OCORA

Open CCS On-board Reference Architecture

Whitepaper – Evolution Management

Document ID: OCORA-TWS07-020

Version: 2.01

Release: R1

Date: 02.12.2021

Revision history

Version	Change Description	Initial	Date of change
1.00	Inherited content from draft “Safety Strategy” version for OCORA Delta Release	JB	01.08.2021
1.01	Definition of the document structure based on the R1 template	JB	03.11.2021
1.02	Update according to member review. Complete all section	JB	11.11.2021
1.03	Update following Modular Safety reviews	JB	17.11.2021
2.00	Official version for OCORA Release R1	JB	18.11.2021
2.01	Answer to Vreeswijk Pieter comments	JB	02.12.2021

Table of contents

Table of figures

References

Reader's note: please be aware that the numbers in square brackets, e.g. [1], as per the list of referenced documents below, is 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.

[1] OCORA-BWS01-010 – Release Notes

[2] OCORA-BWS01-020 – Glossary

[3] OCORA-BWS01-030 – Question and Answers

[4] OCORA-BWS01-040 – Feedback Form

[5] OCORA-BWS03-010 – Introduction to OCORA

[6] OCORA-BWS03-020 - Guiding-Principles

[7] OCORA-BWS04-010 – Problem Statements

[8] OCORA-TWS01-030 – System Architecture

[9] OCORA-TWS05-021 – Program Requirements

[10] OCORA-TWS07-010 – Modular Safety – Strategy

[11] OCORA-TWS09-010_Testing-Strategy

[12] EN 50126-1:2017-10 – Railway Applications – The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part 1: Generic RAMS Process

[13] EN 50126-2:2017-10 – Railway Applications – The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part 2: Systems Approach to Safety

[14] EN 50128:2011-06 – Railway Applications – Communication, signalling and processing systems - Software for railway control and protection systems

[15] EN 50657: 2017 - Railways Applications - Rolling stock applications - Software on Board Rolling Stock

[16] EN 50129:2018-11 – Railway applications - Communication, signalling and processing systems - Safety related electronic systems for signalling

[17] EN 50159:2010-09 – Railway applications - Communication, signalling and processing systems - Safety-related communication in transmission systems

[18] TSI CCS: 02016R0919 - EN - 16.06.2019 - 001.001 - 1: COMMISSION REGULATION (EU) 2016/919 of 27 May 2016 on the technical specification for interoperability relating to the 'control-command and signalling' subsystems of the rail system in the European Union, amended by Commission Implementing Regulation (EU) 2019/776 of 16 May 2019 L 139I

[19] CSM-RA - common safety method for risk evaluation and assessment and repealing Regulation (EC) 402/2013

[20] Directive 2018/545 - COMMISSION IMPLEMENTING REGULATION (EU) 2018/545 of 4 April 2018 establishing practical arrangements for the railway vehicle authorisation and railway vehicle type authorisation process pursuant to Directive (EU) 2016/797 of the European Parliament and of the Council

[21] ERA 1209-063 Clarification note on safe integration

1 Introduction

1.1 Purpose of the document

The purpose of this document is to address a systematic approach when realising evolution on building blocks and spreading them through the whole railway assessment Lifecyle up to the final vehicle authorisation as defined in Directive 2018/545 [20]. This document provide means against one main issue defined in Problem Statements [7]:

Current ETCS On-board solutions:

[…]

*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)*

[…]

Based on the previous problem statement, it aims at covering the following expected result defined in Introduction to OCORA [5]:

*3. Robust interface specifications allowing for **smooth evolution** and migration.*

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 [4].

If you are a railway undertaking, you may find useful information to compile tenders for OCORA compliant CCS building blocks, for tendering complete on-board CCS system, or also for on-board CCS replacements for functional upgrades or for life-cycle reasons.

If you are an organization interested in developing on-board CCS building blocks according to the OCORA standard, information provided in this document can be used as input for your development.

1.2 Applicability of the document

The document is currently considered informative but may become a standard 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.

1.3 Context of the document

This document, introduced in OCORA Modular Safety Strategy [10], is published as part of the OCORA Release R1, together with the documents listed in the release notes [1]. Before reading this document, it is recommended to read the Release Notes [1]. If you are interested in the context and the motivation that drives OCORA we recommend to read the Introduction to OCORA [5], and the Problem Statements [7]. The reader should also be aware of the Glossary [2] and the Question and Answers [3].

2 Environment of the present whitepaper

2.1 Current situation regarding CCS-OB evolutions

Railway products or systems use to have a life cycle up to 30 years. Therefore, between the first version of an equipment installed in its operational environment (i.e. refer to Phase 11 of the CENELEC V cycle of EN 50126-1 [12]) and the decommissioning/disposal phase (i.e. refer to Phase 12), it will likely evolve by adding new functionalities, correcting defects, providing improvements etc.

Safety critical systems in the ERTMS environment (e.g. CCS-OB) have to be defined according to the TSI CCS [18]. This considers the technical requirements defined by the different SUBSETS and the CENELEC standards (i.e. EN 50126 [12], EN 50128 [14] [for the CCS-OB], EN 50657 [15] [for the Train Adapter] and EN 50129 [16]) plus all the additional standards referred in these three main ones (e.g. EN 50159 [17]).

The conformity of the CCS-OB according to these standards is based on the technical documents provided by the manufacturer whose overall summary is presented in the safety case.

Its structure and content are presented in section 7 of EN 50129 [16] where the first section requires that:

Part 1 — Definition of system

This shall precisely define or reference the system, subsystem or equipment to which the Safety Case

refers, including version numbers and modification status of all requirements, design and application

documentation.

This states that the CCS-OB covered by an ISA certificate corresponds to a frozen picture of it. Fundamentally, no further modification is possible without the realization of a new release of the safety case which will lead to finally get a new certificate for the CCS-OB.

Over the whole life cycle of a CCS-OB system, this will likely happen several times and the costs related to the recertification activities are usually very high and as such negatively affect a lot of evolutions which could improve the overall performances of the CCS-OB. Indeed, most of the time, the ratio costs vs benefits of the evolutions is not worth realizing it from a business point of view. This statement is just a quick summary of the complete CCS risk profile analysis realized in Introduction to OCORA [5]. This documents states that:

The volatility of the CCS system for the railway community at large because of e.g. frequent updates of the specification and technological developments, but also the variability of user specifications, resulting in an average life cycle expectancy for CCS systems of 5 to 10 years with an average of, currently, about 6 years. The net result of this development is, that rolling stock has to be retrofitted several times during its (residual) lifecycle. For new rolling stock fitted with ERTMS and with a life expectancy of +30 years, this would mean at least 4 consecutive retrofits. The CCS market will, therefore, be dominated by the need for retrofits and not by newly built requirements.
This happens today because the monolithic approach of the CCS-OB, presented on Figure 2, prevents smooth changes, especially when dealing with proprietary hardware. Thus, from a manufacturer's business strategy, it is worth accumulating a maximum of evolutions into sustaining baselines (including new hardware). In that case, the CCS-OB (and thus its safety case and certificate) evolve only by big steps. This is represented in the example on Figure 1.

