OCORA

Open CCS On-board Reference Architecture

Prototyping SS-149 “Online Monitoring System”

Concept description

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Management Summary

In this technical workstream, a prototype is carried out for the validation of SUBSET-149, which is currently being developed, not as part of the OCORA project, but with overlapping resources. The aim is to demonstrate the feasibility of implementation and to incorporate findings into the formulation of the SUBSET.

One Swiss partner RU has been found for the prototype. Two prototypes have been realised. It is expected that the final results can be presented in the next OCORA release, preliminary results are shown in R4.

Revision history

Version	Change Description	Initial	Date of change
0.1	▪ Initial draft	FT	31.05.2021
0.2	▪ Update for R3	FT	17.11.2022
0.3	▪ Update for R4	FT	03.06.2023
0.4	▪ Editorial updates in the introduction chapter	ML	31.01.2025

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References

Reader's note: please be aware that the numbers in square brackets, e.g. [1], as per the list of referenced documents below, is used throughout this document to indicate the references to external documents. Wherever a reference to a TSI-CCS SUBSET is used, the SUBSET is referenced directly (e.g. SUBSET-026). OCORA always reference to the latest available official version of the SUBSET, unless indicated differently.

[1] OCORA-BWS01-010 – Release Notes

[2] OCORA-BWS01-040 – Feedback Form

[3] NNTR CH-TSI CSS-026 "Online monitoring of trackside equipment on vehicles", June 2021

1 Introduction

1.1 Purpose of the document

The purpose of this document is to describe the prototype for the validation of ERTMS SUBSET-149, which is currently developed under the responsibility of UNISIG.

This document is addressed to experts in the CCS domain and to any other person, interested in the OCORA concepts for on-board CCS. The reader is invited to provide feedback to the OCORA collaboration and can, therefore, engage in shaping OCORA. Feedback to this document and to any other OCORA documentation can be given by using the feedback form [2].

If you are a railway undertaking, you may find useful information to compile tenders for OCORA-inspired CCS building blocks, for tendering complete on-board CCS systems, or for on-board CCS replacements for functional upgrades or life-cycle considerations.

If you are an organization interested in developing CCS on-board building blocks according to the OCORA design principles, the information provided in this document can be used as input for your development.

1.2 Applicability of the document

The document is informative. Subsequent releases of this document will be developed based on a modular and iterative approach, evolving within the progress of the OCORA collaboration.

1.3 Context of the document

This document is published as part of an OCORA Release, together with the documents listed in the Release Notes [1]. This document describes the concept and the way forward to gain the expected experience in Workstream 15 of the OCORA initiative. As part of the validation of SUBSET-149, a proof of concept of the structure of an online monitoring system is reproduced. Experiences and findings from the prototype will be incorporated into the development of SUBSET-149.

2 Objective of TWS15: Prototyping SS-149 Online Monitoring System

In comparison to OCORA Release 2, the workstream definition hasn't been adapted.

Consequently, the objectives remain the same:

1. Proof if the draft SS-149 format is capable to serve IMs for trackside malfunction (e.g. recognise Balise failures)
2. Proof if the draft SS-149 format is capable to serve RUs for online monitoring of CCS on-board, at the current stage more specifically for ETCS on-board
3. Provide relevant input for SS-149 improvements
4. Provide input for implementation variants regarding the amount of data to be transferred and stored, resulting operational costs and responsibility split between IM and RU.

After generating sufficient amount of data for evaluation, the plausibility and usability of the received data is to be discussed in separate sessions with IM and RU.

To achieve objective 1, a comparison with already available data (SBB Infra OMS) should show the added value of an OMS acc. To SS-149.

To achieve objective 2, it should be assessed with the participating RU to what extent the availability of OMS data is useful regarding previously undetected faults or their repair. For this purpose, the internally available fault reports relating to the ETCS systems should be compared with OMS data.

To achieve objective 3 and 4, possible adaptations for the SS-149 are to be worked out in workshops with IM and RU. A focus in the discussion here is the question of data ownership and the organisation of rights for data access. Within the workstream, the experience of RU/keepers that already operate their own OMS, which includes the ETCS system is to be used and integrated.

