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

Massimiliano Ciaffi
ERSAT PROGRAM MANAGER

Rome, 25th September 2019

Status of railway infrastructure & evolution

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
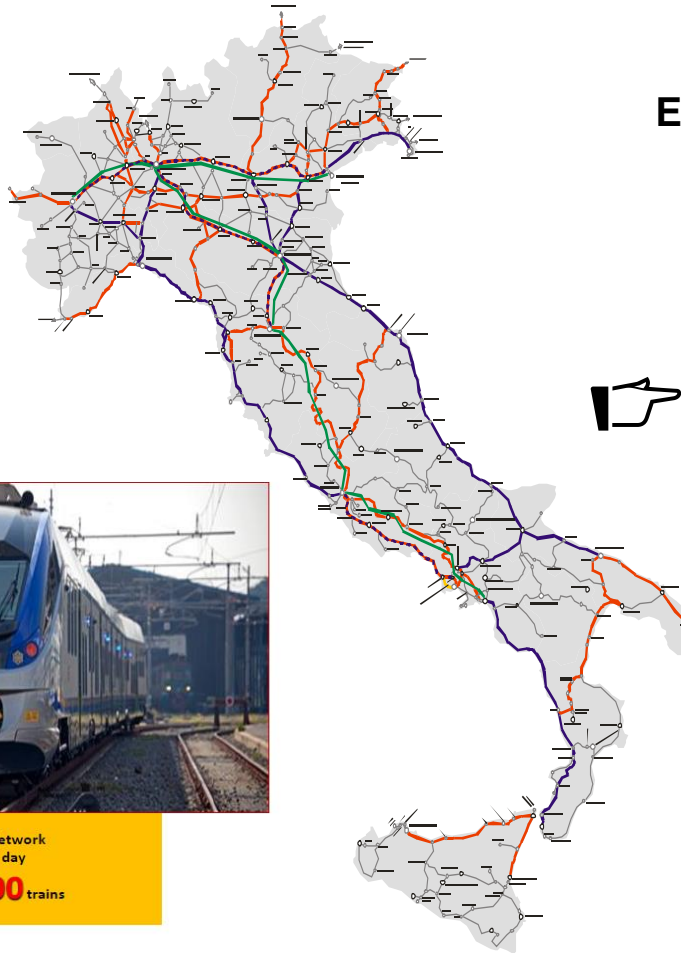
ERTMS Acceleration Plan

Deploy the ERTMS on the <u>entire Italian railway</u> infrastructure and trains

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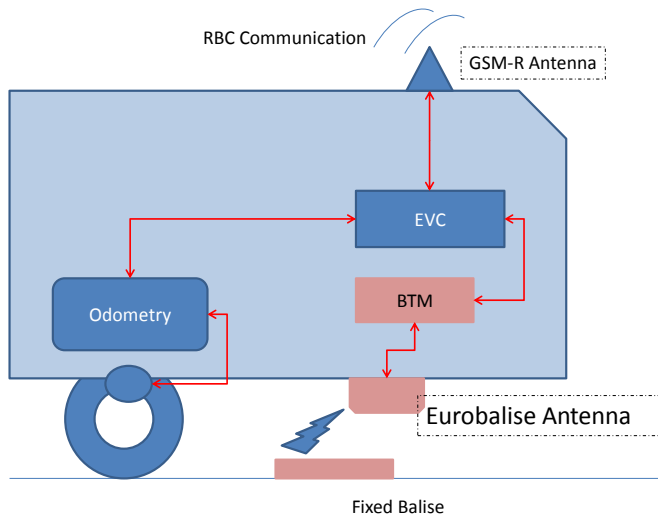
Decommissioning of legacy systems as requested by EC