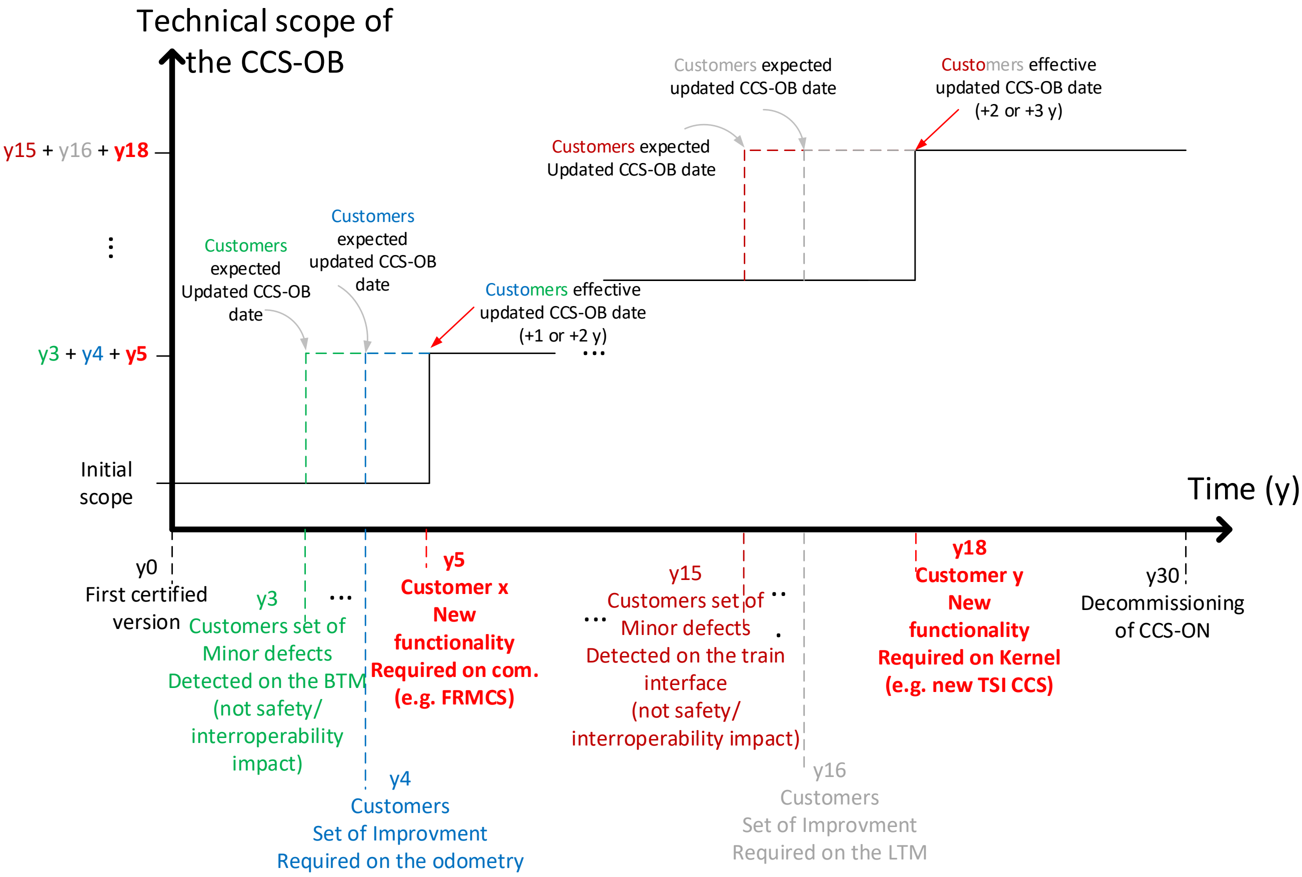

Figure 1 Current example of CCS-OB evolution through its life cycle

An additional reason of this “big steps” approach when managing evolutions is that current CCS-OB are is built following a monolithic architecture, covering a wide scope of different functionalities (refer to Figure 2). The ETCS-OB system covers different critical functions in a single overall safety case. Because of that, any update that is claimed in a function will impact the whole safety case and certificate.

[5][7]

