

# GNSS & RWY safety

## EVAIR findings

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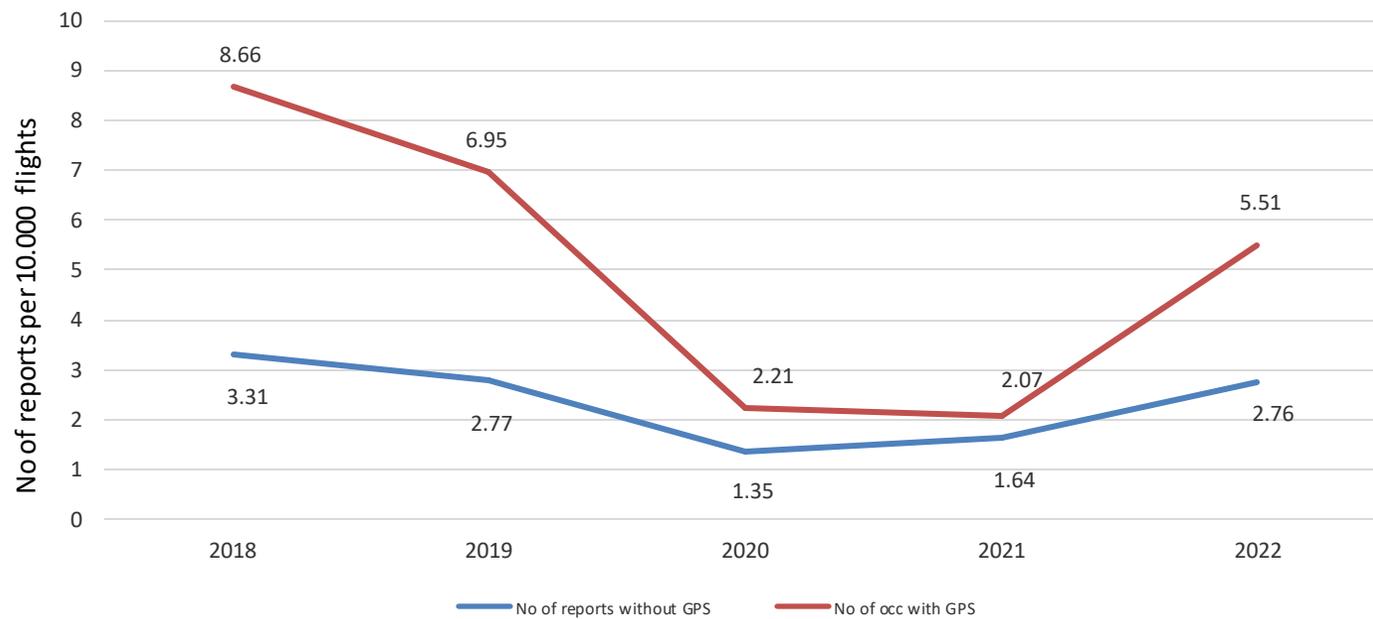
Supporting  
European  
Aviation



