

GNSS/GPS Interference

Reported in MENA Region 2022

Global Aviation Data Management
March 6, 2023

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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

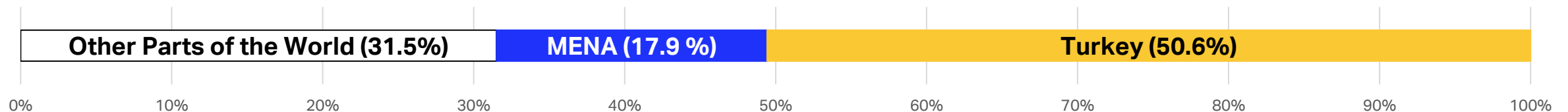
The analysis utilized three datasets: Incident Data Exchange (IDX), Flight Data Exchange (FDX), and NOTAM information held by the IATA. The analysis covers the time period of January 2022 to December 2022.

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)

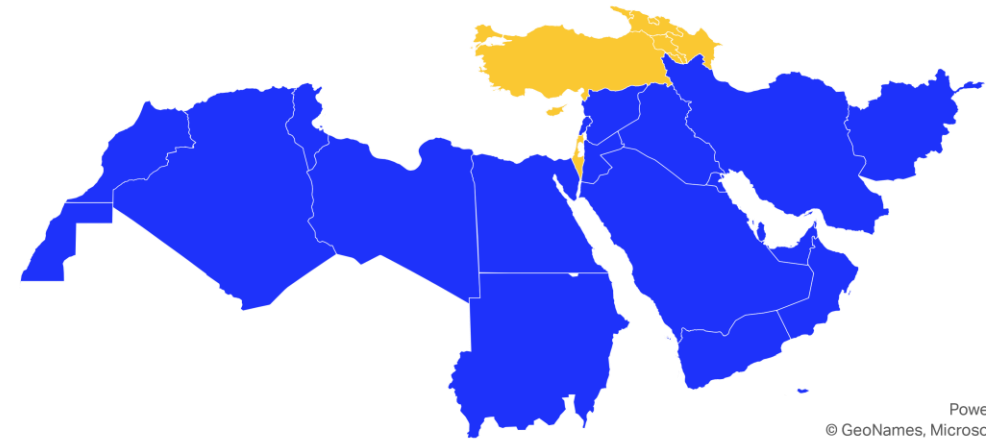
DAAA	Algeria	OIIX	Iran, Islamic Republic of
DTTC	Tunisia	OJAC	Jordan
GMMM	Morocco	OKAC	Kuwait
HECC	Egypt	OLBB	Lebanon
HLLL	Libya	OMAE	United Arab Emirates
HSSS	Sudan	OOMM	Oman
LTAA	Türkiye	ORBB	Iraq
LTBB	Türkiye	OSTT	Syrian Arab Republic
OAKX	Afghanistan	OTDF	Qatar
OB BB	Bahrain	OYSC	Yemen, Republic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

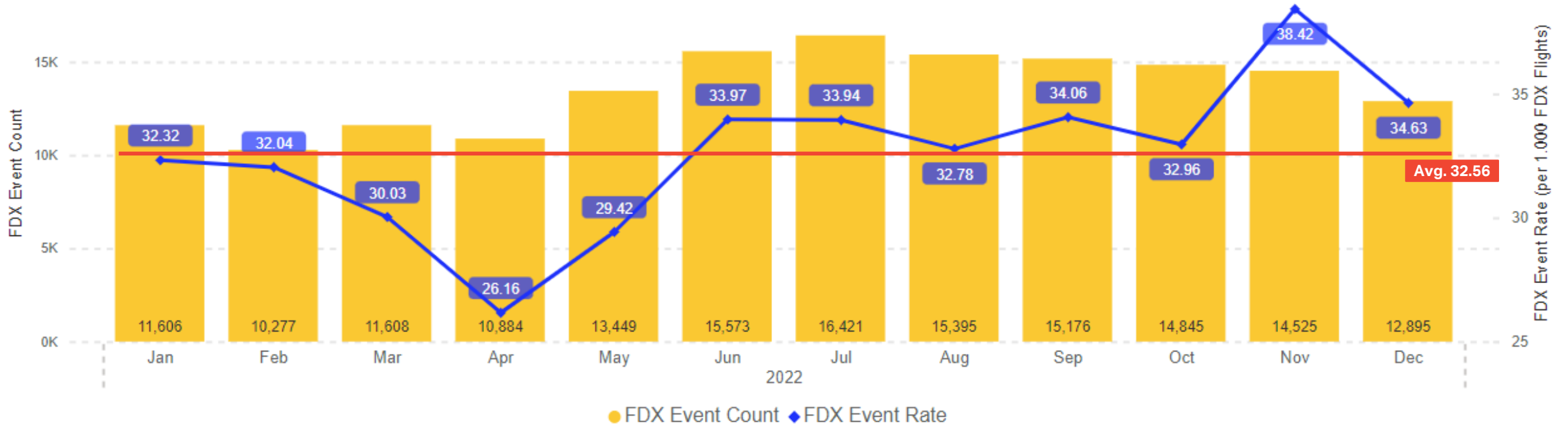
Adjacent States included in this analysis:

Türkiye



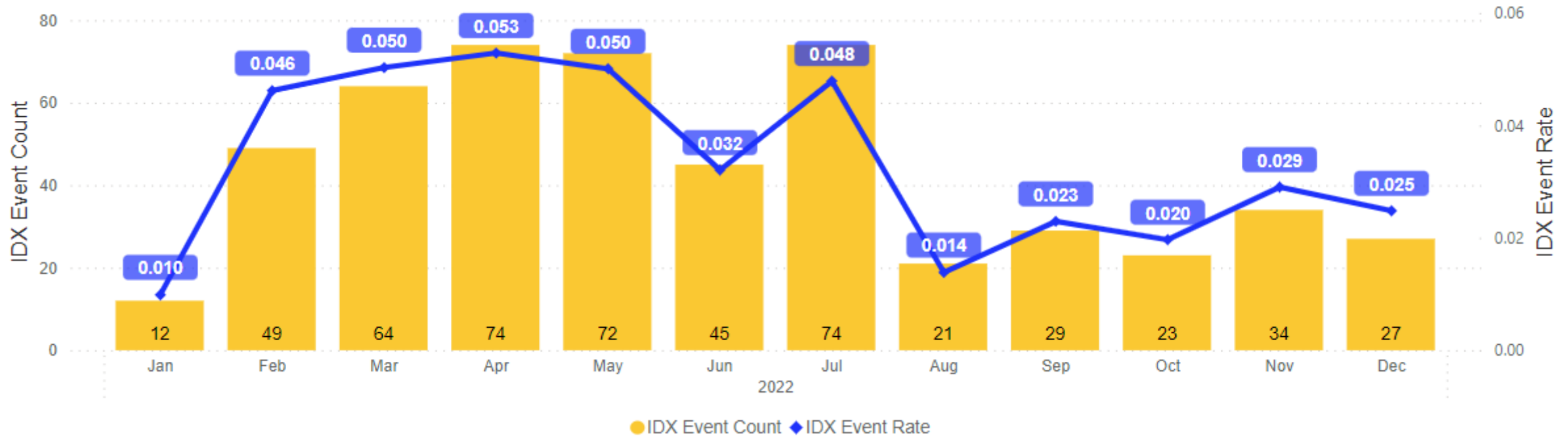
GNSS/GPS Interference Trend

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.

GNSS/GPS Interference Trend

FDX Event Rate per Departure – Arrival Region Combination

Departure	Arrival						
	AFI	ASPAC	CIS	EUR	MENA	NAM	NASIA
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



