International Civil Aviation Organization

Thirtieth Meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/30)

Bangkok, Thailand, 14 – 17 July 2025

Agenda Item 5: Airspace Safety Monitoring Activities/Requirements in the Asia/Pacific Region

CLASSIFICATION AND REPORTING FOR NON-RVSM APPROVED AIRCRAFT OPERATING IN RVSM AIRSPACE AND OCCURRENCES CAUSED BY GNSS RADIO FREQUENCY INTERFERENCE

(Presented by MAAR)

SUMMARY

Regional Monitoring Agency's compliance checks imply that some aircraft, which filed 'W' to operate in the RVSM airspace without valid RVSM approvals in RMAs' database, were not accurately captured or reported as LHD Category L. Additionally, the increasing in Global Navigation Satellite System (GNSS) Radio Frequency Interference (RFI) has become a significant concern in the aviation industry and needs to be monitored for the risk to RVSM operations. Therefore, this paper clarifies the classification and reporting for both non-RVSM approved aircraft operating in RVSM airspace and occurrences caused by GNSS RFI, and encourages pilots, air traffic controllers, and State authorities to report such occurrences so that their effects on safety risk are assessed for possible identification of prevention and mitigation measures.

1. INTRODUCTION

1.1 Large Height Deviation (LHD) Category L is described as an aircraft being provided with Reduced Vertical Separation Minimum (RVSM) separation is not RVSM approved. For example, a non-RVSM approved aircraft had "W" in Item 10 of its flight plan (indicating RVSM approval). As a result, this aircraft operated in RVSM airspace with 1,000 feet vertical separation.

1.2 According to the LHD statistics for Asia Pacific (APAC) airspace, the LHD Category L reports are rarely submitted to responsible monitoring agencies. Between 2019 and 2024, only three reports were submitted in 2019, two reports in 2020 and no report from 2021 to 2024.

1.3 As a role of Regional Monitoring Agency (RMA), regular compliance checks are conducted to verify that operators meet their State's RVSM approval requirements. These checks involve comparing flight plan data and the Traffic Sample Data (TSD) with RVSM approval snapshot databases collected from all RMAs to identify the aircraft that filed 'W' to operate in the RVSM airspace but do not have valid RVSM approvals in RMAs' database. According to the results presented on IP/05 at RMACG/20 (**Attachment 1**), 44 aircraft filed "W" in their flight plans without valid RVSM approval records in 2024. Notably, 6 of 44 aircraft were also identified in 2023. This implied that these occurrences were not captured and reported as LHD Category L to the responsible RMAs.

1.4 In parallel, the Global Navigation Satellite System (GNSS) Radio Frequency Interference (RFI), both jamming and spoofing, has become increasingly widespread. According to the IATA Global Navigation Satellite System GNSS-Radio Frequency Interference Safety Risk Assessment published in September 2024, numerous GNSS RFI occurrences were identified through Flight Data eXchange (FDX) program. **Figure 1** showed the geographic identification of GNSS RFI hotspots, extracted from the FDX program during January to June 2024. Most of GNSS RFI occurrences were observed in Europe and Asia.

