GNSS Interference

Presented by ICAO MID & IATA

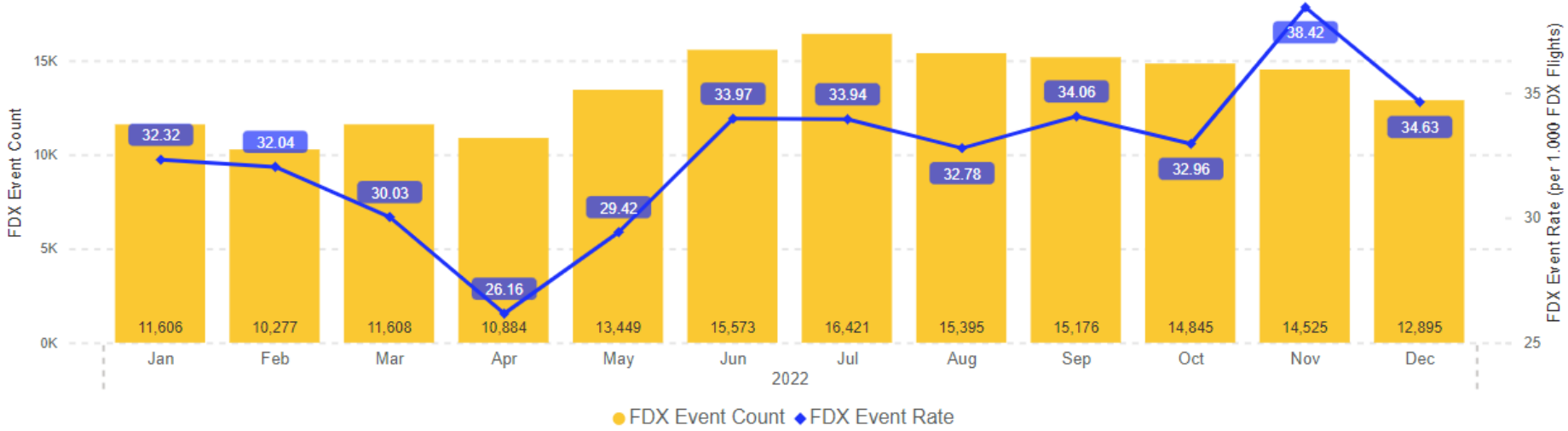
Analysis Scope – Geographic Scope

IATA MENA States:

Afghanistan, Algeria, Bahrain, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, UAE, Yemen. **Adjacent States included in this analysis**: Türkiye

DAAA	Algeria	OIIX	Iran, Islamic Republic of
DTTC	Tunisia	OJAC	Jordan
GMMM	Morocco	OKAC	Kuwait
HECC	Egypt	OLBB	Lebanon
HLLL	Libya	OMAE	United Arab Emirates
HSSS	Sudan	OOMM	Oman
LTAA	Turkiye	ORBB	Iraq
LTBB	Turkiye	OSTT	Syrian Arab Republic
OAKX	Afghanistan	OTDF	Qatar
OBBB	Bahrain	OYSC	Yemen, Republic of
OEJD	Saudi Arabia		

