Les bénéfices de la localisation par Satellites et des Télécom Publiques pour l'Evolution du Système ERTMS:
RETOUR D'EXPERIENCES DU PROJET ERSAT

Lille,16 Mars 2016

RAIL INDUSTRY MEETINGS

Ansaldo STS

A Hitachi Group Company

Francesco Rispoli

Ordre du jour

- GNSS références dans le monde: Etats-Unis, Chine, et Europe
- Un plan européen pour promouvoir la synergie entre GALILEO et ERTMS
- Résultats provisoires du projet ERSAT EAV
  - Le besoins de RFI, Trenitalia, DB Netz, ASSTRA
- Présentation sommaire du projet Pilote RFI pour contribuer à la certification et exploitation en Italie

GNSS on global train signalling market

USA: PTC train control mandatory by a Federal Law (2008) → GPS based solutions preferred choice by majority train operators, biggest Investments ever made on train control ~ 11 B$ → Route miles ~ 55,600, No. Loco ~ 22,900

China: early adopter GPS-based solution for low traffic line (Tibet, 1550 km). Recent plans announced to massive developments based on GPS-BEIDOU for regional networks (~ 50,000 km) but also on high speed lines.

Europe: ERTMS world success with installation on ~10,000 locomotives, 47,000 route-miles and 50% sales outside Europe → GNSS is strategic for improving ERTMS competitivity.

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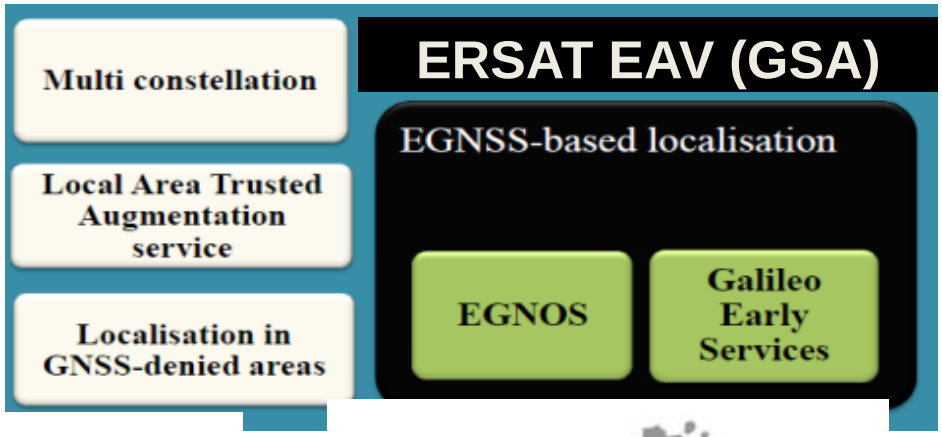
2011

