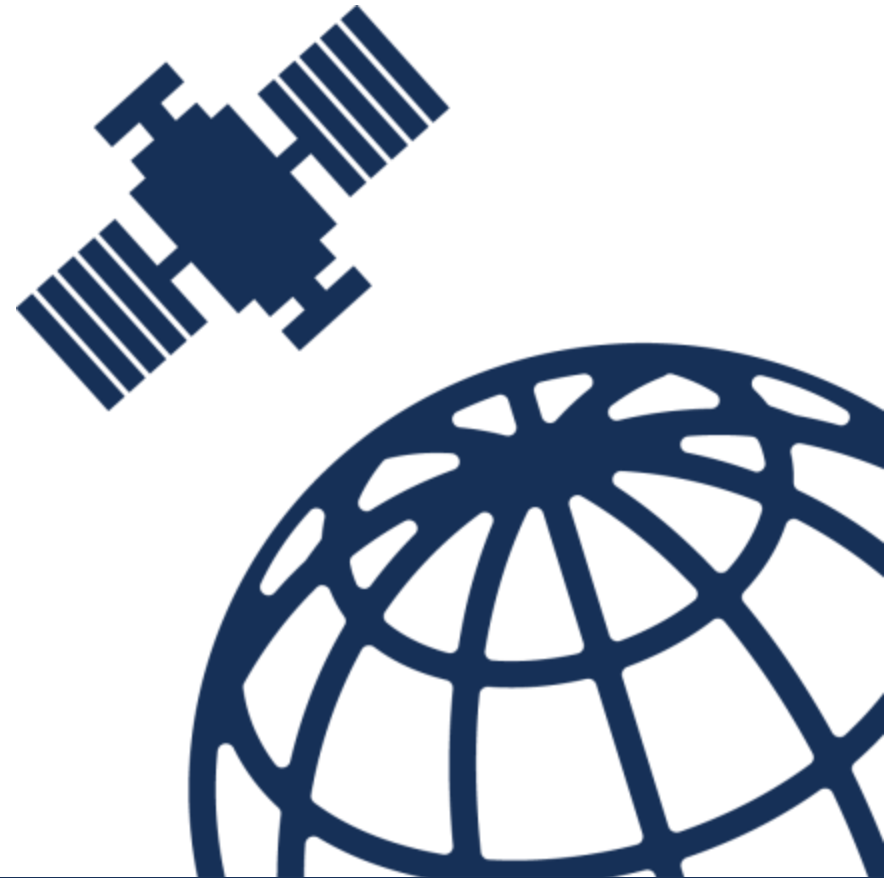


# Downstream GNSS business opportunities in the ASEAN region

**ASEAN Multi-Country Workshop  
on Space Applications**



**Mark Dumville**

General Manager, NSL



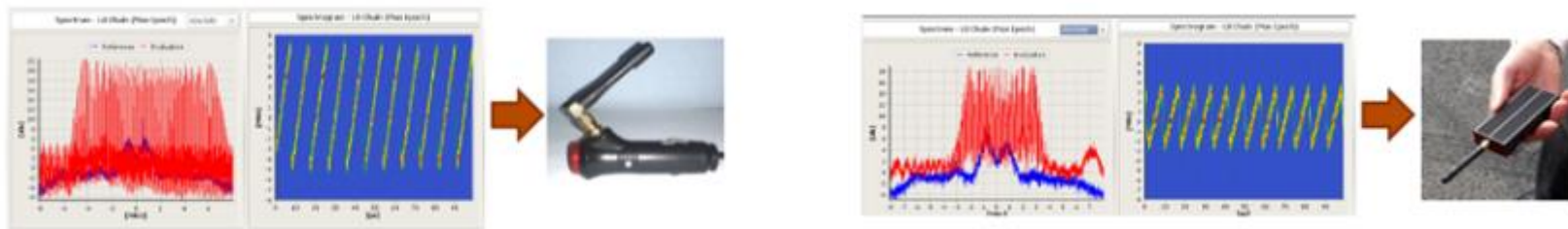
# NSL Company Overview

- NSL is a UK based high-tech small-to-medium sized enterprise.
- NSL specialize in the use of satellite navigation through shaping the use of Global Navigation Satellite Systems (GNSS) within **critical applications** such as those that:
  - directly affect the **safety** of citizens
  - are key in terms of national **security**
  - affect the way **business** is conducted.
- NSL develop and deliver GNSS-based services, systems, solutions, and intellectual property ensuring positioning and navigation is accurate and reliable, safe and secure, resilient and robust.
- NSL has ISO 9001:2015 accreditation



