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International collaboration

a model for integrated satellite and rail applications

Francesco Rispoli
Eu Affairs – satellite technology

EUSPACE
European Union in Space
JEAN MONNET MODULE

UNIVERSITÀ DEGLI STUDI DI GENOVA

Genova, 4-7-2019

Our Company - Hitachi

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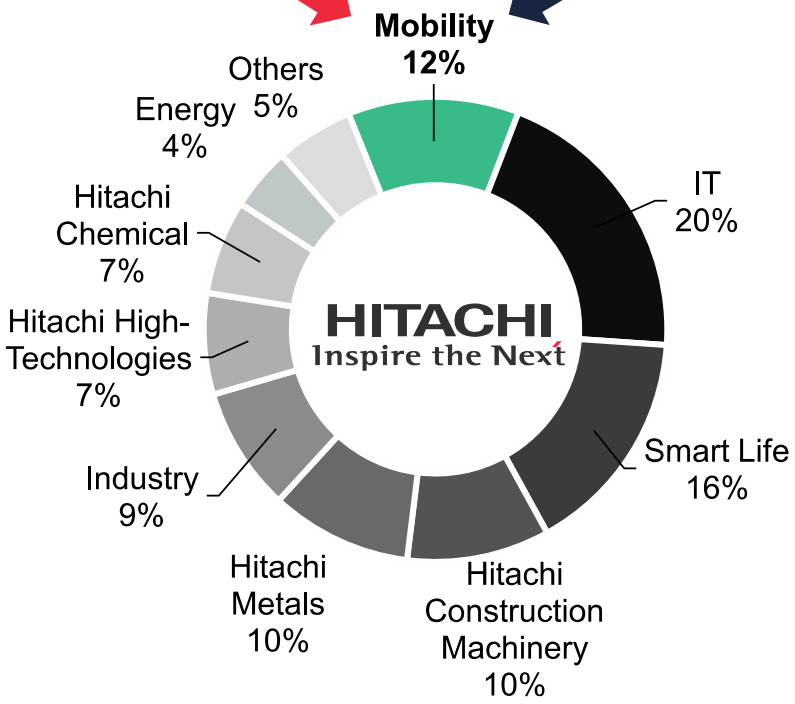
Railway Systems BU

Building Systems BU



Our Company – Railways Systems BU

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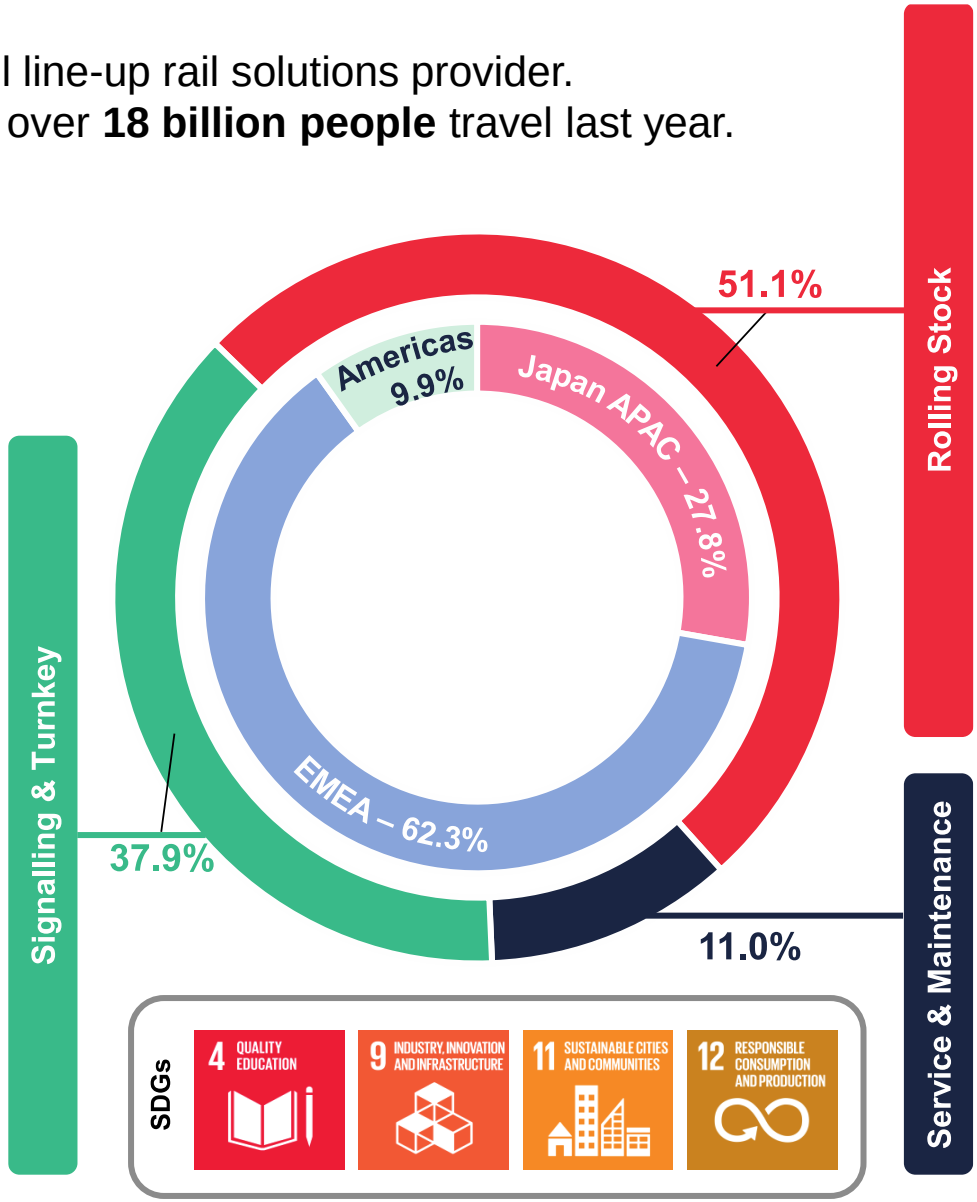
RSBU is a global, full line-up rail solutions provider.
Our products helped over **18 billion people** travel last year.



Worldwide Presence

Headquarters, plants and units

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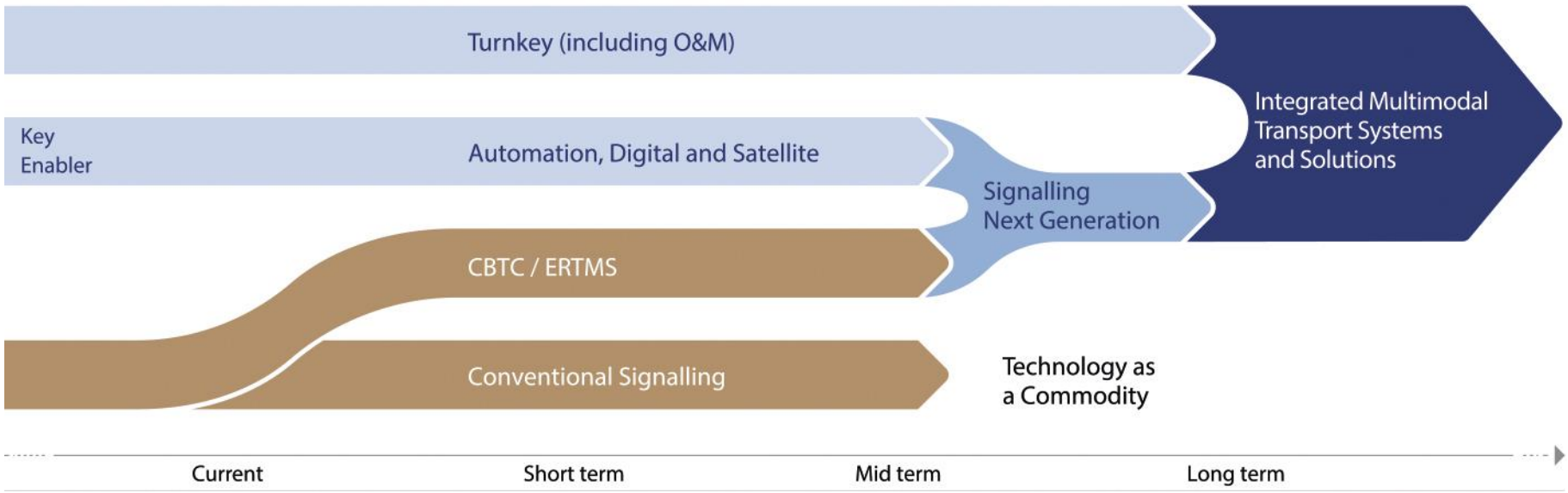
Who we are

Hitachi Rail STS is a Provider of Integrated Technological Systems, delivering signalling and turnkey solutions for Railway and Mass Transit and providing full value-added Services.

