OCORA

Open CCS On-board Reference Architecture

Glossary
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0.01	Release for final review		2020-06-12
1.00	Final version		2020-06-26
1.01	Includes changes of Core Team review		2020-06-27

Table of terms and definitions

Terms	Definition
Architecture	The fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution. (ISO 42010) Describes the structure of a coherent ensemble of building blocks and the glue (e.g. interfaces, bus system) between these building blocks that maintains structure consistency and coherence.
Basic Software	Provides a replica-deterministic environment to the ETCS Kernel - typically using a super-loop architecture. The Basic Software is usually vendor specific and handles all input/output with peripheral functions.
Building Block	A building block is a top-level unit of the CCS on-board system (hardware and/or software), having well defined tasks to be performed to achieve a predefined result and interfaces towards other building blocks of the CCS system. Building blocks consist of 1 – n component(s) and are regression free modifiable / adaptable and therefore portable / replaceable. As a result, every building block is "plug & play"-like exchangeable, without impacting other building blocks. OCORA building blocks shall be an optimal balance between "number of interfaces between building blocks" and "desire to exchange building blocks at a low granularity".
CCS Computing Unit	A computing unit hosting all or parts of the CCS on-board and eventually other software. The unit consists of 1 to n processors and has a single connection to the UVCCB.
Component	A component is the 1st level of decomposition of the CCS on-board system. Components are grouped into building blocks for defining the granularity of the "plug & play"-like exchangeability. Components consist of 1 – n sub-components.
Device	A physical entity performing a predefined (set of) task(s). It consists of software integrated on a hardware.
European standard	A standard adopted by a European standardisation organisation (CEN, CENELEC or ETSI).
European Vital Computer	Device for performing the ETCS tasks. It includes the logic needed to perform the ETCS tasks, i.e. data exchange management between internal and peripheral functions like odometry or DMI.
Evolvability	Evolvability (Flexibility) is the ability to easily adopt to new technologies or to extend the functionality of an on-board CCS system without the involvement of the original supplier.
Example	Any physical, graphical or textual representation of a concept, object or abstraction used for explaining or clarifying that concept, object or abstraction. Examples shall not in any way be limitative or perceived as limitative and are not in any way to be understood as prescriptive or as a requirement.
Exchangeability	Exchangeability (Interchangeability) is the ability to replace one or multiple OCORA defined building blocks with (a) respective building block(s) of (an)other supplier(s), without affecting other building blocks or the overall CCS on-board system.

Formal Model	A Formal Model is the description of a Functional Model using formal grammar and the symbolism of a logical language. A precise mathematical set of rules by which a valid Functional Model description is constructed that eventually can be (directly) transformed into computer code.
Function	A (coherent set of) task(s) to be performed to achieve a defined result. Functions express actions that are executed. They are usually embedded in structural elements of a system.
Functional Application	Functional Application refers to the software that implements the actual (Business) Logic of a railway Function. Examples would be the Vehicle Locator or the Vehicle Supervisor.
Functional decomposition	The partition of a system into single structural elements that each represent one or more coherent functions to be performed that together fulfil the design objective of the system. Describes how (clusters of) Functions are embedded into the structural elements of a system.
Functional Model	Abstraction of a system, describing interaction between individual functions of a system. OCORA targets using a formal language for functional modelling. Describes the actions performed by a coherent ensemble of building blocks and the glue between these building blocks (e.g. interfaces, bus system) that together constitute a System.
Functional Vehicle Adapter	The Functional Vehicle Adapter (FVA) is a piece of software deployed on the OCORA computing platform, or on the OCORA Gateway. Its job is to provide an OCORA unified and standardized interface towards the CCS applications and services for vehicle functions and vehicle information needed by the OCORA on-board applications and services.
Gateway	The OCORA Gateway is a piece of hardware providing communication capabilities (OSI layers 1 – 4 or 5 or 6) between the CCS bus (UVCCB) and the Train Control bus (if it exists) or the TCMS (if it exists) or the actors and sensors residing outside the CCS domain but important to CCS.
Harmonised standard	A European standard published on the basis of a request made by the Commission supporting the application of Union harmonisation legislation Its application can be mandatory (referenced standard) or voluntary (standard listed in the Official Journal of the EU in the New Legislative Framework).
International standard	A standard adopted by an international standardisation body (ISO, IEC or ITU).
Interoperability	Interoperability is the ability of a train service to run seamlessly, i.e. without the need to change either rolling stock or train staff, on any ERTMS equipped rail network.
(ETCS) Kernel	The prime task to be performed by the EVC (Vehicle Supervisor), including data exchange management with peripheral Systems like DMI and odometry.
(Business) Logic	The systematic set of principles for retrieving, dispatching, storing, modelling, analysing and predicting information so as to perform a specified task. Pertains specifically to the management of data by a *System*, both internal as in exchange with peripheral Systems.

