International Civil Aviation Organization

Thirty-Sixth Meeting of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG/36)

Bangkok, Thailand, 24 to 26 November 2025

Agenda Item 2: Global and Inter Regional Activities

ENHANCING GNSS RESILIENCE: OPERATIONAL AND TECHNICAL COLLABORATION AGAINST RFI

(Presented by Japan)

SUMMARY

Addressing the increasing risk of global navigation satellite system (GNSS) jamming and spoofing against civil aviation is an urgent issue both globally and regionally, and the APAC region is no exception. This paper introduces initiatives being taken by Japan to address GNSS RFI, including the detection of jamming/spoofing, information sharing and the implementation of a minimum operational network as a backup, and encourages APAC States to implement detection and mitigation systems against GNSS RFI and to enhance cooperation with other States.

Strategic Objectives:

- A: ***Safety*** *– Enhance global civil aviation safety*
- B: ***Air Navigation Capacity and Efficiency*** *— Increase the capacity and improve the efficiency of the global aviation system*
- C: ***Security and Facilitation*** *— Enhance global civil aviation security and facilitation*
- D: ***Economic Development of Air Transport*** *— Foster the development of a sound and economically viable civil aviation system*

1. INTRODUCTION

1.1 Addressing the increasing risk of global navigation satellite system (GNSS) jamming and spoofing against civil aviation is an urgent issue both globally and regionally, and the APAC region is no exception.

1.2 The 14th Air Navigation Conference (Montreal, 26 August - 6 September 2024) presented recommendations and/or agreed actions including the implementation of effective GNSS radio frequency interference mitigation measures, the development of regional GNSS reporting mechanisms, and 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.

1.3 Based on those recommendations and/or agreed actions, APANPIRG/35 (Bangkok, 25-27 November 2024) endorsed the ***Decision ATM/SG/12-8: Establish Procedures for GNSS and Data Link Disruption Ad Hoc Group***. The APAC Radio Navigation Symposium (New Delhi, 7 - 9 April 2025) was held, where useful information was exchanged among participants.

1.4 At CNS SG/29 (Bangkok, 16 – 20 June 2025), the progress and key discussion points of the GNSS and Data Link Disruption Ad Hoc Group were confirmed, and it was agreed that the evaluation and analysis of GNSS RFIs would be conducted by the SRWG group. However, it also became clear that the technical discussions on methods for detecting GNSS RFIs are not yet mature.

1.5 GNSS RFI has become a global threat, and the 60th APAC DGCA Conference (Sendai, 28 July - 1 August 2025) has also set action items.

1.6 At ICAO Assembly 42nd (Montreal, 23 September - 3 October 2025), the Technical Commission invited ICAO to establish a comprehensive review framework to enhance the CNS/ATM resilience.

2. DISCUSSION

2.1 To counter GNSS RFI, Japan has established an RFI detection system and a reporting mechanism.

2.2 In the past, Japan has experienced multiple events of degradation in on-board GNSS performance. One example is the one that affected around 20 aircraft in the vicinity of Komatsu Airport from December 15 to 18, 2020. Japan analysed the GNSS data recorded by Michibiki Satellite-based Augmentation service (MSAS) monitoring station at Komatsu Airport and other stations located in Japan, and identified the degradation of C/N0 (Carrier to Noise density ratio) of the GPS signal at the Komatsu Airport station (**Figure 1** and **Figure 2**). It was determined that the RFI was caused by external interference other than GPS, and with the Regional Telecommunications Bureau, the source of the RFI was identified (**Figure 3**).

