



ERJU SYSTEM PILLAR


Document and Release Plan - System milestones



ARC Roadmap and Release Plan - System milestones

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Abstract	This document is an annex of the Document and Release Plan (DRP). It aims at defining the architecture system milestones and checking them versus the STIP content. The document also includes a dependency analysis between the different topics and on how other harmonization topics are affected.
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2 2024 nn Bitsch see also [Notes on Sharepoint](#)
Added link to stip items
- 0. 23.09. Friedema update of chapter 3; answers to open comments
3 2024 nn Bitsch
- 0. 28.10. Friedema update due to review comments, the ARC meeting at 07.10.2024 and the info from
4 2024 nn Bitsch ERTMS Control Group Meeting October 2024 in relation to TSI release planning

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1 Introduction

- What is meant by Architecture Roadmap?
 - The roadmap shall show the different releases of the target architecture (steps/milestones how to achieve the final target architecture). In difference to this the migration domain gives guidance to achieve target architecture.
 - While migration/deployment plans focus on the deployment of products in the market this plan focus on the system releases for harmonised specifications and standards.
 - Roadmap is a number of 'System Milestones' (system releases) over a period of several years.
 - Describes the content of each system milestones (system release).
 - The planning is driven by the TSI releases. The milestones are linked to TSI releases also in case of SP standards.
 - 'Architecture' is a coherent description of the underlying system architecture that enables one to use a System Milestone.
 - In relation to the STIP we have an iterative process. The Architecture Roadmap has to consider the STIP and for this STIP the consistency with the Architecture Roadmap has to be ensured.
 - Architecture roadmap considers STIP and defines from an architecture view what is needed to support.
 - In parallel to STIP the Architecture Roadmap needs to be defined and concepts agreed.
 - Architecture Roadmap need to incorporate Migration requirements incorporating the 'Migration' and 'Evolution' concepts.

[SPT2ARC-3351]

- Who uses Architecture Roadmap?
 - T2 domains, SP Core Group, Innovation Pillar Flagship project groups (as e.g. R2DATO) and other tasks

[SPT2ARC-3353]

- STIP vs. Roadmap
 - The STIP is the strategic high level document. The STIP is used to inform sector.
 - The roadmap has to consider and guide from an architectural view the STIP.
 - The STIP shows the different harmonization topics and which channel shall be used on a very detailed level and not only focused to CCS.

[SPT2ARC-3352]

A basis for the items in this document shall come from knowledge of ongoing work (i.e. bottom up), especially from the domains Train CS, Traffic CS, Trackside Assets, PRAMS and Transversal. [SPT2ARC-3357]

Normally the STIP is referenced for harmonisation items of the different steps so that the STIP should be used for the definition and description of the items. [SPT2ARC-3356]

2 Systems Milestones Planning

Remark: In any case the years have to be linked to a TSI release also in case of SP standards. [SPT2ARC-3345]

The dates are in relation to a complete system release, which are oriented to the TSI releases. In difference to this the dates of the STIP are topic/item specific and are the plan when the System Pillar shall work on which topic. Therefore, several dates in the STIP are earlier than in the milestones planning. [SPT2ARC-3343]

2.1 Milestone 2023

In 2023 there was the latest TSI release and a first publication of System Pillar documents which is reflected with this milestone. [SPT2ARC-3347]

- Trackside Assets Requirements Specifications and Interfaces (see in the table below)

[SPT2ARC-3291]

2.2 Milestone 2025

For 2025 a CCS TSI ammendment is planned so that a specific milestone is planned for this. [SPT2ARC-3316]

- FRMCS v2 (version be used for pilot tests) - STIP_48 - _66

[SPT2ARC-3294]

- Single Set of Specification for ERTMS (S-153)

[SPT2ARC-3293]

- Test specifications for ETCS and ATO (Subsets-076, -094, and -151

[SPT2ARC-3290]

- Trackside Assets Interfaces updates for SCI - STIP_85 - _8

[SPT2ARC-3289]

- Trackside Assets Interfaces updates for SDI and SMI - STIP_90 - _100

[SPT2ARC-3292]

2.3 Milestone 2027

This milestone is related to the expected TSI release for 2027. [SPT2ARC-3308]

- Agile system approach for cyber-security (from ERA list) / Cybersecurity for telematics applications (from ERA list) STIP_75 - STIP_78

[SPT2ARC-3281]

- CCS On-board Network Communications Layers (S-147 v2) (up to layer 6) (without any option) - STIP_68

[SPT2ARC-3279]

- Extension of ETCS B3 for FRMCS (FRMCS baseline light)

[SPT2ARC-3284]

- FRMCS test specification - STIP_56

[SPT2ARC-3271]

- Cross-border TMS STIP_12/_13

[SPT2ARC-3270]

Dependencies (full list see in section 3): [SPT2ARC-3311]

- Secure Component Specification - STIP_78

[SPT2ARC-3341]

- Secure Communication Specification - STIP_76

[SPT2ARC-3339]

- Shared Security Services Specification - STIP_75

[SPT2ARC-3337]

- Security Program Requirements - STIP_77

[SPT2ARC-3335]

- TCMS Ethernet topics - STIP_120 - _124

[SPT2ARC-3333]

2.4 Milestone 2029

This milestone is related to the expected TSI release for 2029. [SPT2ARC-3328]

- Phase 1 – SERA Harmonised Operational Processes (baseline for Piloting: Harmonized CCS related operational processes for ETCS L2, excl. ATO GoA 3/4); focus of 2028 is trackside harmonisation for which the operational processes are a precondition. So, it is needed to assign the operational harmonisation already to this target. - STIP_2

[SPT2ARC-3269]

- Improved radio (FRMCS v3) (version be used for operations) - STIP_48 - _66

[SPT2ARC-3268]

- Online Monitoring System (S-149) (updated version for having it mandatory)

[SPT2ARC-3267]

- Trackside Digital Register - STIP_08 - _09

[SPT2ARC-3266]

- Minor Enhancements for ERTMS (from ERA list) (from ERA CCM database and new ones) - STIP_135

[SPT2ARC-3265]

- Harmonisation of different data elements needed to support the DataPrep use case (from ERA list)

[SPT2ARC-3277]

