Annual Work Programme

System Pillar

The System Pillar aims to define the concept of operations for Rail and a functional rail system architecture for the future, considering interfaces within different rail segments and other modes.

To achieve an architecture that offers the demanded functional improvements concerning production performance, reliability, quality, and cost as well as the needed architecture quality, the System Pillar (SP) follows the defined process, based on the principles of Model-Based System Engineering (MBSE):

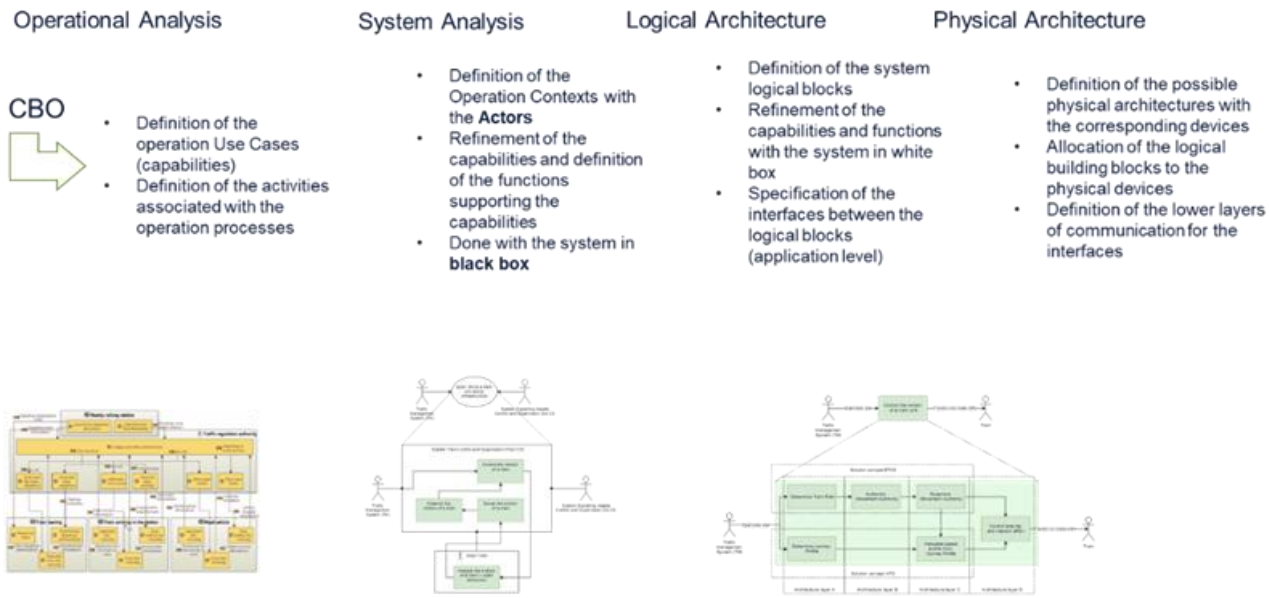

Figure 1: MBSE process used by the System Pillar to develop the overall architecture.

The System Pillar is managed and led by the System Pillar Unit of EU-Rail, under the responsibility of the Executive Director, within the governance established by the Single Basic Act (Council Regulation (EU) No 2021/2085 of 19 November 2021).

The System Pillar (SP) has the responsibility to support a consistent and coordinated approach to the evolution of the rail system according to the EU policy goals. The outputs of the System Pillar are:

- Specifications, and standards, related to among others, to cyber-security, command, control, and signalling systems (CCS), Traffic Management (TMS) and Digital Automated Coupling (DAC) to support European deployment of digital systems.

- Through the Standardisation and TSI Input plan, a coordinated and transparent view of all the harmonisation elements from EU-RAIL in order to define a clear and agreed plan for the evolution of the CCS/TMS system, the TSI enhancements, and standards, which will support interoperability, modular interchange ability, system integration ability, robustness, harmonisation and implementation of the SERA, and the role of EU-RAIL (both System Pillar and Innovation Pillar) in delivery.

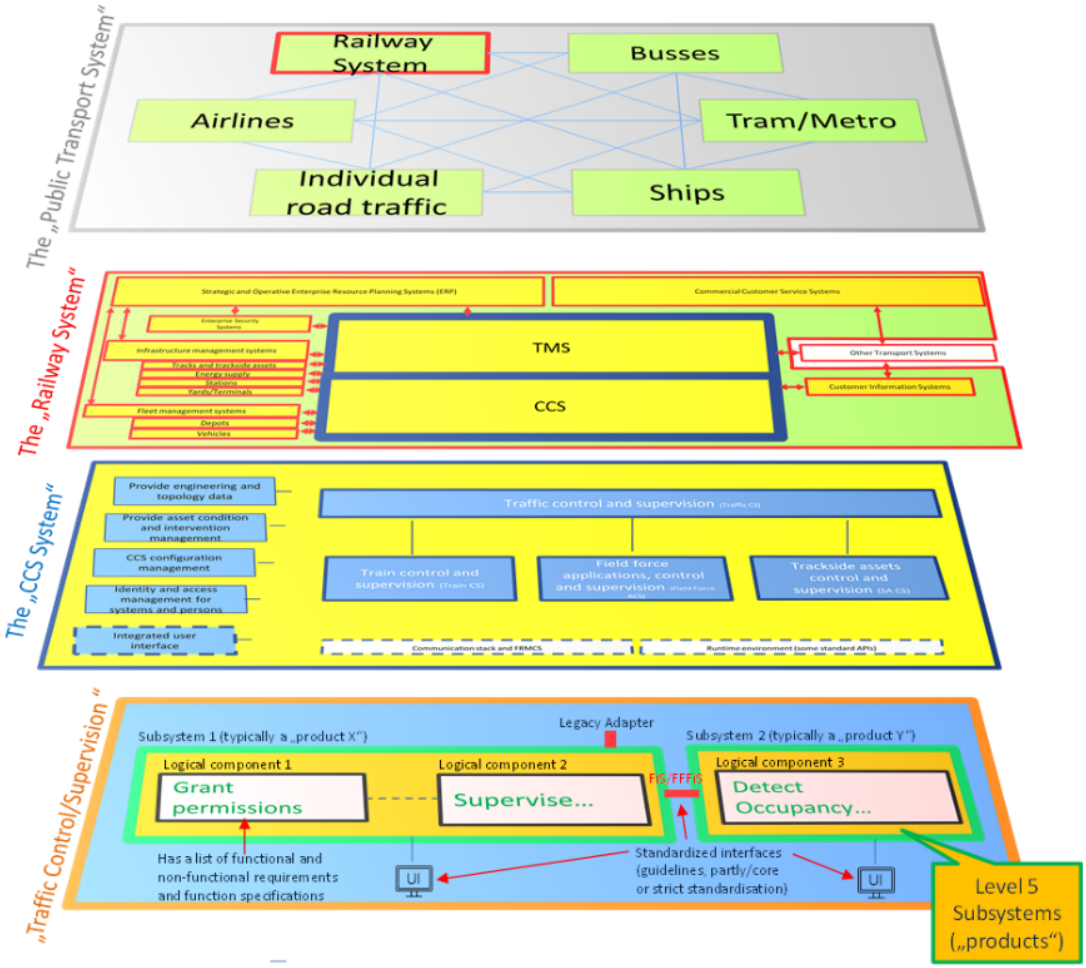

Figure 2: System Level 1-5 view, the content is based on indicative CCS/TMS

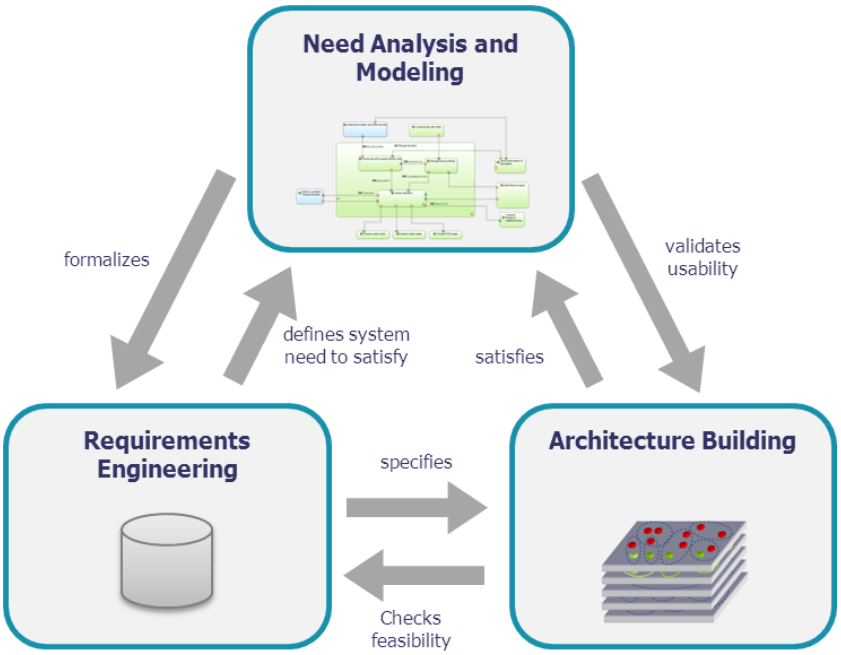

Figure 3: Viewpoint driven approach [Augmenting requirements with models to improve the articulation between system engineering levels and optimize V&V practices', INCOSE International Symposium, 29: 1018-1033]

Through the Ramp-up phase for the SP (2022) a draft high-level architecture has been drafted and reviewed with the sector. The full resource for the System Pillar has been in place since October 2022.

During the first year of the System Pillar (Q4 2022-Q3 2023), the workflows supporting the described model-based system engineering approach for developing the railway system architecture have been launched. The performed work comprises both the top-down system engineering approach, starting from the CBOs and operation use cases, as well as the bottom-up integration of the existing outcomes of previous S2R works or other sector initiatives (as OCORA, EULYNX etc.) The process steps of the implemented model-based system engineering approach have been elaborated in the System Engineering Management Plan (SEMP) and applied to a first set of operational capabilities.

During the second year of the System Pillar (Q4 2023-Q3 2024), the above-described approach has been pursued. Additionally, the System Pillar is coordinating the harmonisation outputs and needs from the EU-RAIL programme in the Standardisation and TSI Input Plan (STIP) and supporting the interaction of the related activities of EU-RAIL with ERA and the standardisation bodies (incl. the Sector Forum Rail (SFR) and RASCOP). The specific harmonisation topics for EU-RAIL as a whole are being integrated and delivered in the Standardisation and TSI Input Plan.

During the third year of the System Pillar (Q4 2024 – Q3 2025), the first outputs of Technical Specifications for Interoperability (TSI) and their associated documents (subsets, applications guides, etc.), EU Standards and other SP documents are expected to be published.

SP organisational structure of the activities

Given that it is necessary to define the whole rail system in order to determine the areas of priority and focus. For this, there are two different structures co-existing within the System Pillar organisation of the activities:

- The content structure: Describes the work items that need to be built in a certain sequence to create the deliverables. Content structures have many levels of details and are connected in all directions by the “flow of requirements”.

- The organisational structure: Defines the team structure and the control flow, aimed to be as simple (top-down), efficient, and effective as possible.

Regarding the difference between the content structure and the organisational structure, a “design team” for the business architecture of the railway system cannot be the “leading” team for all System Pillar projects. Design work and program management is not the same. The Task 1 analysis and design team contributes important requirements to the SP projects, but the progress management of the SP is done by the SP Core Group/the JU.

The figure below, includes the first and second level operational break down structure of the System Pilar, as of 2024. Additional specific projects and/or may be added in the upcoming years, as the development identifies new lines of work to fulfil the CBOs.

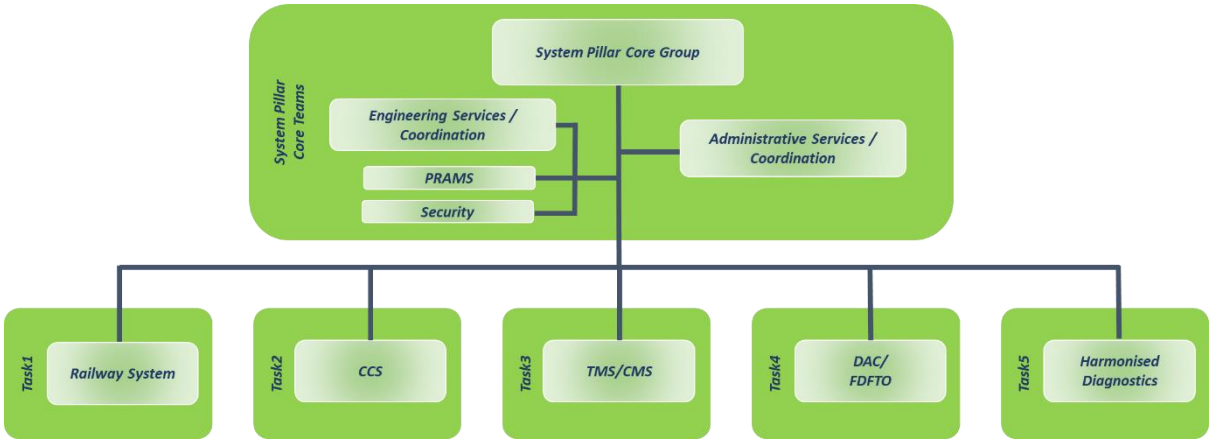

Figure 4: first level operational breakdown structure of the System

The roles and responsibilities of the following SP groups are depicted in the EU-Rail's Governance and Process Handbook1:

- SP Steering Group, Core Group, Engineering Services / Coordination (comprising Engineering Environment Team, Standardisation and TSI input planning, External Architectural support, PRAMMS Management and Assurance), Administrative Services (comprising Programme Office, Economic Analysis),
- Task 1: Railway System,
- Task 2: (Advanced) CCS system design,
    - The cross-cutting domain teams (comprising Operational Design, Architecture and release coordination and Migration and roadmap),
    - The CCS System Design Teams (comprising Traffic control and supervision, Trackside assets control & supervision, Train control and supervision, Transversal CCS component, Field force CCS application, Communication team, Computing environment),
- Task 3: TMS system design,
- Task 4: DAC/FDFTO2 System design.
- Task 5: Harmonised diagnostics

System Pillar Core Teams

System Pillar Core Group

The System Pillar Core Group provides the competent leadership and expertise of the development of the functional layered railway system architecture, specification models and Operational Concepts that enable safe, secure and efficient delivery of the new systems. Moreover, the SPCG manages the common business objectives and deliverables from the different SP Tasks.

