

# Data Analysis

## **MENASASI –Seminar**

Jeddah-Kingdome of Saudi Arabia

November 08-09, 2023

Jehad Faqir-Head Regional Safety Africa & Middle East



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- GADM Program Introduction
- GNSS Interference
- Status of Accident Investigation Reports
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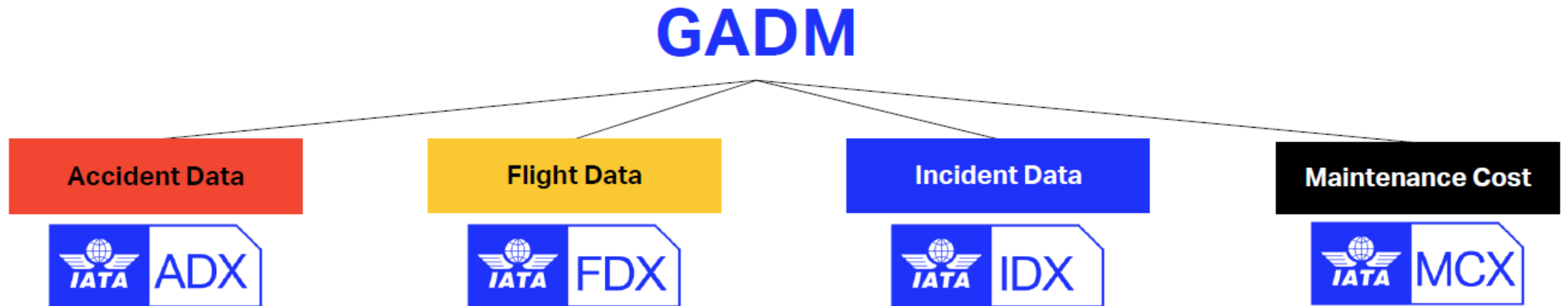
# GADM Program Introduction

2023



# Global Aviation Data Management

- IATA's Operations, Safety & Security Division
  - Safety & Operational Data and Analytics Programs
- GADM is a unique global aviation safety database with IATA serving as a custodian trusted by the industry to do this.



# GADM Statistics Overview 2023

as at 06/06/2023

GADM Members

**271 Participants**

IDX Participants

**253 Participants**

FDX Participants

**194 Participants**

Yearly Flights (FDX)

**5 million flights +**

Total Number of Aircraft (FDX)

**6500+ Aircraft**

The members are keep growing

# Flight Data eXchange (FDX)



Global aggregate flight  
data sharing program –  
using web-based  
platform



Benchmarking your  
performance against  
global scale data



De-identified data  
protected by rule-of-  
three

# Important Definitions

## USER EXPERIENCE DESIGN – FUNNEL (MAD) APPROACH

This approach follows three simple steps:

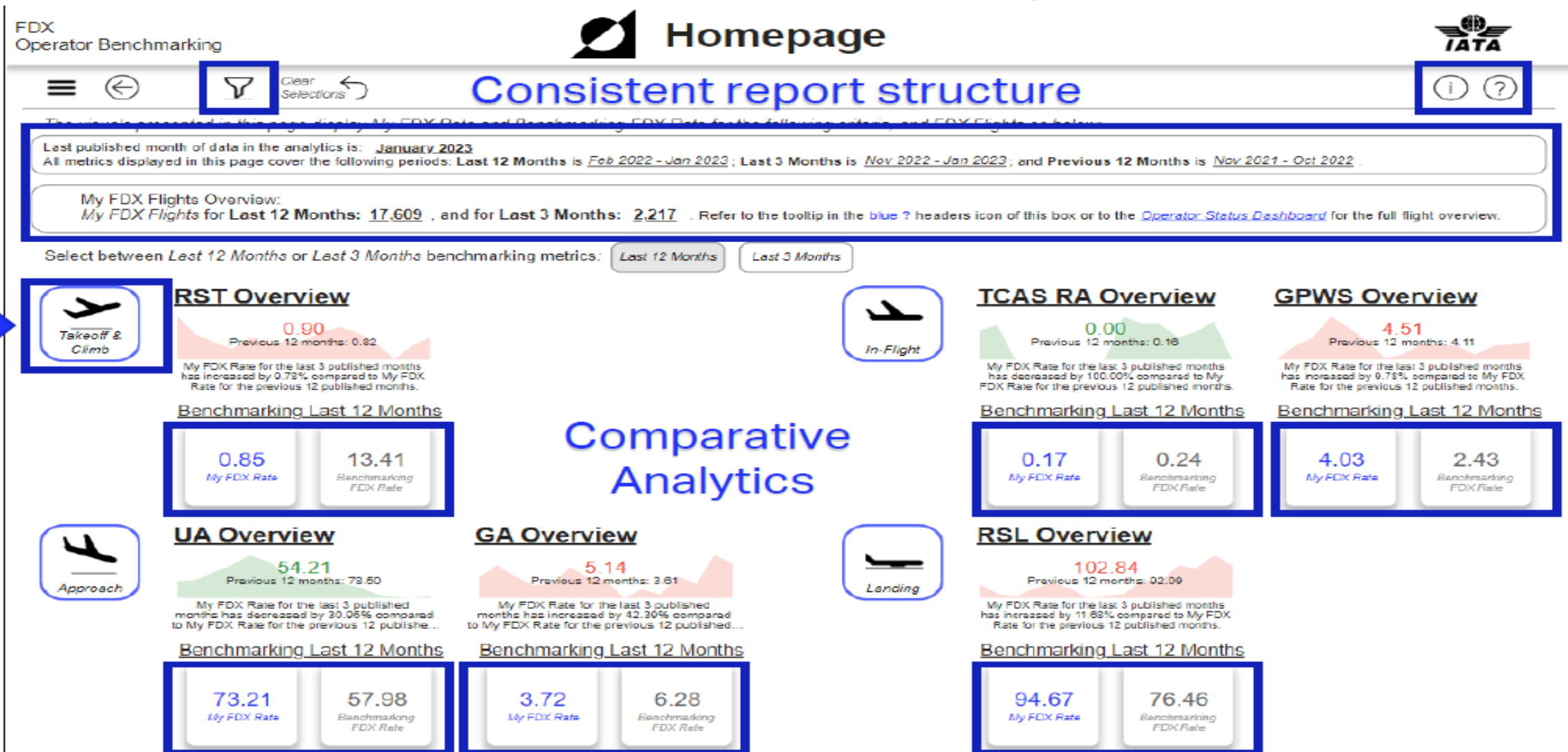
**M - Monitor:** Summarized overview of the data, enable users to assess their trend at a glance.

**A - Analyze:** Enables users to review KPIs from different perspectives by using advanced filtering options.

**D - Detail:** Offers an advanced view of the data, to perform a deep dive analysis with additional context and advanced analytics such as Boxplots, Scatter charts and others.



