



Space-based data for flight tracking

Aireon's Unique Capabilities

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Director of Business Development and Sales
Commercial Data Services

2nd April 2025
Aerospace Tech Week, Munich

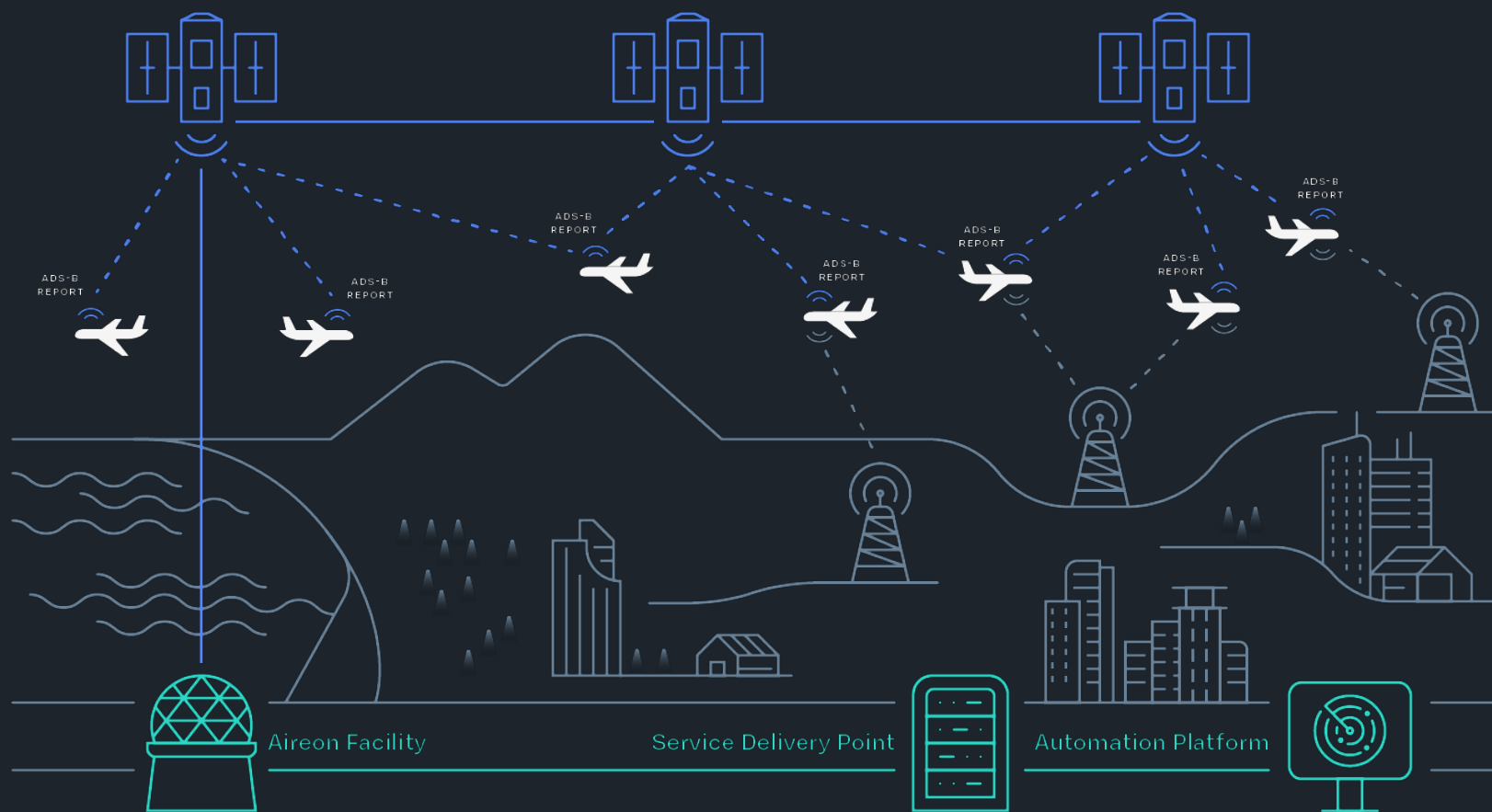


What is space-based data for flight tracking?



Space-based detection of ADS-B Data

Iridium Next satellites equipped with ADS-B receiver 1090ES



- **ADS-B = Automatic Dependent Surveillance - Broadcast**
- **Positions and velocity signals broadcast from transponders twice per second from all ADS-B equipped aircraft**
- **Mandated for vast majority of commercial operations around the world**
- **Transmits on the 1090 MHz frequency; requires line of sight detection**
- **Space-based receivers remove topographic barriers and geographic range limitations, giving pole to pole coverage – over oceans, deserts & mountains.**



ADS-B receivers on the Iridium NEXT Satellite Constellation



Aireon's ADS-B receivers are hosted on the Iridium NEXT constellation. 66 satellites distributed in six polar orbital planes (+14 in-orbit 'spare' satellites)

Each **Hosted Payload (HPL)** receives, demodulates, and transfers ADS-B messages from each 1090 MHz equipped aircraft to the ground with < 700ms latency.

A professional, robust ADS-B receiver network, EASA certified for safety of life operations.



Over 4 Billion Raw ADS-B Messages per Day



PROPRIETARY INFORMATION, © AIREON LLC

Who is Aireon?



Aireon is the world's leading provider of space-based automatic dependent-surveillance broadcast (ADS-B) data to the global aviation community



Headquarters
McLean, Virginia
USA

Global Locations
Belgium, South
Africa, Switzerland,
Spain, New Zealand,
Singapore, Sweden,
Greece, Canada

