Les bénéfices de la localisation par Satellites et des Télécom Publiques pour l’Evolution du Système ERTMS: RETOUR D’EXPERIENCES DU PROJET ERSAT

Lille, 16 Mars 2016

Ansaldo STS
A Hitachi Group Company

Francesco Rispoli
Ordre du jour

- GNSS références dans le monde: Etats-Unis, Chine, et Europe
- Un plan européen pour promouvoir la synergie entre GALILEO et ERTMS
- Résultats provisoires du projet ERSAT EAV
  - Le besoins de RFI, Trenitalia, DB Netz, ASSTRA
- Présentation sommaire du projet Pilote RFI pour contribuer à la certification et exploitation en Italie
GNSS on global train signalling market

**USA**: PTC train control mandatory by a [Federal Law (2008)](#) → GPS based solutions preferred choice by majority train operators, biggest Investments ever made on train control ~ 11 B$ → Route miles ~ 55,600, No. Loco ~ 22,900

**China**: early adopter GPS-based solution for low traffic line (Tibet, 1550 km). Recent plans announced to massive developments based on GPS-BEIDOU for regional networks (~ 50,000 km) but also on high speed lines.

**Europe**: ERTMS world success with installation on ~10,000 locomotives, 47,000 route-miles and 50% sales outside Europe → GNSS is strategic for improving ERTMS competitiveness.
ERSAT: ERtms on SATellite

2011

ERSAT EAV (GSA)
EGNSS-based localisation
EGNOS
Galileo Early Services

Local & Regional Lines
RFI-Trenitalia, DBNetz

3InSat (ESA)

Mobile Access Router
TETRA SATCOM GSM-3G

Train On-board system
GNSS Localizer

RBC
TLC

Track area station
Rail TLC
Track area Stations

ERtms Regional with Virtual Balise & Bearer independent TLC

Pilot Line
ERTMS evolution towards satellite

With the use of satellite technology in the development of existing ERTMS, following targets are expected to be achieved:

- Train integrity
- Virtual balise and odometer
- Hybrid TLC

The functionality of "Train Integrity" is mandatory for the introduction of the ERTMS level 3 (increase of 40% of transport capacity) removing track circuits with considerable economic benefits.

Adopting ERTMS level 3, the train is able to establish independently its position and integrity to optimize lines capacity.
Future Evolution of ERTMS and Roadmap

New Capabilities – Game Changers

- Automation (incl. ATO)
  - ETCS Level 3 (moving block, etc.)
  - Bearer-independent radio
  - Satellite-based functions
- Results of SHIFT2RAIL (to be phased in)
- Scope extension to global perspective
- New brand: GRTMS/URTMS?

Future Evolution

- Next Evolution: L3, GPS, Automation
- Compatibility Reference

Approx. 5 years

Extract from ERA presentation, Lille 22-23 September 2015
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ERSAT EAV overview

User Requirements

Main target areas
- Australia
- USA
- Russia
- Europe

Cost Benefit analysis

GNSS Measurement Campaign

Reference Architecture Design

Modelling & Simulation

ERSAT EAV Core Developments

EGNOS Application for Railway

Local Enhancement for Railway

Localisation in GNSS-denied areas

Trial Site

Contribution to ERTMS evolution standardisation

Dissemination & Exploitation

- Case studies
  - Germany
  - Italy
- Economic assessment for Europe
- Impacts for other markets
- Impacts on specific players

Contribution to UNISIG WG

ERSAT EA V Core Developments

EGNOS Application for Railway

Local Enhancement for Railway

Localisation in GNSS-denied areas

Trial Site

Contribution to ERTMS evolution standardisation
ERSAT EAV Architecture

- **ERTMS**
- **EGNOS**
- **Radio Block Center (RBC)**
- **TALS**
- **Public networks**
- **Signal of opportunity**
- **TLC networks**
- **Track Area Augmentation Network**
- **RS 1**
- **RS 2**
- **RS n**
- **virtual balise**
- **Multi-bearer TLC**
ERTMS with GNSS & Public telecom

**GNSS Domain**
- GNSS Antenna
- Virtual Balise Reader
- Verify Position Report Augmentation Mng

**Signalling Domain**
- ERTMS/ETCS (EVC, Odometry, Radio Mng)
- RBC Functions

**Multi Bearer**
- DMI
- Multi Bearer

**Public Communication Networks**
- GNSS Domain Minimum Performance Reqs
- Augmentation & Integrity
- Balise
- Augmentation & Integrity
- RBC Platform

**ERTMS** with **GNSS & Public telecom**
IP-based communications and Virtual Balise in order to:

- Reduce costs
- Increase the accuracy of odometry
- Develop a competitive product on the international market

Multi-bearer TLC system capable of ensuring the Quality of Service required by ETCS, using public networks (ie cellular-satellite) and inter-operable with GSM-R.

