Europe's Rail Joint Undertaking: System Pillar

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CSD&M 2022
15-16 DECEMBER

CESAM COMMUNITY

DELIVER AN **INTEGRATED EUROPEAN RAILWAY NETWORK** BY DESIGN

DEVELOP A **UNIFIED OPERATIONAL CONCEPT AND A FUNCTIONAL SYSTEM ARCHITECTURE** FOR INTEGRATED EUROPEAN RAIL TRAFFIC AND CCS/AUTOMATION

DELIVER A **SUSTAINABLE AND RESILIENT RAIL SYSTEM**

DELIVER A **COMPETITIVE, GREEN RAIL FREIGHT** FULLY INTEGRATED INTO THE LOGISTICS VALUE CHAIN

DEVELOP A **STRONG AND GLOBALLY COMPETITIVE EUROPEAN RAIL INDUSTRY**

EUROPE'S RAIL:

ONE INTEGRATED R&I PROGRAMME

Europe's Rail

SYSTEM PILLAR

OPERATIONAL CONCEPTS

FUNCTIONAL SYSTEM ARCHITECTURE

A SINGLE COORDINATING BODY FOR THE WHOLE SECTOR EVOLUTION

OPEN INTERFACES TO OTHER TRANSPORT MODES AND BUSINESSES

SYSTEM REQUIREMENT SPECIFICATIONS

INNOVATION PILLAR

TECHNOLOGICAL AND OPERATIONAL SOLUTIONS FOR SERVICES OF FUTURE

FLAGSHIP PROJECTS

LARGE-SCALE DEMONSTRATIONS

EXPLORATORY AND FUNDAMENTAL R&I

- **EUROPEAN RAIL TRAFFIC AND MOBILITY MANAGEMENT**
  - Manage and improve rail traffic at EU level
  - Adjust rail traffic management in function of the mobility demand
- **DIGITALISATION & AUTOMATION IN TRAIN OPERATIONS**
  - ATO implementation
  - Digital train operations
- **SUSTAINABLE AND DIGITAL ASSETS**
  - Integrated assets testing & life-cycle framework
  - Zero-emmission, silent rail system
- **COMPETITIVE, DIGITAL, GREEN RAIL FREIGHT**
  - New digital customer interaction & innovative rail freight services
  - Multimodal and rail freight innovation integration
- **REGIONAL RAIL SERVICES IN LOW DENSITY AREAS**
  - New system approach to regional rail services in low density areas

DEPLOYMENT GROUP

FUTURE SOLUTIONS DEPLOYED IN A COORDINATED AND CONSISTENT WAY AT EUROPEAN LEVEL, TAKING INTO ACCOUNT ALTERNATIVE ROLLOUT SCENARIOS, BEHAVIOURAL AND ORGANISATIONAL CHANGES, SYNERGIES WITH OTHER MODES OF TRANSPORT

The System Pillar

- develops a **unified operational concept and system architecture** for the future railway system
- is the **system integrator** for the Europe's Rail Joint Undertaking (EU-Rail)

In Single Basic Act

Article 84(5)a

develop in its System Pillar a system view that brings together the rail manufacturing industry, the rail operating community and other rail private and public stakeholders, including bodies representing customers, such as passengers and freight and staff, as well as relevant actors outside the traditional rail sector. The "system view" shall encompass:

- *i. the development of the operational concept and system architecture, including the definition of the services, functional blocks, and interfaces which form the basis of rail system operations;*
- *ii. the development of associated specifications including interfaces, functional requirement specifications and system requirement specifications to feed into Technical Specifications for Interoperability (TSI) established pursuant to Directive (EU) 2016/797 of the European Parliament and of the Council or standardisation processes to lead to higher levels of digitalisation and automation;*
- *iii. ensuring the system is maintained, error-corrected and able to adapt over time and ensure migration considerations from current architectures;*
- *iv. ensuring that the necessary interfaces with other modes are assessed and validated, in particular for freight and passenger flows.*

Article 93: The System Pillar Steering Group

The System Pillar Steering Group shall be composed of representatives of the Commission, representatives of the rail and mobility sector and of relevant organisations, the Executive Director of the Europe's Rail Joint Undertaking and representatives of the European Union Agency for Railways. […].

- *The System Pillar Steering Group shall be responsible, for providing advice to the Executive Director and Governing Board on any of the following:*
  - *the approach to operational harmonisation and the development of system architecture, including on the relevant part of the Master Plan;*
  - *delivering on the specific objective set out in point (c) of Article 83(2);*
  - *carrying out the task set out in point (a) of Article 84(5);*
  - *the detailed annual implementation plan for the System Pillar in line with the work programmes adopted by the Governing Board in accordance with point (b) of Article 92.*

Article 91 (3): Functioning of the governing board

Notwithstanding Article 15(1) with regard to activities to be performed under the System Pillar, a decision shall be deemed adopted by a majority of at least 55% of the votes including the votes of representatives who are absent.