# FDX Operator Benchmarking Dashboard







IDX

# Incident Data eXchange



## IDX in numbers



STEADDES incident reports



GDDB aircraft damage reports

Streamline the Data Submission Process

Enhanced analytic tools & Interactive User Interface

Comprehensive analyses integrating Artificial Intelligence analytics

## Benefits

- ✓ Understanding of critical incident trends
- ✓ Identifying targets for improvement
- ✓ Continuous improvement of standards, procedures and recommended practices
- ✓ Easy access to shared safety & security data
- ✓ Benchmarking at the regional and global level
- ✓ Performance Monitoring

IDX

# Incident Data Exchange

[HOME](#)[DATA SUBMISSION](#)[DATA SUBMISSION RESULTS](#)[USER MANAGEMENT](#)[DASHBOARDS](#)



# IATA Incident Data Exchange (IDX) - Birdstrike Reports

## Region of Event

- ☐ Africa
- ☐ Asia Pacific
- ☐ Commonwealth of Independent States
- ☐ Europe

## Bird Strike Detail

- ☐ Bird strike
- ☐ Bird strike - Unknown type
- ☐ Multiple Birdstrike
- ☐ Near Birdstrike

## Aircraft Type

- ☐ Airbus A320 Passenger
- ☐ Boeing 737-800 Passenger
- ☐ Airbus A321 Passenger
- ☐ Airbus A310 Descender

## Flight Phase

- ☐ APPROACH
- ☐ CRUISE
- ☐ DESCENT
- ☐ ENGINE START DEPART

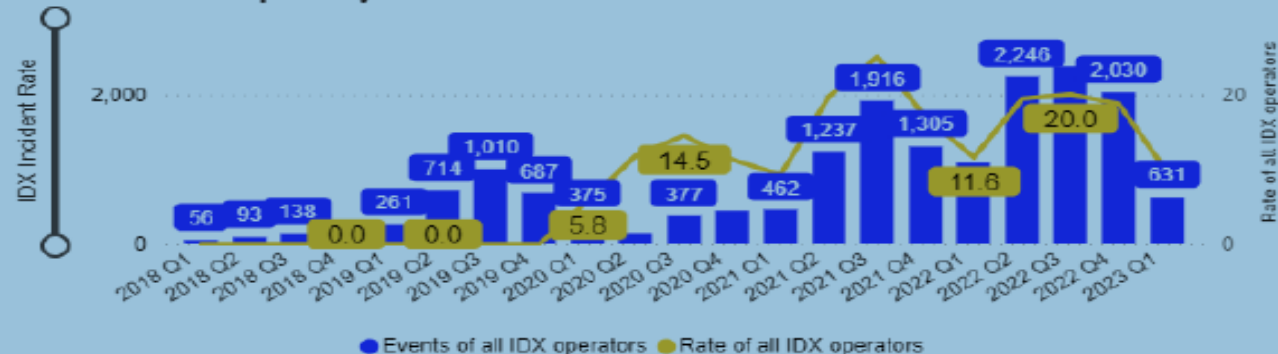


## Aircraft Type

Airbus A350 - Unknown	1,091.0
Airbus A340-600	330.3
Boeing 747-400 Passenger	220.3
Boeing 787-10	179.6
Airbus A330-200 Freighter	138.1
Boeing 777-200 / 200ER	138.0
Boeing 787 - Unknown	105.9
Boeing 777 Passenger	89.2

0 1,000  
IDX Incident Rate

## Number of Reports by Quarter



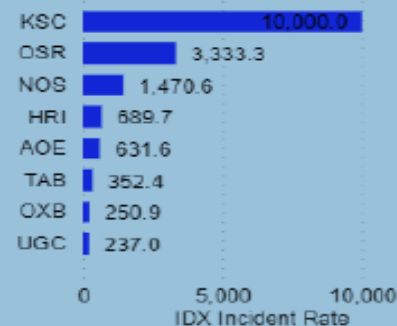
## Phase of Flight



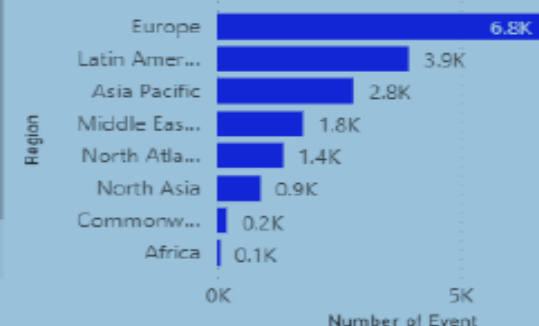
## Bird Strike Detail



## Top 10 Airport of Occurrence



## Number of Event by Region





# MCX

Introduction to  
Maintenance Cost  
data eXchange (MCX)

2023

# About MCX

- A voluntary data exchange program; free of charge
- The focal point on aircraft maintenance costs
- Objectives:
  - Define and standardize maintenance cost reporting
  - Develop benchmark capabilities
  - Share knowledge, experience and industry best practices for cost management

# GNSS/GPS Interference Reported in MENA Region 2022

Global Aviation Data Management  
March 15, 2023

# Background

- The GPS signal is a low power signal. It is comparable to the **power emitted by a 60W light-bulb** located more than **20,000 km away** from the surface of the earth.
- GPS L1 frequency band (**1575.42 MHz +/-10 MHz**),

- **GNSS spoofing**

Some of the known RFI sources are reportedly capable of emitting signals that **mimic GNSS signals**



# Background – GNSS/GPS Vulnerability

Global Navigation Satellite Systems (GNSS) have become an indispensable component of the Communications, Navigation, and Surveillance (CNS) infrastructure, supporting vital navigation applications such as ADS-B, as well as providing surveillance used in safety nets such as the GPWS. GNSS is also widely employed in all phases of flight and enables the synchronization of systems and operations in ATM.

However, the vulnerability of GNSS/GPS to both intentional and unintentional signal interference presents a significant safety issue, as the technology is embedded in numerous critical infrastructures. The risk posed by intentional interference is particularly worrisome, as it poses a significant threat to aircraft and passengers. As such, effective monitoring and assessment of such interference is critical to mitigate operational risk.

To address this challenge, the GADM IDX program provides a comprehensive approach for identifying and monitoring hot spots and trends in reported GNSS/GPS interference reports. Additionally, the GADM NOTAM repository facilitates tracking of NOTAMs issued by States to inform airspace users of potential GNSS/GPS interferences. To further enhance risk management, the IATA FDX program has introduced a new event of GPS outage, effective August 2021, enabling the monitoring of potential GNSS/GPS interference risk.

In April 2019, the RASG-MID released [guidance material on GNSS vulnerabilities](#) to mitigate the safety and operational impact of GNSS service disruption. The guidance recommends that pilots report GNSS interference and ANSPs issue appropriate advisories and NOTAMs.

To facilitate the joint monitoring of GNSS/GPS interference in the region, IATA GADM presented the first version of [GNSS/GPS interference analysis](#) in November 2020 and continues to update it annually. The GNSS/GPS Interference was published in the 10th MID Annual Safety Report (2021) as one of the emerging safety risks in the ICAO MID region.

In February 2022, IATA presented the [MIDANPIRG/19 & RASG/19-WP/16](#), providing the status of GNSS and Radio Altimeter Interferences and proposing the development of a standard NOTAM text template to facilitate operators in filtering and searching through NOTAMs for GNSS Interference.

To address the recent intensification of the issue, EASA published [SIB 2022-02](#) in February 2022, and revised it in February 2023 with [SIB 2022-02R1](#).

Given the continuous monitoring of the regional safety risk of GNSS/GPS interference, this analysis provides an updated figure until December 2022 of GNSS/GPS Interference in MENA and adjacent countries.



# Analysis Scope – Event Definition

**The GNSS/GPS Interference events or NOTAMs in this analysis typically includes the following cases:**

- (Incident Data) GNSS/GPS Signal Lost or degeneration over certain airspace.
- (Incident Data) EICAS/ECAM warning with GPS out or fault over certain airspace (ADS-B out or EGPWS TERR POS message may follow).
- (Incident Data) GPS timing failing (e.g. GPS clock/chronometers running backwards) over certain airspace.
- (Incident Data) Pilot reporting suspected GNSS/GPS interference including GPS jamming and spoofing.
- (Flight Data) 'GPS Signal Loss' recorded more than 60 seconds in Flight Data
- (NOTAM) NOTAMs with planned military activities with GNSS/GPS interference.
- (NOTAM) NOTAMs with information about the possible signal jamming/interference/anomalies

**The following cases WERE NOT considered as GNSS/GPS inference:**

- EICAS/ECAM warning without GPS faults.
- Mechanical or technical defects of GPS receiver in aircraft, which are not related to GNSS/GPS signal interference.
- NOTAMs with GNSS procedural change (procedure became unavailable without reason of unreliable or interfered GNSS/GPS signal).
- NOTAMs about waypoints, decision heights, etc.