# EVAIR – ATM and GNSS outages reports



ATM trends with and without GPS  
2018-2022

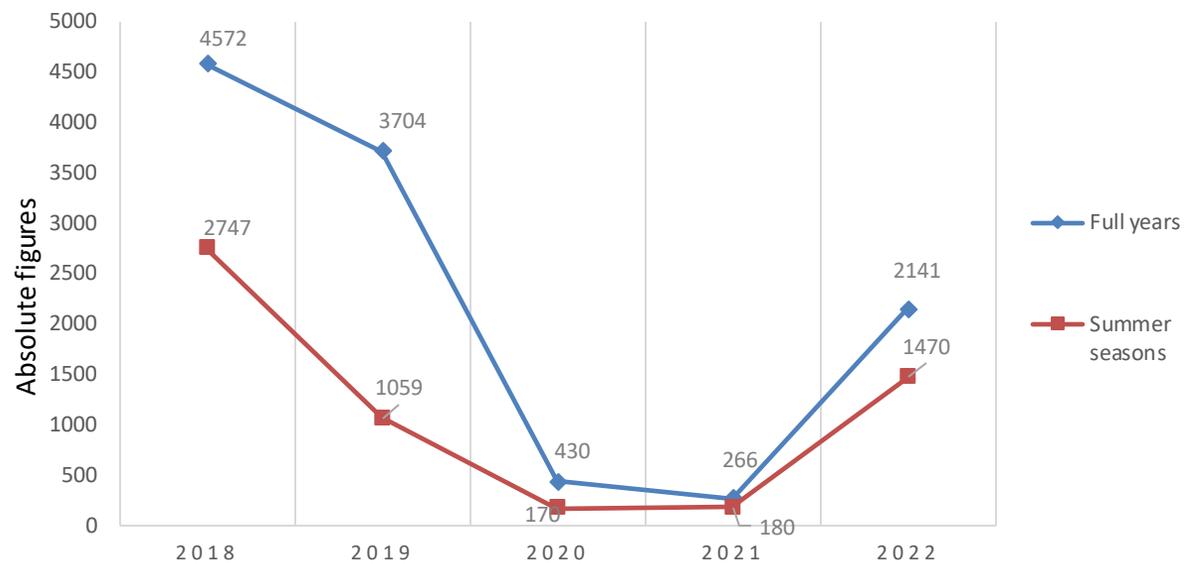


**9139** AO/ANSPs reports

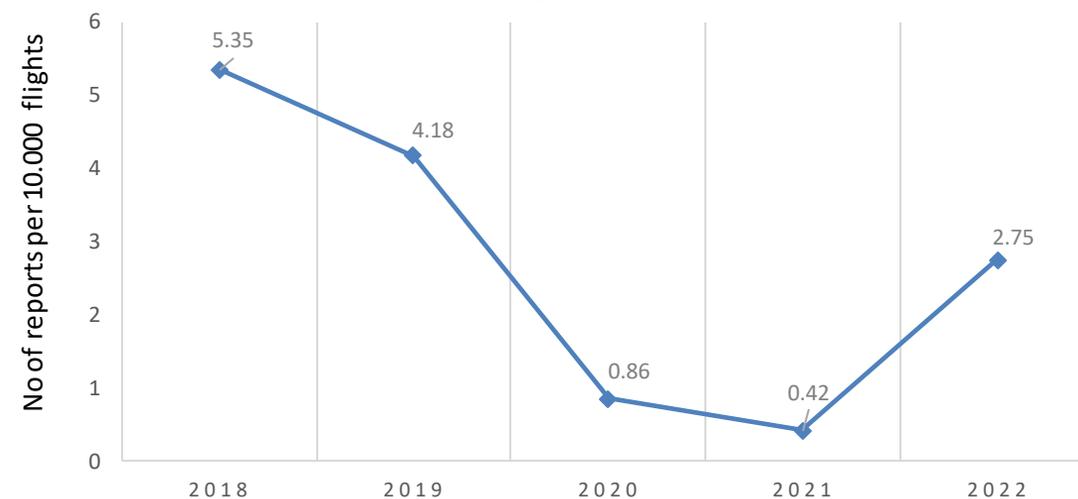
**11113** GPS Outage reports

# EVAIR GNSS summer and full years 2018-2022

### GPS OUTAGES 2018-2022



### GPS OUTAGES 2018-2022

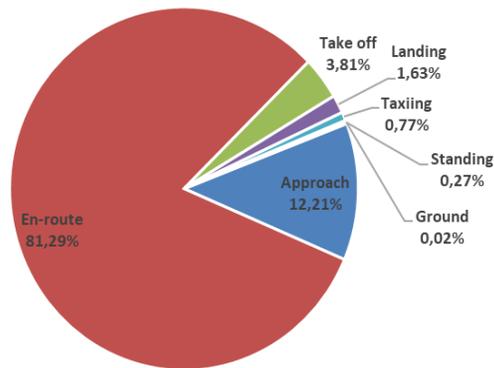


# EVAIR GNSS analysis airspace & traffic flows affected

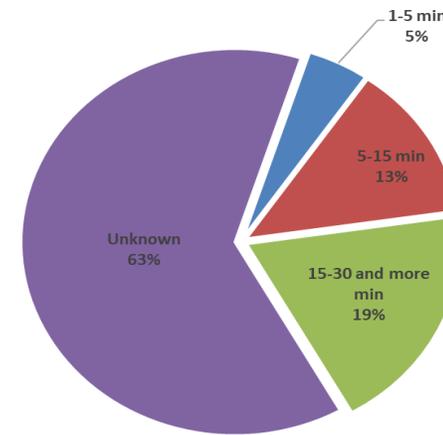


- More than 100 FIRs affected
- Turkish airspace for the traffic to/from Europe – Middle East and the traffic to/from the East to the South East Mediterranean across Turkey
- South – East Mediterranean for the traffic to/from Europe
- Middle East – Mainly the traffic to/from Europe
- Middle East – Canada and America via Cross polar routes
- European airspace during approach to main hubs- about
- For about 20 % of flights this information is not available.

GPS outages/interferences phases of flight 2018-2022



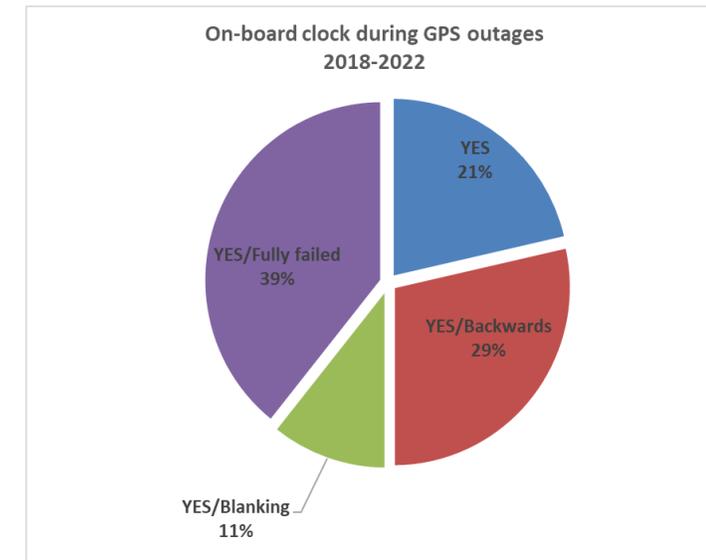
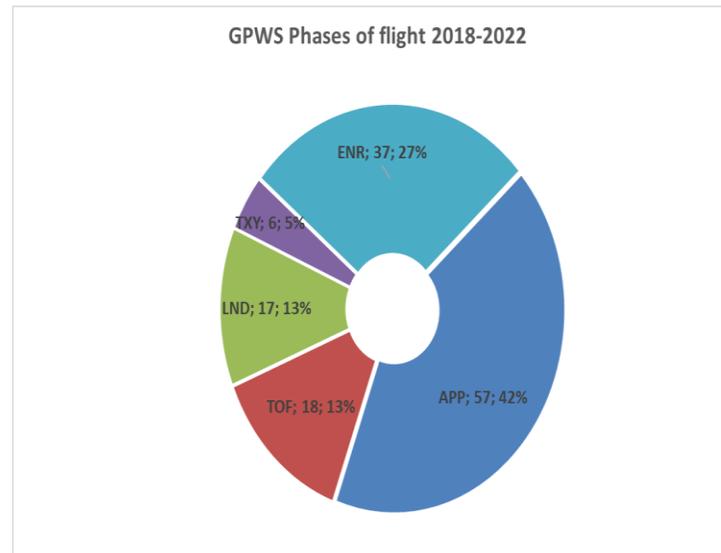
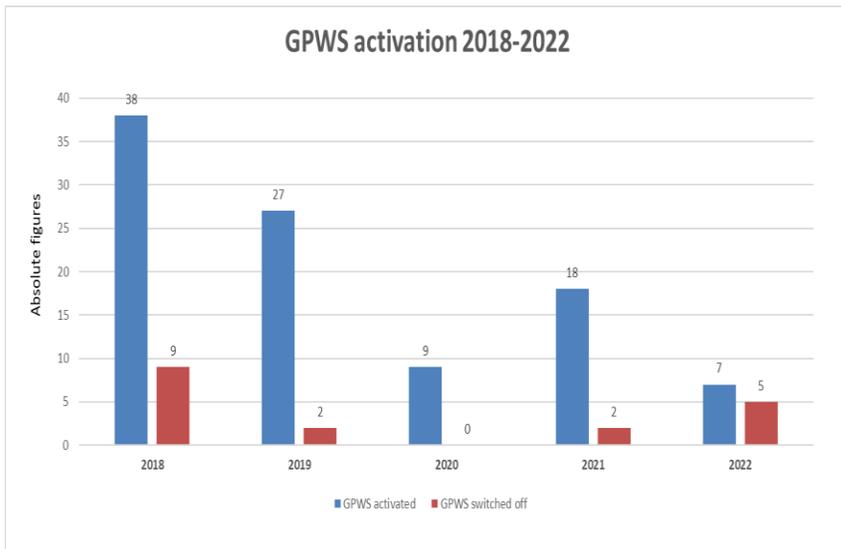
GPS outages duration 2018-2022



