Some European Union Activities on GNSS Spectrum Protection

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Galileo Programme

31 October 2015

European Commission Role

- **EC plays a *role at international level, eg ITU, ICG***
- **Also, a strategic role setting policy at EU level**
  - **EU Regulations already clear, Jamming is illegal**
- **EU Member States responsible for resolving national unintentional interference/jamming**
- **European GNSS Agency (GSA) helps coordinate and develop knowledge at this level**
  - **Technical projects/events**
- **EC supported by its in-house technical arm, the Joint Research Centre (JRC)**

International activities on interference: UN ITU-R

Mission Statement

The mission of the ITU Radiocommunication Sector is, inter alia, to ensure rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including those using satellite orbits, and to carry out studies and adopt recommendations on radiocommunication matters.

- *To ensure interference-free operations of radiocommunication systems by implementing the Radio Regulations and regional agreements, as well as updating these instruments in an efficient and timely manner through the processes of world and regional radiocommunication conferences;*

EC participates at ITU level

Active member of ITU-R WP4C

- **Dealing with satellite navigation issues**
- **Develops ITU-R Recommendations on GNSS protection**
- **Prepares for World Radiocommunication Conferences**
- **GNSS community has a common interest to protect GNSS spectrum (against the bad guys... they know who they are!)**
- **Excellent working links between all GNSS operators**

- **EC similarly active in European groups (CEPT) working with European frequency regulators**

Example GSA event Jamming Trials - Aachen, Germany

'Live' event demonstrating jamming projects:

- **Detection**
  - Skyguide (CH), airborne RFI detection
  - NSL (UK), DETECTOR project
  - Astri Polska (PL), Trust device
  - FOI (SE), Signal Figure of Merit
- **Mitigation**
  - Thales (FR), JamBuster
  - Spirent (UK), jammer replay simulator
  - DLR & Aachen/Ilmenau Universities (DE), Array Processing Antenna/Receivers

further details from the GSA

Example project - DETECTOR

Fingerprinting GNSS Interferences "in-the-wild"

Nottingham Scientific Ltd (NSL)

(further details: mark.dumville@nsl.eu.com)

Deploy systems   **Detect** Interference   **Characterise** the threat

Overview

- **The DETECTOR system, funded by the European GNSS Agency (GSA) under the FP7 programme**

- **RF data sampled at the roadside, characterised and linked to a central database for storage**

- **The DETECTOR project was completed in 2013 and then developed into a commercial product**

- **Extensive jammer and interference event database built**

- **The following slides were assembled using data collected at several roadside monitoring sites in Europe**

