# Standardization of GNSS Threat reporting and Receiver testing through International Knowledge Exchange, Experimentation and Exploitation

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# GNSS Benefits

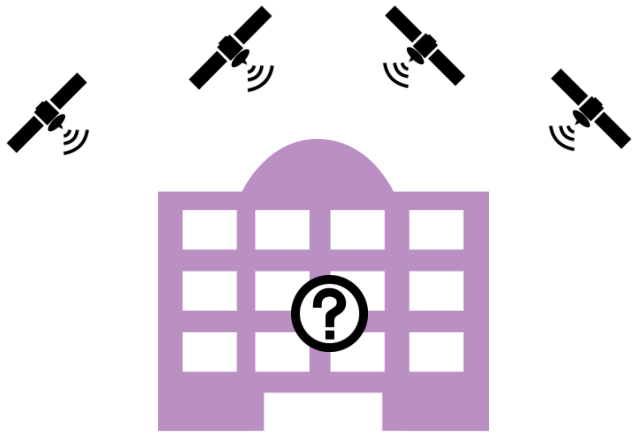
- Freely available signals, 24/7, all weather
- Position, precise timing
- Used in wide range of domains and industries
  - Consumer
  - Commercial
  - Safety
  - Security
  - Transactions
  - Liability
  - Governmental

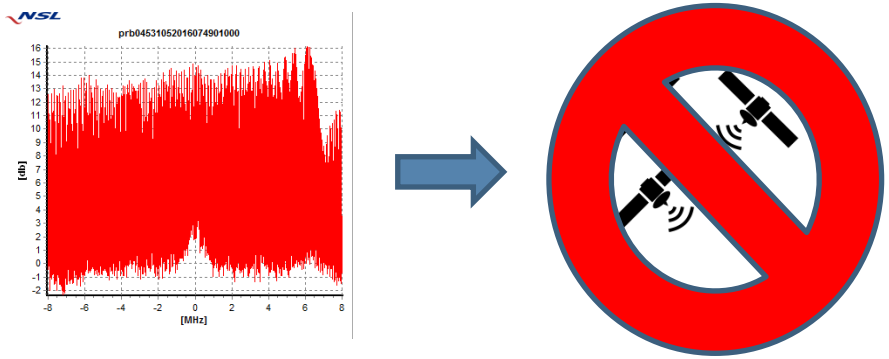




# GNSS Limitations

- Weak signals
  - Difficult to track indoors and in obstructed areas
  - Susceptible to interference



# Radio Frequency Interference

- Unintentional
  - Mis-tuned or faulty equipment, Space Weather
- Intentional
  - Jamming, Spoofing, Meaconing
- Impacts of Interference
  - Receiver
    - Degraded solution
    - No solution (position, timing)
  - Services
    - Small nuisance
    - Economic impact
    - Safety impact

# Counter Measures

- Legislation (Supply, Possession, Use)
- Education
- Enforcement
  - Detect and remove
  - Direct or indirect
- Equipment
  - Antenna
  - Receiver
  - Hybridisation
- Procedure/process

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**All dependent on understanding the threat**

# Understanding the Threat

- Interference Monitoring and Reporting
  - What threats are out there?
  - Focus on jamming (STRIKE3)

- Receiver Response to Threats
  - Are we protected?
  - If not, how can we improve?

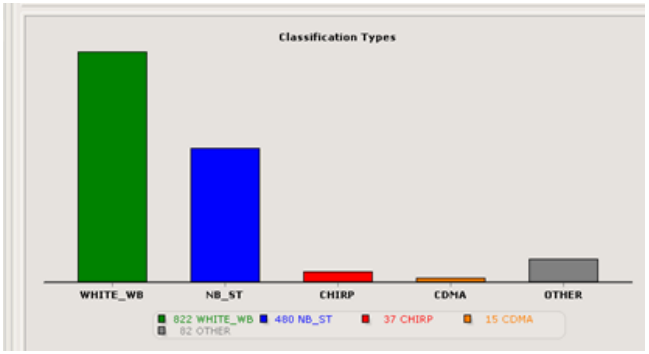
# State of the Art

- Previous studies
  - DETECTOR, SENTINEL, PROTECTOR, etc.
- Existing systems
  - GSS100D Detector
  - Signal Sentry 1000
  - N6841A RF Sensor


- Why STRIKE3?