Engineering Environment Team

The Engineering Environment team (previously Central Modelling Services) includes methods definition (System Engineering Management Plan (SEMP)) and tools provision and training (Polarion, Capella, SysML specification environment) for the whole System Pillar. The Engineering Environment

[1] https://rail-research.europa.eu/wp-content/uploads/2023/01/EU-Rail-Governance-and-Process-Handbook.pdf

[2] DAC = Digital Automatic Coupler / FDFTO = Full Digital Freight Train Operations (part of FA 5 project)

team monitors the formal quality of the work items, their correct allocation to the tasks and domains, and the consistency, traceability and integrity of the specification.

PRAMS Team

The PRAMS team is in charge to define the strategy, policies, methods, and principles to be followed by the other Tasks and Domains during the design activities as well as to coach and support implementation. PRAMS team do not produce PRAMS Analysis, Hazard and Risk Analysis, for system components or system parts; these activities are delegated to the related Domain that have to include members with PRAMS skills. The PRAMS Functional team is in place to have a proper coordination and synchronization.

Security Team

Security requirements are coordinated centrally this includes top-level design and assurance of the security strategies and requirement implementation in the System Pillar Tasks and the specification of the subsystems for monitoring and the system control access.

System Pillar Task 1: EU Rail System

The System Pillar Task 1 will be focused on the European railway network to which Directive 2016/797 applies. The vision of the European railway system is:

- Open access to SERA, i.e. no technical and operational boundaries for trains, standardisation (economies of scale), safety (including learning from information sharing) and resilience.
- Performant and competitive.
- Synchronised deployment, and
- Full alignment with the future system

The system architecture used by the System Pillar needs to be structurally and logically consistent, and reflect the structural reality that, currently, there is no single European railway system.

The high-level target architecture(s) will input to the considerations of the optimal level of technical and safety harmonisation building on cutting-edge technologies, making it possible to facilitate, improve and develop railway services within the Union, and with third countries, and to contribute to the completion of the SERA and the progressive achievement of the internal market. Interoperability must be achieved and maintained.

The scope of Task 1 should not be time-bound and can consider several iterations of development i.e. it should be ambitious and flexible to consider the impact of new technologies and processes with regards to rail (e.g. from the innovation pillar) which may require a substantial revision of, inter alia, safety concepts and the regulatory framework underpinning operations both with the clear goal to harmonise across Europe.

To achieve the overall evolution and target architectures defined in Task 1 will be a complex challenge. Best practice from other industries shows that successful integration of system architecture approaches, especially when moving from current engrained systems like in rail, is to take the opportunity when systems are in any case evolving to put in place the correct system architecture processes and principles.

System Pillar Task 2: CCS

The regulation and implementation of European rail control-command and signalling (CCS) is of central importance in the running of a safe, efficient, interoperable, robust cost-efficient and reliable rail service in Europe. CCS deals with all the on-board and trackside equipment required to ensure safety and to plan, command and control movements of trains authorised to travel on the network as well as the efficient integration of maintenance processes that occupy tracks.

Historically the automatic systems developed over time to monitor drivers' operation (continuous speed monitoring and avoidance of signals passed at red) have been developed to be different and they are still substantially different in each national railway network, and thus a major barrier to operate one European network.

A central focus at European level has been the implementation of ERTMS (European Railway Traffic Management System), a major industrial programme to harmonise the automatic train control and communication system and underpin interoperability throughout the rail system in Europe. Deployment of ERTMS provides the backbone for a digital, connected Single European Rail Area.

The current harmonisation at European level, through the CCS TSI, addresses the safety and interoperability requirements, the on-board functions and the interfaces between trackside and on-board related to train protection, signalling the permission to move the train and radio communication. Hence, not the full CCS system.

For trackside CCS beyond that specified in the CCS TSI, there are currently network or deployment specific approaches of trackside engineering, operational concept, signalling rules and their interfaces.

The current typical CCS on-board configuration includes multiple proprietary TCMS (train control management systems) and Class B driven interfaces between the main train on-board building blocks, which are currently not harmonised.

As a result, even if ERTMS as it stands is implemented in full across the EU, national systems for significant parts of the CCS system would continue, along with national operational rules driving customisation, and a continued overall fragmented CCS market of signalling configurations and rail business models.

This situation significantly increases CCS complexity and reduces the opportunity for more open and competitive markets across Europe. It also creates a system that is not conducive to harmonised evolution and innovation and induces errors and incompatibilities in implementation of the TSI regulated interfaces. Finally, it undermines the performance of the rail system in favour of clients opting for other mobility and transport solutions.

Hence the CCS task is to develop a harmonised operational concept and functional system architecture for a genuine integrated European CCS system, supported by a model-based systems architecting & engineering approach, beyond the current specifications in the CCS TSI, with much greater standardisation and much less variation than at present. Differences in operation are one of the key root causes for complexity as well as product diversity and therefore are a major cost driver. The harmonization of operational principles where economically possible – in particular under cab signalling and radio-based ETCS is key to achieve generic CCS solutions, minimize national requirements, reduce life cycle cost and achieve operational interoperability. This integrated CCS system will on the one hand deliver unrestricted movement of trains, on the other hand, it will create a single market for rail components.

CCS – both on-board and trackside - will be based on a standardised modular system architecture using standardised interfaces. In order to preserve investment made, the System pillar should not only create adequate interface but care about migration feasibility (i.e. clear and affordable transition steps) and find paths for moving beyond the current system with proprietary interfaces and allowing modularity of components.

The need for the CCS task is because digitalisation technologies are ready for use in rail with huge potential to improve passenger and freight services. Digitalisation coupled with automation is one effective way to increase performance and capacity with less new infrastructure investments. Without high quality architecture, adding such new technologies and maintaining compatibility will not be possible.

The purpose of the focus on CCS is therefore to take advantage that as networks and Member States migrate to CCS systems of ERTMS L2 or above – the opportunity is taken to do this in a harmonised manner following functional layered architecture principles: this will set a common baseline that will allow to evolve systems at the technological evolution pace. It will be a major change from "black boxes" to "software solutions" computing environments.

Operational interoperability is an equally important goal of the Single European Rail Area. A further major opportunity is thus to create harmonized operational rules.

On this basis, a converging shared vision on future rail operations based on ERTMS-alone Level 2 and Level 3 networks will set up the baseline for the operational and technological solutions to ensure and continue evolutions of rail.

System Pillar Task 3: TMS/CMS

TM/CM means to create a long-term to short-term operational plan (production plan) that fulfils customer needs in an optimized way, to prepare and let execute the plan, and to predict and react on deviations and events with adapted planning or initiated interventions to solve production problems. The operational plan describes in very detail all types of track usage (train movements, stabling, construction sites, usage restriction areas, etc.).

Task 3 aim for Traffic Management is to reach a high, smart and flexible automation and cooperation levels for its long- or short-term simulation, planning, forecasting and coordination processes (cross-company, cross-country) in a way that allows to work with an integrated and rolling high-quality plan in near-real-time, based on automated information exchange between all involved planning partners.

The harmonization of operational processes is a key driver towards a deep and seamless integration of the new services and capabilities, with a specific focus on national borders; this is fundamental for the evolution of the Traffic and Capacity Management System to get an effective Single European Railway Area (SERA).

The basic vision will also include a highly digitalized tactical short-term planning with the relevant cost-efficient approach to address risks and opportunities.

This will allow task 3 of SP to achieve the objectives to:

- Strengthen the ability to sustain a given service quality, punctuality, and safe operation, by completeness of planning, adequate level of information, rapid responses to capacity requests and planning changes and reducing the impact of disturbances,

- Leverage on real-time information and data sharing to provide accurate status in order to provide to customer rapid alerts of traffic congestion and in general provide valuable data and information,

- Enable more efficient infrastructure usage and better predict capacity needs of infrastructure.

System Pillar Task 4: DAC/FDFTO

Coupling is done manually by a worker who must climb between wagons to hook and un-hook them, requiring physically exhausting manual operation in a hazardous environment. A more efficient, sustainable and competitive rail freight system is essential to meet the needs of both climate protection and rising transport volumes. Digital automatic coupler is an enabler to create a modern and digital European railway freight transport. It will not only increase efficiency thanks to automation processes, but it will also ensure sufficient energy supply for telematics applications, as well as safe data communication throughout the entire train.

Through the work in task 4, mainly regarding the high-level specifications and providing the system view, System Pillar will be supporting the improvement of freight train composition, operation and capacity allocations of paths, stabling tracks (e.g. waiting for terminal slots) and shunting (yard) work.

System Pillar Task 5: Harmonised Diagnostics

The ambitious plans of the European Union and railway undertakings are targeting a significant increase in rail usage. This increase requests a higher availability of railway infrastructure and rolling stock but also shortens the time for maintenance for both infrastructure and rolling stock. Thus, fast, and accurate data sharing among different stakeholders is key for better maintenance.

Previous and on-going projects have already developed approaches and concepts for standardized data exchange. However, a harmonized European approach for exchanging maintenance data has not yet been established and data which is currently produced by different technologies (e.g. checkpoints) cannot be exchanged across Europe, which hinders development of the railway sector and blocks business cases.

The initial remit is to select a limited number of examples to demonstrate “proof of concept” European harmonization on the approach, based on the SP Data Model. The procedure methodology and proposed solution should be worked out using simple, non-critical and useful examples, keeping the complexity of the task within manageable limits. Therefore, existing and proven systems should be considered as far as possible, and feasibility demonstrated using a non-critical, useful applications and applying a system wide view.

SP DELIVERABLES, MILESTONES AND HARMONISATION PLANNING

The work of the System Pillar is structured along the different tasks described in previous section **SP Organisational Structure of the activities**. In the following section the deliverables and milestones are summarized per task and domain.

Detailed information can be found in Annex V.

Other outputs, such as the Standardisation and TSI Input Plan are also described, and the work to support the maintenance and update of the CCS TSI are also described.

Task 1 Railway System

The main ambition for the Task 1 System Levels is to get a list of the needed and important improvements in selected interaction processes (for a better "to be" architecture). A preliminary analysis should highlight differences in the selected interaction processes between countries represented in Task 1 to assess migration issues. For prioritized capabilities, full operational analysis and system analysis should be finalized using the SEMP.

The system view will allow a common understanding in the space of European railway systems the stakeholders' needs, resources, and capability to deliver beyond the existing implementation of railway sub-system or products. It will support tackling harmonisation, enable innovation, and build the capability in the railway system.

These improved business and technical process solutions will, to the extent needed, describe the rationale behind the requirements of the to-be target Business Process Architecture and Operational Design. The design work for Task 1 is not intended to describe all process and improvement aspects of the full railway system in full detail, especially when no need for harmonisation inside of the System Pillar is identified.

The deliverables for the period of the Work Programme are:

- Development of the to be architecture for "maintain and monitor rolling stock" and "maintain and monitor infrastructure" capabilities with operational process and scenarios, highlighting divergencies between members states.

- Operational analysis of the to-be architecture, based on "maintain and monitor rolling stock" and "maintain and monitor infrastructure", including the provision of a draft of performances which could be reached by the To-Be Architecture and derived requirements. Additionally, Task 1 will continue with the Operational Analysis of the to-be architecture for the Operate Train and Manage Energy capabilities.

- Identification and mapping of pain points in the operational architecture, in order to highlight activities and interactions where there are opportunities for harmonization

Task 2 CCS

The activity of task 2 on CCS represents the main focus of the System Pillar activities and is divided in several domains.

Task 2 CCS: Domain Architecture and Release Coordination

T2 ARC domain is responsible for the following "coordination areas". Each coordination issue is not a design task per se, but fulfils a cross-domain, cross-task and SP-IP oriented roles and supports by this the management task of the Coregroup for a specific content area. Each coordination issue shall be handled by one coordinator who is responsible for it.

The deliverables for the period of the Work Programme are:

- CCS TSI CR Overview including a compilation of the following: SP analysis for the backlog CR enhancements in the ERA CCM DDBB; Preassessment content of the bundles of CR to the different TSI, related to CCS outcomes in EURail; other content work related to alignment with the CCS CR authors from other domains or IP; plan and status of the work according to the plan shared with ERA.

- High level logical architecture on system level 3, including Logical architecture (on System Level 3) of the CCS Reference, coherent overview on the CCS reference architecture identifying the TSI relevant parts and specification of the common CCS architecture including all relevant interfaces.

- System Pillar Document and Release Plan ("DRP") to show all existing or future result documents, their current status, the release planning and packages, the publication dates for drafts and final versions, the links to the documents, dependency analysis between the different topics and analysis on how other harmonization topics are affected. Its expected to include consistency check with the released STIP.

