OCORA

Open CCS On-board Reference Architecture

Stakeholder Requirements

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Management Summary

OCORA requirements are engineered in a top-down manner. The following levels are defined:

- **"Stakeholder Requirements" (A-Level requirements)**
- **"Program- & Design Requirements" (B-Level requirements)**
- **"System Requirements" (C-Level requirements)**
- **"Building Block Requirements" (D-Level requirements)**

This document intend to hold all **"Stakeholder Requirements" (A-Level requirements).** It will be updated and enriched with return on experience.

OCORA requirements are engineered in Polarion with full traceability.

Revision History

Version	Change Description	Initials	Date of change
1.01	Official version for OCORA Delta Release	RM	30.06.2021
2.0	Official version for OCORA Release R1	RM	26.11.2021
2.1	All requirements updated to follow the Eurospec syntax	TM	01.06.2022
2.11	Updated requirement OCORA-458	TM	14.11.2022
2.2	Added requirement OCORA-10082 - Support reduction of trackside elements	TM	31.05.2023

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References

Reader's note: please be aware that the document ids in square brackets, e.g. [OCORA-BWS01-010], as per the list of referenced documents below, are 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.

- [OCORA-BWS01-010] – Release Notes
- [OCORA-BWS01-020] – Glossary
- [OCORA-BWS01-030] – Question and Answers
- [OCORA-BWS01-040] – Feedback Form
- [OCORA-BWS03-010] - Introduction to OCORA
- [OCORA-BWS03-020] - Guiding Principles
- [OCORA-BWS04-010] - Problem Statements
- [OCORA-BWS07-010] - Alliances

1 Introduction

1.1 Purpose of the document

The purpose of this document is to provide the collection of all Stakeholder Requirements in a structured manner.

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 [OCORA-BWS01-040] .

1.2 Applicability of the document

The document is currently considered informative but may become mandatory 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.

OCORA requirements can be divided into two application groups.

1. OCORA Initiative Requirements applied for any OCORA internal activities (e.g. modelling)
2. OCORA CCS On-Board System Requirements, applied for any development and tendering (e.g. prototyping, MVP developments, projects)

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 [OCORA-BWS01-010] . Before reading this document, it is recommended to read the Release Notes [OCORA-BWS01-010]. If you are interested in the context and the motivation that drives OCORA we recommend to read the Introduction to OCORA [OCORA-BWS03-010], and the Problem Statements [OCORA-BWS04-010]. The reader should also be aware of the Glossary [OCORA-BWS01-020] and the Question and Answers [OCORA-BWS01-030].

1.4 Requirements Engineering Process

This OCORA requirement document is developed, using the Requirements Management Guideline [OCORA-TWS05-010]. The requirements are engineered in a top-down manner:

- As a starting point all **"Stakeholder Requirements"** towards the OCORA initiative **(A-Level requirements)** are captured and formalised.

- In a second step, the **"Program- and Design Requirements" (B-Level requirements)** are developed. These requirements define tools, processes, methodologies and design rules to be used within the program and to be considered during the system analysis and the system design/architecture work.

- As a next step, the A- and B-Level requirements are further developed in the MBSE analysis to become **"System Requirements" (C-Level requirements).**

- As part of the MBSE architecture work, building blocks are identified taking into account the MBSE analysis (C-Level requirements). All applicable requirements (A-Level, B-Level, and C-Level) are apportioned to the identified building blocks, resulting in **"Building Block Requirements" (D-Level requirements)**, forming the OCORA tender templates, together with the applicable program & design requirements.
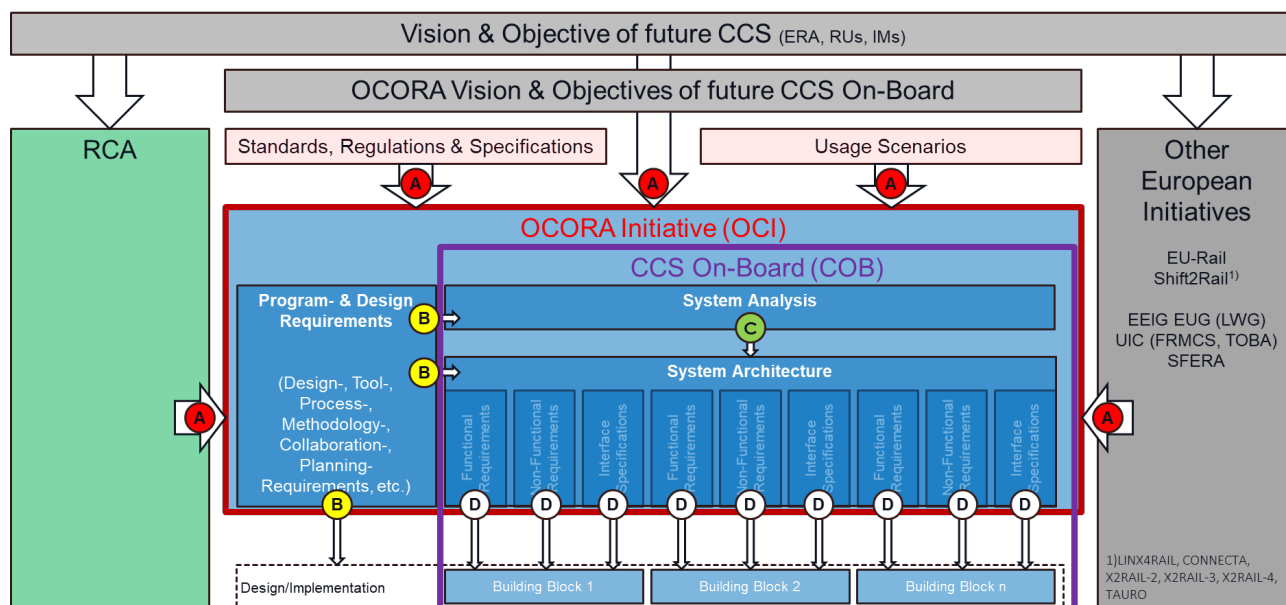