There are "Good" Jammers
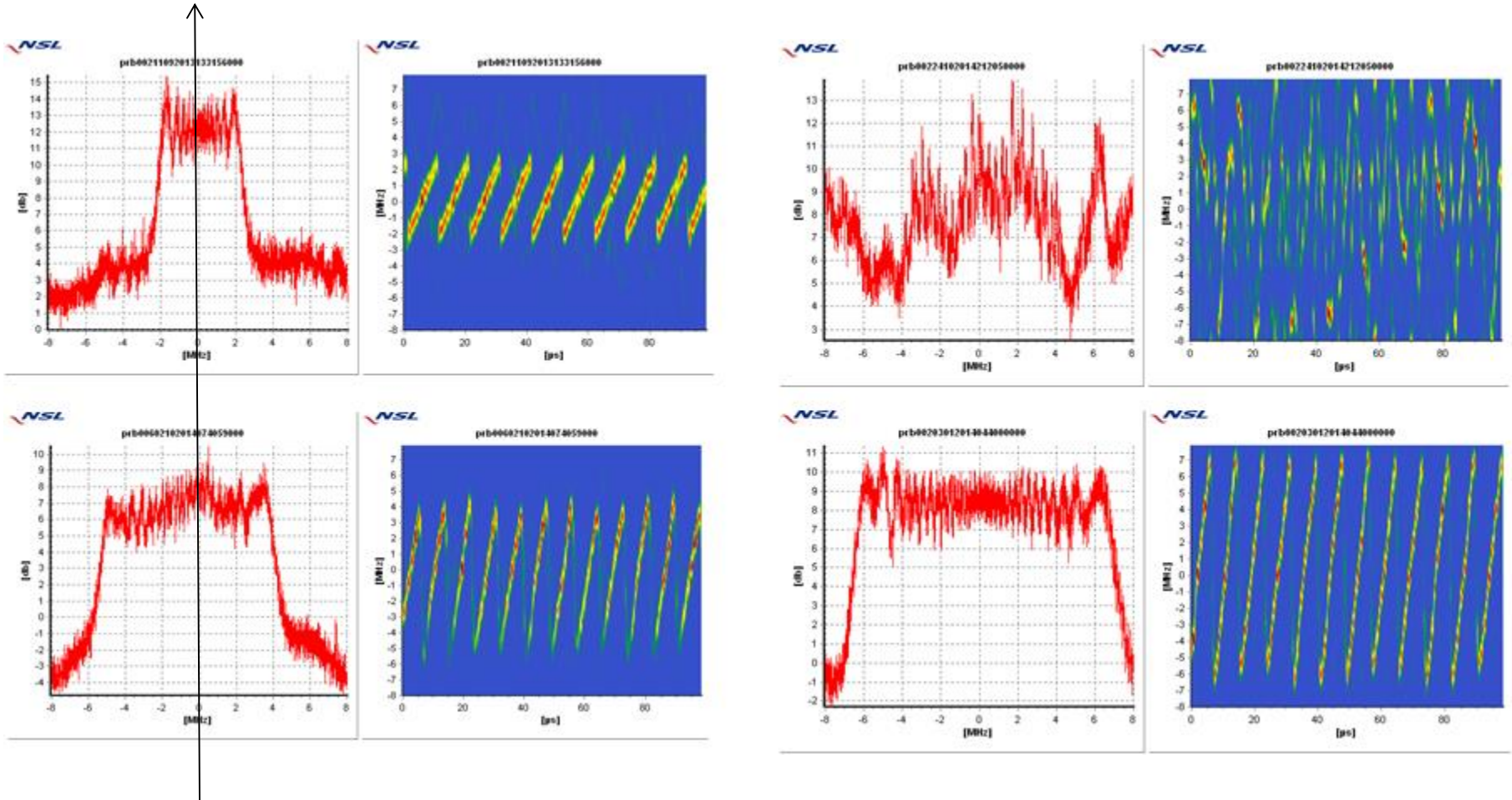
There are "Bad" Jammers
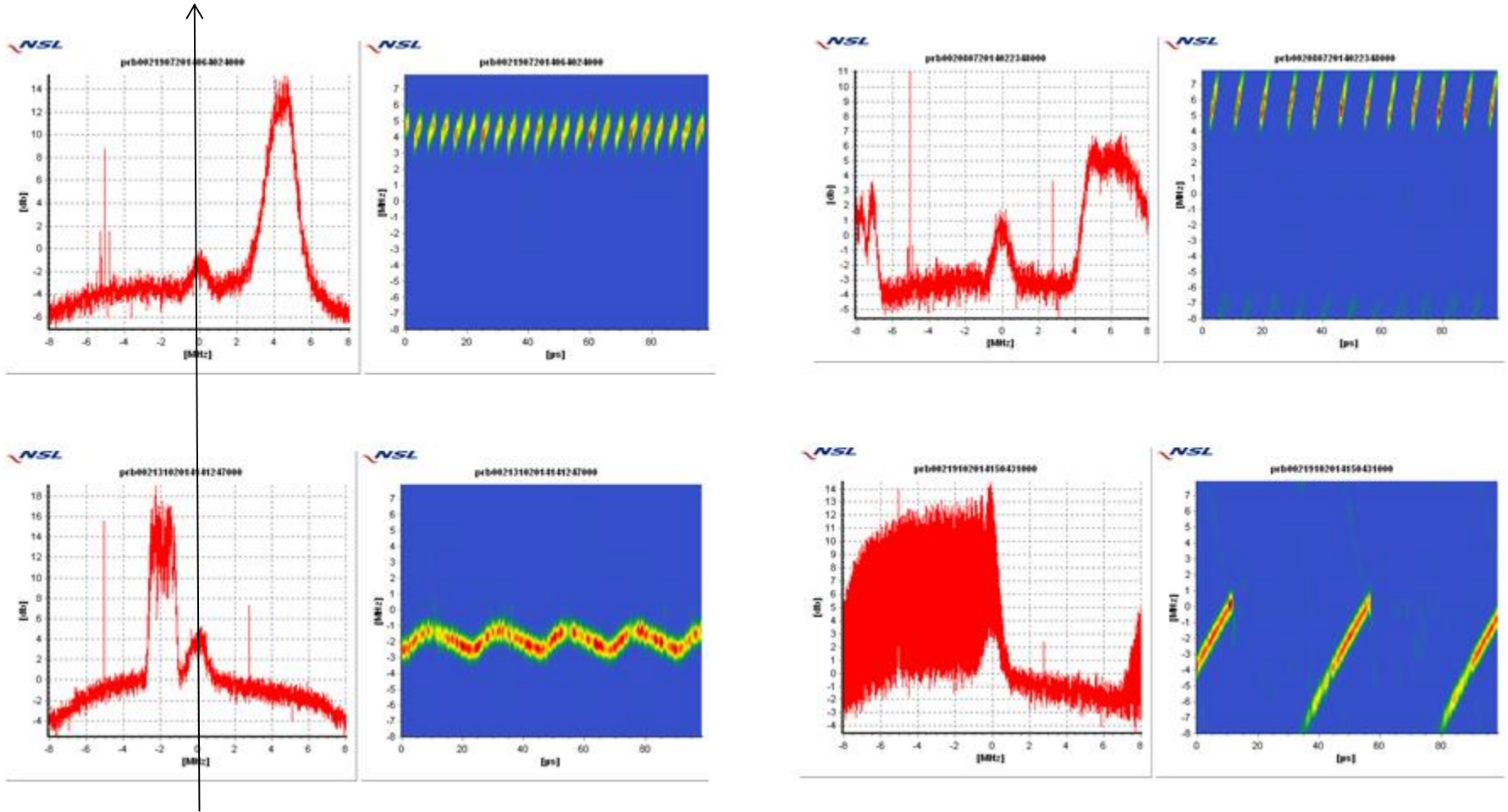
