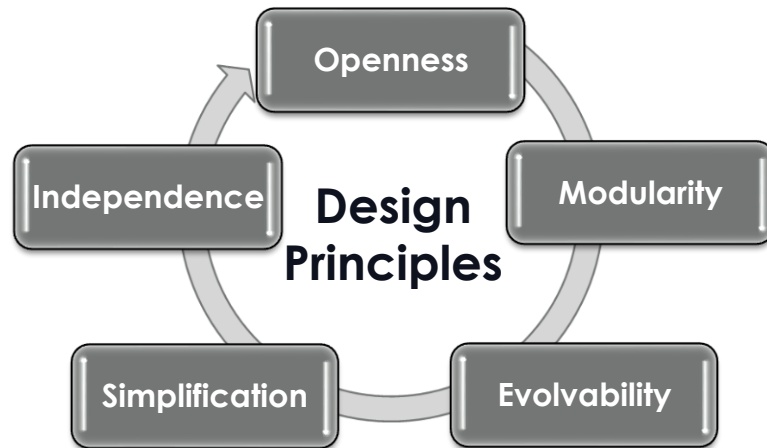


OCORA

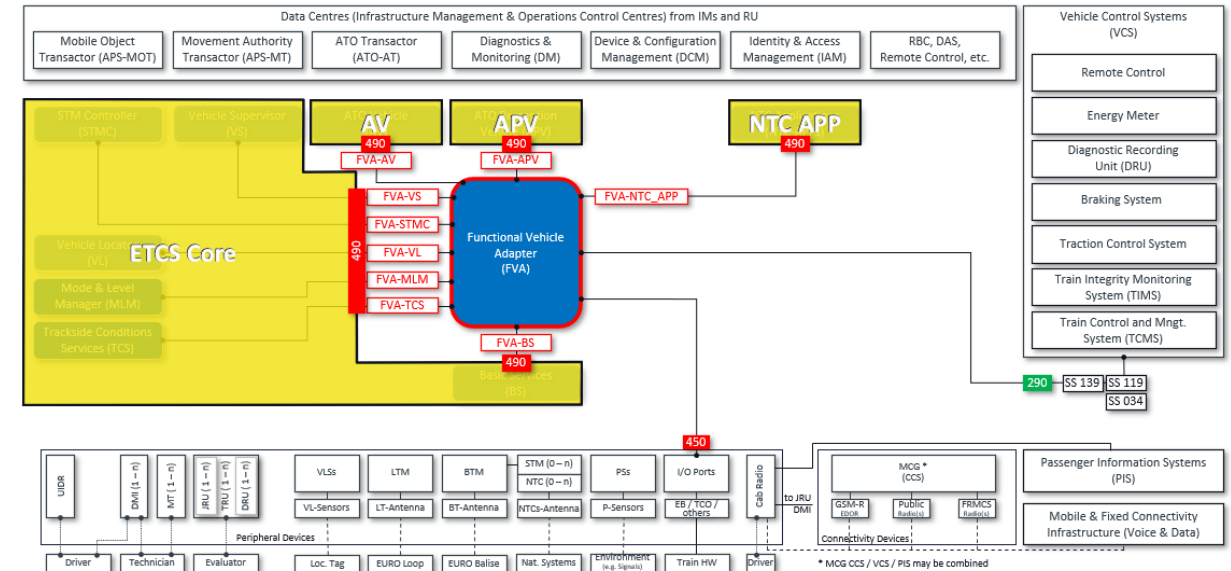
Gamma – Program Slide Deck

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 **Gamma Release** 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 Gamma Release** describes **CCS On-board** and includes **sector feedback** based on the Beta Release. It is **feeding TSI-2022 and S2R-2** with **qualified technical input**.



OCORA deliverables are published under the **European Union Public License (EUPL)** and are consequently available for all stakeholders. **OCORA plans a series of prototypes, technical demonstrators and tests** in the coming years. The **Delta Release** is planned for **mid 2021** and **Release 1.0 end of 2021**.