Task 2 CCS: Domain Operational Harmonisation
It is the task of the domain to integrate the stakeholder needs of RU and IM into the operational design in a way that allows to harmonize CCS procedures in the interoperable interactions and to harmonize CCS products according to the harmonization scope of the System Pillar. The target of the domain is to deliver until October 2025 the rulebook chapters for the topic package 1 for drivers, signallers, trackworkers and shunting workers.

The deliverables for the period of the Work Programme are:

- Guideline for harmonized CCS related operational processes for ETCS L2 and ATO GoA ½: The target of the domain is to deliver until October 2025 the rulebook chapters for the topic package 1 for drivers, signallers, trackworkers and shunting workers. Additionally, the domain will support the CCS CR process for update, drafting and reviewing existing ERTMS EUG engineering guidelines participating also in any related workgroup with ERA

Task 2 CCS: Domain Traffic Control and Supervision
The domain Traffic CS is a core element of the overall CCS functionality. Therefore, the progress with regards to the description of the functionality, the final alignment about interfaces and the interior architecture is key for the coming period until October 2025. The domain now goes into the phase of concrete specification of system and interfaces, which also increases the workload and need a tight collaboration with Task 2 OD.

The deliverables for the period of the Work Programme are:

- System specification and interfaces for ATO Trackside function (GoA2), System specification and interfaces of the trackside protection system and System specification and interfaces of the execution and adaption layer. The requirements are to be described and approved as SRS and for all harmonized system and user interfaces as FiS/FFFiS. Impact to existing interoperability specifications (in CCS TSI) is to be identified including harmonization of functional/engineering rules and proposed changes to existing requirements.

- CCS Trackside migration analysis considering the economic assessment results. Providing answers to key migration questions such as the basic integration strategy to interconnect existing (national legacy) and SPRA compliant (existing and SPRA) products; functional packages (CCS trackside) mandatory for SPRA to simplify migration; decision criteria for national migration steps that help to decide an optimal migration plan; interfaces that can realistically and economically be rolled out before 2030.

- Preparation of major design decisions for management level and steering group, including a clear but compressed view on major design decisions and their rationales, for experts and for

management level. The system concept is approved by domain and SPCG and lists concrete decision questions which are assessed by their major impacts.

- Additionally, members of the Traffic CS team are involved in the following working groups System analysis group and system specification subgroups; UI design group; CCS trackside risk management group; CCS trackside migration group; Technical specialists and advisors' group.

Task 2 CCS: Domain Train Control & Supervision
The Train CS domain is responsible for the onboard CCS system. This includes beside the ETCS vehicle equipment also the additional components and functions like ATO (GoA 2 -4), RTO (Remote train operation), C-DAS and others from the on-board perspective. Close alignment with the communication domain (now Lot 3) required to define the interface between FRMCS and the Train CS system.

The deliverables for the period of the Work Programme are:

- Ethernet CCS consistent network (full stack), complete harmonization onboard CCS communication layer full stack (OSI layers 3-6 and safety layer) based on the deliverables agreed with FP2.

- Train interfaces enhancement, functional enhancement for the train interface to allow for CCS onboard systems to be deployed on vehicles as a product from different vehicle suppliers. (ensure CCS onboard exchangeability).

- Train Display System – Multiple display system concept and definition of Multiple DMI concept based on existing documents / information and specific topics.

- Train interface adaption for integrity handling and train length / overall consist length, following the CCS CR ERA process.

- Definition of Computing Platform for safe applications up to SIL4 (relating to CCS applications or other on-board applications e.g. passenger information). Decoupling software, hardware and computing platform lifecycles.

- Basic ASTP: Odometry performance and robustness enhancement. Enhance the specified performance of accuracy of distances measured on-board and improve its robustness. Consider and may be update the odometry performance targets for new CCS onboards to the state of the art of available and proven technologies (update TSI CCS to existing reality using existing technology).

- Basic advanced safe train positioning: General system requirements and architecture and ASTP interface specification

Task 2 CCS: Domain Computing Environment
The task of the computing environment domain is to find solutions to simplify software installation, hardware configuration and life-cycle processes such as upgrades, updates, or replacements with different software products. These solutions can include standardized API(s) related to the runtime environment and/or hardware on which CCS applications are hosted.

The deliverables for the period of the Work Programme are:

- Computing Environment System capabilities and functions – System Analysis (FRS CONEMP, Functional Requirement specification)

- Standardisation of Computing Environment interfaces I2/3. Usable specification for Hardware Abstraction Interface (I2) and Virtualization Interface (I3) for Computing Platforms for safe applications up to SIL4 (relating to CCS applications or any other applications used in the context of rail operation). Decoupling software, hardware and computing platform lifecycles. Enabling interchangeability between computing platforms, onboard and trackside.

Task 2 CCS: Domain Trackside Assets Control & Supervision
The Trackside CS domain is responsible for the specification of the sub systems controlling the trackside objects like points, track vacancy detection, level crossings and others. With this a unified interface between the Traffic CS system and the object controller should ensure the interchangeability between both components. After the successful release of the second version of the interface specification in June 2024 the work in this period should focus on the remaining topics for a final stable release of the specification for Trackside Assets.

The deliverables for the period of the Work Programme are:

- Finalize TACS specification, according to the STIP.

- Decision proposal for further harmonization of interfaces between object controllers and field devices, following the Granularity Principles method.

- Decision proposal for harmonization of interfaces to power supply and power management, following the Granularity Principles method.

Task 2 CCS: Domain Transversal Systems
The Transversal Systems domain and its three subdomains provide systems, standard protocols, and data structures for functionalities that are needed on network level and for engineering use cases.

The deliverables for the period of the Work Programme are:

- CCS/TMS Data model updated and functional requirements specification for Digital Registry.

- Generic Diagnostics System Specification and Traffic CS Diagnostics Data Model Specification

- Configuration & Maintenance Management and Configuration Management Specification for trackside constituents

Task 3 TMS & CMS
TMS&CMS carries out the coordination and execution of the detailed design work for the lower System Levels 3, 4 and 5 for the Traffic Management System/Capacity Management and defines detailed operational processes and requirements, functional system analysis and technical architecture

The deliverables for the period of the Work Programme are:

- Interface TMS/Traffic CS: Update Function distribution and Interface between TMS/TCS.

- Recommendation of harmonization scope TMS/CMS

- Integration of Timetable Revision (TTR) Messages. The TTR (Timetable Revision) project and the linked digitalization concept DCM (Digital Capacity Management) define new concepts such as ECM (European Capacity Management), Capacity Broker, TCR (Temporary Capacity Restrictions).

- Cross border variants analysis CMS & TMS, including the preparation of operational, functional, technical, deployment and economic content to support strategic decisions in SPSG regarding TMS and CMS Cross borders.

Task 4 DAC/FDFTO

Task 4 is responsible to manage all cross-cutting activities related to DAC/FDFTO (e.g., regarding operational procedures, architecture and interfaces embedding the onboard system, developed by FP51, into the overall railway system), manage the input to the Standardisation and TSI Input Plan (STIP) for DAC/FTDFTO and supports FP5 regarding authorisation strategy. This implies working in close alignment and cooperation with Innovation Pillar Flagship Project 5 (FP5) and EDDPneo@EU-Rail, including participation in mediation of conflicts with other Innovation Flagship Areas and SP Tasks.

The deliverables for the period of the Work Programme are:

- EU DAC Based Operational Standards and Rule Book based on sector feedback and final mature input from FP5.

- Interfaces between train-internal FDFT and the "outside" world, with focus on Train-Lenth/-Integrity.

- Central Instance for management of Data & Software, including a detailed description of and roadmap for the implementation of a basic functionality of a European Central Instance (incl. connected IT/Cloud architecture) for the pre-deployment phase

Task 5: Harmonised Diagnostics

Harmonised European Railway Diagnostic (HERD) of the System Pillar will generate a set of proven technically and procedurally harmonised diagnostic data use cases and will provide a guideline for a harmonised diagnostic data exchange. The main benefit of HERD is the gain of harmonised condition information for integrated asset management.

The HERD team consists of representatives of the data user as well as of the data provider from supplier industry, infrastructure managers (IM), railway undertakings (RU), and vehicle keepers (VK). Strong alignment with the Innovation Pillar Flagship projects FP1, FP3 and FP5 as well as with the System Pillar Tasks 1, 2 and 4 is ensured by the team members.

The deliverables for the period of the Work Programme are:

- Aligned Use Case 1 demonstrator specification for a Pilot implementation.

- Processing of new Use Cases. There will be a recommendation of how the data exchange between the data users and the data providers should/could be performed.

System Pillar Core Teams

Engineering Environment Team

The Engineering Environment team includes methods definition (System Engineering Management Plan (SEMP)) and tools provision and training (Polarion, Capella, SysML specification environment) for the whole System Pillar. It monitors the formal quality of the work items, their correct allocation to the tasks and domains, and the consistency, traceability and integrity of the specification. The Engineering Environment team has a central and active role in guiding and supporting other teams. Modelling and specification (including integration of external input) is done in the Tasks and domains.

The Engineering Environment team is not contributing to the specification or modelling work itself but is actively supporting where needed and taking care that the work of the Tasks and domain can be done in an efficient way and with the needed quality.

The deliverables for the period of the Work Programme are:

- New version of the System Engineering Management Plan (SEMP), describing the processes for quality management, defines the result structure for output documents, adapts the OA/SA processes to the newest workflow version and includes several other smaller updates.

- Consolidated and checked system requirements set V1, including the system requirement set of the SP in its current managed state is accessible via Polarion in a structured way.

- Updated SP Glossary (incl. terms from European legislation) including cleanup and synchronization with ERA ontology.

PRAMS

The PRAMS team is in charge to define the strategy, policies, methods, and principles to be followed by the other Tasks and Domains during the design activities as well as to coach and support implementation. PRAMS team do not produce PRAMS Analysis, Hazard and Risk Analysis, for system components or system parts; these activities are delegated to the related Domain that have to include members with PRAMS skills. The PRAMS Functional team is in place to have a proper coordination and synchronization.

The deliverables for the period of the Work Programme are:

- Establish a “Design Safety Case structure” adequate to the new railway standardised modular architecture of SP and provide the specific process for their application and authorisation (e.g. how to assess them, integrate them, deal with authorisation/approval. This structure will allow to drastically reduce the number of SRAC, support parallel developments between systems and ease integration activities of modular building block.

- Extend the list of accidents and hazards with risk acceptance principles and quantified values (i.e. for top level system hazards having explicit risk estimation as risk acceptance principle) to fasten the realisation of risk assessment and harmonized practices among manufacturers and RUs/IMs. The quantified values to be defined based on an analysis of hazards and contributing conditions leading to the accidents classified within the ERJU. The list of accidents and hazards is based on the future regulation CSM-ASLP but will consider a larger scope with actual lists of accidents and hazards at national level (i.e. SIRF, VDE, EPSF).

- Risk assessment template (i.e. CENELEC Phase3) and a safety guideline presenting all safety activities within SP Domains (up to Phase 5).

- Maintenance of the existing documentation related to Performance Criteria, P-RAM requirements/guidelines and CBM Requirements.

- Integration of Human Factors in the CENELEC V cycle through EET domain. The HOF impact evaluation on Domains design activities (e.g. OD domain) to be completed within EET deliverables.

Security

The Security team is in charge of centrally coordinating the Security requirements, including top-level design and assurance of the requirement implementation in the System Pillar Tasks and the specification of the subsystems for monitoring and the system control access.

It is expected that in Q1 2025 the Security domain provides the outs of the following STIP specifications:

- STIP_75: Shared Security Services Specification
- STIP_76: Secure Communication Specification
- STIP_77: Secure Program Requirements
- STIP_78: Secure Component Specification

In addition to the security specifications foreseen for 20252, the deliverables for the period of the Work Programme are:

- Interface definition to Shared Security Services (TIME, PKI, IAM, BKP, LOG…)
- Security profiles of common security communications protocols (TLS, OPC UA SC, HTTPS…).
- Process security requirements (ISMS, VMS, supply chain security…). Definition of Procedural requirements for Railway Operators (Infra managers and undertakings) and Suppliers to support the technical implementation and life-cycle management of Security for the system under consideration.
- Security requirements for components (not related to interoperability but required for security level and compliance to legal requirements and standards).
- Identification and performance on Gap analysis in other sector areas as was done in SC2.3 for TAF/TAP. Possible investigation areas could be FRMCS, DAC, etc. The requested Gap analysis will result in an evaluation of the gaps, the actions needed and eventually the needed effort.

Standardisation and TSI input plan (STIP)
The System Pillar has developed a strategic Standardisation and TSI Input Plan of the main changes to be introduced within TSIs (mainly CCS and OPE TSIs) and Commission standardisation request. This will include, inter alia, new functionalities and rules. This plan will also be made on the basis of migration considerations and alignment with Innovation Pillar flagship projects. Allowing for an agreed plan and timeline for the evolution of the CCS/TMS system, consistent with the agreed operational concept and system architecture and a clear picture of the role of the EU-RAIL in delivery, including the allocation of those elements that will be delivered by the Innovation Pillar, and the System Pillar.

Topics for harmonisation have been delivered by the members of EU-RAIL via the Task and Domains of the System Pillar as well as the Flagship Projects of the Innovation Pillar. In total, over 200 topics have been proposed, analysed by the System Pillar Core Group and EU-RAIL and classified to allocate the topic to a manageable number of categories. The proposed categories are outlined in the Table 3.

