GALILEO OPERATIONAL ALGORITHMS DEVELOPMENT: INTEGRITY, ORBIT DETERMINATION AND TIME SYNCHRONISATION

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Galileo is the European Global Navigation Satellite System, under civilian control, and consists on a constellation of medium Earth orbit satellites and its associated ground infrastructure. Galileo will provide to their users highly accurate global positioning services and their associated integrity information. The elements in charge of the computation of Galileo navigation and integrity information are the OSPF (Orbit Synchronization Processing Facility) and IPF (Integrity Processing Facility), within the Galileo Ground Mission Segment.

Navigation algorithms play a key role in the provision of the Galileo Mission, since they are responsible for computing the essential information the users need to calculate their position: the satellite ephemeris and clock offsets. Such information is generated in the Galileo Ground Mission Segment (GMS) and broadcast by the satellites within the navigation signal, together with the expected a-priori accuracy (SISA: Signal-In-Space Accuracy), which is the parameter that in fault-free conditions makes the overbounding the predicted ephemeris and clock model errors for the Worst User Location.

In parallel, the integrity algorithms of the GMS are responsible of providing a real-time monitoring of the satellite status with timely alarm messages in case of failures. The accuracy of the integrity monitoring system is characterized by the SISMA (Signal In Space Monitoring Accuracy), which is also broadcast to the users through the integrity message.

Galileo is currently in its detailed design and development phase. The design and development phase for the OSPF started on February 2005 and for the IPF in May 2005. In both cases, the Preliminary Design Reviews (PDR) have been successfully held and the algorithms are now entering in the final prototyping activities, which are expected to be finished by the middle of 2006. Innovative changes have been proposed with respect to the initial baseline coming from the previous Galileo development phases, such as the real-time synchronization process with sub-nanosecond accuracy (below 0.5 ns).

The main objective of this paper is to present the navigation and integrity algorithms for Galileo and to briefly describe the development approach which is being followed including aspects such us:

- The implementation of a strict Dependability and Safety Assurance program within the OSPF and IPF development.
- The application of Safety-critical SW development practices.
- The application of a strict system engineering process.
- The design of OSPF and IPF to operate autonomously with high reliability in terms of continuous and unmanned operations.

- The implementation of a comprehensive verification process, comprising the formal verification of the product according to the applicable standards and also the validation of key mission performances