Future business as provider of integrated solutions



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Build the future, fuelling the present

" We design and implement solutions and components for rail transport and mobility, creating value for our community.
We are committed to create innovative products which improve the quality of life and sustain responsibly the world we live in"

Andy Barr - CEO and General Manager of Hitachi Rail STS

An eco-friendly and safe transport

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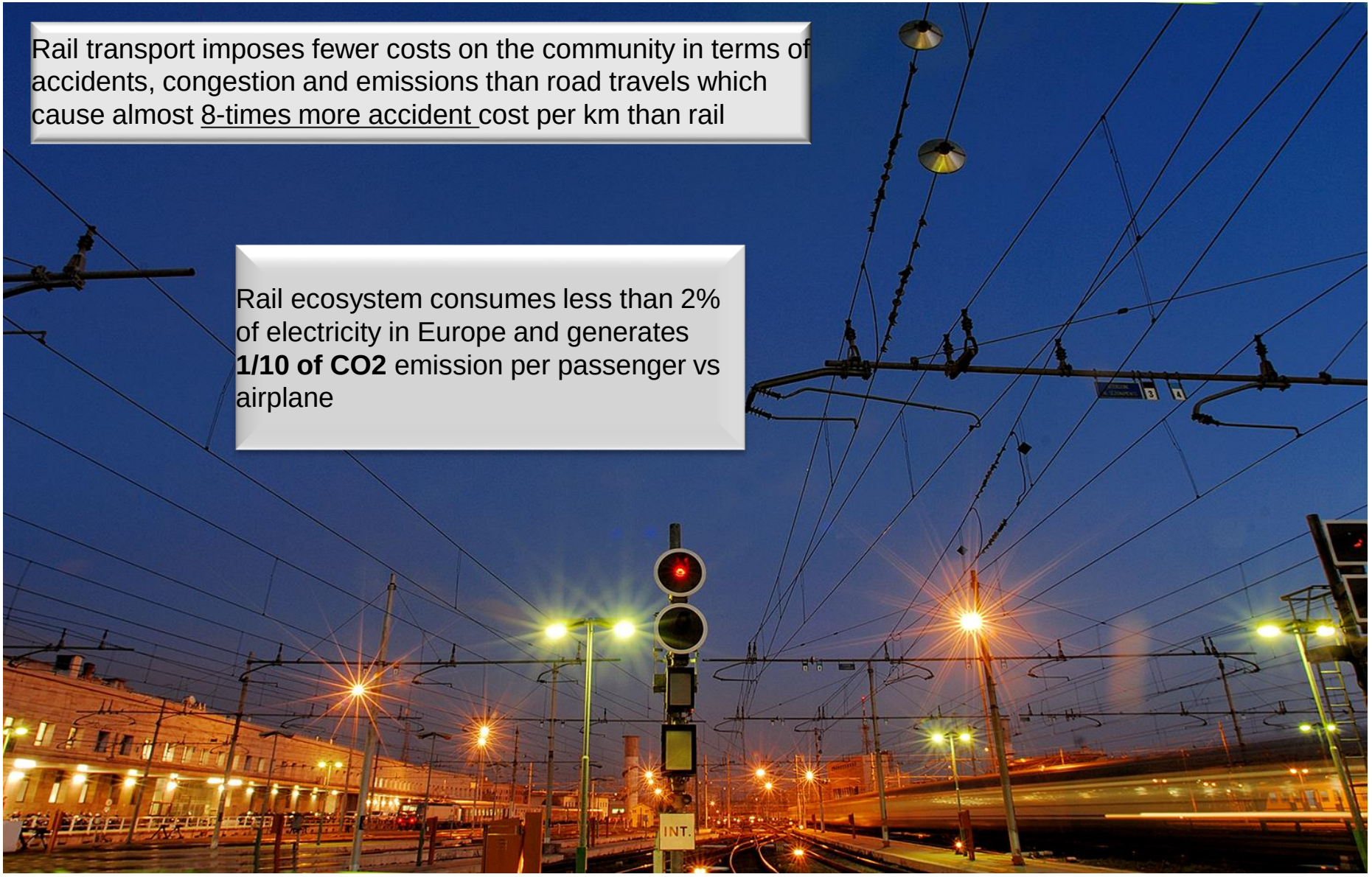

Rail transport imposes fewer costs on the community in terms of accidents, congestion and emissions than road travels which cause almost 8-times more accident cost per km than rail

Rail ecosystem consumes less than 2% of electricity in Europe and generates **1/10 of CO2** emission per passenger vs airplane

Technology trend

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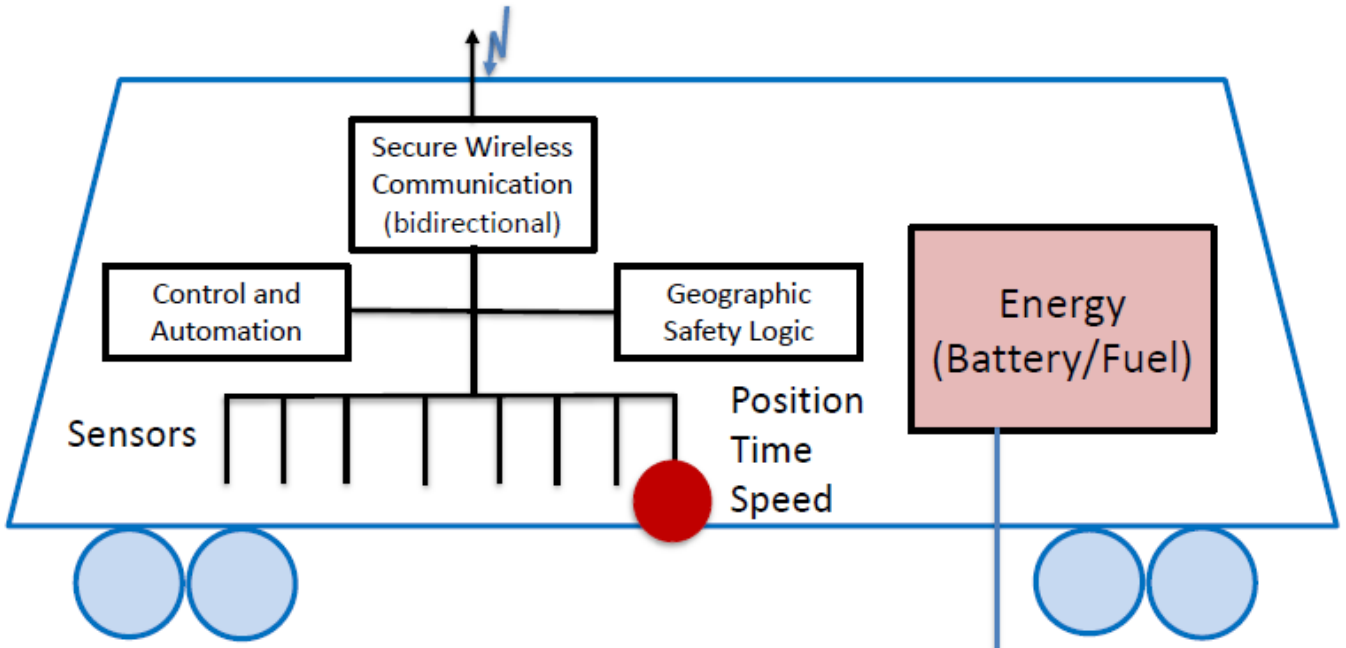
EUROPEAN UNION AGENCY FOR RAILWAYS