Figure 1 OCORA Requirements Engineering Process

Please note, that the A-Level requirements are applicable to the OCORA Initiative (OCI) while the B- and C-Level requirements are targeted towards the CCS On-Board System (COB) and its architecture. D-Level requirements are applicable to the respective building blocks.

2 Requirements

2.1 Vision & Objectives of future CCS (ERA, RUs, IMs)

This chapter is based on the Introduction to OCORA [OCORA-BWS03-010] and the Problem Statements [OCORA-BWS04-010] .

OCORA-617, A-Level - Improve Technical Specifications for Interoperability, TSI

The OCORA initiative shall improve the current Technical Specifications for Interoperability, TSI

Status	✔ Approved
Classification	Requirement
Rationale	- To close gaps in TSI subset specifications - To eliminate inconsistencies in TSI subset specifications - TSI CCS is a complex, historically grown landscape. To manage this complexity (e.g. impact analysing of changes).
Acceptance Method	Design Review
Acceptance Criteria	The OCORA planning shall include milestones refering to TSI susbsets reviews deliveries. They shall contain Change Requests submitted to ERA. The review files shall be available under GitHub

OCORA-328, A-Level - Serving the development Technical Specifications for Interoperability

The OCORA initiative shall take an active role (beyond specification/proposal review) serving sector discussions by bringing in the User / Railway Undertaking perspective.

Status	✔ Approved
Classification	Requirement
Rationale	- To support a solid foundation of TSI, especially TSI-CCS - To promote OCORA as de facto standard based on the normative/ de jure TSI - To request unified changes among railways to the TSI, but only if current TSI does prevent a modular, open architecture framework - To ensure simplification of the TSI framework wherever possible - To ensure user friendly, lean and cost efficient integration of new functions into the of TSI framework
Acceptance Method	Process Review
Acceptance Criteria	The OCORA planning shall integrate ERJU and then include milestones and synchronisation points to be an active player.

OCORA-7208, A-Level - Define Life Cycle Cost reduction targets

The OCORA initiative shall define the capital expenditure and operational expenditure cost reduction targets for a CCS On-Board.

Status	✔ Approved
Classification	Requirement
Rationale	• To have a clear, concrete goal regrading the desired cost reduction
Acceptance Method	Design Review
Acceptance Criteria	A verification check in Phase 2 shall ensure that the reduction targets are defined and documented by one of the BWS outputs.

OCORA-53, A-Level - Reduce Total Cost of Ownership

The OCORA Reference architecture shall reduce the amount of capital and operational expenditure for a CCS On-Board, taking into account the full life cycle.

Status	✔ Approved
Classification	Requirement
Rationale	• Rail transport must remain competitive with other modes of transport • CCS On-board solutions are costly in general • CCS On-board needs to develop from project based approach to a product base • CCS On-board batch sizes need to be increased • CCS On-board standardisation needs to increase
Acceptance Method	Design Review
Acceptance Criteria	The costs analysis shall be defined as an expected document to be delivered by the BWS06 in Phase 5 (i.e. end of OCORA program). A verification check in Phase 5 shall ensure that this analysis is performed and the results are as expected.

OCORA-54, A-Level - Shorter Time2Market

The OCORA initiative shall reduce the amount of time to introduce CCS On-board in general, as well as, new or adapted CCS functionalities into a new or an existing vehicle, taking into account the following scope:

- Unifying User Requirements
- TSI improvement
- Specification
- Design
- Development
- Integration
- Testing
- Verification
- Validation
- Certification
- Rollout
- Service / Operation

Status	✔ Approved
Classification	Requirement
Rationale	- Existing and upcoming challenges require shorter Time2Market. This applies for (Cyber-) Security patching as well as error correction and functional adjustment / enhancements - to adapt and foster innovation
Acceptance Method	Design Review
Acceptance Criteria	Each workstream shall define its contribution to that goal in a top level document. A verification check shall ensure after each development phase (between 2 and 5) that its "Shorter Time2Market" is continuously under realisation.

OCORA-61, A-Level - Support different vehicle types

The OCORA initiative shall consider Passenger Trains, Cargo Trains as well as Construction Trains (on track machines) when defining the OCORA architecture.

Status	✔ Approved
Classification	Requirement
Rationale	• A wide range of vehicle types have to be supported to achieve economy of scale with a generic design based on a single open OCORA architecture.
Acceptance Method	Design Review
Acceptance Criteria	This support shall be part of the TWS02 (CCN) and TWS04 (FVA). documentation. A verification check shall ensure after each development phase (between 2 and 5) that OCORA supports different vehicle types.