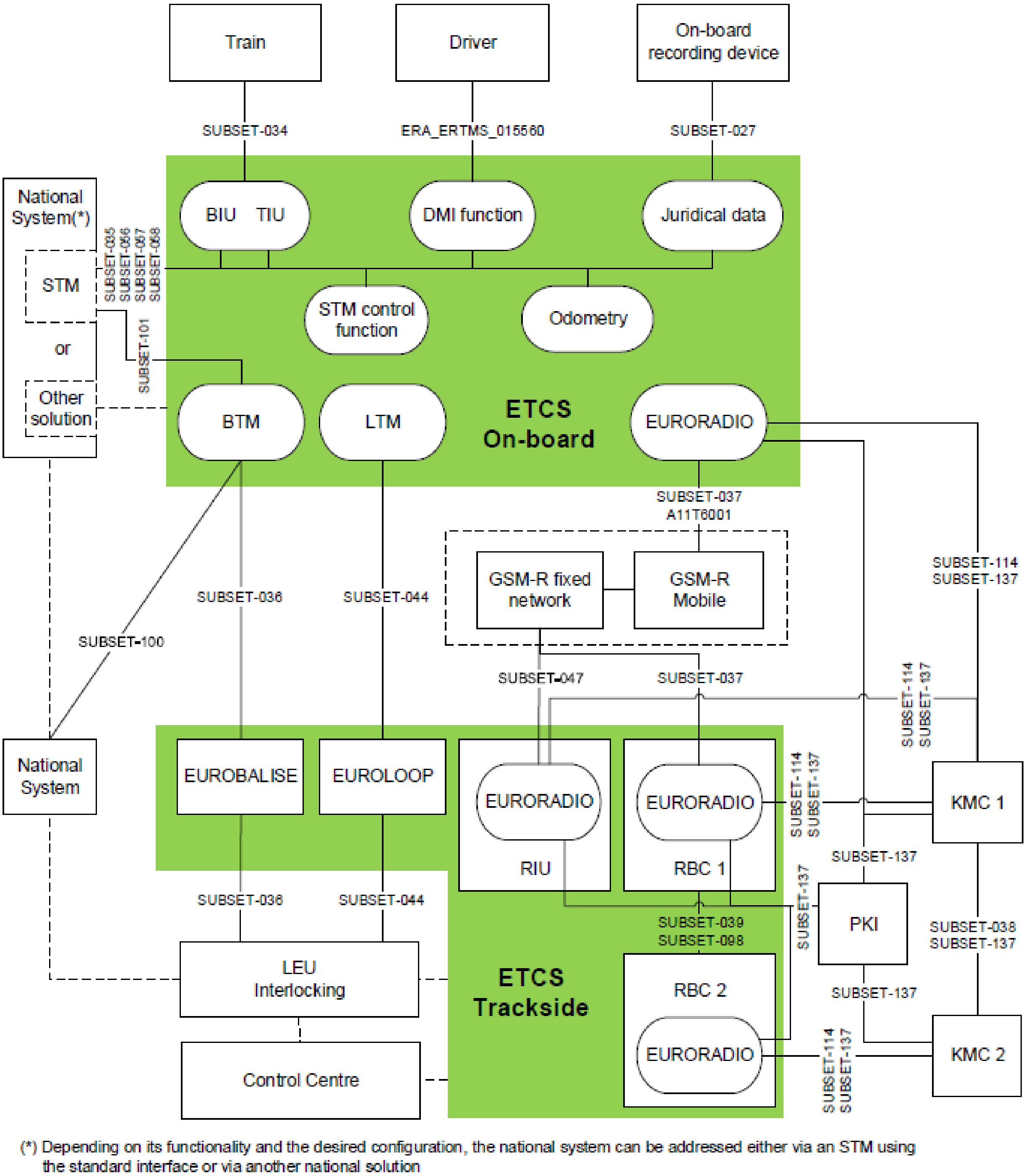

Figure 2 SUBSET-026 overall vision for ERTMS systems

Safety activities in railway sectors represent a large part of the overall system costs during the whole lifetime. The previous statement about the slow evolutions of the CCS-OB system is also applicable:

- when safely integrating the technical equipment into one or several train types,
- when safely integrating a fleet to a dedicated network.

All these activities aim at getting a “vehicle authorization for placing on the market” as required by the European directive 2018/545 [20]. This is the mandatory condition for a railway undertaking (or another entity) to use a train on a railway network.

The process described in this document, which includes the modular approach and architecture from OCORA, will allow to do “smaller steps” (update, change, evolution etc. identified in dashed lines on Figure 1) of the CCS-OB in terms of vehicle authorization when the RU/operator requires it. These “smaller steps” will not systematically require applying for new vehicle authorization (e.g. none-safety critical modifications). **The objective of this process is to**

limit at maximum the need of complete retrofit once a train is equipped with an OCORA compliant CCS-OB by only performing evolutions on the latter.

2.2 Existing regulations related to evolution management

The case of retrofitting current trains equipped with monolithic CCS-OB with new OCORA ones is not the purpose of this process. This will be addressed in another document. Existing regulations related to evolution management

In today's standard related to the interoperability world, directive CSM-RA [19] provides a unified methodology in Europe for managing safety activities in case of evolution of a system covered by a Vehicle Authorization as defined in Directive 2018/545 [20].

CCS-OB is basically covered by its scope:

> *Article 2*
> *Scope*
>
> *3. This Regulation shall apply also to structural sub-systems to which Directive 2008/57/EC applies:*
>
> *(a) if a risk assessment is required by the relevant technical specification for interoperability (TSI); in this case the TSI shall, where appropriate, specify which parts of this Regulation apply;* (see 3.2 below)

Extract from TSI CCS [18]:
3.2. Specific Aspects of the Control-Command and Signalling Subsystems
3.2.1. Safety
Every project to which this specification is applied shall take the measures necessary to ensure that the level of risk of an incident occurring within the scope of the Control-Command and Signalling Subsystems, is not higher than the objective for the service. For this purpose the Commission Implementing Regulation (EU) No 402/2013 (1), as referred to in Article 6(3)(a) of Directive 2004/49/EC (Common Safety Method), applies.

> *(b) if the change is significant as set out in Article 4(2), the risk management process set out in Article 5 shall be applied within the placing in service of structural sub-systems to ensure their safe integration into an existing system, by virtue of Article 15(1) of Directive 2008/57/EC.*

[…]

> *ANNEX I*
> *1. GENERAL PRINCIPLES APPLICABLE TO THE RISK MANAGEMENT PROCESS*
> *1.1. General principles and obligations*
>
> *1.1.4. The **actors who already have in place methods or tools for risk assessment may continue to apply** them if such methods or tools are compatible with the provisions of this Regulation and subject to the following conditions:*
>
> > *(a) the risk assessment methods or tools are described in a safety management system accepted by a national safety authority in accordance with Article 10(2)(a) or Article 11(1)(a) of Directive 2004/49/EC; or*
> >
> > *(b) **the risk assessment methods or tools are required by a TSI** or comply with publicly available recognised standards specified in notified national rules.*

Based on the previous statement, usually two different strategies are developed by the manufacturers:

- Apply the CSM-RA directive with the use of "significant" and "non-significant" modifications which drive at the end to the edition (i.e. for significant changes) or not (i.e. for non-significant changes) of a new certificate for the CCS-OB or,

- Apply the CENELEC development process as allowed by ANNEX I 1.1.4 (b) where the modifications management are presented into EN 50129:

1 Scope

[...]

This document is not applicable to existing systems, subsystems or equipment which had already been accepted prior to the creation of this document. However, so far as reasonably practicable, it should be applied to modifications and extensions to existing systems, subsystems and equipment.

[...]

8.3 Modification and retrofit

During the operational life of a system, change requests can be raised for a variety of reasons, not all of which will be safety-related. Each change request shall be assessed for its impact on safety, by reference to the relevant portion of the safety documentation.

Where a change request results in a modification which could affect the safety of the system, or associated systems, or the environment, the appropriate portion of the safety life cycle shall be repeated to ensure that the implemented modification does not unacceptably reduce the level of safety.

Modifications shall be controlled using the same quality management, safety management and functional/technical safety criteria as would be used for a new design. All relevant documentation, including the Safety Case, shall be updated ***or supplemented by additional documentation****.*

Based on the last segment “or supplemented by additional documentation”, the present document aims at proposing additional systematic means for managing evolutions without necessarily update the CCS-OB or its constituent safety cases, depending on their criticality. This is the entry point for this evolution process.

2.3 Elements covered by “evolution management”

The term “evolution” in defined in the Glossary [2]. Evolution management refers to the changes of a CCS-OB system or its constituting building blocks that have already been certified according to:

- NoBo independent conformity assessment defined in TSI CCS [18]
    - Interoperability certificate (i.e. design examination certificate),
    - ISA certificate (i.e. compliance to CENELEC standards),
- DeBo examination report (only when dealing with NTR),
- OCRA requirements (this will be defined in in another document planed for OCORA release R2)

Evolutions are a central key element of OCORA to reach the seven design goals defined in Guiding Principles [6]:

- ***Openness****: the property that design, contents, operation of a system and any information hereon is fully transparent and accessible to users and stakeholders.*
- ***Modularity****: The property of being composed of a coherent whole of individual, independent building blocks, each of which can be separately treated as an independent, single and isolated entity necessary to make a system work. These could be concrete products or devices (such as ‘functional vehicle adapter module’) but also software and services (e.g. testing, insurance).*
- ***Exchangeability****: The property that individual building blocks can be replaced without affecting the integrity of the whole system or of other building blocks. This property implies that provisions have been made*

regarding the connection between discrete building blocks which should enable the system to retain its integrity in case building blocks are replaced.