# Analysis Scope – Event Definition

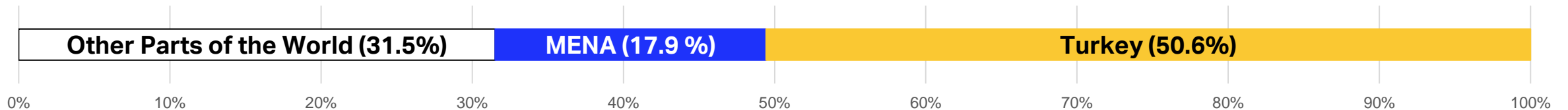
The analysis utilized three datasets: Incident Data Exchange (IDX), Flight Data Exchange (FDX), and NOTAM information held by the IATA. The analysis covers the time period of January 2022 to December 2022.

## **Incident Data Exchange (IDX)**

The analysis revealed 524 GNSS/GPS jamming or suspected interference reports from 12 operators in the MENA region and adjacent states gathered through the Incident Data Exchange (IDX) from January 2022 to December 2022. A total of 462 reports of GNSS interference were excluded from the analysis because the exact location of the incident could not be determined for flights that departed from or arrived in the MENA region.

## **Flight Data Exchange (FDX)**

The analysis also utilized data from the Flight Data Exchange (FDX) to extract a total of 162,654 'GPS signal loss' events from 54 operators in the MENA region and adjacent states from January 2022 to December 2022. This is 68.5 % of all GPS Signal Loss Events in FDX database in 2022. The Total Event Count around the world was 237,489.



## **NOTAM (FAA SWIFT Portal)**

In addition to the above datasets, 66 GNSS interference NOTAMs were extracted from the NOTAM archive issued over MENA States from January 2022 to December 2022, sourced from the FAA SWIFT Portal.

# Analysis Scope – Geographic Scope

This report provides an update to our previous analysis of the Global Navigation Satellite System (GNSS) in MENA region with Türkiye given its geographical proximity to the MENA region.

## List of FIRs (Flight Information Regions)

In alphabetical order of FIR Code (as per 2022 December)

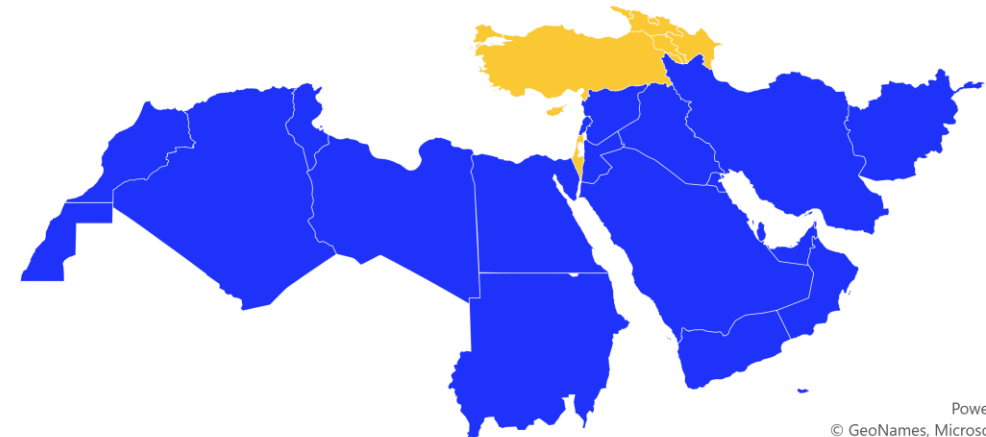
DAAA	Algeria	OIIX	Iran, Islamic Republic of
DTTC	Tunisia	OJAC	Jordan
GMMM	Morocco	OKAC	Kuwait
HECC	Egypt	OLBB	Lebanon
HLLL	Libya	OMAE	United Arab Emirates
HSSS	Sudan	OOMM	Oman
LTAA	Türkiye	ORBB	Iraq
LTBB	Türkiye	OSTT	Syrian Arab Republic
OAKX	Afghanistan	OTDF	Qatar
OB BB	Bahrain	OYSC	Yemen, Republic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

## 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:

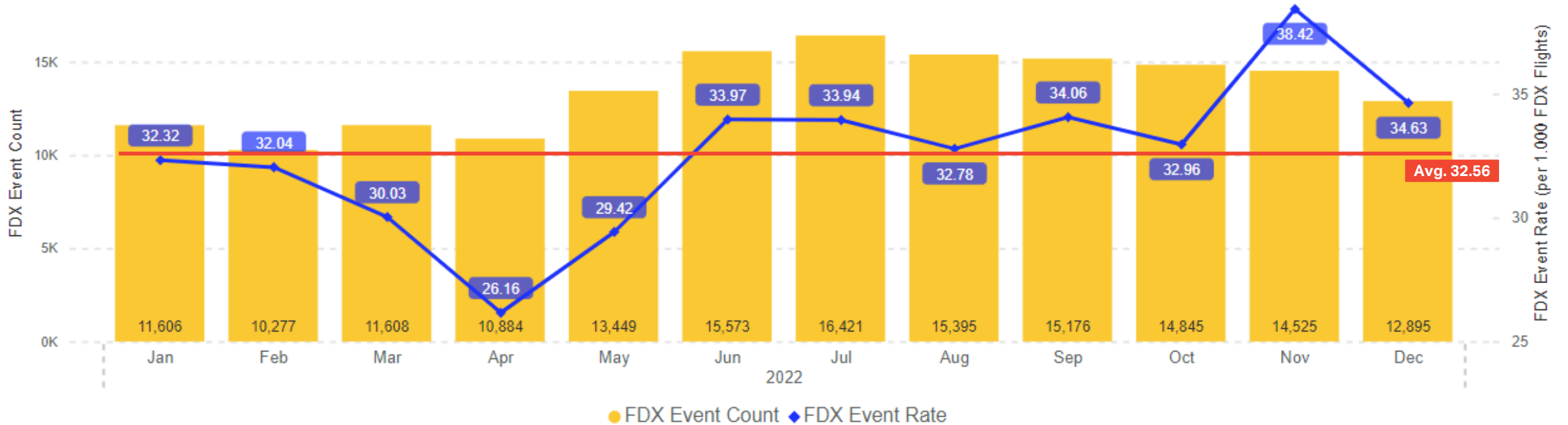
Türkiye



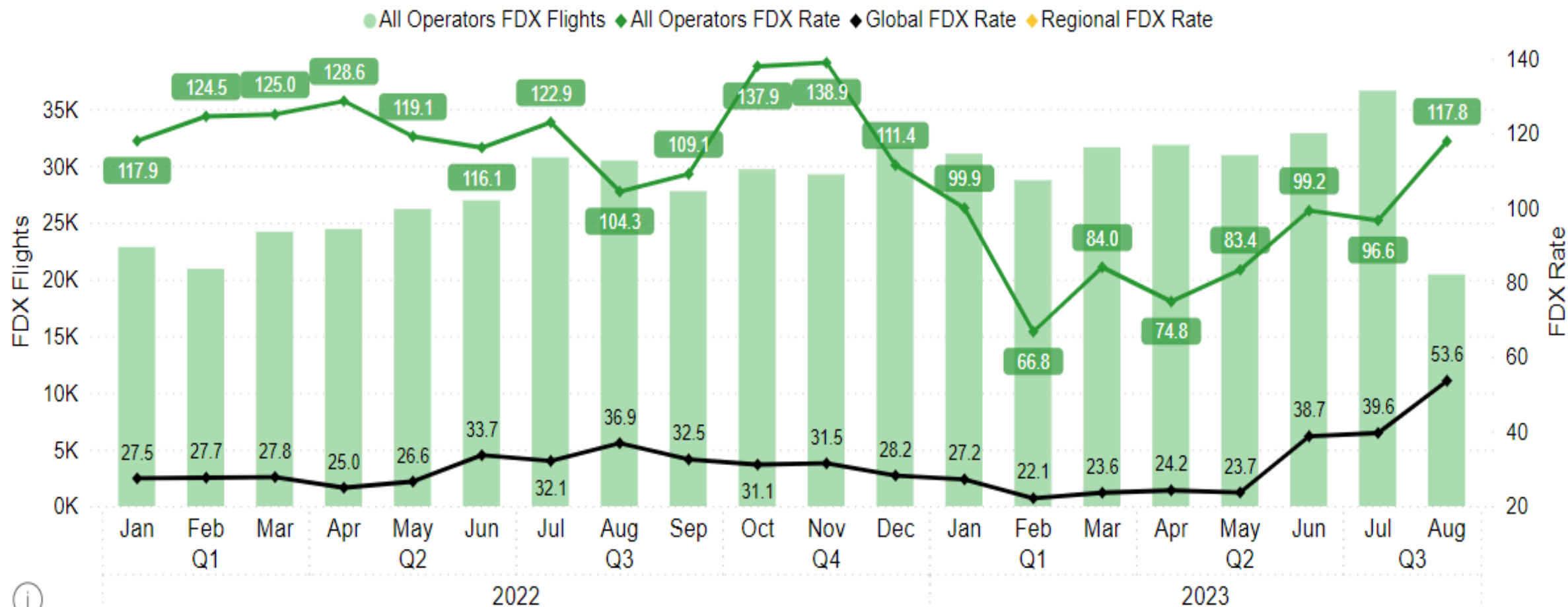
Powered by Bing  
© GeoNames, Microsoft, TomTom

