



GNSS for Train Control Systems

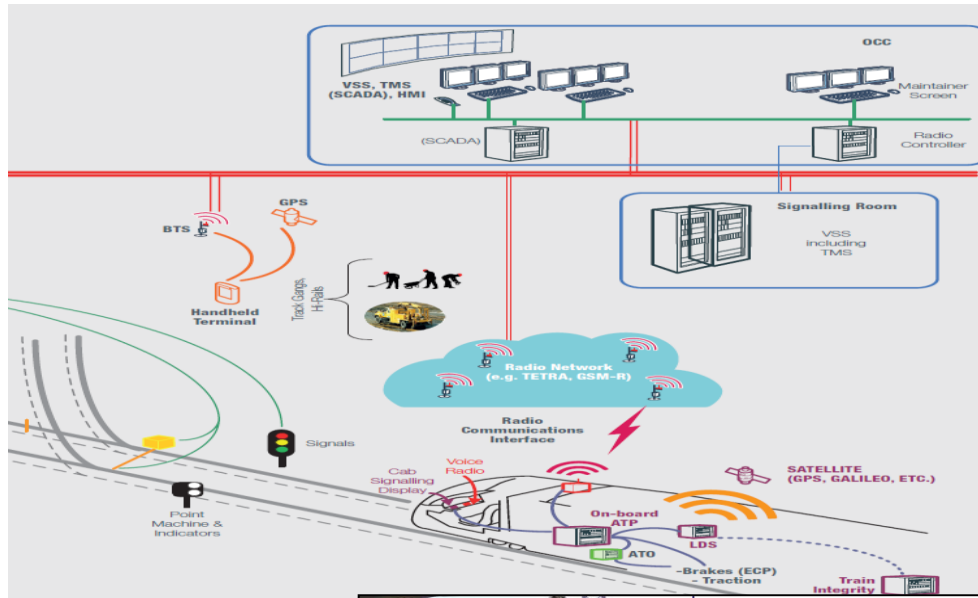
Showcase ERSAT EAV and RHINOS projects

EU – Japan GNSS Mission, Tokyo 8 March 2017

Francesco Rispoli

Background

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



GNSS



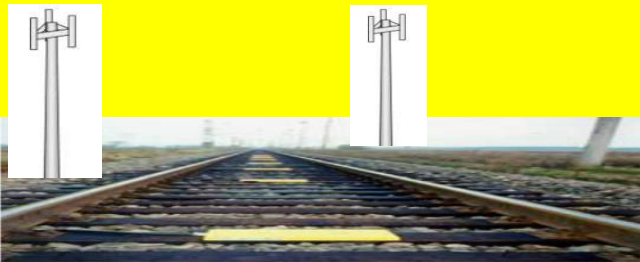
Satcom



GNSS + Satcom



Paradigm shift



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

Multi GNSS
Constellation

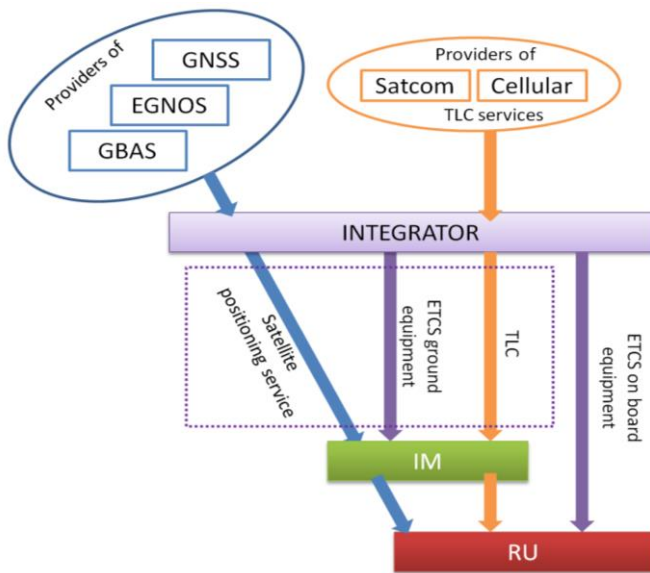
Multi bearer
public telecom



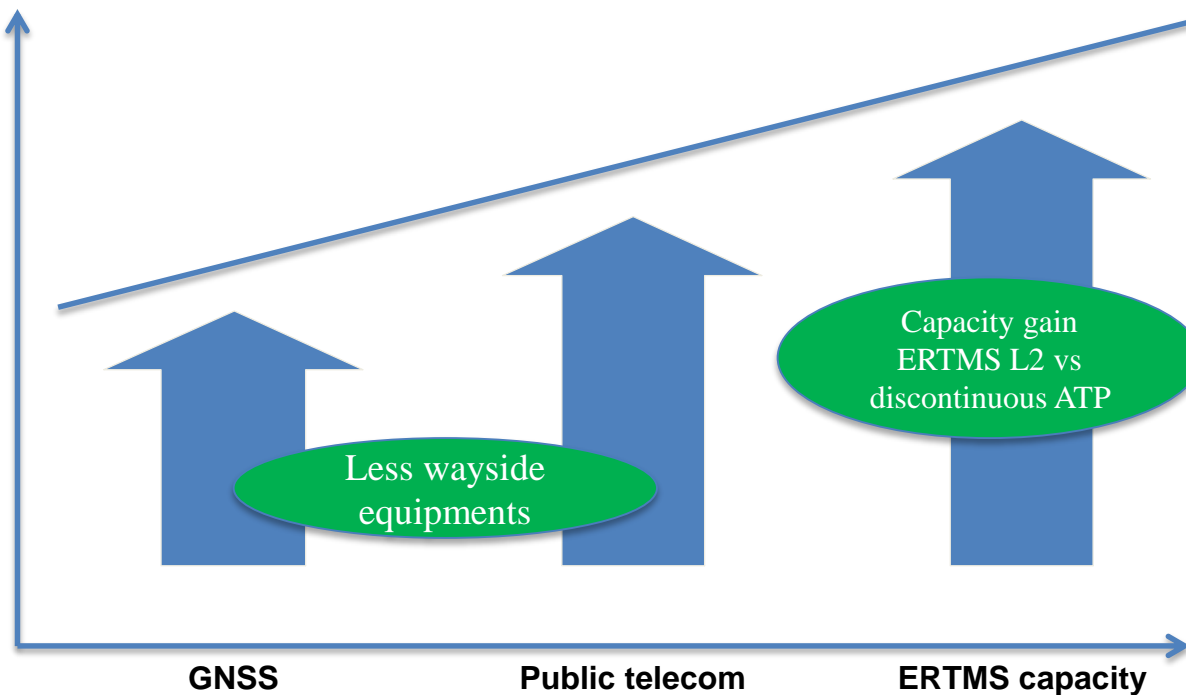
- Use of public networks
- Opex «depending» on train traffic