- ***Migrateability****: The property allowing to add or remove independent building blocks to the system or exchange existing building blocks by alternative ones, without compromising the integrity of the structural environment they are part of, and…*
- ***Evolvability****: The property of enabling new technologies to be integrated into existing building blocks (or the mortar between them) while retaining at least the necessary functions of the integral system.*
- ***Portability*** *(Platform Independence): the property to exchange software between systems. A good example is regular office software that can be installed and used on laptops from multiple manufacturers and using different operating systems (e.g. Windows and iOS), e.g. software.*
- ***Security****: the property that a system cannot be used, or its correct functioning compromised by an unauthorized source.*

The evolutions of the CCS-OB system or its constituting building blocks must be categorized to systemize their management. They can be (not exhaustive for OCORA R1):

- Enhancement change requests in a building block,
- Corrective change requests in a building block,
- Upgrade with new functionalities in a building block,
- Update of operational, installation and/or maintenance conditions at any level,
- Addition of a new building block within the CCS-OB level,
- …

Evolutions managed in this whitepaper are limited to the CCS-OB and the Train Adapter as described in the System Architecture document [8]. They are represented by the green and blue frame on Figure 3. It must be noticed that the Train Adapter will, on a longer run, exist not anymore. The convergence of vehicle networks, consisting of one or multiple bus systems that integrate the CCS and vehicle bus systems is already under scrutiny of OCORA and Shift2Rail Connecta. This is presented into the Introduction to OCORA [5].

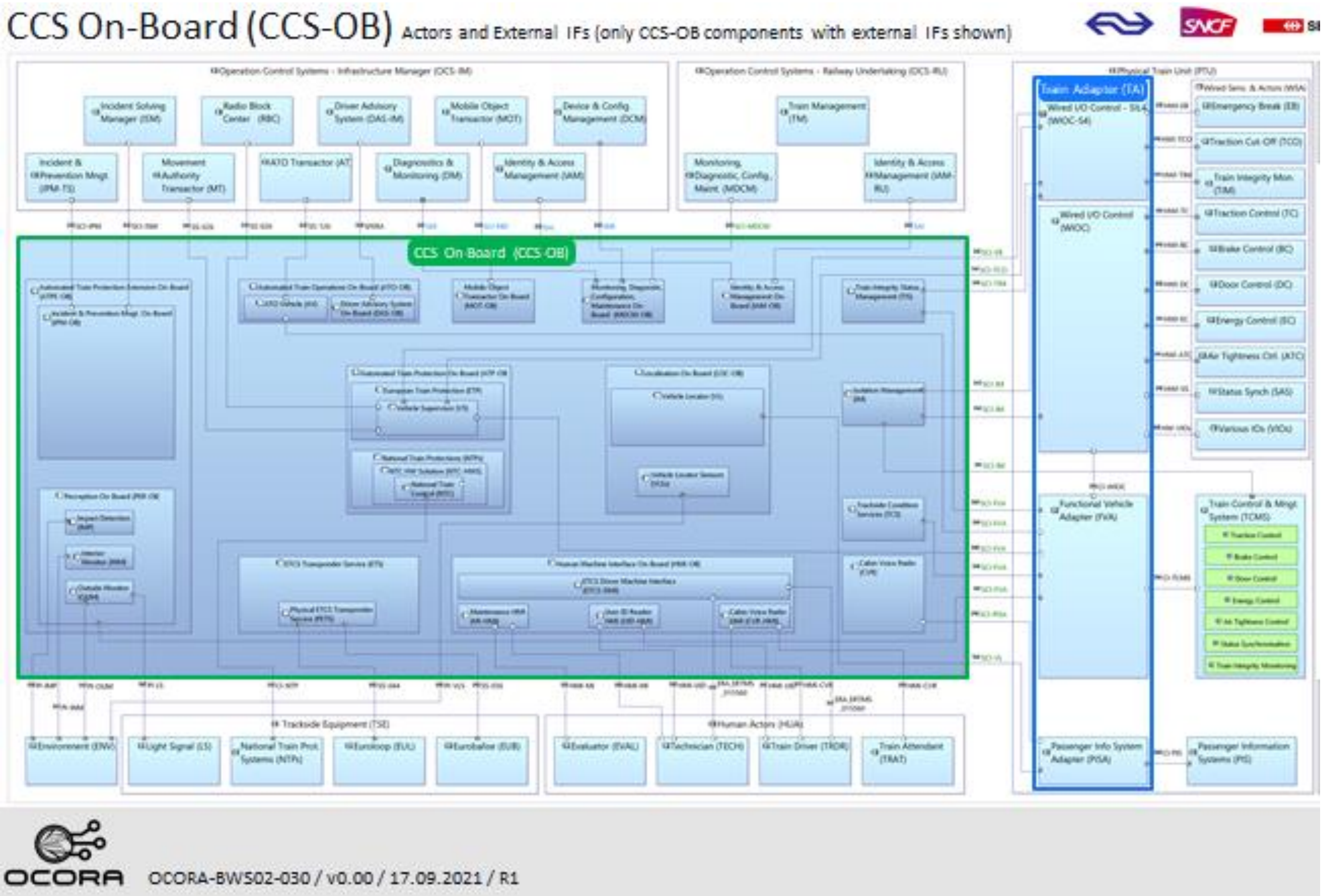

Figure 3 OCORA CCS-OB architecture

2.4 Benefits of evolutions in a modular architecture

The general benefits of deploying a modular architecture in the CCS-OB systems are presented in Introduction to OCORA [5]. In accordance with OCORA expected benefits, this document tends to provide benefits for all the stakeholders involved into OCORA compliant programs thanks to smooth evolutions:

- Manufacturers: The standardization of different certification levels requiring different shades of documentation to be updated aims at avoiding a systematic new certificate request to the assessor. This will greatly ease the management of non-critical evolutions (i.e. not related to safety functions evolutions).
- Integrators (i.e. at CCS-OB and vehicle levels as defined in the Testing Strategy [11]): The evolution management process defines standardized non-regression tests based on the evolutions under consideration. These scopes, in addition to the specific tests procedures check the modification itself, aim at accelerating the evolved building blocks or CCS-OB at their integrated level. This is possible because individual analyses for non-regression activities will be avoided.
- Assessors: The current evolution process will be submitted to several ISA for their approval. This will be done when the present document will be finalized (OCORA R2 or later). The benefit for them is that this process provides clear frames for the different certification levels (i.e. not to be re-defined for each evolution) which means more frequent updates of the certified systems but with a clear defined assessment scope.
- Railway Undertakings: The process allows to accelerate the update of the deployed vehicles equipped with OCORA compliant systems and reduce drastically costs. The “big steps” as presented on Figure 1 will be replaced by more frequent “small steps” composed of minor evolutions with strong benefits in time and costs development for the projects, close to evolutions of other rolling stock systems.