# GNSS/GPS Interference Trend

## Monthly rate trends for the FDX 'GPS Signal Loss' event and Event Count



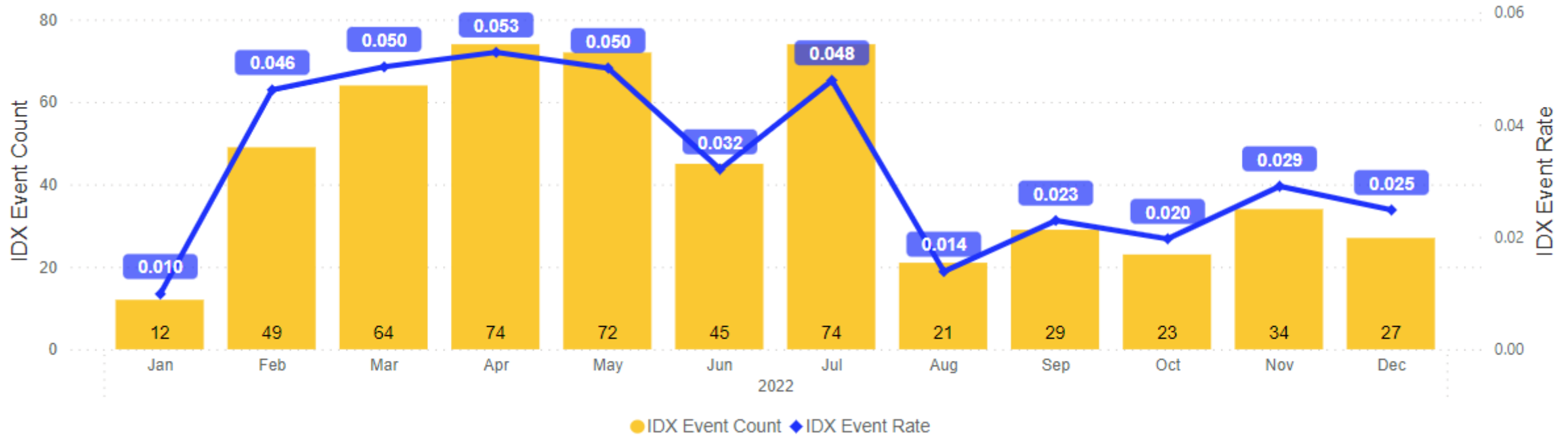
# GNSS/GPS Interference Trend (22-Aug.23)



**MENA rate 107.57 Global 30.34**

# 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.

# GNSS/GPS Interference Trend

## FDX Event Rate per Departure – Arrival Region Combination

	Arrival						
	AFI	ASPAC	CIS	EUR	MENA	NAM	NASIA
Departure	AFI				152.5		
ASPAC			13.1	176.2	4.2		
CIS		12.2	0.1	271.2	147.9		
EUR	0.2	185.4	215.9	73.7	430.2		93.4
MENA	114.9	2.5	135.9	376.5	169.1	80.6	5.6
NAM		8.9			103.2		
NASIA				72.5	0.4		

- EUR – MENA routes exhibit significantly higher rates of 'GPS Signal Loss' events compared to other regions.
- The event rate is approximately 400 per 1,000 flights, indicating 40% of FDX flights experienced 'GPS Signal Loss' events on these routes

# GNSS/GPS Interference Trend

## Percentage of 'GPS Signal Loss' Events per Flight Segments



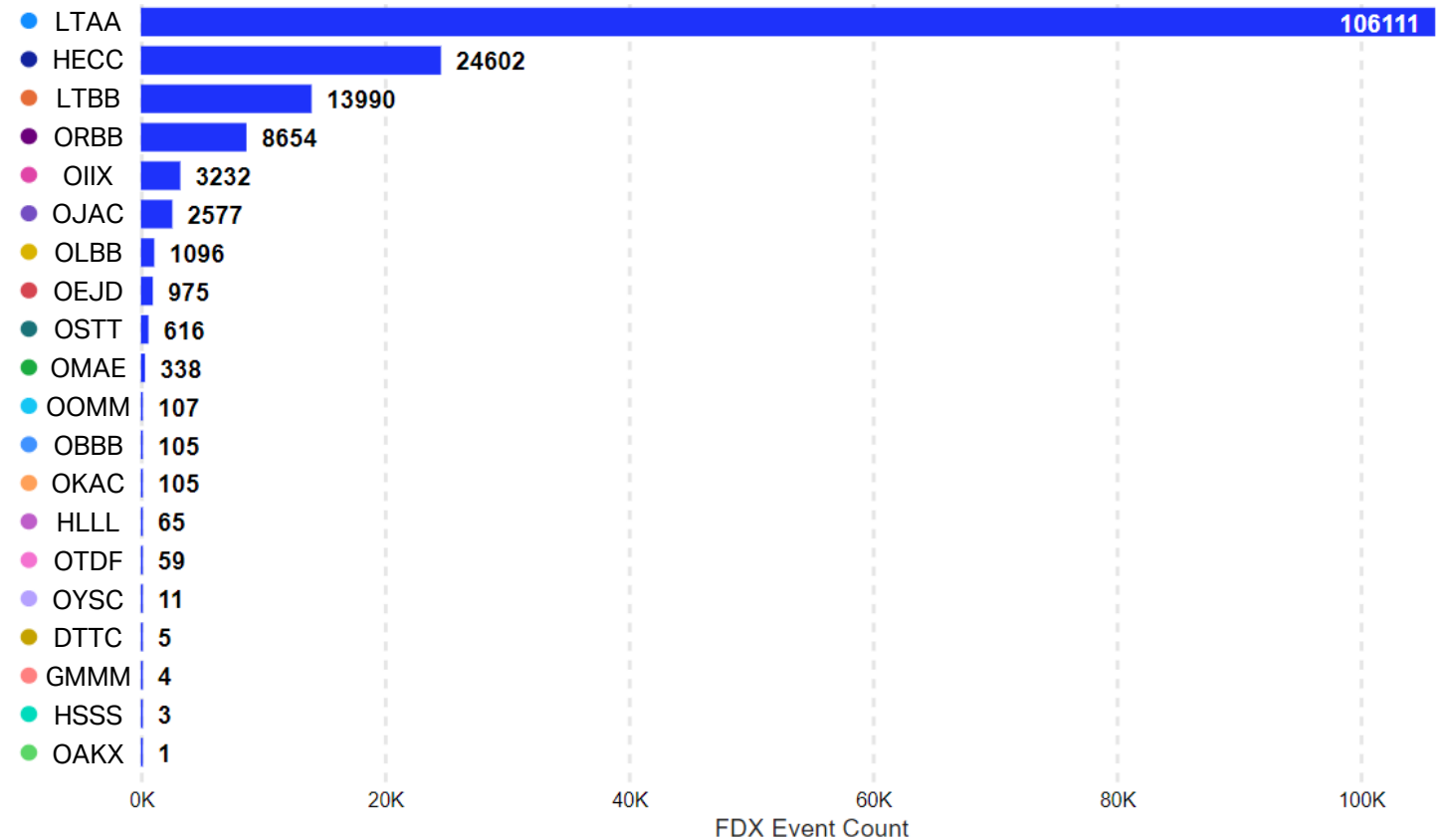
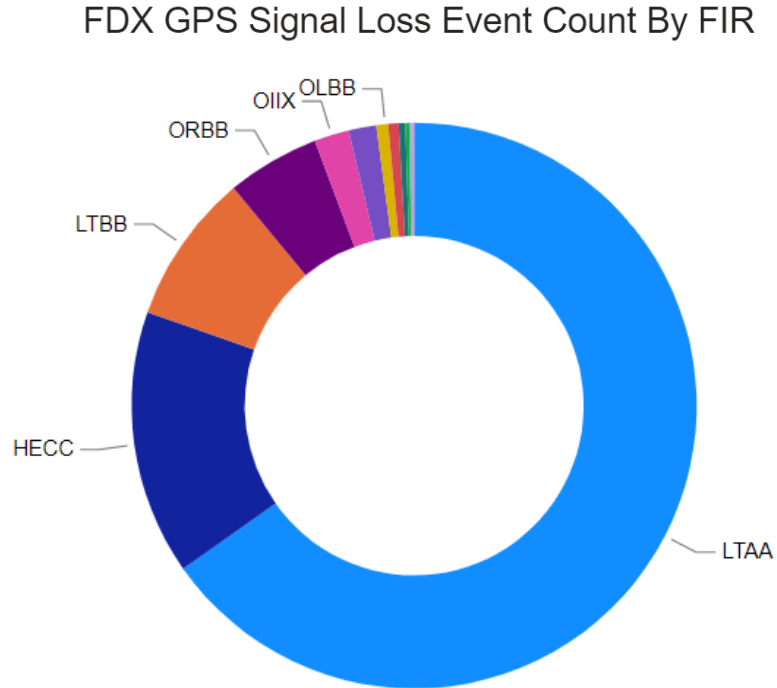
% over FDX GPS Signal Loss events

