**Institut français
des sciences et technologies
des transports, de l'aménagement
et des réseaux**

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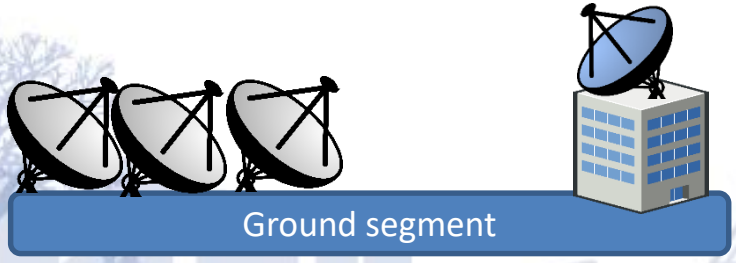
Developing GNSS for the rail industry

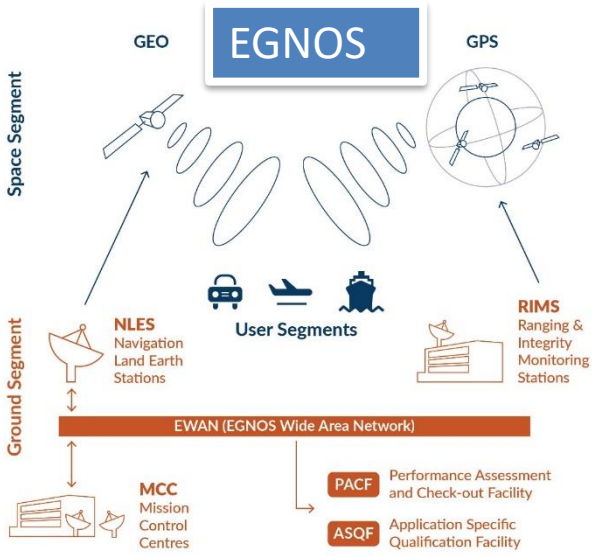
IFSTTAR

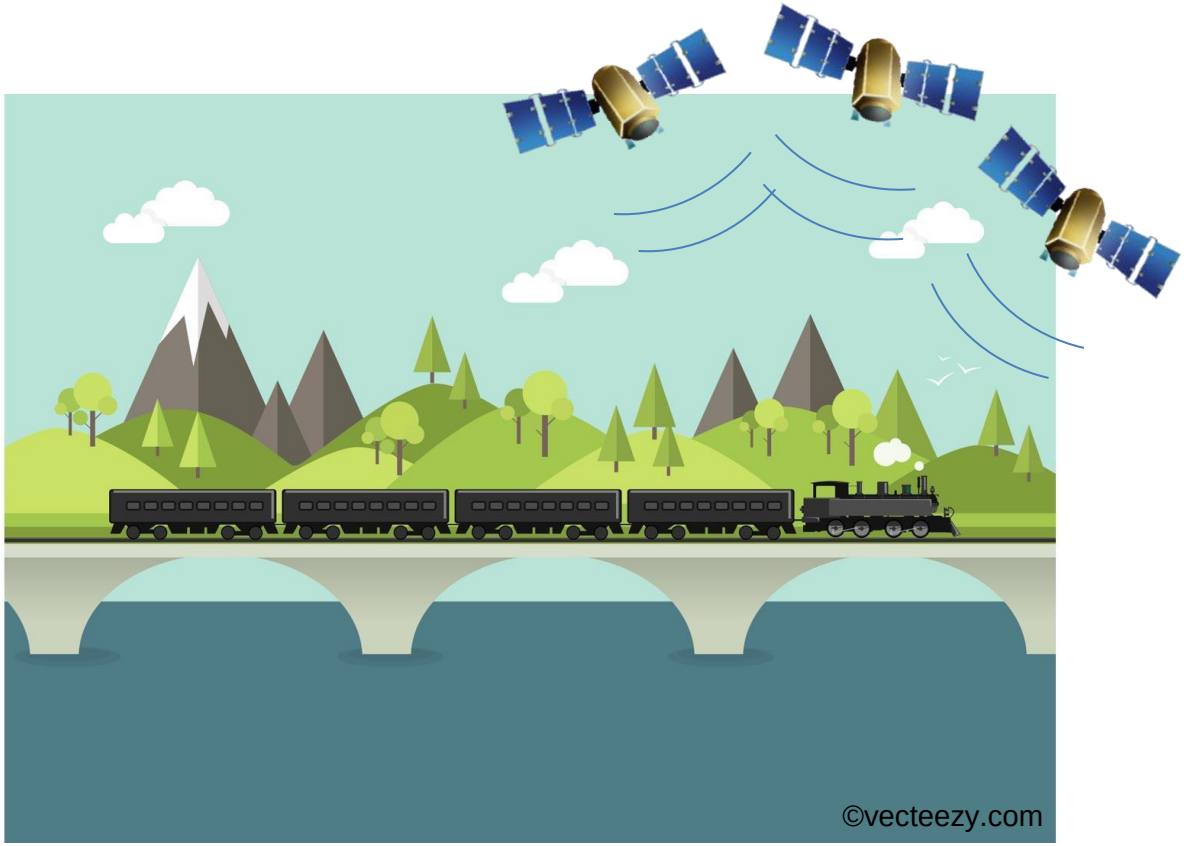
GNSS? What are we talking about?