Category for topic classification		
Category		**Description**
Main section		
C1	Operational harmonisation	Topics related to operational processes and rules

C2	Evolvability and maintainability	Topics aiming at enhanced compatibility between versions and easy maintainability
C3	TMS and CMS	Topics related to enhanced European TMS and CMS
C4	ATO GoA2	Topics related to ATO until GoA2
C5	ATO GoA3/4	Topics related to ATO until GoA3/4
C6	Remote supervision and control	RTO as application independent from ATO Goa3/4 (can come earlier) specific applications, e.g. shunting yards.
C7	ASTP	Topics related to enhanced odometry and localisation systems
C8	FDFTO	Topics related to enhanced freight traffic including DAC
C9	FRMCS	Topics related to new radio system
C10	Onboard	Topics related to CCS onboard systems
C11	Cybersecurity	Topics for cybersecurity in CCS systems
C12	Safety management	Topics related to safety in CCS
C13	PRAM	PRAM topics
C14	Trackside assets	Topics related to CCS trackside assets
C15	Traffic CS	Topics related to enhanced Traffic CS and interfaces to TMS/CMS
C16	Driving control, Adhesion management	Topics related to adhesion management and driving control
C17	Energy management and supply	Topics related to energy management and operational measures
C18	Bridge dynamics	Topics related to vehicle-bridge dynamical interaction
C19	Alternative propulsion, traction energy	Topics related to battery and hydrogen train
C20	TCMS	Topics related to TCMS
C21	Subsystem Components	Topics considering e.g. braking, environmental conditions etc.
C22	Reduction environmental impact	Topics considering noise, air quality and climate change
C23	Composite materials	Use of composite materials for lightweight design
C24	ETCS CR enhancement	ETCS CR enhancements from ERA assessed by the SP
Additional topics[3]		
C25	Digital asset management, data spaces and models	Topics related to data spaces, data models and asset engineering
C26	Digital Twin	Topics related to Digital twin modelling and digital register

[3] The section "Additional Topics" includes topics with one or more of the following characteristics:

- Topics which do not yet have a defined time planning due to the early state and uncertainty in the development process.
- Topics which are very innovative and disruptive compared to established technical solutions. Acceptance and uptake by the sector might therefore require additional alignment and coordination.
- Topics for which the state of maturity does not allow a scheduled input to harmonisation channels in the short/medium term. Development and specification work is still ongoing, aiming at a higher maturity and the inclusion in one of the next STIP versions.

C27	Virtual certification	Methods for virtual certification and implementation
C28	Zero-Onsite-Testing	Use of simulations and lab testing procedures
C29	Drones	Topics related to the use of drones in railway applications
C30	Field force applications	Topics related to field forces (maintenance staff and machines)
C31	Diagnosis, monitoring	Topics related to diagnosis, condition-based maintenance in railway applications

Table 3: Categories for Harmonisation.[4]

Through the Standardisation and TSI Input Plan, the System Pillar has defined a clear and agreed plan for the evolution of the CCS/TMS system, the TSI enhancements, and standards, which will support interoperability, modular interchange ability, system integration ability, robustness, harmonisation and implementation of the SERA, and the role of EU-RAIL (both System Pillar and Innovation Pillar) in delivery.

The STIP does not include an explicit prioritisation of the topics. The implementation of the topics depends on the defined expected timeline, considering harmonisation needs and dependencies with related specification documents. The STIP key input will be obtained from the different tasks that conform the System Pillar and from the Flagship Projects in the Innovation Pillar, in order to obtain a cohesive multiannual plan.

The STIP document will be reviewed and updated in 2025, in order maintain the critical role supporting the harmonised introduction of improvements into the European rail system, supporting competitiveness interoperability, and safety.

CCS TSI Maintenance Activities
The aim of the activities defined in the Lot 3 CCS TSI Maintenance Activities is

- To resolve errors in the current TSI CCS in order to remove ambiguities in the specifications.
- To transfer results of Lot 2 and any other agreed enhancements into the ERA CCM process for the TSI CCS (with possible impact on TSI OPE).
- To facilitate the inclusion of completed versions of FRMCS specifications in future CCS TSIs
- To help infrastructure managers and vehicle owners with the deployment of ERTMS by solving their (potential) technical problems and by putting into place appropriate processes for testing, validation and certification in view to facilitate the authorisation
- To provide and maintain harmonised engineering guidelines

SYSTEM PILLAR AND INNOVATION PILLAR INTERACTIONS

EU-Rail, through the System Pillar (SP) will aim to have a coherent approach to the evolution of the EU rail system through a system architecture approach.

The SP has a discrete work scope to set the system architecture of the rail system (Task 1), and in particular the CCS, TMS/CMS and DAC/FDFTO architecture (Task 2, 3 and 4), as well as coordinating the standardisation and TSI outputs of EU-RAIL. While the main focus will be on these Tasks, the

[4] Please consider that the list of topics may change/evolve as the project progress.

System Pillar will have to integrate and duly consider other key elements, such as interfaces to urban mobility and energy systems.

EU-RAIL will develop the operational concept(s) and functional system architecture with much greater standardisation, a wider scope, aiming at no variation compared to present.

The Innovation Pillar (IP) will deliver, through research and innovation, advances in, inter alia, advanced traffic management, digital and automated train operations, and rail freight.

The description of the interaction is found in the EU-Rail Governance and Programme Handbook5.

The interaction between the IP projects and the SP is both-way. For the specification and development of the demonstrators for innovative technologies, the Flagship Projects of the IP will consider the specifications of the railway target architecture, developed by the System Pillar. Since the complete specification of all levels of the target architecture (including level 5, physical architecture) will not be available in the coming year, higher-level specifications and realistic assumptions will be used.

In return, the Flagship projects will inform the SP about the technical feasibility and efficiency of different system solutions evaluated in the demonstrators and therefore contribute to the guidance and realignment of the specification of the target railway architecture.

Therefore, the main objective of the IP-SP interaction are:

- Identify the main technical standardisation areas of collaboration between SP and IP,
- build in the projects the necessary details of the continuous process integration to reach together the EU-Rail outcomes that will achieve target system complying with the CBO,
- include necessary provisions to achieve the Standardisation and TSI input plan together with all the necessary mature standards and regulation proposals,

revision that the inputs expected by the Flagship projects from the SP are foreseen to be achievable on time

Annex IV – System Pillar working method and System Engineering management plan

The System Pillar working method aims at fast and balanced decision making with full sector involvement. Integrated teams within one place - the System Pillar - work on and propose developed positions for sector consideration:

To ensure best results, the System Pillar design process ensures clarification and agreement on objectives and requirements early in the process as a basis for the subsequent decisions on operational design and architecture.

- The aim is to have developed positions put forward by the tasks and associated domain teams based on concentrated resource and a short interaction flow on system design level within the System Pillar teams, enabling speed of development. For this purpose, a detailed working

[5] https://rail-research.europa.eu/wp-content/uploads/2023/01/EU-Rail-Governance-and-Process-Handbook.pdf

plan, following the concepts of sprints, is established for 2024 for most of the System Pillar Teams. It specifies in detail the process flow and timeline for the development of the target railway system architecture, comprising the conception and modelling of operational capabilities and processes, system capabilities and functional chains as well as logical and physical architecture of the different subsystems (onboard, trackside CCS, etc.). Every design phase of the target architecture (described by the architecture level) is divided into a specification and review phase, aiming at fast and efficient content generation and a reliable, high-quality review.

- To ensure an effective and efficient use of the available resources, the detailed work planning includes the allocation of the resources to specific roles: Specifiers are responsible for developing the architecture concepts and models, requiring a high level of resource commitment to enable the most efficient content generation. The created content is then reviewed and revised by the advisor group, with limited time but a high level of expertise to ensure the high quality of the created content.
- The quality of the System Pillar deliverables is ensured by a review and approval process, defined in the Review and Approval process of the SEMP. Outcomes of a task/domain are first reviewed internally, including the related mirror groups, to ensure the high quality and sector alignment for the performed specification work. Afterwards, the internally approved deliverable is sent to the Core Group for review and approval. Once approved, the deliverable is presented at the Steering Group for decision and final approval before official release.
- Where appropriate, sector organizations are encouraged to support their representatives in the System Pillar teams and the Core Group with input - consolidated positions, early consideration of issues etc.

On all hierarchical levels of the decision-making process a balanced sector representation will ensure that developed and fully considered positions are put forward to the System Pillar Steering Group and Governing Board.

A detailed description of the model-based system engineering process and the related working arrangement including specification work, review and approval can be found in the 2nd version of the System Engineering Management Plan (SEMP). The SEMP is structured along the following content:

- The engineering processes describing the workflow of engineering regarding:
    - System Design Processes: e.g. process steps to get from use cases down to functional design, conception and modelling of the levels of the railway target architecture.
    - Management Processes: e.g. how to collect, decide or allocate requirements or project management processes, or change management processes, how to monitor progress and verify consistency with Common Business Objectives.
    - Review and approval processes: how to ensure a high-quality review by relevant sector stakeholders and a transparent approval of SP deliverables.
    - Publication/Standardisation Processes: e.g. TSI input processes, specification maintenance.
- Definition of design methods:
    - Methods: e.g. how hazards should be linked to risks, and risks be linked to requirements.
    - Ontology, vocabulary: e.g. how to name results of SP or things in the railway landscape.
    - Design and modelling standards, notation: e.g. template structures for documents like “system definition”, or how to describe and draw a function or interface, or how requirements or use cases should be formulated.
- Tools to be used:

- Design Tools: e.g., to write traceable content, for modelling, approval tools, model proving, etc.
- Management tools: e.g. project management, issue management, workflow automation, etc.
- Information flow automation: Carrying, converting and linking files from different tools, manage exchanges between teams.

Annex V – System Pillar deliverables and milestones

1. Engineering Environnent Team

Updated Glossary including cleanup and synchronization with ERA terminology

No	Deliverable	Milestone
01	**Updated Glossary including cleanup and synchronization with ERA ontology**	Q3 2025
	• **Description of Deliverable:** The SP glossary is available and accessible	
	• **Intermediate Milestones:**	
	○ Draft glossary	Q4 2024
	○ Approved glossary V1 covering all imported entries	Q1 2025
	○ Approved glossary V2 covering all existing definitions of system domains	
	• **Definition of Done:** The glossary items are checked and approved, no redundant entries, the synchronization and link to ERA terminology is assured, the glossary is used in the domains.	
	• **Interaction with other Domains/IP:**	
	• **STIP Reference (if applicable):**	

Consolidated and checked system requirements set V1

No	Deliverable	Milestone
02	**Consolidated and checked system requirements set V1**	Q3 2025
	• **Description of Deliverable:** The valid system requirement set of the SP in its current managed state is accessible via Polarion in a structured way	
	• **Intermediate Milestones:**	
	○ The requirement set is consolidated and linked (traceability) for the existing requirements of the domains	Q1 2025
	○ An system integrated requirement set is consolidated and approved	Q1 2025
	○ Q2 2025 Mid-milestone description	Q2 2025
	• **Definition of Done:**	
	• **Interaction with other Domains/IP:**	
	• **STIP Reference (if applicable):**	

SEMP V4

No	Deliverable	Milestone
03	**SEMP V4**	Q3 2025
	• **Description of Deliverable: SEMP Version 4 describes the processes for quality management, defines the result structure for output documents, adapts the OA/SA processes to the newest workflow version and includes several other smaller updates.**	
	• **Intermediate Milestones:**	
	○ List of all elements and chapters to be updated together with work planning	Oct 2024

	○ Draft SEMP V4 ○ Approved SEMP V4 • **Definition of Done:** SEMP is approved in domains and SPCG • **Interaction with other Domains/IP:** All domains • **STIP Reference (if applicable): -**	Q1 2025 Q2 2025

2. PRAMS

Modular Safety Case Structure

No	Deliverable	Milestone
02	**Modular Safety Case Structure** • **Description of Deliverable:** To establish a "Design Safety Case structure" adequate to the new railway standardised modular architecture of SP and provide the specific process for their application and authorisation (e.g. how to assess them, integrate them, deal with authorisation/approval). It is a structure made to benefit from the new railway standardised modular architecture of SP. This structure will allow to drastically reduce the number of SRAC, support parallel developments between systems and ease integration activities of modular building block, In the SC2.3 contract the Modular Safety Case Structure has been developed and ready for review in the Sector in the SC2.4. • **Intermediate Milestones:** ○ Start the System Pillar Review Process according to the SEMP (NoBo/AsBo organizations to be involved) ○ Second release updated according to the feedbacks/comments from the sector. • **Definition of Done:** Released to the sector • **Interaction with other Domains/IP:** All Domains and IPs • **STIP Reference (if applicable):** STIP_79	Q3 2025 Nov. 2024 Jan 2025

EU Hazard Database

No	Deliverable	Milestone
03	**EU Hazard Database** **Description of Deliverable:** To extend the list of accidents and hazards with risk acceptance principles and quantified values (i.e. for top level system hazards having explicit risk estimation as risk acceptance principle) to fasten the realisation of risk assessment and harmonized practices among manufacturers and RUs/IMs. The quantified values to be defined based on an analysis of hazards and contributing conditions leading to the accidents classified within the ERJU. The list of accidents and hazards is based on the future regulation CSM-ASLP but will consider a larger scope with actual lists of accidents and hazards at national level (i.e. SIRF, VDE, EPSF). • **Intermediate Milestones:** ○ Start the review process for the intermediate release of updated ERHD to be shared for review with other domains and ERA including extended list of accidents and hazards and their connections. ○ Updated release of ERHD addressing comments from other SP Domains and ERA and updates on list of hazards/accidents and their connections. • **Definition of Done:** Released to the sector. • **Interaction with other Domains/IP:** All domains and IPs • **STIP Reference (if applicable):** STIP_80	Q3 2025 Nov. 2024 Jan 2025