# Supporting GNSS applications in ASEAN

- **Background:** ASEAN countries are implementing advanced GNSS applications to support **governmental policy objectives**:
  - Road pricing
  - Vehicle speed monitoring and reporting
  - Ground Based Augmentation Systems (GBAS)

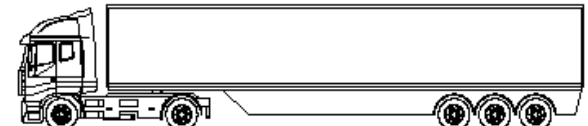
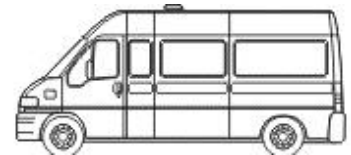


- **Alignment:** NSL offers products and services that support governmental implementation of GNSS
- **Motivation:** opportunities to collaborate, identify supply-chains and to commercialise NSL products
  - GNSS performance monitoring
  - GNSS interference and jammer detection systems
    - H2020 STRIKE3 project ([www.gnss-strike3.eu](http://www.gnss-strike3.eu))



# Why use a GNSS jammer?

1. To disable “**covert surveillance**” (eg privacy protection)
2. To disable “**tracking**” systems (eg fleet management)
3. To disable pre-defined **route-guidance** systems (eg courier)
4. To fool **scheduling** systems (eg taxis)
5. To disable **pay-per-use** (eg tolling, insurance, eco)
6. To disable “stolen vehicle **recovery systems**”
7. To confuse **cargo control systems** (eg geo-locks)
8. To disable **electronic monitoring** (offenders, fisheries)
9. To **deny capability** to adversaries (governmental use)
10. **VIP protection** (governmental use)



# STRIKE3 is a project to protect GNSS...

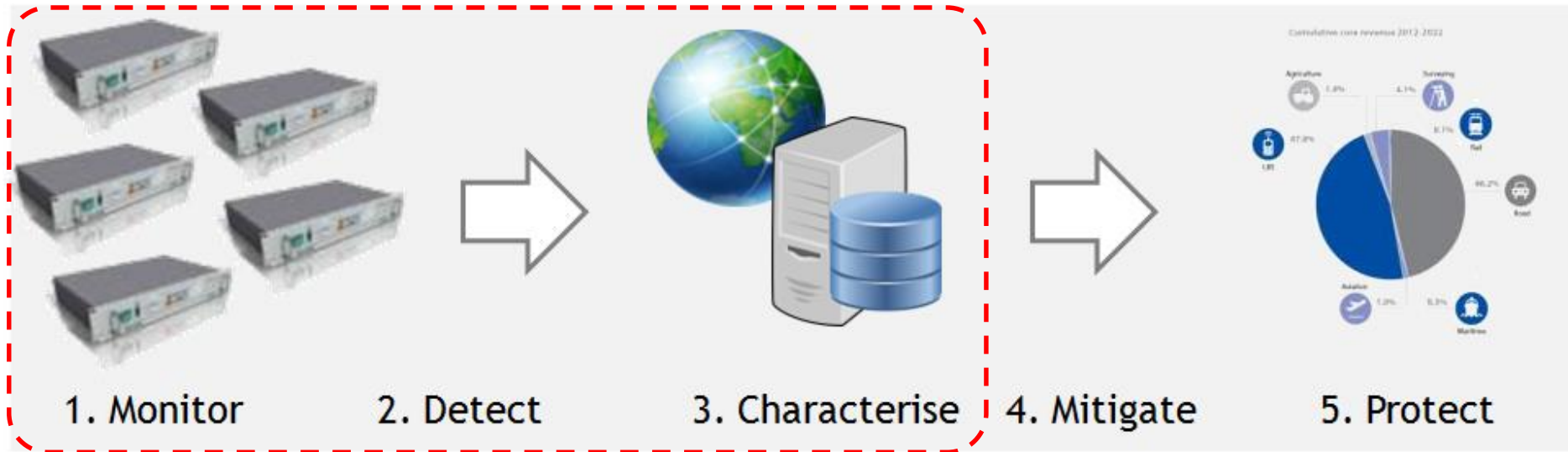
- **S**tandardisation of GNSS **T**hreat reporting and **R**ecceiver testing through **I**nternational **K**nowledge **E**xchange, **E**xperimentation and **E**xploitation [**STRIKE3**]
- Project funded by European GNSS Agency (GSA) under the European Commission's H2020 Framework Programme



