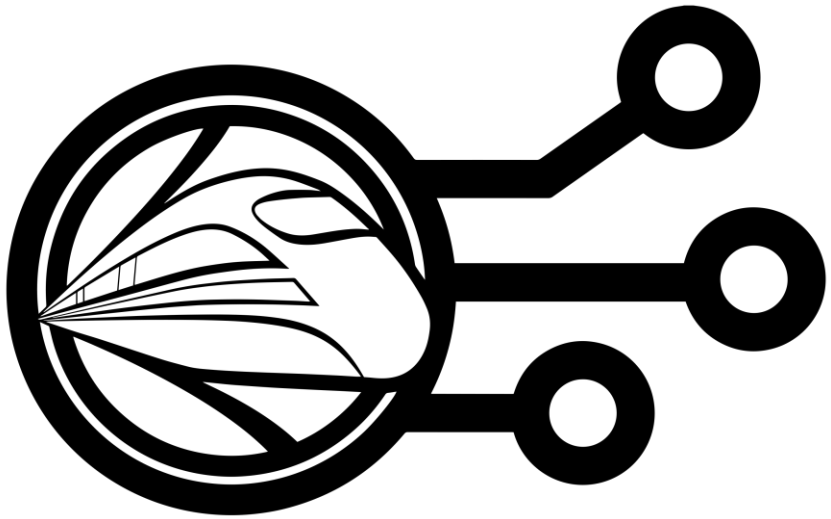


OCORA

Program Slide Deck

OCORA-BWS02-020 / v1.00 / 26.11.2021 / Release R1

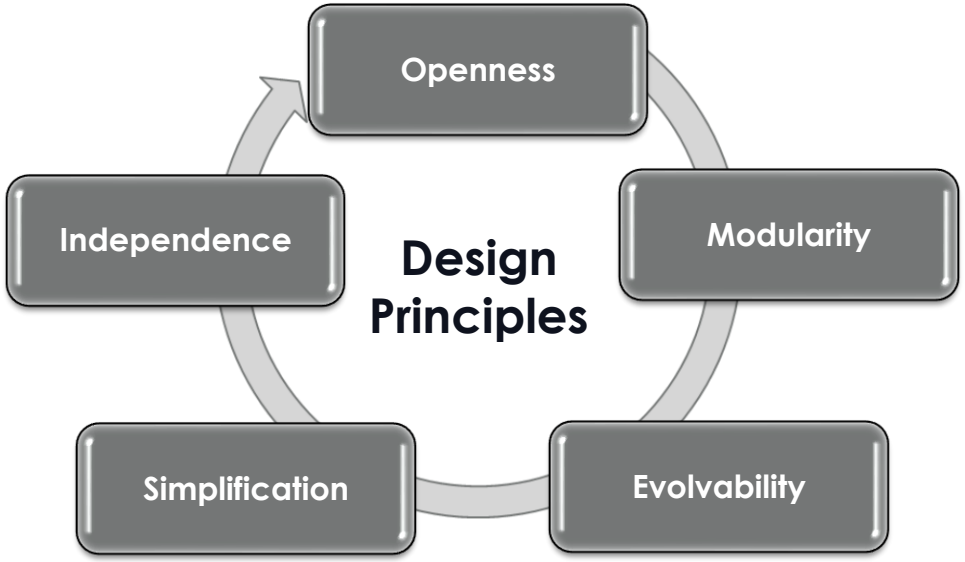
OCORA Release R1 - OnePager

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

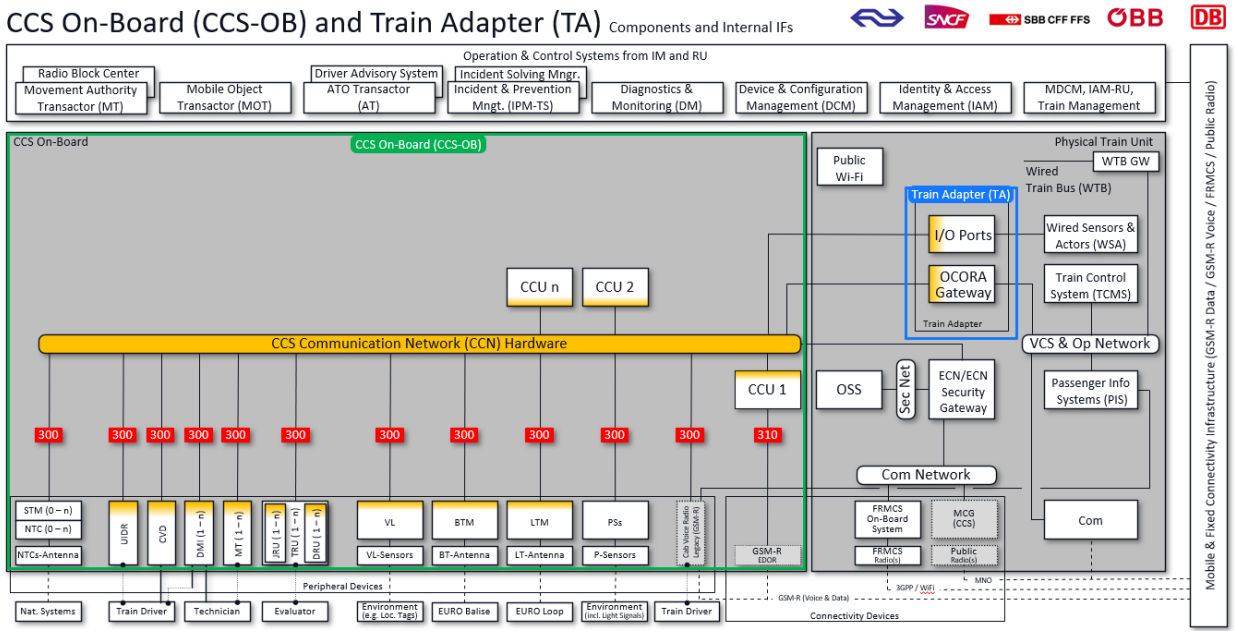
Founding Members

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 R1** 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 R1** descripts **CCS On-board** and includes **sector feedback**. It **is again feeding TSI-2022 and prepares for Europe's Rail Joint Undertakings System- & Innovation-Pillar.**



