

OCORA

Open CCS On-Board Reference Architecture
A Collaboration of 5 European Railway Undertakings



Technical Slide Deck

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 - Network Topology Scenarios
- Safe Computing Platform (SCP)
- Configuration Management Concept
- Functional Vehicle Adapter (FVA)
- Modular Safety
- Methodology & Tooling
- Operational Concept



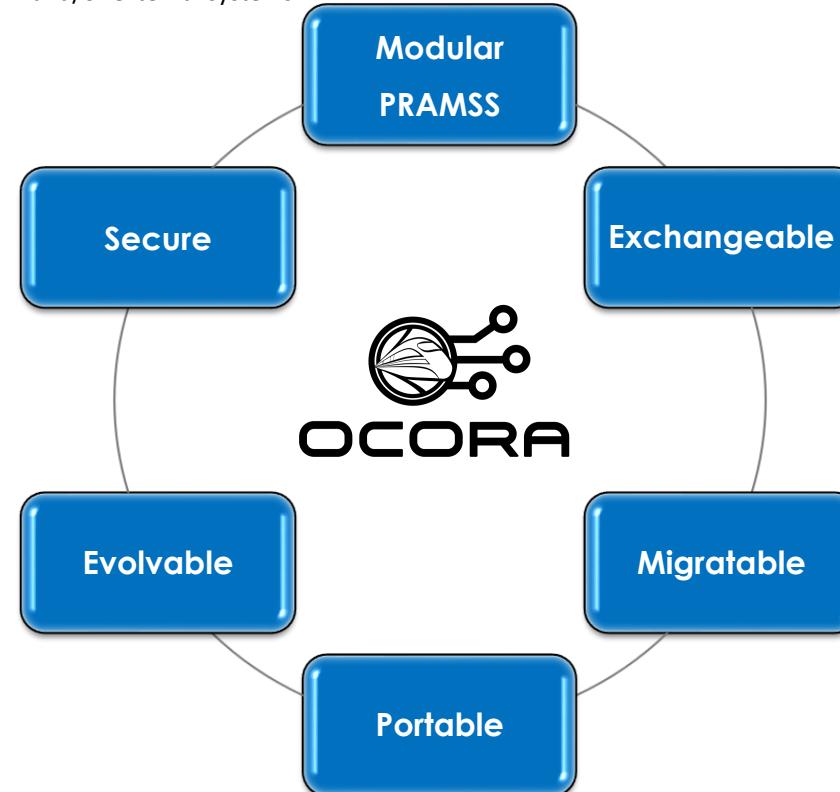
OCORA Design Objectives

OCORA-BWS02-030 / v5.10 / 01.07.2024

Ability to protect the CCS On-Board from attacks. In context of OCORA security means the protection of (especially safety related communication and data used in) CCS on-board systems against threats (in particular cyber-attacks and hacks). To achieve this, all main security functionality like identify, protect, detect, respond and recover are considered.

Ability to easily adapt the CCS On-Board to new technologies and to easily add new Building Blocks. In the context of OCORA evolvability means 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.

A reasonable number of Building Blocks are defined for CCS On-Board. Each Building Blocks has standardised functionality, standardised PRAMSS requirements (including Tolerable Functional Failure Rate [TFFR], Safety Integrity Level [SIL] and Safety Related Application Conditions [SRAC]), standardised interfaces (on all OSI Layers) towards other building blocks and/or external systems.



Ability to replace CCS On-Board Building Block. In the context of OCORA exchangeability means 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 of the train or the overall CCS on-board system.

Ability to introduce changes to any CCS On-Board Building Block. In the context of OCORA migrateability is the ability to introduce changes (bug-fixes, improvements, new functionality) to one or multiple OCORA defined building blocks, without affecting other building blocks or the overall CCS on-board system.

Ability to port CCS On-Board Software Building Blocks (software applications) from one computing platform to another. In the context of OCORA portability 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).



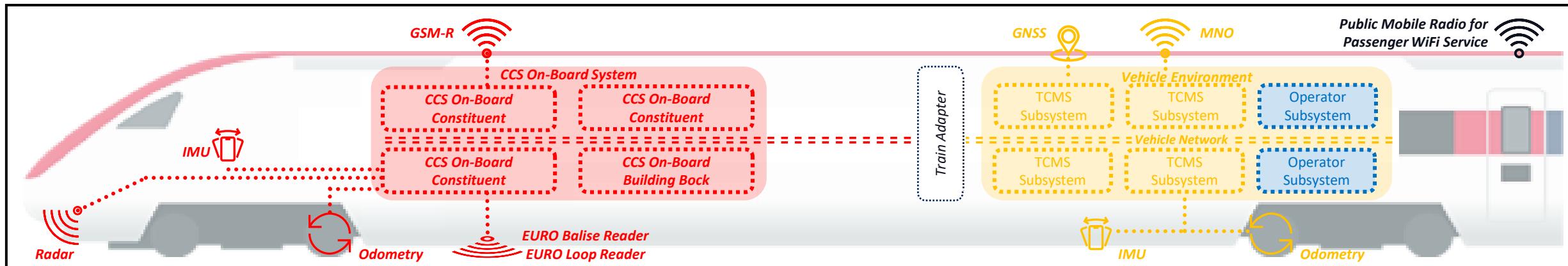
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OCORA Roadmap

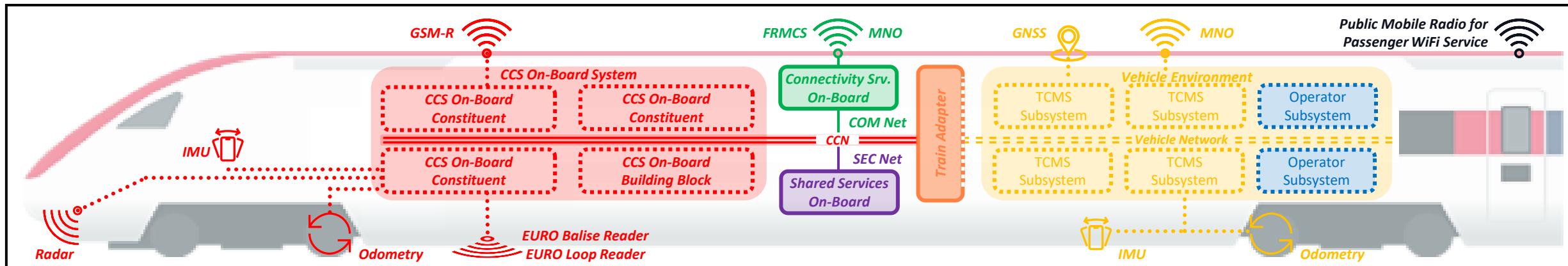
OCORA-BWS02-030 / v5.10 / 01.07.2024

Technical Roadmap – Current Situation



Step 0: Current Situation (TSI 2016)

Today, the proprietary CCS On-Board System (marked in red) is fully integrated in the proprietary Vehicle Environment (marked in yellow), complicating the life-cycle and obsolescence management of the CCS On-Board System.



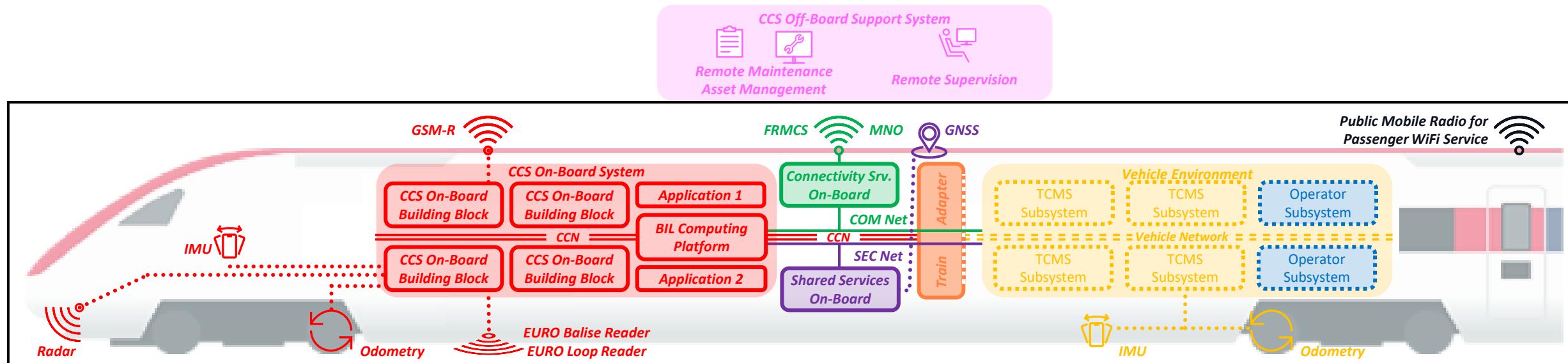
Step 1: TSI CCS 2023

The interface between the proprietary CCS On-Board System and the Vehicle Environment is unambiguously standardised. The standardized CCS Communication Network (CCN) is available. The Connectivity Services over FRMCS or MNO are available for all (CCS) subsystems on a train. Shared Services provide synchronized time and continuous absolute localisation, and other means to allow secure operations. First version of the On-Board Monitoring System is available as part of the shared services.

Benefits:

- Allows for a product-based approach for CCS-OB.
- Allows pre-certification (generic application) for TCMS.
- Basis for modularisation of CCS-OB.
- Single communication system for all on-board applications.
- Efficient solution for shared services such as:
 - Time Synchronisation.
 - Continuous absolute localisation.
 - Diagnostics.
 - Cyber-Security.

Technical Roadmap Step 2 – Mid-Term

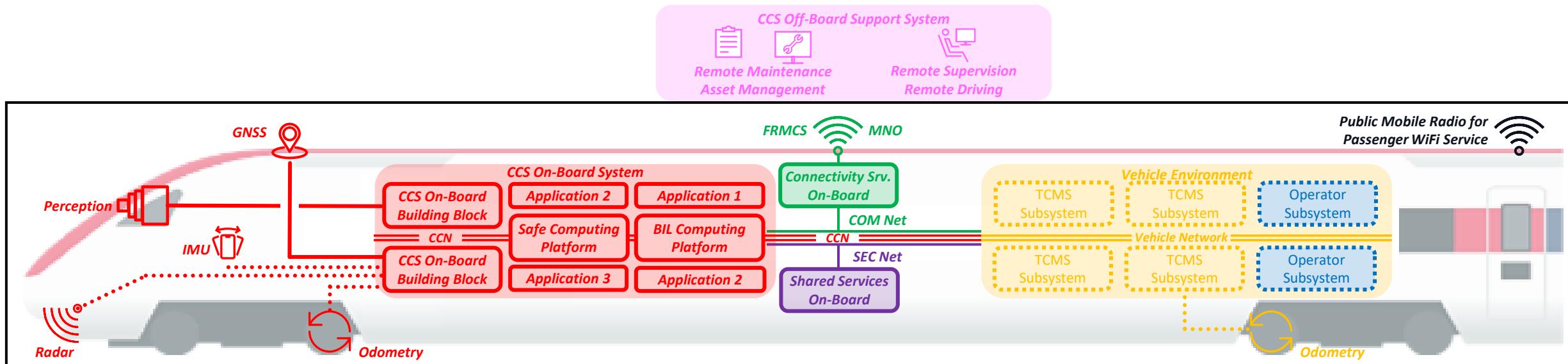


Step 2: Mid-Term (e.g. TSI >2023)

The CCS On-Board System consists of a reasonable number of Building Blocks. The CCS On-Board Building Blocks communicate with each other, with the Vehicle Subsystems and any Off-Board System via a fully standardized CCS Communication Network (CCN). Shared services support Remote Supervision, Remote Maintenance, and digitalized Asset Management.

Benefits:

- Facilitates efficient maintenance.
- Allows for efficient asset management.
- Basis for a more efficient homologation.
- Allows for a product based approach for CCS-OB constituents.
- Allows pre-certification (generic product) for CCS-OB constituent.



Step 3: Vision

The standardised CCS On-Board Communication Network (CCN) is fully integrated with the Vehicle Network, allowing to interface from any CCS On-Board Application directly with any Vehicle Subsystems and vice-versa. The need for a Train Adapter vanishes and certain Applications from the Vehicle Environment may be hosted on the CCS On-Board BIL (Basic Integrity Level) Computing Platform.

The ATO functionality is fully developed and standardised up to GoA 3/4.

Due to the increased performance of the CCS On-Board localisation through better sensor fusion algorithms, the use of GNSS localisation, digital map data, and augmentation data, the EURO Balise and EURO Loop readers are not needed anymore.



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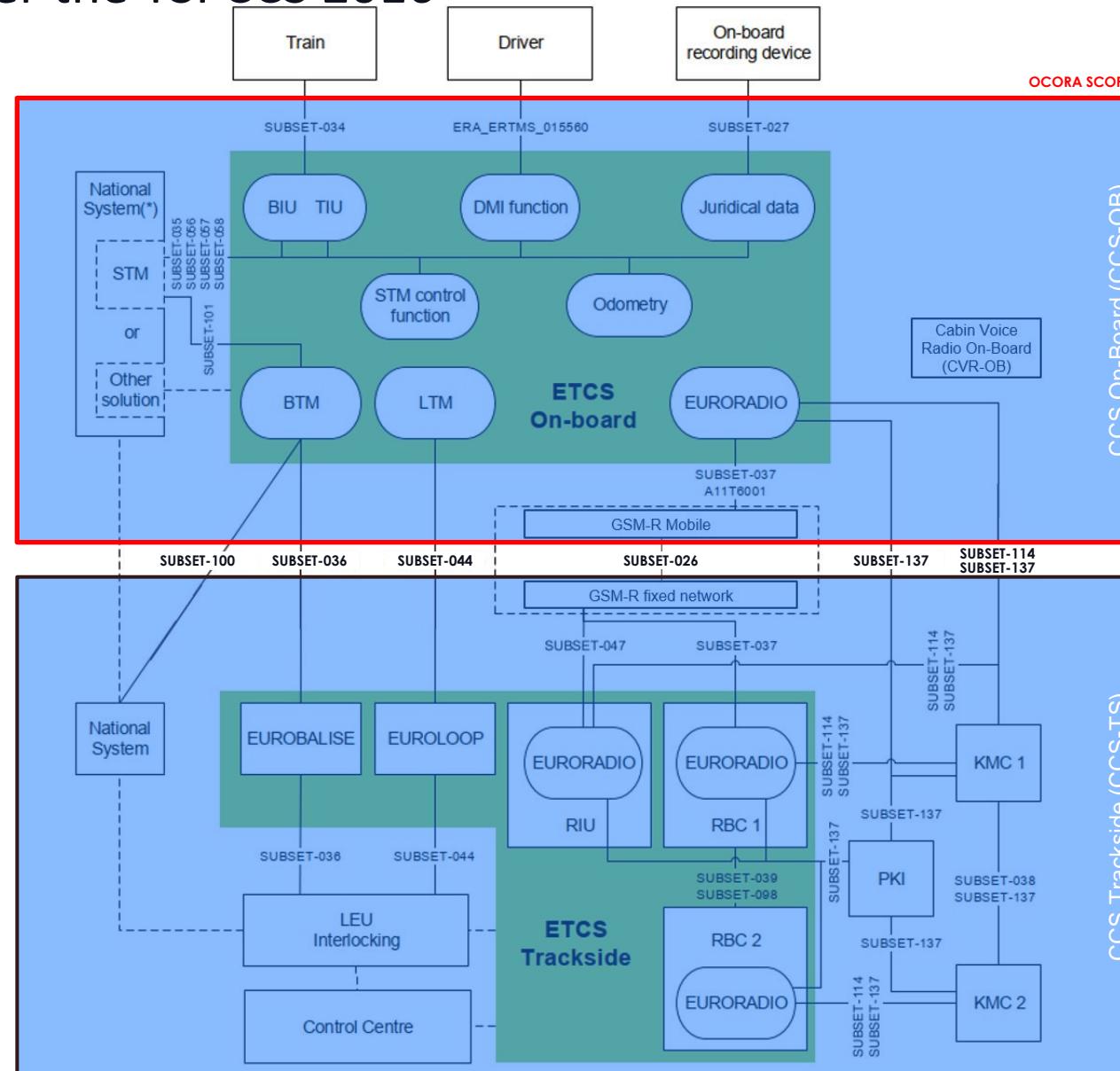
Modularisation Roadmap Proposal

OCORA-BWS02-030 / v5.10 / 01.07.2024



Modularisation as per the TSI

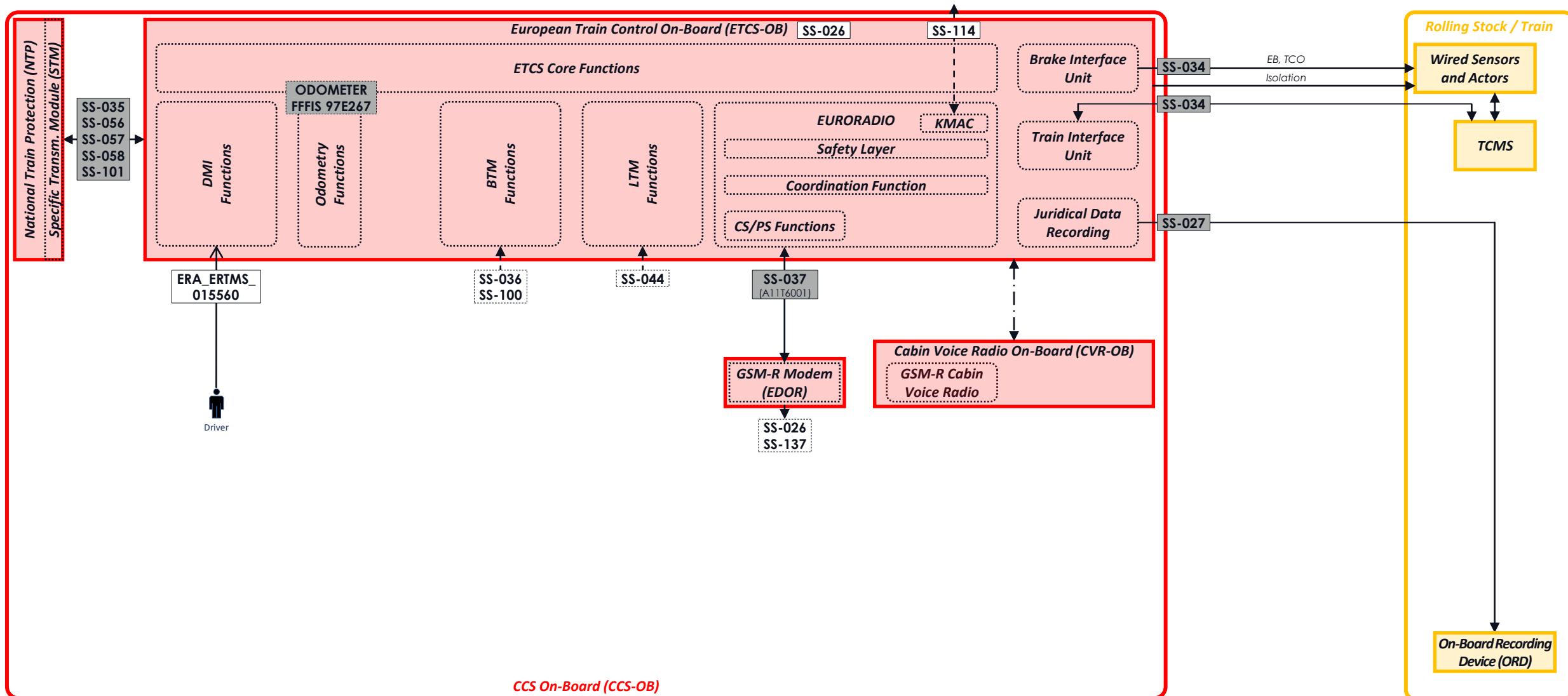
Modularisation as per the TSI CCS 2016



Modularisation as per TSI 2016 (amended in 2019 & 2020)



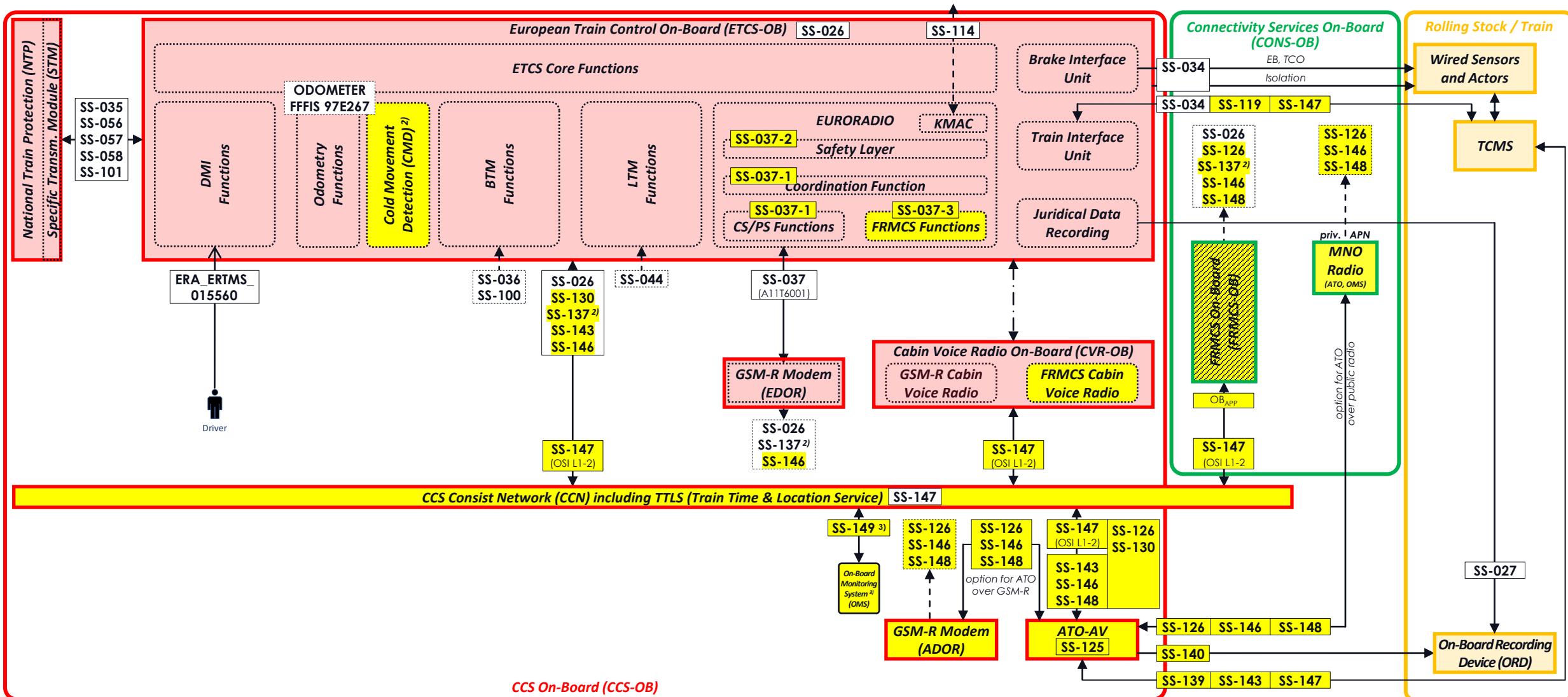
Functionality Level: ETCS and Cab Voice



Modularisation as per TSI 2023¹⁾ (newly developed vehicle designs, requiring first authorisation)



Functionality Level: ETCS, Cab Voice, FRMCS (ready), ATO (GoA 1-2)



Yellow marks

changes introduced compared to TSI 2016

Not fully specified with TSI 2023 / FRMCS BLO

logical grouping

data exchange with track-side

optional, vendor specific integration

subsystem / function within a building block

1) Including amendments for FRMCS

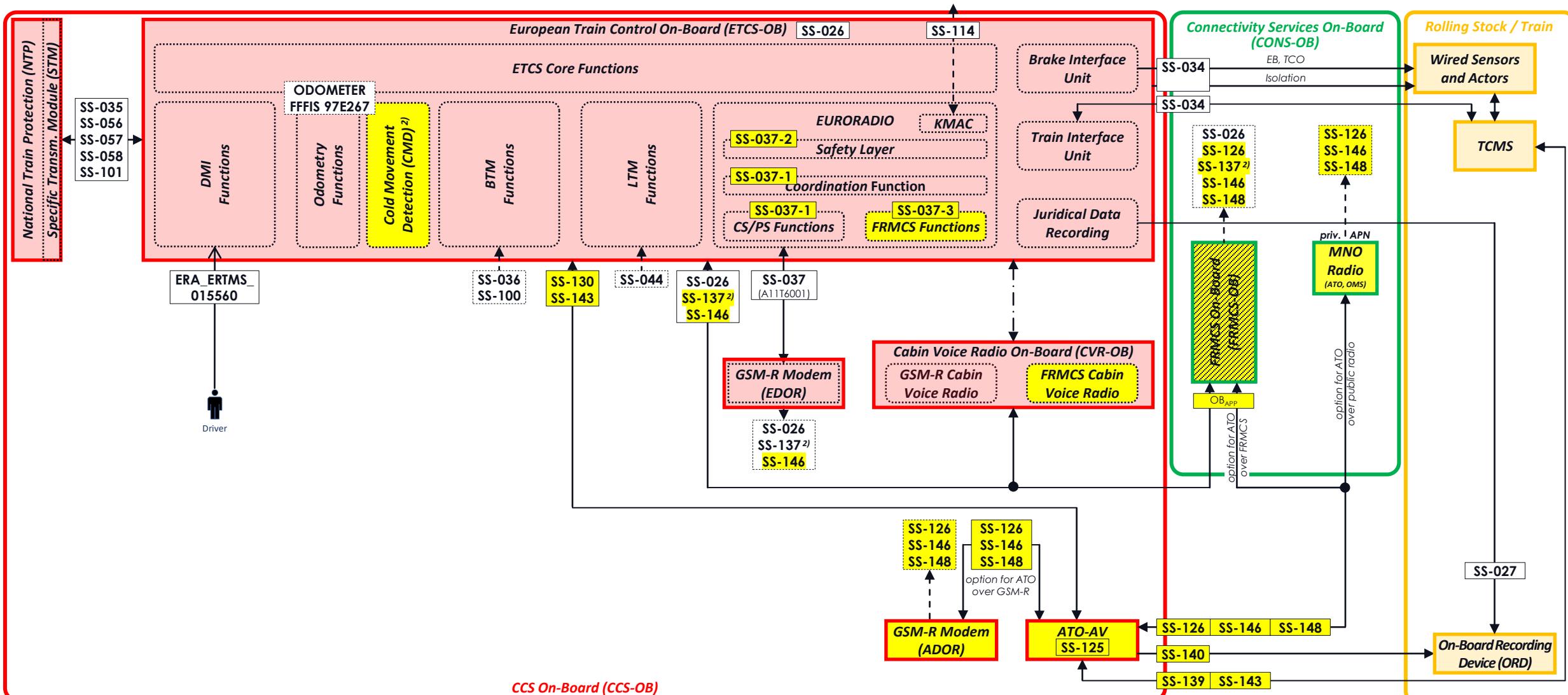
2) refer to related transition regime

3) referenced in the Application Guide

Modularisation as per TSI 2023¹⁾ (existing vehicle designs)



Functionality Level: ETCS, Cab Voice, FRMCS (ready), ATO (GoA 1-2)



Yellow marks

changes introduced compared to TSI 2016

Green diagonal stripes

Not fully specified with TSI 2023 / FRMCS BLO



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OCORA Modularisation Roadmap Proposal

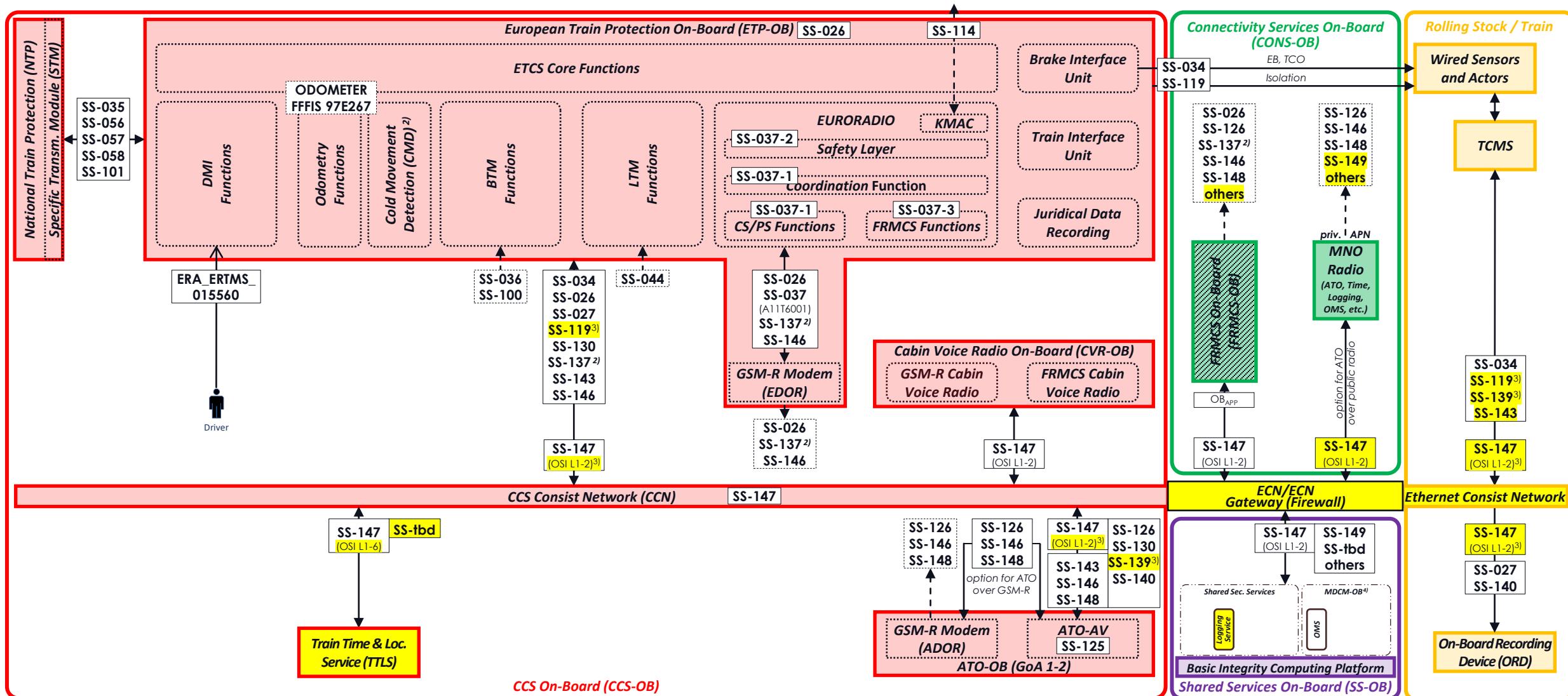
for new vehicles
(based on TSI 2023)

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OCORA Modularisation proposal based on TSI 2023¹⁾ (new vehicles)



Functionality Level: ETCS, Cab Voice, FRMCS ready, ATO (GoA 1-2)



Yellow marks

changes introduced compared to TSI 2023

Not fully specified with TSI 2023 / FRMCS BLO

logical grouping

data exchange with track-side

optional, vendor specific integration

subsystem / function within a building block

1) Including amendments for FRMCS

2) refer to related transition regime

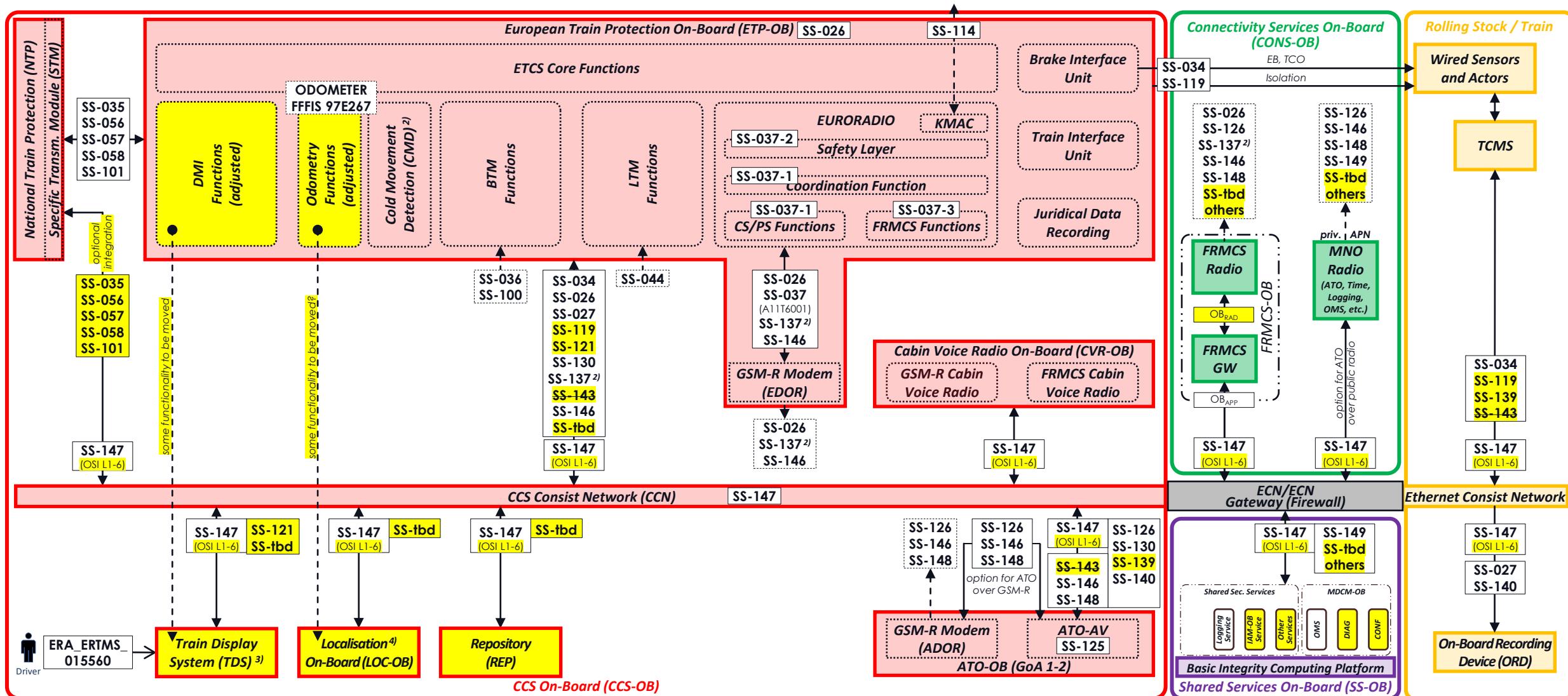
3) incl. OCORA addendum

4) incl. OCORA addendum

OCORA Modularisation proposal for TSI >2023 (new vehicles)



Functionality Level: ETCS, Cab Voice, FRMCS, ATO (GoA 1-2), MDCM, TDS, LOC-OB, Shared Sec. Services, etc.