Employees
140+

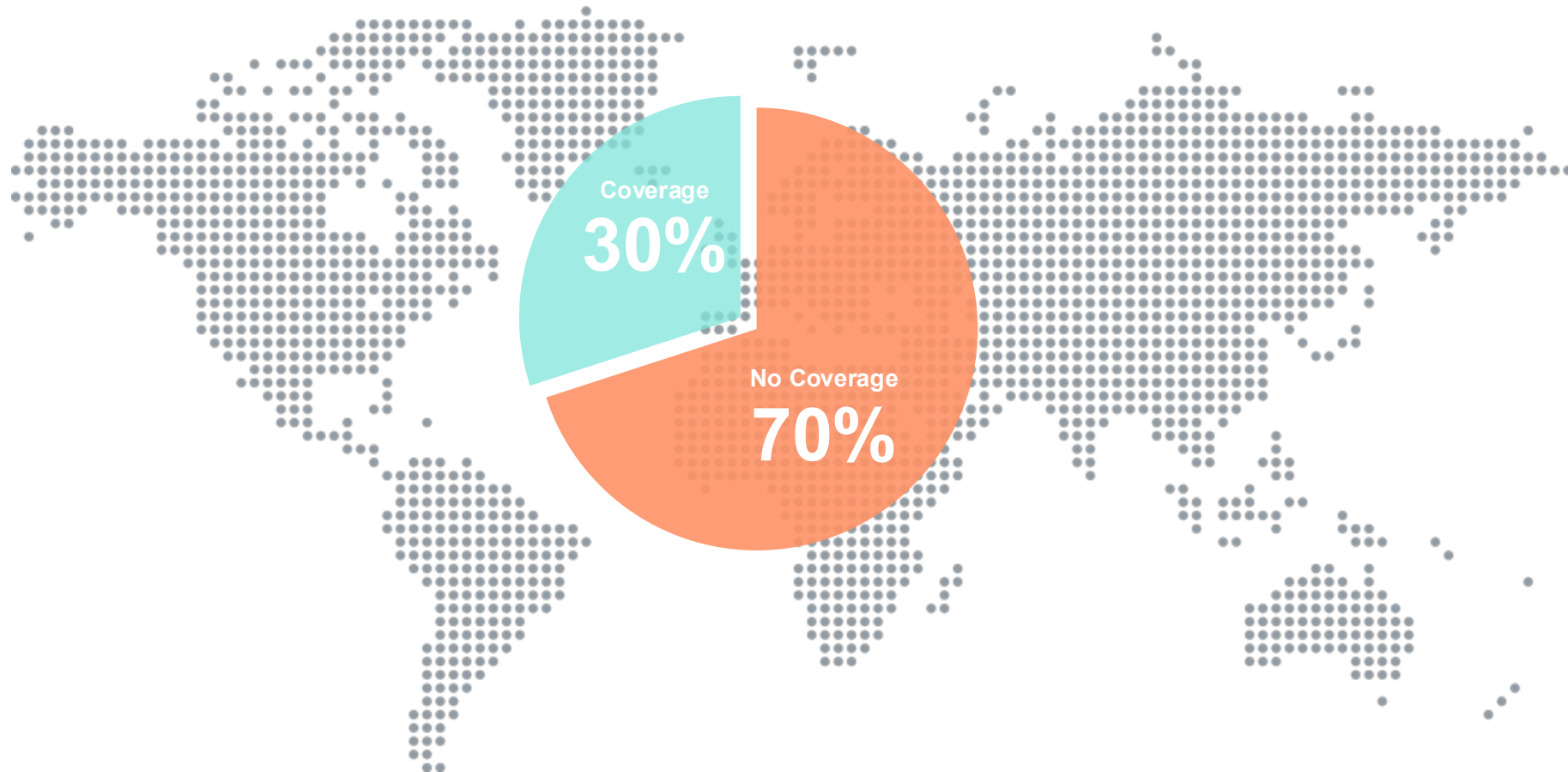


PROPRIETARY INFORMATION, © AIREON LLC

Best-in-Class aerospace investors



Prior to Aireon, much of the globe was not surveilled



A quick history of Aireon

2011

Aireon created

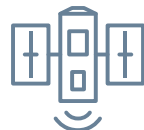
World's first service provider of global, real-time air traffic surveillance, regardless of location



January 2019

Iridium Constellation completed

Cutting-edge constellation with Aireon's ADS-B receivers on each satellite



April 2019

All Payloads in Orbit and Operational

All 66 Aireon ADS-B payloads active and operational



2020

Commercial Data Services introduced

Leveraging the same trusted data stream, Aireon launched AireonSTREAM™, AireonINSIGHTS™, and AireonFLOW™, designed to bring new capabilities to the broader aviation community



Today

Globally Established ATS & CDS Provider

Locate search & rescue tool

Safety Dashboard – RoRo, TCAS Advisories, Rejected Takeoffs

GPS Interference monitoring

Turbulence Monitoring

More than 20 ANSPs representing >40 countries, and multiple Airlines around the world use Aireon ADS-B data to safely and efficiently manage their operations



Top Commercial Aviation Entities & ANSPs rely on Aireon



What can Aireon offer the Aviation Tech Community?



The Answer is our Data

Aireon can provide access to the only **air traffic surveillance-quality & EASA certified** aircraft position data in the world.



AireonSTREAM

Real time high-fidelity, low-latency, flight tracking feeds



AireonINSIGHTS

Historic ADS-B data and
Derived Flight Events Data.
Full Archive since Apr 2019.