OCORA deliverables are published under the **European Union Public License** (EUPL) and are consequently available for all stakeholders.
The OCORA **Release R2** is planned for **mid of 2022.**

Program Slide Deck

Content

- Introduction into OCORA
- Timeline
- Alliances
- Release Overview
- Sector Dialogue

Introduction

OCORA-BWS02-020 / v1.00 / 26.11.2021 / Release R1

Introduction

Topic Overview

- Who
- Why – Goals – Motivation – Objectives - Benefits
- Key Principles
- What (Scope)
- Problem Statements
- Reference to Technical Slide Deck, Program Poster & Technical Poster

Introduction

Who is OCORA - **O**pen **C**CS **O**n-board **R**eference **A**rchitecture

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.

OCORA IS…	OCORA IS NOT…
Open Cooperation	**Not a Representative Body/Organisation**
A set of public specifications	**Not a product**
For the On-board CCS	**Not for Trackside CCS**

Introduction

Why – Goals – Motivation – Objectives - Benefits

Triggers

- **Inter-modal competition**
- **Learnings from ETCS**
- **Replacement needs**
- **Fast migration**
- **Innovation / digital trans-formation**

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**

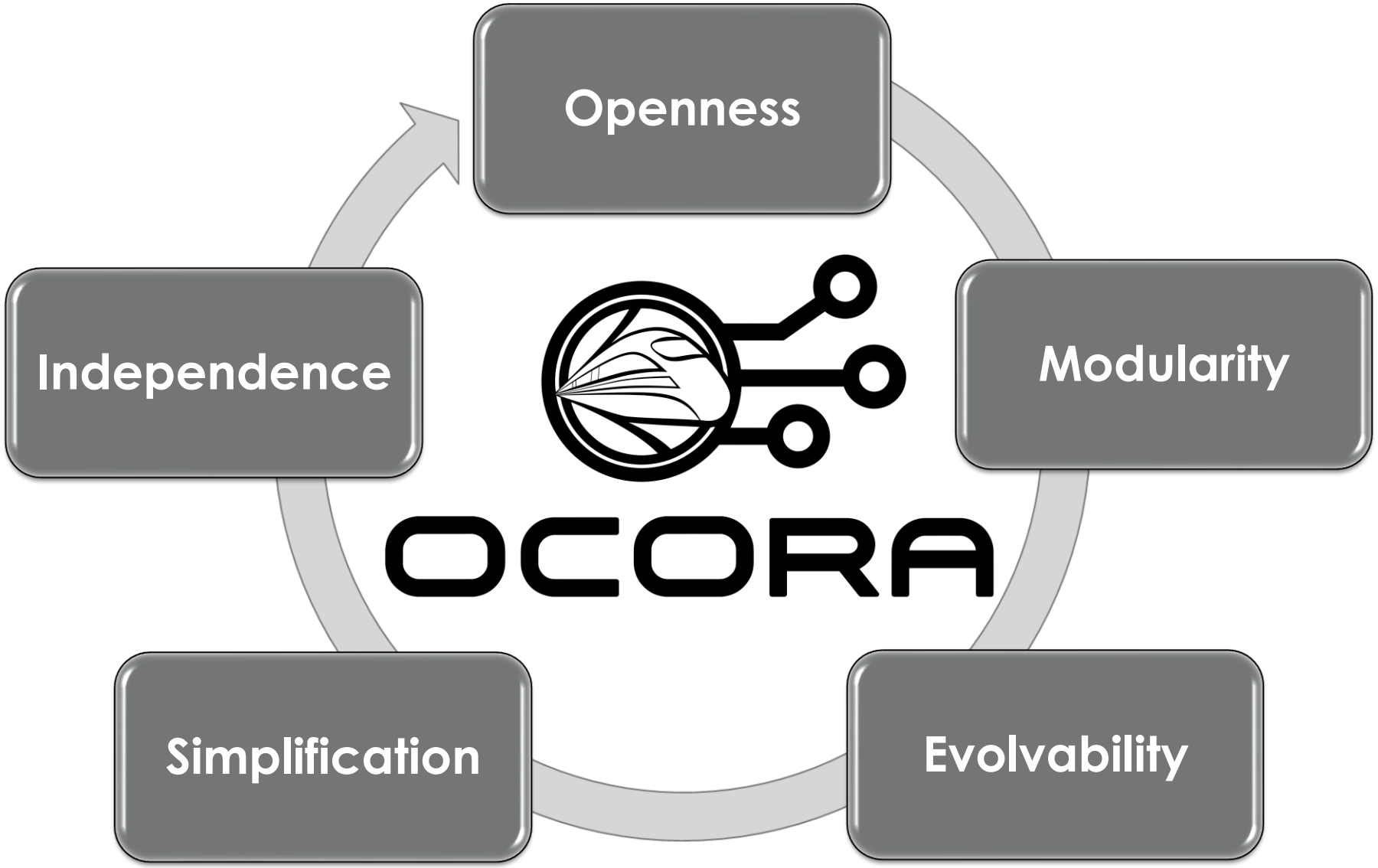
Migration

- **Upgradable and exchangeable components**
- **Compatibility framework**

Foundation — **ETCS + Pervasive Mobile Communication for Railway**

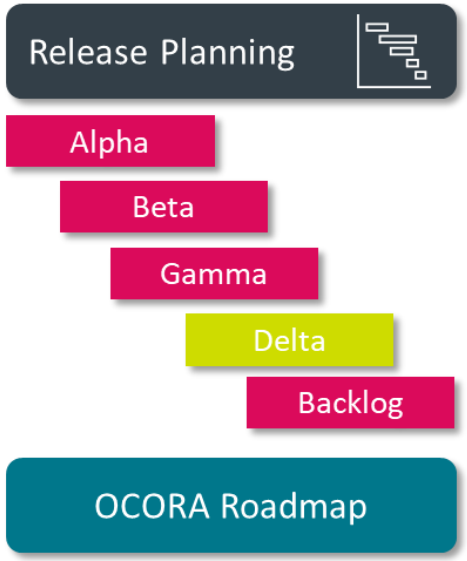
Introduction

Key Principles



Introduction

What (Scope)



OCORA targets a comprehensive and coherent set of specification for a modular CCS On-board environment published through consecutive OCORA releases.