# EVAIR – GNSS analysis - frequent problems reported



- Failure of one or both GPS boxes
- Disagreement between GPS positions and NAV FMSs
- Inability to fly RNP and request for radar vectoring
- Wrong wind and ground speed presentations
- Loss of ADS-B L/R
- Aircraft clocks L/R/both failed or began to count backwards
- Terrain warnings – pull up requests.



# EVAIR EXAMPLES OF PILOTS' NARRATIVE

04/03/2023 Jamming event in Turkish airspace, en route to VADEN (between 60 nm to 30 nm southeast) led to AMBER CAS ADS-B OUT, SVS FAIL CYAN CAS, and GNSS NOT AVAILABLE notifications.

08/03/2023 GPS L/R invalid signal encountered from waypoint ABKAL until SOBIL. DME update in FMC manually switched from OFF to ON in order to keep ANP below 1.00. Uneventful continuation of flight

10/03/2023 During initial climb out, before passing 2000 feet, ADS-B RPTG 1 than 2 failed, followed by GPS 1 than 2 failing. Systems didn't recover until flight completion.

14/03/2023 When passing FL290 we got ECAM message "NAV ADS-B RPTG 1(2)FAULT" at the same time we lost all three GPS. The GPS MONITOR page in MCDU showed only dashes and no info were available. However, we had GPS PRIMARY and accuracy HIGH indicated on the PROG page. No indications of any navigation failures or problems. All three GPS came back again when passing FL 100 descending. During climb out another crew experienced the same thing in approximately the same area.

01/02/2023 Crew reported GPS FAILURE. ACFT position: W part of LUKK TMA – SEC 1. Radial 220 Distance 8NM from KIV VOR, FL60.

24/02/2023 During cruise in Turkish Airspace, under control of Ankara Frequency 127.925, were cleared to proceed direct to waypoint OTKEP. On the CDU legs page OTKEP was selected and transferred to L1 PSN on page 1. Prior to executing the change, observed the following 1. The FMA indication from SPD/LNAV/VNAV PTH, with the Autopilot engaged changed to SPD/LNAV/VNAV PTH with associated AMBER line across the pitch and roll mode, indicating the degraded mode of the Pitch and Roll mode. 2. Both L and R CDU displays temporary became BLANK for approx. 3-5 seconds. 3. Upon recovery of both CDUs, observed the legs pages were no longer active, indicated by CYAN on the ND displays. Some performance data were observed to be missing; ZFW, Reserves, COST INDEX and CRZ ALT. 4. Reverted to basic modes by selecting HDG and FLCH, on the MCP with associated FMA SPD/HDG/ALT 5. CDU data were entered, validated and verified, prior to Executed. LNAV an VNAV were reengaged, and flight continued to DOH without any further events. 6.N.B. Prior to the incident, GPS interference were also affecting the Navigation of the aircraft, as this is a normal occurrence in Turkish Airspace.

20/01/2023 GPS 1 fault with ADSB REPORTING 1 and 2 fault on UR660 from DASIS to ERZ UL704 to SONAD UL746 to ODERO.



# Pilot feedback and requirements collected by NAV

- There is no GPS JAMMING light



- Multiple systems affected making failure analysis difficult

## Conclusions



### GNSS signal interference

- Flight deck effects not easily tied to GPS jamming
- Flight crew workload increased
- Negates PBN operations. Often not only for the duration of the outage.
- Warrants solid contingency procedures
- A/C navigation performance depends on available DMEs
- DME grid necessary as Minimum Operating Network

## Our mitigations

- High level of flight crew awareness
- Flight crew contingency procedures
- Flight crew simulator training with GNSS PVT degradation
- Airbus configured with multi constellation MMR (less susceptible to jamming)

# Ground Requirement

## On-ground problems

- Loss of some **surveillance** capabilities (ADS-B, ADS-C)
  - Possible loss of **communication** CPDLC
  - **ATC workload** increase
  - Capacity reduction
- 
- 2014: Preparation for EU PBN Implementing Rule:
    - ATC Human in the Loop Impact Studies for impact assessment including GPS Loss
    - Budapest simulation, high level of “GPS-only for PBN” traffic (20%)
    - ATCO Statement: **“I can deal with GPS RFI, just tell me when it starts, how many sectors are affected, and when it ends”**
  - Validated OPS Requirement through EUROCONTROL NETOPS
    - **NETOPS Conclusion 23/10:** NETOPS agreed the following recommendations:
    - *b) With reference to paragraph 3.2: confirm the **Operational need to be aware of the geographic area of GPS outages and that they (ATC) intend to use this information in the context of contingency operations.***

