Status of FRMCS migration scenario's

Webinar

18 March 2026

Pipsa Hallner

Joachim Eriksson

Karel van Gils

EU-Rail FRMCS Deployment Group

Agenda

FRMCS European Deployment Group

1. Introduction	10:00
EU-Rail	
The FRMCS European Deployment Group	
2. Status of FRMCS Migration Scenarios	10:20
3. Q&A	11:30
Further Information	
4. End	12:00

Introduction

FRMCS European Deployment Group

Pipsa Hallner
EU-Rail / Trafikverket

Karel van Gils
EU-Rail

Joachim Eriksson
Trafikverket

EU-Rail

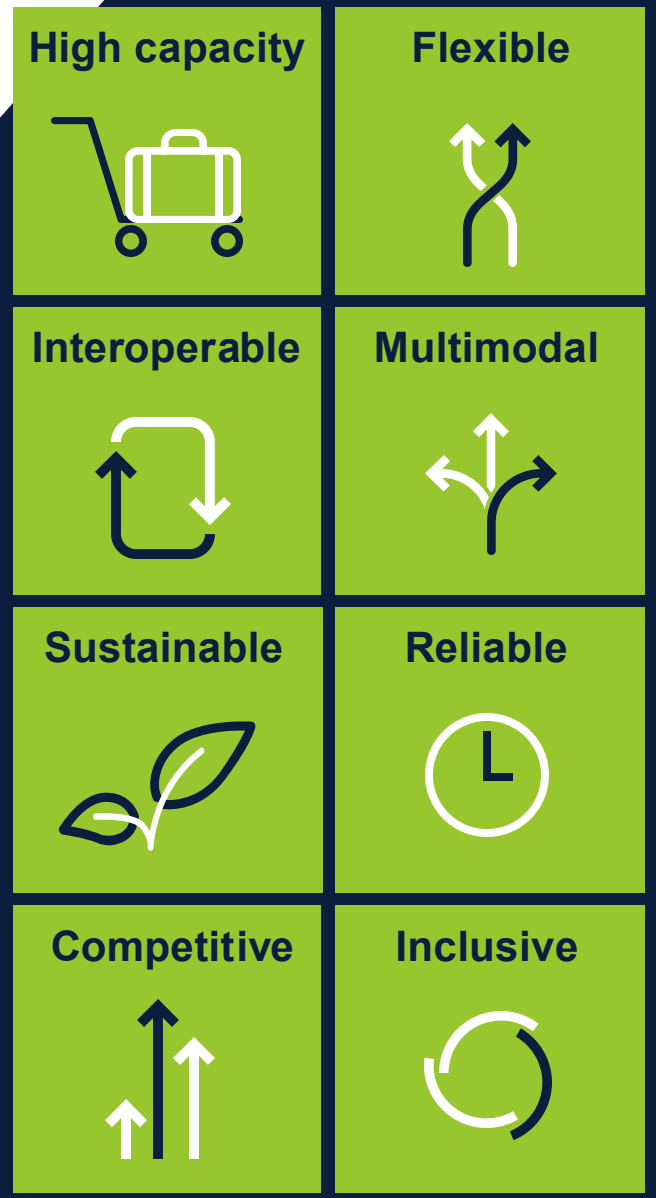
&

FRMCS European Deployment Group

Vision

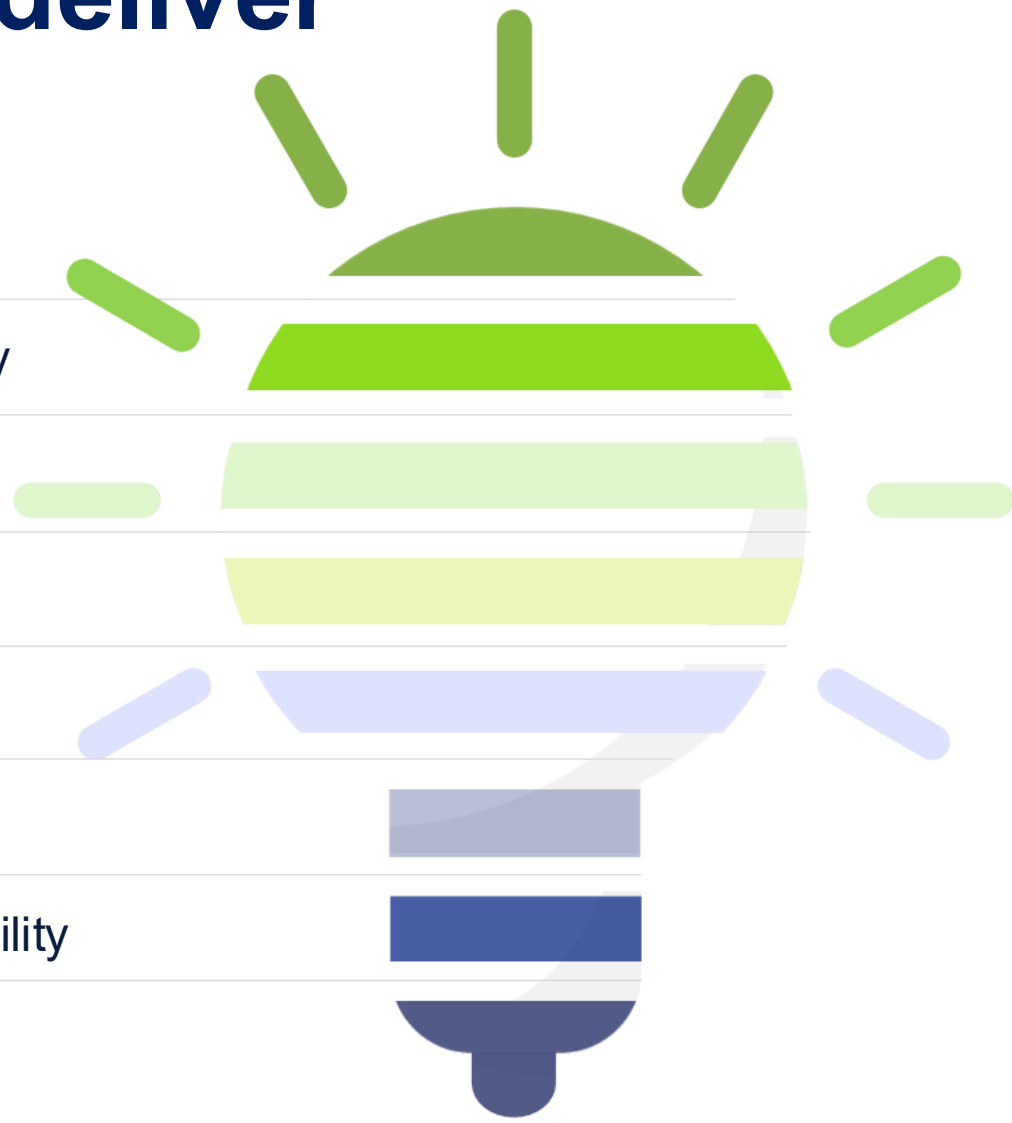
To deliver a **fully integrated European railway network for citizens and cargo.**

Rail Research and Innovation to Make Rail the Everyday Mobility



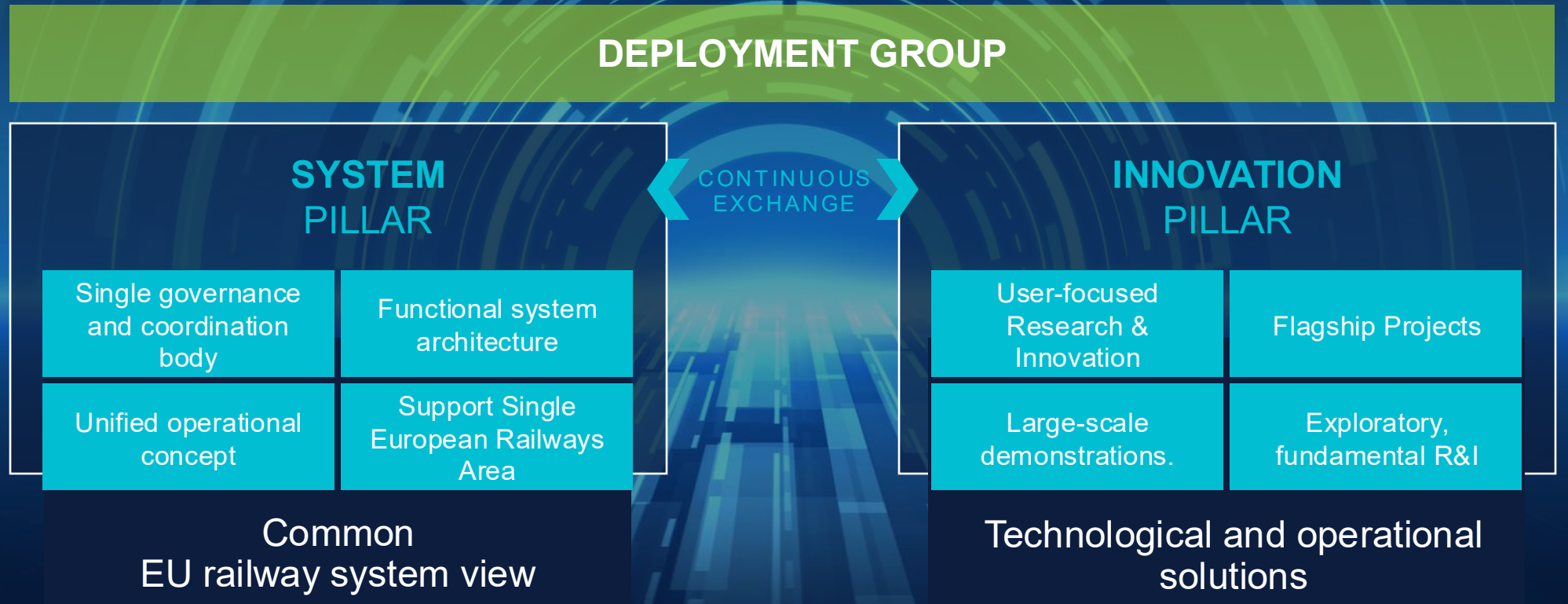
EU-Rail, a R&I integrated Programme and a cooperation to deliver