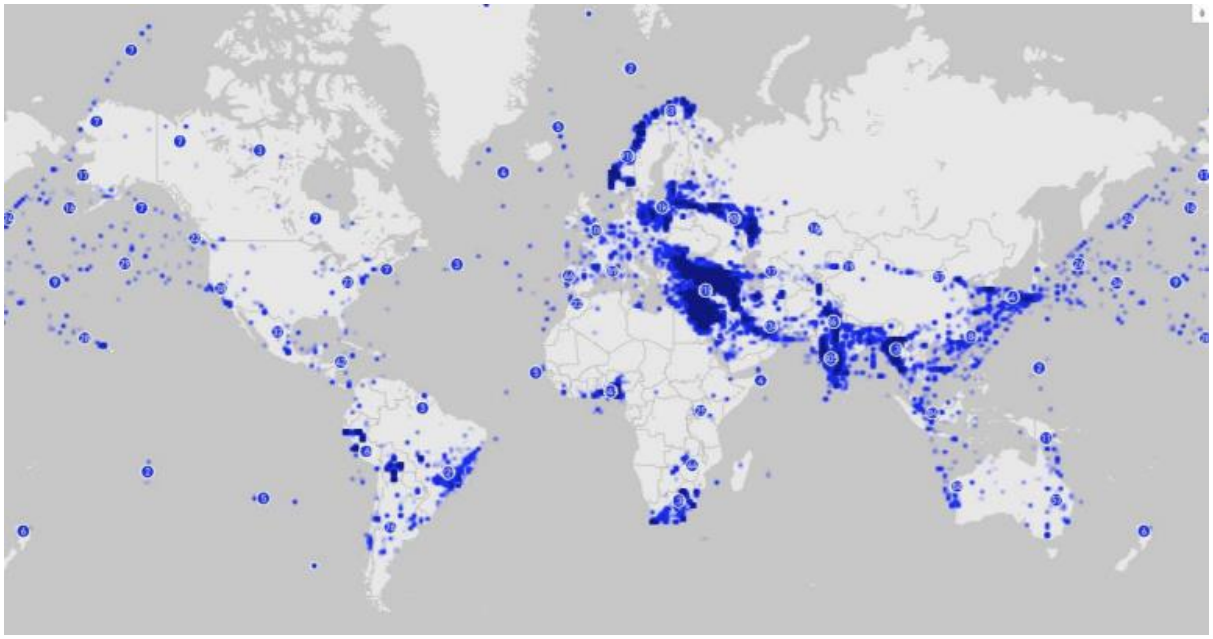

Figure 1 GNSS Jamming and Spoofing Recorded during January to June 2024

1.5 This issue has also raised significant concern from IATA and ICAO, as highlighted in WP/4 to the RMACG/20 meeting (**Attachment 2**). As a monitoring agency, MAAR would like to raise awareness and promote one of the existing occurrence reporting channels among aviation authorities and stakeholders.

1.6 Regarding the principle of GNSS RFI, it can degrade aircraft performance, particularly with position, navigation, and timing. Its effects can lead to deviations, comparable to LHDs, Large Lateral Deviations (LLDs), and Large Longitudinal Errors (LLEs). To address the concern, RMAs and the En-route Monitoring Agency (EMA) have potential to treat GNSS RFI occurrences similar to LHD/LLD/LLE with existing materials such as the risk assessment procedure and reporting system.

1.7 As a result, this paper aims to clarify the classification and reporting for non-RVSM approved aircraft operating in RVSM airspace, and for occurrences caused by GNSS RFI.

2. DISCUSSION

LHD Category L Scenarios

2.1 LHD Category L involves situations where an aircraft is provided with RVSM separation despite not being RVSM approved. This type of occurrence can be caused by an aircraft operator's error in flight plan filing, lack of verification by Air Traffic Service (ATS) units, an outdated list of non-RVSM approved aircraft, and system-induced errors in flight plan processing. The following examples illustrate the possible scenarios that should be reported as LHD Category L:

a) Aircraft Operator's Errors in Flight Plan Filing

An operator mistakenly inserted the letter "W" (indicating RVSM approval) in field 10 of the flight plan for a non-RVSM approved aircraft. Consequently, the aircraft was then cleared to an RVSM flight level and provided 1,000-feet vertical separation.

b) Lack of Verification by ATS Units

A controller mistakenly assigned a non-RVSM approved aircraft to a RVSM flight level and provided 1,000 feet vertical separation without querying the pilot or verifying RVSM approval status.

c) Outdated List of Non-RVSM Approved Aircraft

The RMA's list of non-RVSM-approved aircraft that is distributed to the States and ANSPs is not distributed, properly communicated or updated to the air traffic controllers handling the aircraft. As a result, the air traffic controllers may not be aware that an aircraft's RVSM approval is not valid. This can lead to the aircraft being cleared to operate at RVSM flight levels with 1,000-feet vertical separation.

d) System-Induced Errors in Flight Plan Processing

A flight data processing system in FIR C erroneously inserted "W" in the flight plan for a non-RVSM approval aircraft. Then, non-RVSM approval aircraft was cleared to operate in RVSM airspace with 1,000-feet vertical separation, relying on incorrectly system-generated label.

2.2 In addition to the basic data requirements indicated in the LHD reporting system/form, the issue of RVSM operations without RVSM approvals can be reported as LHD Category L to highlight the risk by providing a summarized description indicating that a non-RVSM-approved aircraft operated in RVSM airspace with 1,000-feet separation, together with the exact or estimated duration of the operation in RVSM airspace to support the airspace risk assessment.

Occurrence Caused by GNSS RFI Scenarios

2.3 GNSS RFI is separated into two types of interference: jamming and spoofing. Jamming involves intentional radio frequency interference that prevents GNSS receivers from locking onto satellite signals, rendering the system ineffective or degraded. Conversely, spoofing involves the transmission of counterfeit satellite signals that deceive GNSS receivers into computing incorrect position, navigation, and timing information. The following scenarios illustrate various occurrences that may result from GNSS RFI with their classification and reporting guidance.

a) No Deviation (Increased Workload or Operational Complexity)

GNSS RFI is detected, but the aircraft remains at its correct position without any lateral, longitudinal, or vertical deviation. However, both the ATS unit and flight crew must revert to traditional non-GNSS procedures (e.g., ground-based navigation or time-based reporting), resulting in increased workload or operational complexity. This scenario does not need to be reported as LHD, LLD, or LLE.

b) Lateral Deviation

GNSS RFI is detected, and the aircraft laterally deviates from the flight plan track by greater than a regionally agreed value relevant to the applied separation minimum. This scenario should be reported as LLD.

c) Longitudinal Deviation

GNSS RFI is detected, and the aircraft's reported position or pilot estimate varies from the expected estimate, affecting the spacing with other traffic. This scenario should be reported as LLE.

In another case, the aircraft reaches the transfer point earlier than expected by more than the longitudinal separation criteria. This is treated similarly to a "Negative Transfer" or a case where the transfer information was not coordinated. As a result, the aircraft may enter the adjacent FIR unexpectedly, potentially leading to both horizontal and vertical risks. Thus, this should be reported as both LLE and LHD.

d) Vertical Deviation

GNSS RFI causes the aircraft to deviate by 300 feet or more from the assigned flight level or unintentionally cross over another flight level. This scenario should be reported as LHD.