3 Implementation of the prototype

Within the scope of the workstream, it is planned to equip two vehicles with the trainborne part of the OMS.

3.1 Support of a vehicle keeper for implementation

Initially, it was planned to include DB Cargo vehicles for the proof of concept. Due to difficulties regarding the integration of new hardware on the vehicles, as well as regarding the resources available in the short term for the provision of documentation and implementation, the advancement of the prototype with a Swiss operator was prioritized.

Its vehicles now foreseen for the proof of concept are equipped with BL 3.4-OBU from supplier Siemens. The vehicles operate exclusively in Switzerland on the tracks of two different infrastructure managers. In regular operation, they are used almost exclusively in ETCS Level 1 LS traffic and operate only occasionally on Level 2 tracks.

3.2 Selection of system provider

For the integration of the OMS on the vehicle, a system supplier independent from the OBU supplier was chosen that is already active in the rail industry. Reasons for the decision can be summarized as follows:

Up to now, the interfaces on the EVC for the integration of an OMS have not been designed according to SS-149. Accordingly, the existing designs needed to be taken into account for the prototype.

This means that either proprietary solutions from the manufacturers of the EVC or JRU or non-proprietary solutions which read data at the interface between these two units are possible. In the Proof of Concept, the decision was made in favour of a non-proprietary solution in order to enable transferability of the concept in the event of an extension of the prototype beyond proprietary. In principle, the structure corresponds to the “Alternative architecture” described in chapter 3.2.4 of SS-149.

It was also assumed that customizations to meet the needs of the SUBSET-149 would be much easier to implement with a more flexible solution.

The relevant criteria were:

- The availability of documentation to prove that the reading device used is non-intrusive
- The availability of all other verifications relevant to the integration of hardware in rail vehicles (EMC, fire protection, vibrations)
- The availability of a concept for ensuring security.
- The availability of a dashboard for visualization of the transmitted data for the initial phase of the prototype.

Finally, a solution from the Belgian company Railnova was chosen for the project. A second potential provider with a similar range of functions would have been available with ERTMS Solutions.

In the first step, it is planned to use Railnova's existing infrastructure and dashboards for the evaluation.

3.3 Implementation concept

On the vehicle the installation is relatively simple. It requires a sniffing device to read the data between the EVC and the JRU on the MVB, a connection to the power supply protected with an adequate circuit braker, an antenna to receive the GNSS data, as well as to transmit data to the server, and grounding of the potentially current-carrying surfaces and parts in the event of a fault.

Reading of the data works via a non-reactive sniffer named "Interposer" in Railnova's portfolio. The Interposer provides galvanic isolation and prevents the writing and modification of data from the MVB by means of hardware. The interposer is inserted as a DB9 connector at an existing connection point of the MVB.

The necessary GNSS/mobile radio combination antenna was placed under the GRP bonnet of the driver's cab. Sufficient distance to antennas of safety-relevant systems was ensured. The specifications of the GSM-R network operator SBB Telecom are complied with.

The power supply is protected by a separate two-pole CB. The Railster depends on the battery voltage and is thus charged even without the main switch being switched on.