Towards Autonomous Trains



- Simplification
- On-board becomes more important

Energy density (MJ/kg)

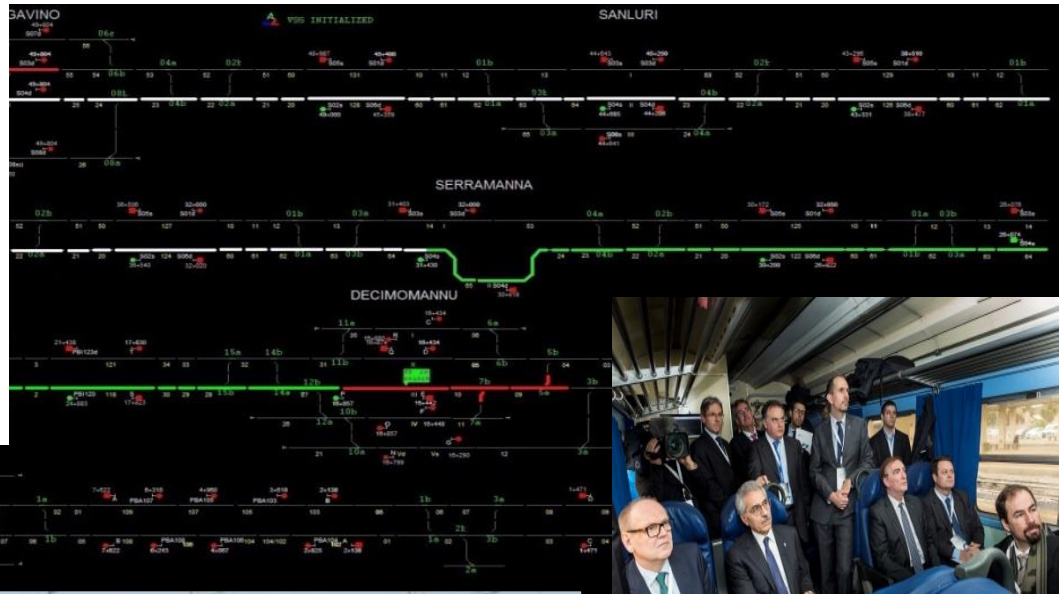
• Batteries	< 1
• Gasoline (Diesel)	47,5
• Hydrogen	142

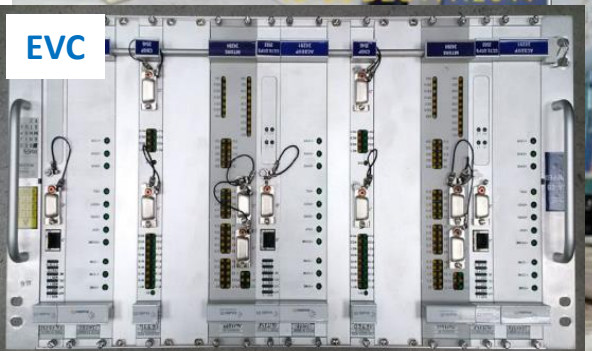
Virtualization of train infrastrucures

Same level of safety

RFI
RETE FERROVIARIA ITALIANA

ERSAT: ERTMS + Satellite





Impact of new technologies

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New features

Satellite & Telecom services

Providers of
- GNSS
- EGNOS
- GBAS

Providers of
- Satcom
- Cellular

TLC services

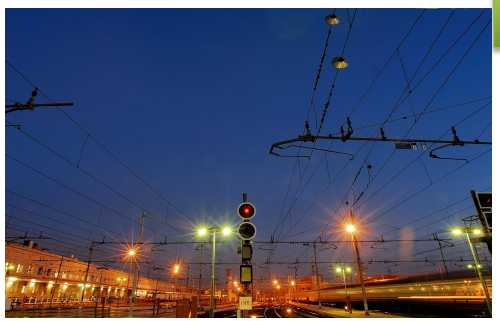
INTEGRATOR

Train Control System

- Satellite positioning service
- ETCS ground equipment
- TLC
- ETCS on board equipment