- Extended on-board modularity for CCS and RST part (from ERA list) - next evolution step

[SPT2ARC-3264]

- 1st step for harmonized for Advanced Safe Train Positioning (Basic ASTP) (meaningful evolution step to be defined, if any e.g.: excluding perception, e.g. harmonized performance) - STIP_29

[SPT2ARC-3263]

- Function distribution and Interface between TMS/CMS and EAL - STIP_17

[SPT2ARC-3288]

- *Currently not planned anymore: Enhancement Driving control, Adhesion management: "Adhesion Management consideration in Kwet", "Automated adhesion determination", and "Dynamic adaptation of deceleration values" - STIP_105, _106, and _107*

[SPT2ARC-3287]

- Train Interface Enhancements (incl. for train length) - STIP_71, Train interface adaptation for integrity handling and train length / overall consist length - STIP_73

[SPT2ARC-3286]

- Enhancement of ATO GoA 2 for freight operation - STIP_20

[SPT2ARC-3285]

- Enhancements for ATO GoA 1/2 (from ERA CCM database)

[SPT2ARC-3283]

- System requirements and interfaces Advanced Protection System (APS) (Trackside Protection System - TPS) - STIP_102

[SPT2ARC-3282]

- System requirements Execution / Adaptation Layer and interfaces - STIP_103

[SPT2ARC-3280]

- Interface ATO-TS to Execution / Adaptation Layer or TMS - STIP_19 and _104

[SPT2ARC-3278]

Dependencies (full list see in section 3): [SPT2ARC-3329]

- Guideline for harmonized CCS related operational processes for ETCS L2 and ATO GoA 1/2 - STIP_1

[SPT2ARC-3332]

- Demonstrations based on FRMCS v2

[SPT2ARC-3323]

- Digital automated couplers (DAC) - STIP_31 - STIP_47

[SPT2ARC-3321]

- Safety analysis for ASTP 1st step - Basic ASTP - STIP_29

[SPT2ARC-3319]

- Harmonised interface between ETCS on-board and Train Display System System (TDS) - STIP 69

[SPT2ARC-3317]

- Further details to be added (list of interfaces)

[SPT2ARC-3314]

- Interface to adjacent TCS area - STIP_101

[SPT2ARC-3312]

To be decided if part of chapter 2.4: [SPT2ARC-3326]

- Remote upgrade sw and data

[SPT2ARC-3309]

- Maintenance & diagnostics

[SPT2ARC-3306]

- Support of Passenger Information System

[SPT2ARC-3305]

2.5 Milestone 2032 - part 1

This milestone is related to the expected TSI release for 2032 and a final switch-off of GSM-R for ETCS radio, ATO radio and voice radio for 2035.

Note: The milestone 2032 is divided in two parts which reflects that some of the topics of part 1 are a precondition for the topics of part 2.

General objective: Trade-off between “reduced wayside infrastructure” and “optimized train driving”. [SPT2ARC-3327]

- Phase 2 of Harmonised Operational Processes (Harmonized CCS related operational processes for ETCS L2 in combination with ATO GoA 1/2 and 3/4) - STIP_3

[SPT2ARC-3276]

- Minor Enhancements for ERTMS (from ERA list)

[SPT2ARC-3303]

- DMI modernization (from ERA list)

[SPT2ARC-3302]

- Moving Block

[SPT2ARC-3301]

- On-Board Repository - STIP_67

[SPT2ARC-3300]

- 2nd step for harmonized for Advanced Safe Train Positioning – target system - STIP_30

[SPT2ARC-3299]

- TDS FFFIS - STIP_69

[SPT2ARC-3298]

Dependencies (full list see in section 3): [SPT2ARC-3330]

- System requirements and interfaces Advanced Protection System (APS) - STIP_102

[SPT2ARC-3304]

- CCS On-board Network Communications Layers (S-147 v2)

[SPT2ARC-3350]

- For minor enhancements for ERTMS: Depending on the CR

[SPT2ARC-3349]

- Full safety analysis for ASTP

[SPT2ARC-3348]

- Full safety analysis for moving block

[SPT2ARC-3346]

- On-board Perception - STIP_2

[SPT2ARC-3344]

- Train Integrity, DAC - rain interface adaption for integrity handling and train length / overall consist length STIP_73

[SPT2ARC-3342]

- Multi-Display On-board - STIP_70

[SPT2ARC-3340]

2.6 Milestone 2032 - part 2

- ATO over ETCS up to GoA3/4 - STIP_20

[SPT2ARC-3297]

- System requirements ATO Trackside / Track-train interface ATO / Interface ATO-TS to Execution /adaptation Layer or TMS. Upgrade from GoA2 to GoA3/4 - STIP_24, _25 and _26

[SPT2ARC-3296]

- Remote Shunting / remote Supervision & Control independent from ATO or ETCS - STIP_28

[SPT2ARC-3295]

- Remote Driving - STIP_23

[SPT2ARC-3262]

- TMS / CMS: Data interface between Digital Register and CCS/TMS components (Phase 2) - STIP_9

[SPT2ARC-3261]

- Extended on-board modularity for CCS and RST part (from ERA list) - further evolution step

[SPT2ARC-3260]

- FRMCS only (no GSM-R for ETCS, ATO radio, voice radio) for 2035

[SPT2ARC-3259]

Dependencies (full list see in section 3): [SPT2ARC-3331]

- Full safety analysis for GoA3

[SPT2ARC-3338]

- Full safety analysis for GoA4

[SPT2ARC-3336]

- On-board Perception - STIP_22

[SPT2ARC-3334]

- On-board Automatic Processing Module (APM) - STIP_21

[SPT2ARC-3325]

- Remote Driving (GoA3/4 Fallback solution) - STIP_23

[SPT2ARC-3324]

- Interface ATO-TS to Execution layer: Upgrade from GoA2 to GoA 3/4 - STIP_24

[SPT2ARC-3322]

- System requirements ATO Trackside: Upgrade from GoA2 to GoA 3/4 - STIP_25

[SPT2ARC-3320]

- Track-train interface ATO: Upgrade from GoA2 to GoA4 - STIP_26

[SPT2ARC-3318]