2.4 In addition to the basic data requirements indicated in the LLD/LLE/LHD reporting system/form, a summarized description indicating that the occurrence was affected by GNSS RFI should be included, along with its deviation magnitude such as the duration, distance, time difference, or number of flight levels crossed to support the airspace risk assessment. The GNSS RFI occurrences can be mapped to the existing LLD/LLE/LHD categories as shown in **Table 1.** RMAs and EMAs would utilize this mapping to classify the occurrences consistently for safety analysis.

Table 1 Classification of GNSS RFI-Related Occurrences under LLD, LLE, and LHD Categories

Type of Occurrence	Category	Description
GNSS RFI led to LLD	Category G	Navigation errors due to airborne equipment failure
GNSS RFI led to LLE	Category G	Navigation errors due to airborne equipment failure
GNSS RFI led to LHD	Category H	Airborne equipment failure leading to unintentional or undetected change of flight level

Conclusion

2.5 Pilots, air traffic controllers, and State authorities are encouraged to closely monitor occurrences involving non-RVSM-approved aircraft (LHD Category L) and those related to GNSS RFI. It is vital that these occurrences that led to LHD/LLE/LLD are reported to the respective RMAs or EMAs so that their effects on safety risk are assessed for possible identification of prevention and mitigation measures.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;

b) closely monitor and report occurrences involving non-RVSM approved aircraft (LHD Category L) and GNSS RFI; and

c) discuss any relevant matters as appropriate.

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International Civil Aviation Organization

INFORMATION PAPER

REGIONAL MONITORING AGENCIES COORDINATION GROUP
TWENTIETH MEETING (RMACG/20)

(Bangkok, Thailand 19 - 23 May 2025)

Agenda Item 1: RVSM Approvals

MAAR ASSESSMENT OF NON-RVSM APPROVED AIRCRAFT

(Presented by MONITORING AGENCY FOR ASIA REGION)

SUMMARY

This paper presents the result of an annual W-verification of flight plans for aircraft operating within RVSM airspace across MAAR's designated States, based on data from the 2024 TSD and monthly Bangkok FIR flight plans. (Note: TSDs from 3 FIRs were not submitted in time for inclusion in this exercise.) The verification identified **44** aircraft operating in RVSM airspace without proof of RVSM approval (rogue aircraft). This figure is generally consistent with last year's total of **57** aircraft. Furthermore, six aircraft—four registered in India and two in the United States—were identified as repeat rogue aircraft, appearing in both the 2024 and 2023 TSDs.

1. INTRODUCTION

1.1. As part of the Regional Monitoring Agency (RMA) duties and responsibilities, MAAR conducts an annual W-verification of flight plans of aircraft transiting through RVSM airspace based on the Traffic Sample Data (TSD) for the month of December from 24 FIRs under MAAR's responsibility.

1.2. The 2024 TSD is used as the main data source for this paper. Afghanistan Mongolia and Nepal have yet to submit TSD. The annual TSD format has been updated to include Items 10 and 18 of the Flight Plan; therefore, the 2024 TSD data sets now contain an indicator of whether 'W' was filed or not.

1.3. The MAAR also conducts monthly 'W' checks of flight plans from the Bangkok FIR. The most recent result (March 2025) is also included in this paper.

1.4. The RMA RVSM snapshots shared on the ICAO Secure Portal Site were used for the audit. **Table 1** contains a summary of the versions of the snapshots used. In addition, confirmation from RMAs via e-mails has also been taken into account.

RMAs	Version
AAMA	March 2025
ARMA	March 2025
CARSAMMA	April 2025
CHINA RMA	April 2025
RMA EURASIA	April 2025
EURRMA	April 2025
JASMA	April 2025
MAAR	April 2025
MIDRMA	April 2025
NAARMO	April 2025
NATCMA	April 2025
PARMO	April 2025
Combined Snapshot	10 April 2025

Table 1: RVSM approval snapshot version

1.5. In addition, MAAR has updated the format of all date fields in its existing database to the yyyy/mm/dd format, in line with **Action 19/09 from RMACG/19**. This updated format has also been applied to the MAAR RVSM snapshot shared on the ICAO Secure Portal. The action also requested all RMAs to include RCP and RSP fields in their databases. MAAR would like to inform the meeting that both the date format modification and the inclusion of RCP and RSP fields have been completed in the MAAR RVSM database.

2. DISCUSSION

2.1 **Table 2** lists the aircraft registrations operating in the RVSM airspace but no matching RVSM approval records based on 2024 TSD from 21 FIRs and March 2025 Bangkok FPL data.

Remarks:

- Registrations in red indicates aircraft previously reported in the December 2023 TSD.
- Registrations marked with an asterisk (*) indicate aircraft reported in both the December 2024 TSD and the March 2025 Bangkok FPL.

