

GPS SPOOFING RESILIENCE FOR BUSINESS AVIATION

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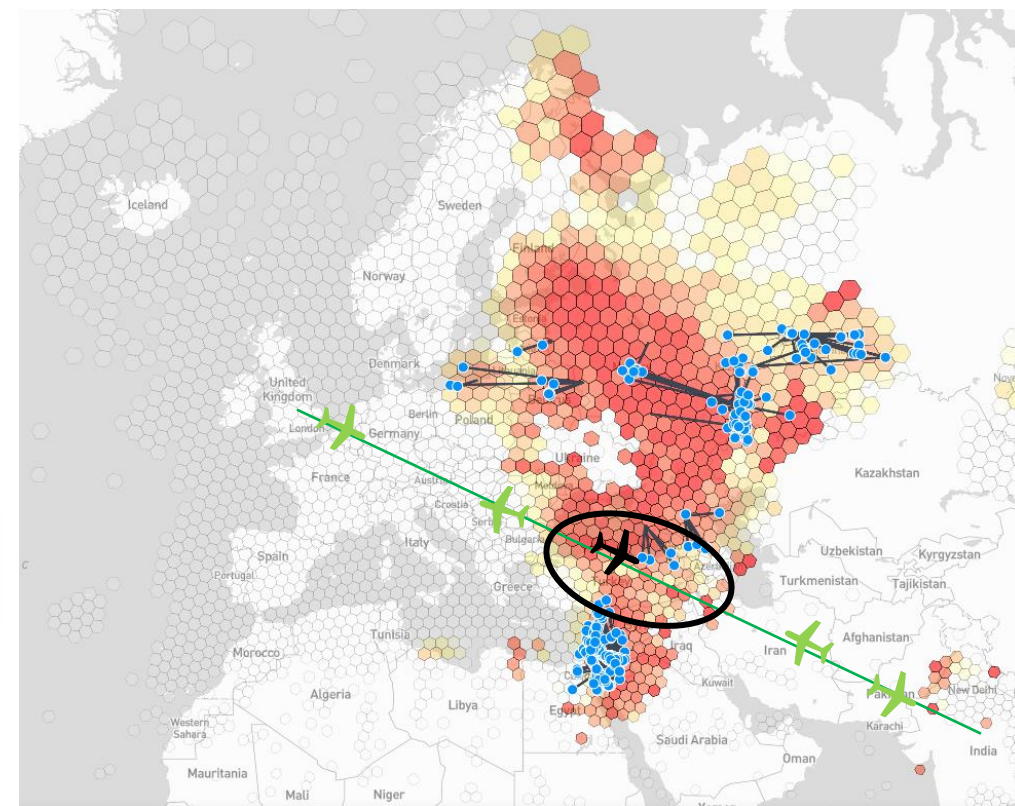
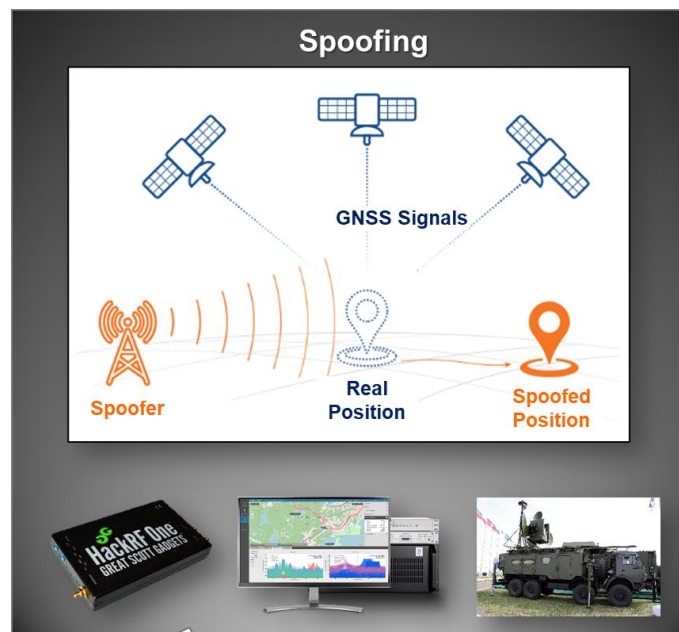
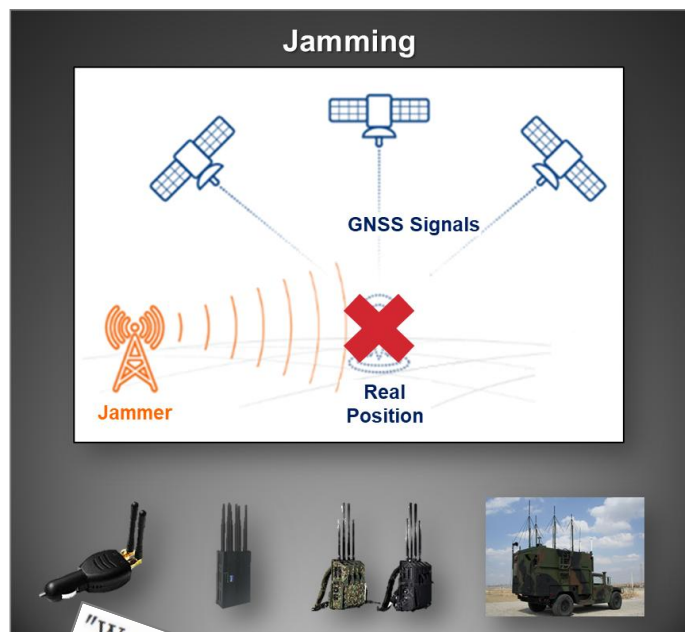
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GNSS | JAMMING & SPOOFING (J&S)