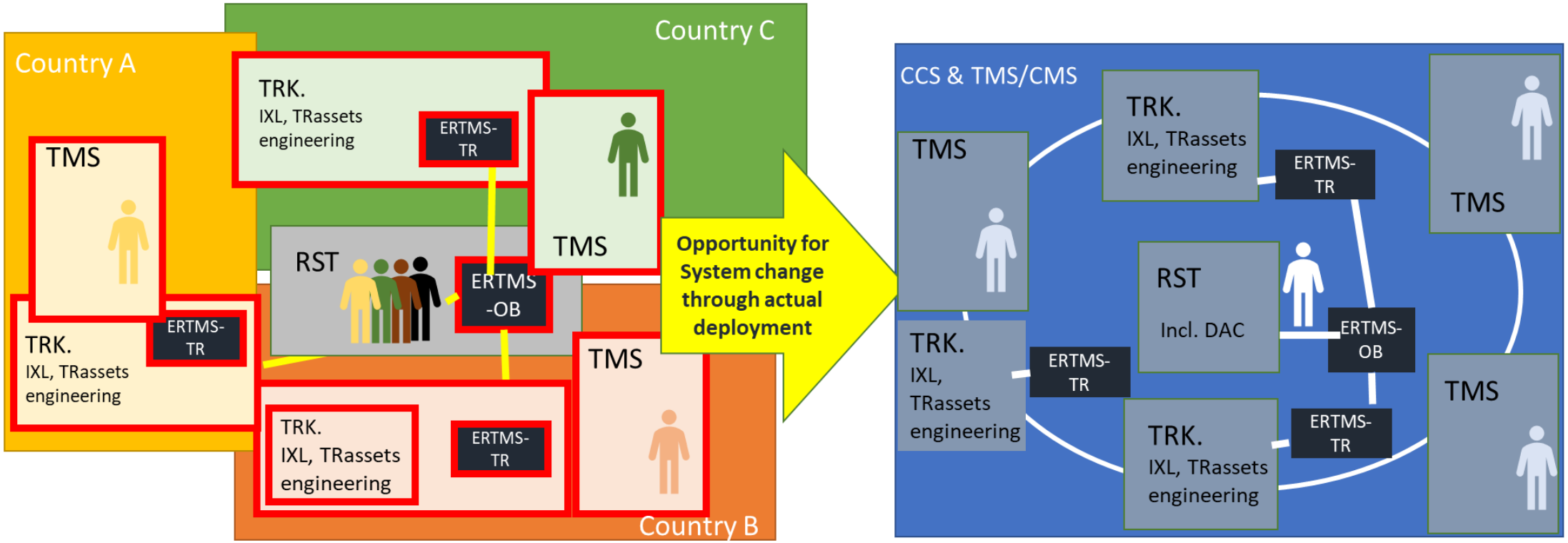
Why the System Pillar is important for the European Railways

European railways have **differences in operations and most technical systems**, leading to:

- Expensive and slow deployment of innovations
- Limited market potential and return on investment
- An undermined performance and competitiveness of the European rail system and the European railway supply industry in global markets

To overcome these shortcomings, the System Pillar provides **governance, resources, and outputs** to allow the sector to converge on the evolution of the future railway system through:

- Defining the fundamental design principles and architecture – drawing on best practice from other industries
- Harmonising the architecture at European level, including standardization of interfaces, communications and data exchange – supporting the strategic vision of the Single European Rail Area
- Defining any necessary technical specifications to feed into standards or TSI



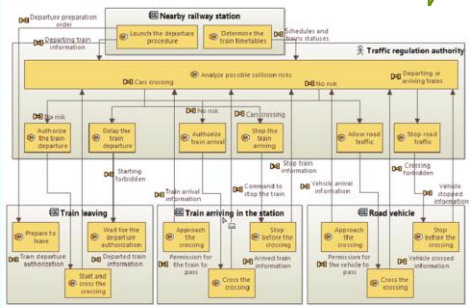
System Pillar is the opportunity for the sector to converge on the evolution of the Railway system - operational concept and system architecture

Canonical Design Process

CBO

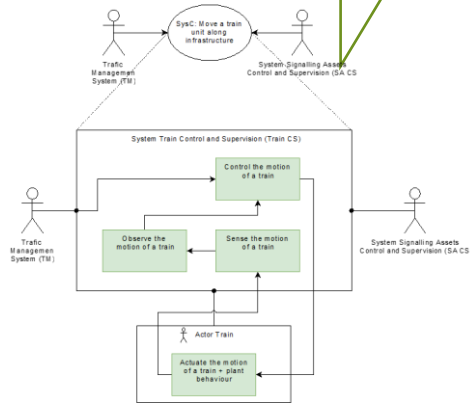
Operational Analysis

- Definition of the operation Use Cases (capabilities)
- Definition of the activities associated with the operation processes



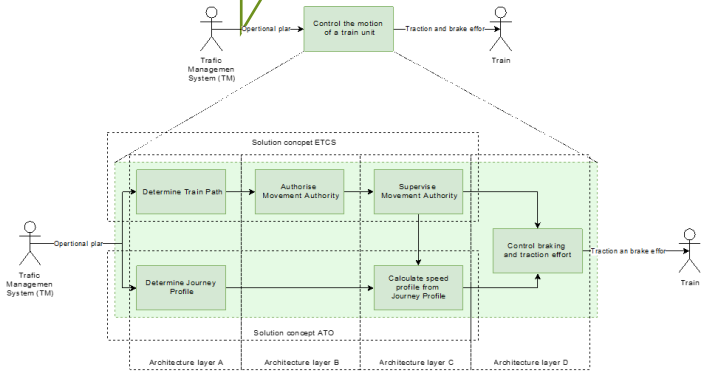
System Analysis

- Definition of the Operation Contexts with the **Actors**
- Refinement of the capabilities and definition of the functions supporting the capabilities
- Done with the system in **black box**



Logical Architecture

- Definition of the system logical blocks
- Refinement of the capabilities and functions with the system in white box
- Specification of the interfaces between the logical blocks (application level)

