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IFALPA

SAFETY BULLETIN

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GNSS Radio Frequency Interference and Signal Manipulation: Emerging and Unknown Impacts on Aircraft Systems

Civil aviation is currently experiencing an escalation in Global Navigation Satellite System (GNSS) Radio Frequency Interference (RFI) events, i.e. intentional jamming and spoofing, that degrade or manipulate satellite-based position, navigation and timing information. These events may occur without notice. GNSS RFI compromises aircraft system performance and introduces safety risks.

Incidents have been reported worldwide with unpredictable onset, duration, and extent. In addition, a growing number of aircraft and ground systems are observed to be affected, including systems not previously recognized as GNSS-dependent. These unknown and emerging impacts heighten concerns that RFI may be propagating through complex, insufficiently documented interactions within the system.

IFALPA has published two documents addressing this issue. The publications are available at the links below:
https://www.ifalpa.org/news/ifatca-ifalpa-on-gnss-interference/
https://www.ifalpa.org/publications/library/manipulated-gnss-signals--3907

WHAT IS GNSS RFI?

Current GNSS RFI can be classified as either Jamming or Spoofing. Both phenomena constitute intentional RFI and can cause severe degradation or misleading outputs from GNSS-dependent systems.

AFFECTED ONBOARD SYSTEMS

GNSS manipulation can degrade or compromise multiple aircraft systems that rely on accurate Position, Navigation, and Timing (PNT) data:

Navigation & Flight Management

- Flight Management System (FMS) & Inertial Reference Systems (IRS), erroneous or lost GNSS data can mislead navigation or override more robust sensors.
- ILS receiver functionality can be corrupted, degrading approach capability.

Safety & Guidance Systems

- Terrain Awareness & Warning System (TAWS) & Runway Overrun Awareness & Alerting System (ROAAS), false alerts or degraded terrain/landing cues.
- GNSS RFI, particularly spoofing, may also lead to erroneous inputs to Airborne/Traffic Collision Avoidance System (ACAS/TCAS) surveillance and tracking functions, as these systems rely on accurate own-ship and intruder position and use internal test functions that might render the system inoperative under certain RFI conditions.
- Weather radar systems can be affected by RFI.

Operational Communications & Surveillance

- Automatic Dependent Surveillance (ADS-B/ADS-C), CPDLC, incorrect or lost positional broadcasts affecting ATC and traffic awareness.

Timing & System Coordination

- System timing inputs, synchronization issues can affect avionics, communications, and coordination with ground systems.

UNKNOWN / EMERGING IMPACTS

Beyond the effects already observed and documented, GNSS RFI may also impact other aircraft, ground, or supporting systems through mechanisms that are not yet fully understood or formally documented.

System integration, data fusion, and automation increasingly seen in modern aircraft mean that GNSS-derived position, navigation, and timing information may be used indirectly and/or non-transparently within systems not explicitly identified as GNSS-dependent. As a result, interference or manipulation of GNSS signals could lead to unexpected system behavior, degraded performance, or misleading outputs in areas not currently anticipated by operators or manufacturers.

The full scope of these secondary and cascading effects remains uncertain, underscoring the need for heightened operational vigilance and conservative decision-making whenever GNSS anomalies are suspected.

IMMEDIATE ACTIONS RECOMMENDED

- Brief flight crews and operations teams on RFI/jamming and spoofing risks.
- Brief flight crews and operations teams on RFI mitigating SOPs

- Clarify the description of technical systems available to flight crews to facilitate understanding of the usage of GNSS signals throughout the various aircraft systems potentially affected by RFI
- Plan routes to minimize exposure to known high-risk RFI regions where possible.
- Ensure alternate navigation procedures are available, up to date and documented.
- Ensure recurrent flight crew training is up to date and covers known effects and required actions.
- Retain conventional radio navigation aids (VOR, DME, ILS) for redundancy.
- Promptly report suspected GNSS interference to ATC and internal safety reporting systems.
- Perform a ground reset after every flight suspected to be influenced by RFI, erasing all corrupted GNSS signals from all aircraft systems.