EGNOS for Railway Traffic Management and Control

D. JOLY, G. CARRIE, S. TRILLES, J. POUMAILLOUX and F. BAUER

THALES ALENIA SPACE, Toulouse, France

The current maturity and the high performance level provided by EGNOS open the door for multiple railway applications. The added value of EGNOS for the train is an improvement of the EGNSS positioning accuracy performance but primarily by providing an integrity capability. Integrity is the ability to compute horizontal protection level that bound the positioning error with a given confidence interval. Introducing EGNSS through the processing EGNOS messages, is the base of multiple railway applications as the reduction of the number of equipment installed along-track for train position tracking in conjunction with ERTMS system.

The challenge of EGNOS for train support is to provide reliable position and integrity information under varying operational conditions. Before using GNSS technics for train positioning it is mandatory to identify which type of local environmental may cause significant GNSS positioning degradation with respect to those that have negligible effects or can be managed by the design of the receiver. In this aspect two key points have to be precisely analyzed: first a point positioning taking benefit of Doppler measurements and second the identification of different railway environments where the same local error variance model is valid and ensures integrity.

As the movement of the train is forced by the railway, the along tack positioning is controlled by the intensity of the velocity. The train's velocity can be accurately estimated using Doppler measurements that are weakly affected by interference or multipath effects. In particular the accuracy of a filter point computation, traditionally based on code measurements only, can be really improved by integrating the velocity along time. The different experimentations done show that the merge of code and Doppler measurements in only one "noise adaptive" Kalman filter is able to produce very good accuracy performance in various environment.

The determination of the railway user error budget models is the second part of the activity. The level of local errors budget is strongly dependent of the railway topography and environment. To measure the environment effects, a set of integrity algorithms have been developed inside the GNSS receiver in order to catch and characterize the nature and the level of degradation in regards to GNSS signal reception. A first formulation of user error budget models is proposed and tested in different railways sections corresponding to different environments. The experimentations have shown that integrity can be maintained with a good margin most of the time.

The purpose of this paper is to present a first assessment, based on several and different real data collects, on the possible achievable EGNSS accuracy and integrity performances through a various set of environment. Associated with the integrity information offered by EGNOS, the technics and methodologies presented in this paper provide a first step for the future standardization of GNSS using EGNOS within the European Rail Trafic Management System Standard.