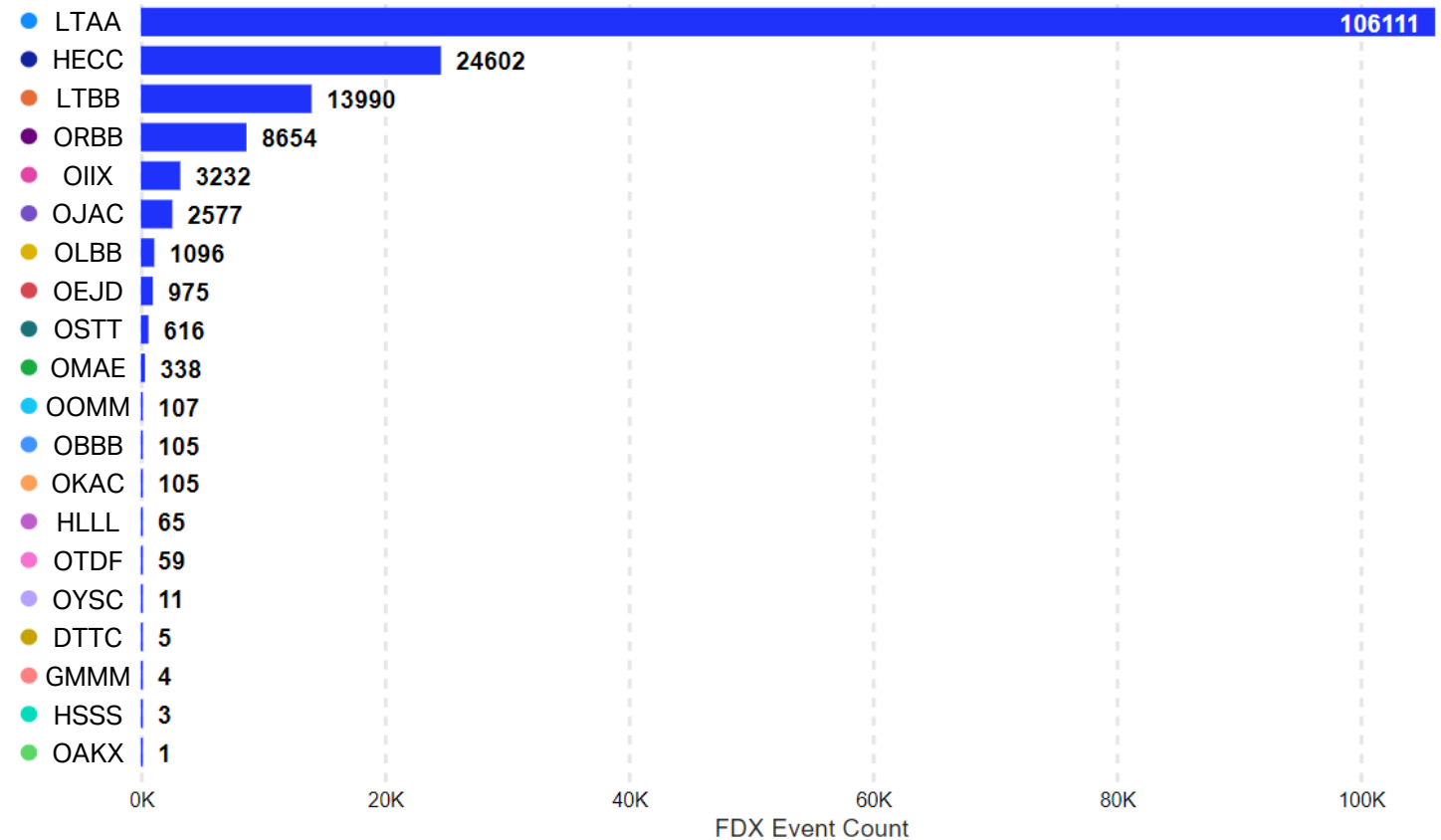
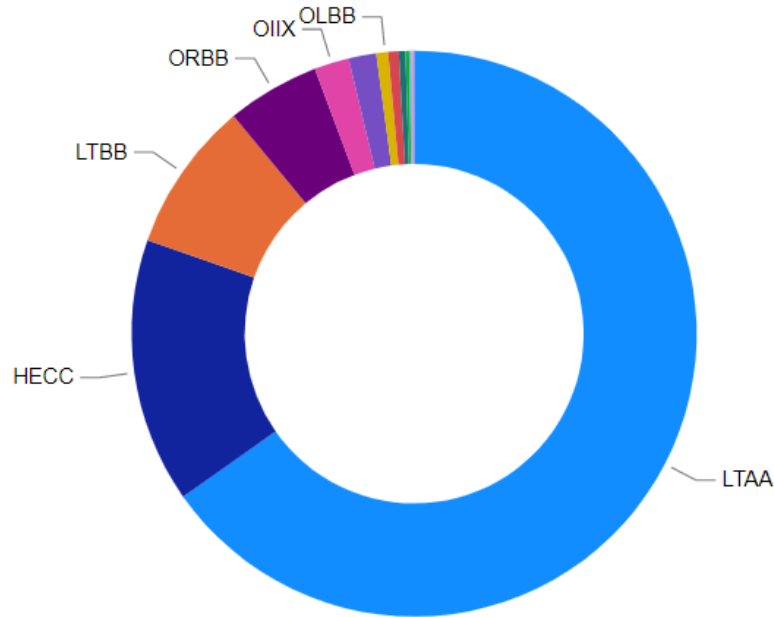
% over FDX GPS Signal Loss events