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



# STRIKE3 Project Rationale



- STRIKE3 has deployed an international GNSS interference monitoring network (with support from partners, including BELS)
- STRIKE3 has used the data from the network to ensure that there is:
  - a standard for GNSS threat reporting and analysis
  - a standard for assessing the performance of GNSS receivers and applications under threat.



# STRIKE3 International Monitoring 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
- France
- Poland
- Czech Republic
- Spain
- Slovakia
- Slovenia
- Netherlands
- Belgium
- Croatia
- Latvia
- India
- Vietnam
- Thailand
- Malaysia
- New Zealand
- Canada
- Japan (pending)
- US (exploring)
- Singapore (exploring)

## Involving a range of entities:

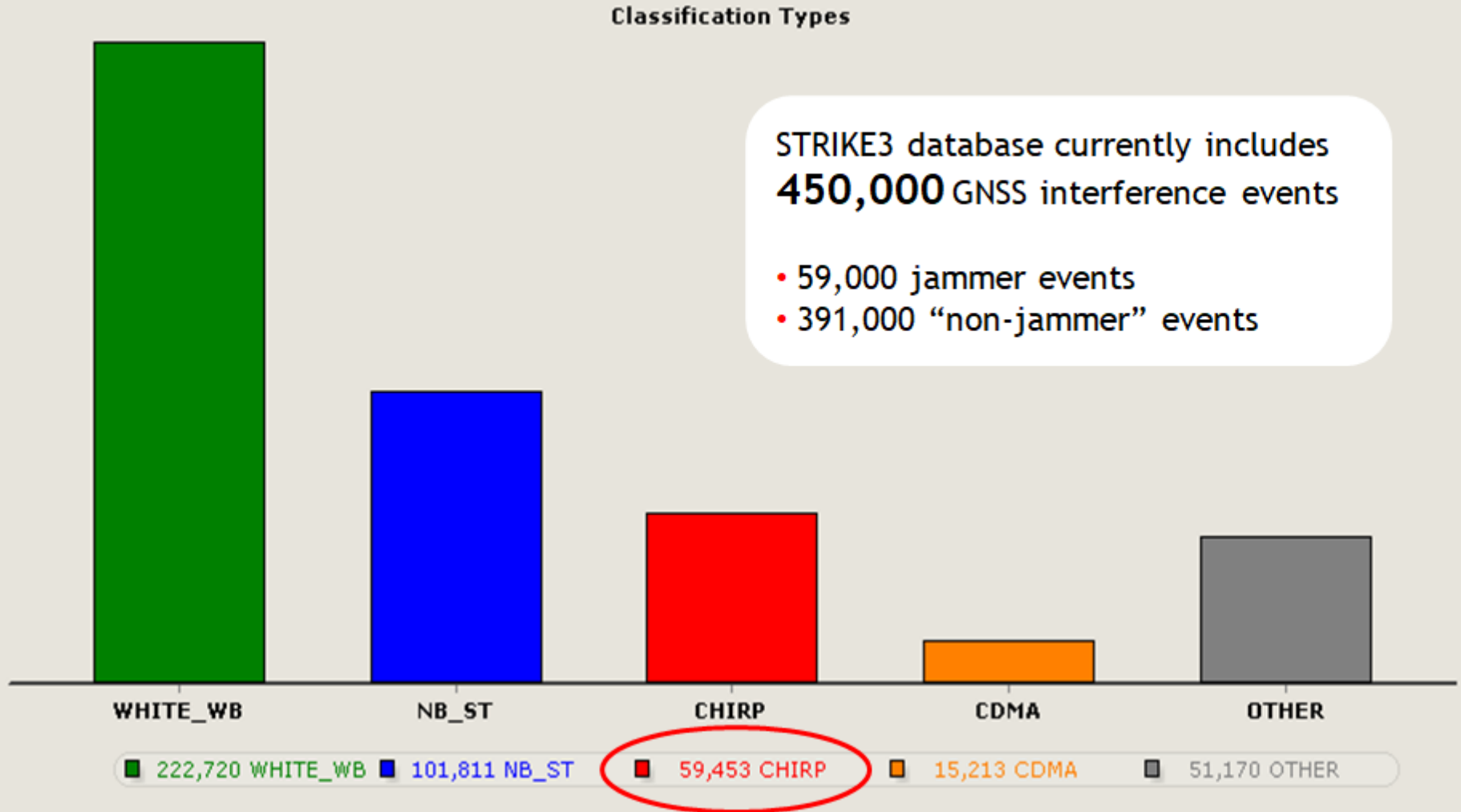
- Government agencies
- Frequency regulators
- Road operators
- Tolling operators
- Airport operators
- Air Navigation Service Providers
- Power grids
- Research