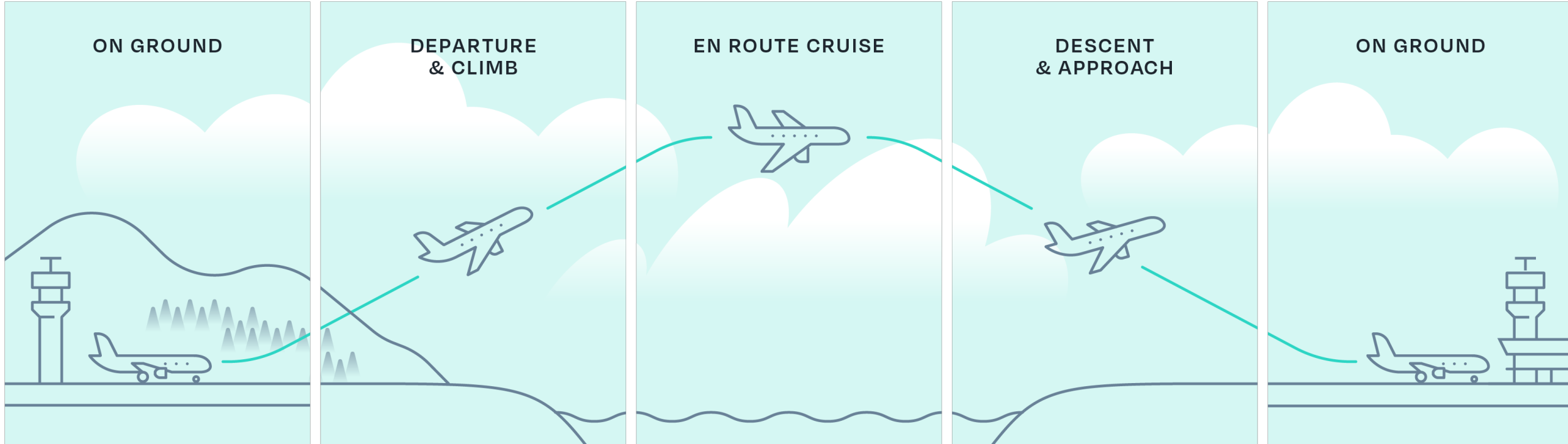
AireonVECTOR

A full suite of unique
capabilities to mitigate
against GPS Interference

Launching in 2025



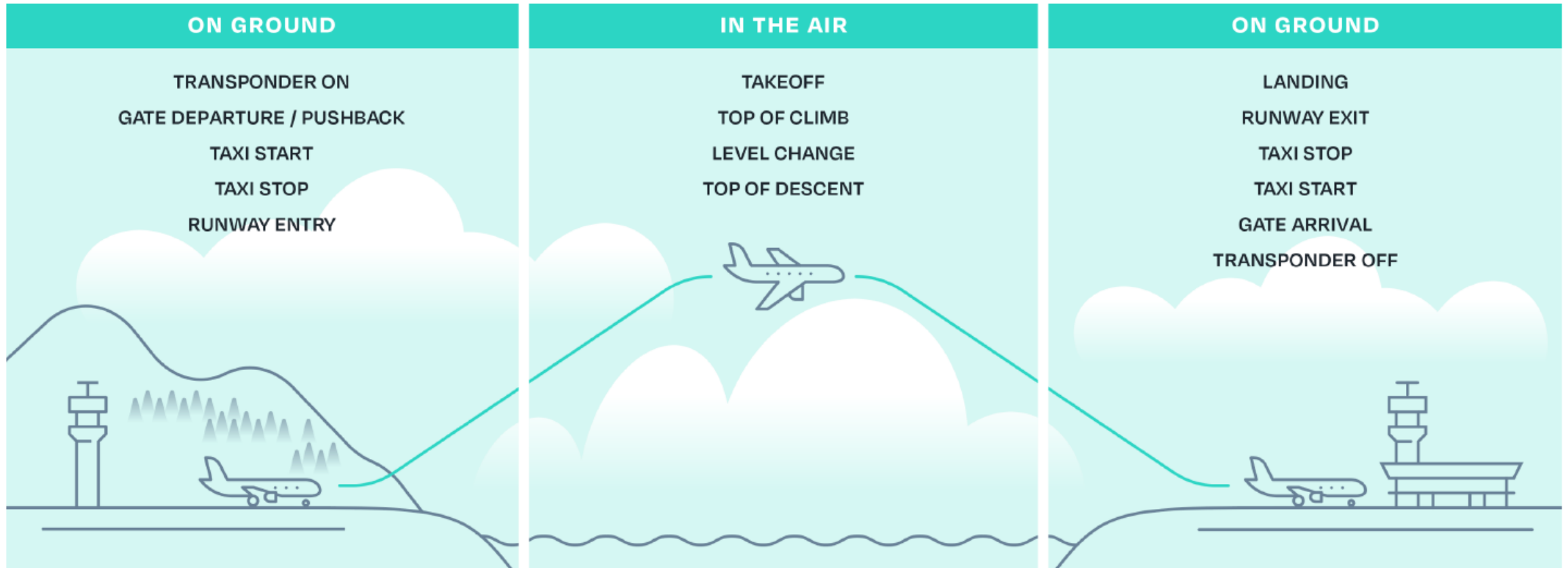
AireonSTREAM – Flight Positions



> 190k unique flights per day, > 600M ADS-B CAT021 messages



AireonINSIGHTS – Flight Events



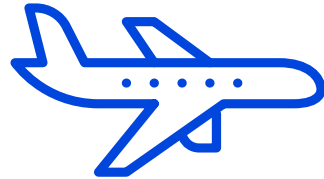
7.1M Flight Events per day, from Transponder On to Transponder Off. Live & Historic Access.



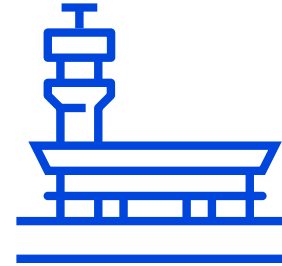
Delivering enhanced Safety, Efficiency and Environmental Benefits across the Industry



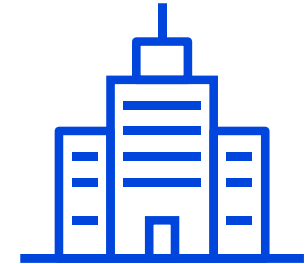
**Air Navigation Service
Providers (ANSP)**



**Airlines, Lessors and their
Solution Providers**



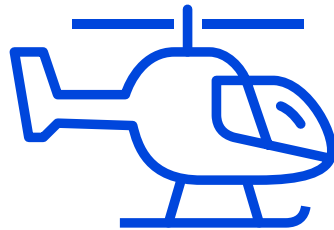
**Airports and their Solution
Providers**



**Financial institutions,
consultancies &
insurance providers**



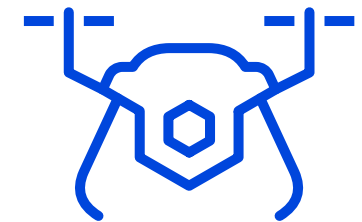
**Aviation emissions and
efficiency analytics**



**Search & Rescue (SAR)
organizations**



**Maintenance, Repair &
Overhaul (MRO)**



**Unmanned Aerial Vehicles
(UAV), Unmanned Traffic
Management (UTM)**



GNSS Interference

Aireon's Detection, Monitoring and Mitigation Capabilities



Intentional GNSS Interference: A threat to our aviation ecosystem

The Serious Threat Of GPS Spoofing: An Analysis

Patrick Veillette, Ph.D. October 09, 2023



Aircraft afflicted with GPS Spoofing have flown perilously close to the Iranian border without clearance to fly into Iran's airspace.

EASA partners with IATA to counter aviation safety threat from GNSS spoofing and jamming

26 Jan 2024 SUGGESTED



COLOGNE, January 26, 2024 - The European Union Aviation Safety Agency (EASA) and the International Air Transport Association (IATA) announced the conclusions of a [workshop](#) jointly hosted at EASA's headquarters to combat incidents of GNSS spoofing and jamming.

The workshop's high-level conclusion was that interference with satellite-based services that provide information on the precise position of an aircraft can pose significant challenges to aviation safety. Mitigating these risks requires short-, medium- and long-term measures, beginning with the sharing of incident information and remedies.

Increasing GNSS interference: UK and EU warn aviation

April 11, 2023 - By Dana Goward Est. reading time: 2:30



Image: Chalabala/iStock/Getty Images Plus/Getty Images

"Since February 2022, there has been an increase in jamming and/or possible spoofing of GNSS. This issue particularly affects the geographical areas surrounding conflict zones but is also present in the

GPS interference now a major flight safety concern for airline industry

You're wrong to think that jammin' was a thing of the past

 Mon 29 Jan 2024 / 13:26 UTC

 [Dan Robinson](#)

Europe's aviation safety body is working with the airline industry to counter a danger posed by interference with GPS signals - now seen as a growing threat to the safety of air travel.

