# Project Overview

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# Partners

RAILWAY INFRASTRUCTURE MANAGER AND OPERATOR → RESEARCH CENTER → ENGINEERING PARTNER → CERTIFIED LABORATORIES → NOTIFY BODY → RAILWAY SOLUTION PROVIDER

GATE4Rail

| No. | Participant organization name | Short name | Country | Role |
|---|---|---|---|---|
| 1 | **RadioLabs** | RDL | Italy | Coordinator |
| 2 | **Institut français des sciences et technologies des transports, de l'aménagement et des réseaux** | IFSTTAR | France | Partner |
| 3 | M3 Systems Belgium SPRL | M3SB | Belgium | Partner |
| 4 | Rete Ferroviaria Italiana | RFI | Italy | Partner |
| 5 | Union des industries ferroviaires européennes | UNIFE | Belgium | Partner |
| 6 | Bureau Veritas Italia | BVI | Italy | Partner |
| 7 | Centro de Estudios y Experimentación de Obras Públicas | CEDEX | Spain | Partner |
| 8 | **Ingeniería y Economía del Transporte S.M.E. M.P., S.A.** | INECO | Spain | Partner |
| 9 | GNSS Usage innovation and Development of Excellence | GUIDE | France | Partner |

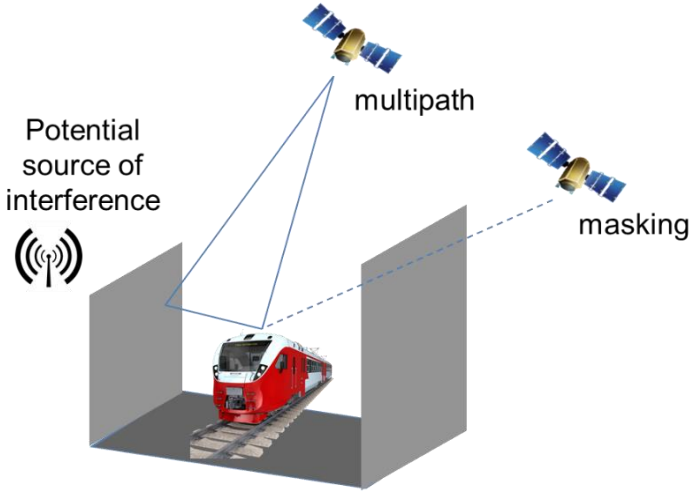
# GATE4Rail Project

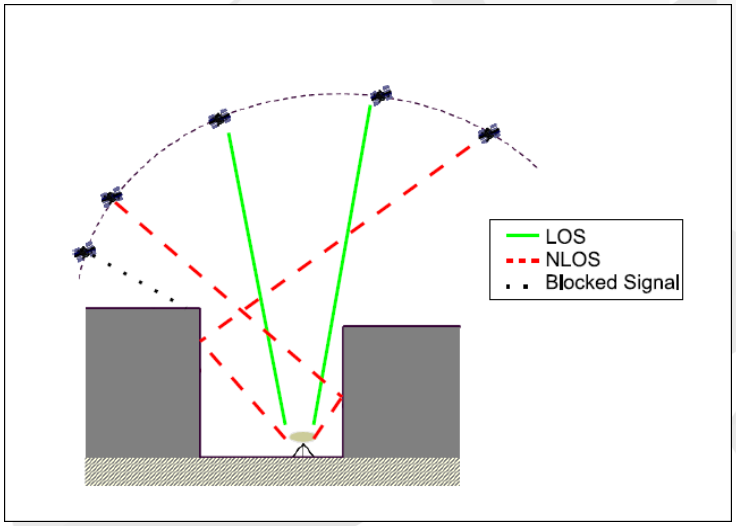
- GATE4Rail will provide a **LABORATORY TEST ARCHITECTURE** capable of simulating **railway scenarios for GNSS-based ERTMS applications** by integrating different simulation blocks and by defining their interfaces in order to cover a global simulation chain.

- GATE4Rail is driven by a consortium composed of the **main actors** involved in current and recent state of the art projects, concerning GNSS introduction in ERTMS and evaluation tools.

