Episode Book

EPISODE #5832

When Your GPS Is Lying: Aviation's Spoofing Problem

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SYNOPSIS

Aircraft are being fed counterfeit satellite signals that produce a confident, wrong position — with no red lights, no master caution, and no checklist. This episode unpacks the difference between jamming and spoofing, the hybrid IRS trap on the 787 and G650, and the manual alignment trick crews use at Larnaca, Tel Aviv, and Beirut. From the Vilnius aborts at 850 feet to FlySafe's finding that the Middle East accounts for over 68% of global GNSS interference events, we trace how a timing system disguised as a navigation system became one of aviation's hardest operational problems — and what a listener's airport sign question taught us about independent reality checks.

TRANSCRIPT



Corn

There's a number painted on a piece of metal at every airport gate in the world, and almost nobody looking at it can read it. Underneath the stand number, stencilled in white, there's a string of coordinates. Fifty-one degrees, nine minutes, seventeen point six six north. You can see them from a terminal window if you lean the right way.



Herman

And you can't do anything with them.



Corn

Daniel noticed this. He sent us a note about a sign he saw airside, stand number on top, coordinates underneath, and he asked the obvious question. Those coordinates are surveyed. Somebody measured them. Could a pilot, suspecting that the aircraft's reported position is a lie, just compare what the box says against a number painted on a stand and get an independent reality check? Is anyone doing that?



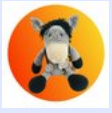
Herman

And from there, he wants the whole map. Jamming versus spoofing, how crews spot a discrepancy when nothing on the panel says anything is wrong, how the warning reaches the next aircraft, and what you actually do on approach into the Middle East when you think your position is fiction.



Corn

So let's start with the sign itself. Because the answer to Daniel's first question is more interesting than a yes or no.



Herman

The stand identification sign is a catalogued airport data element. ICAO Annex 14, section I 5.4.6, the identification sign tells you which stand you're at. That's it. That's its job.



Corn

And the coordinates under it are a different thing entirely.



Herman

Completely separate property. ICAO's AIM Data Catalogue lists it as "Position, geographical location of aircraft stand point." It's a surveyed point. Half a metre accuracy, published to a hundredth of a second of arc, referenced to WGS-84.



Corn

Half a metre.



Herman

Somebody stood there with a survey-grade receiver and measured it. Eurocontrol's AIXM guidance is unusually blunt about this. The ParkingStandLocation "is represented by one point and only this point shall be measured." One point. You don't interpolate, you don't average, you measure the point.



Corn

Which tells you what it's for. You don't survey something to half a metre so a pilot can squint at it from a window.



Herman

You survey it because it feeds the airport mapping database. The AMDB. The docking guidance systems. The ground movement radar. When an aircraft's nosewheel is supposed to stop at a specific patch of concrete, the system needs to know exactly where that patch is. That's the consumer.



Corn

And national AIPs publish them as tables. Gatwick lists stand one as five one zero nine one seven point six six north, zero zero zero nine five zero point nine five west.



Herman

Dubai's chart for OMDB lists E1 through E24 with latitude, longitude and elevation. E1 comes out at twenty-five degrees sixteen minutes five point seven zero north, fifty-five degrees twenty-one minutes five point seven eight east, elevation eight point nine feet.



Corn

Eight point nine feet. Not nine. Eight point nine.



Herman

That's what a survey gets you. And none of it is signage for pilots. It's survey data that happens to be painted on a sign.



Corn

So. Could it do the job Daniel wondered about?



Herman

In principle, the arithmetic is trivial. You know your reported position, you know the surveyed position of the stand, you compare. Two numbers, one subtraction.



Corn

In principle, I could navigate the Atlantic with a sextant and a good attitude.



Herman

In practice, no. And I want to be careful here because there's a version of this where we just say "no, silly" and move on, and that's not fair to the question. The reason it doesn't work isn't that it's stupid. It's that the geometry is wrong.



Corn

Because you can only read the sign when you're parked at it.



Herman

You can only read the sign when you're parked at it. Which is the one moment in the entire flight where you already know exactly where you are. You've stopped. The chocks are in. So as an in-flight cross-check it's useless, and I went looking, and I could not find a single source describing a crew doing this. Not a procedure, not a recommendation, not a training note. It's a plausible-sounding idea that turns out to be unsubstantiated.



Corn

Which is a genuine shame, because a non-electronic position reference is exactly the kind of thing you want when the electronics are lying to you.



Herman

It is. And crews do have them. They're just not the sign.



Corn

So what are they?