Every flight through Eastern Europe or Middle East exposed to Spoofing

"We were spoofed on approaching Kirkenes today"
Norway is sounding the alarm after discovering that Russia is no longer only jamming the Global Navigation Satellite Systems (GNSS) across the border, but also spoofing GPS signals, an attack that can cause significant disruption to aviation.
17 January 2025 - 22:15

Commercial pilots rattled by surge of GPS attacks sending them bogus signals
Pilot Akseli Meskanen's cockpit is warning him that his Airbus A330 is being spoofed.
10mo

"Pull up! Pull up!"
Pilot Akseli Meskanen's cockpit is warning him that his Airbus A330 is being spoofed.

FAA flags global surge in GPS jamming & spoofing, updates its playbook
Disruptions are spreading ... and are not limited to conflict zones

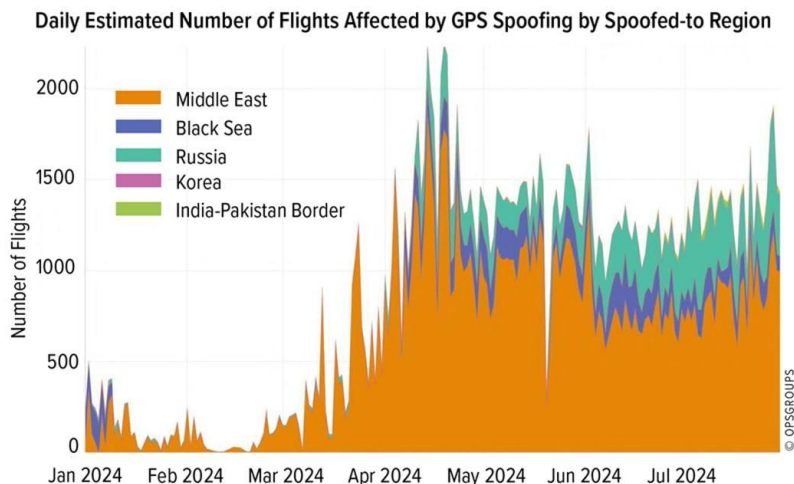
GNSS signals are low power hence susceptible to Radio Frequency Interference