- New subset for testing, validation, certification. Upgrade from GoA2 to GoA 3/4 - STIP_27

[SPT2ARC-3315]

- FRMCS v3

[SPT2ARC-3313]

- Full FRMCS roll-out

[SPT2ARC-3310]

- Euroradio Gateway (see  SPT2TRAIN-579 - Summary of the Discussions for a Preliminary Bottom-up On-board CCS Architecture)

[SPT2ARC-3307]

2.7 Milestone 2037

This milestone is related to the expected TSI release for 2037. [SPT2ARC-3254]

- No ETCS level 0, 1 for 2045

[SPT2ARC-3258]

- No ETCS level NTC for 2045

[SPT2ARC-3257]

- Virtual Coupling

[SPT2ARC-3256]

- Extended on-board modularity for CCS and RST part (from ERA list)

[SPT2ARC-3255]

Dependencies (full list see in section 3): [SPT2ARC-3253]

- Train to train communication

[SPT2ARC-3275]

- Relative braking distance considered in the braking curves concepts

[SPT2ARC-3274]

- TMS is enhanced for platooning / virtual coupling

[SPT2ARC-3273]

- Full Safety Analysis for Virtual Coupling

[SPT2ARC-3272]

3 System Standardization Topics Roadmap

3.1 Standadisation topics, dependencies and affects

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Trackside Assets Interfaces				<p>Requirements Specs and Interfaces:</p> <p>Eu.Doc.20 Generic interface and subsystem requirements</p> <p>Eu.Doc.119 Generic interface and subsystem requirements for SCI</p> <p>Eu.Doc.120 Generic interface and subsystem requirements for SMI</p> <p>Eu.Doc.92 Interface definition SCI</p> <p>Eu.Doc.93 Interface specification SCI Generic</p> <p>Eu.Doc.32 Requirements specification for subsystem Light Signal</p> <p>Eu.Doc.33 Interface specification SCI-LS</p> <p>Eu.Doc.36 Requirements specification for subsystem Point</p> <p>Eu.Doc.38 Interface specification SCI-P</p> <p>Eu.Doc.45 Requirements specification for subsystem Generic IO</p> <p>Eu.Doc.46 Interface specification SCI-IO</p> <p>Eu.Doc.43 Requirements specification for subsystem TDS</p> <p>Eu.Doc.44 Interface specification SCI-TDS</p>		2023
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				<div>Eu.Doc.108 Requirements specification for subsystem Level Crossing</div> <div>Eu.Doc.109 Interface specification SCI-LC</div> <div>Eu.Doc.18 Maintenance and data management specification</div> <div>Eu.Doc.76 Interface definition and specification SMI</div> <div>Eu.Doc.77 Interface definition SDI</div> <div>Eu.Doc.78 Interface specification SDI-LS</div> <div>Eu.Doc.94 Interface specification SDI Generic</div> <div>Eu.Doc.80 Interface specification SDI-P</div> <div>Eu.Doc.82 Interface specification SDI-IO</div> <div>Eu.Doc.81 Interface specification SDI-TDS</div> <div>Eu.Doc.110 Interface specification SDI-LC</div>		
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Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Trackside Assets Interfaces updates for SCI - STIP_85 - _89						2024
Trackside Assets Interfaces updates for SDI and SMI - STIP_90 - _100	Improved maturity for Standard Diagnostic Interface and Standard Maintenance Interface			Eu.Doc.120 Generic interface and subsystem requirements for SMI Eu.Doc.18 Maintenance and data management specification Eu.Doc.76 Interface definition and specification SMI Eu.Doc.77 Interface definition SDI Eu.Doc.78 Interface specification SDI-LS Eu.Doc.94 Interface		2024

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
				specification SDI Generic Eu.Doc.80 Interface specification SDI-P Eu.Doc.82 Interface specification SDI-IO Eu.Doc.81 Interface specification SDI-TDS Eu.Doc.110 Interface specification SDI-LC		
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Harmonised Operational processed STIP_1 - STIP_3	Everything what is needed for operation of trains shall be harmonized	ETCS Specifications (e.g. Subset-026) and new Traffic CS and Train CS specifications, especially System requirements and interfaces Advanced Protection System (APS) - STIP_102 System requirements Execution / Adaptation Layer and interfaces - STIP_103			Different solutions for different countries	TSI 2028, 2032 tbd
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
No ETCS level 0, 1			analysis that the existing functions (if any) can be evolved to get rid of controlled balises needed for some L2 functions		Euroloop, controlled balises, LEU, RIU, signals	TSI 2037 2045
No ETCS level NTC					National systems	TSI 2037 2045
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Extension of ETCS B3 for FRMCS (FRMCS baseline light)	Extension of ETCS Baseline 3 for FRMCS readiness of TSI 2023			Interfaces: 1.) OB_APP 2.) Euroradio Gateway / On-board FRMCS (Subset-148 and Subset-37-3)		TSI 2024 tbd

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
				3.) Cab Radio / On-board FRMCS 4.) On-board FRMCS / TCMS		
FRMCS v2	One common radio system (basis for field demonstration)	Affects: * Repository/ Digital Maps STIP_67 * GoA3/4 STIP_20 * Full Advanced Safe Train Positioning STIP_30		Interfaces: 1.) OB_APP 2.) TS_APP 3.) Euroradio Gateway / On-board FRMCS (Subset-148 and Subset-37-3) 4.) Cab Radio / On-board FRMCS 5.) On-board FRMCS / TCMS		TSI 2024 tbd

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Improved radio (FRMCS v3)	One common radio system (mature specification based on results from field demonstration)		FRMCS v2		GSM-R, ATO radio, voice radio	TSI CCS 2027 2029 (FRMCS only: 2035)
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
CCS On-board Network Communications Layers (S-147 v2) (up to layer 6) (without any option) - STIP_68	Full standardised common CCS Network Communications Layers 3-6 in S-147	Affects: * Remote upgrade sw and data * Maintenance & diagnostics * Online Monitoring System * Support of Passenger Information System * TDS FFFIS STIP_69 * On-board repository STIP_67 * Train Interface Enhancements (incl. for train length) - STIP_71 * Train interface adaption for integrity handling and train length / overall consist length STIP_73 * Basic ASTP STIP_29 * Full ASTP STIP_30 * Extended On-board modularity for CCS and RST part (from		Extension of FFFIS CCS On-board Network Communication Layers (S-147); Update of Subset-139 (FFFIS ATO/ETCS On-board) and FFFIS Train interface (Subset-119)	Options for Layers 3-6 (OPC-UA, TRDP, Profinet)	TSI CCS 2026 2028

