

ICAO EUR/MID Radio Navigation Symposium

GNSS RFI – Operator’s Perspective

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Let's stay tuned

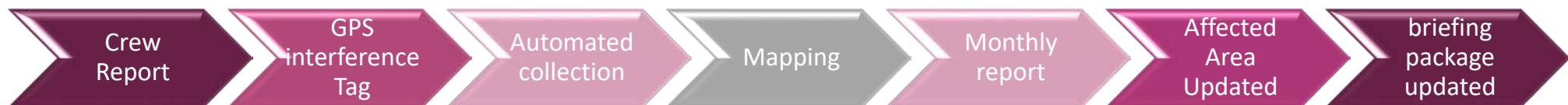
GNSS RFI – Operator's Perspective

Introduction

- *Worldwide Safety Operational issue*
- *Increasing Number of events during the last few months*
- *New Cockpit effects*
- *Different Interference : Spoofing versus Jamming*
 - *Jamming causes a loss of measurement and therefore a degradation of the position/velocity/time (PVT) solution.*
 - *Spoofing is a fake signal that causes the receiver to output misleading data, such as an incorrect geo position or time.*
- *Enlarged Area Affected*
- ***International involvement required***

GNSS RFI – Operator’s Perspective

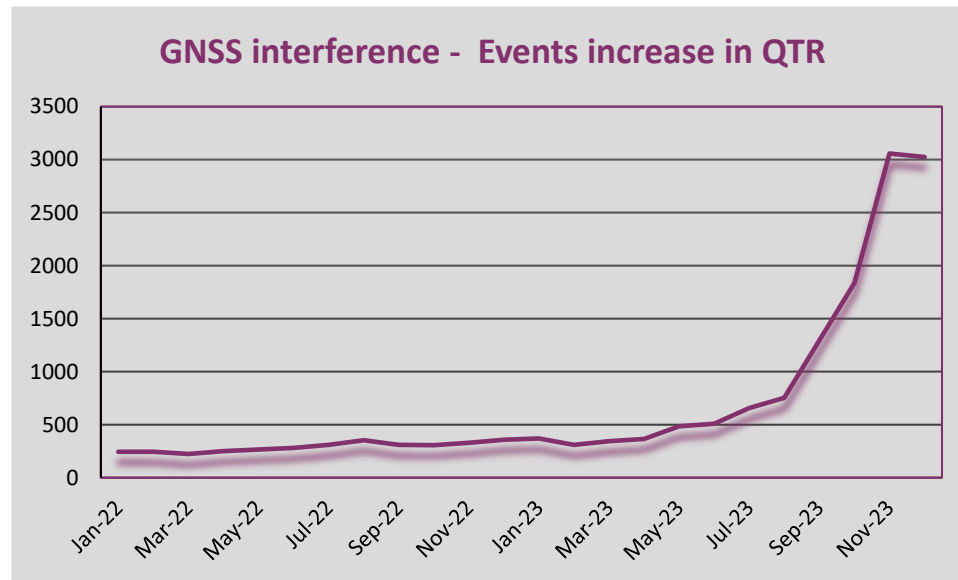
GPS interference – Affected Area - QTR process



- *Crew report with dedicated Topics “GPS interference”*
- *Automated process to capture the reports*
- *Location mapped and populated through a monthly report*
- *Dedicated crew alert in FPS – Briefing package with affected FIRs*
- *Crew informed*

