

RNTFnd.org



Advocating for policies and systems to protect satellites, signals, and users



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How GPS is used by almost every technology



Where GPS was jammed yesterday



Where GPS is being spoofed right now



Protect the Frequencies – By preventing interference

Toughen Receivers – With readily available technology

Augment Services – With difficult to disrupt terrestrial signals



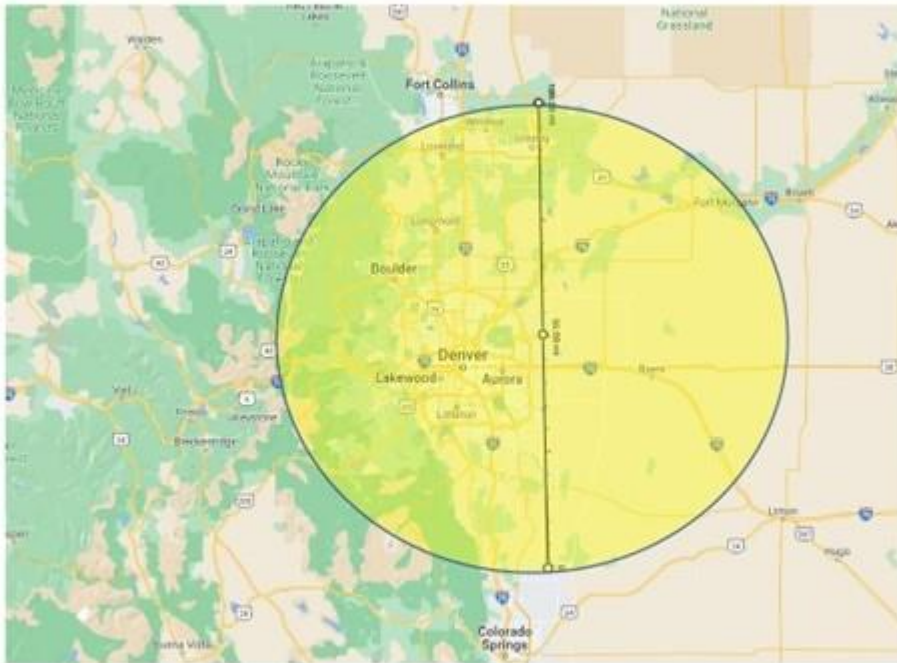
- Court allowed suit against U.S. govt to proceed.
- October report to the FCC that they have met a requirement

Denver Intl Airport

21 -22 January 2022

Air Traffic Disrupted, Endangered

33 hours



GPS World

The Business and Technology of Global Navigation and Positioning

What Happened to GPS in Denver?

Notice To Airmen 21 January 2022
NAV GPS UNRELIABLE (INCLUDING WAAS, GBAS, AND ADS-B) MAY NOT BE AVAILABLE A 50NM RADIUS CENTERED AT 394900N1044800W OR ALL QUADRANTS OF THE DEN VOR SFC-FL400. 22 JAN 05:00 2022 UNTIL 01 FEB 05:00 2022. CREATED: 22 JAN 05:33 2022

From Pilots:

Aborted landing

Quick maneuver to avoid

Confusing signals

Can't leave until fixed

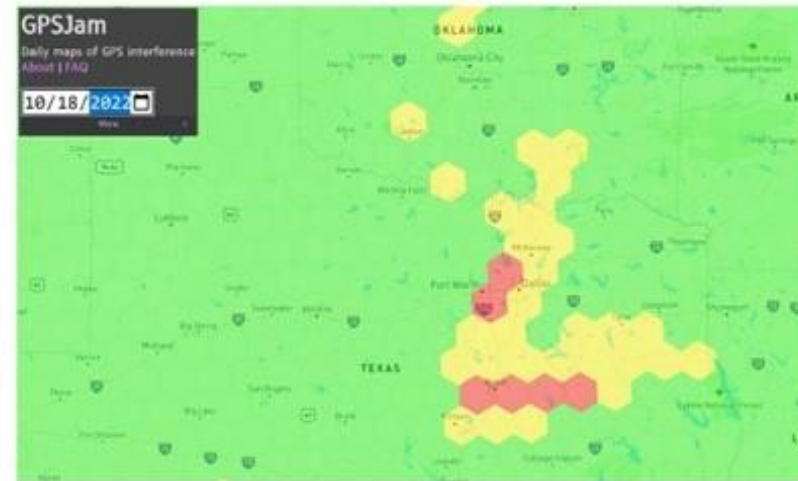
Dallas-Fort Worth

17 - 18 October 2022

Air Traffic Disrupted, Endangered

44 hours

Source Never Located



Bloomberg

FAA Warns Airline Pilots as GPS Signals Disrupted Around Dallas

- Runway at Dallas closed, flights using older technology
- FAA says it's found no evidence of intentional interference

