OCORA

Open CCS On-board Reference Architecture

Capella Modelling

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Revision history

Version	Change Description	Initial	Date of change
1.05	Official version for OCORA Delta Release	ML	30.06.2021
2.00	Official version for OCORA Release R1	ML	03.12.2021

Table of contents

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-BWS01-020 – Glossary

[3] OCORA-BWS01-030 – Question and Answers

[4] OCORA-BWS01-040 – Feedback Form

[5] OCORA-BWS03-010 – Introduction to OCORA

[6] OCORA-BWS04-010 – Problem Statements

[7] OCORA-BWS08-010 – Methodology

[8] OCORA-BWS08-020 – Tooling

[9] OCORA-TWS01-030 – System Architecture

[10] OCORA-TWS01-050 – Capella Model Export

1 Introduction

1.1 Purpose of the document

The purpose of this document is to provide the reader:

- the reasoning why OCORA is using Model Based System Engineering (MBSE),
- the tools proposed for MBSE,
- the status of MBSE modelling activities for CCS on-board and
- information about the next steps for MBSE

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 [4].

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

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

1.2 Applicability of the document

The document is currently considered informative but may become a standard at a later stage for OCORA compliant on-board CCS solutions. 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 the OCORA Release R1, together with the documents listed in the release notes [1]. Before reading this document, it is recommended to read the Release Notes [1]. If you are interested in the context and the motivation that drives OCORA we recommend to read the Introduction to OCORA [5], and the Problem Statements [6]. The reader should also be aware of the Glossary [2] and the Question and Answers [3].

2 Why is OCORA using MBSE?

Current ETCS documentation (Subset 026, 034, 119, etc.) is expressing the system requirements in textual form. Although these specifications are quite comprehensive, they still leave room for interpretation (**problem #1**) and are lacking details in some cases (**problem #2**). In addition, the sheer number of specifications naturally causes inconsistencies (**problem #3**) and creates risks for errors during implementation (**problem #4**). As a result, testing and certification efforts increase accordingly (**problem #5**). All this may lead to quality and performance issues and generates very high total costs of ownership for ETCS on-board solutions.

To overcome the issues mentioned, it is important to decompose the CCS on-board system in well specified components / building blocks (refer to System Architecture documentation [9] for details) and to use MBSE to develop the needed specifications for all building blocks. The resulting model is intended to amend the current TSI specifications with the necessary details allowing CCS system or component providers to implement high quality ETCS on-board systems at a competitive price. Furthermore, MBSE based simulations will help reducing the test and certification effort.

3 Why is OCORA using Arcadia / Capella?

OCORA members have decided to use MBSE for developing the detailed system level specifications. There are certainly many different tools and methodologies available to support the MBSE process. For the following reasons, the Arcadia method has been chosen:

- Arcadia is a system engineering method developed for safety critical systems and therefore relevant in the context of OCORA.
- The method is supported by a dedicated, powerful tool (Capella).
- Most founding members of OCORA are using the Arcadia method and the Capella tool in their CCS projects already.
- Capella is available with free licenses, hence allowing all interested parties to use it at no cost.

It is yet to be decided to what extent and in what phases of the product definition/development cycle the Arcadia method will be used. Refer also to document [7] and [8] for further details.

4 Status on MBSE modelling

Specialists from different OCORA founding members (DB, SNCF, NS, SBB) are currently conducting MBSE activities, using Capella. For the CCS on-board scope, these activities are mainly around the ATO Vehicle (AV) and the Vehicle Locator (VL).

These activities are, to some extent, already synchronized with each other and with other activities in the same field (e.g. S2R, X2RAIL, SFERA, RCA, etc.). However, there is currently no focus for a common, open, standardized on-board model that is compatible with the intended OCORA architecture / platform.

OCORA provides with its R1 release a starting point for discussions regarding the modelling work of the OCORA CCS on-board system. Refer to the System Architecture documentation [9] for details.

For this release (Release R1) the logical architecture perspective in Capella was updated to reflect the architectural changes developed for Release R1. The taken approach is still the same as it was in the Delta Release and is not yet following the Arcadia methodology (e.g., no top-down approach, no descriptions). However, this initial representation shall support structuring the architectural view and act as a starting point when allocating functions to logical components once the end-to-end CCS system analysis has been completed in collaboration with RCA. The model [10] published as part of this release does not contain any descriptions and is meant to provide an initial structure of the logical components. It is intended to support the alignment with other initiatives in the same field.

For this Release, OCORA has also elaborated the integration of Capella into the Application Life-Cycle Management Tool Polarion (for further details refer to the Tooling document [8]).

5 Next steps for MBSE modelling

Modelling the CCS On-Board System will require the collaboration of many modelling and subject matter experts. To ensure that all modelers follow the same approach, a guideline needs to be developed. As a first step, the modelling guideline developed by RCA will be reviewed to identify to what extent this guideline or parts of it could be adopted by OCORA.

The following topics shall be covered in the OCORA modelling guideline:

- Define the scope and the level of detail to be modelled
- Define the perspectives (OA / SA / LA / PA / DC) of the Arcadia method to be used and applied for the different modelling needs
- The approach how to synchronize with other initiatives (e.g. RCA, X2Rail4, LinX4Rail etc.)

  Possible approaches are:
  - Using one single model – e.g. model CCS on-board as part of the RCA model
  - Transition the CCS on-board sub system from RCA and periodically re-transition and merge the two models
  - Use an independent CCS on-board model in combination with an RCA-Library. Periodically update the library, fix inconsistencies, and adopt changes on both sides.
  - Use an independent CCS on-board model only connected to RCA via the defined interfaces. Potentially the initial CCS on-board model could be generated via a one-time transition of the CCS on-board sub system from the RCA model.

Important note: *in addition to the official OCORA releases, frequent publications of the Capella Model shall facilitate discussions with other initiatives (e.g. RCA, X2Rail4, LinX4Rail) and/or potential suppliers without overreaching someone. Model updates will be available for download on the OCORA public GitHub.*