Anticipated results from the OCORA collaboration as defined in the OCORA MoU are:

- A reference architecture guiding the development of (a specification for) a consistent and modular On-board CCS system.
- An economic evaluation supporting the OCORA architecture and approach.
- Robust interface specifications allowing for smooth evolution and migration.
- Improvements of the regulatory framework as a enabler for technology and migration uptake.
- So called “demonstrators”, “real life application” of products to showcase usability and applicability in test environments.
- A ‘Minimum Viable Product’ or MVP, the condensed version providing the core functionality of the OCORA platform for both validation and verification as well as authorization purposes.
- Publications targeting the dissemination of OCORA results to the benefit of stakeholders in the European railway community.

Introduction

Problem Statements - Current ETCS On-board solutions…

1. are based on the **TSI specifications** ensuring interoperability, but the **subset specifications are incomplete and ambiguous**. Therefore, interoperability is not a given.
2. are **more expensive than technologically justifiable**. This seems to be a result of **high integration engineering and certification efforts**, as well as **small batch sizes** and **high project risks**.
3. are **difficult to be integrated into existing vehicles**.
4. are **difficult and time consuming to adapt/change/update/upgrade**:
   - In the case of patching in non SIL area (e.g. cyber- security patching)
   - In the case of error correction in SIL area
   - In the case of baseline upgrade (e.g. ETCS baseline 2 to 3)
   - In the case of functional enrichment (ex. base for game changer introduction is not a given)
5. do **not respect different, non-overlapping life cycles** (e.g. vehicle vs. CCS vs. connectivity).
6. are **difficult to maintain** (e.g. maintenance, monitoring, diagnose possibilities very limited).
7. are **lacking built-in cyber security**, since this is a newer topic, especially in combination with 4 + 6.
8. are **performing below expected availability and reliability** (from overall ETCS system perspective).

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.

Introduction

OCORA Release Communication Material

- OCORA-20-001-Executive Summary Slide Deck
  - Official summary slide set
- OCORA-20-002-Program Slide Deck (this document)
  - Official slide set for presenting program aspects (e.g. problem statements, road map, etc.)
- OCORA-20-003-Technical Slide Deck
  - Official slide set for presenting technical aspects (e.g. architecture, UVCC Bus Evaluation, etc.)
- OCORA-20-004-Program Posters
  - Official posters for presenting program aspects (e.g. problem statements, road map, etc.)
- OCORA-20-005-Technical Posters
  - Official posters for presenting technical aspects (e.g. architecture, CCN, CP, FVA, (Cyber-) Security, Modular Safety, etc.)