- Global Navigation Satellite System

https://www.gsa.europa.eu/galileo-your-pocket







What are their uses in operational rail today?

Challenges & EU context

With GNSS

© www.sncf.com

Unsafe information

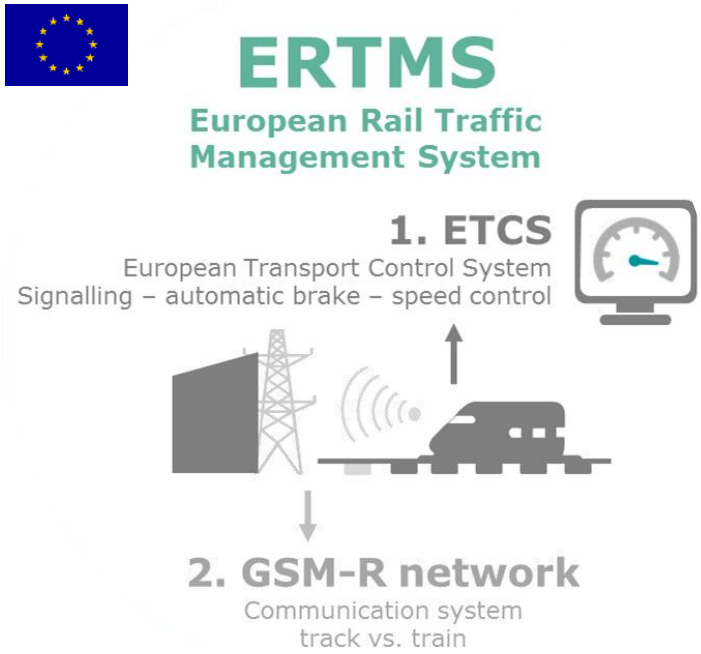
Signaling: Very safe information

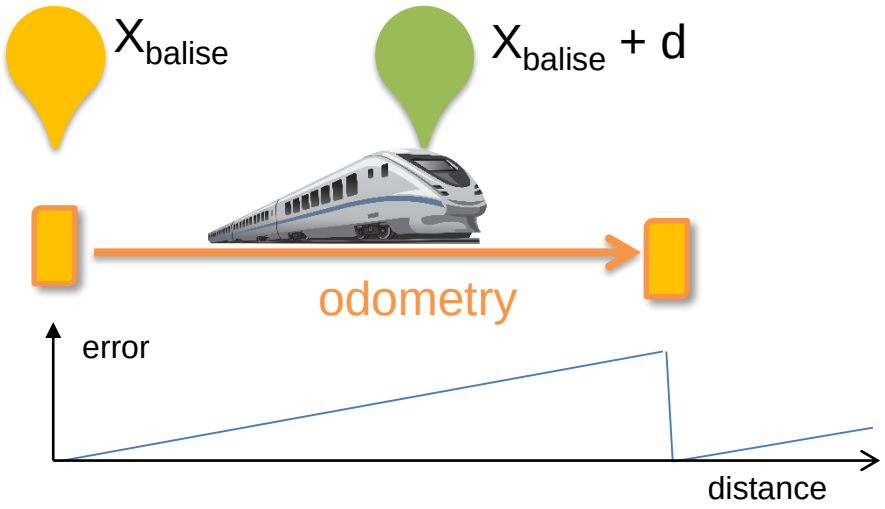
WHY?