DFW Flight Delays @FAA_DFW - Oct 18
Due to OTHER GPS ANOMALIES Gate Hold and Taxi delays between 30-45 minutes and increasing. [#DFW](#)

KDFW
Departure

DFW ARR 2020 L 1801Z. 20R13KT 280K
FEQ25R 37/MDZ A3830 (THREE ZERO
TWO NINE) ONE ONE ZERO SIX TWO. SIGMA
VERBAL APCH TO RWYS, 36L, 35C,
31R, 31L. LING RWY 31C EXP LAHSD
TAY 87 3859 FT AGL, LOG RWY 36L
EXP LAHSD TAY 7. UNIMB FT AGL.
NOTICE TO 22R MISSIONS. RWY 32L
CLOSE. RWY 31R 60.07L. TAY 3R CLOSE
STAY RWY 30R AND TAY E. ATTN ALL
SOFT TO NOTAM IN EDCY FOR DFW 88PT
FOR 2020-18 01Z ETC ETC
**END ACTIVITY VORBY APPT. ATTN ALL
SIRAMPT GPS AND ADS-B REPORTED
UNRELIABLE WITHIN 40NM OF DFW.
ADTS YOU HAVE 1800 L.**

Final

Aviation GPS incidents show importance of backup systems. Policy makers should take note

High level assessment of the impact of GNSS disruption at Dallas Fort Worth and Denver airports

May 2024



LE
London
Economics

Aviation GPS incidents show importance of backup systems, Policy makers should take note

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May 2024



LE
London
Economics

1. Backups (VOR, DME, ILS) essential to avoid major impacts to flight operations.
 - Available at big airports
 - Govt moves to reduce terrestrial nav aids
2. Interference was directed up. If ground was impacted almost certain impact on flight ops.

Big companies don't always admit to having problems.

19 July 2024

MEMORANDUM

FROM: Thad Allen, Admiral (USCG, Ret), Chair, National Space-based Positioning, Navigation, and Timing (PNT) Advisory Board

TO: Honorable Kathleen H. Hicks
Deputy Secretary, Department of Defense
Co-Chair, National Space-based PNT Executive Committee

Honorable Polly E. Trottenberg
Deputy Secretary, Department of Transportation
Co-Chair, National Space-based PNT Executive Committee

SUBJECT: Report of the 30th National Space-based PNT Advisory Board Meeting and Associated Activities

Madam Co-Chairs,

The National Space-based PNT Advisory Board (PNTAB) held its 30th session on April 24-25, 2024, in Colorado Springs. The meeting was held under the provisions of the Federal Advisory Committee Act, with appropriate public notification and documentation for the public record. At this meeting, the Board reaffirmed the recommendations in my January 27, 2024 report and approved three additional recommendations (see Enclosure). The Colorado Springs session was guided by the Board's Protect, Toughen, and Augment (PTA) of the Global Positioning System (GPS) for all users, our long-term framework to organize our advice. The scope of our work continues to broaden to consider the evolving capabilities of Global Navigation Satellite Systems (GNSS), (2) complementary PNT technologies (terrestrial and space-based), ongoing policy, strategy, and governance challenges presented by global GNSS competition and execution of the GPS program. I delayed this report as further context was provided at the EXCOM's Executive Steering Group (ESG) meeting on May 29, 2024, and in subsequent classified briefings by the 2nd Space Operations Squadron (2SOPS).