Timeline

OCORA-BWS02-020 / v1.00 / 26.11.2021 / Release R1

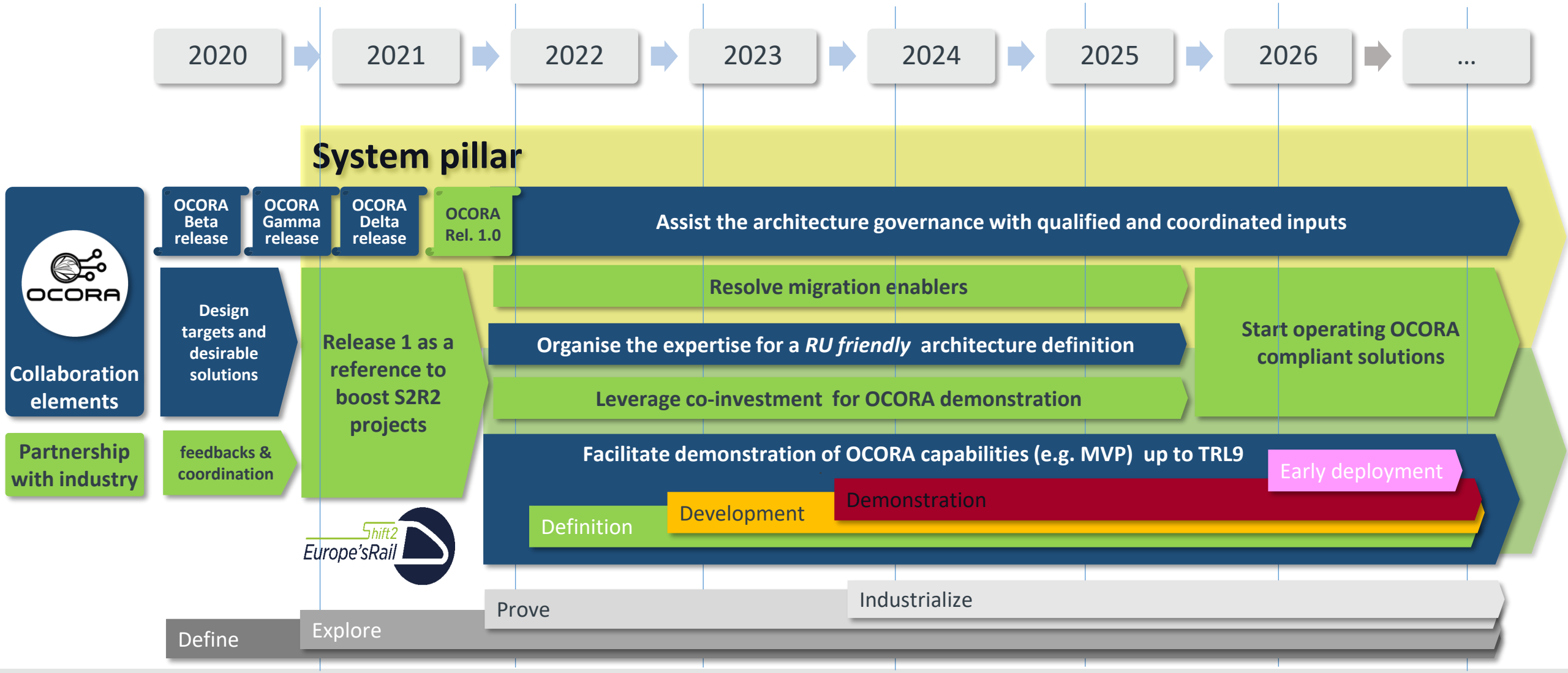
Timeline

Topic Overview

- Roadmap
- MVP

Roadmap

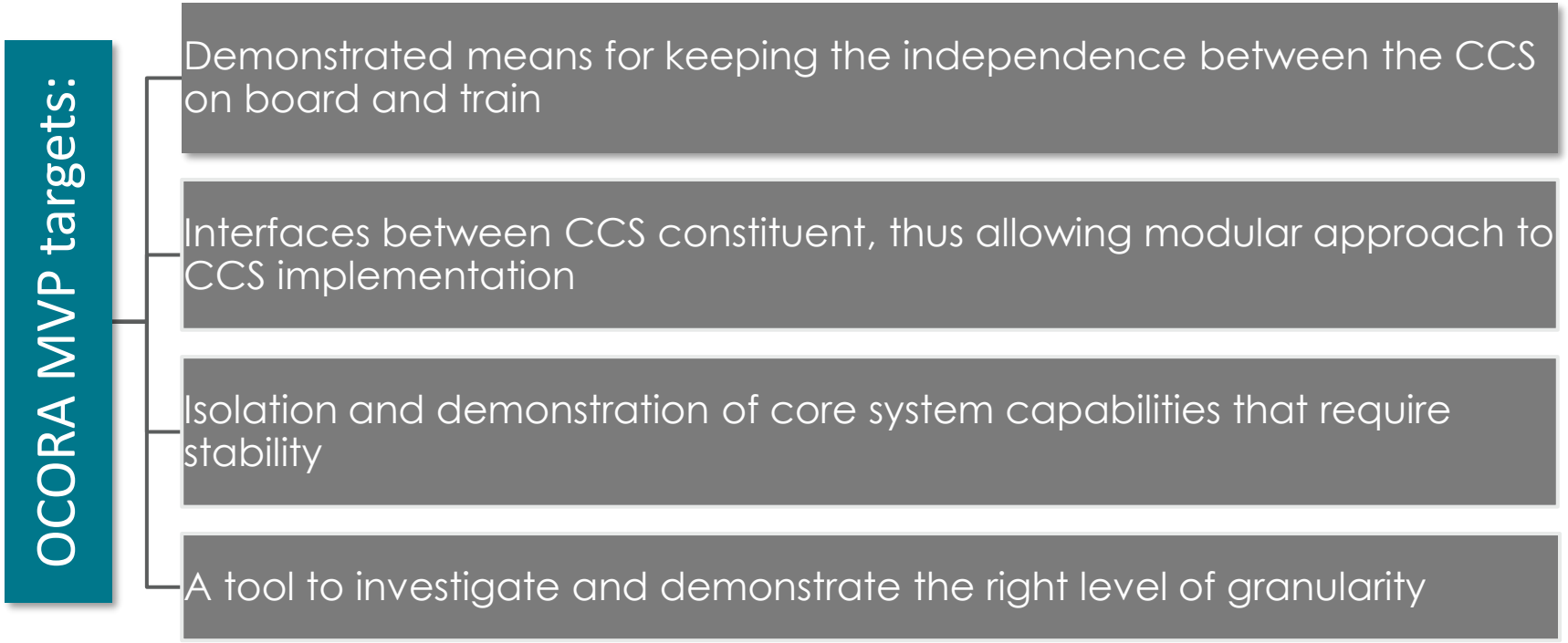
With an architecture framework, the ERJU can be a collaborative platform supporting technological migrations



Timeline

The OCORA Minimum Viable Product

The MVP is proposed as a development process within OCORA development roadmap allowing to reach a sufficient level of readiness for large scale industrialisation. It should allow to consolidate return of experience for deployment and complementary developments.



The demonstration roadmap for OCORA MVP is envisaged as a collaborative path with the European supply Industry. It is expected that the set up of the system and innovation pillar as part of the new Europe's Rail Joint Undertaking will allow to facilitate such a process.

Alliances

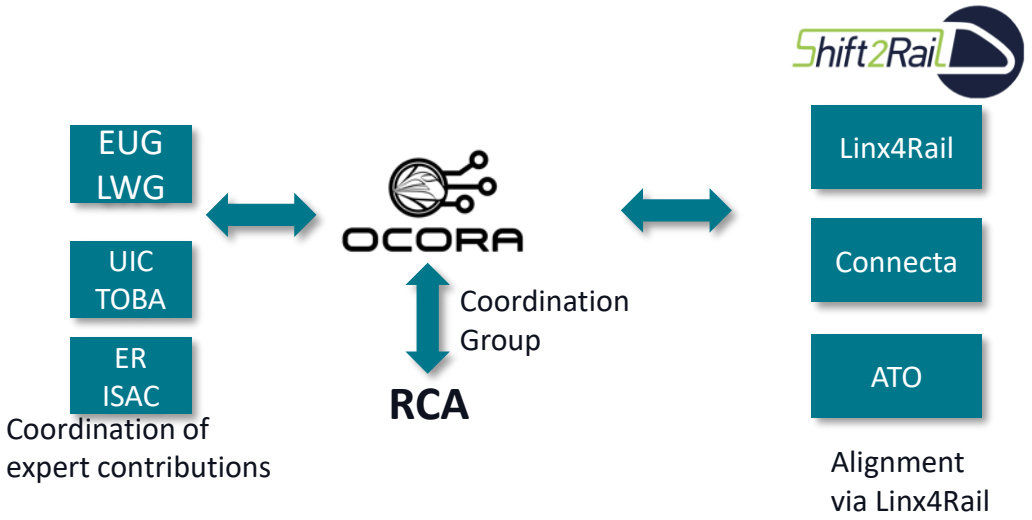
OCORA-BWS02-020 / v1.00 / 26.11.2021 / Release R1