IM

RU



Expected benefits

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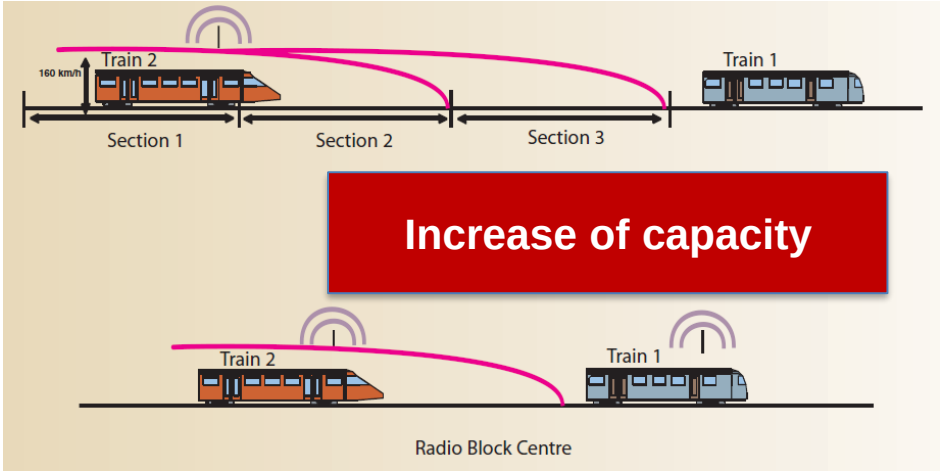
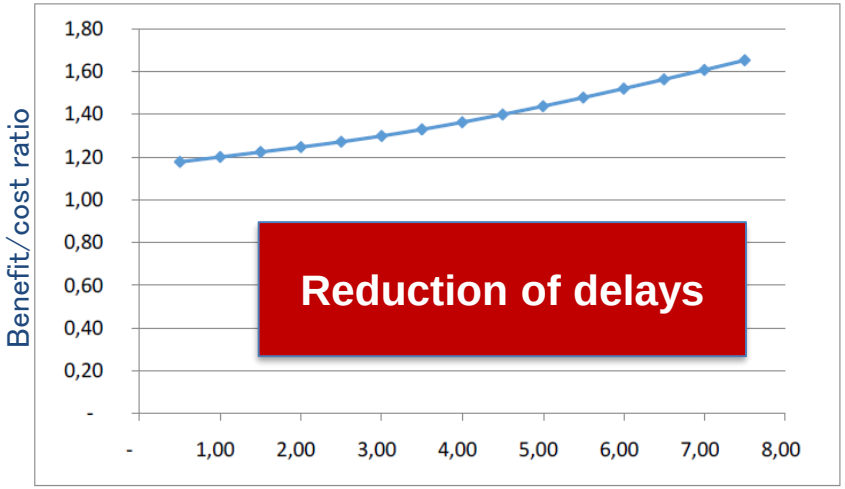
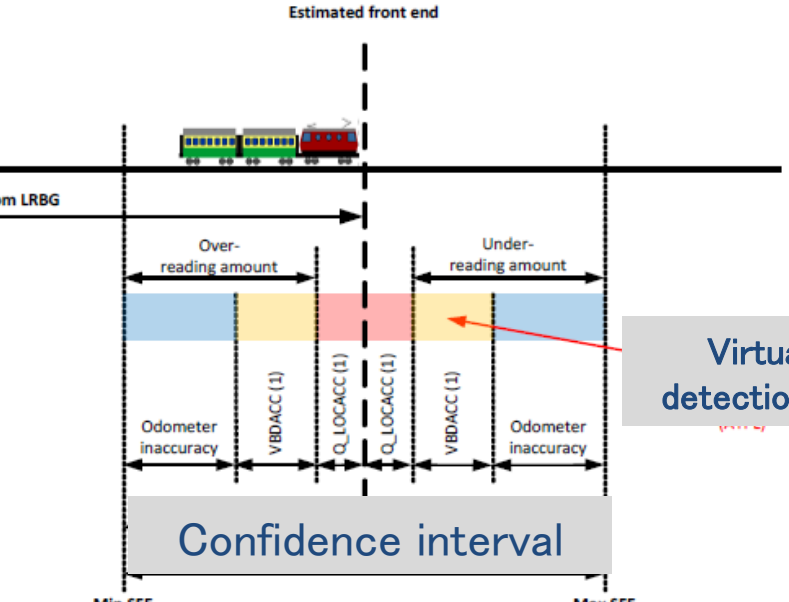
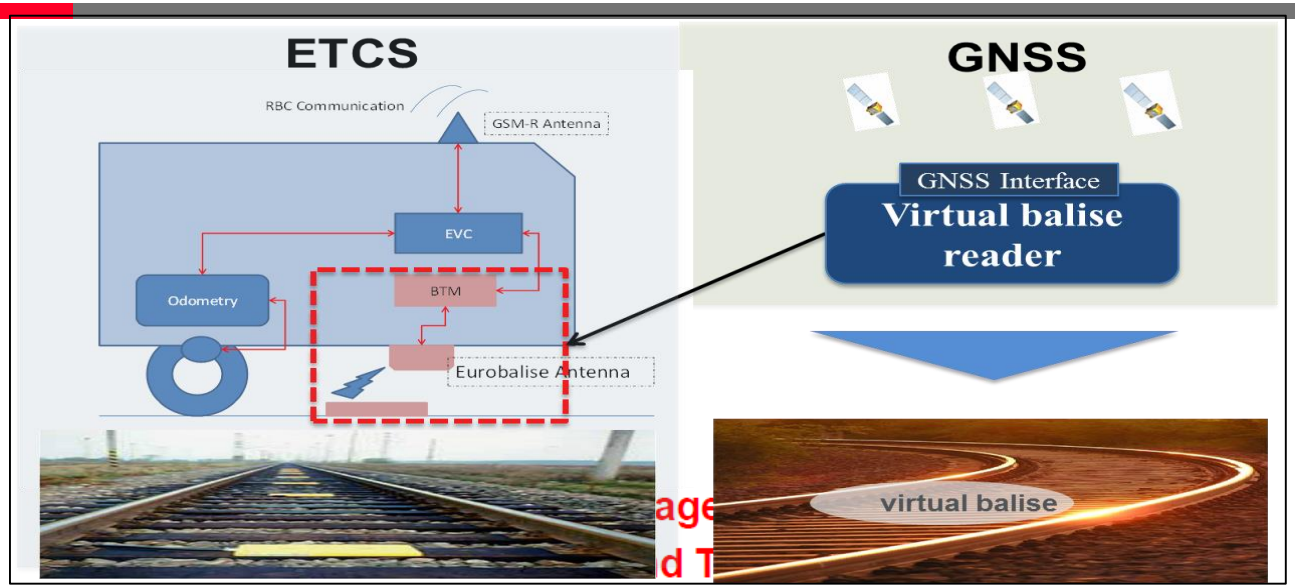


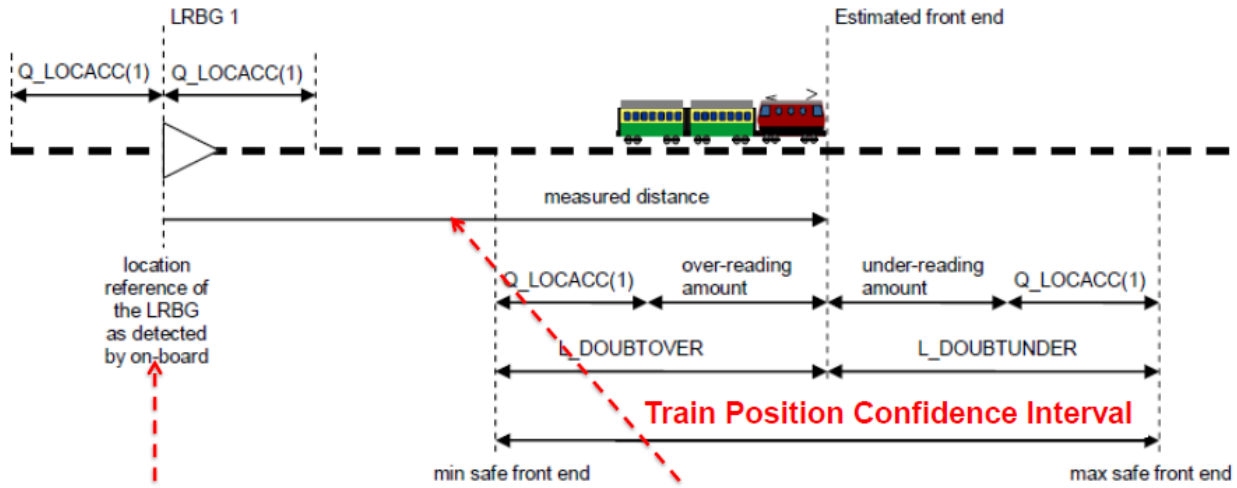
Figura 8: Benefit/Cost Ratio del progetto al variare dell'entità del ritardo medio in ora di punta





Virtual balise concept





Measurement Error in the Location of the Reference Balise ≤ ±1 m (in all conditions) [Subset 036]

Measurement Error in the measured travelled distance *s* (on-board fault-free conditions) due to odometry only [Subset 041] ≤ ± (4 m + 5% * *s*)