OCORA-1203, A-Level - Reduction of one-off product efforts

The OCORA initiative shall minimize the effort spent for requirement engineering, specification and development of CCS On-board as a product.

Status	✔ Approved
Classification	Requirement
Rationale	• One-off efforts are a driver for implementation costs, durations and risks.
Acceptance Method	Design Review
Acceptance Criteria	A buisines check (maybe combined with external ressources) shall be performed at the end of Phase 5 to ensure that the OCORA project outputs aims at reaching the cost efficiency goal expected.

OCORA-326, A-Level - Reduction of one-off integration efforts

The OCORA initiative shall minimize engineering and certification effort needed for adjusting CCS On-board to specific vehicle types / fleets.

Status	✔ Approved
Classification	Requirement
Rationale	• One-off efforts are a driver for implementation costs, durations and risks.
Acceptance Method	Design Review
Acceptance Criteria	This support shall be part of the TWS02 (CCN), TWS04 (FVA) and TWS07 (Modular Safety). documentation. A verification check shall ensure after each development phase (between 2 and 5) that OCORA supports different vehicle types. To be completed once requireemnt is modified

OCORA-327, A-Level - Respect different technology life-cycles

The OCORA reference architecture shall respect the different technology life-cycles of its sub-systems and ensure plug-and-play like exchangeability of the same.

Status	✔ Approved
Classification	Requirement
Rationale	• Long lasting life cycle of rolling stock assets are in conflict with shorter, more consumer oriented technology developments.
Acceptance Method	Process Review
Acceptance Criteria	Modular Safety shall define a process for the evolutions management of OCORA compliant programs. This requirement shall be taken as input. Verification check shall ensure this new process respect non-overlapping life cycles. Verification check shall ensure in Phase 5 that exchangeability has been taken into account design (e.g. API, standardized interfaces between BB).

OCORA-55, A-Level - Increase performance

The OCORA initiative shall increase reliability, availability, maintainability and security of the CCS on-board solution whilst maintaining the current level of safety. Targets for each performance category shall be elaborated and set after the development of the OCORA RAM Model.

Status	✔ Approved
Classification	Requirement
Rationale	• With increasing dependency on CCS On-board the general level of performance need to increase.
Acceptance Method	Design Review
Acceptance Criteria	RAM and Security requirements shall introduce improved targets (regarding OCORA members return of experience data) without degrading safety. Verification check at the end of Phase 4 shall control it.

OCORA-10082, A-Level - Support reduction of trackside elements

The OCORA reference architecture shall support infrastructure efforts to reduce trackside elements.

Status	✔ Approved
Classification	Requirement
Rationale	• To reduce the overall CCS cost of ownership
Acceptance Method	Design Review
Acceptance Criteria	A verification check shall ensure after each development phase (between 2 and 5) that OCORA supports the reduction of trackside elements.

2.2 OCORA Vision and Objectives of future CCS On-Board

This chapter is based on the Introduction to OCORA [OCORA-BWS03-010] and on the Guiding Principles [OCORA-BWS03-020].

2.2.1 Openness

In context of OCORA openness means information can be found, used, shared, easily understood, analysed, validated and verified and applied without the user being hampered by financial, legal, technical or ethical barriers or constraints.

OCORA-43, A-Level - European Union Public License (EUPL)

All OCORA documentation shall be published under the European Union Public License (EUPL) agreement.

Status	✔ Approved
Classification	Requirement
Rationale	- EUPL was selected since it is available in all EU languages and well known in die administration and government sector. - To allow easy access to all interested parties sector wide. - To ensure return on experience, REX from projects using OCORA artefacts
Acceptance Method	Process Review
Acceptance Criteria	A "Publication" process requires publication under the European Union Public License (EUPL). Verification check shall be done after each OCORA Release public delivery.

OCORA-330, A-Level - Open Collaboration

The OCORA initiative shall be an open collaborative technical platform open to any railway company, for instance railway undertakings, fleet keepers or owners. It is based on sharing subject matter expertise and making publicly available its deliverables for the benefit of the whole railway sector. All members bring into the collaboration experiences, practice among CCS On-board and use OCORA Requirements for CCS purchase to establish a de facto standard.

Status	✔ Approved
Classification	Requirement
Rationale	To envisage a "de facto" unified user standard based on the "de jure" standard of TSIs.
Acceptance Method	Process Review
Acceptance Criteria	OCORA open collaboration shall be defined in a BWS01, 02 or 03 document.

OCORA-331, A-Level - Open Standard Publishing

The OCORA initiative shall publish its work as open standard.

Status	✔ Approved
Classification	Requirement
Rationale	- To serve as basis for CCS On-board tenders (new build & retrofit) any OCORA publications are open to public. - To avoid any conflict with competition law and IP-rights.
Acceptance Method	Process Review
Acceptance Criteria	A "Publication" process step requires to publish documentation under Public GitHub folder. A verification check shall be performed at the end of each OCORA release; all documents presented in the Documentation Plan shall be delivered into the Public depository.

OCORA-613, A-Level - Open Standard Usage

The OCORA initiative shall take design decisions (e.g. technology choices, protocols definitions, monitoring tools, etc.) based on existing open standards, if available.

