

# OCORA

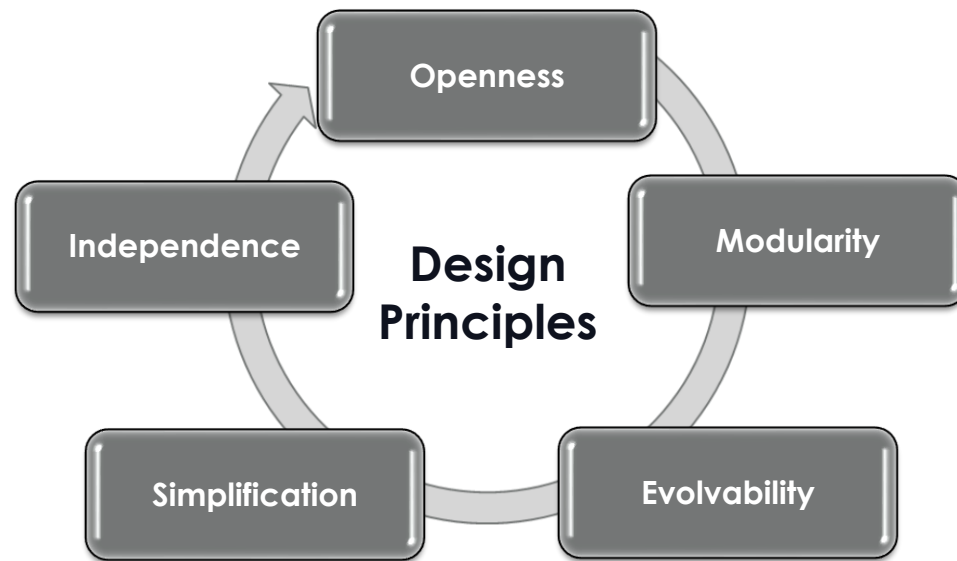
## Program Slide Deck

# OCORA Release R3 - OnePager

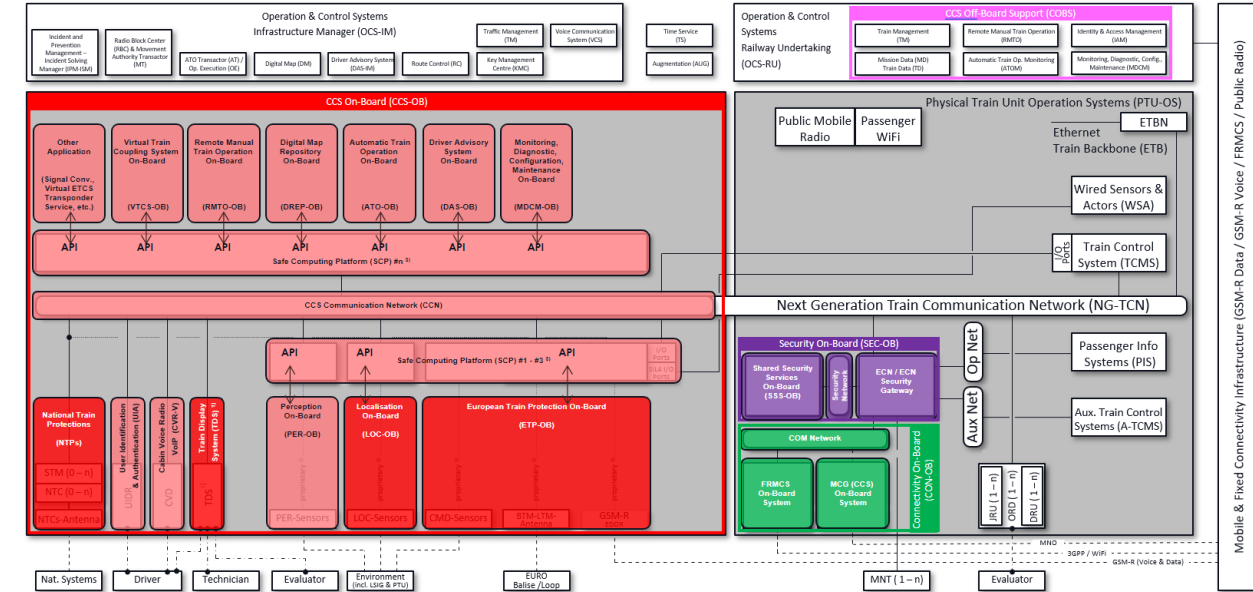
<https://github.com/OCORA-Public/Publication>

**OCORA**, the “**Open CCS On-board Reference Architecture**” initiative, whose signatory founding Members are NS, SNCF, DB, SBB and ÖBB, has reached a next important milestone with the **Release R3** of the specifications of the OCORA architecture.

**OCORA** aims to **reduce life-cycle costs** and **facilitate** the introduction of **innovation** and **digital technologies** beyond the current proprietary interfaces, by establishing a **modular, upgradeable, reliable** and **secure CCS on-board architecture**.