● <15 mins after TO ● 15-30 mins after TO ● Other ● 30-15 mins before LDG ● <15 mins before LDG



# Distribution of GPS Signal Loss by FIR

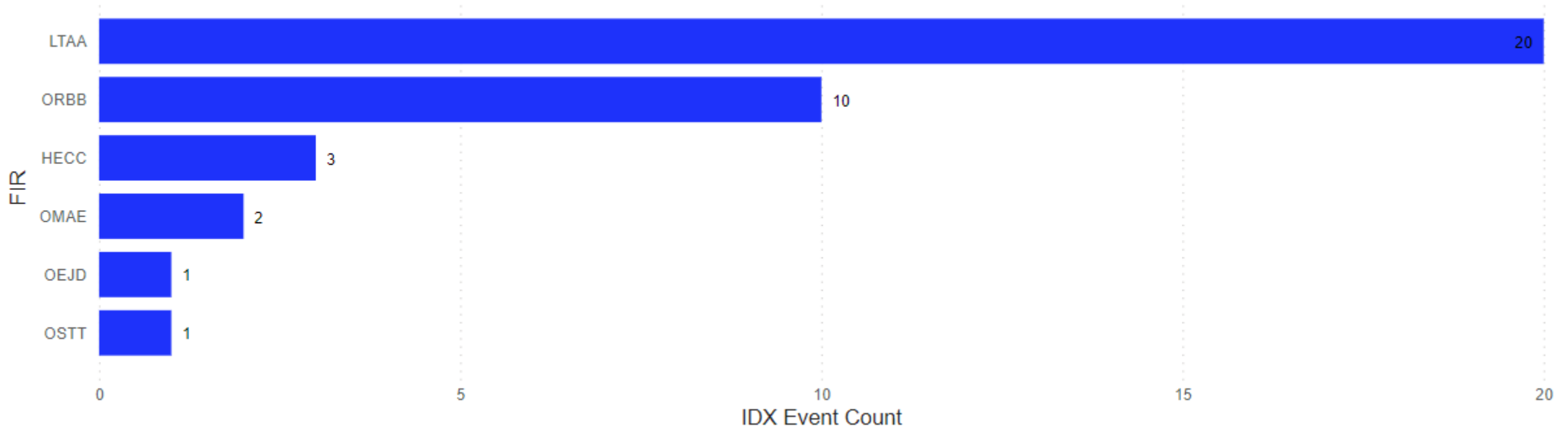
FDX GPS Signal Loss Event Count Per FIR



# Distribution of GNSS Interference by FIR

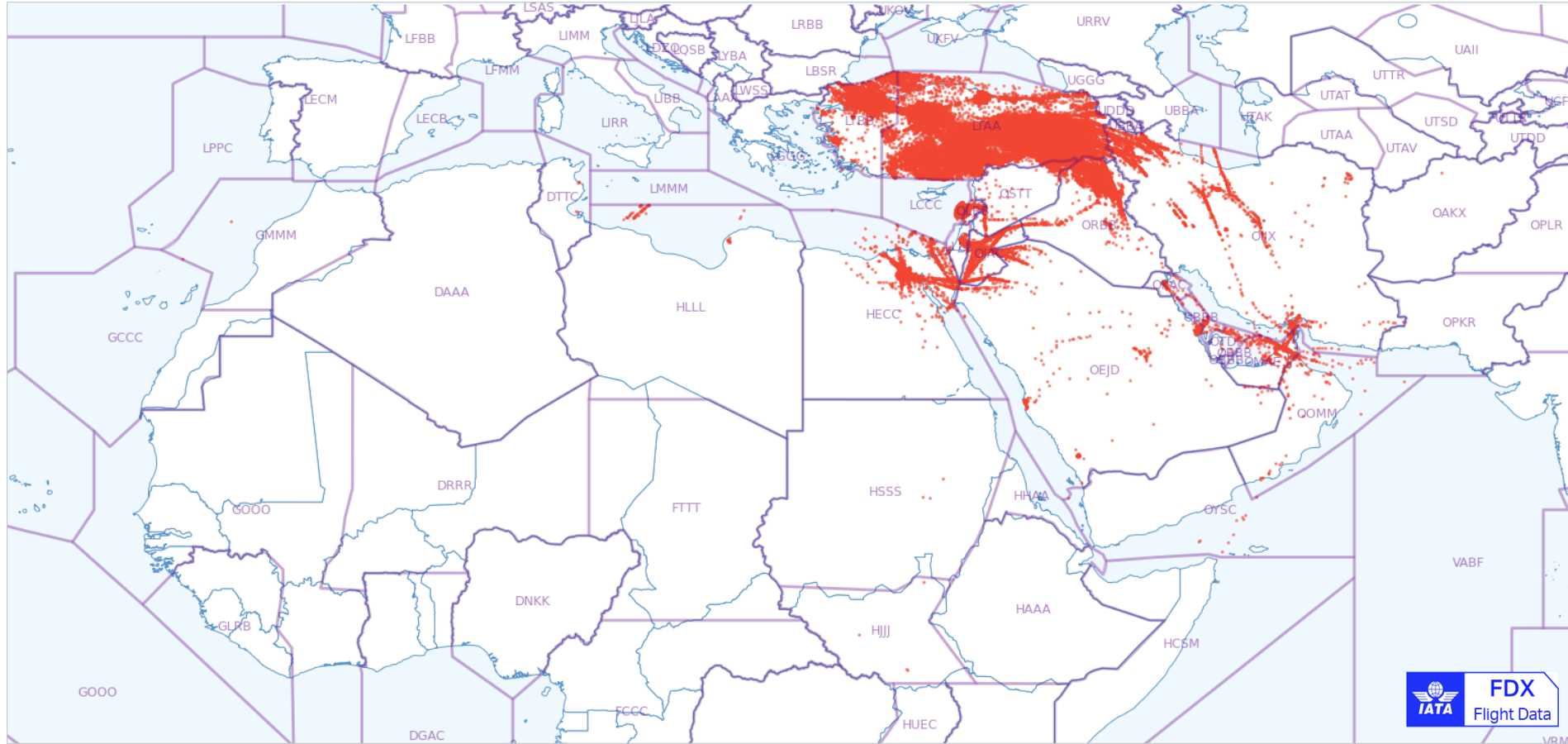


## IDX Event Count of GNSS Interference



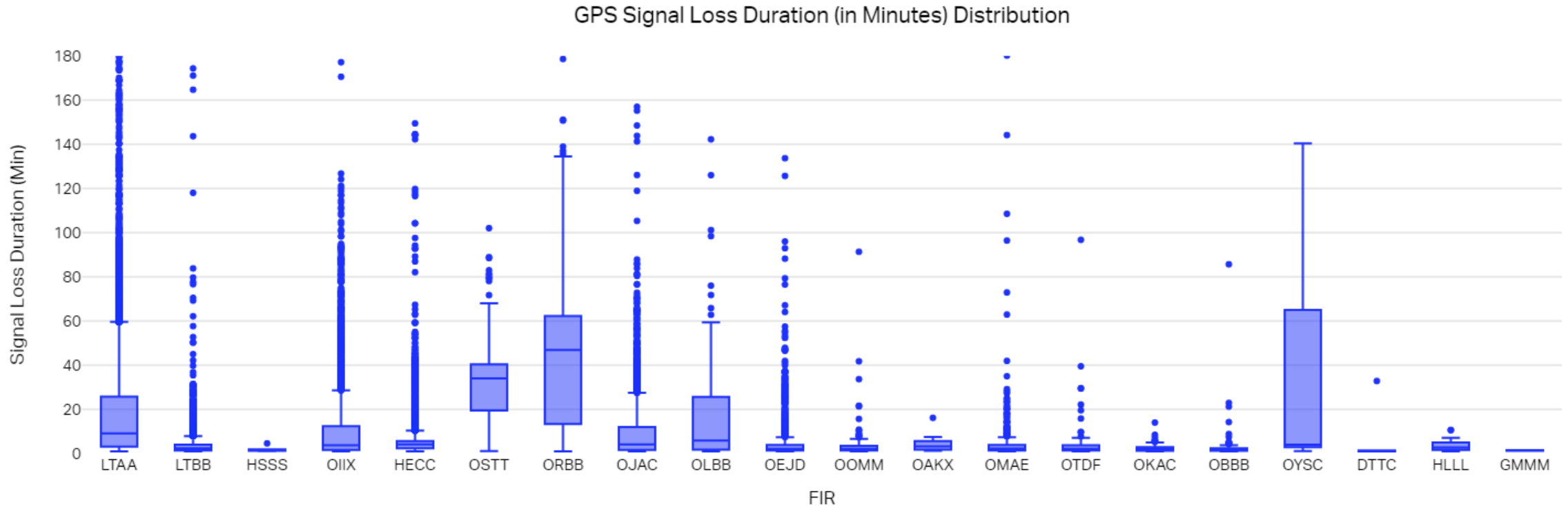