Many other "RF events" in L1
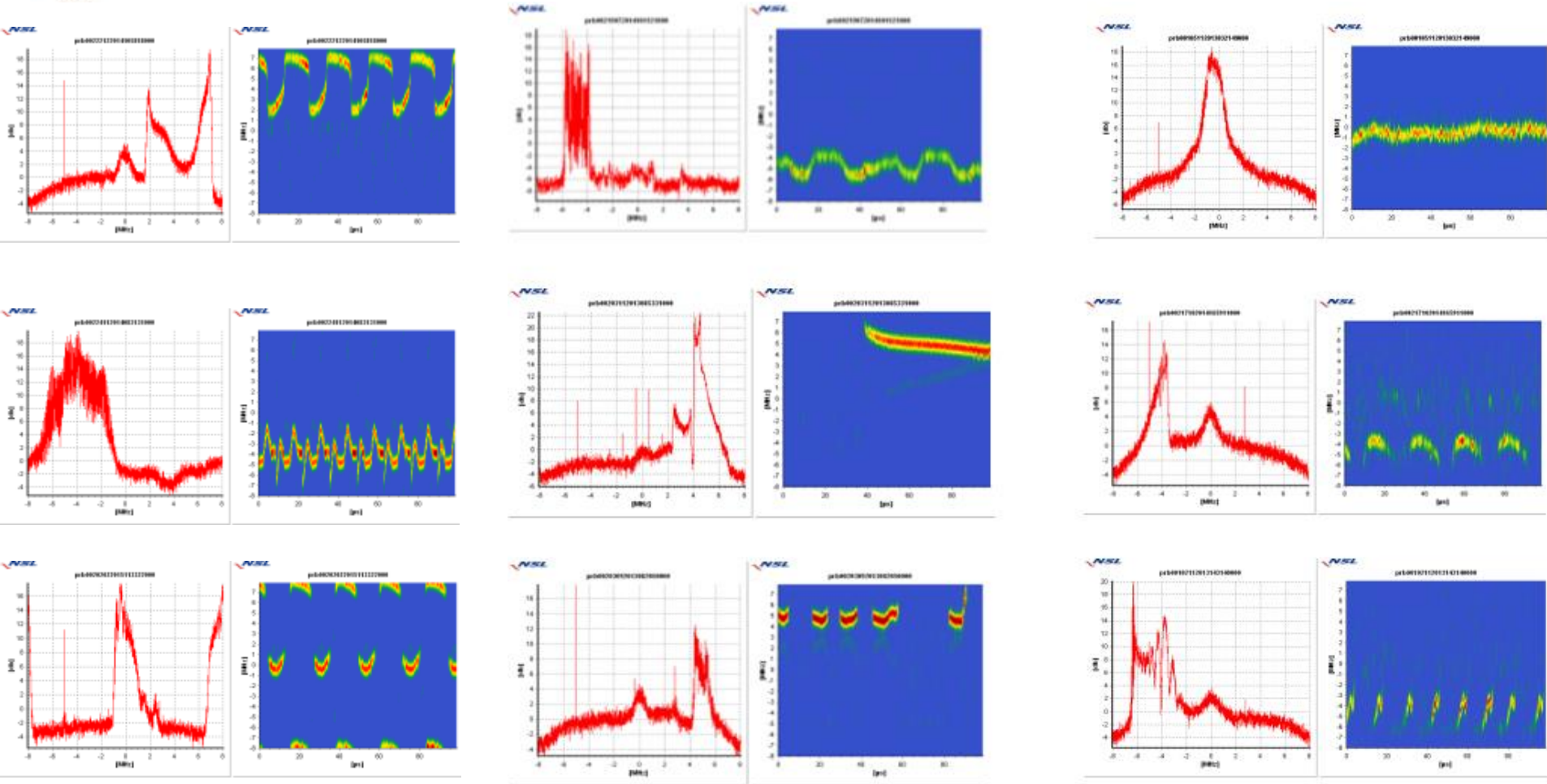
There are many types of jammer
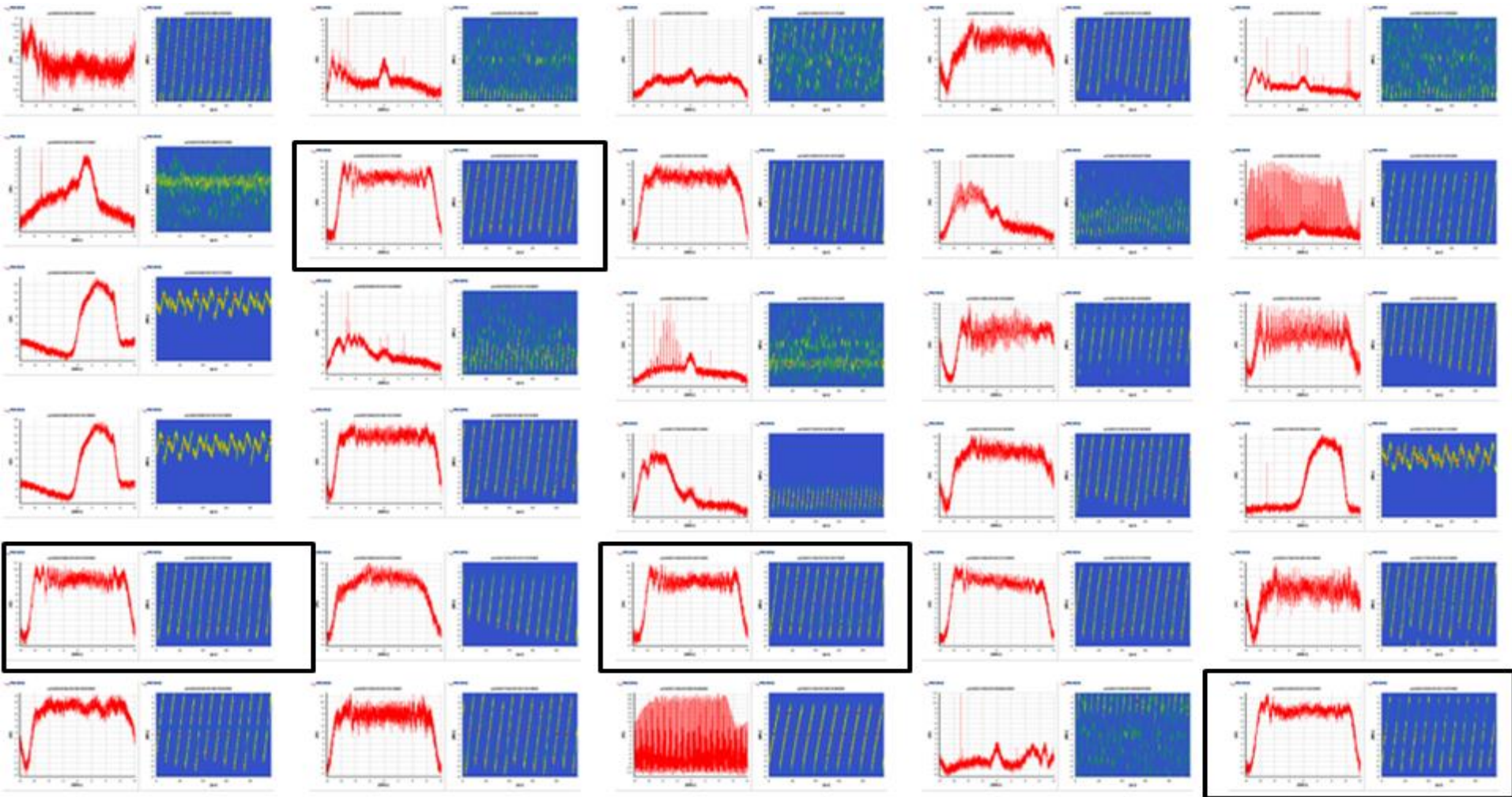