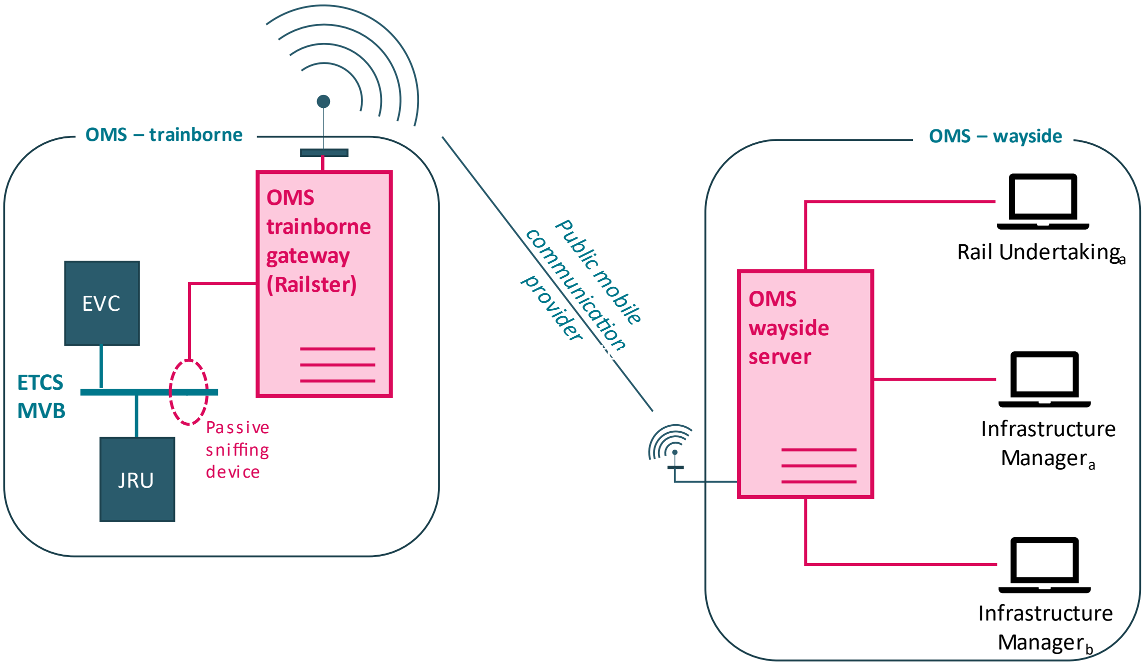

Figure 1 System architecture (trainborne side dependant on integration of JRU & EVC inside the vehicle), whereby the allocation of data to different operators (IM) will (initially) be simplified in the prototype.

The integration of new hardware requires compliance with Swiss requirements for modification approval. The interoperability directive (EU) 2016/797 and the corresponding implementing regulation (EU) 2018/545 have not yet entered into force in Switzerland. The assessment is made by the vehicle keeper according to the RTE 49100. The assessment showed that the implementation can evaluated as "non-relevant change" („Nicht-wesentliche Änderung").

Since the vehicles are still under warranty, the owner required the supplier's release of the installation with regard to the warranty right of the owner. In this context, a review of the safety documentation by the OBU supplier took place with positive outcome.
The vehicle manufacturer was also finally asked to approve the installation with a positive result.

The vehicle keeper was assured of the right to terminate the prototype immediately in the event of unreliable behavior, presumably caused by the integration of the proof-of-concept equipment.

3.4 Data access and functionalities in the dashboard

The functions of the system allow to display all collected data in tabular form and make them downloadable. The evaluation of the data with regard to errors on the OBU or infrastructure side occurs offline as background task on the trackside server.

In addition, the viewable data of a potential IM is restricted according to its area of responsibility.

Further, as an example, a balise alarm is implemented, where incorrectly read balise data triggering a JRU message generates a notification on the trackside server.

3.5 Reference version of SUBSET 149

The workstream takes up the adaptation of SUBSET-149 in its current state "Draft 7", respective its document version 0.0.6.

4 Experiences of NS with an ETCS OMS

Nederlandse Spoorwegen, the state-owned railroad company in the Netherlands, operates a similar concept to what is implemented in the proof-of-concept vehicles.

There, too, the SUBSET-027 messages are read from the ETCS-internal profibus, transmitted to the server, and evaluated there. This means that the same data is already available to NS at trackside as it is defined in SS-149.

NS has agreed to share its experience with the fault revelation system in a workshop. The content focuses on the following questions: system setup, interfaces to the other stakeholders (vehicle keeper, ECM, infrastructure manager), effectiveness of the system for identifying faults and ensuring NS rights in data management.

5 Next Steps

The next steps can be summarized as follows:

After the positive validation, there is a regular evaluation and exchange with the keeper and IM on possible failures.

After a sufficiently long period of operation, the collected findings are synchronized in workshops, and the task of the workstream is evaluated based on this.

The publication of the final results will occur in the next OCORA release, preliminary results are shown in OCORA R4.