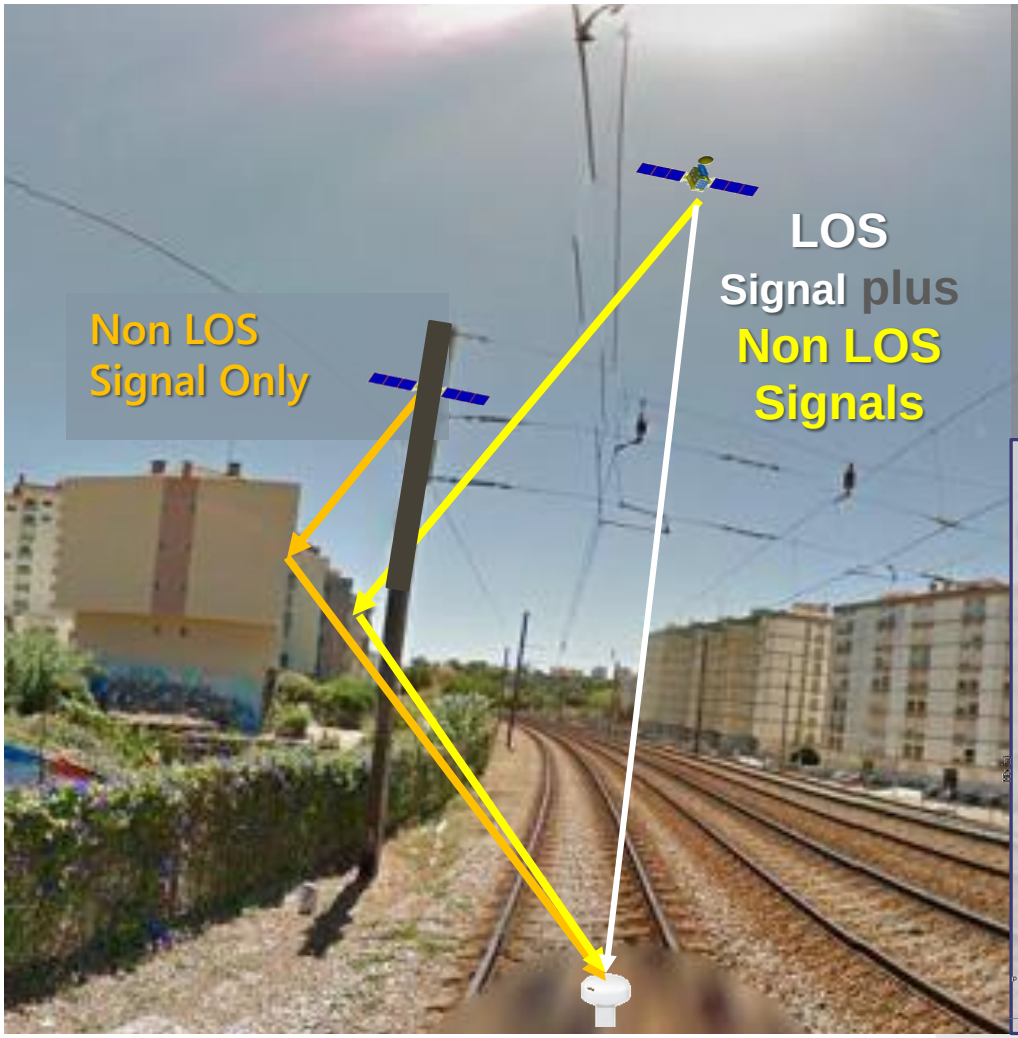
# Objective 1: GNSS characterization in railway

- **Identification**, **modelling** and **simulation** of GNSS reception along a railway line, focusing in particular on **MULTIPATH** and **INTERFERENCES** effects
- **Definition** of **TEST SCENARIOS**, considering both rail operations and GNSS
- **Simulation** of GNSS signal reception in **NOMINAL MODE** and in presence of **FAULTS**

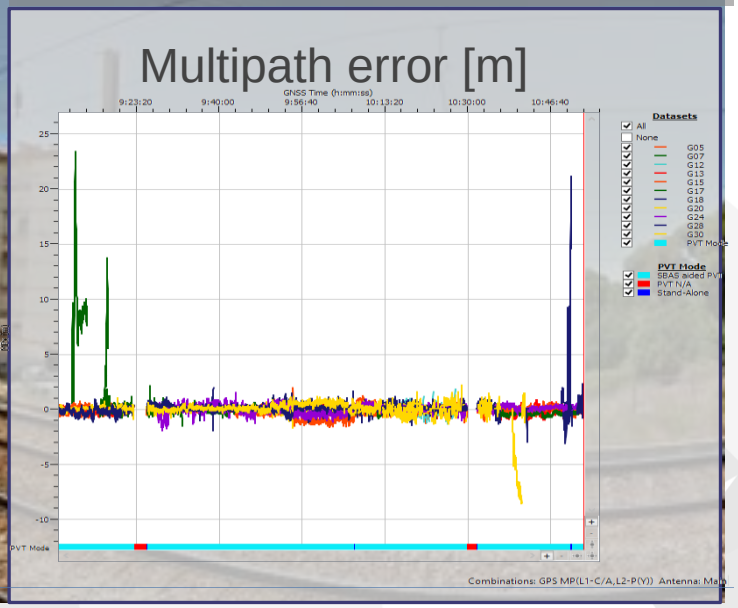


# GNSS Characterization in Railway




- Signal blockages causing the reception of the Non-Line-Of-Sight (NLOS) signal only, introduce significant error into the GNSS suite of measurements.
- GATE4Rail includes mechanisms to detect these situations



# Objective 2: geo-distributed lab for GNSS in rail

- **Contribution in the development of the S2R simulator and its verification and validation through the:**
  - definition of a **dedicated system laboratory test architecture** for GNSS-based positioning solutions;
  - enhancement of the laboratories test environments to support **automated testing and integration of ERTMS and GNSS scenarios connecting different facilities**;
  - definition of the **concept and methodology for a standardized method** to derive and describe test cases;
  - definition of the **safety requirements for a future common test process framework**.