Risk assessment template and Safety guideline

No	Deliverable	Milestone
08	**Risk assessment template and safety guideline:**	Q3 2025

	• **Description of Deliverable:** Realisation of a risk assessment template (i.e. CENELEC Phase3) and a safety guideline presenting all safety activities within SP Domains (up to Phase 5) • **Intermediate Milestones:** o Configuration of Nextedy Polarion add-on to create a template for FMEA o Definition of the safety process for system L3, 4 and 5 (up to CENELEC phase 5) o Template for FTA and connection with FMEA outputs • **Definition of Done:** Document ready for SPCG and STG review • **Interaction with other Domains/IP:** All Domain • **STIP Reference (if applicable):**	Nov 2024 Feb. 2025 April 2025

Evolution Management in a Modular Architecture

No	Deliverable	Milestone
04	**Evolution Management in a Modular Architecture** • **Description of Deliverable:** Changes to the existing regulations to improve the management of evolutions of a CCS systems (including cyber-security related and RAM related evolutions in a safety-related system) • **Intermediate Milestones:** o Start the System Pillar Review Process according to the SEMP o Second release updated according to the feedback/comments from the sector. • **Definition of Done:** Approved by the domain and ERA • **Interaction with other Domains/IP:** All Domain, ERA • **STIP Reference (if applicable):** STIP_81	Q3 2025 Nov. 2024 Jan 2025

Support EGNOS Project

No	Deliverable	Milestone
05	**Support EGNOS Project** • **Description of Deliverable:** Support EGNOS project (FP2) in the finalization and reviewing of: o Support the completion of the WP 2.1 'Definition of overall certification and authorization process': D2.1.1 and D2.1.2 o Contribute and review the D3.3.2 'E4R Space/Rail System function Hazard Analysis'. • **Intermediate Milestones:** o Review D3.3.2: E4R Space/Rail System functional hazard analysis • **Definition of Done: Review** Report released • **Interaction with other Domains/IP:** ARC and Train CS Domain, FP2 • **STIP Reference (if applicable):**	Q3 2025 Jun2025

Creation of Performance criteria

No	Deliverable	Milestone
06	**Creation of Performance criteria** • **Description of Deliverable:** Only maintenance on existing documentation from SC2.3 • **Intermediate Milestones:** not applicable • **Definition of Done:** Document ready for SPCG and STG review • **Interaction with other Domains/IP:** All Domains • **STIP Reference (if applicable):** STIP_82	Q3 2025

P- RAM requirements/guidelines

No	Deliverable	Milestone
07	**P- RAM requirements/guidelines** • **Description of Deliverable:** Only maintenance on existing documentation from SC2.3 • **Intermediate Milestones:** not applicable ○ • **Definition of Done:** Document ready for SPCG and STG review • **Interaction with other Domains/IP:** All Domains • **STIP Reference (if applicable):** STIP_83	Q3 2025

CBM requirements

No	Deliverable	Milestone
08	**CBM requirements** • **Description of Deliverable:** Only maintenance on existing documentation from SC2.3 • **Intermediate Milestones:** not applicable ○ • **Definition of Done:** Document ready for SPCG and STG review • **Interaction with other Domains/IP:** All Domains • **STIP Reference (if applicable):** STIP_84	Q3 2025

Human Organizational Factor

No	Deliverable	Milestone
08	**Human Organizational Factor:** • **Description of Deliverable:** Integration of Human Factors in the CENELEC V cycle through EET domain. The HOF impact evaluation on Domains design activities (e.g. OD domain) started in the SC2.3 to be completed in the SC2.4 within EET deliverables • **Intermediate Milestones:** ○ Integration and adaptation of SC2.3 draft documentation into EET domain ○ Start the System Pillar Review Process according to the SEMP ○ Second release updated according to the feedbacks/comments from the sector. • **Definition of Done:** Document ready for SPCG and STG review • **Interaction with other Domains/IP:** All Domain • **STIP Reference (if applicable):**	Q3 2025 Nov 2024 Dec. 2025 Jan 2025

3. Security

Shared Security Services Specification

No	Deliverable	Milestone
01	**Shared Security Services Specification** • **Description of Deliverable:** Interface definition to Shared Security Services (TIME, PKI, IAM, BKP, LOG,…) • **Intermediate Milestones:** ○ Document completion according to the comment received ○ Document release ○ Document maintenance • **Definition of Done:** Specification Publication • **Interaction with other Domains/IP:** All	Q3 2025 Nov. 2024 Jan 2025 Q3 2025

	• **STIP Reference (if applicable):** STIP_75	

Secure Communication Specification

No	Deliverable	Milestone
02	**Secure Communication Specification** • **Description of Deliverable:** Security profiles of common security communications protocols (TLS, OPC UA SC, HTTPS,…). • **Intermediate Milestones:** o Document completion according to the comment received o Document release o Document maintenance • **Definition of Done:** Specification Publication • **Interaction with other Domains/IP:** All • **STIP Reference (if applicable):** STIP_76	Q3 2025 Nov. 2024 Jan 2025 Q3 2025

Secure Program Requirements

No	Deliverable	Milestone
03	**Secure Program Requirements** • **Description of Deliverable:** Process security requirements (ISMS, VMS, supply chain security,…). Definition of Procedural requirements for Railway Operators (Infra managers and undertakings) and Suppliers to support the technical implementation and life-cycle management of Security for the system under consideration. • **Intermediate Milestones:** o Document completion according to the comment received o Document release o Document maintenance • **Definition of Done:** Specification Publication • **Interaction with other Domains/IP:** All • **STIP Reference (if applicable):** STIP_77	Q3 2025 Nov. 2024 Jan 2025 Q3 2025

Secure Component Specification

No	Deliverable	Milestone
044	**Secure Component Specification** • **Description of Deliverable:** Security requirements for components (not related to interoperability, but required for security level and compliance to legal requirements and standards) • **Intermediate Milestones:** o Document completion according to the comment received o Document release o Document maintenance • **Definition of Done:** Specification Publication • **Interaction with other Domains/IP:** All • **STIP Reference (if applicable):** STIP_78	Q3 2025 Nov. 2024 Jan 2025 Q3 2025

4. Task 1 Railway System

To be architecture of one new capability

No	Deliverable	Milestone
01	**To be architecture of 1 new capability** • **Description of Deliverable:**	Q3 2025

	The pain points and to be architecture for either "maintain and monitor rolling stock" or "maintain and monitor infrastructure" should be derived. To the extent relevant/necessary for the Level 2 architecture, the inputs from other System Pillar Tasks should be incorporated Compare the to be of both capabilities with the SP harmonized diagnostics (Task 2) and SP Task 5 HERD, also considering the work of FP3, as relevant. • **Intermediate Milestones:** ○ Identification of Pain point on either "maintain and monitor rolling stock" or "maintain and monitor infrastructure". ○ To be architecture for either "maintain and monitor rolling stock" or "maintain and monitor infrastructure" • **Definition of Done:** First draft to be architecture for either "maintain and monitor rolling stock" or "maintain and monitor infrastructure" harmonized for SP • **Interaction with other Domains/IP :** Task 2-TRANS and Task 5 HERD, FP3, Task 4 • **STIP reference (if applicable): none**	 Q1 2025 Q3 2025

Continued analysis of "Operate Train" and "Manage Energy"

No	Deliverable	Milestone
02	**Analysis of pain points and outputs from other SP Tasks** **Description of Deliverable:** For the to be architectures as developed in SC 2.3 for Operate Train and Manage Energy, there should be an iteration and refinement including incorporation where needed of existing and ongoing work in other System Pillar domains. ○ Operate Train to be architecture i. To the extent relevant/necessary for the Level 2 architecture, the inputs from other System Pillar Tasks should be incorporated ii. Compare the to be 'operate train' architecture with the SP Task 3 activities iii. Highlight any issues, if relevant, between Task 2 outputs and the to be architecture for operate train ○ Manage Energy to be architecture i. To the extent relevant/necessary for the Level 2 architecture, the inputs from other System Pillar Tasks should be incorporated ii. Compare the to be "manage energy" architecture with the SP Task 3 activities • **Intermediate Milestones:**	Q3 2025
	○ Update To be architecture of Operate Train regarding other task analysis	Q1 2025
	○ Update To be architecture of Manage Energy regarding other task 3 analysis	Q2 2025
	○ Propose recommendation for both capabilities to update architecture on the other task if urgent discrepancies are discovered	Q3 2025
	• **Definition of Done:** Update and harmonized architecture for Operate Train and Manage Energy	
	• **Interaction with other Domains/IP:** Task 4, Task 3, Task 2 • **STIP Reference (if applicable)**: none	

5. Task 2 CCS Domain Architecture and Release Coordination

CCS Harmonisation overview

No	Deliverable	Milestone
01	**ATP/ETCS overview** • **Description of Deliverable:** The overview document aims to provide a compressed content summary of the ongoing specification work in task 2 status, interaction and relation with the TSI. It includes technical content overview for all CCS elements (independent of their channel of harmonization), summarizing the main hypothesis in a very compressed way. • **Intermediate Milestones:** ○ Structure of the overview document agreed ○ First Draft ○ Update document to present to STG • **Definition of Done:** An implementer of CCS product features gets a complete picture of all existing specification in EURAIL, the main technical content and its maturity status. • **Interaction with other Domains/IP:** Task 2 Traffic CS/Train CS, Task 3, R2DATO demonstrators	Sept 2025 Nov. 2024 Mar 2025 May 2025

CCS TSI CR Overview

No	Deliverable	Milestone
02	**TSI CR Overview** • **Description of Deliverable:** This deliverable is a compilation of the following: SP analysis for the backlog CR enhancements in the ERA CCM DDBB; Preassessment content of the bundles of CR to the different TSI, related to CCS outcomes in EURail; other content work related to alignment with the CCS CR authors from other domains or IP (e.g. quality check of solution proposals, compatibility assessments, etc); plan and status of the work according to the plan shared with ERA • **Intermediate Milestones:** ○ Document structure agreed ○ Updated for different CR • **Definition of Done:** EURail can demonstrate to work following the Eurail harmonization document and achieving the objectives included in STIP for CCS related topics with channel of harmonization TSI • **Interaction with other Domains/IP:** All SP Tasks and domains	continuous Nov 2024 Quarterly

System level 3 architecture

No	Deliverable	Milestone
03	**High level logical architecture on system level 3** • **Description of Deliverable:** Logical architecture (on System Level 3) of the CCS Reference: Coherent overview on the CCS reference architecture identifying the TSI relevant parts. Specify the common CCS architecture including all interface relevant for: • Interoperability • basic functional allocation • to facilitate integration • overview on Level 3 interface standards and external interfaces • clarification of the scope and the system boundaries of the CCS system	Q1 2025

	• High level control loops including high level hazards and allocation of risk acceptance for the logical components on System Level 3. Support of vertical PRAMS and Security design work. • **Intermediate Milestones:** ○ Produce SP document - Logical architecture (on System Level 3) of the CCS Reference: Architecture including naming its subsystems and interfaces. Document is already reviewed at Domain and mirror group level ○ SP Document is reviewed and published ○ SP Document updated versions • **Definition of Done:** SP Document is published. i.e. document is aproved by domain, mirror group (if applicable), SPCG and STG. • **Interaction with other Domains/IP:** No • **STIP Reference (if applicable**): STIP_5	Dec. 2024 Mar. 2025 June, Sept. 2025

System Pillar Document and Release Plan

No	Deliverable	Milestone
04	**System Pillar Document and Release Plan ("DRP")** • **Description of Deliverable:** The DRP shows all existing or future result documents, their current status, the release planning and packages, the publication dates for drafts and final versions, the links to the documents, dependency analysis between the different topics and analysis on how other harmonization topics are affected. It includes a check of consistency with the released STIP • **Intermediate Milestones:** ○ Structure agreed, first draft ○ Updated Version • **Definition of Done:** The DRP is complete and the status is correct. • **Interaction with other Domains/IP:** All SP Tasks and domains	Continuous Nov. 2024 Monthly

System Pillar newsletter

No	Deliverable	Milestone
05	**System Pillar Newsletter** • **Description of Deliverable:** The newsletter shows new content design elements of all task 2 domains for expert level, and separately for management level. • **Intermediate Milestones:** ○ Structure agreed, first draft ○ Updated Version • **Definition of Done:** The newsletter is appreciated by the two target groups. • **Interaction with other Domains/IP:** All Task 2 domains	Continuous Nov. 2024 monthly

Support to the EGNOS Project

No	Deliverable	Milestone
06	**Support to the EGNOS Project** • **Description of Deliverable:** the Architecture and Release coordination (SP-ARC) domain, to provide the SP architecture vision and planning (as well as the TSI CCS input plan) EGNOS roadmap needs to comply with, to facilitate the involvement of sector organisations (CER, EIM, UNIFE …) • **Intermediate Milestones:** ○ Support and validation of EGNOS WP1.2: Preliminary roadmap and strategic plan. ○ Support of EGNOS WP2.1 "Definition of overall certification and authorisation approach", including	*See mid-milestones* Jun 2025 Dec. 2025

	i. Contribute to Deliverable D2.1.2 "Overall certification and authorisation approach for introduction of EGNOS ", v2 • **Definition of Done:** *Please see 23E101_EGNOS WBS* • **Interaction with other Domains/IP:** EGNOS project, Train CS, PRAMSS, SPCG	

6. Task 2 CCS: Domain Operational Harmonisation

Guideline for harmonized CCS related operational processes for ETCS L2 and ATO GoA 1,2