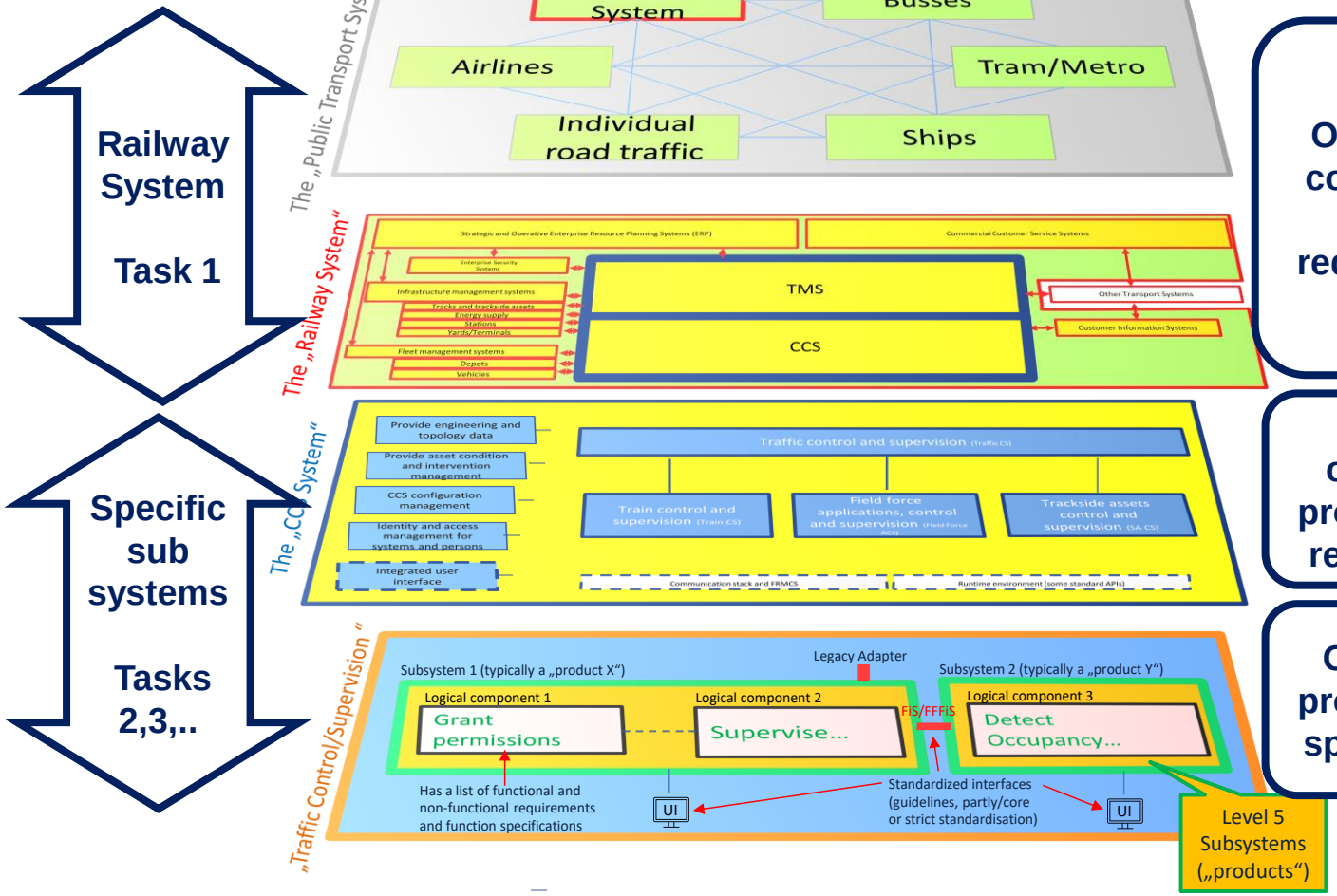


Physical Architecture

- Definition of the possible physical architectures with the corresponding devices
- Allocation of the logical building blocks to the physical devices
- Definition of the lower layers of communication for the interfaces

System Pillar: design levels

Because of the size of the Railway System, it is necessary to distinguish for the content structure between different level of details (design level). There is a hierarchy of process and system levels



Operational concept and Basic requirements

Basic operational processes and requirements

Operational processes and specifications

Examples

- Level 1: For public transport, how railways and other transport systems shall interact concerning management connections in a station
- Level 2: For Railway system, how shall customer information, TMS and CCS interact in general to manage connections for passengers in case of a deviation
- Level 3: For CCS, how shall different actors in the production (trains, field forces, ..) be coordinated to execute a changed plan
- Level 4: For vehicle control and supervision, what processes shall happen onboard in general when the movement authorisation changes

System Pillar: Common Business Objectives

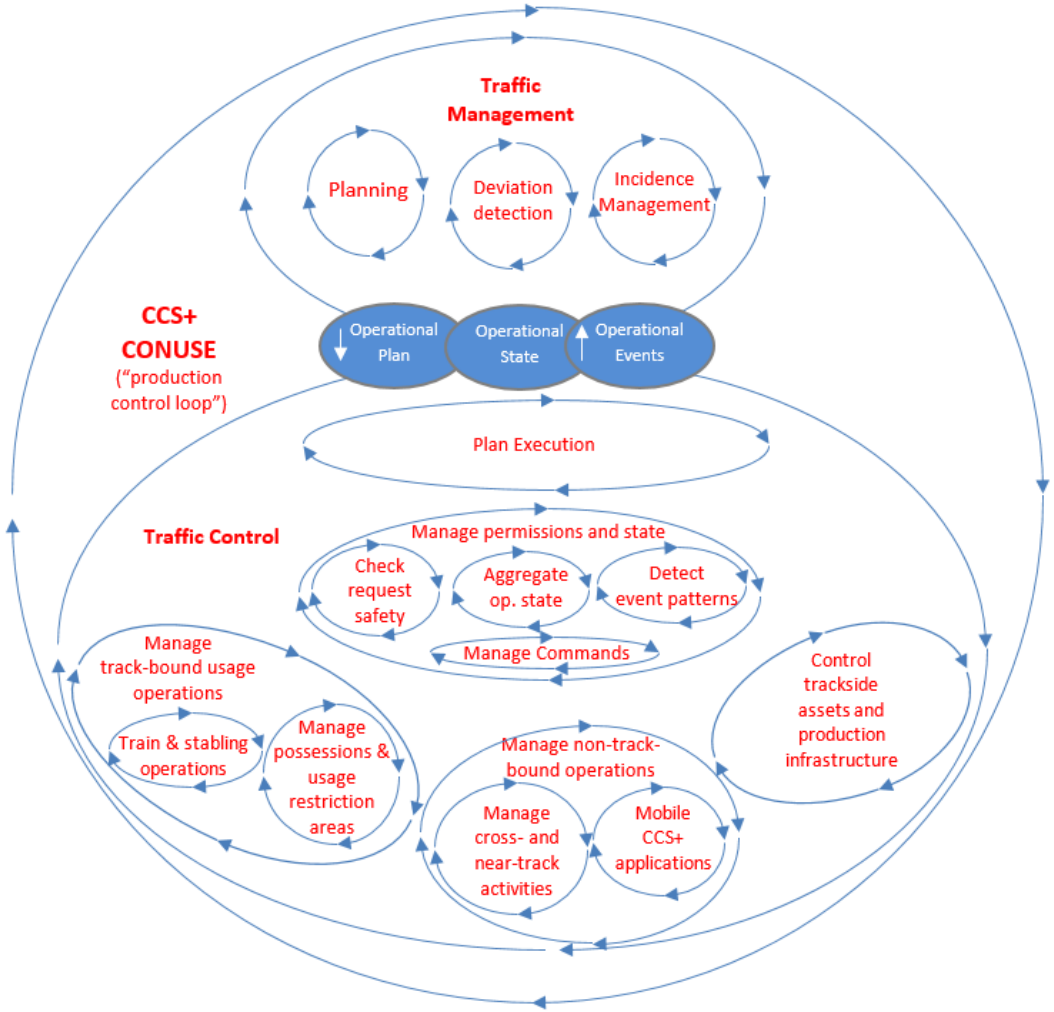
More flexibility and punctuality for passengers and freight	service quality and improve punctuality	real-time data sharing
Improved performance and capacity	Increase capacity, reduce travel time	Better predict capacity needs
	Optimise capacity	efficient capacity of lower used lines
Reduced costs	Affordable LCC	Economically attractive solutions
	Affordable system updates	
More sustainable and resilient transport	efficient energy consumption& smart energy infra	proper security regulations and standards
	Improve availability/reliability/robustness	integration of transport systems in populated areas