● <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

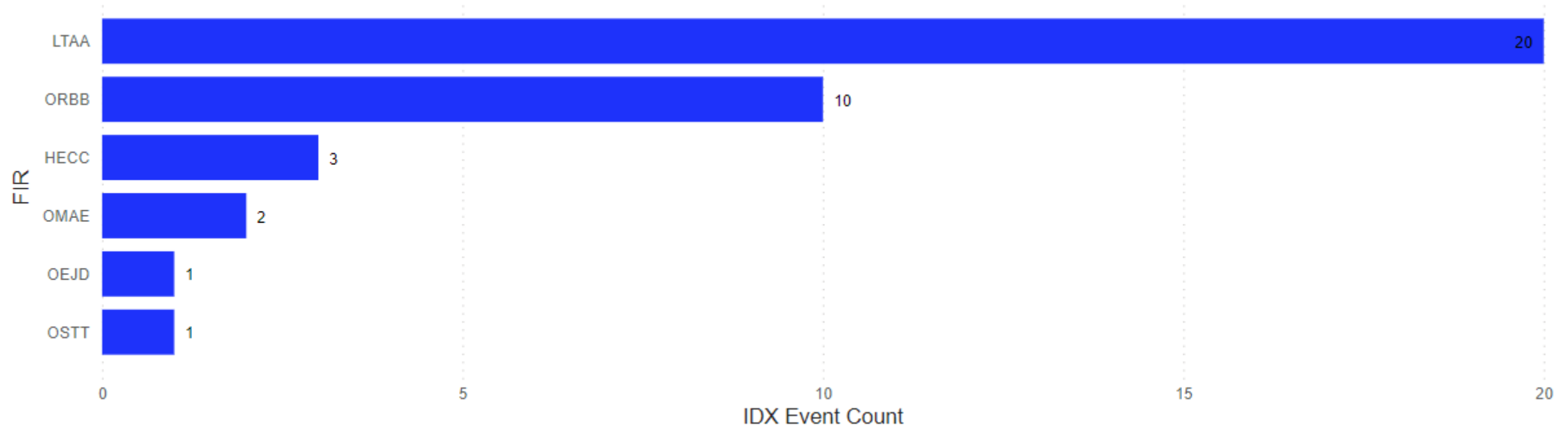
FDX GPS Signal Loss Event Count Per FIR

FDX GPS Signal Loss Event Count By FIR



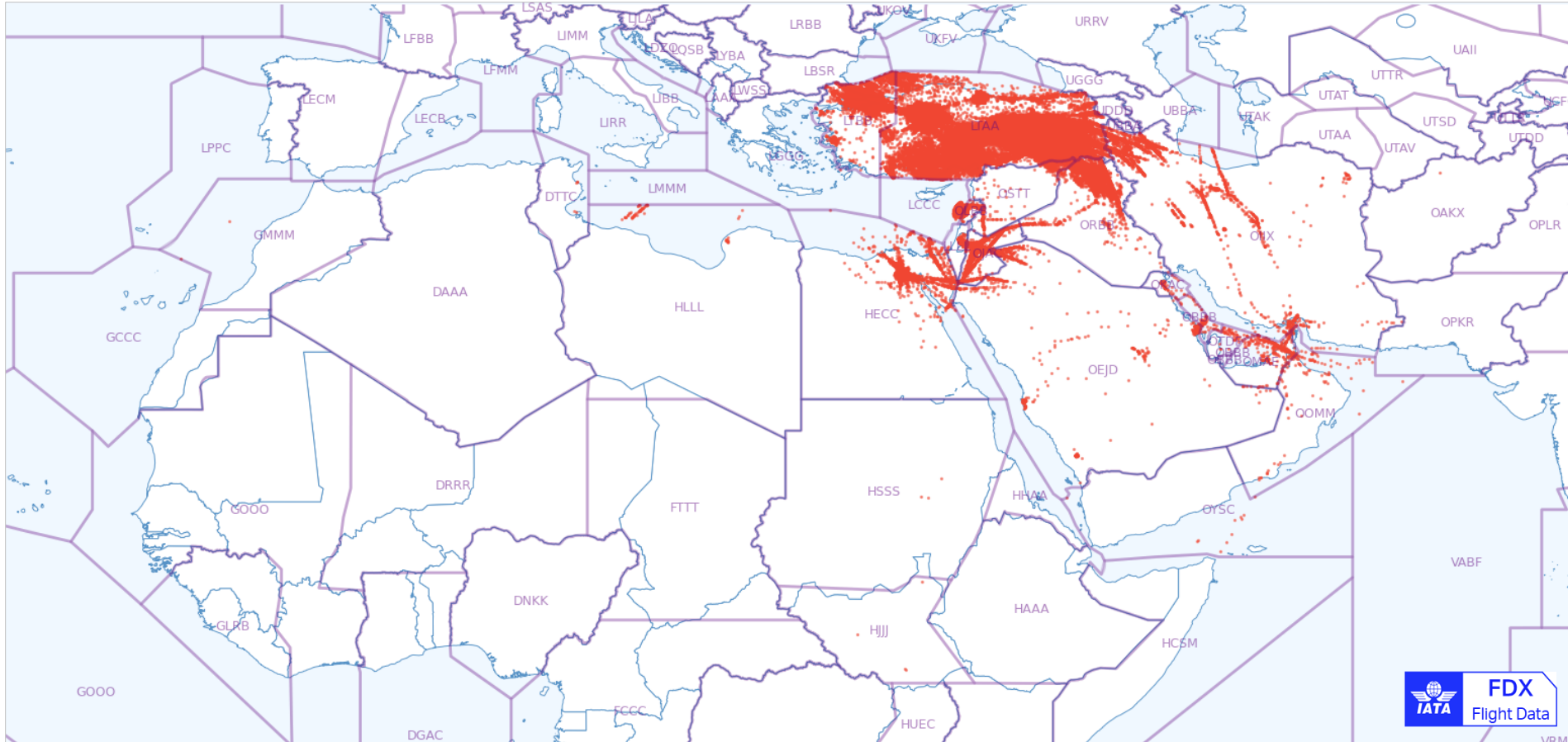
Distribution of GNSS Interference by FIR