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Increasing Number of events

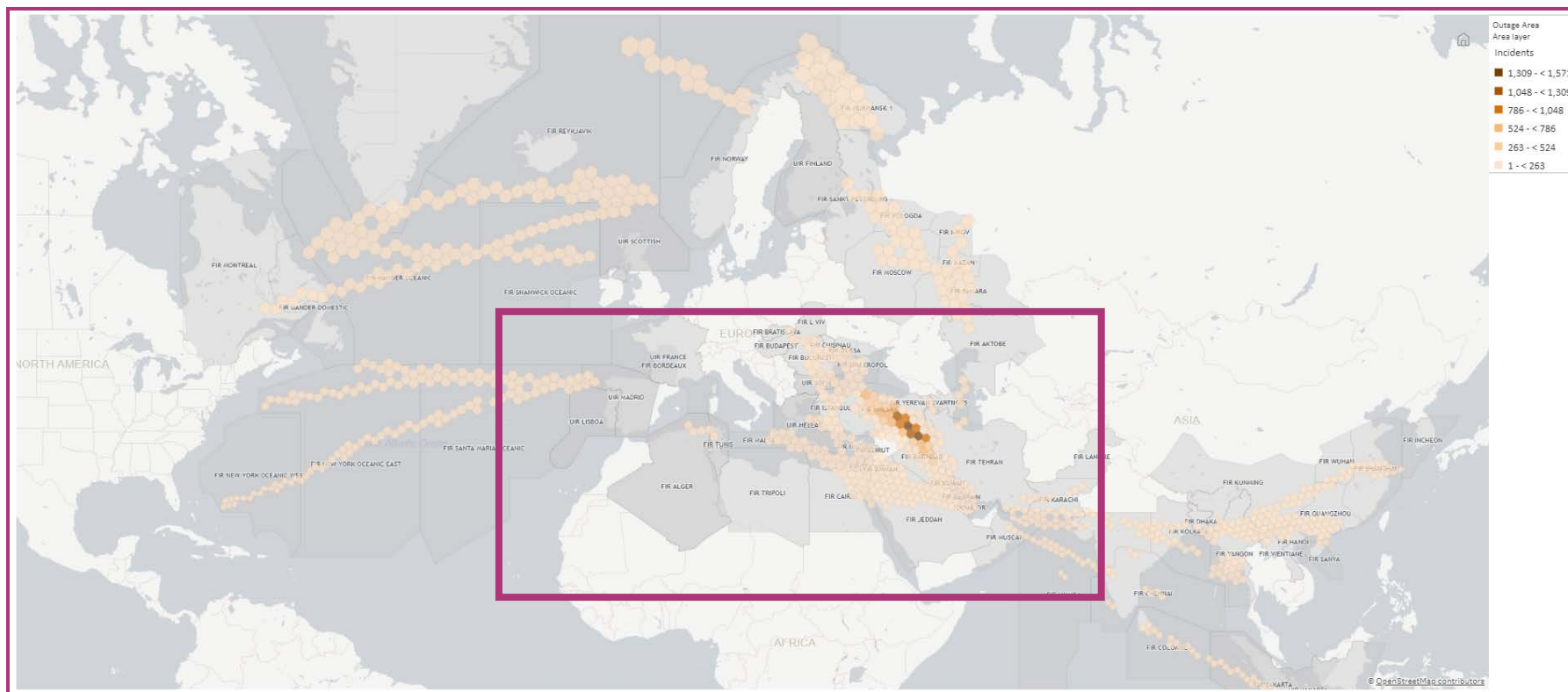


Number of events in QTR :

- *GPS interference is not new*
- *Steady number during the last few years*
- *Sudden increase noticed starting April 23*
- *November and December 2023*
 - ✓ *Peak*
 - ✓ *Around 3000 events a month*
 - ✓ *10 times more than 2022 average*

