RCA

Reference CCS Architecture

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

RCA Architecture Poster
Preliminary issue
With OCORA contribution

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RCA Baseline set: 0
Version: 0.4 (0.A)
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RCA/OCORA Subsystem Architecture Overview (track side)
Viewpoint: Standard Communication Interfaces
Document id: RCA.Doc.40
RCA Baseline set: 0
Version: 0.4 (0.A)

1. EULYNX interface/system
2. Used for migration only
3. Defined by OCORA

Planning System PAS
Incident Solving Manager ISM
SCI-OP
SCI-OP
SCI-ISM
Operations Manager
ATO Execution AE
Plan Execution PE
Generic Function Layer
Workbench WB
AoE SS-131
SCI-CMD
Plan Implementation Layer
Engineering & Data Preparation EDP
Safety Logic SL
SCI-CMD
Safety Manager SM
Safety Control Layer
Topo4
SCI-AO
Object Aggregation OA
Diagnostics & Monitoring DM
SCI-AD
SCI-AD
SCI-AD
Identity & Access Management IAM
ATO Transactor AT
Movement Authority Transactor MT
Mobile Object Transactor MOT
Fixed Object Transactor FOT
Object Aggregation Layer
AoE SS-126
ETCS SS-026
SCI-MD
SCI-MD
SCI-MD
SCI-MD
SCI-TDS[1]
SCI-P[1]
SCI-IO[1]
SCI-LS[1,2]
SCI-LC[1]
Device Abstraction Layer
Device and Config Management DCM
CCS+ on-board subsystems CCS-OB[3]
Automatic Train Operation ATO-OB
Automatic Train Protection ATP-OB
Digital Map on-board DM-OB
Mobile Object Locator MOL
Person Supervisor & Locator PSL
Train Detection System TDS[1]
Light Signal LS[1,2]
Point P[1]
Level Crossing LC[1]
Generic IO IO[1]
For migration only
Device Control Layer
Date Time Reference
Infra-structure Manager
Collective Warning System
Mobile Object
Authorised Trackside Person
Physical Train Unit
Train Driver
Point Machine
LC Protection Facility
Adjacent IO System

Note: Elements of light grey colour are not included in the modelling scope of RCA BL 0.4 release

RCA/OCORA Subsystem Architecture Overview (on-board side)
Viewpoint: Standard Communication Interfaces
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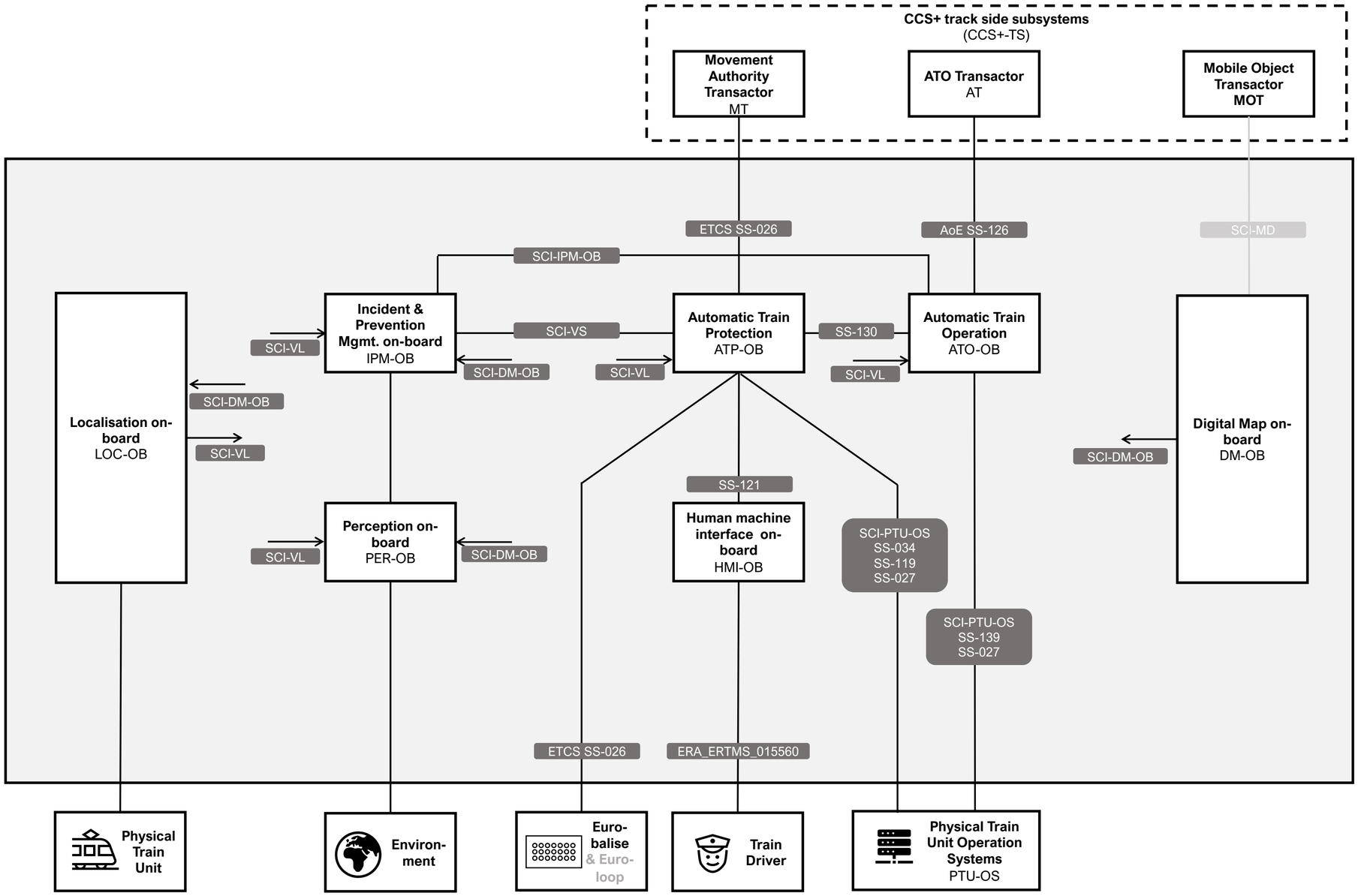