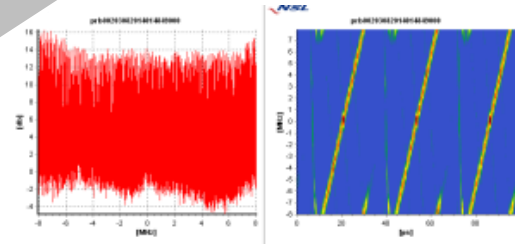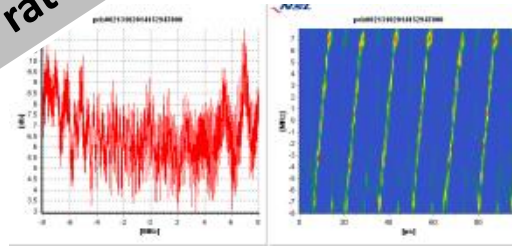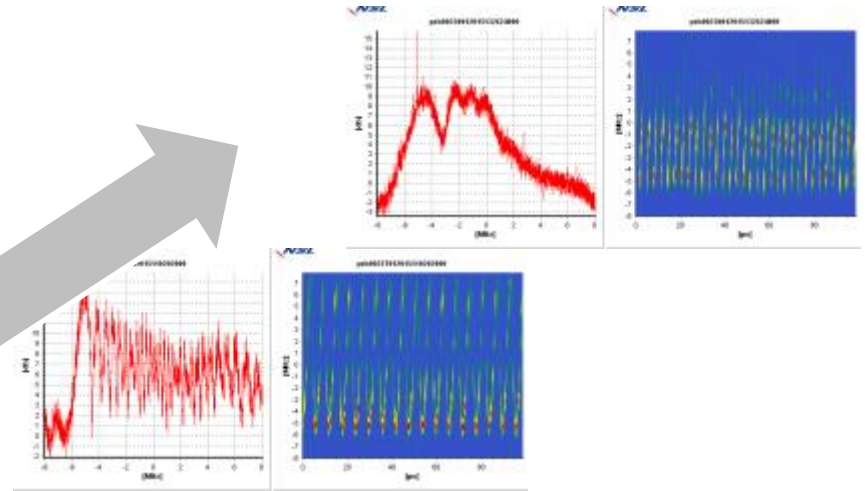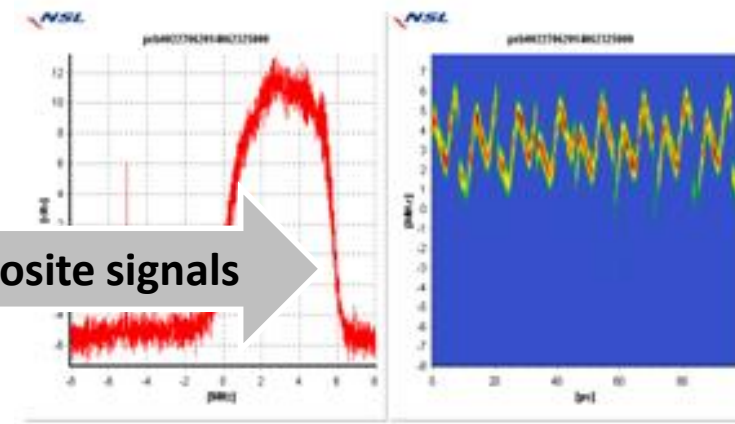*DETECTOR can identify the same jammer when it appears in the database*