- Reduce costs
- Boost competitivity
- Increase safety

The ERTMS framework

Positioning in ERTMS

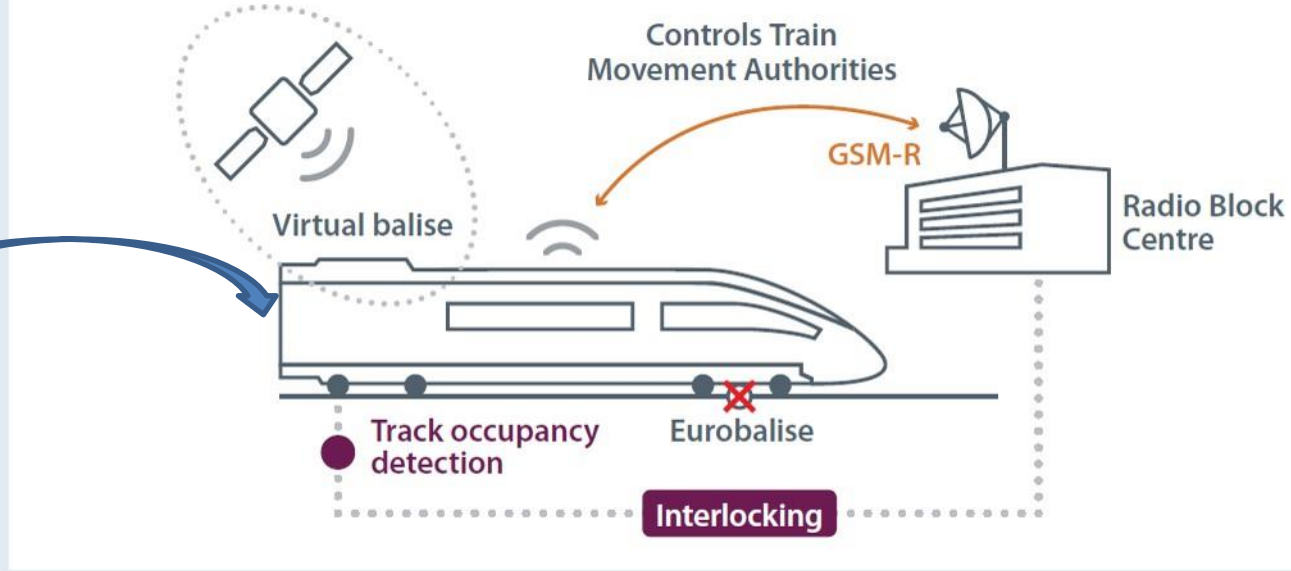





Balise ETCS @Infrabel

The virtual balise concept

Virtual balises positions



Picture source: NGTC Network of End Users, Prague 7.7.2016

What are the expected benefits?

Expected benefits

"The ERSAT Galileo Game Changer", Presentation from RFI, Trenitalia, Ansaldo STS, Milan March 2018