Impact of new technologies with ERTMS L2

Service-based packages in the supply chain

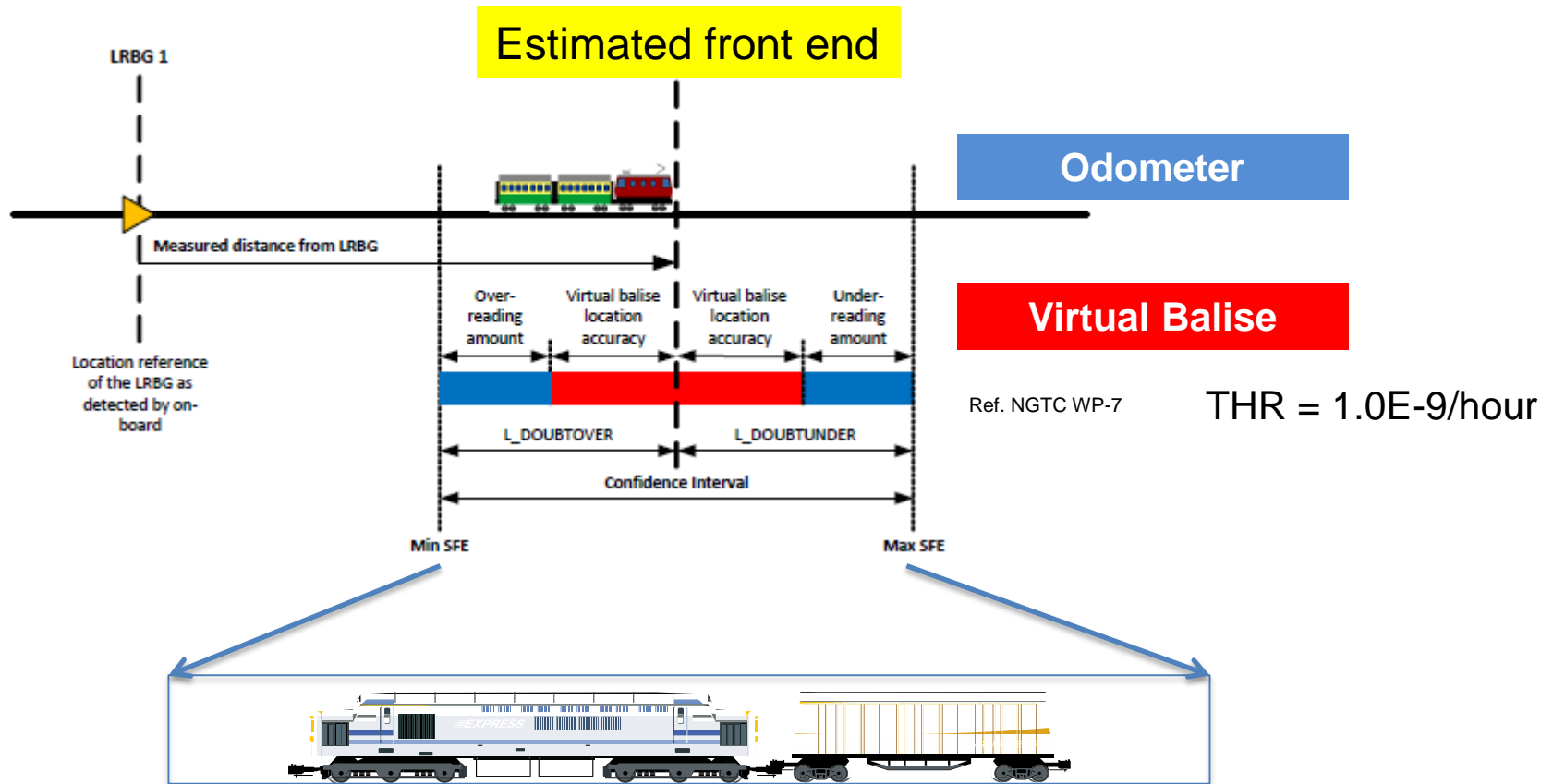


CBA



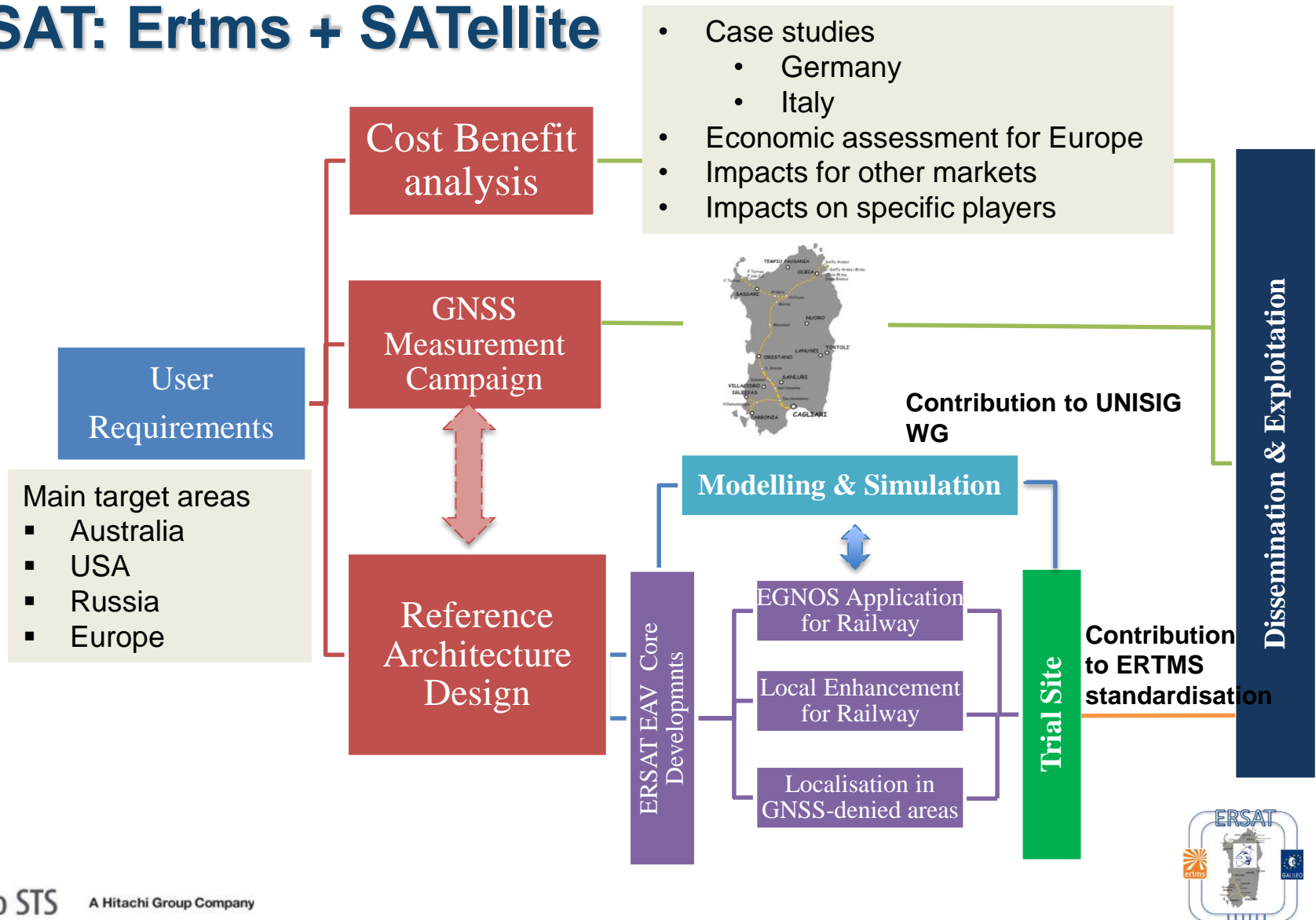
**What If implemented on 28,000 km - 20% of European regional lines -
NPV → 2 billion Euro
Benefit/Cost Ratio 1.42 ***