30+ monitoring sites



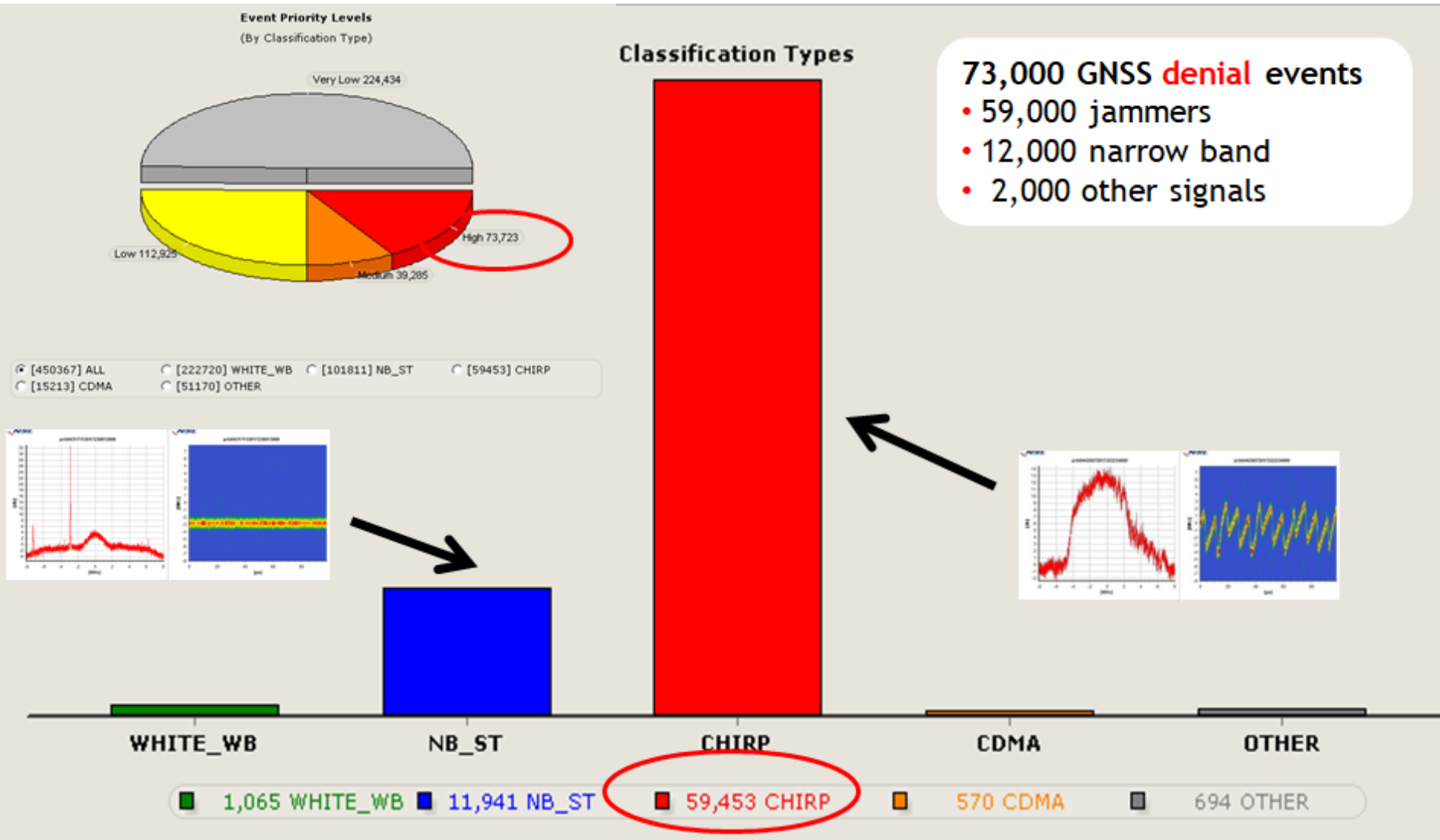


# STRIKE3 “Database” [1/2/2016 – 1/9/2018]



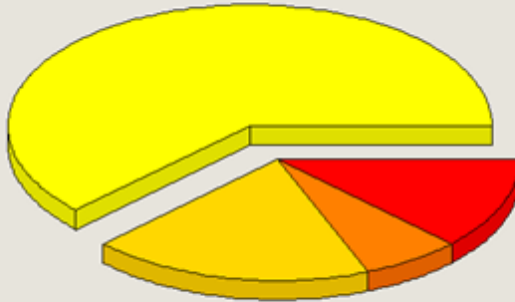


# STRIKE3 "GNSS Denial Events" [1/2/2016 – 1/9/2018]



# STRIKE3 "Durations" [1/2/2016 – 1/9/2018]

ALL events (450,363 events)



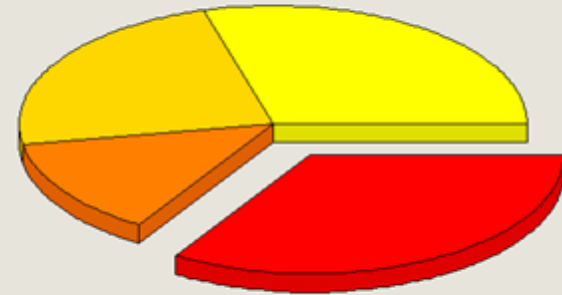
279,828 [00 to 20 sec] 85,832 [20 to 40 sec] 29,339 [40 to 60 sec] 55,368 [60+ sec]

Most events are very short durations  
12% of ALL events are greater than 60 seconds

## Some findings:

- 7191 events > 5 minutes
- 1112 events > 30 minutes
- 610 events > 60 minutes
- 5 events > 1 day
- Longest event = 5 days

High Priority events (73,723 events)