Yellow marks changes introduced to OCORA proposal, based on TSI 2023

----- logical grouping

→ data exchange with track-side

← → optional, vendor specific integration

..... subsystem / function within a building block

4) LOC-OB includes the time service, but discussion is ongoing in ERJU to confirm this.

1) Including amendments for FRMCS

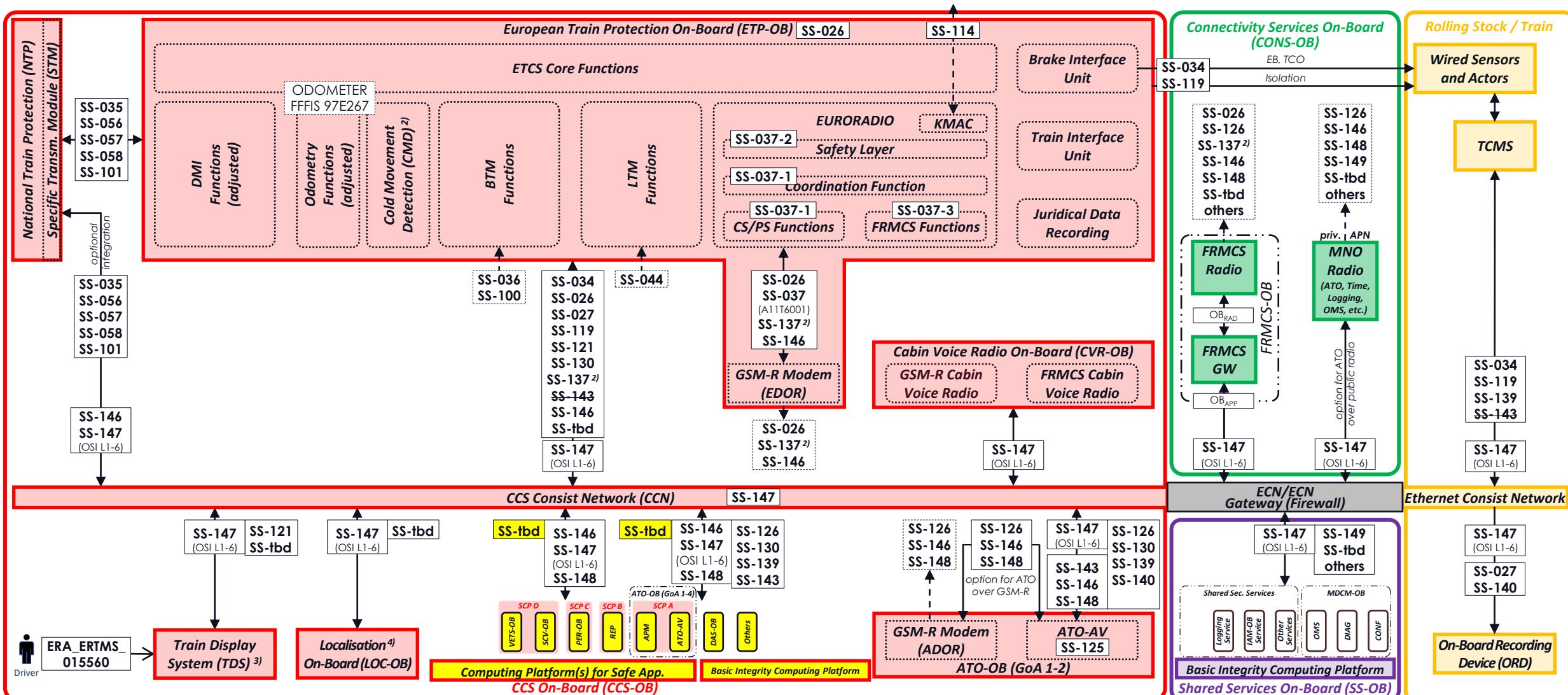
2) refer to related transition regime

3) May be moved outside of CCS-ON

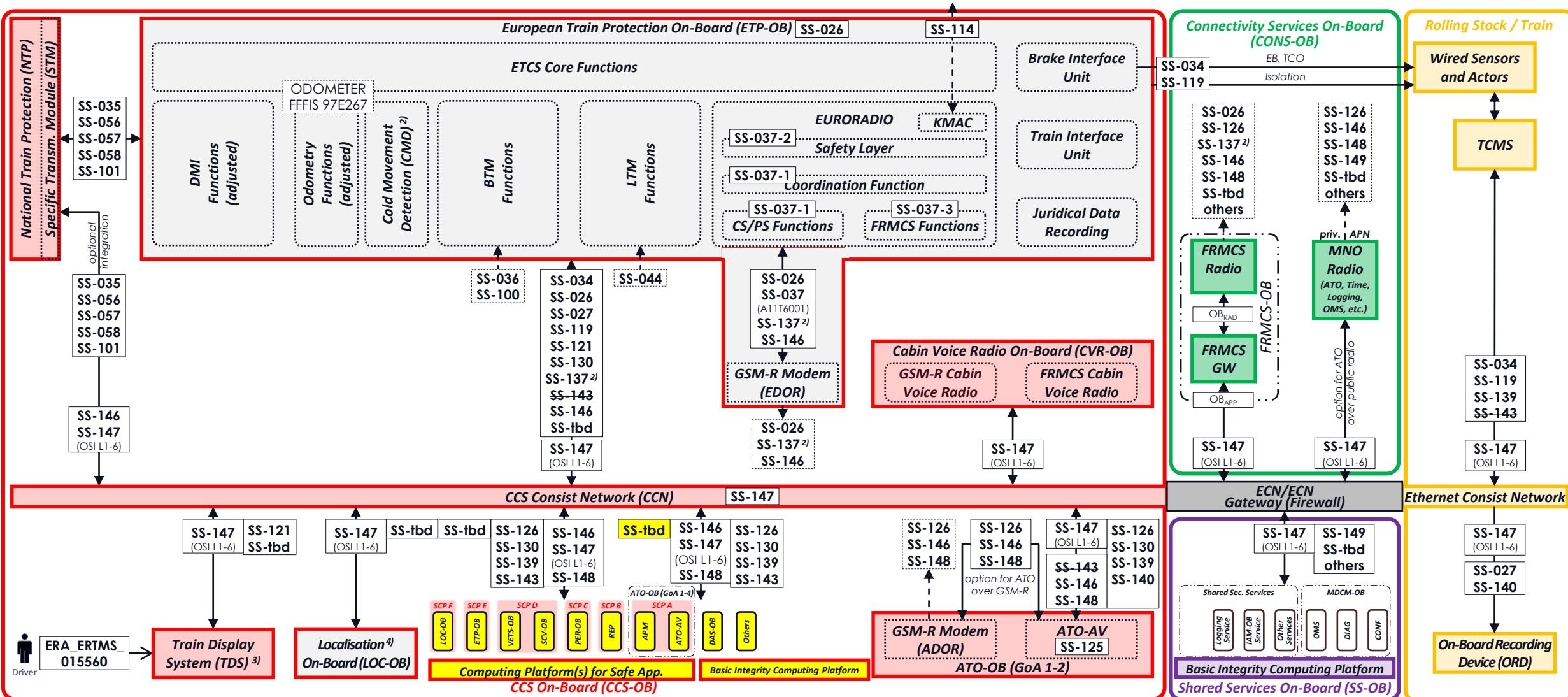
OCORA Modularisation proposal for TSI >>2023 (new vehicles)



Functionality Level: ETCS, Cab Voice, FRMCS, ATO (GoA 1-4), MDCM, TDS, LOC-OB, Shared Sec. Services, DM, etc.



Functionality Level: ETCS, Cab Voice, FRMCS, ATO (GoA 1-4), MDCM, TDS, LOC-OB, Shared Sec. Services, DM, etc.





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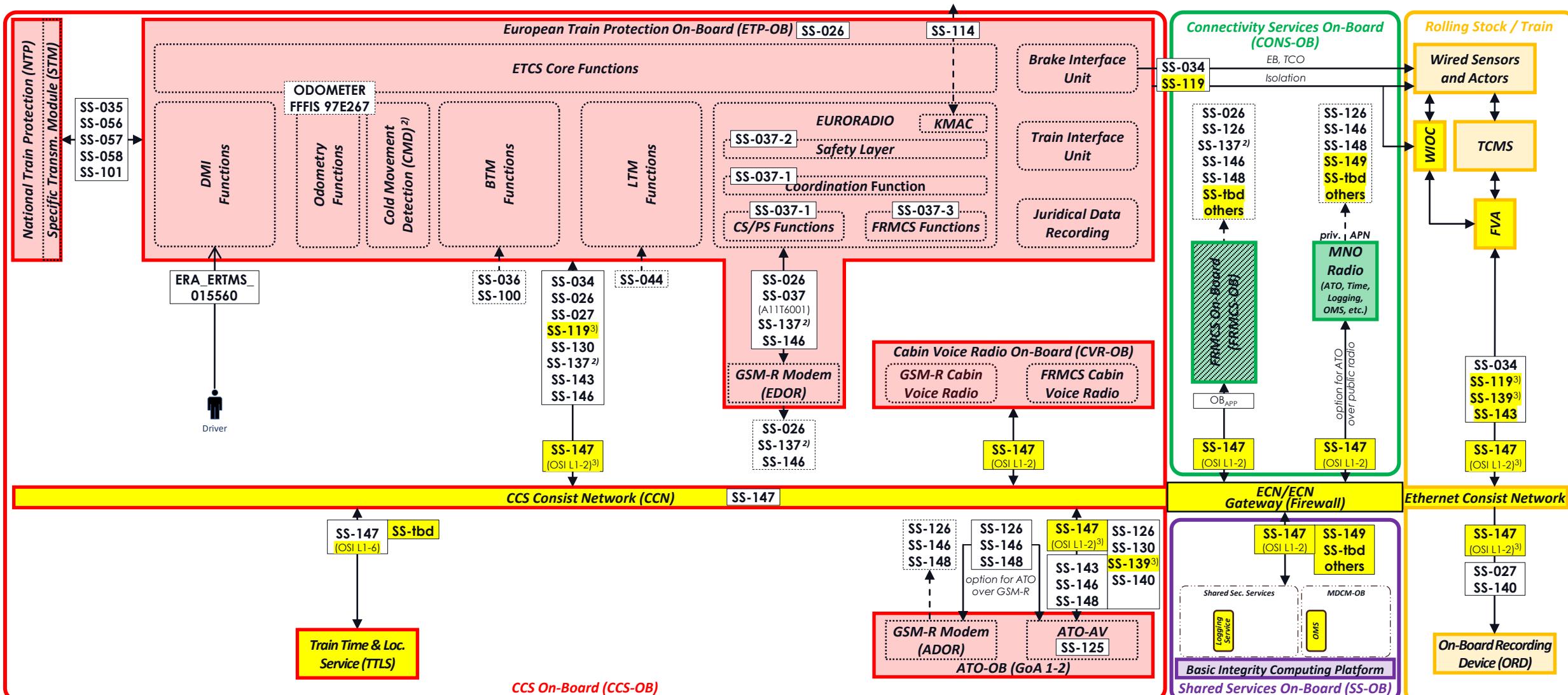
OCORA Modularisation

for ETCS upgrades & updates of vehicles in operation
(based on TSI 2023)

OCORA Modularisation proposal based on TSI 2023¹⁾ (vehicles in operations)



Functionality Level: ETCS, Cab Voice, FRMCS (ready), ATO (GoA 1-2)



Yellow marks

changes introduced compared to TSI 2023

Not fully specified with TSI 2023 / FRMCS BLO



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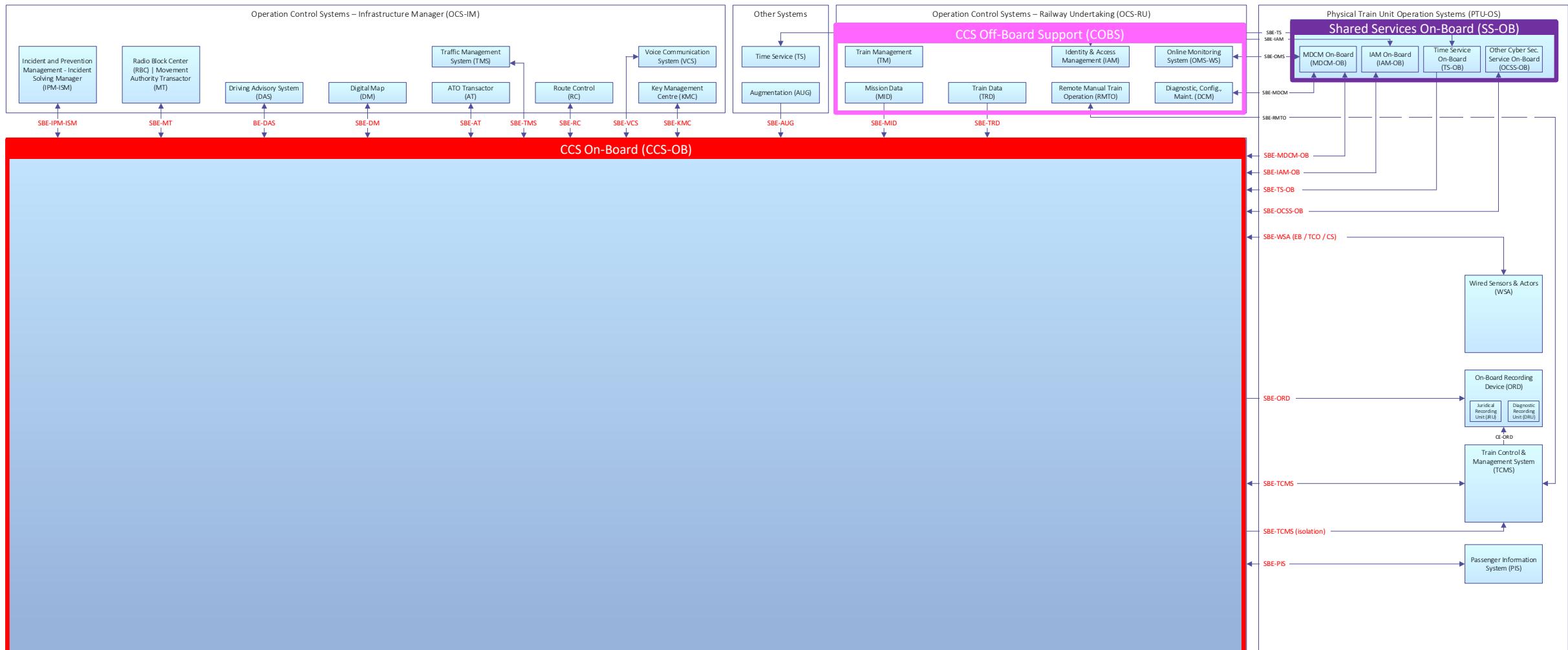


OCORA Scope

Logical & Physical Architecture

OCORA-BWS02-030 / v5.10 / 01.07.2024

Logical Architecture – Scope & Context (New Generation Train)



OCORA Architecture
ETCS-Levels: 0, 1, 2, 3, NTC / ATO GoA Levels: 1-4

CCS On-Board (CCS-OB) – Logical Architecture

Logical Scope & Context

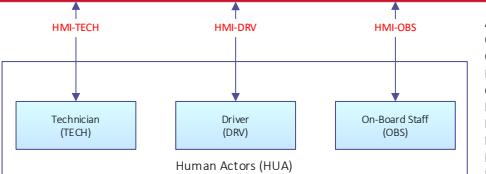
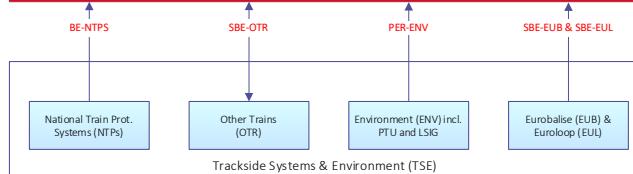
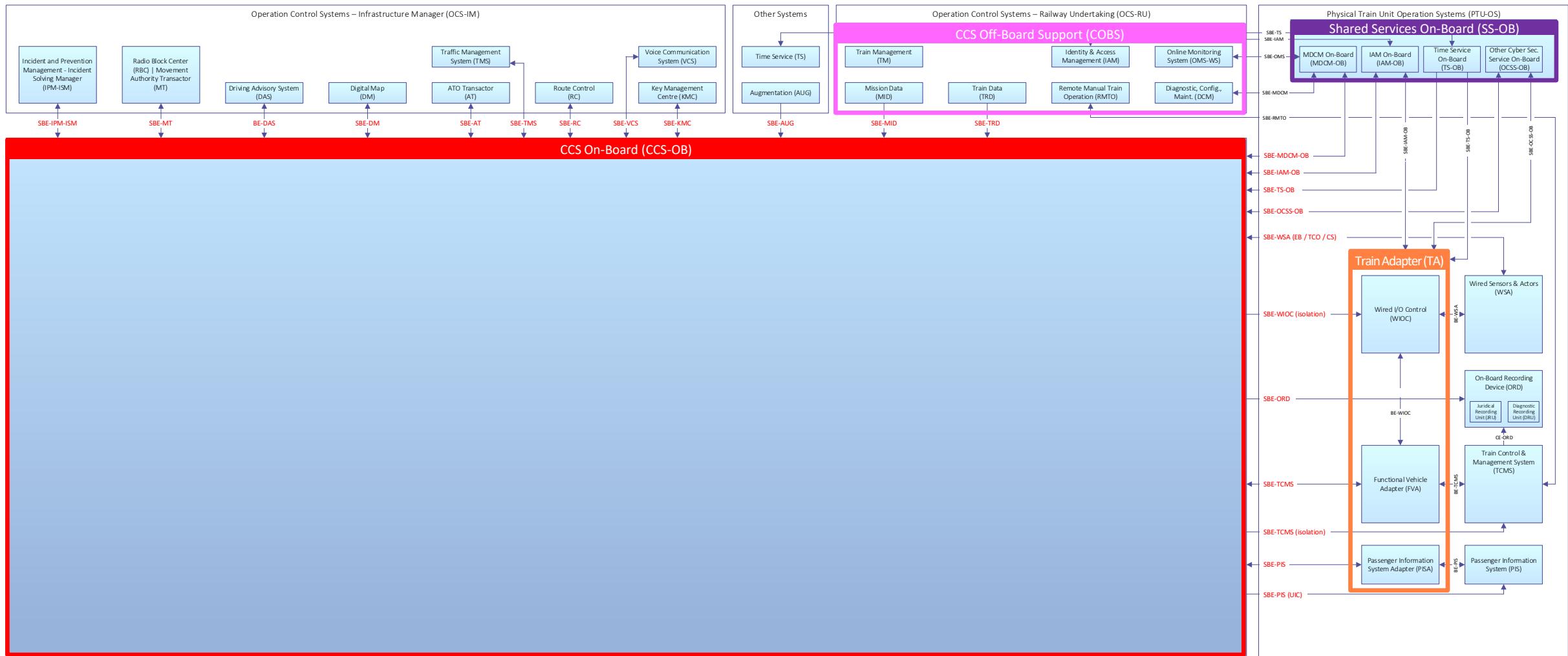
New Generation Train

(TCMS compliant with SS-119+, SS-139+, SS-147+)

Graphic ID: LA-000-NGT Version 6.00 / 2024-05-30

API	Application Programming Interface	OPN	Operations Network
CCN	CCS Consist Network	PER	Perception
CCU	CCS Computing Unit	SBE	Standard (Building) Block Exchange
BE	(Building) Block Exchange	SS-nnn+	SUBSET-nnn amended by OCORA
CON-OB	Connectivity On-Board	SS-OB	Shared Services On-Board
HMI	Human Machine Interface	OPN	Operations Network
LSIG	Light Signals	PTU	Physical Train Unit
MCG	Mobile Communication Gateway (Public Network)	TCN	Train Communication Network
MCU	Main Computing Unit	UIC	International Union of Railways
NG	New Generation	UID	User Identification

Logical Architecture – Scope & Context (Legacy Train Example)



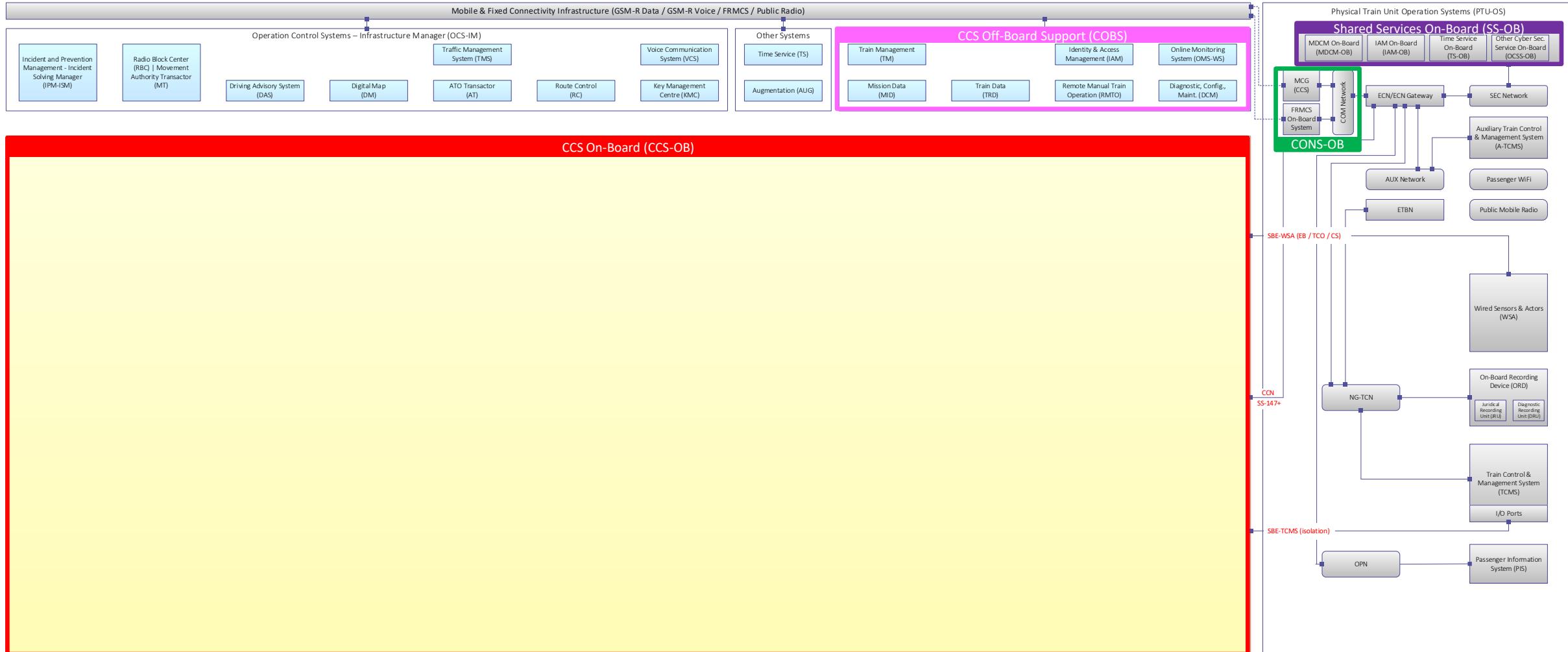
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OCORA Architecture
ETCS-Levels: 0, 1, 2, NTC / ATO GoA Levels: 1 - 4
CCS On-Board (CCS-OB) – Logical Architecture
Logical Scope & Context
Legacy Train Example
(TCMS not compliant with SS-119+, SS-139+, SS-147+)
Graphic ID: LA-000-LTE Version 6.00 / 2024-05-30



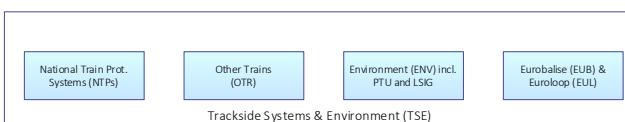
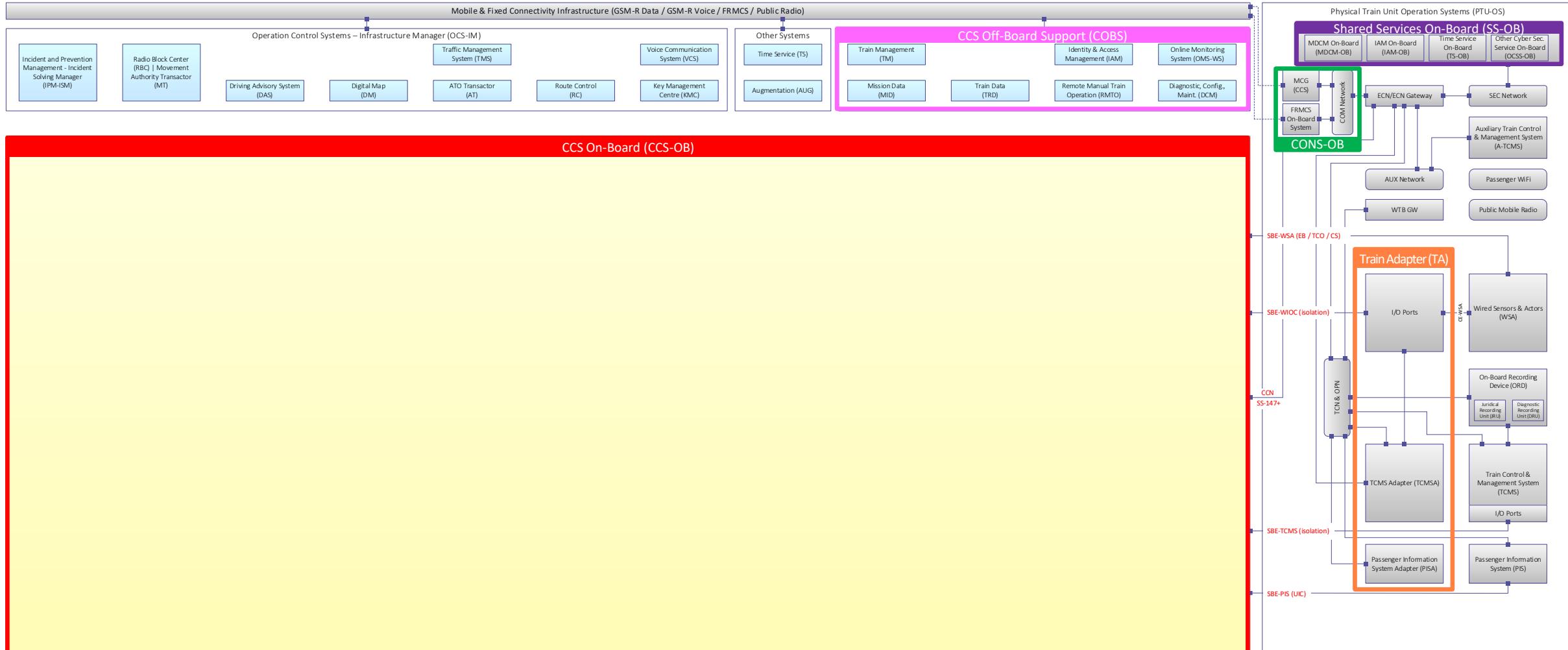
Physical Architecture – Scope & Context (New Generation Train)



API	Application Programming Interface	OPN	Operations Network
CCN	CCS Consist Network	PER	Perception
CCU	CCS Computing Unit	SBE	Standard (Building) Block Exchange
BE	(Building) Block Exchange	SS-nnn+	SUBSET-nnn amended by OCORA
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OCORA Architecture
ETCS-Levels: 0, 1, 2, 3, NTC / ATO GoA Levels: 1-4
CCS On-Board (CCS-OB) – Physical Architecture
Physical Scope & Context
New Generation Train
(TCMS compliant with SS-119+, SS-139+, SS-147+)
Graphic ID: PA-000-NGT Version 6.00 / 2024-05-30

Physical Architecture – Scope & Context (Legacy Train Example)



API	Application Programming Interface	OPN	Operations Network
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OCORA Architecture
ETCS-Levels: 0, 1, 2, 3, NTC / ATO GoA Levels: 1-4
CCS On-Board (CCS-OB) – Physical Architecture
Physical Scope & Context
Legacy Train Example
(TCMS not compliant with SS-119+, SS-139+, SS-147+)
Graphic ID: PA-000-LTE Version 6.00 / 2024-05-30



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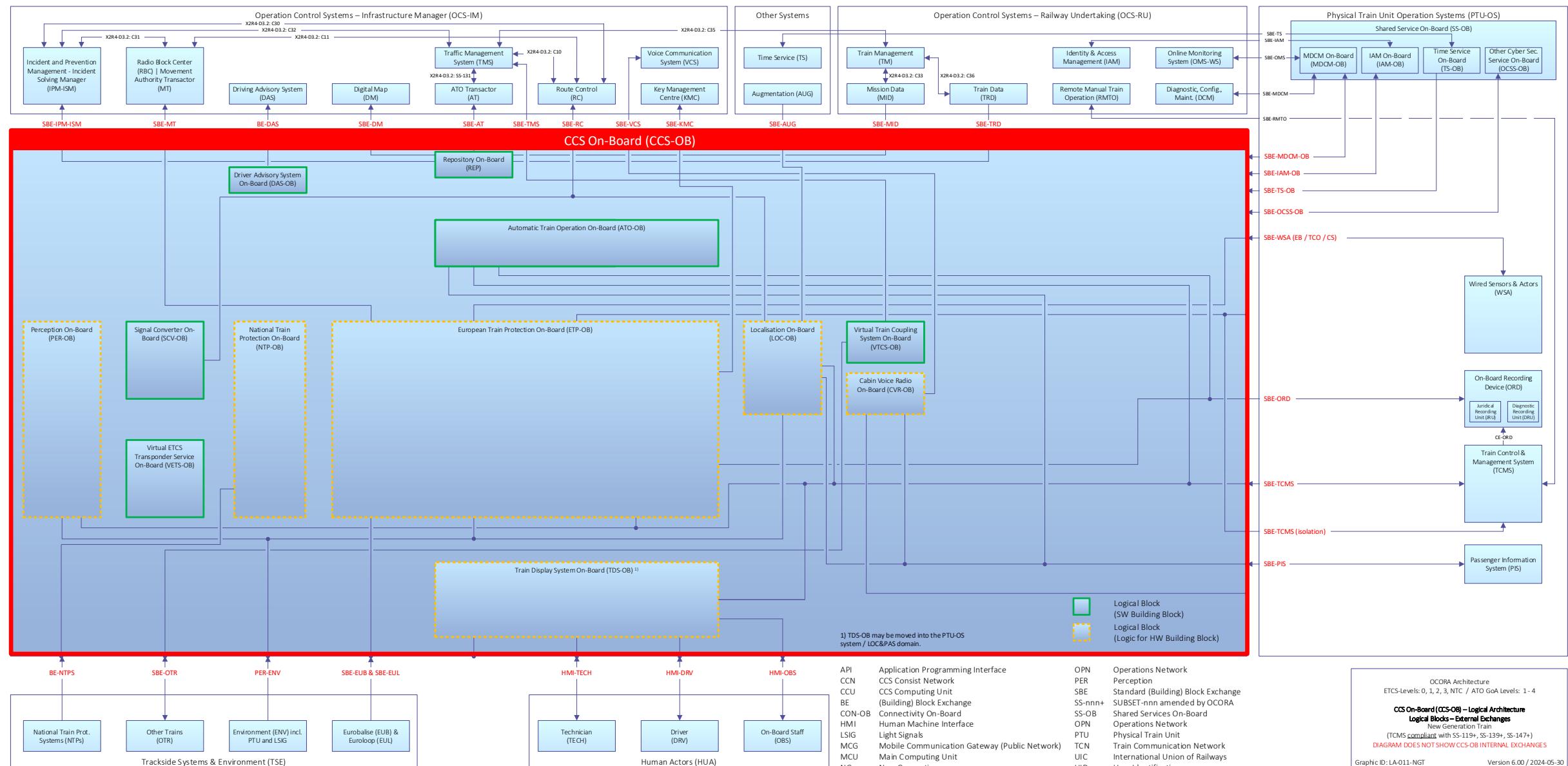


CCS On-Board (CCS-OB)

