Session 6
Introductory Keynote

EU-RAIL Executive Director, Giorgio Travaini

EU-Rail after 3 years

29
PRIVATE MEMBERS

377 / 801
PARTICIPANT(s)/ION(s)

55
SMEs

28
COUNTRIES

106
RESEARCH CENTERS & UNIVERSITIES

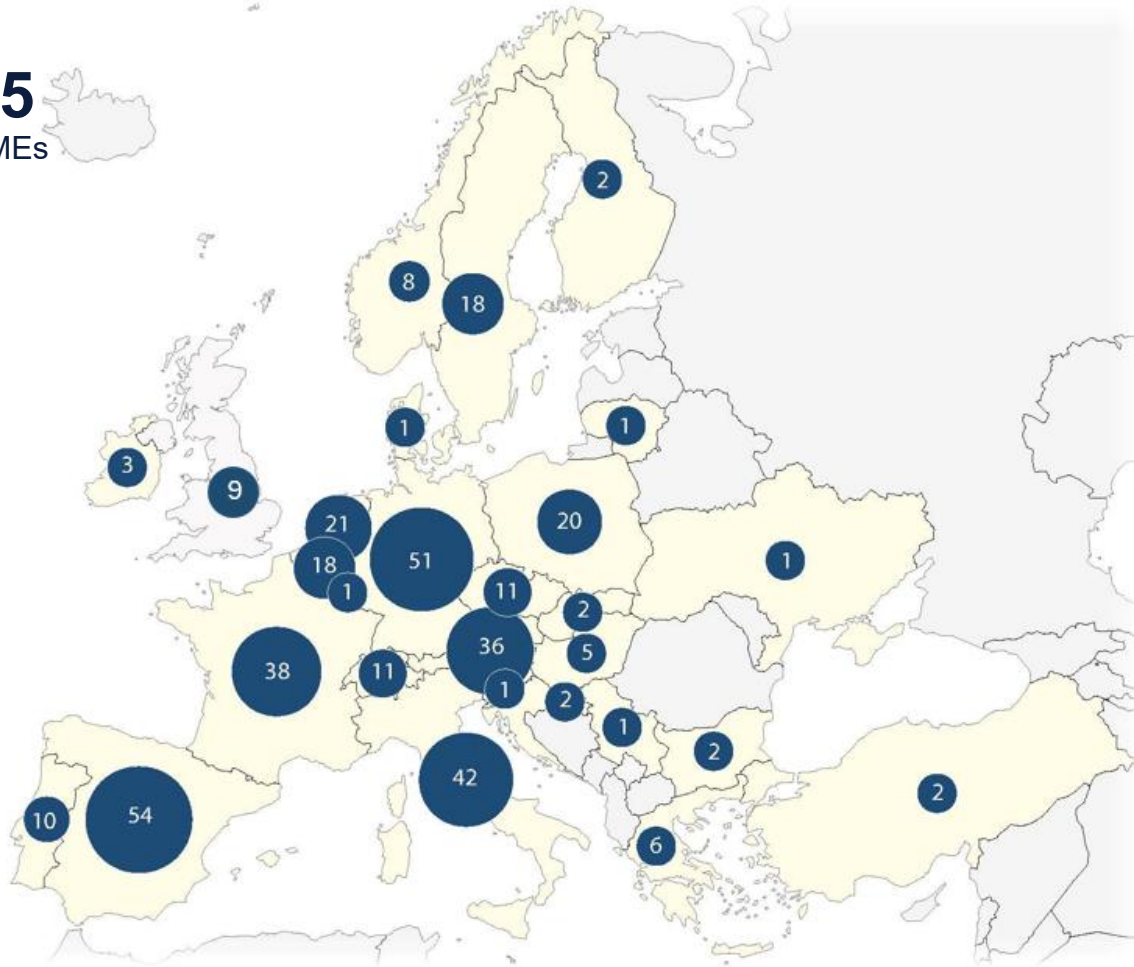
2022 - € 566.7 M
14 projects & 2 Tenders

2023 - € 44 M
7 projects & 2 Tenders

2024 - € 31.9 M
3 projects & 8 Tenders

2025 - € 7.9 M
1 project & 3 Tenders

Number of Participants per Country



Administrative boundaries: © EuroGeographics © OpenStreetMap
Cartography: Eurostat – IMAGE, 12/2025

