

SAFETY INFORMATION 7/2021 REV1

29 March 2022



HARMFUL INTERFERENCE TO GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) AND ITS IMPACTS ON FLIGHT OPERATIONS

Introduction

GNSS includes navigation satellite infrastructures and constellations which provide position and timing information supporting aircraft and air traffic management operations. GNSS satellite constellations which are currently recognized by International Civil Aviation Organization (ICAO) include the US. Global Positioning System (GPS), the Russian GLONASS, the European Galileo and the Chinese BeiDou. Frequencies for GNSS signals supporting safety-of-life applications, such as aviation, are globally harmonized and legally protected under the International Telecommunication Union (ITU) Radio Regulations.

Aircraft GNSS receiver is a safety-critical equipment and the main source of position information which drives aircraft navigation system in most commercial aircraft. The GNSS receiver is the primary equipment supporting Required Navigation Performance (RNP) operations and provides position input to many aircraft avionics, such as Navigation Display (ND), Ground-Proximity Warning System (GPWS) and Automatic Dependent Surveillance (ADS). GNSS also provides timing information to some satellite communication systems. Moreover, some business aircraft are referencing GNSS for flight control and stability systems.

Impact on Aircraft Operations

Reported impacts on airline flight operations received from various airlines and airspace users include:

- a) Sustained loss of on-board GNSS functionality - [GPS-L INVALID] and/or [GPS-R INVALID] messages appear.
 - 1) Some aircraft may lose its area navigation capability, including directing to a waypoint.
- b) Decrease in navigation performance leading to RNP alert
 - 1) Through increasing aircraft horizontal position error, Actual Navigation Performance (ANP) decreases beyond RNP requirement. - [NAV UNABLE RNP] message appears.
 - 2) In some aircraft, navigation reverted to inertial (INS/IRU) or DME/DME after GNSS loss.
- c) Impact on Navigation Display - A large “map shift” was observed.
- d) Sustained loss of capabilities for GNSS-based approach and landing.

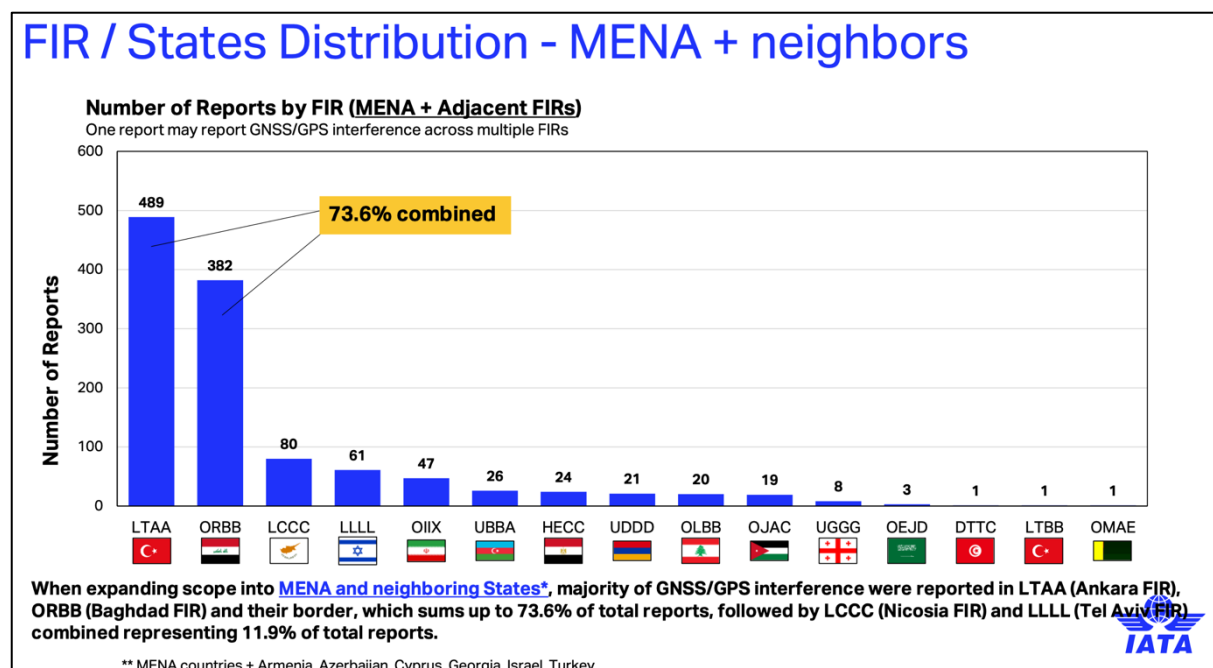
- e) Impact on GPWS - [TERR POS] and [EICAS TERRAIN POSITION] messages appear.
- f) Impact on Runway Alerting systems
- g) Loss of GNSS positioning input to ADS position reporting, ELT and PFD/MFD.

For some business aircraft which are using GNSS as a reference source for aircraft flight stability systems, the US FAA has advised that the unavailability and unreliability of GNSS may impact aircraft's Attitude and Heading Reference System (AHRS), Stall Warning Protection System (SWPS), Ventral Rudder, Yaw Damper and Auto Pilot. The interference may also generate warning messages associated with unexpected rolling and yawing oscillations (Dutch Roll) at high airspeeds.