Agenda

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



Introduction

OCORA-20-002-Gamma / v1.10 / 04.12.2020 - Final

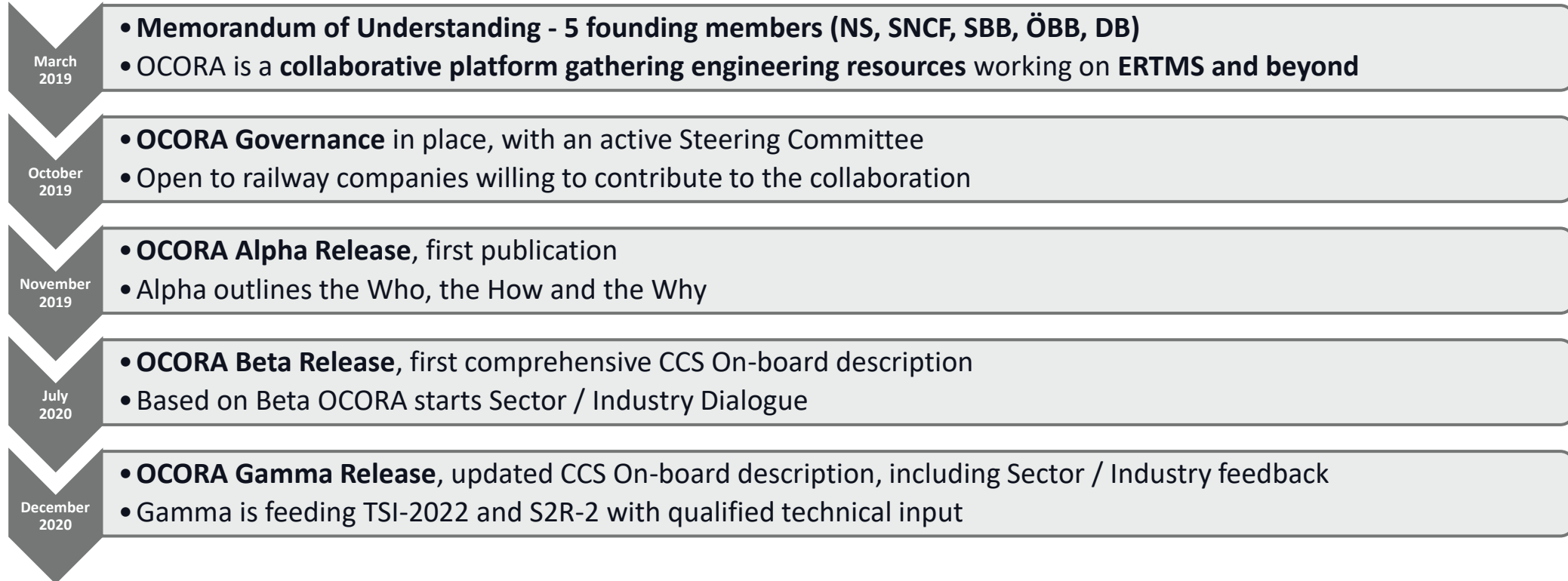
Introduction

Topic Overview

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



Who is OCORA - Open CCS On-board Reference Architecture



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



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

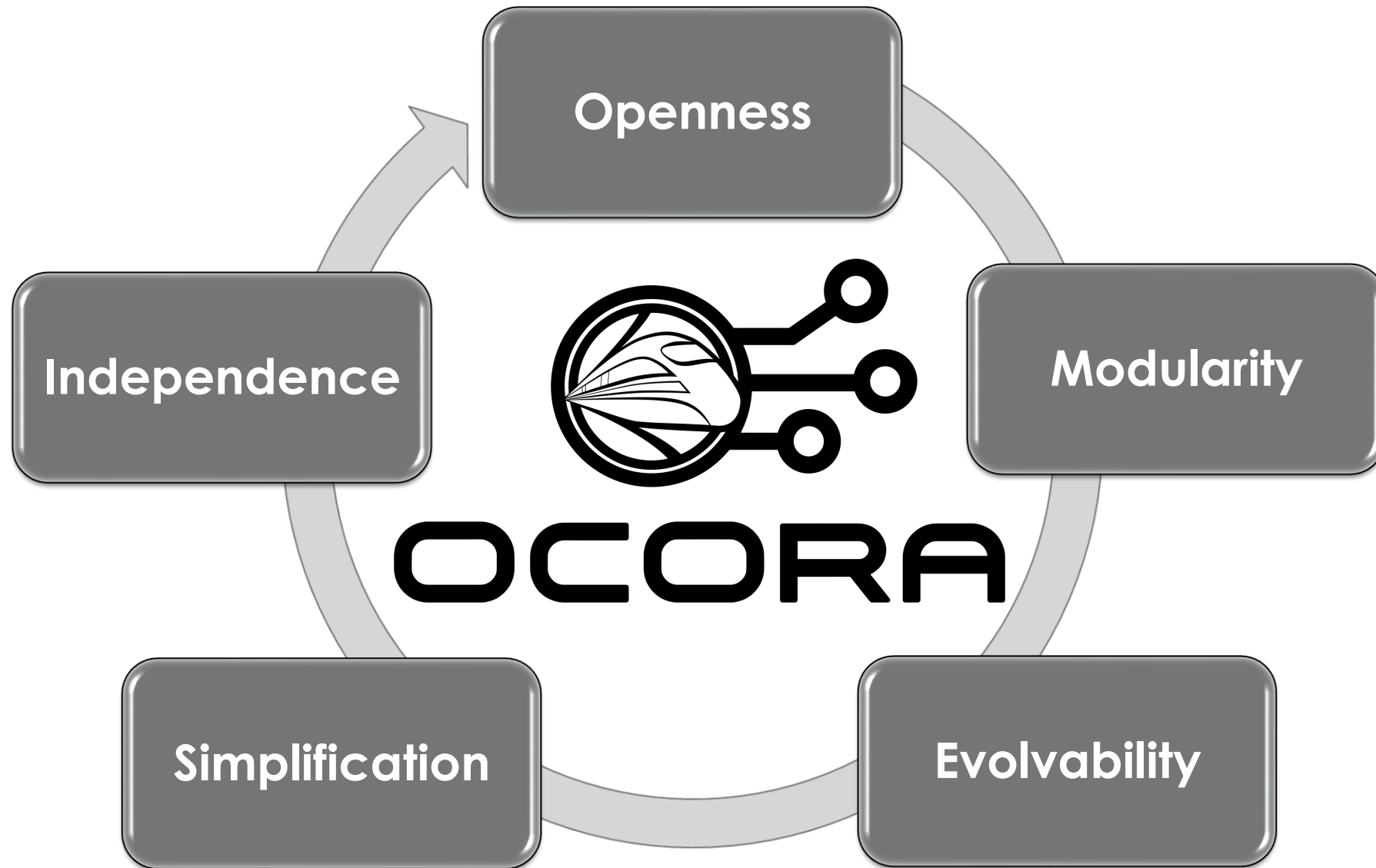
- Reference requirements → verifiable products
- Model based standardised interfaces and functions
- Economic modeling

Target

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

Foundation

ETCS + Pervasive Mobile Communication for Railway



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.

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.