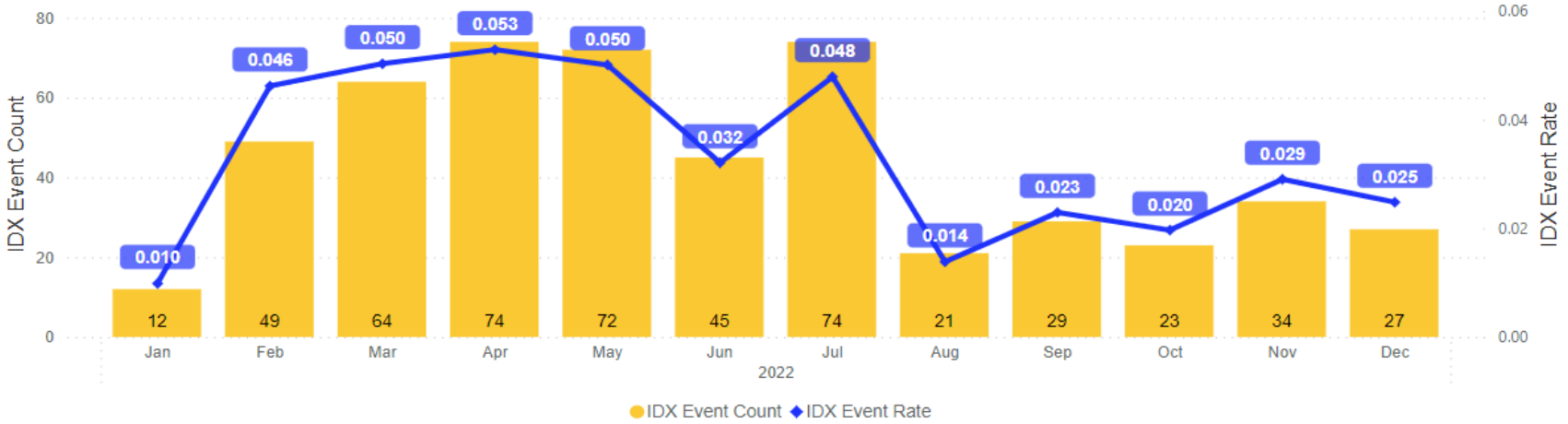
GNSS/GPS Interference Trend



Monthly rate trends for the FDX ‘GPS Signal Loss’ event and Event Count

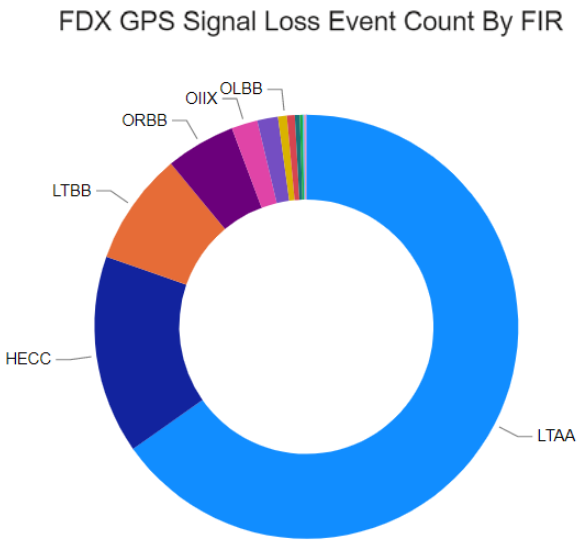
GNSS/GPS Interference Trend

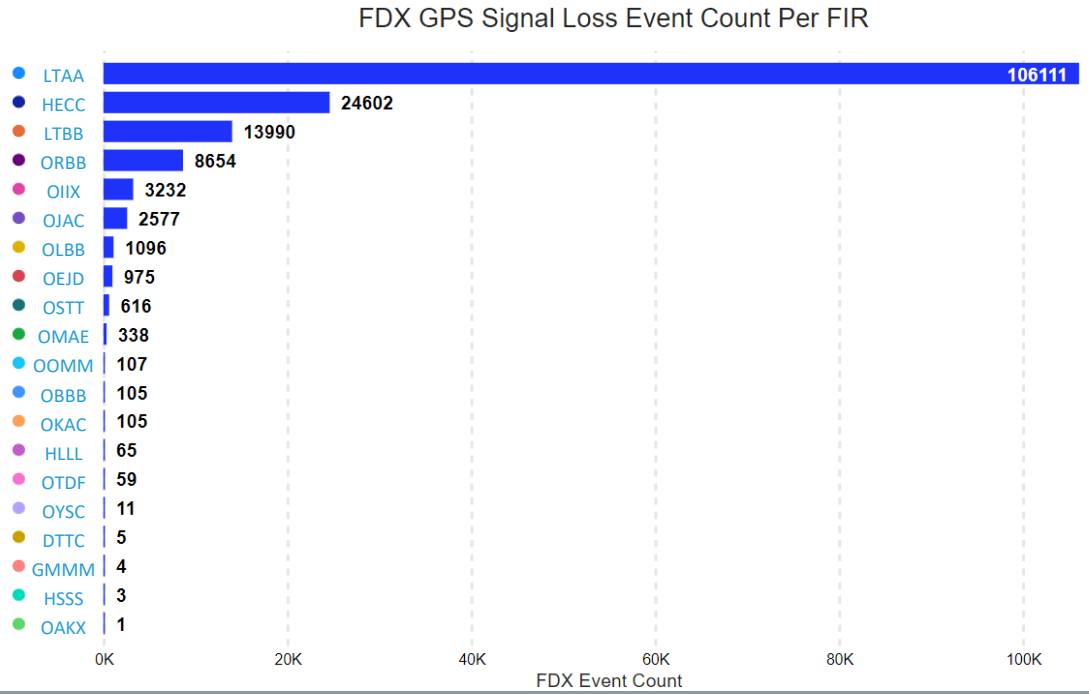
Monthly rate trends for the IDX GNSS Interference event and Event Count