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
		ERA list) - all building blocks (subsystems) in the Train CS Architecture * Subset-139 (FFFIS ATO/ETCS On-board)				

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Train Interface Enhancements (incl. for train length) - STIP_71		Extended On-board modularity for CCS and RST part (from ERA list)	CCS On-board Network Communications Layers (S-147 v2) - STIP_68	Extension of FIS/FFFIS Train interface (Subset-034/-119/-120)		TSI CCS 2028 2030
Train interface adaptation for integrity handling and train length / overall consist length - STIP_73		Hybrid Block; Full Moving Block	Train Interface Enhancements (incl. for train length) - STIP_71; CCS On-board Network Communications Layers (S-147 v2) - STIP_68	Extension of FIS/FFFIS Train interface (Subset-034/-119/-120)		TSI CCS 2028 2030
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Hybrid block			Train integrity, DAC (unless you restrict it to train sets) - Train interface adaptation for integrity handling and train length / overall consist length - STIP_73; normally used in cases which provide integrity inherently; System requirements and interfaces Advanced Protection System (APS) - STIP_102			Sufficiently solved with TSI CCS 2023 tbd
Full Moving block	Headway reduction		<p>Train integrity, DAC (unless you restrict it to train sets) - Train interface adaptation for integrity handling and train length / overall consist length - STIP_73;</p> <p>full safety analysis (extension of Subset-091) for Full Moving Block;</p> <p>System requirements and interfaces Advanced Protection System (APS) - STIP_102</p>	<p>Interfaces: 1.) Interface to adjacent TCS area, STIP_101;</p> <p>2.) Interface between Advanced Protection System (APS) and Execution and Adaptation Layer (EAL) STIP_102/STIP_103</p>		TSI CCS 2028 tbd

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Function distribution and Interface between TMS/CMS and EAL - STIP_17		Traffic CS: System requirements Execution / Adaptation Layer (EAL) and interfaces - STIP_103		Interface between TMS/ CMS and EAL		TSI CCS 2028 tbd
Enhancement Driving control, Adhesion management: "Adhesion Management consideration in Kwet", "Automated adhesion determination", and "Dynamic adaptation of deceleration values" - STIP_105, _106, and _107						Currently not planned

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Perception STIP_22	To sense the Physical Railway Environment in place of a driver	Affects: * Automatic Processing Module (APM) STIP_21 * GoA3/4 STIP_20 * Remote Shunting STIP_28 * Remote driving STIP_23 * Extended On-board modularity for CCS and RST part (from ERA list)	Repository/Digital Map STIP_67	Interfaces: 1.) Automatic Processing Module / Perception On-board 2.) Advanced Train positioning System / Perception 3.) Perception / TCMS		TSI CCS 2032 tbd
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Trackside Digital Register - STIP_08/_09		Affects: On-board Repository/ Digital Map STIP_67				TSI CCS 2028 tbd

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
On-board Repository/ Digital Map STIP_67	Support ATO GoA3/4, Advanced Safe Train Positioning, Passenger Information etc.	Affects: * Perception STIP_22 * Automatic Processing Module (APM) STIP_21 * GoA3/4 STIP_20 * Full Advanced Safe Train Positioning STIP_30 * Extended On-board modularity for CCS and RST part (from ERA list)	FRMCS, Trackside Digital Register STIP_08/_09, FRMCS v2; CCS On-board Network Communications Layers (S-147 v2) - STIP_68	Interfaces: 1.) Automatic Driving Module / Digital Map On-board (Repository) 2.) Advanced Train positioning System / Digital Map On-board (Repository) 3.) Digital Map On-board (Repository) / ETCS On-board 4.) Repository <-> Operational Execution (TMS gateway)		TSI CCS 2032 tbd
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Automatic Processing Module (APM) STIP_21	should substitute driver and train attendant responsibilities for reacting in case of incident. It manages mission execution, safe reflexive reactions, evaluated reactions and safety procedures.	Affects: GoA3/4 STIP_20, Extended On-board modularity for CCS and RST part (from ERA list)	Perception STIP_22, On-board Repository/ Digital Map STIP_67, Full ASTP STIP_30	Interfaces: 1.) Automatic Processing Module / Perception On-board 2.) Automatic Processing Module / ETCS on-board 3.) Train positioning System / Automatic Processing Module 4.) Automatic Processing Module / On-board Recording Device 5.) Automatic Processing Module / TCMS		TSI CCS 2032 tbd

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Enhancement of ATO GoA 2 for freight operation - STIP_20						TSI CCS 2028 tbd
Enhancements for ATO GoA 1/2 (from ERA CCM database)						TSI CCS 2028 tbd
GoA 3 STIP_20		Affects: GoA 4 STIP_20	Perception STIP_22, On-board Repository/ Digital Map STIP_67, OB Attendant, FRMCS, full safety analysis (extension of Subset-091), Automatic Processing Module (APM) STIP_21, FRMCS v2	Interfaces: See preconditions OB Perception, OB APM, Digital Map, FRMCS	OB Driver	TSI CCS 2032 tbd
GoA 4 STIP_20			GoA 3 STIP_20, full safety analysis (extension of Subset-091); Remote driving (GoA 3/4 Fallback solution)	Interfaces: See preconditions OB Perception, OB APM, Digital Map, FRMCS	OB Attendant	TSI CCS 2032 tbd

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Remote driving (GoA 3/4 Fallback solution) STIP_23		Affects: GoA3/4 STIP_20	Perception STIP_22, full safety analysis (extension of Subset-091)	existing		TSI CCS 2032 tbd
Remote Shunting STIP_28			Perception STIP_22, full safety analysis (extension of Subset-091)	existing		TSI CCS 2032 tbd
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
						case of SP standards)
Virtual coupling			Train to train communication, relative braking distance; braking curves concepts; Platooning is a new concept in VC. Might have large impact on TMS; Full Safety Analysis needed	Interfaces: On-board / On-board via radio		TSI CCS 2037 tbd