ERSAT: ERtms on SATellite

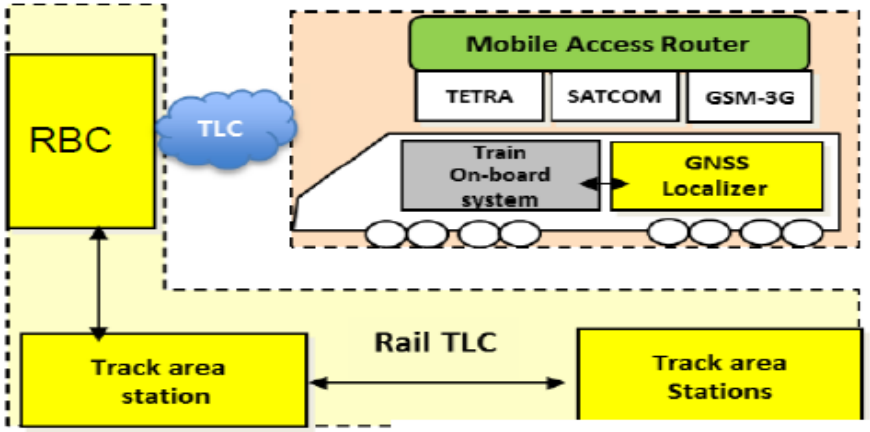
2011	2012	2013	2014	2015	2016	2017	2018

Local & Regional Lines

RFI-Trenitalia, DBNetz



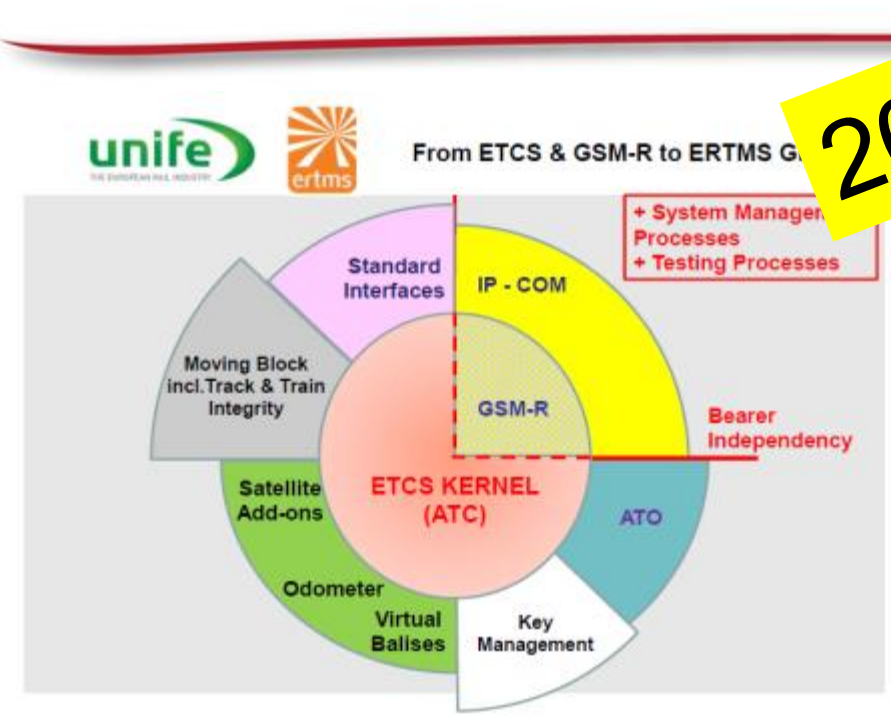
3InSat (ESA)



Pilot Line

ERTMS Regional with Virtual Balise & Bearer independent TLC

ERTMS evolution towards satellite



With the use of satellite technology in the development of existing ERTMS, following targets are expected to be achieved:

- **Train integrity**
- **Virtual balise and odometer**
- **Hybrid TLC**

The functionality of "**Train Integrity**" is **mandatory** for the introduction of the **ERTMS level 3** (increase of 40% of transport capacity) removing track circuits with considerable economic benefits.

Adopting ERTMS level 3, the train is able to establish independently its position and integrity to **optimize lines capacity**.

TRENITALIA
GRUPPO FERROVIE DELLO STATO ITALIANE

Extract from Trenitalia presentation at the ERSAT Workshop on February 12th 2016

European Railway Agency
An agency of the European Union

2015

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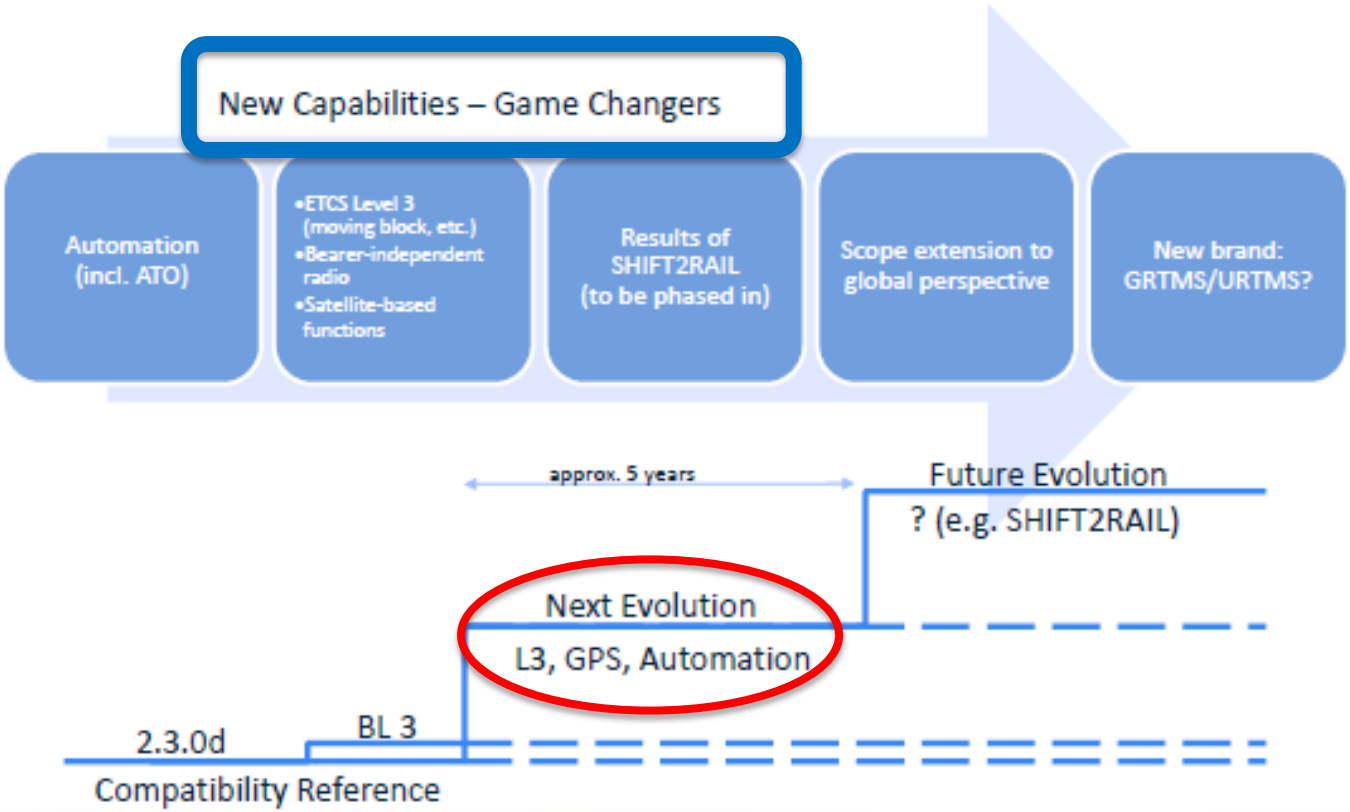
Future Evolution of ERTMS and Roadmap