Alliances

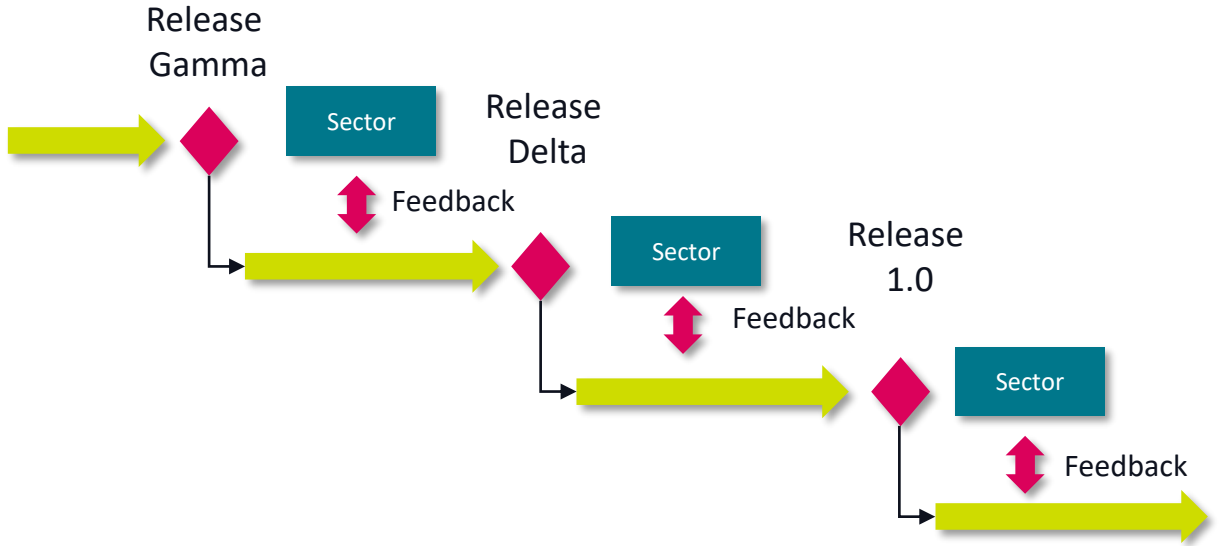
OCORA collaboration with many sectoral groups

OCORA covers explicitly CCS On-board, the train borne part of the overall control-command and signalling infrastructure needed for safe and automatic railway operation (Automatic Train Protection and Automatic Train Operation).

A good integration in the overall CCS environment is therefore essential and requests a good collaboration and liaison with related activities.



OCORA and other sector initiatives



OCORA iterative stakeholder involvement

Alliances

Ongoing liaisons

Sector interest group	Collaboration area	Liaison in place
CCS SG (CER)	Preparing TSI 2022 revision Setting secto 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 itneroperability) 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 initatives.
Localisation WG (EUG)	Mission requirement for onboard localisation Interface for localisation peripherals	Coordination done through experts involved in both initatives.
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-BWS02-020 / v1.00 / 26.11.2021 / Release R1

Release Overview

Topic Overview

- Released Content
- Business Rationale
- Economic Model
- High Level Methodology
- High Level Tooling
- Acceptance of Global Standards

Release Overview

Program Content

Release Documentation

- OCORA-BWS01-010 – Release Notes
- OCORA-BWS01-020 – Glossary

Supporting Documentation

- OCORA-BWS01-030 – Question and Answers
- OCORA-BWS01-040 – Feedback Form

Communication Material

- OCORA-BWS02-010 – Executive Summary Slide Deck
- OCORA-BWS02-020 – Program Slide Deck
- OCORA-BWS02-030 – Technical Slide Deck
- OCORA-BWS02-040 – Program Posters
- OCORA-BWS02-050 – Technical Posters

Program Documentation

- OCORA-BWS03-010 – Introduction to OCORA
- OCORA-BWS03-020 – Guiding Principles
- OCORA-BWS04-010 – Problem Statements
- OCORA-BWS05-010 – Road Map
- OCORA-BWS05-020 – Minimal Viable Product
- OCORA-BWS06-010 – Economic Model – Guiding Principles - Assumptions - Assessment Criteria
- OCORA-BWS06-020 – Economic Model
- OCORA-BWS06-030 – Economic Model – Model Description
- OCORA-BWS06-040 – Economic Model – User Manual
- OCORA-BWS06-050 – Economic Model – CCS System Life Cycle Costing Scenario Studies
- OCORA-BWS07-010 – Alliances
- OCORA-BWS07-020 – CCS On-board for Europe's Rail Joint Undertaking
- OCORA-BWS08-010 – Methodology
- OCORA-BWS08-020 – Tooling
- OCORA-BWS09-010 – Acceptance of Global Standards
- OCORA-BWS09-020 – Acceptance of Global Standards – Focus on Safety in CCS
- OCORA-BWS09-030 – Acceptance of Global Standards – Cartography of Standards

Release Highlights Program Documents are:

- Updated communication material
- Updated Economic Model, including new User Manual, Model Description and CCS System Life Cycle Costing Scenario Studies
- Only minor update on ER JU → our Delta assumptions were correct
- Additional document out of the Acceptance of Global Standards workstream regarding the "Cartography of Standards"

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

Release Overview

Technical Content

Technical Documentation

- OCORA-TWS01-010 – Design Requirements
- OCORA-TWS01-020 – System Capabilities
- OCORA-TWS01-030 – System Architecture
- OCORA-TWS01-040 – Capella Modelling
- OCORA-TWS01-050 – Capella Model Export
- OCORA-TWS01-100 – Localisation On-Board (LOC-OB) – Introduction
- OCORA-TWS01-101 – Localisation On-Board (LOC-OB) – Requirements
- OCORA-TWS01-112 – Automatic 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 – Draft Initial 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 – Functional Vehicle Adapter – Standard Communication Interface Specification
- OCORA-TWS04-013 – Functional Vehicle Adapter – Design Guideline
- 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-TWS06-020 – (Cyber-) Security – Guideline
- OCORA-TWS07-010 – Modular Safety – Strategy
- OCORA-TWS07-020 – Modular Safety – Evolution Management
- OCORA-TWS07-030 – Modular Safety – SRAC Management
- OCORA-TWS09-010 – Testing – Strategy
- OCORA-TWS09-020 – Testing – Benchmarking Report Modular Testing
- OCORA-TWS09-030 – Testing – Software Test and Integration Engineering according to EN 50657 or EN 50128
- OCORA-TWS10-010 – CENELEC Phase 1 – Concept

