

# RCA



Reference CCS Architecture

*An initiative facilitated by the ERTMS Users Group and the EULYNX consortium*

## **RCA Alpha – Process Overview**

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# RCA Alpha – Process Overview

## Table of contents

<b>1.</b>	<b>Introduction</b>	<b>3</b>
<b>2.</b>	<b>Overview RCA context and process</b>	<b>4</b>
2.1.	Important stakeholders and their roles with respect to RCA	4
2.2.	RCA deliverables	6
2.3.	RCA process perspective	6
2.4.	Interaction of RCA with on-going national programs	7
2.5.	RCA and the TSI process	7
2.6.	RCA development process	7
2.7.	Applying / Utilizing RCA	8
<b>3.</b>	<b>RCA organizational structure / Governance</b>	<b>9</b>
<b>4.</b>	<b>Roadmap RCA development</b>	<b>11</b>
4.1.	The RCA development process applies spiral development	11
4.2.	Iterations within spiral development	11
4.3.	Overview roadmap 2019	12
4.4.	Work breakdown for working groups / clusters	12
<b>5.</b>	<b>Information dissemination and intellectual property management</b>	<b>14</b>
5.1.	Intellectual property management	14
5.2.	Making information about RCA available	15

# 1. Introduction

## Purpose of the document

An overview of the process and organization needed to develop and apply RCA as outlined in the RCA white paper.

## Purpose of Release Alpha

This document is the result of Iteration 0 on the RCA performed by the RCA group in the second half of 2018 and provides a first, high-level draft of the RCA called release “alpha”. This release provides the necessary foundation for:

- achieving the next level of understanding and commitment by the EUG and EULYNX members concerning RCA;
- organizing the next steps in the RCA development process (the RCA process is described separately) involving several working groups;
- continuing the discussion, allowing feedback, providing guidance with other stakeholders (industry, regulators, owners).

RCA Alpha is the first specification of RCA, and therefore not yet complete and precise. It is likely that the architecture will change/evolve in 2019, based on feedback we expect from within and from the outside of the RCA group.

## Other relevant documents

- RCA white paper: the rationale for starting RCA (published in August 2018): [https://ertms.be/workgroups/ccs\\_architecture](https://ertms.be/workgroups/ccs_architecture) and here <https://www.eulynx.eu/index.php/home2/37-reference-ccs-architecture-white-paper>).
- RCA Alpha Architecture Overview
- RCA Alpha FAQ
- Recommended read: Command and Control 4.0 by Josef Doppelbauer (ERA): [https://www.era.europa.eu/sites/default/files/library/docs/command\\_and\\_control\\_en.pdf](https://www.era.europa.eu/sites/default/files/library/docs/command_and_control_en.pdf).

## Principles

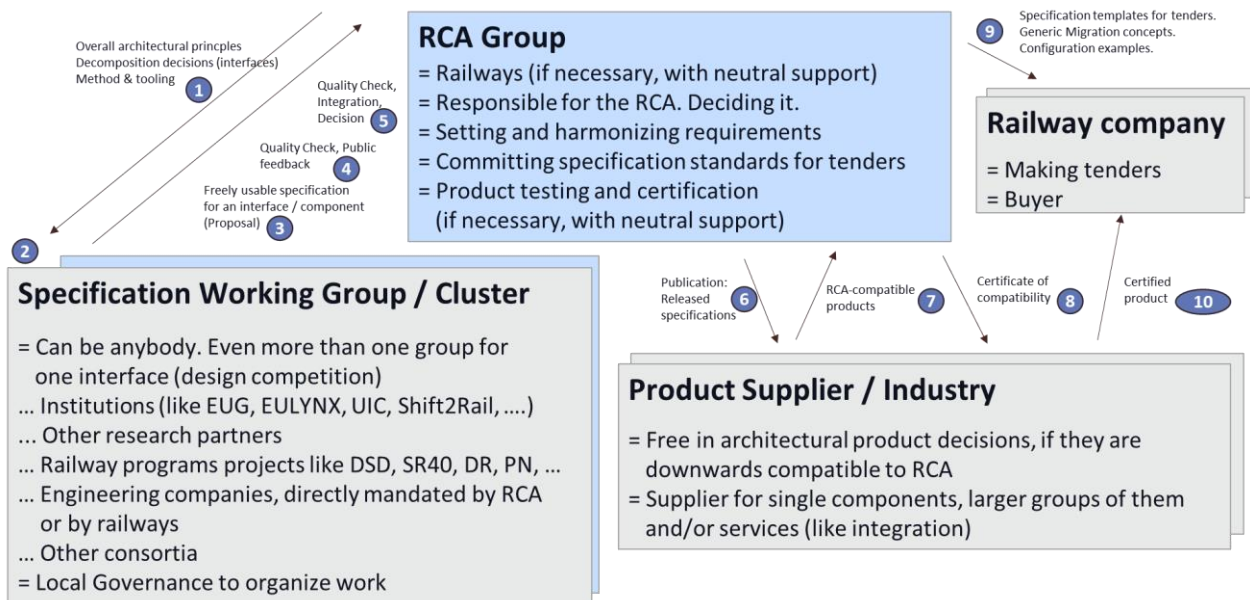
The RCA group will act according to the following principles:

- The RCA group will not specify everything by itself or work without feedback of the industry;
- To produce harmonized requirements between railways, the RCA group members (the customers) need to have a consensus process;
- The RCA group will not delegate final decisions to a single industry company or industry group, or to a group of some railways, that do not represent all RCA railways. A delegation of final decisions to other third parties has to be supported by all RCA group members;
- The RCA group agrees upon the need of free availability (without any IPR restrictions) of the top-level architecture and specifications. The RCA group will not exclude anyone (railway, industry company) unreasonably from the RCA usage. The RCA group does not expect product implementations to be free of IPRs from industry;
- RCA will rely on EULYNX specifications and will use organizational synergies with EUG and EULYNX.

## 2. Overview RCA context and process

### 2.1. Important stakeholders and their roles with respect to RCA

The following diagram shows 4 important roles in the RCA process and their interactions. The table below gives a broader and more complete overview over RCA stakeholders.



Stakeholder	Description / Interests
RCA Group	<ul style="list-style-type: none"> <li>• Drives and manages the RCA process</li> <li>• Defines the RCA scope and content (e.g. if a specification is included in RCA)</li> <li>• Drives and enables the goals outlined in the RCA whitepaper</li> <li>• Maintains and fosters RCA Architecture</li> <li>• Takes decisions that influence the RCA Architecture and therefore cannot be taken within one or more working groups</li> <li>• Coordinates stakeholder management</li> <li>• Supports top management and procurement meetings of IMs at least by providing appropriate documents</li> <li>• Supports implementation of national RCA projects</li> <li>• Defines and maintains Open Source Policy</li> <li>• Dissemination of results</li> <li>• Assures on time delivery</li> <li>• Coordinates schedules of working groups</li> <li>• Provides tools and rules where essential (RCA Framework)</li> <li>• Coordinates product testing and assurance of proper implemented RCA specification</li> <li>• Coordinates dedicated and managed feedback of industry and industry bodies</li> <li>• Supports dialogue between IMs and industry</li> <li>• Supports dialogue to RUs</li> </ul> <p>Details for this role: see chapter 2.6</p>