Status	✔ Approved
Classification	Requirement
Rationale	- To minimize specification effort. - To ensure access to existing technology proven in use. - To support innovation.
Acceptance Method	Design Review
Acceptance Criteria	A verification check shall be done at the end of each CENELEC V cycle phase: Has an OCORA design decision be taken on non-open standard? If yes, the author shall argue on that choice (e.g. no open standard exists).

2.2.2 Modularity

In the context of OCORA modularity is a prerequisite for having "plug and play"-like exchangeability of an on-board CCS system or its building blocks without the need to involve either the original supplier of the vehicle, of the CCS system or one of its building blocks. Refer also to Modularity in the Glossary [OCORA-BWS01-020].

OCORA-500, A-Level - Standardised CCS on-board system for different vehicle types

The OCORA reference architecture shall minimize the required integration effort for introducing CCS on-board into different vehicle types, ensuring plug-&-play" like deployment and efficient development, certification, installation and maintenance.

The simplicity and effort related to the "plug-&-play" vision is expected to develop over time depending on technical readiness level.

Status	✔ Approved
Classification	Requirement
Rationale	• Reusing the same CCS on-board system for multiple vehicles reduces development, certification, installation and maintenance costs. • Reusing the same CCS on-board system in different environments increases the chance of finding and eliminating issues.
Acceptance Method	Design Review
Acceptance Criteria	Each workstream shall define its contribution to that goal in a top level document. A verification check shall ensure after each development phase (between 2 and 5) that its "plug-&-play" strategy is continuously under realisation.

OCORA-501, A-Level - CCS on-board consists of separately sourceable building blocks

The OCORA initiative shall decompose the CCS on-board system into an optimal and reasonable number of standardized building blocks

Status	✔ Approved
Classification	Requirement
Rationale	- Reusing the same building blocks in different CCS on-board implementations reduces development, certification, installation and maintenance costs. - Reusing the same CCS on-board building blocks in different environments increases the chance of finding and eliminating issues. - Since efforts to define building blocks are quite extensive, and since OCORA wants to leave as much room as possible to the industry to provide their (already existing) solutions, OCORA defines building blocks at a reasonable granularity.
Acceptance Method	Design Review
Acceptance Criteria	A first check shall ensure that the criteria list to define the building blocks decomposition exist and has been internally approved (i.e. Phase 2). A verification check shall be done in phase 5 to check if a frozen list of standardized building blocks is defined by OCORA according to the input criteria.

OCORA-499, A-Level - Standardised Interface to the Vehicle

Communication between the CCS on-board and the vehicle shall be realised through a vehicle independent, standardised interface.

Status	✔ Approved
Classification	Requirement
Rationale	- A standardised interface to the vehicle ensures "plug-&-play" like exchange of a CCS on-board system of one supplier with a CCS on-board system of another supplier. - To decouple TCMS and CCS migration steps - To decouple the vehicle and CCS solution choice
Acceptance Method	Design Review
Acceptance Criteria	A verification check shall be done in Phase 2 to verify that the Vehicle <-> CCS interface is presented as a (future) standardized one. Another verification check in Phase 5 shall ensure that this CCS <-> Train has been standardized by OCORA

2.2.3 Exchangeability (Interchangeability)

In the context of OCORA exchangeability means the ability to replace one or multiple OCORA defined building blocks with (a) respective building block(s) of (an)other supplier(s), without affecting other building blocks of the train or the overall CCS on-board system. Refer also to Exchangeability in the Glossary [OCORA-BWS01-020].

OCORA-46, A-Level - Exchangeability (Interchangeability)

The OCORA reference architecture shall allow to exchange one or multiple OCORA defined building blocks with (a) respective building block(s) of (an)other supplier(s), without affecting other building blocks or the overall CCS on-board system.

Status	✔ Approved
Classification	Requirement
Rationale	- To respect the different life-cycles profiles of building blocks. - To minimize the integration cost.
Acceptance Method	Process Review
Acceptance Criteria	Modular Safety shall define a process for the evolutions management of OCORA compliant programs. This requirement shall be taken as input. Verification check shall ensure this new process covers a smooth exchangeability as required. Verification check shall ensure in Phase 5 that exchangeability has been taken into account design (e.g. API, standardized interfaces between BB).

2.2.4 Migrateability (Upgradeability)

In the context of OCORA migrateability is the ability to introduce changes to one or multiple OCORA defined building blocks, without affecting other building blocks or the overall CCS on-board system. Refer also to Migrateability in the Glossary [OCORA-BWS01-020].

OCORA-45, A-Level - Migrateability (Upgradeability)

The OCORA reference architecture shall allow to migrate, hence introduce changes to one or multiple OCORA defined building block(s), without affecting other building blocks or the overall CCS on-board system.

Status	✔ Approved
Classification	Requirement
Rationale	• Typically, the most cost of a software intensive system occurs after its initial release. Therefore, the cost for change must be low.
Acceptance Method	Process Review
Acceptance Criteria	Modular Safety shall define a process for the evolutions management of OCORA compliant programs. This requirement shall be taken as input. Verification check shall ensure this new process covers a smooth upgradability as required. Verification check shall ensure in Phase 5 that upgradability has been taken into account design thanks to (e.g.) API, standardized interfaces between BB.