A safe localization system provides the so-called virtual balises according to the requirements and interfaces provided by ETCS.
Main constituents of Trial Site

- GNSS Antenna
- Virtual Balise Reader
- ERTMS/ETCS (EVC, Odometry, Radio)
- DMI
- Radio I/F
- Public Communication Network
- TALS & RBC Functions
- Peripheral Post I/F
- IXL Functions
- Reference Station
- Communication Network
- Existing CTC

50 Km

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First Movement Authority based on GNSS Localization!
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The Italian Rail Network

Lines classification related to the traffic development

- **High Speed Network** (~ 1000 km)
  - Command Control System: ERTMS/ETCS L2
  - Train spacing with radio block

- **Metropolitan Traffic Lines** (~ 950 km)
  - Command Control System: CTC, SCC, SCC-M
  - Train spacing with short block sections (High Capacity)

- **Fast Lines** (~ 2,900 km)
  - Command Control System: CTC, SCC
  - Train spacing with SCMT

- **Middle performances + Freight lines** (~ 3,900 km)
  - Command Control System: CTCev, SCC
  - Train spacing with block sections: SSC, SCMT

- **Subsidiary + Low Traffic Lines** (~ 7,950 km)
  - Command Control System: CTC
  - Train spacing with block sections: SSC

Economic Sustainability
Trenitalia expectations for regional and local rail lines

1. **Reduction of** investment and maintenance **costs**

2. Modernise signalling system at lower costs to ensure sustainability, according to the European scale numbers

3. Guarantee a real and **long-term interoperable** European **standard**

4. **Improve capacity** of transportation networks extending ERMTS system **on secondary lines and urban nodes**

5. Minimize Impact on Operational Rules.

Extract from DB Trenitalia presentation at the ERSAT Workshop in Roma on February 12, 2016
DB Netz role & contribution on ERSAT EAV

~ 10,000 Km regional lines

WP2 Requirements
WP5- Impact & Sustainability Analysis
WP9: System Simulation
WP11: Test Review Analysis & Validation

RailDriVE® vehicle of DLR

Additional tests on a real regional line in Germany with challenging geographic conditions as complement to ERSAT EAV tests.

Extract from DB Netz presentation at the ERSAT Workshop in Roma on February 12, 2016
Local lines in France and Italy: results from ASSTRA analyses

France

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- ~ 10,6 to 74,7 million passenger in 2013

Italy

Eight Rail companies: Ente Autonomo Volturno, Ferrovie Udine,-Cividale, Ferrovienord, GTT, ARST, Trasporto Ferroviario Toscano, SAD, Trentino Trasporti

- ~ 3560 Km of lines (whose 2100 Km secondary lines mainly single track)
ERSAT EAV: Users & Rail-Satellite Stake-holders

RFI - DB Netz - ASSTRA
First harmonised User Requirements
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Stepping into certification process

RFI Coordinator of Technical Committee – Railway Risk Management for User Requirements – PHA

Preliminary Hazard Analysis

User Requirements

CE 402/2013 Regulation

Team: RFI, Ansaldo STS, Radiolabs, Sogei and Telespazio.

Output: Final Report for Railway Risk Management

Next step: Request of certification to ANSF with NoBo assessment
ERSAT and ERTMS Regional - RFI

ERSAT (ERTMS Satellite) - Pilot Line in Sardinia:

Trackside:
ETCS L2 (by Virtual balise - GNSS Satellite application) + Euroradio over Public Bearer
Overlapping existing Class B and existing signalling system

Trainborne:
ETCS L2 + STM, Class B

**Match ERTMS Evolution: Management of New CR**

ERTMS Regional (Only ETCS L3) in a Low density Line

*but using Virtual Balise*

Trackside:
Interlocking + CTC + ETCS L3 (By Virtual balise - GNSS Satellite application) + Euroradio over Public Bearer

Trainborne
ETCS L3 + STM (optional)

**Economical Sustainability for Total Cost of Ownership (TCO) of the regional lines**

Extract from RFI presentation at the ERSAT Workshop on February 12th 2016
Launch a Pilot Line

1. Development & Test Satellite Technology
2. Signalling System with Satellite technology
3. ETCS L2 with GNSS + Euroradio over Public Bearer as primary means

Pilot Line
Expected impacts

→ the case of ERTMS on 30% local lines in Europe (~ 18,000 km)

~ 3.5M Movement Authority daily

~ 62% Opex reduction

GNSS & telecom services provisioning with SLA

Overall ERTMS system
• Project NPV: € 1.2 bln
• Benefit/cost ratio: 1.40

Reference ERSAT EAV University Bocconi preliminary assessment of the economic effects at the system level.
Other Potential impacts

Relevant savings in operating expenses: -67% each year compared to the traditional ERTMS → Thus, it can contribute to the diffusion of ERTMS:

→ In low density lines, where the low traffic and the deriving poor economics of the service generate the risk of disruption of services (forcing a shift to road which increases the generalized logistics cost by some € 0.1 per pax*km)

→ In local lines where safety standards are currently not SIL4, thus reducing the risks of accidents (which can be valued at about € 0.6 per 1000 pax*km), at lower costs (deriving benefits in safety in Europe = € 23 mln per year

→ In all lines where ERTMS is to be deployed, allowing the implementation of the «EcoDriving» concepts, which generates benefits for up to € 70 mln per year in savings in energy consumption and braking equipment.

→ In international markets especially in remote and difficult to access areas

→ In exploiting satellite assets and creating a synergy with EGNOS-GALILEO

Reference ERSAT EAV University Bocconi preliminary assessment of the economic effects at the system level.
ERSAT EAV contribution to global roadmap

ERSAT EAV

STARS

SHIFT²RAIL IP2

IP2 TD 2.4
Fail-safe train positioning

ERSAT Workshop
Roma, 12 February 2016

Carlo Des Dorides (executive director GSA) with Joseph Doppelbauer (executive director ERA) and Maurizio Gentile (CEO RFI)
Only those who risk going too far will find out how far they can go…