Rail to Digital Automated up to Autonomous Train Operation

D36.1 – Demonstrator Specification

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EXECUTIVE SUMMARY

The Onboard Platform Demonstrator work package (WP36) is dedicated to implementing and validating future-prove onboard platform technologies. WP36 leverages deliverables from selected "Digital Enablers" within the R2DATO program. The important goal of WP36, is to serve as a blueprint and enabler for industrialisation and anchoring of modularisation concepts towards future Technical Specifications for Interoperability (TSI).

The objective is to demonstrate, in a controlled laboratory environment, the coexistence of safety-critical and non-safety-critical railway applications on a Modular Computing Platform. This is achieved through the utilisation of a safe Runtime Environment (RTE), unified diagnostic services, and onboard Future Railway Mobile Communication System (FRMCS) functions. By adhering to the recommendations of a forthcoming Onboard Communication Network, WP36 showcases the harmonised use of Train Control and Management System (TCMS) data, facilitating safe and secure communication between onboard applications and trackside entities.

WP36's central goal has two aspects. Firstly, to determine the appropriate level of onboard platform modularity, and secondly, to prove the feasibility of hardware-independent integrability of mixed-Safety Integrity Level (SIL) functions potentially provided by different suppliers. This achievement shall serve as a blueprint for larger-scale EU-RAIL phase 2 demonstrators, with the aim of facilitating modularisation and the adoption of new technologies within the Onboard Control-Command and Signalling (Onboard-CCS) domain.

Throughout the specification phase (36.1), the project team achieved a common understanding, aligning terminology and work methodologies, and provided a more detailed specification beyond the initial grant agreement's high-level definition. This also includes the agreement on the exact work split and implementation plans for the demonstrator setup as detailed in the “Statement of Work” document.

Further results of this deliverable are technical specifications, comprised in three technical documents. “System Definition”, a document that defines “User Stories & Test Cases” and an “Architecture” document. All those specifications together tailor the foundation to conduct the technical realisation in the forthcoming three-step implementation tasks (36.2 - 36.4) and establish the initial specification baseline.

It is imperative to recognize the dependency on the outcomes of other work packages (mainly WP23, WP24, WP26, WP27, WP31, WP34) as well as the System Pillar (SP) activities. Resulting risks, key assumptions and restrictions have been identified, analysed, and described but need further attention. We hope to fulfil the raised expectations in an environment, where specification and standardisation work in System Pillar and Innovation Pillar is ongoing in parallel, which puts out major challenges in coordination and alignment.

Since planned and allocated resources have emerged as critical consideration, they demand vigilant monitoring and adaptability. It should be noted that the currently defined User Stories represent a comprehensive collection that may need additional resources, not yet fully covered by the current allocation. Therefore, we would like to encourage further partners to join WP36 to close the identified gaps, in particular addressing here application suppliers and specialist for train integration topics and IT/OT security.

Nevertheless, the partners have achieved a common understanding and have successfully set the basis for upcoming work by defining the scope and targets for the demonstrator in a cooperative, quite intensive but fruitful exchange.

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1 INTRODUCTION

1.1 BACKGROUND

In the work package 36 (WP36) “Onboard Platform Demonstrator” the partners Deutsche Bahn (DB), Ground Transportation Systems (GTS), Kontron (KONTRON), Schweizerische Bundesbahnen (SBB), Siemens Mobility (SMO) and Trafikverket (TRV) cooperate to validate the feasibility of a future-proof onboard IT-platform that is suitable to host safety critical applications.

In the context of R2DATO this work package demonstrates a concrete implementation of the modular computing platform based on the available input from work package 26 to a Technology Readiness Level (TRL) 5/6 (demonstrated in relevant environment) enhanced by onboard connectivity to a train adapter, FRMCS communication modules and shared services (e.g., diagnostics and maintenance).

The project timeline started in December 2022 (M1) and ends in May 2026 (M42).

1.2 PURPOSE OF THIS DELIVERABLE

In this first task of the work package the exact demonstrator setup is defined based on the identified technical enablers and their available specification.

The main achievement is the agreement on the demonstrator system definition and architecture together with the exact work split and implementation plan for its realization.

A collection of relevant user stories together with derived requirements and test cases provide the basis for investigations on the demonstrator setup, that is implemented in the following tasks.

