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GLOBAL
MEDIA DAY

Safety and Operations Update

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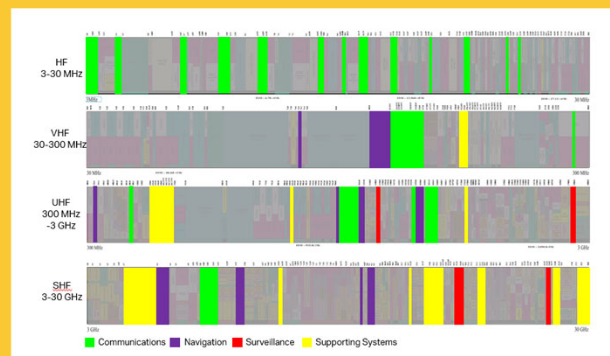
Navigating growing threats:
Protecting aviation in a high-risk digital world

1. Preserving radio frequency spectrum for safe operations
2. Addressing GNSS Spoofing and Jamming
3. Promoting Safe Carriage of Lithium Batteries

What is aviation spectrum?

Aviation uses a protected set of radio frequency allocations so aircraft and air traffic control can communicate, navigate, and share critical operational flight data, including weather information.



Aviation relies on a dedicated part of the radio spectrum to communicate, navigate, and manage flights safely.

This spectrum supports everything from pilot–ATC communication to weather updates and aircraft navigation systems.

It enables clear, reliable pilot–ATC communication.
It delivers weather and operational data to the flight deck.
It guides aircraft navigation systems
It lets ATC track and manage aircraft safely

It is foundational to safe global air transport, and without clean, interference-free access, the entire aviation system becomes vulnerable.

Why protecting aviation spectrum is challenging

While aviation depends on interference-free frequencies, many different players share and regulate the airwaves.

- Global aviation spectrum is allocated by the International Telecommunication Union (ITU)
- National regulators (e.g., FCC in the U.S., ISED in Canada) control nearby non-aviation bands
- These adjacent bands are heavily used by telecom networks and other industries
- Spectrum auctions generate major government revenue
  - Four telecom companies spent US$100B in the U.S. on 5G-related spectrum

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Protecting this spectrum is not straightforward.

Globally, aviation frequencies are allocated by the ITU, but each country regulates the bands around them differently.

Telecom networks, including 5G, often operate very close to aviation frequencies, sometimes at high power.

Governments also auction spectrum for significant revenue, which adds pressure to use frequencies aggressively.

This patchwork of national rules creates inconsistencies and operational uncertainty for airlines.

Because so many high-power systems operate close to aviation frequencies, interference risks are rising.

What’s causing interference? (non-exhaustive)

- **High-powered telecom systems operating close to aviation frequencies**
  - Even when operating legally, strong adjacent-band signals can bleed into or overload sensitive aviation receivers.
- **Older aircraft systems with limited filtering capability**
  - Early-generation avionics are more vulnerable to nearby frequency activity due to less robust receiver design.

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When interference does occur, it typically comes from two sources.

First, modern telecom systems operating very close to aviation frequencies can unintentionally spill over into the bands used by aircraft.

Second, some older aircraft systems were not designed with today’s high-power adjacent-band environments in mind. They simply have limited filtering capability.

These two factors together increase the risk of interference.

What interference can lead to

Safety Risks

- Missed or unclear communications
- Degraded or lost navigation signals
- Increased risk during critical flight phases

Operational Disruptions

- Delays: Planes might have to hold or reroute if navigation is compromised
- Diversions: Aircraft might be prohibited from using specific airports or runways

More Manual Procedures Required

- Pilots and controllers may need to use alternate and less efficient operational procedures.

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Interference doesn't just affect one system it can impact the entire operation.

From a safety perspective, it can disrupt communications and degrade navigation signals.

Operationally, it can cause delays, rerouting, or limit which runways an aircraft can use.

And when automated systems can't be relied upon, pilots and air traffic controllers must revert to more manual and less efficient procedures.

This adds workload and reduces overall efficiency.

The economic costs are also significant

Punctuality

- On-time operations depend on interference-free navigation
- Backup procedures add to delays and cost

Fuel Efficiency

- More holding and rerouting increases fuel burn
- Less ability to optimize flights dynamically

Operational Costs

- Higher maintenance demands due to inefficiencies
- Increased passenger compensation when flights are disrupted

Mitigating 5G interference could cost US aviation $5.5 billion or more

*Independent study extrapolating from the assessment of operations at 10 major US Airports
**Evaluates operational, retrofit, and revenue impacts for the 2028-2035

While we are hopeful that the US Gov and industry come up with a solution that meets everyone's needs mitigating 5G interference could cost US aviation $5.5 billion or more across 10 major US airports.