The **OCORA Release R3** describes **CCS On-board** and includes **sector feedback**, especially from the **System Pillar Ramp Up** activities. It is **laying out the foundation for EU-Rail's System- & Innovation-Pillar** and provides the **concept on Configuration Management**.



**OCORA deliverables** are published under the **European Union Public License (EUPL)** and are consequently available for all stakeholders. The **OCORA Release R4** is planned for **mid of 2023**. It is expected to be reduced by the already transferred EU-Rail activities.

- Introduction into OCORA
- Roadmap
- Alliances
- Release Overview
- Economic Model
- Sector Dialogue



## Problem Statements - **Current ETCS On-board solutions...**

1. are built on **incomplete, not fully standardized**, and sometimes **ambiguous specifications**
2. do not have a reasonable **total cost of ownership**
3. are **difficult to be integrated** into existing vehicles
4. are **costly and time consuming to adapt/change/update/upgrade**
  - In case of patching and error corrections in non SIL and SIL areas (e.g. cyber- security patching)
  - In case of baseline upgrades (e.g. ETCS baseline 2 to 3)
  - In case of functional enhancements (e.g. adding ATO)
  - In case of adaptation to new technologies (e.g. upgrade to FRMCS)
5. **do not respect different life-cycles profiles** of the different vehicle based constituents (e.g. vehicle vs. ETCS vs. connectivity)
6. are **difficult to maintain** (e.g. monitoring, diagnosis, configuration, and maintenance possibilities very limited – no remote functionality)
7. are **lacking built-in cyber security**
8. are **performing below expected quality levels**

In addition:

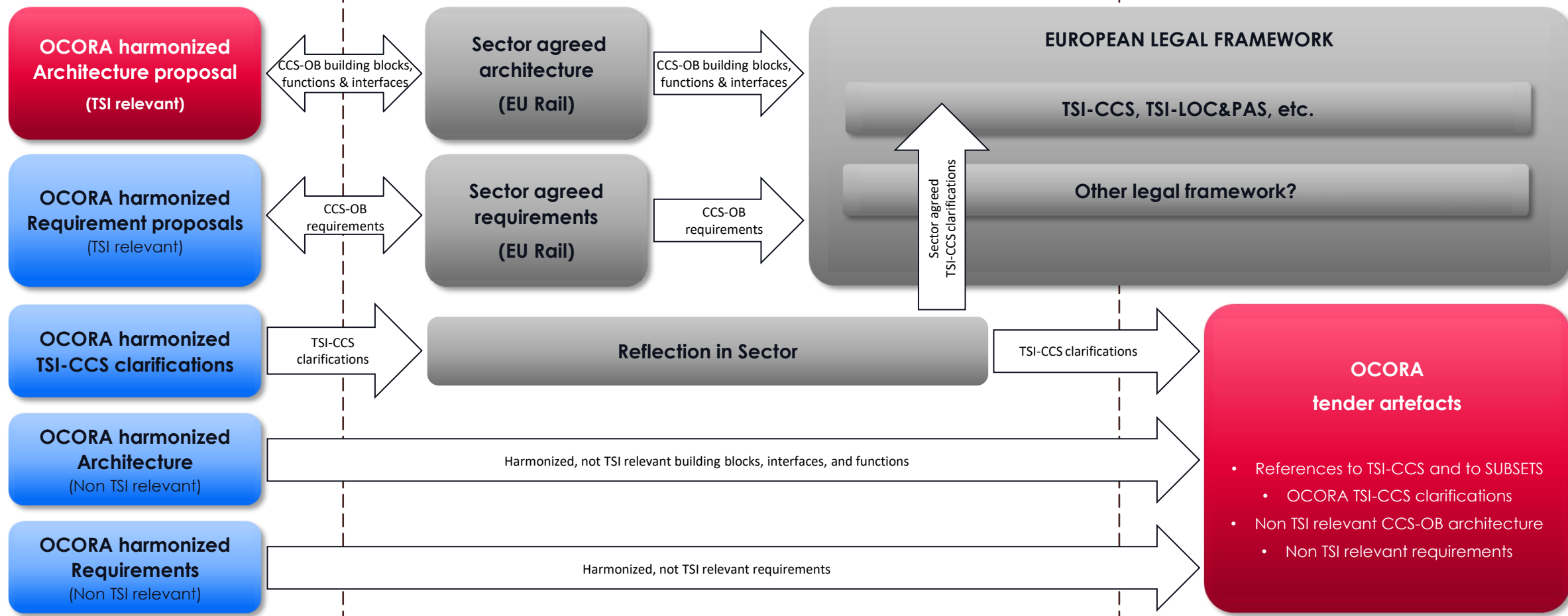
- The benefit of ETCS On-board only pays off, if the ERTMS rollout progresses in Europe on large scale.
- The ETCS On-board functions as such also need some improvements (e.g. braking curve, odometry accuracy, etc.) to serve current operational needs.
- Difficult, expensive and time consuming ETCS On-board fitments in general, are delaying national deployment plans, impacting trackside investments, and postponing ERTMS rollouts.