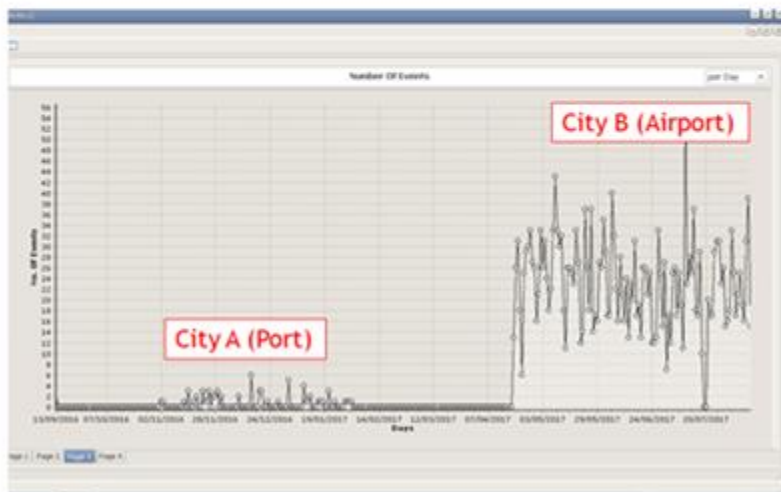
21,640 [00 to 20 sec] 17,271 [20 to 40 sec] 9,883 [40 to 60 sec] 24,929 [60+ sec]

34% priority events are greater than 60 seconds

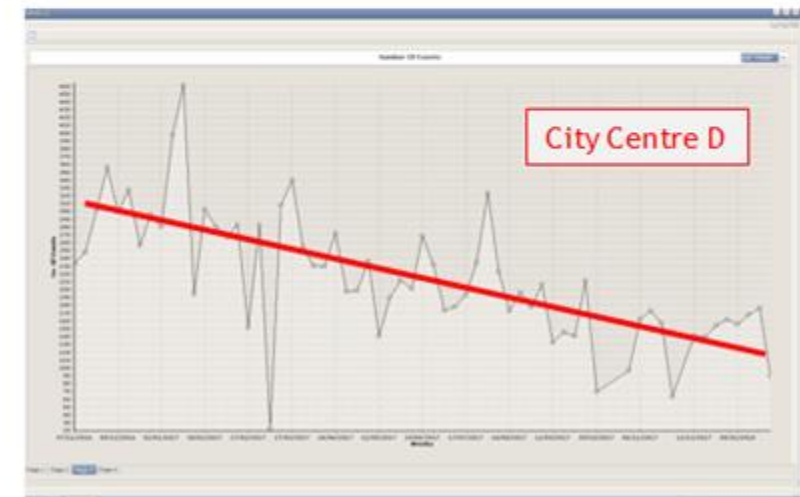
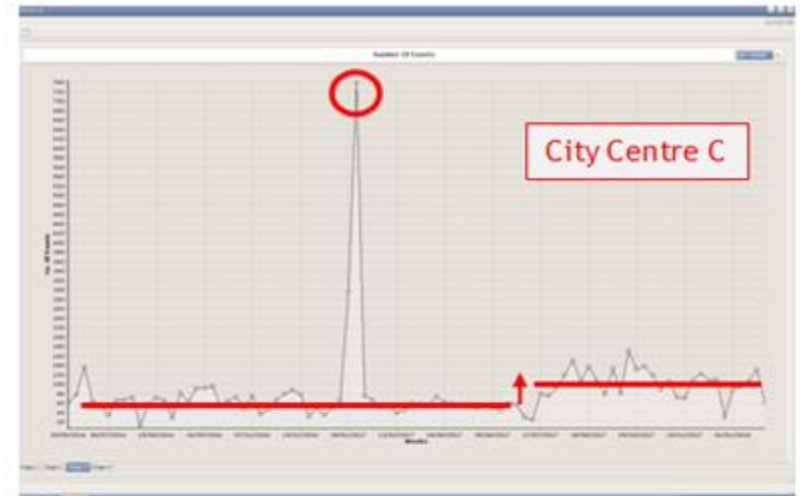


# STRIKE3 Trend Analysis

- Trends per site
- Trends per infrastructure
- Trends per week/month/year
- Trends per grouping
- Trends per event classification
- Overall trends within the database
- *(Trends per GNSS, per frequency)*