# Gate4Rail Technology Readiness Level

Previous projects

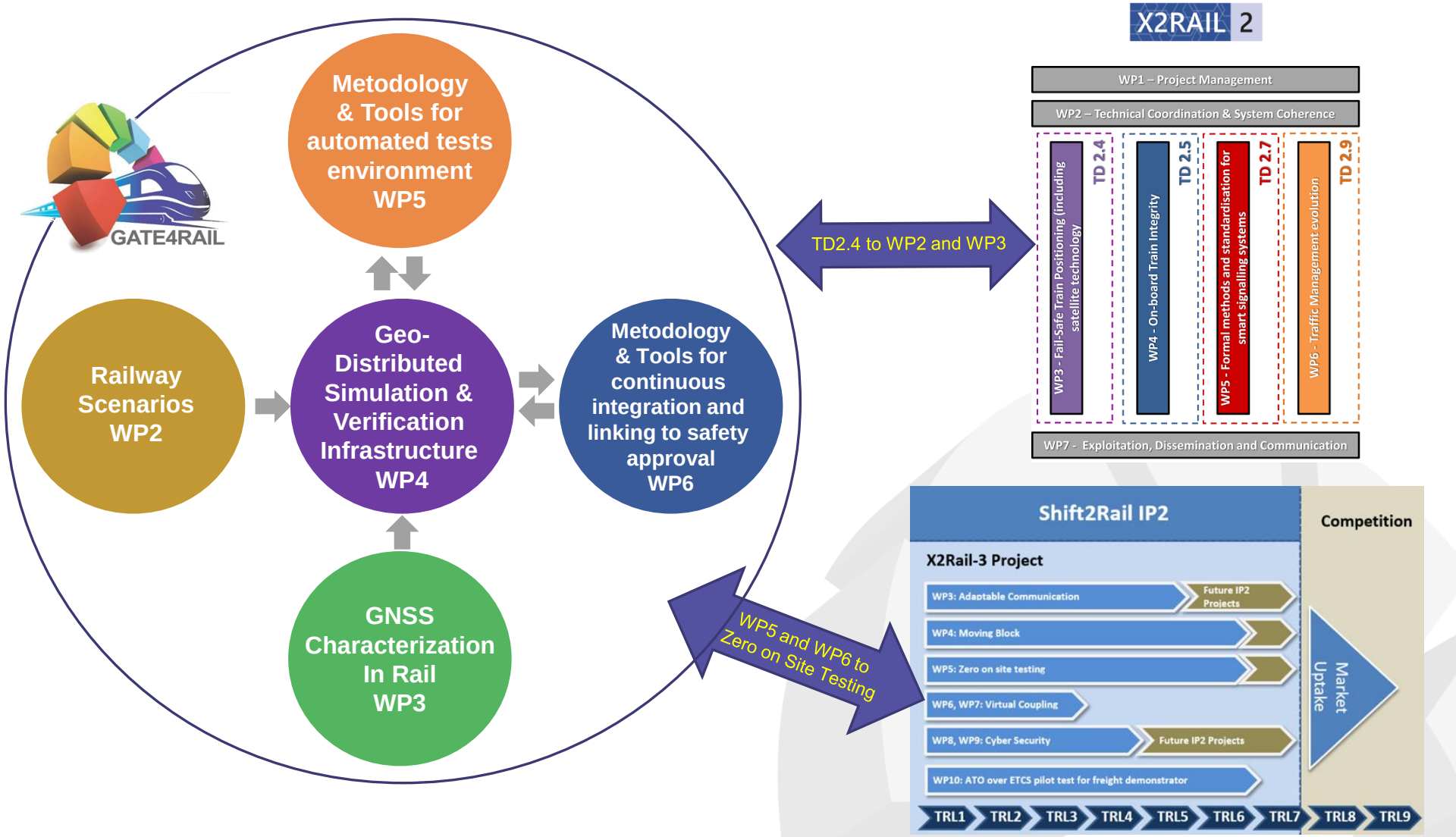
## GATE4Rail

1. *Characterization of GNSS behaviour in the railway environment*
2. *Development of geo-distributed virtualized testing facilities*
3. *Automated update of test environment*
4. *Automated test repetition and evaluation*
5. *Link with Safety Assessors Requirements*