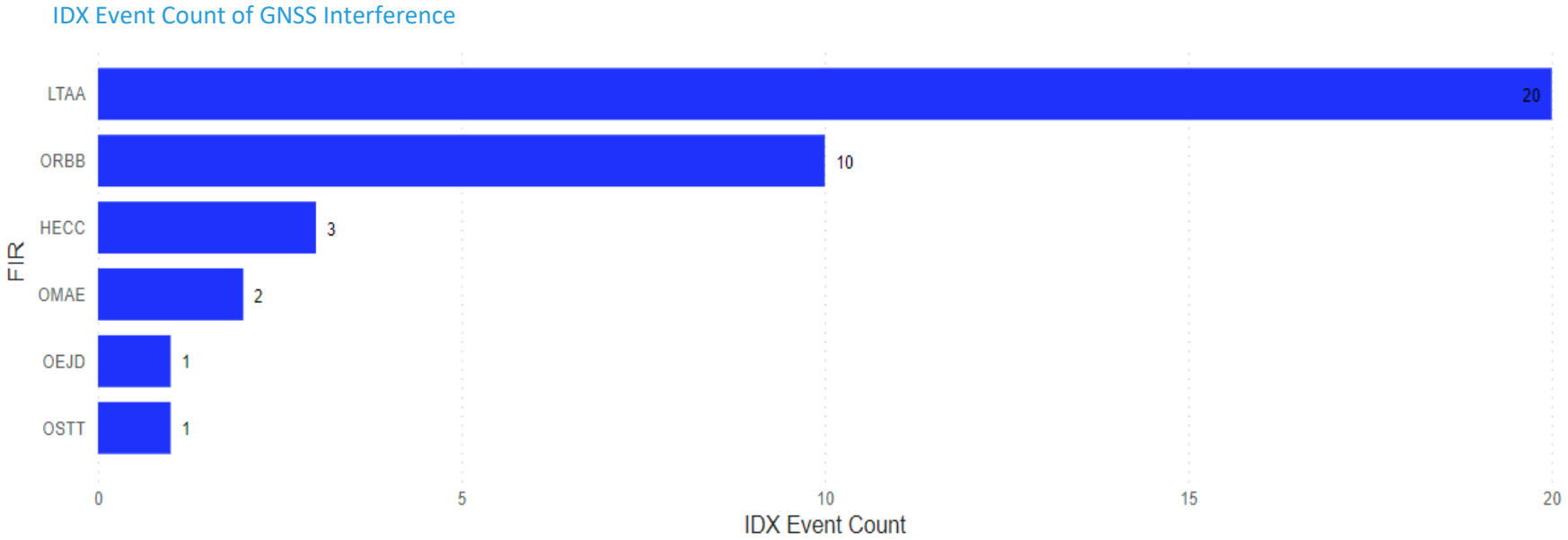
- The number of reported GPS Signal Loss events in the IDX data is significantly lower than in the FDX data.
- This may be due to the fact that these events are not mandatory to report, and they have become so common that they are no longer considered abnormal or worthy of reporting.
- Additionally, many reports that mentioned GNSS interference were not included in the analysis because the exact incident location could not be determined with the information provided in the report. As a result, the actual number of GPS Signal Loss events may be even higher than reported in the data.