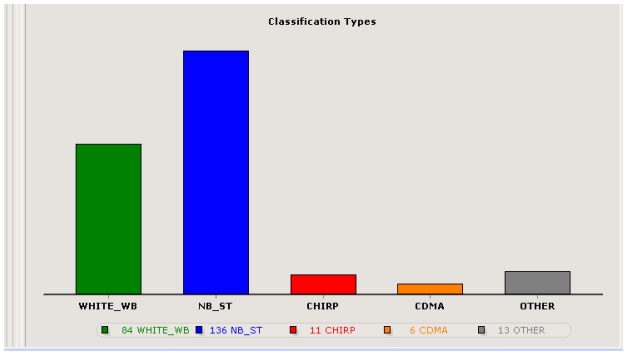
# STRIKE3 Rationale 1

- Site 1




  - 1436 events
  - 37 Chirp

- Site 2

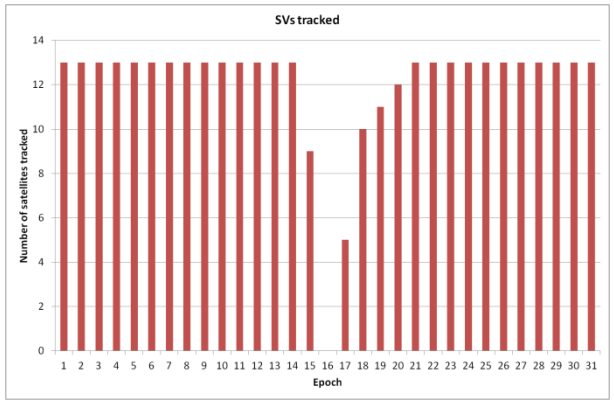


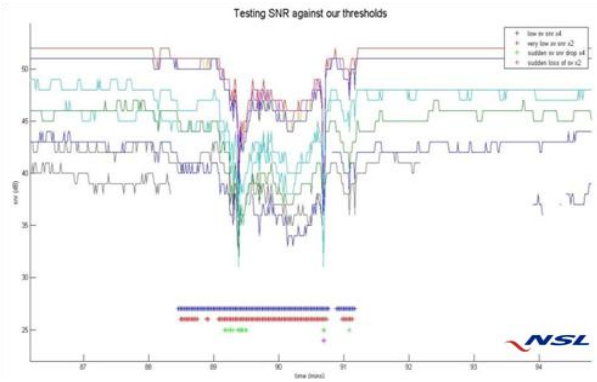

  - 250 events
  - 11 chirp (different signatures)

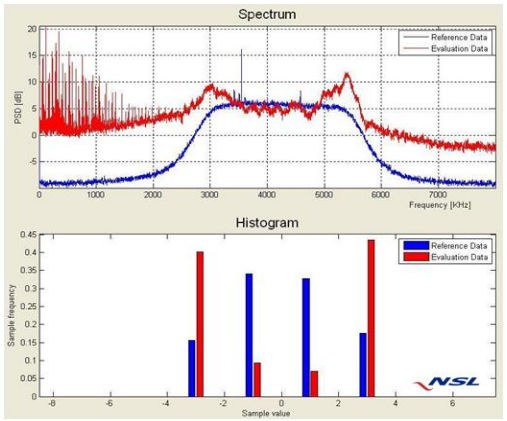
- To monitor single site – one sensor
- To understand wider threat environment – monitoring network required (regulators, government, users)

# STRIKE3 Rationale 2

- Monitoring network deployment
  - Limited if deploy own network with single type of sensor
  - Larger network and more data if allow reports from different systems
  - Are results compatible?

