PROJECT

TREND

Test of Rolling Stock Electromagnetic Compatibility for cross-Domain interoperability

**Funding:** European (7th RTD Framework Programme)
**Duration:** Nov 2011 - Apr 2014
**Status:** Complete with results
**Total project cost:** €2,825,600
**EU contribution:** €2,042,026

**Call for proposal:** FP7-SST-2011-RTD-1
**CORDIS RCN:** 99923

**Background & policy context:**

Currently rolling stock electromagnetic emissions is a major concern for train manufacturers and railway infrastructure operators [ERA EMC Report 2010]. Available harmonized EMC standards (EN50121-2, EN50121-3-1 and EN50121-3-2) do not completely address interoperability issues caused by rolling stock interferences with signalling systems (GSM-R, BTM, LTM and STM). Moreover, these standards do not cover representative worst-case conditions derived by transients in the rolling stock behaviour typically generated by feeding and track circuits' discontinuities.

On one hand this situation causes an important waste of time and resources for train manufacturers when integrating rolling stocks and signalling systems. And moreover in already tested trains, occasionally problems may still arise. Then, not only the responsibilities but also the technical solutions are not straight forward. The duration of the field testing employed to solve this kind of problems and to go through the certification process may vary between 3 months and 12 months. And the cost of the complete process may vary between 25k€ to 1,5M€ [ERA EMC Report 2010].

On the other hand, railway infrastructure operators suffer the railway infrastructure availability reduction caused by the rolling stock electromagnetic incompatibility with the safety critical signalling systems. The previously commented problems might cause an estimated reduction of 10% of the availability in the most crowded lines.

**Objectives:**

TREND project has the objective to progress beyond the state of the art, addressing this situation by means of the design of a test setup and a test procedure that enable the harmonisation of freight and passengers rolling stock approval tests for EMC, focusing not only on interferences with broadcasting services but also on railway signalling systems.

TREND will also identify and design the cross acceptance test sites on electrified and non-electrified lines that reproduce representative worst case conditions for steady state and transient behaviours. These worst case conditions will be obtained thanks to the electromagnetic modelisation of the rolling stock within the rail and feeding infrastructure.

The dissemination of the project outcomes is the last objective of the project. Thanks to this, the impact of TREND embraces the terms safety, availability and economy, and is addressed to the main stakeholders in the European railway industry: web page, 9 contributions to technical journals, 2 workshops for companies, 2 courses for professional advancement and students, the creation of an advisory board and of course concrete proposals for enhancing EMC standards and Technical Specification for interoperability.

The medium size TREND consortium is formed by CEIT (S); CAF (S); CEDEX (S); IFSTTAR (F), Y-EMC (UK), TV (S) and LTU (S), which guaranties a more efficient coordination. Such consortium presents unique features in terms of technical competence, representation of the complete value of chain, quality assurance and research orientation.

**Methodology:**
The thorough analysis comprises measurement, modelization and safety and availability analysis of the effect of rolling stock's EMIs on the neighbouring systems. The system potentially affected by these EMIs will be completely covered. These are classified in four research areas: spot signalling system (which includes BTM, LTM and STM), track circuit, GSM-R and broadcasting services (which include TV, radio, Freight RFID, WFi and GSM). This complete physical environment will permit a precise analysis of the EMI coupling model affecting the whole communication systems. Thanks to the safety and availability model of the communication systems, TREND will design a test procedure that recreates representative worst-case for the rolling stock electromagnetic emissions that could affect interoperability including transient phenomena.

**Parent Programmes:**
FP7-TRANSPORT - Transport (Including Aeronautics) - Horizontal activities for implementation of the transport programme (TPT)

**Institute type:** Public institution

**Institute name:** The European Commission

**Funding type:** Public (EU)

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**Lead Organisation:**

**Asociacion Centro Tecnologico Ceit**

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http://www.ceit.es

**EU Contribution:** €424,573

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**Partner Organisations:**

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**EU Contribution:** €305,115

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**Centro De Estudios Y Experimentacion De Obras Publicas**

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**EU Contribution:** €193,855

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<table>
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<th>Organisation Website:</th>
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**EU Contribution:** €352,548

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**Organisation Website:**
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**EU Contribution:** €305,940

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**Technologies:**

- Electromagnetic fields
- Electromagnetic interference testing

**Development phase:** Research/Invention

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**Key Results:**

**Safer European railways**

A European project sought to improve the test definition to ensure interoperability of trains taking into account the ERTMS Level 1-2 communications and signalling systems.

The electromagnetic interferences of trains themselves with multiple railway signalling and communication systems has become an important concern for rolling stock manufacturers and rail infrastructure operators. Available harmonised standards for electromagnetic compatibility (EMC) amongst existing railways do not ensure interoperability between trains and signalling systems. This situation causes significant losses in time and resources for manufacturers, both in terms of system integration and track signalling and might be a risk for operators.

Funded by the EU, the project ‘Test of rolling stock electromagnetic compatibility for cross-domain interoperability’ ([http://www.trend-eu.org/](http://www.trend-eu.org/)) (TREND) studied and designed the specified test sites and test setups that enables harmonising freight and passenger rolling stock approval tests for EMC focusing on interferences with communication and railway signalling systems, reproducing...
representative worst-case conditions for steady-state and transient short-circuit currents.

Dedicated 3D electromagnetic model have been dedicated to each one of the communication and signalling systems of the rolling stock and the rail infrastructure. There were classified in four categories: spot signalling (balise transmission module), direct-current track circuit, Global System for Mobile Communications – Railway (GSM-R) and broadcasting service systems. Thanks to the safety and availability requirements of these systems, TREND defined the test procedure that recreates representative worst cases, concerning the rolling stock electromagnetic emissions that could affect system interoperability, including transient phenomena. Actually the specific study of the transient signals into their time-frequency footprints has been the key stone of the scientific step forward of the project.

Railway transport is a key area of development from an economical and environmental point of view. The steps taken by TREND should help reducing the time to market of the equipped rolling stocks, improve the availability of railway infrastructure and passenger safety. Furthermore, enhanced interoperability and cross-operation between different rail networks is crucial to avoid obstacles found in the use of large European lines and of equipment from different suppliers.

Documents:
- Final Report Summary - TREND (Test of Rolling Stock Electromagnetic Compatibility for cross-Domain interoperability)

STRIA Roadmaps: Vehicle design and manufacturing, Network and traffic management systems
Transport mode: Rail transport
Transport sectors: Passenger transport, Freight transport
Transport policies: Societal/Economic issues
Geo-spatial type: Other