GNSS for Train Control Systems

A step-change innovation for the competitiveness of the rail industry

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Brussels, 4 June 2013
Presentation Agenda

- Satellite-based Signalling System Trends
- European projects: Shift2Rail
- Roadmap
Satellite-based Market Evolution

- **GNSS**
  - GPS, GLONASS fully operative
  - GALILEO under development to provide Europe independence and greater robustness

- **ERTMS (new MoU)**
  - extending specifications to meet global requirements by introducing:
    - Network independent TLC
    - Satellite positioning

- **Increase market**

- **Exploit new technologies**

- **Making investments more attractive**

- **New markets**
  - private freight/mining/heavy haul lines
  - public or private lines, operating in rural/critical regions
  - Low traffic-regional lines
### Market trends

**Virtual balises / GNSS solutions:** ensures safety both in dark territories and low traffic routes

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<tr>
<th>The need</th>
<th>Virtual balises / GNSS answer</th>
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<td><strong>Dark territories</strong></td>
<td><strong>Satellite-based localization with SIL4 accuracy combined with TETRA IP-based TLC network</strong></td>
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<tr>
<td>Ensure cost-effective train localization and protection over long stretches of semi-deserted areas</td>
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<td>• Typically freight applications in Regions such as Australia, US, Russia, South America...</td>
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<td><strong>Low traffic routes</strong></td>
<td><strong>Next step is two-way satellite-based communication</strong></td>
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<td>Make it possible to efficiently ensure safety on low traffic passenger lines with satellite-based ATP solutions</td>
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<td>• Command-control systems or ETRMS/ETCS systems are too expensive to be used on railway lines with low traffic density</td>
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<td>Satellite-based localization combined with communication based on public GSM network instead of GSM-R</td>
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<td>• Major reduction in ground infrastructure costs</td>
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**Market expected to boom:** above 1B€ in three years
Challenges & threats

Europe: huge market potential but...competition issue vs US

About 172,000 km of local and regional lines (60% of the total railway network). The service of these lines employs, in about 220 rail undertakings, 320,000 people which is the equivalent of all the aviation companies, but transporting annually 20 times more passengers.

Australia: first market adopter

GNSS already approved on private freight only networks for mining: by 2014 first SIL-4 localization system in operation.

USA: government-backed strategy

PTC is a U.S. Federal law that affects all Freight and Passenger railroads in the USA which introduces satellite-based technology on a great part of the tracks in the USA.

Russia: GNSS «core» for railways

Russian Railways plans to install GNSS solutions on over 2.5 thousand train engines for passenger trains and more than 17 thousand locomotives for freight trains.

Set a standard?

- Need to include GNSS on the ERTMS platform
- Urgency to validate ERTMS with GNSS
- Focus EGNOS/Galileo on rail applications

Boost a strategy

Rail-GNSS to defend Eu primacy on ERTMS

Technology heritage

GLONASS GALILEO

Market lead
A technology shift at the forefront of ERTMS evolution

Lack of European leadership: "ERTMS like" solutions emerging

New markets enabled by ERTMS consolidated premiership

New clients needs: ERTMS technological specifications evolving to meet raising requirement in communication and functionalities

In this evolving scenario Europe is losing coordination in implementing even the ERTMS:
- Some countries still reluctant even in implementing ERTMS EU Corridors...
- ...even if others plan to go beyond EU obligations and will equip entire network

GNSS & IP-TLC enabling technologies

Examples of ongoing projects:
- Taiwan
- US HS
- India
- Denmark...

Examples of ongoing projects:
- Australia
- US PTC
- Russia...

Examples of ongoing projects:
- UK
- Use of ERTMS in Suburban – Mexico, Río...
Satellite-based solutions lead the future growth

Development times and costs to achieve certified solutions as well as client references represent a defensible barrier to entry
ASTS is investing on GNSS technologies

US and Australia

1° LTE
Installation and FRA certification of the SEPTA PTC system (€73m)
- First major PTC project as a prime contractor

1° SATCOM
Rio Tinto (€408m)
- Autohaul
- Other projects

1° GNSS
Roy Hill (€118m)
- Centralized routing and automatic train protection (ATP) with satellite positioning

ATP/ERTMS with satellite technology lead the growth
Presentation Agenda

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- Roadmap
**Passenger traffic**

- Triple the length of the existing high-speed rail network. By 2050 the majority of medium-distance passenger transport should go by rail.
- High-speed rail outpacing the increase in aviation for journeys up to 1000 km – +176 billion pass-km (rail) versus +67 billion pass km (aviation) compared to 2005.
- By 2050, connect all core network airports to the rail network.