2.2.5 Evolvability (Flexibility)

In the context of OCORA evolvability means the ability to easily adopt to new technologies or to extend the functionality of an on-board CCS system without the involvement of the original supplier. Refer also to Evolvability in the Glossary [OCORA-BWS01-020].

OCORA-47, A-Level - Evolvability (Flexibility)

The OCORA reference architecture shall allow to adopt new technologies or to extend the functionality of an on-board CCS system without the involvement of the original supplier.

Status	✔ Approved
Classification	Requirement
Rationale	• To extend the CCS on-board system with additional components to implement new functionality not yet contained.
Acceptance Method	Design Review
Acceptance Criteria	A verification check in phase 4 and 5 shall ensure that the design is defined to allow the addition of Sw BB not yet defined (e.g. to no limit the load capacity to the current list of known CCS on-board elements)

2.2.6 Portability (Platform Independence)

In the context of OCORA portability is achieved when a functional application, based on the generalized abstraction, runs un-changed on different (computing) platform implementations. For this, the functional application shall only use external functions through a defined application programming interface (API). Refer also to Portability in the Glossary [OCORA-BWS01-020].

OCORA-48, A-Level - Portability (Platform Independence)

The OCORA reference architecture shall allow to effectively and efficiently transfer software building blocks from one operational or usage environment to another.

Status	✔ Approved
Classification	Requirement
Rationale	- To minimize CAPEX - To reduce time-to-market - To reduce certification and integration efforts by appropriate test environment
Acceptance Method	Design Review
Acceptance Criteria	Modular Safety shall define a process for the evolutions management of OCORA compliant programs. This requirement shall be taken as input. Verification check shall ensure this new process covers an efficient portability as required. A verification check in Phase 5 shall ensure that portability (i.e. platform independence) has been taken into account into OCORA requirements

2.2.7 Security (Cyber Security)

In context of OCORA security means the protection of (especially safety related communication and data used in) CCS on-board systems against threats (in particular cyber-attacks and hacks). To achieve this, all main security functionality like identify, protect, detect, respond and recover are considered.

OCORA-49, A-Level - Security (Cyber Security)

The scope of Cyber Security shall contain all main security functionality including but not restricted to identify, protect, detect, respond and recover.

Status	✔ Approved
Classification	Requirement
Rationale	• Limit the risk of cyber-attacks and hacks.
Acceptance Method	Design Review
Acceptance Criteria	Verification check in Phase 2 shall ensure that a OCORA Security Plan is available and reviewed according to the "review process" based on TS 50701 (linked to IEC 62443).

OCORA-7209, A-Level - Maintain Security Level

The OCORA reference architecture shall organise mechanisms that allow maintaining the defined security level throughout the full life-time of a CCS-on-board deployment.

Status	✔ Approved
Classification	Requirement
Rationale	• Security threads change and as a result the system may need adjustments
Acceptance Method	Design Review
Acceptance Criteria	A check shall be performed in Phase 4 and then 5 that the Cybersecurity team has reviewed and validated the architecture choices related to Cybersecurity and no open points remain.

2.2.8 Modular Safety

In context of OCORA the safety concept applied needs to me modularised to serve the same level of modularity as the architecture defines building blocks.

OCORA-111, A-Level - RAMS

The OCORA initiative shall provide a modular RAMS concept on multiple layers (e.g. building blocks, CCS On-board system, CCS vehicle integration).

Status	✔ Approved
Classification	Requirement
Rationale	- To enable changes, adaptations and extensions throughout the life cycle of CCS On-board - To enable a safe system and its certification based on building block - To minimize effort for safety assessment
Acceptance Method	Design Review
Acceptance Criteria	Verification check in Phase 2 shall ensure that a OCORA Safety plan is available and reviewed according to the "review process". This plan shall address the complete safety cycle in a modular architecture (i.e. from building block to specific application at vehicle authorization level). This applies for the first homologation and for the next ones when dealing with evolutions.