Indications of an evolution…

Evidence that jammers are becoming more sophisticated: faster sweep rates, wider bandwidths and more complex signals

1. Faster sweep rates (illustrative)
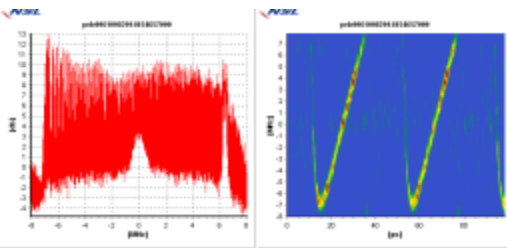
2. Composite signals

Next steps for DETECTOR

- Densify the DETECTOR monitoring network in Europe
  - Working with some Member States

- Potential inclusion of international partners and extension of the monitoring network
  - International monitoring network
  - Identify whether the types and numbers are similar in different geographical locations

- GNSS receivers being tested against "replays" of the threat waveforms to analyse performance impacts eg via Spirent simulator

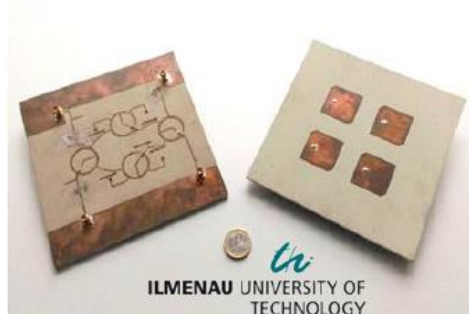# Example Mitigation – Antenna Array Demonstrators
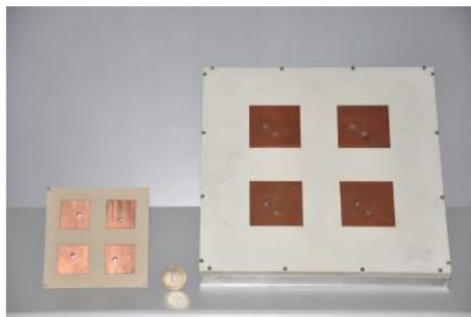
GPS/Galileo E1/E5
(standard and miniaturized)
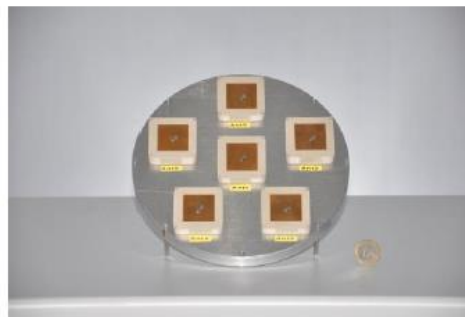

GPS
(miniaturized)

GPS conformal

GPS/Galileo E1
(miniaturized)

GPS/Galileo E1 (miniaturized,
analog frontend integrated)