- Adapt to changing customer requirements
- More cost-efficient solutions and services compared to today
- Need for improved performance and capacity
- Addressing workforce shortage
- Climate change adaptation and environmental sustainability
- Increased competitiveness
- Interaction with other modes, make rail central to future mobility
- Addressing legacy systems and obsolesce



EU-Rail

Single R&I Programme based on a system view



EU-RAIL HL-Deployment Group - Started February 2025 -

From Talking to Testing to implementing

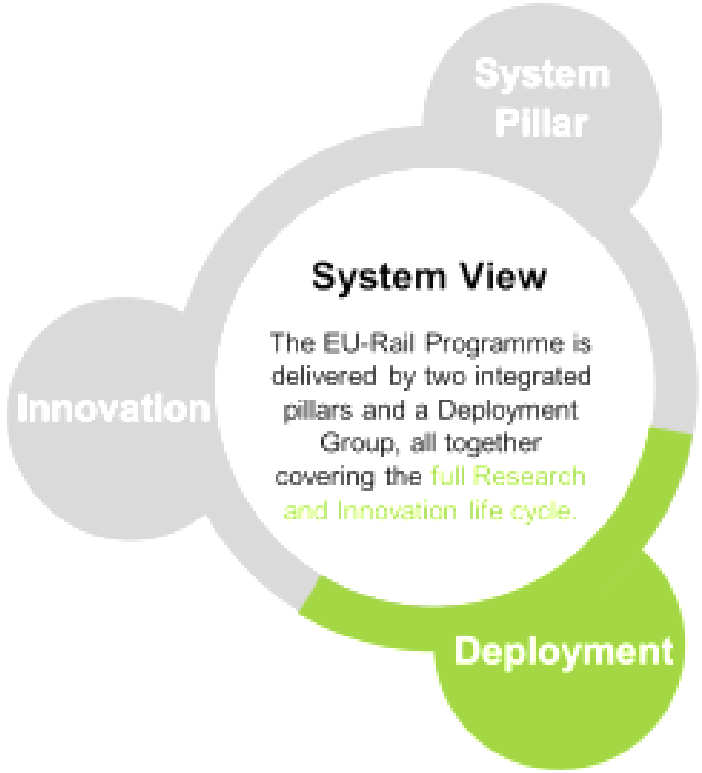
- Objective is to close gap between R&I activities and Deployment and Migration
- Support smooth, fast and cost-effective introduction of Innovations and new architecture
- Open group, contributing to whole railway sector and industry

Examines and provides recommendations on:

- Scenarios and analyses for the fast rollout of innovative solutions
- authorisation, cost-drivers, capacity and migration risks

Main sub programmes:

- European DAC Delivery Programme (EDDP)
- European FRMCS Deployment Group
- Coherence between transformation programmes



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)