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.

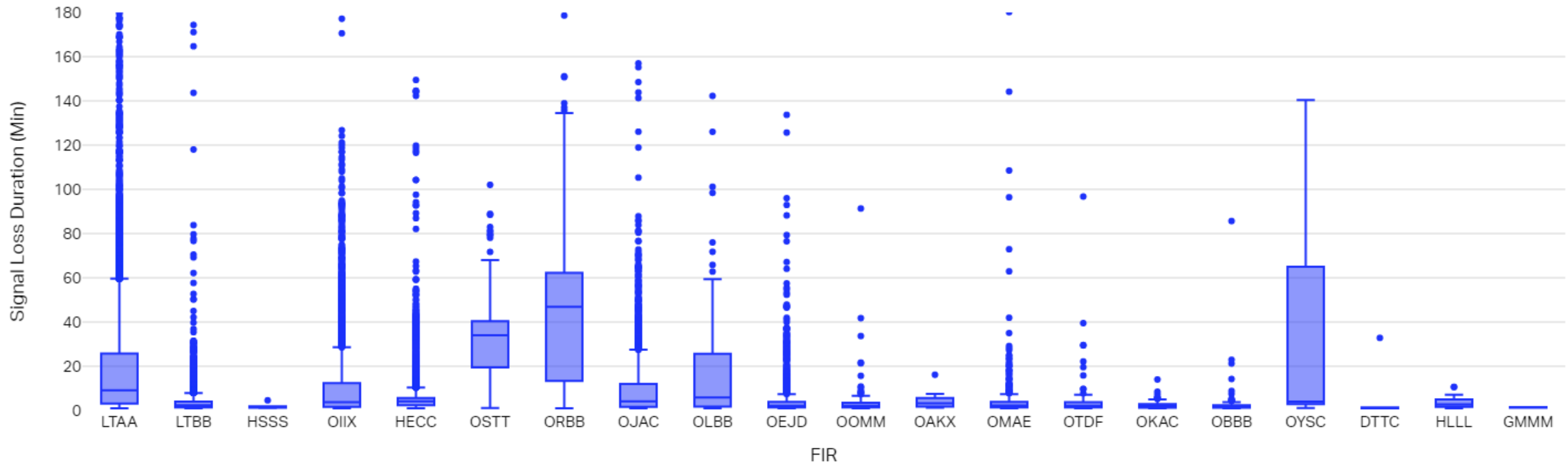
GPS Signal Loss Hot-Spots



- 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.