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Extract from ERA presentation , **Lille 22-23 September 2015**

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ERSAT EAV overview

User Requirements

Main target areas
- Australia
- USA
- Russia
- Europe

Cost Benefit analysis

- Case studies
  - Germany
  - Italy
- Economic assessment for Europe
- Impacts for other markets
- Impacts on specific players

GNSS Measurement Campaign

Contribution to UNISIG WG

Reference Architecture Design

ERSAT EAV Core Developmnts

Modelling & Simulation

EGNOS Application for Railway

Local Enhancement for Railway

Localisation in GNSS-denied areas

Trial Site

Contribution to ERTMS evolution standardisation

Dissemination & Exploitation

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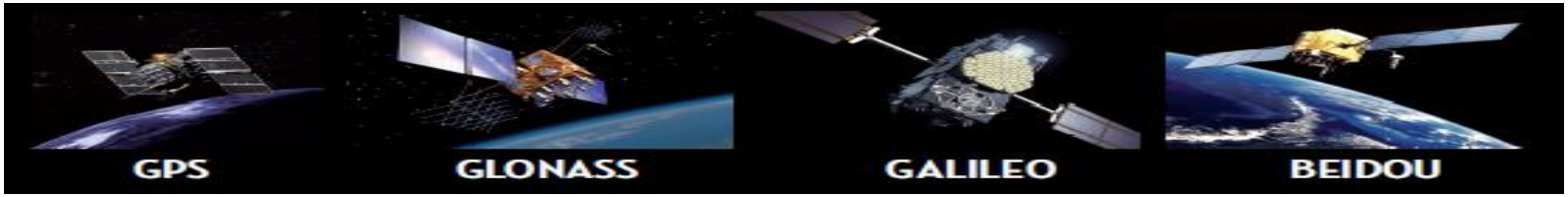
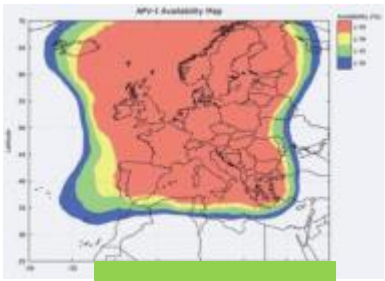
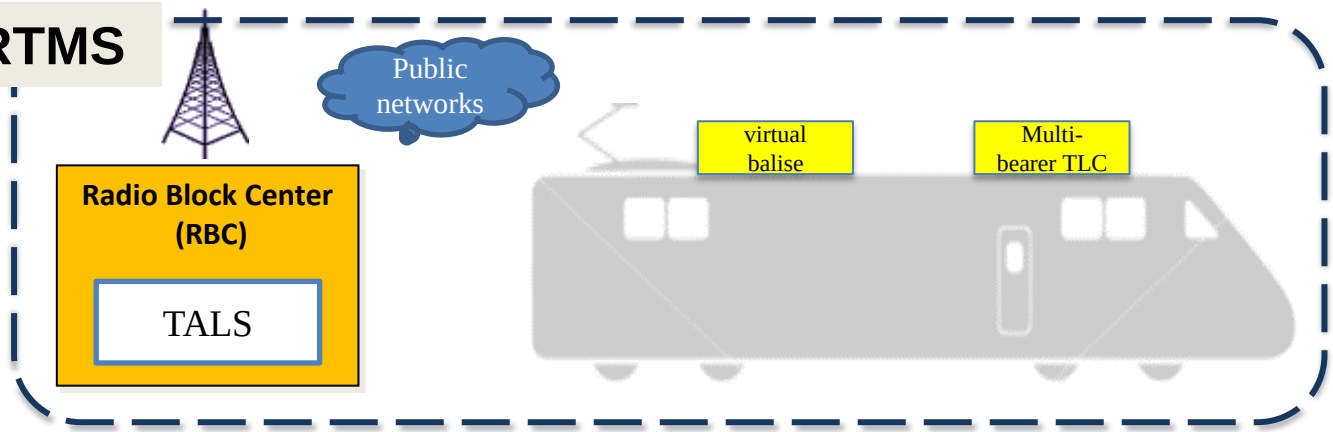
ERSAT EAV Architecture