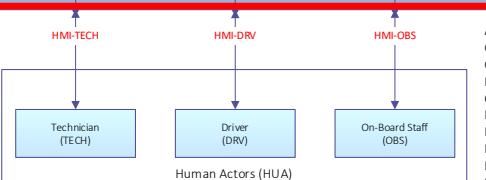
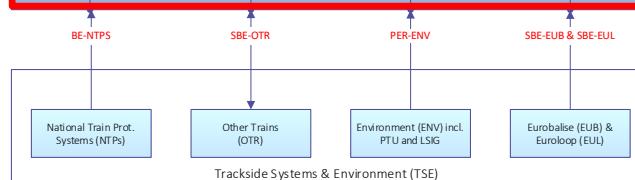
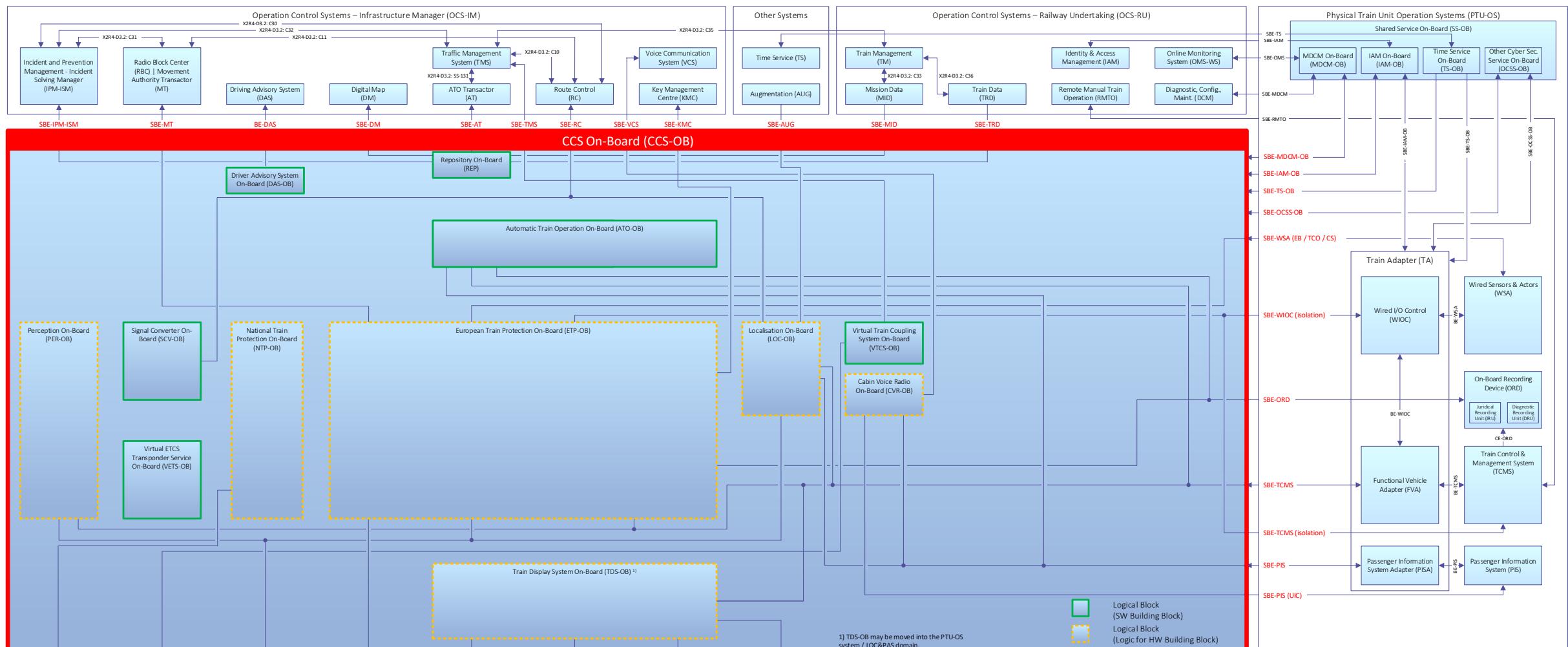
Logical Architecture

OCORA-BWS02-030 / v5.10 / 01.07.2024

Logical Blocks – External Exchanges (New Generation Train)



Logical Blocks – External Exchanges (Legacy Train Example)



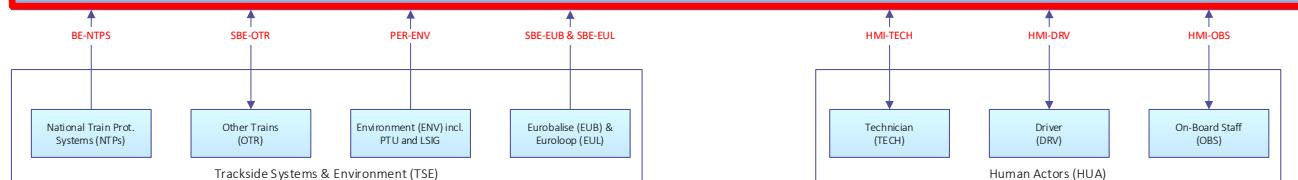
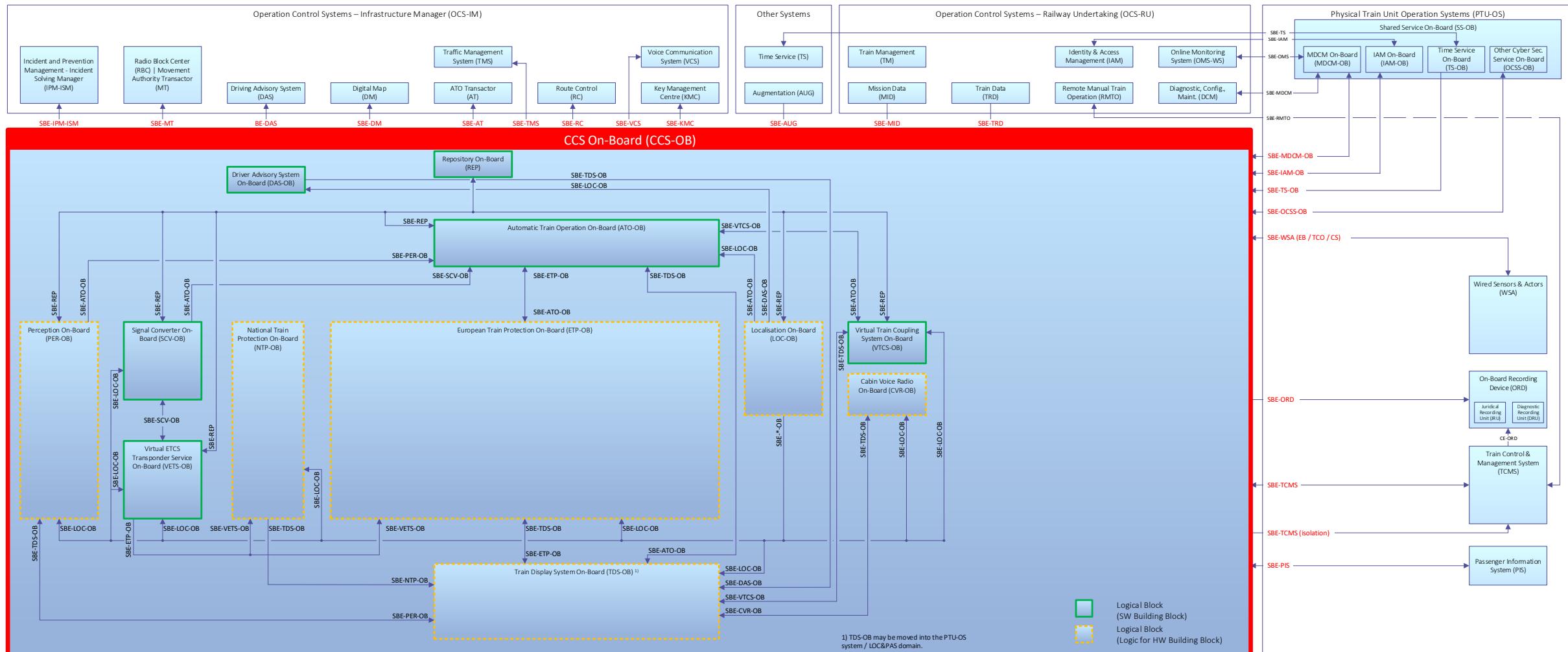
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SS-nnn+	SUBSET-nnn amended by OCORA
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OCORA Architecture
ETCS-Levels: 0, 1, 2, NTC / ATO GoA Levels: 1 - 4
CCS On-Board (CCS-OB) – Logical Architecture
Logical Blocks – External Exchanges
Legacy Train Example
(TCMS not compliant with SS-119+, SS-139+, SS-147+)
DIAGRAM DOES NOT SHOW CCS-OB INTERNAL EXCHANGES

Graphic ID: LA-011-LTE Version 6.00 / 2024-05-30



Logical Blocks – Internal Exchanges (New Generation Train)



I	Application Programming Interface	OPM
N	CCS Consist Network	PER
U	CCS Computing Unit	SBE
	(Building) Block Exchange	SS+R
N-OB	Connectivity On-Board	SS-OB
M	Human Machine Interface	OPM
G	Light Signals	PTU
CG	Mobile Communication Gateway (Public Network)	TCC
CU	Main Computing Unit	UIO
	Unit	

- Operations Network
- Perception
- Standard (Building) Block Exchange
 - SUBSET-nnn amended by OCORA
- Shared Services On-Board
- Operations Network
- Physical Train Unit
- Train Communication Network
- International Union of Railways
- Model Identification

OCORA Architecture
ETCS Levels 0, 1, 2, 3, NTC / ATC G+AI Levels 1, 4

CCS On-Board (CCS-OB) – Logical Architecture

Logical Blocks – Internal Exchanges
New Generation Train
(TCMS compliant with SS-119+, SS-139+, SS-147+)

GRAM DOES NOT SHOW CCS-OB EXTERNAL EXCHANGES

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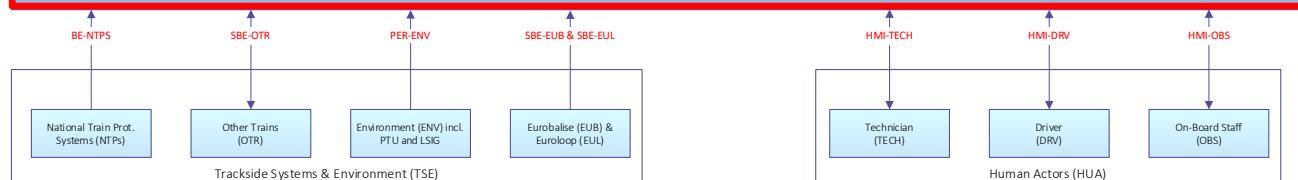
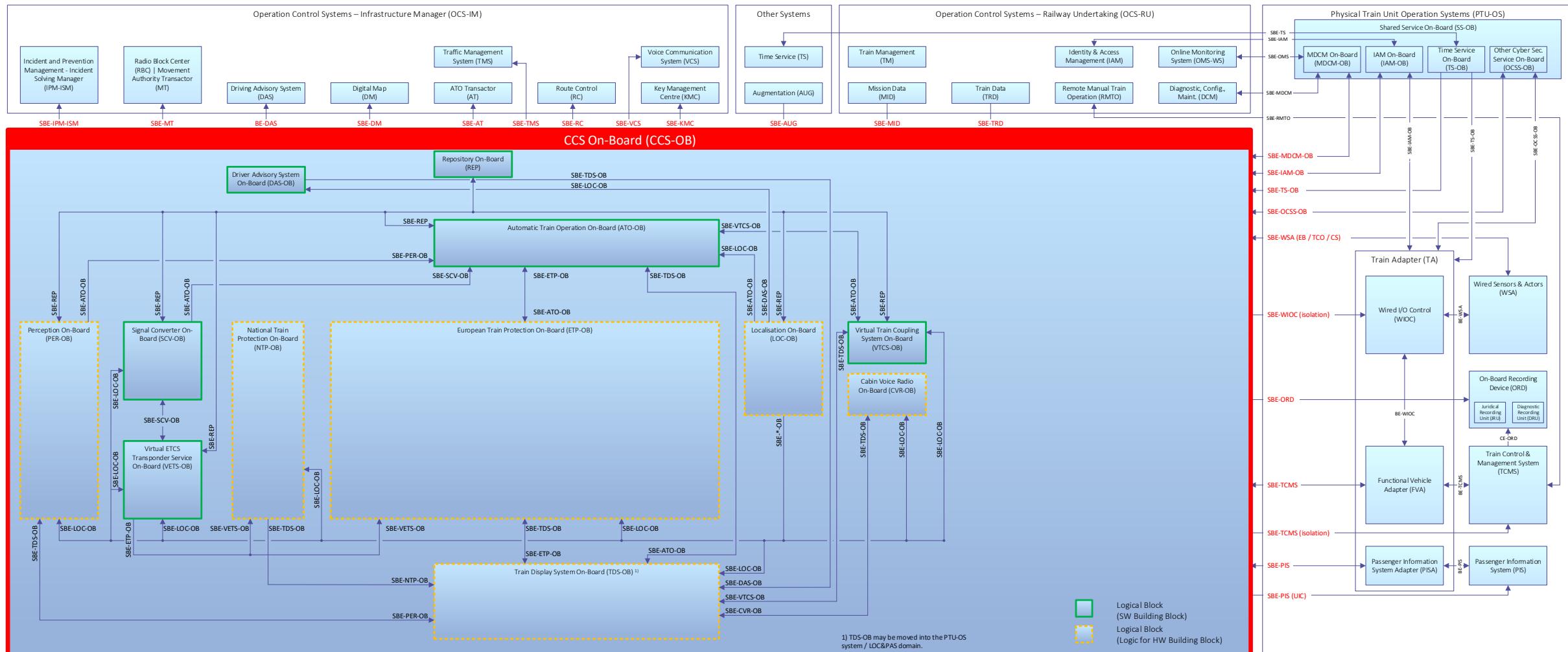
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Logical Blocks – Internal Exchanges (Legacy Train Example)



 SBB CFF FFS



I	Application Programming Interface	OP
N	CCS Consist Network	PER
U	CCS Computing Unit	SBE
BN-OB	(Building) Block Exchange	SS-OB
MI	Connectivity On-Board	SS-OB
G	Human Machine Interface	OP
CG	Light Signals	OP
CG	Mobile Communication Gateway (Public Network)	TCT
CU	Main Computing Unit	UI
	Unit	UI

Operations Network
Perception
Standard (Building) Block Exchange
SUBSET-nnn amended by OCORA
Shared Services On-Board
Operations Network
Physical Train Unit
Train Communication Network
International Union of Railways
Model Identification

OCORA Architecture

CCS On-Board (CCS-OB) – Logical Architecture

Logical Blocks – Internal Exchanges

Legacy Train Example

(TCMS not compliant with SS-119+, SS-139+, SS-147+)

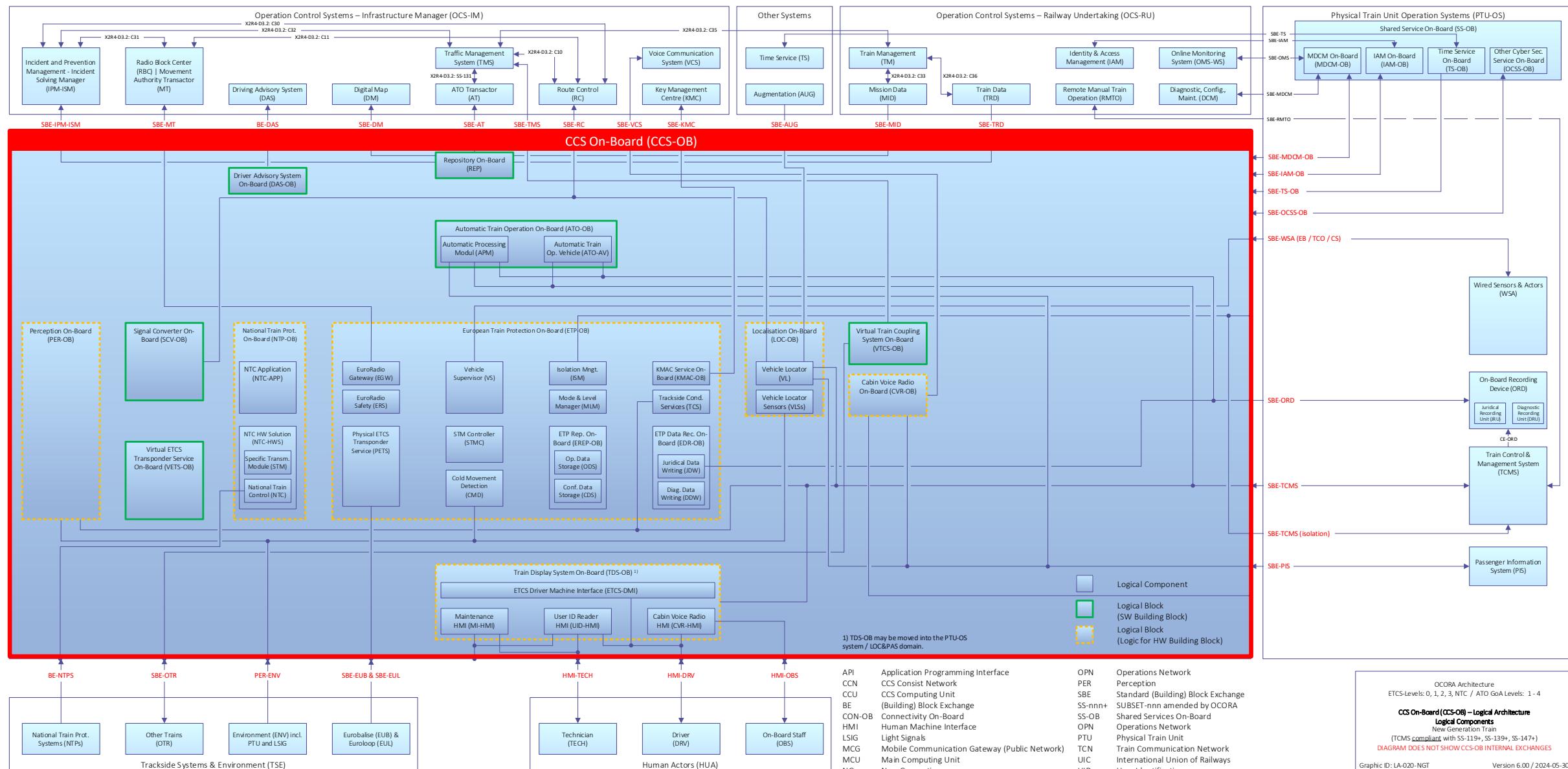
GRAM DOES NOT SHOW CCS-OB EXTERNAL EXCHANGES

D: LA-012-LTE Version 6.00 / 2024-05-30

ANSWER



Logical Components (New Generation Train)

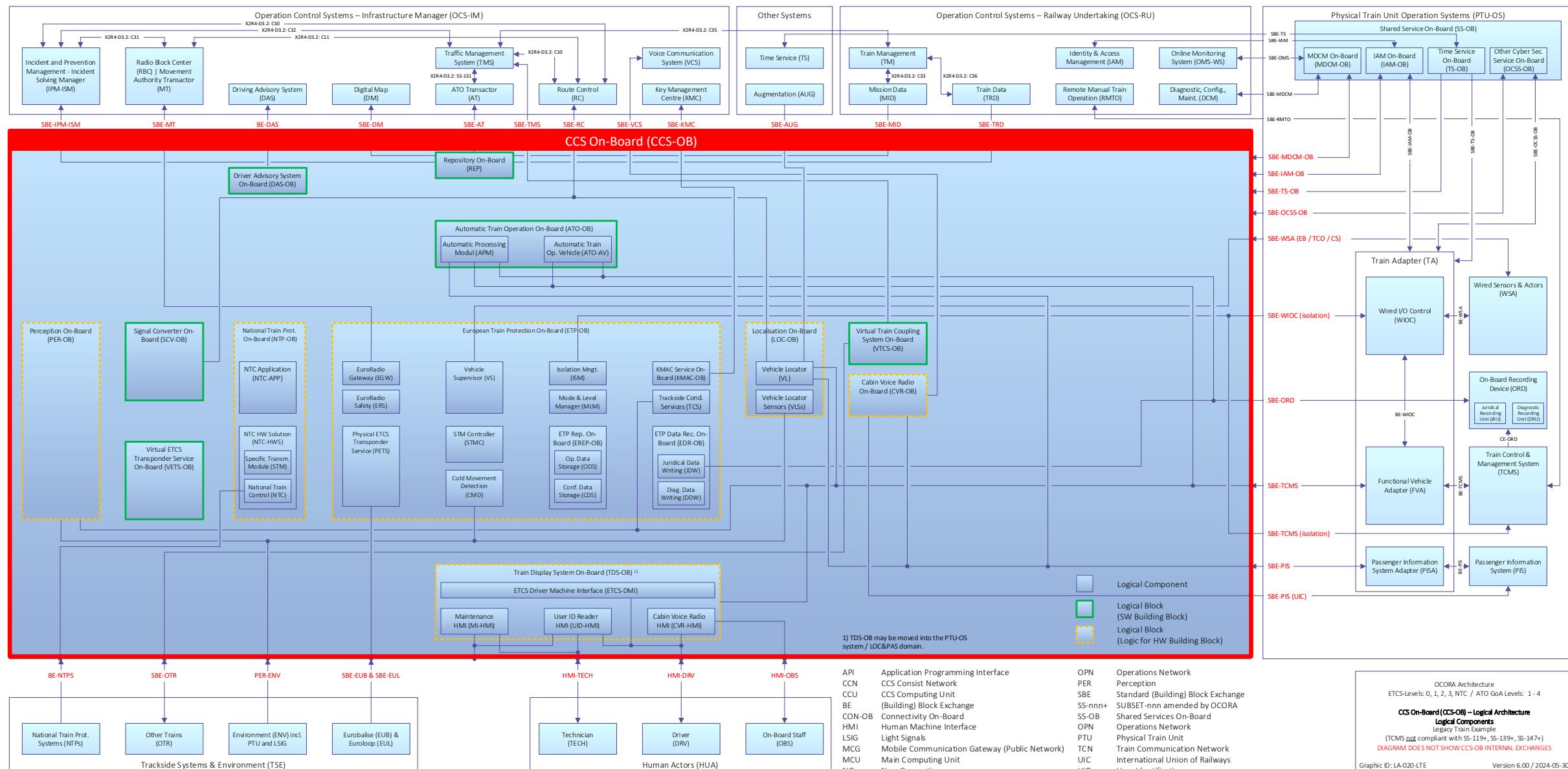


OCORA Architecture
ETCS-Levels: 0, 1, 2, 3, NTC / ATO GoA Levels: 1-4
CCS On-Board (CCS-OB) – Logical Architecture
Logical Components
New Generation Train
(TCMS compliant with SS-119+, SS-139+, SS-147+)
DIAGRAM DOES NOT SHOW CCS-OB INTERNAL EXCHANGES

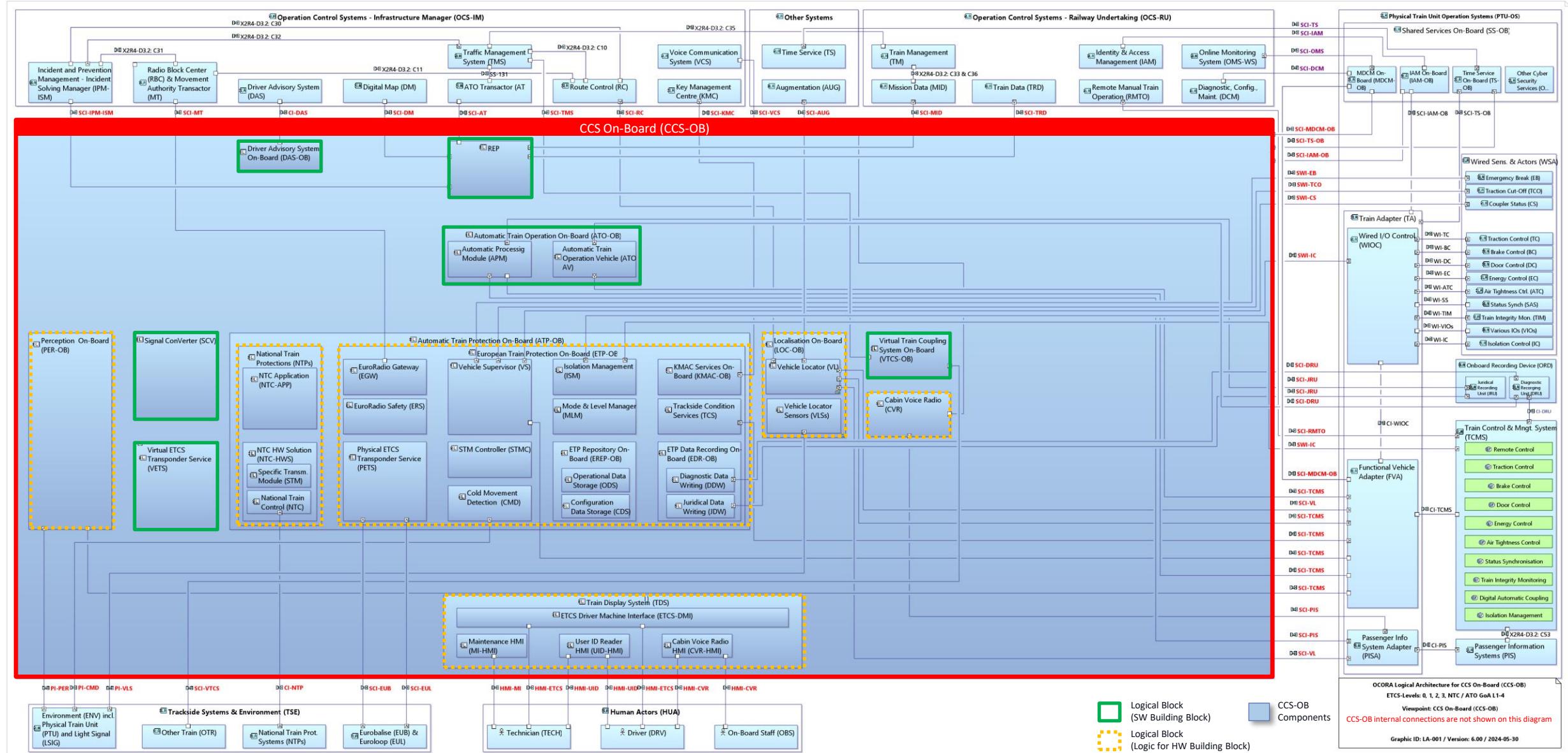
Graphic ID: LA-020-NGT

Version 6.00 / 2024-05-30

Logical Components (Legacy Train Example)



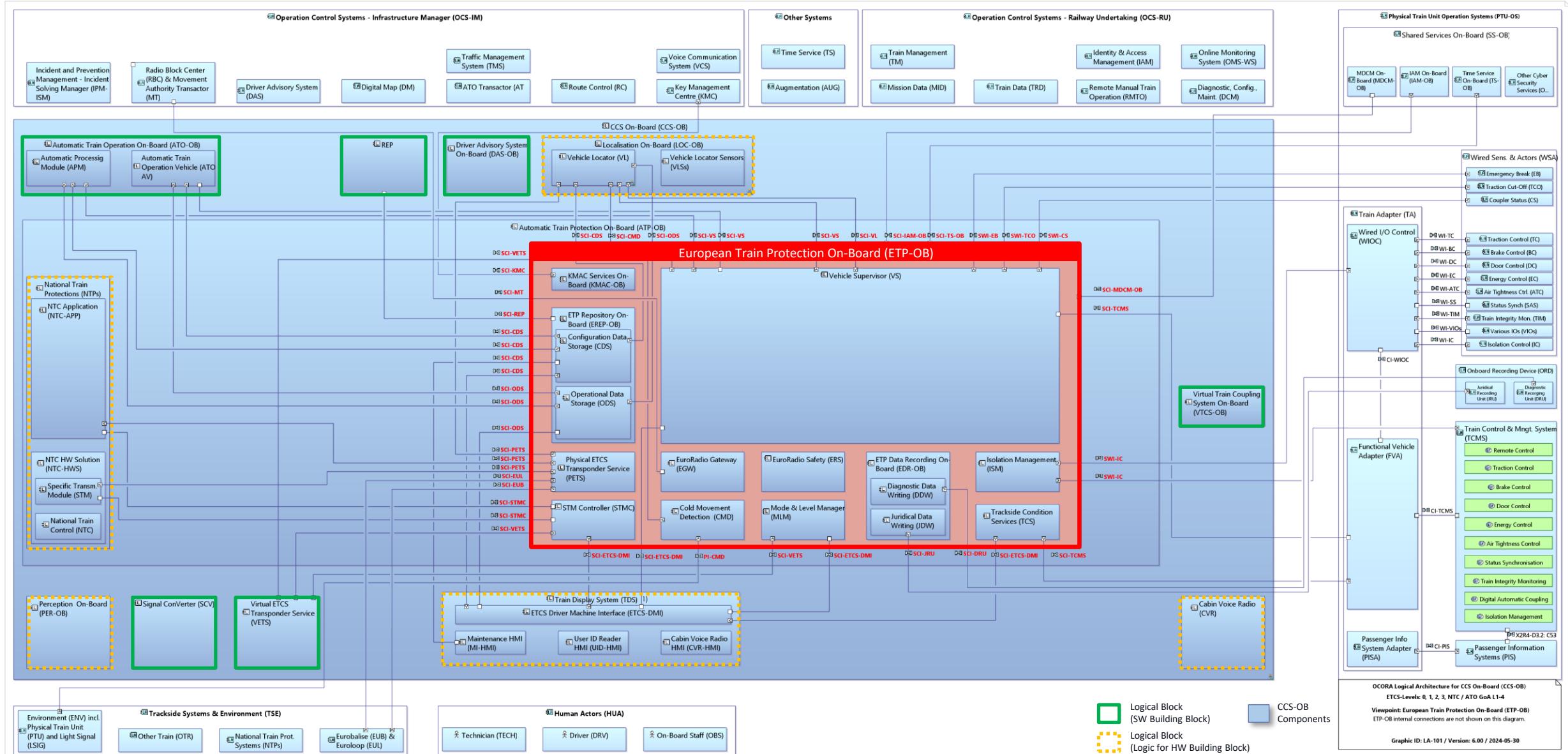
External Logical Interfaces (Legacy Train Example)



1) TDS-OB may be moved into the PTU-OS / LOC&PAS domain.



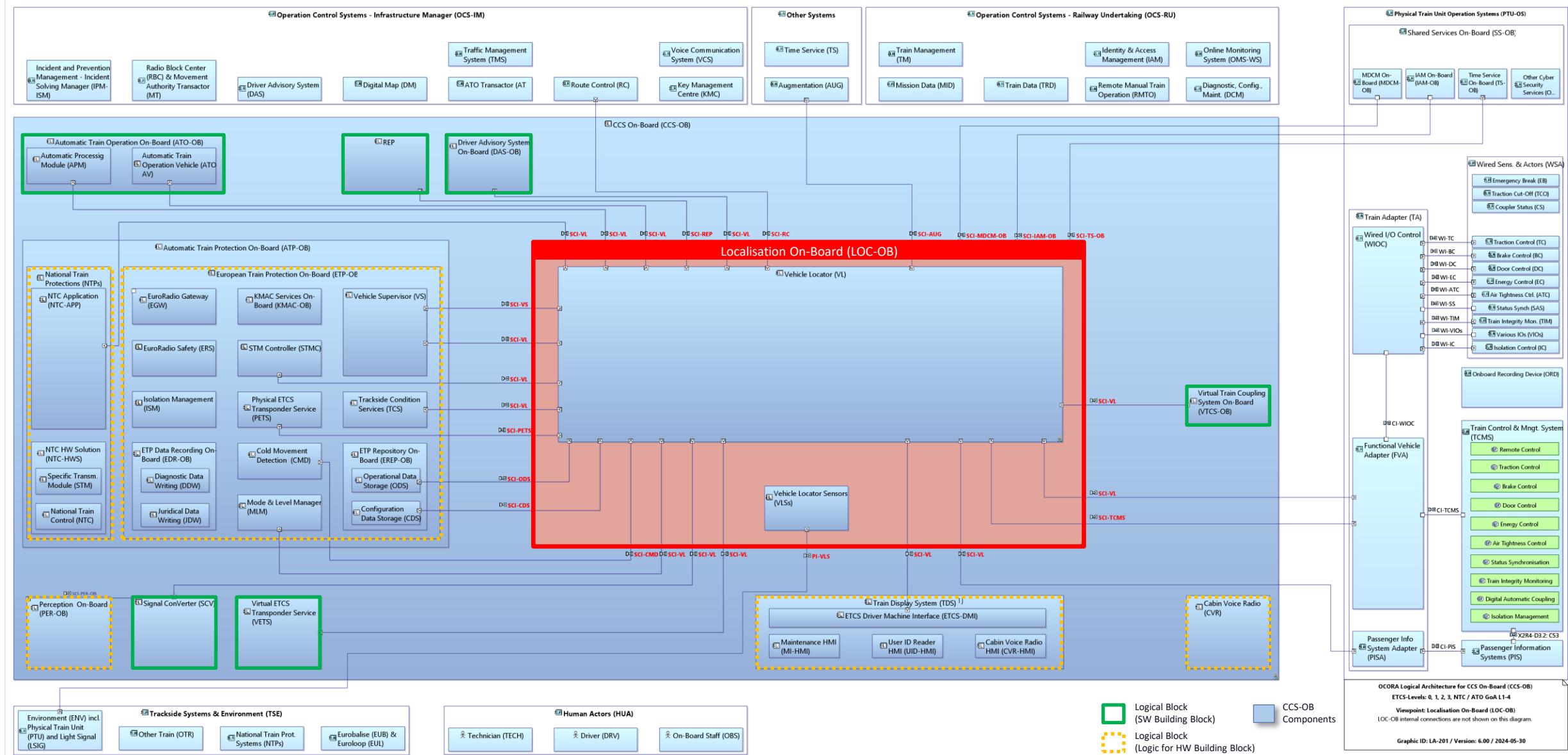
External Logical Interfaces – ETP-OB (Legacy Train Example)



1) TDS-OB may be moved into the PTU-OS / LOC&PAS domain.