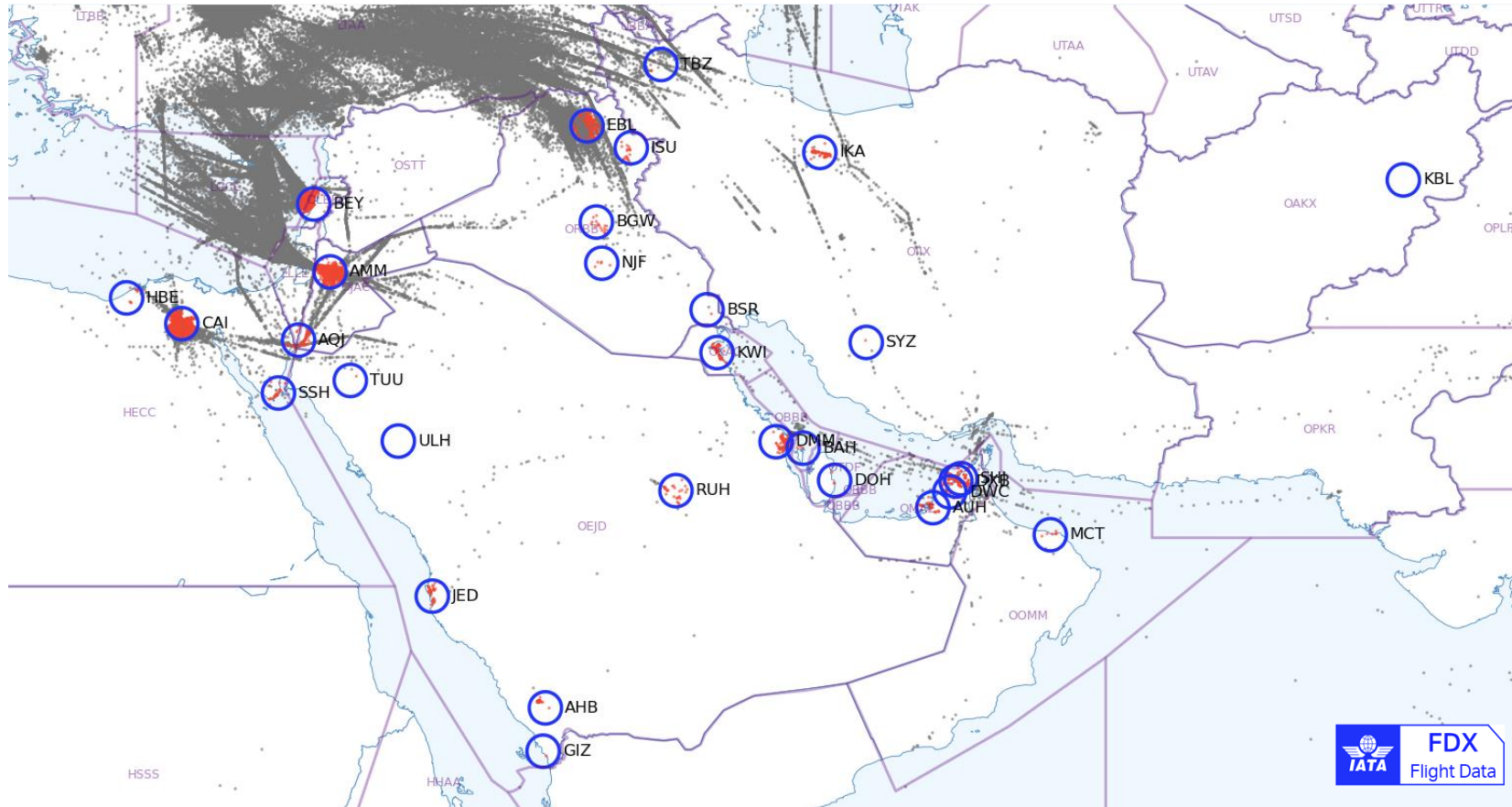
GPS Signal Loss Duration

GPS Signal Loss Duration (in Minutes) Distribution



- 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)



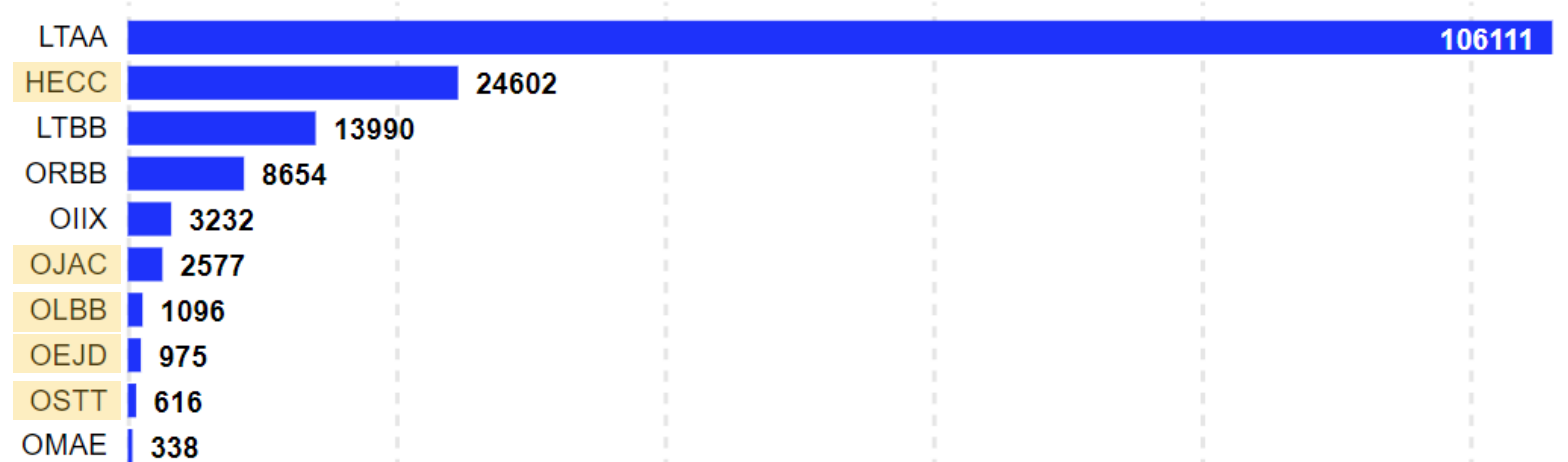
- The bar chart and table display the frequency of 'GPS Signal Loss' events during departure or arrival at airports in the MENA region.
- Cairo International Airport stands out as having a significantly higher frequency of events compared to other airports.
- This difference is clearly shown in both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