Harmonised approach to evolution and greater adaptability	Harmonize ope & strengthen interop	Optimize Safety regulations
	Standardize architecture	Increase systems adaptability
Reinforced role for rail in European transport and mobility	Improve methods and tooling	Reduce regulatory complexity
	Enable fast migration and roll out	
Improved EU rail supply industry competitiveness	Make future railway system attractive	international design authority

System Pillar: Operational concept

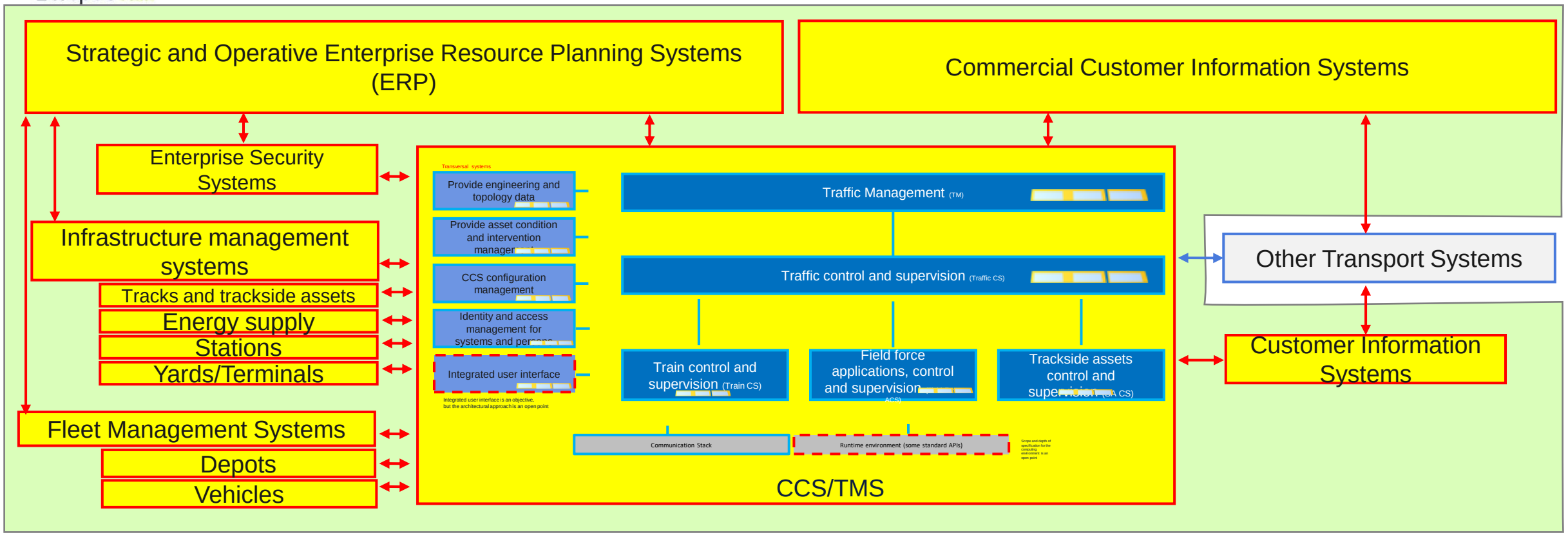
Clear operational vision and concept is necessary to build the target system

- The operational concept describes three different conceptual areas
  - CONOPS: Concept of operations, business, legal, commercial, and organisational view
  - CONUSE: Concept how to use the system, production view
  - CONEMP: Concept of employment, provide system and resources, “asset management view”



Example of CONUSE control loops to detail scope of TMS

Railway system



Level 2 Systems (like Railway System)
Level 3 Systems (like CCS+ or Energy supply, not all shown)
Level 4 Systems (like Traffic Management, not all shown)
Level 5 Systems ("subsystems")

CCS+ Core Systems
CCS+ Transversal Systems
CCS+ Technical system (APIs to the runtime environment, stack of communication layers)

