



ERTMS Trackside Certification by an Unmanned Railway Vehicle  
**TINO – *Train for INspection Of railway***

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# TINO – Train for INspection Of railway

Main features of the Unmanned Railway Vehicle prototype

## Performance:

- Vmax 200Km/h
- 4 hours autonomy

## Mechanical Design:

- Design approved for high-speed lines
- Hybrid powertrain

## Autonomous Systems and Signalling:

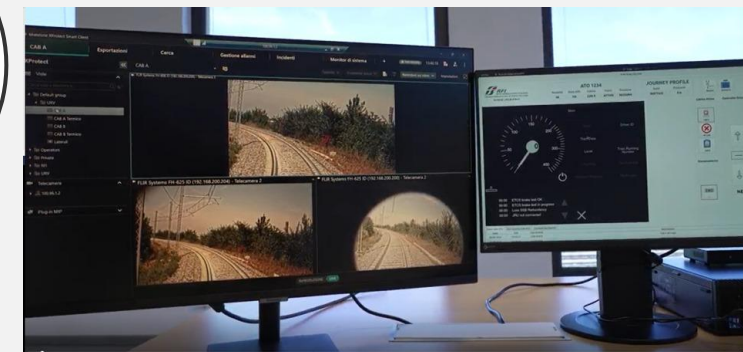
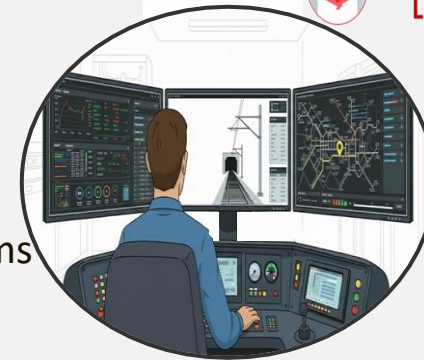
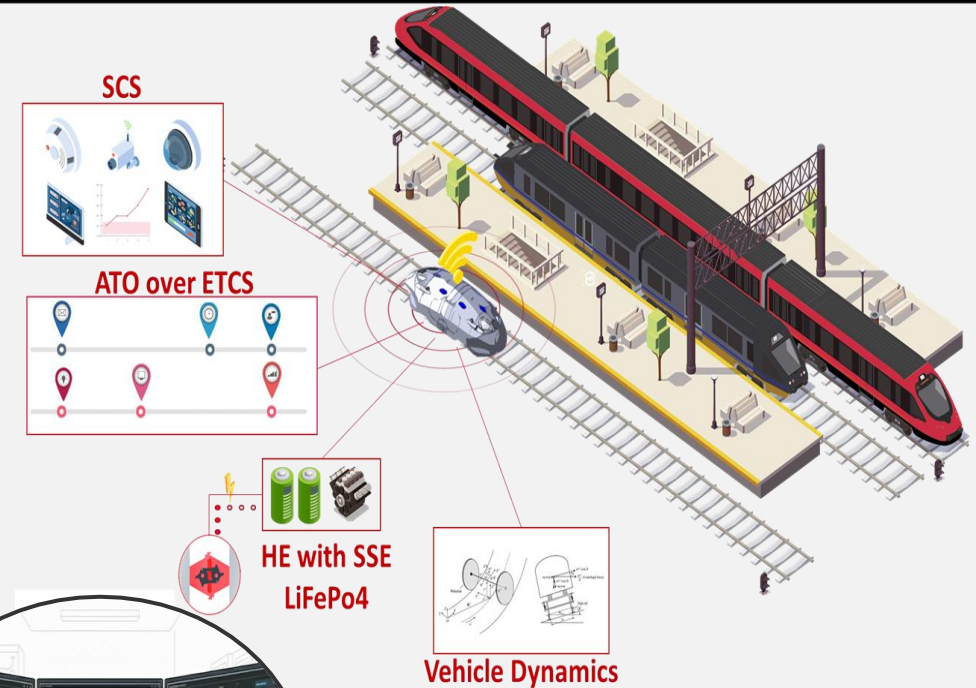
- Equipped with ATO (GoA 4)
- Equipped with Hitachi ETCS BL3

## Vision Systems:

- Long distance and perimeter vision
- Object and anomaly detection using artificial intelligence algorithms

## Remote Control:

- Equipped with remote control functions through the dedicated operator interfaces



# TINO - Train for INspection Of railway lines

URV – Unmanned Railway Vehicle - ATO Grade of Automation 4 (GoA 4)

The TINO/URV vehicle is the first prototype of a fully autonomous railway vehicle built by RFI to travel on Italian HS/HC lines, as a "relay" train , reactivate lines after critical seismic or atmospheric events, certify lines under construction (e.g.: ERTMS ground-on-board integration)