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

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

1	EUROPEAN RAIL TRAFFIC AND MOBILITY MANAGEMENT	Manage and improve rail traffic at EU level Adjust rail traffic management in function of the mobility demand
2	DIGITALISATION & AUTOMATION IN TRAIN OPERATIONS	ATO implementation Digital train operations
3	SUSTAINABLE AND DIGITAL ASSETS	Integrated assets testing & life-cycle framework Zero-emmission, silent rail system
4	COMPETITIVE, DIGITAL, GREEN RAIL FREIGHT	New digital customer interaction & innovative rail freight services Multimodal and rail freight innovation integration
5	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

Europe's Rail

Objectives of 2025 and achievements:

Innovation Pillar – Flagship Areas 1, 2, 3 and 4

FP1 MOTIONAL
European Rail Network and Mobility Management

- Over 70 Demonstrations ongoing or under preparation
- Completion of multimodal interface solutions for ticket distribution, financial clearing and disruption management.
- On-boarding of partners to the sandbox of Rail data Space

Travel Wise
FA1

- Completion of benchmarking and user requirements activities
- Delivery of the first version of the Concept of Operations and preparation of demonstrations

FP3 IAM4Rail

- IAMS analytics models for anomaly detection, fault prediction, and maintenance strategies developed for the two Use Cases on Wayside Monitoring and TMS link
- Production of a door panel compliant with flame retardancy standards. Lead time reduction of over 80%, while the production cost was approximately 50% lower compared to the conventional manufacturing process.

FP2 R2DATO

- First official baseline of Automation processes specifications issued.
- Several demonstrations during the year, including RTO in the Netherlands and full ATO GoA4 in the Czech Republic
- First specification was delivered for a novel system integrating a Radio Block Center (RBC) and Interlocking

FP2-MORANE 2

- Planning of the start of test cases writing ongoing
- Test architecture- E2E Generic Architecture ongoing – to be completed by January 2026.

Rail FP4EARTH

- Pilot demonstrator of urban Energy hub in a light urban rail environment as energy storage.
- Two immersive tools, 3D virtual reality configurators of train layout developed.
- E-Panto: 2 prototypes being built.

Europe's Rail

Objectives of 2025 and achievements:
Innovation Pillar – Flagship Areas 5, 6 and 7

FP5TRANS4M-R
Transforming Europe's Rail Freight

- Preliminary operational procedures and system requirement specification for DAC finalised.
- Swedish demonstrator trains are running and other demos are under preparation and retrofitting.
- Authorisation strategy and overall safety plan finalised.

FP5DACtiVate

- Work on specifications of the testing procedures and setup required to evaluate the interchangeability of DAC Interface A subsystems.
- Work on main functionalities of hybrid couplers and the integration of the system into the locomotive.

FP6-FutuRe
Cost effective regional lines

- List of use cases and demonstration setup for cost efficient CCS, wayside assets and passenger information completed.
- Over 30 demonstration activities are ongoing
- Concept design for 2 lightweight, emission free rolling stocks defined

FA7 pods 4 RAIL

- A high-level functional requirements specification and a concept proposal for a Pod System were developed.
- Generic Business Case Elements and Business Case Study for selected Use Cases were carried out.

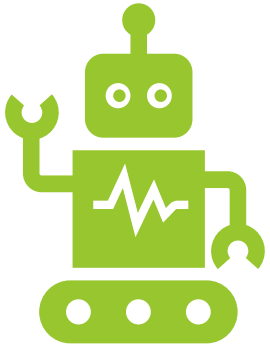
FA7 Hyper4Rail

- A concept of operations for Hyperloop has been completed.
- End user survey gathering public input on expectations for a new ultra-high-speed transport system has been carried out.

MaDe4Rail 2

- The project has been launched in December 2025. The GA signatory is in progress.