Virtual balise performance

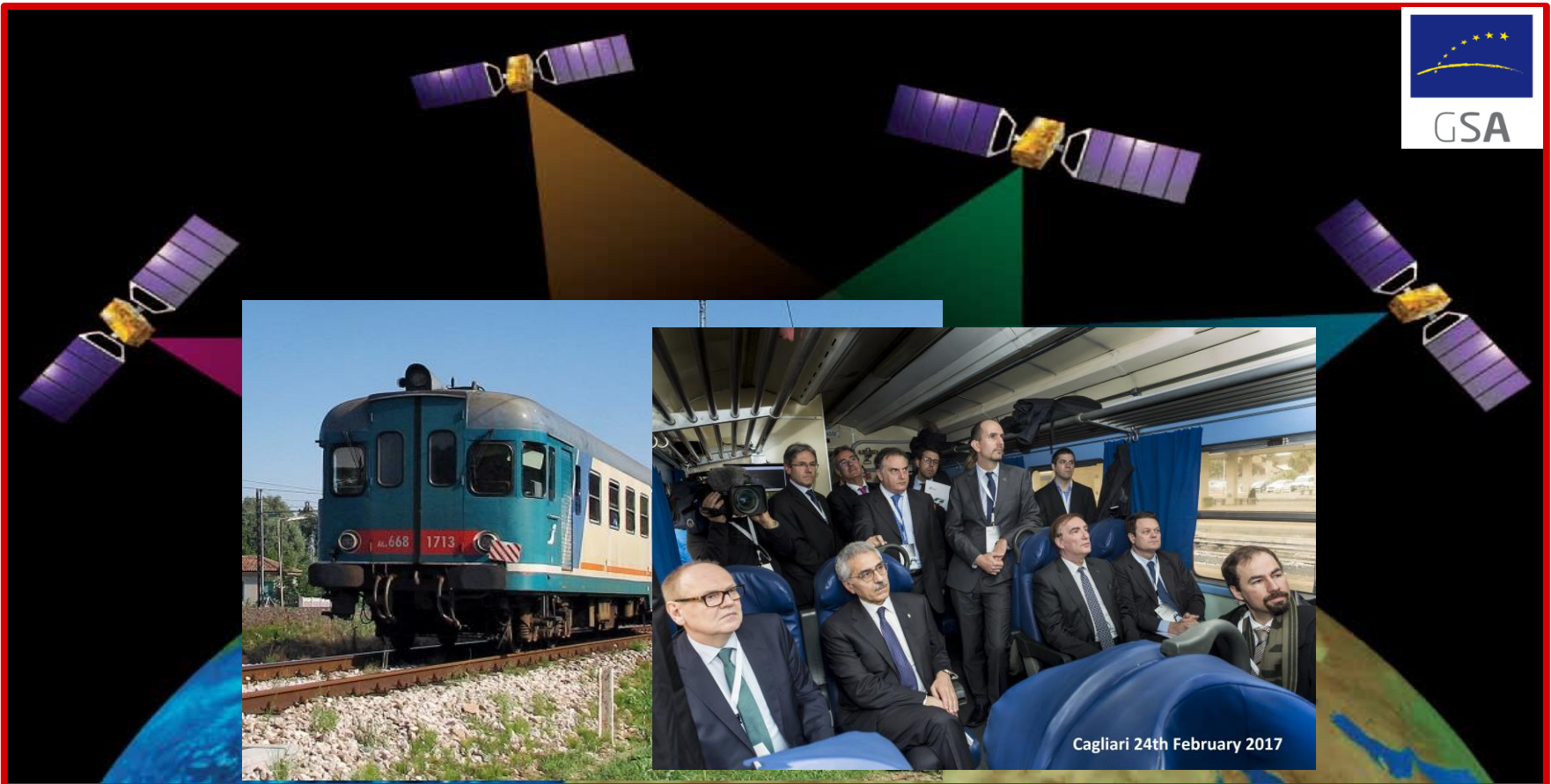


Lowering the confidence error, higher the potential traffic capacity

ERSAT: Ertms + SATellite