## Mechanical/electronic/IT project status

Ground/edge integration tests and dynamic tests carried out on the roller bench in Florence Osmannoro

The hull was mounted according to a scheme similar to that of the Diamante diagnostic train

Preliminary movement tests carried out on the pitch on the Bologna San Donato circuit

## Innovative features

- ✓ Hybrid drive system: battery and endothermic range extender
- ✓ Charging via coupler
- ✓ Vehicle-specific driving dynamics
- ✓ ATO-over-ETCS system enabling GoA-4 management
- ✓ Artificial Intelligence applied to vision algorithms for obstacle detection



# Tino Features



ATO 1234  
VER. 01.2021.11\_10 Rev 0

Driver ID: 06.04.2023  
User Role: 12:04:45

Main: 46  
SP: 00:00:00  
ATQ: 00:00:00

SE EG 45 Km/h 0.10813 Km

Train Active Cabin: CAB 1  
Direction Controller: FW  
Virtual Speed Lever: 0 Km/h

ATO Events	Date	Remote	Time	Type	Description
	06.04.2023		11:59:29	ATO STATE	ATO state switched to BO
	06.04.2023		11:59:29	THB STATE	THB active
	06.04.2023		11:59:30	ATO STATE	ATO state switched to CO
	06.04.2023		12:00:59	MISSION	Journey Profile Request received...
	06.04.2023		12:03:48	ATO STATE	ATO state switched to AV
	06.04.2023		12:05:18	ATO STATE	ATO state switched to BF



# Automatic Train Operation and Remote Control

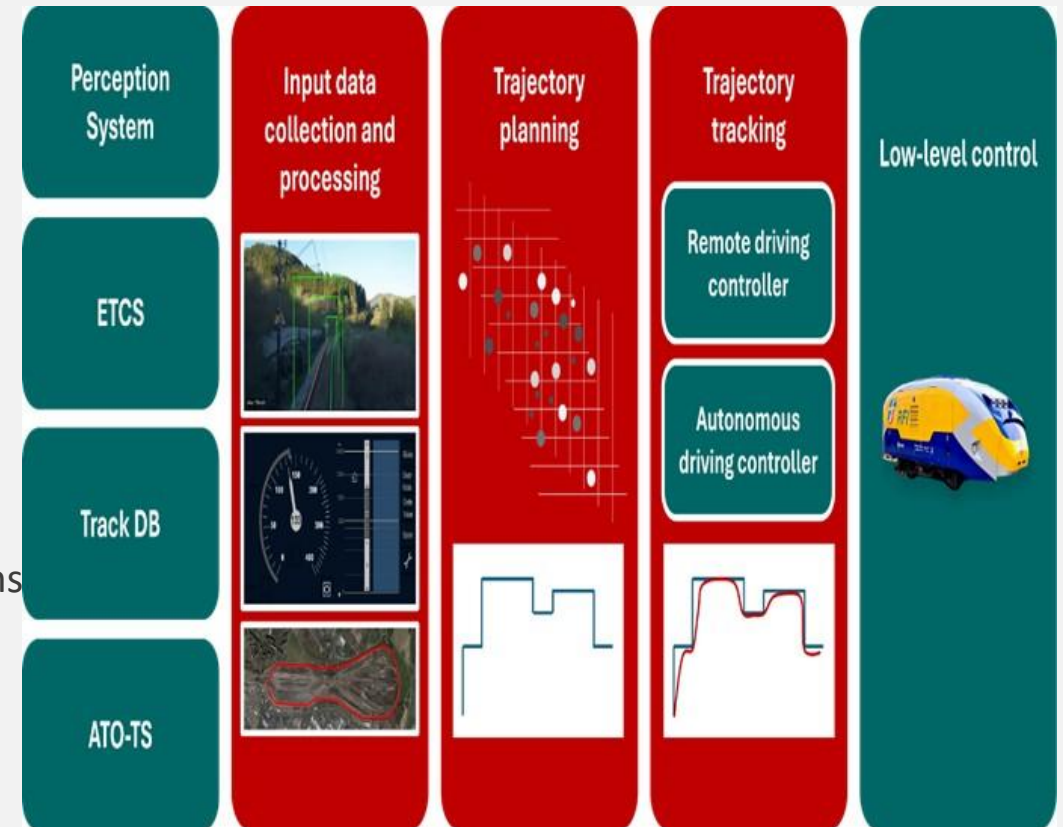
## Functions of TINO

The **Automatic Train Operation (ATO)** implements autonomous driving function to guarantee:

- Compliance of the journey profile with timetable, constraints imposed by the ETCS system and physical constraints of the train
- Real-time replanning based on vehicle and line conditions
- Energy efficiency in accordance with the travel profile