No	Deliverable	Milestone
01	**Guideline for harmonized CCS related operational processes for ETCS L2 and ATO GoA 1/2** • **Description of Deliverable:** TSI OPE 2026 - Guideline for harmonized CCS related operational processes for ETCS L2 and ATO GoA 1/2 (based on the entity/actor analysis and the analysed operational use cases of SC2.3). For the case of radio-based ETCS alone operation, operational rules described as detailed situation and configuration specific processes for all actors (incl. signaller), for degraded modes, and with a binding time-ordered sequence of actor and system actions with defined input and output. The operational design is based on specific system and engineering requirements which define a more restricted trackside implementation for radio based ETCS alone operation. The recommended amendment for TSI OPE in the form of actor specific Rulebooks. Includes operational rules now also described as detailed situation and configuration specific processes for all actors (incl. signaller), for all degraded modes, and with a binding time-ordered sequence of actor and system actions with defined input and output. The result shall be introduced in 3 steps: As a TSI guideline for 2027 for using ETCS L2 in a specific harmonized way with ATO GoA1/2 and linked to a specific technical implementation**;** • **Intermediate Milestones: See chapter 6.5** • Definition of Done: Rulebooks with filled chapters for the topics of SC2.4, aligned with existing TSI or running TSI CR (e.g. EUG guidelines), approved on domain level and by the Coregroup. Major harmonization impacts are prepared as a compressed harmonization decision list, ready for the Steering Group. • **Interaction with other Domains/IP:** Traffic CS, Task 3, TrainCS • **STIP Reference (if applicable):** STIP_1	Q3 2025

Support to the EGNOS Project

No	Deliverable	Milestone
02	**Support to the EGNOS Project** • **Description of Deliverable:** The Operational Harmonisation (SP-OH) domain contributes/reviews to the definition of rail (train positioning) operational requirements • **Intermediate Milestones:** o Support EGNOS WP3.1 "Rail Operational needs and EGNOS system definition ", including: i. The review of D3.1.1: Operational needs and system capabilities of an ASTP system. • **Definition of Done:** *Please see 23E101_EGNOS WBS* • **Interaction with other Domains/IP:** EGNOS project, Train CS, PRAMSS, SPCG, ARC	*See mid-milestones* Dec 2024

7. Task 2 CCS: Domain Traffic Control and supervision

System specification and interfaces ATO Trackside function (perh. incl. interface to EAL)

No	Deliverable	Milestone
01	**System specification and interfaces ATO Trackside *function***	Q3 2025

	• **Description of Deliverable:** The result document structure (along EN50126, phase 1-5, and for the design safety case) is completed concerning topics package 1 and concerning the ATO trackside function • **Intermediate Milestones: General intermediate milestones see chapter 6.5** o Identification and allocation of ATO-TS functions for GoA2 o Document structure and properties in Polarion (SEMP P1.8), identified task associated and detailed scope added. • **Definition of Done:** The topic workitem traces are complete, aligned with existing TSI documents or running CR, and reviewed by SPCG. Major design decisions are described ready for decision in STG. The topic requirements are described and approved as SRS and for all harmonized system and user interfaces as FiS/FFFiS. Impact to existing interoperability specifications (in CCS TSI) is identified including harmonization of functional/engineering rules and proposed changes to existing requirements. • **Interaction with other Domains/IP:** OD, Train CS, Task 3 • **STIP Reference (if applicable):** STIP_19, STIP_104	 Dec. 2024 Dec. 2024

System specification Trackside Protection System (TPS) incl. interface to adjacent CCS area

No	Deliverable	Milestone
02	**System specification and interfaces of the trackside protection system** • **Description of Deliverable:** The result document structure (along EN50126, phase 1-5, and for the design safety case) is completed concerning topics package 1 and concerning the trackside protection system • **Intermediate Milestones: General intermediate milestones see chapter 6.5** o Identification and functional allocation of the Trackside Protection System o Document structure and properties in Polarion (SEMP P1.8), identified task associated and detailed scope added. • **Definition of Done:** The topic workitem traces are complete, aligned with existing TSI documents or running CR, and reviewed by SPCG. Major design decisions are described ready for decision in STG. The topic requirements are described and approved for all harmonized system and user interfaces as FiS/FFFiS. Impact to existing interoperability specifications (in CCS TSI) is identified including harmonization of functional/engineering rules and proposed changes to existing requirements. • **Interaction with other Domains/IP:** OD, Train CS, Task 3, Lot 3 • **STIP Reference (if applicable):** STIP_102, STIP_101	Q3 2025 Dec. 2024 Dec. 2024

System specification and interfaces of the Execution and Adaption Layer

No	Deliverable	Milestone
03	**System specification and interfaces of the execution and adaption layer** • **Description of Deliverable:** The result document structure (along EN50126, phase 1-5, and for the design safety case) is completed concerning topics package 1 and concerning the execution and adaption layer system • **Intermediate Milestones: General intermediate milestones see chapter 6.5** o Identification and functional allocation of the Execution and Adaption Layer o Document structure and properties in Polarion (SEMP P1.8), identified task associated and detailed scope added. • **Definition of Done:** The topic workitem traces are complete, aligned with existing TSI documents (like EUG guidelines) or running CR, and reviewed by SPCG. Major design decisions are described ready for decision in STG. The topic requirements are described and approved for all harmonized system and user interfaces as FiS/FFFiS. Impact to existing interoperability specifications (in CCS TSI) is identified including harmonization of functional/engineering rules and proposed changes to existing requirements. • **Interaction with other Domains/IP:** OD, Train CS, Task 3 • **STIP Reference (if applicable):** STIP_103	Q3 2025 Dec. 2024 Dec. 2024

Trackside migration analysis

No	Deliverable	Milestone
04	**CCS Trackside migration analysis** • **Description of Deliverable:** The deliverable will take the economic assessment results as a basis. The analysis answers the following questions: **a.** What is the basic integration strategy to interconnect existing (national legacy) and SPRA compliant (existing and SPRA) products. What is the typical effort to adapt legacy systems to the new harmonized interfaces? Are "standard adapters" possible and do they make sense? Which harmonized interfaces shall include additional features to connect to the legacy (normally to be avoided)? b. What functional packages (CCS trackside) shall be mandatory for SPRA to simplify migration (e.g. just TPS, or always TPS+EAL together, or even TPS+EAL+ATO GoA2 functions together)? i. Each deployment of mandatory functional packages (subsystems) needs to be self-sufficient concerning functions and user interfaces (e.g. TMS does perhaps not exist). ii. Each deployment of mandatory functional packages (subsystems) needs to be integrateable – offer interconnection possibilities for adjacent legacy systems iii. How do i. and ii. influence the optimal functional allocation for CCS/TMS c. What are recommended decision criteria for national migration steps that help to decide an optimal migration plan. **d.** Which interfaces can be integrated already in existing rollouts before 2030 – what is realistic and economically viable? (e.g. EULYNX TA SCI, T2CE I2/I3, OP, SDI/SMI ??) The deliverable will take the economic assessment results available at October and address additional questions that might be raised in the work realized before the start of this remit • **Intermediate Milestones:** o A. Clarification document for task understanding and result structure o B. Comparison and assessment from migration perspective for mandatory depl. packages o C. CCS trackside migration integration strategy o D. Assessment of pros and cons, and economic assessment examples, for integration of harmonized interfaces already into the rollouts of current systems. • **Definition of Done:** The analysis is approved on domain level, in task 3, in SPCG and ready for presentation on expert level and with a strategic summary also on management level and in the STG • **Interaction with other Domains/IP:** OD, Train CS, Task 3 • **STIP Reference (if applicable):** -	Q3 2025 Nov. 2024 May 2025 Sept. 2025 Mar 2025

Preparation of major design decisions for management level and Steering Group

No	Deliverable	Milestone
05	**Preparation of major design decisions for management level and steering group** • **Description of Deliverable:** The current status of the Traffic CS design shall be described concerning its major design aspects ("Traffic CS system concept"), which shall be decided in SP STG as a basis for further detailed designs. The concept shall include and assess concerns coming from the sector, which are collected upfront), and give the rationales for its recommendations. The system concept shall cover aspects like reduction of the SIL functionality, hybrid train detection and sensor fusion, train-centric safety logic, free placement of movement authorities (moving block), optimized ETCS version management, efficient change of topology data, and functional scopes of TPS and EAL (perhaps ATO TS, if it is a separate subsystem).	Q3 2025

	• **Intermediate Milestones:**	
	○ A. Clarification document for task understanding and result structure	Nov. 2024
	○ B. results from sector consultation	Dec. 2024
	○ C. Traffic CS system concept ready for decision	Feb. 2025
	• **Definition of Done:** The document gives a clear but compressed view on major design decisions and their rationals, for experts and for management level. The system concept is approved by domain and SPCG and lists concrete decision questions which are assessed by their major impacts. • **Interaction with other Domains/IP:** OD, Train CS, Task 3 • **STIP Reference (if applicable):** -	

8. Task 2 CCS: Domain Train Control and supervision

Ethernet CCS consist network (full stack)

No	Deliverable	Milestone
01	**Ethernet CCS consist network (full stack)**	Q3 2025
	• **Description of Deliverable:** Complete harmonized onboard CCS communication layer full stack (OSI layers 3-6 and safety layer) based on the deliverables agreed with FP 2.	
	• **Intermediate Milestones:**	
	○ CR solution proposal in Polarion, identifying associated tasks and detailed scope.	Dec. 2024
	○ Continuation of Task 2010 from SC2.3. contract: pre assessment CR launched phase 1	Dec. 2024
	○ Review of the solution proposal for the update of Subset-147 (Proposal expected by FP 2 WP 23: Oct. 2024).	Feb. 2025
	○ Adaptation of the application layer Subsets (eg. SS 119, 139 etc.) to take the new version of SS 147 into account. (Support by mirror group for specification work expected. Due date depending on scope of SS-147).	Sep. 2025
	• **Definition of Done:** CR and solution proposal are submitted to ERA. • **Interaction with other Domains/IP:** FP2 • **STIP Reference (if applicable):** STIP_68	

Train interfaces enhancement

No	Deliverable	Milestone
02	**Train interfaces enhancement**	Q3 2025
	• **Description of Deliverable:** Functional enhancement for the train interface to allow for CCS onboard systems to be deployed on vehicles as a product from different vehicle suppliers. (ensure CCS onboard exchangeability)	
	• **Intermediate Milestones:**	
	○ CRs and solution proposal in Polarion, identified task associated and detailed scope added.	Q1 2025
	○ Continuation of Task 1050 ad 2060 from SC2.3. contract. Pre assessment CR launched phase 1 and take into account diagnostics, configuration and monitoring requirements / specification of TCCS-domain and requirements from OD-Domain as well as corresponding CRs	Dec. 2024
	○ Definition of requirement to allow for CCS onboard systems to be deployed and exchanges without vehicle side adaptation on vehicles as a product from different vehicle suppliers.	Q1 2025
	○ Collect the demands and prioritize the harmonization demands. Alignment with SS-147, Layers 1 to 6.	
	○ Additional CCS internal signals will be made available to be used in the vehicle.	Q2 2025
	• **Definition of Done:** CRs and solution proposals for the existing documents S-139, S-119, S-034 and maybe S-125, S-026 are submitted to ERA • **Interaction with other Domains/IP:** No, partial by corresponding CRs • **STIP Reference (if applicable):** STIP_71	

Multiple Display Concept

No	Deliverable	Milestone
03	**Multiple Display Concept** • **Description of Deliverable:** Train Display System – Multiple display system concept. Define Multiple DMI concept based on existing documents / information and specific topics. • **Intermediate Milestones:** ○ Document structure and properties in Polarion (SEMP P1.8), identified task associated and detailed scope added. ○ Continuation of Train CS Task 2100 from SC2.3. contract ○ Basic concept of apportionment of the logic of applications for the "Multi Display System" (Option 1: the logic in the DMI, Option 2: the logic in the central unit of an application (like EVC for ETCS on-board), Option 3: Option 1 and 2 can be individually decided for each application). ○ After that a decision can be taken for the logic apportionment (based on the multiple display system concept) for the ETCS application in Subset-121. • **Definition of Done:** Document is approved at domain level and reviewed by SPCG • **Interaction with other Domains/IP:** TCCS • **STIP Reference (if applicable):** STIP_69	Q3 2025 Nov. 2024 Dec.2025 Q1 2025 Q2 2025

Train interface adaption for integrity handling and train length / overall consist length

No	Deliverable	Milestone
04	**Train interface adaption for integrity handling and train length / overall consist length** • **Description of Deliverable:** One or more CRs proposal in order to **a**dapt train interface for train integrity handling and train length / overall consist length automation of freight and passenger trains currently defined in Ss-119, Ss-120, Ss-34, using also new technologies (e.g. the digital automatic coupling (DAC). • **Intermediate Milestones:** ○ Analyze and review the working document delivered in Polarion (SEMP P1.8) during the Phase 2.3 . ○ Definition of CRs and solution proposals . ○ In case of the DAC TI / TL interface this will include the so called "merging function", generating out of two independent SIL 2 Train Length information channels one SIL 4 train length / overall consist length. • **Definition of Done:** One of more CRs submitted to ERA • **Interaction with other Domains/IP:** Task 4, FP2, FP5 • **STIP Reference (if applicable):** STIP_73	Q3 2025 Q1 2025 Q3 2025 Q3 2025