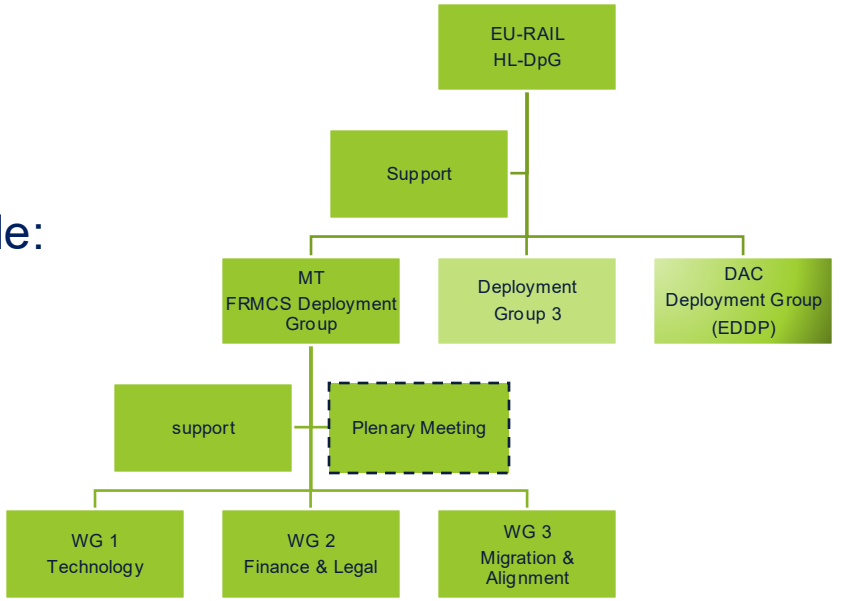
Deliverables

- Analyse (current) Infra, rolling stock, industry and workshop capacity for (fast, easy and cost effective) deployment. Estimate necessary capacities
- 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 dedicated cross-border (installation) alignment analyses 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).
- In close cooperation with UIC (Development specifications), MORANE2 (Test programme) ERA (EECT process), ETSI (Standardisation) and associations (Stakeholder Alignment meeting)

Working areas

FRMCS European Deployment Group



Working Group 1 (WG1) - Deployment Technology

Practical deployment guidelines on different topics, for example:

- Cross-Border Landscapes / National Investment Plans
- MNO serving FRMCS Service Level Agreements
- Practical rooftop antenna coexistence and installation
- non-MCX FRMCS-using applications (survey)

Working Group 2 (WG2) - Finance and legal

- Cost driver studies vehicles and rolling stock
- Recommendations to simplify Testing & Validation and Authorisation processes

Working Group (WG3) - Scenarios and alignment

- Report on FRMCS Deployment scenario's
- Questionnaire 2026 (Survey, now also including MNOs and NoBo's)
- Analyses of coherence with other large transition programmes (ETCS, ATO, DAC, …)

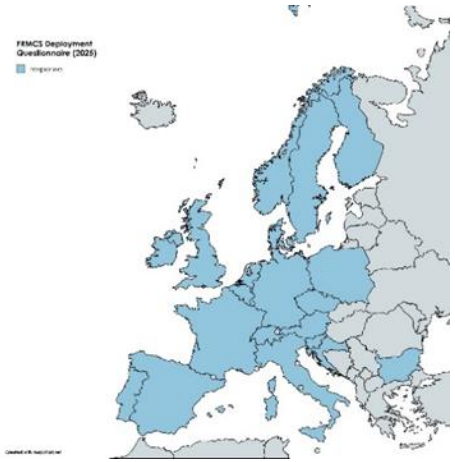
Management

- Risk management, stakeholder management, communication and dissemination

FRMCS Deployment survey (questionnaire 2025)

FRMCS European Deployment Group

- EU-RAIL FRMCS Deployment Group conducting a survey to gather sector information regarding the FRMCS deployment activities and to create more awareness in the sector about the upcoming big transformation.
- 66 answers have been received.
- The distribution of respondents:
  - 19 Infrastructure Managers from 19 countries,
  - 26 Railway Undertakings from 12 countries,
  - 5 Trackside Providers,
  - 5 Onboard Providers,
  - 11 NSAs from 11 countries.



- The respondents are from 20 different countries (including UK, Switzerland and Norway)
- New questionnaire June 2026

* Full report and analyses available on EU-Rail website.

First Publications

FRMCS European Deployment Group

- WG1 – Status Report (National Investment Plans 2024)
- FRMCS Deployment Questionnaire 2025 Report + Summary Presentation
- Intermediate Deliverable 2025 WG2: Financial and Legal (V1.2)
- Report on the FRMCS Migration Scenarios 2025
- FRMCS supplier perspectives, insights from the EU-Rail Deployment Group
- FRMCS Deployment Group – Communication Plan
- FRMCS Deployment Group – Workplan 2026 – 2027
- Meeting minutes + overview participants

More information: https://rail-research.europa.eu/about-deployment-group/

Status of FRMCS Migration Scenarios

Agenda

- Migration scenarios workplan and working methodology
- Concept for master plan
- Deployment scenarios principles and methodology
- Deployment challenges
- FRMCS deployment layers
- FRMCS deployment and migration landscape
- FRMCS migration scenarios and conditions
- Topics to be further explored
- Next steps
- Summary

Migration scenarios workplan

FRMCS European Deployment Group

- Define conditions to deploy FRMCS as part of ERTMS system (ETCS, RMR (GSM-R + FRMCS), ATO)
- Understand challenges and identify synergies
- Identify funding and financing schemes
- Legal, economical and political layer approach
- Technical layer
- Country specific conditions to be taken into account

Migration scenarios working methodology

FRMCS European Deployment Group

- Knowledge sharing in WG3 team meetings
- Joint sharepoint for the contributions
- Transparency and consensus
- The FRMCS questionnaire as input to the migration scenarios.