# AWARENESS - GNSS weekly updates: NOTAMs & EASA SIB



## LTBB - ISTANBUL FIR

### EN-ROUTE

- + PILOTLAR TARAFINDAN TURK HAVA SAHASININ BAZI BOLUMLERINDE GPS SINYALLERININ ZAMAN ZAMAN ALINAMADIGI RAPOR EDILMEKTEDIR. TURK HAVA SAHASINDA RNAV UCUS DUZENLEYECEK VEYA RNAV/RNP USULLERINI UYGULAYACAK PILOTLARIN YASANABILECEK GPS SINYAL KAYIPLARINA KARSI MUTEYAKKIZ OLMALARI TAVSIYE EDILIR.  
FROM: 09 JAN 2023 06:18 TO: 07 APR 2023 12:00 EST G0160/23
- + IT IS REPORTED BY PILOTS THAT GPS SIGNALS CAN NOT BE RECEIVED OCCASIONALLY IN SOME PARTS OF TURKISH AIRSPACE. PILOTS WHO PLAN RNAV FLIGHT OR EXECUTE RNAV/RNP PROCEDURES WITHIN TURKISH AIRSPACE ARE ADVISED TO BE CAUTIOUS ABOUT GPS SIGNAL LOSSES.  
FROM: 09 JAN 2023 06:20 TO: 07 APR 2023 12:00 EST A0180/23

## LTAA - ANKARA FIR

### EN-ROUTE

- + A) LTRC  
MRD VOR/DME 116.9MHZ/CH116X, VOR KISMI CALISMAMAKTADIR.  
-GPS KAYBI NEDENIYLE UCUS KONTROL GERCEKLESMEDIGINDEN-  
FROM: 10 DEC 2022 21:01 TO: 10 MAR 2023 21:01 G7490/22
- + A) LTAJ  
GAZ VOR/DME 116.7 MHZ/CH114X, VOR KISMI CALISMAMAKTADIR.  
-GPS SINYAL KAYBI NEDENIYLE UCUS KONTROL TESTI YAPILAMADIGINDAN-  
FROM: 30 DEC 2022 07:34 TO: 01 MAR 2023 14:00 G7883/22

## LCCC - NICOSIA FIR

### EN-ROUTE

- + GNSS SIGNAL INTERRUPTIONS HAVE BEEN REPORTED WITHIN NICOSIA FIR. PILOTS ARE REQUESTED TO REPORT TO ATC. WITHIN TMA CONVENTIONAL INSTRUMENT PROCEDURES ARE AVAILABLE ON PILOT REQUEST  
FROM: 08 JAN 2023 21:06 TO: 08 APR 2023 23:59 EST A0006/23

## LFMM - MARSEILLE

### EN-ROUTE

- + INTERFERENCES OF GPS RECEIVER (GNSS JAMMING) FROM DIFFERENT POSITIONS  
CENTRED ON AVG PSN 434238N 0024611E  
- POTENTIAL RISK OF INTERFERENCE, IMPACT VOLUME CENTRED ON COORDINATES ABOVE :  
260NM AT FL400  
209NM AT FL250  
145NM AT FL150  
137NM AT FL100  
92NM AT 4000FT  
INFO :  
RAMBERT ('CDC' OF LYON MONT VERDUN) 143.550MHZ / 317.500MHZ  
MARSAN ('CDC' OF MONT DE MARSAN) 143.550MHZ / 317.500MHZ  
- IN CASE OF OBSERVED GPS INTERFERENCE, REPORT THE INFORMATION TO THE COMPETENT ATS SERVICE.  
IN CASE OF INTERFERENCE OF AIR TRAFFIC BY THE GPS INTERFERENCE, THE HEAD OF OPERATIONAL PERMANENCE OF THE OPERATIONS DEPARTMENT ('RPO DO') WILL STOP THE INTERFERENCE.  
FROM: 20 FEB 2023 13:30 TO: 26 FEB 2023 21:00 F0237/23  
SCHEDULE: 20 1330-1630, 21 0830-1000 1200-1630 2100-2300, 22 1200-1630 2100-2300, 23 0830-1030 1300-1630 1900-2100, 24 0830-1030 1330-1630, 25 0800-1100 1800-2100, 26 0800-1100 1430-1700 1800-2100

## LFBB - BORDEAUX

### EN-ROUTE

- + POSSIBLE GNSS JAMMING, DISTURBANCE OF THE SIGNAL RECEIVED BY GPS RECEIVERS IN THE 'CAPTIEUX' AREA, POSSIBLE 360 DEGREE INTERFERENCE ORIENTATION.  
-PSN : 441232N 0001805W  
IMPACT VOLUME : HALPH-SPHERE OF 40NM RADIUS CENTRED ON PSN  
-INFO, ATS SERVICES AWARE OF THE JAMMING :  
MARSAN 122.100MHZ  
AQUITAINE INFO 120.575MHZ  
PYRENEES APP 128.800MHZ  
-IN CASE OF OBSERVED GPS INTERFERENCE, REPORT THE INFORMATION TO THE COMPETENT ATS SERVICES.  
FROM: 14 FEB 2023 07:00 TO: 24 FEB 2023 17:00 F0192/23  
SCHEDULE: 0700-1700

## EPWW - WARSZAWA FIR

### EN-ROUTE

- + PRECAUTION - GNSS SIGNAL INTERFERENCE CAN BE EXPECTED IN THE NORTH-EAST AND EAST PART OF FIR EPWW. AIR CREWS ARE ASKED TO INFORM AN ATC OF ANY GNSS INTERFERENCE ANOMALIES.  
FROM: 13 FEB 2023 16:16 TO: 14 MAR 2023 23:59 EST C0118/23
- + OSTRZEZENIE - ZAKLOCENIA SYGNALU GNSS MOGA WYSTEPOWAC W POLNOCNO-WSCHODNIEJ I WSCHODNIEJ CZESCI FIR EPWW. ZALOGI PROSZONE SA O INFORMOWANIE ATC O ZAKLOCENIACH SYGNALU GNSS.  
FROM: 13 FEB 2023 16:19 TO: 14 MAR 2023 23:59 EST M0118/23