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RCA/OCORA Subsystem Architecture Overview (track side)
Viewpoint: Supporting Interfaces
Document id: RCA.Doc.40
RCA Baseline set: 0
Version: 0.4 (0.A)

SCI Standard Communication Interface
SDI Standard Diagnostic Interface
SMI Standard Maintenance Interface
SAI Standard Authentication/Authorisation Interface
SWI Standard Workbench Interface

Planning System PAS
Incident Solving Manager ISM
Operations Manager
Generic Function Layer
SWI-PE
SWI-CMD
SWI-TOPO4
ATO Execution AE
Plan Execution PE
Workbench WB
SWI-EDP
Engineering & Data Preparation EDP
SCI
Topo4
Diagnostics & Monitoring DM
Identity & Access Management IAM
Device and Config Management DCM
Safety Logic SL
Safety Manager SM
Object Aggregation OA
SCI
ATO Transactor AT
Movement Authority Transactor MT
Mobile Object Transactor MOT
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Automatic Train Protection ATP-OB
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Light Signal LS[1,2]
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Plan Implementation Layer
Safety Control Layer
Object Aggregation Layer
Device Abstraction Layer
Device Control Layer

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RCA/OCORA Subsystem Architecture Overview (track side)
Viewpoint: RCA handover and legacy Interfaces
Document id: RCA.Doc.40
RCA Baseline set: 0
Version: 0.4 (0.A)

SHI Standard Handover Interface
P1, R1 Legacy Interface

(Note: This is a preliminary version, based on an architectural design hypothesis. Handover and legacy interfaces will be refined in a future version)

Planning System PAS
P1
Incident Solving Manager ISM
Operations Manager
Generic Function Layer
Workbench WB
ATO Execution AE
Plan Execution PE
SHI-PE
Plan Implementation Layer
Engineering & Data Preparation EDP
SHI-SL
Safety Logic SL
Safety Manager SM
SHI-SM
Safety Control Layer
Topo4
Object Aggregation OA
Object Aggregation Layer
Diagnostics & Monitoring DM
Identity & Access Management IAM
AoE SS-132
ATO Transactor AT
Movement Authority Transactor MT
R1
SHI-MT
Mobile Object Transactor MOT
SHI-MOT
Fixed Object Transactor FOT
Device Abstraction Layer
Device and Config Management DCM
CCS+ on-board subsystems CCS-OB[3]
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Automatic Train Protection ATP-OB
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Light Signal LS[1,2]
Point P[1]
Level Crossing LC[1]
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Authorised Trackside Person
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Train Driver
Point Machine
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Adjacent IO System

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RCA/OCORA Subsystem Architecture Overview (track side)
Viewpoint: Specification Scope
Document id: RCA.Doc.40
RCA Baseline set: 0
Version: 0.4 (0.A)

ETCS spec. influenced
EULYNX spec. influenced
Partially RCA specified
Out of scope
Fully RCA specified
to be determined
OCORA specified

Planning System PAS
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Safety Logic SL
SCI-CMD
Safety Manager SM
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SCI-P[1]
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SCI-LS[1,2]
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Automatic Train Protection ATP-OB
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RCA/OCORA Subsystem Architecture Overview (track side)
Viewpoint: Safety Integrity Level
Document id: RCA.Doc.40
RCA Baseline set: 0
Version: 0.4 (0.A)