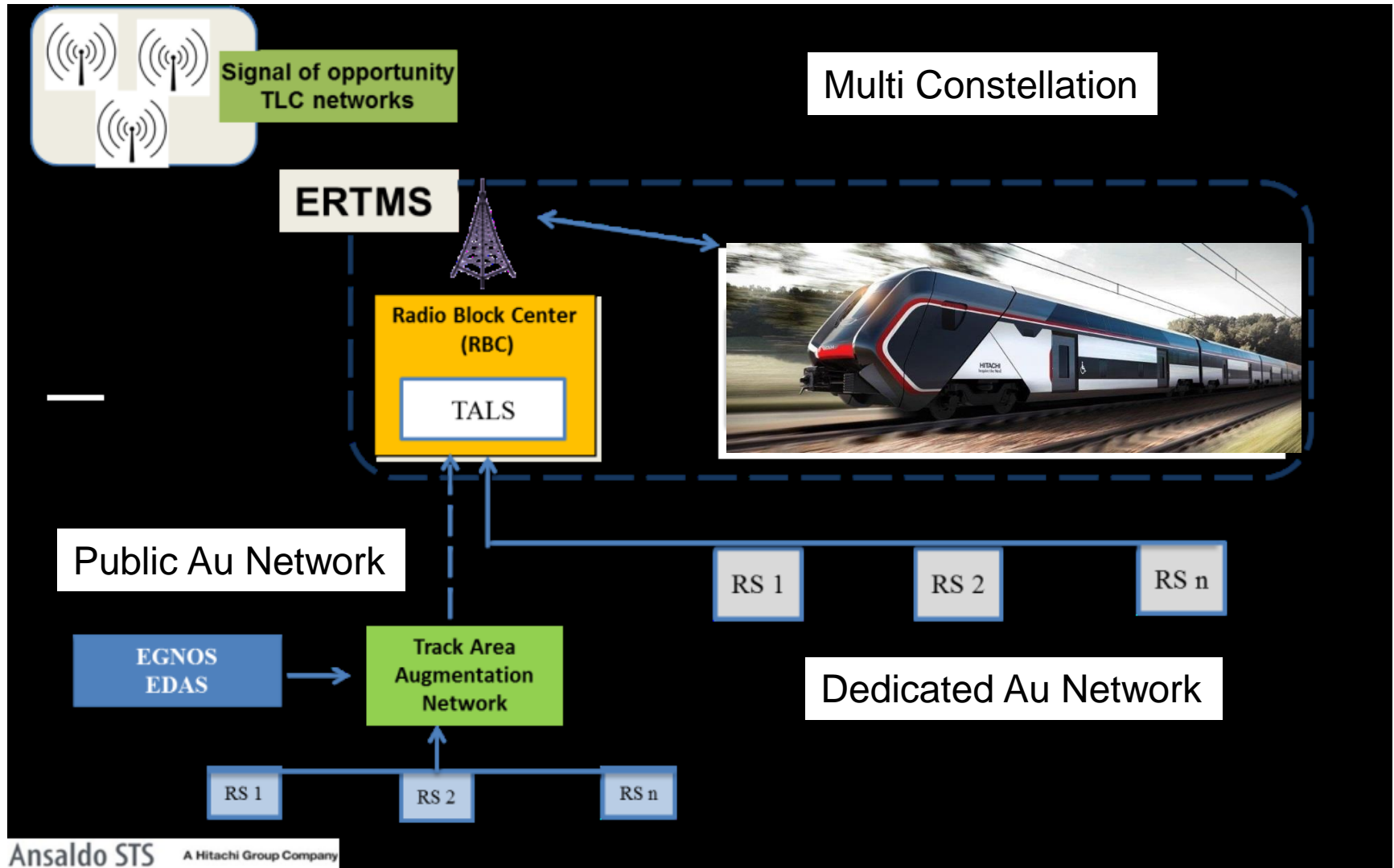


ERSAT EAV Consortium



Cagliari 24th February 2017

ERSAT EAV Reference Architecture



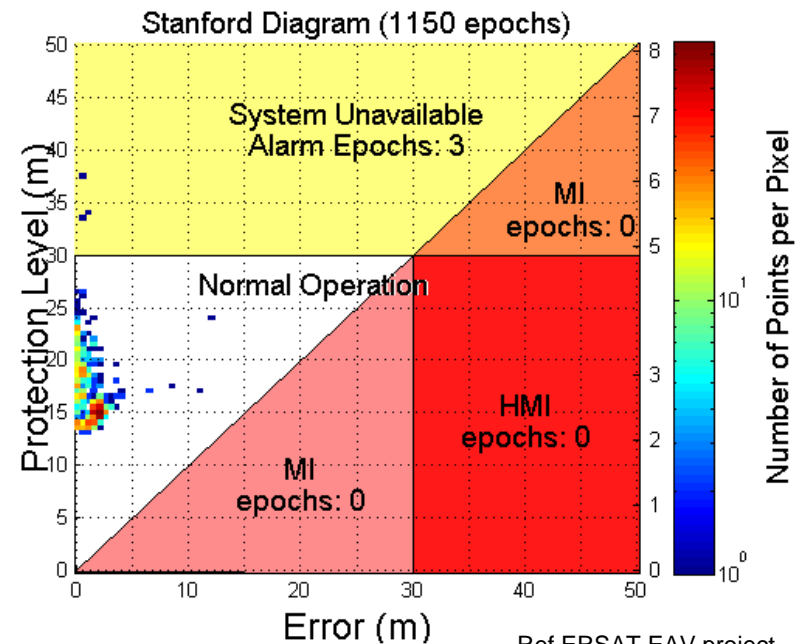
