

GNSS Vulnerabilities

The Regional Aviation Safety Group for the Middle East Region (RASG-MID) has issued a Safety Advisory concerning GNSS Vulnerabilities and provided guidance material to mitigate the safety and operational impact of GNSS service disruption. The Safety Advisories are issued to encourage States and aviation Stakeholders to adopt practices that mitigate major aviation safety risks in the Middle East Region as identified through the analysis of regional safety data.

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.

With the increasing dependence on GNSS, it is important that GNSS vulnerabilities be properly addressed. This RASG-MID Safety Advisory provides guidance on a set of mitigation measures that States would deploy to minimize the GNSS vulnerabilities impact on safety and air operations. The RSA-14 also includes the regional reporting and monitoring procedures of GNSS anomaly with the aim to analyze the threat and its impact on performance and assess the effectiveness of the mitigation measures in place.

There are two types of GNSS Interference Sources; Intentional and Unintentional sources. The latter is not considered a significant threat, provided that States exercise proper control and protection over the electromagnetic spectrum for both existing and new frequency allocations. Solar Effect, Radio Frequency Interference, and On-board systems are examples of Unintentional GNSS interference sources. However, the Intentional sources such as jamming and spoofing are considered serious threats to the continued safety of air transport.

The success of many of the countermeasures is dependent on having a detailed understanding of the threats. In order to establish this understanding and to maintain an up-to-date knowledge of the threats, in terms of both types and number of threats, it is necessary for States to monitor the threat environment and the impact on performance.

The Air Navigation Service Provider (ANSP) must be prepared to act when anomaly reports from aircraft or ground-based units suggest signal interference. If an analysis concludes that interference is present, ANS providers must identify the area affected and issue an appropriate NOTAM.

From the perspective of the aircrew, a GNSS anomaly occurs when navigation guidance is lost or when it is not possible to trust GNSS guidance. In this respect, an anomaly is similar to a service outage. An anomaly may be associated with a receiver or antenna malfunction, insufficient satellites in view, poor satellite geometry, or masking of signals by the airframe. The perceived anomaly may also be due to signal interference, but such a determination requires detailed analysis based on all available information.

In case of GNSS anomaly detected by aircrew,

PILOT ACTIONS SHOULD INCLUDE:

- reporting the situation to ATC as soon as practicable and requesting special handling as required;
- filing the **GNSS Interference Reporting Form** (page 3-4 of this document), and forwarding information to the IATA MENA sfomena@iata.org and ICAO MID Office icaomid@icao.int as soon as possible, including a description of the event (e.g. how the avionics failed/reacted during the anomaly).

CONTROLLER ACTIONS SHOULD INCLUDE:

- recording minimum information, including aircraft call sign, location, altitude, and time of occurrence;
- cross check with other aircraft in the vicinity;
- broadcasting the anomaly report to other aircraft as necessary;
- notify the AIS Office in case NOTAM issuance is required and enable the fallback mode and implement related procedure and process (contingency measures).

ANSP ACTIONS SHOULD INCLUDE:

- ensuring the issuance of appropriate advisories and NOTAM, as necessary;
- attempting to locate/determine the source of the interference if possible;
- notifying the agency responsible for frequency management (the Telecommunication Regulatory Authority);
- locating and eliminating source in cooperation with local regulatory & enforcement Authorities;
- tracking and reporting all activities relating to the anomaly until it is resolved; and
- reviewing the effectiveness of the mitigation measures for improvement.

MID OFFICE ACTIONS SHOULD INCLUDE:

- collecting anomaly-related information and determining the course of action required to resolve reported anomalies;
- follow-up with State having interference incident to ensure implementation of required corrective actions;
- coordinate with concerned adjacent ICAO Regional Office(s) to follow-up with States under their accreditation areas, when needed; and
- Communicate with ITU Arab Office and Arab Spectrum Management Group to resolve frequent interference incidents, when needed.

A copy of the ICAO MID-Region Guidance Material Related to GNSS Vulnerabilities is available from the IFALPA Regional Officer, Carole Couchman, carolecouchman@ifalpa.org.

Please find GNSS Interference Reporting Form on page 3-4 of this document.

1. GNSS interference reporting form to be used by pilots

** Mandatory field*

| | |
|------------------------------------|--|
| Originator of this Report: | |
| Organisation: | |
| Department: | |
| Street / No.: | |
| Zip-Code / Town: | |
| Name / Surname: | |
| Phone No.: | |
| E-Mail: | |
| Date and time of report | |
| Description of Interference | |
| *Affected GNSS Element | <input type="checkbox"/> GPS <input type="checkbox"/> GLONASS <input type="checkbox"/> other constellation <input type="checkbox"/> EGNOS <input type="checkbox"/> WAAS <input type="checkbox"/> other SBAS <input type="checkbox"/> GBAS (VHF data-link for GBAS) |
| Aircraft Type and Registration: | |
| Flight Number: | |
| *Airway/route flown: | |

| | |
|---|--|
| Coordinates of the first point of occurrence / Time (UTC): | UTC: Lat: Long: |
| Coordinates of the last point of occurrence / Time (UTC): | UTC: Lat: Long: |
| *Flight level or Altitude at which it was detected and phase of flight: | |
| Affected ground station (if applicable) | Name/Indicator; [e.g. GBAS] |
| *Degradation of GNSS performance: | <input type="checkbox"/> Large position errors (details): <input type="checkbox"/> Loss of integrity (RAIM warning/alert): <input type="checkbox"/> Complete outage (Both GPSs), <input type="checkbox"/> Loss of GPS1 or Loss of GPS 2 <input type="checkbox"/> Loss of satellites in view/details: <input type="checkbox"/> Lateral indicated performance level changed from: ___ to ___ <input type="checkbox"/> Vertical indicated performance level changed from: ___ to ___ <input type="checkbox"/> Indicated Dilution of Precision changed from ___ to ___ <input type="checkbox"/> information on PRN of affected satellites (if applicable) <input type="checkbox"/> Low Signal-to-Noise (Density) ratio <input type="checkbox"/> Others |
| *Problem duration: | <input type="checkbox"/> continuous for 20 minutes <input type="checkbox"/> intermittent |

Note: Only applicable fields need to be filled!