

UNISIG®



ANNEX I - UNIFE's ERTMS® Vision Paper

Odometry enhancements and ASTP

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UNIFE – The European Rail Supply Industry Association

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1 INTRODUCTION

1.1 The odometry challenge

Odometry is one of the most complex components of ETCS on-board systems. Suppliers face a significant challenge in odometry development, balancing system availability against stringent SIL 4 safety requirements. This is compounded by the limited availability of physical sensors - typically, wheel, radar, and acceleration sensors - which are highly susceptible to changing environmental and physical conditions. Other data sources, such as GPS, are often insufficient for ETCS safety requirements and can only be used as complementary information, if available.

Therefore, odometry has been a major challenge for ETCS implementations, particularly under complex environmental conditions (e.g., snow) and varying trackside realities (e.g., ballasted versus ballastless tracks) in earlier implementations.

However, these issues have largely been resolved, and ETCS on-board odometry has evolved into a robust component of the products. Although the complexity of railway environmental conditions means problems can still arise, they can typically be resolved through product updates or configuration changes. Through internal supplier research and development, odometry performance today often exceeds the requirements of Subset-041 [1] (Performance Requirements).

1.2 EU-Rail goals, recent discussions and positions on odometry improvements

1.2.1 EU-Rail goals

Given the poor performance of earlier implementations and the desire to utilise safe odometry data for other purposes, such as ATO GoA 3/4 (Grade of Automation), which will require higher odometry accuracy as provided today by the ETCS on-board systems, certain ETCS users have long asked to improve ETCS on-board odometry.

This is also reflected in the Standardisation and TSI Input Plan (STIP) [2] of EU-Rail [3], specifically items STIP_29 and STIP_30 under the designation ASTP (Advanced Safe Train Positioning). STIP_29 is defined as 'Basic ASTP', representing a migration step towards STIP_30 'Full ASTP'.

ASTP has been discussed in the domain Train Control & Supervision of EU-Rail's System Pillar [4] – Task 2 (Train CS). In addition, research activities concerning ASTP are being performed in EU-Rail's Innovation Pillar [5].

1.2.2 Recent discussions and earlier UNISIG positions

Earlier UNISIG positions on ASTP have been thoroughly described in Subset-150, Section 6 (see www.ertms.net/facts-figures/publications/).

Reflecting the recent discussions and the content of Subset-150, the following bullet points provide a brief summary of the discussions and positions.

- **Odometry enhancements:** The goal was to enhance current odometry technology to improve performance and accuracy defined in the following Change Requests (CR):
 - SP CR 07692 – Odometry Robustness
 - SP CR 07695 – Odometry Performance Targets
 - SP CR 11989 – Localisation Interface

During discussions within the Train CS domain, railway organisations demanded a test specification and a technical interface. They specified that this interface must include an output channel for raw data, enabling the verification of whether performance and accuracy targets are met. The railway organisations aim to repurpose this interface for future odometry concepts, thereby outsourcing odometry capabilities and establishing this configuration as preparatory groundwork for a future interface between ETCS on-board and an external odometry system (e.g., full ASTP).

If standardised, this would necessitate changes to the suppliers' ETCS on-board products without delivering a proven benefit to the majority of ETCS customers and users. However, they would need to bear the costs of such a standardised interface.

[1] https://www.era.europa.eu/domains/infrastructure/european-rail-traffic-management-system-ertms_en

[2] <https://rail-research.europa.eu/standardisation-and-tsi-input-plan/>

[3] EU-Rail (Europe's Rail Joint Undertaking) is the EU-funded rail innovation partnership.

[4] The EU-Rail System Pillar defines and develops the future harmonized railway system specifications and architecture to support interoperability, efficiency, and the evolution of ERTMS® across Europe.

[5] The EU-Rail Innovation Pillar drives research, development, and validation of future railway technologies and operational concepts.

- **Basic ASTP:** This term served as a preparatory step for Full ASTP and means outsourcing current odometry as a standalone component and providing an external interface for other odometry users, similar to the discussions under the term 'odometry enhancements'. The earlier UNISIG position on Basic ASTP according to Subset-150 is the following:

- Rejection of separating Basic ASTP from ETCS on-board odometry until 2029: UNISIG opposes extracting odometry into a separate, exchangeable subsystem component prior to the introduction of 'Full ASTP', as this would be economically and strategically unsound. Instead, odometry should remain integrated within the ETCS on-board system.
- Avoiding double workload and minimising risk: Separating the components would force two major on-board system updates (FRMCS and ASTP) in quick succession, jeopardising existing investments for ETCS on-board customers and users. Instead, current standards should be optimised through genuine enhancements individually by the suppliers without standardisation.