### OCORA

### Sector

ERA, UNISIG/Unife, EU-Rail, S2R (LINX4Rail, CONNECTA, X2Rail-4, Tauro), EUG-LWG, UIC (FRMCS, TOBA), SFERA

### Tender Artefacts



# Introduction

Why – Goals – Motivation – Objectives - Benefits



WHY

WHAT

HOW

## Triggers

- Inter-modal competition
- Learnings from ETCS
- Replacement needs
- Fast migration
- Innovation / digital transformation

## Supported goals

- Cost ↘
- Reliability ↗
- Capacity ↗
- Safety ↗

## Scope

**IN:** on-board Control and Command Systems

**OUT:** Track-Side CCS, Train Control Management System, Future Mobile Radio

## Harmonized architecture

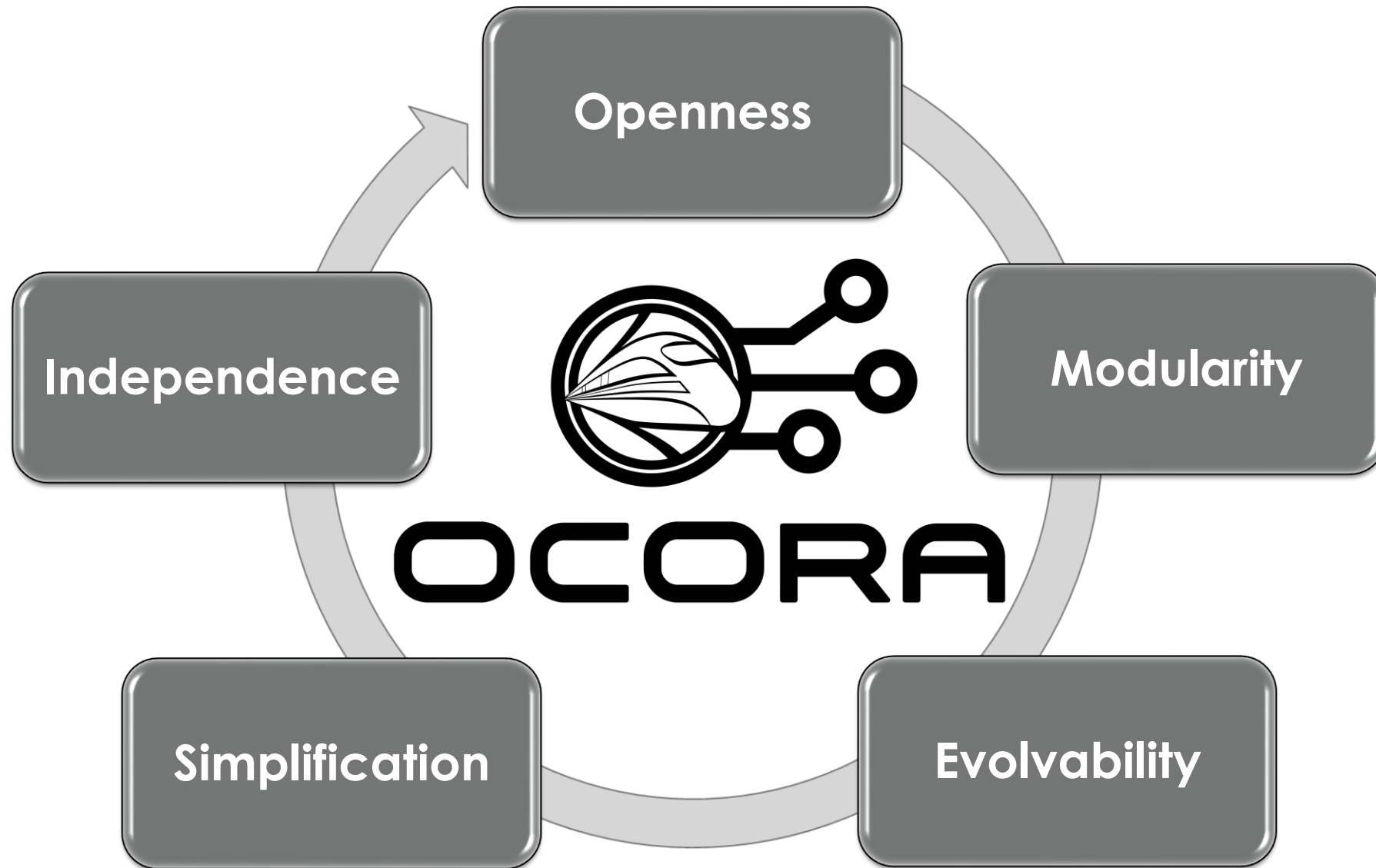
- Reference requirements → verifiable products
- Model based standardised interfaces and functions
- Economic modeling

## Target

- Openness
  - Modularity
  - Evolvability
  - Simplification
  - Independence
- Migration**
- Upgradable and exchangeable components
  - Compatibility framework