GPS Spoofing in the Middle East Is Now Capturing Avionics

FORBES > BUSINESS > AEROSPACE & DEFENSE

Eric Tegler Contributor [Follow](#)

Dec 5, 2023, 09:15am EST



Avionics like those equipping Bombardier's Global 7500 business jet and other commercial aircraft ... [\[+\]](#) BOMBARDIER

"What we've seen since late September," University of Texas

Finnair cancels flights amid increased GNSS jamming

May 7, 2024 - By Jesse Khalil



[Photo: Finnair](#)



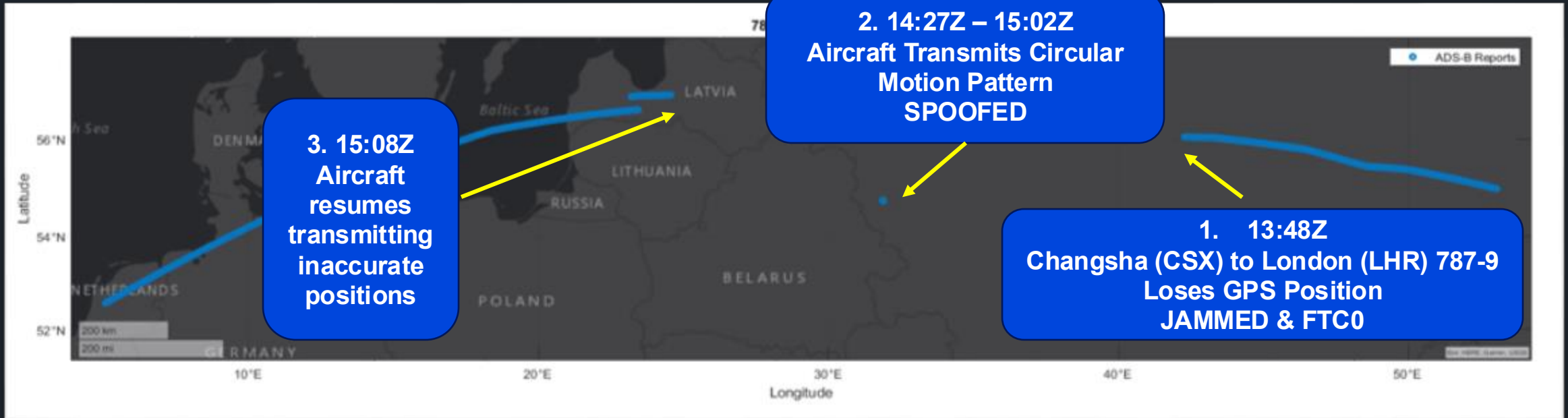
GNSS Interference: Jamming vs Spoofing

GPS Jamming

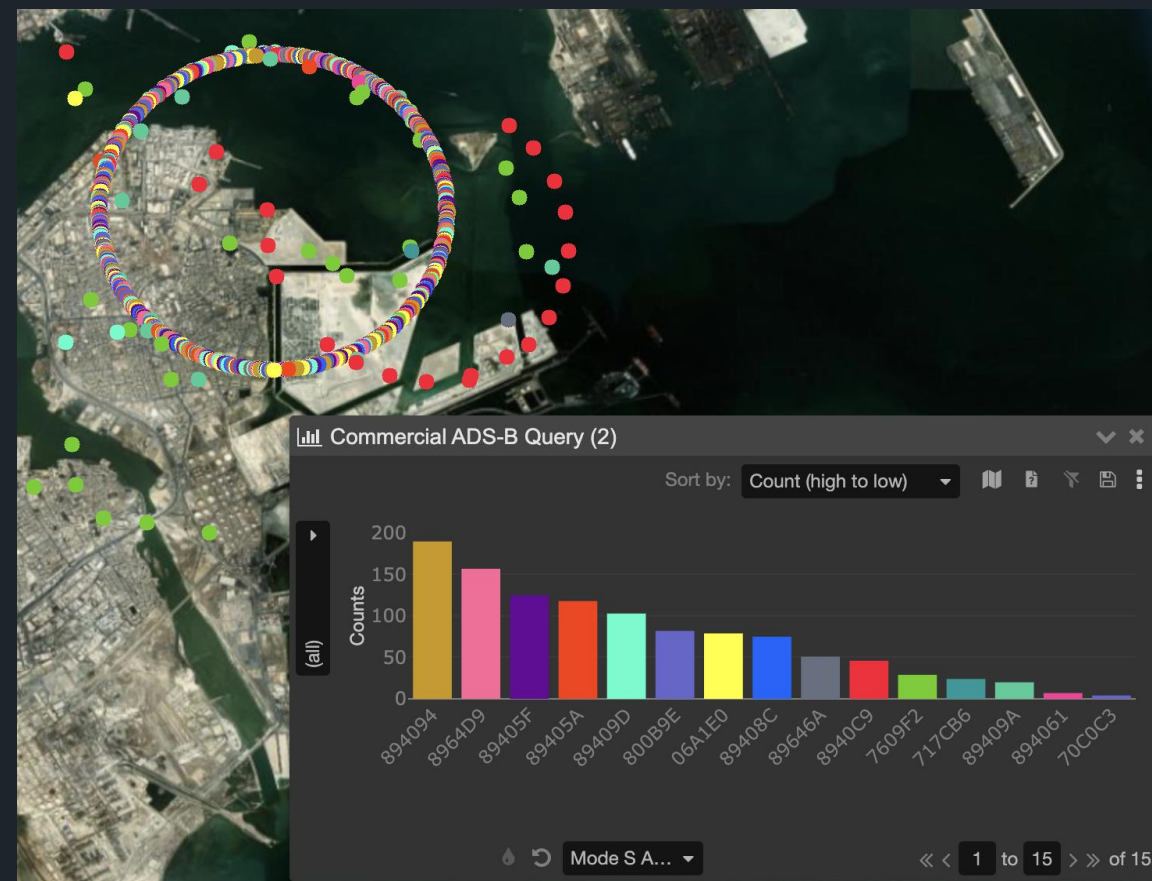
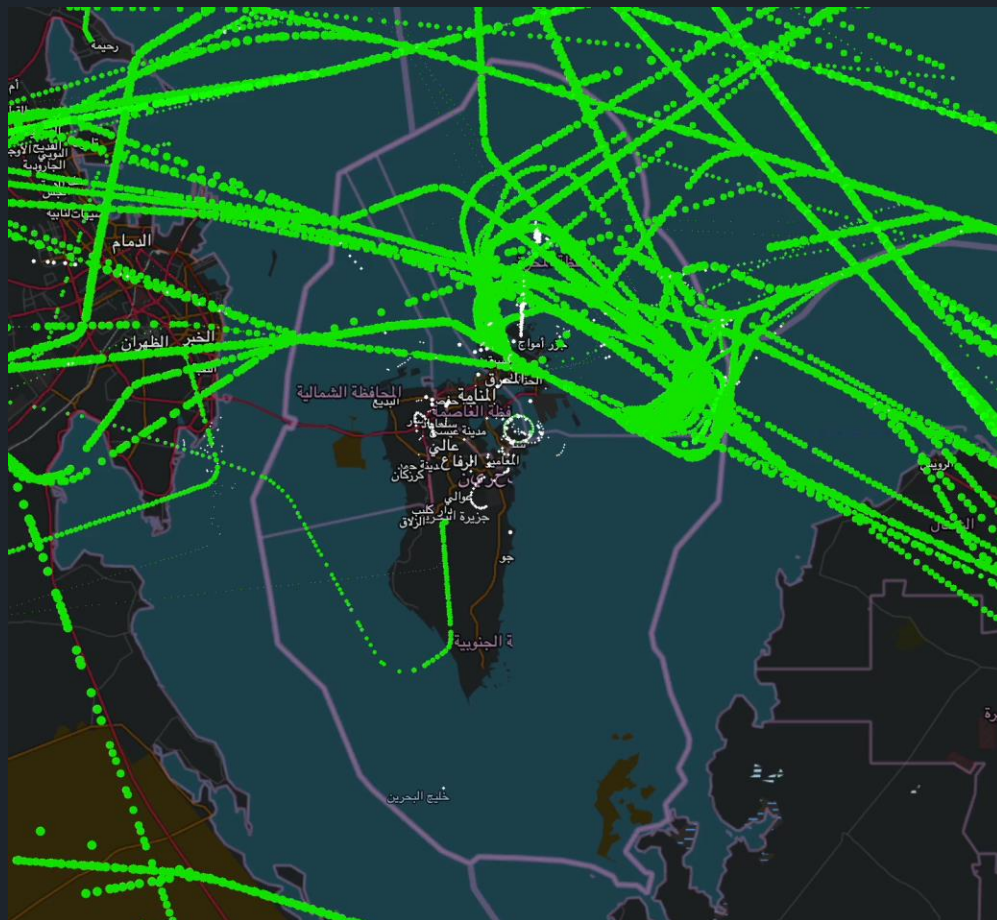
The intentional interference of GPS signals to degrade or block position accuracy

