

# RAILWAY INTEROPERABILITY LABORATORY (LIF)

2024 Activity Report

## *“Towards a Testing Environment Adapted to New Solutions in Railway CCS”*

Year 2024 marked the beginning of technical activities at the **Railway Interoperability Laboratory (RIL/LIF)** of **CEDEX** aimed at developing a testing environment capable of integrating new and innovative technological solutions within the railway **Control, Command, and Signalling (CCS)** subsystem, particularly those revolving around the ERTMS signalling system.

The laboratory’s objective, with a timeline extending to the end of 2031, is to expand its digital testing platform in combination with **Hardware-in-the-Loop (HiL)** systems. Until now, this platform has focused on ETCS component conformity testing and system-level compatibility and interoperability tests between trackside (ETCS TS) and onboard (ETCS OB) components.

This expansion aims to **introduce new functionalities** related to Advanced Safe Train Positioning (**ASTP**), moving block systems (**MB**) associated with train protection, and communication links for simulating **FRMCS** (Future Railway Mobile Communication System)-based alternatives to GSM-R for information exchange between trackside and onboard **ETCS** equipment.

This new phase is comparable to the early years of ERTMS deployment in Spain and the adaptation of test benches at our Center to support a testing platform that enabled early-stage **interoperability and compatibility assessments** between trackside and onboard equipment in multi-supplier contexts.



Now that the **ETCS system** has stabilized in terms of standards and specifications—beyond version compatibility—a range of new technologies is emerging around it. These are being developed as prototypes by technology providers to address use cases and operational needs defined by end users such as infrastructure managers and railway operators. These needs are outlined in flagship projects under the Innovation Pillar and standardized through the System Pillar, both part of the governance structure of **Europe's Rail Joint Undertaking (ERJU)**.

During this period, our laboratory must align with these developments by designing appropriate test architectures and new generations of test benches and modules compatible with future versions of the Technical Specifications for Interoperability. The standardization of these new CCS solutions is expected to take several years, until the prototypes reach sufficient **Technology Readiness Levels (TRL)** for operational deployment.

In any case, during this year, the laboratory has begun its development by incorporating a **GNSS signal simulation and generation system**. This equipment is essential for validating future ASTP modules, which ensure **the safe positioning of ETCS systems** installed on trains.

In future updates, this satellite simulation system is expected to connect with test benches and railway traffic simulators to enable subsystem-level integration. In a first phase, a reliability study was

conducted on the positioning tools of existing ETCS test benches (odometry and balise simulators) for integration with the **SkyDel satellite simulator**, along with the implementation of a test management system for conducting tests on ASTP components and other GNSS receivers used as references.



*Interfaz gráfica de Skydel (fuente: Manual de Skydel, 2024 Safran)*

Also, this year, LIF has continued dedicating a significant portion of its staff to **ERJU projects**, as in the previous year. LIF's participation has remained focused on **Flagship Projects (FPs) 1, 2, and 6**.

In **FP1**, efforts have continued in work packages (WPs) related to Digital Twins and harmonization of railway line data formats.

In **FP2**, activities have focused on satellite technologies and enhanced odometry systems, as well as centralized digital records of trackside and onboard information, serving ETCS and ATO (Automatic Train Operation) modules. In November 2024, a task related to test specification and architecture was completed, leading to the start of **implementation and certification activities within WP34 on Testing, Validation, and Certification**.

In **FP6**, the definition of key use cases for regional services has been completed. These will be developed and validated in application scenarios by various demonstrators and prototypes of innovative solutions for ATO at Grades of Automation 2 and 3/4, advanced train positioning (ASTP), moving block, and **new adaptive communication systems around ERTMS and ATO**.

Additionally, within its broad portfolio of European projects, a new project coordinated by the Italian infrastructure manager (RFI) has been granted, involving various railway sector entities, universities, and European research centers, including LIF.

At the national level, R&D activity has continued through collaboration with ADIF on two ongoing assignments. One involves the **development of a cost-optimized regional ERTMS** to reduce signalling and infrastructure assets, incorporating new ERTMS functionalities. The other focuses on railway digitalization through the development of a self-propelled inspection vehicle equipped with sensor technology to identify and store infrastructure and signalling elements of a regional line in common formats.

In more traditional areas of activity, the laboratory completed a new series of validation tests in 2024 for the **certification of industrial onboard ERTMS equipment** (Bistandard ERTMS/TVM Version 9.3A-RC2.1), used in French high-speed trains. Additionally, the update of the Test Specifications (SUBSET-076) was completed in accordance with ERTMS Baseline BSL 4,

in which LIF participates as part of the European Association of Accredited Laboratories (EAL).