Foundation

ETCS + Pervasive Mobile Communication for Railway



# Introduction

## OCORA - History



### OCORA IS...

Open Cooperation

A set of public specifications

For the On-board CCS

### OCORA IS NOT...

Not a Representative Body/Organisation

Not a product

Not for Trackside CCS

March  
2019

- **Memorandum of Understanding - 5 founding members (NS, SNCF, SBB, ÖBB, DB)**
- OCORA is a **collaborative platform gathering engineering resources** working on **ERTMS and beyond**

October  
2019

- **OCORA Governance** in place, with an active Steering Committee
- Open to railway companies willing to contribute to the collaboration

November  
2019

- **OCORA Alpha Release**, first publication
- Alpha outlines the Who, the How and the Why

July  
2020

- **OCORA Beta Release**, first comprehensive CCS On-board description
- Based on Beta OCORA starts Sector / Industry Dialogue

December  
2020

- **OCORA Gamma Release**, updated CCS On-board description, including Sector / Industry feedback
- Gamma is feeding TSI-2022 and S2R-2 with qualified technical input

July  
2021

- **OCORA Delta Release**, updated CCS On-board description, including Sector / Industry feedback
- Delta is again feeding TSI-2022 and prepares for Europe's Rail Joint Undertakings System- & Innovation-Pillar

December  
2021

- **OCORA Release R1**, updated CCS On-board description, including Sector / Industry feedback
- Prepares for Europe's Rail Joint Undertakings System- & Innovation-Pillar.

July  
2022

- **OCORA Release R2**, updated CCS On-board description, including industry feedback from System-Pillar Ramp Up
- Serves as further input for EU-Rail System- & Innovation-Pillar.

December  
2022

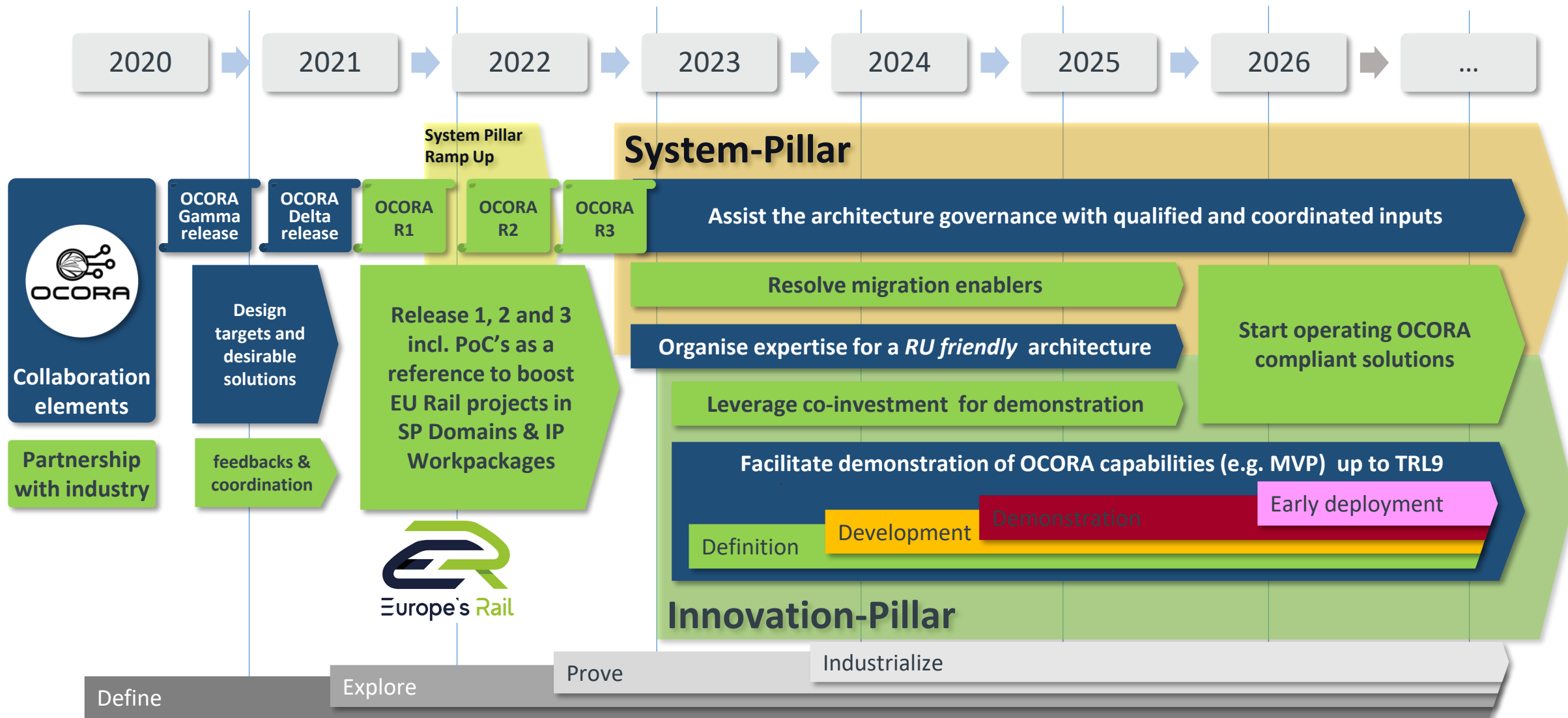
- **OCORA Release R3**, updated CCS On-board description
- Serves with operational input for EU-Rail and provided the concept on Configuration Management