It must be noticed that all the benefits presented above must not degrade the overall safety quality of the different projects. It may at the opposite reinforce it. The objective behind it is that it is considered safer

to handle smaller but more frequent updates following a systematic approach rather than important ones, less frequent but with a wider and more complex scope.

2.5 Concept of “safe integration”

The decomposition of the current CCS-OB system as defined by TSI CCS [18] and represented on Figure 2 introduces two new actors whose tasks are today mostly intrinsically covered by the train manufacturers. The most common current ERTMS homologation process is synthetized on Figure 4. Other possible organizations are proposed in §4.1.

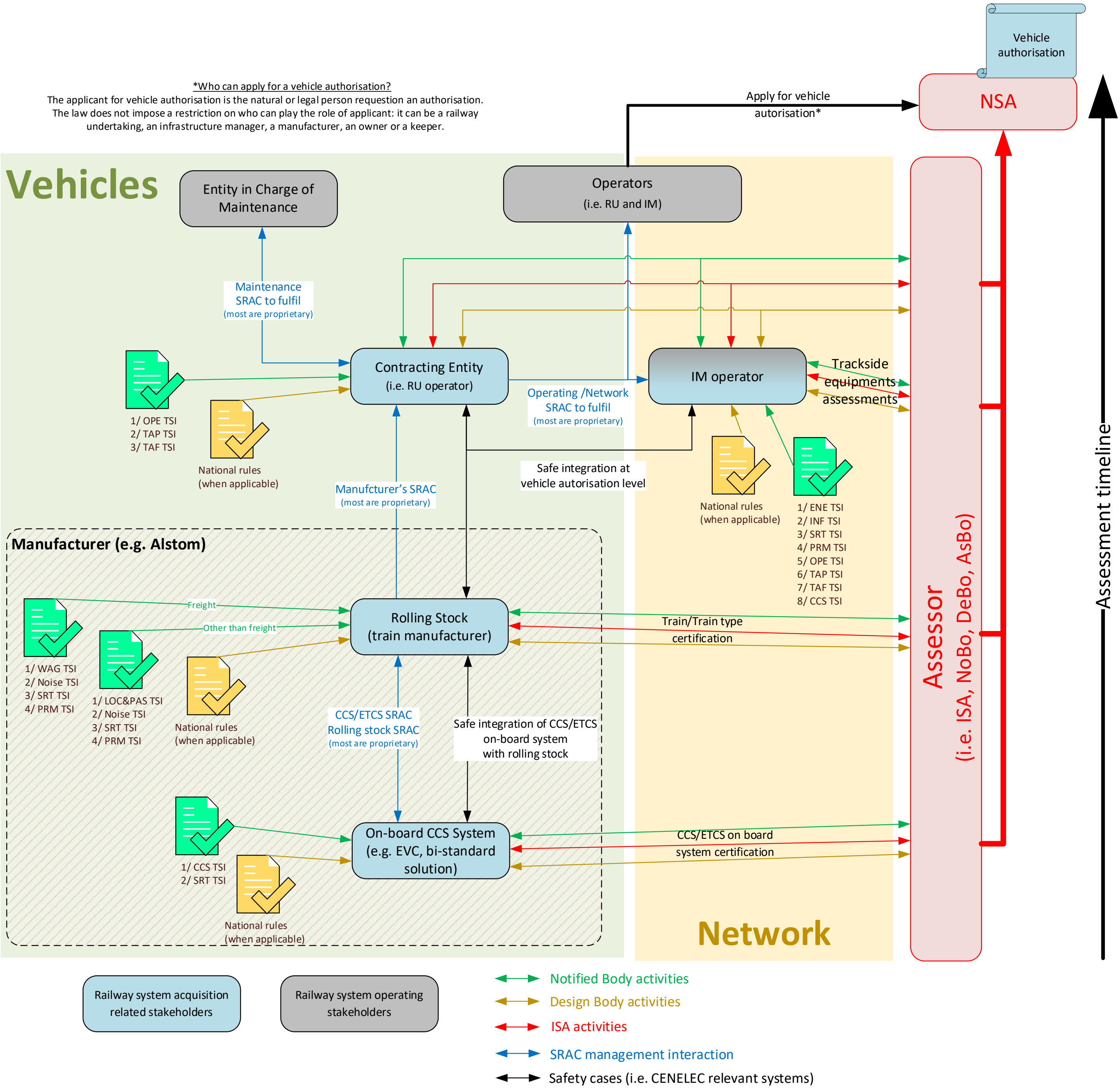

Figure 4 Current ERTMS homologation process

Figure 5 tends to present a possible future ERTMS homologation that integrates OCORA requirements. **It must be understood that the assignment of the CCS-OB integrator and, vehicle integrator are not defined by**

OCORA. Each contracting entity is responsible for assigning these roles to chosen actors. OCORA will focus on the definition of the tasks and responsibilities for these two levels.

Depending on the maturity of the RU regarding technical skills for CCS-OB integration activities (refer to alternative homologation processes in §4.1), different possibilities can be suggested:

- The first OCORA compliant projects handled by a contracting entity may request these integration activities to historical train manufacturers (e.g. Alstom, Siemens),
- After several successful projects, the contracting entity has developed some skills and knowledge related to safe integration and can now handle these two roles internally.

Again, these are just typical suggestions that may likely occur in the future.