RMA	State	Registration	Aircraft Type
AAMA	**Indonesia**	PKAZW*	A320
		PKAZV	A320
		PKLEY	A333
		PKTLG	A321
	Australia	VHOYW	A21N
ARMA	**Tanzania**	5HTCR	B788
CARSAMMA	**Brazil**	PREGR	E290
	Cayman Islands	VPCCY	GLF6

RMA	State	Registration	Aircraft Type
		VPCJP	A20N
	Venezuela	YV1004	A342
China RMA	**China**	B1262	B738
EURRMA	**Finland**	OHLWT	A359
	San Marino	T7FRI	MD83
	Belgium	OELRI	B744
MIDRMA	**Sudan**	STPSA	F900
MAAR	**India**	VTARL	E35L
		VTKOL	E135
		VTBXB	B38M
		VTBXG	B38M
		VTVEL*	GALX
		VTVSG*	E35L
		VTAFO	B738
		VTAST	G150
		VTBXE	B38M
		VTBXF	B38M
		VTBXJ	B38M
		VTDBI	C56X
		VTIAZ	A21N
		VTIKP	A320
		VTIKS	A320
		VTIWW	A320
		VTIWX	A320
		VTIWZ	A320
		VTKSE	F900
		VTRKP	F2TH
		VTVRR	LJ45
	Pakistan	APBOI	B734
		APBOV	A320
		APBOZ	A320
		APBPE	A320
NAARMO	**United States**	N788DP	B737
		N799JR	GLEX
		N868AV	P180

RMA	State	Registration	Aircraft Type
		N30NB	E55P

Table 2: Aircraft operating in the RVSM airspace with no matching RVSM approval records

2.2 MAAR identified **44** aircraft registrations that have 'W' in their flight plans but do not have matching RVSM approval records. This represents a slight decrease from the previous year's total of **57** aircraft registrations.

- **25 of the 44** registrations are aircraft under MAAR's responsibility, with the majority originating from India.
- **6 of the 44** aircraft were identified as repeat rogue aircraft, having also appeared in the December 2023 TSD. Of these, 4 are Indian aircraft and 2 are from the United States.

2.3 These six repeated rogue aircraft, observed in both TSD 2023 and TSD 2024, were also identified operating within the FIRs, as detailed in the table below for further investigation:

Registration	FIRs Flown
N788DP	Hanoi, Vientiane, Yangon
N799JR	Manila
VTARL	Delhi
VTKOL	Chennai, Kolkata
VTBXB	Delhi, Mumbai, Kolkata, Chennai
VTBXG	Delhi, Mumbai, Kolkata, Chennai

2.4 With reference to **Action 19/01 from the RMACG/19**, the meeting agreed that all RMAs should compare traffic compliance results over multiple years to identify operators consistently operating in RVSM airspace without an RVSM approval. In line with this, MAAR compared the 2024 TSD with the 2023 TSD and identified **6 aircraft** operating in RVSM airspace without proof of RVSM approval for two consecutive years, as previously indicated.

2.5 **Table 3** provides a summary of the number of aircraft registrations without RVSM approvals by RMA/State and compares this year's traffic compliance results with those presented at RMACG/19.

RMA	State	No. of Registrations	No. from RMACG/19
AAMA	Indonesia	4	23
	Australia	1	0
		AAMA Total **5**	**23**
ARMA	Tanzania	1	2
		ARMA Total **1**	**2**
CARSAMMA	Brazil	1	0

RMA	State	No. of Registrations	No. from RMACG/19
	Cayman Islands	2	0
	Venezuela	1	0
	CARSAMMA Total	**4**	**0**
China RMA	China	1	6
	China RMA Total	**1**	**6**
EURRMA	Malta	0	1
	Lithuania	0	1
	Turkey	0	2
	Finland	1	0
	San Marino	1	0
	Belgium	1	0
	EURRMA Total	**3**	**4**
MIDRMA	Qatar	0	2
	Sudan	1	0
	United Arab Emirates	0	2
	MIDRMA Total	**1**	**4**
NAARMO	United States	4	7
	NAARMO Total	**4**	**7**
PARMO	South Korea	0	2
	PARMO Total	**0**	**2**
MAAR	India	21	8
	Pakistan	4	0
	Philippines	0	1
	MAAR Total	**25**	**9**
	Grand Total	**44**	**57**

Table 3: Number of aircraft by State and RMA Compared to RMACG/19

2.6 While the overall number of rogue aircraft identified in this year's audit decreased compared to last year, the number associated with MAAR's area of responsibility has risen significantly, increasing from **9 to 25**. India continues to account for the highest number of rogue aircraft among all MAAR States.

2.7 Based on MAAR's initial observation, it is assumed that most of these aircraft operate domestically, as they were found only in the TSD from India, with 2 aircraft also appearing in the Bangkok FIR flight plan data. However, some of these aircraft were observed operating in European airspace on a small number of flights. MAAR contacted DGCA India to verify the RVSM approval status but has yet to receive a response. MAAR then reached out to the aircraft operators, who confirmed that the aircraft are RVSM approved. Nevertheless, MAAR will await formal confirmation from DGCA India via submission of the F2 Forms before updating the approval status in the database.