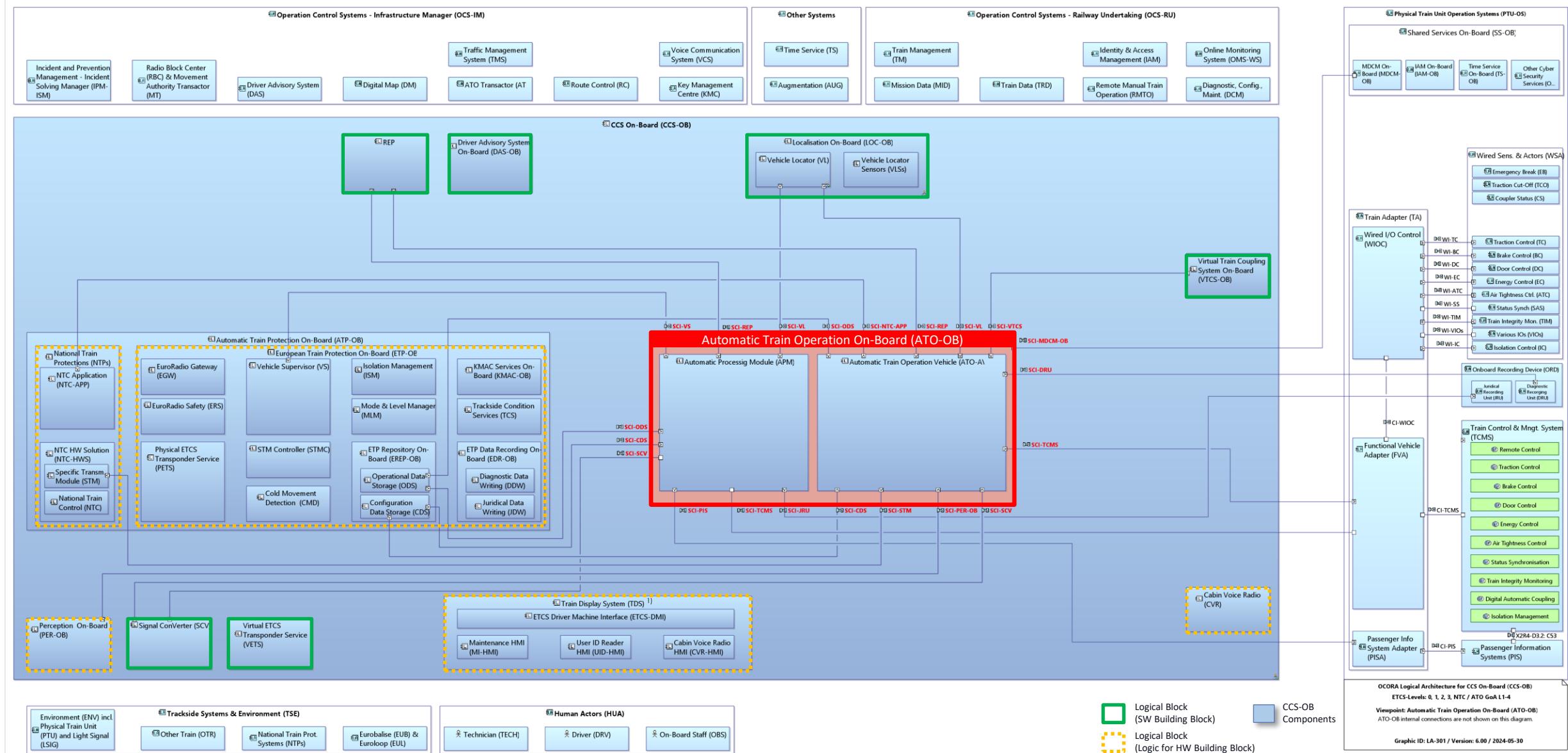
External Logical Interfaces – LOC-OB (Legacy Train Example)



- 1) TDS-OB may be moved into the PTU-OS / LOC&PA domain.



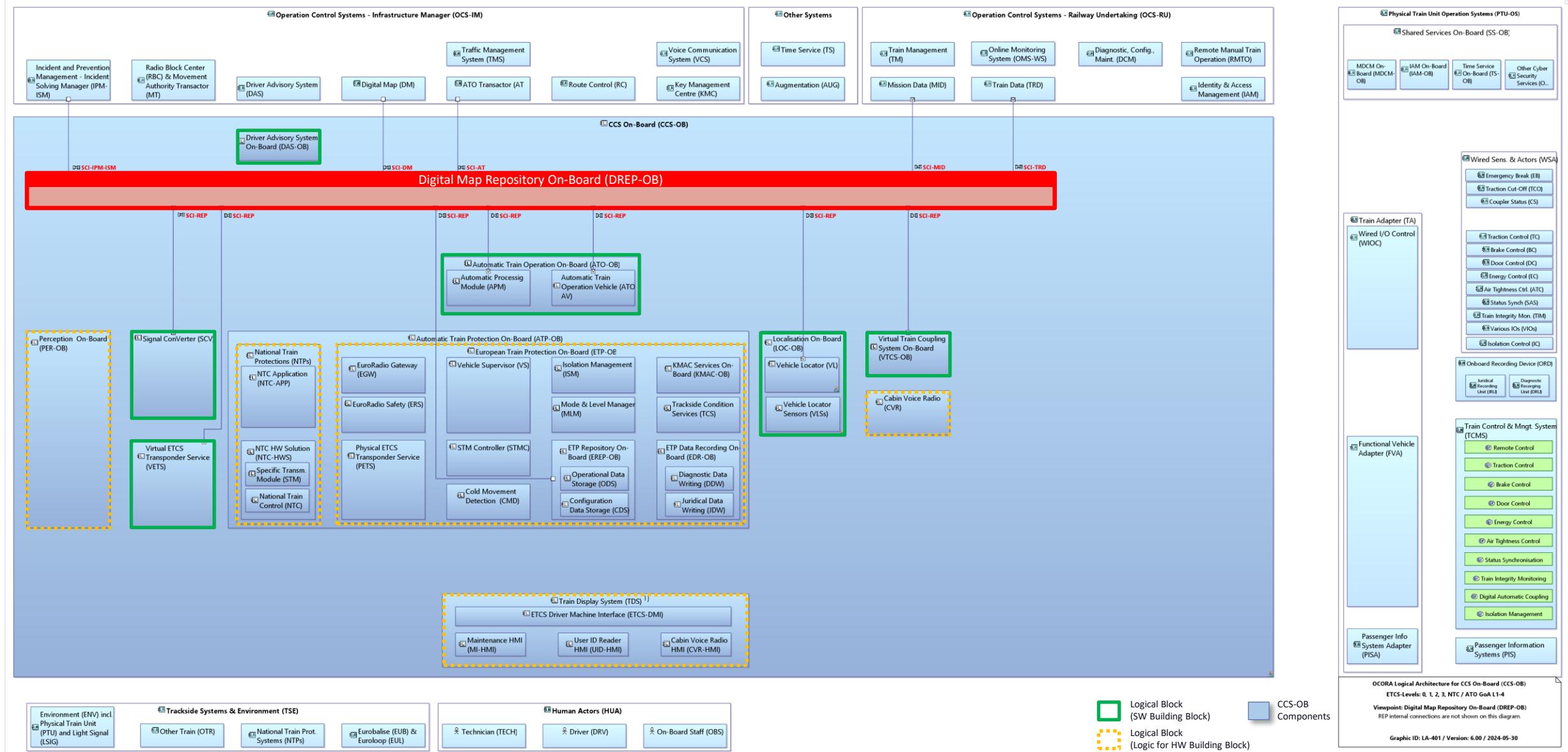
External Logical Interfaces – ATO-OB (Legacy Train Example)



- 1) TDS-OB may be moved into the PTU-OS / LOC&PA domain.



External Logical Interfaces – REP (Legacy Train Example)



1) TDS-OB may be moved into the PTU-OS / LOC&PAS domain.





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CCS On-Board (CCS-OB)

Physical Architecture – Building Blocks

OCORA-BWS02-030 / v5.10 / 01.07.2024

Definition

- A **Building Block** is a sourceable unit of the CCS on-board system (hardware and/or software), having standardised functionality, standardised PRAMSS requirements (including Tolerable Functional Failure Rate [TFFR], Safety Integrity Level [SIL] and Safety Related Application Conditions [SRAC]), standardised interfaces (on all OSI Layers) towards other building blocks and/or external systems.

Building Blocks are separately sourceable from different suppliers and capable of being integrated by a third party.

There are 2 types of building blocks: a) Hardware Building Blocks and b) Software Building Blocks.

- **Hardware Building Blocks** consist of hardware and typically software that provide the building block's functionality. They exclusively communicate with each other and with external systems through the CCS Communication Network (CCN) using standardised interfaces.
- **Software Building Blocks** consist of software that provide the building block's functionality. They are deployed on an instance of the Generic Safe Computing Platform (SCP) and shall communicate with each other through the standardised Platform Independent Application Programming Interface (PI-API). Communication with computing platform external building blocks and systems is realised by the Computing Platform (integrating with the CCN).

Software Building Blocks are portable i.e., they may be deployed on different Computing Platform implementations.



Building Blocks support the following OCORA design objectives:

- **Exchangeability:** Building Blocks are individually exchangeable, by a third party integrator, with a building blocks of the same or of a different supplier without the involvement of any other building block supplier.
- **Migrateability:** Building blocks are individually migratable (introducing bug-fixes, improvements, new functionality), without affecting the other building blocks, unless changes on external interfaces are needed that are not backward compatible (note: backward in-compatible changes must be avoided, if possible).
- **Portability:** Software Building Blocks are portable. This means, that they runs un-changed, based on the generalized abstraction, on different (computing) platform implementations.
- **Evolvability:** Building blocks support the evolvement of the overall CCS.

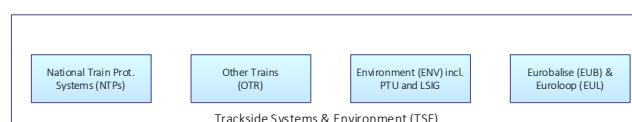
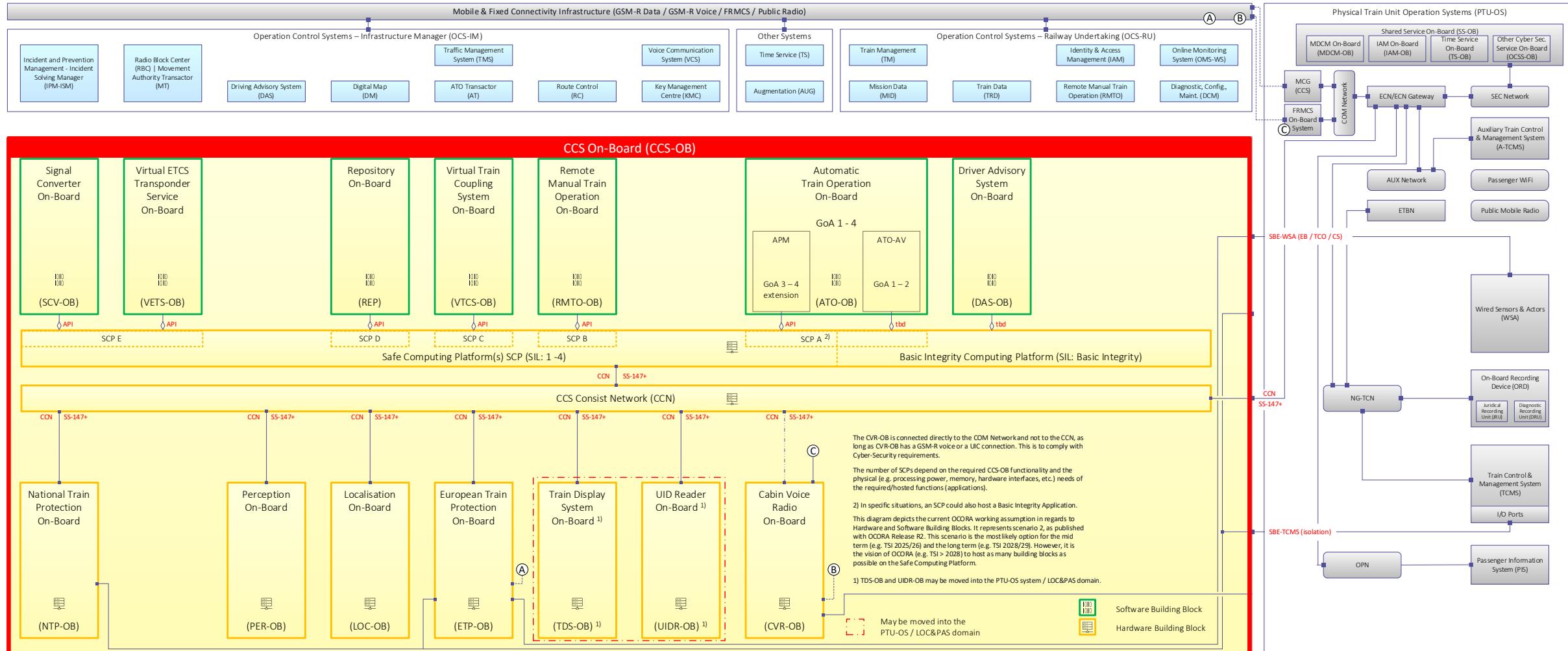
Building Blocks also support the OOCRA vision for simplicity (reduced complexity) and for improved maintainability.

CCS-OB Building Blocks (New Generation Train)



 SBB CFF FFS

OB

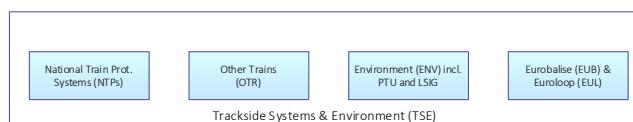
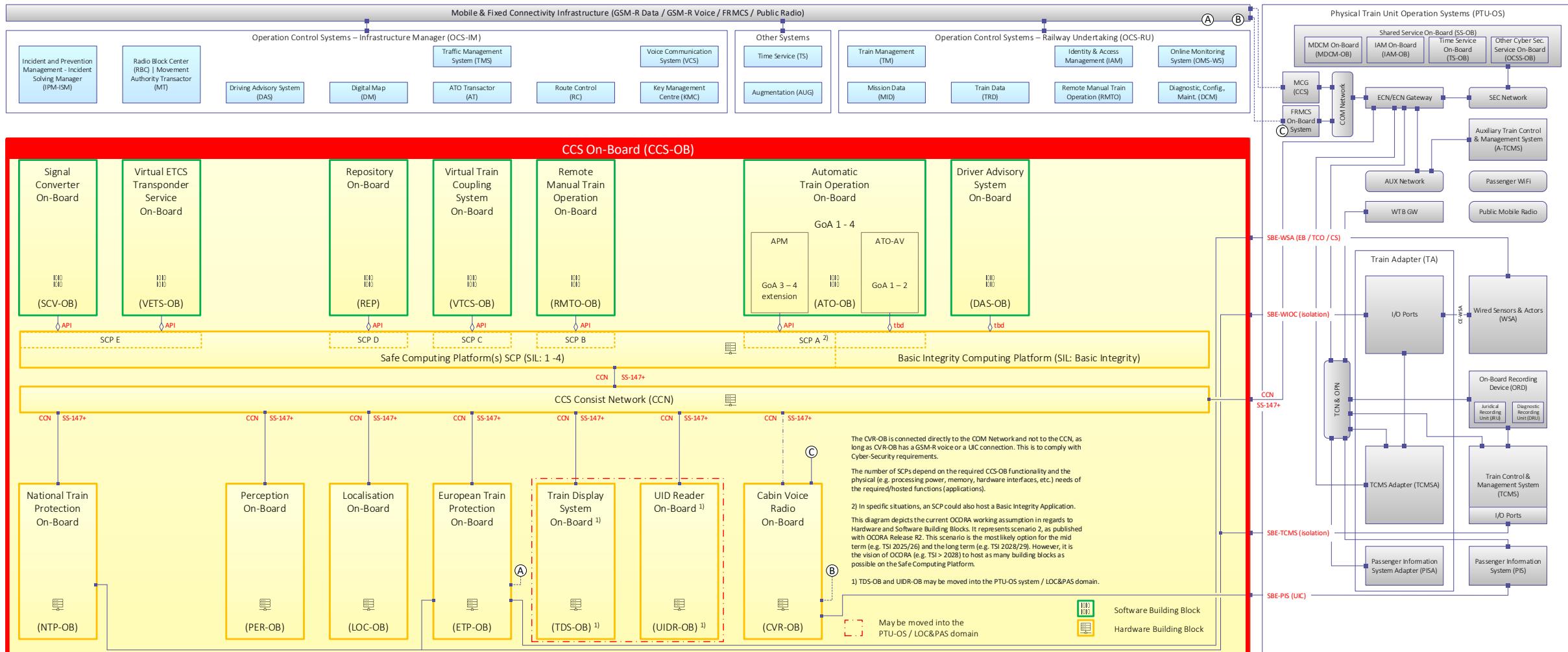


PI	Application Programming Interface	OPN	Operations Network
CN	CCS Consent Network	PER	Perception
CU	CCS Computing Unit	SBE	Standard (Building) Block Exchange
E	(Building) Block Exchange	SS-nnn+	SUBSET-nnn amended by OCORA
ON-OB	Connectivity On-Board	SS-OB	Shared Services On-Board
MI	Human Machine Interface	OPN	Operations Network
SIG	Light Signals	PTU	Physical Train Unit
CG	Mobile Communication Gateway (Public Network)	TCN	Train Communication Network
CU	Main Computing Unit	UIC	International Union of Railways
G	New Generation	IID	User Identification

OCORA Architecture
ETCS-Levels: 0, 1, 2, 3, NTC / ATO GoA Levels: 1-4
CCS On-Board (CCS-OB) – Building Block Architecture
Hardware & Software Building Blocks
New Generation Train
(TCMS compliant with SS-119+, SS-139+, SS-147+)



CCS-OB Building Blocks (Legacy Train Example)



API	Application Programming Interface	OPN	Operations Network
CCN	CCS Consist Network	PER	Perception
CCU	CCS Computing Unit	SBE	Standard (Building) Block Exchange
BE	(Building) Block Exchange	SS-nnn+	SUBSET-nnn amended by OCORA
CON-OB	Connectivity On-Board	SS-OB	Shared Services On-Board
HMI	Human Machine Interface	OPN	Operations Network
LSIG	Light Signals	PTU	Physical Train Unit
MCG	Mobile Communication Gateway (Public Network)	TCN	Train Communication Network
MCU	Main Computing Unit	UIC	International Union of Railways
NG	New Generation	UID	User Identification

OCORA Architecture
ETCS-Levels: 0, 1, 2, 3, NTC / ATO GoA Levels: 1 - 4
CCS On-Board (CCS-OB) – Building Block Architecture
Hardware & Software Building Blocks
Legacy Train Example
(TCMS not compliant with SS-119+, SS-139+, SS-147+)

Graphic ID: BA-000LTE



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CCS On-Board (CCS-OB)

Physical Architecture – Hardware Block Diagram

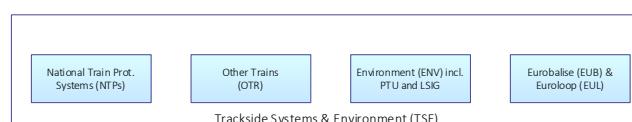
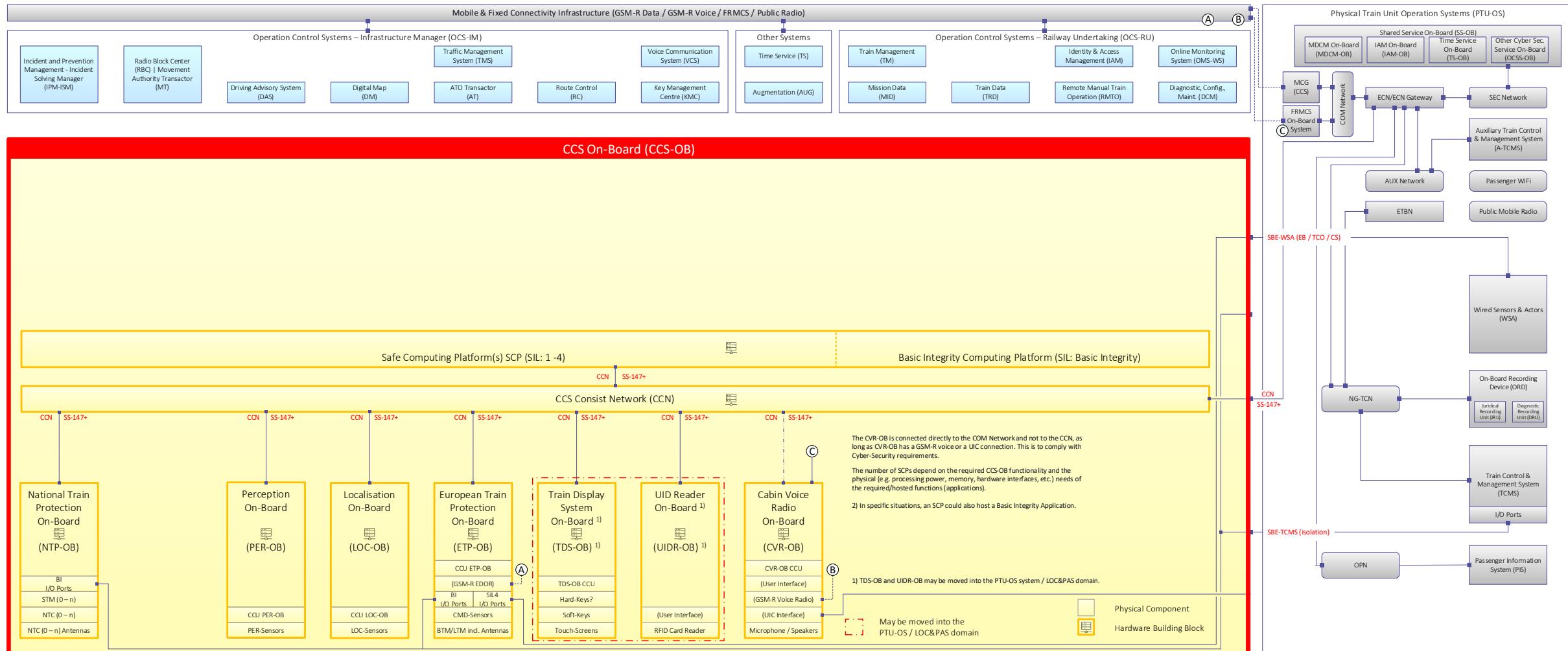
CCS-OB Hardware Block Diagram (New Generation Train)



 SBB CFF FFS

© B&B

The logo of Deutsche Bahn (DB) is displayed, consisting of the letters "DB" in a bold, red, sans-serif font, enclosed within a white square border.



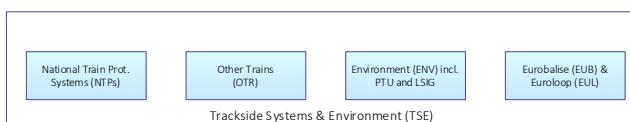
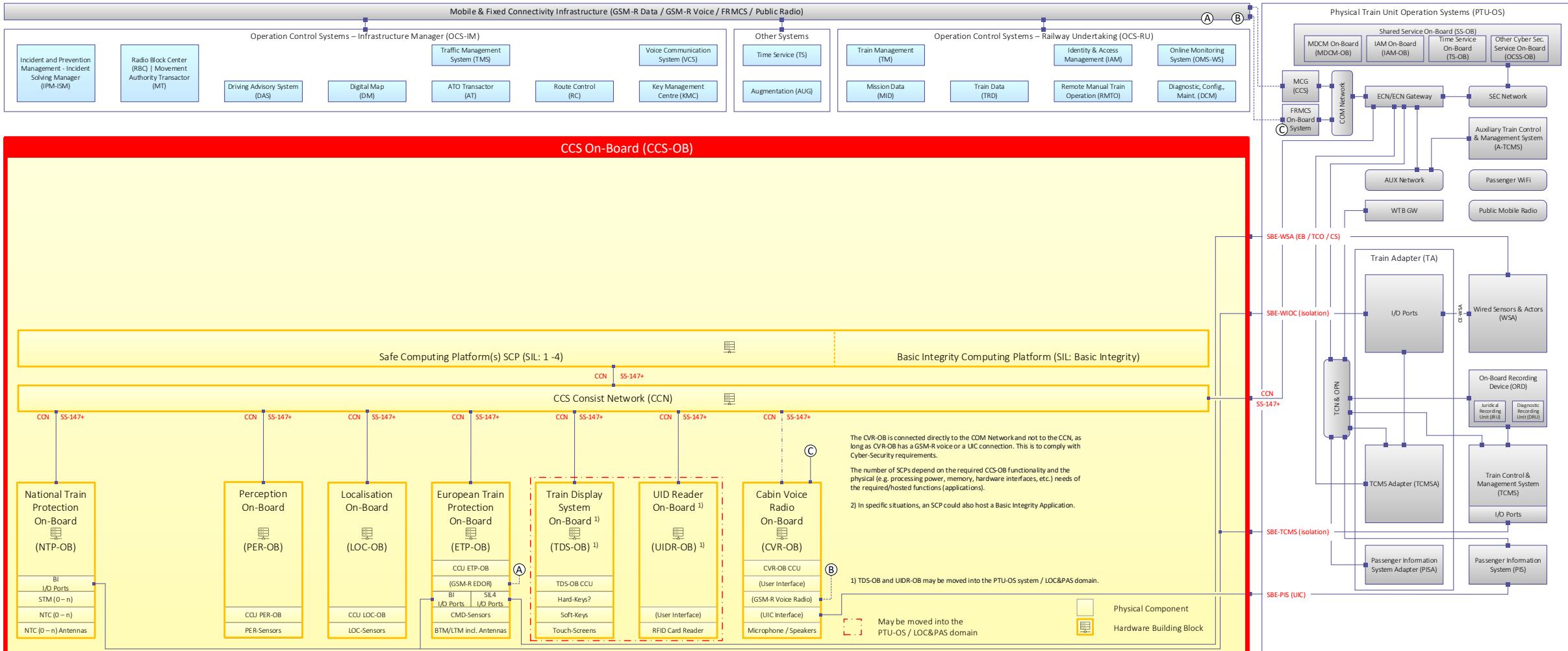
API	Application Programming Interface	OPN	Operations Network	
CCN	CCS Consist Network	PER	Perception	OCORA Architecture ETCS-Levels: 0, 1, 2, 3, NTC / ATC GoA Levels: 1 - 4
CCU	CCS Computing Unit	SBE	Standard (Building) Block Exchange	
BE	(Building) Block Exchange	SS-nnn+	SUBSET-nnn amended by OCORA	
CON-OB	Connectivity On-Board	SS-OB	Shared Services On-Board	CCS On-Board (CCS-OB) – Physical Architecture Physical Components New Generation Train (TCMS compliant with SS-119+, SS-139+, SS-147+)
HMI	Human Machine Interface	OPN	Operations Network	
LSIG	Light Signals	PTU	Physical Train Unit	
MCG	Mobile Communication Gateway (Public Network)	TCN	Train Communication Network	
MCU	Main Computing Unit	UIC	International Union of Railways	
NG	New Generation	UID	User Identification	



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CCS-OB Hardware Block Diagram (Legacy Train Example)



API	Application Programming Interface	OPN	Operations Network
CCN	CCS Consist Network	PER	Perception
CCU	CCS Computing Unit	SBE	Standard (Building) Block Exchange
BE	(Building) Block Exchange	SS-nnn+	SUBSET-nnn amended by OCORA
CON-OB	Connectivity On-Board	SS-OB	Shared Services On-Board
HMI	Human Machine Interface	OPN	Operations Network
LSIG	Light Signals	PTU	Physical Train Unit
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MCU	Main Computing Unit	UIC	International Union of Railways
NG	New Generation	UID	User Identification

OCORA Architecture
ETCS-Levels: 0, 1, 2, 3, NTC / ATO GoA Levels: 1 - 4

CCS On-Board (CCS-OB) – Physical Architecture
Physical Components
Legacy Train example
(TCMS not compliant with SS-119+, SS-139+, SS-147+)

Graphic ID: PA-020-LTE Version 6.00 / 2024-05-30





SBB CFF FFS

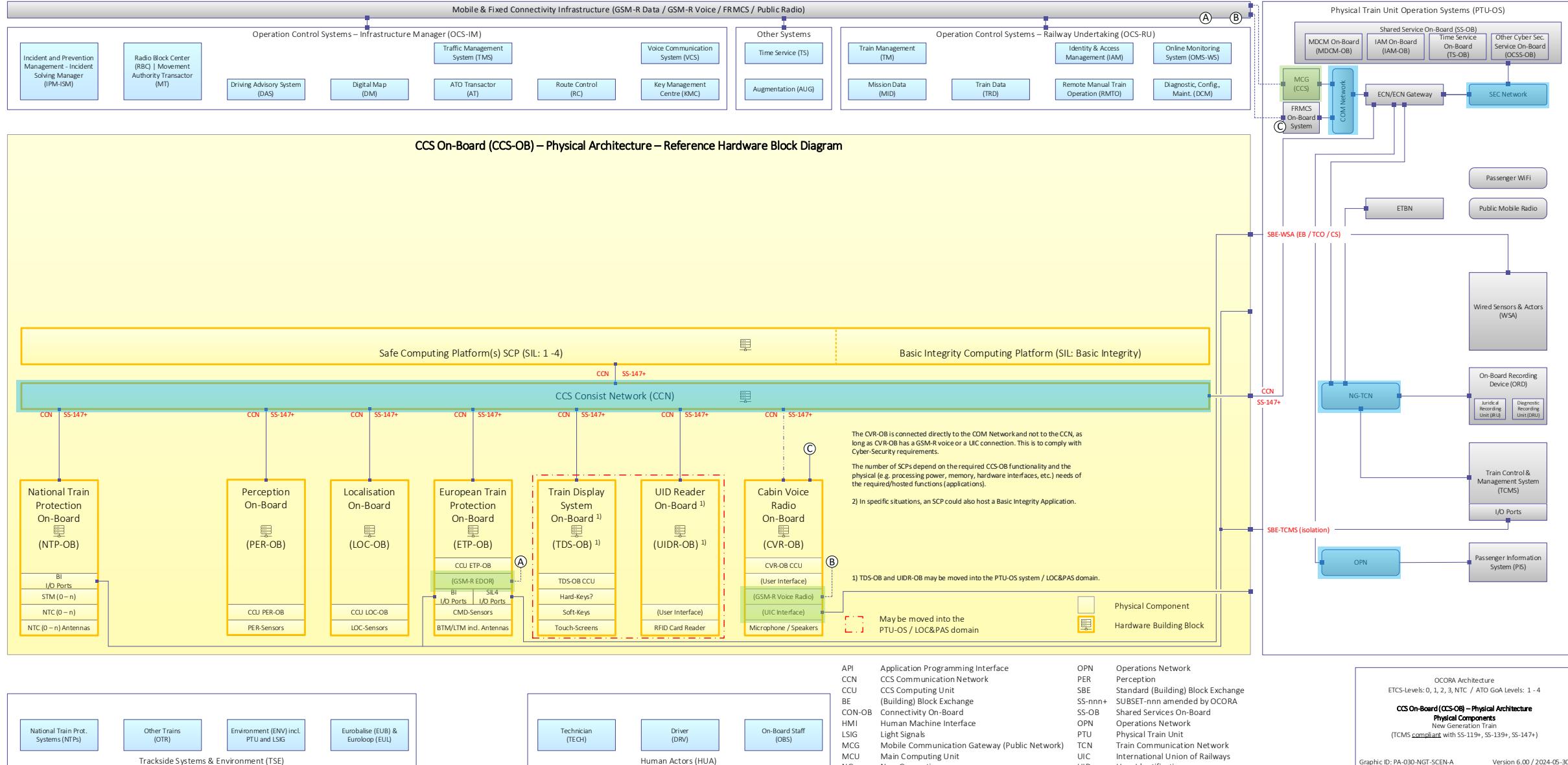


CCS On-Board (CCS-OB)

