GEARS project goals, achievements, future and lessons learnt

Webinar: Fundamental Elements Call 2022

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GEARS
GalileO Authenticated Robust timing System

Participants

FDC  GNSS receiver
NLR  IDM and Smart Antenna
NLS/FGI  T-RAIM and tropo/iono model
NavCert  Testing and Standardisation
Orolia  Coordinator, integrated T&S server
         access to market
FDC in a nutshell

Bringing Security and Resilience to critical applications

**Services**
- Business Consulting & Management
- Technology Consulting
- Research, Development & Innovation

**Fields of Expertise**
- Space Programmes and Applications
- Security

**Technologies**
- IP development
- GNSS attacks simulation
- GNSS Performance simulation
- Secure GNSS Rx module design and development (SW & HW)

**Key facts & figures**
- Founded in 1989
- HQ in Vincennes, France
- Financially & legally independent
- Turnover ~ 3 M€
- R&D intensity ~ 20%
- 20 employees
Netherlands Aerospace Centre (NLR)

+ Since 1919
+ 700+ specialists
+ Large range of disciplines
  • Aerodynamics
  • Materials and structures
  • Safety
  • Satellite navigation
  • Thermal management
  • ...
+ Facilities
  • Windtunnels
  • Environmental test facilities
  • Air-traffic control simulator
  • Structural test facilities
  • ...

Dedicated to innovation in aerospace
Finnish Geospatial research Institute (FGI)
part of National Land Survey of Finland

• **FGI’s current core competencies**
  • Spatial Data Solutions Supporting Digitalisation
  • Dynamic Earth
  • Smart Environments and Interaction
  • Robotics and Intelligent Transportation Systems

• **Our research impacts society widely**
  • We create opportunities for innovations in smart traffic, autonomous driving, surveying, Position Navigation Timing, and terrestrial mapping systems, etc.
  • Spatial Data Solutions Supporting Digitalisation
  • Dynamic Earth
  • Smart Environments and Interaction
  • Robotics and Intelligent Transportation Systems
NavCert profile

• Provides independent testing, validation and certification of GNSS components, products, solutions and services.

• The NavCert GmbH was founded as a Joint Venture between TÜV Süd and OECON in 2006, since 2012 100% subsidiary of the OECON Holding GmbH.

• Based in Braunschweig & Munich.

• The only laboratory in Europe accredited by a national accreditation Authority in the domain of GNSS.

• Notified Body (NB 2603) for European Electronic Tolling Service and Chair of expert groups EETS.

• Provides certification:
  o eCall - first eCall type approval in Europe
  o GNSS solutions, GNSS testbed systems (e.g., GATE), Digital Maps
  o UAS, ....

• Member of DIN and ETSI standardization organisations and delegated expert at DIN, CEN/CENELEC and ISO
OROLIA

- A Reference **GNSS Critical Applications Specialist** With Worldwide Leadership Positions

- European Private Company Founded in 2006, with a Strong US Footprint

- Develops, Manufactures and Sells Electronic Equipment and Software to Assure Precise and Reliable Positioning, Navigation and Timing (PNT) Data for Critical Operations

- Supplier of Large System Integrators, Governments and Blue-Chip Companies

- 2nd Largest High-Precision Timing Specialist
  N°2 World Leader for GPS/GNSS* Signal Simulation

- Only Independent Provider of Resilient PNT Solutions

- 4 Main Hubs; Industrial Presence in 4 Countries (FR, ES, CH, US)
Project objectives

- **OBJ# 1** Improving performances and resilience of Galileo and GNSS Timing receiver
- **OBJ# 2** Develop and demonstrate the effectiveness of unique Galileo services to operators within 2 Y
- **OBJ# 3** Strengthen market adoption through Standardisation activities
Market driven approach

• End User and Critical infrastructures operators survey
  • Focus on Telecom, Energy, Finance