OCORA Gamma Release Communication Material

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



Timeline

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Timeline

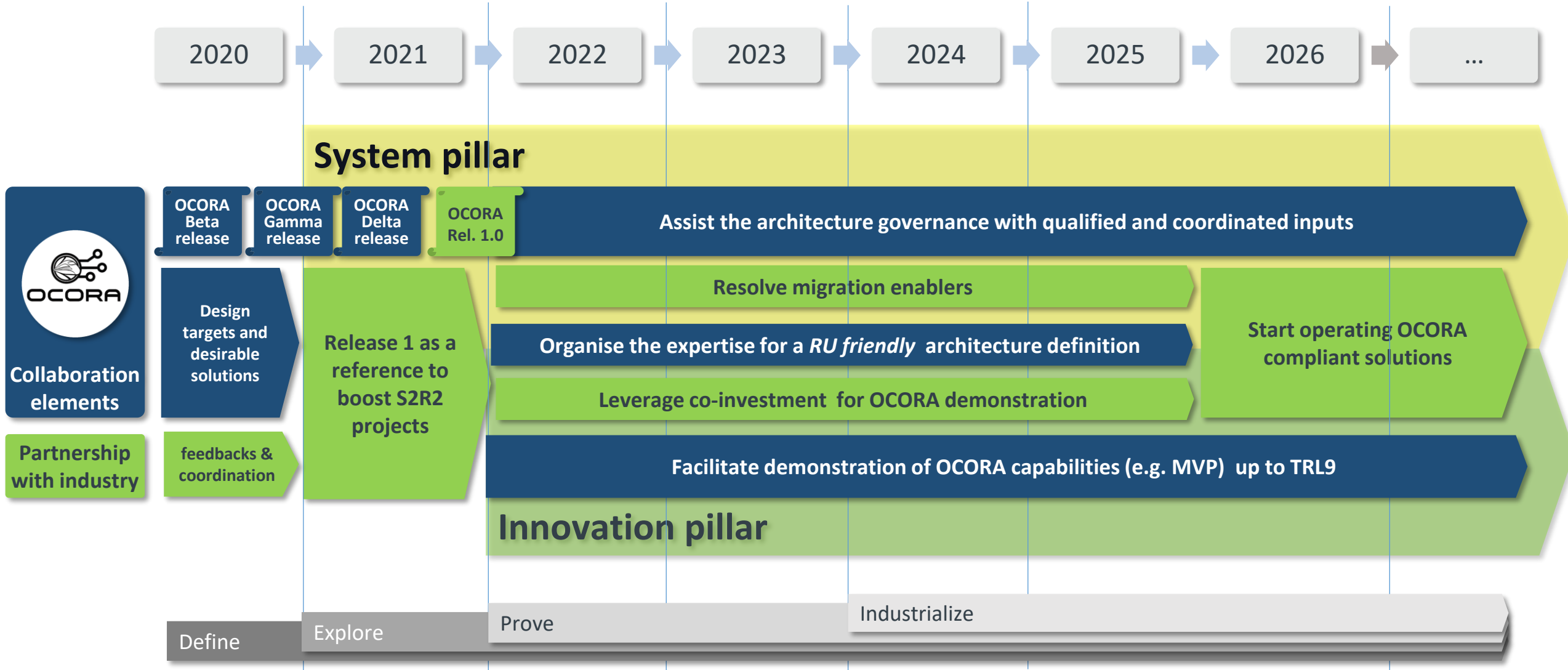
Topic Overview

- ▶ Roadmap
- ▶ MVP
- ▶ TSI-2022



OCORA Gamma Road-Map

Principles for a new Long term roadmap

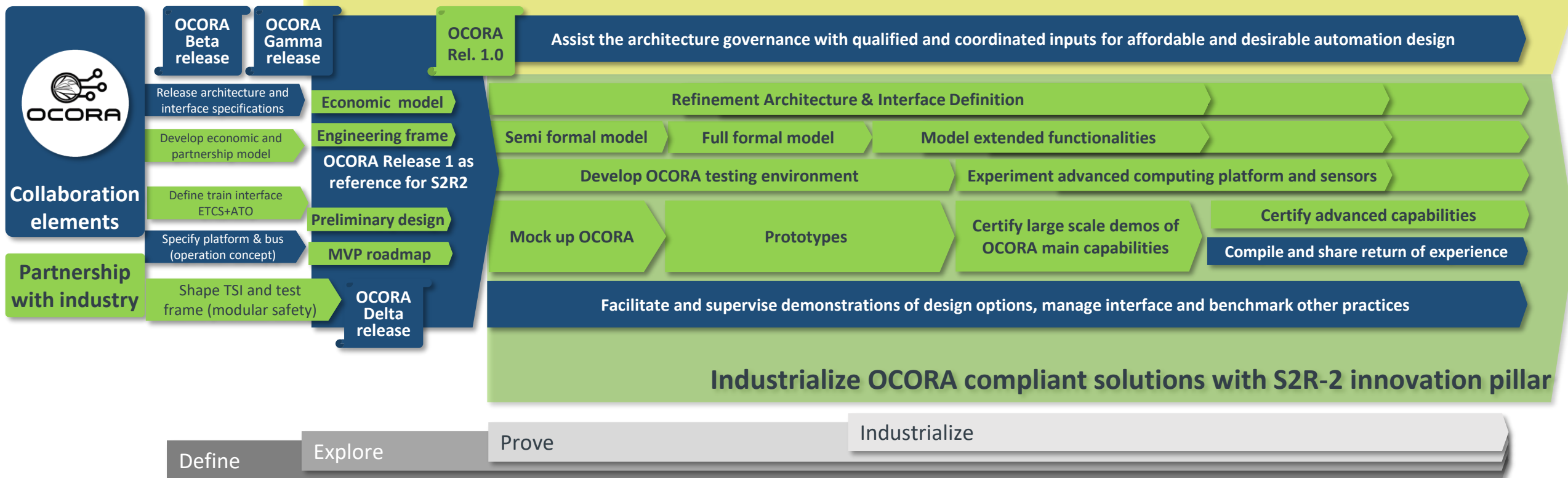


OCORA Gamma Road-Map

Detailed activities new Long term roadmap

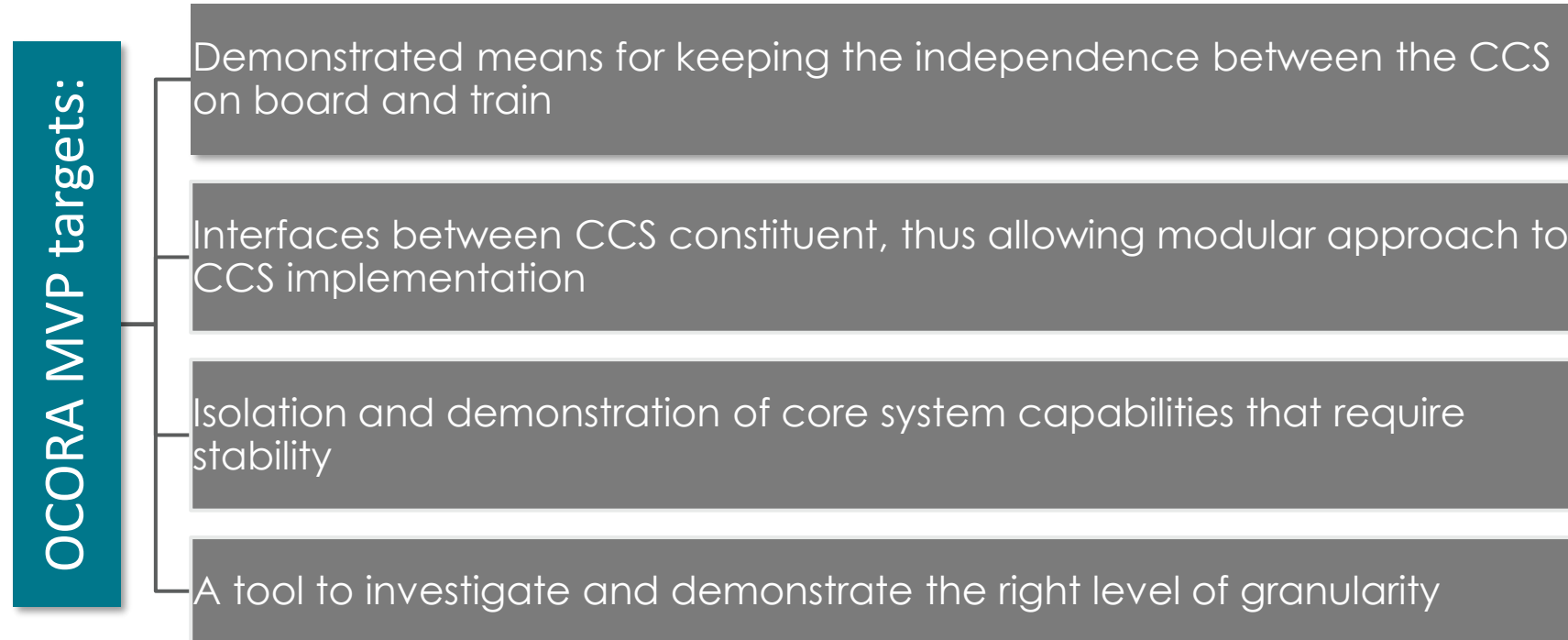