Stakeholder	Description / Interests
Specification working group	<ul style="list-style-type: none"> <li>Group working on an aspect (cluster) of RCA (e.g. an interface specification)</li> <li>This can be a organization attached to RCA or independent of it (e.g. S2R, UIC, supplier, ...)</li> <li>Details for this role: see chapter 2.6, for a list of clusters, see chapter 4.4.</li> </ul>
Product Supplier	<ul style="list-style-type: none"> <li>Uses RCA specification for product implementation</li> <li>Product Design / Driving product portfolios</li> <li>Homologation</li> <li>Product Authorization</li> </ul>
Railway company (IM) <ul style="list-style-type: none"> <li>in general</li> </ul>	<ul style="list-style-type: none"> <li>Decision for rollout/modernization and applicable technology</li> <li>Contracting Entity for product suppliers</li> </ul>
Railway company (IM) <ul style="list-style-type: none"> <li>RCA member</li> </ul>	<ul style="list-style-type: none"> <li>Full support of RCA goals</li> <li>Member of the RCA group</li> <li>Provision of personnel and/or financial resources according to availability of resources and intended role in the process</li> </ul>
Railway company (IM) <ul style="list-style-type: none"> <li>National Railway Modernization Program</li> </ul>	<ul style="list-style-type: none"> <li>Drives rollout/modernization and uses RCA in its overall architecture and tender templates</li> <li>Systems Integration</li> <li>Contributes to working groups</li> </ul>
Railway company (RU)	<ul style="list-style-type: none"> <li>Decision for rollout/modernization and applicable technology</li> <li>Works with IMs to establish migration plans</li> </ul>
Testing Body	<ul style="list-style-type: none"> <li>Issues compatibility certificates according to implemented test procedures</li> <li>Uses and elaborates test cases provided by RCA working groups</li> </ul>
EUG and EULYNX	<ul style="list-style-type: none"> <li>"Founders" of RCA</li> <li>Coordination of stakeholder management</li> <li>Execution of dedicated stakeholder relations</li> <li>Provision of processes, structures and tools</li> </ul>
Shift2Rail	<ul style="list-style-type: none"> <li>Welcome the RCA initiative</li> <li>Incorporation of RCA in the S2R strategy</li> <li>Include specification work and demonstrators in the deliverables (The Annual Work Plan 2019 of S2R already include references to the RCA to be considered in order to ensure future alignment as appropriate)</li> </ul>
European commission	<ul style="list-style-type: none"> <li>Support of the vision of RCA</li> </ul>
ERA	<ul style="list-style-type: none"> <li>Support of the vision of RCA</li> <li>Integration of relevant RCA features into TSI</li> </ul>
Industry Organizations (UNIFE, UNISIG, ...)	<ul style="list-style-type: none"> <li>Responsible for feasibility checks and content reviews</li> </ul>
Railway Organizations (UIC, CER, EIM, PRIME...)	<ul style="list-style-type: none"> <li>May host RCA Working Groups</li> <li>Coordination of compatibility to RCA activities</li> <li>CER involvement important for onboard changes</li> <li>Support of the vision of RCA</li> <li>Support of TSI changes</li> </ul>

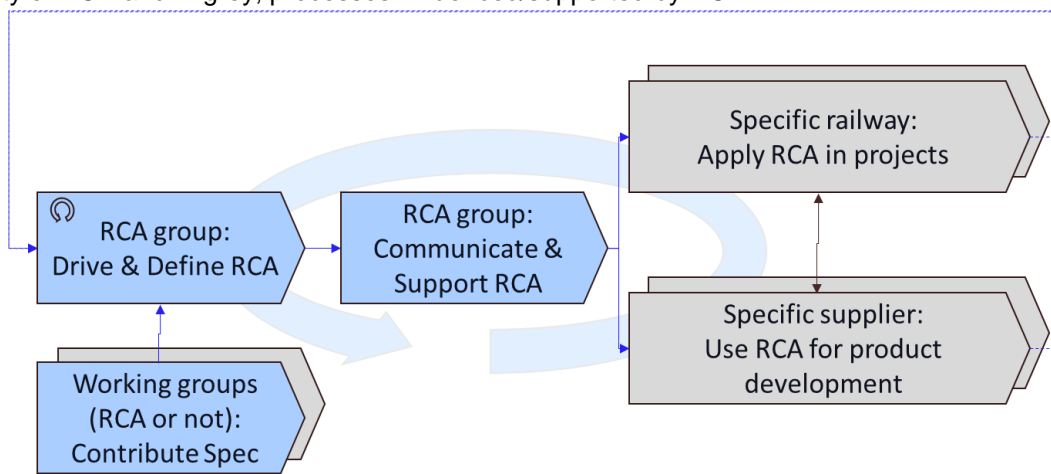
Stakeholder	Description / Interests
NSAs	<ul style="list-style-type: none"> <li>Support of the vision of RCA</li> <li>Support of TSI changes</li> </ul>
Funders/Owners (of the IMs)	<ul style="list-style-type: none"> <li>Support of the vision of RCA</li> <li>Provision of funding</li> </ul>
Users / Public	<ul style="list-style-type: none"> <li>Generation of supporters for the initiative</li> </ul>

## 2.2. RCA deliverables

Please refer to the document “RCA Alpha architecture overview”.

## 2.3. RCA process perspective

The following diagram shows the top-level processes for RCA. In blue, processes that will be under the responsibility of RCA and in grey, processes influenced/supported by RCA.



The following table provides a brief description of the processes above (omitting process steps).