Flagship Area 2 | Overview



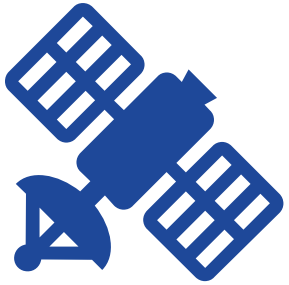
Automation process

ATO up to GoA4

Perception

Remote driving

Automating functions



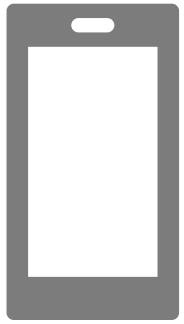
Optimised headway

Moving Block, HTD

Train Positioning

Train integrity/length

NG brake

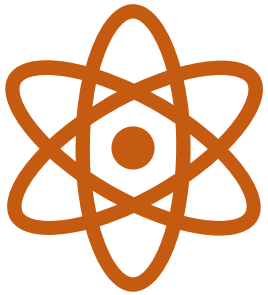


Enabling digital technologies

Connectivity

Modular Platform

Digital register



Innovative operational solutions

Self driving wagon

Virtual Coupling

Autonomous route setting

Flagship Area 2 | Expected improvements

Shunting & stabling
Up to 50% productivity increase

Vehicle preparation
50 to 70% productivity increase

Parking after operations
Up to 15% productivity increase

Capacity increase
Up to 15%

Punctuality
10 to 15% improvement

System Pillar and Deployment Group

Current ERTMS Deployment: Too variable, Too expensive, Too slow

Too variable

There is a high degree of variability in deployed ERTMS due to

- interactions with existing systems
- specific project requirements
- wide variety of implementation options

Over 150
ETCS System Compatibility types

These represent differences in trackside implementation that require a check for onboard compatibility

Too expensive

ERTMS deployment costs remain high.

- fragmented implementations, repeated approval processes, and heterogeneous installed bases across member states.
- Each country bears the full cost of bespoke engineering, national product development, and system approval.

Too slow

Deployment timelines are consistently overrun.

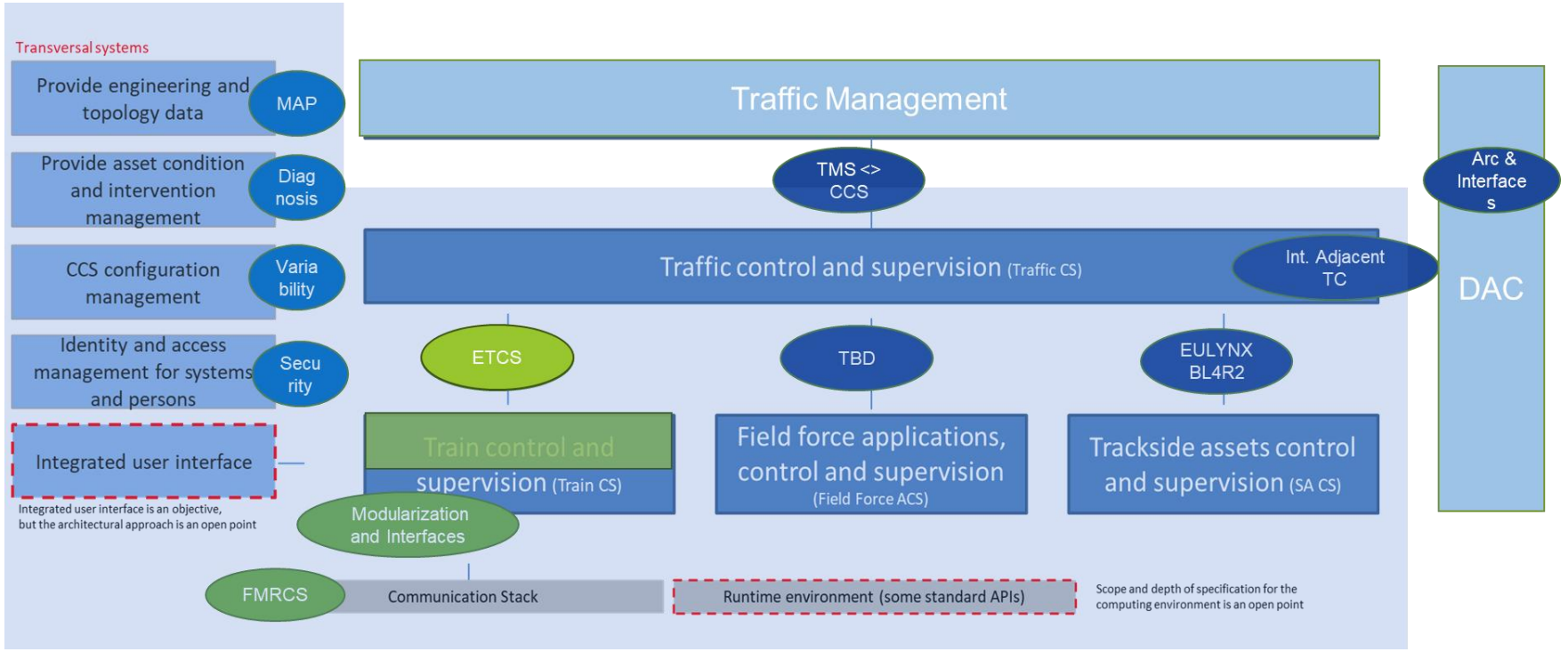
Without a common reference system, projects have specific requirements and processes.