Speed up OCORA development and adoption with S2R-2 system pillar

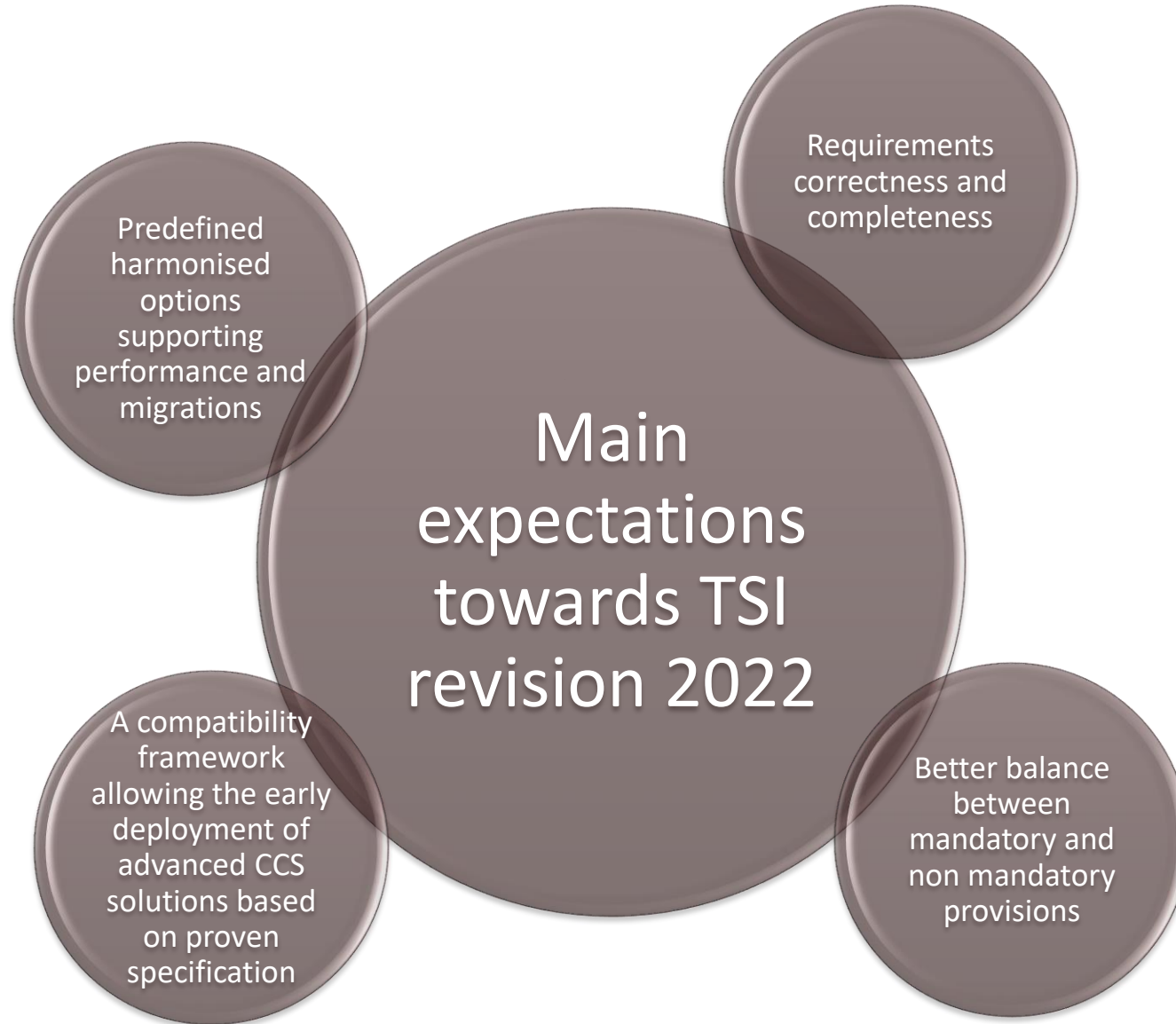


The OCORA Minimum Viable Product

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.



OCORA input to TSI : requirement consistency and optimal level of granularity for modules supporting innovation and smooth migrations.

OCORA is collaborating with representatives bodies and other sector initiatives to support ERA related activities in 2020 and 2021.