2 DELIVERABLE DOCUMENTS

The deliverable 36.1 of the work package 36 is the output of various work items and thus consists of multiple documents.

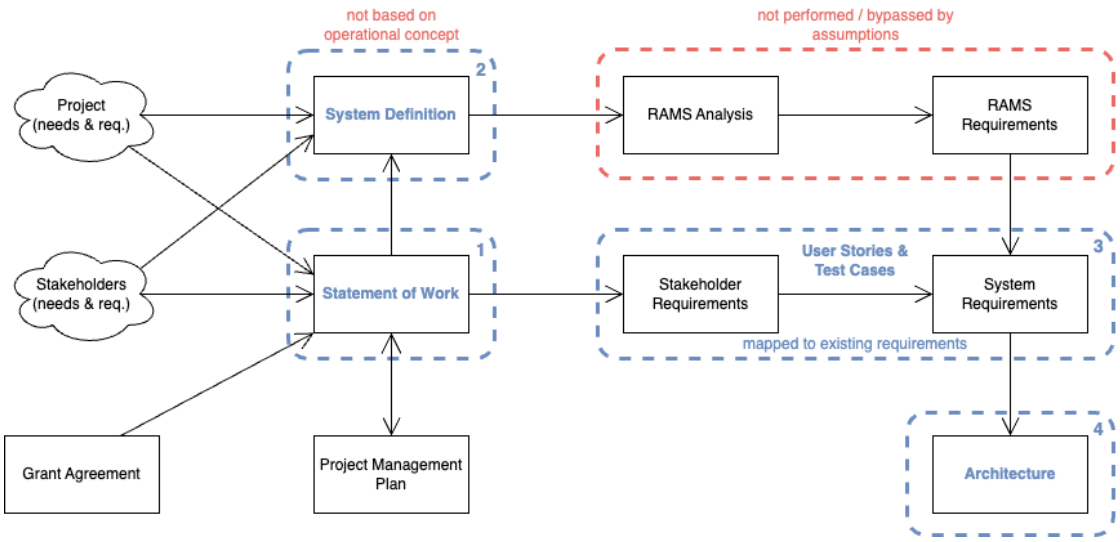

Figure 1: Deliverable 36.1 Demonstrator Specification Document Structure

The document structure is inspired by a systems engineering process model as depicted in Figure 1: Deliverable 36.1 Demonstrator Specification Document Structure. However, many steps are not applicable in the context of this work package; either due to missing input or resources or because they are not appropriate in the context of the target TRL.

Next to the overall executive summary and conclusion, this document provides an overview of all the documents that belong to the deliverable. In total these deliverable references four additional documents:

1. Statement of Work
2. System Definition
3. User Stories & Test Cases
4. Architecture

The chapters below outline their purpose and content and reference the corresponding documents.

2.1 Statement of Work

2.1.1 Purpose

The Statement of Work (SoW) refines the work package description of the grant agreement to a commitment of the work to be done. It especially details the objectives, scope and aspects that are written as conditionals in the grant agreement.

Among the partners it serves as an agreement on the exact work split and provides an implementation plan for the demonstrator setup and execution.

2.1.2 Content

The statement of work contains a concrete commitment on the work to be done in work package 36 based on the current knowledge.

With the implementation plan it also details the agreement on the responsibilities and supporting work provided by each partner in respect to the work items necessary to complete the demonstrator planning, setup, testing and the consolidation of findings.

2.1.3 Document Reference

ERJU_WP_36_1_Statement_of_Work

2.2 System Definition

2.2.1 Purpose

The system definition provides an unambiguous description of the envisaged demonstrator setup as a reliable basis for the concrete subsystem designs and integrations in the following implementation tasks. It also names and defines all involved entities to ensure a common understanding among the partners in the context of this demonstrator work package.

2.2.2 Content

To set the stage, the system definition gives additional external context as well as identifies external constraints. Its main content is the definition of the demonstrator system boundary, the involved actors, and their interfaces alongside the high-level system capabilities.

2.2.3 Document Reference

ERJU_WP_36_1_System_Definition

2.3 User Stories & Test Cases

2.3.1 Purpose

To properly derive findings from the demonstration work, the evaluation of the demonstrator is based on predefined user stories and test cases that ought to be investigated.

References to related system or sub-system requirements set the demonstrator user stories in a meaningful and relevant context.

