OCORA

Open CCS On-board Reference Architecture

Capella Modelling

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
3.00	Official version for OCORA Release R2	ML	22.06.2022
3.10	Official version for OCORA Release R3	ML	30.11.2022
3.20	Official version for OCORA Release R4	ML	30.06.2023

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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-BWS01-020 – Glossary

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

[4]   OCORA-BWS01-040 – Feedback Form

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

[6]   OCORA-BWS03-020 – Guiding Principles

[7]   OCORA-BWS04-010 – Problem Statements

[8]   OCORA-BWS08-010 – Methodology

[9]   OCORA-BWS08-020 – Tooling

[10]   OCORA-TWS01-030 – System Architecture

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

[12]   OCORA-TWS01-041 – MBSE Modelling Guidelines

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].

1.2 Applicability of the document

The present document is currently considered 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 the OCORA Release together with the documents listed in 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], the Guiding Principles [6], and the Problem Statements [7]. 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 [10] 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 [8] and [9] 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 provided 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 [10] for details.

For this release, most of the System Capabilities were modelled and an initial transition of the System Perspective to the Logical Perspective was conducted. Decomposition of the logical functions was started to assign the functions to the existing logical components identified in the previous OCORA Releases. A Capella export of the current model [11] (Capella 6.0) is available with this publication in a "work in progress" status.

The MBSE Modelling Guidelines [12] was further optimized with the learnings from the modelling activities.

5   Next steps for MBSE modelling

With this release, OCORA will discontinue its modelling work and the content produced so far will serve as an input and knowledge base for the EU-RAIL activities.