OCORA

Open CCS On-board Reference Architecture

System Architecture

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Revision history

Version	Change Description	Initial	Date of change
1.04	▪ Official version for OCORA Delta Release	AL	30.06.2021
1.05	▪ Improved quality of graphics	AL	09.07.2021
2.01	▪ Official version for OCORA Release R1	AL	03.12.2021
2.20	▪ All CCS-OB specific content removed (moved to document OCORA-TWS01-035 – CCS-OB Architecture. ▪ Short description added for all systems in scope of OCORA.	AL	24.06.2022

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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-BWS05-010 – Road Map

[9] OCORA-TWS01-035 – CCS On-Board (CCS-OB) – Architecture

[10] OCORA-TWS04-010 – Functional Vehicle Adapter – Introduction

[11] OCORA-TWS04-011 – Functional Vehicle Adapter – Requirements

[12] OCORA-TWS04-012 – Functional Vehicle Adapter – Standard Communication Interface Specification

[13] OCORA-TWS04-013 – Functional Vehicle Adapter – Design Guideline

[14] OCORA-TWS06-010 – (Cyber-) Security – Project Security Management Plan

[15] OCORA-TWS06-030 – (Cyber-) Security – Concept

[16] TOBA, On-Board FRMCS Functional Requirements Specification, TOBA-7510

[17] TOBA, On-Board FRMCS System Requirements Specification, TOBA-7530

[18] UIC, FRMCS User Requirements Specification, FU-7100

[19] UIC, FRMCS Functional Requirements Specification, FU-7120

1 Introduction

1.1 Purpose of the document

The purpose of this document is to provide the wider context of the CCS On-Board architecture and to identify all systems of interest to OCORA.

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 considered informative. 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 is published as part of an OCORA Release, 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 reading the Introduction to OCORA [5], the Guiding Principles [6], the Problem Statements [7], and the Road Map [8].The reader should also be aware of the Glossary [2] and the Question and Answers [3].

2 Scope

The aim of OOCRA is to define an open CCS On-Board reference architecture. Although the focus of OOCRA is the CCS On-Board (CCS-OB) system, other systems interacting with the CCS-OB are also of interest and hence in scope of OCORA.

During its initial architectural work, OCORA identified 5 different systems of interest to OCORA. The following diagram depicts the 5 different systems in the logical and in the physical architecture.