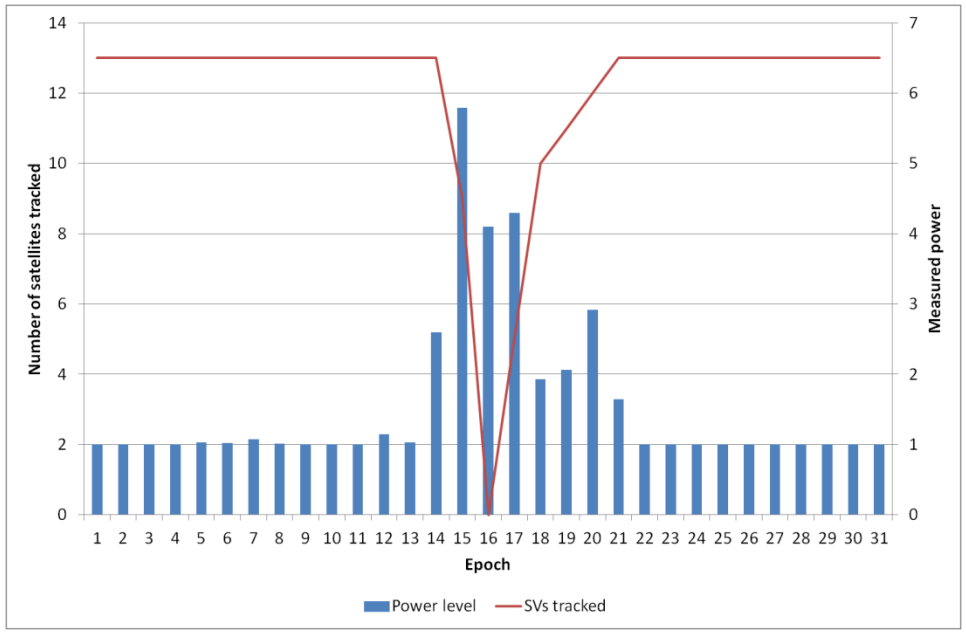


# STRIKE3 Rationale 3

- Monitoring useful – understand the threat environment
- So what? - Countermeasures
  - Legislation (Supply, Possession, Use)
  - Education
  - Enforcement
    - Detect and remove
    - Direct or indirect
  - Equipment
    - Antenna
    - Receiver
    - Hybridisation
  - Procedure/process