GPS Spoofing

The transmission of false GPS signals to deceive receivers into calculating incorrect positions



GNSS Interference: Typical Spoofing Indicators



Detecting GNSS Interference

1. Error Trending of Position Integrity Category (PIC) values.

An industry standard for measuring interference and possible jamming based on the positional containment value.

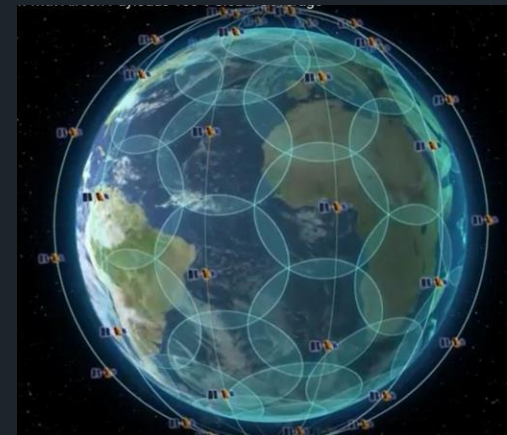
TARGET DETAILS			
	AIRCRAFT ID	ICAO	
	ANA398	84B794	
	LATITUDE	LONGITUDE	
	38.6894	139.9290	
	FLIGHT LEVEL	GEO ALTITUDE	
	FL97	9,675 ft	
	SELECTED ALTITUDE	GROUND SPEED	
	28,000 ft	315 kts	
	MODE 3/A CODE	LINK VERSION	
	1752	ED-102A/DO-260B	
	ADDRESS TYPE	REPORT TYPE	
	ICAO	Target	
		Transponder	
	RANGE CHECK	POSITION INTEGRITY CATEGORY	
	Default	11	
	EMERGENCY	SURVEILLANCE STATUS	
	No Emergency / Not Reported	No Condition Reported	

For the value of "PIC", the following conversion table shall be used:

PIC	Integrity Containment Bound	NUCp ED102/DO260	NIC (+ suppl.) DO260A	NIC (+ suppl.'s) Version 2 or higher		
				NIC	A/B	A/C
15	not defined					
14	< 0.004 NM	9	11	11	-	-
13	< 0.013 NM	8	10	10	-	-
12	< 0.04 NM		9	9	-	-
11	< 0.1 NM	7	8	8	-	-
10	< 0.2 NM	6	7	7	-	-
9	< 0.3 NM	-	-	6	0/1	1/0
8	< 0.5 NM	5	6 (+ 0)	6	0/0	-
7	< 0.6 NM	-	6 (+ 1)	6	1/1	0/1
6	< 1.0 NM	4	5	5	-	-
5	< 2.0 NM	3	4	4	-	-
4	< 4.0 NM	-	3	3	-	-
3	< 8.0 NM	-	2	2	-	-
2	< 10.0 NM	2	-	-	-	-
1	< 20.0 NM	1	1	1	-	-
0	No integrity (or > 20.0 NM)	0	0	0	-	-

2. Trending of Aireon Independent Position Check (IPC) values

A unique to Aireon attribute, possible only with Aireon's global satellite network. IATA Approved even for ATS.