Virtual balise performance

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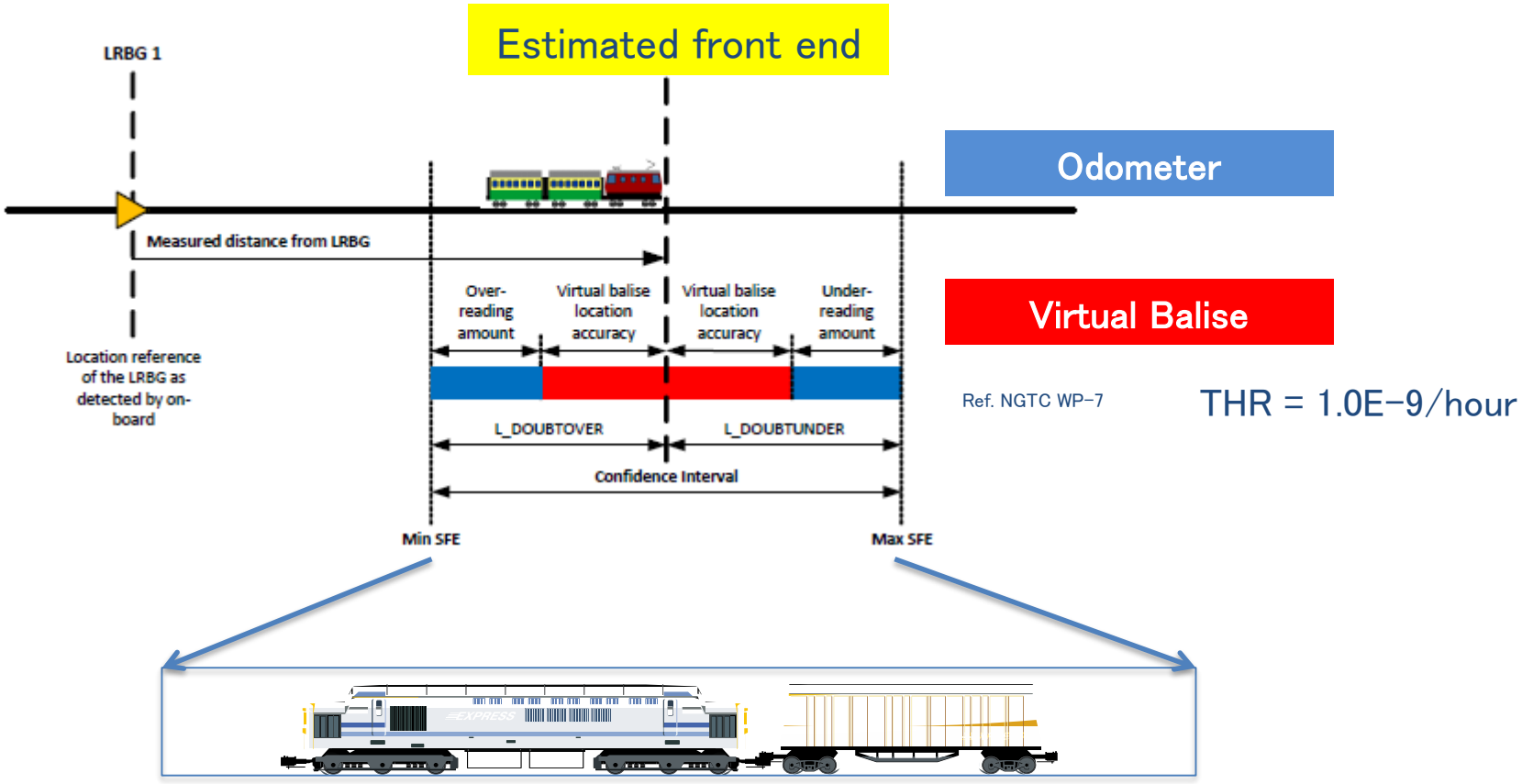

Ref. NGTC WP-7

THR = 1.0E-9/hour

Lower confidence error, higher is the potential traffic capacity

EU-Regulatory context

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EUROPEAN UNION AGENCY FOR RAILWAYS

The Regulatory Context for Rail


Official Journal
of the European Union
L 138
Legislation

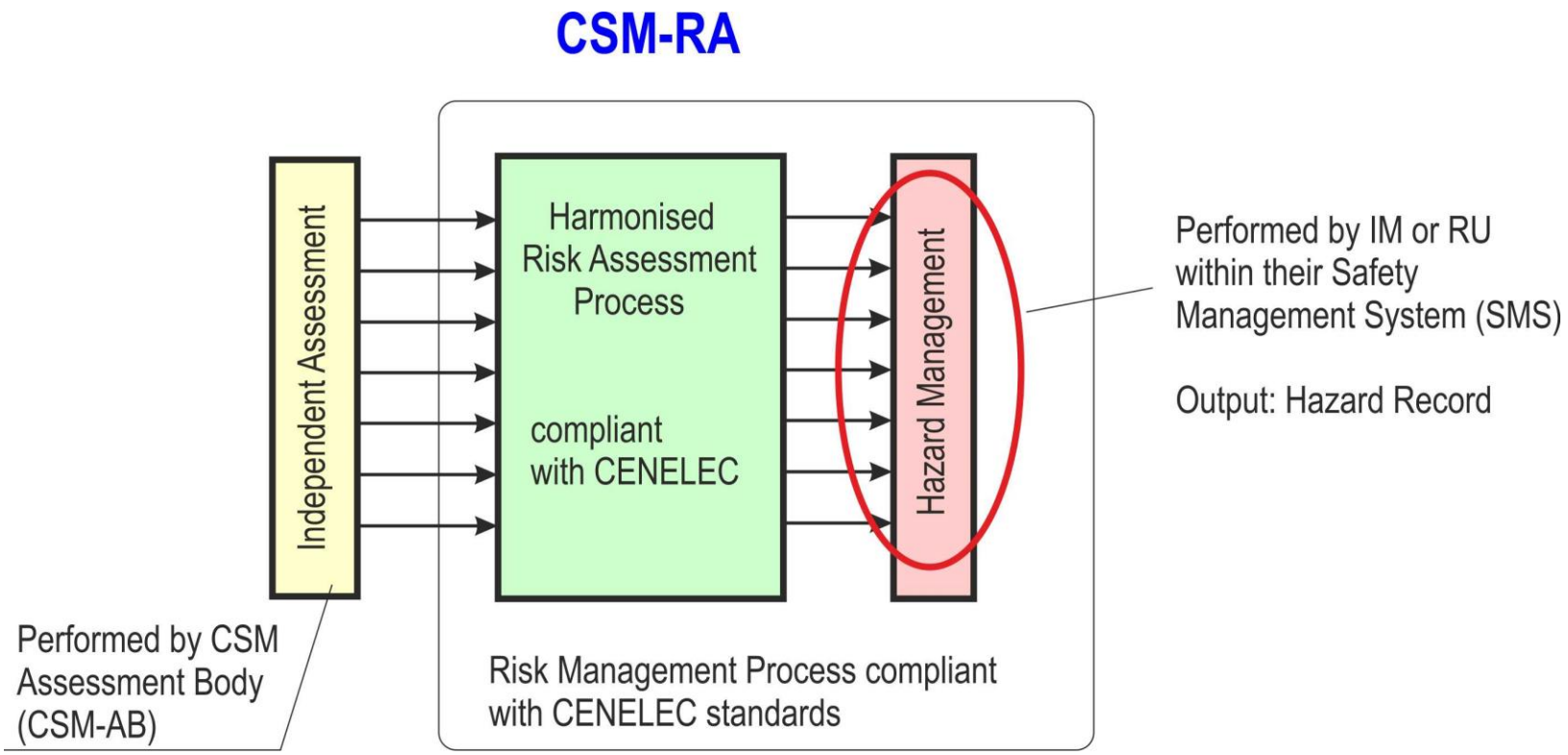
- Quality of rail services in Europe depends on excellent **compatibility** between the characteristics of the network and those of the vehicles
- Performance levels, safety, quality of service and cost depend upon that compatibility
- Fixed subsystems shall comply with the TSIs and national rules in force at the time of the request for **authorisation of placing in service**
- Vehicles shall comply with TSIs and national rules in force at the time of the request for **authorisation of placing on the market**
- In carrying out their duties and fulfilling their responsibilities, infrastructure managers and railway undertakings should implement a **safety management system**