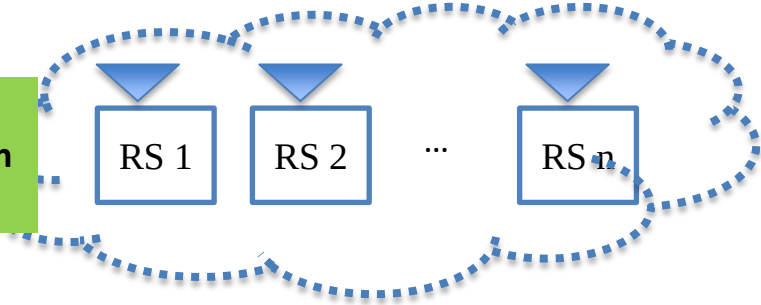
EGNOS

ERTMS

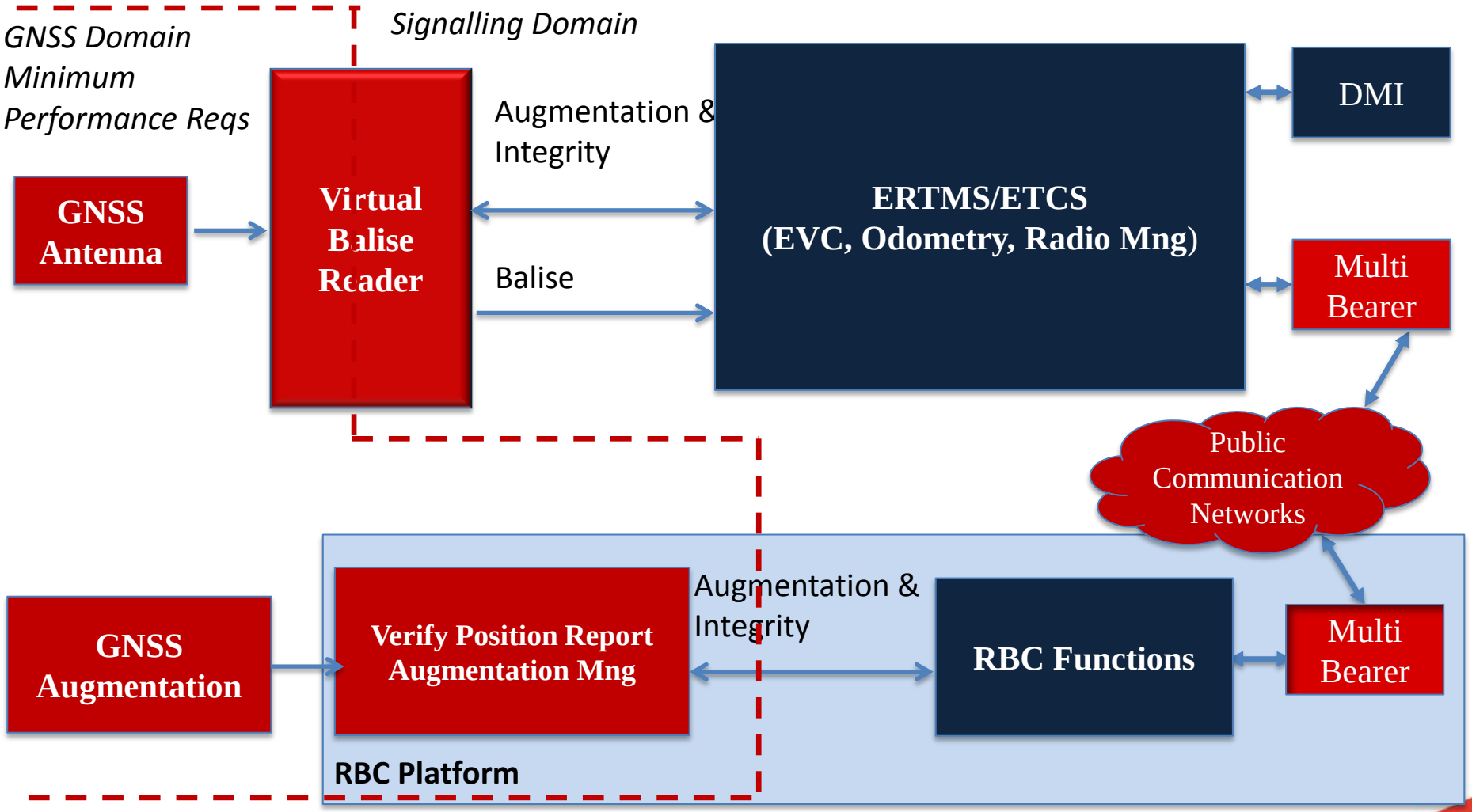


Signal of opportunity TLC networks

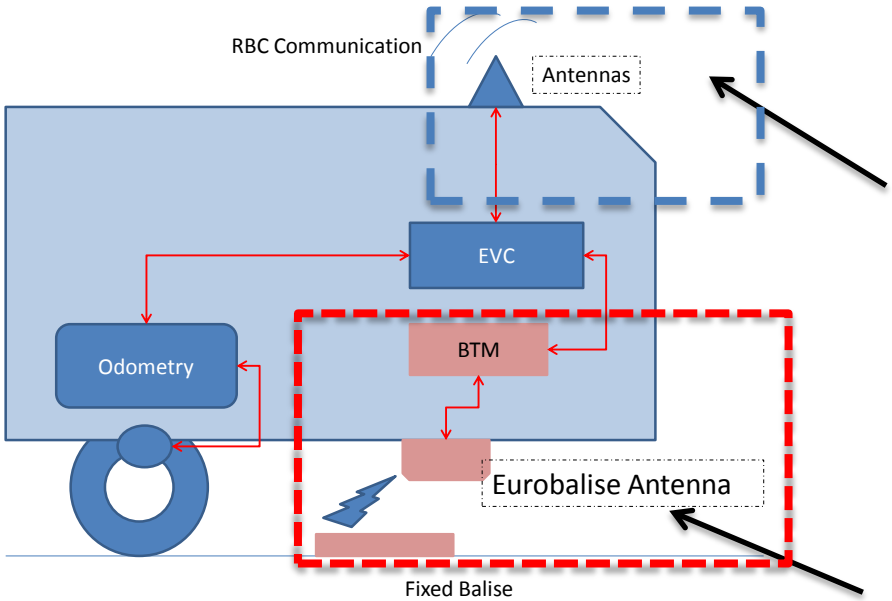
Track Area Augmentation Network

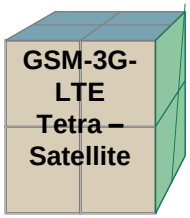


ERTMS with GNSS & Public telecom



Architecture on board





Multi-bearer TLC system capable of ensuring the Quality of Service required by ETCS, using public networks (ie cellular-satellite) and and inter-operable with GSM-R.

Virtual Balise Reader

A **safe localization system** provides the so-called **virtual balises** according to the requirements and interfaces provided by ETCS.

IP-based communications and **Virtual Balise** in order to:

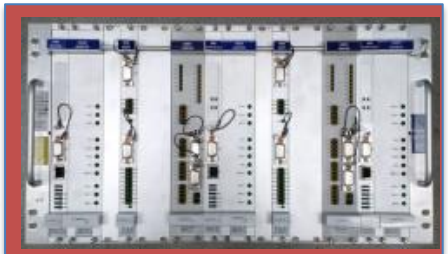
- Reduce costs
- **Increase the accuracy of odometry**
- Develop a competitive product on the international market

Main constituents of Trial Site

50 Km

GNSS Antenna

Virtual Balise Reader



ERTMS/ETCS
(EVC, Odometry, Radio)

DMI

Radio I/F

Public Communication Network

Radio I/F

TALS & RBC Functions

Peripheral Post I/F

IXL Functions

GNSS Antenna

Reference Station

Communication Network

Existing CTC

Ansaldo STS

GNSS blueprint !

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First Movement Authority based on GNSS Localization !

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The Italian Rail Network

Lines classification related to the traffic development

(6%) **~ 1000 km** — **High Speed Network**

Command Control System : ERTMS/ETCS L2
Train spacing with radio block

(5%) **~ 950 km** — **Metropolitan Traffic Lines**

Command Control System : CTC, SCC, SCC-M
Train spacing with short block sections (High Capacity)