ERSAT Program: ERTMS + SATELLITE

- Conceived in 2012 to enhance the **ERTMS standard**

- Contribution to the **Game Changer** innovation

    - Satellite positioning

    - Bearer-independent telecoms

    2 of the 4 Game Changers included in the ERSAT Program

- 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**

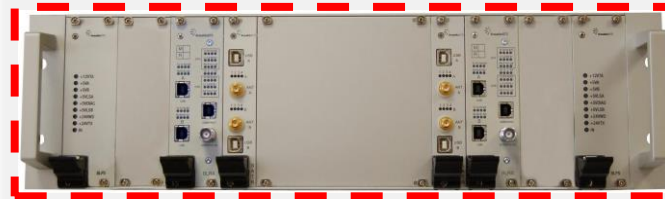- Expectations that EGNOS be a ***Service o ERTMS*** with support from EC, GSA, ESA and ESSP

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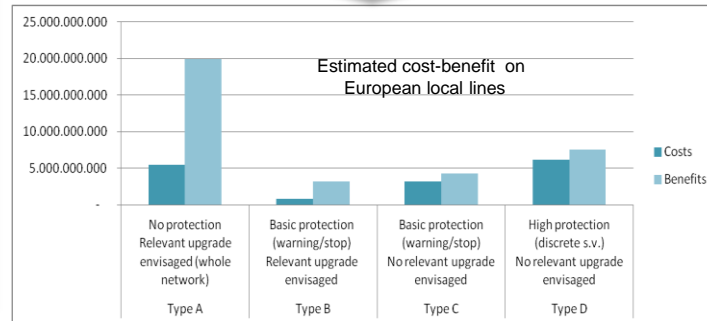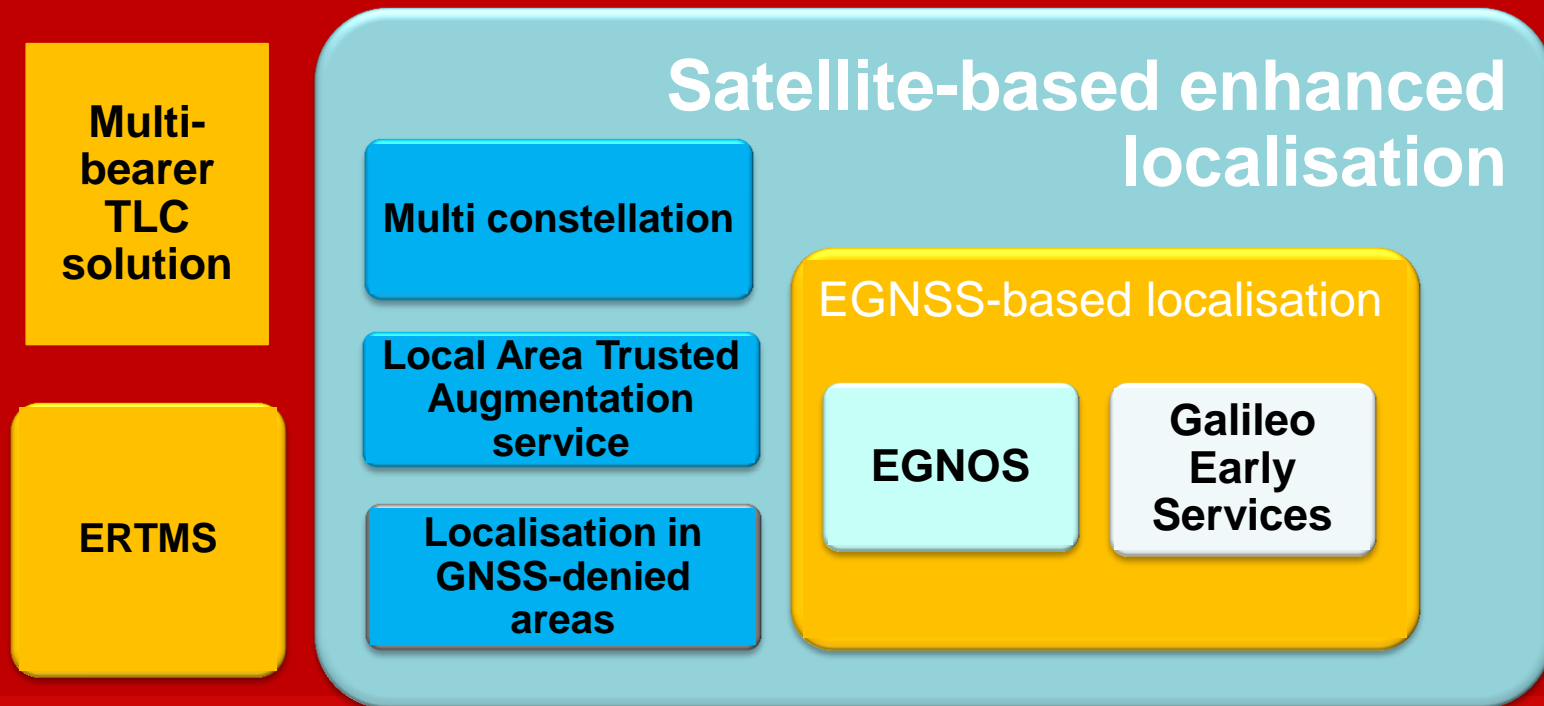**RETE FERROVIARIA ITALIANA**
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Game Changing