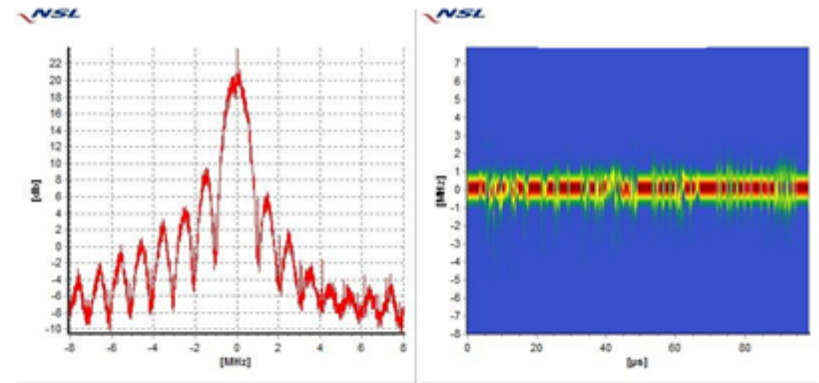


Same DETECTOR, two different locations



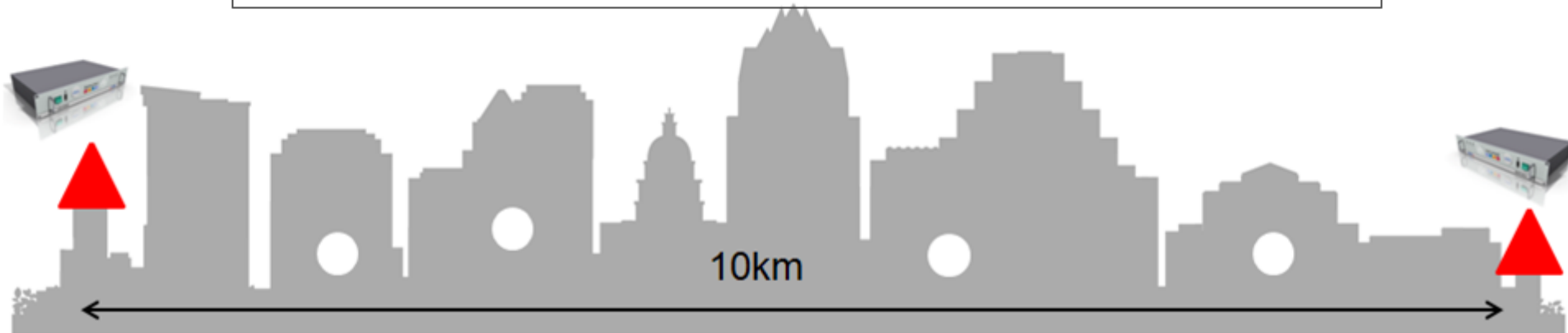
Trends at two "city centre" sites

# New threats to GNSS have been detected...



- Number of events = 4576
- Longest duration = 27504secs
- High power (but from a distance)
- Unable to identify cause

May 2018: Major Capital City. Two STRIKE3 sites, separated by 10km.  
Same waveform detected at same times



# Engagements in ASEAN region

- **Workshops:** NSL has participated in 5 x BELS workshops, 4 countries
  - Involving Industry, government and researchers
  - Interests include: GNSS, survey, scientific, transport, telecomms, electronics, aviation
  - Vietnam, Thailand, Malaysia, Singapore (+Indonesia)
- **Meetings**
  - 1-2-1 meetings
  - Government departments and agencies
    - aviation, roads, highways, survey/mapping, Space Agencies
- **Demonstrations**
  - Long term (12+ months) demonstrations throughout the region
    - Vietnam, Thailand, Malaysia
  - Presentation of results (by BELS partners) in ASEAN events



# Key Outcomes from ASEAN collaborations

- Collaborating with regional experts has enabled NSL to expand its global *GNSS threat monitoring network* into the ASEAN region
- NSL has established *long-term linkages* with regional ASEAN stakeholders interested in GNSS
  - Formed the basis of longer term collaborations
- NSL now understands the *ASEAN challenges/priorities*, applications/requirements and plans.
- NSL has *technology* deployed in ASEAN region, delivering value developing new partnerships (and a “prospects list”)
- NSL is engaged with 3 (of 5) countries regarding *follow-on activities*
- NSL is developing a *name* and a *presence* in ASEAN region *thanks to BELS*



# Thank you for your kind attention



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