Process	Goal / Outcomes	Roles/Actors
Drive & Define RCA	<ul style="list-style-type: none"> <li>Harmonized requirements expressed in a top-level architecture and a set of interface specifications</li> <li>The process must be much faster “than usual”, while ensuring a critical mass of actively supporting IMs and enough followers</li> </ul>	<ul style="list-style-type: none"> <li>Lead: RCA Group backed by EUG and EULYNX</li> <li>Approvers: all members of EUG and EULNYX</li> </ul>
Contribute Spec to RCA	<ul style="list-style-type: none"> <li>A specification or other RCA-element as a candidate for integration into the RCA</li> <li>Prototypes / Demonstrators</li> <li>See also chapter 4.4 “Work breakdown for working groups / clusters”</li> </ul>	<ul style="list-style-type: none"> <li>Basically, any party willing to provide a “building block” for RCA (according to rules such as IPR, design principles, tooling)</li> </ul>
Communicate and Support RCA	<ul style="list-style-type: none"> <li>Disseminate RCA activities and results</li> <li>Ensure that the RCA is known and appreciated at the right levels by IMs</li> <li>Get commitments for applying RCA</li> <li>Support IMs interested in applying RCA</li> </ul>	<ul style="list-style-type: none"> <li>RCA Group backed by EUG and EULYNX</li> </ul>

Apply RCA in modernization projects	<ul style="list-style-type: none"> <li>Plan, procure, roll-out and successfully operate modernization projects based on RCA specifications</li> </ul>	<ul style="list-style-type: none"> <li>IMs (and their financiers &amp; regulators)</li> </ul>
Use RCA for product development and innovative railway solutions	<ul style="list-style-type: none"> <li>Orient product strategies, R&amp;D and actual products according to RCA</li> <li>Offer RCA-based products in procurements by IMs</li> </ul>	<ul style="list-style-type: none"> <li>Suppliers and their organizations (UNIFE, UNISIG)</li> <li>Shift2Rail</li> </ul>

The processes “Drive & Define” and “Contribute Spec” are together called “RCA development”.

## 2.4. Interaction of RCA with on-going national programs

The RCA vision can only come to life, if IMs tender RCA features within their national programs as these RCA features will boost and enable national programs. This does not mean that every national program implements all features or the entire architectural framework of RCA.

For RCA features and specifications, there will be a feasibility check if they can be implemented right away or have to be adjusted to practical needs (while respecting the interoperability requirements).

On the other hand, the national programs can be the driving force behind the development of features and specifications within the RCA architecture.

Both ways will foster and enhance the architecture through coordination by the RCA group.

The links between national programs and RCA features and specifications will be established through surveys.

## 2.5. RCA and the TSI process

RCA defines a standard CCS architecture with more than 20 interfaces. One of the interfaces is defined by the TSI CCS to support the interoperability goal in Europe. RCA is a toolbox of building blocks, that shall allow the implementation of the so called “game changers”. The implementation of all known game changers will in some cases not only change the general functionality of CCS products, it can also result in the long run, in change requests for the TSI CCS, that have to be worked out. Some of them are already addressed and a specification change request process is running.

## 2.6. RCA development process

RCA is harmonizing the requirements of railways (IMs), so it is complementary to development programs like S2R and tries to support them with clear and structured requirements from the customer. RCA will not be designed to define a completely new direction for the CCS field, it wants to organize the requirements of the customers. The existing elements like ERTMS, EULYNX and probably also many technical developments of S2R will fit into the RCA from today’s perspective and vice versa.

The architectural elements to be provided by the RCA are described in the “Architecture Overview”.

The process is based on spiral development and is performed in several iterations:

1. Define / refine scope incl. addressed target architecture and migration paths
2. Define / refine top level functional decomposition and interfaces
3. Define / refine cross-cutting concerns (NFR, design principles, ...)
4. Initialize / mandate specification working groups
5. Support / coordinate specification working groups
6. Integrate / validate results of working groups
7. Perform quality check, review of iteration results
8. Formal decision on iteration results (optional)
9. Communicate iteration results

For current content regarding points 1-3, see “RCA Alpha Architecture Overview”.

Rules / principles for contributing to the RCA are:

- Contributions are possible from anywhere;
- Contributions must adhere to the overall architecture;
- Re-use of existing results is encouraged;
- The contributions must be freely usable (see Intellectual property).

Newly started work must conform to the defined method and tooling.