Technical benefits

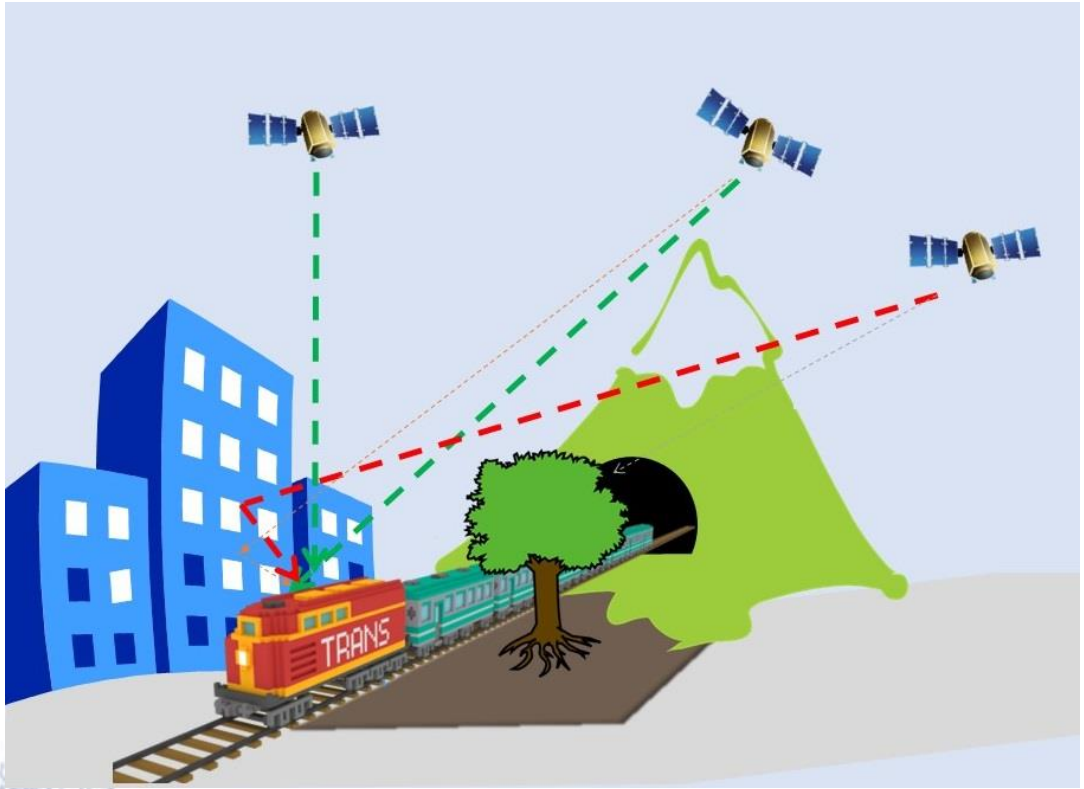
- **Availability** of the on-board Signalling System (eliminate failures of balises, problems with the on-board antenna, cable connections…)
- **Reliability** of Signalling System on-board odometry (slipping/sliding wheel)

Trenitalia long term expectations from ERSAT GGC

- ✓ **Reduction of** investment and maintenance **costs**. (removal of track based train detection systems)
- ✓ Modernise signalling system at **lower costs** to **ensure sustainability**, according to the European scale numbers.
- ✓ Guarantee a real and **long-term interoperable** European **standard**.
- ✓ **Improve capacity** of transportation networks extending ERTMS system **on secondary lines and urban nodes.**
- ✓ **Minimize Impact** on **Operational Rules.**

What are the challenges?

What kind of issues with GNSS?