Physical Architecture – Train Integration Scenarios

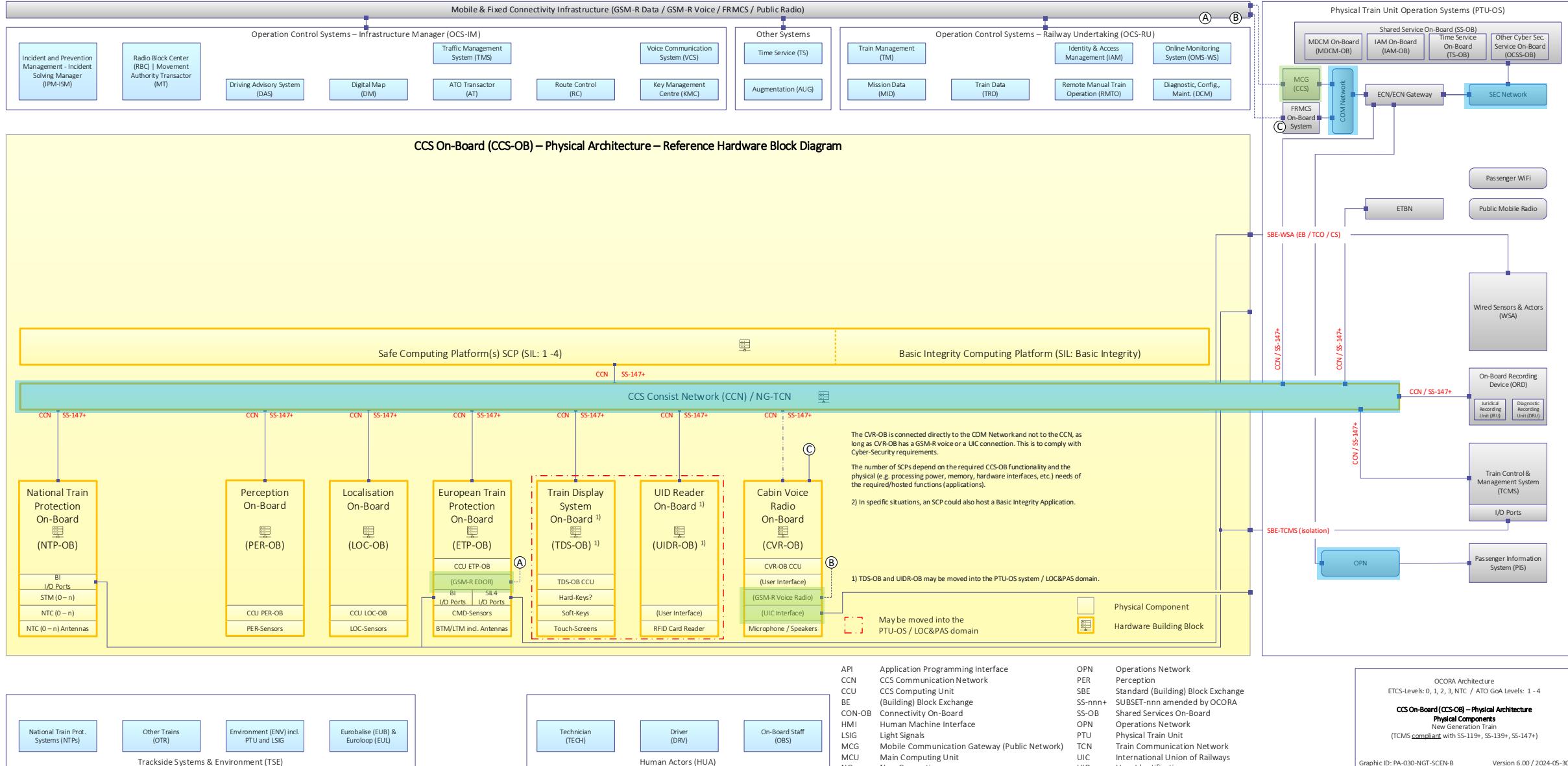
NG-TCN Train – Scenario A

(CCN as physically separated network from Sec Net, Op Net, NG TCN and Com Net with support for legacy trackside infrastructure)



NG-TCN Train – Scenario B

(CCN as logically separated network from NG TCN and physically separated from Sec Net, Op Net and Com Net with support for legacy trackside infrastructure)



API	Application Programming Interface	OPN	Operations Network
CCN	CCS Communication Network	PER	Perception
CCU	CCS Computing Unit	SBE	Standard (Building) Block Exchange
BE	(Building) Block Exchange	SS-nnn+	SUBSET-nnn amended by OCORA
CON-OB	Connectivity On-Board	SS-OB	Shared Services On-Board
HMI	Human Machine Interface	OPN	Operations Network
LSIG	Light Signals	PTU	Physical Train Unit
MCG	Mobile Communication Gateway (Public Network)	TCN	Train Communication Network
MCU	Main Computing Unit	UIC	International Union of Railways
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OCORA Architecture
ETCS-Levels: 0, 1, 2, 3, NTC / ATC GoA Levels: 1 - 4
CCS On-Board (CCS-OB) – Physical Architecture
Physical Components
New Generation Train
(TCMS compliant with SS-119+, SS-139+, SS-147+)

Graphic ID: PA-030-NGT-SCEN-B Version 6.00 / 2024-05-30



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NG-TCN Train – Scenario C

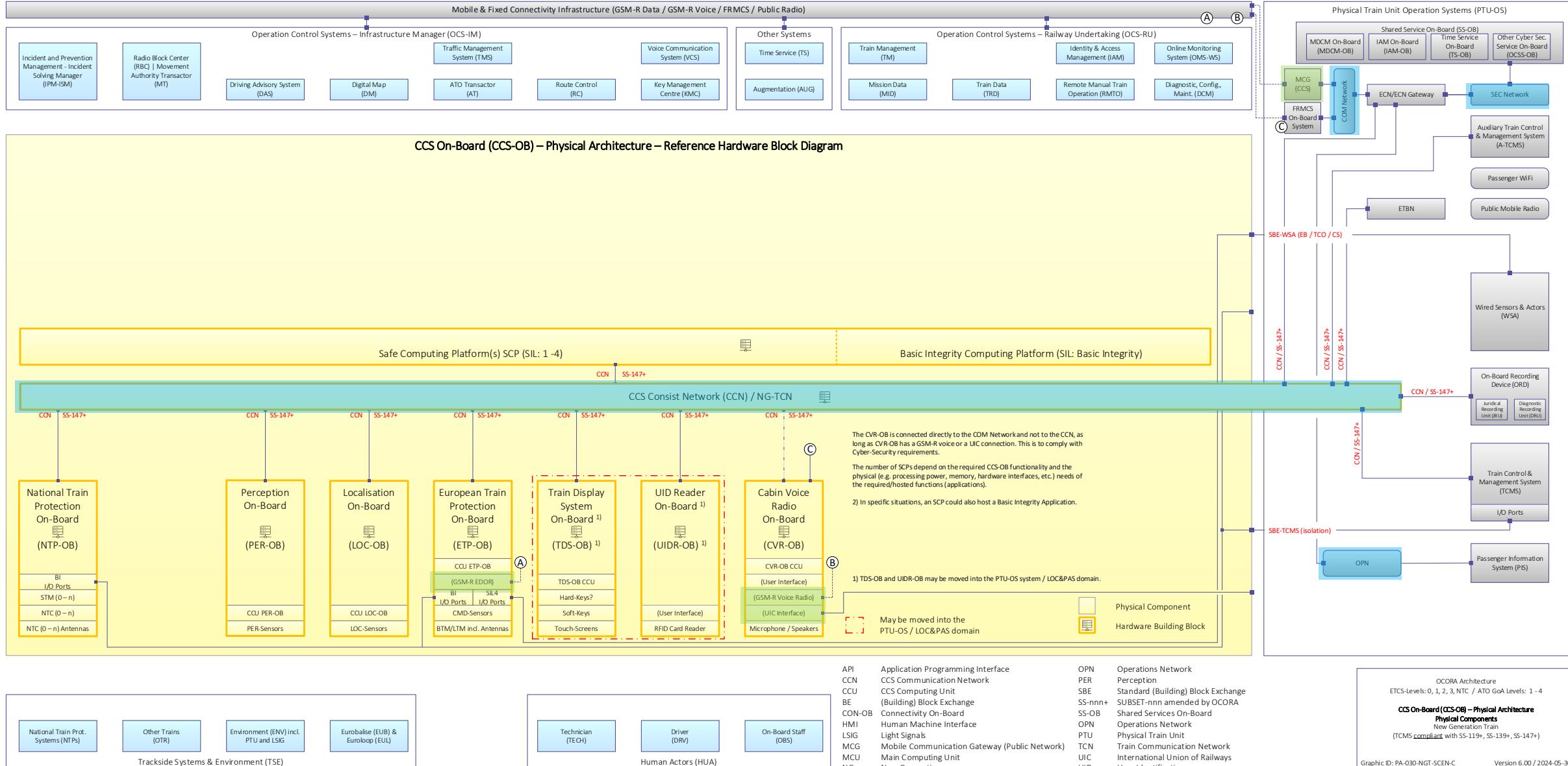
(Common CCN and TCMS network logically separated from A-TCMS and physically separated from Sec Net, Op Net and Com Net with support for legacy trackside infrastructure)



SBB CFF FFS

ÖBB

DB

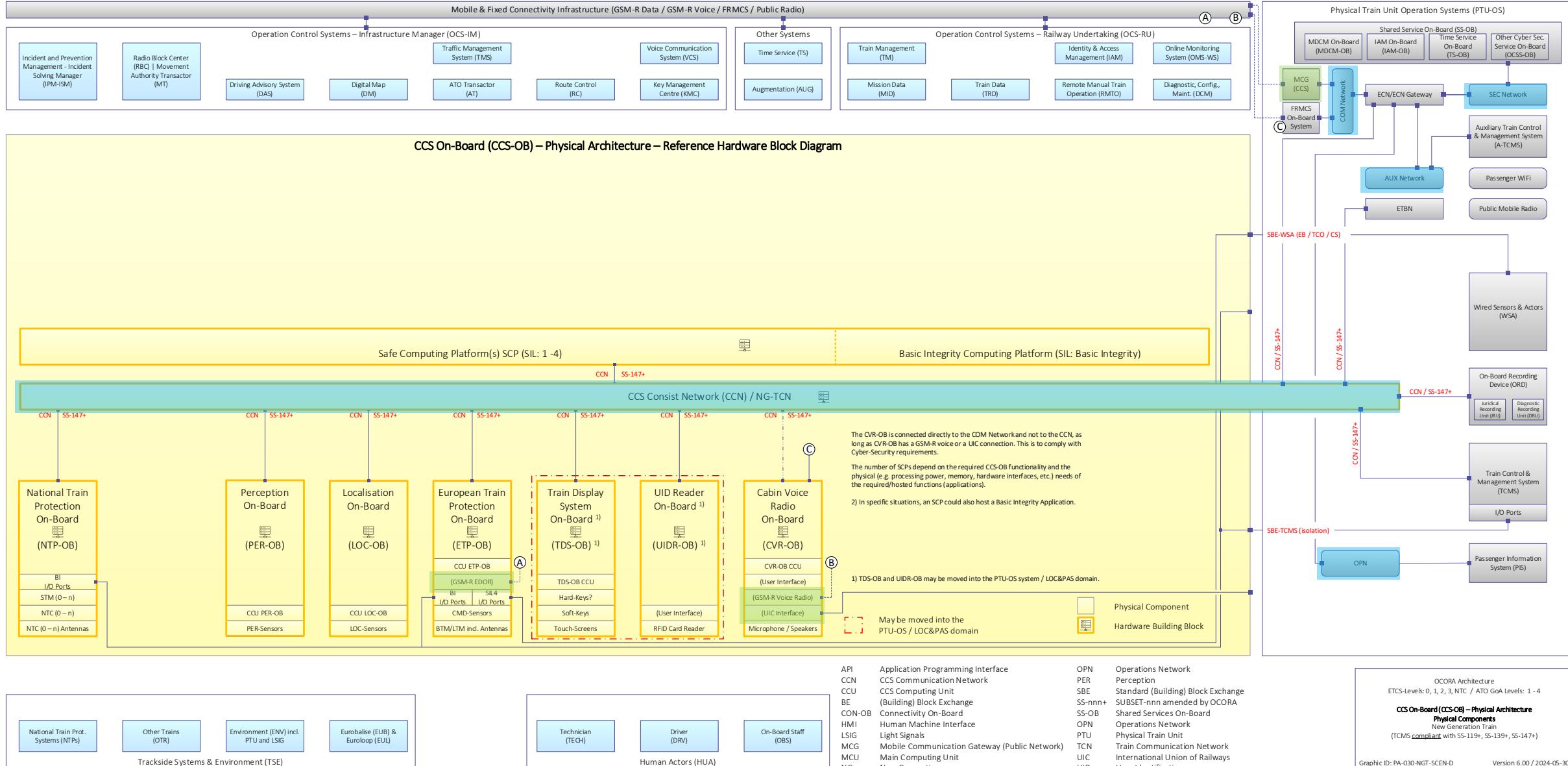


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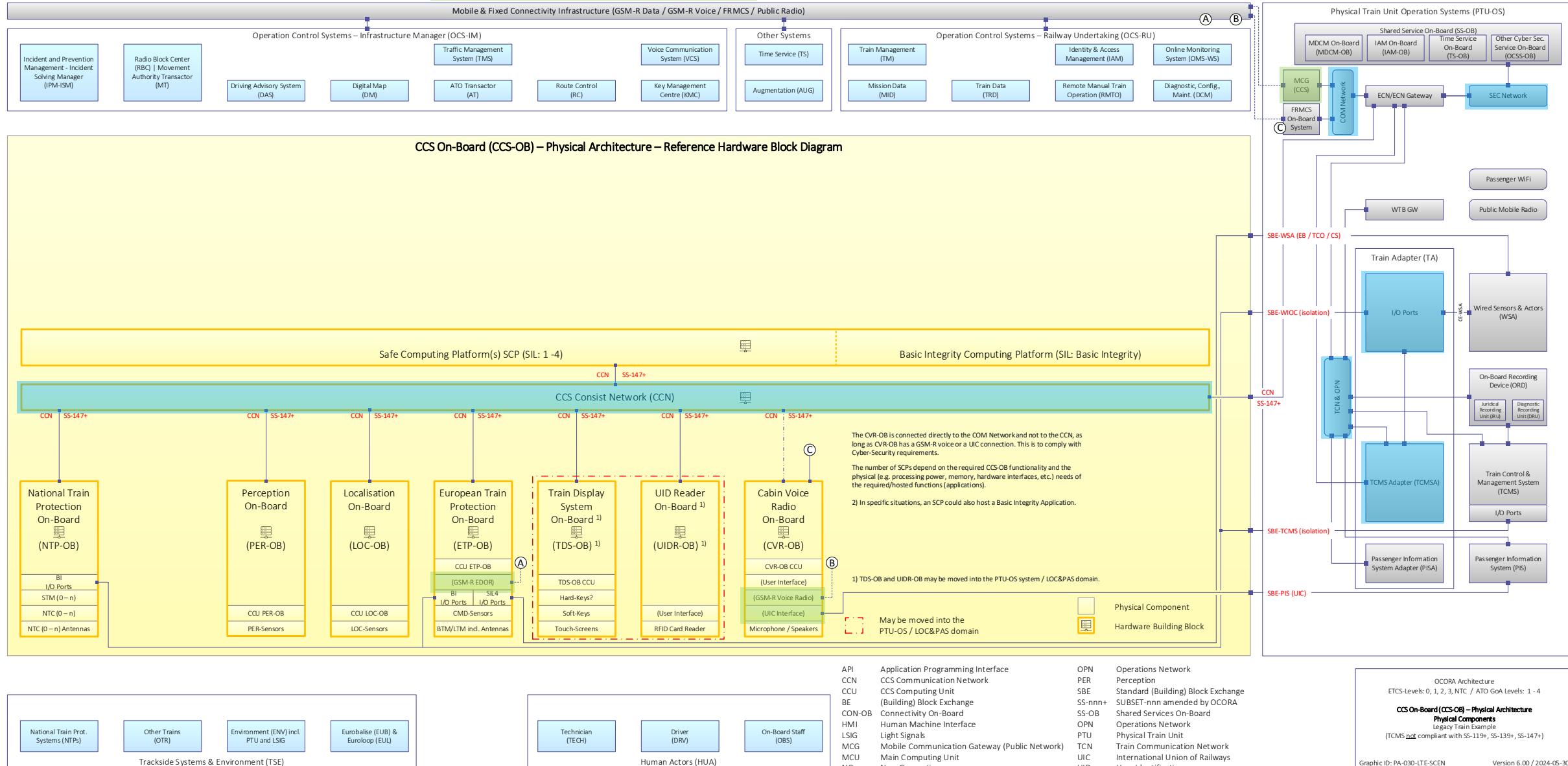
NG-TCN Train – Scenario D

(Common CCN and TCMS network physically separated from A-TCMS, Sec Net, Op Net and Com Net with support for legacy trackside infrastructure)



Legacy Train

(CCN physically separated from Sec Net and Com Net using the OCORA GW connecting to the TCMS / PIS Networks. Support for legacy trackside infrastructure)

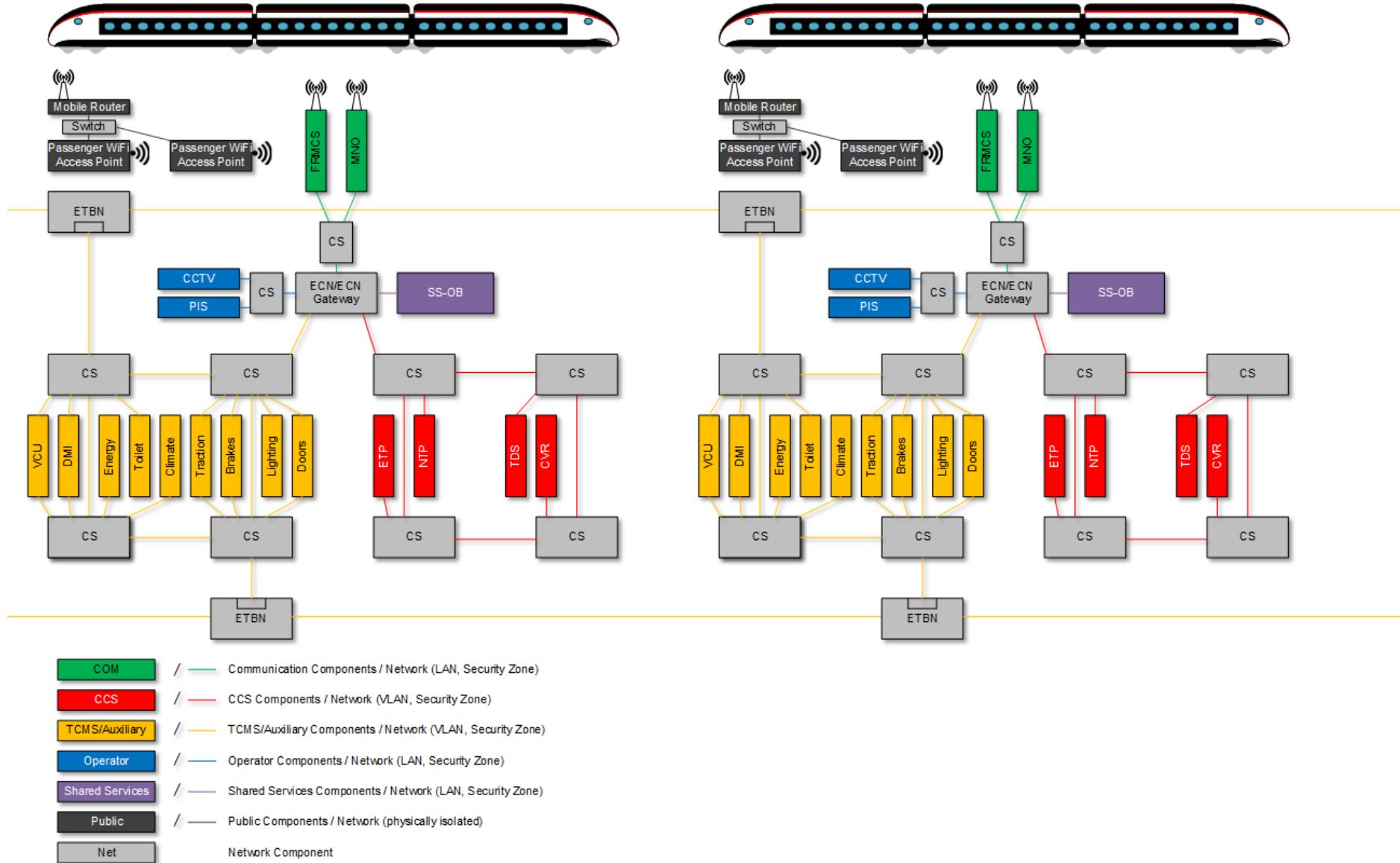




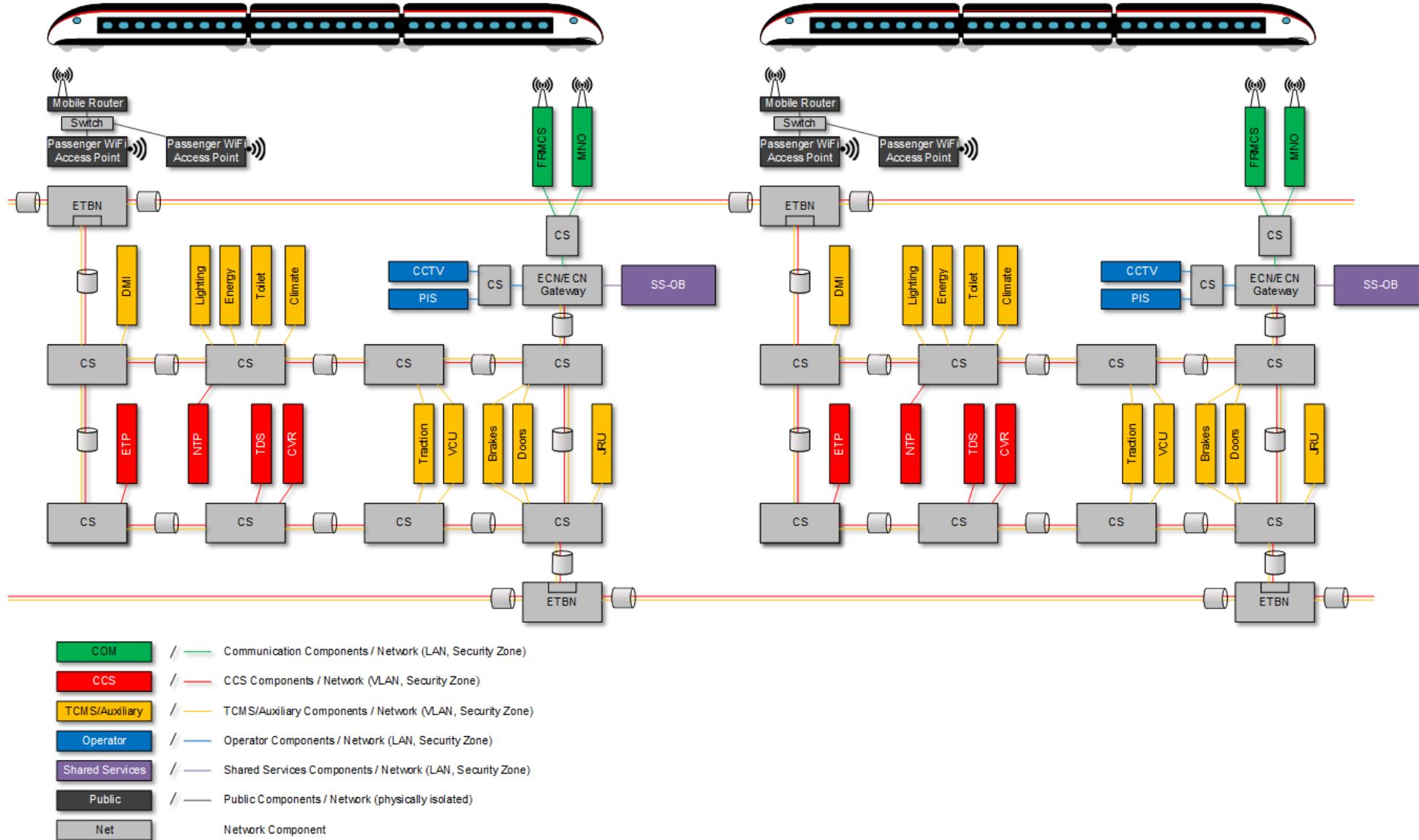
CCS On-Board (CCS-OB)

Physical Architecture – Network Topology Scenarios

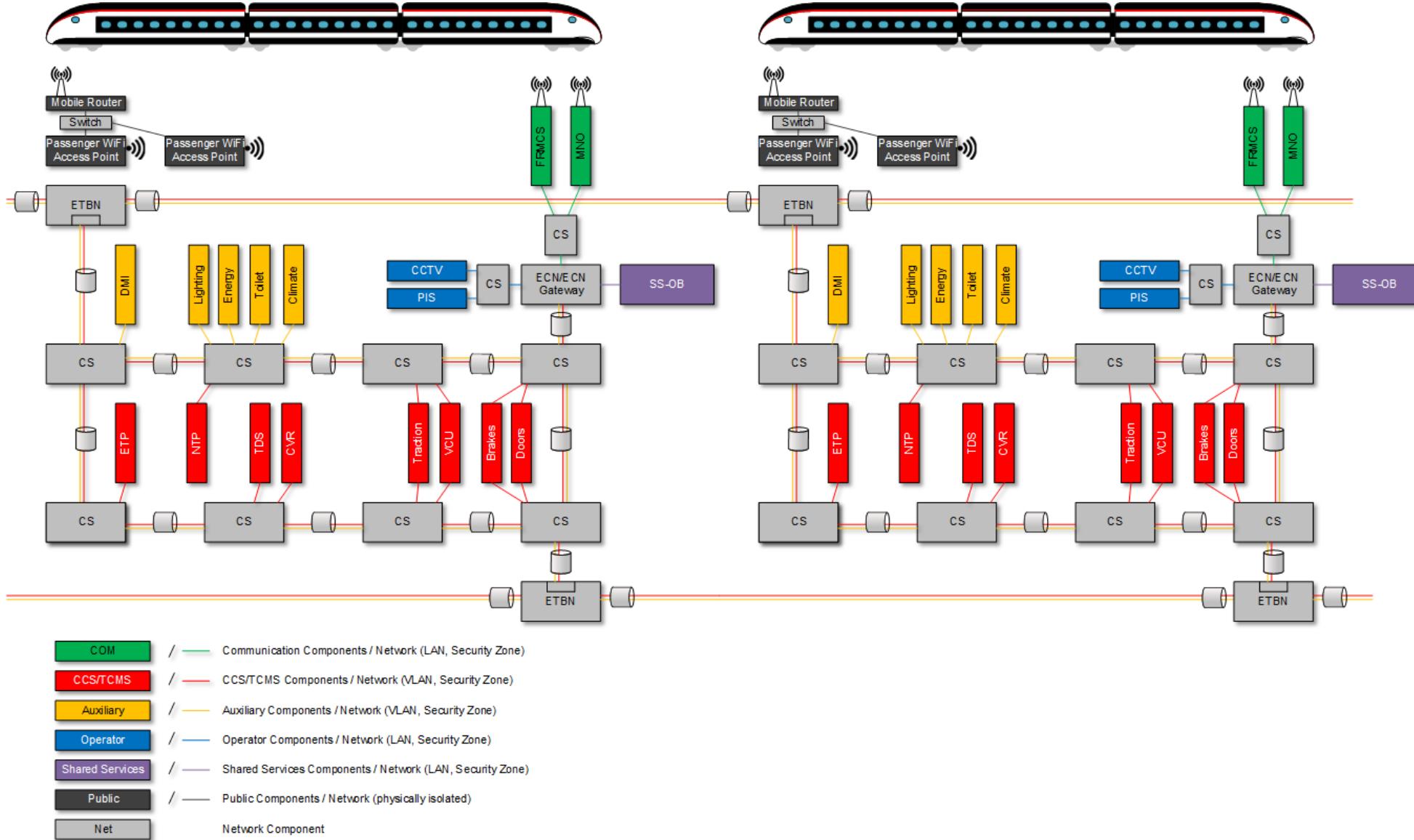
Scenario A: CCN as physically separated network



Scenario B: CCN as logically separated network



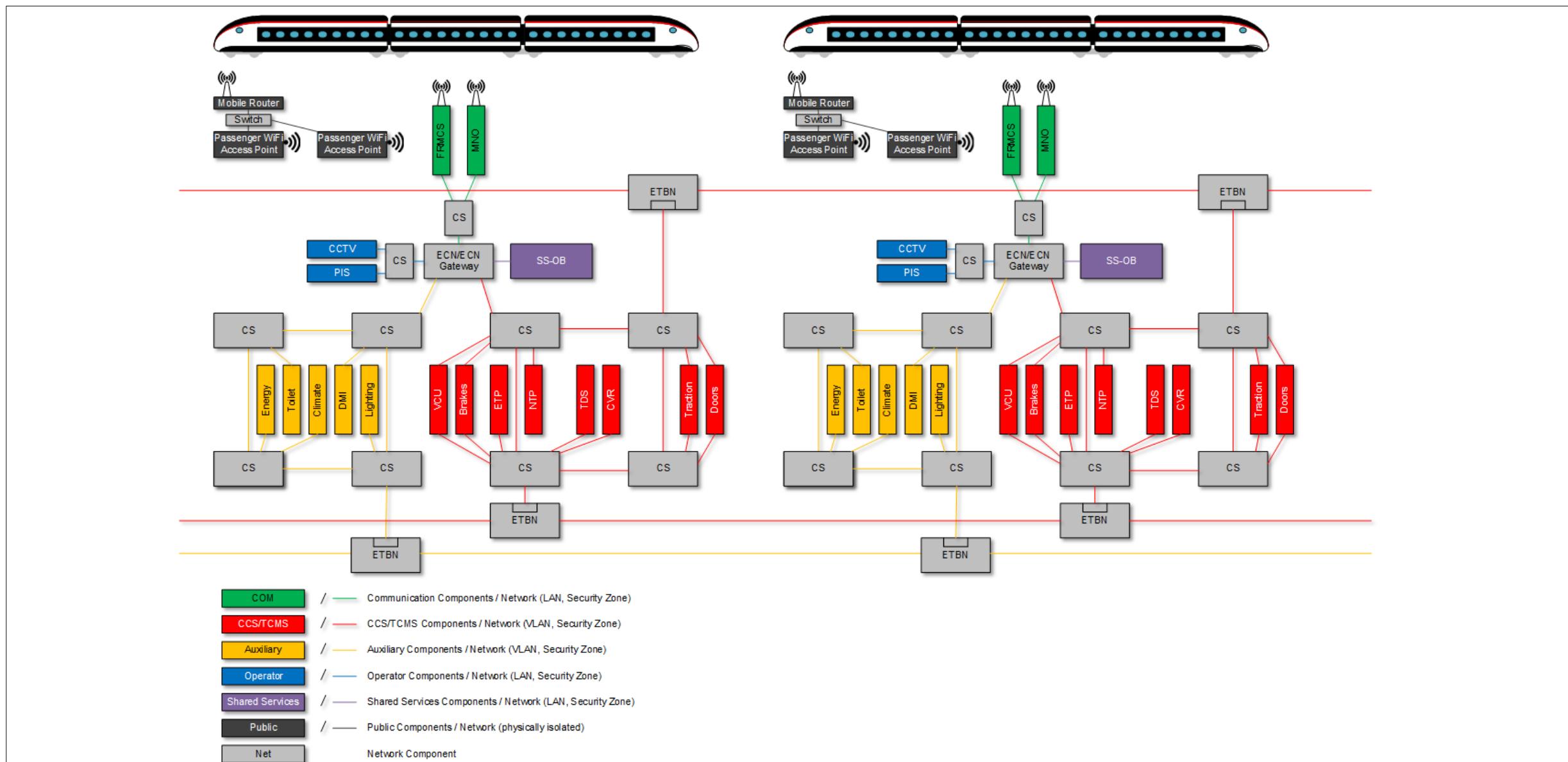
Scenario C: Common critical control network logically separated



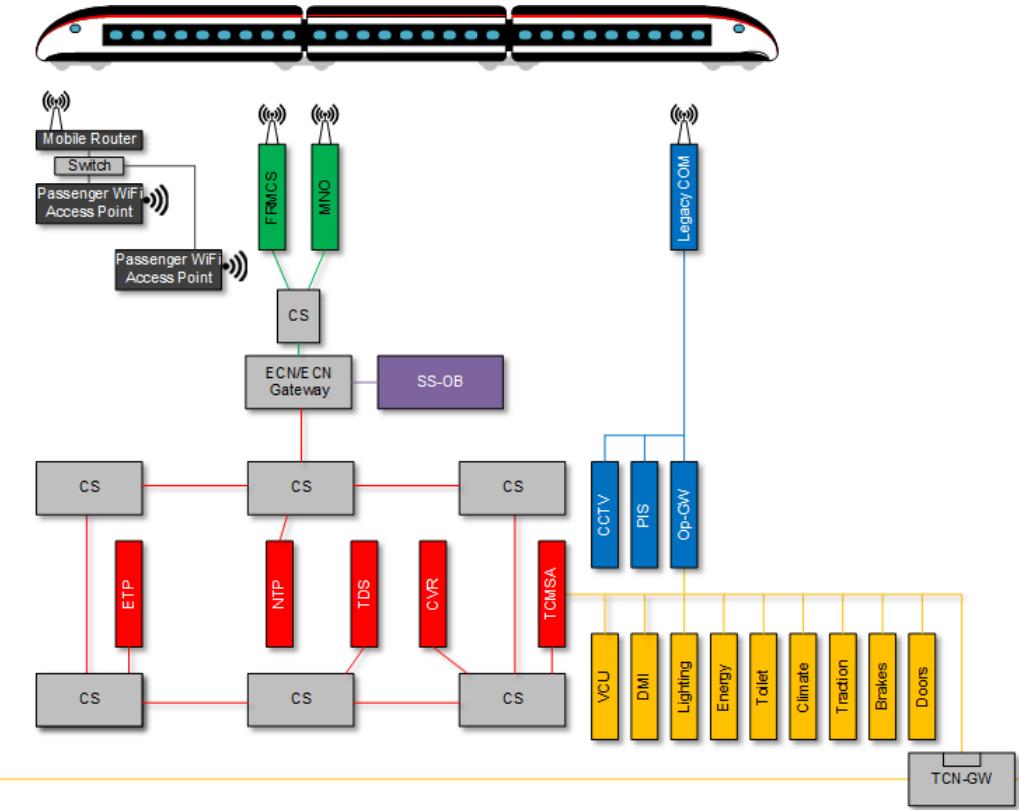
Scenario D: Common critical control network physically separated