## **2.7. Applying / Utilizing RCA**

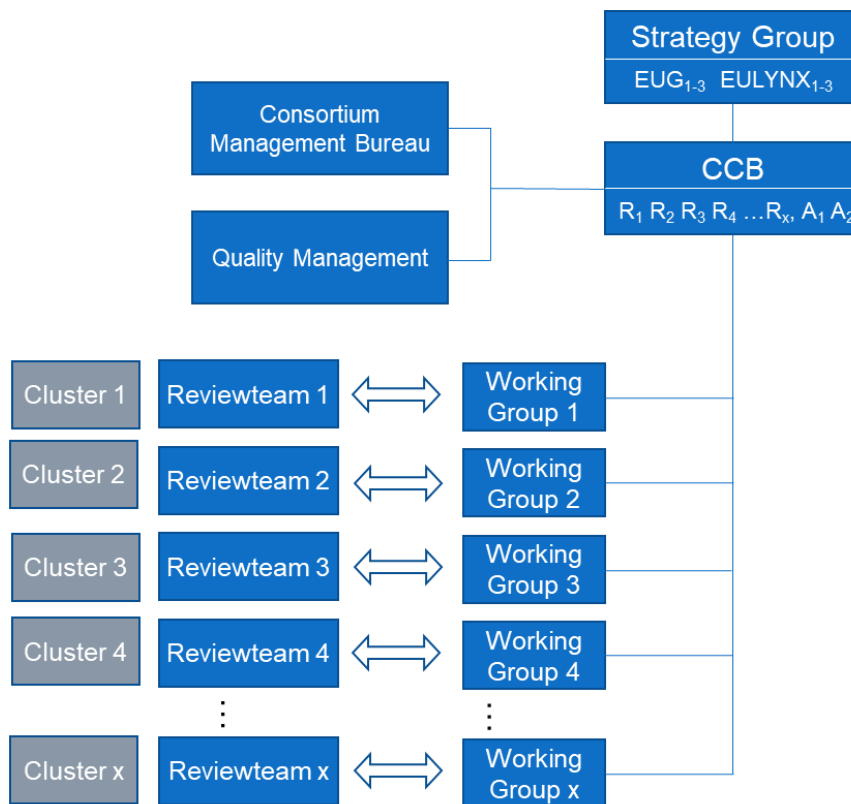
RCA is a set of specifications, tools and architectures that will be freely usable. The document “RCA Alpha Architecture Overview” describes the intended use of RCA by railways, suppliers or institutions such as Shift2Rail. The document also describes:

- How RCA and IM’s modernization program interact;
- Different scenarios for target configurations, migration paths, deployment architectures and sourcing options.



### 3. RCA organizational structure / Governance

The following temporary structure is in place:



Organizational unit	Description	Roles in the RCA process
Strategy Group	<ul style="list-style-type: none"> <li>The Strategy Group (SG) is the equivalent to Steering Board (SC) and Cluster Management Committee (CMC) in EULYNX and steers the RCA</li> <li>It consists of members nominated by EUG GA and EULYNX SC</li> </ul>	<ul style="list-style-type: none"> <li>Steer/decide on behalf of EUG and EULYNX members</li> </ul>
Change Control Board (CCB)	<ul style="list-style-type: none"> <li>Change Control Board (CCB) consists of nominated people and a clear voting process</li> <li>It consists of the leaders of the review teams and two persons of the overall Architectural Team</li> <li>Versioning of the overall architecture and its sub-systems is managed within the CCB</li> <li>CCB votes for dissemination of specifications within RCA</li> <li>SG votes for dissemination of specifications on European level</li> </ul>	<ul style="list-style-type: none"> <li>Head of CCB</li> <li>Leaders of Review Teams</li> <li>Leaders of Working Groups</li> <li>Architecture Team Leader</li> <li>Architecture Team Member (Architecture is a working group within RCA)</li> </ul>