GNSS | SPOOFING IMPACT

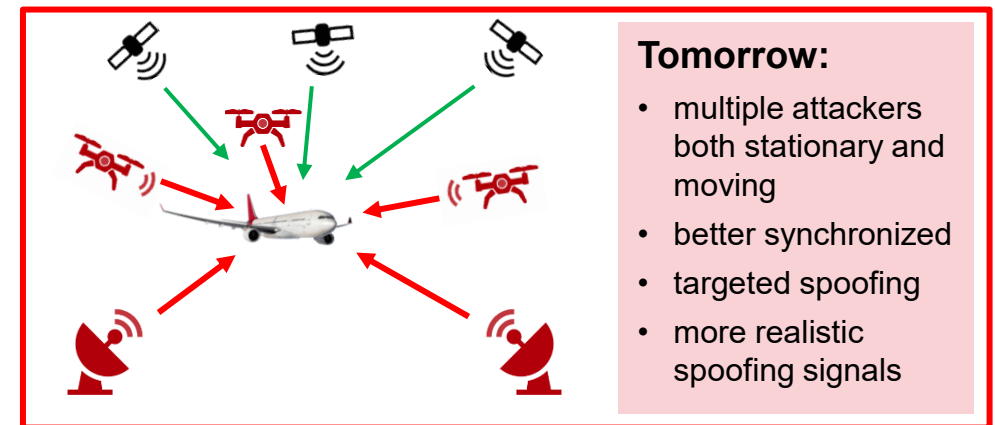
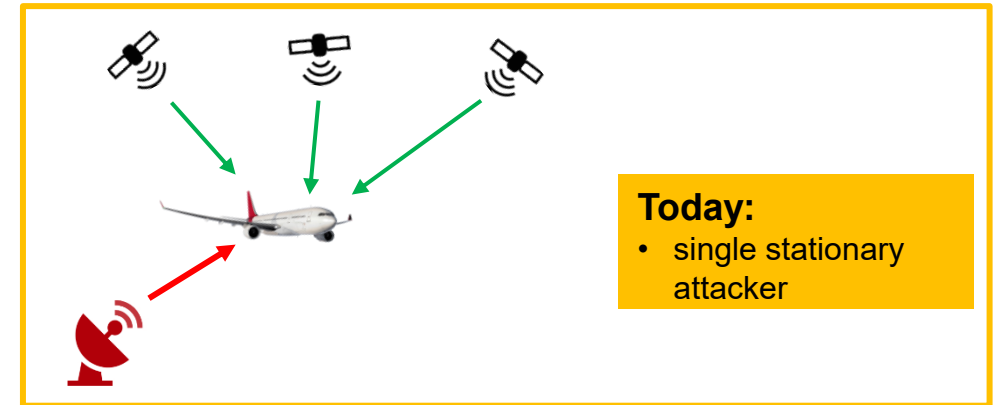
Spoofing consequences:

- Failure or degradation of Navigation capability leading to
 - Route deviations
 - Loss of approach capability
 - Longer routes, extended flight time
- Impaired Com (Datalink), Surveillance (TAWS, WXR)
- Increased pilots and ATC workload, reduced safety margins

Rising number of affected flights



Increasing sophistication of J&S attacks



Need Spoofing Protection for Today and Tomorrow's threats



SPOOFING | FLIGHT TEST FINDINGS

Increased GNSS J&S events experienced by corporate operators pose pilot workload, operational efficiency & safety impacts