Release Highlights Technical Documents are:

- Significantly enriched System Capability Documentation
- Slightly enriched Architecture Documentation
- New document about localisation introduction and requirements for ETCS L3 present
- New document: Specification of the platform independent API between application and platform
- Enriched modular safety documentation with evolution and SRAC management
- New document about software test and integration engineering according to EN 50657 or EN 50128

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

Release Overview

Business Rationale

OCORA business rational

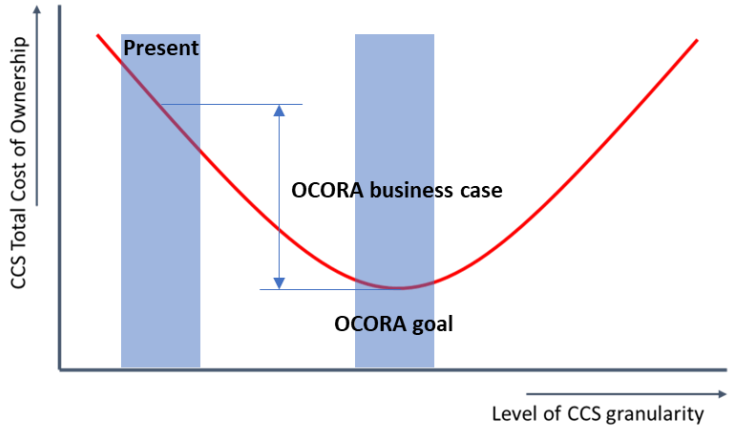
- keep up competition with modal competitors, investing heavily in digitalisation and automation
- embed innovative technologies in railway physical assets, planning systems and operations for boosting productivity, controlling cost and risk levels, and improving performance
- fast and affordable integration of the game changers (ERTMS, ATO, radio, localisation) in the CCS onboard, as a bottleneck for enhanced railway offers
- Anticipate technology lifecycles

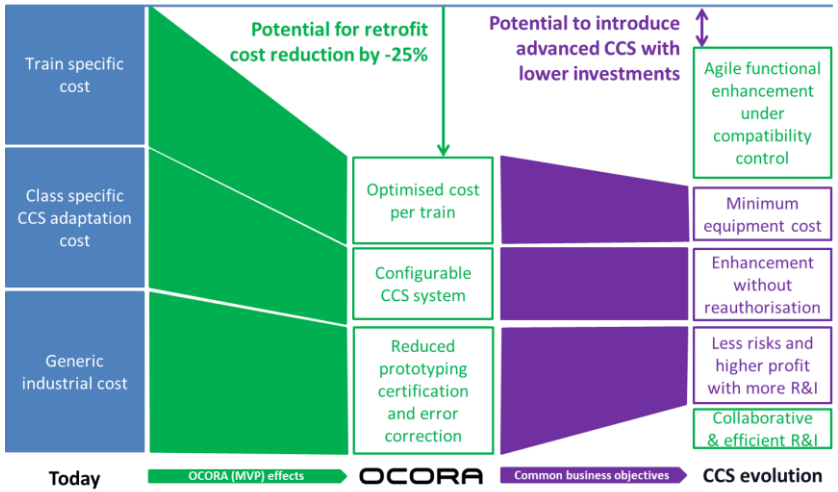
Release business rational

- Align operators' vision on design objectives and requirements for CCS On-board architecture
- Intensify the sector dialogue on new generation products and migration’s drivers