Distribution of GNSS Signal Loss – by FIR



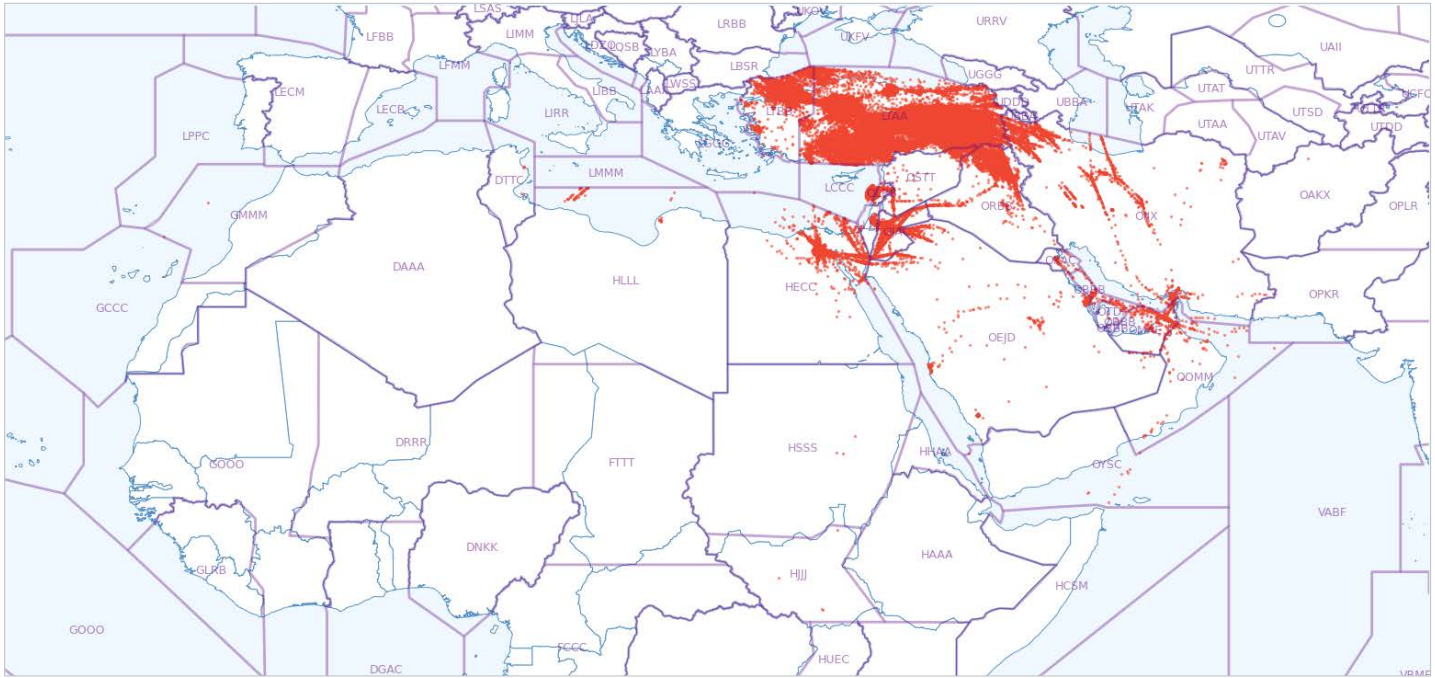


Distribution of GNSS Signal Loss – by FIR



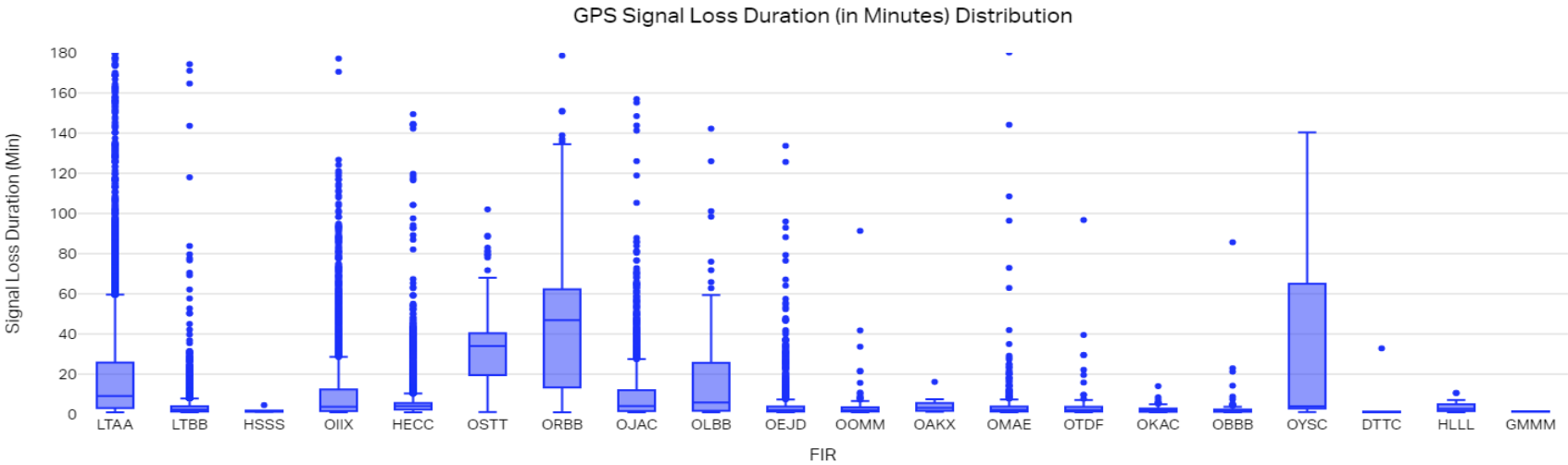
Many reports were excluded from the count due to the absence of FIR information in the reports, which is not mandatory. As a result, the reported numbers are significantly lower.

