“First EGNOS implementation in a commercial rail line: Pinerolo-Sangone”

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Status of railway infrastructure & evolution

ERTMS Acceleration Plan
Deploy the ERTMS on the entire Italian railway infrastructure and trains

first ERTMS deployment on Regional lines
Decommissioning of legacy systems as requested by EC

Total network: 16.700 km
- ~ 1.000 km High Speed
- ~ 2.900 km Basic performance
- ~ 3.900 km Medium performance
- ~ 8.900 km Regional, Local

New priority

Italian Network
Passengers per day
+2 million by train

Italian Network
Every day
+8,500 trains
ERSAT Program: ERTMS + SATELLITE

- Conceived in 2012 to enhance the ERTMS standard
- Contribution to the Game Changer innovation
  - Satellite positioning
  - Bearer-independent telecoms

- Comprehensive plan to validate, certify, standardize and upgrade the new technologies in a stepped manner with milestones to activate the operational service
- Involvement of the rail & satellite community
- Expectations that EGNOS be a Service of ERTMS with support from EC, GSA, ESA and ESSP
Game Changing

ETCS

- RBC Communication
- EVC
- BTM
- Odometry
- Eurobalise Antenna
- Fixed Balise

AS-IS

EGNSS

TO-BE

Estimated cost-benefit on European local lines

Ref: CBA Grail-2, Bocconi University
ERSAT
Enhanced Railway Signalling Application

Multi-bearer TLC solution

Multi constellation

Local Area Trusted Augmentation service

Localisation in GNSS-denied areas

Satellite-based enhanced localisation

EGNSS-based localisation

EGNOS

Galileo Early Services

ERTMS

RETE FERROVIARIA ITALIANA
GRUPPO FERROVIE DELLO STATO ITALIANE
Sardinia Test Bed

Trackside Subsystem:

- 50 Km with 2 Local Reference Stations
  - Samassi
  - Decimomannu
- 1 Radio Block Centre (RBC)
- 1 TALS (Track Augmentation LDS Server)
- EGNOS
- Public Augmentation Network SOGEI GRDNet (GNSS R&D Network): RTK/NRTK technology

Onboard Subsystem:

- Rolling Stock Aln668 3114, equipped with an ERTMS platform
- LDS OnBoard Unit (LDS OBU)
- GPS RTK receiver for the ground truth definition
- Mobile Terminals, via the GSM / 3G public radio network or the satellite network
- Data Logger
Trial Site Architecture and Configuration for Demonstration

Railway Line: Cagliari – S. Gavino (about 50 Km long)

Virtual Balise Only

Centralized Traffic Control

RBC Monitor

RS Diagnostic Monitor

Satellite Radio Communication Network

RFI SDH

TALS & CTC

TAAN - CC

RSs & Servers (SOGEI/EGNOS / GALILEO)

Samassi

Decimomannu

Signalling & Augmentation Data

Railway Line: Cagliari – S. Gavino

Virtual Balise Only
ERSAT EAV INTEGRATION WITH ERTMS

- **GNSS & CPS Domain**
  - GNSS receiver (Septentrio)
  - CPS (CEIT Prototype)

- **On board Antennas**
  - TAAN RIM RSs including EGNOS (SOGEI)
  - AIMN RSs (HITACHI STS)

- **LDS OBU (HSTS)**
  - Augmentation & Integrity
  - Balise detected & Telegram

- **ERTMS/ETCS (EVC, Odometry, Radio Msg)**
  - RBC/TALS Functions
  - Data Logger

- **TLC Network (2G/3G PMRN)**
  - TLC I/F
  - DMI

- **RBC Platform**
  - Data Logger
  - TLC I/F
**Roadmap to certification & operational activation**

**ERTMS L2 baseline 3**

- **2017**
  - Preparatory activities
  - Selection of Train and Logistic elements for deploying local Augmentation Network

- **2020**
  - Activation of ERTMS L2 + GNSS + Local Augmentation Network

- **2021**
  - Preparatory activities
  - Upgrade to ERTMS + GNSS + EGNOS Based SBAS

- **2022**
  - ERA target window for upgrade of TSI

- **2023**
  - Readyness – Sep 25
  - Activation ERTMS L3 + GNSS + IP Based Public TLC

- **Pinerolo Sangone line**

**Cooperative effort involving Rail & Satellite community**

- **Satellite asset to comply with ERTMS certification process**
1. Trackside CCS and On Board Unit must be implemented according to the ERTMS Baseline 3 R2 standard and subject to certification. Regarding TRK ETCS, by not exporting application conditions that affect interoperability to the OBU, the certification will be performed by a NOBO.

2. The certification of the new on-board and trackside functions that include the introduction of GNSS and the train integrity function will be carried out by a DeBO.

All the products and functions of GNSS (including the Augmentation Network), which are added to the provisions of point 1, will be used only for the purpose of improving odometry and is aiming at positioning the train in the railway segment by virtual balise and they are not impeding the line interoperability.
Satellite and Vehicle Authorization, trackside CCS APIs

The ETCS OBU implements all the standard functions. Can be tested and certified as 100% compliant with STI and subsets.

The satnav, route map, VB functions are add-on modules that do not impact or modify the standard functions of ETCS.
The “only” effect of VB is that position is more accurate (odo errors are accumulated over a shorter distance from LRBG)
Therefore Vehicle can be authorized without derogations/conditions.

The real question concerns the trackside: how the increased accuracy is used in the design of the ERTMS trackside subsystem:
• Can a train without those modules run on the line “safely with acceptable performance”?

If the answer is yes, then the MoU clauses are respected, the trackside signalling subsystem is compatible with any B3 equipped train, therefore can be authorized without derogations.
Authorization must take account of the ERA approval (art 19 new Interop Directive).
Challenges

- The ERSAT-GGC track survey will help in the characterization of the line in terms of suitability of the area for the VB location, i.e.
  - Line green: VB can be placed even at small distances;
  - Line red: we need different solutions

- Frequent VBs increase performances through odometry reset

RFI is interested in the results of EU projects, as well as technological and market trends (DCMF, Non GNSS Sensors, Data Fusion) to extend current performances also in GNSS denied zones.
ERTMS Enhancements: Train Position

BTM provides:
- User Bits
- Nominal Balise Location
- Max/Min Balise Detection Error = \( \pm 1 \) m
  GNSS Position matches the VB Position on the track

VBR provides:
- User Bits
- Nominal Balise Location
- Max/Min Balise Detection Error = f(Prot., …)
Train Control System with GNSS localization – ROY HILL

- ERTMS Level 2 with Satellite localization (only means)
- Sil 2 by October 2016
- Sil 4 by January 2017
- **More than 1,5 million km travelled**
Italy - an early adopter of **ERTMS standard** is pioneering new technologies at EU level

- plan to migrate to a full ERTMS infrastructure
- satellite technology mandatory to reduce opex, enabling a massive ERTMS deployment

Certification process of EGNSS asset agreed with ERA to comply with ERTMS (no derogations needed)

Stepped Plan to first validate & certify EGNSS to putting in operation the systems as market is ready

Continue to innovate to improve technologies with an eye to other sectors (automotive, aviation)

Urgent assessment on EGNOS utilization in a seamless way as in aviation

The Pinerolo Sangone line is a European asset benefitting the ERTMS and EGNSS
Thank you

ERSAT represents the missing link between ERTMS and EGNOS-Galileo, both major European industrial projects of strategic relevance.

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