Evaluates operational, retrofit, and revenue impacts

Breakdown of economic impact

1. Arrival Disruptions: $2.2B

- Go-arounds, diversions, delays
- Passenger time losses
- Higher disruption rates under unmitigated conditions

2. Reduced Operations: $1.7B

- Aircraft without mitigated altimeters unable to operate in some conditions
- Lost revenue due to reduced capacity

3. Retrofitting Costs: $1.6B

- Altimeter and antenna upgrade packages
- Labor and installation
- Additional maintenance downtime and lost revenue

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Key Findings

5G C-band RFI impacts could significantly disrupt aviation operations

Largest cost driver: arrival-related disruptions

Reduced operations also contribute materially to losses

Retrofitting costs depend on downtime and equipage rates

Wide scenario variation due to uncertain exposure to unmitigated RFI

Radio altimeters, 5G mitigations, and the emerging gap

Radio altimeters are one of the aircraft systems most sensitive to adjacent 5G signals

Standards for new, more resilient designs have taken years to develop and will take years to enter the fleet.

Next-generation altimeters using these standards will not be widely available before 2032 and will not complete before 2035.

Voluntary mitigation measures by telco's at US airports will expire in 2028, before equipment installation is complete.

Some Canadian and Australian mitigations end in early 2026

The gap (2028-2035) will increase operational complexity and require costly safety management measures.

One of the most sensitive systems is the radio altimeter, which is used during landing to determine an aircraft's exact height above ground.

The 5G band in several countries sits right next to the altimeter band, and while new, more resilient altimeter designs are being developed, they won't be widely available until around 2032.

In the meantime, voluntary mitigations like power limits and antenna adjustments are scheduled to end in 2026 in some countries and 2028 in the United States.

This creates a significant timing challenge for aviation.

Industry and regulators are assessing how to maintain safety between the end of 5G protections and the rollout of new altimeters

The European Union (DG CONNECT/DG MOVE) has published a roadmap for altimeter retrofits in the 2030s

What needs to happen now

Ensure 5G deployment is aviation-safe
Continue to respect aviation-safe 5G deployment frameworks
Align spectrum use, power levels, and antenna siting with proven aviation safety requirements.

Create global consistency
Harmonize 5G safety standards internationally.
Reduce regulatory fragmentation that increases cost and uncertainty.

Strengthen transparency and cooperation
Improve data sharing between telecom and aviation authorities.
Ensure transparent access to 5G deployment characteristics at and around airports.

GNSS Interference

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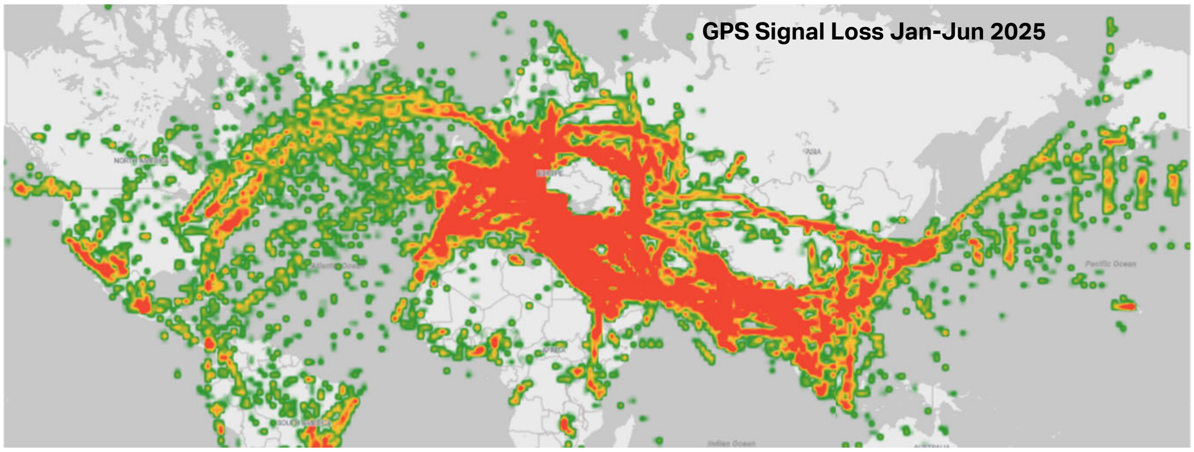
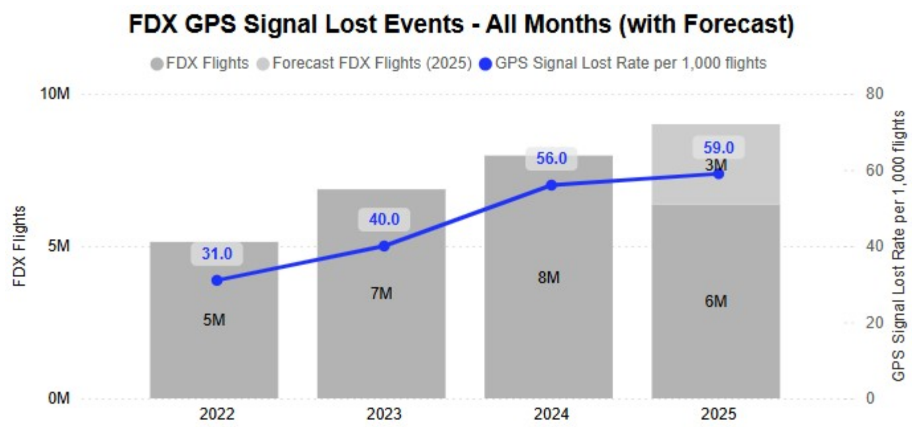
Spectrum interference goes beyond radio altimeters