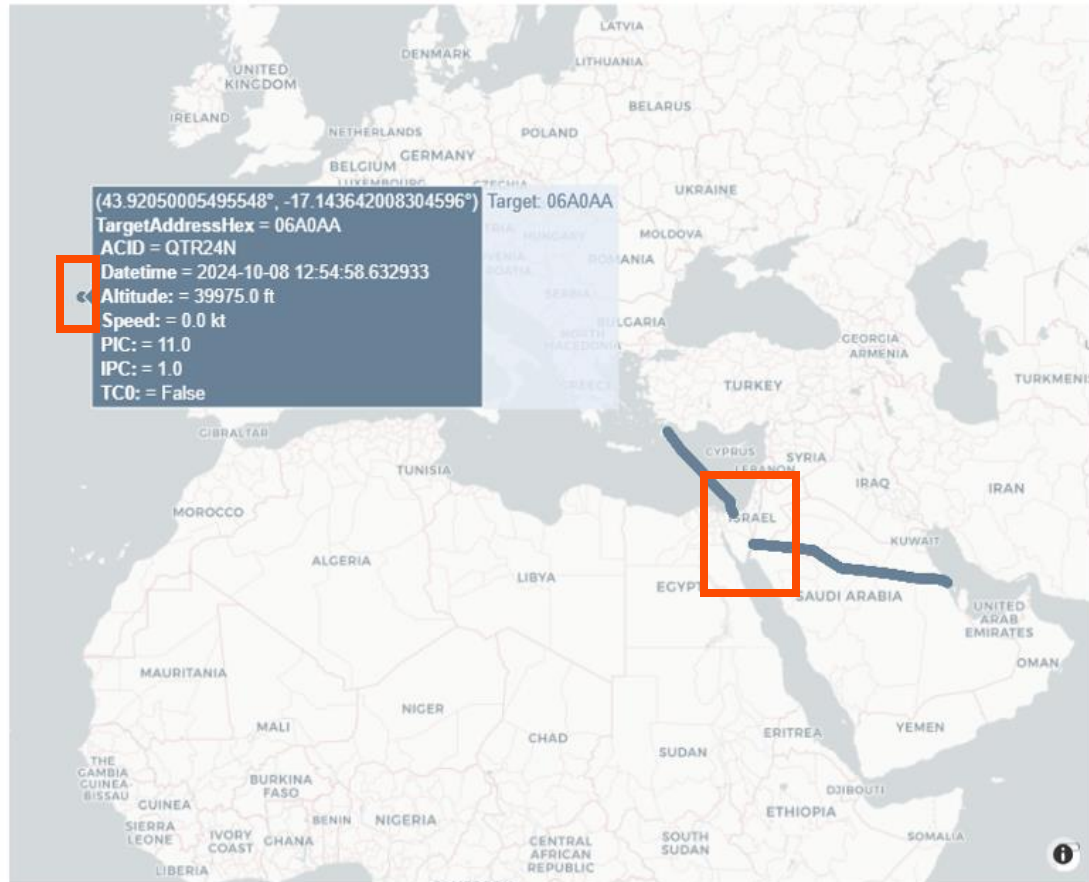


Using Iridium Satellite positioning and Time Difference of Arrival (TDOA) Geolocations, Aireon is able to not only independently validate the integrity of GPS Positions to flag unrealistic reports, but also **calculate the location of aircraft without relying on GPS lat/long data.**