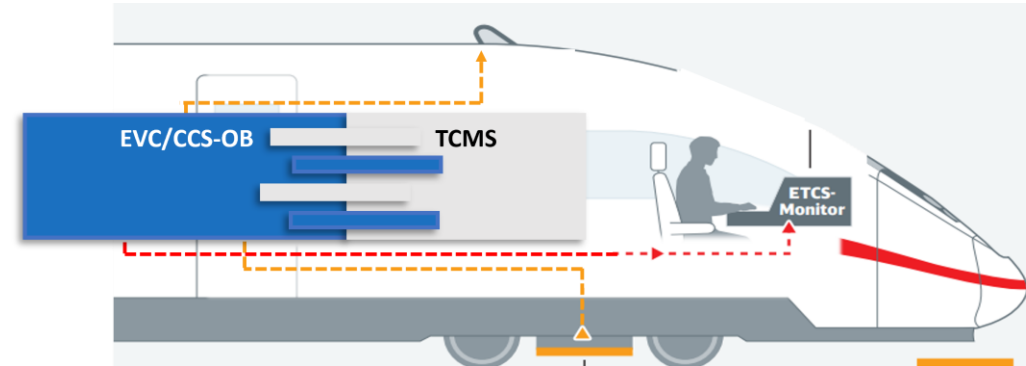
# Roadmap

With an architecture framework, EU-Rail will be the collaborative platform supporting technological migrations



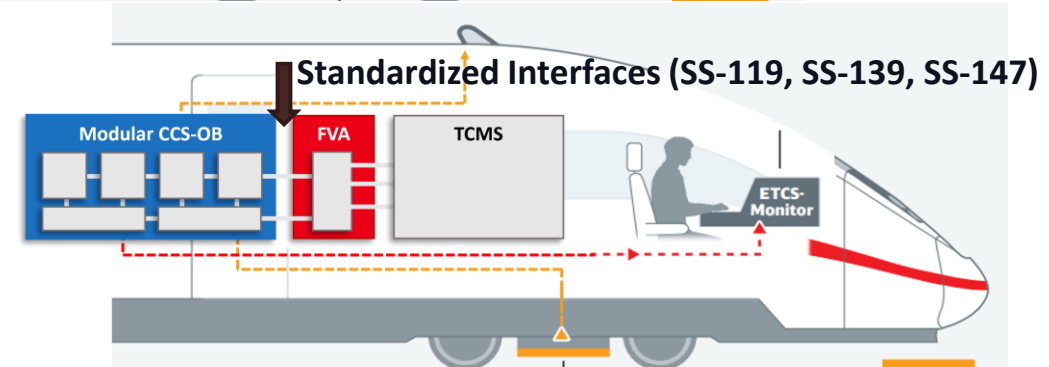
### 1. Current situation

- Monolithic CCS (Command, Control & Signalling).
- EVC/CCS-OB tightly integrated with TCMS.
- CCS-OB replacements requires understanding of individual, manufacturer specific TCMS.



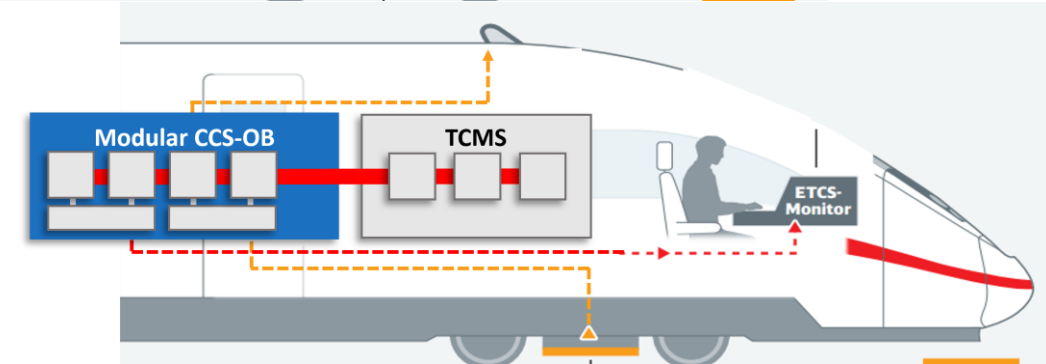
### 2. OCORA Functional Vehicle Adapter

- Modular, upgradeable CCS-OB architecture.
- CCS-OB communicates with TCMS via standardized interfaces (SS-119, SS-139, SS-147). Non-compliant TCMSs are adapted to the standardized interfaces through a Functional Vehicle Adapter (FVA).
- CCS-OB upgrades/replacements do not require a detailed understanding of the TCMS systems anymore.



### 3. OCORA Long Term perspective

- Comprehensive next-gen Communication Network for connecting all train control and safety systems (TCMS and CCS). TCMSs are compliant with the standardized interfaces. The need for an FVA vanishes.
- Separation of HW and SW via Computing Platform.