EASA SIB No.: 2022-02R1



## Safety Information Bulletin

Operations – ATM/ANS

SIB No.: 2022-02R1

Issued: 17 February 2023

**Subject:** Global Navigation Satellite System Outage Leading to Navigation / Surveillance Degradation

**Revision:**  
This SIB revises EASA SIB 2022-02 dated 17 March 2022.

**Ref. Publications:**  
None.

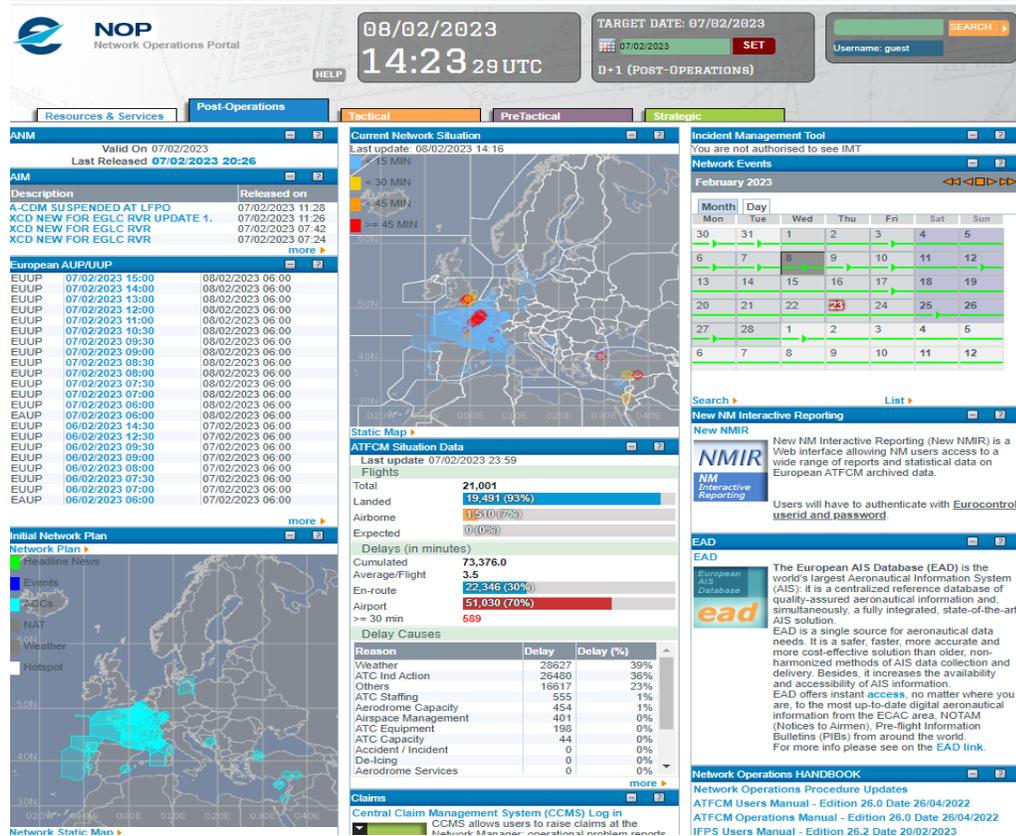
**Applicability:**  
National Aviation Authorities (NAAs), Air Navigation Service Providers (ANSPs) and air operators.

**Description:**  
Since February 2022, there has been an increase in jamming and or possible spoofing of Global Navigation Satellite Systems (GNSS). This issue particularly affects the geographical areas surrounding conflict zones but is also present in the eastern Mediterranean, Baltic Sea and Arctic area.

EASA has analysed data from the Network of Analysts and open sources, and has concluded that GNSS jamming and/or spoofing has intensified in recent months. The main affected flight information regions (FIR) are:

- The Black Sea area:
  - FIR Istanbul LTBB, FIR Ankara LTAA
  - Eastern part of FIR Bucuresti LRBB, FIR Sofia LBSR
  - FIR Tbilisi UGGG, FIR Yerevan UDDD, FIR Baku UBBA
- The southeastern Mediterranean area, Middle East:
  - FIR Nicosia LCCC, FIR Beirut OLBB, FIR Damascus OSTT, FIR Tel Aviv LLLL, FIR Amman OJAC, northeastern part of FIR Cairo HECC
  - Northern part of FIR Baghdad ORBB, northwestern part of FIR Tehran OIIX
  - Northern part of FIR Tripoli HLLL
- The Baltic Sea area (FIRs surrounding FIR Kaliningrad UMKK):
  - Western part of FIR Vilnius EYVL, northeastern part of FIR Warszawa EPWW, southwestern part of FIR Riga EVRR
- Arctic area:
  - Northern part of FIR Helsinki EFIN, northern part of FIR Polaris ENOR

# AWARENESS - NM information communication



The screenshot shows the Network Operations Portal (NOP) interface. At the top, it displays the date 08/02/2023 and time 14:23 29 UTC. The interface is divided into several sections:

- Resources & Services**: Includes a search bar and user information (Username: guest).
- Post-Operations**: Contains a table of flight releases with columns for Description, Released on, and a 'more' link.
- Current Network Situation**: Features a map of Europe with various colored markers indicating network status.
- ATFCM Situation Data**: Provides a summary of flight statistics:
 

Total	21,001
Landed	19,491 (93%)
Airborne	1,510 (7%)
Expected	0 (0%)
- Delays (in minutes)**: Shows cumulative and average flight delays:
 

Cumulated	73,376.0
Average/Flight	3.5
En-route	22,346 (30%)
Airport	51,030 (70%)
>= 30 min	689
- Delay Causes**: A table detailing the reasons for delays:
 