Interoperability and Safety

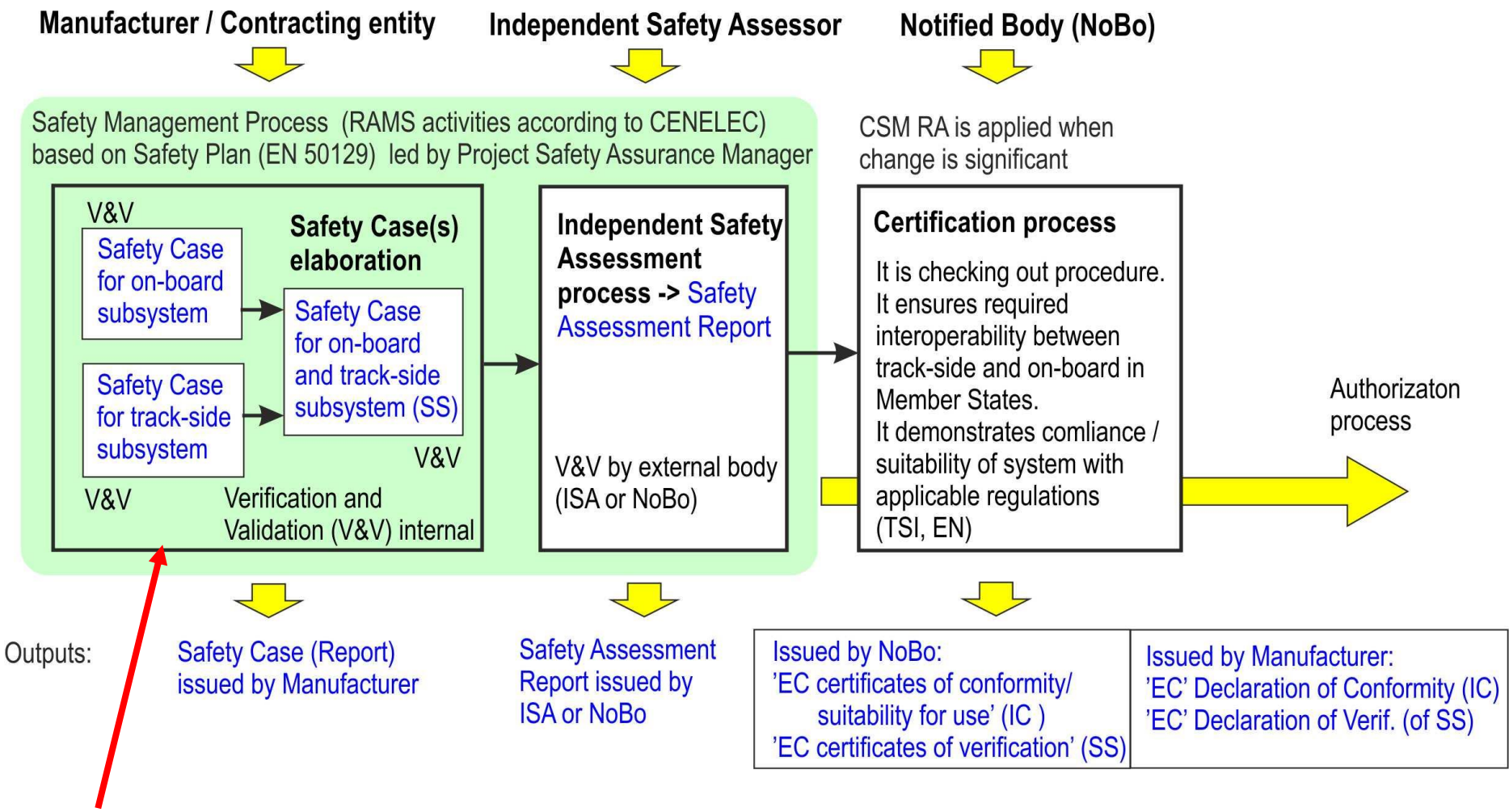
3

Steps in certification and authorization process

- Railway actors have to manage safely changes of the European railway system – including Satellite localization integration with ERTMS.
- Common Safety Method for Risk evaluation and Assessment (CSM-RA) must be used if system change (safety related) is significant



Steps in certification and authorization process



Satellite localization

Satellite Hazards

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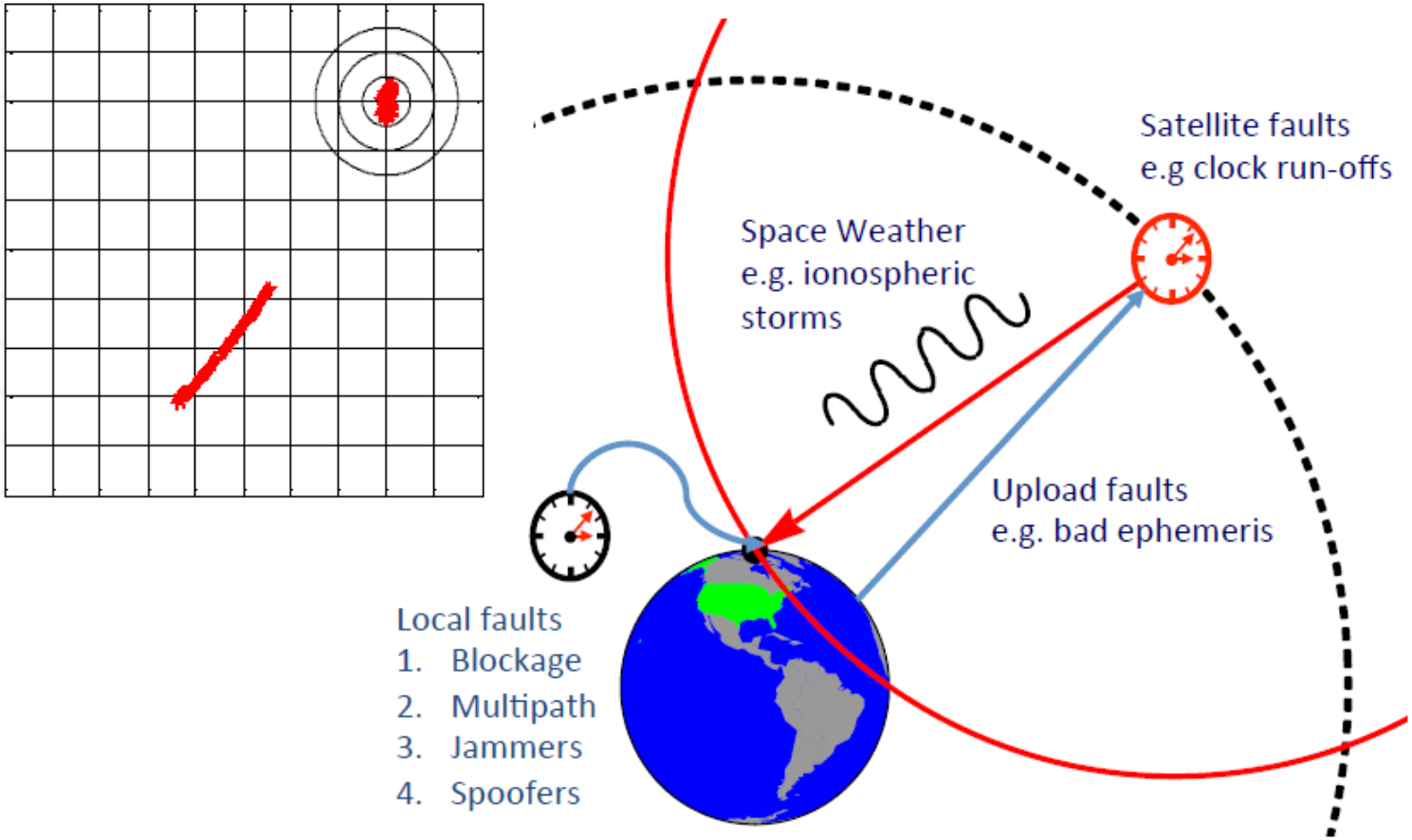
Cartoon Showing the Faults That Effect GNSS