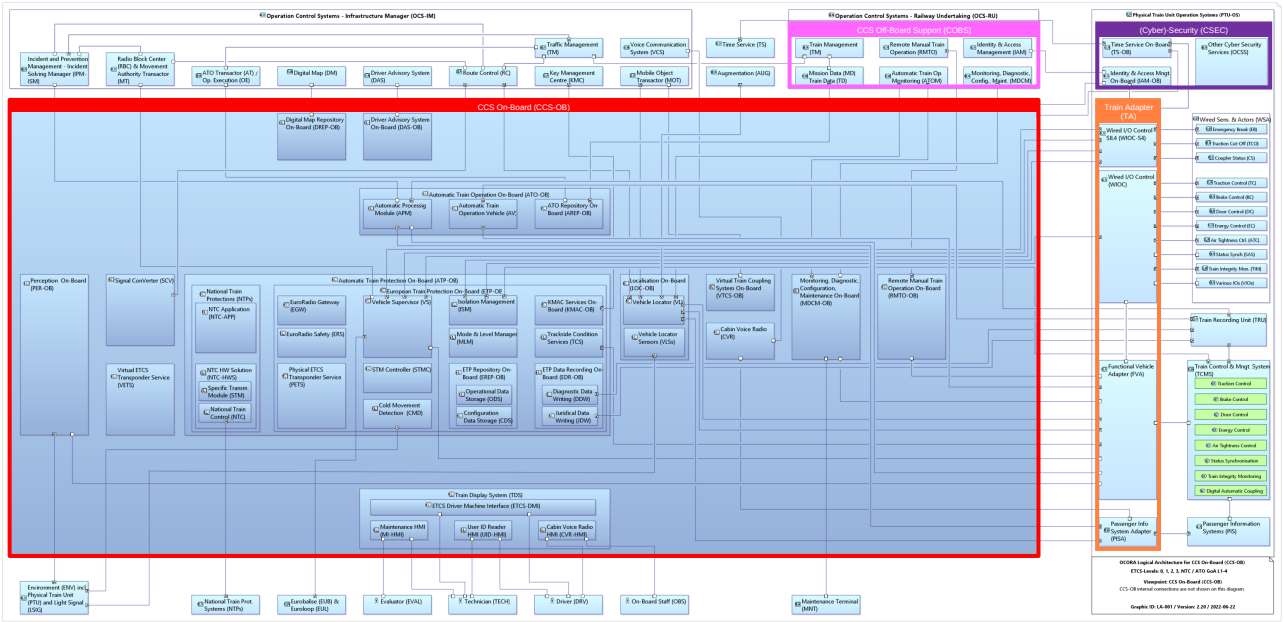

Figure 1: Systems in scope of OCORA – logical view

(refer to Appendix A1 for large scale representation)