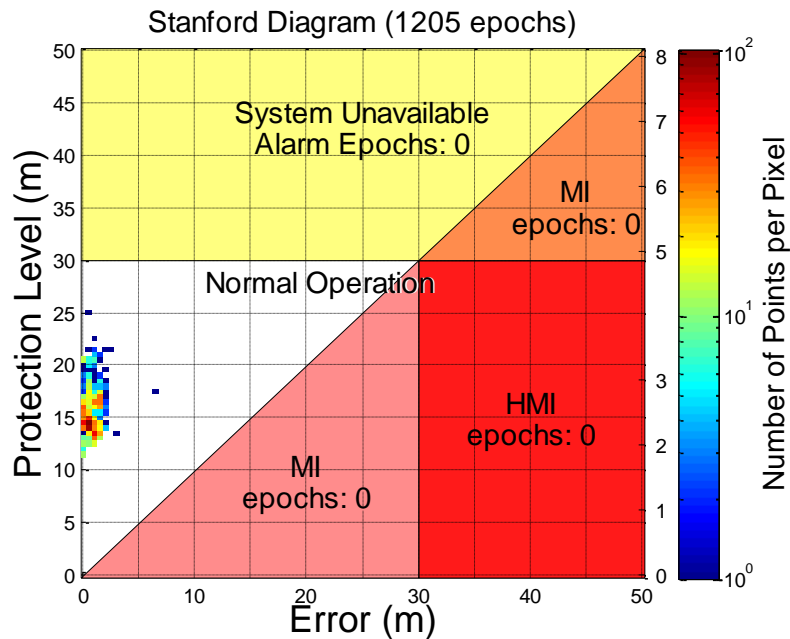
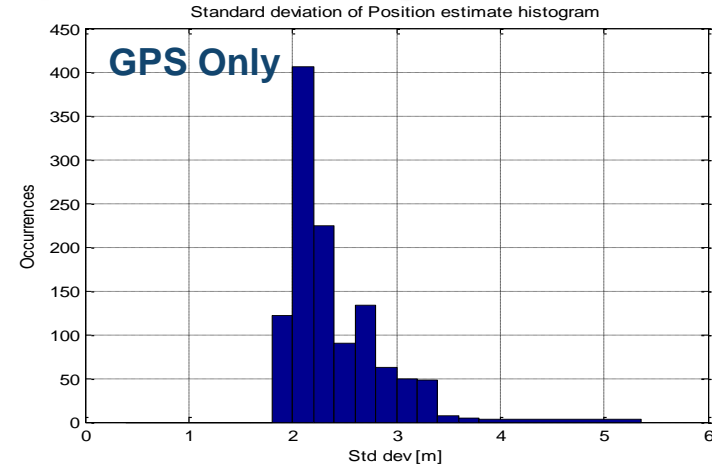
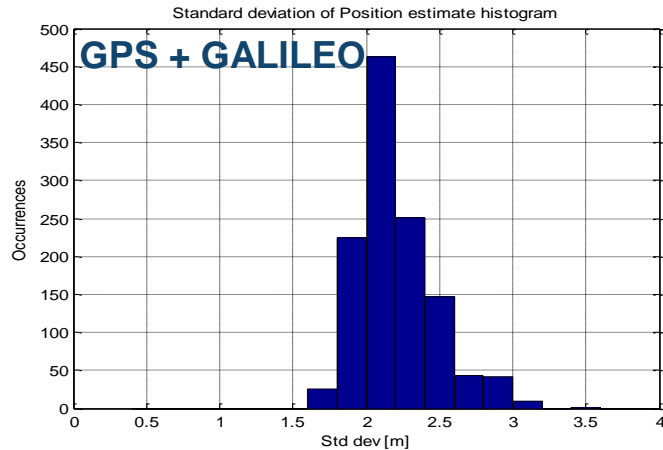
Field Tests on 50km Cagliari – San Gavino line