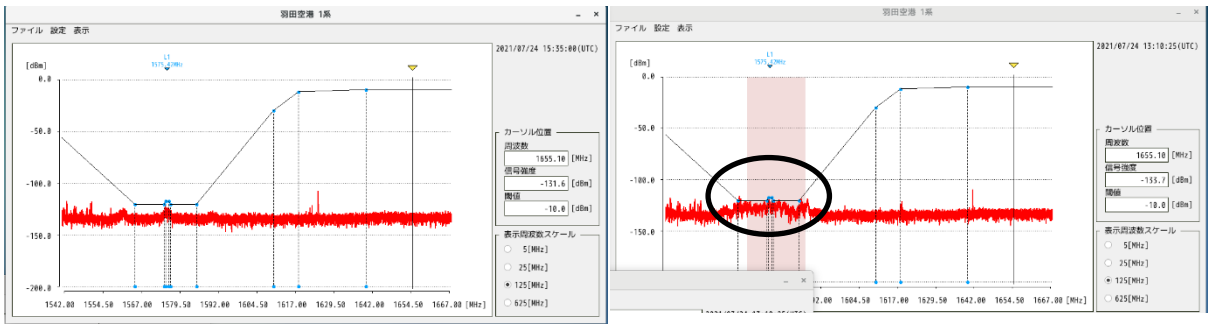

Figure 1. Spectrum analyzer status
Left: Normal, Right: Interference example. The figure illustrates that the interference wave exceeds the lower limit line, indicating a deviation from the acceptable range.

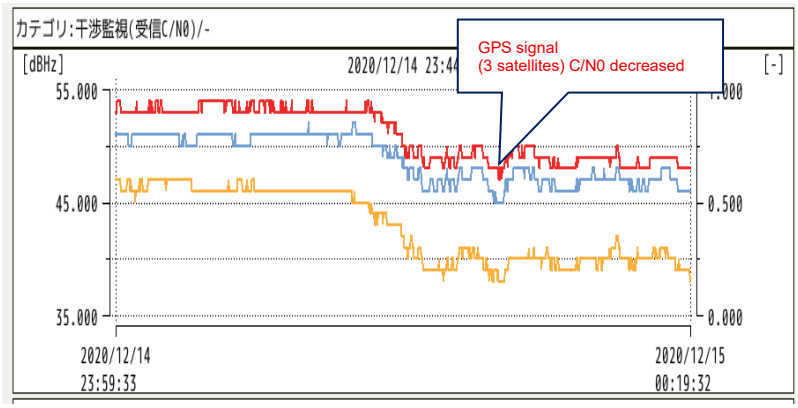

Figure 2. GPS signal C/N0 fluctuations Carrier power to noise power ratio. This figure shows that the signals from three GPS satellites exposed to noise at the same time.

Figure 3. The RFI was caused by a wireless camera mounted on a crane at a construction site

2.3 To detect GNSS jamming in a timely manner, Japan has developed a prototype GNSS jamming detection tool and is currently evaluating it using real-time positioning data from approximately 80 of the 1,300 GPS-based Control Stations managed by the Geospatial Information Authority of Japan. In addition, to detect GNSS spoofing, Japan has also developed a prototype GNSS spoofing detection tool that can detect possible spoofing by comparing ADS-B position data of each aircraft with fusion data of SSR and WAM processed by HARP (Hybrid Air-route suRveillance sensor Processing equipment) at 2-second intervals (**Figure 4**Error! Reference source not found.).