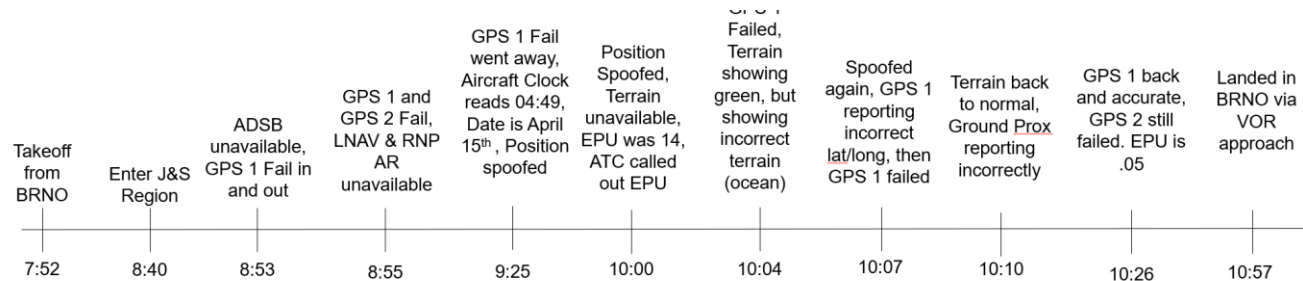
2025 MONITOR RESEARCH

Simulation in RF Chamber Mpls – 3 days

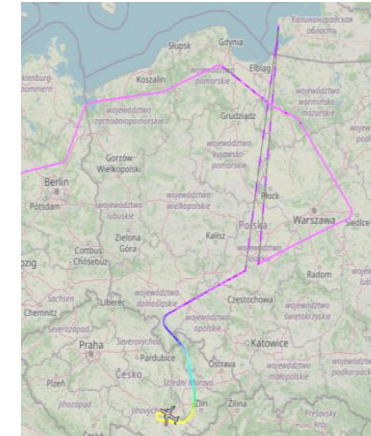
E170 Poland, Black Sea, E Mediterranean – 4 flights

E170 White Sands NM Apex Jamming Event – 6 flights

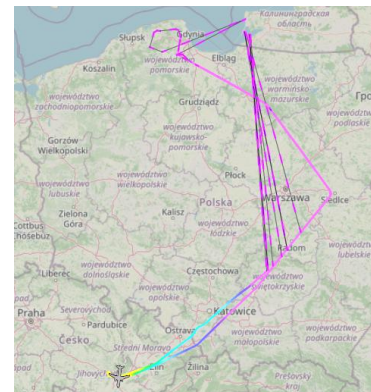
Van Norway Jammer Fest – 5 days



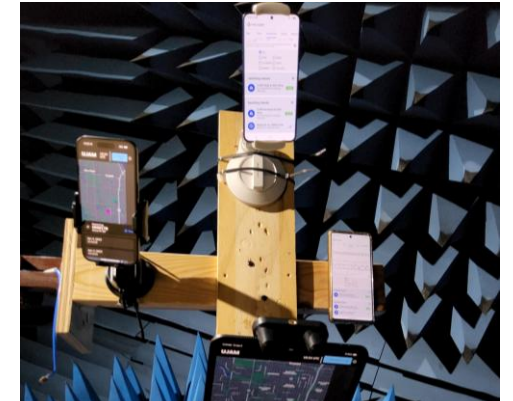
IRS 1 GPS Jam-Spoof
VIDL-G 1 Jam-Spoof
AH2000 1 Jam-Spoof