~ 22.000
virtual balises
generated



Virtual balise accuracy – preliminary results

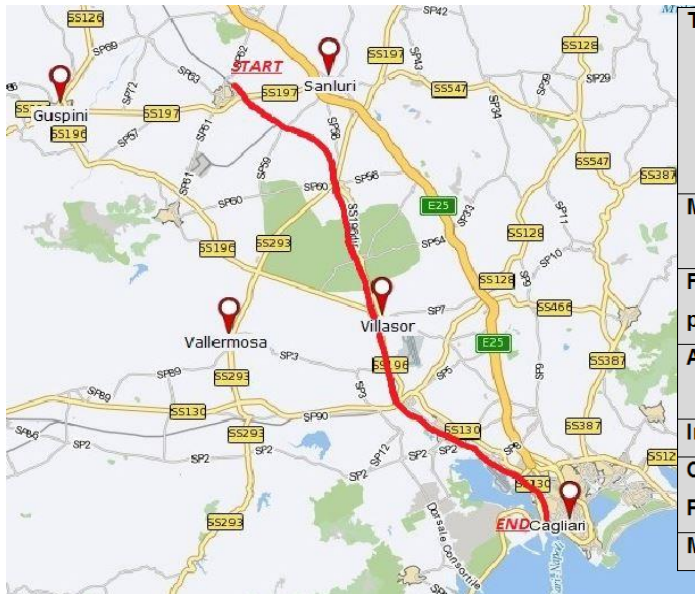


Shared Public Au-Networks

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



Tracking Channels	120 channels GPS: L2, L2P, L2C, L5 GLONASS: GLONASS: L1 C/A, L2P, L2C Galileo: E1, E5a, E5b, E5a+b SBAS: WAAS, EGNOS, GAGAN, MSAS
Measurements Quality	Very low noise GNSS carrier phase measurements (RMS< 0.2 mm)
Fixed Ambiguities RTK positioning accuracy	10 mm + 1 ppm (horizontal)/10 mm + 1ppm (vertical)
Antenna	Standard Dome Margoline with Choke Ring Antenna
Interfaces	Ethernet Card, USB
Communication Protocols/Standards	NTRIP 2.0, RTCM 3.1
Measurements update rate	up to 50 Hz