2.3 Standards, Regulations & Specifications

For illustration and better understanding, the below diagram provides an overview of applicable standards, regulations & specifications with their dependencies.
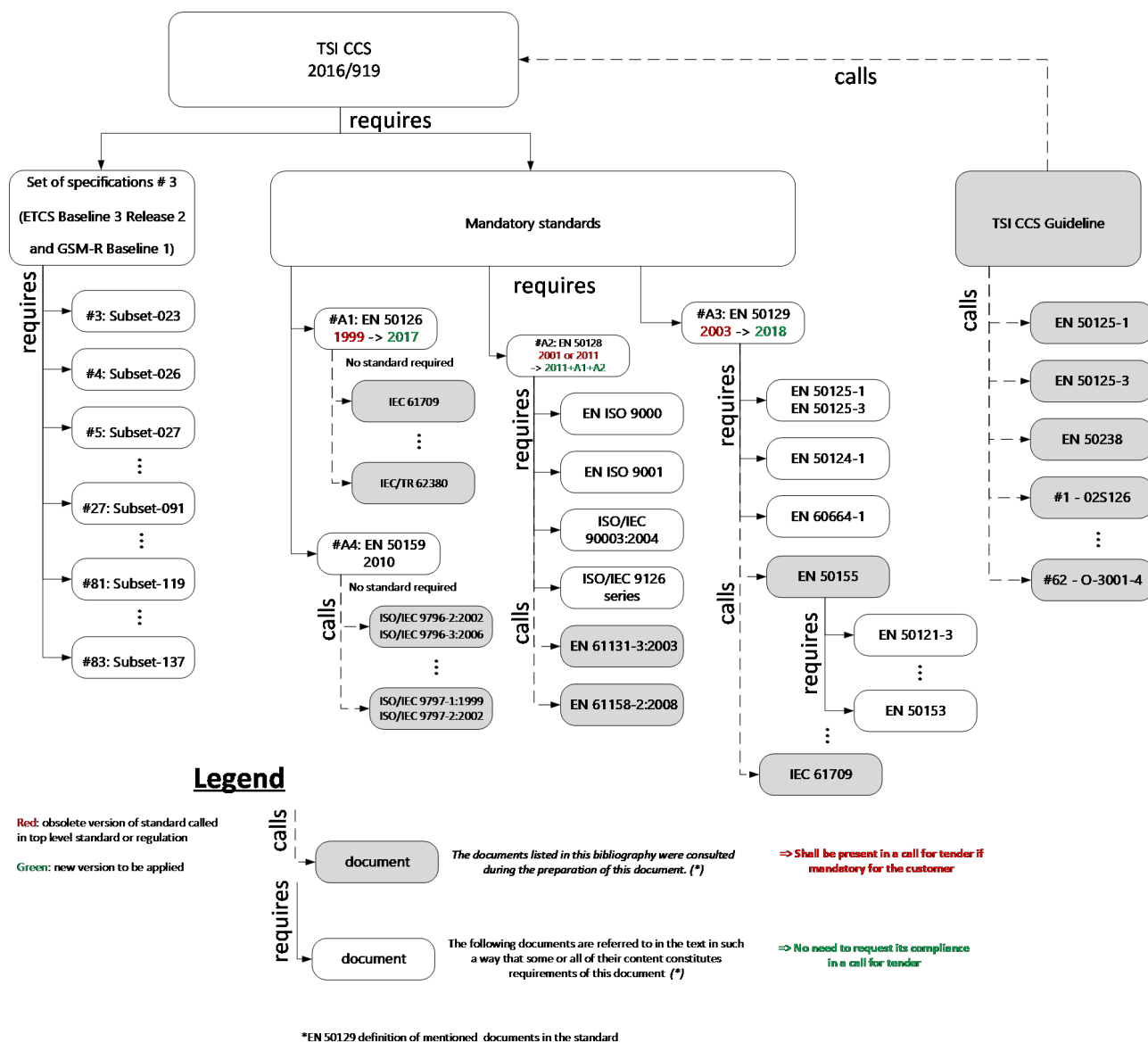
OCORA-40, A-Level - Adhere to TSI-CCS incl. CENELEC standards EN50126, 50128, 50129

The OCORA reference architecture shall comply with the regulation TSI-CCS (at least the latest version including any amendments) for the set of specifications #3 (ETCS Baseline 3 Release 2 and GSM-R Baseline 1), in particular with the following standards & regulations: SS026, SS027, SS035, SS038, SS091, SS093, SS108, SS114, SS119, SS139, SS147, EN50126, EN50128, EN50129

Status	✔ Approved
Classification	Requirement
Rationale	• To ensure interoperability according to Technical Specifications for Interoperability, TSI
Acceptance Method	Certification
Acceptance Criteria	OCORA shall follow an internal assessment (i.e. no final certificate is expected as OCORA is not a legal entity) which ensures that OCORA program has been developed in compliance with TSI-CCS (including CENELEC standards).

OCORA-63, A-Level - Adhere to TSI-CSS Guidelines

The OCORA reference architecture shall be designed according to TSI guideline GUI/CCS TSI/2019 (latest version from ERA website) regarding the following specifications and standards for the *Set of specifications #3 (ETCS baseline 3 Release 2 and GSM-R baseline 1)*:

Standards:

- EN 50125-1
- EN 50125-3
- EN 50238

Specifications:

- #1 - 02S126
- #2 - 97S066
- #3 - SUBSET-074-1
- #4 - 97E267
- #9 - ERA/ERTMS/040092
- #16 - ERA/ERTMS/040093
- #40 - ERA/ERTMS/040063
- #47 - SUBSET-113
- #49A – EN 50592
- #54 - SUBSET-11

Status	✔ Approved
Classification	Requirement
Rationale	• To ensure interoperability according to Technical Specifications for Interoperability, TSI.
Acceptance Method	Certification
Acceptance Criteria	OCORA shall follow an internal assessment (i.e. no final certificate is expected as OCORA is not a legal entity) which ensures that OCORA program has been developed in compliance with TSI-CCS guideline (including CENELEC standards).

OCORA-1040, A-Level - Adhere to TS 50701 Railway Application Cyber Security Standard

The OCORA reference architecture shall comply with the railway application cyber security standard TS 50701.

Status	✔ Approved
Classification	Requirement
Rationale	• To ensure state-of-the-art cyber security by design
Acceptance Method	Certification
Acceptance Criteria	OCORA shall follow an internal assessment (i.e. no final certificate is expected as OCORA is not a legal entity) which ensures that OCORA program has been developed in compliance with TS 50701.