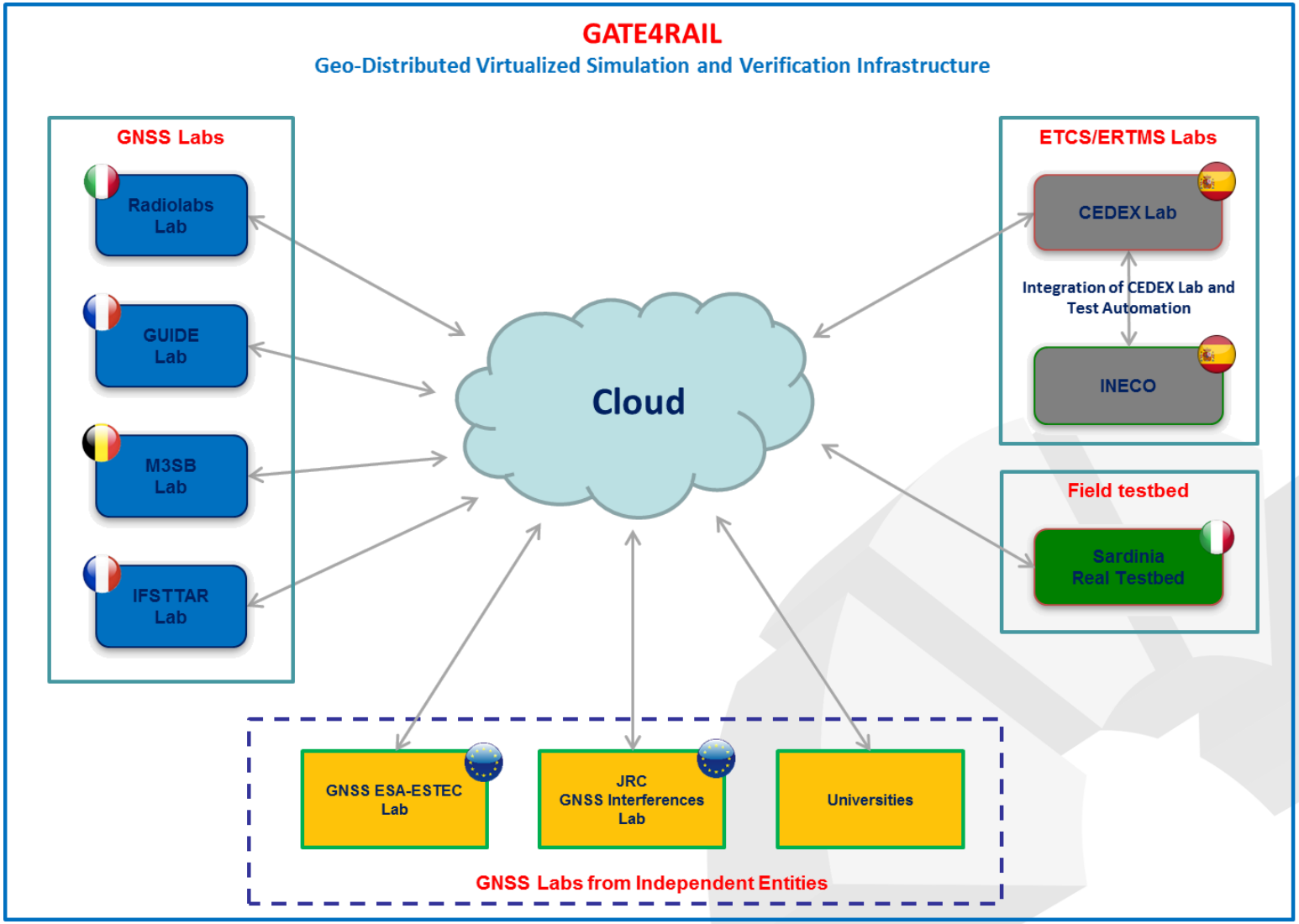
Geo-distributed Virtualized test bed

TRL1 > TRL2 > TRL3 > TRL4 > TRL5 > TRL6 > TRL7 > TRL8 > TRL9

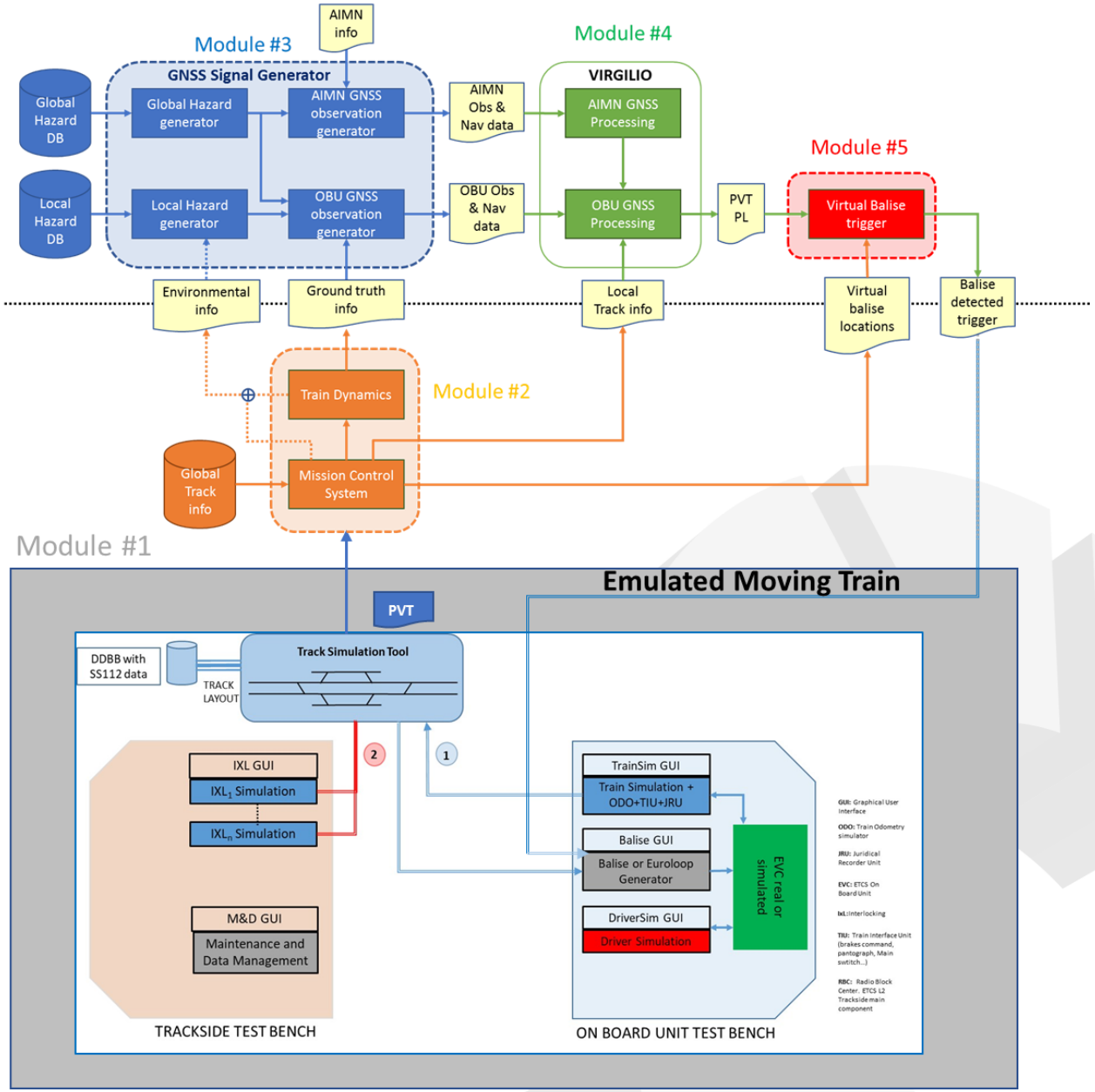
# Interaction with X2RAil-2 and X2RAil-3