Ref H2020 GSA ERSAT EAV project

Railway High Integrity Navigation Overlay System

ERTMS

Global coverage
Backward compatibility
Business case

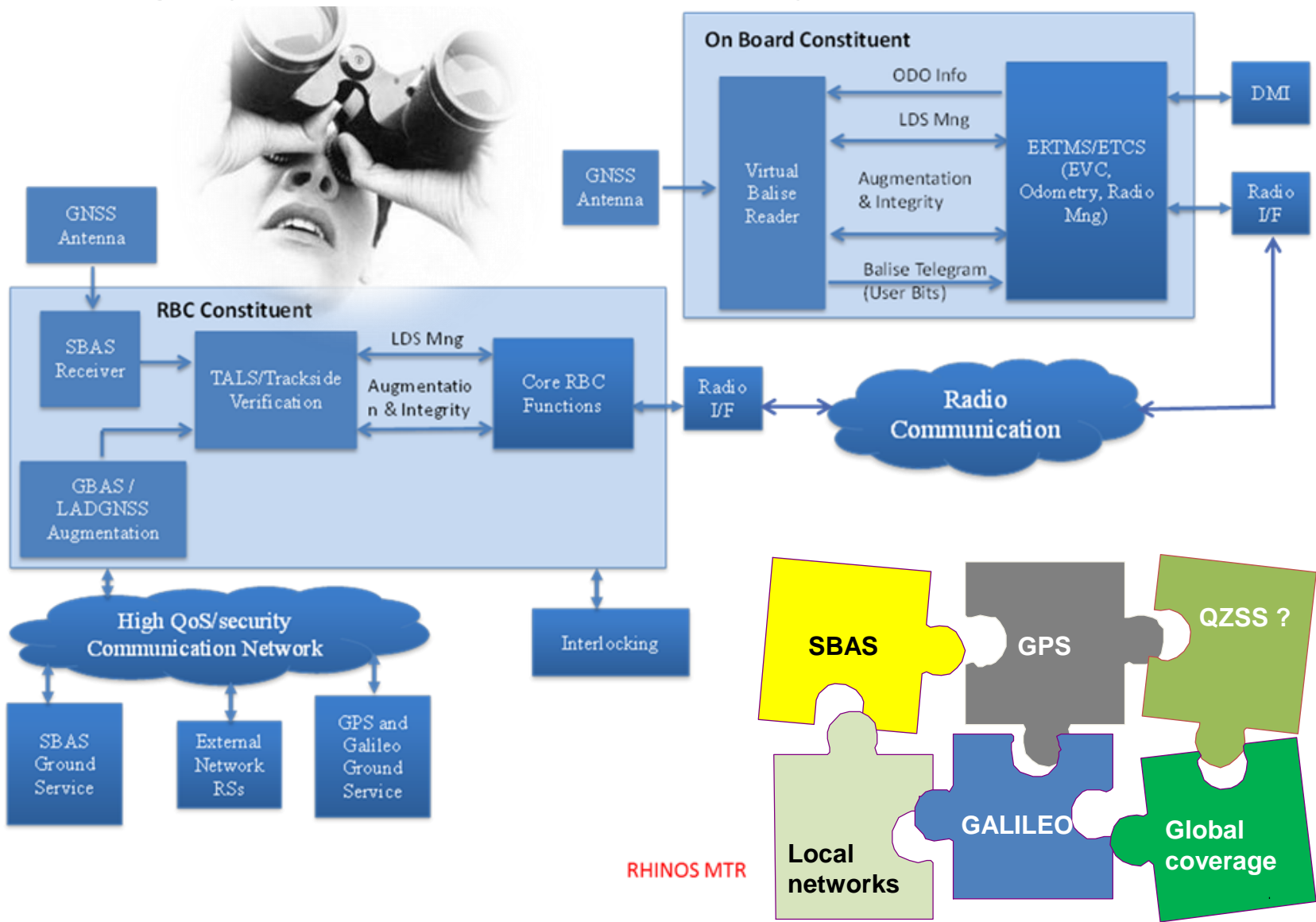
GNSS

SBAS
Local networks
Rail environment

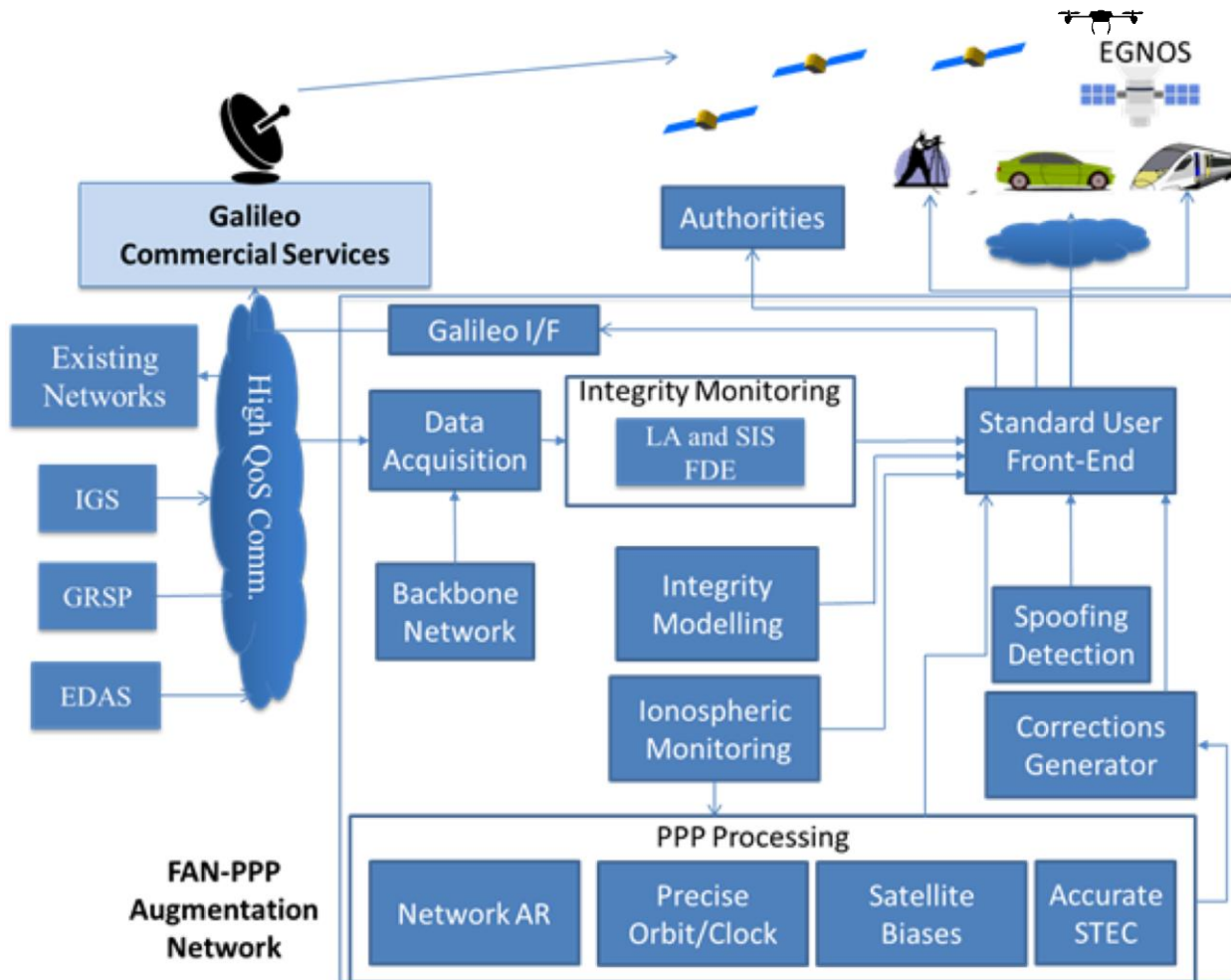
- Multi Constellation
- SBAS and Local networks
- Standard interface
- ERTMS Mitigation techniques
- High integrity for land vehicles