(18%) **~ 2.900 km** — **Fast Lines**

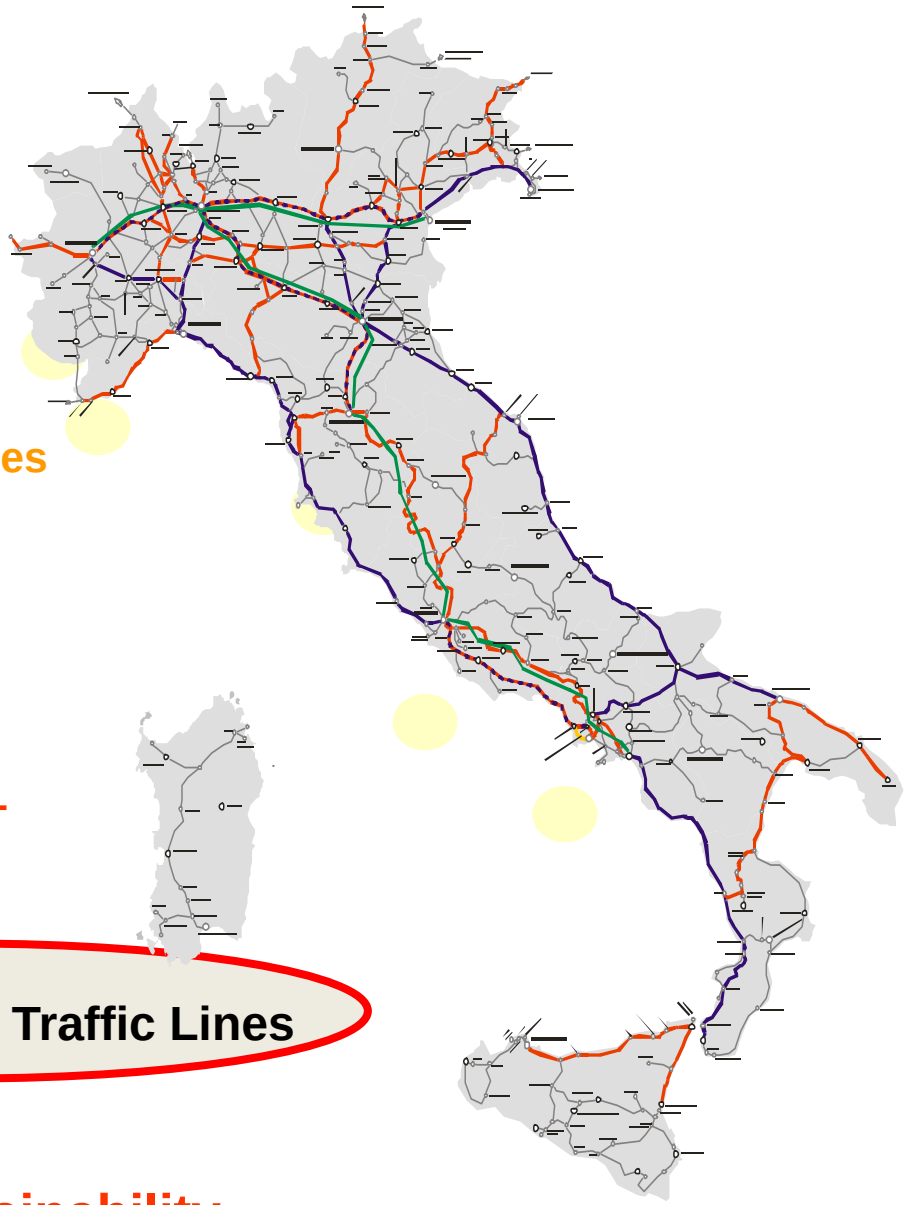
Command Control System : CTC, SCC
Train spacing with SCMT

(23%) **~ 3.900 km** — **Middle performances + Freight lines**

Command Control System : CTCev, SCC
Train spacing with block sections: SSC,SCMT

(48%) **~ 7.950 km** — **Subsidiary + Low Traffic Lines**

Command Control System : CTC
Train spacing with block sections: SSC



Economic Sustainability

RFI

Trenitalia expectations for regional and local rail lines

Passengers every day
More then 2 millions by train

Every day
More then 8.500 trains

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 ERMTS system **on secondary lines and urban nodes**

5. Minimize Impact on Operational Rules.

TRENITALIA
GRUPPO FERROVIE DELLO STATO ITALIANE

Extract from DB Trenitalia presentation at the ERSAT Workshop in Roma on February 12, 2016

DB Netz role & contribution on ERSAT EAV

~ 10,000 Km regional lines

WP2 Requirements

WP5- Impact & Sustainability Analysis

WP9: System Simulation

WP11: Test Review Analysis & Validation

RailDriVE® vehicle of DLR

Additional tests on a real regional line in Germany with challenging geographic conditions as complement to ERSAT EAV tests.

Extract from DB Netz presentation at the ERSAT Workshop in Roma on February 12, 2016

Local lines in France and Italy: results from ASSTRA analyses

France

CITTA'	AZIENDA	LUNGHEZZA RETE[km]
BORDEAUX	Keolis	42,1
BREST	Keolis	14,5
GRENOBLE	SEMITAG	40,3
NANTES	SEMITAN	44,4
STRASBOURG	CTS	53,8

- ~ 10,6 to 74,7 million passenger in 2013

Italy

Eight Rail companies: Ente Autonomo Volturno, Ferrovie Udine,-Cividale, Ferrovienord, GTT, ARST, Trasporto Ferroviario Toscano, SAD, Trentino Trasporti

- ~ **3560 Km** of lines (whose 2100 Km secondary lines mainly single track)

ERSAT EAV: Users & Rail-Satellite Stake-holders

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sogei

RFI RETE FERROVIARIA ITALIANA GRUPPO FERROVIE DELLO STATO ITALIANE

DB NETZE

TRENITALIA GRUPPO FERROVIE DELLO STATO ITALIANE

ASSTRA ASSOCIAZIONE TRASPORTI

ceit

RFI RETE FERROVIARIA ITALIANA GRUPPO FERROVIE DELLO STATO ITALIANE

ESSP

UNIVERSITÀ BOCCONI

DLR

TELESPAZIO A Finmeccanica / Alcatel Company

RadioLabs

Supporting partner

ANSF Agenzia Nazionale per la Sicurezza delle Ferrovie

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Stepping into certification process

RFI Coordinator of Technical Committee – Railway Risk Management for User Requirements – PHA

Preliminary Hazard Analisys

User Requirements

CE 402/2013 Regulation

First Committee in Europe for GNSS application in rail

Team: RFI, Ansaldo STS, Radiolabs, Sogei and Telespazio.