ETCS

RBC Communication

GSM-R Antenna

EVC

Odometry

BTM

Eurobalise Antenna

Fixed Balise

__AS-IS__

EGNSS

__TO-BE__

Estimated cost-benefit on European local lines

25.000.000.000			
20.000.000.000			
15.000.000.000			
10.000.000.000			
5.000.000.000			

■ Costs
■ Benefits

No protection Relevant upgrade envisaged (whole network)	Basic protection (warning/stop) Relevant upgrade envisaged	Basic protection (warning/stop) No relevant upgrade envisaged	High protection (discrete s.v.) No relevant upgrade envisaged
Type A	Type B	Type C	Type D

Ref: CBA Grail-2, Bocconi University

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Sardinia Test Bed

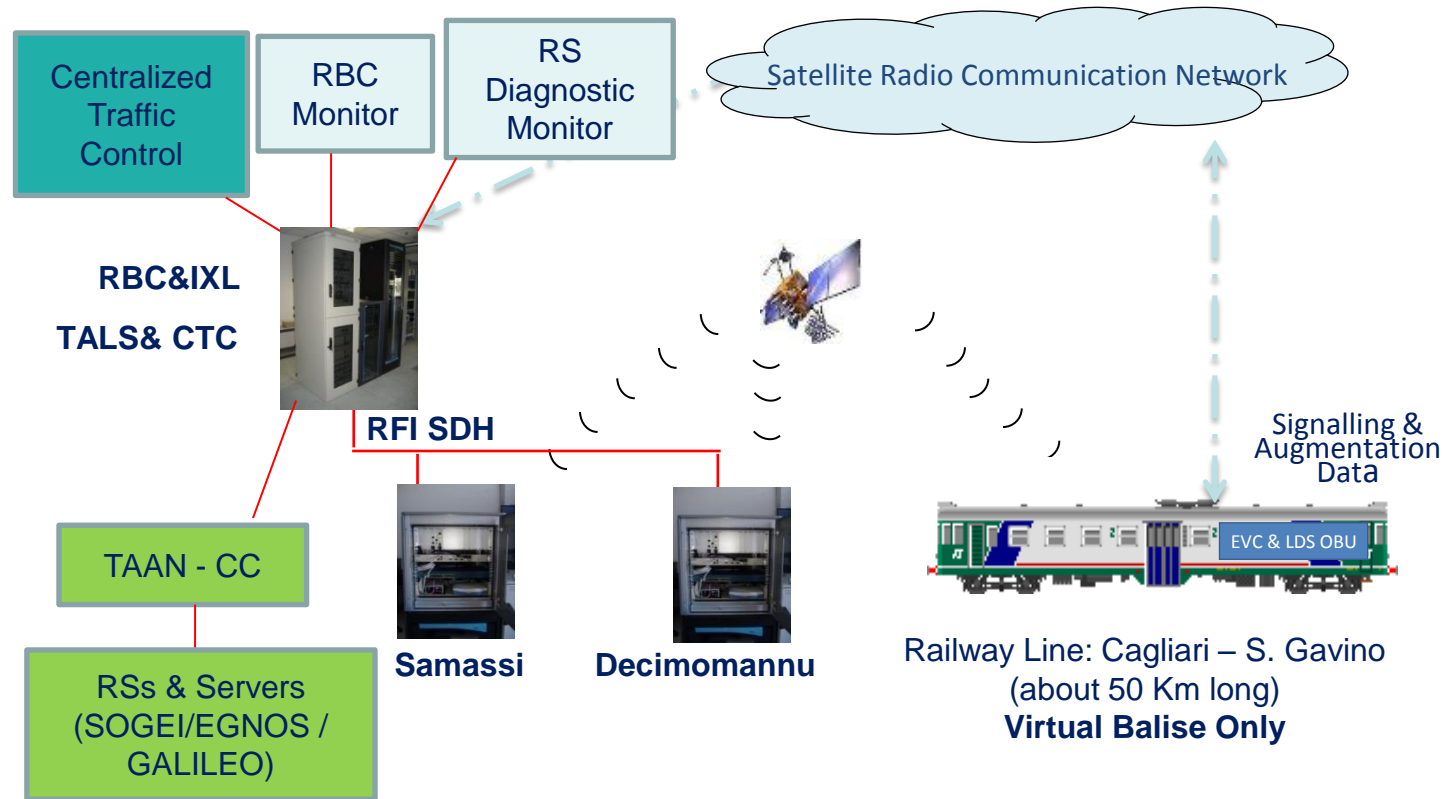

Double-Track

Trackside Subsystem:

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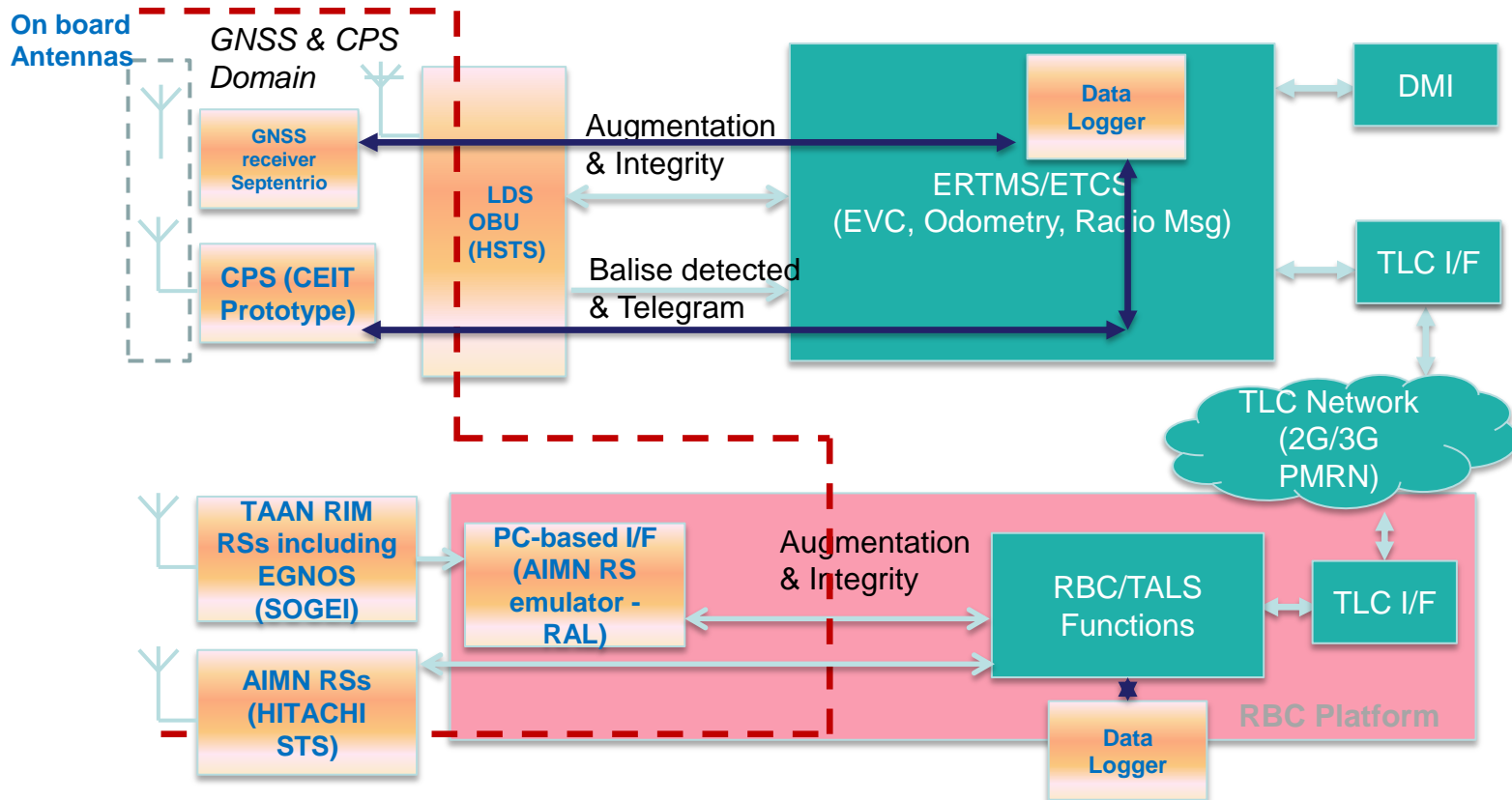- Public Augmentation Network SOGEI GRDNet (GNSS R&D Network): RTK/NRTK technology

