

	<p><b>EC Competitive and Sustainable Growth Programme</b></p> <p><b>Contract:</b> GRD1-40230-2001-SI2.324586</p>	<p><b>Ref.:</b> GADEROS-INE-WP0-MGT-01</p> <p><b>Issue:</b> 1.0    <b>Date:</b> 1/04/02</p> <p><b>Status:</b> Public</p>
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**GADEROS**

**Galileo Demonstrator for Railway Operation System**

Project Overview



**EC FIFTH FRAMEWORK PROGRAMME**  
**COMPETITIVE AND SUSTAINABLE GROWTH**  
**(GROWTH) PROGRAMME**



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### Approval of the Document

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## 1 INTRODUCTION

### 1.1 Purpose

The GADEROS project (GAlileo DEMonstrator Railway Operation System) is aimed at demonstrating the use of GNSS Integrity and Safety of Life service characteristics for defining a satellite-based system to perform train location for safe railway applications.

This document gives a general overview of the objectives and workplan of the project, describing the work packages and the schedule.

### 1.2 Intended audience

This document is open to all public.

### 1.3 Associated documentation

- [1] GADEROS Contract: GRD1-40230-2001-SI2.324586
- [2] GADEROS Documentation Plan, GADEROS-INE-WP0-DEL-20, Iss.1.0

### 1.4 Acronyms

APOLO:	Advanced POsition LOcator system
ERTMS:	European Rail Traffic Management System
ESTB:	EGNOS System Test Bed
ETCS:	European Train Control System
EU:	European Union
GADEROS:	GAlileo DEMonstrator Railway Operation System
GNSS:	Global Navigation Satellite System
UIC:	Union Internationale des Chemins de Fer

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## 2 OBJECTIVES OF THE PROJECT

### 2.1 Overall objectives

GADEROS is aimed at demonstrating the use of GNSS Safety of Life features for defining a satellite-based system to perform train location for safe railway applications, which is to be integrated into ERTMS/ETCS European railway architecture. The system will offer another technological approach for the train location function, mainly for conventional and low density traffic lines. The demonstration on a Low Density Traffic Line, through tests on a number of prototypes developed by other projects outside GADEROS, will provide real-life implementation of train location based on a GNSS receiver with integrity and augmentation.

The GADEROS project proposes:

- Definition of a common functional core and a common interface for the train location functionality integrated in the ERTMS/ETCS.
- Development of a common test scenario and the evaluation procedures that will be used in the different EC and ESA projects that are developing different Railways applications.
- Development of simulation procedures based on an existing ERTMS/ETCS simulator (levels 2 and 3) to demonstrate the interoperability and compatibility of satellite based location with the ETCS KERNEL.
- Setting up of the test bed.
- Trials on at least one prototype.

The GADEROS projects intends to constitute a common test facility so any GNSS locator prototype for railways (within project budget constraints) could come to be tested at it to demonstrate the compatibility with the functional interface defined in GADEROS to be integrated in ERTMS/ETCS. The work will be done maintaining a good coordination with the other related railway projects. It is not an objective of GADEROS to develop a GNSS locator.

### 2.2 Scientific and technological objectives

Five scientific objectives are addressed:

1. Definition of the Users Requirements focused on low traffic lines to be satisfied by the GNSS application, including as input the User Requirements from other related railway projects, in order to define a common ground for this type of application. These requirements will be discussed in a workshop with the other projects and stakeholders.
2. Development of principle, conception and architectures for the GNSS component in the ERTMS/ETCS architecture, to reach the Safety Integrity Level requested for the application of the train location function in railway operation systems
3. Development / adaptation of standard test and evaluation procedures for GNSS based trials for railway safety applications.
4. Adaptation of simulation tools, based on existing UIC ETCS simulator level 2 and 3, to provide compatibility and interoperability of train location by satellite with the ETCS Kernel.
5. Development of a reference site for railway safety-related GNSS applications.

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The technological objectives are:

1. Definition of the functional specification to apply to the future prototype equipment of train location by satellite
2. Realisation / adaptation of test support tools (including Digital Route Map, on-board Database, set of qualification criteria and their dynamic update, corresponding software modules and applications within an on-board computing mainframe -portable professional PC for demonstration)
3. Realisation of a functional module for the GNSS component based on existing UIC ETCS simulator software modules, within an advanced PC computing system.
4. Establishing test bed, test specification and test procedures to demonstrate conformity of GNSS locators with ERTMS/ETCS concept and architecture.

### **2.3 Technical achievements**

The expected technical achievements are:

1. Provide the Requirements Specifications for the software qualification tools used in the project, as well as for the data content, structures and qualification criteria of Digital Route Maps, including the update of software procedure specifications
2. Contribute with the technological development for GNSS Locators and for Safety Qualifiers.
3. Requirements Specification for test, verification and evaluation procedures applicable to validations according to EU standards specification relevant to railway safety and under the frame of ERTMS/ETCS Interoperability Directive.
4. Trials and evaluation of at least one demonstrator produced by other projects, funded through EC or ESA projects.