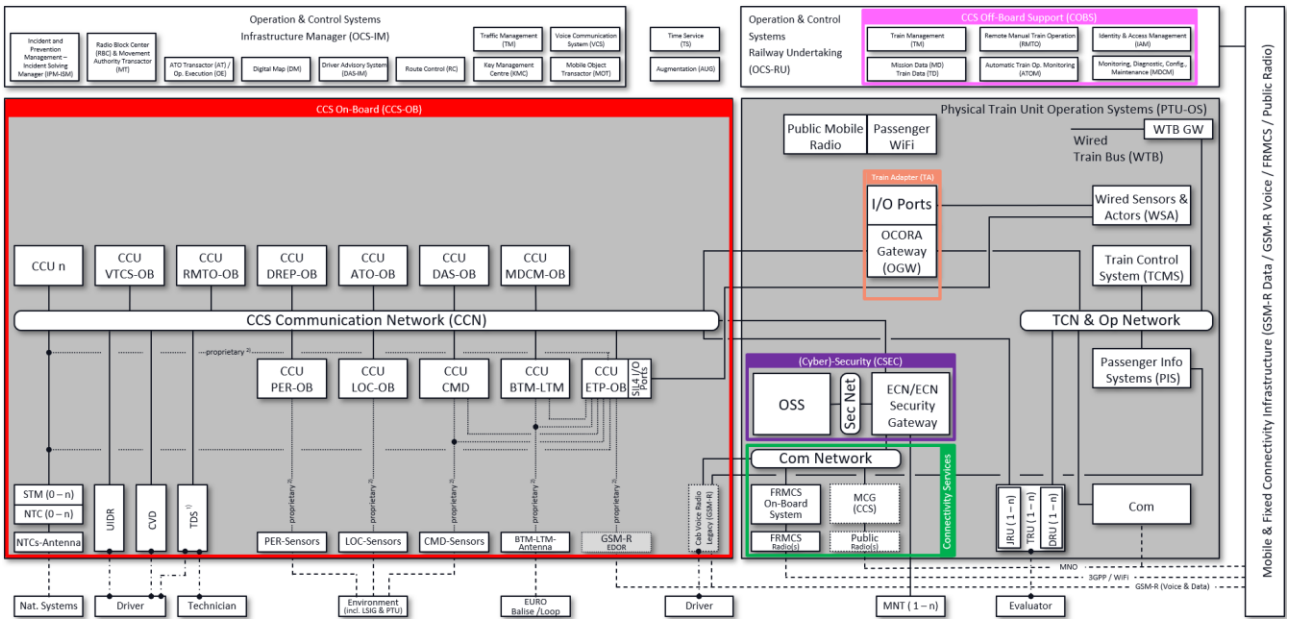

Figure 2: Systems in scope of OCORA – physical view – legacy train example

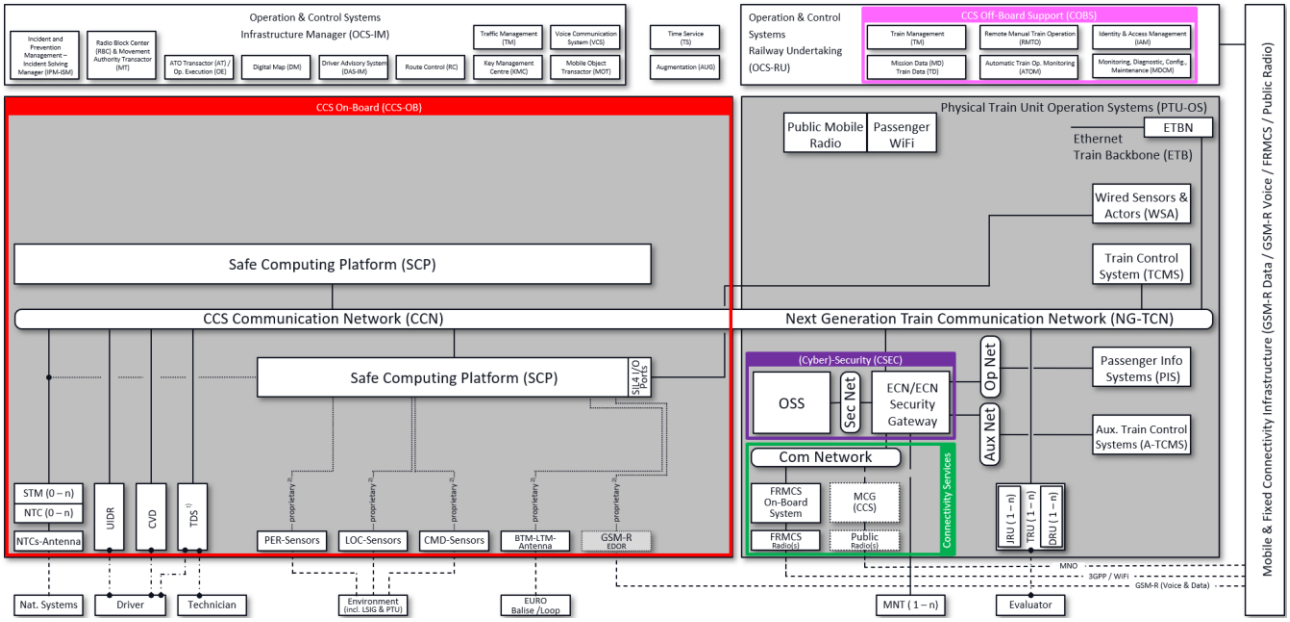

Figure 3: Systems in scope of OCORA – physical view – new generation train example

3 CCS On-Board (CCS-OB)

The CCS On-Board (CCS-OB) system interacts with the Train Adapter (TA) system, the (Cyber)-Security (CSEC) system, the Communication Services (CONS) system, the CCS Off-Board Support (COBS) system, the Operation Control Systems – Infrastructure Manager (OCS-IM), various trackside systems, and human actors.

It includes the following basic functionality:

- European Train Protection On-Board (ETP-OB)
- Localisation On-Board (LOC-OB)
- Train Display System (TDS)
- National Train Protections (NTPs)
- Cabin Voice Radio – Legacy (CVR-L)

The CCS On-Board (CCS-OB) system includes the following new/future functionality:

- Monitoring, Diagnostic, Configuration, Maintenance On-Board (MDCM-OB)
- Driver Advisory System On-Board (DAS-OB)
- Automatic Train Operation On-Board (ATO-OB)
- Perception On-Board (PER-OB)
- Digital Map Repository On-Board (DREP-OB)
- Remote Manual Train Operation On-Board (RMTO-OB)
- Signal Converter (SCV)
- Virtual ETCS Transponder Service (VETS)
- Virtual Train Coupling System On-Board (VTCS-OB)
- Cabin Voice Radio – VoIP (CVR-V)
- User Identification and Authentication (UIA)

Detailed information on the CCS-OB system is available in [9].