Integrity architecture for railway use of GNSS



Integrity architecture for safety-critical applications

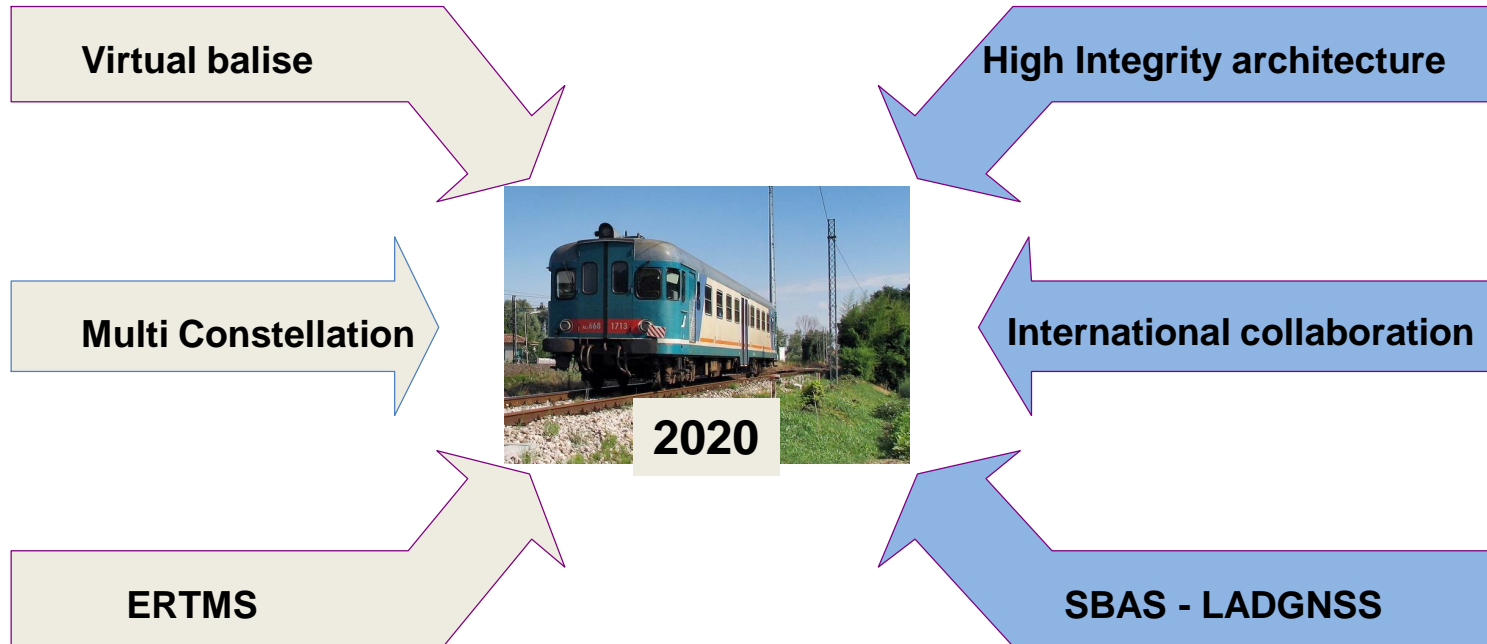


QZSS ?

Rail & Automotive

- Similar operational environment
- Highest safety standard
- Regulated certification processes
- Technology's synergy

ERSAT EAV - RHINOS



*“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

**CHANGE
AHEAD** ↗

Geo Localized - high accuracy & integrity

Always connected using public telecom networks

Secure against cyber attacks