Output: Final Report for Railway Risk Management

Next step: Request of certification to ANSF with NoBo assessment

RFI RETE FERROVIARIA ITALIANA
GRUPPO FERROVIE DELLO STATO ITALIANE

ERSAT and ERTMS Regional - RFI

ERSAT (ERTMS Satellite) - Pilot Line in Sardinia:

Trackside:

ETCS L2 (by Virtual balise - GNSS Satellite application) + Euroradio over Public Bearer
Overlapping existing Class B and existing signalling system

Trainborne:

ETCS L2 +STM, Class B

Match ERTMS Evolution: Management of New CR

ERTMS Regional (Only ETCS L3) in a Low density Line

but using Virtual Balise

Trackside:

Interlocking+ CTC+ ETCS L3 (By Virtual balise - GNSS Satellite application) + Euroradio over Public Bearer

Trainborne

ETCS L3 + STM (optional)

Economical Sustainability

for Total Cost of Ownership (TCO) of the regional lines

RFI
RETE FERROVIARIA ITALIANA
GRUPPO FERROVIE DELLO STATO ITALIANE

Extract from RFI presentation at the ERSAT Workshop on February 12th 2016

Launch a Pilot Line

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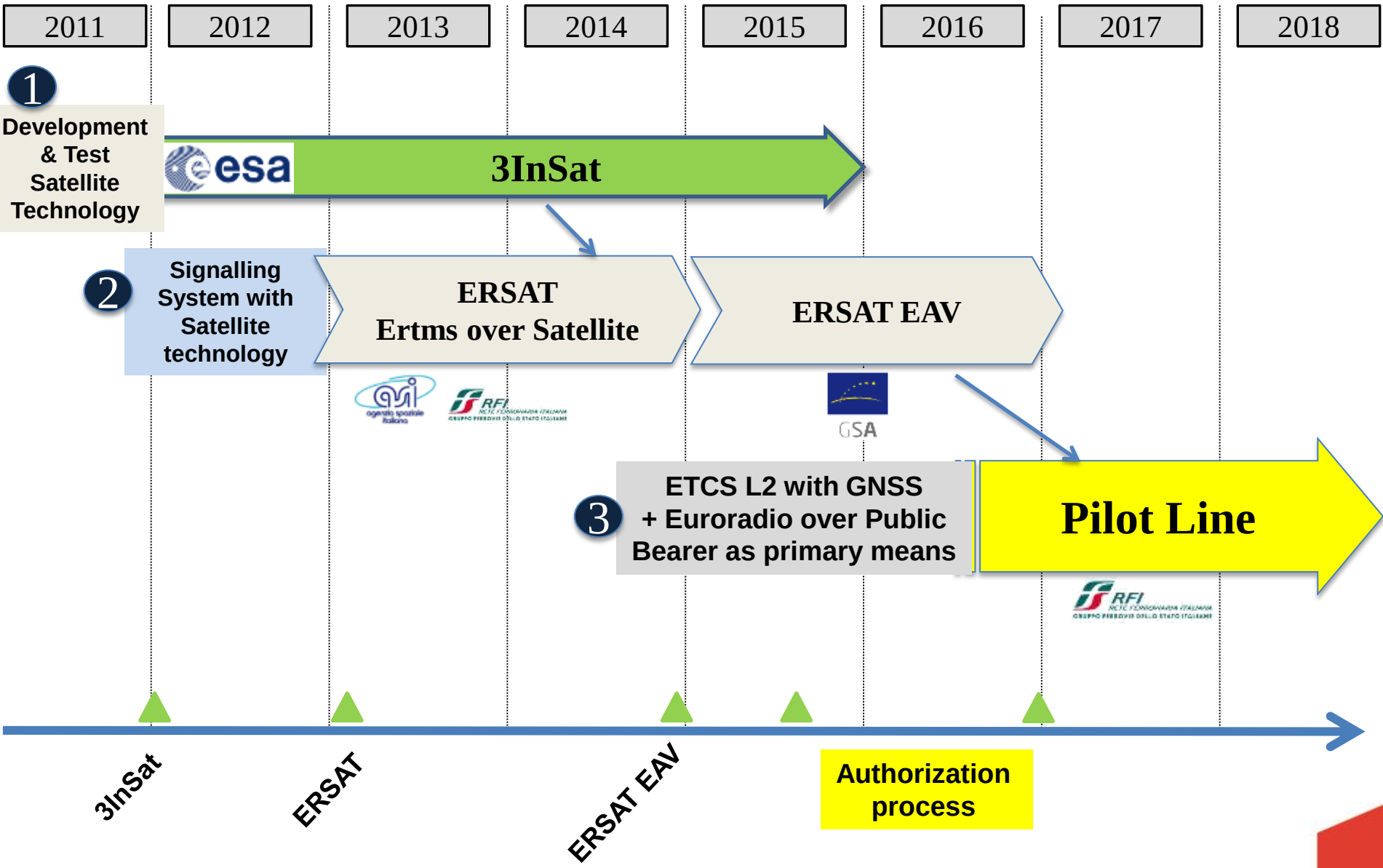