2.3.2 Content

The user stories are a clustered selection based on the areas of interest that were expressed by the partners and the commitment in the grant agreement. Each describes a scenario that is targeted to be studied in the context of this work package.

Concrete ideas how to investigate a user story are outlined in the respective test case(s). Those are mapped to chapters of the implementation plan in the statement of work and thus to one partner responsible for their execution.

Additionally, the user stories are mapped to related requirements out of existing sources.

As source for requirements on the onboard computing platform, work package 26 suggests considering the work of OCORA, namely High-Level Requirements Generic Safe Computing Platform [1] (all the “approved” requirements MSC-XX, with XX from 01 to 127).

For FRMCS the UIC has standardized related requirements in the FRMCS System Requirements Specification [2], the FRMCS Functional Requirements Specification [3] and the On-Board FRMCS Functional Requirements Specification [4].

The onboard communication network requirements are standardized in UNISIG FFFIS - CCS Consist Network Communication Layers (SUBSET-147) [5].

Requirements for Monitoring, Diagnostics, Configuration & Maintenance (MDCM) are considered from the OCORA System Requirements Specification - Monitoring, Diagnostics, Configuration & Maintenance subsystem [6].

2.3.3 Document Reference

ERJU_WP_36_1_User_Stories_Test_Cases

2.4 Architecture

2.4.1 Purpose

The demonstrator architecture provides an overview of the demonstrator setup and depicts the involved (sub-)systems and their connections.

2.4.2 Content

In the architecture document diagrams of the foreseen architecture are accompanied with respective descriptions based on the current knowledge. Due to the iterative integration of the subsystems over the implementation tasks, the architecture will likely be updated with each subsequent deliverable.

2.4.3 Document Reference

ERJU_WP_36_1_Architecture

3 CONCLUSION

During our research and development efforts within Work Package 36 (WP36), we have encountered several key observations and insights that shape the conclusion of our work. These findings are essential for understanding the challenges, opportunities, and future directions within the project:

Resources: It has become evident that the allocation and management of resources are pivotal factors for the successful execution of WP36. With a focus on the implementation tasks WP36.2, WP36.3, WP36.4, and the support activities extending throughout WP36, the planned and allocated resources have emerged as critical considerations. This demands vigilant monitoring and adaptability.

Dedicating project personnel and ensuring the availability of key individuals are factors that can significantly expedite progress. It is important to note that a fragmented workforce can be counterproductive, often stemming from dependencies on other work packages. Agile strategies are key in mitigating these dependencies.

Scope: Our understanding and scope for WP36, especially concerning the upcoming tasks in WP36.2, WP36.3, WP36.4, have undergone refinement. The process of deepening this understanding will continue throughout the subsequent tasks. It is imperative to recognize our dependency on the outcomes of other Work Packages (mainly WP23, WP24, WP26, WP27, WP31, WP34) as well as the System Pillar (SP) activities. As a result, a close dependency management to these entities is essential.

We have accumulated a comprehensive backlog of potential tasks and areas for further study. These represent opportunities for continual improvement and expansion of our research.

Co-Working: Collaboration and co-working among all partners have been a notable success within WP36. The team is well-formed, and in-person workshop style meetings have proven to be highly beneficial. The efficiency of the project can be further enhanced by regular progress reporting among the responsible parties within the work package.

While functional safety remains a paramount concern, it is important to emphasize, that for the demonstrator, the focus should be on the desired outcome rather than an exhaustive adherence to the full systems engineering process. This approach is expected to streamline our efforts and accelerate progress.

Project Management: Strengthening our project management practices is identified as a significant benefit that can contribute to improved project outcomes. A well-organized and efficient project management structure is essential for achieving the objectives of WP36.

The collaboration between railway and industry partners has proven to be fruitful, and it is a model that should be fostered and nurtured throughout the project's lifecycle.

Tooling: Finally, it is imperative to address the co-working platforms and tools used within the project. Frequent changes, disruptions and uncertainties in this regard have been observed, and a well-defined and stable co-working platform and process will enhance efficiency and consistency.

In conclusion, WP36 has made notable progress, identified challenges, and laid the foundation for future endeavours. It is crucial to build upon our achievements and address the identified areas of improvement to ensure the successful realization of our objectives and to use our resources to their full potential.

Works Cited

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