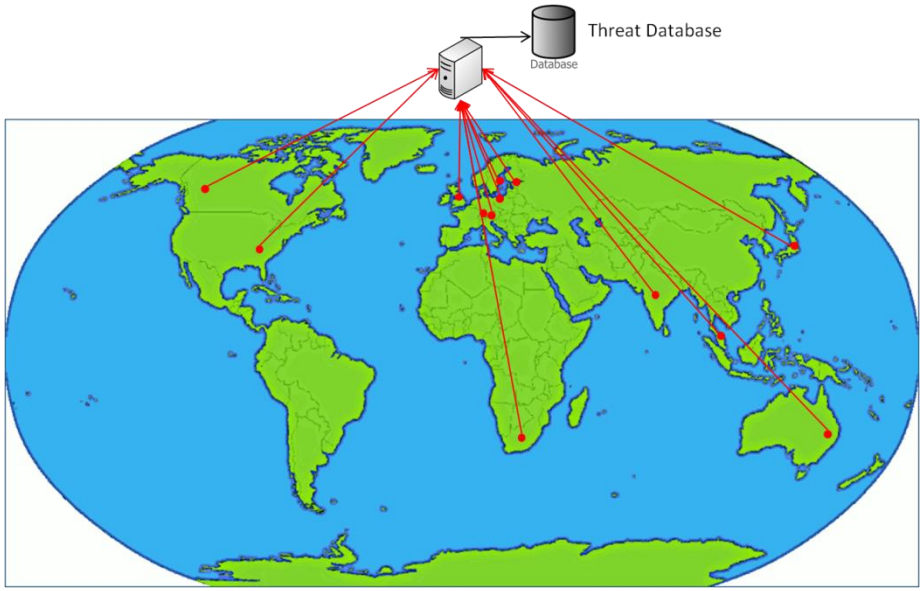


# STRIKE3 and Interference Monitoring

- Development of Reporting Standard for Interference Events
  - Consistency of reporting
  - System independent
  - Help creation of networks and threat database
- Implement reporting standards
  - Modify existing systems
  - Testing, validation of standards

# STRIKE3 and Interference Monitoring

- Deploy international network of sensors
  - Range of countries and types of site
  - Populate database:
    - Analysis and understanding of threat
    - Threat signatures / types of threat

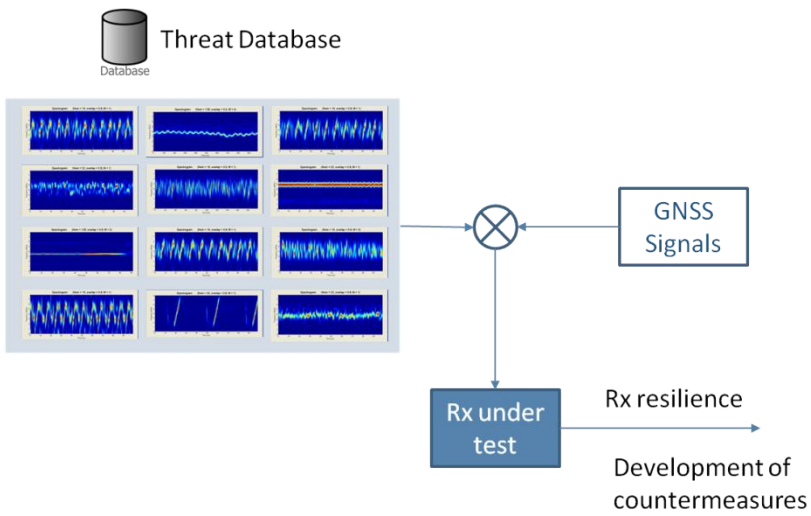


# STRIKE3 and Receiver Testing

- Development of Testing Standard
  - Check receiver resilience against threats
    - Based on identified threats (from database)
  - Consistent approach to testing and analysis
  - Receiver independent

# STRIKE3 and Receiver Testing

- Validation of Testing Standard
  - Test different receivers and algorithms
  - Response to real events
  - Test against emerging threats
  - Improved mitigation



# STRIKE3 Current Status

- KO Feb 2016
- Current activities
  - State of the art review
    - Stakeholders, existing systems, previous projects, current work on standardisation, etc.
  - International threat collection exercise
    - 10 sensors deployed in 5 countries
      - Building up data base of events
    - More deployments planned in coming months

# STRIKE3 Current Sensor Network

- Countries
  - UK, Sweden, Poland, Slovakia, Czech Republic, Finland, India
- Types of site
  - Environment (city, suburban, motorway)
  - Site use (CORS, timing, power grid, airport)
- Types of Sensor
  - Detector (NSL), RF Oculus (FOI), GEMNet (SAC)
  - Some co-location to compare results

# STRIKE3 Initial Results

- Variation in activity between sites
  - < 5 events per day, low power
  - 100+ events per day, many different signals
- Different sensors detect same events
  - Compare results
- Impact on GNSS
  - Many events no impact
  - GNSS tracking can be affected – signal power and type

# STRIKE3 Future Activities

- Analysis of threat collection results
- Development of draft Standards (Jan 2017)
- Implement reporting Standards and develop test environment (Oct 2017)
- Long term threat Monitoring and Receiver Testing (2018)

- www.gnss-strike3.eu – coming soon!

# Thank You for Your Attention!

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