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Multipath

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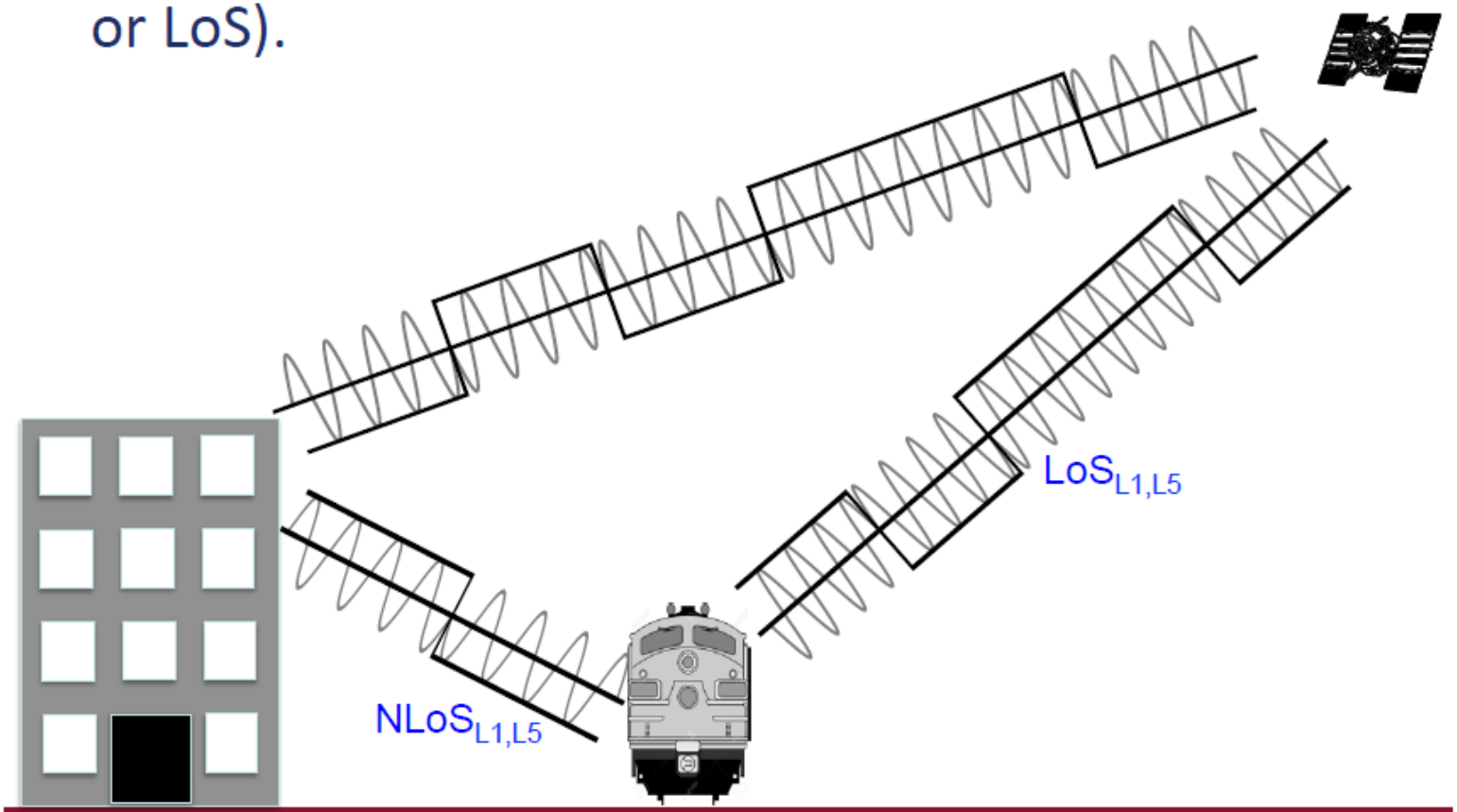
A Mixture of a Reflected Signal (Non-Line-of-Sight or NLoS) Plus a Direct Signal (Line-of-Sight or LoS).



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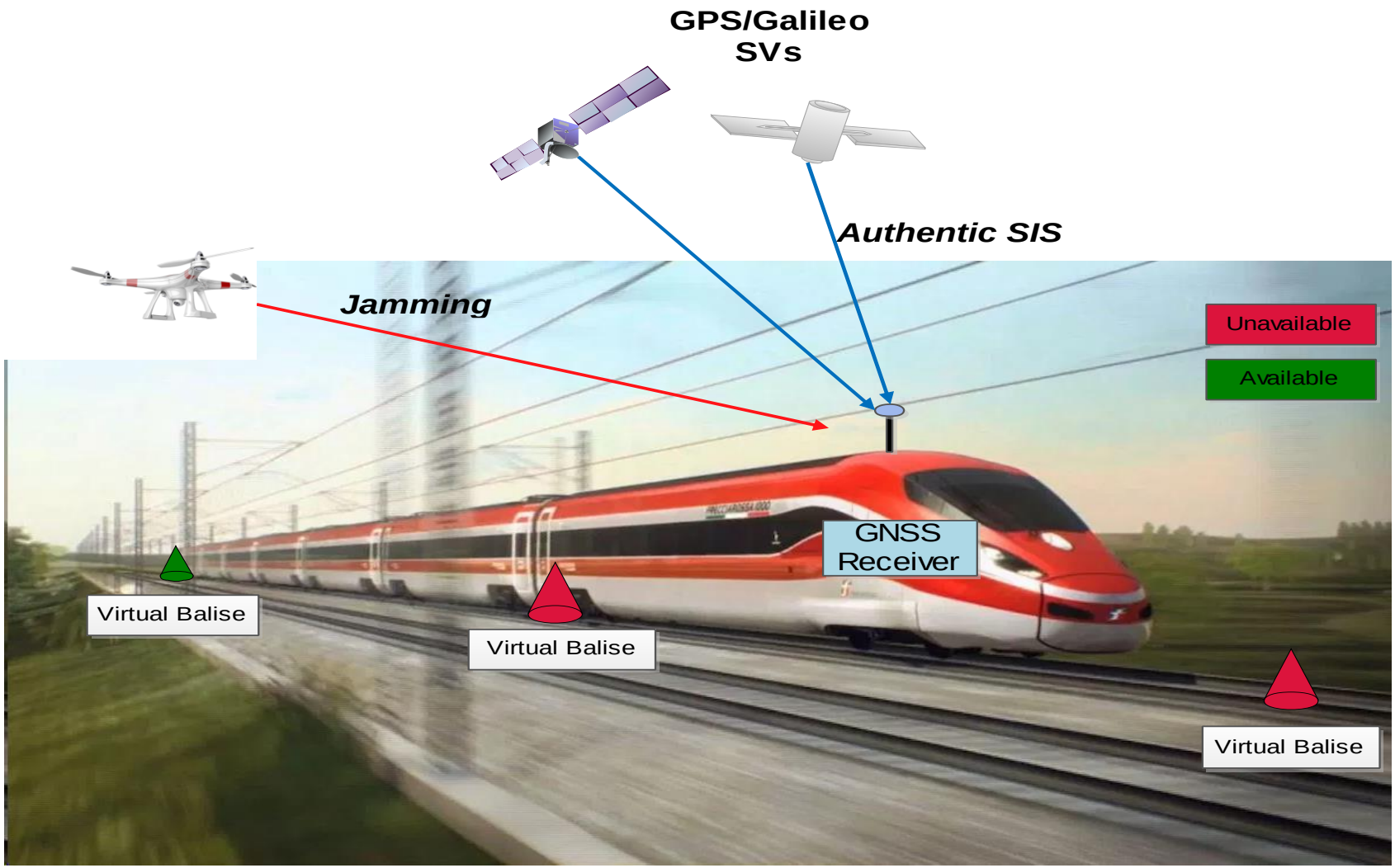
Jammers and cyber-attacks



Potential disruption of GPS signals

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Equivalent Power Ratio

Broadband at $\frac{1}{4}$ mile to GPS

Broadband Proposal -
Niagara ~ 1 Billion Watts

(167 feet with 64,750 cubic feet/ second)

5 Feet

GPS - 0.2 Watts
(1 Tablespoon of water per second through 5 feet)

Power Ratio of 5 Billion to One

PTA Status and Using Velocity 54

Status of railway infrastructure & evolution in Italy

Total network: 16.742 km

~ 1.000 km	City network
~ 950 km	High Speed
~ 2.900 km	Basic performance
~ 3.900 km	Medium performance
~ 7.950 km	**Regional, Local**