2.8 Similarly, MAAR identified four Pakistani rogue aircraft, all of which appeared exclusively in the Pakistan TSD. Upon investigation, it was determined that these aircraft belong to a domestic airline operating solely within Pakistan. MAAR has taken the same approach as with India and is currently awaiting the submission of the F2 Forms from the Pakistan CAA.

2.9 Most of the rogue aircraft listed in Table 2 for all RMAs, except MAAR, were identified through flight

plan data, as the majority of rogue aircraft found in the TSD had been de-registered or transferred after December 2024. The remaining rogue aircraft in Table 2 mainly resulted from delayed F2 Form submissions for newly approved aircraft, consistent with last year's analysis.

2.10 MAAR encourages all RMAs to undertake prompt follow-up actions on each rogue aircraft outlined in Table 2 and to provide updates to MAAR as information becomes available. We sincerely appreciate the continued support and cooperation from all RMAs.

3. ACTION BY THE MEETING

3.1 The Meeting is invited to:

(a) note the contents of this paper; and

(b) discuss any relevant matters as appropriate.

— END —

RMACG/20-WP/04
29/04/2025

International Civil Aviation Organization

WORKING PAPER

REGIONAL MONITORING AGENCIES COORDINATION GROUP
TWENTIETH MEETING (RMACG/20)

(Bangkok, Thailand 19 - 23 May 2025)

Agenda Item 6: Operational Performance and LHDs

GNSS Radio Frequency Interference and Related RMACG Actions

(Presented by the Monitoring Agency for Asia Region)

SUMMARY

This paper presents the background of Global Navigation Satellite System (GNSS) jamming and spoofing, along with the effects on aircraft systems and ATM ground systems. The safety assessment and the identified hot spots of GNSS jamming and spoofing from IATA are introduced for the references to the scale and impact of this type of occurrences. The recommendations from the 14th meeting of ICAO Air Navigation Conference, the decision from the ATM Subgroup of the APANPIG, and recommendations from other international organizations are listed this paper for review by the meeting.

1. INTRODUCTION

1.1 The Global Navigation Satellite System (GNSS), consisting of the USA's Global Positioning System GPS, Russia's GLONASS, China's BeiDou, and Europe's Galileo, includes ground infrastructure and satellite constellations that provide position, navigation, and timing (PNT) information supporting aircraft and air traffic management operations.

1.2 GNSS satellite signals are vulnerable to interference because of their extremely low power. Interference can be unintentional and naturally-occurring (such as atmospheric scintillation and solar effects) or deliberate (such as jamming and spoofing).

1.3 Jamming is an intentional radio frequency interference (RFI) with GNSS signals. This interference prevents receivers from locking onto satellites signals and has the main effect of rendering the GNSS system ineffective or degraded for users in the jammed area. An example of GNSS jamming over Singapore FIR in February 2024 is demonstrated in the attached YouTube link (https://youtu.be/SLyNmdjkUIk?si=ON8wmDsiFA4cV9q5&t=3603) from time 1:00:03 to 1:01:32.

1.4 Spoofing involves broadcasting counterfeit satellite signals to deceive GNSS receivers, causing them to compute incorrect position, navigation, and timing (PNT) data. An example of GNSS spoofing over Bahrain in November 2023 is demonstrated in the attached YouTube link (https://youtu.be/SLyNmdjkUIk?si=MNjLXRNTntZwXgk6&t=3692) from time 1:01:32 to 1:03:13.

2. DISCUSSIONS

Effects of GNSS RFI

2.1 Nowadays, GNSS is incorporated into a large number of modern aircraft systems such as Flight Management System (FMS), aircraft clock, Ground Proximity Warning System (GPWS), Weather Radar, CPDLC, ADS-B, ADS-C, as well as ATM ground systems. Signal jamming and/or spoofing can seriously impact aircraft navigation systems, resulting in non-normal avionic system behavior. The effects of radio frequency Interference (RFI) vary.

2.2 Airspace users rely on the normal functioning of aircraft systems, including automated monitoring, caution, and warning sub-systems. Avionics such as Flight Management Systems (FMS) require GNSS for navigation and timing. GNSS position is also used by the Terrain Avoidance Warning System (TAWS) or Enhanced Ground Proximity Warning Systems (EGPWS). Therefore, interference-free GNSS PNT service is essential for flight safety.

2.3 Repeated or widespread disruptions of the GNSS signals can lead to increased workload of both flight crews and air traffic controllers that can cause cognitive overload or confusion and increase the risk for errors. GNSS Jamming and Spoofing also can affect ground-based systems, especially when they use GNSS as their only source for timing. When exposed to GNSS RFI, the airborne GNSS receiver recovery time can, in a significant number of cases, exceed 30 minutes with consequent elevation in the risk of operational disruption such as the degraded navigation capability during this recovery period. In many cases, the impact lasted for the remaining of the flight until landed and the system had to be reset while on ground.

Safety Risk Assessment

2.4 IATA published their document on GNSS RFI Safety Risk Assessment Version 4 in September 2024. The document provides a structured approach to assess the GNSS RFI safety issue, proposes actions for IATA, and makes recommendations to other stakeholders.