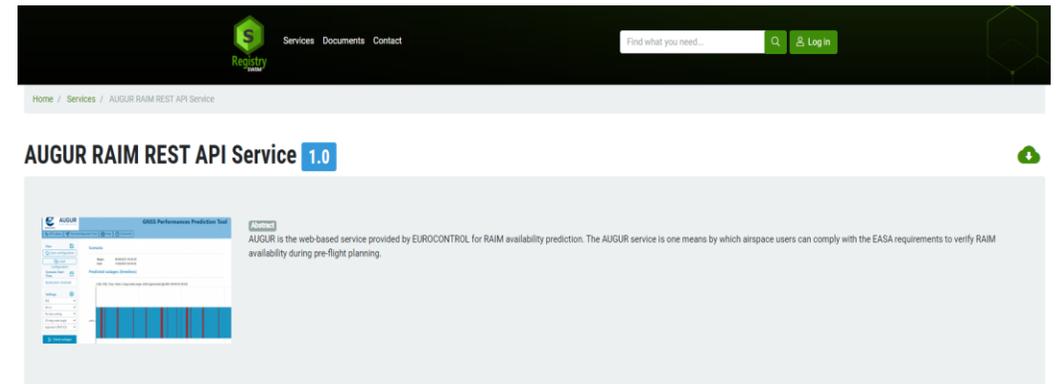
Reason	Delay	Delay (%)
Weather	28627	39%
ATC Ind Action	28400	36%
Others	16617	23%
ATC Staffing	555	1%
Aerodrome Capacity	454	1%
Airspace Management	401	0%
ATC Equipment	198	0%
ATC Capacity	44	0%
Accident / Incident	0	0%
De-icing	0	0%
Aerodrome Services	0	0%
- Initial Network Plan**: Includes a map and a table of flight releases.

## GNSS Operational Status Information



The following section contains the latest information available on GNSS operational status across the network. It shows where aircraft avionics have reported a degraded or unavailable GNSS position. The most common cause for such degradations is radio frequency interference. An update is provided on a weekly basis in the following link: [GNSS update](#)

- 1<sup>st</sup> step
  - Weekly updates via the public NOP portal
- Next step: Integrated NM B2B service
  - providing real-time network situational awareness and supporting collaborative decision making (CDM) processes
  - SWIM compliant
  - Request/Reply or Publish/Subscribe
  - Accessible 24 hours a day, 7 days a week



The screenshot shows the AUGUR RAIM REST API Service interface. It includes a search bar, a 'Log in' button, and a table of flight releases. The table has columns for 'Flight' and 'Status'.

**AUGUR RAIM REST API Service 1.0**

AUGUR is the web-based service provided by EUROCONTROL for RAIM availability prediction. The AUGUR service is one means by which airspace users can comply with the EASA requirements to verify RAIM availability during pre-flight planning.

# GNSS interference course - [NAV-GNSS-RFI]

Learning Zone




**GNSS Radio Frequency Interference [NAV-GNSS-RFI]**  
 Classroom Course  
 Course available 7 Jun 2023 09:00 to 8 Jun 2023 17:00  
 Classroom Course EUROCONTROL Aviation Learning Centre 

<https://learningzone.eurocontrol.int/llp/pages/description.jsf#/users/@self/catalogues/896269/coursetemplates/17804270/description>

## Target audience and objectives:

The course provides strategies and tools for those who wish to implement mitigation measures against GNSS interferences or those who wish to obtain a broad understanding of GNSS interference and its effects on aviation. It will also include a group work/discussion to focus on the main problems the audience is facing with regard to GNSS interferences.

DAY/TIME	09:00	12:30	13:30	17:00	
DAY 1	Introduction	GNSS vulnerabilities	Sources of GNSS interferences	Impact of GNSS interferences	
DAY 2	Impact of GNSS interferences		GNSS interference mitigation	GNSS interference mitigation	Debrief

## Location

Aviation Learning Centre, Luxembourg

## Dates

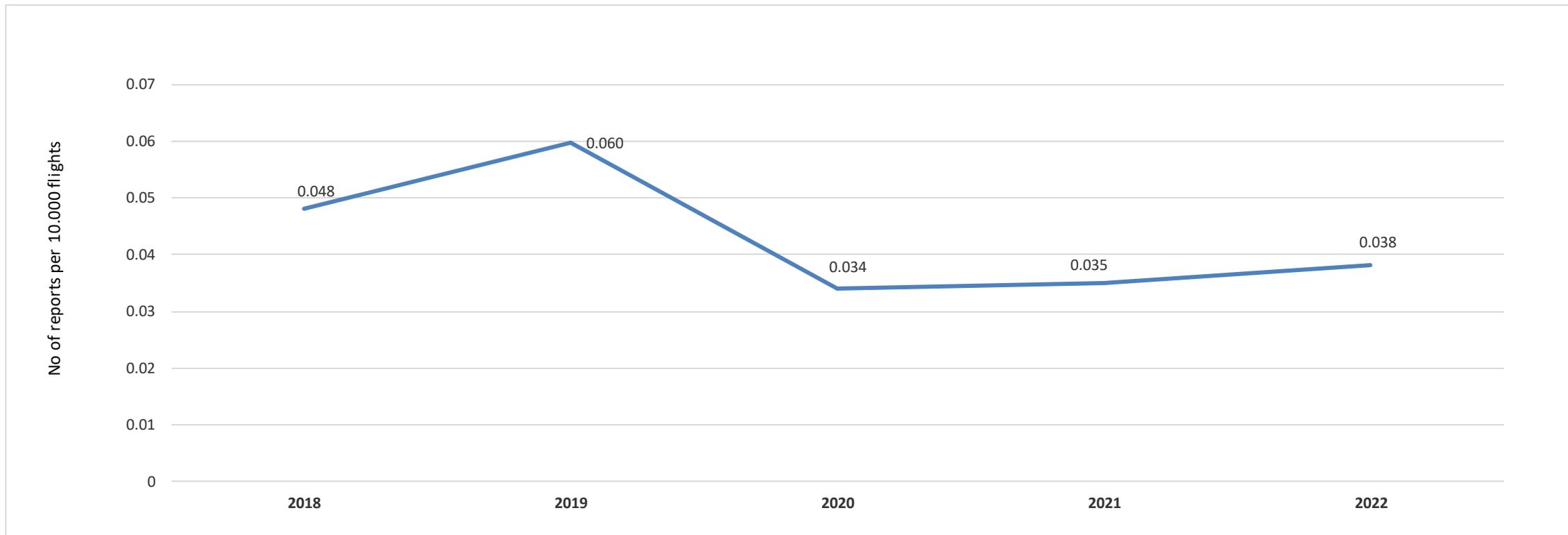
7-8 June 2023

If interested contact:

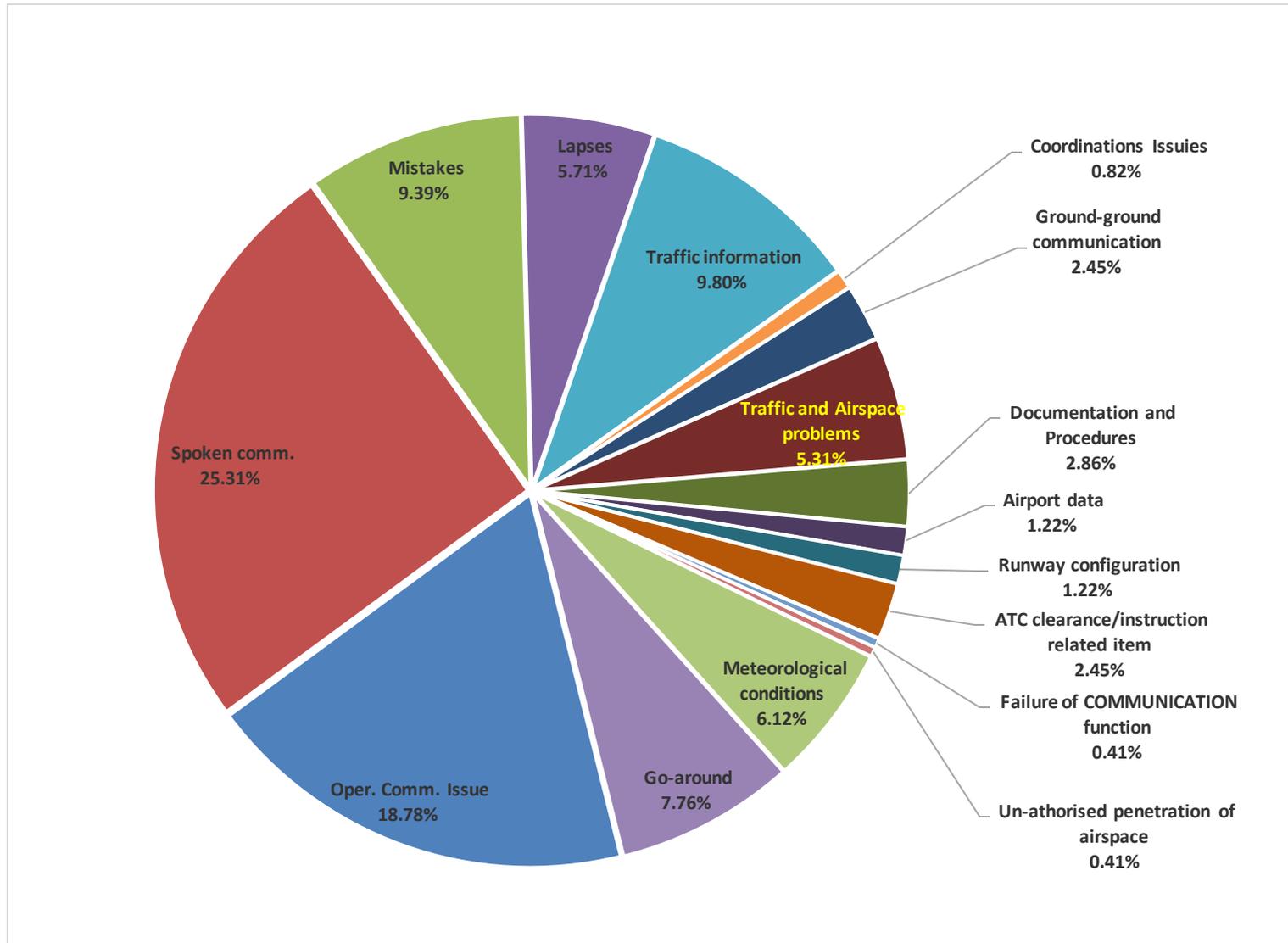
[hamdi.nasser@eurocontrol.int](mailto:hamdi.nasser@eurocontrol.int)  
[gerhard.berz@eurocontrol.int](mailto:gerhard.berz@eurocontrol.int)  
[charlie.eliot@eurocontrol.int](mailto:charlie.eliot@eurocontrol.int)