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

Centralized Traffic Control

RBC Monitor

RS Diagnostic Monitor

Satellite Radio Communication Network

RBC&IXL

TALS& CTC

RFI SDH

TAAN - CC

RSs & Servers (SOGEI/EGNOS / GALILEO)

Samassi

Decimomannu

EVC & LDS OBU

Signalling & Augmentation Data

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

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ERSAT EAV INTEGRATION WITH ERTMS

ERSAT PROGRAM

	2013	2014	2015	2016	2017	2018	2019	2020

3inSAT
GNSS & Satcom Signalling Demonstrator

2013-2016 *Feasibility Study*
esa

ERSAT EAV + GGC
ERTMS Application + Test Site

2015-2019 *Trial Site & Standardization*
GSA

DB4RAIL
Antispoofing and Antijamming technology

2017-2019
esa

SAT4Train
TLC Application

2017-2019
esa

Technology readiness

Gate4Rail
GNSS Virtual Test Bed

2018-2020
Shift2Rail

SBS phase 2
Technology Demonstrator

2018-2020
esa

Commissioning

PILOT LINE
Pinerolo - Sangone

2017-2020
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Roadmap to certification & operational activation

ERTMS L2 baseline 3

Pinerolo Sangone line

Activation of ERTMS L2
+ GNSS
+ Local Augmentation
Network

**Activation –
December**

Implementation ERTMS L3
+ GNSS
+ IP Based Public TLC

**L3 Impl. –
Nov**

| 2017 | | | 2020 | 2021 | 2022 | 2023 |

**Preparatory
activities**

Selection of Train and
Logistic elements for
deploying local
Augmentation Network

**Preparatory
activities**

Upgrade to ERTMS
+ GNSS
+ EGNOS Based SBAS

**ERA target
window for
upgrade of TSI**

**Readyness –
Sep 25**

Activation ERTMS L3
+ GNSS
+ IP Based Public TLC

**Cooperative effort involving
Rail & Satellite community**

Activities underway

Role of GSA-ESA-ESSP

☞ *Satellite asset to comply with ERTMS certification process*

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Certification Process agreed with ERA