Reported GPS signal loss events evolution



- **GPS Loss Events Evolution**
  - This chart shows the trend in GPS signal loss events reported under the FDX program over the last four years.
  - The **blue line** represents the **GPS Loss Rate**, measured as the number of GPS loss events per 1,000 flights.
  - The **grey bars** show the total number of flights recorded each year, in millions.

- **Key Takeaways:**
  - In **2022**, the GPS loss rate was **31.0**, based on a relatively low number of recorded flights.
  - In **2023** and **2023**, the number of recorded flights increased significantly**.** The loss rate rose slightly to **40.0** and **56.0** respectively — showing a steady trend despite higher traffic volumes.
  - In the **GPS loss rate is expected to reach 59.0**

- **Implications:**
  - This growth isnotable and concerning — it suggests that GPS interference or jamming is becoming more frequent, not merely a function of flight volume.

GNSS Interference Priorities (Industry & ICAO Alignment)

- States must improve how interference is detected, reported, and shared, so pilots and controllers know when signals are unreliable.
- Where necessary, countries should maintain backup navigation systems so aircraft can operate safely if GPS/GNSS is disrupted.
- Manufacturers should provide need clear, consistent guidance on how to manage operations in areas affected by interference.
- Airlines continue to conduct their risk assessment and ensure pilot training based on current and emerging GNSS radio frequency interference risks

GNSS interference was a major topic at the latest ICAO Assembly, reflecting growing concern over increased GPS/GNSS jamming and spoofing worldwide.

GNSS interference risks are rising due to a combination of geopolitical tensions, illegal devices, and growing dependency on GNSS for aviation operations. The most significant modern drivers are: Intentional jamming, Spoofing, Electronic warfare activity, Cheap personal RF devices

ICAO emphasized that this is no longer a regional issue — it is now a *global aviation safety challenge* requiring coordinated international action.

States endorsed IATA's multi-faceted approach, which focuses on:
- Better detection, reporting, and sharing of interference events
- Ensuring aircraft have reliable backup navigation options
- Strengthening resilience in future navigation technologies
- Providing operators with clear, consistent guidance

ICAO adopted a revised Resolution calling on States to take GNSS interference seriously and implement appropriate safeguards.
This includes:
- Improved interference reporting mechanisms
- Stronger infrastructure planning to maintain essential backup navigation
- Increased cooperation with manufacturers and operators

ICAO also called for stronger mitigation measures, noting that GNSS interference will continue in the near term.
- States must ensure aircraft can operate safely when GNSS signals are unreliable
- Closer collaboration with aviation stakeholders is essential

These shared priorities — from both industry and ICAO — create a clear roadmap for managing the growing interference threat.

This means continued:

- OEM support to provide updated guidance to operators
- Infrastructure planning that preserves an optimal Minimum Operational Network of backup navigation
- Global coordination through ICAO, including future-proof navigation technologies and standardized crew notification protocols

Lithium Batteries

Travelers Are Carrying More Devices but with Incomplete Knowledge

- 83% of travelers carry a phone
- 60% carry a laptop
- 44% carry a power bank

93% say they know the rules on lithium-powered devices, but key misconceptions remain

- 50% incorrectly believe it's OK to pack small lithium-powered devices in checked luggage
- 45% incorrectly believe it's OK to pack power banks in checked luggage
- 33% incorrectly believe that there are no power limits on power banks or spare batteries carried on aircraft.

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Seven Simple Safety Rules

1. **Pack light:** Only bring the devices and batteries you really need.
2. **Stay alert:** If a device is hot, smoking, or damaged, tell the crew (or airport staff) immediately.
3. **Keep devices with you:** Always carry phones, laptops, cameras, vapes (if allowed) and other battery-powered items in your hand baggage, not in checked baggage.
4. **Protect loose batteries:** Keep spare batteries and power banks in their original packaging, or cover the terminals with tape to prevent short-circuits.
5. **Gate check reminder:** If your hand baggage is taken at the gate to go in the aircraft baggage hold, remove all lithium batteries and devices first.
6. **Check battery size:** For larger batteries (over 100 watt-hours, such as those used in larger cameras, drones, or power tools), check with your airline as approval may be required.
7. **Check airline rules:** Always confirm your airline's policies, as requirements may differ in compliance with local regulations.

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Thank you