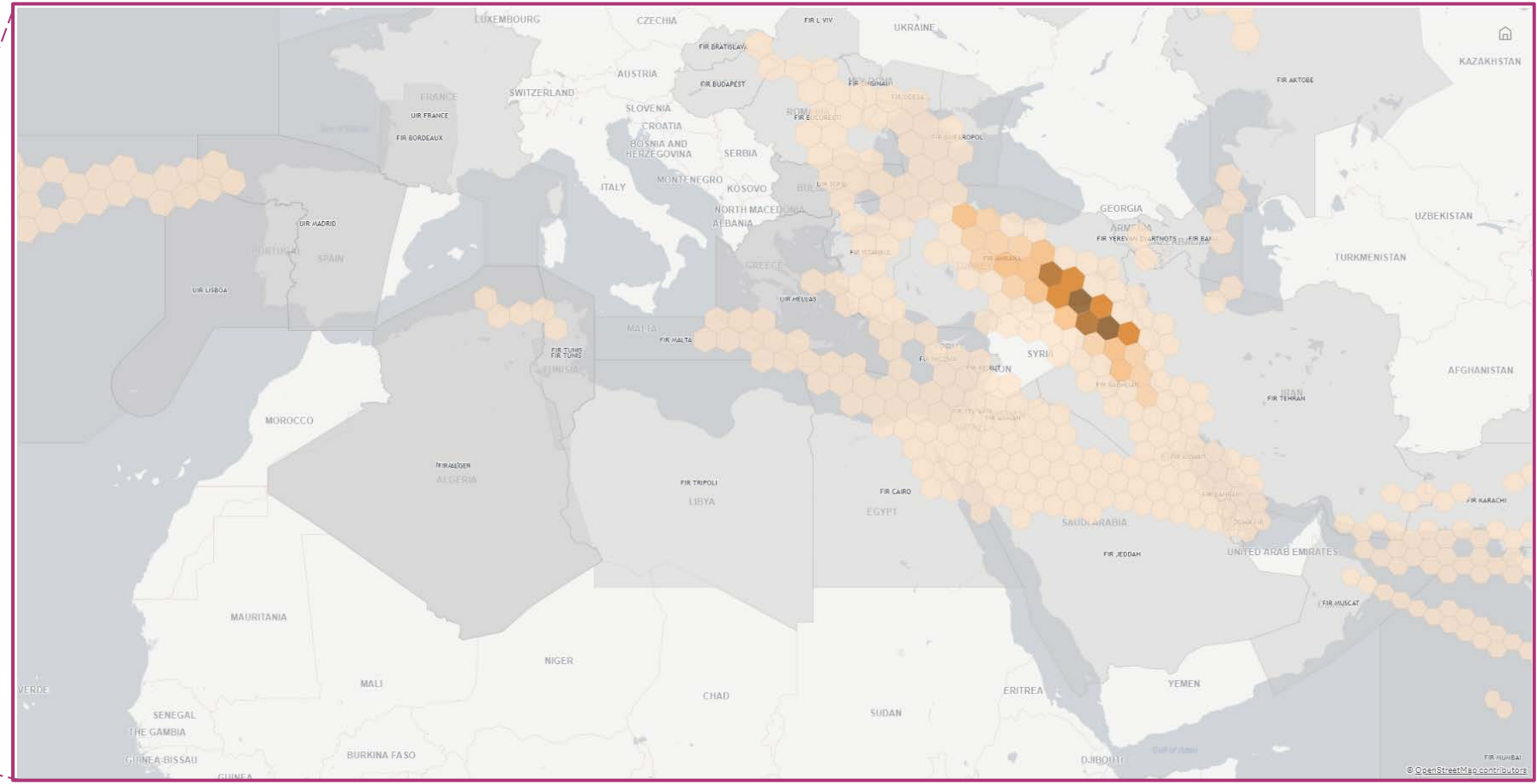
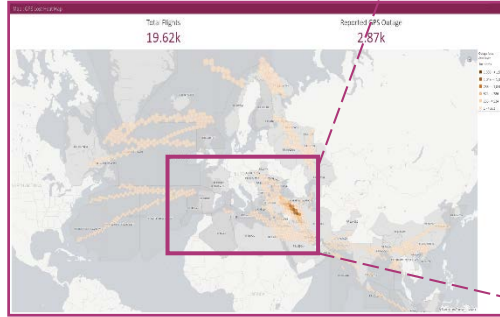
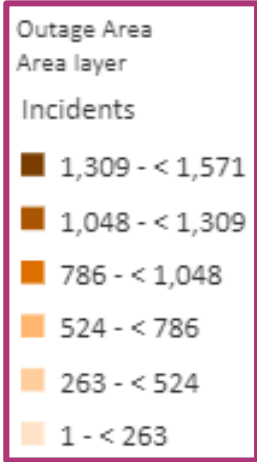
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Affected Areas