GNSS Signal Loss Hotpots



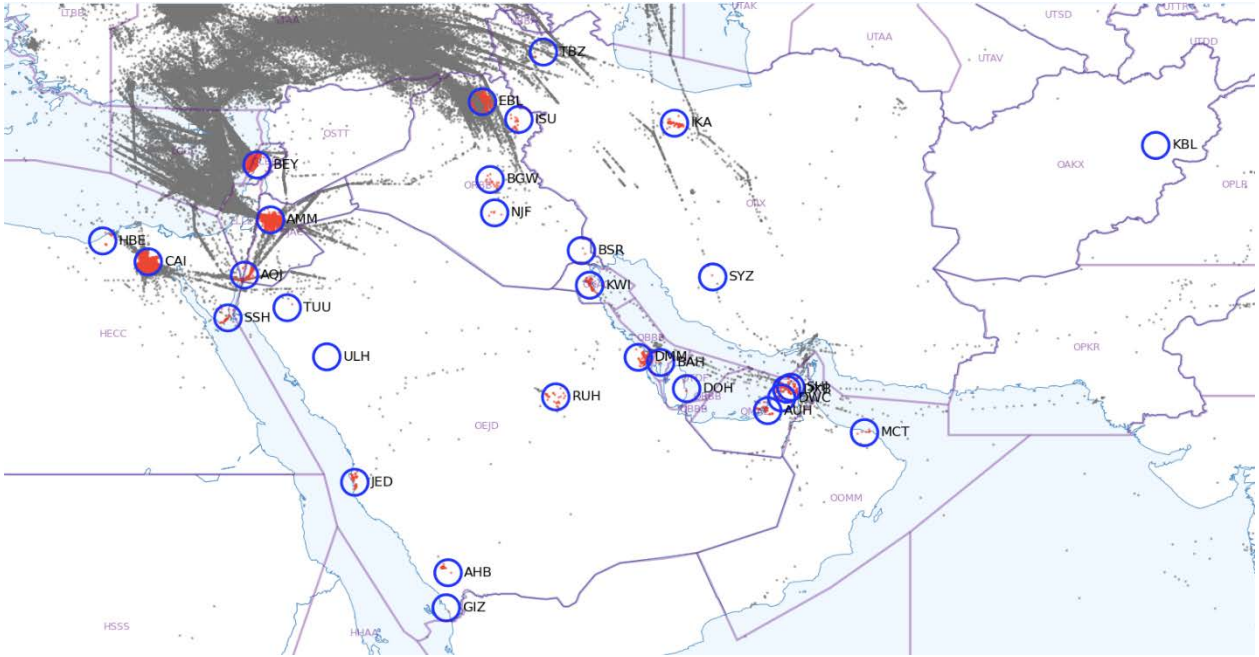
- The chart displays **164,577** red dots, each representing a single ‘GPS Signal Loss’ event in the MENA region.
- This highlights the need for increased awareness and proactive measures to address GPS Signal Loss issues in the region.

GNSS Signal Loss Duration



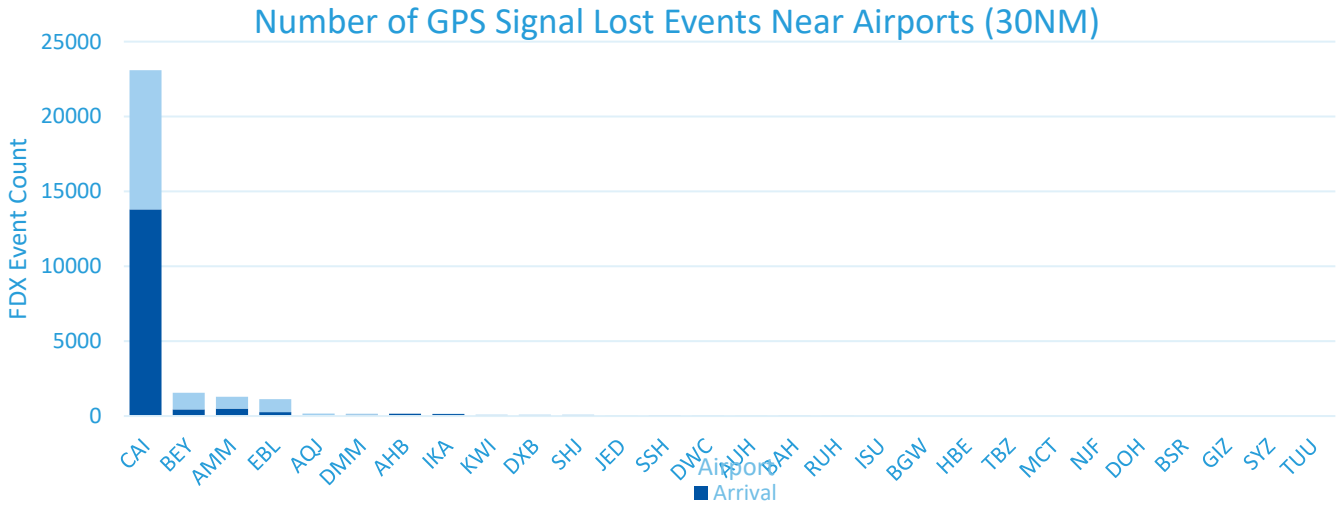
- This box plot visualizes the distribution of 'GPS Signal Loss' event durations across the FIRs in the MENA region
- To better display the central tendency and spread of the data, any outliers with abnormally high values were removed.
- On average, the duration of GPS Signal Loss events is **14.5 minutes**. The lower 25% of events have a duration of **2.5 minutes or less**, while the upper 25% of events have a duration of **21.2 minutes or more**. The median duration of GPS Signal Loss events is **6.0 minutes**, indicating that half of the events lasted shorter than 6.0 minutes, and half lasted longer.