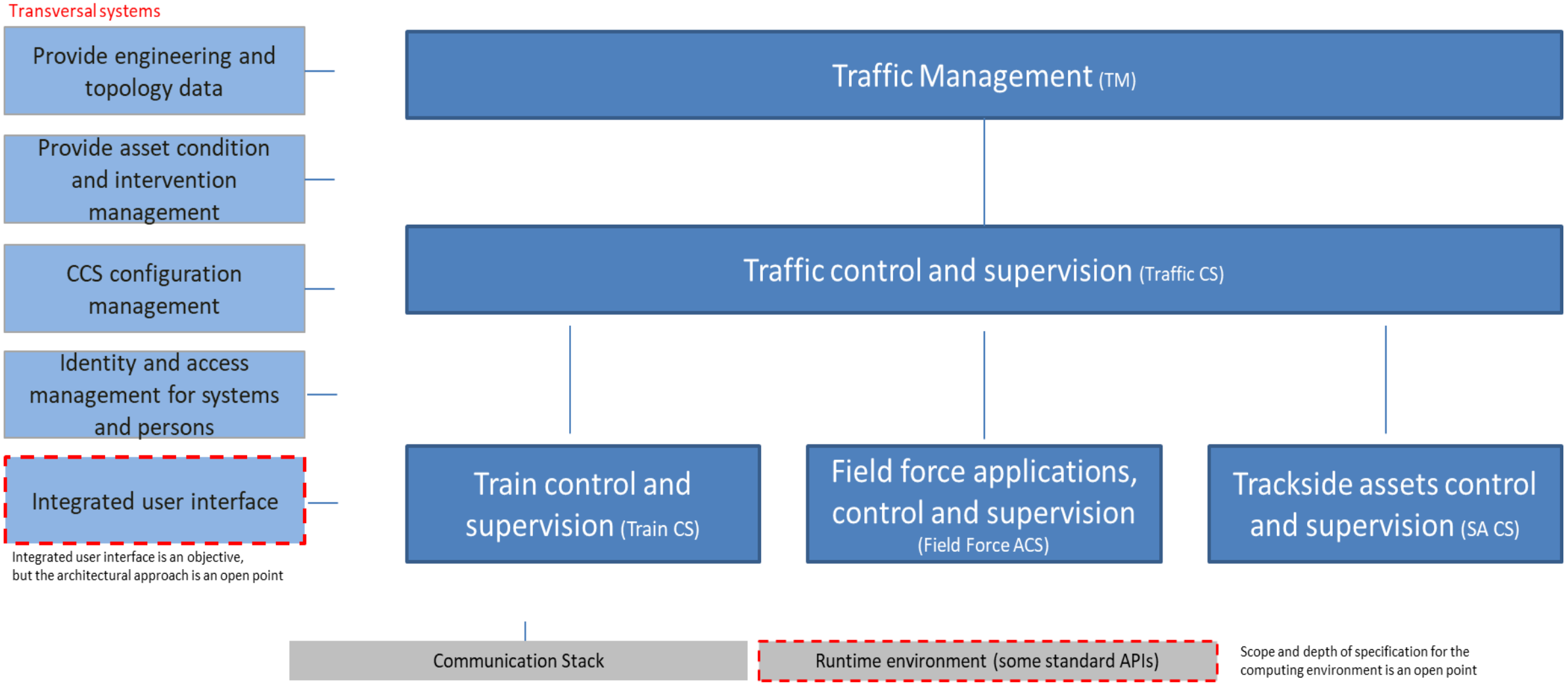
The "subsystems" form the level of standardisation granularity / specification.
The collaboration for defining interfaces is coordinated this way:

The Railway System domain team (lead) coordinates with CCS+ Architecture and Migration Domain Team and relevant system domain teams

The CCS+ Architecture and Migration Team (lead) coordinates with relevant system domain teams

The System Domain teams design the subsystem interfaces for their domain

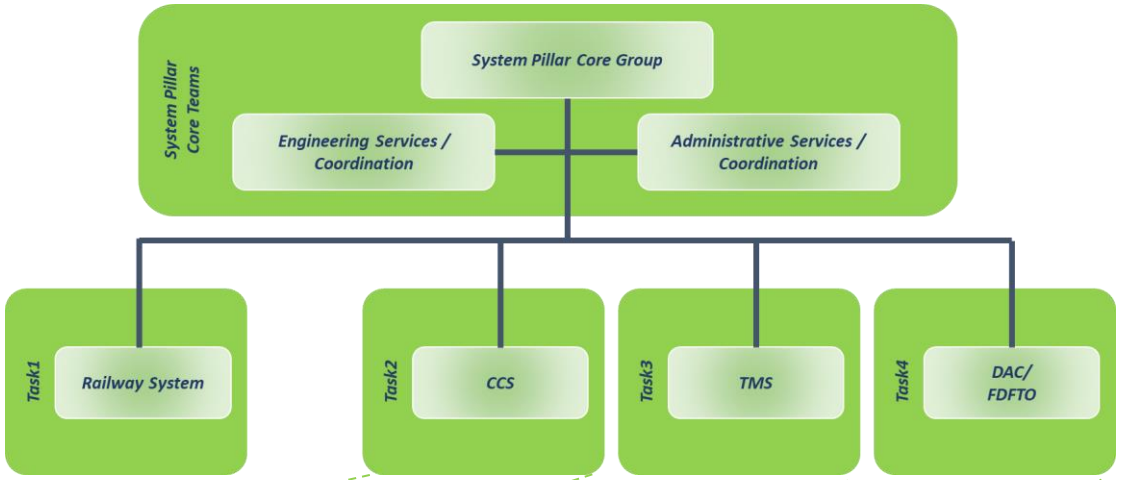
Control Command and Signalling and Traffic Management Systems