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Digital automated couplers (DAC)		Train integrity, DAC (unless you restrict it to train sets) - Train interface adaptation for integrity handling and train length / overall consist length - STIP_73		Interfaces: Impact on ETCS On-board Train Interface		TSI LOC&PAS 2027
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Basic ASTP: 1 st step for harmonized Advanced Safe Train Positioning STIP_29	Improved Odometry; separate subsystem ASTP	Full ASTP; Support of Passenger Information System	CCS On-board Network Communications Layers (S-147 v2) - STIP_68	Interfaces: Absolute Safe Train Positioning / ETCS on-board;		TSI CCS 2027 tbd; pending; sector agreement needed
Full ASTP: 2 nd step for harmonized Advanced Safe Train Positioning STIP_30	to enable new operating principles and ease trackside maintainability by fewer fixed installed assets	Moving block; APM STIP_21; Support of Passenger Information System	On-board Repository/ Digital Map STIP_67, FRMCS, Basic ASTP STIP_29, FRMCS v2, CCS On-board Network Communications Layers (S-147 v2) - STIP_68	Interfaces: 1.) Absolute Safe Train Positioning / Digital Map On-board (Repository); 2.) Absolute Safe Train Positioning / TCMS; 3.) Absolute Safe Train Positioning / Automatic Driving Module; 4.) Absolute Safe Train Positioning / ETCS on-board; 5.) Absolute Safe Train Positioning / Automatic Processing Module; 6.) Absolute Safe Train Positioning / Perception	Fewer fixed installed assets	TSI CCS 2029 tbd

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Identity & access management	Security		Shared function with TCMS (TSI LOC&PAS)			Pending; sector agreement needed
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Remote upgrade sw and data			CCS On-board Network - STIP_68	Standardized Maintenance Interface STIP_7		tbd
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Maintenance & diagnostics			CCS On-board Network - STIP_68; Standardised data exchange and management - STIP_144			tbd
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
						standards)
Online Monitoring System (S-149)			CCS On-board Network - STIP_68, FRMCS, API for other applications STIP_72; Maintenance & diagnostics	Interfaces: 1.) Automatic Driving Module / On-board Monitoring System (Subset-149); 2.) On-board Monitoring System / ETCS On-board (Subset-149) 3.) On-board Monitoring System / Euroradio Gateway		TSI 2028 tbd
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Support of Passenger Information System			CCS On-board Network - STIP_68, Advanced Safe Train Positioning STIP_29/ STIP_30, API for other applications STIP_72	Interfaces: 1.) Passenger Information System / ETCS on-board 2.) Passenger Information System / ATO on-board 3.) Passenger Information System / Cab Radio 4.) Passenger Information System / Automatic Processing Module		tbd
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)


Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Enhanced Backwards Compatibility (Dynamic RBC)		Update of Subset-104 "ETCS System Version Management"		-		Pending; clarification and sector agreement needed; not part of the STIP
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Cross-border TMS STIP_12/_13						TSI TAF 2028 tbd
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
						standards)
Interface ATO-TS to Execution / Adaptation Layer or TMS - STIP_19 and _104		Interface ATO-TS to Execution layer: Upgrade from GoA2 to GoA 3/4 - STIP_24; Traffic CS: System requirements Execution / Adaptation Layer (EAL) and interfaces - STIP_103		Interface ATO-TS to Execution / Adaptation Layer or TMS		TSI 2028 tbd
Interface ATO-TS to Execution and Adaptation Layer: Upgrade from GoA2 to GoA 3/4 - STIP_24			Interface ATO-TS to Execution / Adaptation Layer or TMS - STIP_19 and _104	Interface ATO-TS to Execution and Adaptation Layer		TSI 2032 tbd
System requirements and interfaces Advanced Protection System (APS) (other name: Trackside Protection System - TPS) - STIP_102		Hybrid Block; Full Moving Block; Traffic CS: System requirements Execution / Adaptation	Interface to adjacent TCS area - STIP_101; Harmonised Operational processed STIP_1 - STIP_3	Interfaces (see Figure 5): 1.) SCI-CMD 2.) TPS Handover 3.) ETCS Airgap 4.) Eulynx SCI 5.) SDI-TWS		TSI 2028 tbd

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
		Layer and interfaces - STIP_103		6.) SDI-TPS		
Traffic CS: System requirements Execution / Adaptation Layer (EAL) and interfaces - STIP_103		System requirements and interfaces Advanced Protection System (APS) - STIP_102	Interface ATO-TS to Execution / Adaptation Layer or TMS - STIP_19 and _104; Harmonised Operational processed STIP_1 - STIP_3; Function distribution and Interface between TMS/CMS and EAL - STIP_17	Interfaces (see Figure 5): 1.) SCI-CMD 2.) SCI-ATO 3.) SCI-OP 5.) SDI-EAL		SP 2028 tbd
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Minor Enhancements for ERTMS (from ERA list)			Depending on the CR	Depending on the CR		TSI 2028 tbd

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
DMI modernization (from ERA list)		FFFIS Train Display System – ETCS On-board (S-121) STIP_69; Multi Display System STIP_70		Interfaces: 1.) Subset-121 ETCS On-board / Train Display System; 2.) Automatic Driving Module / Train Display System 3.) Cab Radio / Train Display System 4.) TCMS / Train Display System		TSI 2032 tbd
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
						case of SP standards)
Agile system approach for cyber-security (from ERA list) / Cybersecurity for telematics applications (from ERA list)	this should contain also the replacement of Eulynx SDI by System Pillar Security specs.		Secure Component Specification - STIP_78 Secure Communication Specification - STIP_76 Shared Security Services Specification - STIP_75 Security Program Requirements - STIP_77			TSI / SP 2026 tbd
Harmonisation of different data elements needed to support the DataPrep use case (from ERA list)						TSI 2028 tbd
FFFIS Train Display System – ETCS On-board (S-121) STIP_69		Extended On-board modularity for CCS and RST part (from ERA list); CCS On-board Network	Multi Display System STIP_70; DMI modernization (from ERA list); Extended On-board modularity for CCS and RST part (from ERA list)	FFFIS Train Display System – ETCS On-board		TSI 2032 tbd