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

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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.
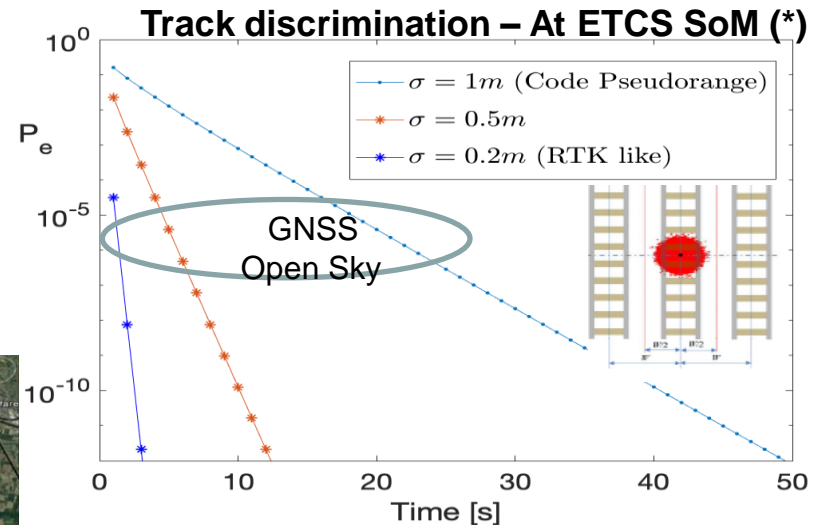
Authorization must take account of the ERA approval (art 19 new Interop Directive).

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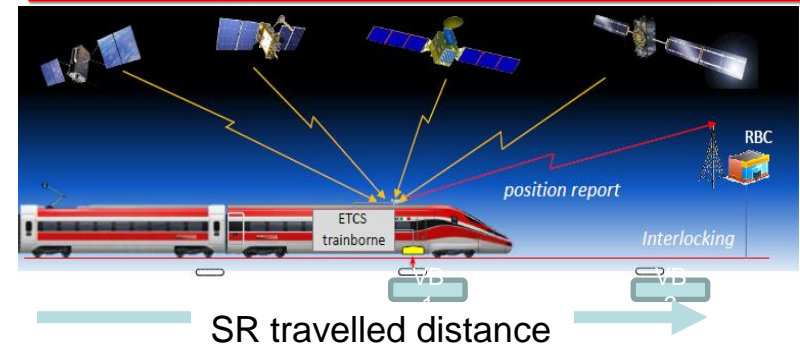GRUPPO FERROVIE DELLO STATO ITALIANE

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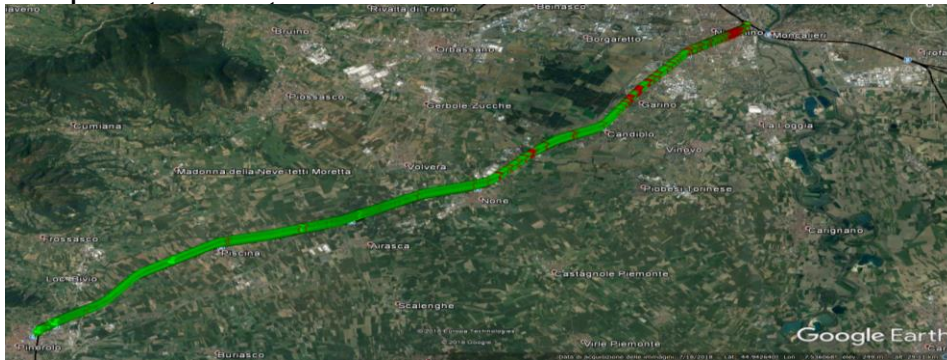
RFI is interested in the results of EU projects, as well as technological and market trends (DCMF, Non GNSS Sensors, Data Fusion) to extend current performances also in GNSS denied zones.

Track discrimination – At ETCS SoM (*)

Legend:
- $\sigma = 1m$ (Code Pseudorange)
- $\sigma = 0.5m$
- $\sigma = 0.2m$ (RTK like)

GNSS Open Sky

Reduce SR travelled distance at Start Of Mission

SR travelled distance

PHYSICAL
BALISE

VIRTUAL BALISE
LOCATION

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**

Roy Hill - Australia

Summary

- 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 <u>to first validate & certify</u> 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

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Thank you

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

Co-funded by the Horizon 2020 programme of the European Union

ERSAT GGC

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