“The ERSAT Galileo Game Changer”
Summary

- Regional lines and GNSS for a new CCS Standard
- ERSAT GGC
- Risk Management and Pilot Line
- Trenitalia contribution and Field Test Results
- Opportunities for Railway Undertakings
- Trenitalia expectations from ERSAT
Regional lines and GNSS for a new CCS Strategy

- **ETCS L2**
  - LFI Arezzo-Stia
  - Arezzo-Sinalunga

- **IXL+CTC+ETCS L2**
  - STA Merano-Malles

- **IXL+CTC+ETCS L3 Pilot line**
  - Avezzano-Roccasecca

- **ETCS L3 + GNSS + ATO Pilot line**

- **ETCS L2/L3 + GNSS Pilot line**
  - Pinerolo-Sangone

- **ETCS L2 + GNSS Trial Site**
  - Cagliari-S.Gavino
# What has been done – ERTMS on Satellite Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Year Range</th>
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<tbody>
<tr>
<td>3inSAT GNSS &amp; Satcom Signalling Demonstrator</td>
<td>2013-2016</td>
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<tr>
<td>ER SAT EA V + GGC ERTMS Application + Test Site</td>
<td>2015-2019</td>
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<tr>
<td>DB4RAIL Antispoofing and Antijamming technology</td>
<td>2017-2019</td>
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<tr>
<td>SAT4Train TLC Application</td>
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<tr>
<td>SBS phase 2 Technology Demonstrator</td>
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<td>PILOT LINE Pinerolo - Sangone</td>
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ERSAT GGC - A unique european team

Primary goals of ERSAT GGC are to launch an operational line by 2020, the same year GALILEO services will be operational and to contributing the standardization process at European level for including the satellite requirements into the new ERTMS TSI.

- 22 satellites launched
- Initial operational services “on”
- 12 additional satellites in production
- 4 satellites per year until 2020
ERSAT GGC - project planning

| WP1 | Project Coordination and Management |
| WP2 | Enhanced ERTMS Spec and Architecture |
| WP3 | Safety and Hazards Analysis |
| WP4 | Track Survey and Track Classification |
| WP5 | Assessment of Enhanced ERTMS architecture and of Survey process and related toolset |
| WP6 | Demonstration |
| WP7 | Exploitation and Dissemination |

<table>
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<tr>
<th>2017</th>
<th>2018</th>
<th>2019</th>
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<tr>
<td>Quarter 4</td>
<td>Quarter 1</td>
<td>Quarter 2</td>
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</table>
Activated **First Formal Certification Process in Europe** for using GNSS & Public Telecom as primary communication infrastructure in ERTMS platform

- **Preliminary Hazard Analysis**
  - Sept. 2015

- **User Requirements**
  - June 2016

- **RFI Report on Risk Management**
  - Jun. 2017

- **NoBo Assessment**
  - Sept. 2017

- **Sharing of Risk Management Report & NoBo Assessment**

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CE 402/2013 Regulation - **Coordinator of technical committee & Responsible for Authorization Request to ANSF**: RFI

**Team of external experts**: Ansaldo STS, Radiolabs, Sogei, Telespazio

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1st UIC GLOBAL CONFERENCE ON SIGNALLING MILAN 2018 26-28 March The Evolution of ERTMS
Working Group to support the certification process
Pilot Line *Pinerolo-Sangone* - Roadmap

2017
- **Selection** – Oct 12
  - Selection of Train Set and Logistic elements for deploying local Augmentation Network

2020
- **Activation** – Nov 29
  - Activation of ERTMS L2 + GNSS + Local Augmentation Network + IP Based Public TLC

2021
- **Upgrade** – Nov 21
  - Upgrade to ERTMS L3 + GNSS + EGNOS Based SBAS

2022
- **Implementation**
  - Implementation ERTMS L3 + GNSS + IP Based Public TLC
  - New Annex A TSI CCS

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

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ERSAT to modernizing regional lines:
Great opportunity for a lot of Passengers!

Passengers per day
+2 million by train

Every day
+8,500 trains
Trenitalia contribution on ERSAT

- Rolling Stock
- Engineering (V&V, field-tests, design)
- Train Driver
- Maintenance

Next step: Tests with 2 rolling stocks contemporary active in the pilot line
Preliminary Field Test Results

10,000 km of field test – 22,000 generated Virtual Balises

The expected value of GNSS Position Average Accuracy per train run is less than +/- 3 meters

Std Dev: <4m (GPS); <2m (Galileo)

Control Command System performed different tests, all >95% passed

- Expected Delivered vs Planned Virtual Balises per train run
- Correct Sequence of Provided Virtual Balises per train run
- Virtual Balise Groups detected inside Expectation window per train run
- Train Position Confidence Interval
Integration with Satellite and Virtual Balise: An opportunity for the Railway Undertakings

1. **Increase in the Availability** of the OnBoard Signalling System

*Now: 46 events/MLNkm* of unreliability of Signalling System due to failures of balises, problems with the on-board antenna, cable connections....

on whole regional network would mean → 46 x 156 MLNkm/year ~ 7176 events/year (20 per day)

*With ERSAT: The Virtual balise eliminates malfunctioning related to the detection of the physical balises*
Integration with Satellite and Virtual Balise: An opportunity for the Railway Undertakings

2. **Increase of reliability** of Signalling System

**Now:** Problems related to on-board odometry (slipping/sliding wheel), already experienced in ERTMS

**With ERSAT:** Integration of satellite improve the accuracy of the odometry in condition of low adhesion rail/wheel

**RUs benefits** from the following savings:
- Savings in **energy** and **time** for unnecessary braking
- Savings for time spent at **starts of mission**
Multipath TCP communications

Seamless bearer independent connectivity using public networks
State of the art of Transmission Control Protocol allows connection to use multiple paths to maximize resource usage and increase redundancy.

Multipath TCP is particularly useful in the context of wireless networks. Different bearers (GSM 3G/4G/5G mobile networks, Wi-Fi, Tetra, Satellite…) links may be added or dropped as the train moves in or out of coverage without interrupting the end-to-end TCP connection.

Same technology can be used also to aggregate multiple mobile network operators increasing overall bandwidth.
Trenitalia: long term expectations from ERSAT

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 ERTMS system **on secondary lines and urban nodes**.

5. **Minimize Impact** on **Operational Rules**.
Thank you
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