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
		Communications Layers (S-147 v2) - STIP_68				
Multi Display System STIP_70		Extended On-board modularity for CCS and RST part (from ERA list); CCS On-board Network Communications Layers (S-147 v2) - STIP_68; Extended On-board modularity for CCS and RST part (from ERA list)	FFFIS Train Display System – ETCS On-board (S-121) STIP 69; DMI modernization (from ERA list); Extended On-board modularity for CCS and RST part (from ERA list)	FFFIS Train Display System – ETCS On-board, FFFIS TDS - ATO, Cab Radio - TDS, TCMS - TDS		TSI 2032 tbd
API for other applications STIP_72			Passenger Information System; On-line Monitoring System; Extended On-board modularity for CCS and RST part (from ERA list)	API		TSI 2032 tbd
Extended On-board modularity for CCS and RST part (from ERA list)			Automatic Processing Module STIP_21, Perception STIP_22, ASTP STIP_29/_30, On-board repository STIP_67, Ethernet CCS consist network STIP_68, TDS FFFIS STIP_69, Multi Display System STIP_70, Train interfaces	See interfaces in  SPT2TRAIN-592 - Resulting Interfaces		TSI 2028 - 2037 tbd

Standardisation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
			enhancement STIP_71, API for other applications STIP_72			
Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Interfaces	Removed func/ building block (sub-system)	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
C-DAS without ATO						<p>Not to be standardized; not part of the STIP</p> <p>C-DAS should be merged with ATO. Trackside function is the same as for ATO GoA 2.</p>

[SPT2ARC-1197]

We did not take into account the details of the list DELIVERABLE DP 1.3 of SC#5 because it is too detailed for a CCS system roadmap (too domain specific) and in many cases it is not clear what exactly is meant behind the different Standardisation Areas. [SPT2ARC-3355]

Note: Items for which a sector agreement is noted it is assumed to be clarified latest in the scope of the CR pre-assessment. [SPT2ARC-3354]

3.2 Candidates for adding later after receiving inputs from the domains

Standardi-sation topic	Objective	Affects to other topics	Dependencies from other topics	Year for adopting rollout (in any case the years have to be linked to a TSI release also in case of SP standards)
STM via CCS On-board Network				Pending; sector agreement needed
Additional Train Interface Functions				Pending; sector agreement needed

4 Architectural Assumptions

Railway system / CCS Architecture from the Ramp-up project:

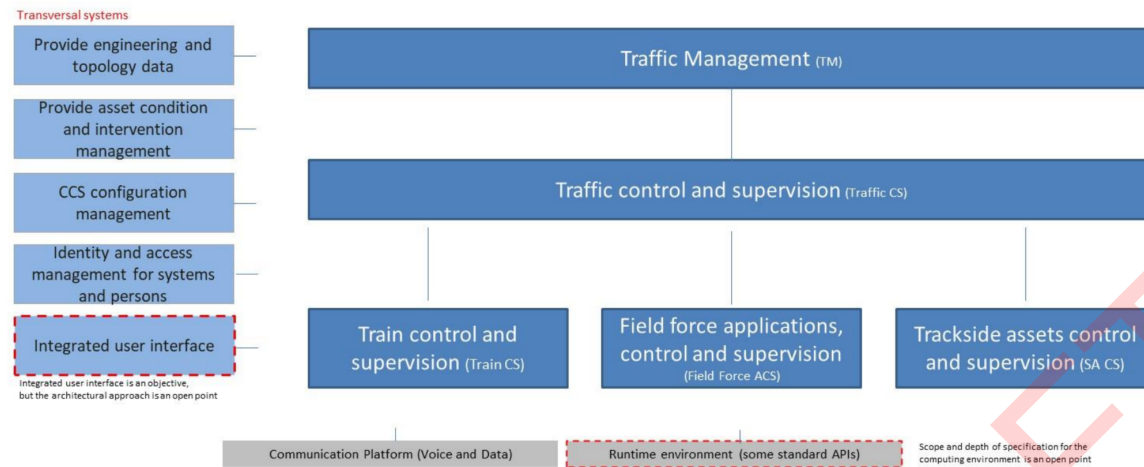


Figure 1: CCS TMS System of Systems Architecture

For details see: [Link to Sharepoint](#)

The architecture of Trackside Assets domain:

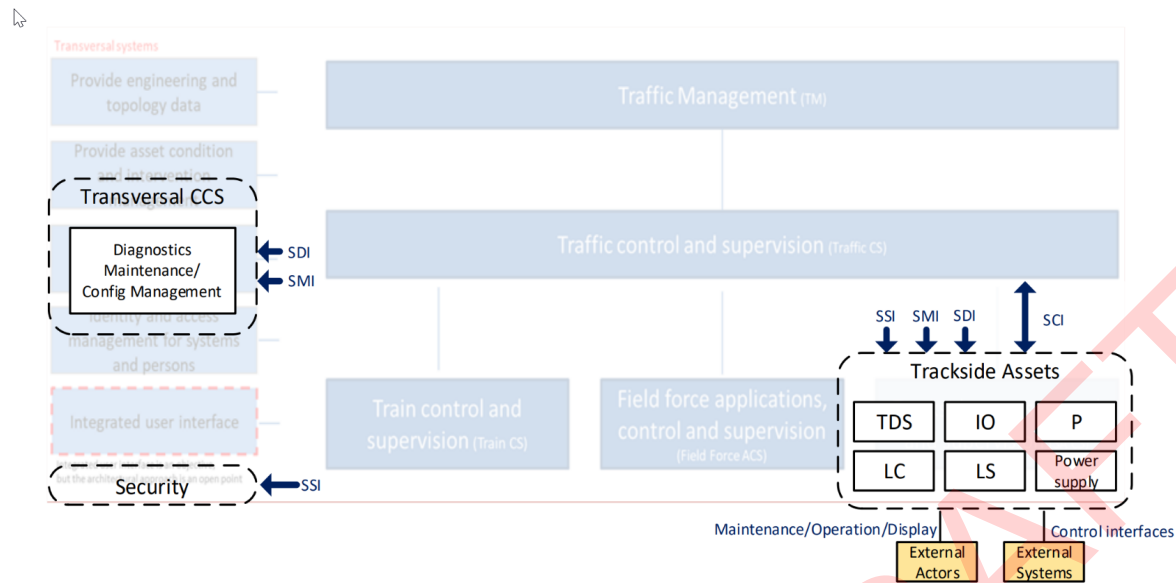


Figure 2: Overview of the Trackside Assets interfaces

For details see: [Link to Sharepoint](#)