SBB CFF FFS

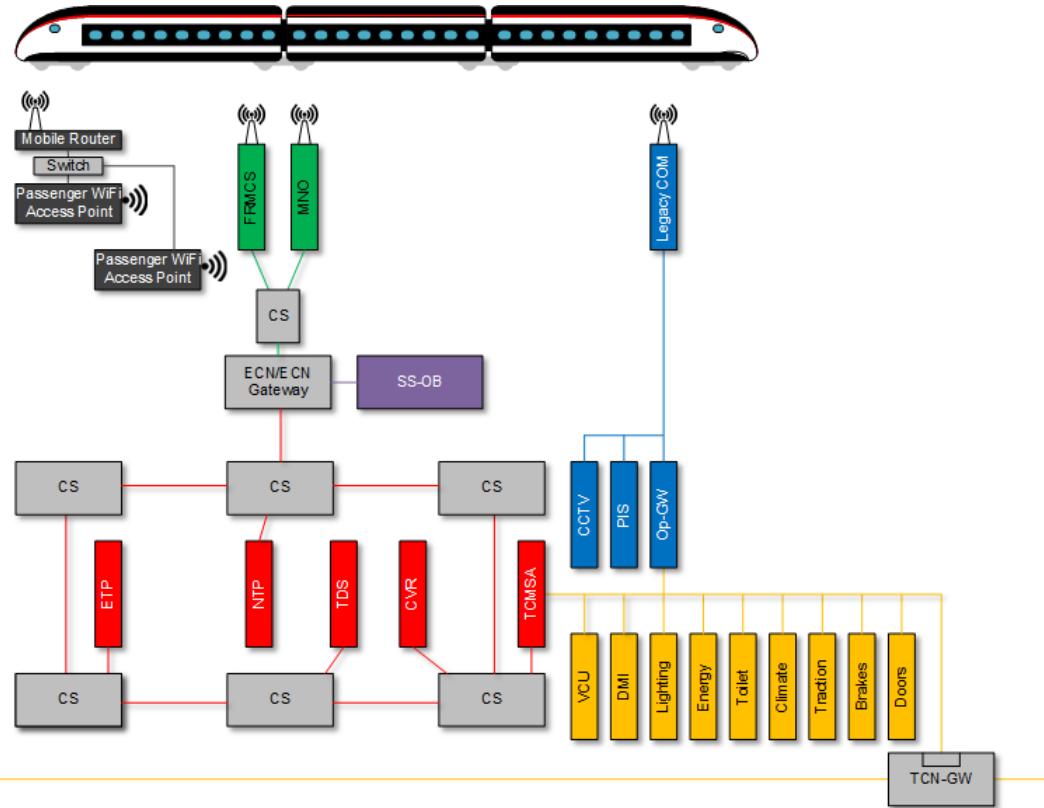


Legacy Train – Integration with OCORA-GW



COM	/	Communication Components / Network (LAN, Security Zone)
CCS	/	CCS Components / Network (VLAN, Security Zone)
TCMS/Auxiliary	/	TCMS/Auxiliary Components / Network (VLAN, Security Zone)
Operator	/	Operator Components / Network (LAN, Security Zone)
Shared Services	/	Shared Services Components / Network (LAN, Security Zone)
Public	/	Public Components / Network (physically isolated)
Net		Network Component

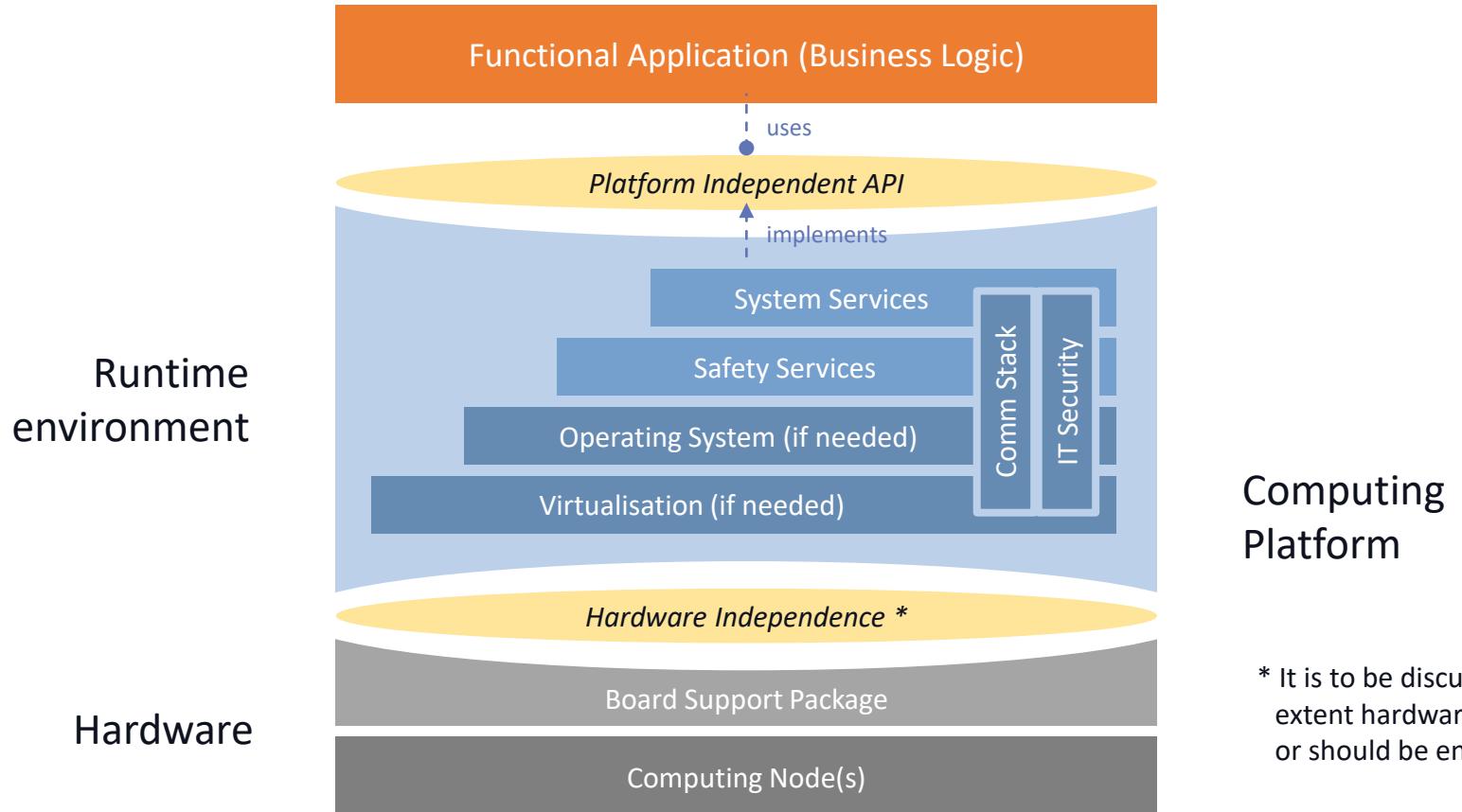
Remark: The network architecture of retrofit vehicles is only an example. Legacy architectures are always vehicle dependent and therefore the CCS integration is project specific.



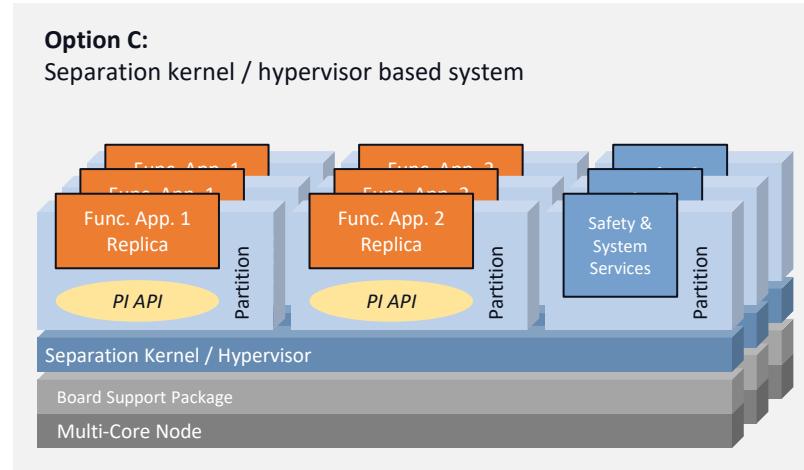
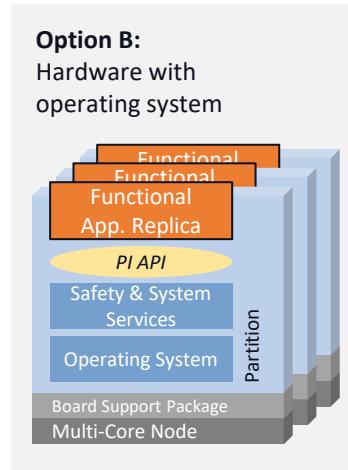
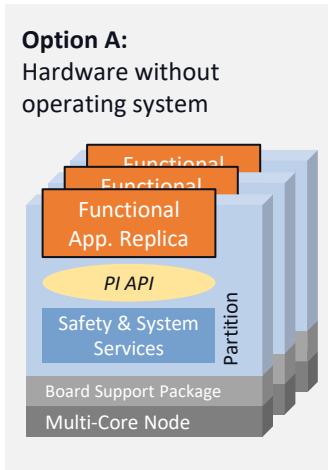


Safe Computing Platform (SCP)

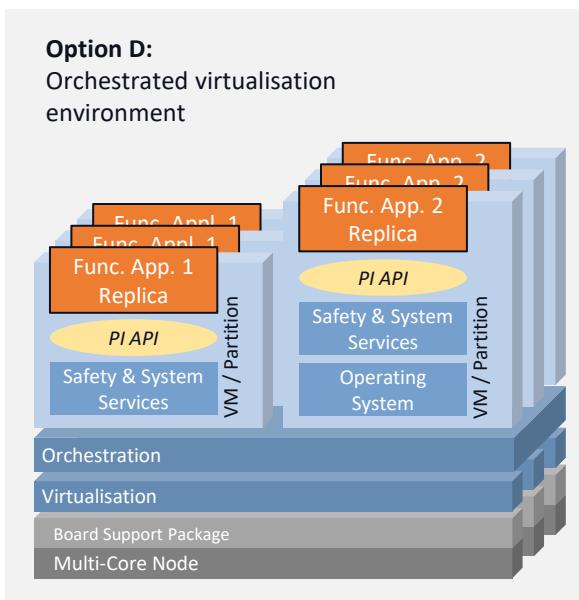
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Computing Platform – Deployment Options



Likely options for **onboard** deployments



Likely option for **trackside** deployments

Platform options where applications are programmed against PI API
Approaches depicted in the diagram are non-exhaustive. The industry may propose different state-of-the-art solutions.



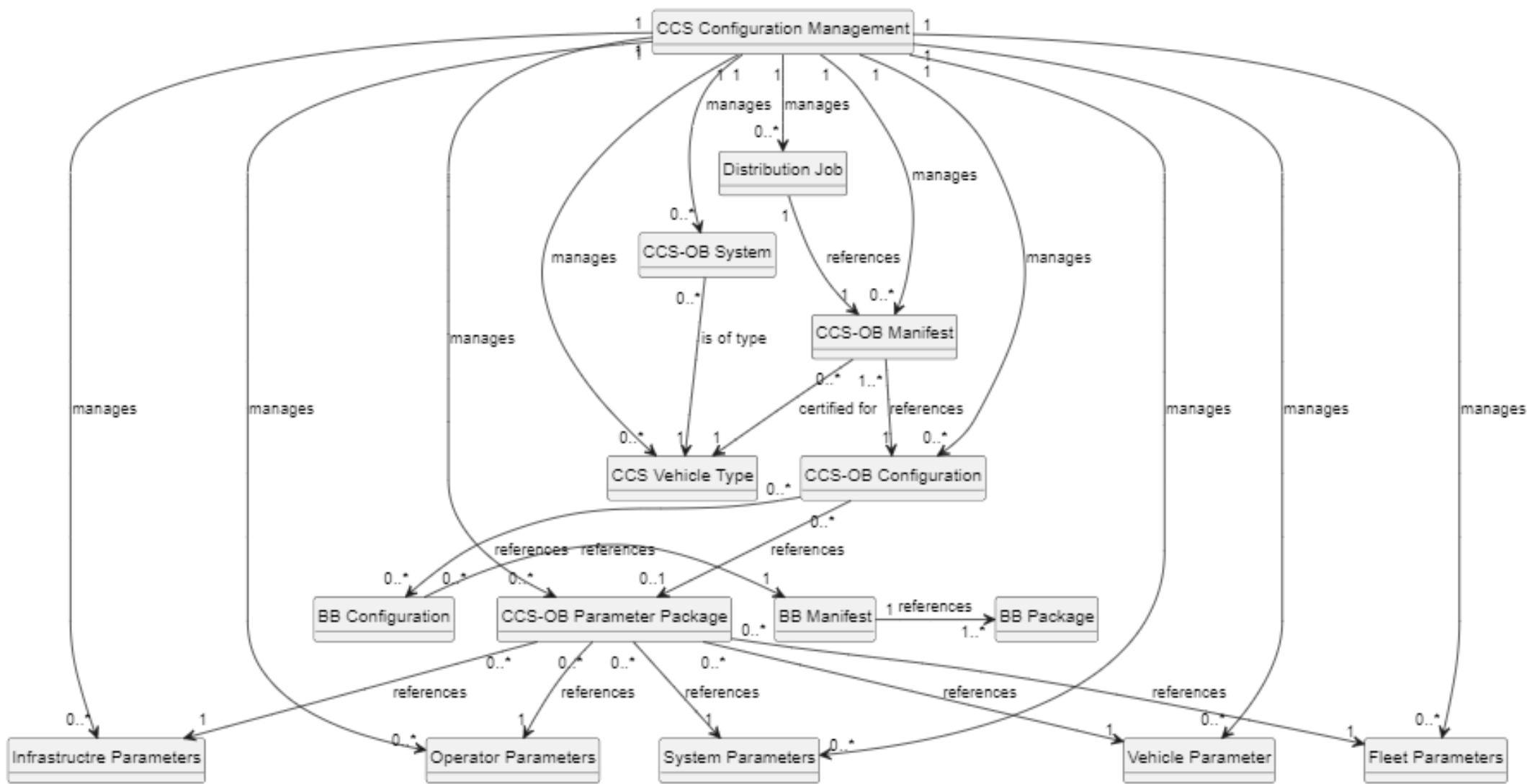
Configuration Management Concept

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Entity Relationship Diagram



 SNCF



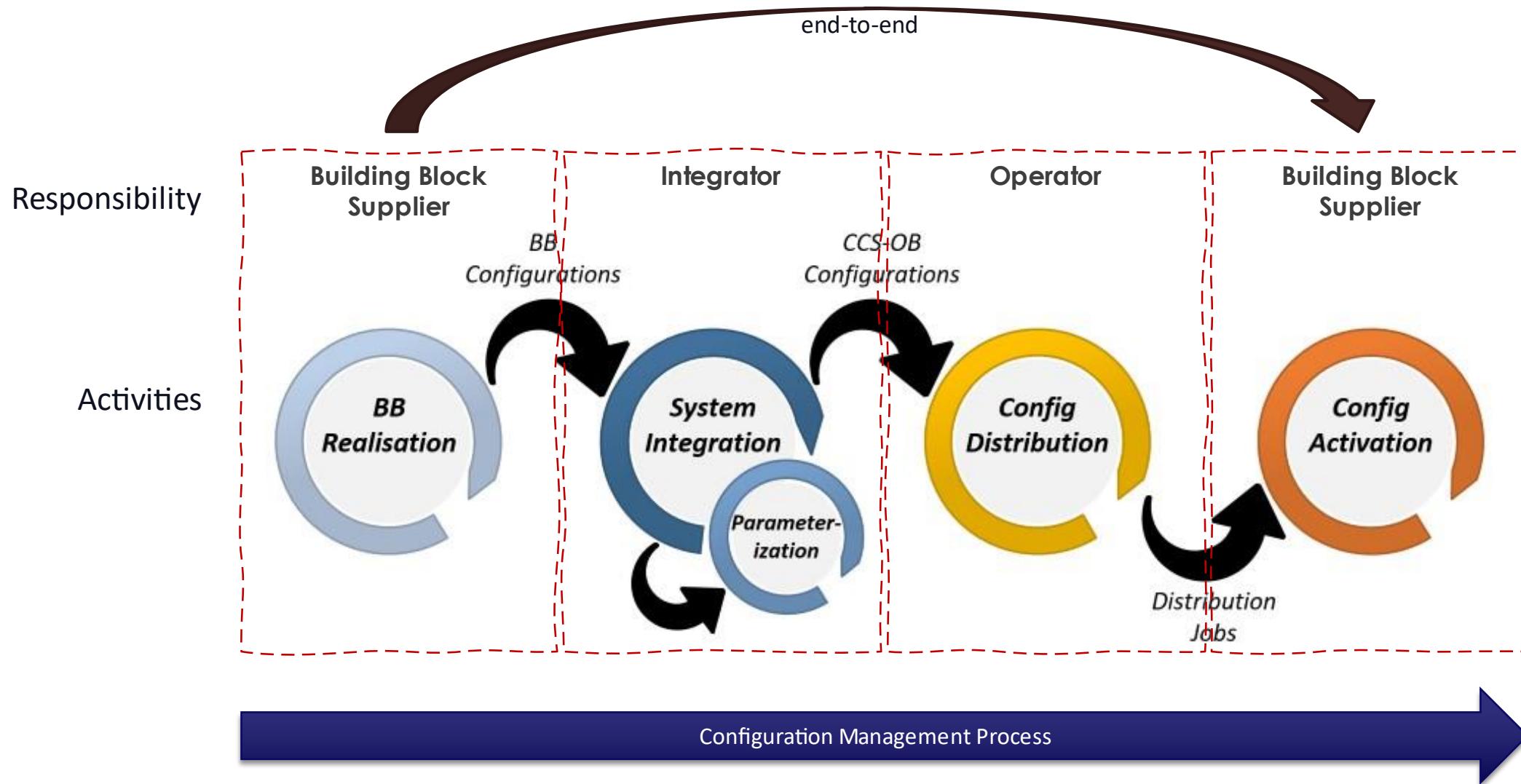
OCORA

OCORA-BWS02-030 / v5.10 / 01.07.2024

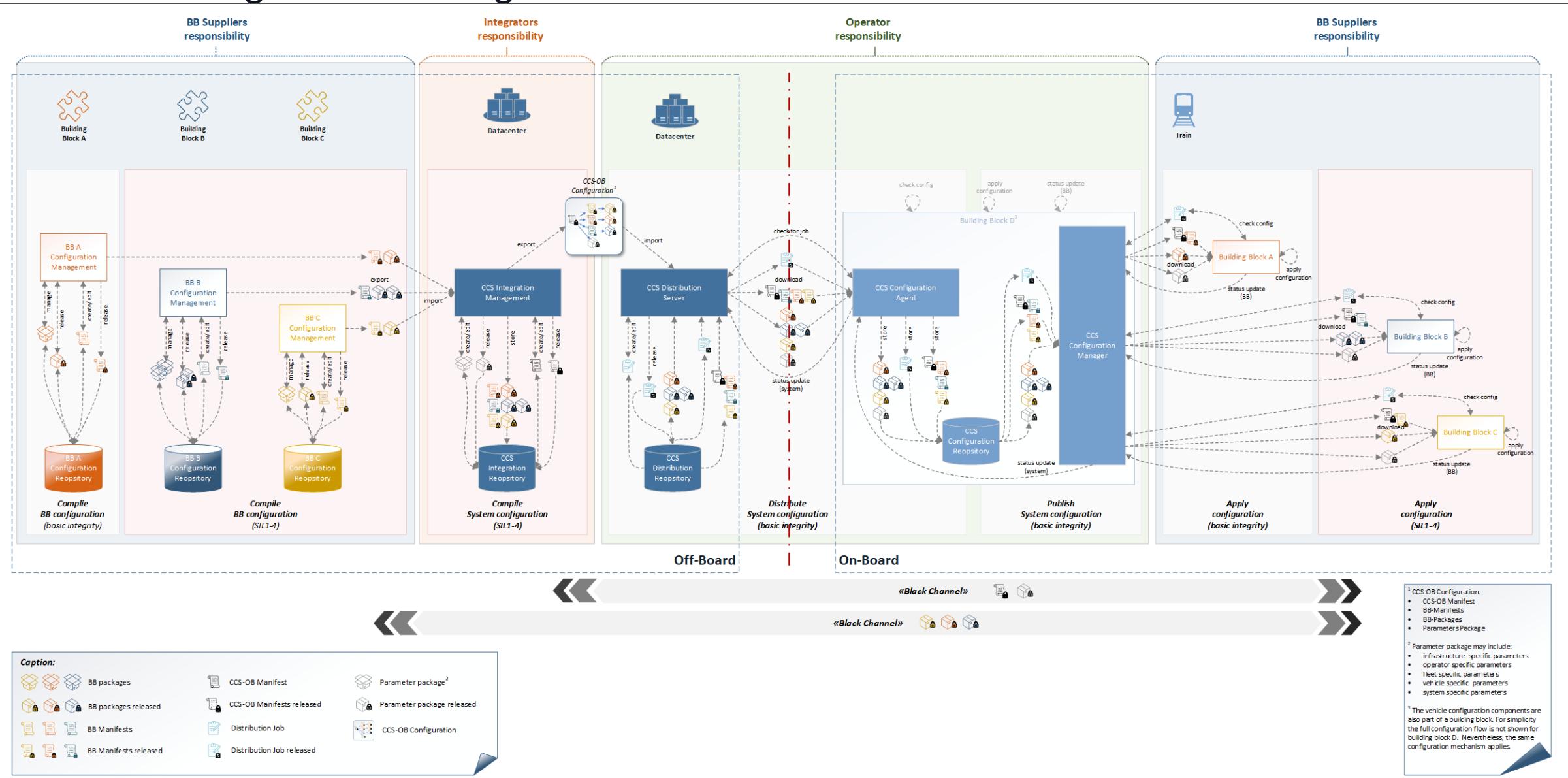
Configuration Management Stakeholders & Activities

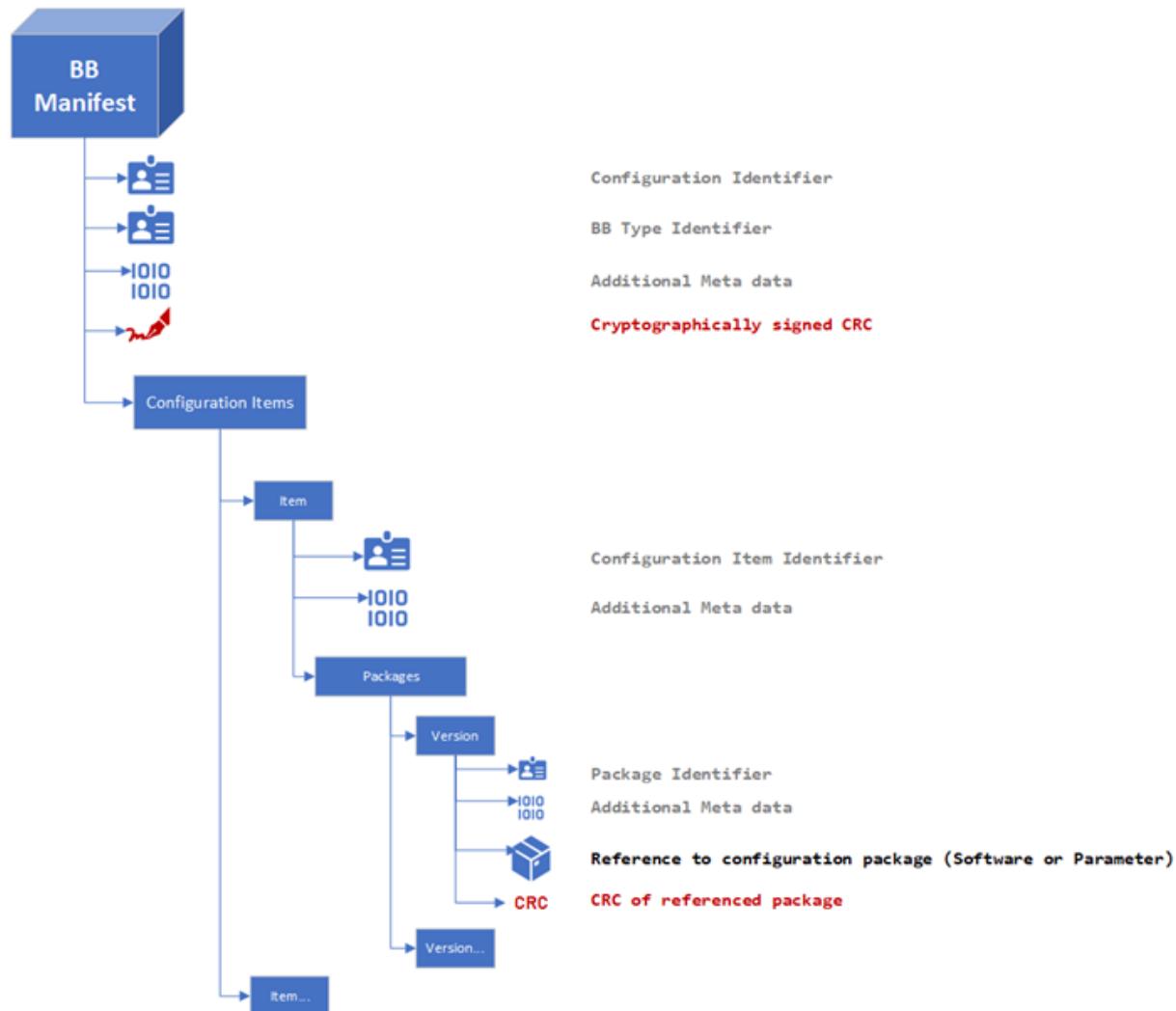


SBB CFF FFS

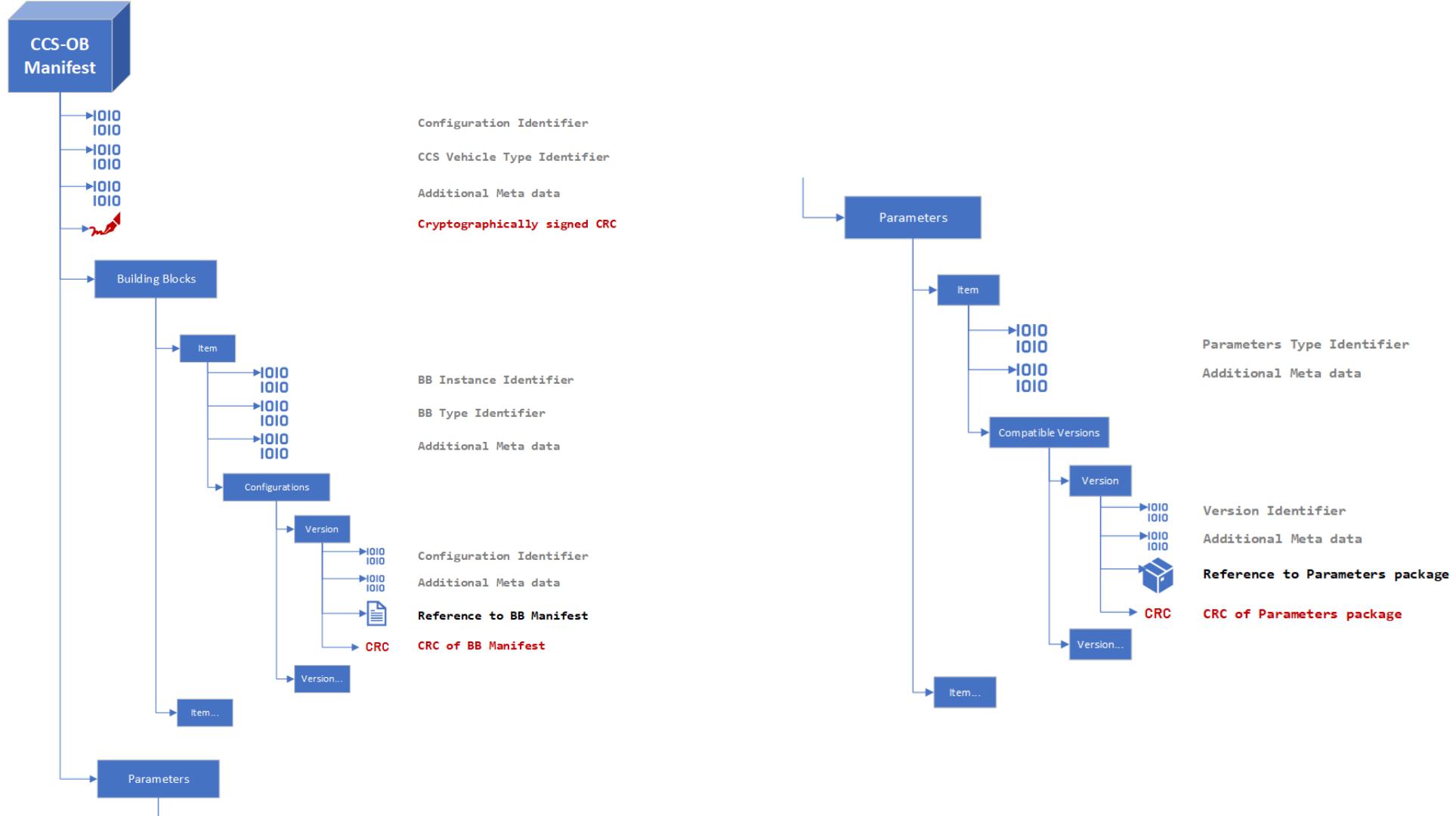


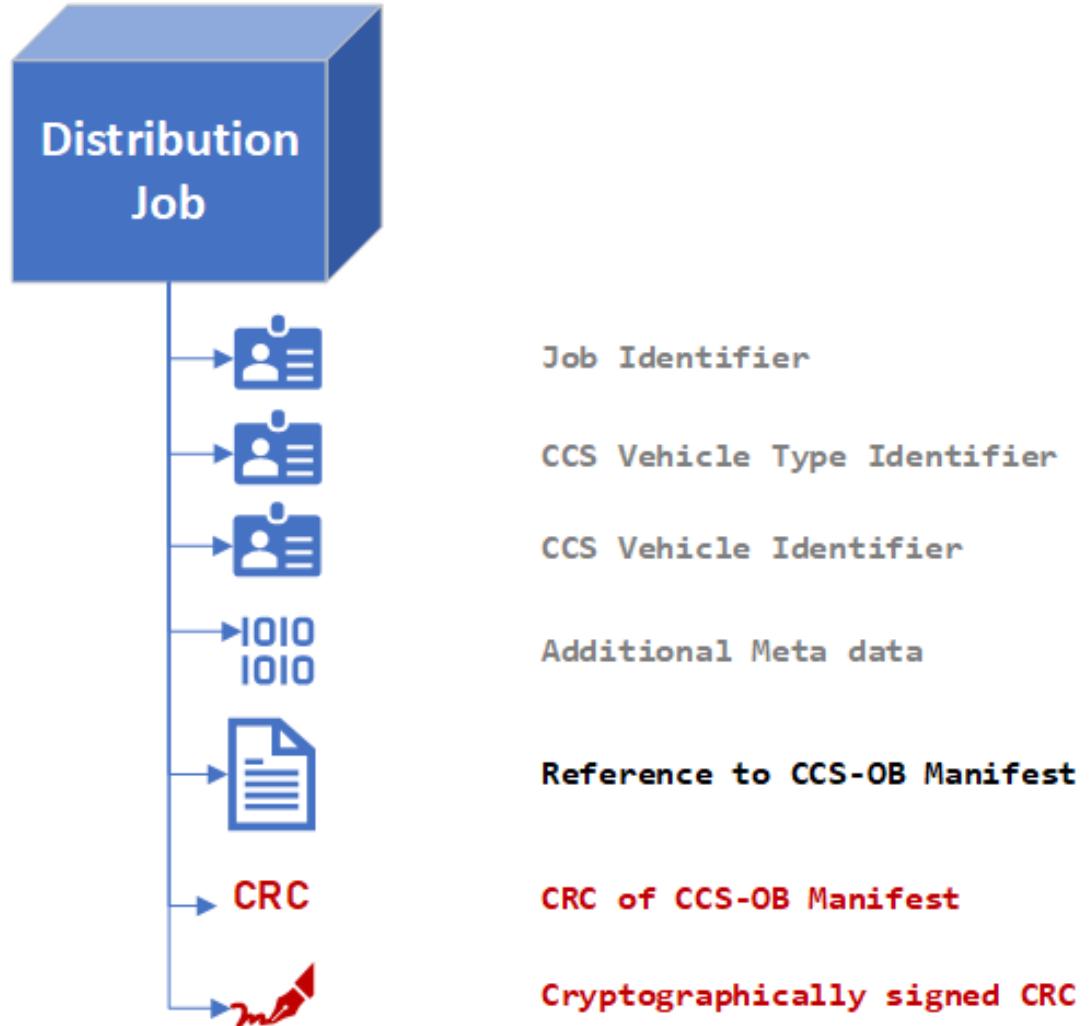
Detailed Configuration Management Process