- Many reports were excluded from the count due to the absence of FIR information in the reports, which is not mandatory.
- As a result, the reported numbers are significantly lower.

# GPS Signal Loss Hot-Spots



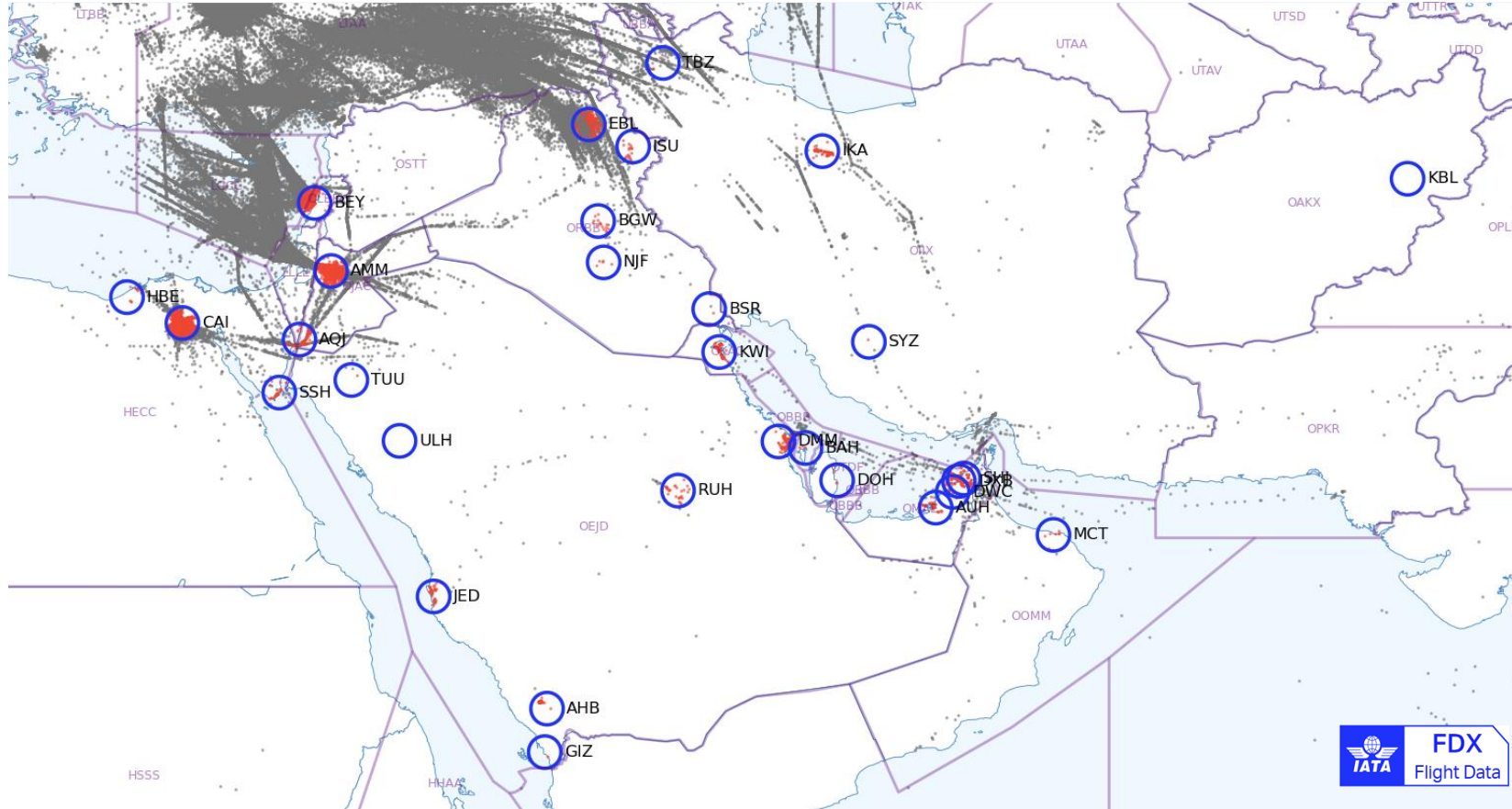
- The chart displays **164,577** red dots, each representing a single 'GPS Signal Loss' event in the MENA region.
- This highlights the need for increased awareness and proactive measures to address GPS Signal Loss issues in the region.