On board modularity and upgradability

No	Deliverable	Milestone
05	**On board modularity and upgradability** • • Definition of Computing Platform for safe applications up to SIL4 (relating to CCS applications or other on board applications e.g. passenger information). Decoupling software, hardware and computing platform lifecycles. The work should be based on the results from Task 2 CE and also include the results from the SC 2.3 works in the PRAMS domain on modular safety case incl. a continuation if required to achieve a modular on board upgrade without re authorization of the complete vehicle. Also the work of TCCS regarding on board configurability should taken into consideration to improve the	Q3 2025

	upgrade process. Needs of railways on upgradeability as well as supplier capabilities (granularity, business cases) to be considered. • • **Intermediate Milestones:** o Analysis of the Task 2 CE results and other relevant input (e.g. FP 2 on board demonstrator) o Time plan for deliverable STIP 72 (currently STIP indicates tbd) o Delivery Cost Benefit Analysis on Modularity, shared Computing Platform(s) and upgradeability concept o CCS onboard System Logical Architecture and requirements Management/Maintenance o CCS onboard System Physical Architecture and requirements Management/Maintenance o CCS onboard migration strategy o • **Definition of Done:** • **Interaction with other Domains/IP: FP2 / CE / PRAMS /TCCS** • **STIP Reference (if applicable): STIP 72**	Dec. 2024 Q1 2025 Q2 2025 Q3 2025 Q3 2025 Q3 2025

Basic advanced safe train positioning: Odometry performance and robustness enhancement

No	Deliverable	Milestone
06	**Basic advanced safe train positioning: Odometry performance and robustness enhancement** • **Description of Deliverable:** Basic ASTP: Odometry performance and robustness enhancement Enhance the specified performance of accuracy of distances measured on-board and improve it's robustness . Consider and may be update the odometry performance targets for new CCS onboards to the state of the art of available and proven technologies (update TSI CCS to existing reality using existing technology). • **Intermediate Milestones:** o CRs preassessment 1 stage achieved. o Writing the questionnaire on current odometry performance achieved and sending it to the Railway stakeholder o Deliver the solution proposal for the Robustness CR o Analysis of the answers to the questionnaire on current odometry performance achieved. o Deliver the solution proposal for the Odometry performance enhancement • **Definition of Done:** Document incl. pre-assessment stage 1 is approved at domain level and reviewed by SPCG and presented to STG incl ERA • **Interaction with other Domains/IP:** FP 2 and SP Lot 3 • **STIP Reference (if applicable):** STIP_29	Q3 2025 Q4 2024 Q4 2024 Q1 2025 Q2 2025 Q3 2025

A) Basic advanced safe train positioning: General Architecture Analysis

No	Deliverable	Milestone
07a	**Basic advanced safe train positioning: General system requirements and architecture** **Description of Deliverable:** Top priority for an ASTP is the increase in accuracy and reliability of the on board localization for ETCS. To reach this target two distinct approaches should be considered. • Definition of the functional requirements, including aspects of application and operation • Physical separation of the localization / odometry functionality into an independent unit providing speed and localization for all users (single source of truth)	

	• Specifying this separate unit to a point where it becomes an independent constituent with a standardized interface to the ETCS onboard system This analysis should include a CBA of both approaches especially considering the integration complexity of two SIL 4 components incl. comparison of other relevant criteria • **Intermediate Milestones:** o High level functional and operational description of "Enhanced Odometry" and possible, future "Full ASTP" o CBA (with external support) o Decision • **Definition of Done:** Decision on architecture presented to STG incl. ERA • **Interaction with other Domains/IP:** FP 2? • **STIP Reference (if applicable):** STIP_29	Q1 2025 Q2 2025 Q3 2025

B) Basic advanced safe train positioning: ASTP interface specification

No	Deliverable	Milestone
07b	**Basic advanced safe train positioning: ASTP interface specification** **Description of Deliverable:** Logical and physical analysis for the separation of the localization functionality from the EVC by a harmonized interface. The future ASTP will base on a mix of sensor technologies which will need perhaps additional standard input and output interfaces, which are not in scope in this deliverable. Within this deliverable only the interface between ASTP and EVC (FFFIS) should be defined. In case the existing Eurobalise based relative localization system will be remain, the allocation of the balise reader interface (EVC or ASTP) must be defined based on a model based analysis. • **Intermediate Milestones:** o Planning of the work incl. intermediate milestones. o Logical analysis o Physical analysis o interface specifications FIS – first structure and first topics • **Definition of Done:** Document incl. pre-assessment stage 1 is approved at domain level and reviewed by SPCG and presented to STG incl. ERA • **Interaction with other Domains/IP:** FP 2 • **STIP Reference (if applicable):** STIP_29	Q4 2025 Q1 2025 Q2 2025 Q3 2025

Support to the EGNOS Project

No	Deliverable	Milestone
8	**Support to the EGNOS Project:** EGNOS Interoperability interfaces and dissemination' • **Description of Deliverable:** Lead the activities planned for WP 3.3.1 supported by FP2 resources, Review the deliverables D3.3.2, D3.3.3, D.3.3.4 • **Intermediate Milestones:** o Support EGNOS WP3.1 "Rail Operational needs and EGNOS system definition ", including: i. The review of D3.1.1: Operational needs and system capabilities of an ASTP system. ii. The review of D3.1.2: SARPs+ for rail SoL applications o Support EGNOS D3.3.1: Service dissemination and interoperable interfaces. i. Activities Plan ii. Interface Description V1 iii. Interface Description final release • **Definition of Done:** *Please see 23E101_EGNOS WBS* • **Interaction with other Domains/IP:** EGNOS project, OD, PRAMSS, SPCG • **STIP Reference (if applicable):** STIP_30	*See mid-milestones* Dec 2024 Feb 2025 June2025 Oct 2024 Apr 2025 Sept 2025

9. Task 2 CCS: Domain Computing Environment

CE System Analysis (System Capabilities and functions)

No	Deliverable	Milestone
01	**Computing Environment System capabilities and functions – System Analysis (FRS CONEMP, Functional Requirement specification)**	June 2025
	• **Description of Deliverable:** update/continuation to finalize design for I2/I3 as basis for API specification. Further detailing of design with focus on I1 specific needs for the computing environment (e.g. orchestration, diagnosis, update & configuration management, monitoring), as input to TCCS SD2 and SD3 and R2DATO WP 26 for the detailed specification.	
	• **Intermediate Milestones:**	
	○ System Analysis for I2/I3 completed	Q4 2024
	○ System Analysis for I1 completed	Q1 2025
	○ Input to TCCS SD2/SD3 and R2DATO WP 26 specifications approved	Q3 2025
	• **Definition of Done:** Input to TCCS SD2/SD3 and R2DATO WP 26 specifications delivered and included in TCCS / IP deliverables.	
	• **Interaction with other Domains/IP:** TCCS, R2DATO WP26	
	• **STIP Reference (if applicable):** No	

Specification for Hardware Abstraction Interface (I2) and Virtualization Interface (I3)

No	Deliverable	Milestone
02	**Specification of concrete APIs in the context of Computing Environments**	September 2025
	• **Description of Deliverable:** Standardisation of Computing Environment interfaces I2/3 Usable specification for Hardware Abstraction Interface (I2) and Virtualization Interface (I3) for Computing Platforms for safe applications up to SIL4 (relating to CCS applications or any other applications used in the context of rail operation). Decoupling software, hardware and computing platform lifecycles. Enabling interchangeability between computing platforms, onboard and trackside.	
	• **Intermediate Milestones:**	
	○ I2/I3 specification drafted	Q4 2024
	○ I2/I3 specification ready for Domain review	Q2 2025
	○ I2/I3 specification ready for first discussion in Mirror Group	Q3 2025
	• **Definition of Done:** I2/I3 specification mature enough for JU internal publication, envisaging decision and publication in Q1/2026	
	• **Interaction with other Domains/IP:** No	
	• **STIP Reference (if applicable):** STIP_4 “Standardisation of Computing Environment”	

10. Task 2 CCS: Domain Trackside Assets Control & Supervision

Maintaining TACS specification

No	Deliverable	Milestone
01	**Finalize TACS specification**	Q3 2025
	• **Description of Deliverable:** Finalize update of TACS Specification with freeze of all parts of the specification: a. Update the relevant specifications in the System Pillar engineering environment. Assumption: EULYNX tools and methods are used for all System	

	Level 5 specs in SP, so for the model import the effort is small. But explanation and requirements documents need to be maintained in Polarion, linked and integrated. b. Complete backlog topics on specifications (SMI, SDI, SCI) for all documents of SP/EULYNX BL4R3 scope, freeze specifications c. Refine Test Case Specification / Test Catalogue as part of release, targeting to enable interchangeability tests for product implementations d. Publish a release update of frozen specifications • **Intermediate Milestones:** o Pending tickets identified and final actions to be performed before publication identified. • **Definition of Done:** SP documents published • **Interaction with other Domains/IP:** TCCS • **STIP Reference (if applicable):** STIP_85, STIP_86, STIP_87, STIP_88, STIP_89, STIP_95, STIP_96, STIP_97, STIP_98, STIP_99, STIP_100, STIP_90, STIP_91, STIP_92, STIP_93, STIP_94	Oct. 2024

Interface to field devices

No	Deliverable	Milestone
02	**Interface to field devices** • **Description of Deliverable:** Finalize decision proposal for further harmonization of interfaces between object controllers and field devices, following the Granularity Principles method. Based on SP STG decision continuation of work for specification of selected interfaces. • **Intermediate Milestones:** o Finalization of the Interface to field devices document. Document ready for SPCG review. • **Definition of Done**: Decision proposal is ready to be decided at December SP STG • **Interaction with other Domains/IP:** No • **STIP Reference (if applicable):**	Feb 2025 Dec 2024

Power supply

No	Deliverable	Milestone
03	**Power supply** • **Description of Deliverable:** Finalize decision proposal for harmonization of interfaces to power supply and power management, following the Granularity Principles method. Based on SP STG decision continuation of work for specification. • **Intermediate Milestones:** o Finalization of the Power supply document. Document ready for SPCG review. • **Definition of Done:** Power supply SP document is ready to be decided at December SP STG • **Interaction with other Domains/IP:** No • **STIP Reference (if applicable):**	Feb 2025 Dec 2024

11. Task 2 CCS: Domain Transversal Systems

SD1 – Data model & Digital Registry

No	Deliverable	Milestone
01	**SD1 – Data model & Digital Registry** **Description of Deliverable:** Define end-to-end harmonized data processes and model, based on ERA-ontology "single source of truth" approach up to Catalog of Symbols for harmonized user interfaces. Define and implement process for continuous upgrade of	Q3 2025

	ERA-ontology according to the needs of the CCS/TMS Data Model. Consider in the end-to-end process the engineering requirements of System Design domains for CCS assets and include in the CCS/TMS Data Model specification once approved by the other SP Domains.
	Specify functional allocation for the Digital Registry as a system serving trackside and onboard CCS components based on top-down SEMP process and aligned and approved with the respective SP Domains.
	• **Intermediate Milestones:**
	  ○ OA/SA/LA/PA for Digital Registry drafted
	  ○ OA/SA/LA/PA for Digital Registry ready for review
	  ○ OA/SA/LA/PA for Digital Registry ready for decision
	• **Definition of Done:** CCS/TMS Data model updated and released and functional requirements specification for Digital Registry approved by all system design domains
	• **Interaction with other Domains/IP:** All system design domains, in particular Traffic CS
	• **STIP Reference (if applicable):** STIP_7, STIP_8, STIP_11
		
		Q4 2024
		Q1 2025
		Q2 2025

SD2 – Generic Diagnosis System Specification

No	Deliverable	Milestone

02	**SD2: Generic Diagnostics System Specification**
	• **Description of Deliverable:** Finalize decision process for harmonized generic diagnostics system concept covering all trackside constituents (trackside assets, trackside protection system, execution and adaption logic, …) and onboard and the relevant diagnostic functional building blocks (e.g. MDM, MDCM). Refine based on decided diagnosis concept, the operational analysis considering distinct business processes of RUs and IMs, complete System Analysis and next steps for logical and physical architecture, including northbound interface of diagnostic system for transmission of collected diagnostic information to adjacent diagnosis systems (SDI-DS).
	Assumption: The relevant taskforce is employed in the top-down engineering process (including the impacted Domains and the EULYNX toolchain)
	• **Intermediate Milestones:**
	  ○ OA/SA/LA/PA for Diagnosis System drafted
	  ○ OA/SA/LA/PA for Diagnosis System ready for review
	  ○ OA/SA/LA/PA for Diagnosis System ready for decision
	• **Definition of Done:** System specification decided
	• **Interaction with other Domains/IP:** PRAMS and IP (FA1, FA3), Train CS, TACS, Traffic CS
	• **STIP Reference (if applicable):** STIP_10
		Q3 2025
		
		Q4 2024
		Q1 2025
		Q2 2025

SD2 – Diagnostic Model for Traffic CS

No	Deliverable	Milestone

03	**SD2: Traffic CS Diagnostics Data Model Specification**
	• **Description of Deliverable:** Specification of core diagnostic data model for Traffic CS (SDI-TPS), including Computing Environment aspects as next steps for SDI and in alignment with Traffic CS.).
	Assumption: EULYNX tools and methods are used for all System Level 5 specs in SP, and EULYNX toolchain is included through the relevant taskforce in the drafting process.
	• **Intermediate Milestones:**
	  ○ SDI-TPS outline drafted
	  ○ SDI-TPS first full iteration for core specification ready for internal review
	• **Definition of Done:** SDI-TPS (for core diagnostic model) specification as internal draft approved
	• **Interaction with other Domains/IP:** Traffic CS, Computing Environment
		Q2 2025
		