TINO can be **managed remotely from the control center** through the following functions:

- Mission management: operator assigns the journey profile
- Remote driving: operator controls the vehicle through real-time vision systems
- Autonomous driving: operator engages autonomous driving
- Diagnostics: operator monitors the status of the vehicle



# On Site ERTMS Trackside Certification: by almost two different Train Test

AS-IS Model

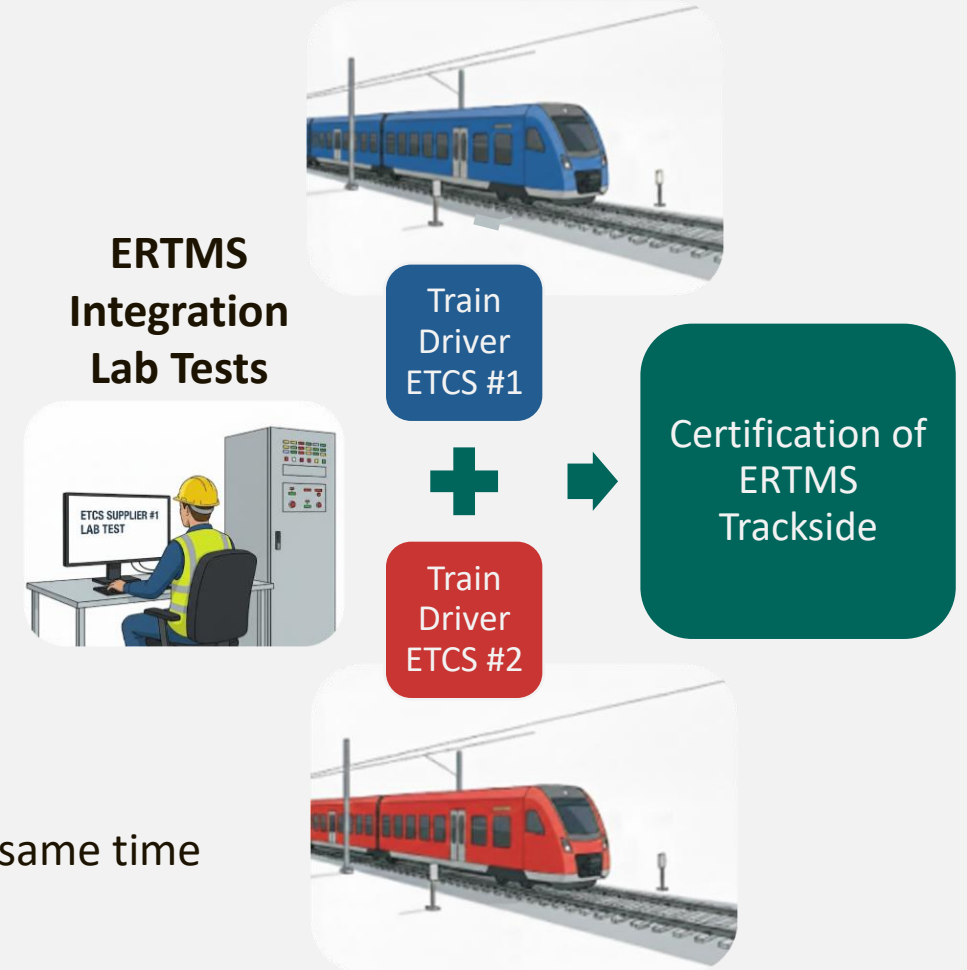
Today ERTMS Trackside is certified by lab test and field tests with 2 different ETCS on-board suppliers

- Validation of communication via GSM-R, transmission and reception of ETCS telegrams, system response to operational scenarios such as speed limitations and signal management
- Analysis of system performance in critical situations, such as emergency braking and signal loss
- ETCS logs for 2 suppliers are analyzed to verify compliance with technical and interoperability requirements

For **many ERTMS lines** to be realized:

- ⚠️ ▪ IM has to organize and rent **many trains and many drivers** at the same time

## ERTMS Trackside Field Tests



# ERTMS Trackside Certification by TINO

TO-BE Model

## New Idea:

- TINO replacing trains and drivers rented by operators (e.g., Trenitalia)

