

Galileo Local Element Augmentation System (GALILEA)

***Galileo Workshop for SMEs
organised by the GJU
April 5th & 6th 2006***

Project General Info

- The project addresses **local elements innovative aspects**
- It focuses new methods and algorithms to **locally predict, monitor and possibly improve in near real time the service performance**
- **Duration: 12 Months**
- **Consortium: 2 SME's, 2 Universities, 1 Federal Authority**

Project General Info

- Consortium:
 - ◆ ***Space Engineering (Italy)***
 - Prime Contractor
 - In charge of: SW Specification, Model Development, Integration and Validation
 - ◆ ***CISAS (Italy)***
 - In charge of: Models Development, Data Fusion
 - ◆ ***NavPos System (Germany)***
 - In charge of: Application Definition, Integration and Validation
 - ◆ ***Federal Agency for Cartography and Geodesy (Germany)***
 - In charge of: Specification, dissemination
 - ◆ ***Budapest University of Technology and Economics (Hungary)***
 - In charge of: Validation Campaign

Overview & Objectives

- The local prediction, monitoring and improving of the service performance is an additional feature, with respect to the baseline services presently planned for local elements, therefore it represents an opportunity to some classes of users for safer navigation and better accuracy.
- The objective is to complement the local element service performance by additional data, e.g.:
 - ◆ near real time prediction and monitoring of SISE,
 - ◆ local iono corrections
 - ◆ Local tropo corrections.

Research Directions

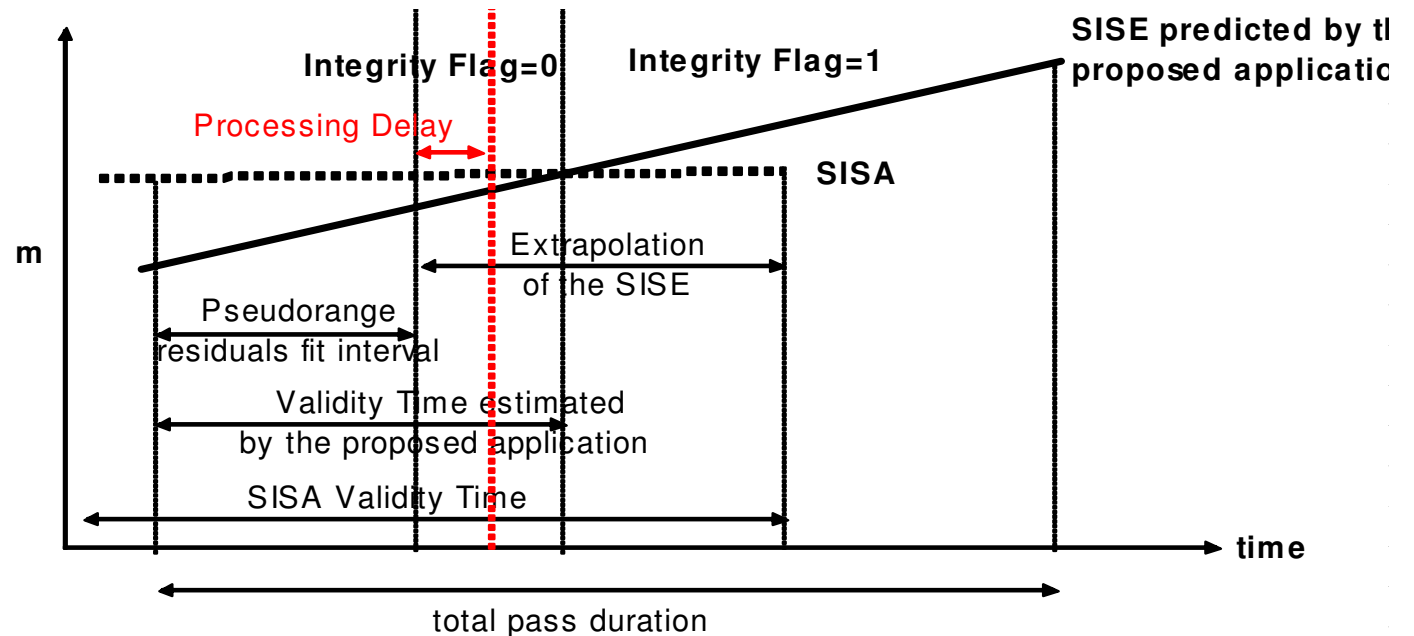
The following complementary **research directions** are investigated:

- **efficient computational methods** for generating high-accuracy local data in a very short time making use of only local reference stations. This requires a careful identification of the algorithms, which at the same time should exploit the Galileo specific features (e.g. three frequencies) and guarantee the best compromise between the algorithms processing time and the estimation accuracy;
- innovative **data fusion techniques** to merge local data with global/regional data, in order to predict and monitor SISE, tropo and iono corrections. As we will show later, we will use in the process data from IGS and EUREF networks for better estimation of local and global parameters;
- **efficient local communication architecture** able to disseminate the SISE and the derived information with the lowest latency time using Internet or UMTS technology (building on the example of ESTB, SISnet and the EUREF IP project).

SISE Prediction & Monitoring Concept (1/2)

Predict if/when the SISE will exceed the SISA

- The SISE extrapolation interval is composed on two contributions:
 - ◆ a short processing delay needed to obtain SISE estimates from the set of data,
 - ◆ a validity interval in which the confidence of SISE prediction is high.
 - ◆ The recursively of the process guarantees to the user a continuous availability of updated SISE estimates.