2.5 The analysis indicates that when as an aircraft operates in the vicinity of areas with GNSS RFI, the aircraft communication (CPDLC), navigation and surveillance performance degrade and may result into a mid-air collision (MAC), a controlled flight into terrain (CFIT), or a runway excursion (RE). As a result, IATA suggests recommendations for airlines, IATA, ANSP, States, and ICAO in relation to the topics of:

- Risk Assessment
- Simulator Training
- Aircrew Awareness / Notifications / Briefings
- Regular Engagements with the Manufacturers
- Recovery / In-flight Procedures
- Crew Reports

Hot Spots of GNSS FRI

2.6 Since February 2022, there has been an increase in jamming and/or spoofing of Global Navigation Satellite Systems (GNSS). EASA has analyzed recent data from the Network of Analysts and open sources and has concluded that GNSS jamming and/or spoofing has shown further increase in the severity of its impact, as well as an overall growth of intensity and sophistication of these events. This issue particularly affects the geographical areas surrounding conflict zones, but it is also encountered in the south and eastern Mediterranean, Black Sea, Middle East, Baltic Sea, and Arctic area.

2.7 IATA also reported that their Flight Data eXchange (FDX) program members experienced +580K instances of GPS signal loss of around 18.4 million flights processed by the program. Figure 1 - 3 provide geographic identification of the RFI hotspots based on the aircraft-recorded data from the FDX program, not voluntary reports. The plots also demonstrate the increase of GNSS jamming and spoofing in the Asia Pacific region in these recent years.