Herman

The inertial reference system is the first one everybody names. It's self-contained, it doesn't receive anything from outside the aircraft, it just integrates accelerations. But there's a caveat that has become a big deal, and it's the one that gets left out of the simplified version.



Corn

Go on.



Herman

Hybrid IRS. On types like the 787 and the Gulfstream G650, the inertial system and the GPS are tightly coupled. The GPS corrects the drift in the inertial solution, and the inertial solution smooths the GPS. It's a good design. It makes the position very accurate.



Corn

Until the GPS is wrong.



Herman

Then the inertial system is being corrected toward a lie. OPSGROUP's guidance uses the word "infected," and it's the right word. The independent reference isn't independent if it's drinking from the same straw.



Corn

That's the part that would catch people out. You'd think "well, IRS is my fallback," and your fallback has been quietly poisoned for the last forty minutes.



Herman

Which is why the advice for departing airports inside a spoofing area, Larnaca, Tel Aviv, Beirut, is a full manual IRS alignment with the GPS receiver switched off before you start. You give the inertial system a clean start and you don't let it talk to the GPS at all.



Corn

What else is in the stack?



Herman

VOR and DME. DME/DME is a good independent position fix, two or three ground stations and the slant ranges intersect. ILS on approach. Radar vectoring from ATC, which is somebody else's radar seeing a primary return off your airframe. A handheld GPS, a Bad Elf or a Garmin, held up against the window with the antenna shielded from the horizon so it doesn't pick up the spoofed signal coming in strong from below. Alerting apps like



Herman (continued)

APG's NaviGuard. And the aircraft clock.



Corn

The clock.



Herman

Which sounds like nothing until you remember that GNSS is a timing system that also does position. Spoof the timing and the position goes with it.



Corn

So hold on. Let's get the mechanism straight, because I think people hear jamming and spoofing as the same problem at different volumes.



Herman

They're different attacks. EASA's definition is clean. Jamming is intentional radio-frequency interference that prevents the receiver from locking onto the satellites at all. The signal is drowned.



Corn

So the box says I can't see anything.



Herman

The box says no satellites. And that is, counterintuitively, the good outcome. The receiver knows it's blind, the aircraft drops out of GPS as a navigation source and falls back to the inertial systems, and the crew gets an unambiguous degradation. Spoofing is different. Spoofing broadcasts counterfeit satellite signals. The receiver locks onto them. They're stronger than the real ones, they're consistent with each other, and the box computes a position.



Corn

A position that is wrong.



Herman

A position that is wrong, and that the box believes completely. EASA's line on this is worth reading twice. "There are no specific flight crew alerts that would indicate which kind of interference is being experienced. Detection of spoofing may be more difficult and not immediate for the flight crew, thus posing more safety risk than jamming."



Corn

So the harder attack is the one that looks like everything is fine.



Herman

And OPSGROUP adds the detail that makes it worse. Jamming commonly precedes spoofing. The attacker jams first, the receiver loses lock and starts ranging around for a signal, and because it's now in search mode it's more willing to lock onto the first plausible thing it finds. Which is the counterfeit.



Corn

That's an unpleasant piece of design.



Herman

It's an elegant attack. I'd rather it weren't.



Corn

Jeppesen had a line about this that I think is the best description of the whole problem I've read.



Herman

Go ahead.



Corn

"The FMS is confident. It commands a turn to intercept a track that a second ago was directly beneath the aircraft and is now two hundred miles to the right. The displays are clean. Nothing has failed, and that is precisely the problem."



Herman

Nothing has failed. There's no red, there's no master caution, there's no checklist. There's just an aircraft doing exactly what it's told to do with a wrong number.



Corn

Give me the scale, because I want to know whether this is a nuisance or a genuine operational problem.



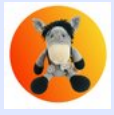
Herman

Early 2024, OPSGROUP was tracking on the order of three hundred flights a day being spoofed. By August 2024 that was about fifteen hundred a day. Between the middle of July and the middle of August 2024, roughly forty-one thousand flights. In one month.



Corn

Forty-one thousand.



Herman

IATA's 2025 safety report records a sixty-seven percent increase in reported jamming between 2023 and 2025, and a hundred and ninety-three percent increase in reported spoofing over the same period.



Corn

And where is it concentrated?



Herman

FlySafe's data for the first part of this year puts the Middle East at over sixty-eight percent of all reported GNSS interference events globally.



Corn

So two-thirds of a global problem in one region.



Herman

The first major spoofing wave was centred on Baghdad, northern Iraq, in September 2023. That's the origin point of the recurring Middle East problem we're still living with.