Model	A consistent digital representation of an Architecture, allowing to generate different views for documenting and explaining different aspects of the Architecture.
Modularity	Modularity is a prerequisite for having "plug & play"-like exchangeability of an on-board CCS system or its subsystems without the need to involve either the original supplier of the vehicle, of the CCS system or one of its subsystems.
Migrateability	Migrateability (Upgradability) is the ability to introduce changes to one or multiple OCORA defined building blocks, without affecting other building blocks or the overall CCS on-board system.
Non-Safe	The characteristic of a Non-Safe railway system is that its failure in no way endangers neither persons nor its environment.
Non-Vital	See Non-Safe
(Computing) Platform	Refers to the environment on which Functional Applications are run, comprised of - Hardware (i.e. compute nodes, memory, etc.) and - Runtime Environment
Platform Independence	Platform Independence is the fact of using a "generalized abstraction" between Functional Application logic and the underlying (Computing) Platform. To concretely attain Platform Independence, the following elements are needed: - A definition of a "generalized abstraction" (in the form of an API specification) - At least one provider implementation of the "generalized abstraction" in form of a concrete (Computing) Platform - One or more Functional Applications applying the specification and being able to run on the (Computing) Platform. Platform Independence is achieved when a Functional Application, based on the generalized abstraction, runs un-changed on different (Computing) Platform implementations. For this, the Functional Application shall only use external functions through a defined application programming interface (API).
Portability	The ability to migrate a software from one concrete Computing Platform implementation to another concrete Computing Platform implementation. See also Platform Independence.
Presumption of conformity	The presumption of conformity is a concept that is widely used in the context of the European "New Approach" for better regulation. The presumption of conformity means that a manufacturer who has complied with a harmonised standard listed in the OJEU can legally assume he has met the requirements of the directive (or TSI) covered by that standard, as described in its Annex Z. ANNEX Z of standards and the Official Journal of the European Union The listing of a European standard in the OJEU requires a positive assessment of the Harmonized Standard Consultant and a corresponding positive statement of the EC desk officer. Furthermore, it is required that the listed standard contains an Annex Z detailing to which requirements of the directive (or TSI) it provides presumption of conformity.
Radio Block Centre	The Radio Block Centre (RBC) is a specialised computing device with Safety integrity level 4 (SIL) for generating Movement Authorities (MA) and transmitting it to trains. It gets information from Signalling control and from the trains in its section. It hosts the specific geographic data of the railway section and receives cryptographic keys from trains passing in. According to conditions the RBC will

	attend the trains with MA until leaving the section. RBC have defined interfaces to trains but have no regulated interfaces to Signalling Control and only follow national regulation.
Referenced Standard	A standard or a part of a standard referenced in a Technical Specification for Interoperability (TSI). Furthermore, article 4.8 of Directive (EU) 2016/797 sets out that normative documents, such as specifications or technical documents can also be referenced in a Technical Specification for Interoperability (TSI). When referenced, their nature changes from voluntary to mandatory.
Replaceability	Replaceability is synonym to exchangeability. See Exchangeability.
Runtime Environment	The Runtime Environment represents the execution context of Functional Applications. It consists of all software aspects required to provide that execution context including safety and security services, communication stack and if applicable Operating System and Virtualization. It provides a Platform Independent API - a general abstraction that allows *Functional Applications* to run unchanged on different Computing Platform implementations.
Safe / Safety	Safety is defined as a property of a railway system which does not in any way endanger neither persons nor its environment. Another definition is the removal of inacceptable risk. Safe systems ensure that the overall acceptable risk is never exceeded and that in case of detected failure, the system always enters its fail-safe state.
(Cyber) Security	(Cyber) Security is the protection of (especially safety related) communication and data used in on-board CCS systems against threats (like cyber-attacks and hacks). To achieve this, all main security functionality like identify, protect, detect, respond and recover are considered.
Service	Services are specialized Functional Applications providing common functionality used by multiple other Functional Applications or an "input-output" conversion from and to other Functional Applications in coherence with the data model. An example of a Service is the "Vehicle Locator" (VL) which is used by the "Vehicle Supervisor" (VS) and the "ATO vehicle" (AV).
Standard	A technical specification, adopted by a recognised standardisation body, for repeated or continuous application, with which compliance is not compulsory, except when referenced in a Technical Specification for Interoperability, or any other regulatory text (e.g. national rule, law, …)
System	A coherent group of interacting or interrelated entities that form a unified whole, described by its structure and purpose and expressed in its functioning. A System is described by its spatial and temporal boundaries as surrounded and influenced by its environment. Refer to OCORA-40-001-Beta, System Architecture for a definition of the OCORA system under consideration.
Train Control and Management System	The Train Control and Management System (TCMS) is an on-board system built with the purpose to control and monitor a list of train equipment. At interface level it refers to all aspects of the integration into the "Train": conceptually it groups together the two types of interfaces "serial interface" and "hard-wired interface" indicated in SUBSET -119.
Train Interface Unit	The Train Interface Unit (TIU) specifically defines the interface between the ERTMS / ETCS on-board equipment and the train. To avoid confusion, the term TIU is no longer used in context of OCORA as it would also be used in another context than only ERTMS / ETCS. The newly introduced Functional Vehicle