		Feb 2025
		Apr 2025

	• **STIP Reference (if applicable):** STIP_10	

SD3 – Configuration & Maintenance Management

No	Deliverable	Milestone
04	**SD3 – Configuration & Maintenance Management**	Q3 2025
	• **Description of Deliverable:** Finalize decision process for harmonized configuration and maintenance management concept covering all trackside constituents (trackside assets, trackside protection system, execution and adaption logic, …) and on-board together with Train CS and Computing Environment. Refine based on decided configuration and maintenance management concept, the operational analysis considering distinct business processes of RUs and IMs, complete system Analysis and derive logical and physical architecture for the transversal configuration and maintenance management service functions/subsystems. Do and deliver required PRAMS (PRAMS vertical activities) and Cybersecurity risk analysis to deliver design safety case for the overall end-to-end configuration management process. Assumption: The relevant taskforce are employed in the top-down engineering process (including the impacted Domains and the EULYNX toolchain)	
	• **Intermediate Milestones:**	
	○ OA/SA/LA/PA for Configuration Management System drafted	Q4 2024
	○ OA/SA/LA/PA for Configuration Management System ready for review	Q1 2025
	○ OA/SA/LA/PA for Configuration Management System ready for decision	Q2 2025
	• **Definition of Done:** Operational and system analysis for trackside and onboard CCS configuration management process approved by other SP Domains and decided in SP STG	
	• **Interaction with other Domains/IP:** FP2 for test implementation with IP to be aligned, TACS, Traffic CS, Security, PRAMS, Train CS	
	• **STIP Reference (if applicable):** STIP_6	

SD3 – Configuration Management Specification for trackside constituents

No	Deliverable	Milestone
05	**SD3: Configuration Management Specification for trackside constituents**	Q3 2025
	• **Description of Deliverable:** Specification of configuration management interfaces for trackside constituents (Trackside assets and Traffic CS (SMI and SCI)) based on decided harmonized configuration management concept, including Computing Environment aspects and in alignment with Traffic CS as next steps for SMI and affected SCI. Consider forward compatibility to enhancement to onboard configuration management process. Assumption: EULYNX tools and methods are used for all System Level 5 specs in SP, and EULYNX toolchain is included through the relevant taskforce in the drafting process.	
	• **Intermediate Milestones:**	
	○ SMI-XX and, if needed, CRs for affected SCIs drafted	Q1 2025
	○ SMI-XX and, if needed, CRs for affected SCIs ready for approval with mirror groups	Q2 2025
	• **Definition of Done:** SMI-XX specification released and, if needed, CRs for affected SCIs submitted	
	• **Interaction with other Domains/IP:** TACS, Traffic CS, Computing Environment	
	• **STIP Reference (if applicable):** STIP_10	

12. Task 3: TMS & CMS

Function distribution and Interface between TMS/TCS

No	Deliverable	Milestone
01	**Interface TMS/Traffic CS: Update Function distribution and Interface between TMS/TCS**	Q3 2025
	• **Description of Deliverable:** Consistent splitting of the features of a Supervision system between the two systems (TMS and TCS) which implement the specification of the interface between TMS and TCS, based on SP previous results in task 3 and task 2. Review	

	the Operational Rulebook specification for TMS/TCS related operational concepts and capabilities that require harmonized operational processes with impact on TMS actors (e.g. dispatcher). Update TMS/TCS specification in line with remaining open points to be clarified with Traffic CS. • **Intermediate Milestones:** o List of operational capabilities that should be harmonized for interface TMS-TCS and added in System Architecture Document. Alignment with the operational concepts and capabilities in OD that include TMS o Close remaining open point to update the TMS-TCS interface specification with the precise and complete set of structured information to be exchanged between TMS and TCS, which supports the execution of the apportioned functions to the two systems. • **Definition of Done:** TMS/TCS Document is aligned with Traffic CS and other possible Task 2 related domains and in line with related operational capabilities harmonized in Operational Rulebook of OD/Traffic. • **Interaction with other Domains/IP:** Traffic CS, OD • **STIP Reference (if applicable):** STIP_18	Q1 2025 Q2. 2025

Recommendation of harmonization scope TMS/CMS

No	Deliverable	Milestone
02	**Recommendation of harmonization scope TMS/CMS** • **Description of Deliverable:** Based on the existing system design documents of SC2.3 (e.g. TMS/CMS functional split, TMS/CMS variants analysis) develop recommendation for the functional distribution and interface specification to be harmonized. The deliverable shall analyze the harmonization scope based on operational use cases and considering current pain points and limitations in the European level planning and dispatching process. The analysis shall include rational that demonstrate the benefit of a respective harmonization, following the ARC D2.3 Granularity Concepts and Principles Guideline. • **Intermediate Milestones:** o Identify relevant operational use cases to be analysed o Analysis of operational use cases with pain points and limitations completed o Granularity Concepts and Principles for CMS/TMS split completed, draft recommendation of functional scope to be harmonized • **Definition of Done:** Approved decision proposal for harmonization scope of TMS/CMS interface, ready for SP STG decision • **Interaction with other Domains/IP:** FP1 • **STIP Reference (if applicable):** STIP_17	Q2 2025 Dec. 2024 Feb . 2024 May 2025

Integration of TTR Messages

No	Deliverable	Milestone

03	**Integration of TTR Messages**
	• **Description of Deliverable:** Include the technical messages defined in the TTR process in the TSI framework. The TTR (Timetable Revision) project and the linked digitalization concept DCM (Digital Capacity Management) define new concepts such as ECM (European Capacity Management), Capacity Broker, TCR (Temporary Capacity Restrictions) to answer the ambitions of Task 3.
	• **Intermediate Milestones:**
	  ○ TTR harmonization scope identified and agreed
	  ○ Draft specification for technical messages
	  ○ Final specification of technical messages
	• **Definition of Done:** Specification ready for publication
	• **Interaction with other Domains/IP:** FP1
	• **STIP Reference (if applicable):** STIP_16
		Q3 2025
		
		Q4 2024
		Q1 2025
		Q2 2025

Support content for strategic cross border discussions in STG

No	Deliverable	Milestone

04	**Cross border variants analysis CMS & TMS**
	• **Description of Deliverable:** Preparation of operational, functional, technical, deployment and economic content to support strategic decisions in SPSG regarding TMS and CMS Cross borders.
	• **Intermediate Milestones:**
	  ○ Update based on SP STG discussion 10/2024
	  ○ Update based on SP STG discussion 03/2025
	  ○ Update based on SP STG discussion 05/2025
	• **Definition of Done:** CMS/TMS variants discussion closed in SP STG
	• **Interaction with other Domains/IP:** FP1
	• **STIP Reference (if applicable):** STIP_16, 12, 13
		Q3 2025
		
		Dec 2024
		Q2 2025
		Q3 2025

13. Task 4: DAC/FDFTO

EU DAC Based Operational Standards and RuleBook [WP2]

No	Deliverable	Milestone

01	**EU DAC Based Operational Standards (continuing WP2 from SC2.3)**
	• **Description of Deliverable:** EU DAC Based Operational Standards and RuleBook
	• **Intermediate Milestones:**
	  ○ From SC2.3: Finalization of Operations Architecture related to FDFTO interfaces: ERTMS use cases, ASO/ATO [WP3.2, WP3.3] – as a side product of the RuleBook discussion
	  ○ From SC2.3: General agreement with Task 2-OD on structure and format of the RuleBook
	  ○ Continuation from SC2.3: Elaboration of preliminary EU Harmonised Operation Procedures (FDFTO Rule Book) – based on FP5 deliverable D2.1[WP2] Note: RuleBook will still show white spots where FP5 input is not yet available
	  ○ Document structure and properties in Polarion (SEMP P1.8), identified task associated and detailed scope added (with support of PMO)
	  ○ Agreement with FP 5 on timetable to fill the white spots
	  ○ Filling of the white spots based on input by FP5, based on mentioned timetable deadlines.
	  ○ Review of rulebook by the sector, inclusive alignment with Task2 and via the EDDP operational sounding board.
		Q3 2025
		
		Q3 2024
		
		Q3 2024
		
		Q1 2025
		
		Nov. 2024
		
		Q4 2024
		
		Continuous
		Q3 2025

	○ Finalization of draft EU Harmonised Operation Procedures (FDFTO Rule Book) including mature final input from FP5, ready for training of staff for pre-deployment trains	Q4 2025
	• **Definition of Done:** FDFTO Operation Procedures and RuleBook are reviewed by the domain and SPCG • **Interaction with other Domains/IP:** OD, FP5 • **STIP Reference (if applicable):** STIP_38	

Interfaces between train-internal FDFT and the "outside" world, with focus on Train-Lenth/-Integrity [WP3.1]

No	Deliverable	Milestone
02	**Interfaces to the "outside" world (restarting WP3.1 from SC2.3)**	Q2 2025
	• **Description of Deliverable: Final agreement with FP 5 on concept and implementation of Safe Train Length (SIL 4)** • **Intermediate Milestones:**	
	○ Document structure and properties in Polarion (SEMP P1.8), identified task associated and detailed scope added (with support of PMO)	Nov. 2024
	○ From SC2.3: Agreement with Task 2, FP2 and FP5 on CR for draft concept of “merging function” and interfaces to FDFT	Sept. 2024
	○ Agreement with FP5 on architecture and concept for FDFT-internal function to deliver 2. independent train length information (SIL 2), incl. safety concept	Q1 2025
	○ Definition of FFFIS for both channels to ETCS OBU	Q1 2025
	○ Agreement with FP5 on a roadmap for implementation (target for implementation: end 2027)	02 2025
	• **Definition of Done:** Agreement with FP5 on concept, FFFIS and roadmap for implementation • **Interaction with other Domains/IP:** FP5, FP2, Task 2 Train CS • **STIP Reference (if applicable):** STIP_36 (FDFTO Train Functions), STIP_73 (interface)	

Central Instance [WP4]

No	Deliverable	Milestone
03	**Central Instance** for m**anagement of Data & Software**	Q3 2025
	• **Description of Deliverable:** Detailed description of and roadmap for the implementation of a basic functionality of a European Central Instance (incl. connected IT/Cloud architecture) for the pre-deployment phase • **Intermediate Milestones:**	
	○ Document structure and properties in Polarion (SEMP P1.8), identified task associated and detailed scope added (with support of PMO)	Nov. 2024
	○ From SC2.3: Approved concept for organisation and processes of Central Instance	Q3 2024
	○ From SC2.3: Approved concept for implementation for the pre-deployment phase (stakeholder analysis, project organisation, budget)	Q3 2024
	○ Agreement with EDDP (and FP5) on requirements and needs for data upload (mainly for operation of FDFT and monitoring of reliability of the pre-deployment trains)	Nov. 2024
	○ Detailed roadmap for implementation of a basic functionality of the CI for the pre-deployment phase	Q1 2025
	○ Preparation of a PoC	Q3 2025
	• **Definition of Done:** Definition of Management Organization , Procedures, IT (Cloud) Architecture for FDFT applicative software download, FDFT data upload and dispatching to authorized data owners and data users. • **Interaction with other Domains/IP:** FP5, EDDP • **STIP Reference (if applicable):** STIP_47	

14. Task 5: Harmonised Diagnostics

Aligned UC 1 demonstrator specification for a pilot implementation

No	Deliverable	Milestone
01	Aligned UC 1 demonstrator specification for a Pilot implementation • **Description of Deliverable:** a. Performance definition and measurement specification b. Structure of KPIs c. Time schedule for the implementation of the Pilot application d. Definition of Pilot participants: roles and responsibilities e. Risk assessment and supposed mitigation actions f. CBA structure • **Intermediate Milestones:** ○ Q4 2024 Mid-milestone description i. Completion of the synergies analysis with other SP-domains and IP ii. Plan and action implementation based on the synergies iii. Risk assessment and risk mitigation plan ○ Q1 2025 Mid-milestone description i. Performance definition ii. KPIs-structure iii. Draft of the Harmonised Diagnostic Data Interface (HDDI) iv. Identification of the Pilot participants and their roles ○ Q2 2025 Mid-milestone description i. Time schedule for the implementation of the Pilot application ii. Measurement specification iii. Specification of the HDDI iv. CBA structure for UC1 • **Definition of Done:** The main objectives are the alignment on the implementation of the Use Case demonstrator and the specified time schedule for the pilot project. The HDDI is defined and accorded with the other tasks in the SP and the Flagship projects. • **Interaction with other Domains/IP:** SP/Task 2, FP3, FP1-TT • **STIP Reference (if applicable):** No STIP entrance related to TSI	Q2 2025 Q4 2024 Q1 2025 Q2 2025

Processing of new Harmonisation Use Cases

No	Deliverable	Milestone
02	Processing of new Use Cases • **Description of Deliverable:** a. Evaluation of the results of Phase 2 and alignment on the next Use Cases for harmonisation b. Definition of the HDDI requirements of the selected Use Cases c. Specification of the interaction with the most relevant synergies with the SP-tasks and the IP-projects. d. Preparation of an European Map draft of the existing/planned railway diagnostic systems • **Intermediate Milestones:** ○ Q1 2025 Mid-milestone description i. Table of the next Use Cases with recommendations of the next steps ○ Q2 2025 Mid-milestone description i. Identification and recommendation of how the harmonised diagnostic data can be exchanged in the specific Use Cases ○ Q3 2025 Mid-milestone description	Q3 2025 Q1 2025 Q2 2025 Q3 2025

	i. HDDI requirements of the prioritised Use Cases • **Definition of Done:** The main objectives are the description of the maturity of the next Use Cases and develop a road- map. There will be a recommendation of how the data exchange between the data users and the data providers should/could be performed. • **Interaction with other Domains/IP:** SP/Task 2, FP3, FP1-TT • **STIP Reference (if applicable):** No STIP entrance related to TSI	