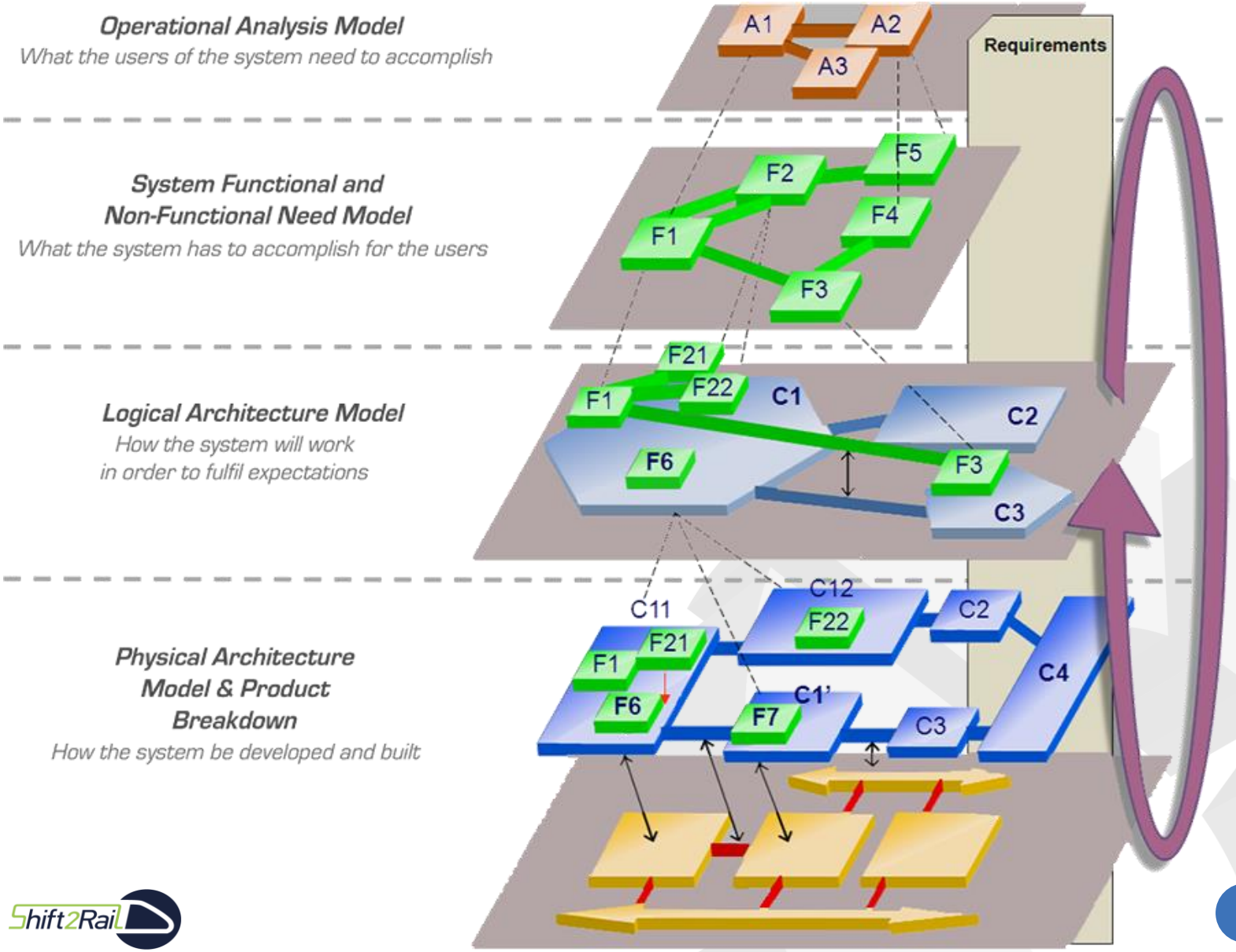
# Geo-distributed Infrastructure Concept



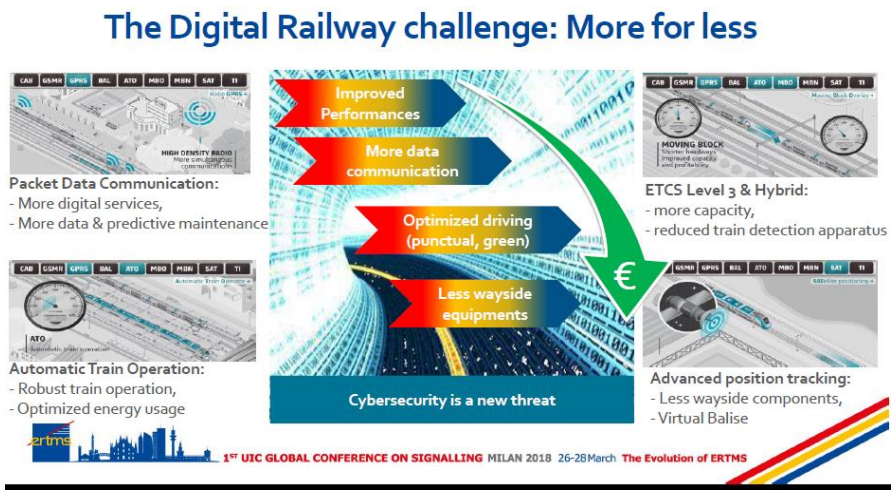
# Geo-distributed Infrastructure Architecture