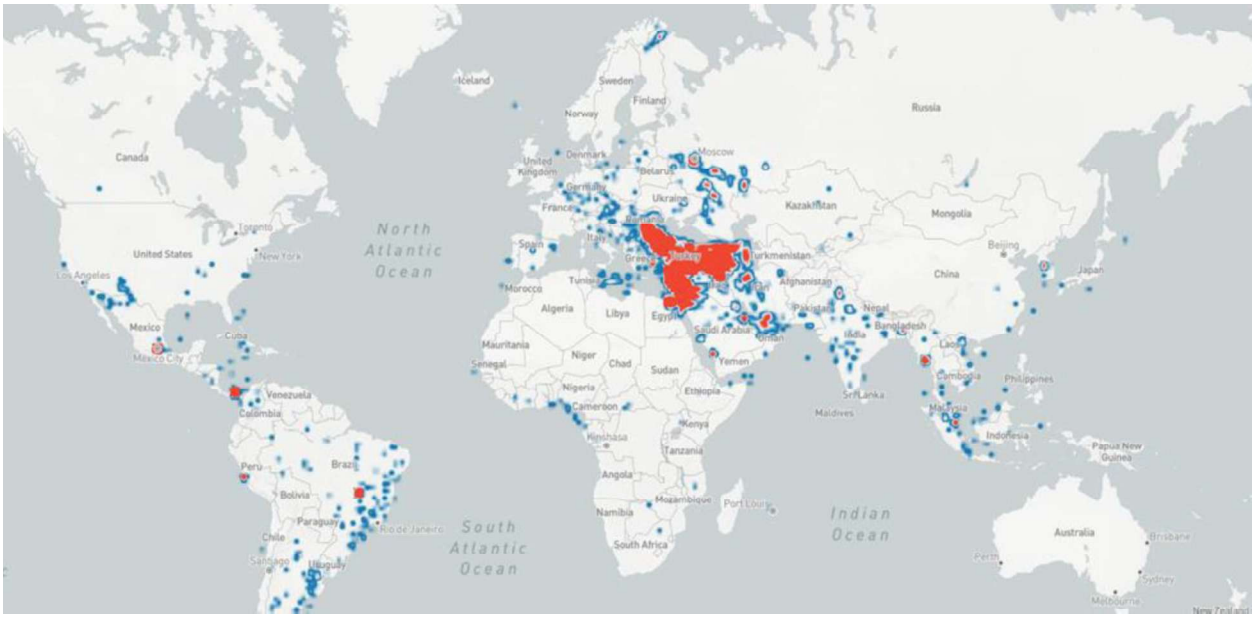

Figure 1: GNSS RFI Recorded Events in 2022

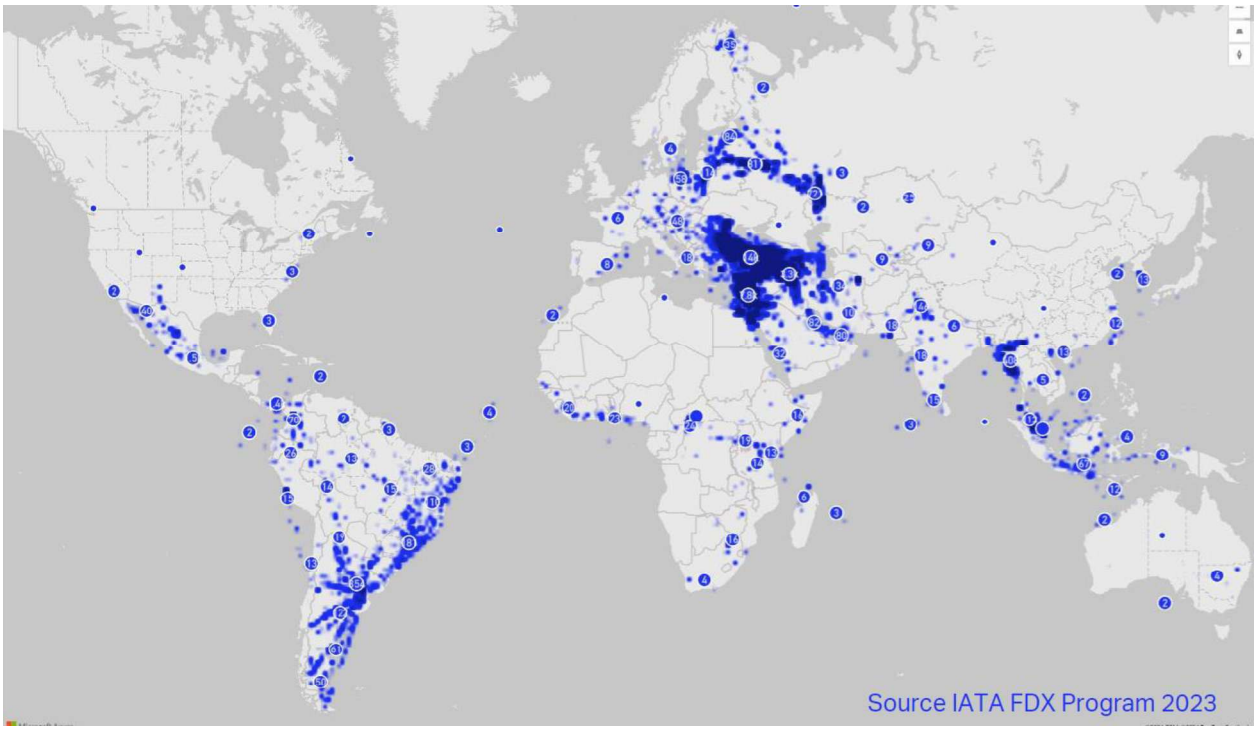

Figure 2: GNSS RFI Recorded Events in 2023

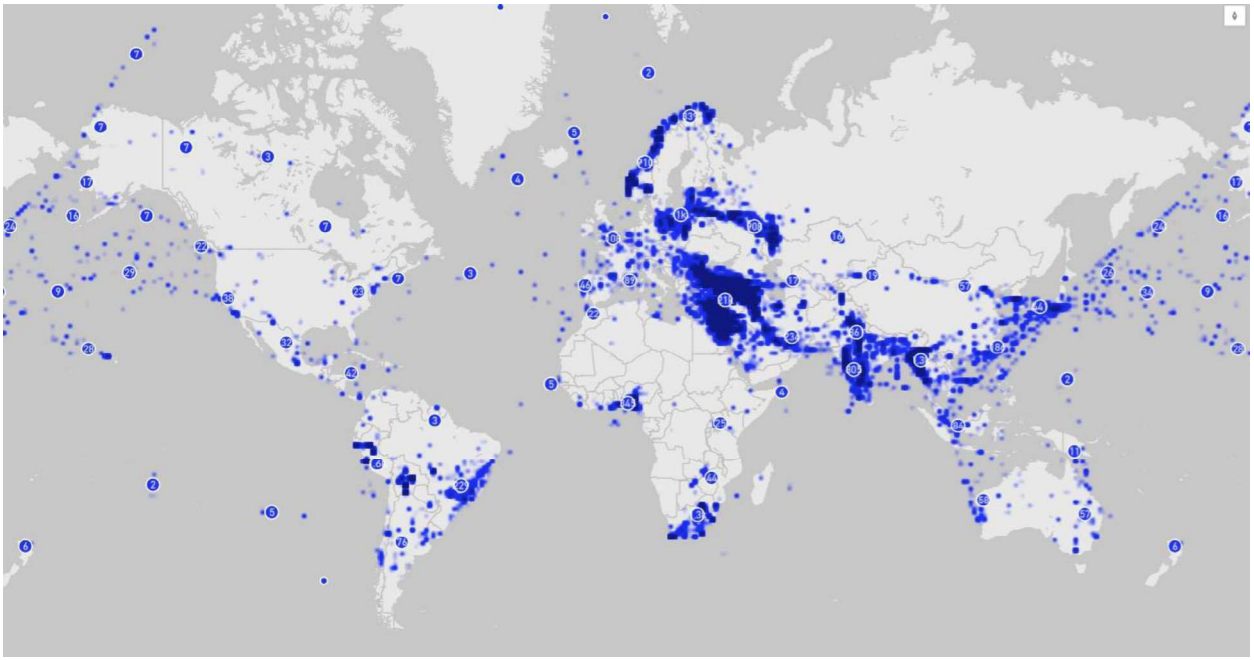

Figure 3: GNSS RFI Recorded Events during Jan - Jun 2024

ICAO ANC/14 (26 August - 06 September 2024)

2.8 In considering the effects of GNSS FRI, the 14th meeting of ICAO Air Navigation Conference:

a) expressed significant concerns with the recent escalation of harmful interference to GNSS, the risk it poses to civil aviation, and the critical impact this has had on global operations, particularly on areas surrounding conflict zones; and

b) agreed on the importance of maintaining a sufficient network of conventional navigation aids, supported by very high frequency omnidirectional radio range (VOR), distance measuring equipment (DME) and instrument landing system (ILS) facilities, to ensure operational safety as well as sufficient airspace capacity during times of GNSS interference.

