**Position Paper**
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# Safe and precise localisation systems using satellite (SAT)


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Safe and precise localization systems without trackside installations, notably through satellite positioning (SAT) are a railway sector need that will improve the performance of the rail system. Development must now support positive business cases on actor level.

As a representative body, CER participates in the ERTMS change control management process of the Agency which has included SAT as one of the 'game changing' activities.

The ability to manage interoperability and a plug and play module are key for railway business cases. Strict principles for compatibility and evolution must be adopted. Open functional and physical interface (FFFIS) of SAT module for ETCS shall be part of SAT specification. It must provide a technical solution that will facilitate upgrade with SAT without impact on ETCS on board equipment.

EUAR/EC shall define an agreed roadmap to develop an affordable (i.e. cost effective) SAT that delivers long term value for railways. The design should support cost objectives agreed at sector level, which includes the investigation of the most suitable use of EGNOS (European Geostationary Navigation Overlay System) and other technology for safe localization (e.g. 5G, inertial navigation, RTLS…).

# Guiding principles

The application cases and success conditions must be well addressed.

It is still important that common principles for the migration will be investigated right from the beginning. Migration strategy shall support early return on investment and ambitious innovation.

Within this process SAT main guidelines for development have to be defined:

- SAT development must be kept compatible with ERTMS specifications;
- SAT should be an add on and should not prevent access to the network in respect of interoperability;

- In case SAT should prevent access to the network (introduction of virtual balises in place of real balises could be the way to avoid the closedown of some regional lines) social-economic benefits shall be shared between IM and RUs;
- SAT on-board subsystem should be completely independent from the ERTMS train control EVC via a clear interface specification (FFFIS), allowing a "plug-and-play" approach and enabling different suppliers to provide ERTMS and SAT sub-systems, in order to increase competition and facilitate migration/upgrade of existing and future ERTMS trains;
- All SAT developments must be interoperable;
- At this stage, most developments focus on the train-front-position, SAT shall also provide solutions for the train-end localization (e.g. for L3, virtual end train balise might provide a cost effective solution for a smooth migration)

# Open issues

CER has identified several issues that will need to be addressed to reach good business case and increase rail efficiency:

- Cyber Security
- Reliability of CCS on board: ERTMS and SAT have a direct impact on operation performance.
- Communication needs/protocol for SAT data
- Open interfaces (FFFIS solution made available for standard integration of SAT module with ERTMS and train)
- Odometry accuracy for ERTMS, especially investigate, if it's feasible to receive positioning improvement information from EGNOS directly via satellite by the vehicles.
- Management of temporary and/or permanent Track Data Bases (digital track maps (TrackDB) providing information about the track net, the positions of (virtual) balises, and the telegrams of each of the balises).
- Complementary Positioning System/engineering rules (for both virtual and physical balises) to ensure high accuracy and availability, notably to cope with GNSS Denied Areas (e.g. combination of inertial navigation, 5G, RTLS…)

- Subset 36 FFFIS interface specification: investigate if this interface can be used for connecting the SAT system to the EVC
- Independent odometry module, without external sensors, included in the SAT on-board subsystem generating virtual balises in case the GNSS signal is not available.

# Conclusion

To ensure proper development and get all value, it is important that ERA/EC build a European agreed roadmap that enables a harmonized vision and ensures timely mitigation of SAT program risk:

- Research and financing support / support to pilot projects
- Legal framework
- Technical framework (ERA) including authorisation issues for early implementers
- Needed radio spectrum provisions (no interference, sufficient performance, security, interoperability)
- Migration concept facilitating the introduction of mature technologies and supporting rail economic performance
- Developments in accordance with the strict compatibility concept agreed in the ERTMS MoU signed in 2016.