STRIKE3

Outcomes of Long Term Monitoring of GNSS Threats and Receiver Testing

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European Global Navigation Satellite Systems Agency



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GNSS Needs Protection



1. GNSS air navigation



Illegal device caused delays to flights at Nantes airport A La Rochelle man has been fined €2,000 after 'forgetting' to switch off a GPS jammer in his vehicle when he left it in a carpark at Nantes Atlantique Airport.

Airport operations suspended for 75 minutes due to GPS jammer





2. GNSS road pricing

Aanbevelen Delen 100 y Tweet

24/01/17 - 15u31 Source: Belga

By: Editor

3. New GNSS Jammers

Fines up to 50,000 euros for truckers with GPS jammer to avoid toll

13 COMMENTS

SAVE ARTICLE



G+1 0

TOLL Truckers who use a GPS jammer to avoid the toll, risking fines up to 50,000 euros. That is informed today at Viapass, the government agency that coordinates the kilometer charge. Moreover, there are three ways in which the fraud is detected: via fixed porches above the road, and flexible control over the mobile control units. In addition, irregularities can be noted in the billing says Edward Claessens of Viapass.



New



USB powered Jammer L1 + L2 frequency

An initiative to protect our GNSS ...



• Project funded by European GNSS Agency (GSA) under the H2020 Framework Programme for R&D





- Duration: 3 years (1. Feb. 2016 to 31.01.2019)
- Main subjects: Standardization of GNSS
 - Threat Reporting and Receiver Testing



STRIKE3 Project Overview





- STRIKE3 provides a response at an international level to ensure that there is:
 - i. a standard for GNSS threat reporting and analysis
 - ii. a standard for assessing the performance of GNSS receivers and applications under threat.

STRIKE3 Monitoring Equipment



DETECTOR



GSS100D – Interference detector

GPS/EGNOS/Galileo L1/E1



GSS200D – Interference detector

GPS/Galileo/EGNOS/GLONASS L1/E1/G1



GSS200D' - Interference detector

- L1/L5 + ICAO/Eurocae interference masks
- Spoofing detection



- GPS/SBAS/GALILEO L1/E1
- Autonomous monitoring
- Centralised server with web-interface

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- Dedicated STRIKE3 project server
- Autonomous and persistent monitoring
- Records events in secure database

STRIKE3 International Network



At a range of infrastructures

- Major City Centres
- City-ring roads
- National timing labs
- Motorways/Road network
- Airports
- GNSS infrastructures
- Power stations
- Railway
- EU Borders
- Ports







- At a range of locations
- United Kingdom
- Sweden
- Finland
- Germany
- India
- Vietnam
- France
- Poland
- Czech Republic

- Spain
- Slovakia
- Slovenia
- Netherlands
- Belgium
- Croatia
- Latvia
- + 3 EU
- + 4 outside EU



STRIKE3 "Systems of Systems" Database



- Ensure event reports from different monitoring systems are compatible
- Minimise changes to existing monitoring system equipment
- Limit "sensitive" information that needs to be sent (and stored)
- Protect against data "Integrity" issues (copies/changes)
- Flexibility in data provision and analysis



Overall 2-Year Activity





Comparison between Multiple Sites





Comparison of Site Activity over Time



Year 1



Example Changes in Site Activity







- City Centre Site
- One week with very high activity (>700 events!)
- General increase in weekly activity after Oct 2017 (from 60 to 100 per week)

- City Centre Site
- Gradual decrease in weekly activity since installation
 - From 300 to 150 per week

Repeating Jammer at a Site





- Jamming signal at airport site
- Detected almost exclusively on Sundays
- Usually twice per day morning and early afternoon



Track-a-jammer





STRIKE3 Receiver Test Standards



- The purpose is to assess GNSS receiver performance when subjected to "real-world" GNSS threats.
- Develop an outline test specification which can be used to assess performance of different GNSS receivers under a range of typical interference/jamming threats.



- The test standard shall be based on a generic series of threats as detected during the monitoring campaign.
- The test standard should evolve to incorporate new RF interference and jamming threats as they emerge

Selected Threat Signatures for Testing

Type of signal	Example Plots	Reason for choice
Wide Sweep – fast repeat rate		Very common (total number of events, and number of sites)
Narrow band at L1		Example unintentional signal – this type seen on multiple occasions and at multiple sites
Triangular		Common (and number of sites)
Triangular wave		Common (and number of sites)
Tick		Quite common. Evolving threat (new type).

STRIKE3 Test Architecture Overview

STRIKE3_

- Lab tests based on simulated GNSS signals
 - Easy to control, repeatable
- Interference signals added to clean GNSS signals



MM03-STATIC-SENSITIVITY: ENU variations with respect to true position

Test ID:MM03-STATIC-SENSITIVITY 50 70 E + N • U 60 0 signal power ratio Coordinate variations [m] 50 -50 40 Jamming/GNSS 30 -100 20 -150 10 -200 389100 12:05 389700 12:15 390300 12:25 390600 12:30 391500 12:45 391800 12:50 390000 388800 389400 390900 391200 392100 392400 12:10 12:35 12:55 12:00 12:20 12:40 13:00 GPS Time (s) UTC Time (HH:MM)

No C/N0 masking in PVT

PRO03-STATIC-SENSITIVITY: ENU variations with respect to true position

Default C/N0 masking in PVT



PRO03-STATIC-SENSITIVITY: Average C/No



Conclusions



- There are RFI threats to GNSS
- Long term monitoring can help us understand and quantify the threat
- Receiver testing against real threats can help assess receiver resilience and develop better mitigation

Available from: <u>www.gnss-strike3.eu</u>

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Project info at web: <u>www.gnss-strike3.eu</u>