NOTE: The economical layer and political layer will be analyzed (during 2026)

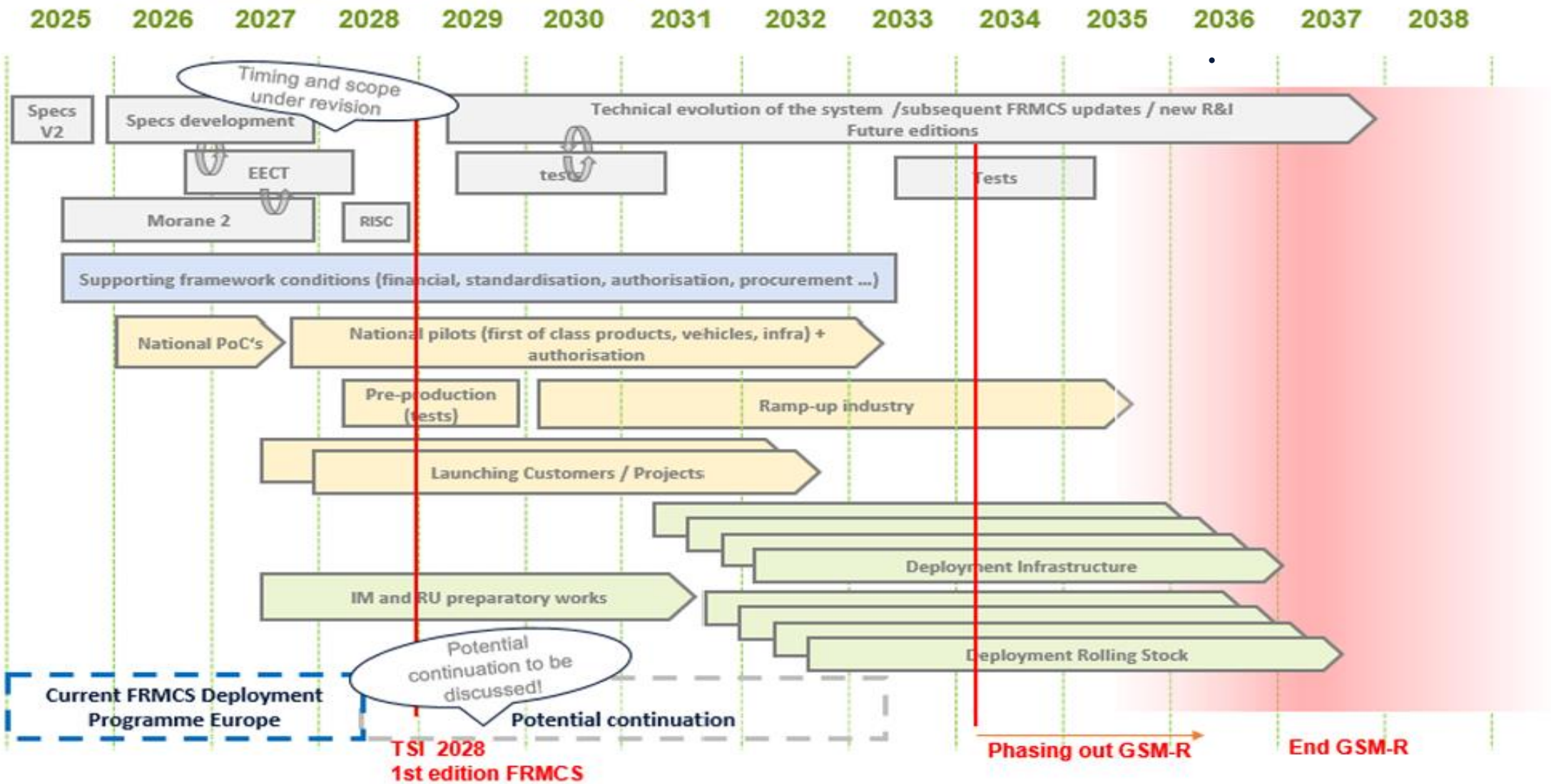
The Migration scenarios 2025 report can be found here:

FRMCS Migration Scenarios 2025 Report_V1.0

Figures from slides 17,19, 20, 21 can be found in the report, other figures are created for this webinar derived from the content of the report.