Organisation, Principles and working method

System Pillar **Principles**

- **Integrated leadership team** (*System Pillar Core Group*) with representatives of **sector organizations and ERA**
- Engineering Services, eg:
  - **(Central) Modelling service** (incl. Process, methods & tools definition for the whole System Pillar, support of the modelling platform)
  - "**Standardisation and TSI Input planning**"
- Defined set of standardization areas (***Tasks***). For each area a **joint leadership team** with **one representative from Railways and Suppliers each** will work together
  - Task 1 will specify the **Business Process Architecture for the Railway System**
  - Task 2: **CCS**
  - Task 3: **TMS**
  - Task 4: **DAC/FDFTO**
- Avoid consensus based 'working group style' process, but fast and integrated **system design process directly under control of EU Commission**
- **Integration of sector standardization activities** (OCORA, RCA, EULYNX, ERTMS, …)

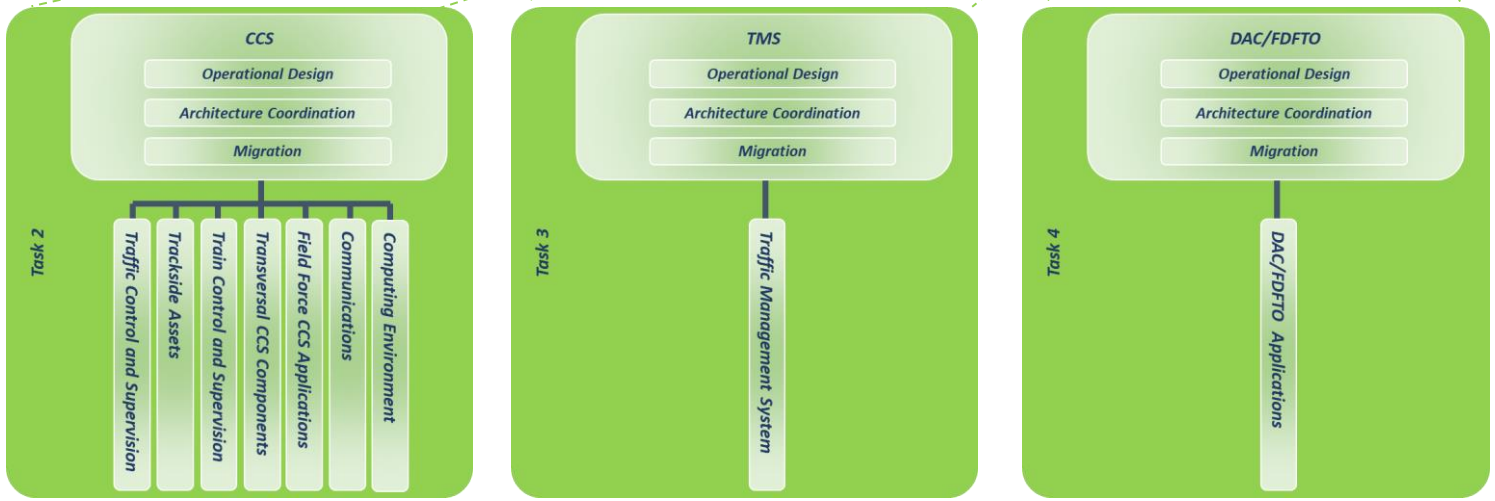


Operational design
- Creating **harmonized operational processes** and define process improvements

Architecture coordination
- Create and maintain **one consistent target architecture** for the whole system

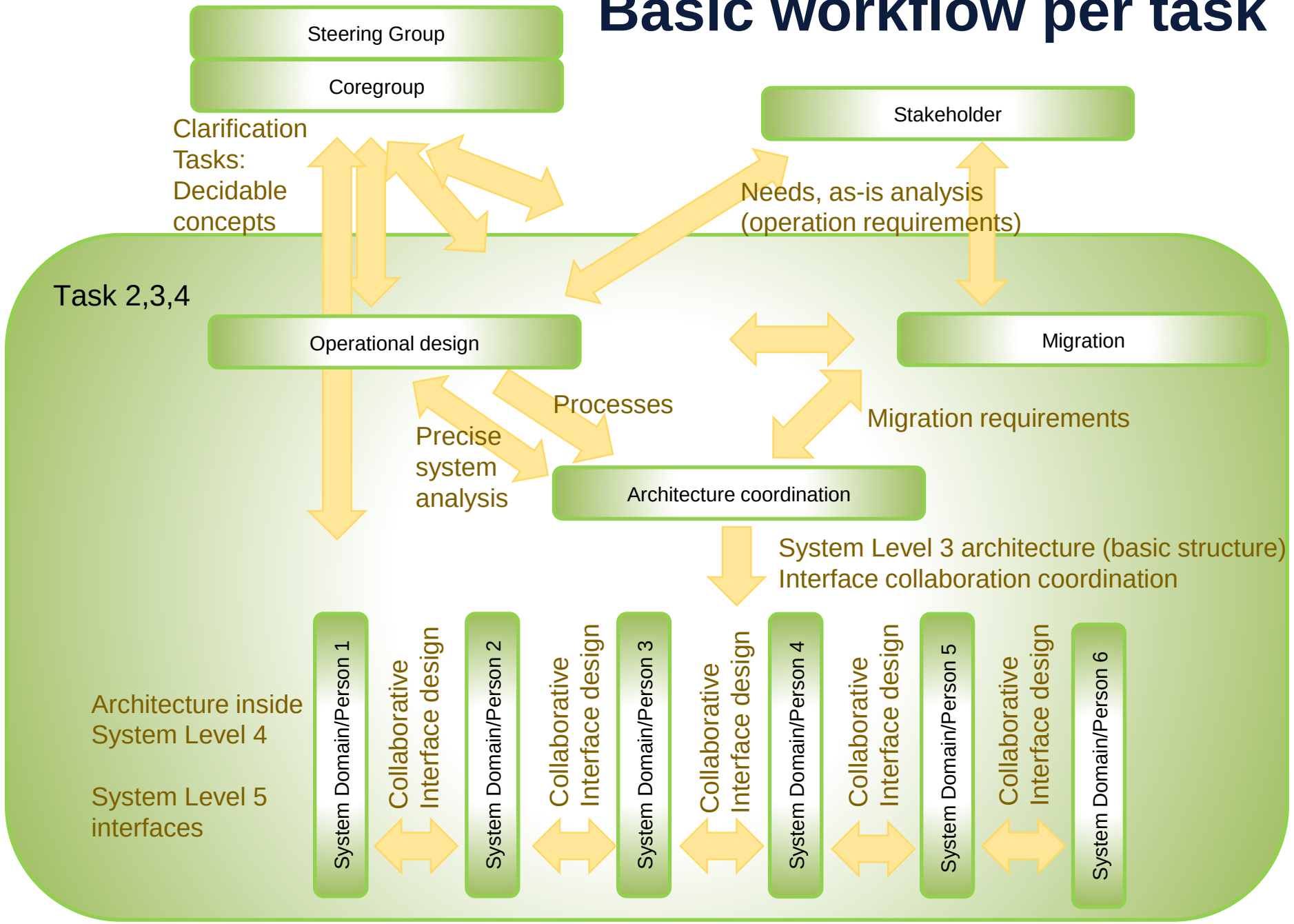
Migration design
- Define migration plateaus that allows national Infrastructure Managers to **stepwise migrate towards European target architecture**