Corn

And the incident that made people sit up was Vilnius.



Herman

January 16, 2025. A Ryanair 737 MAX 8-200, flight FR3466, and a Swiss A220, both on approach to Vilnius, both aborted at about eight hundred and fifty feet. Spoofing was feeding them false position data. Eight hundred and fifty feet is roughly the point where you should be visual and committing to land. Instead both crews went around.



Corn

Because the numbers they were being handed didn't match the world out the window.



Herman

Or didn't match whatever else they had to cross-check against. Something disagreed, and they were right to go around.



Corn

So spoofing is the hard problem. The next question is how you would even know it's happening.



Herman

This is where it gets practical, and the literature on this is unusually specific. OPSGROUP's crew guidance has a list of indications, and what's striking is how few of them are the kind of thing that announces itself.



Corn

Walk them.



Herman

A rapid increase in estimated position uncertainty, the EPU, or the actual navigation performance, ANP. That's the box telling you it's become less sure of itself, which is the honest version of a spoofing event.



Corn

What else?



Herman

A caution that says GPS position and IRS or FMS position disagree. That's the aircraft catching itself in the act. The clock changing, or the captain's clock and the first officer's clock showing different times.



Corn

The clocks disagreeing. That's such a small thing to notice at cruise.



Herman

It's exactly the kind of thing that gets missed. Transponder dropping into ATC FAIL. The autopilot making a turn nobody asked for. ADS-B failure. Synthetic vision reverting from a rendered terrain picture to blue over brown, because the terrain database has stopped agreeing with the position it's being fed.



Corn

Blue over brown.



Herman

That's the display giving up.



Corn

If you know what you're looking for.



Herman

If you know what you're looking for, and if you're looking. Wind and groundspeed that don't make sense together. The GPS symbol on the navigation display slowly drifting away from the FMS and IRS symbols, which is the one I'd want to watch, because it's a slow walk rather than an alarm.



Corn

It's a divorce happening in real time on the display.



Herman

CPDLC and ADS-C failing, which the controller sees as you going quiet. A handheld GPS on the glareshield that disagrees with the aircraft's own. GPS one and GPS two differing by more than a hundred metres. An ACARS message from operations saying the airport you're heading to has an active interference report. And then the loud ones.



Corn

Pull up.



Herman

EGPWS terrain warnings. The enhanced ground proximity warning system compares your position from the FMS against a terrain database, and if the position is a lie, the terrain it predicts ahead of you is a lie too. So it starts shouting at you about a mountain that isn't there.



Corn

Which, on approach, means the warning you'd most want to trust is the one most likely to be nonsense.



Herman

CNN described exactly this in April, spurious terrain warnings in the Middle East, the Baltic and the Black Sea. Crews getting "Terrain ahead, pull up" over flat ground.



Corn

And EASA adds the monitoring side.



Herman

Monitoring the estimated position uncertainty, comparing GNSS time against non-GNSS time sources, and watching the conventional navaids to see whether they agree.



Corn

The subtle ones are the whole game, though. Your list is mostly small things. A clock a few seconds off, a groundspeed that doesn't match the wind, a horizon that quietly changes colour. None of it says spoofing.



Herman

Nothing says spoofing. That's the design.



Corn

So how does the warning reach the next aircraft? Because that's the part I actually don't know.



Herman

The official channel exists and it's structured. EASA's safety information bulletin directs national authorities to verify that NOTAMs are being issued, and directs the air traffic service providers to collect GNSS degradation information and notify operators promptly by voice, by ATIS, by NOTAM, and through the AIP.



Corn

Voice, ATIS, NOTAM, AIP. That's four channels for one piece of information.



Herman

Four official channels. And then OPSGROUP's crew guidance says this, flatly: "Don't rely purely on NOTAMs to give comprehensive warnings of spoofing locations."



Corn

So the practitioner guidance is telling crews not to trust the official warning system.



Herman

Not to trust it as the only source. Which is a real gap, and it's a gap between how the regulator expects information to move and how it actually moves.



Corn

What fills it?



Herman

Frequency. Pilots talking to each other. If one crew has just been spoofed on the approach and the controller has the frequency open, the next three aircraft know about it in ninety seconds. That's faster than any NOTAM pipeline on earth.



Corn

Because a NOTAM has to be written, validated, published, and then read. And nobody reads NOTAMs at cruise.



Herman

There are also tracker maps now. SkAI's live GPS spoofing tracker shows you where the interference is being reported in near-real time. Jeppesen has put a GPS interference layer into FliteDeck Pro, so it's overlaid on the enroute map next to your route.