OCORA-616, A-Level - Acceptance of Global Standards

The OCORA initiative shall investigate if Acceptance of Global Standards (no rail) are alternatives

Status	✔ Approved
Classification	Requirement
Rationale	• To increase possibilities for other pre-certified products • To enable innovation and easier technology transfer into the rail sector
Acceptance Method	Process Review
Acceptance Criteria	A process "acceptance of global standards" shall be defined.

2.4 Usage Scenarios

OCORA-56, A-Level - Support ETCS

The OCORA reference architecture shall support ETCS Levels 0-3 (including level NTC). ETCS is the primary ATP, hence always present.

Status	✔ Approved
Classification	Requirement
Rationale	• To ensure CCS On-board base functionality.
Acceptance Method	Design Review
Acceptance Criteria	A verification check shall be done at the end of phase 2 (and obviously 3, 4 and 5) to ensure that the ERTMS levels 0-3 including NTC are still covered by the latest version of the "System Architecture" document.

OCORA-58, A-Level - Support ATO

The OCORA reference architecture shall support ATO GoA 1-4 over ETCS

Status	✔ Approved
Classification	Operator Choice
Rationale	• To ensure CCS On-board base functionality.
Acceptance Method	Design Review
Acceptance Criteria	A verification check shall be done at the end of phase 2 (and obviously 3, 4 and 5) to ensure that the ATO GoA 1-4 over ETCS are still covered by the latest version of the "System Architecture" document.

OCORA-57, A-Level - Support STM Integration of National ATP Systems

The OCORA reference architecture shall support the Integration of National ATP Systems using STM

Status	✔ Approved
Classification	Operator Choice
Rationale	• To ensure CCS On-board base functionality.
Acceptance Method	Design Review
Acceptance Criteria	A verification check shall be done at the end of phase 2 (and obviously 3, 4 and 5) to ensure that the Integration of National ATP Systems using STM are still covered by the latest version of the "System Architecture" document.

OCORA-458, A-Level - Support integration of Driver Advisory Systems

The OCORA reference architecture shall allow the integration of Driver Advisory Systems (DAS) via a standardised interface.

Status	✔ Approved
Classification	Requirement
Rationale	• To ensure CCS On-board base functionality.
Acceptance Method	Design Review
Acceptance Criteria	A verification check shall be done at the end of phase 2 (and obviously 3, 4 and 5) to ensure that the latest version of the "System Architecture" document still foresees a standardised interface for DAS integration.

3 Collaboration / other European Initiatives (ob be revised)

This chapter is based on the OCORA Alliance [OCORA-BWS07-010].

3.1 Reference CCS Architecture (RCA)

RCA aims at defining the overall future CCS reference architecture for trackside and on-board. However, RCA is focusing on the trackside aspects and manages the overall end-to-end view. OCORA focusses on the CCS on-board aspects, which is a sub-system of the overall CCS system as defined by RCA.

OCORA-41, A-Level - Cooperation with RCA

The OCORA initiative shall work in close cooperation with RCA

Status	✔ Approved
Classification	Requirement
Rationale	- To ensure system consistency (architecture : actors, interfaces, capabilities...) and CCS related process consistency (requirement engineering, modular safety, integration,...). - Ensure that the architectures of RCA and OCORA are aligned. - Minimize efforts needed for developing the overall CCS reference architecture (e.g. common development of the system capabilities). - Limit efforts when performing changes on functionality that involves the trackside and on-board sub-systems. - Minimize integration and testing efforts. - Minimize operational interoperability issues.
Acceptance Method	Process Review
Acceptance Criteria	Produce a Project Management Plan that describes the OCORA collaboration. Periodic milestones shall be present in the OCORA planning to set-up synchronization meetings with RCA. The MoM shall be stored under GitHub.

3.2 Telecom On-Board Architecture (TOBA)

The Telecom On-Board Architecture (TOBA) Working Group, part of the UIC FRMCS (Future Railway Mobile Communication System) Program structure, specifies the FRMCS On-Board Connectivity Architecture.

OCORA-42, A-Level - Cooperation with UIC TOBA

The OCORA initiative shall work in close cooperation with TOBA

Status	✔ Approved
Classification	Requirement
Rationale	- To align onboard architecture for Connectivity / FRMCS - Ensure that the architectures of TOBA and OCORA are aligned. - Minimize efforts needed for developing the overall CCS reference architecture (e.g. common development of the sub system connectivity). - Minimize integration and testing efforts. - Minimize operational interoperability issues.
Acceptance Method	Process Review
Acceptance Criteria	Produce a Project Management Plan that describes the OCORA collaboration. Periodic milestones shall be present in the OCORA planning to set-up synchronization meetings with TOBA. The MoM shall be stored under GitHub.

3.2.1 Localisation Working Group of EEIG ERTMS Users Group

OCORA-519, A-Level - Cooperation with LWG

The OCORA initiative shall work in close cooperation with Localisation Working Group of EEIG ERTMS Users Group

Status	✔ Approved
Classification	Requirement
Rationale	- To ensure consistent interfaces and performances for the train localisation with the rest of CCS On-board - Ensure that the architectures of EUG LWG and OCORA are aligned. - Minimize efforts needed for developing the overall CCS reference architecture (e.g. common development of the sub system localisation). - Minimize integration and testing efforts. - Minimize operational interoperability issues.
Acceptance Method	Process Review
Acceptance Criteria	Produce a Project Management Plan that describes the OCORA collaboration. Periodic milestones shall be present in the OCORA planning to set-up synchronization meetings with Localisation Working Group of EEIG ERTMS Users Group. The MoM shall be stored under GitHub.