Release Overview

An economic model to discuss the optimal level of granularity



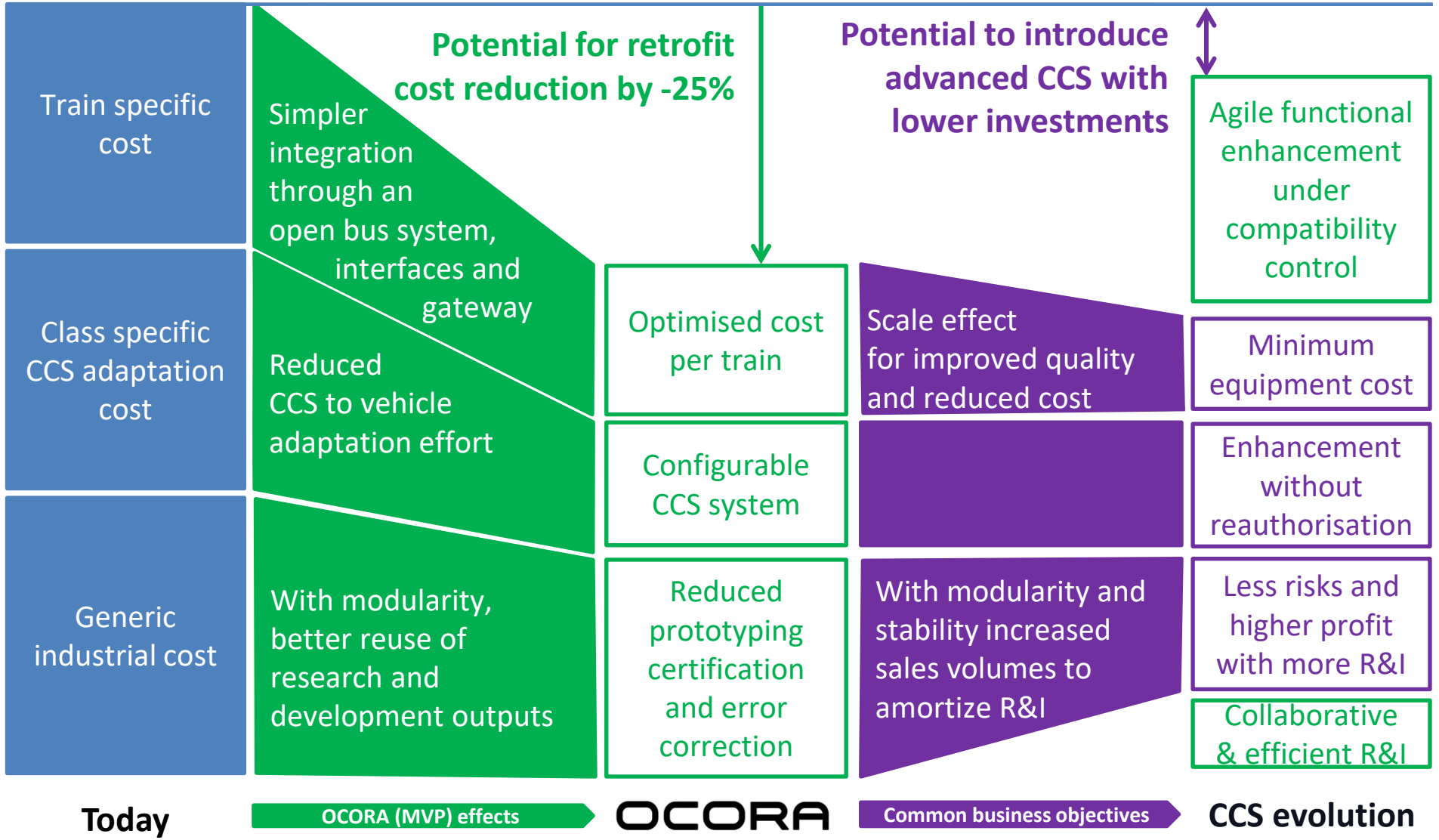


The development of the OCORA economic model, intends to provide tools for:

- 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:
  - Todays 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.

Release Overview

OCORA architecture brings benefit to suppliers and operators



Release Overview

Methodology & Tooling

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 CENLEC phases
- OCORA deliverables are following the V cycle

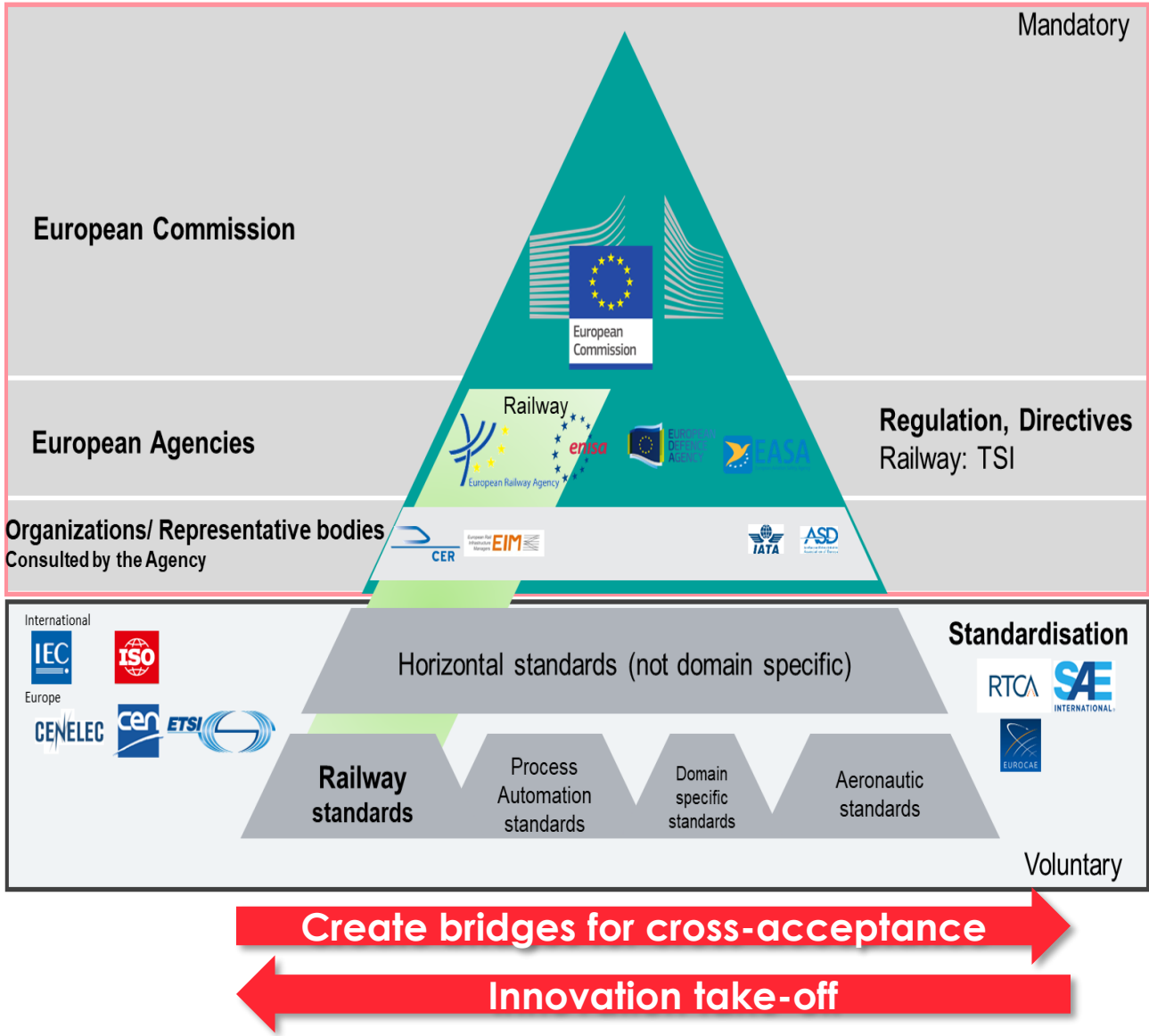
Tooling:

- 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
- OCORA uses SCADE for Model Based Software Development

Release Overview

Acceptance of Global Standards

- OCORA targets:
  - Facilitate, for the railway industry, the use of off-the-shelf components compliant with well-proven and largely-applied standards
  - Reduce the time necessary to introduce new technologies in the railway industry
  - Allow for safety-related electronic systems, the use of well-proven and largely-applied standards
  - And ensure the safety levels required by CSM are still reached
- Overall approach = ease the safety demonstration:
  - Overview - **how to ease the acceptance and the re-usability of equipment from other sectors certified according to well-proven and largely-applied standards**
  - Focus on Safety Assessment - **9 major differences between IEC EN61508 – CENELEC EN5012x for cross-acceptance**
- OCORA exchanging on this item with European organizations (CER, EIM, CENELEC, JPCR, NBRAIL, ERA, UNIFE…)



Sector Dialogue

OCORA-BWS02-020 / v1.00 / 26.11.2021 / Release R1

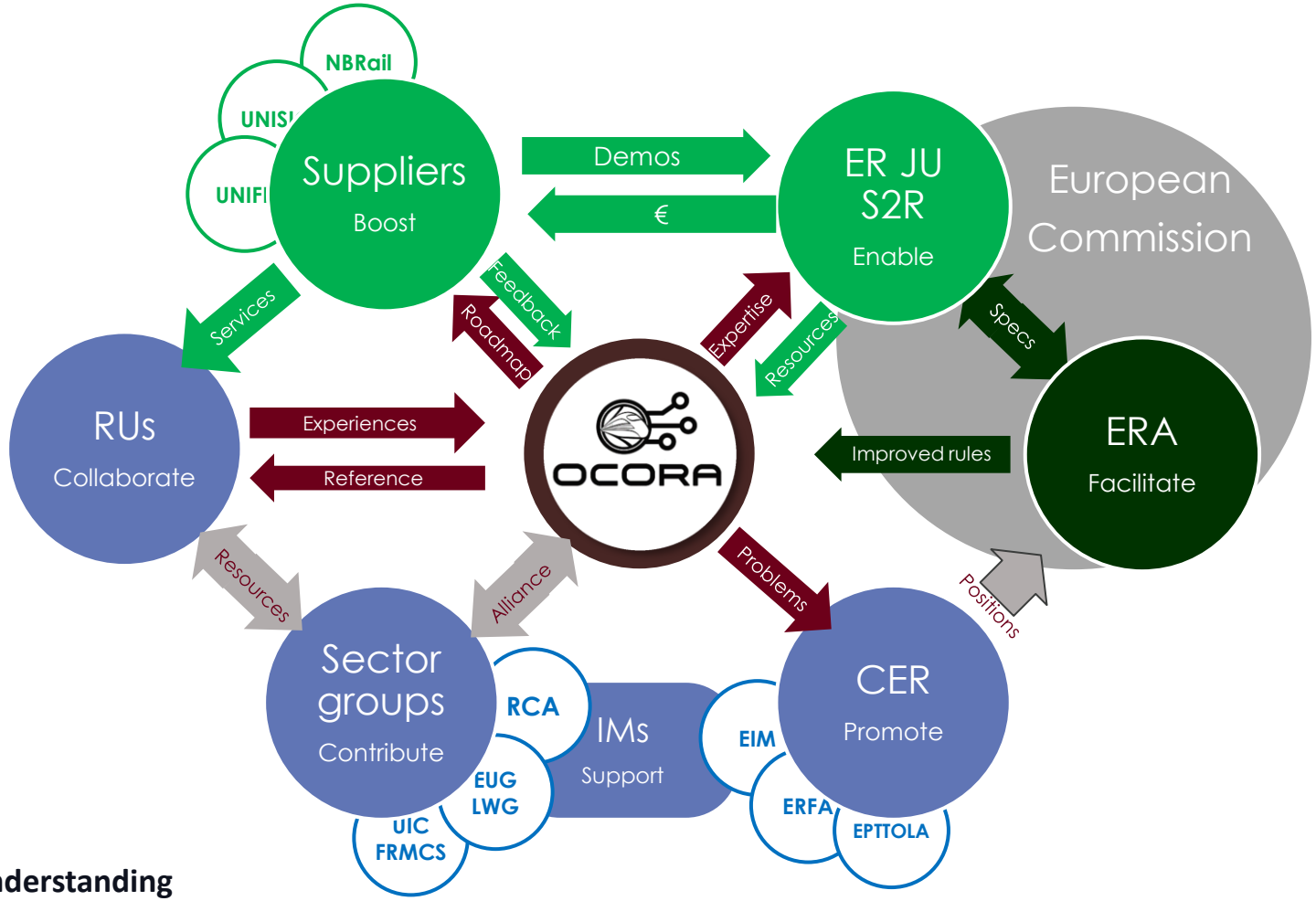
Sector Dialogue

OCORA, as an open architecture reference, support alignment between sector initatives

OCORA collaboration is open to support:

- ➔ ER JU / S2R: financing and an agile frame for industry partnering
- ➔ Suppliers : joined activities (e.g. models, PoC, prototype, MVP…)
- ➔ ERA : optimised acceptance based on just rules

Other fleet owners and any expert or EU citizen are welcome to join as supporter or contributors.



OCORA liaisons and alliances allow to find common understanding and complementarity at expert, corporate and institutional level.

Sector Dialogue

OCORA Release Imprint

- Publisher: OCORA Cooperation
- Channel: OCORA publishes exclusively over https://github.com/OCORA-Public/Publication
- OCORA liaison partners: UIC TOBA, RCA, CER
- Any feedback for OCORA is welcome!
  If you would like to attend a workshop or give a feedback, please contact jean-baptiste.simonnet@sncf.fr.
  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.
- All OCORA deliverables and work will be published and licensed under the dual licensing Terms EUPL 1.2 (Commission Implementing Decision (EU) 2017/863 of 18 May 2017) and the terms and condition of the Attributions- ShareAlike 3.0 Unported license or its national version (in particular CC-BY -SA 3.0 DE).