# GPS 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.

# GPS 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.

# GPS Signal Loss Near Airports

Number of GPS Signal Lost Events Near Airports (30NM)

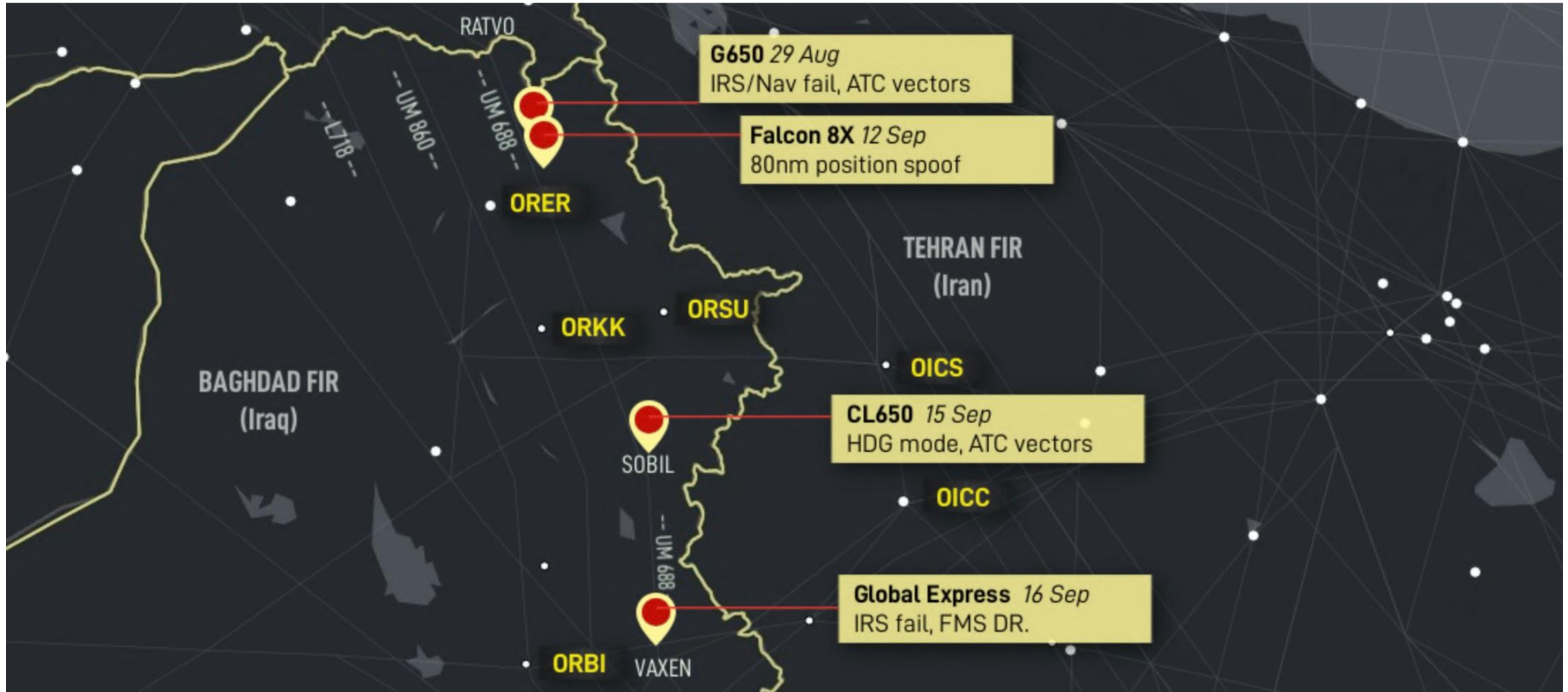


- The bar chart and table display the frequency of 'GPS Signal Loss' events during departure or arrival at airports in the MENA region.
- Cairo International Airport stands out as having a significantly higher frequency of events compared to other airports.
- This difference is clearly shown in both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



**Pilot View southbound on airway UM 688 from RATVO**

**Baghdad FIR - Iraq**

**Tehran FIR - Iran**

**OPS GROUP**

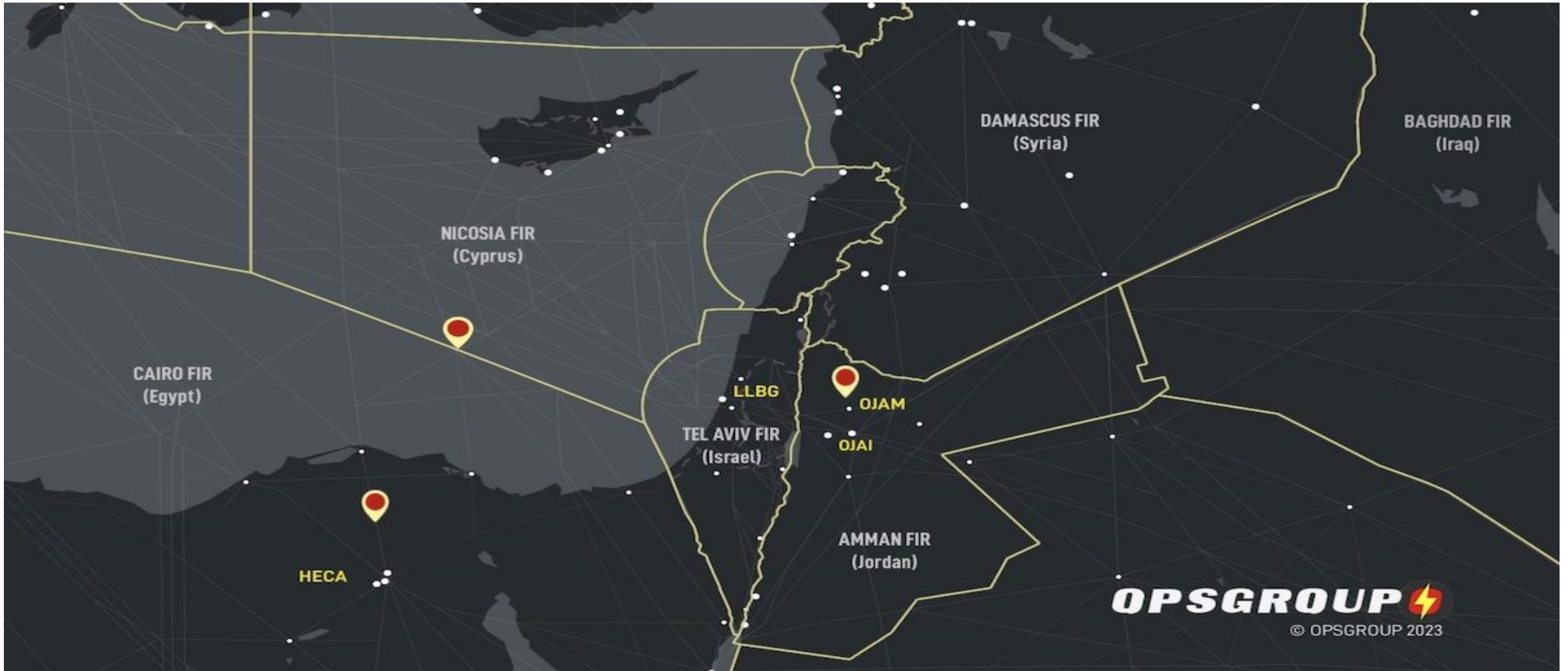
**Map Date: 28 Sep 2023**

**Aircraft almost enters Iranian airspace without clearance**

**Dotted area shows area of navigation failures in past 10 days**



# New variety of GPS spoofing (LLBG)



# GNSS Spoofing

- Fake GPS signal (spoofed) gives the FMS the **indication it is 60nm off track**
- IRS failure follows rapidly
- No reliable on-board navigation – ATC vectors required

## Aircraft types affected so far:

- Gulfstream G650
- Boeing 777, 747, 737
- Bombardier Global Express
- Bombardier Challenger 604, 650
- Embraer E190
- Embraer Praetor 600, Embraer Legacy 650
- Dassault Falcon 8X

# GNSS Spoofing

The spoofing reports are as alarming for two reasons:

- the sophistication of the methodology, and
- the unexpected “infection” of the IRS. (May update the IRS with bad data)
  - FMS and IRS have only been designed to cope with a loss of GPS signal, and not an intentional spoofed signal.