• Requests:
  ▪ Compatibility with existing per domain standards
  ▪ Network element with IP infrastructure enhancement connectivity
  ▪ Resilience to threat: maintain service in predictable way, detect failure, recover from compromised status

• Evaluation of market value and market share target
### Technical development definition

#### FOCUS ON DIFFERENTIATING RESILIENCE CAPABILITIES

<table>
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<th><strong>IDM filter</strong></th>
<th>Clean residual jammer in frequency vs time: Digital filtering in frequency domain</th>
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<td><strong>Iono-tropo corrections</strong></td>
<td>Improve single frequency iono-correction: NeQuick correction scheme</td>
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<td><strong>T-RAIM</strong></td>
<td>Detect integrity issues: Timing Receiver Autonomous Integrity Monitoring</td>
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<tr>
<td><strong>OS-NMA</strong></td>
<td>Authenticate Galileo data: Galileo OS-NMA authenticated data</td>
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#### NEW GNSS CLOCK

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<th><strong>CRPA 4 elements</strong></th>
<th>Prevent jammer entering signal processing: Spatial filtering of RFI in up to 3 directions</th>
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GNSS Clock prototype

A FULLY CAPABLE GNSS CLOCK IN A COMPACT FORM FACTOR

- All time transfer standards implemented as inputs and outputs
- Three high speed Ethernet ports to support NTP, PTP and network management on different media: copper or fibre
- New Orolia mRO-50 integrated as high stability frequency reference
- Dual frequency, multi-GNSS, Galileo OSNMA processing receiver
- All new functions IDM filter, Corrections, T-RAIM, integrated
GNSS smart antenna

Resilience - Radio Frequency Interference (RFI) can seriously degrade time availability from GNSS constellations:

- 4-element Controlled Reception Pattern Antenna (CRPA) with null forming for spatial filtering of RFI.
- Protects Galileo and other constellations.
- Specially designed for use with the new GNSS Clock.
- Receiver agnostic processing, will also work with other timing receivers.
Standardisation activity

- The definition and establishment of a **Galileo-Based GNSS timing receiver** standard will provide a context on which a certification process can take place.

- Possible ESO’s were to develop a **Galileo-Based GNSS timing receiver** standard are:

  - [CEN](https://www.cen.eu)
  - [CENELC](https://www.cenelec.eu)
  - [ETSI](https://www.etsi.org)

- The certification of a product is a powerful tool to support the market development, to establish a consensus among stakeholders, such as manufactures, providers, users, and regulators.

- A certification is, therefore, a quality stamp which assures the user that the product fulfils, at least, the minimum requirements of a standard for timing accuracy and stability.

- This is important because it will ensure users, using the product, that the product comply with the most advanced techniques, providing trust on the product. By consequence, it will also define a state-of-art product.
After grant and future

• NLR is following engineering work on automatic processing of jamming with **smart antenna**

• FDC and OROLIA are using GNSS receiver and clock unit to test **live sky open test Galileo OSNMA signals** and validate long periods of operation

• OROLIA is **industrialising the clock unit** to release a comprehensive product to the market in phase with declaration of full operation for OSNMA service

• NAVCERT and OROLIA are supporting EC initiative to develop **standardisation for timing GNSS device** dedicated to supply critical services. Activity submitted to **CEN**
Lessons learnt: Submission

• Initial core team was active about 1 year before the call for proposal to define main goals for participants

• Demonstrate business model fit to goals of the grant and market requests

• Engage in funding completion of the industrialisation and productisation tasks

• Balance technical and application skills within the consortium
Lessons learnt: Execution

• Create a balanced **consortium agreement** and management scheme

• Work in **pro-active mode** with weekly coordination meeting inside the consortium

• Need to extend 6 months to recover from pandemic slow-down and extend to live OSNMA signals tests – **Grant amendment**

• Dedicate careful attention to **IP share** and sign pre-industrialisation agreements to enable productisation

• **EUSPA is adapting** to project definition evolutions to enable effective market fit.
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