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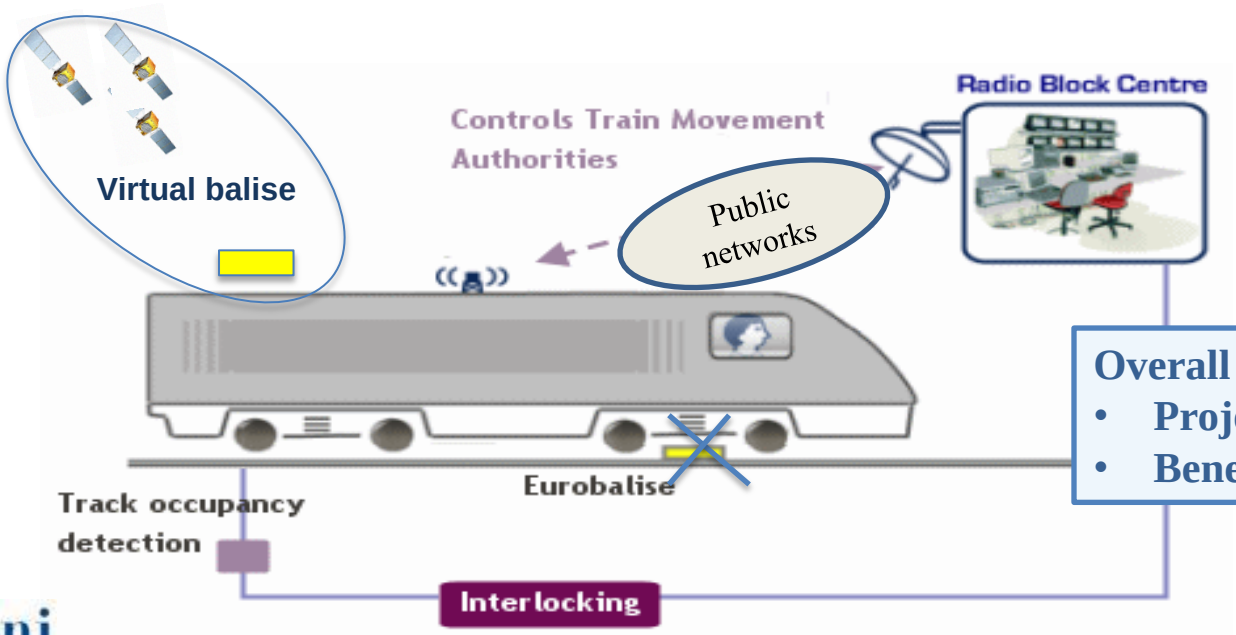
Expected impacts

→ the case of ERTMS on 30% local lines in Europe (~ 18,000 km)

~ 62% Opex reduction

~ 3.5M *Movement Authority* daily

GNSS & telecom services provisioning with SLA



Overall ERTMS system

- **Project NPV: € 1.2 bln**
- **Benefit/cost ratio: 1.40**

Bocconi Università Commerciale Luigi Bocconi

Reference ERSAT EAV University Bocconi preliminary assessment of the economic effects at the system level.

Other Potential impacts

Relevant savings in operating expenses: **-67% each year** compared to the traditional ERTMS → **Thus, it can contribute to the diffusion of ERTMS**:

→ In low density lines, where the low traffic and the deriving poor economics of the service generate the risk of **disruption of services** (forcing a shift to road which increases the generalized logistics cost by some € 0.1 per pax*km)

→ In local lines where safety standards are currently not SIL4, thus reducing the risks of accidents (which can be valued at about € 0.6 per 1000 pax*km), at lower costs (deriving **benefits in safety in Europe** = € 23 mln per year

→ In all lines where ERTMS is to be deployed, allowing the implementation of the «EcoDriving» concepts, which generates benefits for up to **€ 70 mln per year** in savings in energy consumption and braking equipment.

→ In **international markets** especially in remote and difficult to access areas

→ **In exploiting satellite assets** and creating a synergy with EGNOS-GALILEO

Reference ERSAT EAV University Bocconi preliminary assessment of the economic effects at the system level.

ERSAT EAV contribution to global roadmap

ERSAT Workshop
Roma, 12 February
2016

Carlo Des Dorides (executive director GSA) with Joseph Doppelbauer (executive director ERA) and Maurizio Gentile (CEO RFI)

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