PNTAB Chair's Bottom Line Up Front (BLUF)

- Reliable and resilient PNT (space-based and terrestrial) faces a broad spectrum of risks and challenges. Regarding



**NATIONAL
SECURITY
SPACE
ASSOCIATION**

**America's Asymmetric Vulnerability to
Navigation Warfare:
Leadership and Strategic Direction
Needed to Mitigate Significant Threats**

**“GPS Blackmail”
November 2021**

Mark Berkowitz

“Eurocontrol tech directors worried over GNSS/ GBAS”

Network Directors of Technology Working Group

27.5.24
ITEM 5.2

Action paper NDTECH/24/13/7

GBAS STATUS

PROGRESS SINCE THE NDTECH/12 "MATTERS ARISING" REPORT

Submitted by the Network Manager

EU Regulation: Network Functions Implementing Rule, Article 7

EXECUTIVE SUMMARY

At NDTECH/12, the "Matters Arising" report noted that no tender relating to GBAS CAT III implementation had been submitted in the case of two successive EU funding opportunities. In the discussion that followed, a number of arguments were presented and it was noted that the non-implementation of GBAS, as part of the long-term strategy to maintain and improve low visibility operations (LVOs), might have adverse effects on the long-term viability of LVOs. On the other hand, a significant increase in GNSS jamming and spoofing raised questions on the use of GNSS-based systems for such critical operations. NDTECH thus considered it necessary to request feedback from expert-level groups to maintain the long-term viability of CAT III landing operations, either through GBAS GAST D or investment in other CAT III technologies.

Two of the expert groups have already started addressing the issue, with others set to follow. Discussions to date have indicated that the issue cannot, however, be solved by technology discussions but is embedded in a greater context, notably as regards the future reliance on GNSS. Policy decisions, such as those relating to the PBN IR, the RP4 requirements and the funding arrangement of certification authorities, have an impact on business case feasibility for all of the parties involved.

These hurdles can only be overcome with a coordinated strategy. The members of NDTECH are asked to support contributions to ongoing activities at expert level and to consider the

GPS Spoofing

FINAL REPORT OF THE GPS SPOOFING WORKGROUP

Technical Analysis & Impact

Flight Crew Guidance

Safety Concerns

Solutions

Recommendations

GPS Spoofing WorkGroup

OPSGROUP

“What is the next navigation system to be adopted for global aviation?”

Complementing GNSS for Resilient Performance Based Navigation

November 2024
Dr. Okuary Osechas, ZHAW, Switzerland
Dr. Gary A. McGraw, Consultant, USA



Dr. Okuary Osechas



Dr. Gary McGraw

	Operations Supported	Operational Coverage	Deployment	Backwards Compatibility	Spectrum Efficiency	Capacity Limits	Other Applications	Provides Timing	Authentication
VOR/DME	RNAV 1 - 5	75 NM	Deployed / Certified		High PAPR	Ranging	Designed for Aviation		
DME/DME	RNAV 1	140 NM	Deployed / Certified		High PAPR	Ranging	Designed for Aviation		
Multi-DME	RNP 1	140 NM	Deployed / Certified		High PAPR	Ranging	Designed for Aviation		
eDME	RNP 0.3	140 NM	New Gnd / Air Equip.	Yes: 100%	High PAPR	PR mode	Designed for Aviation	~100 ns	Possible
eLORAN	RNP 0.3	~1000 NM	New Gnd / Air Equip.	New Aviation NAVAID	Not L-Band	Passive	Maritime & Timing	~100 ns	Possible
LDACS-NAV	< RNP 0.3	200 NM	New Gnd / Air Equip.	New Aviation COM	Shared with COM	PR mode	Potential for AAM	< 100 ns	Encrypted COM
5G Cellular	<RNP 0.3 ?	<10 NM	New Air, Expanded Gnd	New System	Shared with COM	Capacity Limited	Potential for AAM, GND	< 100 ns	Encrypted COM
Commercial Pseudolite	<RNP 0.3 ?	<20 NM ?	New Gnd /Air Equip.	New System	Not ARNS spectrum		Potential for AAM, GND	<< 100 ns	Likely
LEO SATNAV	<RNP 0.3 ?	Potentially Global?	New SVs / Air Equip.	New System	Shared with COM	Passive?	Land/Sea/Air	< 100 ns	Likely

	Poor/High Cost		Marginal/Costly		Fair/Moderate Cost		Good		Excellent		N/A
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Recommendation: eDME, eLoran, LDACS-NAV

Looking ahead



SPACENEWS[®]

Opinion

America is at risk of high impact GPS jamming and spoofing from space

GPS Interference Over Land a Recurring Problem for Transatlantic Flights



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