<b>Organizational unit</b>	<b>Description</b>	<b>Roles in the RCA process</b>
Consortium Management Bureau (CMB)	<ul style="list-style-type: none"> <li>The Consortium Management Bureau forms the central core team of the consortium. Its primary role is management and coordination of the activities within the RCA group</li> </ul>	<ul style="list-style-type: none"> <li>Coordination of activities</li> <li>Liaison with stakeholders</li> </ul>
Quality Management	<ul style="list-style-type: none"> <li>Supervises the quality process</li> <li>Is responsible for the quality control of deliverables and conformity with a quality assurance plan.</li> </ul>	<ul style="list-style-type: none"> <li>Quality assurance</li> </ul>
Working Group Team	<ul style="list-style-type: none"> <li>Working Group Leaders must be assigned full time</li> <li>Team Members can be of any stakeholder if agreed by the Strategy Group</li> </ul>	<ul style="list-style-type: none"> <li>Working Group Leader</li> <li>Team Member Working Group</li> </ul>
Review Team	<ul style="list-style-type: none"> <li>Review Teams check applicability of specifications for all IMs and feed requirements of IMs into the Working Groups</li> <li>Review Team consists of people from contributing IMs</li> <li>Leader of the Review Team must be assigned full time to keep up with the development within the cluster as pace is high</li> </ul>	<ul style="list-style-type: none"> <li>Review Team Leader</li> <li>Team Member Review Team</li> </ul>
Core group	<ul style="list-style-type: none"> <li>Special case: the so-called core group is the "Review Team" for the clusters dealing with cross cutting topics</li> </ul>	

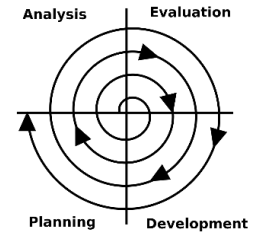
## 4. Roadmap RCA development

RCA development follows spiral model to ensure early first results while acknowledging that not all parts of the RCA can be developed in one iteration.

### 4.1. The RCA development process applies spiral development

An effective RCA cannot be developed in one big step:

- Some national programs are already started and will need quick (if preliminary) answers from RCA.
- The RCA idea is new for the sector, before joining, many stakeholders will need to see first results.
- The technological evolution will go on, RCA is never finished in that sense. However, RCA will provide stability by defining releases and requiring backwards compatibility.



The goal is to work in many iterations, getting feedback for every iteration to steer the process. While there is an overall goal and roadmap, it must be possible to include new learnings. For every iteration its feedback and the necessary scope and quality must be explicitly specified.

### 4.2. Iterations within spiral development

The iterations have several goals:

- early communication of fundamental direction and principles;
- practice collaboration among the RCA contributors;
- allow prompt feedback.

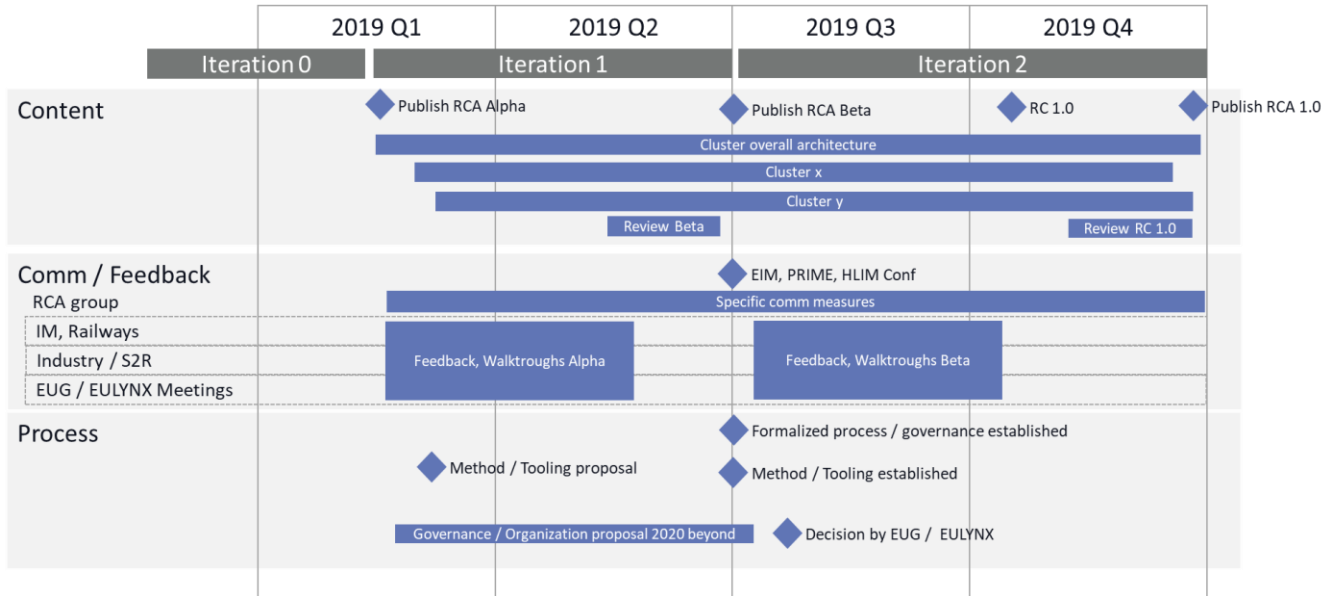
Iterations are not planned in detail for the long run but iterations 1 and 2 are already set.