The pace of rollout is insufficient to meet European interoperability targets.

Q: What drives variability?
A: There is no harmonised European CCS system

Shaded area is the CCS system.

Green areas are harmonised in the CCS TSI.



- Variability in CCS TSI compliant ERTMS implementation is because **ETCS and radio are not the whole CCS system**:
  - many other critical and important elements, for example the interlocking, are not harmonised and therefore national approaches are developed in these areas
  - there are various ways to achieve similar trackside-on board ETCS behaviour

This is a multi-billion euro issue

Increasing Complexity

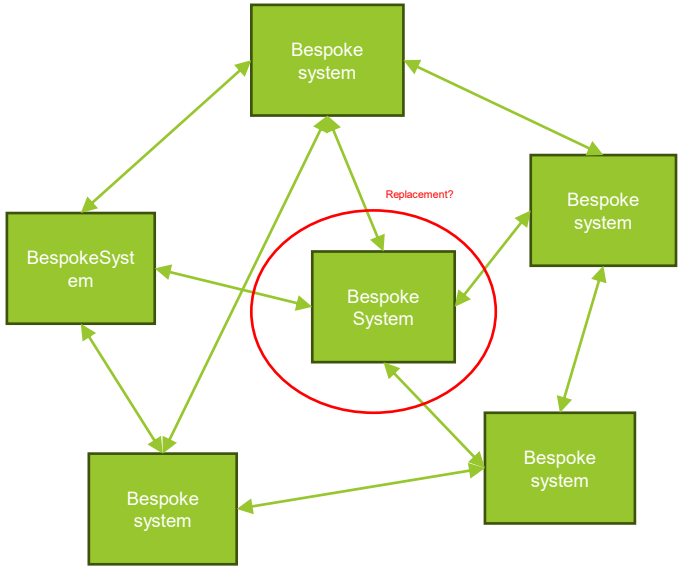
- The more we digitalise without harmonisation, the more complex the system becomes.
- Lifecycle shortening accelerates obsolescence.

Growing Dependencies

- Inter-system dependencies multiply complexity as digital layers are added on top of fragmented foundations.
- Even simple changes require bespoke analysis.

Operational Issues

- Operational interoperability is also impacted – see ongoing discussions eg ESC complexity, cross border interoperability etc.



If perpetuated, the situation will deteriorate

Opportunity vs reality with no action

Where ERTMS is introduced as a standalone system – **ETCS only without lineside signalling - there is the opportunity to address the main the sources of variability:**

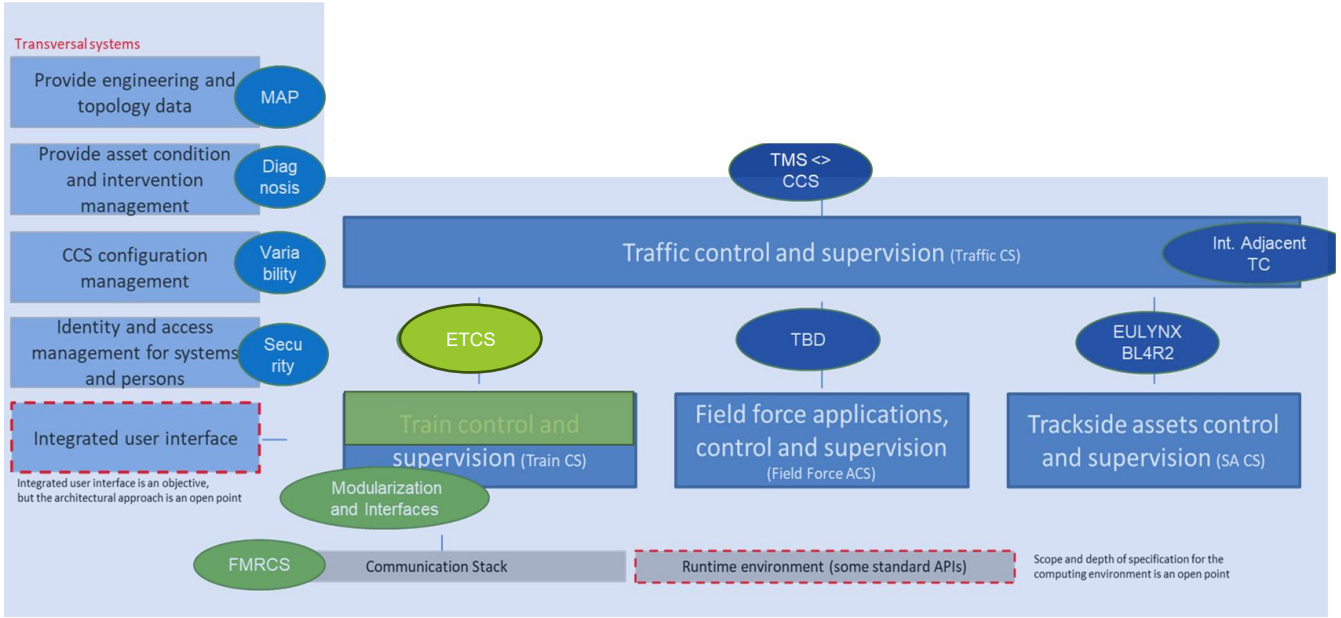
- interactions with existing systems
- specific project requirements
- requirements based on national signalling rules
- operational implementation options