Safety critical
Not safety critical
Out of scope
To be determined

(Note: This is a preliminary version, based on an architectural design hypothesis. Final SIL will be assigned after safety risk analysis)

Planning System PAS
Incident Solving Manager ISM
Operations Manager

Generic Function Layer
Workbench WB
Engineering & Data Preparation EDP
Topo4
Diagnostics & Monitoring DM
Identity & Access Management IAM
Device and Config Management DCM

ATO Execution AE
Plan Execution PE
Safety Logic SL
Safety Manager SM
Object Aggregation OA
ATO Transactor AT
Movement Authority Transactor MT
Mobile Object Transactor MOT
Fixed Object Transactor FOT

CCS+ on-board subsystems
CCS-OB³
Automatic Train Operation ATO-OB
Automatic Train Protection ATP-OB
Digital Map on-board DM-OB

Mobile Object Locator MOL
Person Supervisor & Locator PSL
Train Detection System TDS1
Light Signal LS1,2
For migration only
Point P1
Level Crossing LC1
Generic IO IO1

Plan Implementation Layer
Safety Control Layer
Object Aggregation Layer
Device Abstraction Layer
Device Control Layer

Date Time Reference
Infra-structure Manager
Collective Warning System
Mobile Object
Authorised Trackside Person
Physical Train Unit
Train Driver
Point Machine
LC Protection Facility
Adjacent IO System

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RCA/OCORA Subsystem Architecture Overview
Notation, descriptions and abbreviations
Document id: RCA.Doc.40
RCA Baseline set: 0
Version: 0.4 (0.A)

Graphical notation

This graphical element shows an Architecture Layer. The text contains the name of the Layer. Architecture Layers are used for structuring the overall architecture.

This graphical element shows an interface. The text contains the type of the interface. The lines are connecting the interface to the systems.

ATO Execution
AE

This graphical element shows a subsystem. The text in bold font contains the full name of the subsystem. The text in plain font contains the short name of the subsystem (abbreviation).

Actor descriptions

Adjacent IO System	The Adjacent IO System is interfaced by the physical Input Channels and/or Output Channels of the Subsystem Generic IO. Via the Output Channels. Examples of Adjacent IO Systems are a key lock, a departure signal or a moveable bridge.
Authorised Trackside Person	Authorised Trackside Person is a person authorised to access and work on the tracks for the construction or maintenance of the track side infrastructure.
Collective Warning System	Collective Warning System represent the devices which actuate the required warning state provided by System RCA to the track workers. Warnings are given audibly and optically. The warning devices are located at the track and are forming one collective warning system to cover the respective warning area.
Date Time Reference	Date Time Reference is the system/organization that provides reference of date and time to System RCA.
Environment	Environment represents the external physical environment the System RCA operates in. It is a source for environmental conditions, localisation references like landmarks or dedicated electromagnetic signals and also for possible obstacles impeding the railway operation.
Eurobalise	A transponder, mounted on the track, which can communicate with a train passing over it, compliant to the ERTMS/ETCS specifications.
Incident Solving Manager	The Incident Solving Manager coordinates the non-safety related actions to cope with the incidents
Infrastructure Manager	Infrastructure Manager means any body or firm responsible for establishing, operating, and maintaining railway infrastructure, including the management of all relevant infrastructure data, traffic management, and control-command and signalling in alignment with key term definition in Directive 2012/34/EU. The functions of the Infrastructure Manager on a network or part of a network may be allocated to different bodies or firms.
Level Crossing Protection Facility	All equipment at a Level Crossing protecting vehicles and persons crossing the tracks (e.g half/full barriers, obstacle detectors and road signals).
Mobile Object	An object that is reporting to RCA system but is not able to be controlled directly by RCA, e.g. excavators, ladders, etc.
Operations Manager	The Operations Manager represents a person responsible for the railway operation of the System in a given geographic area. This person is part of the Infrastructure Management entity. The Operations Manager supervises the normal operation performed automatically by Planning System and manages specific actions that cannot be executed automatically.
Planning System	Planning System provides functionality for preparing and optimising the entire schedule within an Area of Control. This schedule will be represented by Missions for Train Units. Missions are provided to System RCA where they enable command and control of traffic operations. System RCA provides the current operation state to the Planning System as feedback.

Actor descriptions (cont.)