GNSS Signal Loss Near Airports



- This chart depicts flights in the MENA region that have experienced ‘GPS Signal Loss’ during departure or arrival near airports.
- The 30 NM radius circle around the airport was used to determine the vicinity.
- Red dots within the airport area indicate where the interference occurred, while grey dots represent events that occurred outside the airport area or during the cruise phase.
- The intensity of the red color reflects the frequency of the events.
- Cairo International Airport has the highest number of events near the airport.

GNSS Signal Loss Near Airports

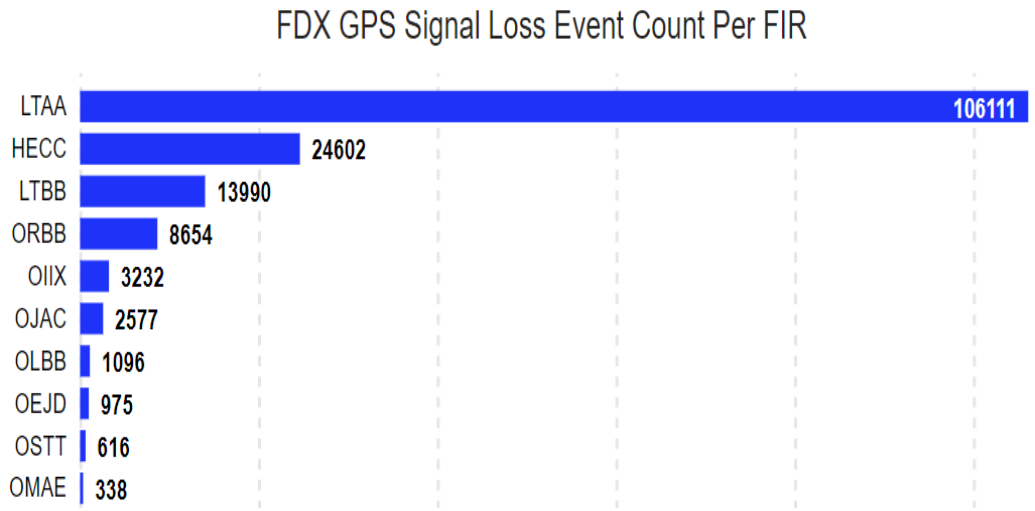


- The bar chart and table display the frequency of 'GPS Signal Loss' events during departure or arrival at airports in the MENA region.
- Cairo International Airport stands out as having a significantly higher frequency of events compared to other airports.
- This difference is clearly shown in both the bar chart and table.

	CAI	BEY	AMM	EBL	AQJ	DMM	AHB	IKA	KWI	DXB	SHJ	JED	SSH	DWC	AUH	BAH	RUH	ISU	BGW	HBE	TBZ	MCT	NJF	DOH	BSR	GIZ	SYZ	TUU
Arrival	13803	439	498	262	30	95	151	132	60	66	74	18	44	31	16	29	16	9	10	4	1	6	4	3	1	1	0	1
Departure	9295	1119	789	866	140	64	0	19	30	23	13	34	7	19	25	8	13	11	8	7	10	2	3	0	0	0	1	0

GNSS Interference NOTAM Issued

Month	1	2	3	4	5	6	7	8	9	10	11	12
LTAA												
LTBB												
HSSS												
OIIX												
HECC												
OSTT												
ORBB												
OJAC												
OLBB												
OEJD												
OOMM												
OAKX												
OMAE												
OBBB												
OKAC												
OYSC												
DTTC												
HLLL												
GMMM												



- The left table shows if an effective NOTAM was available for each month.
- Green indicates at least one effective NOTAM, while red means no NOTAM for GNSS interference.
- Yellow highlights on the FIR indicate significant ‘GPS Signal Loss’ events in FDX data, but no NOTAM was published.