At the moment this opportunity is not taken – **there is no European reference for the whole CCS system**. National CCS implementation is the reality even for current L2 implementation.

Therefore the System Pillar works to provide this reference for L2 only operations – to allow the sector to take advantage of European solutions when installing ETCS L2.

Results are available

- TACS/EULynx,
- Cybersecurity
- Onboard modularity
- And the releases for Operational harmonisation and CS Trackside specifications available for the sector for review in the coming months



Why focus on Deployment

bridging the "valley of death" between R&I and commercial operations

EU-Rail High-Level Deployment Group

FROM…

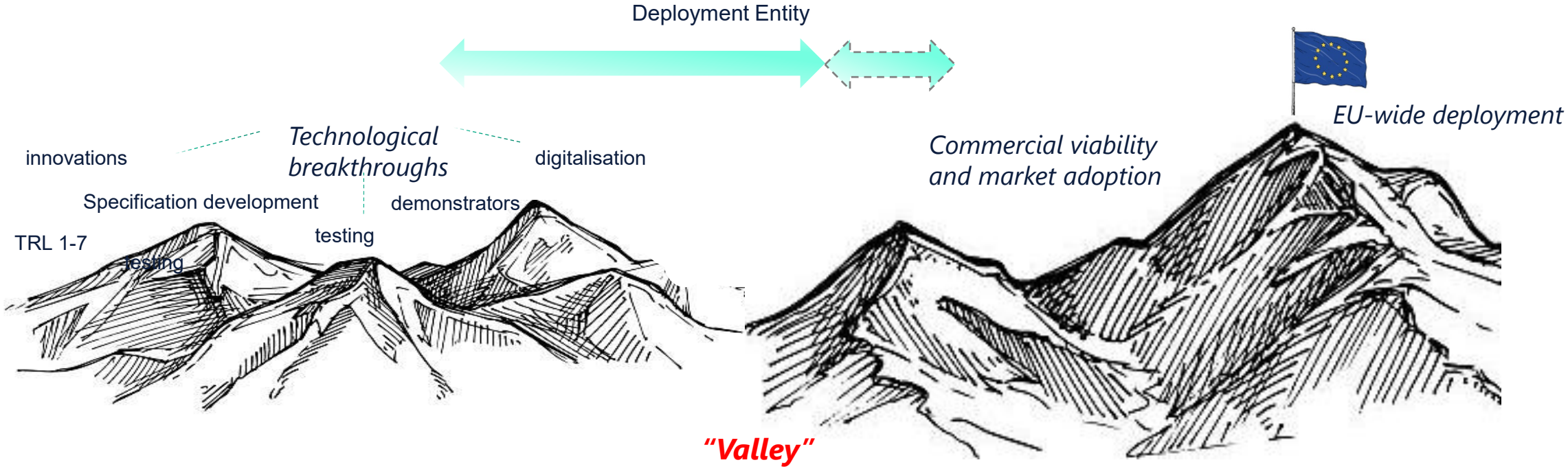
The realm of

Research and Innovation Programmes

TO…

The realm of

Commercial Operations



Importance of pre-deployment phase

Why large-scale usage (pioneering) and scale-up is needed

Currently many ongoing development of new system requirements, design, technology and processes.