Physical Train Unit	Physical Train Unit (PTU) is physically existent, driveable and made up of a single or an ordered sequence of Physical Consists coupled together.
Physical Train Unit Operation Systems	Physical Train Unit Operation Systems (PTU-OS) represents all on-board subsystems not in RCA and OCORA scope, including the TCMS and hard-wired electrical and electronical components that are necessary for the operation of the Physical Train Unit.
Point Machine	Point Machine is a device, which can drive movable parts of field elements (e.g point blades) to a required position. Such a fiedd element may be equipped with model tan one Point Machine
Train Driver	A person capable and authorised to drive trains

Interface descriptions

SCI-OP	Operational Plan Interface
SCI-CMD	Command Interface
SCI-AO	Abstract Object Interface
SCI-AD	Abstract Device Interface
SCI-MD	Mobile Device Interface
SCI-VL	Vehicle Locator Interface
SCI-P	EULYNX SCI-P
SCI-LC	EULYNX SCI-LC
SCI-TDS	EULYNX SCI-TDS
SCI-LS	EULYNX SCI-LS
SCI-IO	EULYNX SCI-IO
SCI-ISM	Incident Solving Interface
AoE SS-131	CCS TSI ATO over ETCS SUBSET-131
AoE SS-126	CCS TSI ATO over ETCS SUBSET-126
AoE SS-132	CCS TSI ATO over ETCS SUBSET-132
ETCS SS-026	CCS TSI ETCS SUBSET-026
SHI-PE	PE Handover Interface
SHI-SL	SL Handover Interface
SHI-SM	SM Handover Interface
SHI-MOT	MOT Handover Interface
SHI-MT	MT Handover Interface
P1	Legacy Interface
R1	Legacy Interface

Abbreviations

SCI	Standard Communication Interface
SDI	Standard Diagnostic Interface
SMI	Standard Maintenance Interface
SAI	Standard Authentication/Authorisation Interface
SWI	Standard Workbench Interface
SHI	Standard Handover Interface
AoE	ATO over ETCS
SS	CCS TSI ETCS Subset

RCA Subsystem descriptions

Plan Execution (PE)	PE translates operational plans into discrete requests for movement permissions and state changes of abstract objects representing Field Element.
ATO Execution (AE)	AE translates operational plans into journey profile for automatic train operations.
Safety Logic (SL)	SL grants or rejects requests for state changing of either a Field Element or for a planned movement, based on a safety evaluation.
Safety Manager (SM)	SM monitors the state of the railway operation, recognises hazardous combinations of states, and triggers safety reactions.
Object Aggregation (OA)	OA routes and disaggregates abstract commands to the transactors and aggregates state from into abstract representations of the state of the railway operation.
ATO Transactor (AT)	AT distributes automatic train operation journey profiles, to the CCS on-board of Physical Train Units.
Movement Authority Transactor (MT)	MT translates commands and state feedback between the device-specific track-train message set specified.
Mobile Object Transactor (MOT)	MOT translates between the abstract objects used by the Object Abstraction Layer and the device-specific commands and vice versa.
Fixed Object Transactor (FOT)	FOT translates between the abstract objects used by the Object Abstraction Layer and the device-specific commands from EULYNX subsystems and vice versa.
Mobile Object Locator (MOL)	MOL provides the position of a trackbound or non-trackbound object on the railway network topology.
Person Supervisor & Locator (PSL)	PSL provides additionally to MOL warnings and protection from approaching movable objects.
Point (P)	The EULYNX subsystem P is used to control and monitor the Point machines of moveable elements based on a request from the FOT.
Level Crossing (LC)	The EULYNX subsystem LC protects the crossing area of rails and vehicles through its level crossing protection facility.
Train Detection System (TDS)	The EULYNX subsystem TDS monitors the vacancy and occupancy status of TVP sections.
Light Signal (LS)	The EULYNX subsystem LS transmits information to Train Driver.
Generic IO (IO)	The EULYNX subsystem IO is used for integrating signalling systems, controlled and monitored by FOT.
Workbench (WB)	WB is a platform for providing process specific user interfaces.
Engineering & Data Preparation (EDP)	EDP support commissioning and maintenance processes.
Topo4	Topo4 provides a correct, validated topology and topography data for RCA subsystems.
CCS on-board (CCS-OB)	All train-borne subsystems needed for CCS and ATO. CCS on-board is specified by OCORA.
Device and Config Management (DCM)	DCM is used to register, setup and manipulate Devices.
Diagnostics & Monitoring (DM)	DM collects monitoring and diagnostics information from subsystems.
Identity & Access Management (IAM)	IAM authenticates and authorizes users and technical systems and grants or denies access to the system.

RCA Logical Architecture Overview
Name changes
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Document History

Version	*Content / Changes*
Version 0.1	First version of document
Version 0.2 (0.A)	Incorporation of SCI-OS and SCI-PS GoA 3, 4 additions
Version 0.2 (0.B)	Incorporation of review comments after internal review
Version 0.3 (0.A) Preliminary	Train-borne system and interfaces aligned with OCORA Update on GoA4 trackside subsystems Clean up SCI-CMD, SCI-OS, SCI-PS
Version 0.4 (0.A)	Integration of OCORA preliminary architecture Adaptions to actors from BL0 R4 modelling work Colour code for BL0 R4 model content