3.2.2 Shift2Rail

3.2.2.1 CONNECTA

CONNECTA aims at contributing to the Shift2Rail 's next generation of TCMS architectures and components with wireless capabilities as well as to the next generation of electronic braking systems. The project conducts research into new technological concepts, standard specifications and architectures for train control and monitoring, with specific applications in train-to-ground communications and high safety electronic control of brakes.

The project is developed in four phases of work which are reinforcing and extending the early work done in the TCMS part of Roll2Rail as well as start the specific activities of the MAAP of Shift2Rail. The major streams are described below.

1. Define General Specifications for TCMS technologies and high-level architectures to shape the future system with less cabling, increased availability, enhanced performance, easier integration and commissioning of functions and, above it, reduced life cycle costs.
2. Progress and implement new architectures and technologies, tools, norms and standards for the future generation of TCMS as well as for high safety level electronic brakes.
3. Simulate and test virtually all the communication networks and functions of the new generation TCMS subsystems to help to simplify business processes and enhance the interoperability.
4. Evaluate results, disseminate, communicate and exploit as much as possible at this TRL3-4 level of achievements.

OCORA-520, A-Level - Align with CONNECTA

The OCORA initiative shall align the long term vision and related requirements of On-board communication with CONNECTA.

Status	✔ Approved
Classification	Requirement
Rationale	• Ensure that the architectures of CONNECTA and OCORA are aligned. • Develop TCMS and CCS domain into a common compatible future • Minimize integration and testing efforts. • Minimize operational interoperability issues.
Acceptance Method	Design Review
Acceptance Criteria	Produce a Project Management Plan that describes the OCORA collaboration. Milestones shall be present in the OCORA planning to set-up synchronization meetings with CONNECTA. The MoM shall be stored under GitHub. A verification check shall be done at the end of phase 2, 3, 4, 5 to check if both long term visions are still aligned

3.2.2.2 LINX4RAIL

The ambition of LinX4Rail is to achieve a comprehensive approach for the Conceptual Data Model, as a models' federation, global system modelling specification and the strategy for implementation of technological breakthroughs.

OCORA-517, A-Level - Follow the LinX4Rail

The OCORA initiative shall follow actively the Linx4Rail development of the Conceptual Data Model, its operational analysis and system architecture.

Status	✔ Approved
Classification	Requirement
Rationale	- to ensure compatibility of the conceptual data model with OCORA - to understand leveling among LinX4Rail - RCA - OCORA in terms of CCS end-2-end functionality - to identify other touchpoints between LinX4Rail and OCORA outside of the CCS end-2-end functionality domain - Prevent duplicated activities
Acceptance Method	Process Review
Acceptance Criteria	Produce a Project Management Plan that describes the OCORA collaboration. Regular milestones shall be present in the OCORA planning on the active participation of OCORA to LINX4RAIL meetings. The MoM shall be stored under GitHub.

3.2.2.3 X2RAIL4

X2Rail-4 aims to bring to conclusion the research and development of some key technologies to foster innovations in the field of railway signalling, automation and supervision, as part of a longer term Shift2Rail IP2 strategy towards a flexible, real-time, intelligent traffic control management and decision support system. The actions to be undertaken in the scope of X2Rail-4 are related to the following specific objectives:

- On the basis of ERTMS/ETCS to implement (develop and test) the Automatic Driving up to the highest grade of automation GoA4 increasing line capacity, reducing operating costs, saving energy;
- To specify and prototype an innovative On-Board Train Integrity solution, capable of autonomous train tail localisation, wired or wireless communication between the tail and the front cab, safe train integrity supervision (SIL-4 at system level) of train interruption, traditional power supply or energy harvesting solutions without the deployment of any fixed trackside equipment;
- To develop a standardised communication structure linking rail different business services and new software applications for Time Table Management and Traffic Control to support the operation of the new drive modes e. g. ATO;
- To develop and test new concept Object Controllers consisting of a solution scalable and flexible enough to fulfil different configurations and scenarios, where locally derived power and wireless communications, guaranteeing safety and security justifications, together with maximum de-centralisation are applied. Additionally, the higher bandwidths will be used for transmission of status reports / maintenance information and further required data.

The actions foreseen in X2Rail-4 will bring to the highest readiness level (TRL) taking the results of previous X2Rail-1, X2Rail-2 and of the ongoing X2Rail-3 projects.

OCORA-521, A-Level - Follow the X2Rail-4

The OCORA initiative shall work in close cooperation with X2Rail-4 to implement Automatic Driving into the modular architectural framework

Status	✔ Approved
Classification	Requirement
Rationale	- to ensure compatibility of automatic driving with OCORA - Prevent duplicated activities - Use exiting or yet to be defined ATO business logic without adaptation for OCORA
Acceptance Method	Process Review
Acceptance Criteria	Produce a Project Management Plan that describes the OCORA collaboration. Regular milestones shall be present in the OCORA planning on the close cooperation of OCORA to X2Rail-4 meetings. The MoM shall be stored under GitHub.