2.9 As a result of the discussion, the Committee agreed on **Recommendation 2.2/2: Addressing global navigation satellite system interference and contingency planning**,

That States:

a) ensure that effective GNSS RFI 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 GNSS interference;

b) through the mechanism of the planning and implementation regional groups (PIRGs), develop regional or global navigation satellite system reporting mechanisms, as described in the Global Navigation Satellite System (GNSS) Manual (Doc 9849);

c) work with industry to provide guidance on detecting global navigation satellite system jamming or spoofing and maintaining safe and efficient aircraft operation in case of GNSS anomalies;

That ICAO:

d) develop a standardized implementation package to assist and guide States in implementing effective GNSS RFI mitigation measures, including optimization and rationalization of conventional navigation aids, commensurate with their local conditions, to ensure continuity in the provision of ANS;

e) develop guidance on civil-military coordination in relation to harmful interference to GNSS(s) originated or detected by military authorities; and

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

2.10 Considering various suites of responses and actions being proposed to address the GNSS RFI issues, they can be grouped as:

Strategic Measures

- Assess the likelihood and effects of GNSS RFI
- Raise the awareness and collaborate with relevant stakeholders
- Include GNSS jamming and spoofing in both pilots and ATCOs training
- Review and ensure that the aircraft minimum equipment list and ATM infrastructure is sufficient and resilient

- Develop and enforce a strong regulatory framework
- Provide effective spectrum management and protection of GNSS frequencies

Tactical Measures

- Detect GNSS jamming/spoofing
- Monitor aircraft deviation from ATC clearances (e.g., navigation track and altitude)
- Provide relevant and timely information to pilots through relaying pilot report (PIREP), ATIS, NOTAMs, AIP, etc.
- Apply abnormal/contingency procedures and infrastructures

Post Flight Measures

- Report confirmed cases of GNSS RFI to the applicable spectrum authority for the airspace where the RFI occurred, as well as ANSPs and other relevant national authorities
- Perform safety risk assessment and identify effective preventions/mitigations

Roles of the Monitoring Agencies and RMACG

2.11 Considering the roles and responsibilities of the monitoring agencies and RMACG, the potentially related actions are to:

- Perform safety risk assessment and quantify the safety risk caused by GNSS FRI in relation to RVSM and PBCS operations;
- Support the development of procedures to report and share GNSS and data link disruption information among stakeholders; and
- Raise the awareness and collaborate with relevant stakeholders to identify effective preventions/mitigations.

2.12 When exposed to GNSS RFI, an aircraft degrades its performance in position, navigation, and timing. This type of occurrence can be considered as an aircraft/avionics contingency event and classified as an LLD, LLE, or LHD (navigation errors due to airborne equipment failure or airborne equipment failure leading to unintentional or undetected change of flight level). The resultant errors can be observed when

- the aircraft deviates in a lateral dimension from the current flight plan track that is greater than a regionally agreed value pertinent to the applied separation minimum (LLD);
- the aircraft infringes the longitudinal separation standard based on routine position reports (LLE);
- the pilot estimate varies by 3 minutes or more from that advised in a routine position report (LLE); or
- the aircraft deviates in a vertical dimension of 300 ft. or more from an ATC assigned/coordinated flight level (LHD).

2.13 The current LHD/LLD/LLE data collection process and reporting template are sufficient for reporting GNSS RFI events to the monitoring agencies with the necessary information for risk estimation. The monitoring agencies should identify if the regional or global navigation satellite system reporting mechanisms exist under their Planning and Implementation Regional Groups (PIRGs) as described in the Global Navigation Satellite System (GNSS) Manual (Doc 9849) and RMA may be able to provide any support in the development of procedures to report and share GNSS and data link disruption information.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) Share their experiences in safety risk assessment, risk estimation, and managing the safety risk from GNSS RFI;

b) Discuss the roles and responsibilities of the RMAs and RMACG, as outlined in paragraph 2.11; and

c) Consider if there is any prevention or mitigation measure which should be recommended from the RMACG to the aviation community.

— END —

4. REFERENCE

4.1 EASA Safety Information Bulletin Operations – ATM/ANS SIB No. 2022-02R3

4.2 IATA Global Navigation Satellite System GNSS-Radio Frequency Interference Safety Risk Assessment, 4 Sep 2024

4.3 CANSO Webinar on GNSS Interference, 29 October 2024, Speakers: Lisa Bee (Co-chair CANSO CNS WG), Khulekani Ngcobo (Co-chair CANSO CNS WG), Ruby Sayyed (IATA), and Diego Albert (Aireon LLC)

4.4 ATM/SG/12 WP/02 - ATM/SG/11, APANPIRG/34 AND AN-CONF/14 OUTCOMES, 23 - 27 Sep 2024

4.5 ATM/SG/12 Final Report, 23 - 27 Sep 2024