## Ongoing OCORA liaisons

Sector interest group	Collaboration area	Liaison in place
CCS SG (CER)	Preparing TSI 2022 revision Setting sector governance for CCS architecture	OCORA experts sharing achievements for endorsement
TWG Train Modular Architecture (ERA)	Sounding TSI-CCS 2020 On-board preparation	Some OCORA experts present as CER speaker
RCA (EUG+EULYNX)	Functional decomposition Performance requirements (including interoperability) Computing platform Modular safety	Setting up of a coordination group Joined working groups have started
FRMCS (UIC)	On-board telecommunication architecture Safe Communication capabilities Migration from GSM-R	Coordination done through experts involved in both initiatives.
Localisation WG (EUG)	Mission requirement for onboard localisation Interface for localisation peripherals	Coordination done through experts involved in both initiatives.
LinX4Rail (Shift2Rail)	TCMS interface Common sector business objectives Rail system architecture definition and governance	Alignment and collaboration has started

- OCORA assumes that a frequent, well-structured and open, unbiased exchange of views and ideas with its suppliers is fundamental to initiate customer oriented product and service development. Formalised liaisons with suppliers and industry interest groups (e.g. UNIFE/UNISIG) are therefore a sensible objective for OCORA collaboration.

# Release Overview

OCORA Business and Technical Workstreams, Work Packages and RU Projects



## Business Workstreams

BWS01	Core Team
BWS02	Communication
BWS03	Introduction to OCORA
BWS04	Problem Statements
BWS05	Roadmap & Planning
BWS06	Business Model
BWS07	Alliances
BWS08	Methodology & Tooling
BWS09	Acceptance of Global Standards

## Technical Workstreams

TWS01	System Architecture
TWS02	CCS Communication Network
TWS03	Computing Platform
TWS04	Functional Vehicle Adapter
TWS05	Requirements
TWS06	(Cyber-) Security
TWS07	RAMS
TWS08	MDCM
TWS09	Testing
TWS15	Prototyping

## Architecture Work Packages

WP00	CCS-OB Architecture
WP01	ATP-OB Architecture
WP02	LOC-OB Architecture
WP03	ATO-OB Architecture
WP10	MBSE Preparation
WP11	System Capabilities
WP12	Connectivity

## RU Projects

DB Cargo	ATO Freight GoA2+4+RCS
DB Regio	Stuttgart ETCS + ATO GoA2
SBB	PoC OMS SS-149

# Release Overview

## Program Content



### Release Highlights Program Documents are:

- Updated Communication Material
- Updated Problem Statement
- Updated Road Map
- Updated Economic Model and new impact analysis

### Color Legend:

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New document or document with significantly new/additional content.

**Doc. Title**

Updated document with major enhancements

**Doc. Title**

Unchanged content only with minor improvements

# Release Overview

## Technical Content

Technical  
Documentation

- OCORA-TWS01-010 – Design Requirements
- OCORA-TWS01-020 – Operational & System Analysis
- OCORA-TWS01-030 – System Architecture
- OCORA-TWS01-035 – CCS On-Board (CCS-OB) – Architecture
- OCORA-TWS01-040 – Capella Modelling
- OCORA-TWS01-041 – MBSE Modelling Guidelines
- OCORA-TWS01-050 – Capella Model Export
- OCORA-TWS01-100 – Localisation On-Board (LOC-OB) – Introduction
- OCORA-TWS01-101 – Localisation On-Board (LOC-OB) – Requirements
- EUG 22E126 – LOC-OB System Definition & Operational Context
- EUG 22E135 – LOC-OB Risk Analysis
- OCORA-TWS01-112 – Automated Train Protection On-Board (ATP-OB) - MLM Interface Analysis
- OCORA-TWS02-010 – CCS Communication Network – Evaluation
- OCORA-TWS02-020 – CCS Communication Network – Proof of Concept (PoC)
- OCORA-TWS03-010 – SCP – Whitepaper Computing Platform for Railway Applications
- OCORA-TWS03-020 – SCP – High-Level Requirements
- OCORA-TWS03-030 – SCP – Specification of the PI API between Application and Platform
- OCORA-TWS04-010 – Functional Vehicle Adapter – Introduction
- OCORA-TWS04-011 – Functional Vehicle Adapter – Requirements
- OCORA-TWS04-012 – TCMS– Standard Communication Interface Specification
- OCORA-TWS05-010 – Requirements – Management Guideline
- OCORA-TWS05-020 – Stakeholder Requirements
- OCORA-TWS05-021 – Program Requirements
- OCORA-TWS06-010 – (Cyber-) Security – Project Security Management Plan
- OCORA-TWS06-030 – (Cyber-) Security – Concept
- OCORA-TWS07-010 – RAMS – Modular Safety Strategy
- OCORA-TWS07-020 – RAMS – Evolution Management
- OCORA-TWS07-030 – RAMS – SRAC/AC Management
- OCORA-TWS07-040 – RAMS – Optimized Approval Process
- OCORA-TWS07-050 – RAMS – RAM Strategy
- OCORA-TWS07-060 – Configuration Management – Concept
- OCORA-TWS07-100 – CENELEC Phase 1 – Concept
- OCORA-TWS07-201 – QRAMSS – QRAMS Strategy
- OCORA-TWS08-010 – MDCM-OB – Introduction
- OCORA-TWS08-030 – MDCM-OB – SRS
- OCORA-TWS09-010 – Testing – Strategy
- OCORA-TWS09-011 – Testing – Requirements
- OCORA-TWS09-050 – Testing – Cybersecurity Testing Strategy
- OCORA-TWS09-110 – Train Adapter Block Integration Plan
- OCORA-TWS09-111 – Testing - Testplan Functional Vehicle Adapter
- OCORA-TWS15-040 – CCS-OB Retrofit - Guideline for Projects
- OCORA-TWS15-050 – PoC OMS SS-149 - Concept