## **EVAIR Runway Incursion findings**

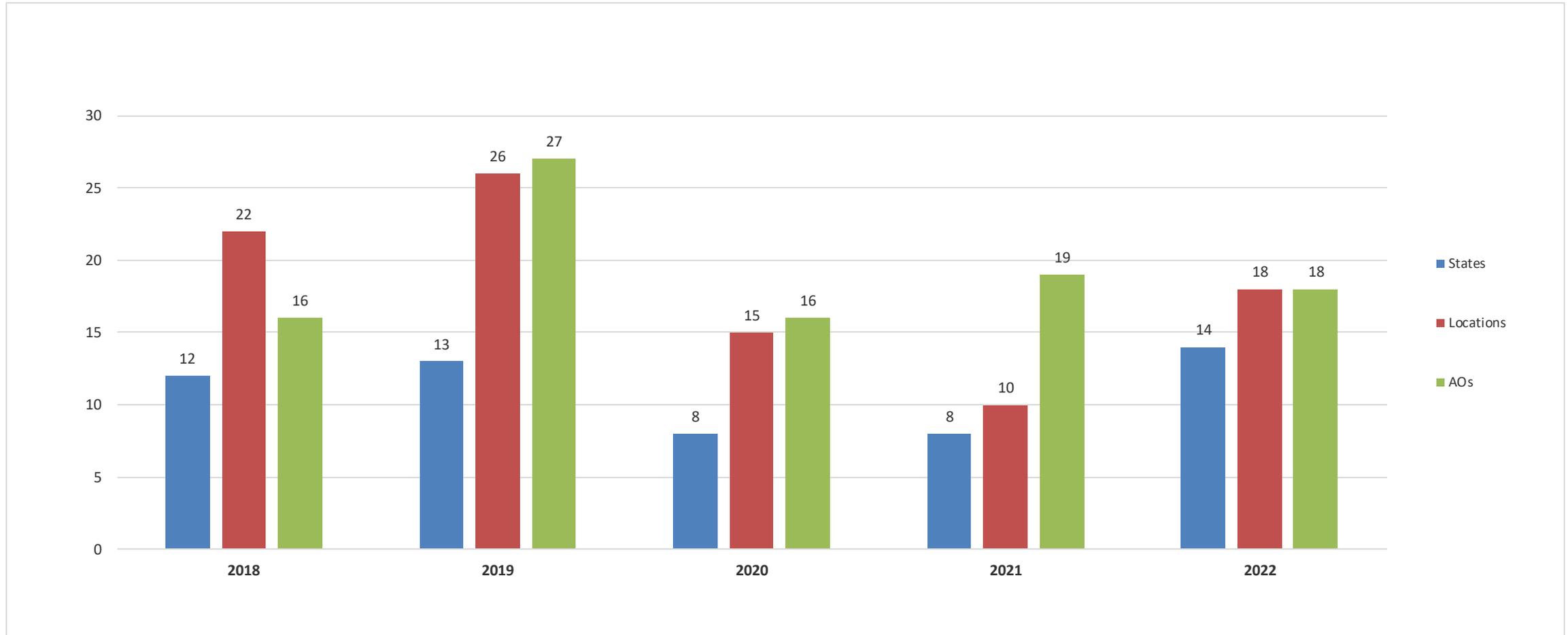
# EVAIR Runway Incursion 2018-2022



# Runway Incursion Contributory factors



# States, locations and AOs affected or participating in Runway incursion 2018-2022



# EUROCONTROL activities and plans



## Continuous monitoring and information data collection

- Daily information/incident provision to EVAIR and upload into the DB
- Publication of analysis – EVAIR Bulletin and customized analysis
- Survey with ANSPs of A and B risk severity Runway Incursion occurrences as part of the Top 5 EUROCONTROL safety concerns
- Publication of report

## Preparation of the Global Action Plan for the Prevention of Runway Incursion (GAPPRI)

- Coordination and discussion with all SHs including IATA
- Inventory of the European Action Plan and its improvement
- Consolidation of proposals and publication of the Global Action Plan
- Kick of meeting 30 Mar 2023



# GAPPRI Expectations from AO

## EUROPEAN ACTION PLAN FOR THE PREVENTION OF RUNWAY INCURSIONS

### RECOMMENDATIONS

- 1.1 General principles
- 1.2 Aerodrome operator issues
- 1.3 Communications
- 1.4 Aircraft operator issues
- 1.5 Air navigation service provider issues
- 1.6 Data collection and lesson sharing
- 1.7 Regulators issues
- 1.8 Aeronautical information management
- 1.9 Technology
- 1.10 Civil military
- 2.0 Future work

### 1.4 AIRCRAFT OPERATOR

#	Recommendation	Action	Guidance
1.4.1	Provide training and assessment for pilots regarding Aerodrome signage, markings and lighting.	Aircraft Operator (lead).	Appendix D
1.4.2	Pilots shall not cross illuminated red stop bars when lining-up or crossing a runway (or on a taxiway where placed), unless contingency procedures are in force, e.g. to cover cases where the stop bars or controls are unserviceable.	Aircraft Operator.	Appendix A Appendix D Appendix J
1.4.3	Ensure that flight deck procedures contain a requirement for explicit clearances to cross any runway. <b>Guidance Note:</b> Includes non-active runways.	Aircraft Operator.	Appendix A
1.4.4	Flight Crew should not enter a runway for departure if not ready to take-off. Flight Crew must advise Air Traffic Control on first contact with the Tower if additional time on the runway is required for operational reasons.	Aircraft Operator, Air Navigation Service Provider.	Appendix D
1.4.5	If received significantly early, flight crew should confirm with ATC the line-up/take-off or crossing clearance when approaching the runway holding position.	Aircraft Operator, Air Navigation Service Provider.	Appendix D
1.4.6	Flight crew should consider confirming landing clearance on short final, if ATC issued it more than 5 nautical miles from touch down.	Aircraft Operator, Air Navigation Service Provider	Appendix D
1.4.7	Promote best practices in flight deck procedures while taxiing and during final approach - to include the "Sterile flight deck" concept.	IATA (lead), ECA/IFALPA (support).	Appendix D
1.4.8	Promote best practices for pilots' planning of ground operations.	IATA (lead), ECA/IFALPA (support).	Appendix D
1.4.9	Ensure a means to indicate receipt of landing / line-up / take off / crossing clearances in the cockpit.	Airframe Manufacturer, Aircraft Operator.	Appendix D
1.4.10	Pilots are advised to switch on forward facing lights when in receipt of a take-off clearance and show forward facing lights on the approach. <b>Guidance Note:</b> Global IFALPA policy	Aircraft Operator.	Appendix D
1.4.11	Pilots must be made aware of current safety significant airport information.	Aircraft Operator.	Appendix H
1.4.12	During taxi for departure or during approach, pilots should not accept a runway change proposal if time to re-programme the FMS / re-brief is not sufficient. This includes a change of departure intersection.	Aircraft Operator, Air Navigation Service Provider.	Appendix D

# Many Thanks for your Attention!



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[www.eurocontrol.int/articles/eurocontrol-voluntary-atm-incident-reporting-evair](http://www.eurocontrol.int/articles/eurocontrol-voluntary-atm-incident-reporting-evair)