Corn

So the warning is migrating out of the paperwork and onto the display.



Herman

Which is where it should have been. And ACARS messages from ground operations, which is a private channel, it's your own company telling you what its other crews have already found.



Corn

And EASA has standardised the phraseology.



Herman

They have, and this is the bit that matters for the loop closing. Special air-reports, AIREPs, are mandated. And the phraseology is fixed. "GNSS reported unreliable due to jamming or spoofing." "Unable, then the arrival designator, arrival due spoofing." "Request time check."



Corn

Request time check.



Herman

Because the controller and the aircraft should have the same clock, and if they don't, one of you is being lied to about the time.



Corn

I like that. It's a handshake you can do over the radio with no equipment.



Herman

It's the cheapest spoofing detector in existence. Two clocks that should agree.



Corn

So give me the practical scenario. Daniel wants a flight on approach into a Middle East airport. Crew suspects the GNSS position is compromised. What happens?



Herman

The first thing is that the order of priorities doesn't change. Aviate, navigate, communicate. The aircraft is flying, that's fine, nothing has actually broken. Then the memory items.



Corn

Which are?



Herman

Note the time on a personal watch, so you have an independent time reference you can compare against later. De-select GPS as an input to the FMS, so the flight management computer stops being fed the lie. Deselect hybrid IRS mode on the types that have it, so the inertial systems stop being corrected toward the spoofed position. Set the clock to internal, which is the aircraft's own oscillator, not the GNSS time. Consider heading mode if the navigation display is not trustworthy.



Corn

I'd be reaching for a paper chart at this point.



Herman

A lot of crews do. Confirm your navigation source, DME/DME or pure inertial. Report to ATC, say what you suspect, and request either vectors or a position confirmation, because the controller has a primary radar return off your aircraft that has nothing to do with satellites.



Corn

So the controller becomes your position source.



Herman

The controller becomes your position source. Inhibit EGPWS at cruise if you're approved to, because the terrain warnings are about to become actively harmful. Use conventional navigation.



Corn

And the approach itself?



Herman

Avoid RNP and RNAV approaches, because those are satellite-dependent by design. Request a conventional-navaid STAR, an ILS, VOR, DME. Brief for false EGPWS alerts on final, because the terrain database doesn't know it's being fed garbage.



Corn

Which is a horrible thing to have to brief. "Expect a terrain warning on final. Ignore it."



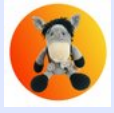
Herman

It's a horrible thing to have to brief and it's the correct thing to do.



Corn

And then the piece that surprised me when I read it.



Herman

The persistence. Leaving the spoofed area does not clean the aircraft. OPSGROUP's line is that most spoofing encounters can be fully recovered from in flight, but an increasing number of aircraft are left with severe impacts that are not recoverable before reaching destination. Receivers can stay corrupted for hours after they've left the interference behind.



Corn

Hours.



Herman

The UAL83 case, Delhi to Newark, is the illustration. The aircraft got well clear of the spoofed airspace and the position solution stayed wrong. The only thing that guarantees integrity is a hard reset, a cold start of the receiver.



Corn

So you can fly out of the lie and the aircraft keeps believing it.



Herman

It keeps believing it. Which reframes what recovery means. Recovery isn't when you leave the area. Recovery is when the receiver is provably clean, and until you've done a cold start you can't prove it.



Corn

And the regulatory response is still escalating.



Herman

EASA's revision four of that same safety bulletin, dated the third of July this year, adds pilot-to-controller phraseology, EFB integration, new training requirements and air traffic control capacity management. And it says, in the regulator's own careful language, that there's been a further increase in the severity of the impact, and an overall growth in intensity and sophistication.



Corn

"Sophistication" is a word you don't often see a regulator use.



Corn

And there's the Black Sea rig.



Herman

Ukrainian forces destroyed an oil rig that was being used as a spoofing platform. The Ukrainian Navy's statement was blunt. Russian forces used the location for GPS spoofing to endanger civilian navigation, and we cannot allow it.



Corn

An oil rig. Purpose-built spoofing station in the middle of a sea lane.



Herman

Sitting where it could reach aircraft crossing the Black Sea.



Corn

So let's pull back. What Daniel was really asking, underneath the sign, is how commercial aviation holds navigational confidence when the position source itself can lie.



Herman

And the answer is that there is no single answer. There's a stack. The technical safeguards, the conventional navaids, the inertial systems when they're not being corrected toward a lie, the controller's radar, and on top of all of it, the flight crew's judgment about whether the world matches the display.