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### 3 PROJECT WORKPLAN

#### 3.1 Proposed approach

The project pursues the integration of the so called GNSS subsystem within ERTMS/ETCS by means of the definition of the functional and interface specification of the navigation module to be used as the reference specification for further developments outside the project. These specifications will be firstly verified using a ERTMS/ETCS simulator platform; afterwards, a real railway environment in the local, low density traffic railway line 310 (Aranjuez – Valencia), in a stretch defined by Aranjuez – Cuenca – Buñol, and within the operational and regulatory framework of RENFE (Spanish railways). The project will design, besides the test specification, test tools and the test procedures. Finally, it will carry out functional evaluation tests on at least one industrial prototype from several possible providers, as the first step towards the certification of a GNSS subsystem within ERTMS/ETCS. The project will take advantage of the APOLO prototype for fixing the test bed.

In the test phase at least one prototype of the SAFETY LOCATORS, realised outside the project, will be tested, verified and evaluated in a range of relevant function scenarios on-board trains. The test, the verification and the evaluation shall highlight:

- The functional interoperability of the different products
- The technical feasibility in a specific railway complex environment
- The achievable performance parameters

#### 3.2 Overall study scheme

The overall study scheme is to:

- Analyse railways needs with regard to train location and identify all the possible applications
- Delimit applications that could be solved with GNSS solution
- Define requirements of these applications
- Define subsystem partitioning and interfaces that satisfy the requirements
- Simulate GNSS locator subsystem conception in an ERTMS/ETCS lab bench
- Adapt the APOLO demonstrator. It will be used to set up and tune the test-bed.
- Integration and trials of different prototypes (depending on budget constraints)
- Evaluate the results
- Disseminate the results

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## 4 DESCRIPTION OF THE WORK

The final outcome of this project will be the definition of unified test scenarios and development of a common test facilities for the execution of common trials for the evaluation of safe location principles of different devices satellite-based in a common controlled environment. The project will also define a common functional requirement specification to integrate the proposed GNSS subsystem into the ERTMS architecture

A set of functional tests on at least one prototype that can be provided by different suppliers will also be executed depending on the devices availability and budget limit.

### 4.1 The GADEROS consortium

The consortium that will carry out the GADEROS project includes nine organisations from four countries. These organisations form a solid critical mass for demonstrating and promoting the new conception at EU level.

The project Co-ordinator is INECO (Spain). The other members of the consortium are European Rail Research Institute (Netherlands), Railway Safety (UK), Nottingham Scientific Limited (UK), THALES Navigation, (France), TIFSA (Spain), GMV Sistemas (Spain), SENER (Spain) and AENA (Spain). Following is a short description of all the partners.

INECO, the Project Coordinator, is a consultancy and engineering firm highly specialised in the transport industry. The activities carried out at INECO embrace all forms of transport. Its staff has accumulated a great deal of experience in planning global and intermodal transport systems, which include railway, airports, air navigation, highways and shipping.

TIFSA is a railway engineering and transport consulting company active in transport consultancy and railway engineering, offering a full range of services, from integral projects to very specific studies. Their main activities deal mostly with transport consulting, railway projects, technical assistance and environmental projects.

THALES Navigation is the European leader and a major player in the world of differential GPS and GNSS systems. Their research and development teams, entirely dedicated to GPS and GNSS activities, are also taking an active part in the GNSS-2 studies for developing the core receiver modules of the current (EGNOS) and future (GALILEO) GNSS-based systems.

The European Rail Research Institute (ERRI) is a foundation under Dutch law within the UIC and it is responsible for carrying out research, studies and tests to advance knowledge of railway technology in fields of common interest.

Railway Safety is a non-profit, wholly owned subsidiary of Railtrack Group PLC. Railway Safety is experienced in the management of safety, the definition of the associated requirements and the production of the associated standards. It enforces the application of those standards. It promotes change on the railway to improve safety. It is the focus for interface matters between infrastructure and rolling-stock.

Nottingham Scientific Limited (NSL) is an associate company of the University of Nottingham, providing a wide range of consultancy services to the space, telecommunications, telematics, and allied industries, with a focus on transport, environmental applications and markets.

GMV Sistemas S.A. is a company within the holding Grupo de Mecánica del Vuelo S.A., particularly oriented towards transportation and telematics markets, having the capability to design, manufacture and commercialise its own products. The two main areas of activity are:

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GNSS-based applications, most noticeably fleet localisation and management systems, and IP networks applications.