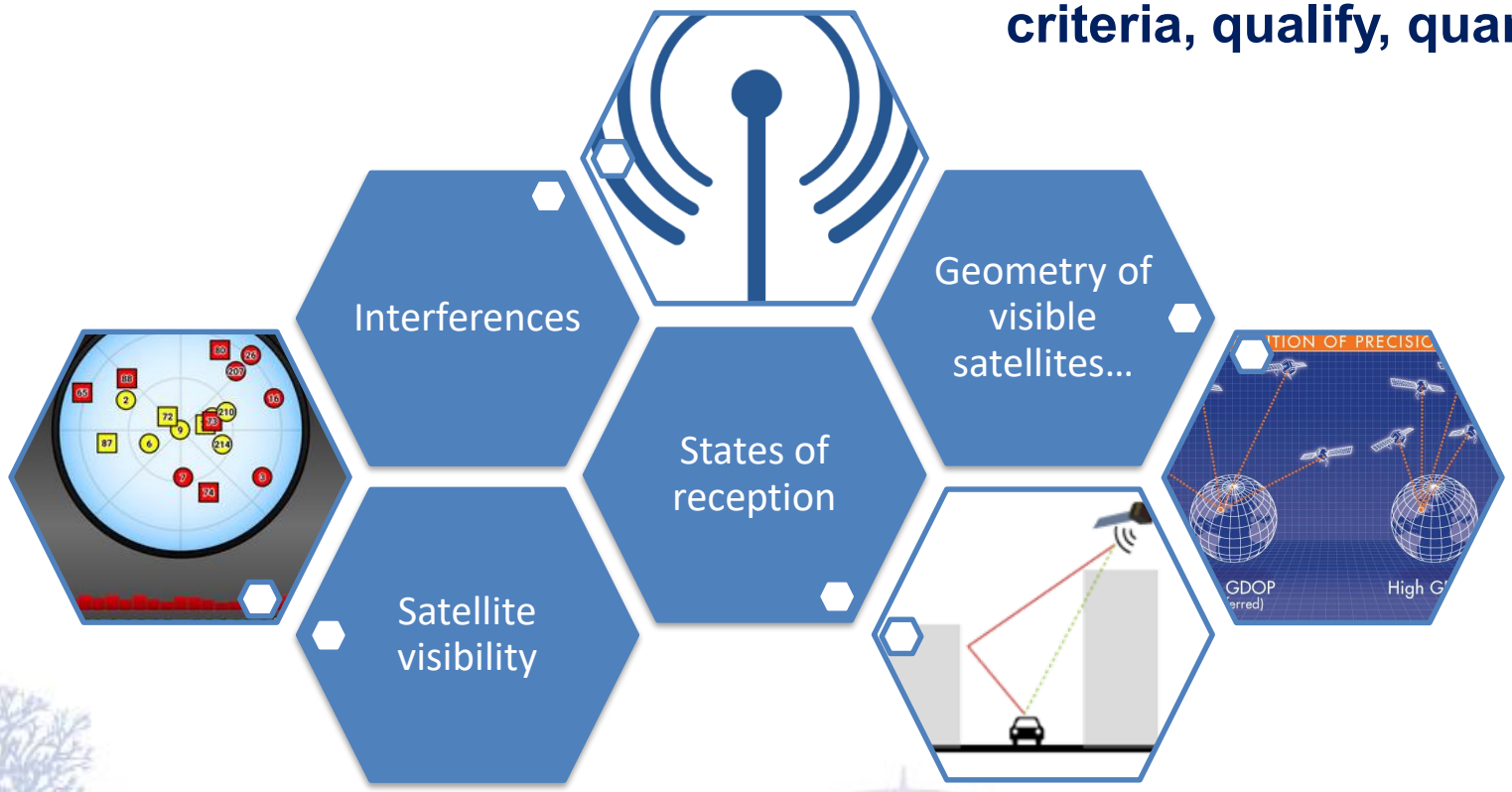
Local phenomena

- Lower service availability
- Decreased accuracy
- Local error models, that differ from aeronautics and make complex transferability of the concepts (integrity monitoring)

