

D7.3 The project leaflet n°2

Project acronym: **Project full title: EC Contract No.:**

STARS Satellite Technology for Advanced Railway Signalling (H2020) 687414

Version of the document:	03
Protocol code:	STR-WP7-D-UNI-007-03
Responsible partner:	UNIFE
Reviewing status:	Final
Delivery date:	26/11/2018
Dissemination level:	PUBLIC



Agency





This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 687414

CHANGE RECORDS

Version	Date	Changes	Authors
01	16.11.2018	Draft of the Deliverable	J. BERTOLIN (UNIFE)
02	17.11.2018	Revision	UNIFE
03	26.11.2018	Quality Check	RINA-C BE



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1 INTRODUCTION

1.1 EXECUTIVE SUMMARY

The project leaflets are one of the main pillars of the STARS project dissemination and exploitation strategy.

The document summarizes the implementation of the 2nd leaflet describing all the main elements of the leaflet and their functionality.

1.2 DEFINITIONS AND ACRONYMS

Acronym	Meaning

2 INTRODUCTION

STARS Project leaflets are developed and published to disseminate and promote the project during the attended events. Throughout their distribution in public events and congresses, the STARS consortium envisages raising public awareness of the STARS framework.

Two project leaflets will be produced beyond the lifetime of the project to ensure that all the relevant stakeholders of the European rail as well as the space sector are informed about STARS. This second leaflet is produced at the end of the project to highlight the main outputs of the project and their potential impacts.

The STARS second leaflet, which it is described in this deliverable 7.3, seeks to present the main achievements accomplished by the technical work packages, the main results of the project and the exported issues for continuation of work in future projects and initiatives.

3 LEAFLET STRUCTURE AND CONTENT

The STARS leaflet is designed following the colours and the appearance of the STARS logo to maintain the consistency of all the dissemination materials. It has been structured merging text together with graphs to make easier the reading of the brochure as well as facilitate the access to the information.

A portrait orientation and A5 size has been selected from all the possible formats to facilitate the portability and the reading of the leaflet. Six A5 format pages are available to include all the content.



Figure 1: Leaflet Cover







4 COVER

The cover is constituted by three A5 pages. The front and back pages will be visible when the brochure is completely folded whilst the third page will be the first interior page visible when the front cover is opened. This part of the brochure contains the foreword and general information with regards the project and the consortium. The front page is used essentially as leaflet presentation and it contains apart from the logo and the name of the project, an attractive picture to catch the attention of the reader.





PROJECT SUMMARY

Figure 3: Leaflet Front Page



The back page contains general information of STARS such as the contact point of the coordinator and partners represented by their Logo. The website of the project is also included to access to additional information or contact the project.



Figure 4: Leaflet Back Page

The third page of the cover includes the foreword that introduce the STARS project, summarizing the origins, scope and main goals. At the end of the foreword a summary of 2nd leaflet's content is included to present the reader the information that it is going to be found in the interior of the leaflet.





Applications of Global Navigation Satellite System (GNSS) in Railways are become more and more frequent. So far, the focus has mostly been on non-safety related applications, such as in passenger information systems and for freight logistics, which are typically not standardised. When moving GNSS application into the domain of safety, such as for train control systems, a much better understanding of GNSS behaviour is needed.

STARS consortium constituted by 17 partners across Europe with partners from Space and Railway sector are working together to fill the gap between ERTMS needs for safety critical applications and GNSS services, through a characterisation of the railway environment and of GNSS performances assessment in that environment.

The STARS project aims to help the improvement of ERTMS through the application of GNSS, which shall lead to significant economic benefits through reduction of trackside equipment, reduction of maintenance, increase of availability and performance. The application of GNSS shall also make ERTMS more competitive in comparison with competing systems in the world market, leading to increased business opportunities for the European signalling and space industry.

This leaflet summarizes the main achievements and results of the project and proposed further activities for continuing the work in future linked R&D project to pave the way for the safe satellite positioning on railways. Additional and more extended information with regards the achievement, results and recommendation for the continuation of the work could be found in the STARS Final Book.

Figure 5: Leaflet Foreword



5 INTERIOR

The interior includes the more relevant and interested information for the main stakeholders of rail and space sector, main achievements, main results and exported issues. The main achievements are classified by the four technical topics of STARS:

- 1. Measurement campaign,
- 2. Environment characterization
- EGNSS performance and service evolution for safety railway applications
- 4. Economic analysis and EGNSS implementation plan for railway application.