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Affected Area is all around

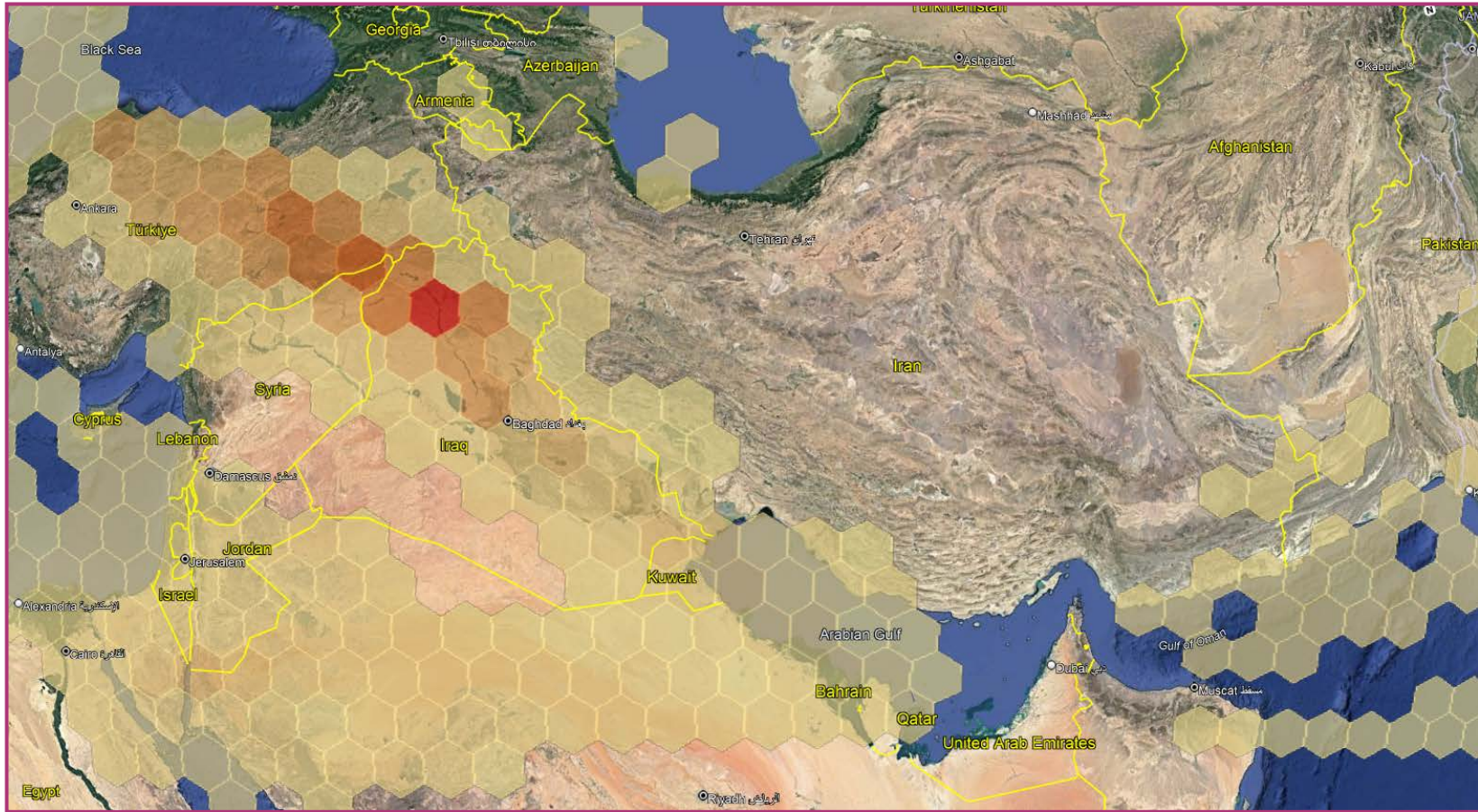


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Affected Area is all around

Top 20 FIRs with GPS Outage Journey Logs

FIR	Reported Flights	%
FIR BAGHDAD	1875	65%
FIR ANKARA	1868	65%
FIR JEDDAH	299	10%
FIR YANGON	289	10%
FIR CAIRO	283	10%
FIR KUWAIT	207	7%
FIR KUNMING	180	6%
FIR BAHRAIN	157	5%
FIR AMMAN	111	4%



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GPS RFI – Cockpit Effects – Similar on different Aircraft types

GPWS Look-Ahead Terrain / EGPWS

For a GPWS Look-Ahead Terrain warning at a cruise altitude that is clearly above the highest known actual terrain in the area, pilot discretion can be used in determining the alert, including persistent alerts, to be false.

The basic GPWS is still operational. The GPWS immediate alerts are still valid.

Selecting GPS updating to OFF on the POS REF page does not inhibit GPS data for GPWS Look-Ahead Terrain.