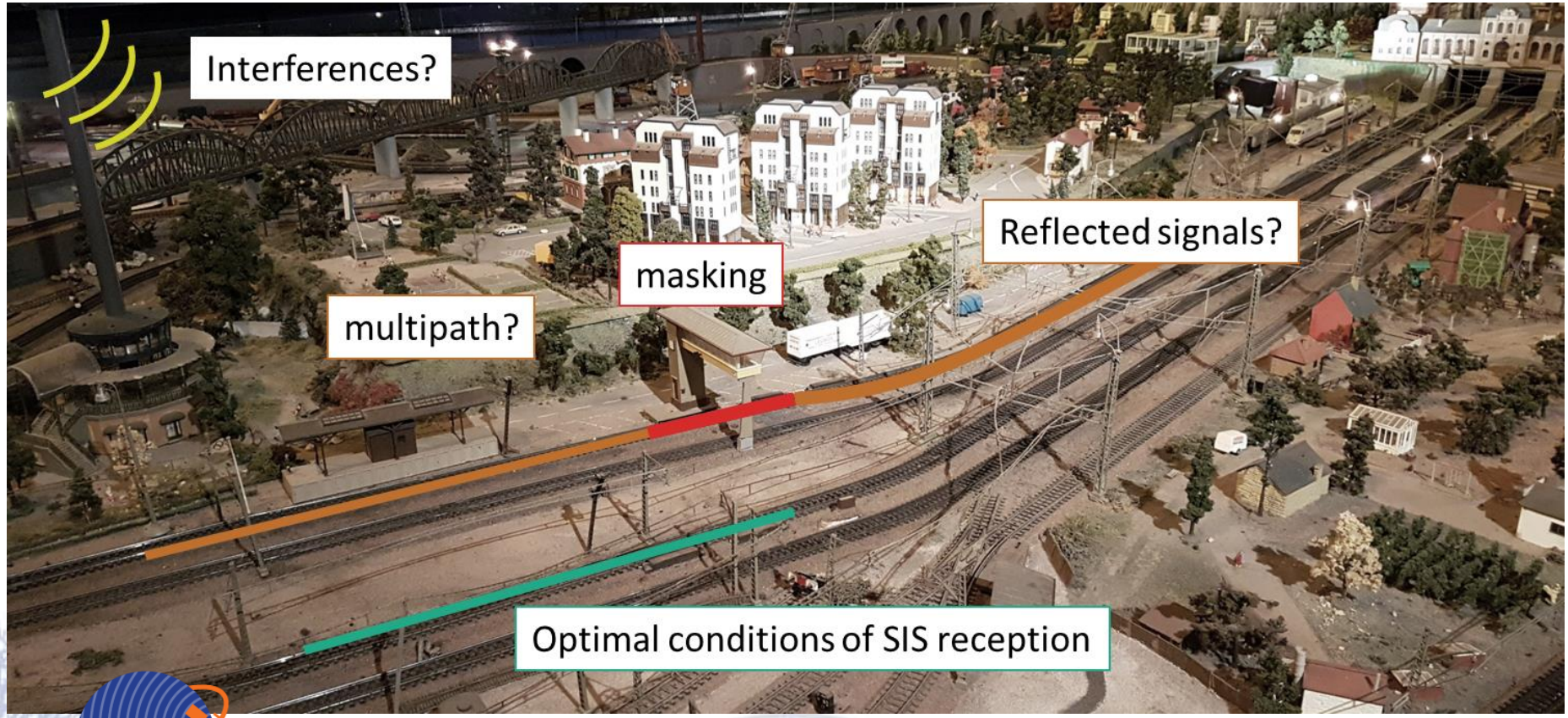
Local effects have not been addressed so far by the aviation community