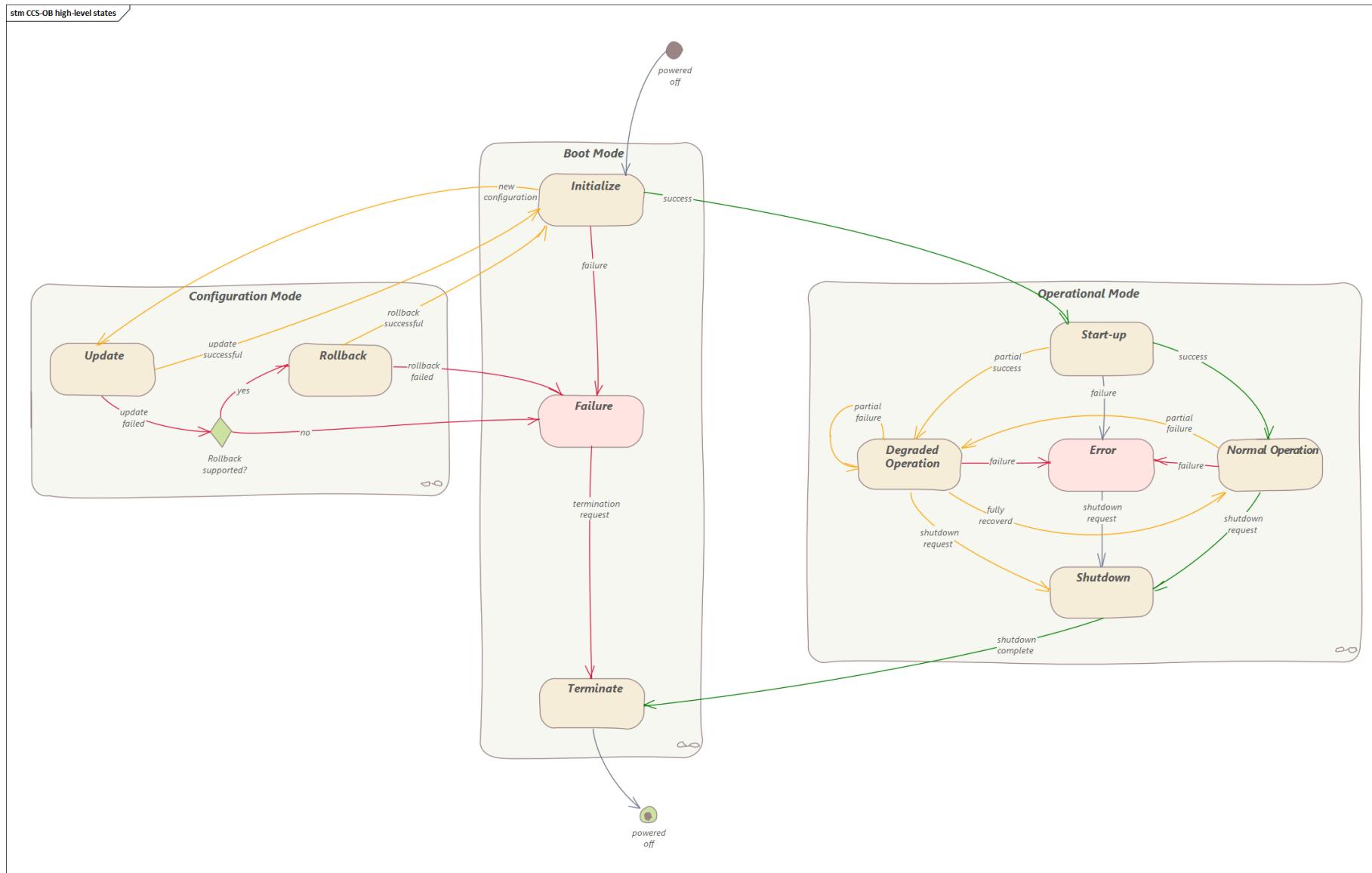


CCS-OB Manifest





Building Blocks Modes & States



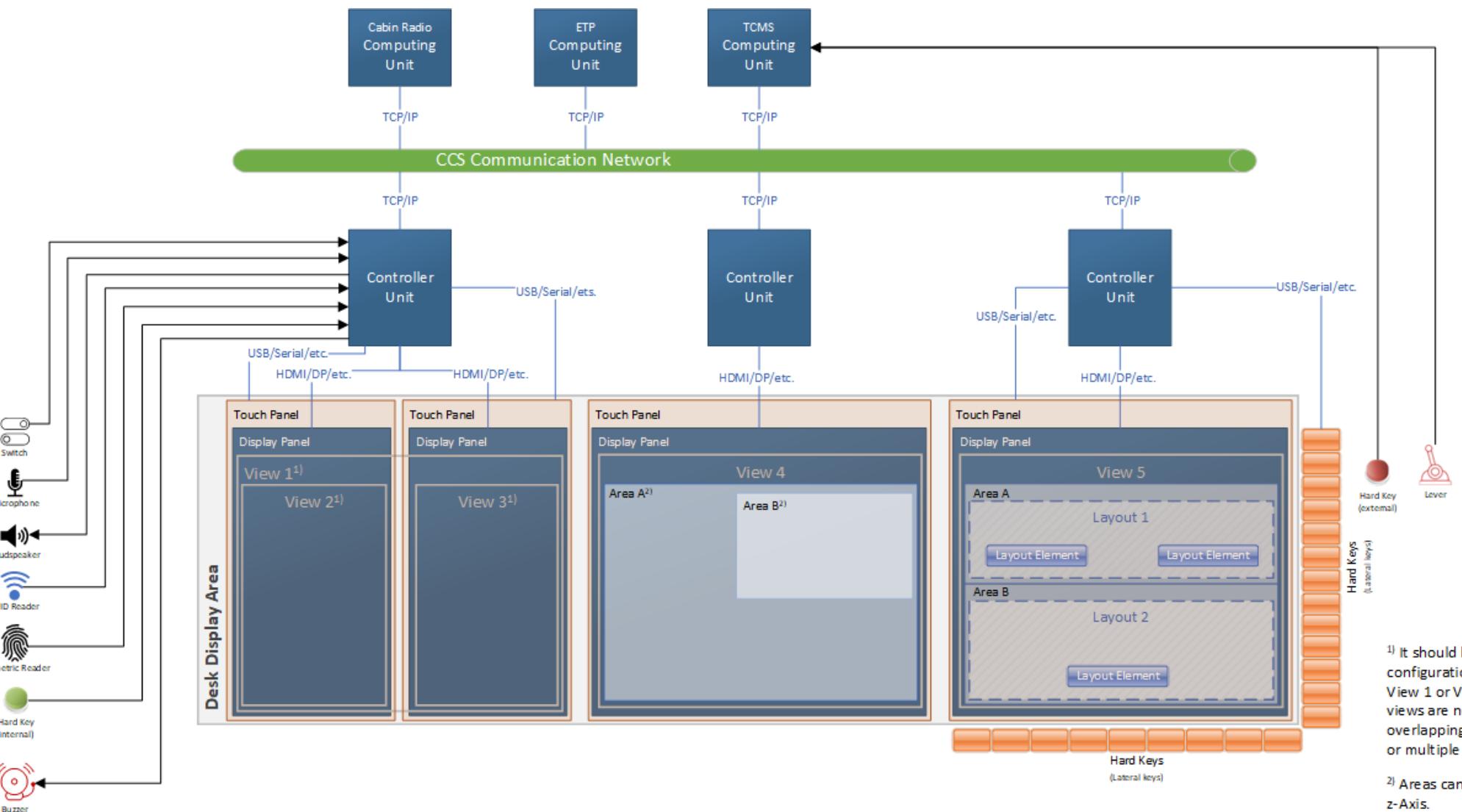


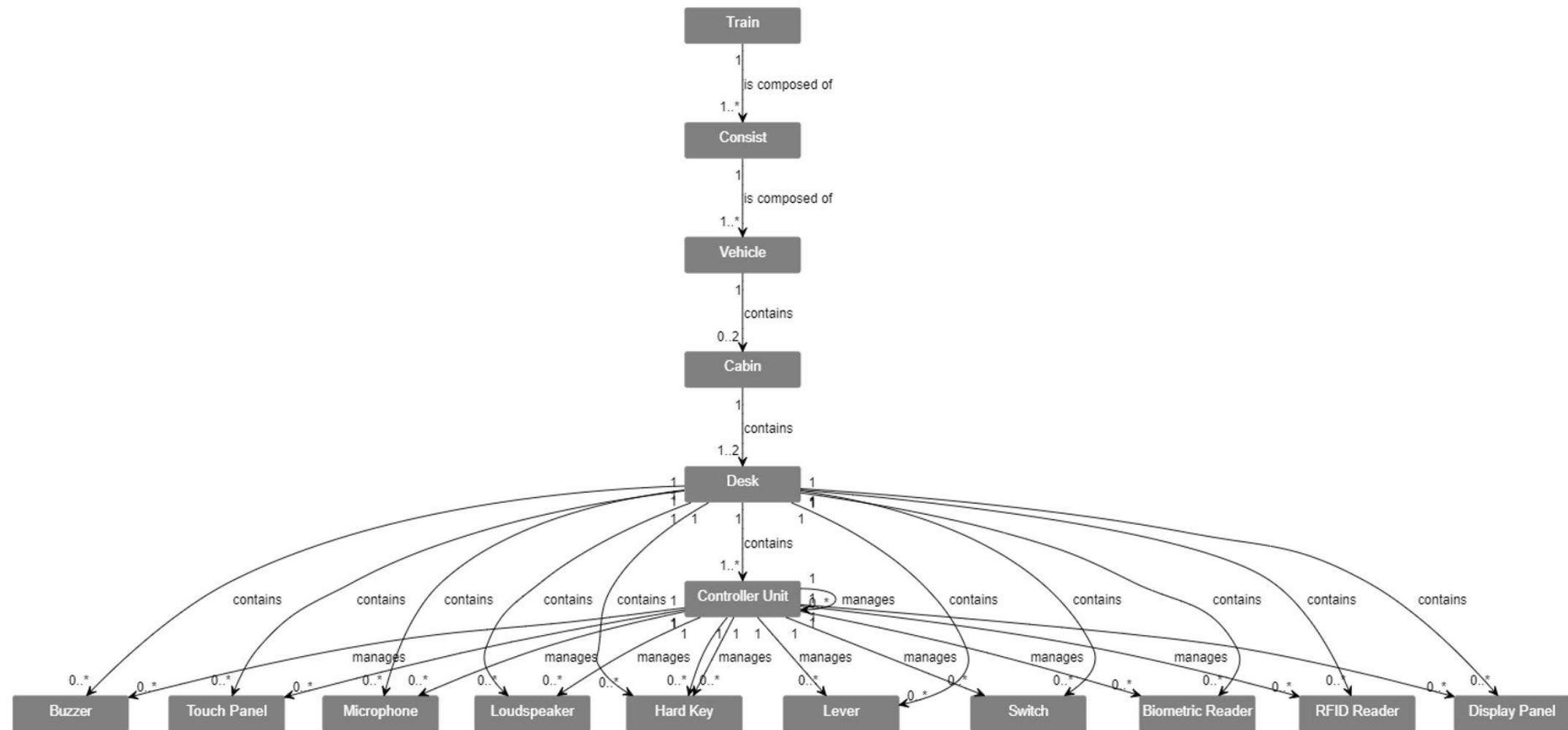
SBB CFF FFS



Train Display System (TDS)

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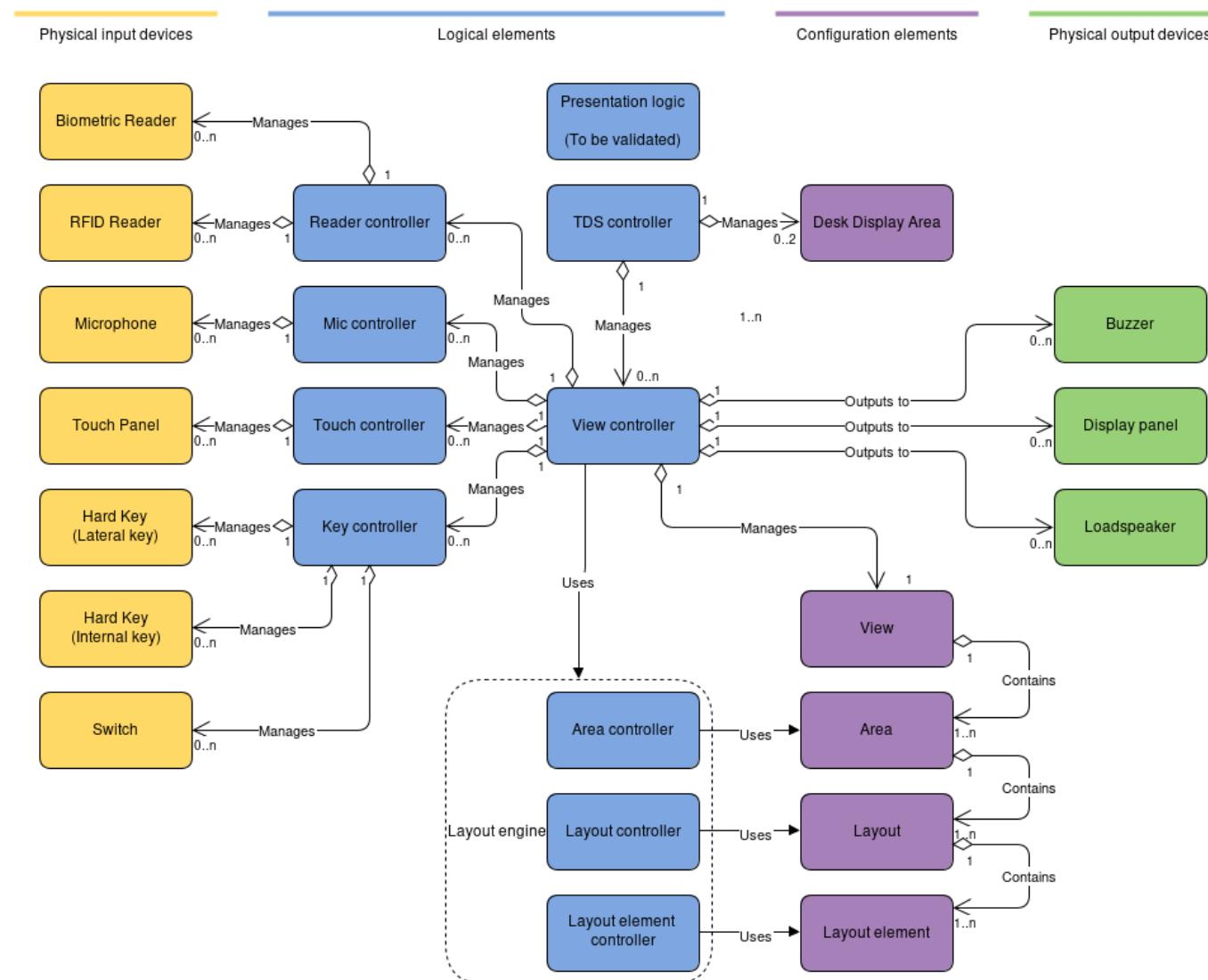




TDS – Logical Terminology



 SBB CFF FFS



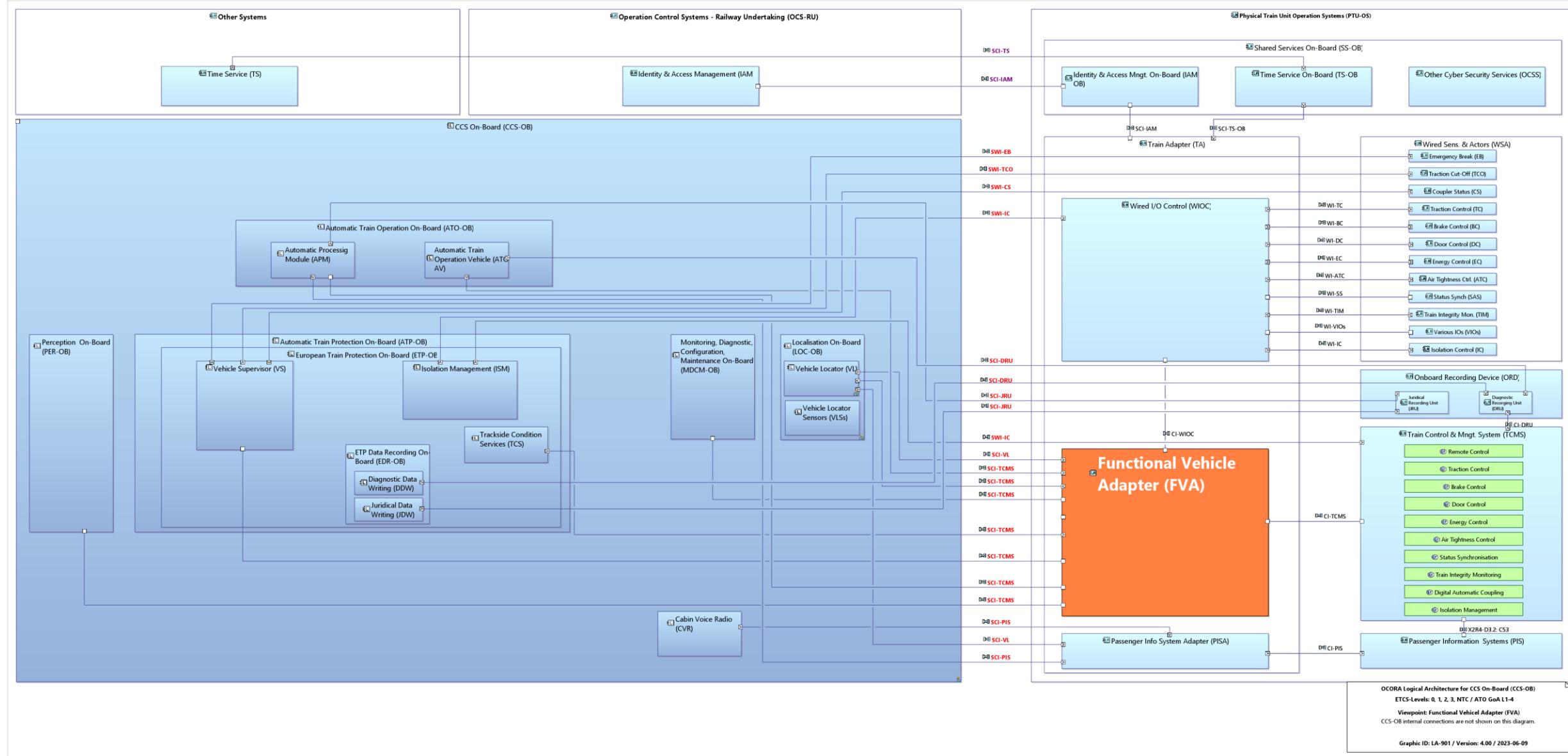


Functional Vehicle Adapter (FVA)

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Legacy Train Example – Focus FVA

Actors and External Interfaces



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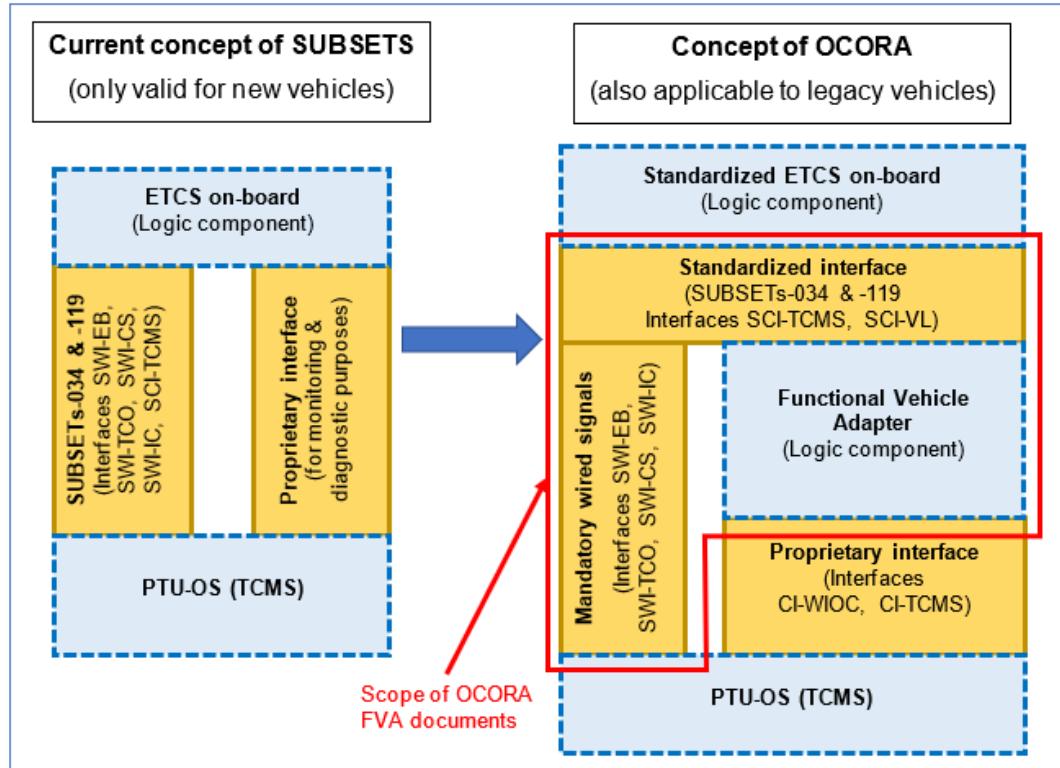
1) May be moved into the PTU-OS / LOC&PAS domain.

1) May be moved into the PTU-OS / LOC&PAS domain.

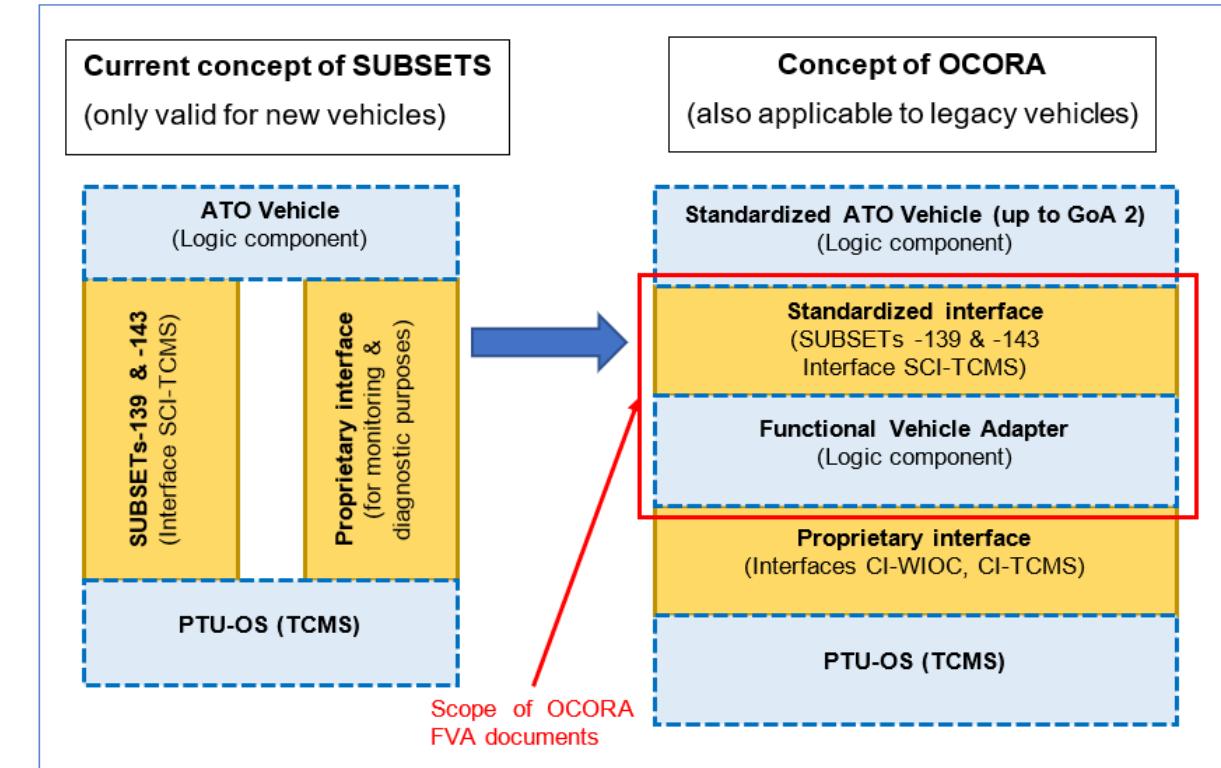
SS-nnn Respective subset contains information for the interface

SS-nnn* Respective subset does not address the interface but should contain the information in the future.

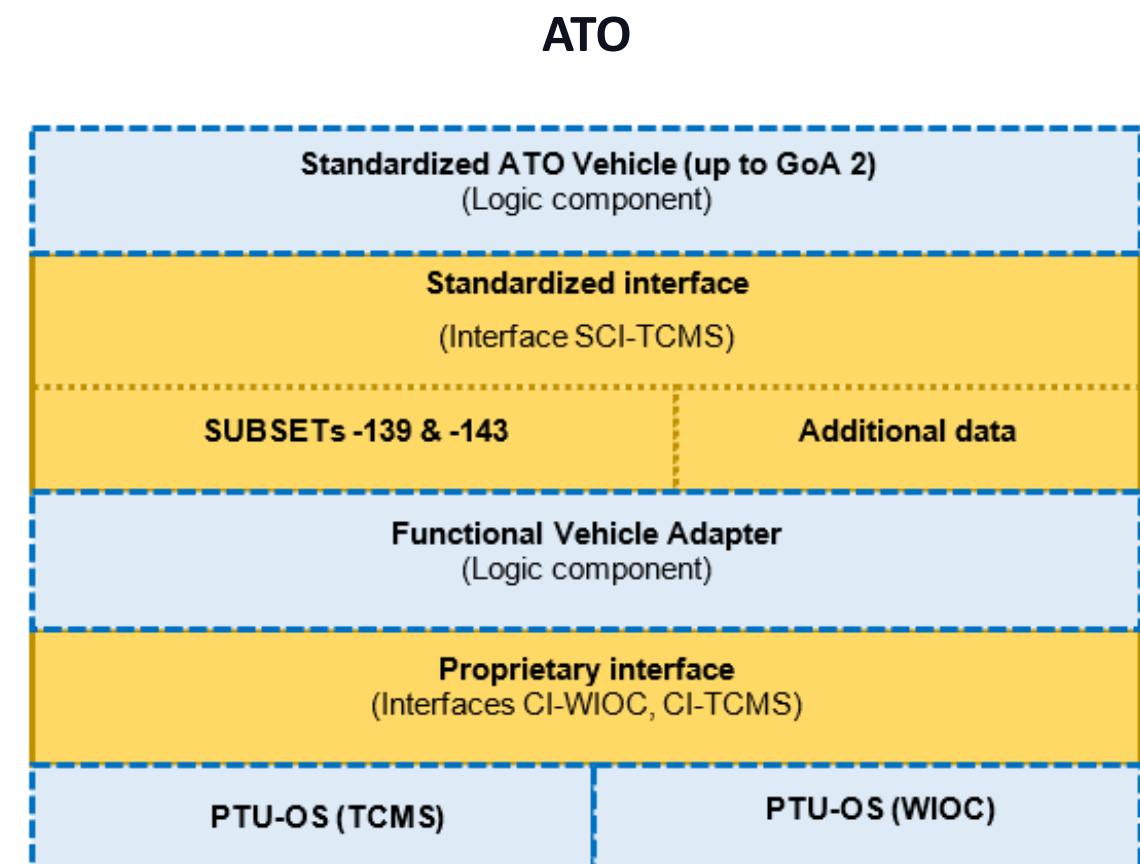
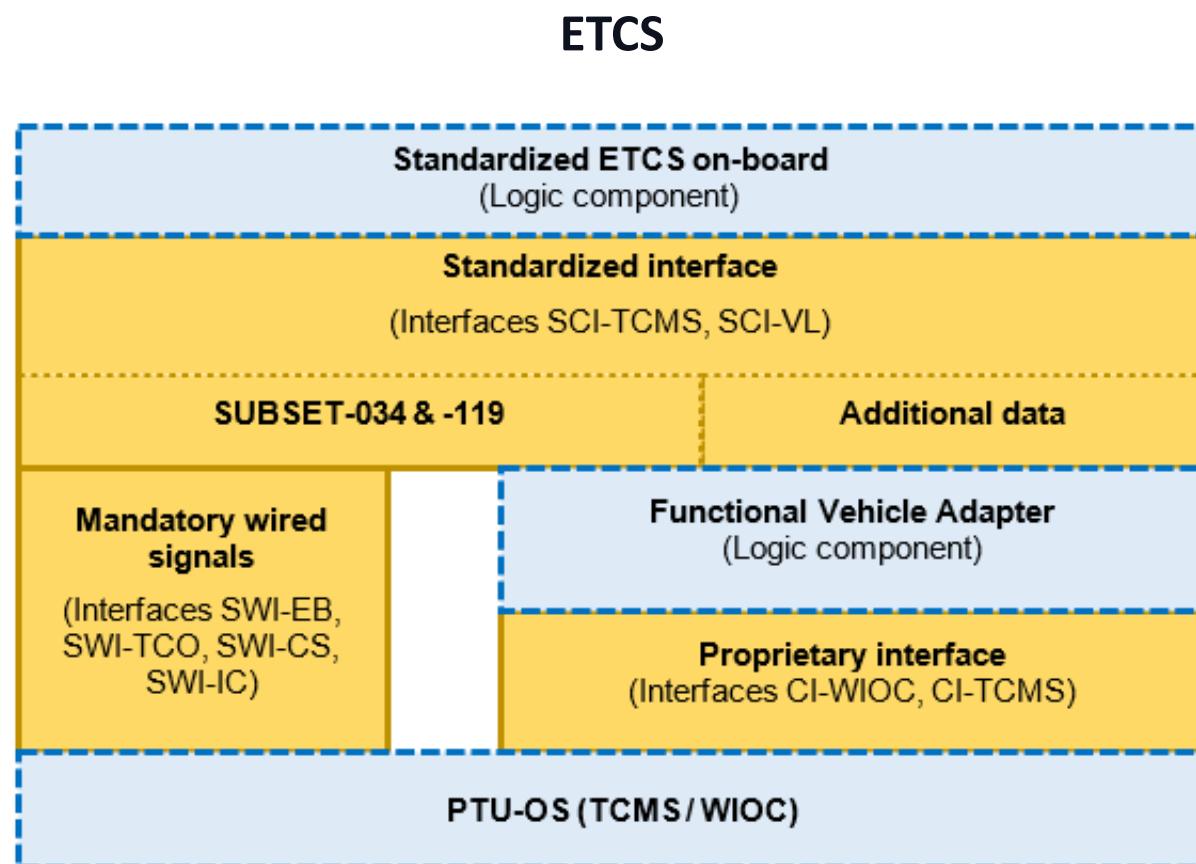
ETCS



ATO



Details in Document: OCORA-TWS04-010 – Functional Vehicle Adapter - Introduction



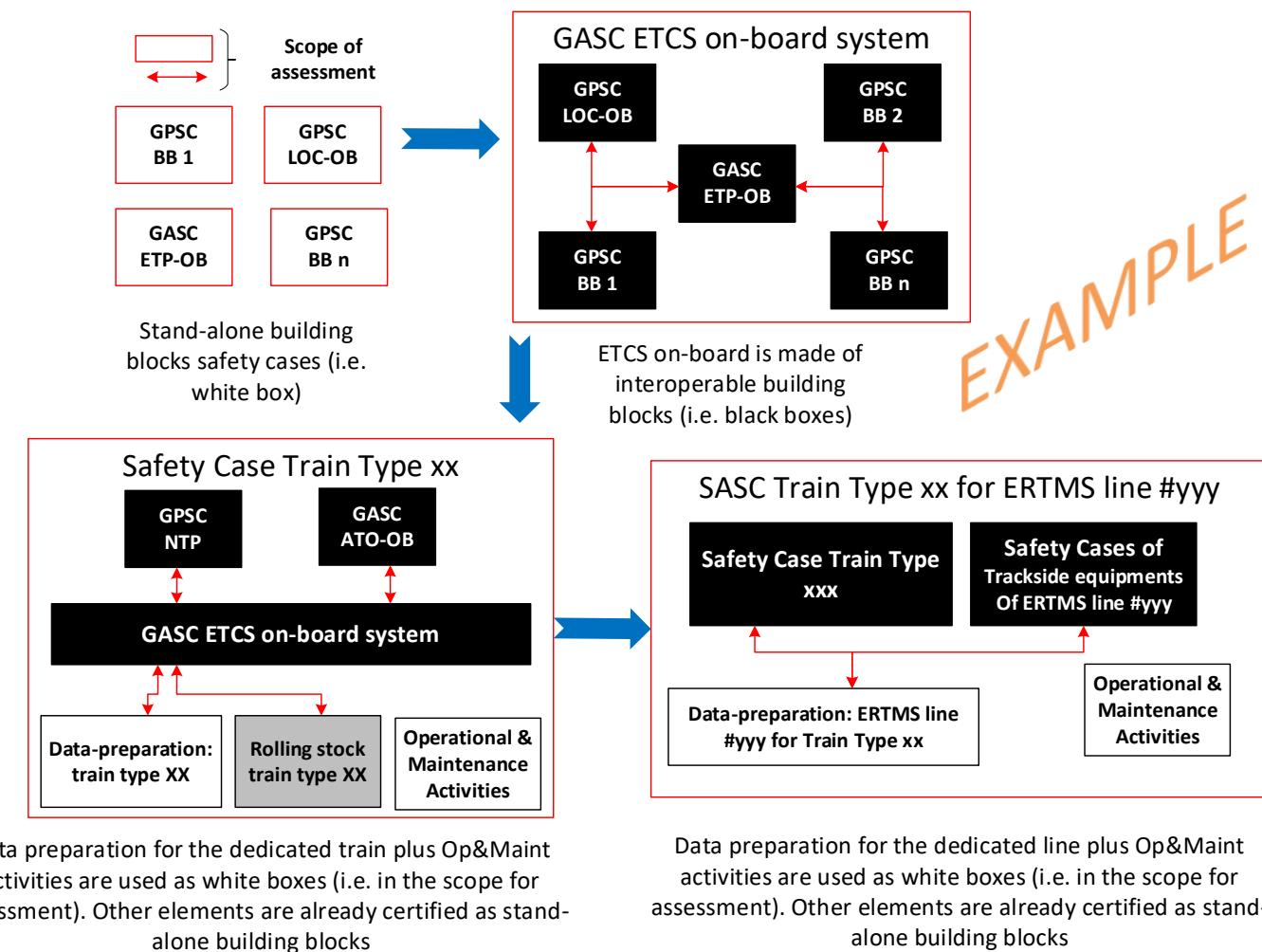
Details in Documents: OCORA-TWS04-013 – Design Guideline