The preliminary bottom-up architecture in Train CS domain:

For details see:

📖 SPT2TRAIN-579 - Summary of the Discussions for a Preliminary Bottom-up On-board CCS Architecture

Draft CCS On-board Architecture TSI CCS 2036

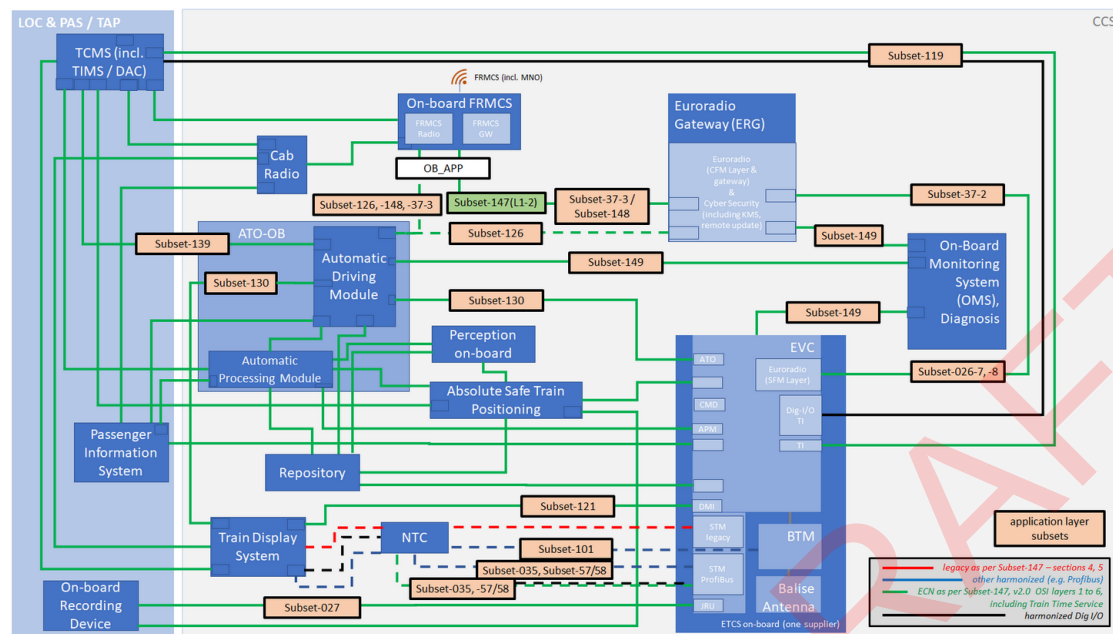


Figure 3: Preliminary Bottom-up Target Train CCS Architecture (~2036 – without GSM-R) – focusing on which sub-systems have interfaces with which other sub-systems

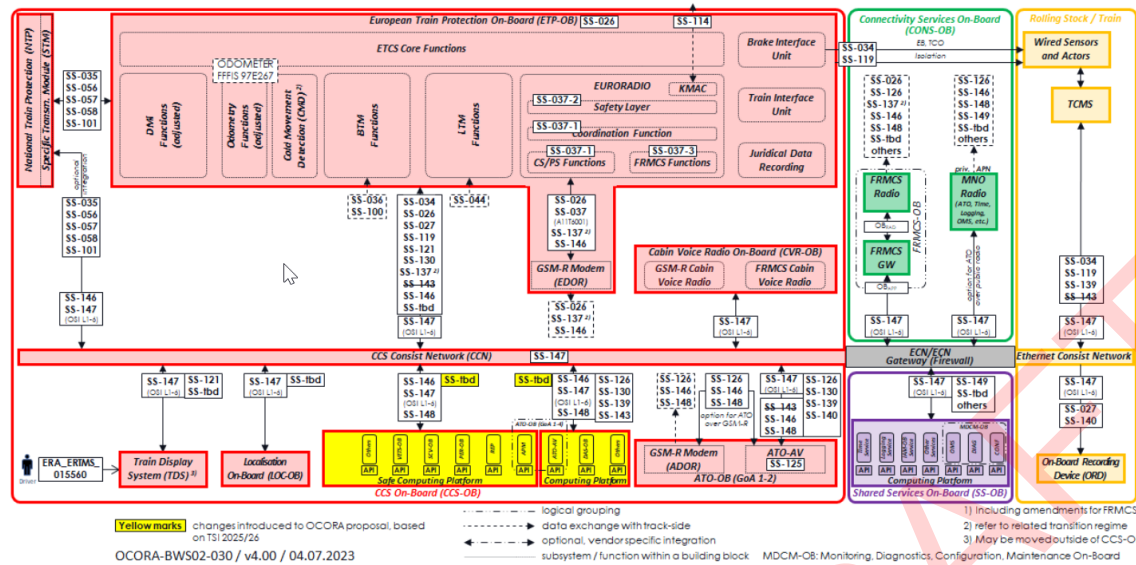


Figure 4: Preliminary Bottom-up Train CCS Target Architecture – focusing on CCS Network communication sub-systems