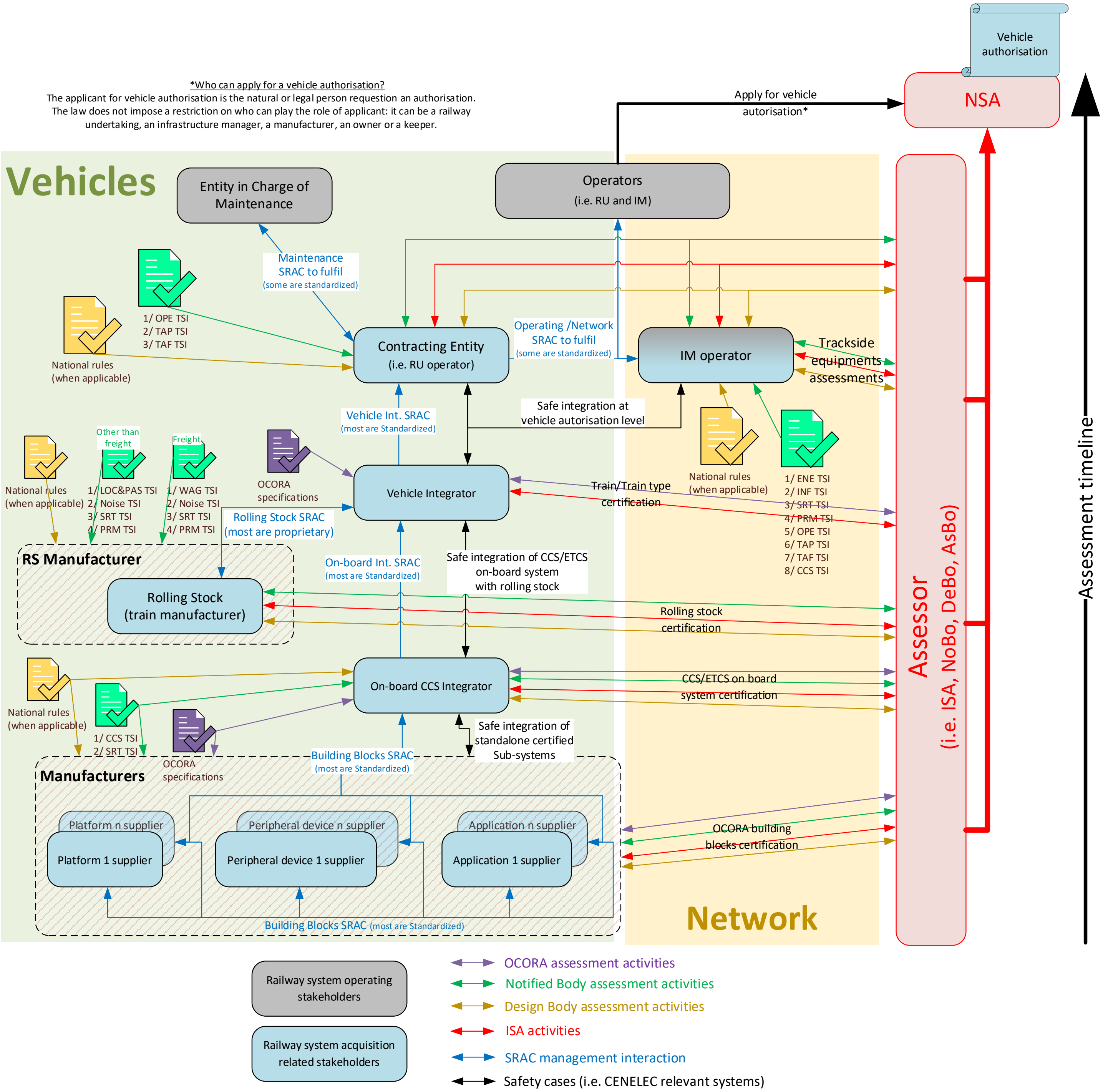

Figure 5 ERTMS homologation process including OCORA

The current ERTMS homologation process and the ERTMS homologation process including OCORA will be further refined into a complete decomposition in a yet to be defined document in OCORA R2. The main task is to define the activities handled by the two integrators' steps. Their scopes of activities have to be defined for:

- First realization of an OCORA compliant CCS-OB (e.g. retrofit of an existing vehicle) and then;
- Evolution of the OCORA compliant CCS-OB once certified.

In both cases, the key point to be followed is that the two kind of integrators have to realize safe integration

The first bullet will be addressed in another document whereas the second in the current document. The latter, detailed in Directive 2018/545 [21], warns the different stakeholders about the wrongly understood limit of safe integration:

2.5.6. In general, the stakeholders responsible for changes of the design of the railway system, i.e. the infrastructure managers and railway undertakings, each one for its part of the system, ***cannot thus be satisfied only with*** *:*

(a) cutting the overall system into a list of constituting sub-systems;

(b) waiting for the suppliers to develop the different sub-systems and then just putting them together technically.

(c) collecting the bottom-up exported safety related application conditions/constraints (SRACs) from the different constituting sub-systems/suppliers;

(d) demonstrating the compliance with those safety related application conditions/constraints imported from the risk assessment of every constituting sub-system/involved actor.

2.5.7. They must consider also the potential impacts of the considered change on:

(a) the other unchanged elements, components, constituents, structural or functional sub-systems of the railway system;

(b) the interfaces with those other elements, components, constituents of the railway system.

2.5.8. In addition to the routine changes of the railway system, there could be other types of changes that are not driven directly by a railway undertaking or an infrastructure manager. Typical examples are :

(a) a financial consortium, or a regional public authority, which purchases a fleet of vehicles or trains from a manufacturer without consulting and involving the future railway undertaking(s), who will operate the vehicles, and the infrastructure manager on whose lines the vehicles will operate.

(b) a regional public authority, or the Ministry, purchases the construction of a new, or the extension of an existing, (regional) railway line to a contractor without involving the infrastructure manager who will manage the traffic on the line.

In order to manage properly these types of changes, and to improve the hazard identification and the proper preventive control of the associated risks, it is essential that the "procurement entity" also applies the top-down and system-based approach described in this paper. Right from the tender stage, and from the beginning of the project, the procurement entity should either involve the future operators (RUs) and the traffic manager (IM) in, or sub-contract to them, the proper management of the project. This gives the possibility to systematically identify early in the project the potential risks and to control the identified risks through technical improvements of the design instead of obliging the users to implement afterwards constraining operational and maintenance safety related application conditions for use.

2.5.9. In the absence of top-down system risk assessment and system risk management, some railway system hazards/risks might be non-identified and the associated system risk control measures missing. The proper risk assessments and risk managements of the constituting sub-systems cannot compensate the lack of proper risk identification and risk control at the level of the railway system.

Following that, ERA 1209-063 Clarification note on safe integration [21] presents the strategy to handle a safe integration when dealing with evolutions in one part of the overall vehicle authorization process. The following activities have been identified:

1) *Whenever a new element is introduced into a system, or an existing one is modified, regardless of significance, safe integration and risk management must ensure that:*

   a) the new or modified element is technically compatible, and thus correctly interfaces, with the other parts of the system into which it is introduced.

   b) the new or modified element is safely designed and fulfils all the intended functional and technical objectives.

   c) the impacts of humans on the operation and maintenance of that element and on the system where it is incorporated are assessed and properly addressed.

   d) the introduction of that new or modified element into its physical, functional, environmental, operational and maintenance context does not have adverse and unacceptable effects on safety of resulting system into which it is incorporated

   Therefore, every actor is responsible for the risk assessment and the safe integration of its contributing part to the overall railway system

2) *Safe integration of a change is therefore not a separate and additional set of tasks to the regular risk assessment and risk management activities.*

The above elements have to be taken in account when developing the integration of evolved OCORA compliant systems.

3 Methodology deployed to define evolutions management

Prior to developing this evolution process, it is important to describe the methodology used as a roadmap. The latter is presented on Figure 6.