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

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.

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 NOTAM Issued

Examples of the NOTAM Texts in 2022

IT IS REPORTED BY PILOTS THAT **GPS SIGNALS** CAN NOT BE RECEIVED OCCASSIONALLY IN SOME PARTS OF TURKISH AIR SPACE.
PILOTS WHO PLAN RNAV FLIGHT OR EXECUTE RNAV/RNP PROCEDURES WITHIN TURKISH AIR SPACE ARE ADVISED TO BE CAUTIOUS ABOUT GPS SIGNAL LOSES.

CTN EXP POSS **GNSS ANOMALIES** MAY OCCUR DRG ALL PHASES OF FLT.

GNSS INTEREFERENCE EXP WI EMIRATES FIR

GPS(GNSS) FAILURE OR DEGRADATION WITHIN OID72 FROM GND UP TO UNL
PILOTS SHALL REPORT GPS(GNSS) ANOMALIES INCLUDING DEGRADED OPERATION AND/OR LOSS OF SERVICE, AS SOON AS POSSIBLE

GPS UNRELIABLE AND MAY BE UNAVAILABLE WITHIN AREA START FM AGINA TO DULAV MAGRI ARB AMBEX ROVON ALRAM AGINA FROM GND UPTO UNL PILOT SHALL REPORT GPS ANOMALIES INCLUDING DEGRADED OPERATION AND/OR LOSS OF SERVICE, AS SOON AS POSSIBLE.

DUE TO RECENT GLOBAL AND REGIONAL REPORTS OF **GNSS ANOMALIES**, PLEASE MONITOR AND REPORT ANY SUCH CONCERNS TO BAHRAIN ATC.

GUN FIRING RPA ACT WILL TAKE PLACE WI D72. ALSO **GPS(GNSS) FAILURE OR DEGRADATION** WITHIN OID72 FROM GND UP TO UNL.
PILOTS SHALL REPORT GPS(GNSS) ANOMALIES INCLUDING DEGRADED OPERATION AND/OR LOSS OF SERVICE, AS SOON AS POSSIBLE.

