCO training and awareness programs focusing on response to abnormal situations and clearance deviations;

h) ensuring timely and effective communication regarding RFI incidents via NOTAM, AIP, and/or ATIS as appropriate;

i) establishing a resilient operational network by ensuring availability of sufficient navigation infrastructure to support continuous Performance-Based Navigation operations and maintain a VOR/DME Network for reliable cross-checking;

j) retaining sufficient conventional navigation infrastructure for contingency support in case of GNSS outages and misleading signals, and develop mitigation techniques for loss of services;

k) submitting GNSS RFI occurrence reports to the ICAO APAC Office using the established reporting form, including incidents that do not have cross-border impact;

l) maintaining a sufficient network of conventional navigation aids to ensure operational safety and sufficient airspace capacity during GNSS interference events - in line with AN-Conf/14 Recommendation 2.2/2 and the ICAO/ITU/IMO Joint Statement; and

m) nominating Points of Contact (POCs) to the ICAO APAC Regional Office for further coordination and discussion on cross-border GNSS RFI.

4 ACTION BY THE CONFERENCE

4.1 The Conference is invited to:

a) note the increasing risk of GNSS RFI in the APAC region and its implications for aviation safety, as identified by DGCA/59, DGCA/60, ICAO APAC Radio Navigation Symposium and the 42nd ICAO Assembly;

b) endorse the establishment of the APAC GNSS Interference Coordination Task Force (AGICTF) to centralize discussions on GNSS RFI from CNS/ATM implementation, safety, and security perspectives, and to report to DGCA meetings until the issue has been adequately addressed;

c) urge States/Administrations to submit GNSS RFI occurrence reports to the ICAO APAC Office using the established reporting form to build a comprehensive regional database;

d) urge States/Administrations to nominate Points of Contact (POCs) to the ICAO APAC Regional Office for further coordination on GNSS RFI matters;

e) urge States/Administrations to maintain sufficient conventional navigation infrastructure to support operations during GNSS interference events;

f) request the ICAO APAC Regional Office to, facilitate the establishment and operation of the AGICTF, support the development of regional GNSS RFI mitigation guidance, follow up with the recommendations of the Radio Navigation Symposium and the ICAO/ITU/IMO Joint Statement, Coordinate with ICAO HQ and ITU on global GNSS RFI initiatives, including the development of standardized NOTAM Q-codes and phraseology.

— END —