Concept Master Planning

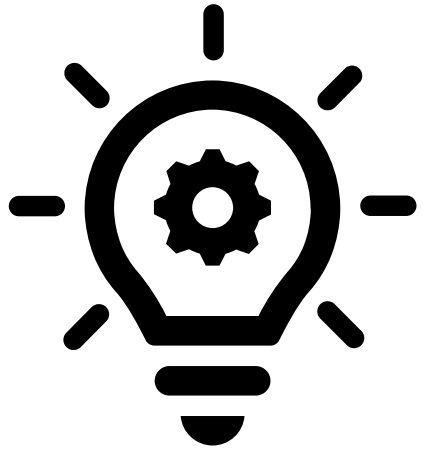
European FRMCS Deployment Subgroup



Deployment scenarios principles

FRMCS European Deployment Group

- To determine the ownership of and required level of control over data
- To consider any necessary modifications towards RINF register to maintain railway safety and rail system performance with regards to route compatibility.
- Installed base per country (existing systems or planned systems)



Migration scenarios methodology

Each scenario consist of:

- Aspects to be considered for the vehicles
- Technical considerations for the infrastructure
- Operational considerations as decision of the FRMCS operator role

For an FRMCS operator, the following figure illustrates interface types to manage and their applicability as part of one FRMCS domain.

