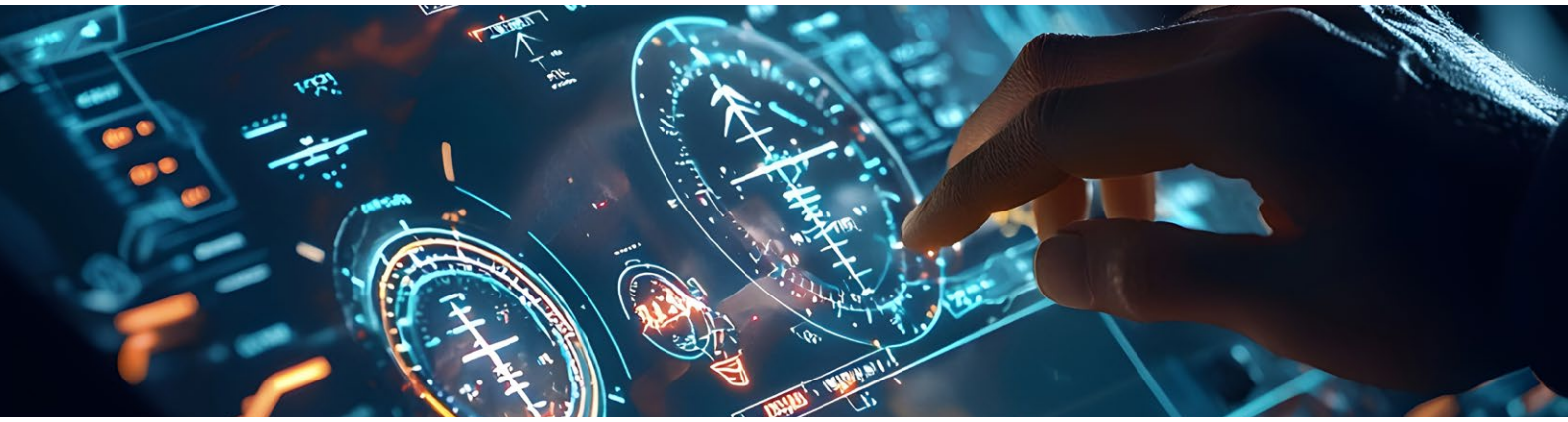
Aerospace Risk Consulting & Management Services Bulletin

GPS Jamming & Spoofing



Global Positioning Systems (GPS) spoofing incidents in commercial aviation have highlighted wider industry concerns about radio frequency interference issues which are affecting aircraft's navigation and operational resilience. The need for robust risk programmes which cover mid-air collisions through to hostile take overs of aircraft, air traffic control (ATC) or air navigation service providers (ANSP) has never been greater.

AIG's expert aerospace underwriting, multinational and claims team understand the complexities of the current and future geo-political aviation environment, enabling us to provide global insurance solutions that create long-term value for our clients' evolving risks.

Managing and reducing insured risks is important to our clients, which is why at AIG we go beyond insurance, and have partnered with GMR Human Performance Ltd to provide risk advisory and consultancy services.

GMR has decades of direct experience with preventable accidents and incidents across industries. Our collaboration brings together people who care about what they do to develop real-world operational solutions and help our clients to avoid learning the hard way.

Jamming causes a loss of measurement in the aircraft's systems and therefore a degradation of navigation data (position, velocity, time – or PVT).

Spoofing (sometimes called smart jamming) is a fake signal that causes the receiving equipment to output or present misleading data to the operator, such as incorrect PVT.

Radio Frequency Interference (RFI) are now everyday occurrences, in flight information regions around the world. There are numerous sources of RFI, of which the main known sources are:

- Personal privacy devices
- Protection of sensitive sites
- GPS repeaters
- TV broadcast station malfunctions
- Military RFI

GPS jamming involves saturating receivers with unknown signals to render the receiver unusable, essentially degrading the ability of all parties to effectively use GPS for navigational or location purposes.

GPS spoofing is the deliberate transmission of a look-alike signal that GPS receivers will decode to place an aircraft at an incorrect position and/or time, resulting in the aircraft appearing to be in places it is not. Spoofing can only be caused by purpose-built devices, originally developed for military use, but which can now be built by any threat actor.

Growing threat

Geopolitical tensions have led to incidents of GPS jamming and spoofing in Eastern Europe and the Middle East. Turkey and the Iraq corridor are other affected areas, while Israel, Egypt and Cyprus have also experienced incidents.