# Model Based Design Engineering



# Ambition




*The evolution of the ERTMS, ref: Casazza, Radomiak, Mindel - 2018*

*Gate4Rail Ambition pillars*

# Impact to the Work Programme

| Impact in the topic | In the project |
|---|---|
| The introduction of GNSS in railway system as a new technology for a fail-safe train positioning system is expected to increase line capacity, reduce installation (CAPEX) and maintenance costs (OPEX) for the application of ERTMS to new railway segments. | • Increase the know-how on GNSS characterization in the railway environment considering the different market segments<br>• Develop testing tools in order to reduce experimentation costs and time to market. |
| **Regarding the work stream 1** | |
| Achieve a realistic characterization of the railway environment in terms of railway and GNSS infrastructure able to evaluate performances and properties of some fail-safe positioning components with respect to normal and specific failure conditions | • Increase the know-how on GNSS behaviour in the railway environment, its modelling and the simulation of fault (multipath and interferences).<br>• Develop GNSS simulation tools capable of simulating global and local faults in train positioning algorithms and their end impact on VB detection. |
| Simplify the analysis of the pros/cons for the GNSS application according to the different lines characteristics and market segment | • Contribute to the definition of the applicability of GNSS according to the **characteristics of line** (regional, urban, sub-urban, freight, high-speed) and **railway local environment** taking into account SIL-4 requirements and different railway operational phases (Movement Authority, Staff Responsible and Start of Mission). |
| Set-up of a geographical and distributed infrastructure able to verify and take advantage from the results of the existing laboratories. | • Define **over Europe a geo-distributed simulation and verification infrastructure (first in the world) connecting GNSS and railway different modules,** together with the latest technological evolutions, and able to evaluate the performance of the complete chain and the end-effect of GNSS on VB detection. |

# Impact to the Work Programme

| Impact in the topic | In the project |
|---|---|
| **Regarding the work stream 2** | |
| The development of a zero-on-site testing environment. Need for a simulation architecture capable of staying in line with the latest evolutions (software and hardware) and avoid unused due to obsolescence. | • Definition and implementation of a dedicated MSBE approach to ensure the development of a Geo-Distributed Simulation and Verification Infrastructure definition, design, development and testing. |
| Reduce costs and improve efficiency for testing technologies and their evolutions and for planning maintenance and replacement activities on the line. | • Definition and implementation of a methodology and tools for assuring automatic test repetition and analysis of their results.<br>• The **MBSE approach** will ensure that the system can be easily upgraded to stay up-to-date, will increase the efficiency of test resources management, and reduce the need of real lab equipment due to acquisition, maintenance |
| Contribution of the necessary safety integrity level | • The simulation infrastructure will allow **simulating rare events**, as well as various configurations encountered in the railway operational environment. **It will allow characterizing the safety level of a solution with large data sets that could not be obtained by experimentation**.<br>• The methods and tools for test environment and needed upgrades implementation will be defined taking into account a **set of common requirements for notified body approval**. |
| Performing tests of innovative products and services using up-to-date simulation environment in order to support new (type) approval processes or even a harmonised European approval process in the context of control, command and signalling systems. | • Definition of **methodology and tools for upgrading the test environment**, as well as the test candidate approvable by an independent safety assessor. |

# Metrics to Measure Impact

| Expected Impacts∑ | KPI name | KPI Description | Target Value | Evaluation phase | |
|---|---|---|---|---|---|
| | | | | PoC | Final Demo |
| Stream 1 | | | | | |
| Development of the GNSS as planned in MAAP | | % of local and global GNSS hazard models in railway included in GATE4RAIL wr.t. all possible cases | >80% | x | |
| Simplify the analysis of the pro/cons for the GNSS application according to different lines characteristics and market segments | System Scenarios Coverage Grade | % of railway scenarios (operational phases), kind of lines (regional, urban, suburban, high speed), kind of motive power, and different market segments to be analysed wr.t. total possible configurations | >70% | x | |
| Help the characterization of the architecture to achieve optimized balance between the constrains due to the lines and the railway environment and the maximisation of the performances | System Architectures vs. Coverage Grade | % of system architectures (in terms of GNSS frequencies, constellations (GPS and GALILEO), kind of augmentation networks (EGNOS-based, DGPS and RTK), on-board fault detection and exclusion techniques, ETCS Levels) that can be tested through GATE4RAIL | >80% | x | x |