Phase		Activities / Results
Startup - Iteration 0 Release "Alpha"	2018H2	<ul style="list-style-type: none"> <li>- early draft architecture «alpha» (functional top level) → basis for feedback with all EUG/EULYNX members and industry (together with S2R) → used to split up the work</li> <li>- work packages, organization &amp; governance for next phase</li> <li>- finding or setting up working groups for 2019 (leads, staff, procurements, funding, ...)</li> </ul>
Fast Version 1.0 - Iteration 1 "Beta" - Iteration 2 "V1.0"	2019	<ul style="list-style-type: none"> <li>- V1.0 of top-level architecture including functional decomposition reviewed.</li> <li>- first commitments by "early" IMs to contribute to RCA and to apply RCA</li> <li>- 5-10 working groups for the main architectural areas</li> <li>- Rough specs for the „white spots“ on the RCA map</li> </ul>
Development - Iteration x - Iteration y	2020-202x	<ul style="list-style-type: none"> <li>- Evolve architecture, complete interface specifications</li> <li>- Additional specification working groups</li> <li>- Establish supporting structures e.g. RCA «homologation procedures»</li> <li>- Prepare long-term organization («steady state»)</li> <li>- Authorisation support</li> <li>- First RCA-base rollouts are planned for 2025</li> </ul>
«Steady state»		<ul style="list-style-type: none"> <li>- Certification, Support for V&amp;V</li> </ul>

- Updates and releases
- Adding new interfaces / Integrating new technologies

### 4.3. Overview roadmap 2019

The following diagram show an overview of the roadmap for 2019. The work clusters are described in chapter 4.4 "Work breakdown for working groups / clusters".



### 4.4. Work breakdown for working groups / clusters

Contributions to the RCA specification will be produced in a “federated” way, relying on “working groups” organized around clusters. The currently identified clusters (for iteration 1, starting after publication of RCA Alpha) include:

Id	Cluster Title	Goals / Content	Notes
AR	Overall Architecture	<ul style="list-style-type: none"> <li>Produce RCA architecture documents able to serve as CENELEC Phase 1-Concept and Phase 2-System Definition document for RCA</li> <li>Ensure technical synchronization among all clusters</li> <li>Produce (minimal/shared) Initial Operational Need &amp; System Need Analysis a.k.a. business architecture</li> <li>Document initial / driving UC / scenarios / interactions</li> <li>Document initial / driving NFRs</li> <li>Start shared data model for data flow on interfaces</li> <li>Clarify degraded modes</li> </ul>	Review team formed by core group
MT	Modeling & Tooling	<ul style="list-style-type: none"> <li>Provide Modelling Standard</li> <li>Provide usable Tool-Chain</li> </ul>	based on EULYNX, DSD work
DI	Dissemination & Interaction	<ul style="list-style-type: none"> <li>Ensure regular publications</li> <li>Ensure stakeholder interactions (presentations etc.)</li> </ul>	
SG	Strategy & Governance	<ul style="list-style-type: none"> <li>Ensure strategy and governance issues are addressed.</li> <li>Ensure top-level communication</li> </ul>	Delegated to strategy group