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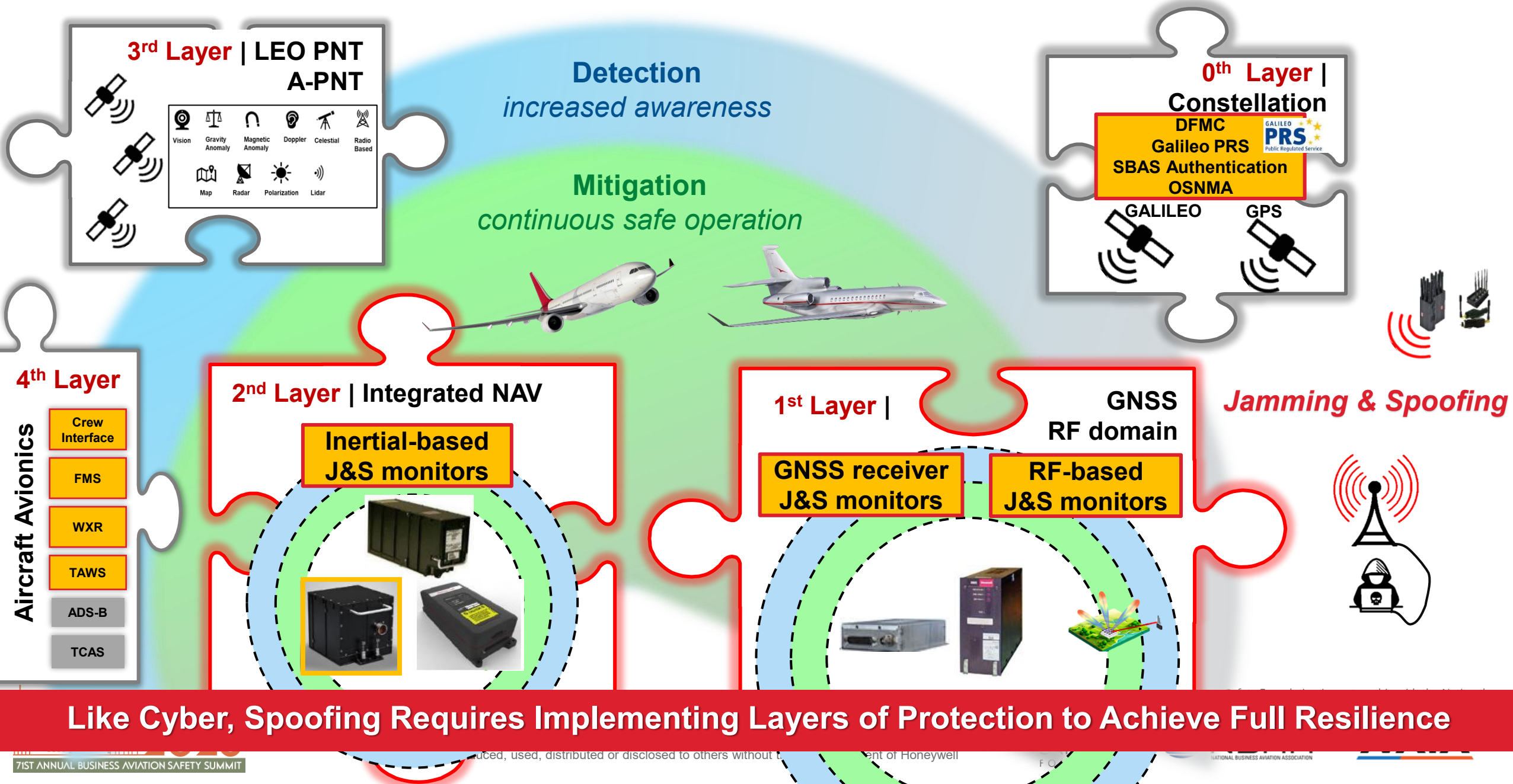


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SPOOFING | LAYERED APPROACH TO RESILIENCE



INERTIAL REFERENCE SYSTEM | LASEREF VI (LR6)



Gulfstream



Global, Challenger



Falcon



Praetor, Phenom 300E



Latitude, Longitude, Ascend



PC-24



- LR6 computes pure inertial solution + tightly coupled GPS/IRS solution aka Hybrid
- Hybrid has better accuracy than pure inertial (affected by gyro drift) and better integrity than pure GPS
- Modern FMS use Hybrid as primary source of position
- If GPS is lost, Hybrid goes to inertial coasting. Drifts 3x less than pure inertial

Broad Adoption On Business Aviation Platforms – How Can IRS Help With GPS Interference?