JamCam: Spatial Detection and Visualization of RFI-signals in Real-time

- The presence of RFI can be detected using time-/frequency-domain analysis
- JamCam allows for spatial detection of RFI-sources in images obtained from a (video-)camera similar to the Acoustic Camera
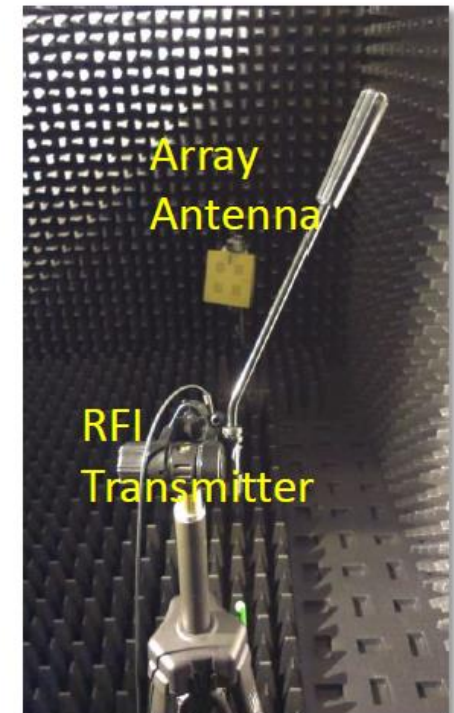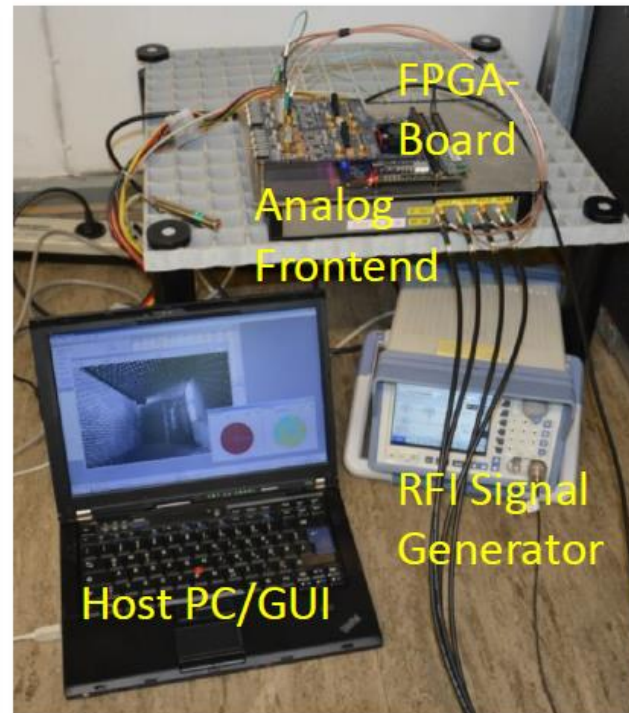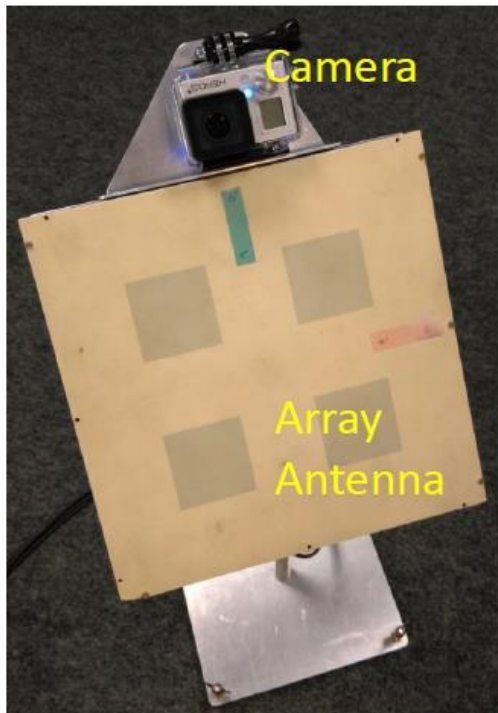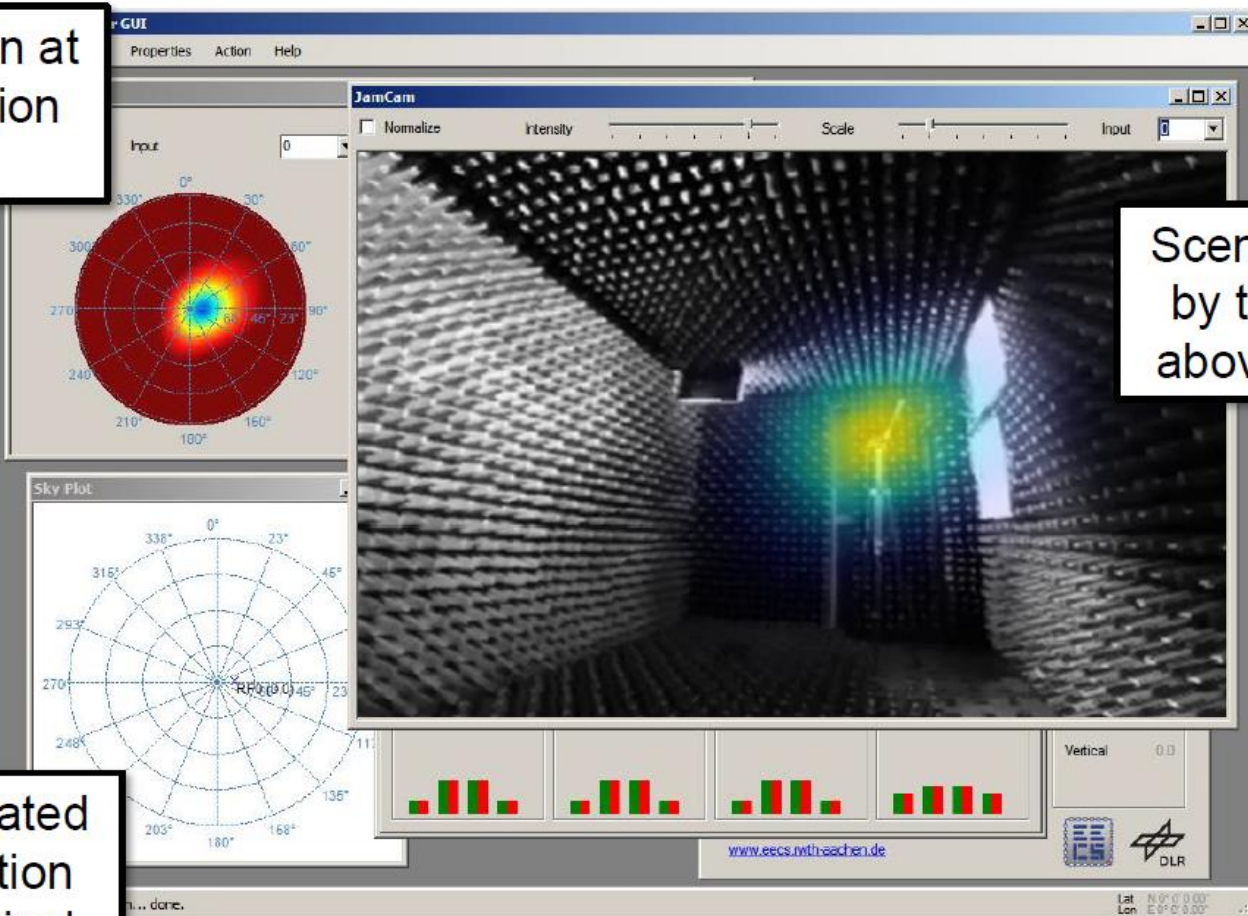
JamCam: Spatial Detection and Visualization of RFI-signals in Real-time

Beampattern at precorrelation stage

Scene observed by the camera above the array

Estimated direction of arrival

Summary

EU activities at many levels on IDM

- **Legislative**
- **Member State consultation/coordination**
- **International cooperation**
- **Interference detection**
- **Interference mitigation**
- **There is no magic bullet, spectrum protection needs combined efforts on many fronts**
- **Perhaps more could be done to educate the public**