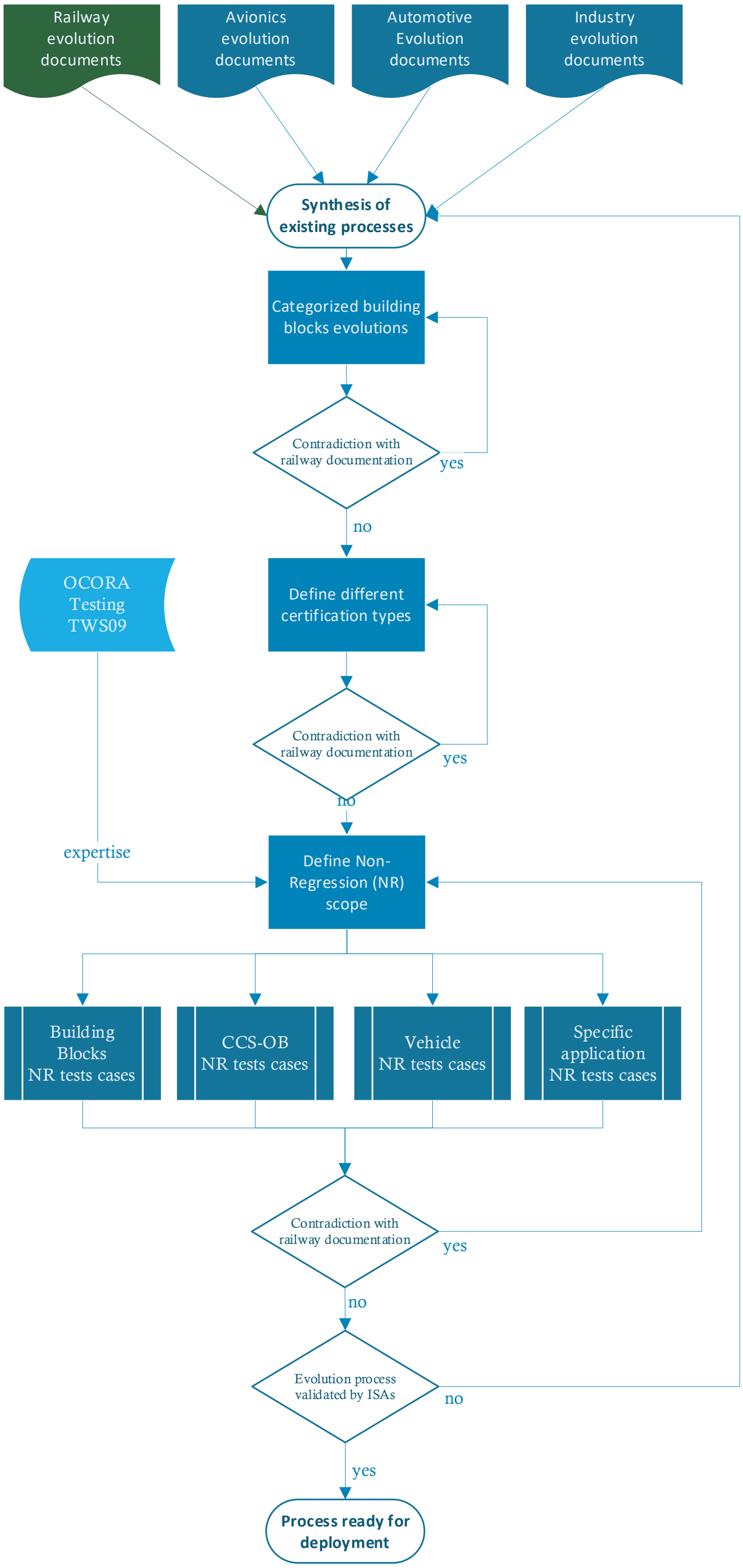

Figure 6 Evolution process methodology

This methodology is architecture around 4 main steps:

1. Research of existing railway documentation applicable when dealing with evolutions:
    a. Railway documentation is identified in §0,
    b. Avionics sector based on the IMA (Integrated Modular Avionics) deployed for decades now with, for instance, the deployment of the AHP (Analytic Hierarchy Process) methodology,
    c. Automotive sector where modularity, upgradability and evolvability are key aspects of this very competitive market,
    d. Industry sector (e.g. https://www.fairphone.com/en/).
2. When the research is over, a summary of the analyzed documents is provided and presents:
    a. The redundancy between the different processes (if any),
    b. The strengths of each process,
    c. The weaknesses of each process,
    d. Its adaptability to the railway world.
3. Once the reusable data is highlighted, a standardized classification of evolution types should be provided (refer to §2.3) for several examples,
4. The Testing group of OCORA (i.e. TWS09) will join the Modular Safety team (i.e. TWS08) to define a typical scope of non-regression tests for each type of classified evolutions:
    a. For each building block or type of building blocks (this will be clarified in OCORA R2),
    b. For the CCS-OB integrating the evolved building block(s),
    c. For the vehicle hosting the CCS-OB through the Train Adapter defined by OCORA,
    d. For the specific application represented by the vehicle in its dedicated network. The vehicle authorization, as required by Directive 2018/545 [20] is done at this final step.

    Obviously, the mandatory non-regression test scope is more and more simplified when moving from building block validation to the vehicle/network integration phase. One main goal of OCORA integration activities, defined in the Program Requirements document [9] is to avoid, at maximum, without degrading safety, redundant and not relevant non-regression activities when dealing with evolutions.

After each step, a check will be done to ensure that what has been achieved so far presents no contradiction or incompatibilities with existing railway standard or directive.

When the process will be judged as mature, it will be share to a selected panel of accredited assessors (i.e. ISA, NoBo, DeBo, AsBo) for review. Once comments have been taken in account, it will be delivered in another document as the reference set of documents for OCORA compliant program certification.

4 Annexes

4.1 Alternative current homologation processes

Beside the mostly spread current homologation process presented on Figure 4, two alternatives (Figure 7 and Figure 8) are presented hereafter. They present the benefits of decoupling the vehicle integrator role from the RS and CCS-OB manufacturers. In OCORA R2; Modular Safety should try to get feedback of the governance of such projects, especially the second alternative on Figure 8) to get return of experience on the way to address the tasks and responsibilities for this role.