- **Full ASTP:** Full ASTP enables improved train localisation by incorporating additional advanced technologies, such as satellite positioning. The UNISIG position on Full ASTP according to Subset-150 is the following:

- Analysis for introducing a separate, standardised subsystem: For Full ASTP there are relevant arguments for having a separate exchangeable subsystem including FFFIS interfaces (Form Fit Functional Interface Specification) for inputs and outputs to ETCS, ATO and other consumers for exchangeability reasons and to limit the technologies which can be used.

However, the introduction of new technology - such as inertial navigation systems (INS) - requires careful analysis to prevent design errors and immature implementations. If it finally makes sense to standardise a separate exchangeable subsystem as interoperability constituent, this must be analysed carefully from both an economic and technical strategic point of view.

- Centralisation of positioning logic within the ETCS on-board: UNISIG believes the ETCS on-board system should remain the central calculator for 'train front position' and should provide additional data (e.g., altitude, rotation rates) to other subsystems, thereby streamlining inputs and maintaining a clear architectural hierarchy within the complete on-board CCS.



2 LESSONS LEARNED

UNISIG has actively contributed to the activities performed within EU-Rail's System Pillar concerning the CRs for Odometry Enhancements and concerning ASTP. The objective of these activities was to evaluate whether modifications to the ETCS specifications for odometry improvements were necessary and justified.

UNISIG acknowledges the effort invested by all stakeholders and recognises the value generated by the work performed. The discussions gave the sector a better understanding of the challenges associated with defining harmonised conditions under which odometry can meet performance requirements. They also highlighted the difficulties involved in establishing new conformity assessment methods and developing interfaces for the exchange of information with new applications.

However, the expectation that the technical specifications could be modified relatively easily regarding the odometry function and deliver immediate benefits to the sector proved unrealistic. The complexity and impact of potential evolutions are significantly greater than initially anticipated, requiring substantial effort, specifically regarding testing and providing information to undefined users through a to-be-established interface.

Consequently, and given the complexity and variability of factors affecting the performance of existing odometry solutions, it remains questionable whether the anticipated benefits of further standardisation would materialise and, if so, in what form, or whether such measures would instead create an unnecessary burden of additional costs, normally better addressed through project-specific contractual arrangements.

In addition, the sector's commitment to maintaining the stability of implemented modifications should be considered as stability of the specifications is seen as one of the most important tools to reduce costs.

The latest major revision of the CCS TSI [5] already introduced CR1389 (reaction when the confidence interval is exceeded by 5m plus 5%) to address the challenges identified in this area. The implementation and operational use of CR1389 can provide additional experience that could help assess its effectiveness and determine whether further improvements are required.

3 THE UNISIG POSITION

UNISIG fully supports the goal of creating a more efficient railway system. Changes must always be underpinned by a robust business case and lead to better safety, security, performance and thus cost reductions for railway users.

Stability is one of the key tools for cost reduction. Therefore, any changes to the system must be duly justified. At present, we do not see sufficient evidence that these conditions can be met by the recent proposals for odometry improvements (e.g., STIP_29 and STIP_30).

In our ERTMS® Vision Paper, we recommend slowing the pace of ERTMS® system evolution. However, stability is not stagnation. Research into improved odometry with Full ASTP is supported but it is currently too early for standardisation. Therefore, pursuing odometry improvements with Full ASTP within the scope of research does not contradict the refusal to standardise them within EU-Rail's System Pillar.

Further analysis is also necessary to identify where the boundary lies between necessary standardisation and manufacturers' freedom to implement.

Drawing on the lessons learned from the discussions within the System Pillar, and considering the expected increase in implementation costs and certification complexity in the short and medium term, alongside the absence of demonstrable and quantified long-term benefits, UNISIG does not support the continuation of STIP_29 and STIP_30 activities falling within the scope of the System Pillar.

This position, however, does not preclude further improvements to the odometry as demonstrated by the proposal 'Mitigations against human mistakes during maintenance procedure', recently discussed with other stakeholders and UNISIG. This proposal is ready to be published as a Change Request.





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