GNSS Quality criteria

Identify GNSS SIS quality criteria, qualify, quantify…



In a « moving » environment (train, satellites, time)…

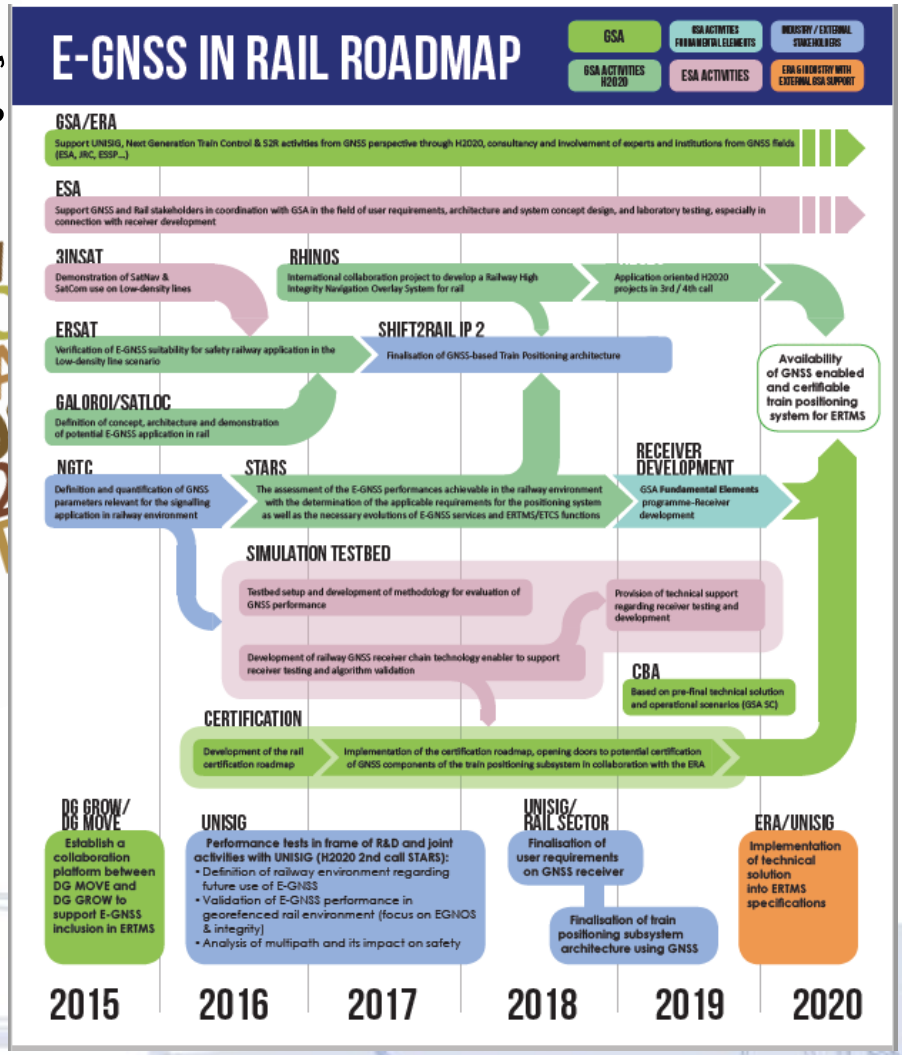


ERSAT GGC

Where are we?

Where are we?

Past EU projects, since the 2000s



GNSS-related issues

Definition of certified standard process, methodology and toolset for classifying track areas for locating VB

Evaluate

- Develop the tools
- Prepare standards and certification framework

Characterize

- Experiment
- Model
- Simulate

Develop

- Mitigate local effects
- Mitigate interferences

DB4RAIL
SBSRail-2

S2R Target:

« zero on-site testing »

GALILEO will be operational

STARS
SATELLITE TECHNOLOGY FOR ADVANCED RAILWAY SIGNALLING

ERSAT GGC

2016 2017 2018 2019 2020 2021 2022

ERTMS L3

X2RAIL 2

Shift2Rail

WP3: FAIL SAFE TRAIN POSITIONING (INCLUDING SATELLITE TECHNOLOGY)

Operational line by 2020 (ERTMS L2)

Pinerolo – Sangone (It)

GNSS is becoming a game-changer in safety and non-safety critical applications

SIA project (2018-2021)
→ *information about the health status of the railway's most demanding assets in terms of maintenance costs (wheel, rail, pantograph and catenary)*

Enhanced odometry

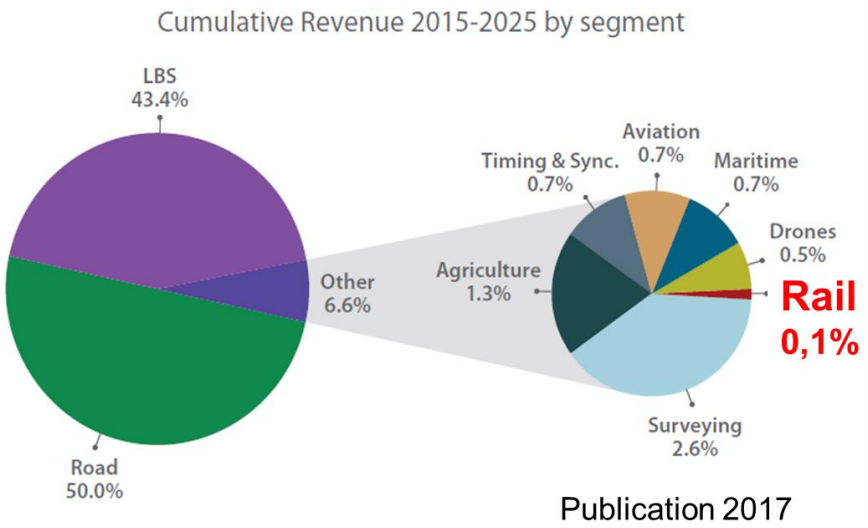
Full GNSS-based-signalling capabilities (with cost savings) for LDL