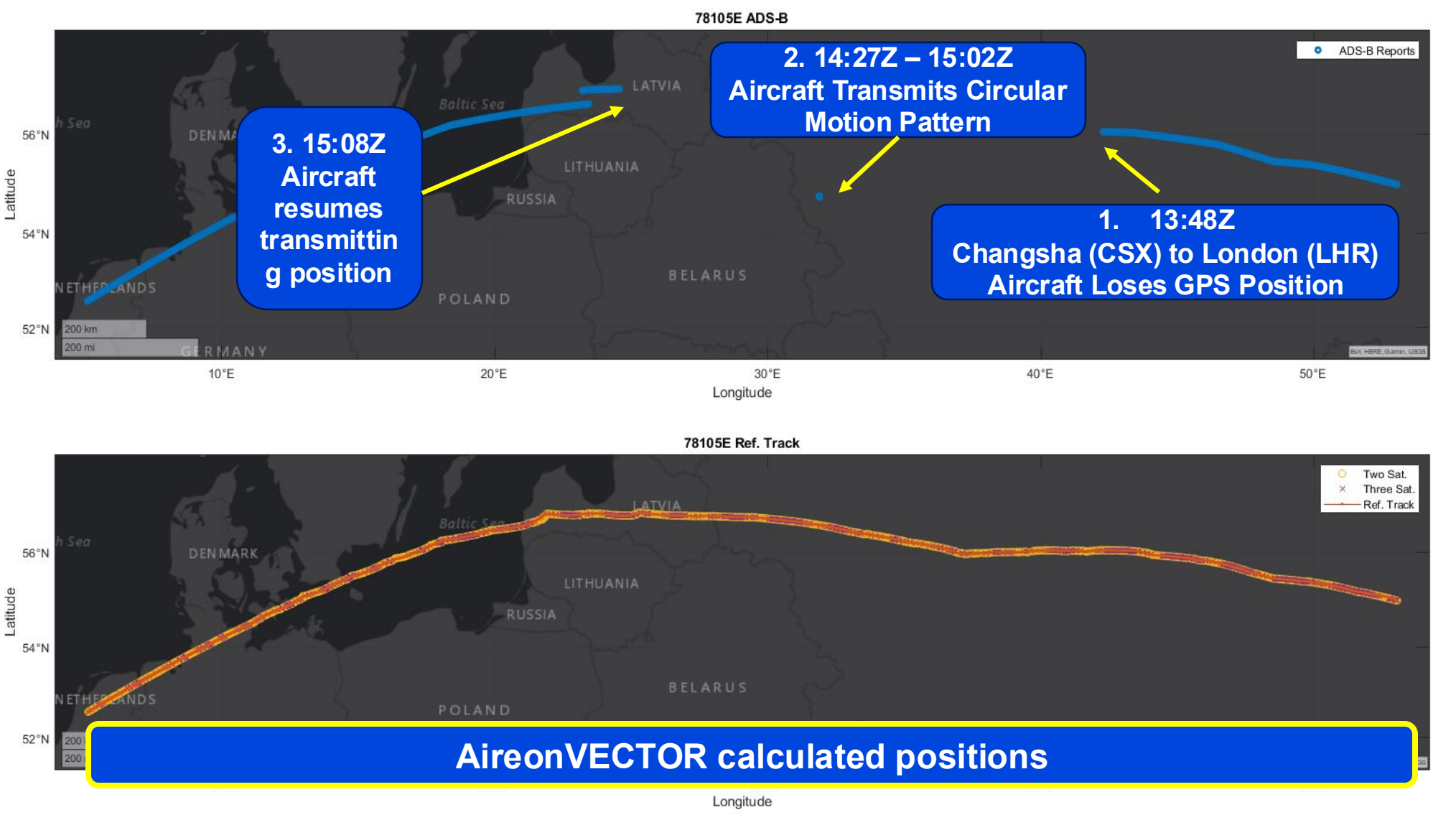


GNSS Interference: The Signals

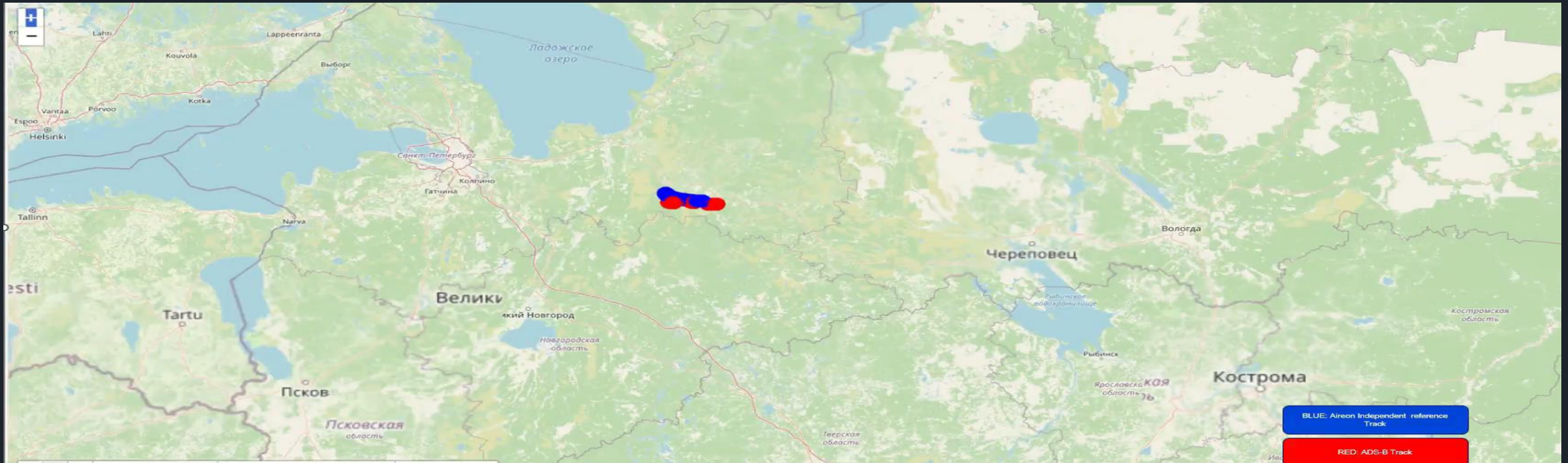
Target address: 06A0AA - Flight ID: QTR24N



GNSS Interference: Real Time Mitigation of Jamming & Spoofing



GNSS Interference: Real Time Mitigation via AireonVECTOR

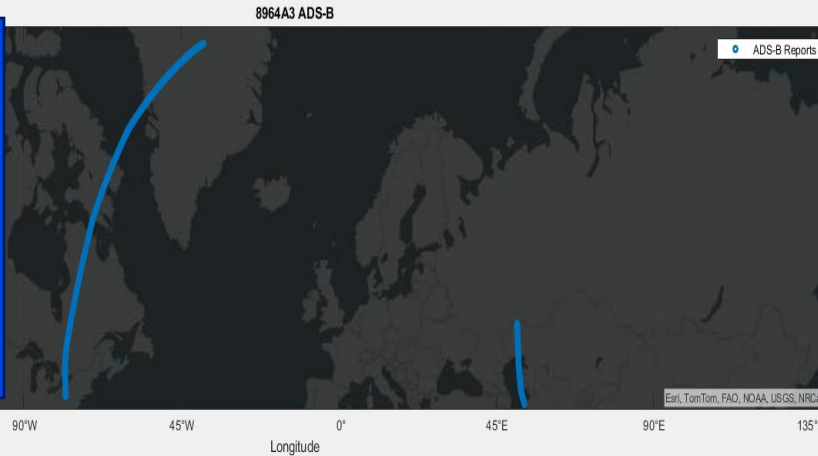


Aireon's space-based technology allows for the calculation of live aircraft positions in times of interference providing a resilient source of flight tracking, despite degraded GPS Integrity.



GNSS Interference: Prolonged effects and Mitigation via AireonVECTOR

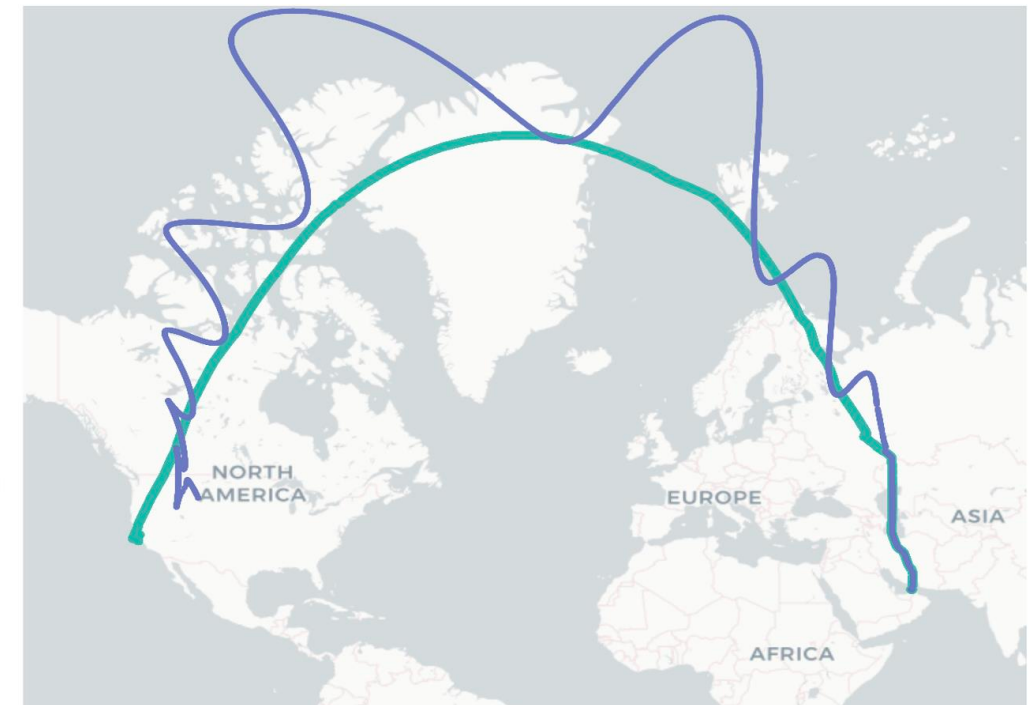
Prolonged effect of GPS Interference - positions not recovered for extended portion of flight.



AireonVECTOR calculated positions



Due to Aireon's global receiver network, aircraft positions can be calculated pole to pole.