Follow-up activities

- *Majority of 2022 GNSS RFI incidents reported in Egypt, Iraq, Iran and Turkey. The CNS SG/12 conduct a follow-up SCM with all concerned States (Egypt, Iraq, Iran and Turkey).*

- *The CNS SG/12 meeting discussed lengthy the possible means to monitor GNSS signal and provide timely warning to Airspace users, in order to reduce the impact of the GNSS interference on Aviation operation (WP76 refers)*

Follow-up activities

- *MIDANPIRG/19 meeting noted that the issued NOTAMs related to GNSS interference had variant Q codes and terminologies (GPS unreliable, GPS Signal interference, GPS Jamming, Loss of GPS Signal, etc.,) making it difficult for operators to filter and search through the NOTAMs.*

- *AIM SG was tasked develop a standard NOTAM text to be used for GNSS Interference and to be attached to the RSA-14, in coordination with IATA, a Standard NOTAM Template has been developed (WP46 refers)*

Follow-up activities

- *ITU Radiocommunication Bureau (BR) issued a circular (CR/488 dated 8 July 2022) on Prevention of harmful interference to Radio Navigation Satellite Service Receivers in the 1559 – 1610 MHz frequency band.*

- *ITU requested Member States to ensure that their operating agencies complied with the applicable provisions of the ITU legal instruments (Circular advisory attached for easy reference)*

Follow-up activities

- *ITU Circular encouraged administrations to consider the following measures:*

a) reinforcing navigation systems resilience to interference;

b) increasing collaboration between radio regulatory and enforcement authorities;

c) reinforcing civil-military coordination to address interference risks associated with RNSS testing and conflict zones;

d) increasing coordination between aviation, military and radio-regulatory authorities;

e) retaining essential conventional navigation infrastructure for contingency support in case of RNSS outages, and developing mitigation techniques for loss of services.

Actions by the Meeting

The meeting is invited to note:

a) the analysis of GNSS RFI in the MID Region and actions taken;

b) the GNSS NOTAM template (pending MIDANPIRG approval) will be attached to RSA-14 on GNSS vulnerabilities and published on ICAO MID Office Website; and

c) urge States to ensure the implementation of mitigation measures as outlined in the RSA-14 and ITU BR (previous slide)

ICAO MID

RECONNECTING THE WORLD

MIDANPIRG/20 & RASG-MID/10

Thank you for your Attention

Radiocommunication Bureau (BR)

Circular Letter
CR/488

8 July 2022

To Administrations of Member States of the ITU

Subject: **Prevention of harmful interference to Radio Navigation Satellite Service Receivers in the 1559 – 1610 MHz frequency band**

Following its initial report to the 2019 World Radiocommunication Conference, the Radiocommunication Bureau has been informed of a significant number of cases of harmful interference to the radionavigation-satellite service (RNSS) in the 1 559 – 1 610 MHz frequency band affecting receivers onboard aircrafts and causing degradation or total loss of the service for passenger, cargo and humanitarian flights. In some cases, this has also led to misleading information provided by RNSS receivers to pilots. Based on in-flight monitoring of air transport category aircraft GNSS receivers by one major aircraft manufacturer, 10 843 radio-frequency interference events were detected globally in 2021. The majority of these events occurred in the Middle East region, but several events were also detected in the European, North American and Asian regions.

The Bureau has noted with great concern the increasing number and range of impact of such harmful interference on safety-of-life radiocommunication services used for the navigation of aircraft (see No. **4.10**[1]). In accordance with RR No. **13.2**, the Bureau reported such cases to the Radio Regulations Board (RRB), together with its recommendations.

At its 89th meeting in March 2022, the ITU Radio Regulations Board (RRB) considered the situation and instructed the Bureau to issue a circular letter to the Member States to disseminate its decisions and other background information about the prevention of harmful interference to RNSS receivers.

Following this instruction, the Bureau has prepared the present circular letter. It summarizes the RRB's decisions on the issue, formulates recommendations concerning mitigation of harmful interference to the radionavigation-satellite service and provides the list of the relevant ITU-R reference documents.