	Non-safety critical applications			Safety critical applications		
Applications	**Asset management**	**Passenger information**	**Driver assistance**	**Train Control and Signalling**	**Traffic Management**	**Autonomous train**
Key GNSS requirements	Accuracy Availability	Accuracy Availability	Accuracy Availability	Accuracy Availability Integrity Robustness	Accuracy Availability Integrity Robustness	
Other requirements	Connectivity Power Consumption	Connectivity (communication link)	Connectivity (communication link) Interoperability	Interoperability	Interoperability	

GNSS Market Report | Issue 5, 2017

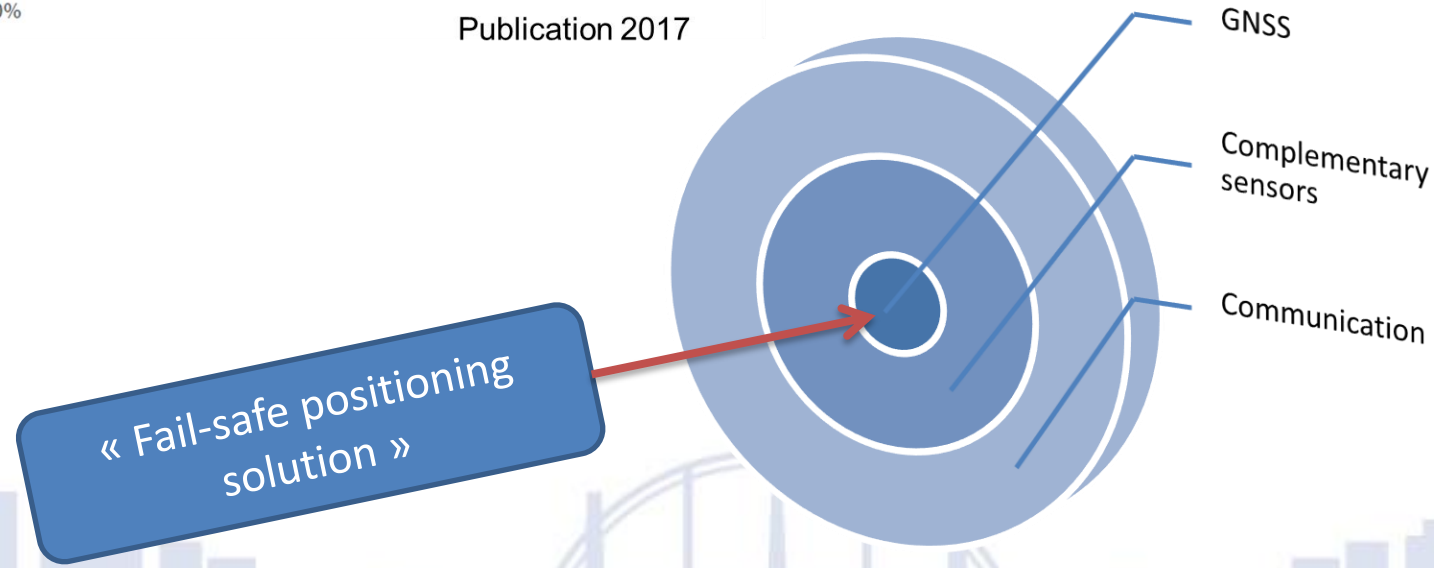
SNCF ambition for 2023

Conclusions



Publication 2017

https://www.gsa.europa.eu/2017-gnss-market-report



© « *Au bout des rails* », *Manuela Salvi, Maurizio A. C. Quarello*

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