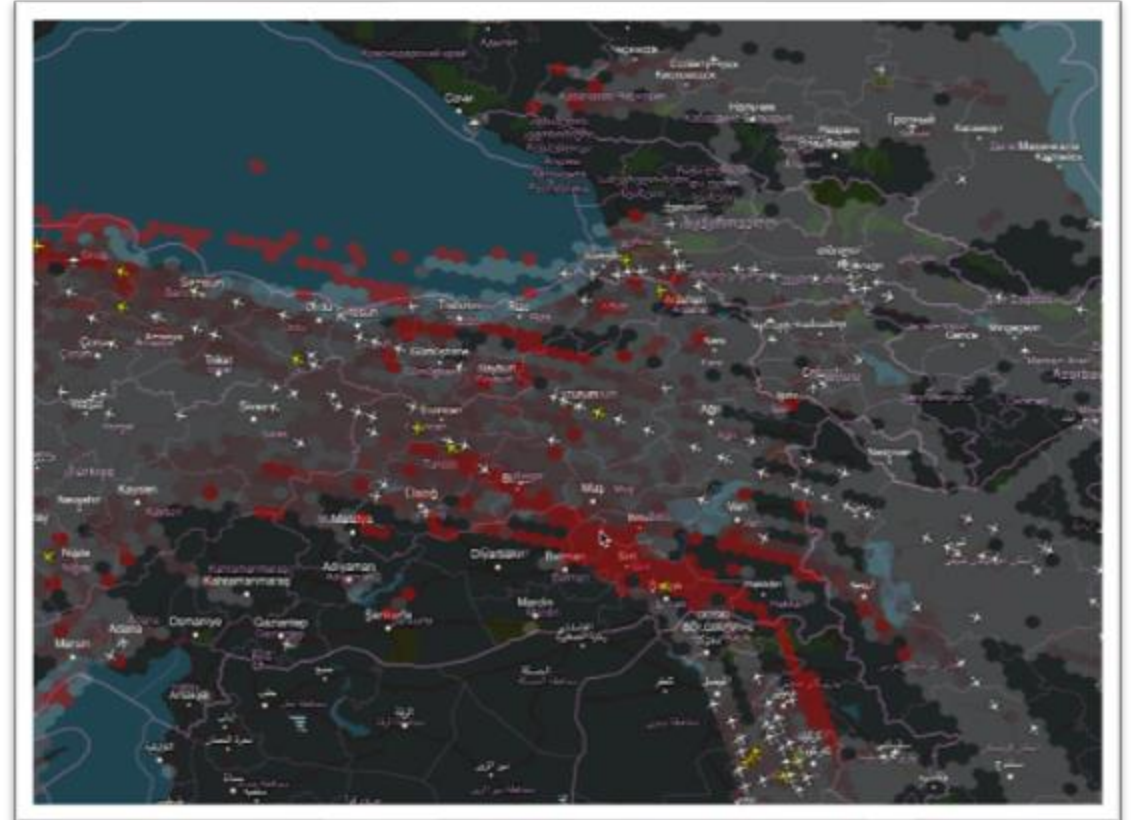


Compromised avionics & degraded positional accuracy for remainder of flight after severe GPS Interference.



AireonVECTOR Product Suite

- ✓ Aircraft position feeds with ADS-B position precision and independent validity flag
- ✓ Aircraft position feeds including calculated positions independent of GPS
- ✓ Live GPS interference event notifications
- ✓ Map layers of global GPS interference locations and severity, updated in near real time.
- ✓ GPS Interference Dashboards



Launching Q2 2025 through Q1 2026



Would you like to learn more?

→ Visit us at Booth K21.

WHITE PAPER

MAY 2024

Dr. Michael Garcia Chief Innovation Scientist
John Dolan Director, Modeling & Analysis/Data Science
Dr. Giuseppe Sirigu Principal Data Scientist

GPS interference and spoofing in the Baltics

Air Navigation Service Providers (ANSP) and aircraft operators rely on the integrity of the GPS signal to navigate the aircraft to its destination. Increasingly, however, the integrity of the GPS signal has become a target for interference—via nefarious actions like spoofing or jamming, or non-intentional actions like malfunctioning avionics. This trend has prompted many in the aviation industry to seek creative, technological redundancies to the GPS signal to ensure the aircraft is able to continue operating safely in the event of an interference.

Using its one-of-kind, space-based automatic surveillance broadcast (ADS-B) data, Aireon has developed a proof-of-concept multilateration solution that allows for independent position determination of ADS-B-equipped aircraft. This solution will allow Aireon to continue tracking aircraft even when they are unable to broadcast their GPS position using only their transmitted 24-bit aircraft address and the time of reception at the Aireon Hosted Payloads onboard the Iridium satellites.

This is done through a Satellite Wide Area Multilateration (SWAM) application that uses Time Difference of Arrival (TDOA) measurements from simultaneous detection of ADS-B transmissions on multiple payloads.

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NATIONAL SECURITY

Enhanced air domain awareness for the national security community



Key attributes for national security applications

- ▶ **Global:** Coverage from floor to 127,600 feet
- ▶ **Persistent:** 1-8 second update interval
- ▶ **Low latency:** normally < 2 seconds
- ▶ **High availability:** > 99.0% end-to-end system
- ▶ **Resilient:** Overlapping coverage and on-orbit spares
- ▶ **Enduring:** Historical data set from 2019
- ▶ **Focused:** RF spectrum coverage (1080MHz)
- ▶ **Trusted:** Architecture includes encryption and cyber-spoofing detection capabilities
- ▶ **Shareable:** Commercially available data is easily shared with coalition partners
- ▶ **Accessible:** Distributable from Gov Cloud planned in 2024
- ▶ **Valid:** Independent verification and validation of positional data

The National Security Community relies on surveillance and intelligence sources that can be trusted, accessed in real time, and analyzed to deliver critical insights and improve decision making. Aireon controls all methods and means of its space-based surveillance, encrypting data from collection to distribution, to ensure its validity.

Aireon's Automatic Dependent Surveillance-Broadcast (ADS-B) service delivers mission-critical, aircraft-derived information—including identity, GPS position, altitude and more. Collected by payloads hosted on the Iridium satellite constellation and delivered in real-time, it provides your surveillance and intelligence operations with an unprecedented layer of reliability, security, and flexibility, anywhere on the globe.

Since becoming operational in 2019, the Aireon system has generated an archive of location and position data of all ADS-B-equipped aircraft worldwide. Scalable to any need, Aireon's data-as-a-service subscription offerings include real-time reporting to enhance track quality, custody, and identification; while improving anomaly detection with historical data sets available to assist pattern-of-life analysis.

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WHITE PAPER

OCTOBER 2023

John Dolan Director, Modeling & Analysis/Data Science
Mike Garcia Chief Innovation Scientist
Giuseppe Sirigu Principal Data Scientist

Space-based ADS-B for GPS-independent position validation

Aircraft operators, Air Navigation Service Providers (ANSP), air traffic control organizations, and others rely heavily on data and associated systems to safely and efficiently operate and navigate aircraft throughout the airspace. From takeoff to touchdown and beyond, positional data is critical. But what happens when the systems fail? What if the GPS data is somehow compromised?

Aireon has developed a proof-of-concept multilateration solution that allows for independent position determination of ADS-B-equipped aircraft. This solution will allow Aireon to continue tracking aircraft even when they are unable to broadcast their GPS position using only their transmitted 24-bit aircraft address and the time of reception at the Aireon Hosted Payloads onboard the Iridium satellites.

This is done through a Satellite Wide Area Multilateration (SWAM) application that uses Time Difference of Arrival (TDOA) measurements from simultaneous detection of ADS-B transmissions on multiple payloads. This solution leverages traditional multilateration techniques used by terrestrial systems but applied via satellite. This is possible due to both the Iridium constellation, with its significant overlapping satellite coverage, and Iridium's ability to accurately track the position and timing of each satellite (on the order of hundreds of nanoseconds), which is shared with Aireon.

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Whitepapers available at Aireon.com





Thank You

Aireon.com

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