<b>Id</b>	<b>Cluster Title</b>	<b>Goals / Content</b>	<b>Notes</b>
		<ul style="list-style-type: none"> <li>• Governance established for 2020 forward</li> <li>• Efficient working relation with S2R</li> </ul>	
CM	Communication	<ul style="list-style-type: none"> <li>• Comm: Versioning &amp; Capabilities</li> <li>• Comm: API &amp; Stack</li> <li>• Candidates for communication stack identified and evaluated with respect to suitability for RCA</li> </ul>	
RT	Runtime Environment	<ul style="list-style-type: none"> <li>• Check availability of usable run-time environments (industry product candidates)</li> <li>• Define suitable platform abstraction / standardization</li> <li>• Standardisation of RT</li> <li>• Scalable performance + SIL</li> </ul>	
FR	FRMCS	<ul style="list-style-type: none"> <li>▪ Ready for TSI Update 2022</li> </ul>	--> EUG: Work in WP8.3
LO	Localization	<ul style="list-style-type: none"> <li>• Focus needs to be clarified, different existing working groups</li> </ul>	
AT	ATO	<ul style="list-style-type: none"> <li>• Ensure integration of on-going S2R work on GoA2 and GoA3/4</li> <li>• Focus on “system-level” effects</li> </ul>	
I/F-1	PAS – PE / AE	<ul style="list-style-type: none"> <li>• Interface specification at quality level sufficient for demonstrators / prototyping</li> </ul>	
I/F-2	PE/SM – SL	Idem	
I/F-3	SL – OA	Idem	
I/F-4	OA – MT/MOT/OT	Idem	
I/F-5	MOT – VL/MOL/PSL	idem	
I/F-6	MT – VS	<ul style="list-style-type: none"> <li>• Prepare candidate change requests TSI</li> <li>• Plan change process</li> </ul>	

Notes:

- CM and RT will be handled together for the time being.
- Lead and/or contribution for clusters can in principle be performed by any organization (railways, supplier, S2R projects, ...).
- Further interfaces will be worked on (without achieving a final specification) in the AR cluster during 2019.
- Other candidate clusters (not yet started) include:
  - Data preparation
  - IAM & Security
  - Test-/Simulation-Environment
  - V&V
  - Homologation
  - Data Model: Topology
  - MMI
  - Diagnostics + Monitoring + Config
  - Generic Operational Concept

## 5. Information dissemination and intellectual property management

An architecture like RCA is all about information sharing. We need to make sure:

- that up-to-date information can be efficiently shared with interested parties;
- that we enable appropriate feedback;
- that we safeguard Intellectual Property Rights;
- that we don't infringe on third-parties' rights and will not be restricted by such rights ("freedom to operate").

### 5.1. Intellectual property management

#### Background

Intellectual property is relevant for RCA for the following reasons:

- The RCA process (documents) creates copyrighted material;
- RCA results may describe (or imply the use of) an invention already patented;
- RCA results may be patented by RCA contributors or third parties;
- The RCA policy on intellectual property management influences if and how confidentiality is needed in the RCA process.

#### Main drivers

- RCA results must be openly available for RCA to work as intended (tender templates for railways, guidance for industry).
- To pursue the goal of interchangeability of components, we need to avoid lock-in on a specific solution / vendor. The RCA specifications must not explicitly or implicitly require specific IPR for their implementation (possibility for royalty-free implementation).
- We continue to need the motivation of our industry partners for development of products, therefore we do not exclude intellectual property protection in product implementations.
- The RCA development process should be as un-encumbered by intellectual property rules as possible.

#### RCA policy on intellectual property management

- The RCA results (documents) are published today under an "open copyright" (e.g. [https://en.wikipedia.org/wiki/European\\_Union\\_Public\\_Licence](https://en.wikipedia.org/wiki/European_Union_Public_Licence)).
- To help protect against new patents by third parties, RCA results will be continuously published (also drafts, defensive publication).
- To help protect against new patents by contributors or persons/organizations included in the RCA process, we will adopt a policy analogous to e.g. <https://opcfoundation.org/news/opc-foundation-news/opc-foundation-announce-updated-opcf-ipr-policy/>.

#### Important message: IPR regarding products based on RCA

- We do not want IPR to be an obstacle to exchangeability (initial procurement or later lifecycle) of components based on the defined specifications.
- Like today, the implementation of the specifications in a specific product / component by any partner may be protected by IPR.

## **5.2. Making information about RCA available**

The results of RCA will be published at the end of each iteration. In the initial iterations the main goal is to get feedback from railways and suppliers.

The publication and communication tasks are assigned to the Consortium Management Bureau which will refer to CCB or Strategy Group decisions what to publish. The CMB shall also foster communication from Working Groups to stakeholders and organize the feedback loop.

Results will be published on the websites of EUG and EULYNX.