A list of the main results and the exported issues for continuation of the work done in STARS for future projects are also included in the interior of the leaflet.



It has been confirmed that the railway environment is indeed very challenging for GNSS in all but the most open sky environments.



quantified, and attrib-

uted to certain identified

environments.

It has been confirmed that suitable detection functions will



have to be applied to handle

local effects, avoiding using

locally degraded GNSS data.

The usability of GNSS can

be improved dramatically if

EGNOS data is sent by other

means than geo satellites to

the receivers.



The economic benefits of applying GNSS with ETCS (GPS L1 + EGNOS over ETCS radio) are largely depending on the application case.





We have shown that the concept of a MOPS, as available for aviation, is not suitable for the railway environment.



GNSS on a standalone basis cannot provide continuously a PVT solution in the railway environment.



Local effects cannot be managed only in a MOPS, unless worst case values from critical locations are used across entire lines, which degrades the achievable availability dramatically.

As a consequence, maximum local effect needs to be defined and use in SBAS ground segment algorithms. It is also necessary to implement an on-board function to discard the Lines Of Sight that overpass this defined maximum.

Figure 6: Main Results





ENVIRONMENT CHARACTERIZATION

- Methods to identify the presence of the environmental local effect, i.e. multipath, electromagnetic interference and reduced visibility of satellites, from raw signals were developed, tested, qualified and agreed as a reference by the project partners and used to characterize the railway environment.
- Large amount of software code was developed for all the methods which could be further utilized and developed in upcoming projects.
- Significant amounts of the collected data have been analysed with regards to the degrading effect of the various environmental effects, using the developed methods.
- Various local environments degrading GNSS performance have been identified and described.



EGNSS ECONOMIC EVALUATION AND IMPACT ANALYSIS

- Economical benefits from applying GNSS to ETCS have been estimated with GPS L1 + EGNOS distributed over ETCS radio, as EGNOS reception from geo satellites in the railway environment is too limited.
- 2. Migration strategy for applying GNSS/EGNSS to ETCS has been drafted among the project partners.

MEASUREMENT CAMPAIGN

- Measurement procedures / methods for the collection of GNSS data in challenging environments agreed with project partners and established as reference framework to simplify any future GNSS performance measurements in Rail.
- 2. Significant amounts of field data based on these methods in a number of representative environments

collected, with a volume and quality that has so far not

 For the 3 STARS measurement sites the partners Ansaldo STS, AZD and Siemens developed suitable procedures for generating accurate ground truth data, as the basis to verify the achieved performance of GNSS.

been available

EGNSS PERFORMANCE AND SERVICE EVOLUTION

- Good understanding of the behaviour of GNSS in the railway environment has been established between European railway industry partners.
- The coverage with Galileo/GPS and EGNOS has been analysed for many different railway lines, demonstrating that Galileo/ GPS can achieve quite good coverage on many lines, but also that EGNOS coverage from geostationary satellites is only usable under the most favourable conditions.
- It has been demonstrated that, in the railway environment, strong local effect (mainly multipath) as well as the K factor associated to the target integrity level used in aviation receivers to calculate position, velocity, time (PVT) and protection level generate false results.
- 4. It has been demonstrated that the methods developed to detect the presence of local environmental effects (mainly multipath) might be usable as the basis of future on-board functions, allowing more accurate and safe algorithms to be developed to calculate PVT and protection level
- It has been demonstrated that on board positioning function cannot be obtained by a receiver alone and that hybridisation with additional sensor(s) is mandatory.
- 6. A concept for EGNOS use in the railway environment has been developed and tested by overlaying EGNOS data onto recorded GPS data simulating EGNOS data distribution over the ETCS radio, as the reception of EGNOS from geostationary satellites in the railway environment is extremely poor.

Figure 7: Main Achievements

EXPORTED ISSUES

WP6

As one of the ambitions of the STARS project, its results shall support ongoing and future linked R&D projects, most significantly those foreseen in the frame of Shift2Rail JU. For this purpose, the STARS project has generated a list of recommendations for developments, whose implementation will support future use of EGNSS in safety critical railway applications.

- Functions and interfaces to distribute EGNOS data to the GNSS on-board equipment
- Sensor fusion algorithms to cope with short term disturbances
- 3. Map matching functions to cope with the lack of track selectivity
- On-board functions to identify in real time the presence of degrading environmental effects
- 5. Better suited PVT algorithm
- 6. Better suited PL algorithm

Figure 8: Exported Issues