4 Train Adapter (TA)

The Train Adapter (TA) system interacts with the CCS On-Board (CCS-OB) system, the (Cyber)-Security Services (CSS) and the train itself. The scope of the Train Adapter (TA) system is to facilitate the standardised interface from the CCS On-Board (CCS-OB) to the train by abstracting the specificities of each train, this allows using the same CCS On-Board (CCS-OB) on all different train types. The Train Adapter includes the following components:

- Wired I/O Control – SIL4 (WIOC-SA)
- Wired I/O Control (WIOC)
- Functional Vehicle Adapter (FVA)
- Passenger Info System Adapter (PISA)

Whether all the TA components are required, or only part of it, depends on the architecture of the train and the specific implementation. On a new generation train with a modern TCMS that already implements the standardised interface for the communication with the CCS On-Board (e.g., SUBSET-119, SUSET-139, etc.), neither the Functional Vehicle Adapter nor the Wired I/O Control (WIOC) is needed. This means that in the long term, these two components will no longer be used and will eventually disappear.

Detailed information on the TA system, focussing on the Functional Vehicle Adapter, is available in [10], [11], [12], and [13]. Further information will be provided in subsequent releases of the OCORA documentation.

5 (Cyber)-Security (CSEC)

The Cyber-Security system addresses the cyber security aspects for the On-Board systems by providing On-Board Security Services and the segmentation of the different networks based on an appropriate zoning concept.

Detailed information on the CSEC system is available in [14], and [15].

5.1 On-Board Security Services (OSS)

The On-Board Security Services encompasses the applications and services to assure cyber secure operations of the On-Board systems and networks.

Although the OSS are not in the prime focus of OCORA, the architecture and network topology discussion do consider the OSS and its required components in regards of the allocation and integration of the following services:

- System-wide time service
- Central logging
- Identity and Access Management
- Backup
- Asset inventory
- Intrusion detection / continuous security monitoring
- Public Key Infrastructure

Further information will be provided in subsequent releases of the OCORA documentation.

5.2 Security Network (Sec-Net)

The Security Network is a standard IP network over Ethernet IEEE 802.3 where the security systems, providing the On-Board Security Services (OSS), are attached. This separation from the other On-Board networks allows the implementation of the required zoning model to address the cybersecurity requirements.

Further information will be provided in subsequent releases of the OCORA documentation.

5.3 ECN/ECN Security Gateway

The ECN/ECN Security Gateway is a central element for the On-Board security. It routes the traffic between the different networks / zones and acts as firewall between them.

Further information will be provided in subsequent releases of the OCORA documentation.

6 Connectivity Services (CONS)

The Connectivity Services provide the communication functionality between On-Board and trackside systems.

The FRMCS On-Board System implements the required functionalities and services providing the connectivity for the CCS Systems with the RBC (for ETCS L2/L3 networks), with ATO trackside (ATO-AT) and with the RCA compliant CCS Data Centres respectively.

The Mobile Communication Gateway (MCG CCS) provides train to track-side connectivity for certain On-Board CCS functions (e.g., remote maintenance) in case the trackside service is not available through FRMCS (e.g., trackside only provides GSM-R and no FRMCS). Depending on the vehicle, it may also provide track-side connectivity for the systems connected to the Train Communication Networks (e.g., TCMS and PIS).

The systems providing the connectivity services reside on a separate communication network to allow its services to be shared with other, non-CCS applications. This assures, that cybersecurity aspects are covered, and appropriate zoning models can be applied to the On-Board communication networks.

Detailed information on the CONS system is available in [16], [17], [18] and [19].

7 CCS Off-Board Support (COBS)

The CCS Off-Board Support (COBS) system interacts with the (Cyber)-Security (CSEC) system, the CCS On-Board (CCS-OB) system, the Operation Control Systems – Infrastructure Manager (OCS-IM), and the respective human actors. It includes the following basic functionality:

- Monitoring, Diagnostic, Configuration, Maintenance (MDCM)
- Identity and Access Management (IAM)
- Automatic Train Operation Monitoring (ATOM)
- Remote Manual Train Operation (RMTO)
- Train Management (TM)
- Mission Data (MD) & Train Data (TD) management

OCORA has not published any documents on COBS systems yet. Information will be provided in subsequent releases of the OCORA documentation.