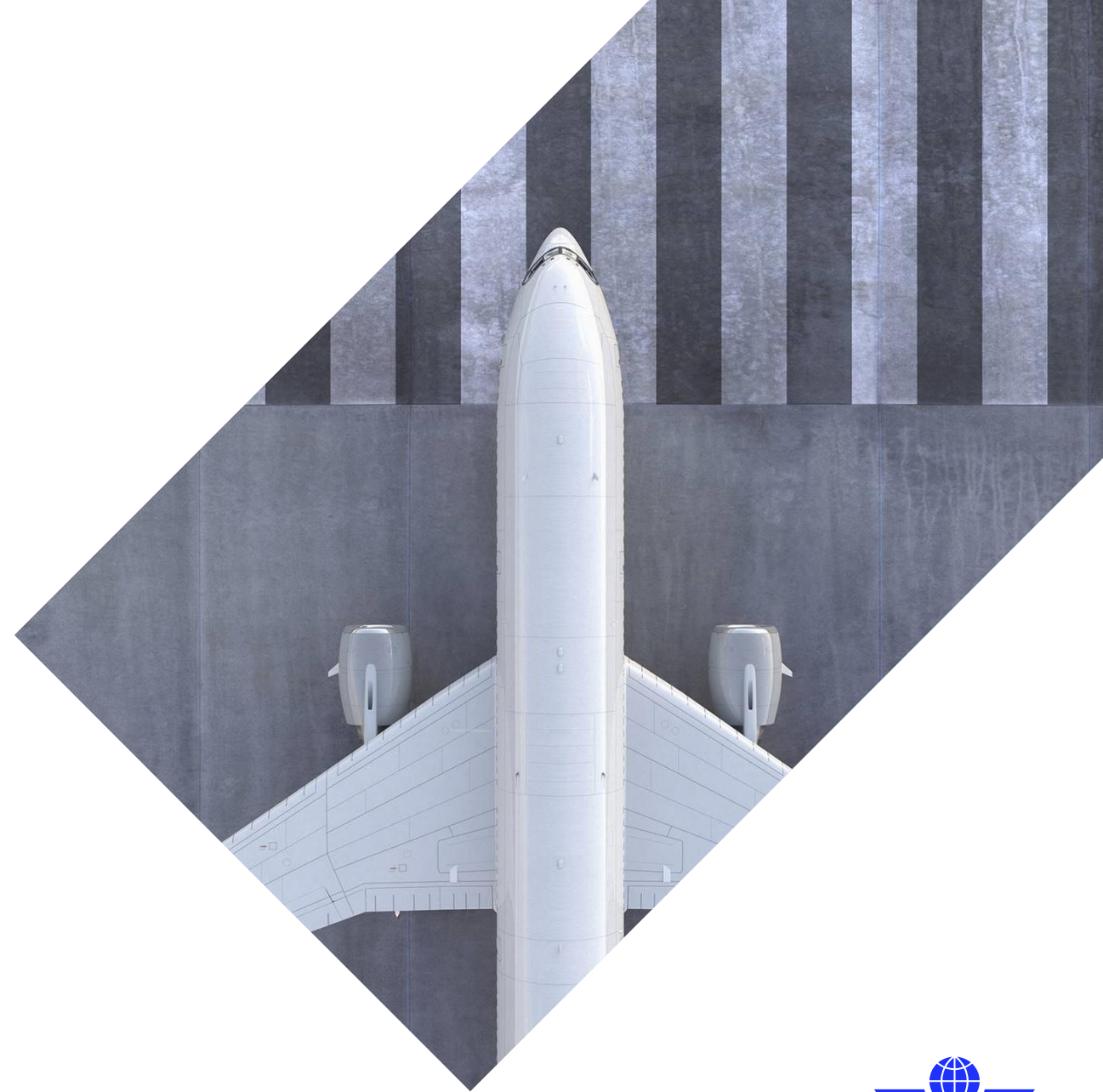
1-ALL AIRLINES FLYING THROUGH BAGHDAD FIR-ORBB SHOULD EXPECT **GPS JAMMING/GNSS INTERFERENCE** IN THE NORTHERN PART OF IRAQ ALONG THE ATS ROUTE UM688 FROM RATVO TO VAXEN.

2-ALL AIRLINES WITH DESTINATION ORER SHOULD EXPECT GPS JAMMING/GNSS INTERFERENCE DURING FINAL APPROACH PHASES.

3-PILOTS ARE EXPECTED TO INFORM THE RELEVANT ATS UNIT IN THE EVENT OF GPS SIGNAL OUTAGE IN ORDER TO REPORT IT TO THE CONCERNED AUTHORITIES AND TAKE THE APPROPRIATE ACTION TO ENSURE THAT ALL FLIGHT OPERATIONS ARE CARRIED IN SAFE AND EFFICIENT MANNER.

Acronyms List

- **ADS-B:** Automatic Dependent Surveillance - Broadcast
- **ANSP:** Air Navigation Service Provider
- **ASR:** Air Safety Report
- **ATM:** Air Traffic Management
- **ECAM:** Electronic Centralized Aircraft Monitor
- **EGPWS/GPWS:** (Enhanced) Ground Proximity Warning System
- **EICAS:** Engine-Indicating and Crew Alerting System
- **FIR:** Flight Information Regions
- **FMS:** Flight Management System
- **GADM:** Global Aviation Data Management
- **GNSS:** Global Navigation Satellite System
- **GPS:** Global Positioning System
- **IDX:** Incident Data Exchange
- **MENA:** Middle East and North Africa
- **ND:** Navigation Display
- **NOTAM:** Notice-to-Airmen
- **PBN:** Performance Based Navigation
- **RAIM:** Receiver Autonomous Integrity Monitoring
- **RASG-MID:** Regional Aviation Safety Group – Middle East
- **RNP:** Required Navigation Performance
- **TAWS:** Terrain Awareness and Warning System



Thank you.

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