GNSS Interference in Middle East & North Africa (MENA) Region

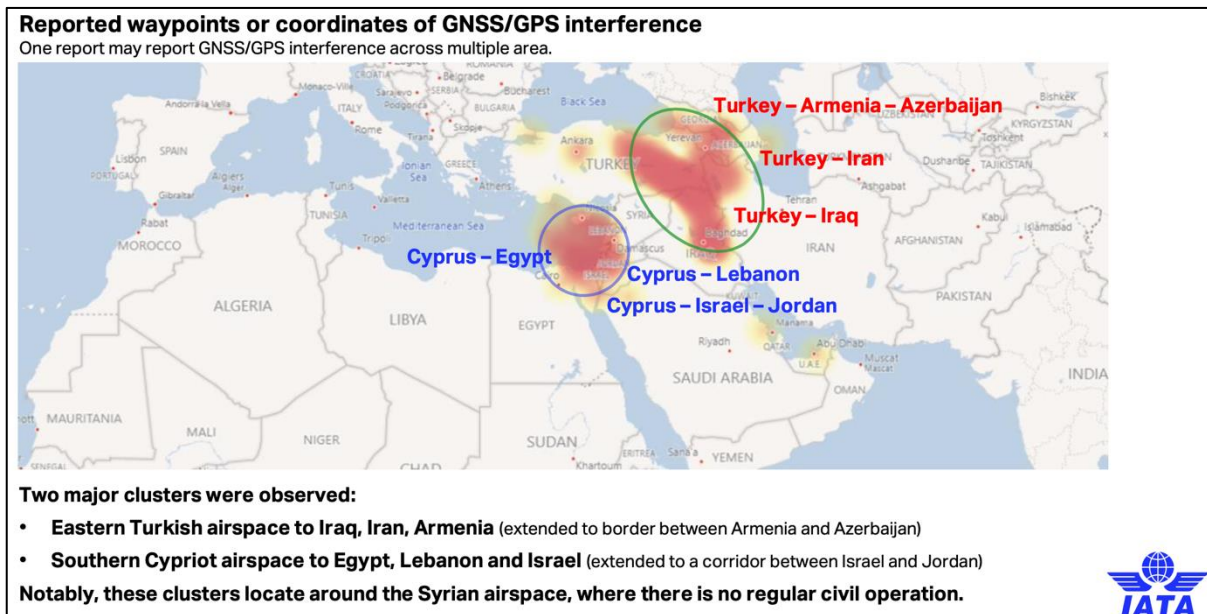
A study was conducted by International Air Transport Association (IATA) on the GNSS vulnerabilities in the MENA region from January 2019 – September 2020. The analysis reported a total of 461 GNSS jamming or suspected interference reports in MENA States and a total of 831 reports from MENA and neighbouring States.

The chart below shows the FIR/States distribution of reports according to the study.



Source: IATA GNSS/GPS Interference – Global Aviation Data Management November 11th 2020

The interference reports gathered was then overlaid on a map to display hotspots in the region, as depicted below.



Source: IATA GNSS/GPS Interference – Global Aviation Data Management November 11th 2020

GNSS Interference in other areas

Eurocontrol, Network of Analysts and open-source data reports analysed by EASA indicate that since 24 February 2022, there are four key geographical areas where GNSS spoofing and/or jamming has intensified, namely:

- Kaliningrad region, surrounding Baltic sea and neighboring States;
- Eastern Finland;
- The Black Sea; and
- The Eastern Mediterranean area near Cyprus, Turkey, Lebanon, Syria and Israel, as well as Northern Iraq.

The effects of GNSS jamming and/or possible spoofing were observed by aircraft in various phases of their flights, in certain cases leading to re-routing or even to change the destination due to the inability to perform a safe landing procedure. Under the present conditions, it is not possible to predict GNSS outages and their effects. The magnitude of the issues generated by such outage would depend upon the extent of the area concerned, on the duration and on the phase of flight of the affected aircraft.

Risk Assessment

Airlines intending to transit areas with reported GNSS interference to assess operational risks and limitations that may occur during loss of on-board GNSS capability. Alternative navigation capability based on INS/IRU or other conventional navigation aids can be helpful.


Recommendation(s):

Air operators should:

- a) Ensure that flight crew promptly report via air report to air traffic control any observed interruption, degradation or anomalous performance of GNSS equipment (jamming and/or possible spoofing) or related avionics;
- b) Assess operational risks and limitations linked to the loss of on-board GNSS capability, including other on-board systems requiring inputs from reliable GNSS signal;
- c) Ensure that operational limitations, introduced by the dispatch of aircraft with radio navigation system inoperative in accordance with Minimum Equipment List, are considered before operating an aircraft in the affected areas;
- d) Ensure flight crew and relevant flight operation personnel:
 - 1) are aware of possible GNSS jamming and/or possible spoofing;
 - 2) verify the aircraft position by means of conventional navigation aids when flights are operated in proximity of the affected areas;
 - 3) check that the navigation aids critical to the operation for the intended route and approach are available; and
 - 4) remain prepared to revert to a conventional arrival procedure where appropriate and inform air traffic controllers in such a case;
- e) Ensure, in the flight planning and execution phase, the availability of alternative conventional arrival and approach procedures (i.e. an aerodrome in the affected area with only GNSS approach procedure should not be considered as destination or alternate).
- f) Airlines and airspace users are encouraged to report harmful interference to GNSS by forwarding information to the CAAM as soon as possible, including a description of the event (e.g. how the avionics failed/reacted during the anomaly) via the Mandatory Occurrence Report form as per CAD 1900 – Safety Reporting System.

For further information, please refer to following document:

- a) [EASA Safety Information Bulletin 2022-02](#)
- b) Doc 9849 – Global Navigation Satellite System Manual, 3rd edition – 2017, International Civil Aviation Organisation (ICAO).
- c) IATA-OSS-INFRA: Harmful Interference to Global Navigation Satellite System (GNSS) and its impacts on flight and air traffic management operations.



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