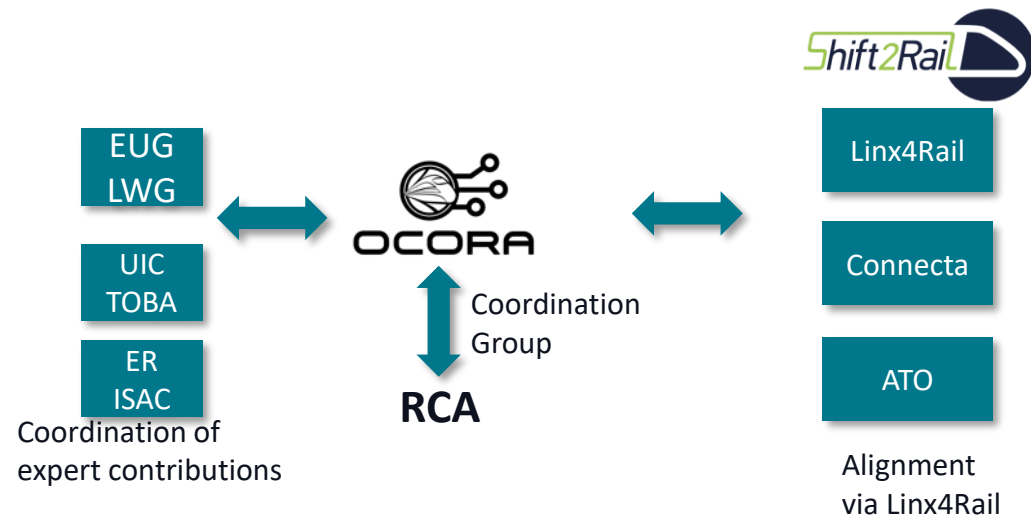
Alliances

Alliances

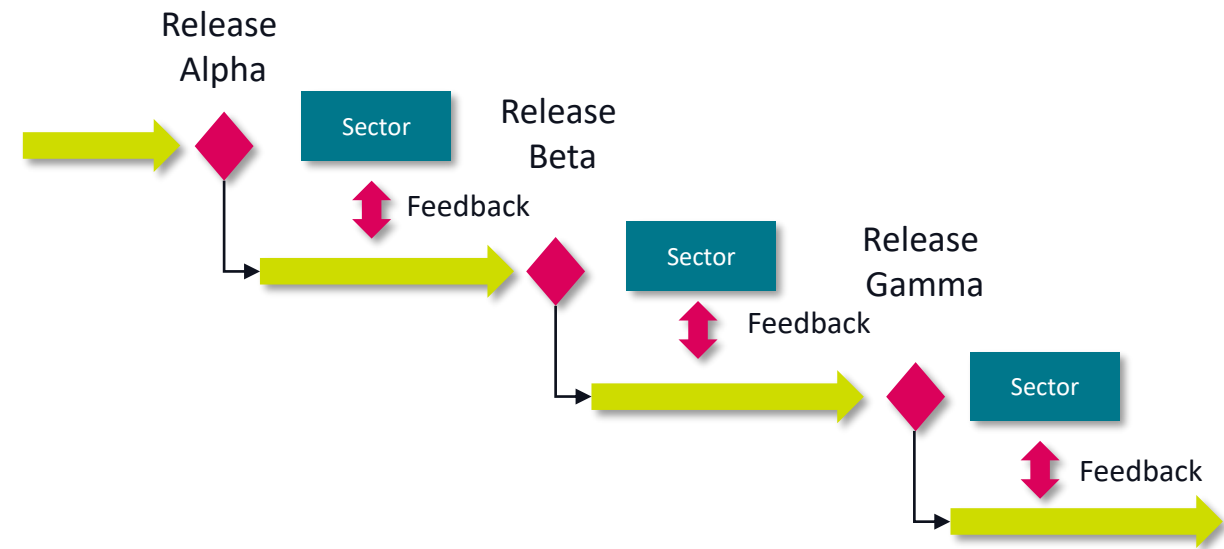
OCORA collaboration with many sectoral groups

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.



