Risk Mitigation in the Ground Mission Segment using the Galileo System Test Bed

M. Falcone, M. Lugert

The Galileo Ground Segment consists in the Galileo Control Segment (GCS) in charge of controlling the Galileo satellites and maintaining the Galileo constellation and the Galileo Mission Segment (GMS).The GMS implements all functions needed for monitoring the Galileo Signal-in Space, for processing all navigation and integrity-related core data products required for the navigation and integrity services as well as for disseminating such core data products either through the navigation signals themselves or through an interface at the Galileo Control Centre (GCC).

The paper provides an architecture overview of the GMS and focuses on the main performance drivers associated to the critical navigation and integrity processing facilities including algorithm implementation aspects relevant for the GMS development. In particular it addresses the assessment of GMS performances through the Galileo System Test Bed (GSTB) activities, initiated by the European Space Agency to mitigate the development risks associated to algorithms performance and to ensure the Galileo frequency filing.

The GSTB is implemented in two experimentation phases – the first one on-going using GPS observable (so called GSTB V1) and the second one using the navigation signals transmitted from Galileo Experimental Satellites (so called GSTB V2).

The paper presents in detail the GMS performance budget file and a feasibility assessment based on the early results from the on-going Galileo algorithms experimentation using GPS observable, in collaboration with the IGS community for the availability of raw measurements and reference products.

The current GSTB-V2 concept and plans for experimentation using the two Galileo Experimental Satellites manufactured by Galileo Industries (GAIN) and the Surrey Satellite Technologies Limited (SSTL) are also presented making reference to possible further links with IGS in the future

GSTB-V1: The First Step Towards the Development of Galileo Navigation Algorithms

Á. M. García, M. Romay Merino, C. H. Medel, A. Cezón Moro

The Galileo System Test Bed V1 (GSTB-V1) is an experimentation platform developed to mitigate risks associated to the Galileo Mission Segment (GMS), responsible for the generation of Galileo navigation and integrity data. The GSTB-V1 experimentation will be based on the processing of real GPS data. Although the GSTB-V1 is an experimental platform, stringent development standards have been followed and an operation plan has been defined aimed at the generation of navigation and integrity products in a routine and near-real time basis.

The GSTB-V1 includes an experimental Orbitography and time Synchronisation Processing Facility (E-OSPF), which implements prototype algorithms for the Navigation data and the Signal In Space Accuracy (SISA). The generation of the Navigation data is based on an Orbit Determination and Time

Synchronisation (OD&TS) process, common in many aspects to those carried out in the frame of the IGS for the ultra rapid products. However, it includes some innovative solutions, mainly for the pre-processing and parameter estimation. Alternative strategies for some functions have been implemented and will be tested with the GPS system. The objective is to support the definition of the final Galileo OSPF algorithms.

The SISA is an integrity parameter, which shall provide a bound of the ephemeris and clock errors at a certain confidence level, in the so-called fault-free state of the system. The feasibility and performances of the SISA, currently known superficially, will be subject of extensive experimentation within the GSTB-V1, since GPS offers a good opportunity to test the novel integrity concept proposed for Galileo in a quite similar environment.

A thorough analysis will have to be performed to extrapolate the GPS-based results obtained with the GSTB-V1 to the Galileo environment. The evolution of the OD&TS algorithms to the Galileo environment is currently under analysis, together with the development of a Galileo Raw Data Generator.

The headlines of the E-OSPF algorithms will be presented, together with the experimentation areas and activities, as well as with some preliminary results.

The IGS GNSS Working Group – Charter and Plans

R. Weber

It is the stated objective of the IGS to pay utmost attention to the development of the upcoming and modernized GNSS Systems. In this context an IGS GNSS Working Group has been created to explore potential contributions to IGS products through the use of GALILEO, modernized GPS and modernized GLONASS Signals. Moreover the WG should prepare a consolidated feedback to GALILEO developments based on relevant IGS experience in specific areas such as receiver site selection, installation and maintenance. A stated goal is to pave the way for fully integrated GNSS data products, comprising orbits, clock offsets, stations coordinates and tropospheric delays available very close to real time.

This presentation will summarize the goals of the WG achieved so far and will give an outlook at upcoming activities.

A Software Tool to Evaluate Navigation Performances at Application Level

A. Gavin

Satellite Navigation Systems currently guide ships, cars and planes around the world. In the near future Galileo, the European satellite navigation system will open the way to a much wider variety of applications, in the mass-market and professional domains, also thanks to the improved navigation performances coming from its compatibility and interoperability with other navigation systems and sensors. In order to evaluate navigation performances from the user perspective, a new software tool, named Polaris, has been developed in the frame of the 5th Framework Programme for Research and Technology Development of the European Commission.

Polaris allows rapid and easy performance assessment of navigation systems and sensors, running in low-cost platforms to support application and system design. Applications being evaluated - in all user domains - can include not only the use of GNSS systems, but also regional and local augmentations (SBAS, DGNSS, pseudolites and GSM/GPRS/UMTS positioning) and navigation sensors (odometers, gyroscopes, etc.). All the systems and sensors can be fully characterised within the tool, and about 300 different combinations can be evaluated, for different modes of transport (pedestrian, road, vehicle and marine) and in different environments, for instance, an urban scenario defined in its three-dimensional model. By assessing navigation performances, it is possible to verify which combination of navigation systems and sensors meets the application requirements. For example, Polaris is able to demonstrate the benefits derived by a combined Galileo/GPS user terminal with respect to a solely GPS based solution (with and without augmentations) in the various representative environments.

This poster will describe the main features of Polaris and its general software architecture. To better understand what Polaris is capable of, its potential will be illustrated through different simulation results (e.g. the performance for a vehicle in the streets of Madrid) for various combinations of systems and sensors.