NEW LR6 SOFTWARE | J/S MITIGATION

Spoofing Resilience

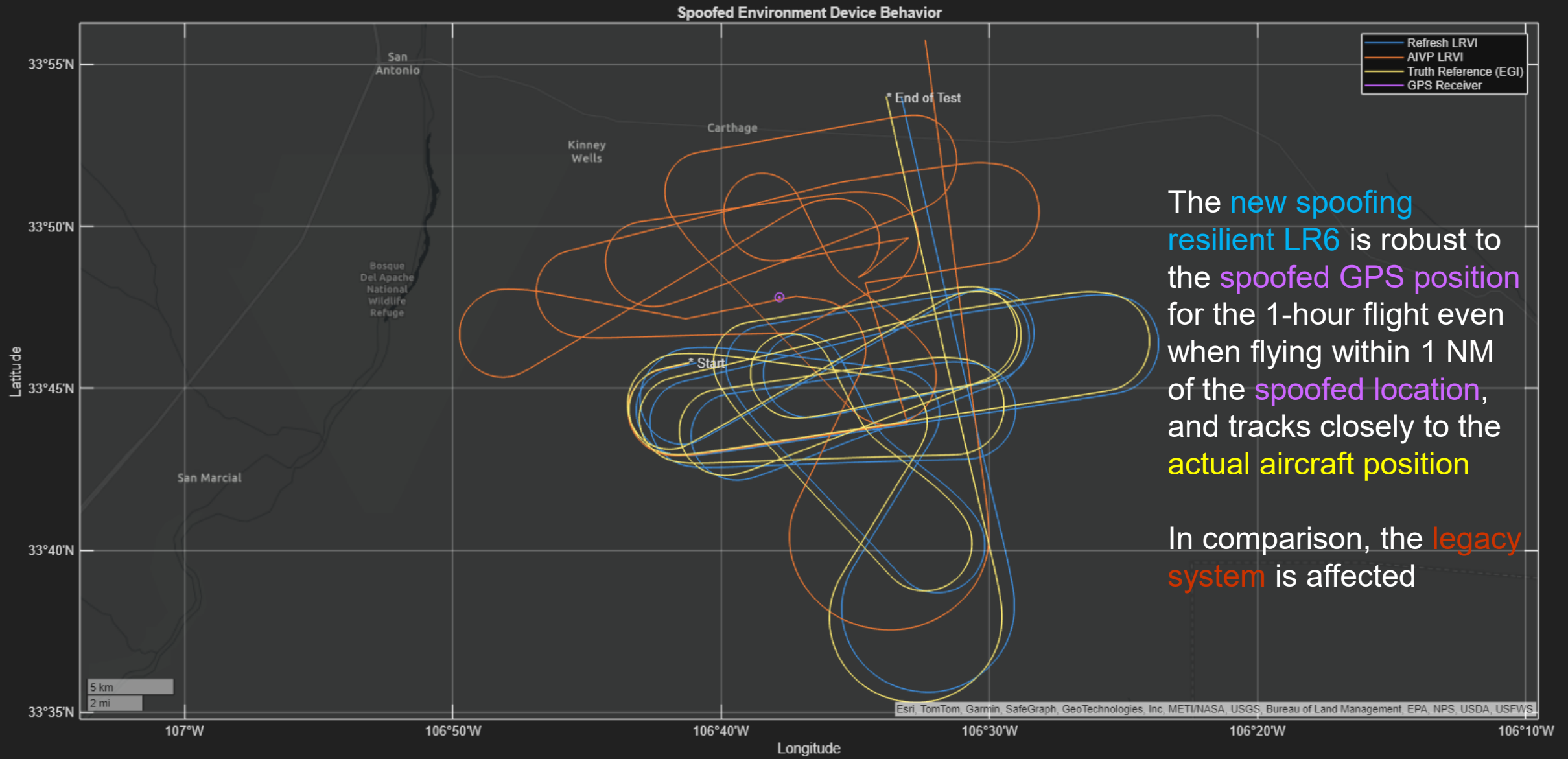
- Spoofing Detection & Annunciation
 - On-ground, In-flight. Designed for tight detection thresholds yet low spurious alert rate
 - Output of Spoofing Status Message for use by downstream systems (FMS, CAS)
- Spoofing Resilience – Maintain Hybrid Integrity & Availability During Spoofing
- Spoofing Recovery – Resume usage of GPS once spoofing is over