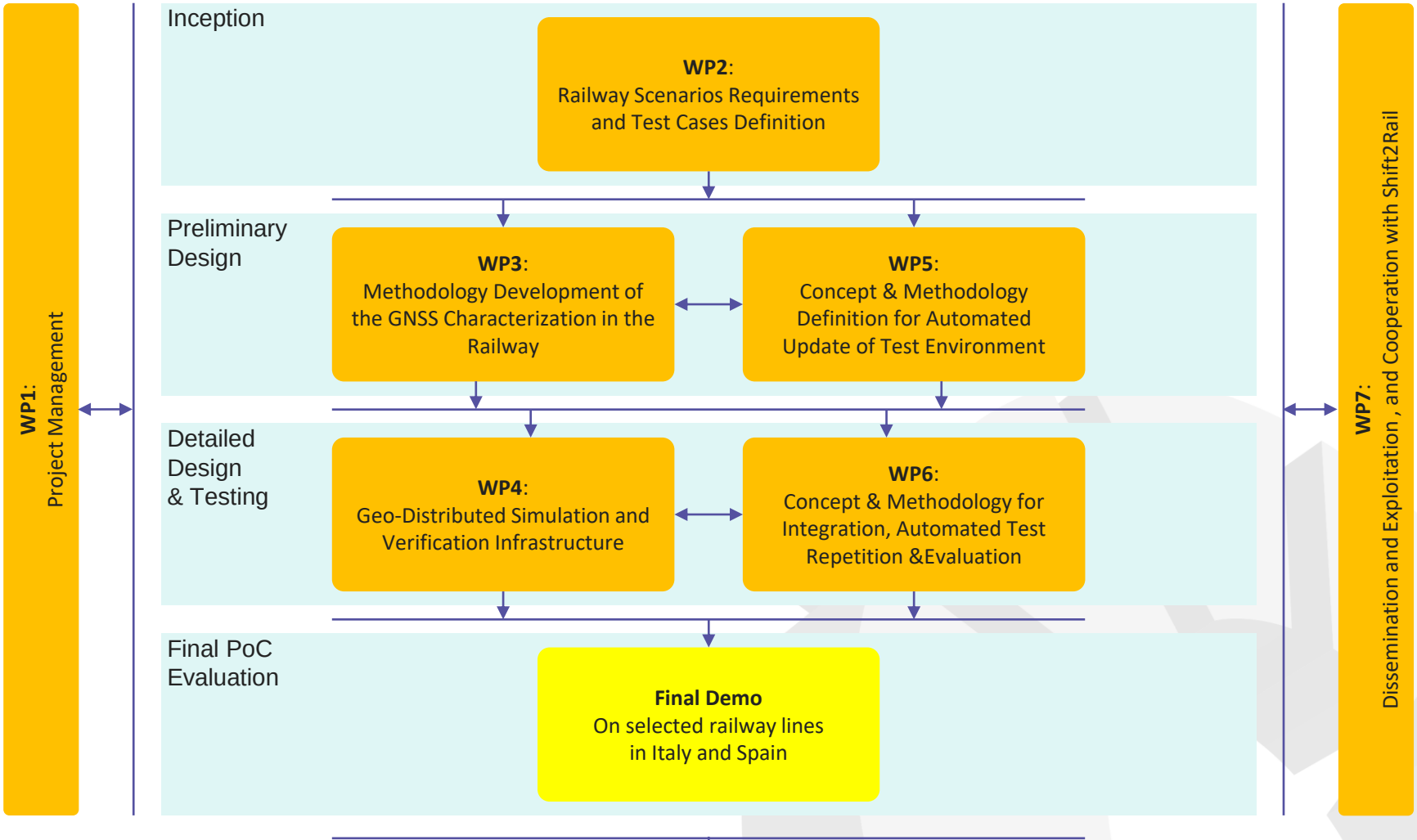
# Metrics to Measure Impact

| Expected Impacts | KPI name | KPI Description | Target Value | Evaluation phase | |
|---|---|---|---|---|---|
| | | | | PoC | Final Demo |
| Stream 2 | | | | | |
| Development of a Zero on-Site Testing environment | Achievable Tests Coverage Grade | Number of tests that can be transferred from field to the lab | >100 | x | |
| Reduce costs and improve efficiency | Tests Solution Gain | % of Time, Cost and Resources saving | >50% (time), >50% (cost), >50% (resource) | x | |
| Decrease of costs of lab resources due to the reduction of real lab equipment needs (acquisition, obsolescence, maintenance, use of energy and space, etc.) and introduction of 'state of the art' technology | System Growth Capability | % of effort reduction to introduce new features and to face H/W and S/W obsolescence | >50% | x | |
| Increase of the efficiency of test resources management | System Flexibility | % of effort and time needed for fully automatic test environment | <80% (effort) <80% (time) | x | x |
| Full accessibility to the test environment available from different locations | System Accessibility | % of effort and time reduction for fully geographical accessibility to test environment | >50% (effort) >50% (time) | x | |
| Support of the necessary safety integrity level. | SIL Readiness | % of remaining effort required for safety approval | <30% | | |

# Metrics to Measure Impact

| Expected Impacts | KPI name | KPI Description | Target Value | Evaluation phase | |
|---|---|---|---|---|---|
| | | | | PoC | Final Demo |
| Dissemination | | | | | |
| Publication Index | | Number of publications fostering GNSS characterization in the railway and automatic test environment | ≥5 publications | | |

# Work Logic


WP1:
Project Management
Inception
WP2:
Railway Scenarios Requirements and Test Cases Definition
Preliminary Design
WP3:
Methodology Development of the GNSS Characterization in the Railway
WP5:
Concept & Methodology Definition for Automated Update of Test Environment
Detailed Design & Testing
WP4:
Geo-Distributed Simulation and Verification Infrastructure
WP6:
Concept & Methodology for Integration, Automated Test Repetition &Evaluation
Final PoC Evaluation
Final Demo
On selected railway lines in Italy and Spain
WP7:
Dissemination and Exploitation , and Cooperation with Shift2Rail

QUESTIONS?