SISE Prediction & Monitoring Concept (2/2)

The **Signal In Space Error (SISE)** will be estimated in two manners:

- the first is based on data from a local network of stations. It consists of cleaning the observation from the above estimated errors, and estimating several coefficients of a specific model using these cleaned observation residuals.
- The second is based on ultrarapid predictions from IGS: the broadcast position/clock of GNSS satellites is compared with IGS predictions and the difference is projected to the line of sight to the station.
- The two methods are complementary: the first is more relayed to a real time service provision, while the second is more global. The motivation to consider both is to merge the information, and to provide methods for comparison and validation of the results.

Local IONO Correction Concept

- The **ionospheric correction** will be computed locally by the reference station using dual (for GPS/GLONASS) or three (for Galileo) frequency techniques.
- This error and a short term prediction will be available to a local user in a neighborhood (the size to be determined within the research activity) of the reference station.
- We believe this approach to be feasible because the ionospheric effects on ray tracing tend to change slowly with time and to maintain a high spatial correlation on the scale of tens of kilometers.

Local Tropo Correction Concept

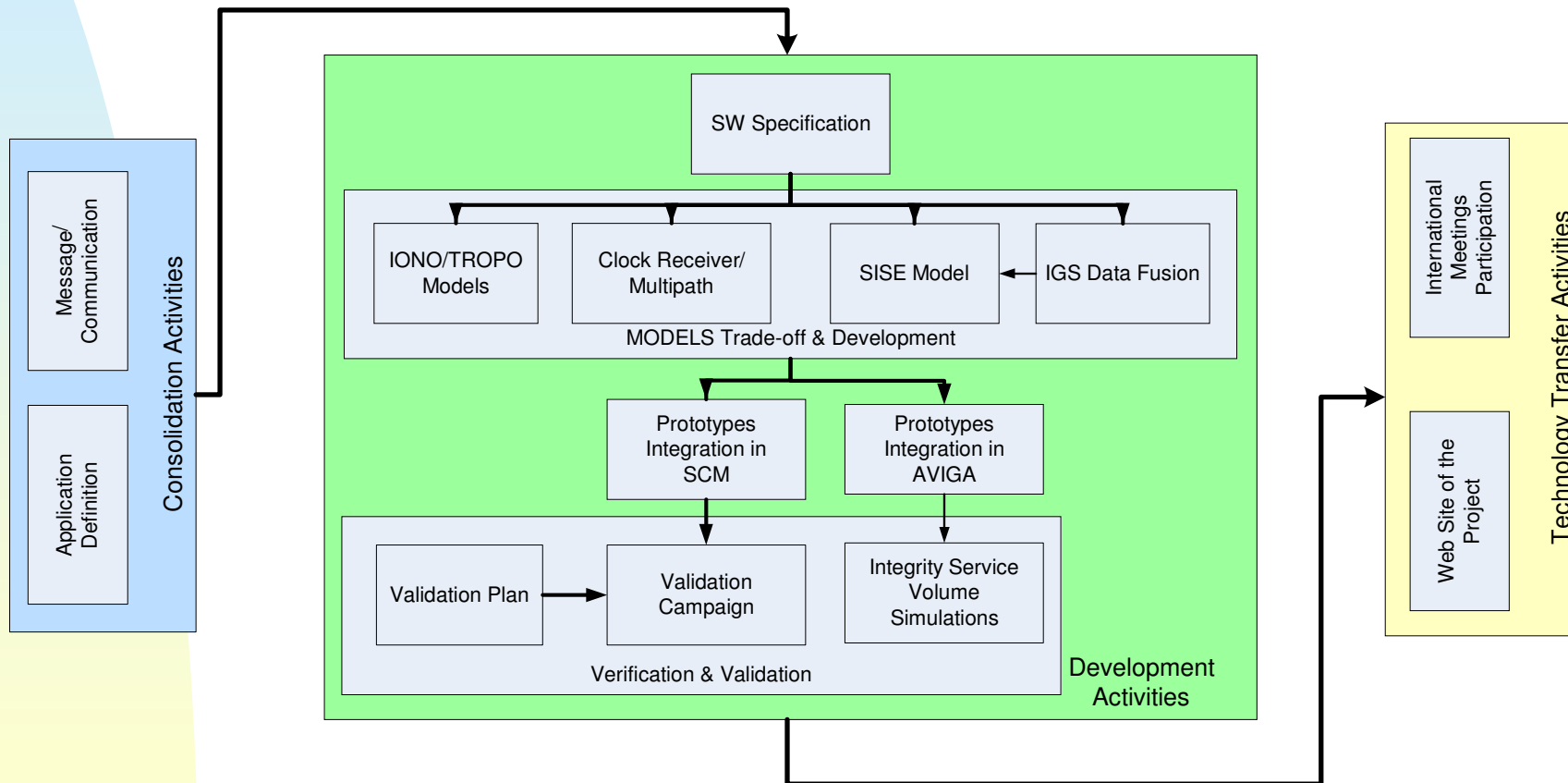
- The **tropospheric correction** includes a term based on Near Real Time data delivered already now by several networks, such as the COST 716 project of the EU, or EUREF.
- The tropospheric correction term will be computed at the station on the basis of local pressure and temperature data measured by traditional sensors, and then extrapolated to a nearby user.
- The prediction is, in this case, more problematic than for the ionospheric effect due to the higher time variability and the shorter correlation scale of the tropospheric terms.
- The refresh rate of this info needs to be understood as well as its decay in accuracy, as a function of the distance from the permanent station and the epoch since it was issued.

Applications

The target for the applications includes some potential users:

- **SoL Users:** requiring high performance requirements both in accuracy and safety. A tight coordination with the local service providers is needed to demonstrate the benefits of the proposed service augmentation.
- **Public / private transport, traffic management:** medium accuracy, low safety. Here, the low cost constraint for terminals could help in the diffusion of local messages providing information useful for accuracy enhancement.

GALILEA Study Logic



GALILEA Schedule

