IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Space-based PNT (Position, Navigation, Timing) Architectures, Applications, and Services (1)

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THE STRATEGY AND SOLUTIONS OF THE ITALIAN SPACE AGENCY TO INTRODUCE A
GNSS-BASED AUTOMATIC TRAIN PROTECTION SYSTEM

Abstract

With reference to the railway ecosystem, the use of GNSS technology in the Automatic Train Protection (ATP) domain can facilitate and accelerate the digitalisation of railways by providing scalable solutions to boost the safety and efficiency of this means of transportation. In relation to low-density lines, which are still largely manually operated, the advent of satellite technologies will be a viable solution to improve safety of operations at an affordable cost with respect to current side-track systems. Moreover, GNSS technologies can address the major challenges of the reduction of CAPEX and OPEX in the railways sector by virtualizing the physical radio-beacons. In addition, the adoption of GNSS-based ATP will boost also the efficiency of rail services. Thanks to the virtualization of balises, GNSS will allow, indeed, a denser distribution of virtualized balises at level 3 of ERTMS/ETCS (European Rail Traffic Management System/European Train Control System) compared to physical buoys, leading to the reduction of the length of the traffic blocks and, consequently, boosting the traffic density on the lines. Further gain in efficiency is expected to be achieved thanks to the implementation of ATO (Automatic Train Operation) eco-drive mode based on high-precision GNSS localizers. Considering that scenario, the introduction of ATP based on satellite navigation has always been, and remains, a priority for the Italian Space Agency (ASI). Based on the expertise developed in the last decade, ASI has devised an overall plan of action to accelerate the adoption of GNSS-based ATP in Europe, identifying and promoting two specific key technological enablers. The first technological pillar comprises the realization of an innovative modular on-board train localisation system, which will be able to merge the current satnav modalities (i.e. Virtual Balise-VB and Enhanced Odometry-EO) in one single comprehensive solution able to cover all phases of the mission, from SOM (Start of the Mission) to FS (Full Supervision). The second pillar is based upon the implementation of a two-tier local augmentation network, necessary to guarantee the requested accuracy and integrity of positioning in the railway operations. This article focuses on the advantages of GNSS-based ATP, gives an overview of current research activities and describes the current ASI heritage in the field, as well as the ASI action plan to accelerate the adoption of this new technical concept. The article also provides a description of the two technological enablers which have been identified and are ready to be realised.