Modular Safety

OCORA-BWS02-030 / v5.10 / 01.07.2024

- Modular Safety defines the hierarchy between safety cases from building blocks to specific application(s).
- One of the main goal is to **reduce the certification efforts from BB to specific application(s)**; initial and re-certification by limiting the “Domino’s effect (propagation of modifications at all upper levels) without degrading the safety level of the analyses.
- Modular Safety shall also defines the safety elements to allow the homologation of stand-alone building blocks:
 - Hazardous events based on TSI CCS SUBSET-088
 - TFFR (Tolerable Functional Failure Rate) based on TSI CCS SUBSET-088
 - Safety requirements based on OCORA R3
 - Harmonised and generic set of SRAC/AC

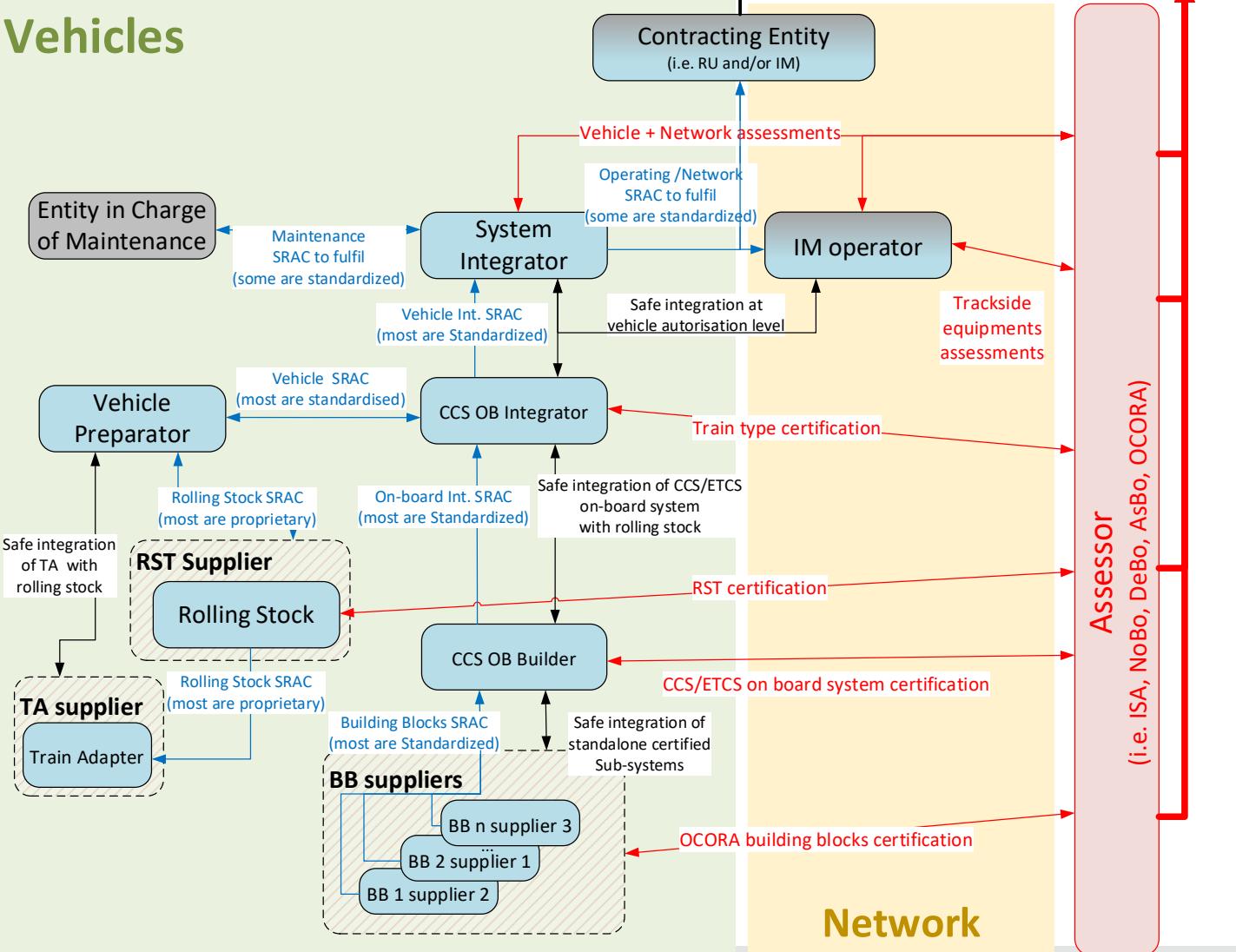


OCORA – Modular Safety - Stakeholders

*Who can apply for a vehicle authorisation?

The applicant for vehicle authorisation is the natural or legal person requesting an authorisation. The law does not impose a restriction on who can play the role of applicant: it can be a railway undertaking, an infrastructure manager, a manufacturer, an owner or a keeper.

Vehicles



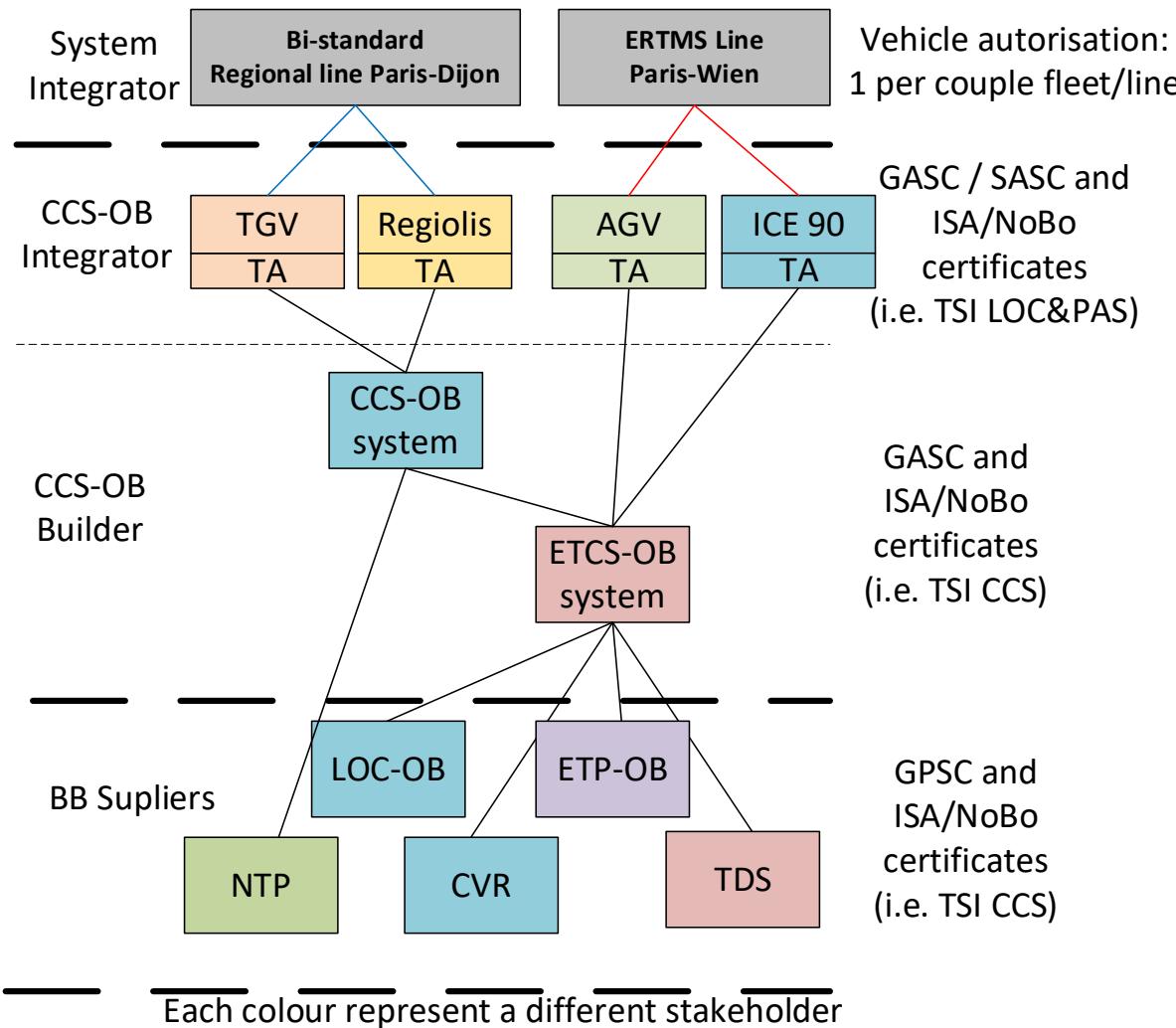
- **BB suppliers** shall create the building blocks and ensuring their certification (NoBo, OCORA, ISA...)
- **CCS-OB Builder** shall ensure the *safe integration* of the different BB and ensure its certification (NoBo, OCORA, ISA...)
- **TA Supplier** shall provide the train adapter according to the Vehicle Environment and ensure its certification (NoBo, OCORA, ISA...)
- **Vehicle Preparator** shall perform the *safe integration* of the TA in the Vehicle Environment
- **CCS-OB Integrator** shall perform the *safe integration* of the CCS-OB system in the prepared vehicle and ensure its certification (NoBo, OCORA, ISA/AsBo...)
- **System Integrator** in collaboration with the IM shall perform the *safe integration* of the full Vehicle in the selected network and ensure its certification (NoBo, DeBo, AsBo...)
- **Contracting Entity** shall realise the call for tenders for all stakeholders and handle the final Authorisation for Placing on the Market with the NSA/ERA

safe integration scope of activities is defined into:
era_1209-063_clarification_note_on_safe_integration_en



OCORA – Modularity & Safety Approval

Key roles



Case of two independent systems made of building blocks from different suppliers

- Different *reference systems* can be created:
 - ETCS-OB
 - CCS-OB
- The *reference systems* can be reused in any type of train thanks to the Train Adapters
- No re-certification is required for them => cross acceptance rules defined by OCORA are respected
- A reference system at train and then at system levels can be created and reuse as basis for all other vehicles equipped with the CCS/ETCS-OB system. Certifications focuses on the different conditions of use (to be defined post OCORA R3)
- That mutualises projects resources at RU's level on similar fleets and ease the process to get the Authorisation for Placing on the Market
- For the next certifications steps (during the lifetime), a generic and systematic approach defined by OCORA, based on CSM-RA will then help any stakeholder to handle easier (I.e. less delay and costs than today) the evolutions at any level

OCORA – Modularity & Integration Tasks



SBB CFF FFS



→ System Integrator

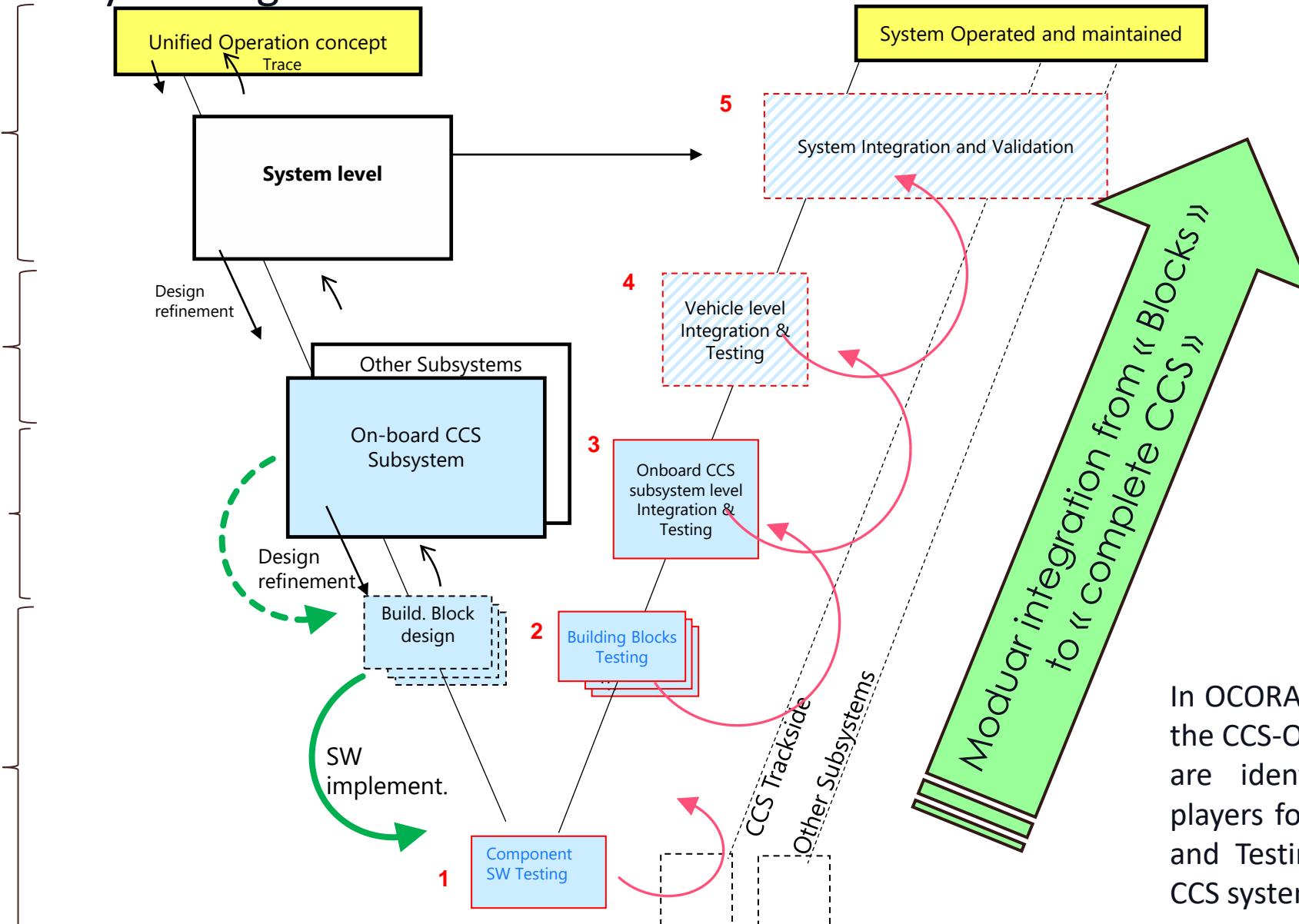
→ CCS-OB Integrator

→ CCS-OB Builder

→ Building Blocks Suppliers

Scope of OCORA

1, 2...: integration steps



In OCORA compliant projects, the CCS-OB builder/integrator are identified as the key players for Safety, Integration and Testing of the on-board CCS system.



OCORA

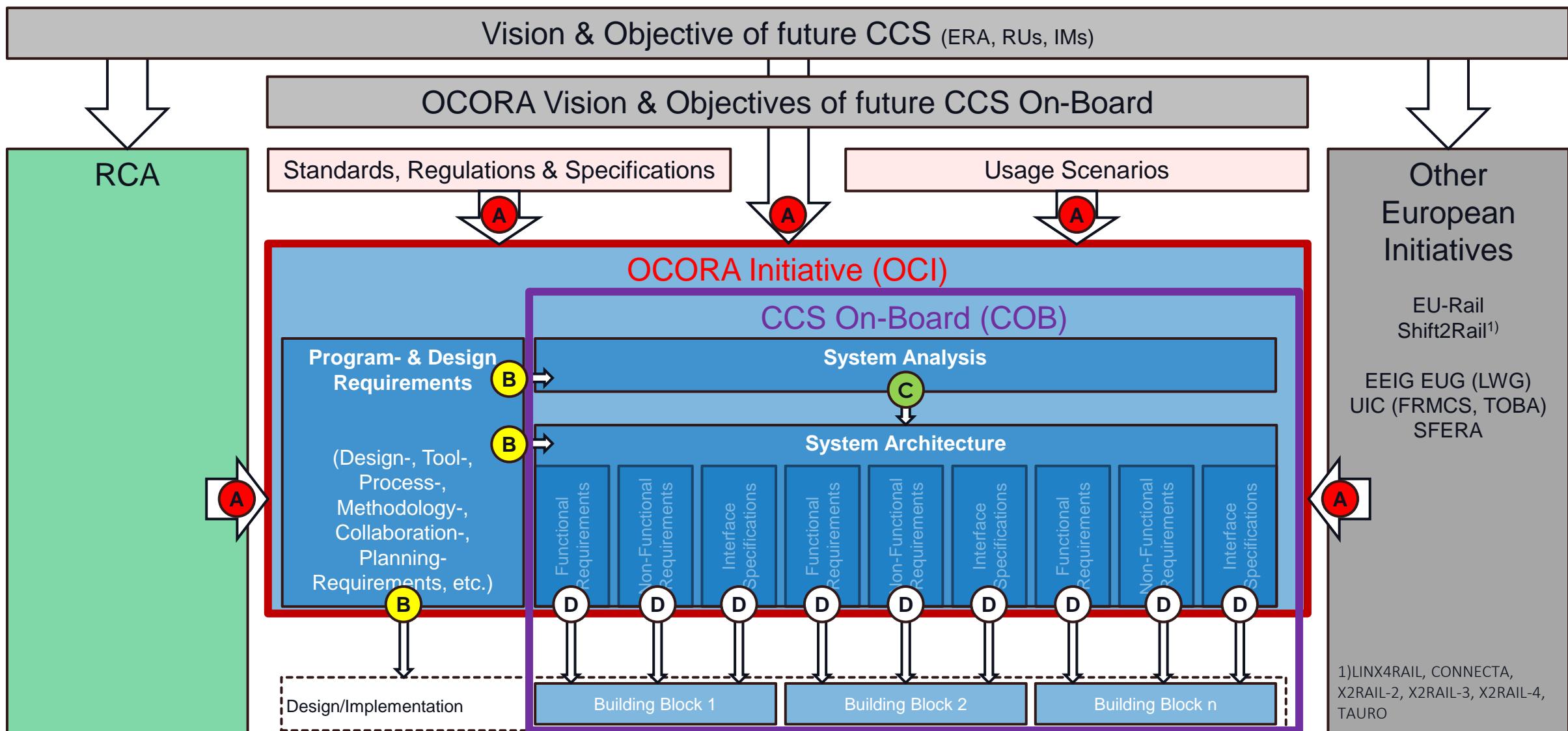
OCORA-BWS02-030 / v5.10 / 01.07.2024



Methodology & Tooling

OCORA-BWS02-030 / v5.10 / 01.07.2024

Structuring the Requirements



1)LINX4RAIL, CONNECTA,
X2RAIL-2, X2RAIL-3, X2RAIL-4,
TAURO

OCORA Requirements Engineering

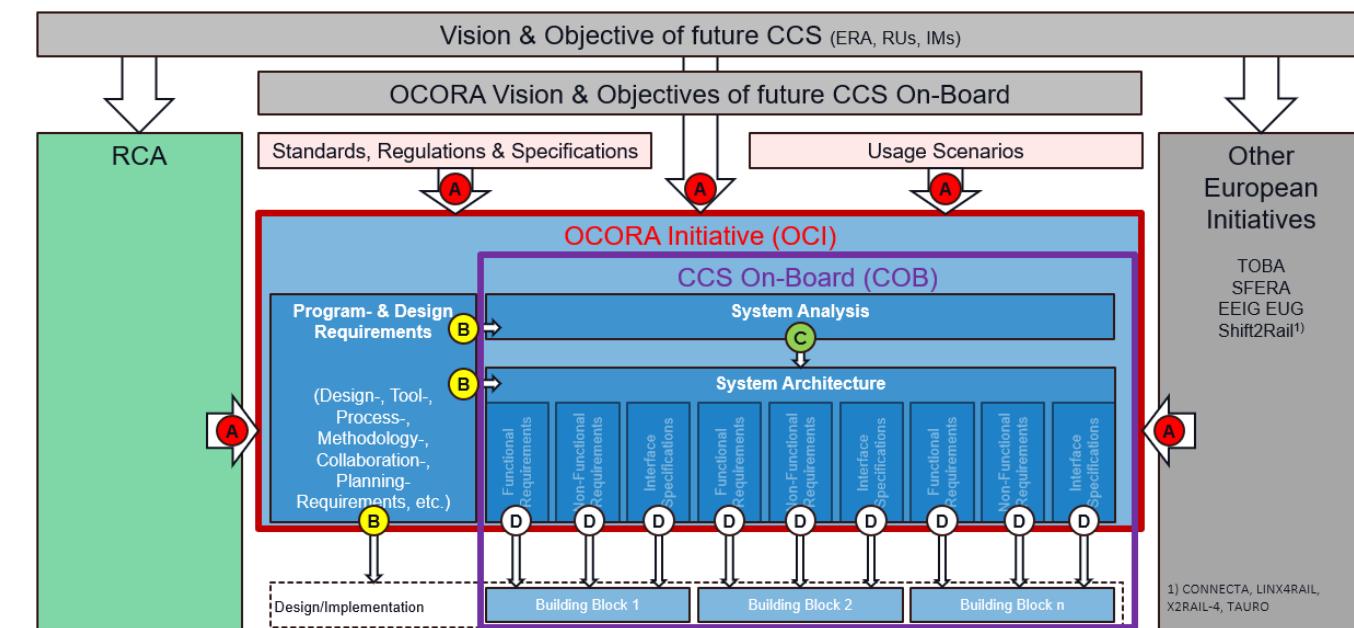
Requirement Definitions

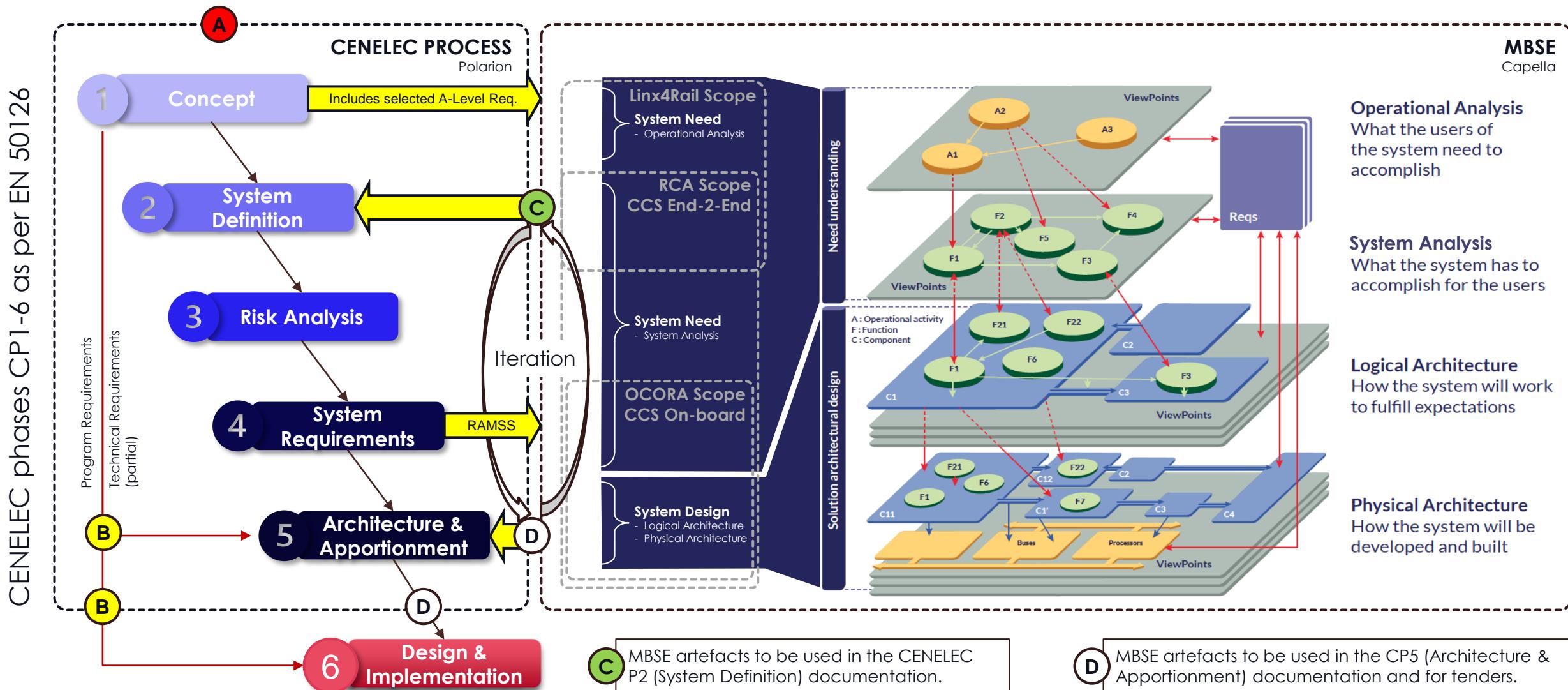
A Stakeholder Requirements: OCORA has to manage many different requirements, coming from many different stakeholders.

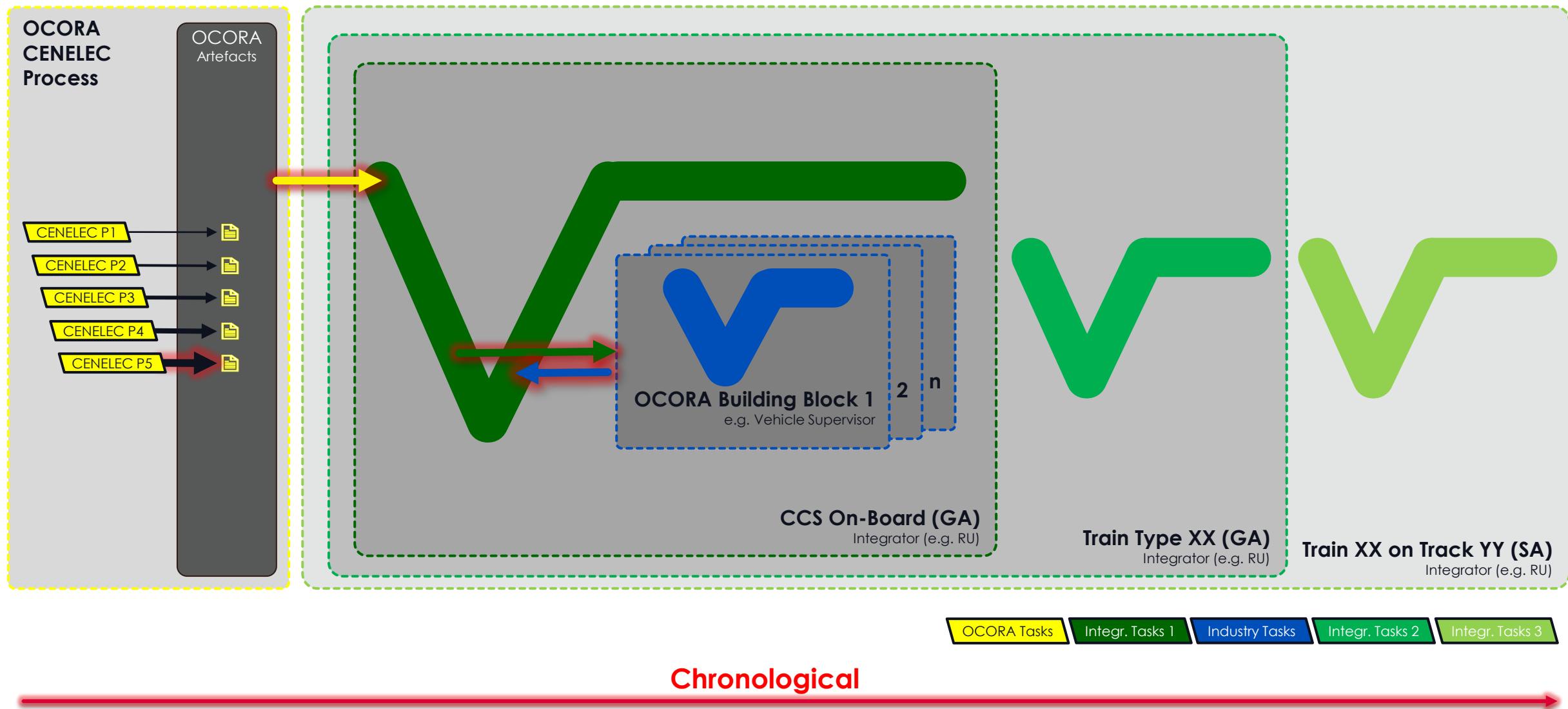
B Program- & Design Requirements: The OCORA program defines tools, processes, methodologies and design rules to be used within the program and to be considered during the system analysis and the system design/architecture work.

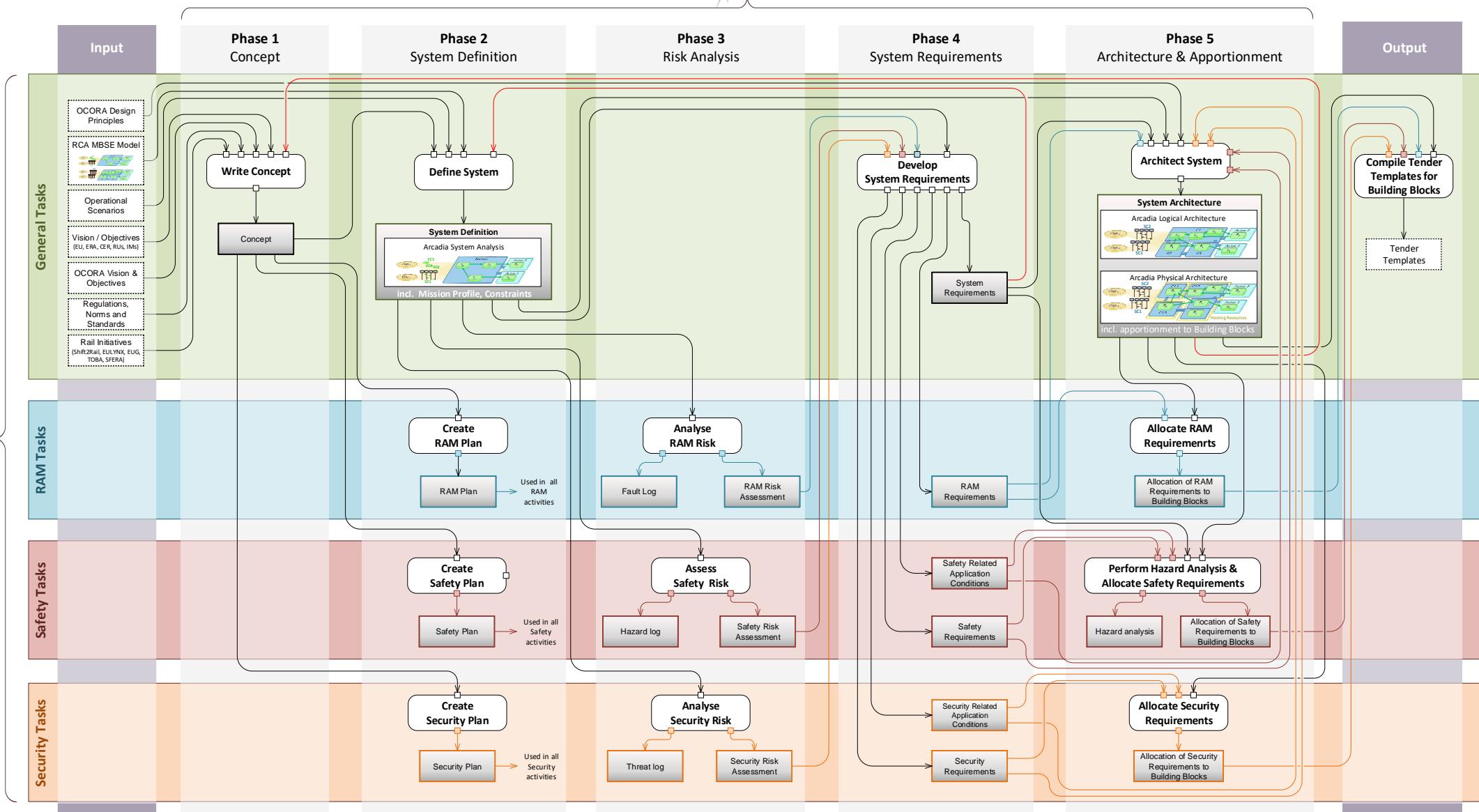
C System Requirements: Requirements in regards to the OCORA system are developed in the MBSE System Analysis (RCA & OCORA), taking into account the A- and B-Level Requirements.

D Building Block Requirements: Requirements in regards to the OCORA building blocks are developed in the MBSE System Architecture (logical / physical), taking into account the MBSE System Analysis. The resulting documentation form the OCORA tender templates, together with the applicable program requirements.











Operational Concept

OCORA-BWS02-030 / v5.10 / 01.07.2024

Operational Concept Overview



Live Cycle of Passenger, Freight, and Construction Trains

+/- 40 years overall life-time