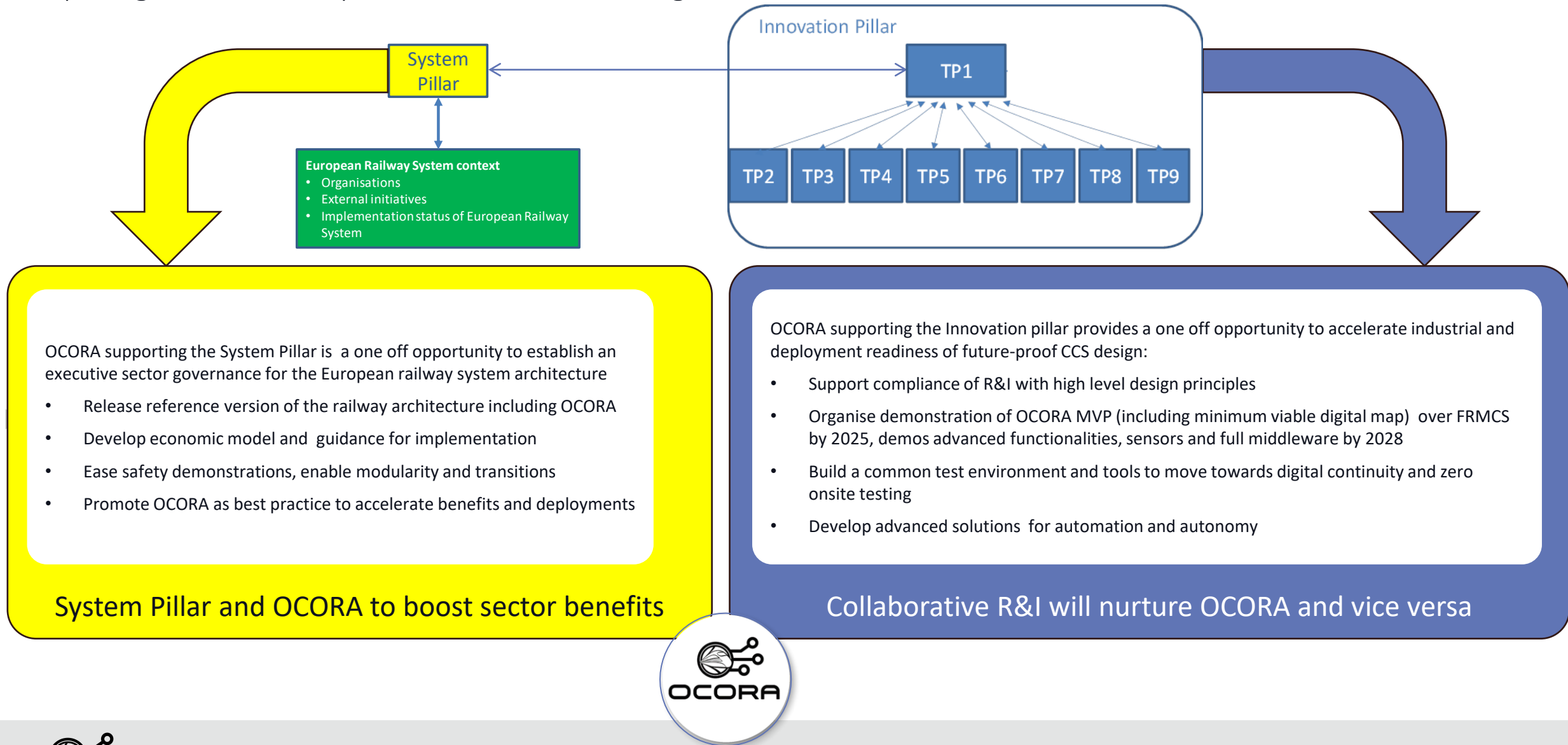
OCORA and other sector initiatives



OCORA iterative stakeholder involvement

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.





Gamma Release Overview

OCORA-20-002-Gamma / v1.10 / 04.12.2020 - Final

Gamma Release Overview



Topic Overview

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

Gamma Release Overview

Released Content

Release Documentation	<ul style="list-style-type: none">• OCORA-10-001-Gamma Release Notes• OCORA-10-003-Gamma Feedback Form
Communication Material	<ul style="list-style-type: none">• OCORA-20-001-Gamma Executive Summary Slide Deck• OCORA-20-002-Gamma Program Slide Deck• OCORA-20-003-Gamma Technical Slide Deck• OCORA-20-004-Gamma Program Posters• OCORA-20-005-Gamma Technical Posters
Program Documentation	<ul style="list-style-type: none">• OCORA-30-001-Gamma Introduction to OCORA• OCORA-30-002-Gamma Problem Statements• OCORA-30-003-Gamma Road Map• OCORA-30-004-Gamma Economic Model• OCORA-30-005-Gamma Alliances• OCORA-30-006-Gamma High Level Methodology• OCORA-30-007-Gamma High Level Tooling• OCORA-30-008-Gamma Minimal Viable Product• OCORA-30-009-Gamma Requirements
Technical Documentation	<ul style="list-style-type: none">• OCORA-40-001-Gamma System Architecture• OCORA-40-002-Gamma System Architecture – Capella Model• OCORA-40-003-Gamma UVCC Bus Specification• OCORA-40-004-Gamma Computing Platform - Whitepaper• OCORA-40-005-Gamma Functional Vehicle Adapter - Introduction & Overview• OCORA-40-006-Gamma CCS-TCMS Interface - ETCS Functionality (SS119)• OCORA-40-007-Gamma CCS-TCMS Interface - ATO Functionality (SS139)• OCORA-40-008-Gamma Gap Analysis SS119• OCORA-40-009-Gamma (Cyber-) Security - Overview• OCORA-40-010-Gamma (Cyber-) Security - Strategy• OCORA-40-012-Gamma Modular Safety• OCORA-40-013-Gamma Generic Safe Computing Platform Requirements• OCORA-40-014-Gamma ATO Demonstrator
Supporting Documents	<ul style="list-style-type: none">• OCORA-90-001-Gamma Question and Answers• OCORA-90-002-Gamma Glossary

The **OCORA Gamma Release** is a set of documentation defining objectives and requirements on a reference architecture for the CCS onboard subsystem.

Documentation can be found under:

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

Colors

Document title = New document or document with significant new topics.