**Freight traffic**

- Greater use of more energy-efficient modes – 30% of road freight over 300 km should shift to other modes by 2030, and more than 50% by 2050.
- Rail freight almost doubled – +360 billion ton-km (+87%) compared to 2005.
- Deployment of ERTMS.
- By 2050, connect all seaports to the rail freight system.
- Rail Freight Corridors as the backbone of the EU freight transport system.
Global Leadership for the European Transport Industry
railway research and innovation

- next generation of transport means
  - development of innovative vehicles incorporating intelligent control systems

- on board, smart control systems
  - vehicle/infrastructure communication

- advanced production processes
  - lower lifecycle cost, facilitate vehicle standardisation and certification; fast and cost efficient design and manufacturing (including assembly, maintenance and automation)

- new transport concepts
  - innovative transport systems, incl. automated vehicles

Europe is behind USA/Russia for the adoption of GNSS in rail control systems
The European Industrial Initiative for the railways sector

What is SHIFT²RAIL?

- An ambitious large-scale, industrially-driven and multiannual research programme that aims at helping EU rail industry to retain world leadership

- A public-private Joint Undertaking with Named Beneficiaries under Horizon 2020

- Estimated budget between 800 million and 1 billion Euros over a six to seven year period

- Official proposal submitted to the European Commission in July 2012; Addendum sent in January 2013
GNSS can boost efficiency and economical sustainability

More, Better, Cheaper!

3 major challenges

✓ CAPACITY (to face increasing user demand)
  Up to 100% increase in capacity

✓ RELIABILITY (to better satisfy the users)
  Up to 50% increase of reliability

✓ LIFE CYCLE COSTS (for more competitiveness)
  Up to 50% of reduction of Life Cycle Costs

Impacting all segments of the rail market!

Making daily life easier for millions of European passengers and rail freight users!
Potential Synergy with GNSS & ERTMS Evolution

- Already 15 major rail stakeholders including Infrastructure Managers (Network Rail & Trafikverket) committed to provide significant resources on the long-term

- Additional stakeholders are joining!
  - Infrastructure Managers (ADIF will join soon), leading Railway Undertakings and industrial partners!

- Triggered participation of SMEs, research institutes & academia
  - >25% of the budget through open calls for proposals
  - Discussions with Clusters (ERCRI) and Academic associations (EURNEX)

Coordinator of Unisig WG on satellite
Presentation Agenda

Satellite-based Signalling System Trends

European projects: Shift2Rail

Roadmap
Roadmap: ERTMS evolution & GNSS

- **2012**
  - **SATLOC**
  - **3InSat**

- **2013**
  - **ERTMS-ETCS Test Site**
  - **EGNOS-GALILEO upgrade for rail**

- **2014**
  - **ERSAT**
  - **Test Site for ERTMS L2, L3 with satellite localization**

- **2015**
  - **GRAIL 2**

- **2016**
  - **Shift2Rail**

- **2017**

**Event Notes**
- **Early Services**
- **Operations (incl. extensions, replenishments)**
- **Reference GSA presentation**
- **Sinergy between ERTMS evolution and GNSS**
The Test Site – Olbia-Cagliari line (Sardinia)

Phase 1: 3InSat (satellite assets validation)
- Total length: approximately 50 km
- Double track: to test train localization on parallel tracks
- Satellite localization system at SIL-4 level
- Multi-bearer TLC network
- Augmentation network validation
- Test Procedures validation
- Independent assessment by a NoBo (Italcertifer)

Phase 2: ERSAT (ERTMS on Satellite)
- Deployment of an ERTMS-ETCS system
- Integration of satellite localization SIL-4
- Integration of a multi-bearer TLC network
- EGNOS “adaptation”
- Fixed block (L2) train separation
- Moving block (L3)
- Certification
Thank You for your kind attention

https://www.youtube.com/watch?v=sKNDhN5Uw-I
SHIFT²RAIL research priorities

**IP1:** Energy & Mass Efficient Technologies for High Capacity Trains

**IP2:** Advanced Traffic Management & Control Systems

**IP3:** Cost Efficient High Capacity Infrastructure

**IP4:** IT Solutions for a Seamless Attractive Railway

**IP5:** Technologies for Sustainable & Attractive European Freight

EGNOS GALILEO