Jamming Detection & Annunciation

- Jamming Detection based on early symptoms before signal loss
- Useful early detection as Spoofing attacks start with Jamming

Maintain High Integrity Throughout GPS Interference...Then Recover Normal Operations

NEW LR6 | SEPT 2025 U.S. GOVT SPONSORED J/S FLIGHT TEST



SPOOFING | AVIONICS RESILIENCE ROADMAP

2026

2027

2028

2029

2030

2031

2032

2033+



EPIC Spoof Resilience Phase 1

Resilient Navigation

- Spoofing resilient LR6
- FMS Automated Reconfiguration
- Crew Alerting



EPIC Spoof Resilience Phase 2

Resilient Avionics

- Phase 1 plus
- GPS Receiver Update
- CRPA



EPIC Spoof Resilience Phase 3

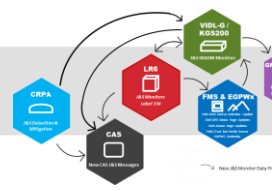
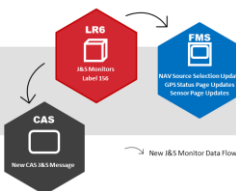
Maintain Full Operations

- Phase 2 plus
- Alternative Navigation (Vision, Terrain, Leo etc)

Common Core Technology



Spoof Resilient LR6 IRS



Anthem Initial Cert

Resilient Avionics

- Spoofing resilient LR6
- Aircraft State Function



Anthem Follow-On

Maintain Full Operations

- Initial Cert plus
- CRPA
- Alternative Navigation (Vision, Terrain, Leo etc)

Progressive Deployment of Foundational Technology on EPIC & Anthem To Full Operational Resilience

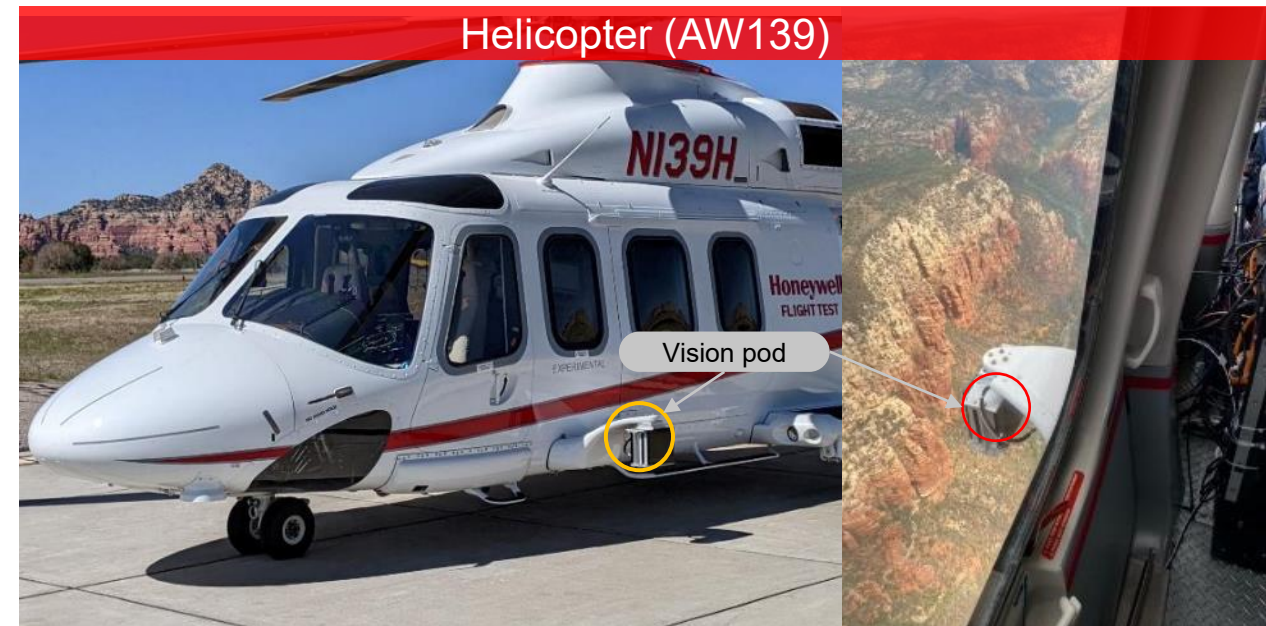
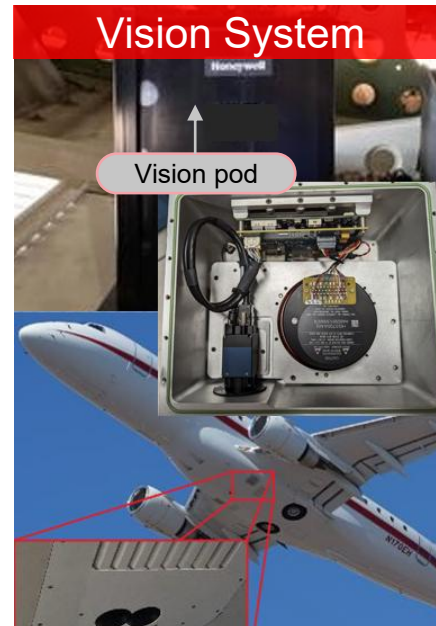
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ROADMAP | LONG-TERM: ALTERNATIVE NAVIGATION