Corn

Which is an uncomfortable place to land, because the top of the stack is a human being deciding whether to believe the panel.



Herman

That's always been the top of the stack. The difference is that the panel used to be honest.



Hilbert

The coordinates are stencilled to be read from the left seat, which is why you could only half-read them from the terminal window. You were reading them upside down and from behind.



Corn

That's the bit Daniel couldn't work out.



Hilbert

It's not the bit that matters. I painted stand numbers and coordinates onto apron signage for one summer. Late eighties. Epoxy paint, two-part, and you mixed it in a bucket and you had about forty minutes before it went hard in the bucket and you were throwing the bucket away.



Herman

That's a specialised trade.



Hilbert

It wasn't specialised. It was a stencil and a brush and a level, and the level was the whole job. You're painting on concrete that has a slope on it for drainage, so the sign has to be set level against the horizon, not against the concrete, or it looks wrong from the cockpit. Nobody tells you that. You work it out on the first one.



Corn

So the accuracy of the paint...



Hilbert

The paint is not accurate. The paint is a sign. The paint is where somebody from the works department came out with a tape and a stick and said right, there. If the paint is off by a hand's width, the aeroplane still stops in the right place, because the aeroplane is being stopped by the docking system and the marshaller, and neither of them is reading the sign.



Herman

So they're two different accuracies. The surveyed point and the painted sign.



Hilbert

They're two different accuracies, and the surveyed point is the one that matters, because it goes into the database, and the database is what the docking system uses. The sign is for the driver.



Corn

Which is basically what Herman said, except you agree with the conclusion for a reason that makes our version sound like we were guessing.



Hilbert

You were guessing.



Corn

Fair.



Hilbert

There was one stand they had to re-stencil. The apron had settled, which happens, and the survey team came back and gave a new number, and the new number was different from the old one by enough that the database had to be updated. Same stand. Same concrete. Different number.



Herman

How different?



Hilbert

Doesn't matter how different. The point is the old number was still close enough for the sign and not close enough for the database, and those are two different thresholds, and nobody writes them down anywhere together. That's the whole thing. Two thresholds, one number on a piece of metal, and only one of them has a consequence.



Corn

And you stopped doing this because...



Hilbert

I was let go.



Corn

Ah.



Hilbert

There was a stand where I didn't trust the number the survey team had given, so I went out at three in the morning with a tape measure and measured it myself.



Herman

Off what?



Hilbert

Off the expansion joint and the stand next to it. Took me about two hours and I was right by about forty centimetres.



Corn

Forty centimetres is more than half a metre.



Hilbert

It's close to half a metre.



Corn

It's more than half a metre.



Hilbert

It's close to it.



Herman

And they let you go for measuring?



Hilbert

They let me go because I was on the apron at three in the morning without a permit. Nobody ever acknowledged the forty centimetres.



Corn

So you were right and you got fired for the method.



Hilbert

I got fired for the permit. The being right was just the aggravating factor.



Herman

Did you tell them you'd been right?



Hilbert

I told them. It didn't come up.



Corn

And the stencil paint.



Hilbert

Forty-two pounds a tin, and that was then. Probably eighty now, and it's the same paint.



Corn

Where does that leave the bigger question?



Herman

It leaves it where Hilbert left it, which is the distinction between the number you can read and the number that has a consequence. The sign is legible and useless. The surveyed point is invisible and load-bearing. That's the shape of the whole spoofing problem in miniature. The display is legible, it's confident, it's clean, and it's the thing you can't trust.



Corn

Here's the open question. If a receiver can stay corrupted for hours after the aircraft has left the spoofed airspace, and the only guarantee of integrity is a cold reset that nobody can perform in flight, how many aircraft are up there right now flying with a quiet, persistent lie in their position solution? Not a dramatic one. Not one that triggered a warning. One that resolved to something plausible enough that the crew never had a reason to look.



Herman

The honest answer is that nobody knows, because the event is defined by the absence of a symptom.



Corn

The system is adapting. Revision four added phraseology and training and EFB integration. The spoofers are adapting faster, and the regulator's own language says so. Sophistication is the word they chose.



Herman

It is.



Corn

For more along these lines, there's episode seven nineteen, The Fragile Signal. Leave us a review if you've enjoyed this one, it helps people find the show. This has been My Weird Prompts, the human-AI collaboration podcast. Thanks to our producer, Hilbert Flumingtop.



Herman

Send us your own prompt on Telegram at t dot me slash MWP listener bot.



Corn

We'll be back soon.



Herman

Soon.

SOURCES

What the research for this episode read before the script was written. Primary sources first.

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