

Standardisation of GNSS Threat reporting and Receiver testing through International Knowledge Exchange, Experimentation and Exploitation [STRIKE3]

Mark Dumville General Manager, NSL

National Space-Based PNT Advisory Board 7-8 December 2016 Crowne Plaza Redondo Beach and Marina Redondo Beach, California







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





- Start date = 1 February 2016
- Duration = 3 years





## **STRIKE3 Project Rationale**



- 6% of European GDP depends on GNSS (800BEuro)
- At the same time, GNSS vulnerabilities are being exposed and threats to degradation and denial of GNSS services are increasing.



- 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.



## Monitor, Detect, Characterise, Mitigate, Protect STRIKE3





## **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
- National Border (\*)
- Port (\*)

#### At a range of locations

- United Kingdom
- Sweden
- Finland
- Germany
- India
- France
- Poland
- Czech Republic

- Spain
- Slovakia
- Slovenia
- Netherlands
- Belgium (\*)
- Croatia (\*)
- Latvia (\*)
- + 3 countries inside EU
- + 4 countries outside EU













## STRIKE3 "DETECTOR" equipment



- GSS100D Interference detector
  - GPS/EGNOS/Galileo L1/E1
- GSS200D Interference detector
  - multi-GNSS, multi-frequency





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- Dedicated STRIKE3 project server
- Autonomous and persistent monitoring
- Records events in secure database
- \* Other equipment is provided by other STRIKE3 partners

## STRIKE3 "Stakeholders"



#### A range of entities/functions:

- Government agencies
- Frequency regulators
- Road operators
- Tolling operators
- Airport operators
- Air Navigation Service Providers
- Power grids

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Number of events per location per time

- A range of concerns:
- What is the scale of the problem?
- How do the results compare at different locations?
- Are there any patterns at my site? At other sites?
- What is the impact on GNSS receivers in the vicinity?
- What is the risk and what options exist to reduce the risk?



#### Impact of an event on "Satellites in view"



## **STRIKE3 "Fingerprint"**

- 1. Size, pressure, patterns
- 2. Identify distinguishing features
- 3. Classify the signature
- 4. Identify different "families"
- 5. Identify new "families"
- 6. Preserve the evidence
  - Create a catalogue
  - Reference for future events
  - Automatic pattern recognition









## STRIKE3 "Database" [58,000 events]





STRIKE3 Results [4 sites, 7 days]



Site1: Critical National Infrastructure (Power substation) Site2: Major Airport Site3: GNSS tolled motorway Site4: Capital City centre

Start time: 00:00:00 Saturday 26/11/2016 Stop time: 23:59:59 Friday 2/12/2016

















## Site 1: Power substation





#### Antenna splitter feeding GPS clock and DETECTOR



### Site 1: Power substation





205 interferences

39 Chirp Jammers

#### Site1: Example waveforms





## Site 2: GNSS tolled motorway







## Site 2: GNSS tolled motorway





138 interferences

41 Chirp Jammers

#### Site2: Example waveforms





## Site 3: Major Airport





#### DETECTOR located outside airport grounds



## Site 3: Major Airport





400 interferences

13 Chirp Jammers

#### Site3: Example waveforms





### Site 4: Capital City





#### Lots of RFI (incl jammers). Few high power events.



## Site 4: Capital City





#### 839 interferences

346 Chirp Jammers

#### Site4: 346 jamming events generated from 6 jammers





#### Event of the week...







- Start Time (UTC): 28/11/2016 10:23:48
- Duration (sec): 3167
- Max Power: 8.813935
- Loss of GNSS and positioning errors (70m max)



## **STRIKE3 Risk Assessments**



Analyse STRIKE3 data to compute PROBABILITY and IMPACT
Use STRIKE3 database over <u>time</u> to (re)assess RISK at the site(s)

Site	Туре	Probability	Duration	Power	Complexity	Impact	Risk
1	CNI	?				?	?
2	Motorway	?				?	?
3	Airport	?				?	?
•••	•••	•••				••••	•••

- Use RISK based approach to develop business/investment cases
- (1) Protect?

(2) Toughen?

(3) Augment?















### thank you

If there is an interest in hosting a STRIKE3 sensor (for 6 months) then please get in touch.

mark.dumville@nsl.eu.com