Appendix A Large scale graphics

This section contains large scale versions of graphics used throughout the document.

A1 Logical architecture

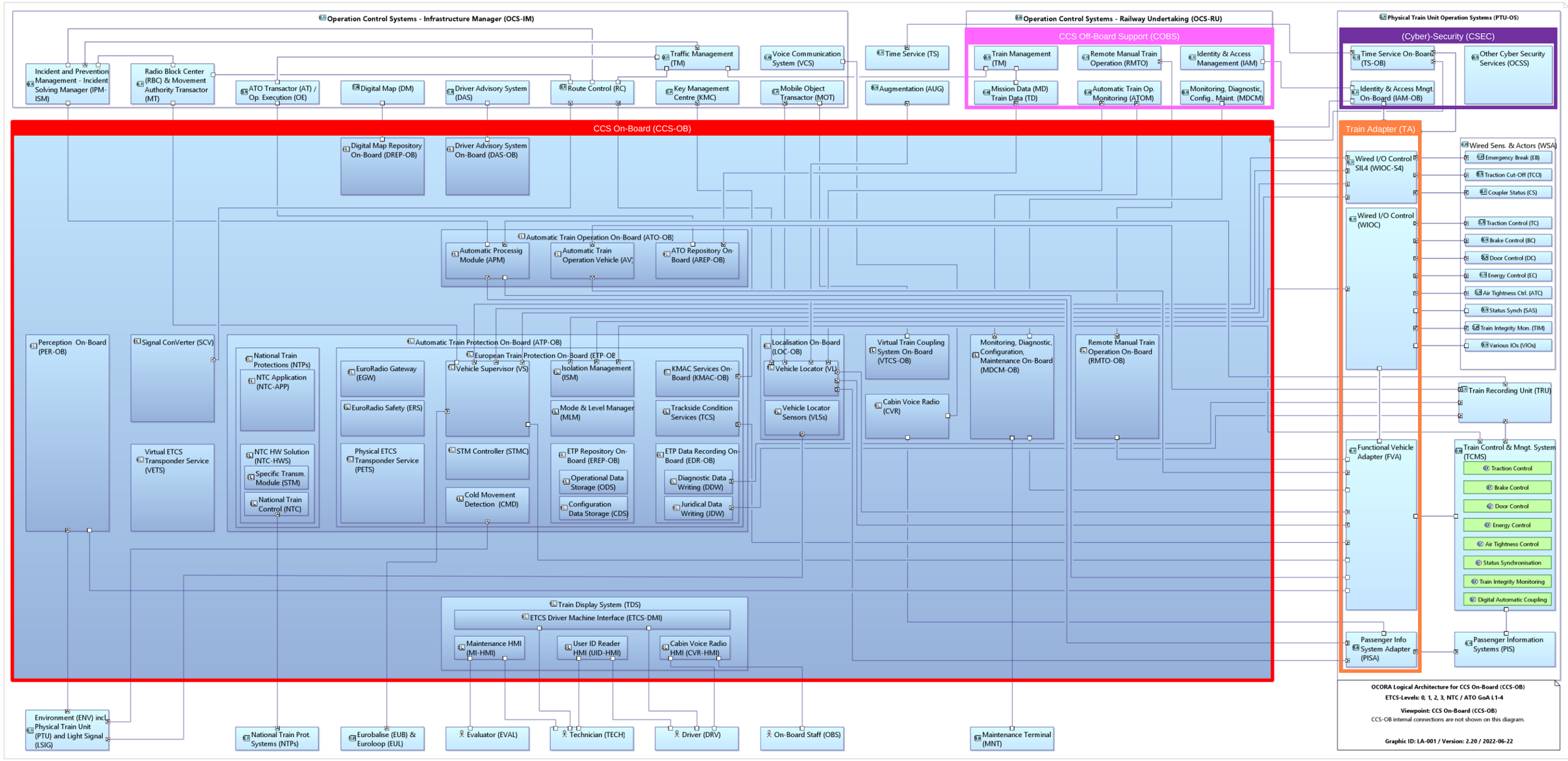

Figure 4: Systems in scope of OCORA – logical view (large scale representation)