SENER is devoted to the development of advanced systems in the aeronautics, marine, industrial and space fields. SENER devotes its entire activity to provide consulting and architectural engineering services in the broadest sense, from feasibility studies to the delivery of turnkey projects. Many space, aeronautic and civil projects have been engineered, developed and produced within SENER.

Aena is the Business Public Entity entrusted with the planning, developing, building, installation, operation and managing of the Spanish civil airports and the air navigation system covering all airspace under Spanish responsibility. Aena, as the Spanish service provider, is deeply involved in the development of GNSS1 and GNSS2 for Europe, both at national and international levels.

## 4.2 Work packages

The GADEROS project is structured in a total of nine work packages, including a work package for project management. The work packages constitute a logical order to ensure the achievement of the technical objectives of the project:

- **WP0: Management & Quality Control.** This work package includes all project-level co-ordination activities in the areas of management and quality control. A robust management structure will co-ordinate and monitor these activities.
- **WP1: User needs identification.** In this activity the needs expressed by the railway user will be analysed through the analysis of the location functionality performed by train control and command applications under the ERTMS/ETCS context. The study will be carried out by railway experts by means of the collection of field information and investigation of operations and infrastructure found in a similar context around Europe, as well as the outputs from other relevant projects. The task will take advantage of other on going projects by means of the co-ordination of the ERTMS Users Group. The goal is to achieve a sufficient level of understanding to facilitate subsequent functional and system analysis.
- **WP2: Subsystem functional requirement specification.** The user needs identified in the previous task will be translated, by functional deployment and structured analysis, to the GNSS locator subsystem requirements. The system will be apportioned and the requirements, parameters and integrity levels attributed to the parts identified. Special attention will be paid to the integration of the subsystem into the ERTMS/ETCS architecture by means of the definition of common interface to guarantee the interoperability of the future GNSS devices. WP1 and WP2 will be carried out in close co-operation with other ongoing projects. The ERTMS Users Group will guarantee the needed co-ordination.
- **WP3: Common test requirements specification.** This work package will provide with the methods and tools definition, as well as the test scenarios specification that allows the demonstration of the interoperability of the GNSS locator subsystem within the ERTMS/ETCS train control architecture.
- **WP4: Test support tools development.** Monitoring tools and the Digital Map to be used during the trials Simulation will be developed according to the WP3 specifications.

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- **WP5: ERTMS/ETCS simulation.** Simulation will be used here as a means to check the feasibility of the location macro-function (GNSS core location function) into the ERTMS/ETCS kernel (using an existing simulator platform).
- **WP6: Common trials.** Not including the test scenario set-up, one trial will be organised using one of the prototypes developed by other projects (more trials can be organised if agreed by the EC and the consortium on the basis of the available resources). The integration effort of the external system to the GADEROS site will be shared between the GADEROS partners and the external provider on the basis of available resources and specific technical knowledge. Different kind of tests, from performance to functional scenarios, will be executed so as to collect data for ulterior analysis. WP 6 is split in two WPs, namely WP6.1: Test scenario set up (using the modified APOLO prototype) and WP6.2: Trials of other industrial devices.
- **WP7: Evaluation of results.** At this stage methods and tools will be used to analyse the obtained bulk data. The evaluation will endeavour to demonstrate the technical feasibility of the GNSS locator subjected to the constraints imposed by devices used for railway safety applications.
- **WP8: Exploitation & Dissemination.** The purpose of this work package is to disseminate the results of the project. GADEROS project's results will be disseminated through forums or workshops organised by the consortium in which the project will be presented. All European organisations will be invited to be informed of the contents of GADEROS. A web site will be developed to facilitate the dissemination of the project.

### 4.3 Work package allocation

WP#	Workpackage Title	Lead Partner	Contributing Partners
WP0	Management & Quality Control	INECO	
WP1	User Needs Identification	RAILWAY SAFETY	INECO, ERRI, TIFSA
WP2	Subsystem Functional Requirements Specification	TIFSA	INECO, ERRI, THALES, RAILWAY SAFETY
WP3	Common Test Requirements Specification	SENER	TIFSA, THALES, ERRI, RAILWAY SAFETY, GMV
WP4	Test Support Tool Development	GMV	THALES, SENER
WP5	ERTMS/ETCS Simulation	ERRI	TIFSA, SENER
WP6	Common Trials	TIFSA	INECO, THALES, ERRI, GMV, SENER, AENA
WP7	Evaluation of the Results	ERRI	INECO, TIFSA
WP8	Exploitation and Dissemination	INECO	TIFSA, THALES, ERRI, RAILWAY SAFETY, GMV, SENER, AENA

#### 4.4 Project schedule

The GADEROS Gantt chart, shown on this page, describes the tasks that will be performed in the context of the overall schedule.