- **Vision Aided Navigation (E170 & AW139)**
 - 10m demonstrated
- **Celestial Aided Navigation (Ground & E170)**
 - 25m demonstrated
- **Magnetic Anomaly Aided Navigation**
 - 250M demonstrated with 100M achievable
- **Low Earth Orbit (LEO) Satellite Nav**
 - 50M demonstrated
- **Radar Altimeter Terrain Aided Nav**
 - 50M demonstrated
- **Radar Doppler Aided Nav**
 - 2% distance travelled demonstrated



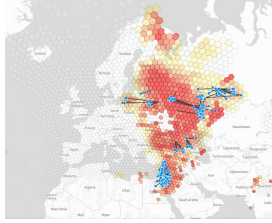
Hundreds of Hours of Alternative Navigation Flight Demonstration

DEMONSTRATED PERFORMANCE: VISION 10M/ CELESTIAL 25M/ MAG 350M/ LEO 50M/ Radar TAN 50M

SPOOF RESILIENCE FOR BUSINESS AVIATION | TAKE-AWAYS

GPS Spoofing Can Affect Communication, Navigation and Surveillance Capabilities of Business Aircraft

- A by-product of military conflicts, but expanding geographically and towards more targeted threats
- Increased GNSS J&S events experienced by corporate operators pose pilot workload, operational efficiency & safety impacts



Like Cyber, Spoofing Requires Implementing Layers of Protection to Achieve Full Resilience

- Protection at the GNSS constellation level, aircraft antenna, aircraft navigation systems, avionics
- Introduce Alternate Navigation sources to reduce the dependency on GNSS



New Laseref VI IRS Software With GPS Spoofing Resilience – 2026 TSO Authorization

- Field-tested and certified against industry standard RTCA DO 384. Effective even for small position errors
- Protects inertial & hybrid solutions through spoofing. Recovers normal operations when spoofing ends



Honeywell Integrated Avionics (EPIC, Anthem) Will Roll-out Incremental Updates

- Same foundational technology will serve both EPIC and Anthem
- Initial deployment in 2027-2028 focused on Resilient Navigation
- Expand spoofing resilience to full avionics and introduce Alternative Navigation modalities



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