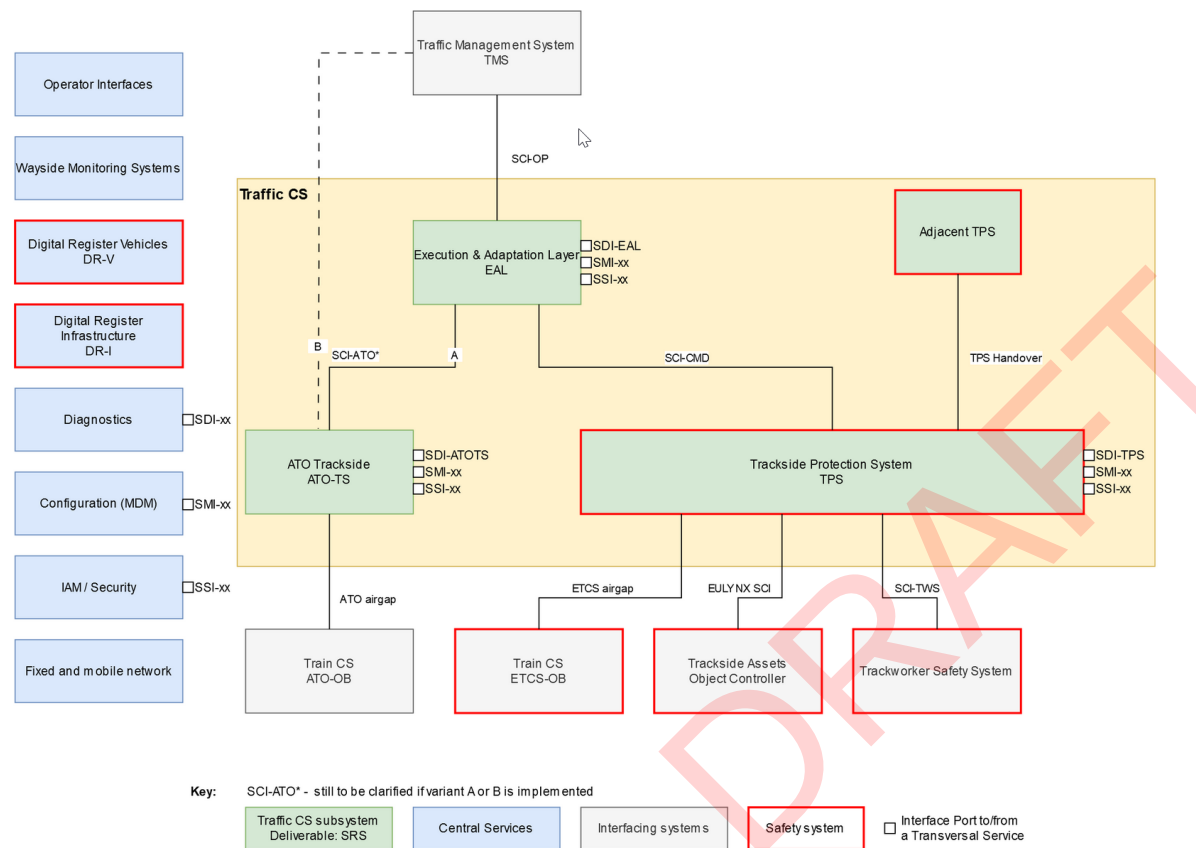




Figure 5: Traffic CS Operational Data Flow

Source of Figure 5: See  SPT2TRAFFIC-4457, Figure 3 ( SPT2TRAFFIC-4815)

4.1 Further Input Documents

The consistency of this document with the following documents has been checked:

- Document of System Pillar Migration Domain:  D1_CCS Features Indivisible for deployment
- Standardisation and TSI Input Plan (STIP) V1.0 final
- Train CS evolution steps:  SPT2TRAIN-579 - Summary of the Discussions for a Preliminary Bottom-up On-board CCS Architecture
- "ERA List" - ERA requested needs for the System Pillar - [230523 SP FP2 F2F_STIP V3.pptx](#)

A further input has been the migration targets (steps 1, 2 and A) defined in the document "Response to CER&EIM Position on Railway System Architecture", March 2024 and a related discussion: [Link to Sharepoint](#) . It defines what shall be achieved for the deployment while the focus of the System Pill Architecture Roadmap is the release planning for the specifications of the harmonisation topics.

5 Generic List of What is Needed for a Standardization Topic

Generic steps (for which the relevance has to be checked topic by topic)	Generic durations
1. Agreed Functional Requirements Specification (Capabilities)	Precondition
1. Economical Evaluation	Can be done in parallel to the process
1. Operating Rules	6 months
1. Dependencies	Can be done in parallel to the process (often is obvious)
1. System Requirements Specification	6 months
1. Specification of changes in impacted Building Blocks (Subsystems) / Surrounding Systems	12 months starting in parallel with step 5
1. Interface Specifications	12 months starting in parallel with step 5
1. Prototyping (in case necessary)	12 months

Generic steps (for which the relevance has to be checked topic by topic)	Generic durations
1. Test Specification for the TSI (if needed)	6 months starting in parallel with step 8
1. Testing including interoperability between different suppliers if needed; includes pilots on real trains/tracks if needed	12 months
1. Safety Analysis and Specification	12 months stating in parallel with step 5
1. Updating documents based on results of testing	6 months
1. Forward for TSI inclusion	-
Sum	48 months ☑ ca. 3 – 6+ years depending on complexity

There is the ERA CR template process including the pre-assessment (see "EU-RAIL and Harmonisation", Rev. 1, Sytem Pillar, [20230604+EURAIL+and+Harmonisation_Version_1_0.pdf](#)). This should be done at appropriate point in time which has to be decided case by case.

6 Open Points

- To be pointed out: The architecture roadmap has to clarify which system releases are possible from architecture point of view including architectural alternatives
- Derivation of a document plan
- Section 5 to be aligned with the config management setup worked out in EET. In SC2.4 we want to start a professional release management based on the designed configuration management in ARC. The milestones of this roadmap would be the basis for releases. A process needs to be designed for the release management in this document to align with EET (or SEMP).
- To add the dates of STIP items after the next release of the STIP.
- For System Milstones a planning is foreseen, more readable, grouping STIP topics together and other topics together (with no STIP request ID)
- System Standardization Topics Roadmap: It is planned to adopt a format that is easier to read (e.g. Excel / PowerBi, planning with view the dependencies and filter per topics for instance)
- A planning is needed considering also the steps of section 5 (maybe with lower detail). Maybe we could do this on the main topics only, and for the next TSI as a first step.
- The question needs to be clarified, if we release also some intermediate "packages" for 2025/26, to be used in current rollouts. Candidates could for example be things like "first 10 capabilities finished by OD/TrafficCS", etc..

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