# Measures to mitigate the effects of GPS spoofing

- Informed ATCO's to help the pilots with radar victors
- Formed a high-level committee to find solutions for the problem
- Support from the Senior management in the Government
- Meetings will be held with military ,to find sources of the jamming/spoofing and to deal with the source.
- Review plans to consider installation of more DME or VOR

# Recommended Procedure – entering risk area

1. Check enroute FIR NOTAMs for any GPS spoofing advice (in time this will likely be published)
2. Cockpit Preparation: Perform full IRS alignment if entering known area with GPS spoofing risk
3. Be aware of typical sensor hierarchy for FMS position: GPS, then IRS, DME/DME, VOR/DME, DR.
4. Consider de-selecting GPS sensor input if option available.
5. Review differences between GPS Jamming and GPS Spoofing.
6. Perform time check and set correct time on personal device or watch.

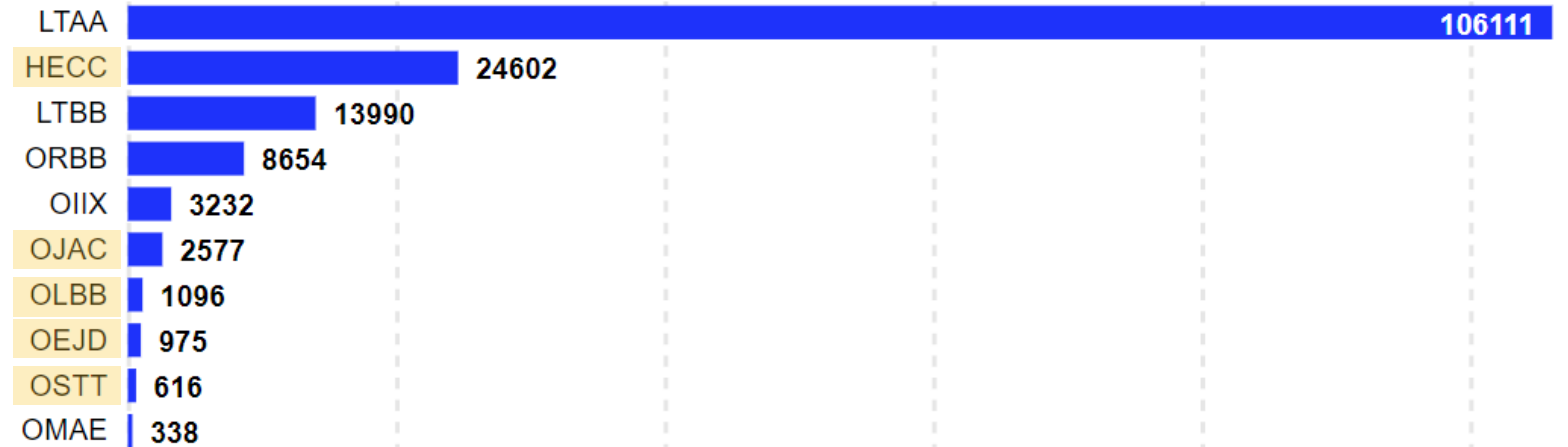
# GNSS/GPS Interference NOTAM Issued

- Some states published NOTAMs, but the inconsistency in terminology and Q code made it challenging for airspace users to ascertain the current GNSS/GPS situation.
- Standardized vocabulary and Q codes can enhance the awareness of airspace users regarding the GNSS situation in the airspace.
- Terminology Examples from NOTAMs
  - GPS Signals
  - GPS Jamming/GNSS Interference
  - GPS(GNSS) Failure or Degradation
  - GPS Unreliable
  - GNSS Anomalies
  - GNSS Interference

# GNSS/GPS Interference NOTAMs 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												

FDX GPS Signal Loss Event Count Per FIR



- 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.

# Safety Issue Hub



- To facilitate the identification and promotion of safety improvement programmes and safety actions for members.
- Supporting members in the implementation of **effective risk mitigations by providing generic risk assessments** ;
- To inform IOSA program as it evolves to a **risk-based approach**.
- Delivering better safety outcomes for IATA members and the wider aviation industry

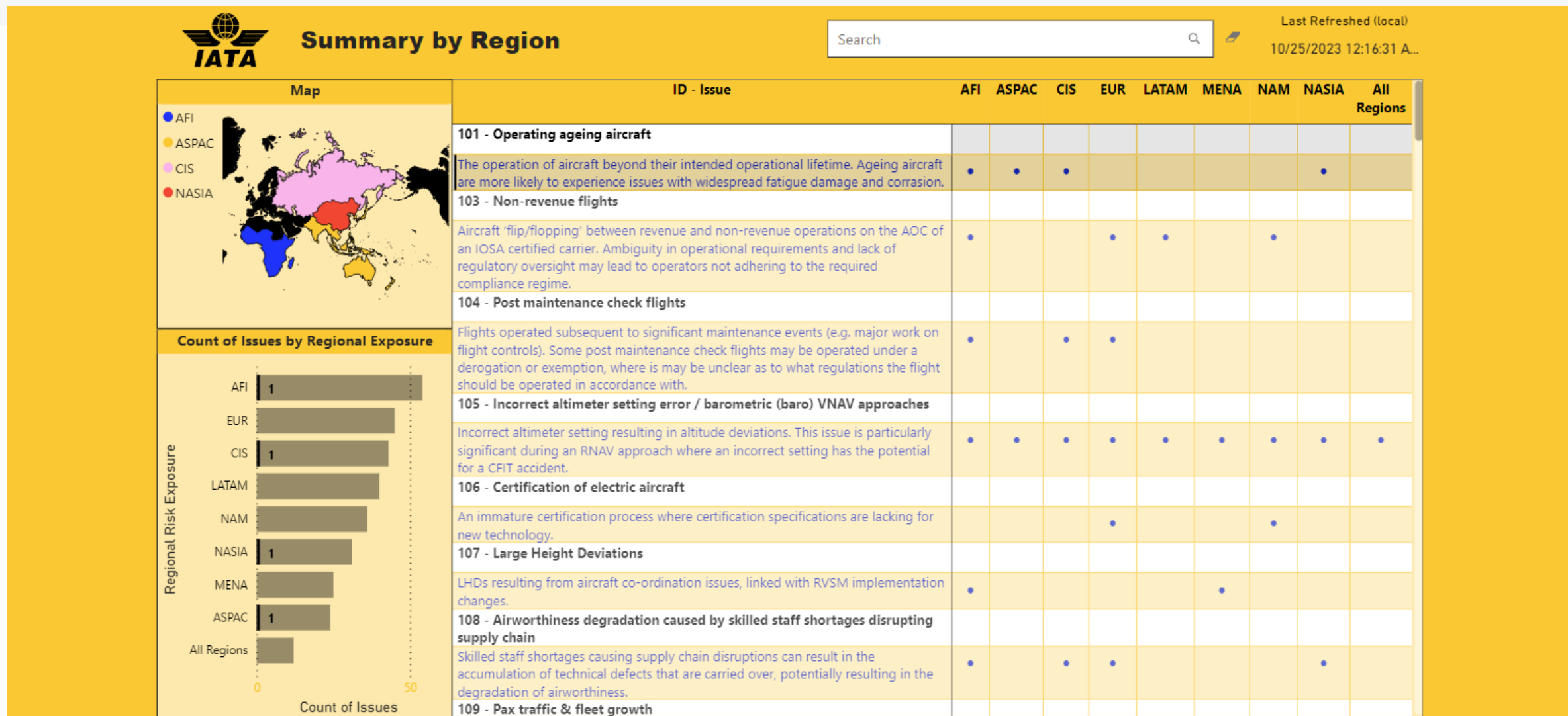


# Top Worldwide Safety Issues



- Carriage of High Energy Storage Devices / ESD / (Lithium Li Batteries) ESD/
- GNSS/GPS Interference GNSS/GPS
- EGPWS Software & Terrain Database out of date EPGWS
- Use of Erroneous Performance Calculations (Parameters) at Take-Off / Landing
- LHDs
- Tailstrikes

# Safety Hub Issues



# Thank you.

faqirj@iata.org