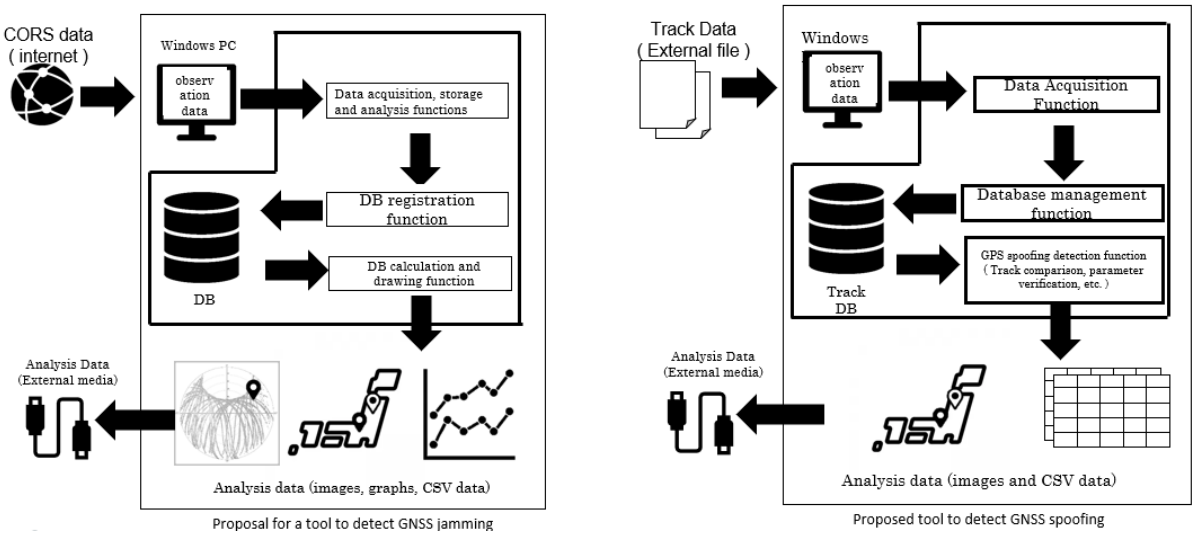

Figure 4. Jamming and spoofing detection tool

2.4 Information about GNSS RFI will be shared through NOTAM to quickly inform ANSPs of GNSS RFI occurrence events, enabling them to notify flight users promptly and help avoid flying deviant routes (**Figure 5**).

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NOTAM
  (6366/21 NOTAMN
    Q)RJJJ/QGWXX/IV/NBO/E/000/999/4155N14652E100
    A)RJJJ B)2110141000 C)2110241459
    E)GPS POSITION ACCURACY MAY BE REDUCED WITHIN A 100NM
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Figure 5. Contents of NOTAM issued by GNSS RFI

2.5 The MON (minimum operation network) using conventional navaids is one of the important methods to mitigate GNSS RFI. VOR provides sufficient coverage at an altitude of 10,000 ft in Japan as shown in **Figure 6**. Japan's territory consists of mountainous regions and islands, so some low-altitude areas and remote islands may fall outside the coverage of VOR, but there are no major issues with the current operations.

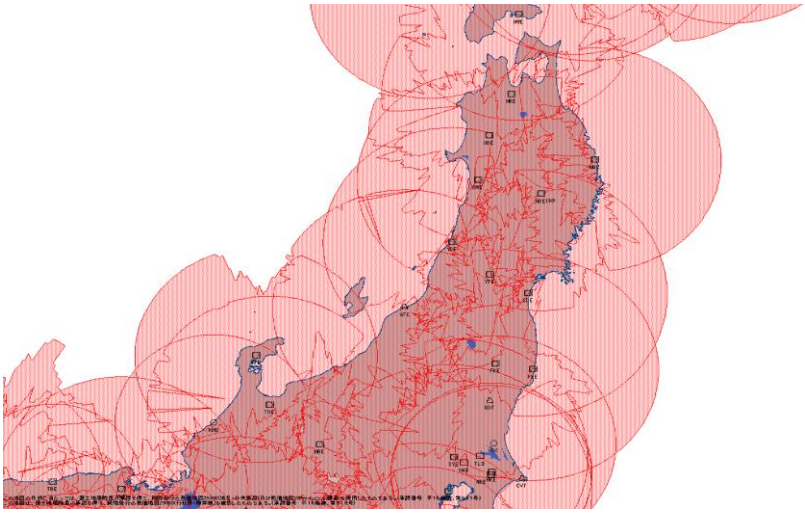

Figure 6. VOR coverage at 10,000 ft

2.6 GNSS RFI is expected to continue increasing in the APAC region. It is important for States to implement mechanisms for the detection and mitigation of GNSS RFI and to enhance cooperation and coordination with other States in order to maintain and improve a safety and sustainable aviation network in the APAC region.

2.7 The first Procedures for GNSS and Data Link Disruption Ad Hoc Group meeting was held on 1st October, and the ToR was decided. This ad hoc ToR included discussion of operational GNSS RFI mitigation measures. It is important to clarify that technical considerations addressed by the CNSSG fall outside the scope of this ToR.

3. ACTION BY THE MEETING

3.1 The Meeting is invited to:

a) encourage ICAO APAC to support the implementation of detection and mitigation systems against GNSS RFI and to enhance cooperation with other regions.

b) requests ICAO APAC to take the initiative in expediting the discussion of technical aspects related to GNSS RFI under the CNSSG framework, in parallel with the operational deliberations taking place within the GNSS and Data Link Disruption Ad Hoc Group, and to promote close coordination between both bodies and

c) encourage States to actively participate in both, operational and technical above discussion including sharing of their experiences such as GNSS RFI events and best practice of mitigation measures with other States.

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