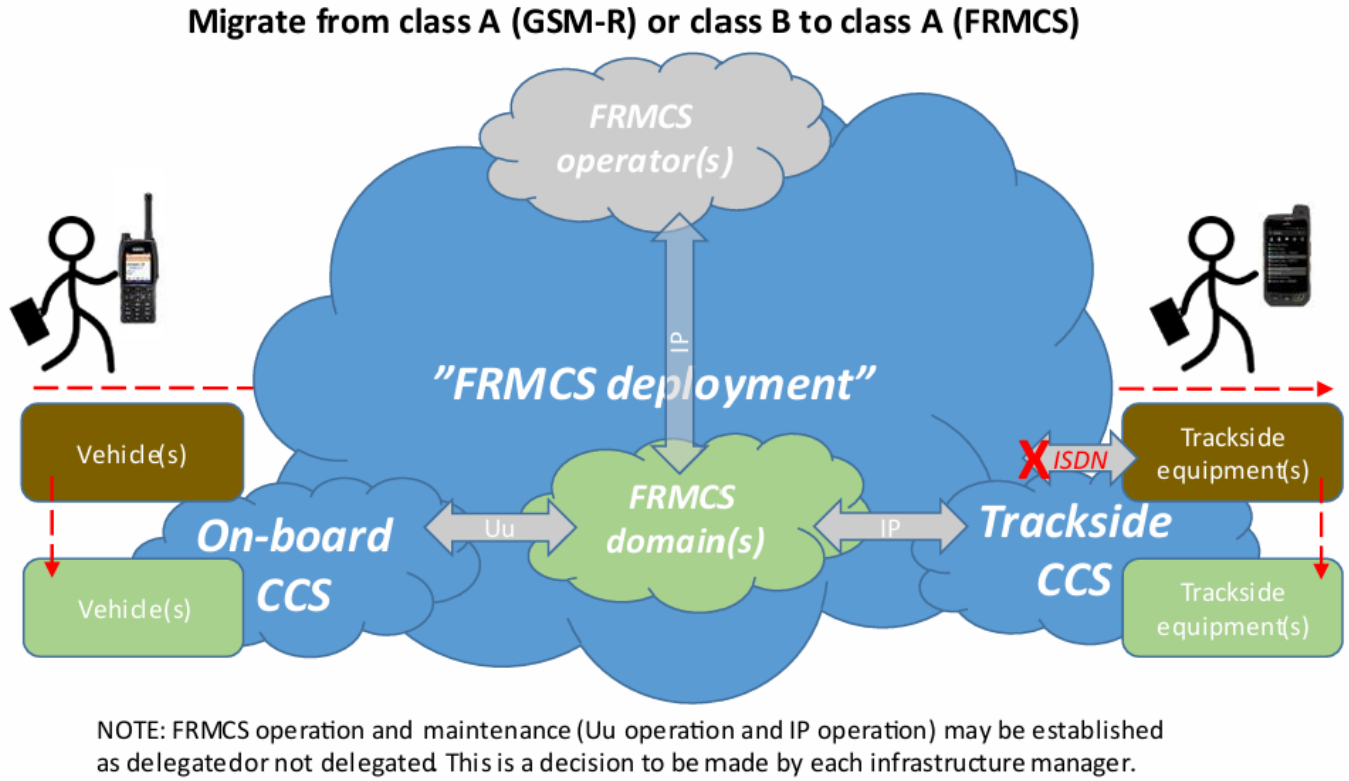


Figure 4-1 Becoming an FRMCS operator

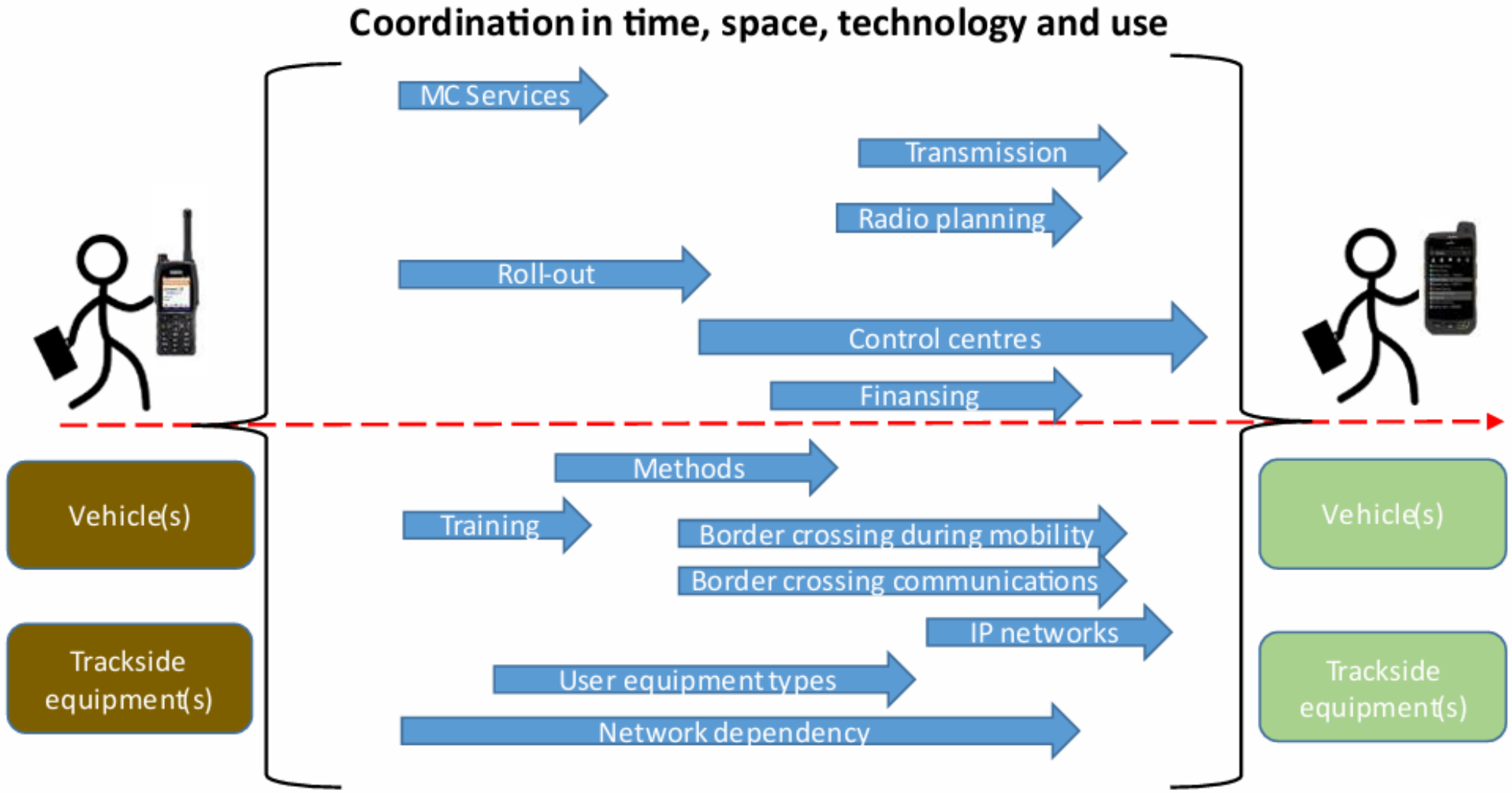


Figure 4-2 Coordination Space Challenges

