The role of satellite technologies and GALILEO for improving the safety of the local and regional train management infrastructures

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Ansaldo STS, Genova October 29th 2013
Agenda

- The Regional and Local lines scenario
- Satellite Technology Trends
- Ansaldo STS roadmap
- Conclusions
What We Want

- Increased safety on local and regional lines
- Lower operational costs
- Higher capacity
- Compatibility with the European ERTMS-ETCS standard
The new paradigm

- Move the “intelligence” from the track side to the trains
- Replace the fixed blocks with a more efficient use of the network: “dynamic blocks”
- Improve the safety/security respect to traditional solutions
- Increase the frequency of train re-using the same infrastructure
GNSS railways applications

• **Safety critical applications**
  – Train control (signalling)
  – Driver status monitoring
  – Shunting operations

• **Security related applications**
  – Tracking and tracing of trains, goods
  – Rail composition integrity
  – Corridor monitoring
  – Geo-fencing
  – Environment protection
  – Level crossing control

• **Non safety/security applications**
  – Freight train management
  – Advanced logistic
  – Train velocity/energy optimisation
  – Survey and Maintenance of rail tracks
Regional and low traffic lines in Europe

- Local lines of about 70km around big towns
- Most of train operations based on old safety systems
- Lack of automatic train protection systems (ATP)
- Signalling train separation and train control (driving) based on human responsibility

Track length per region

- EU15
- New MS
- EFTA
- Candidate countries
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Satellite-technology for rail applications

- **Ensuring ERTMS compatibility**
- **Exploiting new technologies**
- **Making investments more attractive**
- **ERTMS (new MoU)**
  - extending specifications to meet global requirements by introducing:
    - Network independent TLC
    - Satellite positioning
- **Increasing market**

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

**New markets**
- private freight/mining/heavy haul lines
- public or private lines, operating in rural/critical regions
- Low traffic-regional lines
The GNSS “system of systems” vital for economy and safety

By 2012 to 2025 about 44B$ planned to modernise GPS, GLONASS and build GALILEO, BEIDOU

GNSS offers a redundant & resilient global infrastructure for realizing accurate, safe and cost effective train localization systems

Increased GNSS capabilities
• higher integrity
• Lower vulnerability
• Higher accuracy

Multi-constellation pave the way to pursue autonomy and trustiness

New features on TCS
• Satellite localization
• Virtual blocks operation
Whenever environmental conditions are critical, GNSS is the cost efficient way for Train Control Systems
Galileo Implementation Plan

- **Galileo System Testbed v1**
  Validation of critical algorithms
  2003

- **GIOVE A/B**
  2 test satellites
  2005/2008

- **In-Orbit Validation**
  4 fully operational satellites and ground segment
  2013

- **Initial Operational Capability**
  Early services for OS, SAR, PRS and demonstrator for CS
  2020

- **Full Operational Capability**
  Full services, 30 satellites
  2020
## EGNOS & Galileo Services vs Market Segments

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<th>Segment Service</th>
<th>Mass Market</th>
<th>Intelligent Transport Systems</th>
<th>Aviation</th>
<th>Maritime</th>
<th>Rail</th>
<th>Professional</th>
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- Green indicates EGNOS and Galileo Relevance.
ERTMS train control system

- GNSS SATELLITES
- Augmentation network
- RBC
- Virtual Balise
- Today
- Track circuits

- Positioning Data (continuous)
- Positioning Data (discontinuous)
- LDS
- OBS
- Added Components
- Balises
ERTMS Train Control System Evolution

Level 2

Reduce the train distance without impacting the safety

Level 3

Moving block to increase capacity/flexibility

Satellite localization to detect train position and eliminate fixed balyse along the line
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**Unique portfolio:** wide range of solutions and technologies

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<th>Life-cycle stage</th>
<th>Mature</th>
<th>Emerging</th>
<th>Leading edge</th>
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<td>1990s to Now</td>
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**Solutions (samples):**
- Comp. Based Interlocking (CBI)
- ERTMS
- Driverless
- CBTC
- Satellite-based

**Technologies (samples):**
- Distributed Interlocking
- ATS
- Wayside PTC
- Tramwave
- Infrastructure monitoring

**Development times and costs to achieve certified solutions as well as client references represent a defensible barrier to entry.**
Innovation: strengthening the core and selectively expanding footprint

Scope of work: life-cycle
- Operations
- Maintenance
- Spare parts
- Initial CapEx

Core ASTS technologies and solutions
- Signaling
- Transportation solutions

Scope of work: technologies

Core: satellite based
- Satellite based train localization and protection

Core: Tramwave
- Catenaries-free solution for light rail

Adjacencies: infrastructure monitoring
- Weigh in motion
- Train conformity check

Adjacencies: connectivity solutions
- Bundle different TLC carriers

Services/OpEx: connectivity solutions
- Bundle different TLC carriers
Reference projects with GNSS and IP-based Telecommunications

US and Australia
- Installation and FRA certification of the SEPTA PTC system
  - First major PTC project as a prime contractor

Rio Tinto
- Autohaul
- Other projects

Roy Hill
- Centralized routing and automatic train protection (ATP) with satellite positioning

ATP/ERTMS with satellite technology lead the growth
ERTMS/ETCS System: Low Cost ETCS

- Satellite localization is key to remove the balises along the line
- System “simplifications” by merging RBC, IXL and Traffic Management in a single Central Location, or – as it happens typically on Regional lines application – removing lineside signals, etc.

From the On Board point of view the use of the LDS system functionally replaces the use of balises!
“The Navigation Satellite System (GNSS) can play a major role in the rail sector, both for fleet management and rail safety (signalling and train control). The EGNOS and GALILEO would fundamentally contribute to increase reliability and reduce cost of the ERTMS odometer …” (extract from the new ERTMS MoU)

Roadmap for GNSS adoption on rail

Next Generation Train control Systems

Pilot projects & technological platforms are underway almost in parallel with the EGNOS-Galileo roll out plan.

New ERTMS MoU may provide guideline for exploiting ERTMS and GNSS synergy.
Test Bed for Integrated Tests on field

Central MGMT
TALS

RIM Stations

Mobile Access Router
TETRA
SATCOM
GSM-3G

Train On-board system

GNSS Localizer

Rail TLC

RIM Stations

50 km

LDS
Level 3
Level 2
Level 1

Radio

RBC & IXL

Points
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The Regional and Local lines scenario

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Conclusions
Conclusions

- Safety critical applications
- Security related applications

**ERTMS – DELIVERING FLEXIBLE AND RELIABLE RAIL TRAFFIC**

Increase the safety at an affordable cost for Local & Regional lines
About 172,000 km of local and regional lines (60% of the total railway network). Most of them are quite old and costly to operate.

Australia: first market adopter

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

USA

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.

Europe

Russia

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.

ERTMS & GALILEO strategic pillars
Thank You for your kind attention

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