ADS B

- *Jamming causes a loss of ADS-B capability. Coordination with ATC is necessary.*
- *Effects of spoofing on ADS-B:*
 - *Erroneous position data to ADS-B.*
 - *If an ADS-B advisory message shows, it must be considered valid.*
 - *All TCAS alerts must be considered valid.*

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GPS RFI – Cockpit Effects – Similar on different Aircraft types

Time/Clock

Jamming can result in the loss of GPS time source.

Effects of spoofing on time/clock:

- Inaccurate time and date information.
- FMC ETA function can be affected.
- Aeronautical Telecommunications Network (ATN) communication functions are impacted by date/time inaccuracy. Log-on and reporting functions may not be available.

Note:

- Boeing is planning to update the NP Preflight Procedure, to confirm the “time/date” during the Preflight Procedure, and/or to revert the clock to “time/date” manual input instead of UTC fed by GPS.
- Airbus has introduced a procedure to select INT CLOCK before entering known RFI area

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GPS RFI – Cockpit Effects – Similar on different Aircraft types

Air Traffic Control (ATC) data link

The Aeronautical Telecommunication Network (ATN) data link logon reports the time and date. With an incorrect time or date, ATN data link logons can be rejected by the ground system

Runway Awareness and Advisory System (RAAS) – Boeing Aircraft

Runway Overrun Warning (ROW / ROP) – Airbus Aircraft

On airplanes equipped with RAAS or ROW/ROP. when the GPS signal is lost, the system is unavailable and associated EICAS/ECAM will be displayed

Operations in PBN Airspace – NATS

Issues operating in NAT Airspace where 2 LRNS are required



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GPS RFI – Risk Assessment and Operational Mitigations



- *Internal Risk assessment – bi monthly review*
- *Follow up with manufacturers*
- *Flight crew communication*
- *Raise Crew awareness*
 - ✓ *Affected Areas*
 - ✓ *Expected Cockpit Effects*
 - ✓ *Flight crew Vigilance*
- ***No deviation from MFR***

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GPS RFI – Risk Assessment and Operational Mitigations

GPS updating - Temporarily disabled

GPS updating in the FMC can be temporarily disabled as a preventative measure:

- *Before entering areas of known GPS interference and*
- *In the event of unexpected GPS interference*

This practice is at the discretion of the operator after a risk assessment:

- *Provide the flight crew instructions on when to disable GPS updating &*
- *When to turn GPS updating back on upon exiting areas (position accuracy is verified)*

Note

- *Boeing does not recommend preventative disabling of GPS updating for the entire flight.*
- *Airbus (A350) has confirmed that deselecting the GPS functionality via the MCDU or MFD would not prevent the impact of the Radio Frequency Interference (RFI).*

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GPS RFI – Risk Assessment and Operational Mitigations

General Mitigations for Consideration:

1. When responding to alerts, signs, and symptoms of GPS interference, it is important to advise ATC as soon as practical of any degraded navigation capability, advising them of systems that have not recovered due to spoofing.
2. If systems such as LNAV path or VNAV path experience degraded performance reduce the level of automation. **Once clear** of the interference area and the position of the **GPS and FMC is verified**, the **level of automation can be increased**.
3. Revert to another update mode such as **DME/DME** updating or use available ground-based navigation aid such as **VOR** and **NDB**.
4. **Cross-check terrain** altitude using enroute charts if terrain depiction on ND appears unreasonable for the geographic location.
5. Familiarize crew with the availability of **arrival and approach procedures using conventional navigation aids**.



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GPS RFI - Challenges faced from Operator level

- *Safety concern*
- *Affected Area expanding all around our area of operations*
- *Deviation not always possible . Might involve additional Fuel and Cost*
- *Not enough guidance from Manufacturers*
- *Cockpit Warnings during critical phases of flights– Time limited for crew assessment*
- *Risk of Crew complacency*
- *Development of new systems more robust towards GNSS interference is required*
 - ✓ *Time*
 - ✓ *Cost*
 - ✓ *Unknown*

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Conclusion

- *Experience Sharing is important*
- *Lessons learnt from each others*
- *International entities involvement required. Thanks to ICAO*
- *Priority for new systems development required*
- *Working together required*
- *Let's stay tuned*



Thank You!