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[1] "*Member States recognize that the safety aspects of radionavigation and other safety services require special measures to ensure their freedom from harmful interference; it is necessary therefore to take this factor into account in the assignment and use of frequencies.*"

The relevant decisions of the 89th RRB meeting

In accordance with No. 13.2, the Board decided to request Member States to ensure that their operating agencies complied with the applicable provisions of the ITU legal instruments, as emphasized below:

- "*All stations, whatever their purpose, must be established and operated in such a manner as not to cause harmful interference to the radio services or communications of other Member States or of recognized operating agencies, or of other duly authorized operating agencies which carry on a radio service, and which operate in accordance with the provisions of the Radio Regulations.*" (Article 45 of the ITU Constitution)

- "*to take the steps required to prevent the transmission or circulation of false or deceptive distress, urgency, safety or identification signals, and to collaborate in locating and identifying stations under their jurisdiction transmitting such signals.*" (Article 47 of the ITU Constitution)

- "*1 Member States retain their entire freedom with regard to military radio installations.*

2 Nevertheless, these installations must, so far as possible, observe statutory provisions relative to giving assistance in case of distress and to the measures to be taken to prevent harmful interference, and the provisions of the Administrative Regulations concerning the types of emission and the frequencies to be used, according to the nature of the service performed by such installations.

3 Moreover, when these installations take part in the service of public correspondence or other services governed by the Administrative Regulations, they must, in general, comply with the regulatory provisions for the conduct of such services." (Article 48 of the ITU Constitution)

- "*Recognizing that transmissions on distress and safety frequencies and frequencies used for the safety and regularity of flight (see Article 31 and Appendix 27) require absolute international protection and that the elimination of harmful interference to such transmissions is imperative, administrations undertake to act immediately when their attention is drawn to any such harmful interference.*" (RR No. **15.28**)

The Board further decided to request Member States to continue to exercise their utmost goodwill and mutual assistance in the application of the provisions of Article 45 of the Constitution and of Section VI of Article **15** of the Radio Regulations.

Recommendations on prevention and mitigation of harmful interference to RNSS

With respect to unnecessary transmissions, which represent one of the important sources of interference to RNSS, the Bureau would like to point out that the use of devices commonly referred as "GNSS jammers" or any other illegal interfering equipment, which may cause harmful interference to aircraft, are prohibited by provision No. **15.1** of the Radio Regulations:

> *15.1 § 1 All stations are forbidden to carry out unnecessary transmissions, or the transmission of superfluous signals, or the transmission of false or misleading signals, or the transmission of signals without identification (except as provided for in Article **19**).*

In addition, the administrations are encouraged to consider the following additional measures to address this critical issue:

a) reinforcing navigation systems resilience to interference;
b) increasing collaboration between radio regulatory and enforcement authorities;
c) reinforcing civil-military coordination to address interference risks associated with RNSS testing and conflict zones;
d) increasing coordination between aviation, military and radio-regulatory authorities;
e) retaining essential conventional navigation infrastructure for contingency support in case of RNSS outages, and developing mitigation techniques for loss of services.

The above measures were decided by the International Civil Aviation Organization (ICAO) at its 40th Assembly in October 2019 and disseminated by ICAO State Letter AN 7/5-20/89 dated 28 August 2020.

Relevant ITU-R reference documents

In order to get an overview of the usage and protection requirements of systems operating in the radionavigation-satellite service, administrations may consult the following ITU-R Recommendations and Reports:

- Recommendation ITU-R M.1787-4 – Description of systems and networks in the radionavigation-satellite service (space-to-Earth and space-to-space) and technical characteristics of transmitting space stations operating in the bands 1 164-1 215 MHz,1 215-1 300 MHz and 1 559-1 610 MHz
- Recommendation ITU-R M.1901-3 – Guidance on ITU-R Recommendations related to systems and networks in the radionavigation-satellite service operating in the frequency bands 1 164-1 215 MHz, 1 215-1 300 MHz, 1 559-1 610 MHz, 5 000-5 010 MHz and 5 010-5 030 MHz
- Recommendation ITU-R M.1903-1 – Characteristics and protection criteria for receiving earth stations in the radionavigation-satellite service (space-to-Earth) and receivers in the aeronautical radionavigation service operating in the band 1 559-1 610 MHz
- Report ITU-R M.2458-0 – Radionavigation-satellite service applications in the 1 164-1 215 MHz, 1 215-1 300 MHz and 1 559-1 610 MHz frequency bands

The Bureau thanks Administrations for disseminating this information among their different operating agencies to raise awareness of the situation and to remind them of their obligation to prevent any harmful interference in accordance with ITU's Legal Instruments.

Mario Maniewicz
Director

Distribution:

- Administrations of ITU Member States
- Members of the Radio Regulations Board