To date, jamming signals have been prevalent in the area around the Black Sea, while spoofing has been common in areas such as Iraq and the eastern Mediterranean Sea.

However, the aviation sector has reported that the problem is also spreading beyond active conflict zones, with GPS RFI a common issue for commercial airlines, with both air traffic control (ATC) and aviation authorities aware of the problem.

GPS RFI effects

Crews operating in regions known to be hotspots for this activity are routinely briefed on these threats and may observe unusual flight deck effects, depending on the nature of the GPS RFI experienced.

While original equipment manufacturers (OEMs) have assessed that primary flight control functions are not affected by GPS RFI, the main issue for aircrew is receiving spurious or confusing alerts mid-flight.

In the case of spoofing, this can lead to loss of position and entering airspace without clearance, as well as crew losing their situational awareness. Both spoofing and jamming can lead to loss of systems/capabilities for weather avoidance, loss of automated flight path management and flight path deviations.

This interference can present as a range of anomalies across a number of aircraft systems, including:

- Disruption of ADS-B Out, which enables aircraft to broadcast their identification, position, altitude and velocity to other aircraft and air traffic control
- Loss of GPS indications
- Changes in aircraft clock time/date
- Adverse effects on head up displays and some autopilot functions
- Spurious terrain warnings or cautions above FL250, but also at lower altitudes
- The aircraft's vertical situation display may also indicate vertical spoofing with unrealistic terrain indications, potentially causing crews to perform unnecessary aircraft pull-ups during approach and landing phases

Managing RFI incidents

While airlines and flight crews are aware of the risks of GPS jamming and spoofing, they need to be trained to use backup instrumentation when an incident occurs, to ensure the safe operation and completion of flights. Even if a false GPS signal creates a warning in the flight deck, the crew must still respond in a calm and methodical manner, diagnosing the problem and acting appropriately.

Under normal circumstances, when a GPS RFI anomaly is observed, well-trained and experienced aircrews will follow the briefings and agreed industry procedures for the type of aircraft they are flying.

However, if a GPS RFI occurs during an existing emergency situation, that is already placing extra demands on aircrew attention and where the situation is further complicated by night operations, poor weather, and potential diversion to an unfamiliar airfield, the potential disruption of a GPS RFI incident can be significantly amplified.

The old adage of 'Aviate, navigate, communicate' is more applicable than ever in these situations, and it is important that ATC are kept informed of any degradation in navigation capability as a result of a GPS RFI incident.

Mitigating the risks

The issue of GPS RFI is now well known and is included in extensive briefing materials for operators entering known risk areas for incidents. Overflight security and emergency procedures in the event of a diversion should also be carefully reviewed against the backdrop of GPS RFI events.

However, operators and aircrews must avoid any unapproved flightdeck fault-finding and/or disabling or downgrading of navigation systems which could have undesirable and unanticipated secondary effects, due to the complex and integrated nature of modern navigation and avionic systems.

Operational risk assessments should consider whether planned operations into areas of known GPS RFI can be re-routed or avoided altogether, and clear instructions for the use of GPS in areas of known interference should be in place and be well briefed.

Continued reliance on human intervention for mitigation is undesirable because it is ultimately fallible. Operating crews are susceptible to over-familiarisation and de-sensitisation to warnings and alerts due to the frequency of occurrences.

Longer-term technical solutions are therefore being developed by OEMs, to provide greater protection against incidents and ultimately eliminate the threat of GPS RFI. In the meantime, a number of OEM procedures have been published, providing guidance to operators on actions that can be taken when an RFI event occurs.

In summary, GPS spoofing/jamming can disrupt navigation and deliver false information about an aircraft's position, velocity and time to flight crew, operators, ATC and aviation authorities, with the potential to impact automated flight path management.

While the risk of GPS RFI is generally well understood at an operational and crew level, mitigations taken can benefit from continuous assessment and are proven to be effective in protecting flight operations from the impact of Global Navigation Satellite Systems (GNSS) degradation which is outside the control of operators.

Flights into affected regions are routinely reviewed and approved by each organisation's flight operations team, with re-routing of flights taken into consideration. Mitigations should likewise be assessed and reviewed with reference to OEM procedural guidance.

Longer-term, technological solutions could reduce reliance on human interventions and mitigate the risk of human error.

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