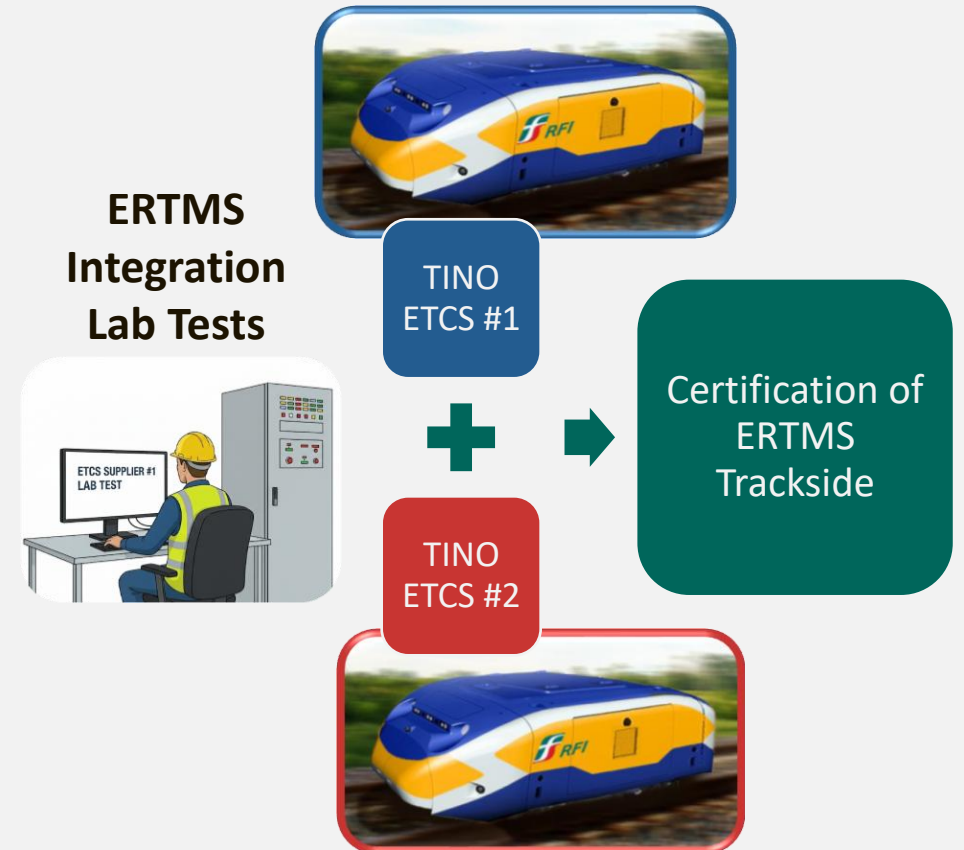
## Advantages:

- Reduction in the cost of renting trains and drivers
- Reduction of logistical complexity and coordination with railway operators
- **Automation of ERTMS trackside field testing** for high-speed lines and traditional lines which shall be equipped with ERTMS BL3
- Real-time data analysis to ensure test accuracy and reliability

## Main Challenges:

- TINO certification ongoing by NoBo
- Realize another TINO with a different ETCS supplier

## ERTMS Trackside Field Tests



# ERTMS Ground On-Board Testing and Integration: Different solutions for RFI

- 1) **Laboratory testing** of RFI independent from suppliers in RFI Lab in Rome with Target Machines and Simulators: assessment tests on new General Ground and On-Board Applications and their configuration
- 2) Dynamic field tests with reference ERTMS L2 Trackside at the **Dynamic Lab** of **Circuit of S.Donato Bologna** for integration with new ERTMS On-Board Applications
- 3) Dynamic tests on line with ERTMS Trackside under construction for its certification with **ERTMS on-board applications reference. Use not only of real trains but also URV/Tino equipped with certified ERTMS for "Tele-Test"**



# AS IS → To Be

## AS-IS

### Laboratory tests

Simulation of the technical configurations of the line to preliminarily verify the compatibility between shore and on-board subsystems

### Field tests

- **Regularity races:** Use of real trains on routes equipped with ERTMS Baseline 3 to verify the functionality of the system under operational conditions
- **Parameter monitoring:** Track-to-train communication via GSM-R, transmission and reception of ETCS telegrams, system response to operational scenarios such as speed changes and signal management
- **Safety validation:** Analysis of system performance in simulated critical situations, such as emergency braking and signal loss
- **Data collection:** Ride logs are analyzed for compliance with technical and interoperability requirements



## TO-BE



### Mission Preparation

Definition of the route, the technical specifications to be verified and calibration of the sensors/systems necessary for monitoring and data collection



### Mission execution

- Tino carries out the tests and inspections independently along the line to be certified
- Verify the compliance of the lines with the technical specifications of Baseline 3



### Data analysis and reporting

- Real-time data collection during the mission, including technical parameters and infrastructure conditions
- Analysis of the data collected to verify compliance with the technical specifications of baseline 3 to support the review of the results

## Benefits



### Cost reduction

Reduce train rental costs and optimize resources



### Operational efficiency

Reduction of logistical complexity and coordination with railway operators (e.g., Trenitalia for train transport)



### Precision and reliability

Real-time data analysis to ensure test accuracy and reliability

# See you a Innotrans 2026