Domain Specification
- Define per System Pillar Task **standardization granularity and related specifications**



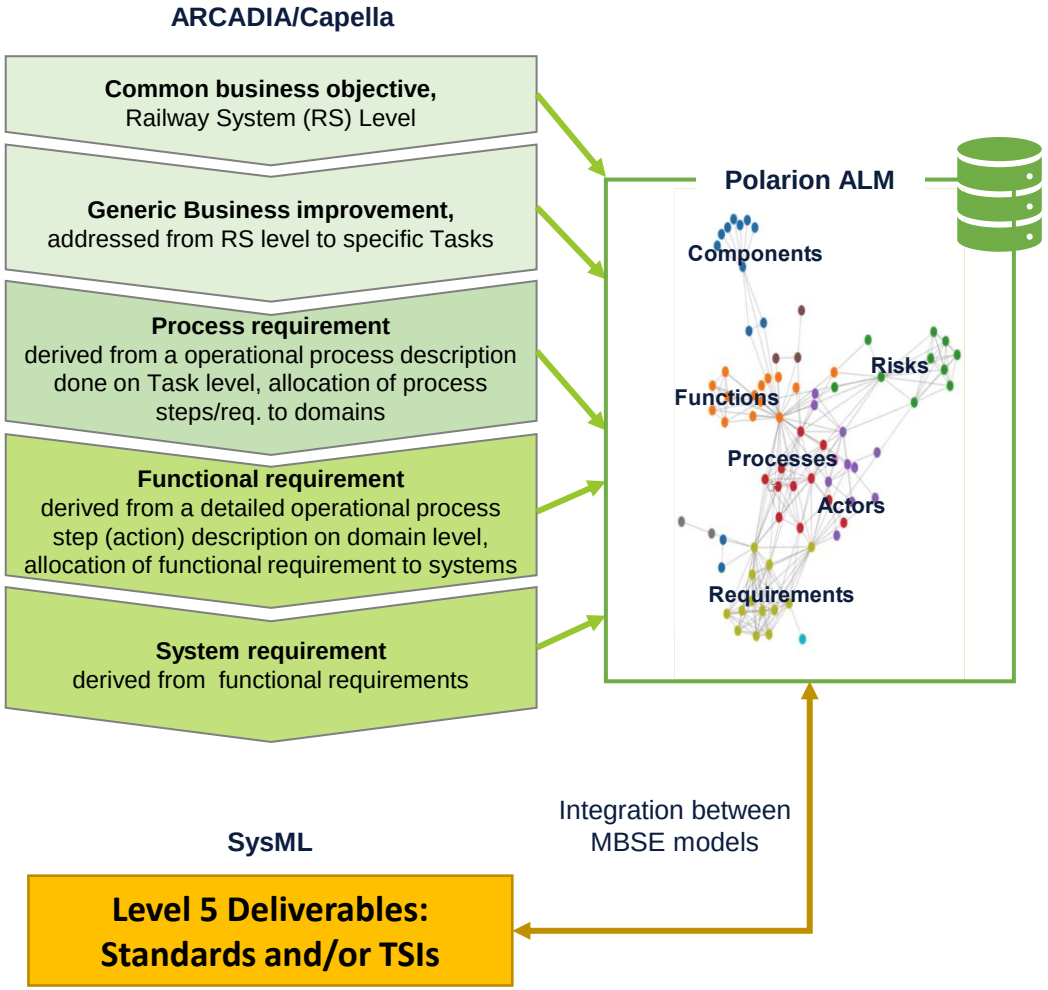
CCS	Control-Command and Signalling
FDFTO	Full Digital Freight Train Operations
DAC	Digital Automated Coupling

Basic workflow per task



Proposed Tools for Requirement Specification

Capella, SysML and Polarion



The engineering service of the System Pillar is the responsible of maintaining, updating and integrating the Capella ALM model for Levels 1-4, considering the analysis and outputs of the different Tasks and Domains.

The different Domain Teams are expected to develop Level 5 requirements aligned with the Core Model, which will conform the Standards and Technical Specification for Interoperability.

It has been preliminary proposed to use:

- ARCADIA/Capella for Levels 1-4 higher requirement development.
- SysML for Level 5 requirements development. To ease traceability process.
- Polarion as ALM data base. To create the digital thread.