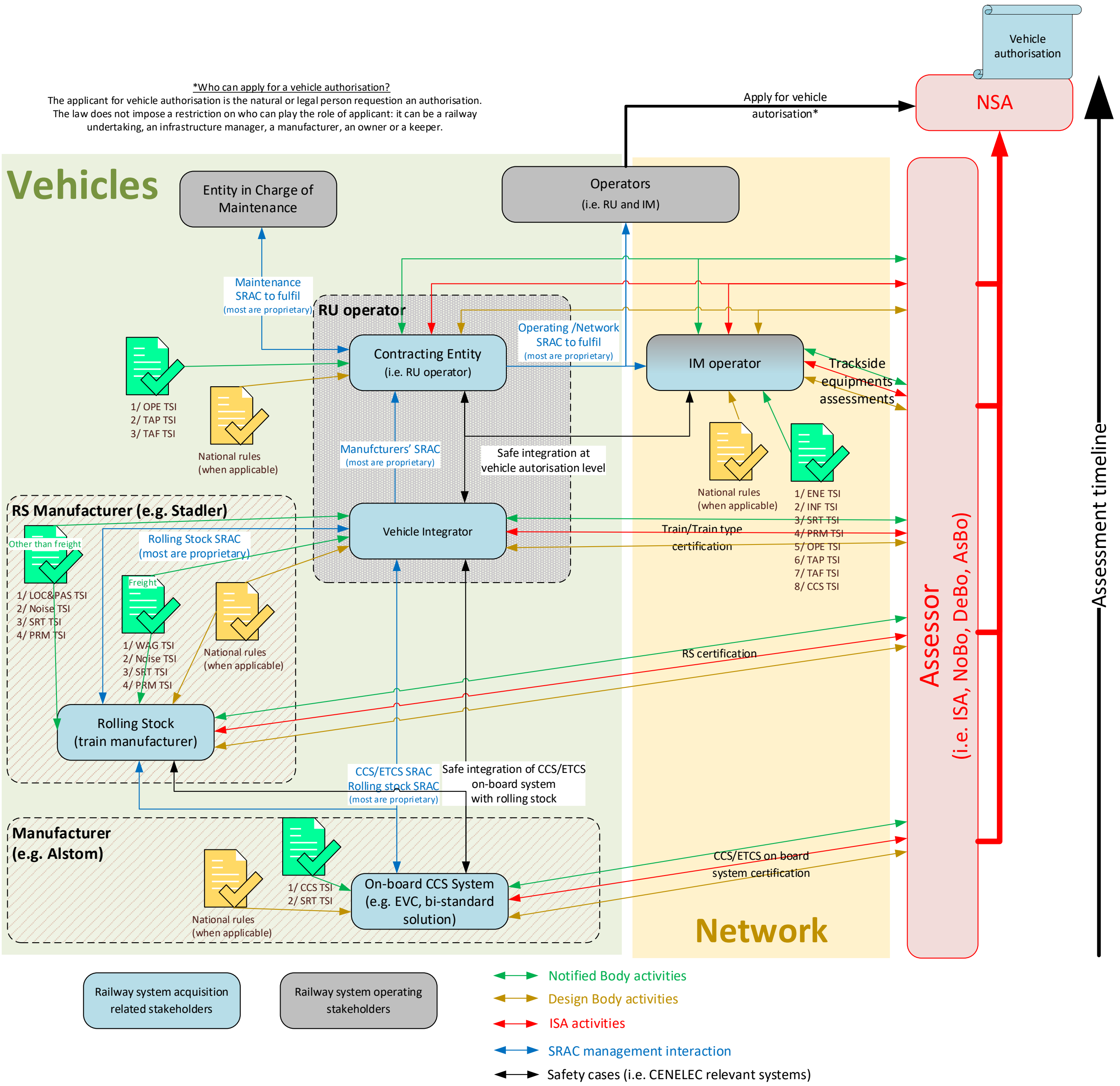

Figure 7 Alternative 1 Current ERTMS homologation process

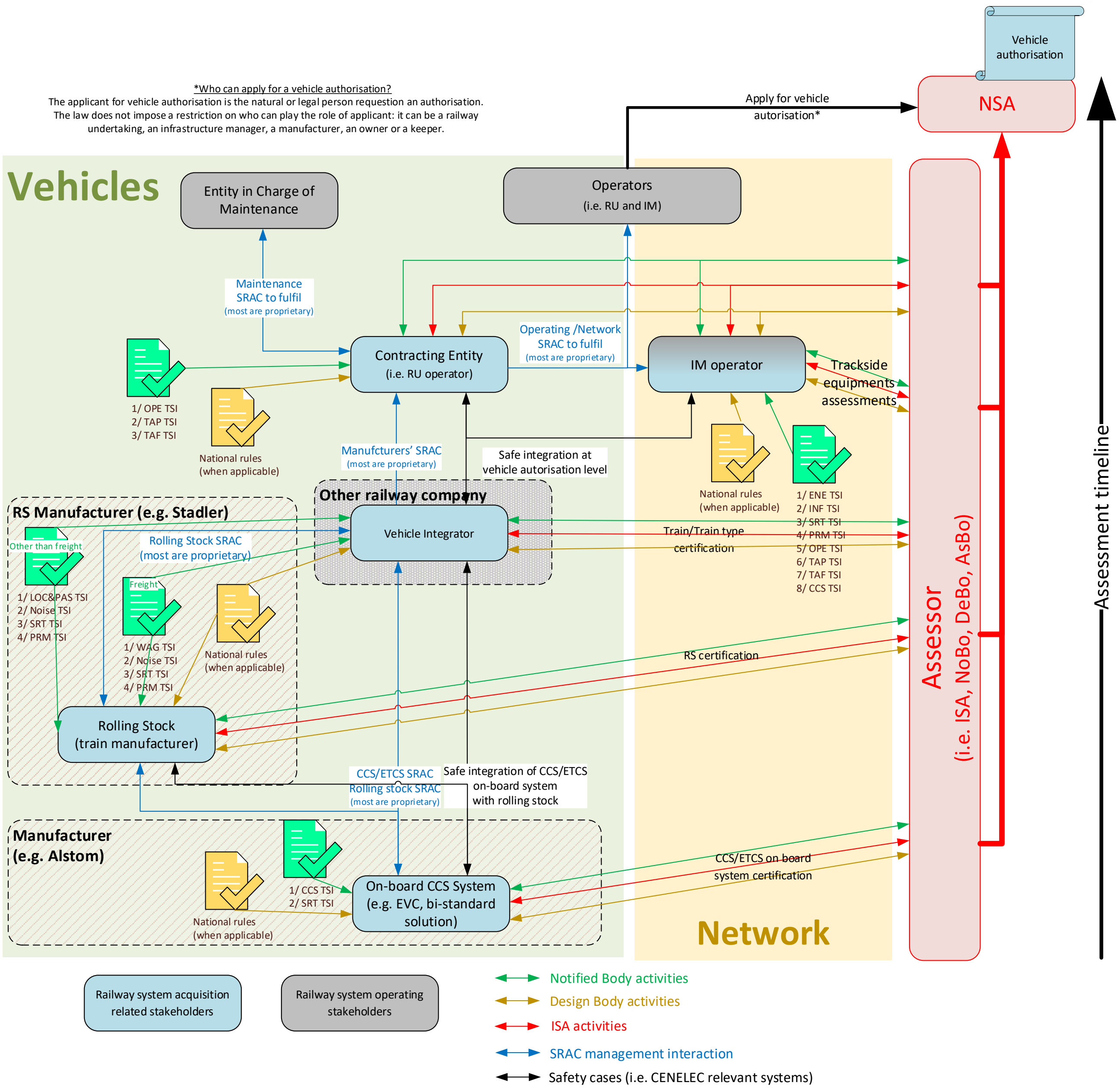

Figure 8 Alternative 2 Current ERTMS homologation process