### Release Highlights Technical Documents are:

- New Concept on Configuration Management
- Significantly enriched Operational & System Analysis
- Updated Architecture Documentation
- Further elaboration for PRAMSS- in particular for future modularity
- New CCS-OB Retrofit - Guideline for Projects

### Color Legend:

Doc. Title

New document or document with significantly new/additional content.

Doc. Title

Updated document with major enhancements

Doc. Title

Unchanged content only with minor improvements



### Methodology:

- OCORA is developing based on topical workstreams
- OCORA is releasing contiguously
- OCORA makes a use of Best Practice
- OCORA uses the OSI model for interface specifications
- OCORA is using Model Based System Engineering based on Arcadia methodology
- OCORA deliverables are in compliance with the CENELEC phases
- OCORA deliverables are following the V cycle

### Tooling:

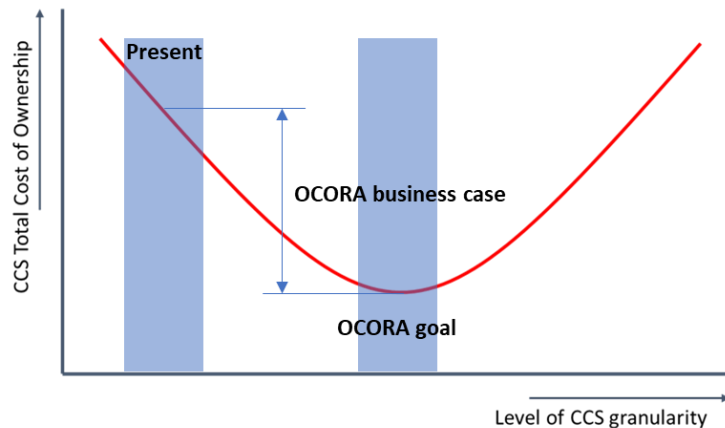
- ▶ OCORA uses MsTeams for telcos
- ▶ OCORA uses a public repository for publications:  
<https://github.com/OCORA-Public>
- ▶ OCORA uses an internal repository for work in progress
- ▶ OCORA uses Polarion for requirements engineering and management
- ▶ OCORA uses Capella for Model Based System Engineering



# Economic Model

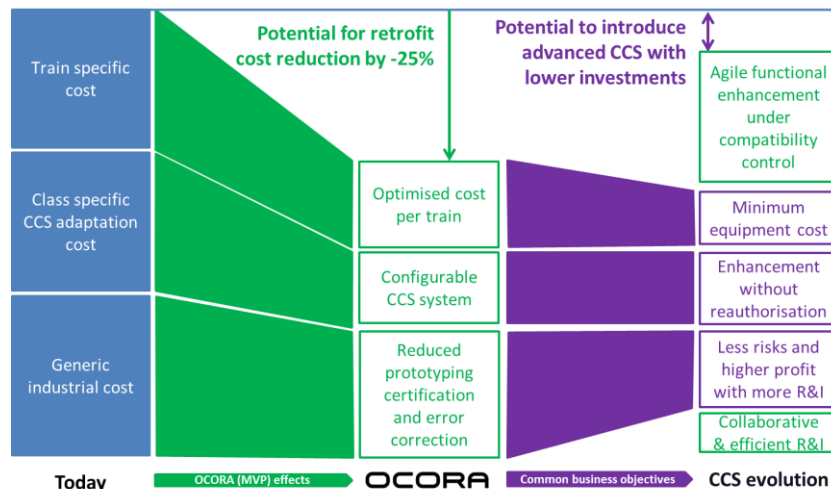


An economic model to discuss the optimal level of granularity



The development of the OCORA economic model, intends to provide tools for:

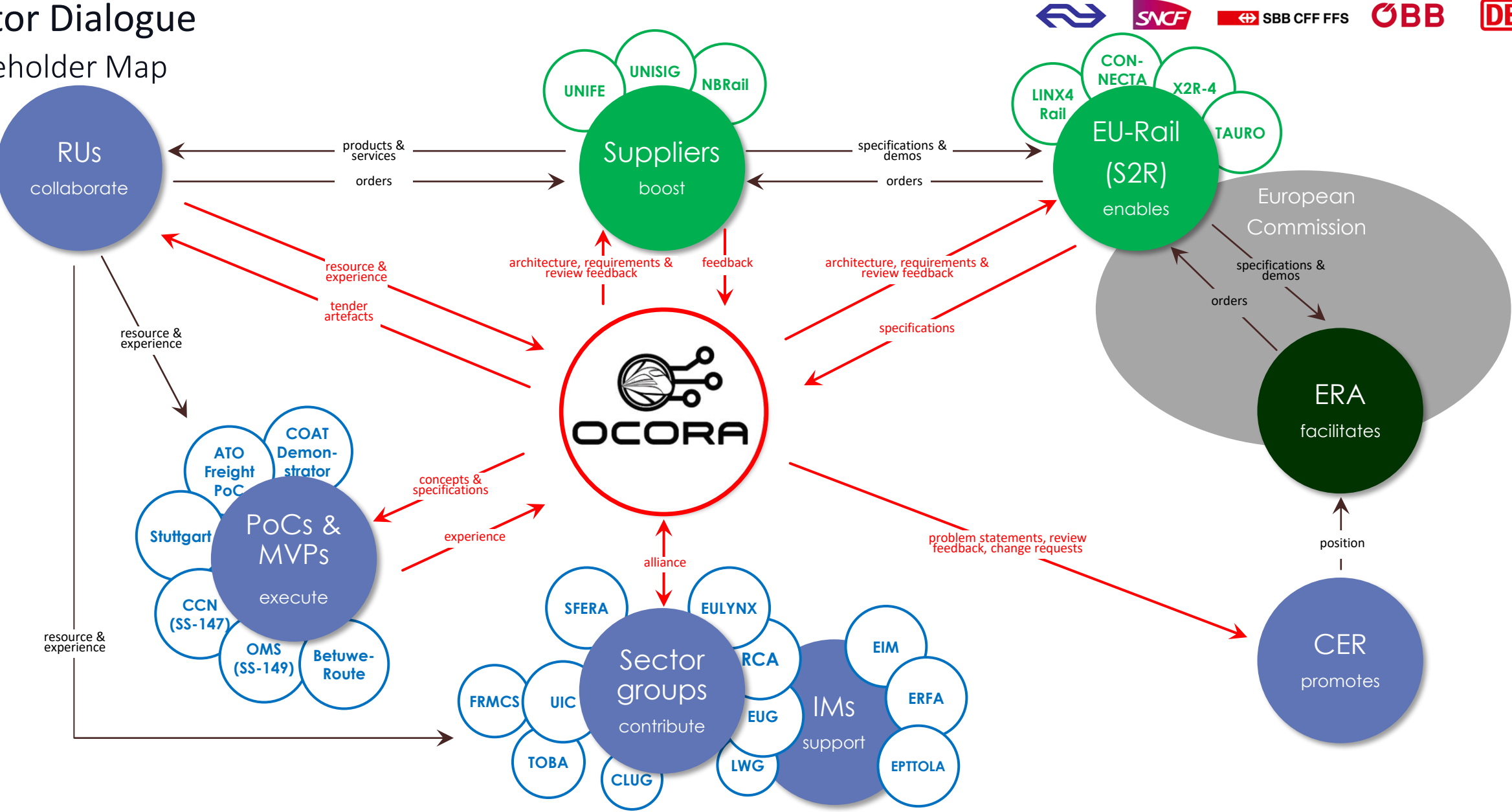
- Getting a clear view on the economic driver for the modularization of the on-board. To this end the model focus on 3 cost categories:
  - Generic industrial cost for developing certified CCS onboard sub systems
  - Cost for authorising operation with a new CCS configuration in a class of vehicle
  - Train specific cost for fitting or upgrading CCS building blocks
- Studying the impact of technology life cycle on the total cost of ownership. To this end scenario are defined for comparison purpose:
  - Today's situation with slow deployment and small project size, based on reference values derived from EC studies on ERTMS.
  - OCORA MVP scenario to model the economic impact of the modularisation of CCS onboard architecture
  - CCS evolution scenarios allowing to investigate impact of larger market, enhanced functionalities and accelerated upgrade scheme
- Optimising the contribution of OCORA breakthrough to Common business objectives. An open dialogue with the industry creates mutual benefit.





# Sector Dialogue

## Stakeholder Map



- Publisher: OCORA Cooperation
- Channel: OCORA publishes exclusively over <https://github.com/OCORA-Public/Publication>
- Any feedback for OCORA is welcome!  
If you would like to attend a workshop or give a feedback, please contact [rolf.muehlemann2@sbb.ch](mailto:rolf.muehlemann2@sbb.ch).  
For specific feedback the OCORA-BWS01-040 Feedback Form shall be used.
- For active collaboration (within the OCORA framework) the OCORA Code of Conduct must be accepted and signed.  
In case of interest for active collaboration and you are eligible to become a partner according to the OCORA Code of conduct, please drop a "interest of becoming a OCORA member by mail" to [rolf.muehlemann2@sbb.ch](mailto:rolf.muehlemann2@sbb.ch).
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