System Pillar - Expected Outcomes

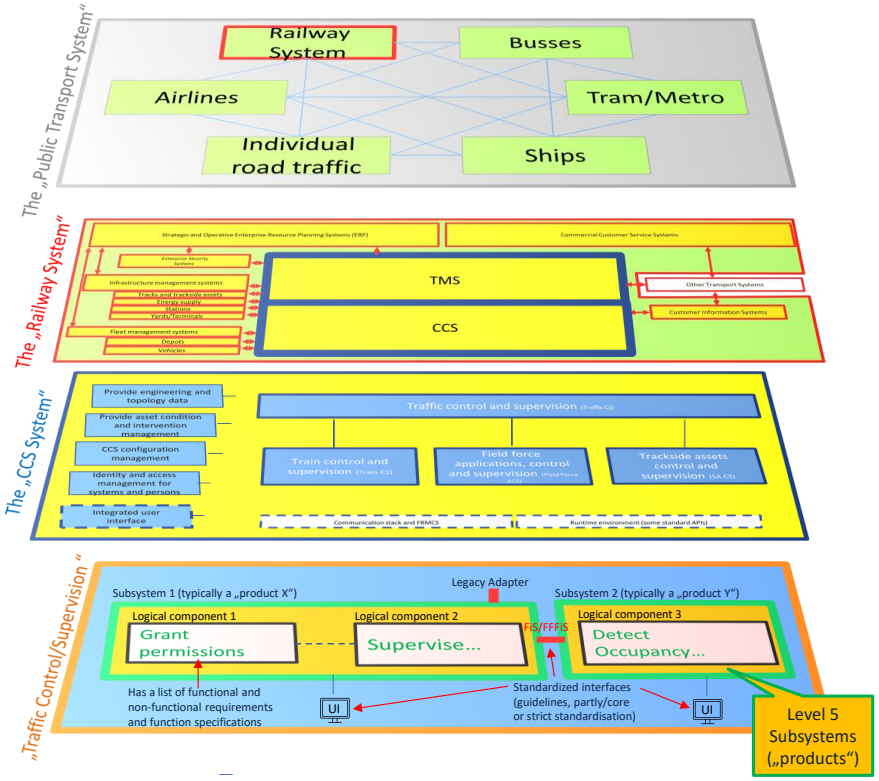
Technical Specifications for Interoperability and Standards

The central tasks of the System Pillar are:

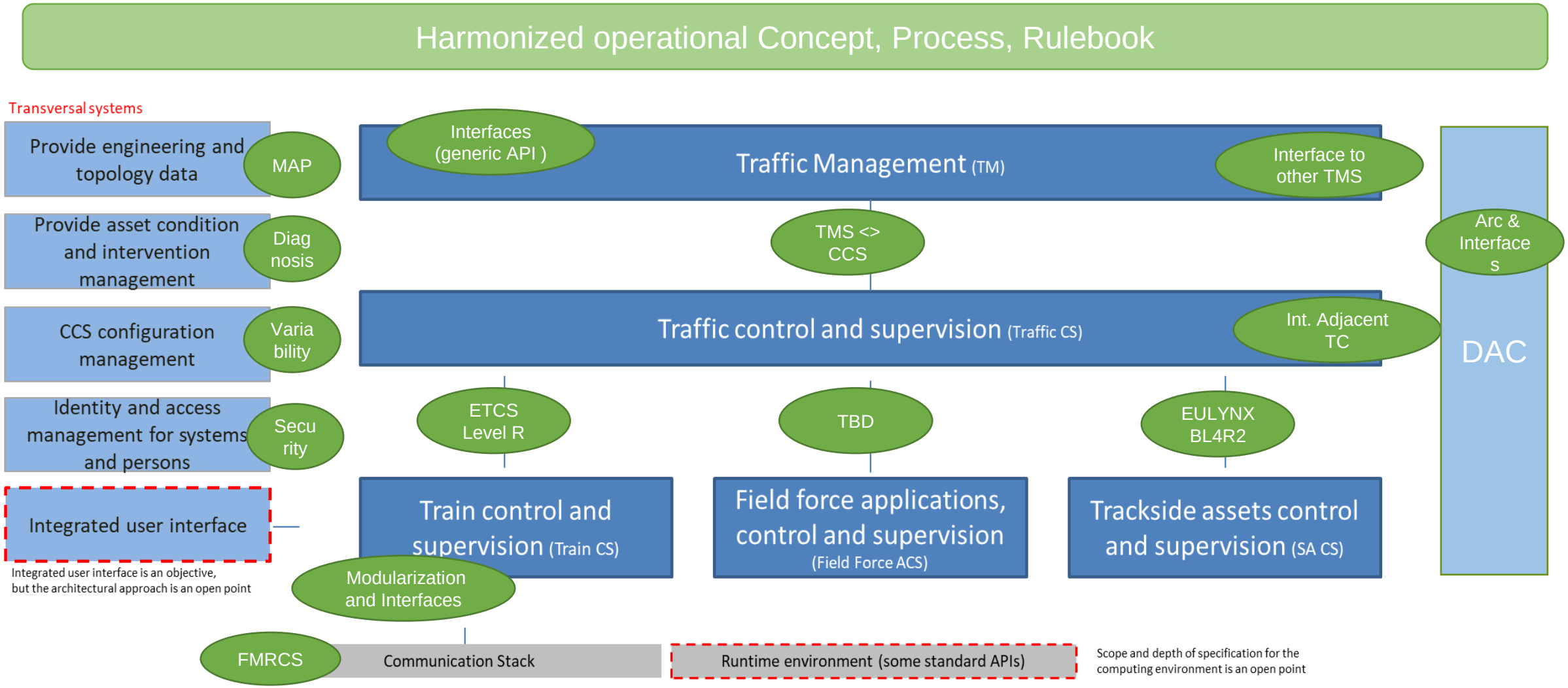
1. Define target system architectures and operational concepts.
2. Coordinate and deliver the means for implementation through inputs to Technical Specifications for Interoperability and harmonized standards.

⇒ **The aim is:**

- **Faster processes**
- **Better design**
- **Deeper harmonisation**



CCS/TMS/DAC: ‘**Very High Priority**’ areas 2023 – 2026



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