Document title = Updated document with enhancements

Document title = Unchanged content only with minor improvements

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

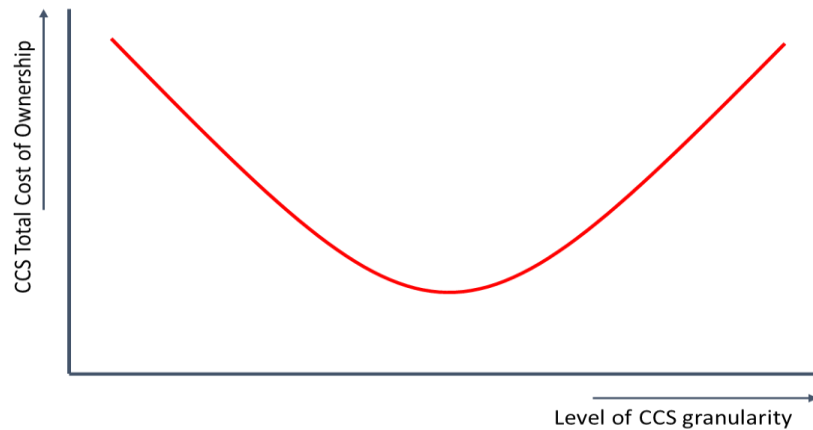
Gamma release business rational

- 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

Gamma Release Overview

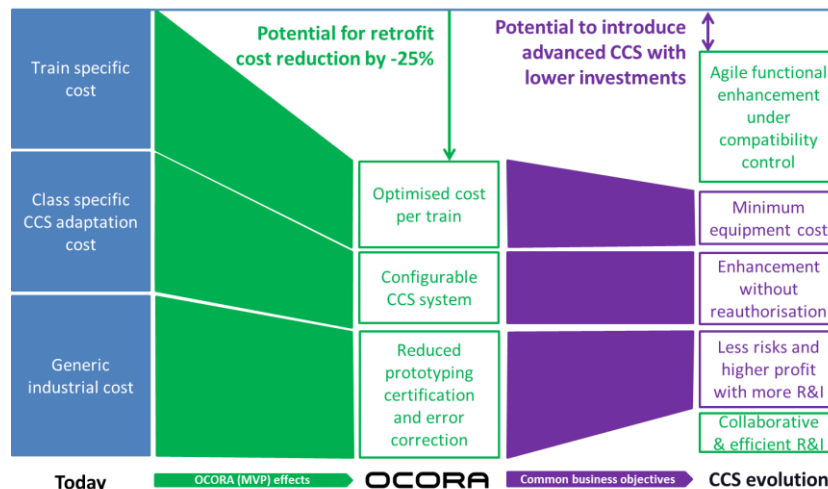


An economic model to discuss the optimal level of granularity



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

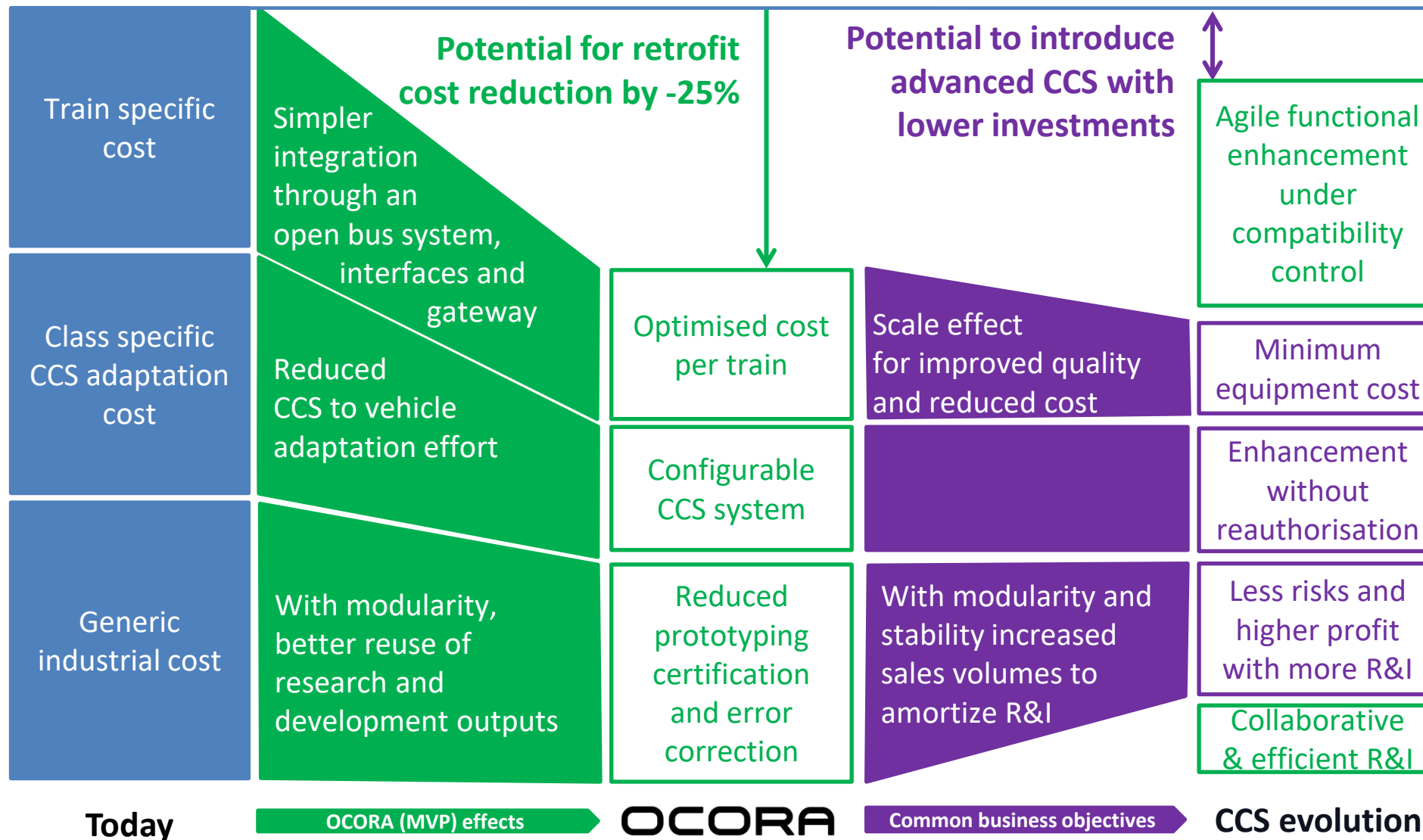
- ▶ Getting a clear view on the economic driver for the modularization of the on-board. To this end the model focus on 3 cost categories:
 - Generic industrial cost for developing certified CCS onboard sub systems
 - Cost for authorising operation with a new CCS configuration in a class of vehicle
 - 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:
 - 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.



Gamma Release Overview



OCORA architecture brings benefit to suppliers and operators



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 Webex & 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

