RHINOS - Railway High Integrity Navigation Overlay System will define a GNSS-based system to support the localization of trains respecting the challenging requirements of the railway safety standards.

Summary of the context and overall objectives of the project

Main RHINOS objectives are: 1: To define the architecture of a train Location Detection System; 2: To assess the performance of the defined architecture by means of: a proof-of-concept integrating, in a virtualized testbed, rich sets of data collected in a real railway environment, historical time series related to rare GPS SIS fault events concerning both satellite malfunctions and atmosphere anomalous behaviours, including simulated faults for the new-coming GALILEO constellation; 3: To contribute to the missing standard in the railway sector about the way of integration of GNSS-based LDS, into current TCS standards.
All activities have been carried out accordingly to the original Grant Agreement and its Amendment reference n. AMD-687399-9.

During the first period (1st Jan 2016 - 30 Sept. 2016) the following activities have been performed. The RHINOS project begun with the definition of European and USA scenarios for the railway control systems. In parallel, harmonization of railway and avionics concepts and terminology has been performed.

The current status of GNSS Augmentation Network services in terms of architectures, services, and standards, together with hints about future trends and relevant updates suitable for meeting RHINOS target applications have been investigated, and some recommendations for the exploitation of high accuracy and high integrity systems for railway applications have been given. In parallel, modifications to ARAIM to cope with local faults to be expected along the train track have been investigated.

Activities on Railway environment modelling (WP5) have been focused on those landscape features in the immediate vicinity of railway tracks that can have a deleterious effect on positioning.

During the second reporting period (01 Oct 2016 - 31 Oct 2017), the following activities have been performed.

In WP7, performance analytical models and a SWOT analysis have been applied to the candidate Augmentation and Integrity Monitoring (AIM) subsystem architectures. Based on them, the 2-Tiers candidate has been selected as the RHINOS reference architecture.

In WP8, the analytical model of the GNSS based Virtual Balise Reader performances assessment has been reviewed. Moreover, algorithms for multiple track discrimination have been investigated, and a qualitative comparative analysis between the proposed OBU Integrity Monitoring Methods has been performed. Finally, as result of the previous analysis, ARAIM has been selected as the OBU Reference Architecture.

In WP9, a “proof-of-concept” design and evaluation for several variations of the preferred RHINOS architecture has been carried out. Several complementary simulation tools have been used to evaluate the nominal and faulted performance of this architecture and demonstrate its suitability: Stanford University MAAST, Radiolabs’s VIRGILIO and the SOGEI’s TAAN simulation packages.

The Performance Analysis activities have been performed within the RHINOS WP 10. Tests have been performed by means of real GNSS raw data recorded on board of a Pilot Train in the Cagliari-S. Gavino railway, in the framework of the ERSAT EAV project, as well as simulated data.

In WP11, the main guidelines to support the rail navigation community to standardize the use of GNSS for safety-critical applications have been provided. A plan to mature the Railway High Integrity Navigation Overlay System (RHINOS) has been reported with a summary of the hazards and monitors that will require the most effort in the upcoming validation and verification phase.

Finally, the assessment and the verification activities required for putting in service new ERTMS interoperability constituents and/or new ERTMS subsystems have been reported together with the description of the possible steps to be applied for the use of the GNSS positioning technology into the innovative ERTMS evolution. The CENELEC standards to be applied in the certification process of new ERTMS interoperability constituents and/or new ERTMS subsystems have been reported together with a
description of the cross acceptance process recommended by CENELEC to reuse, when feasible, products / generic applications already accepted by one authority in accordance with other relevant European Standards. Finally, the possible risks associated with the introduction of the GNSS Positioning technology into the ERTMS certification process have been described. The Dissemination events (WP12) have been organized according with the Dissemination Plan. All communication channels and services have been used to give maximum diffusion to the events, by

**Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)**

RHINOS is a safety critical navigation service for trains. As such, it has been based in part on similar systems developed for aviation. The RHINOS proof-of-concept architecture combines SBAS/LDGNSS and local monitoring via ARAIM along with (optional) additional monitoring to mitigate multipath. In fact, the results reached in the context of RHINOS have confirmed that the Railway environment presents many important and critical differences with respect to avionics and maritime outlining the needs of a specific advanced RAIM for the railway environment, the implementation of the PNT functional block on a railway safe platform, and a tight integration of the GNSS Positioning with the Signalling components to get benefits from the intrinsic defensives of both ERTMS and trackside train detection systems. Although the aviation market is a good match to rail with respect to technology, the rail industry cannot count on an aviation effort to mitigate the local hazards experienced in the rail environment. The automotive market may also provide a marketplace for chip sets and receivers that resemble RHINOS. As the driverless technology matures, the need for a backup function may be an important role for GNSS in the automotive world. Moreover, the automotive signal environment resembles the rail environment for multipath. So, the GNSS chip sets will almost certainly be dual (and maybe triple) frequency and multi-constellation; and they will be aided by the all of the other sensors available on the car. The rail community must monitor these developments and work to harmonize the OBU with the likely evolution of the air or automobile technologies. An important venue for this advance is the EU/US Bilateral Effort on GNSS. Within this overall effort, Working Group C (WG-C) is particularly active in areas of concern to rail navigation.

However, rail navigation will only become a WG-C priority if significant goals will be identified and an SBAS-Rail Working Group drawn upon the E.U. and U.S. rail communities, needed to make reasonable progress towards these goals will be settled. In addition to the definition of the Proof of Concept and to the assessment of the achievable performance, the RHINOS project contributed to the standardization of GNSS integration into current Train Control Systems (e.g. ERTMS/ETCS) by publishing a comprehensive guide on how to employ, in a cost-effective manner, GNSS, SBAS and other local infrastructures in safety related rail applications worldwide, and by proposing a roadmap for the adoption of an international standard for Safe Of Live services, based on the same guide.
Signal Blocking and Use of Multiple Constellations

MITIGATION

Use of Multiple Constellations

Signal reflections

Proof of concept

Share this page

Last update: 29 March 2017
Record number: 196340