- Includes specifications, tests, demonstrators, validation and authorisation

Before full European roll-out, large-scale use of this new technology is needed

- Representative to proof (economical) added value in real-life –commercial- operations (for owners, operators, IM's)
- To give information to stakeholders for sound and robust future investment decisions based on evidence and operational use cases

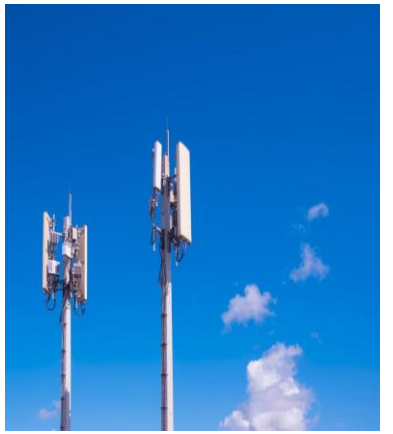
- Use and improve technology and process maturity for general deployment, production and investments
  - Assess the validity of assumptions developed in Design (system, architecture) and Development Projects
  - Ensure full reliability, availability, maintainability and (operational and industry) processes
  - Learn and develop. Create a steppingstone towards full system deployment and roll-out

- Assess interchangeability/broad interoperability/integration with other –existing- digital systems on trains, tracks and central IT systems. Together with technology providers, operators, owners and suppliers
- Assess and improve operational rules and architecture effectiveness

Focus on FRMCS

set up FRMCS European Deployment group

FRMCS European Deployment Group



Provide advice and recommendations to the HL DpG and sector on the best way to deploy FRMCS (business driven: cost efficient, simple, fast)

Deliverables

- Analyse and estimate Infra, rolling stock, industry and workshop capacity for deployment
- Support to accelerate and simplify authorisation
- Perform cost analyses, CBA and risk assessments
- Develop toolbox with diverse migration scenario's (greenfield and brownfield situations)
- Provide cross-border (installation) alignment and public-private mobile network interface analyses
- Alignment with other major Rail programmes (ERTMS, DAC, …) and stakeholders

- Implementation programmes are and stay responsibility of RUs/IMs/lessors and Member States (inclusive financing).
- Based on broader context: Development specifications: UIC programme; Test programme: FP2-MORANE2; EECT process: ERA; Standardisation: ETSI
- EU-Rail System Pillar Radio report 2.4 finalised and agreed as basis for scope, timeline and governance

Looking forward, the European rail need for simplification

Why looking forward together?

🎯 CRITICAL RAIL CHALLENGES

- *System Fragmentation and system costs*: Diverse national standards hinder harmonization - only European approach delivers cost-effective improvements
- *Investment Constraints*: Insufficient public/private investment limits modernisation, especially digital transformation
- *Competitiveness pressure*: not capitalising on a single market with standardised accepted solution, already today advantages non-European competitors
- *Resilience Issues*: Climate change, cybersecurity demand coordinated response

🚀 SYSTEM COMPLEXITY DEMANDS EU COORDINATION

- Structural and functional subsystems + Interconnected components with lifecycles up to 40 years (trains) and 100 years (infrastructure)
- Cross-border operations requiring harmonised implementation
- Multi-year migration plans across national boundaries
- Meeting ambitious EU greening, digitalisation and competitiveness targets

→ **This exceeds any market initiative from single or limited players**

Future Directions: System Simplification Mission

- *Mission*: that centres on **simplifying the rail systems and operations while enhancing its fundamental capabilities and reducing its costs.** Aiming to strengthen the Single Market and deliver a harmonised Single European Rail Area (SERA)
- *Critical challenges*: fragmentation, funding, competitiveness, resilience
- *Enhanced PPP framework building on EU-Rail foundation*:
  - Expanded scope including pre-deployment activities
  - Coordinate pre-deployment to bridge innovation to market impact
  - Greater inclusiveness

→Focus on **Agility**, **Resilience**, and **Competitiveness**

→This would require an ambitious common investment by both private and public entities under the next EU Multi-Annual Financial Framework (2028-2034)

An ambitious common investment

€3 billion in R&I innovation addressing the need for costly yet essential one-time developments of innovative solutions aiming to transition the diverse existing legacy systems into a new, simplified European rail system.

€15 billion in pre-deployment from the participation of diverse stakeholders across different countries to upgrade their systems and make investments in their network. Procurement activities to enable a first implementation at system level.

<u>To deliver for passengers and businesses:</u>

Service Quality + Cost-Effectiveness + System Resilience + Standardisation

FI1: European Simplified and Integrated Railway System

FI2: The Next-Generation Rail Freight Operations with European Digital solutions

FI3: Resilient and Recoverable Railway System

FI4: Innovative EU High-Speed Rail Corridors