Gamma Release Overview

Acceptance of Global Standards

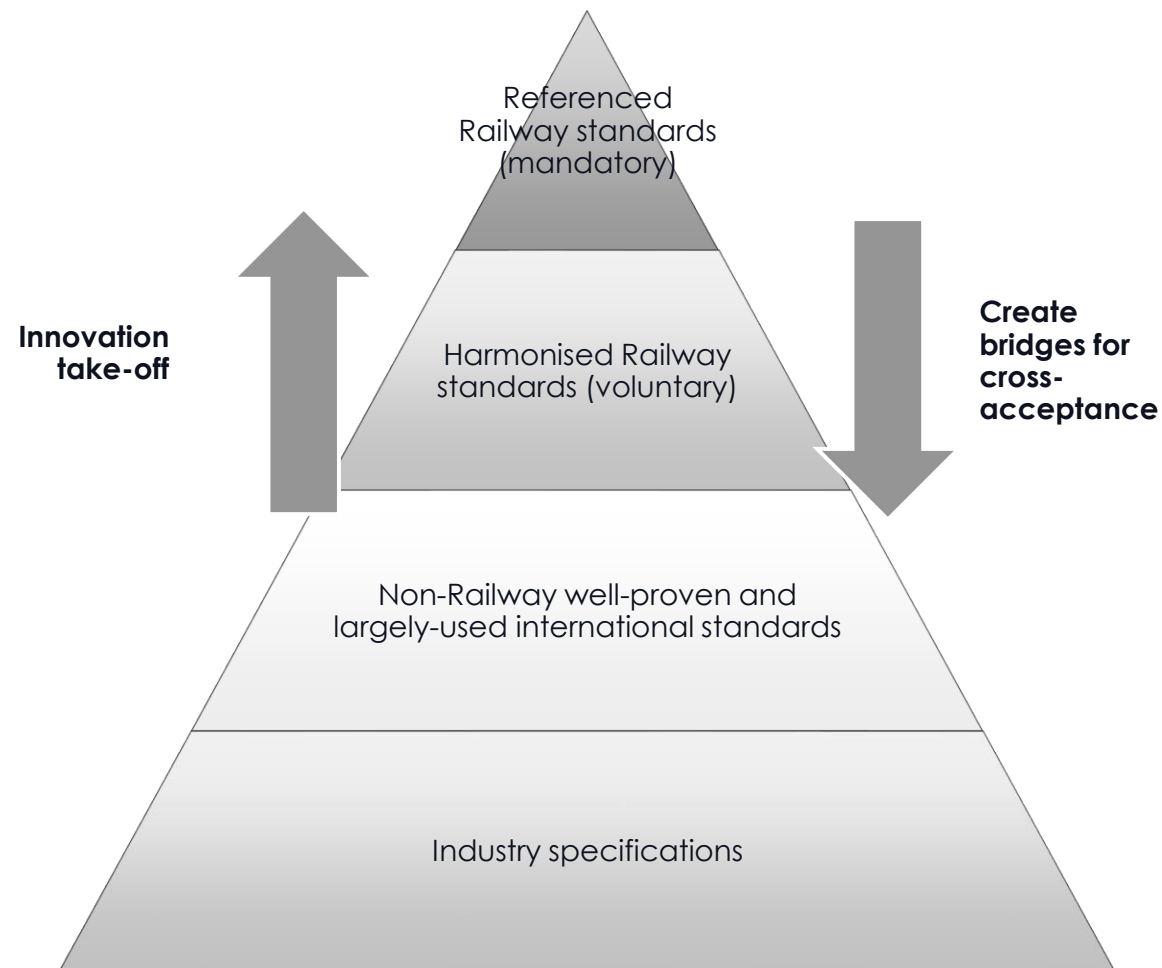


► OCORA targets:

- boost innovation and improve technical and operational performance in the CCS railway industry, by the means of standardization
- 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
- Better highlighting and isolating in EU railway standards the railway-specific parts

► Beta release :

- A first deep dive into IEC61508 - EN5012x cross-acceptance,
- OCORA is proposing to further study this item with European organizations (CER, EIM, CENELEC, JPCR, NBRail, ERA...)





Sector Dialogue

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Sector Dialogue

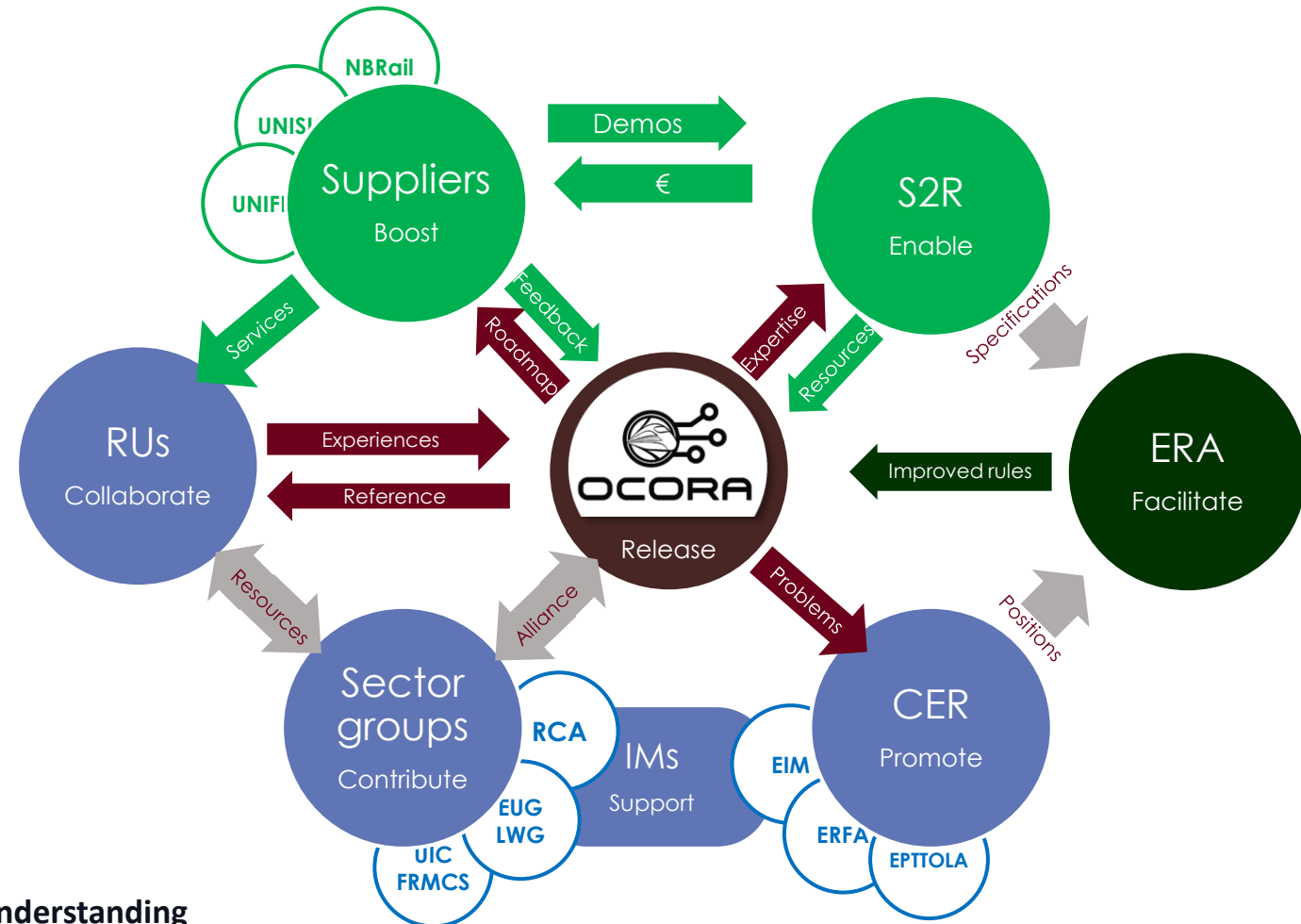


OCORA, as an open architecture reference, support alignment between sector initiatives

OCORA collaboration is open to support:

- 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.

- ▶ 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-10-003-Gamma, 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).