Italian Network
Passengers per day
+2 million by train

Italian Network
Every day
+8.500 trains

ERTMS acceleration plan

Deploy the ERTMS on the entire Italian railway infrastructure and trains

first ERTMS deployment on Regional lines

Decommisioning of legacy systems as requested by EC

RFI RETE FERROVIARIA ITALIANA

Roadmap to certification & operational activation in Italy

Activation of ERTMS L2
+ GNSS
+ Local Augmentation Network

Activation – Nov 29

Implementation ERTMS L3
+ GNSS
+ IP Based Public TLC

L3 Impl. – Nov 29

2017 | 2020 | 2021 | 2022 | 2023

Preparatory activities

Selection of Train and Logistic elements for deploying local Augmentation Network

Activities underway

Preparatory activities

Upgrade to ERTMS
+ GNSS
+ EGNOS Based SBAS

Role of GSA–ESA

ERA target window for upgrade of TSI

Readyness – Sep 25

Activation ERTMS L3
+ GNSS
+ IP Based Public TLC

Cooperative effort involving Rail & Satellite community

☞ *Satellite asset to comply with ERTMS certification process*

RFI RETE FERROVIARIA ITALIANA

ERSAT GGC

ERTMS on SATELLITE
Galileo Game Changer

RFI RETE FERROVIARIA ITALIANA
GRUPPO FERROVIE DELLO STATO ITALIANE

Hitachi Rail STS S.p.A.

adif

BUREAU VERITAS

CEDEX

DLR Deutsches Zentrum für Luft- und Raumfahrt e.V.

IFSTTAR

ineco

ITALCERTIFER

RadioLabs

RINA

SNCF

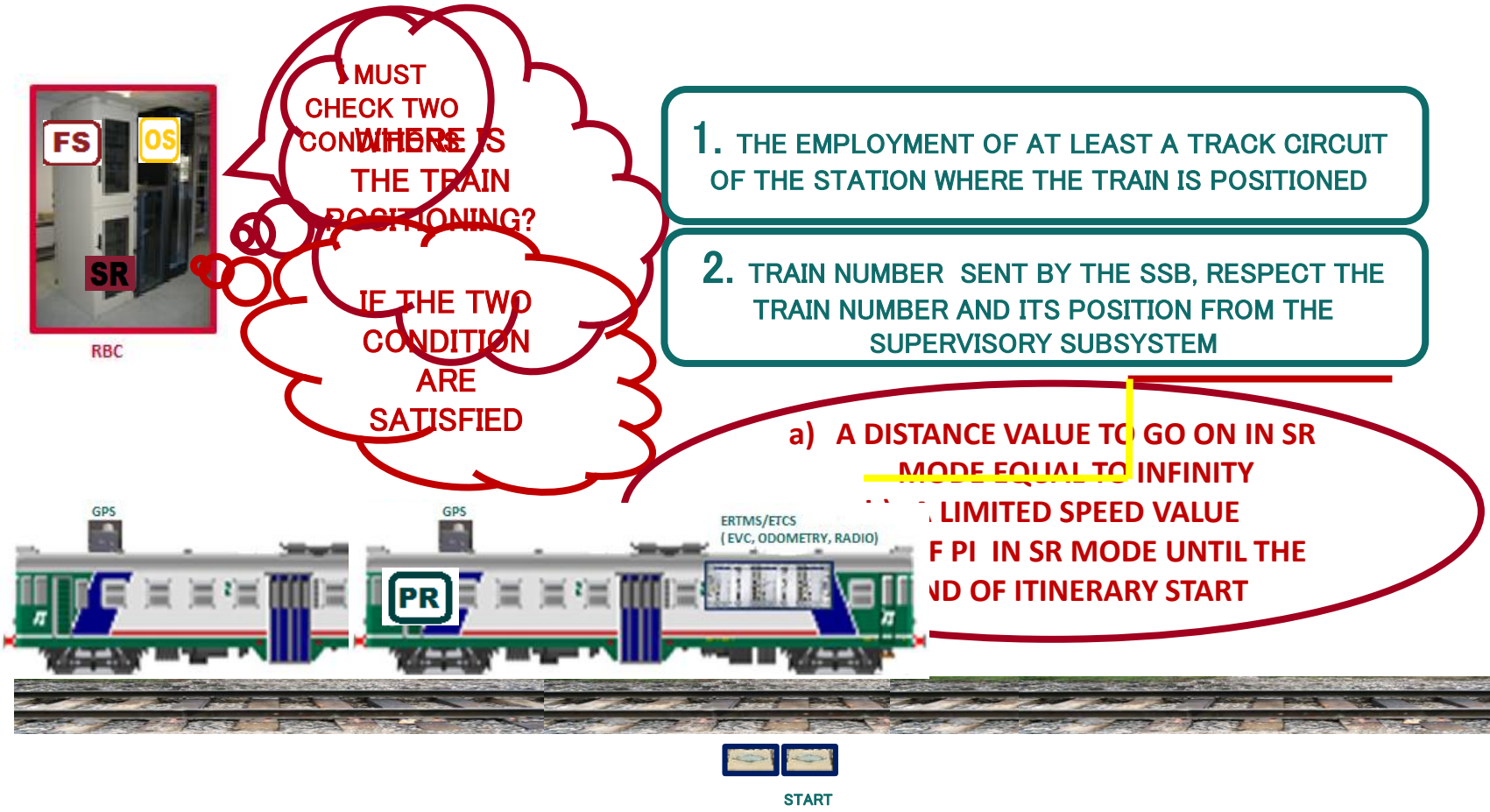
TRENITALIA

unife

Rail & Satellite international experts working together

Endorsement of satellite technology

Potential reduction of train travelling in Staff Responsible



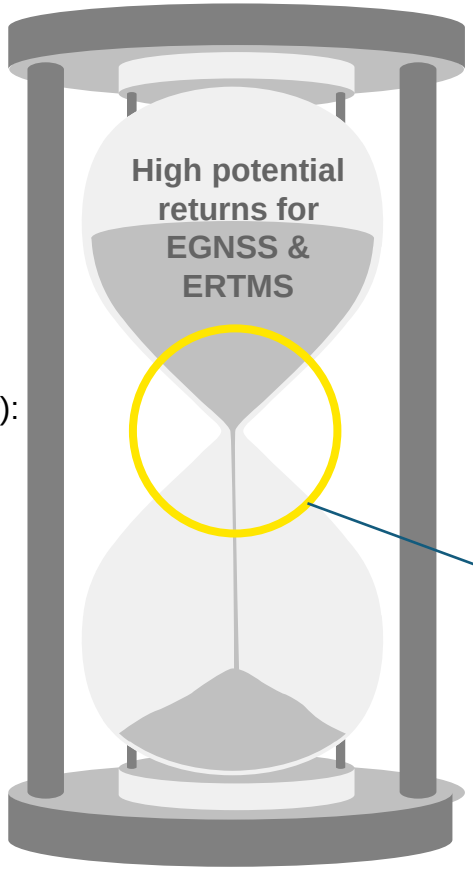
Main Barriers to the EGNSS Solutions Introduction

Legal

- ***Service provisioning*** with liability
- *Inclusion of* ***EGNSS in the STI*** (Specification for Technical Interoperability): Target 2022-23

Other Barriers

- Lack of i**ncentives** to accelerate national deployment plans



Technical

- *Compliance with* the **standard ERTMS**
- Performance in **any operational condition**
- Use of **public augmentation** networks

A collaborations between Space & Rail stakeholders is important to help remove barriers

GNSS: one of the game changer technology for the evolution of the ERTMS system

The commitment of the GSA to supporting the rail sector is clear
Carlo Des Dorides, GSA

We can really ***reshape the railway system with Galileo and EGNOS*** *and enhance the added value*
Elisabeth Werner of European Commission DG MOVE

GNSS has the potential to revolutionise the ERTMS
J.Doppelbauer, ERA

Importance of EGNSS to increasing capacity, efficiency and sustainability of European rail networks

Massive plans to adopt EGNSS outside Europe:

- **USA (~ 20,000 trains equipped with GPS)**
- **China (biggest world's market opportunity is targetting Beidou)**

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END

Thank you for your attention

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