GNSS for Train Control Systems
Showcase ERSAT EAV and RHINOS projects

EU – Japan GNSS Mission, Tokyo 8 March 2017
Francesco Rispoli
Background

Ansaldo STS expertise on GNSS & Satcom technologies for train control solutions
Paradigm shift

- Ad hoc wayside infrastructures
- Opex «independent» from train traffic

Use of public networks
Opex «depending» on train traffic
Impact of new technologies with ERTMS L2

Service-based packages in the supply chain

What If implemented on 28,000 km - 20% of European regional lines - NPV → 2 billion Euro
Benefit/Cost Ratio 1.42 *

* University Bocconi – ERSAT EAV, excluding capacity gain in case a discontinuous system is considered
Virtual balise performance

Estimated front end

Odometer

Virtual Balise

Ref. NGTC WP-7

THR = 1.0E-9/hour

Lowering the confidence error, higher the potential traffic capacity
ERSAT: Ertms + SATellite

User Requirements

Main target areas
- Australia
- USA
- Russia
- Europe

User Requirements

Cost Benefit analysis

GNSS Measurement Campaign

Reference Architecture Design

Modelling & Simulation

ERSAT EA V Core Developments

EGNOS Application for Railway

Local Enhancement for Railway

Localisation in GNSS-denied areas

ERSAT EA V Core Developments

Case studies
- Germany
- Italy

Economic assessment for Europe

Impacts for other markets

Impacts on specific players

Contribution to UNISIG WG

Contribution to ERTMS standardisation

Dissemination & Exploitation

• Case studies
  • Germany
  • Italy
• Economic assessment for Europe
• Impacts for other markets
• Impacts on specific players
ERSAT EAV Consortium

Cagliari 24th February 2017
Field Tests on 50km Cagliari – San Gavino line

~ 22,000 virtual balises generated
Virtual balise accuracy – preliminary results

GPS + GALILEO

GPS Only

Stanford Diagram (1205 epochs)

Stanford Diagram (1150 epochs)

Ref ERSAT EAV project
Shared Public Au-Networks

Example of Local Augmentation Network with 5 Reference Stations for cadastral applications - SOGEI (Ministry of Economy) -

- Infrastructure’s sharing between different services
- Contribution to «federate» public networks

<table>
<thead>
<tr>
<th>Tracking Channels</th>
<th>120 channels</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>GPS: L2, L2P, L2C, L5</td>
</tr>
<tr>
<td></td>
<td>GLONASS: GLONASS: L1 C/A, L2P, L2C</td>
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<tr>
<td></td>
<td>Galileo: E1, E5a, E5b, E5a+b</td>
</tr>
<tr>
<td></td>
<td>SBAS: WAAS, EGNOS, GAGAN, MSAS</td>
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<tr>
<td>Measurements Quality</td>
<td>Very low noise GNSS carrier phase measurements (RMS&lt; 0.2 mm)</td>
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<tr>
<td>Fixed Ambiguities RTK positioning accuracy</td>
<td>10 mm + 1 ppm (horizontal) / 10 mm + 1 ppm (vertical)</td>
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<tr>
<td>Antenna</td>
<td>Standard Dome Margeline with Choke Ring Antenna</td>
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<tr>
<td>Interfaces</td>
<td>Ethernet Card, USB</td>
</tr>
<tr>
<td>Communication Protocols/Standards</td>
<td>NTRIP 2.0, RTCM 3.1</td>
</tr>
<tr>
<td>Measurements update rate</td>
<td>up to 50 Hz</td>
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Ref H2020 GSA ERSAT EAV project
Railway High Integrity Navigation Overlay System

- Multi Constellation
- SBAS and Local networks
- Standard interface
- ERTMS Mitigation techniques
- High integrity for land vehicles
Integrity architecture for railway use of GNSS
Integrity architecture for safety-critical applications

Rail & Automotive
- Similar operational environment
- Highest safety standard
- Regulated certification processes
- Technology’s synergy
“The goal of Rete Ferroviaria Italiana is to have the new technology approved and certified according to the standards dictated by the EUAR on a European-wide scale, and the ANSF on a national scale, with the first line being activated in Italy by 2020” *

* Press Release on ERSAT EAV Demo – 24th February 2017 - Cagliari, Italy
Conclusion

remarkable synergy potential is expected by exploiting GALILEO as complement to GPS and other constellations as QZSS

Geo Localized - high accuracy & integrity

Always connected using public telecom networks

Secure against cyber attacks

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