	Adapter (FVA) incorporates the full TIU functionality and ensures standardized communication with the TCMS on OSI layer 7. It is accessible to all OCORA applications like VS, ATO and any possible future extension.
Vehicle Supervisor	The (Business) Logic enabling calculating location specific speed limits and activation of the braking system in case of speed limit overshoot. Describes the prime task to be performed by the EVC (ETCS Kernel functions), including data exchange management with peripheral Systems like DMI and odometry.
Vital	See Safe

Table of abbreviations and acronyms

Abbreviation	Definition
API	Application Programming Interface
APS	Advanced Protection System
APS-MOT	APS Mobile Object Transactor
APS-MT	APS Movement Authority Transactor
AT	ATO Transactor
ATC	Automatic Train Control
ATO	Automatic Train Operation
ATO-AT	ATO Transactor
ATO-AV	ATO Vehicle
ATP	Automatic Train Protection
AV	ATO Vehicle
BIU	Break Interface Unit
BTM	Balise Transmission Module
CAN	Controller Area Network
CCS	Control-Command and Signalling
CCU	CCS Computing Unit
CER	Community of European Railway and Infrastructure Companies
CiA	CAN in Automation
CMD	Cold Move Detection
CoC	Code of Conduct
COTS	Commercial off-the-shelf
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
DAS	Driver Advisory System
DCM	Device & Configuration Management
DM	Diagnostics & Monitoring
DMI	Driver Machine Interface
EB	Emergency Braking
EBA	Euro Balise Antenna
EDOR	ETCS Data Only Radio
ERA	European Union Agency for Railways (former European Railway Agency)
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
EUDD	European Driver's Desk

EUG	ERTMS User Group
EVC	European Vital Computer
FFFIS	Form Fit Function Interface Specification
FM	Formal Model
FIS	Functional Interface Specification
FME(C)A	Failure Mode Effect (and Criticality) Analysis
FRMCS	Future Railway Mobile Communication System
FVA	Functional Vehicle Adapter
GNSS	Global Navigation Satellite System
GoA	Grade of Automation
GSM-R	Global System for Mobile Communications - Railway
HW	Hardware
I/O	Input/output
IAM	Identity & Access Management
ID	Identification
IEEE	Institute of Electrical and Electronics Engineers
IF	Interface
IM	Infrastructure Manager
IPv4	Internet Protocol version 4
IU	Interface Unit
IVV	Integration, Verification and Validation
IXL	Interlocking (new APS)
JRU	Juridical Recording Unit
LAN	Local Area Network
LTM	Loop Transmission Module
MAC	Medium Access Control
MBSE	Model Based Systems Engineering
MD	Message Data
MOT	Mobile Object Transactor
MoU	Memorandum of Understanding
MT	Movement Authority Transactor
MTC	Manoeuvre Train Control
MVB	Multifunction Vehicle Bus
NG-TCN	Next/New Generation TCN
NNTR	Notified National Technical Rules
NTC	National Train Control
OBU	On-board Unit

OCORA	Open CCS On-board Reference Architecture
OD	Object Detection
ODO	Odometry
OEM	Original Equipment Manufacturer
OPC-UA	Open Platform Communications Unified Architecture
OS	Operating System
OTIS	Onboard Train Integrity System sometimes also referred to as TIMS
PD	Process Data
PS	Perception (Sub-)System
PIN	Passenger Information Network
QA	Quality Assurance
QoS	Quality of Service
RBC	Radio Block Center
RCA	Reference CCS Architecture
RFID	Radio-frequency identification
RIM	Radio Interface Module
RIU	Radio In-fill Unit
RTM	Real Time Model
RU	Railway Undertaking
S2R	Shift2Rail
SB	Service Brakes
SDT	Safe Data Transmission
SDTv2	SDT Version 2
SDTv4	SDT Version 4
SFERA	Smart Communications for Efficient Rail Activities
SFM	Semi-Formal Model
SIL	Safety Integrity Level
SRP	Stream Reservation Protocol
SRS	System Requirements Specification
SSRS	Sub-System Requirement Specification
STM	Specific Transmission Module
SW	Software
TCMS	Train Control and Management System
TCN	Train Control Network
TCO	Traction Cut-Off
TCP	Transmission Control Protocol
THR	Tolerable Hazard Rate

TI	Track Intrusion
TIMS	Train Integrity Monitoring System sometimes also referred to as Onboard Train Integrity System (OTIS)
TIU	Train Interface Unit
TMS	Traffic Management System
TOBA	Telecom On-Board Architecture
TRB	Train Born
TRDP	Train Real-Time Data Protocol
TSN	Time Sensitive Networking
TSN-PD	TSN Process Data
UDP	User Datagram Protocol
UI	User Interface
UIC	Union Internationale des Chemins de Fer
UVCCB	Universal Vital Control and Command Bus
V&V	Verification and Validation
VL	Vehicle Locator
VLS	Vehicle Localisation (Sub-)System
VS	Vehicle Supervisor