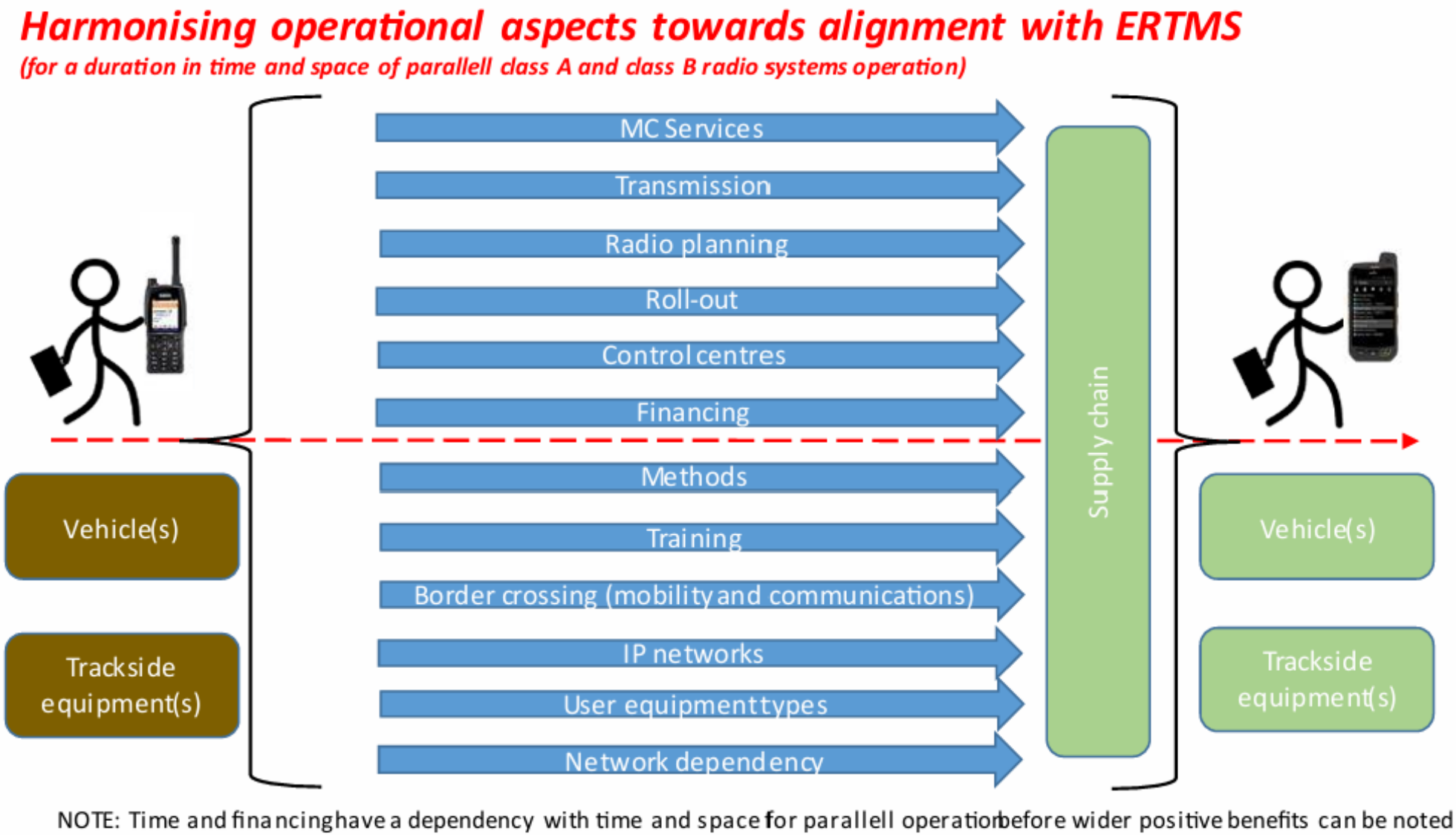
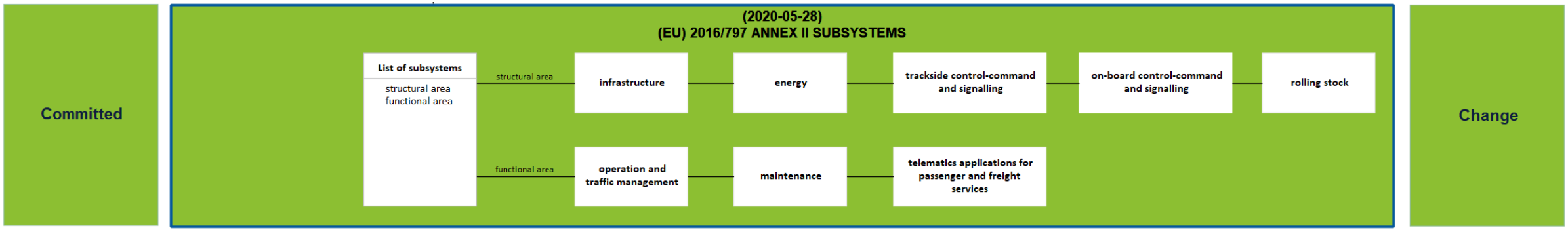


Figure 4-3 Obtaining synchronized planning for rail system operation

FRMCS deployment and legal layer

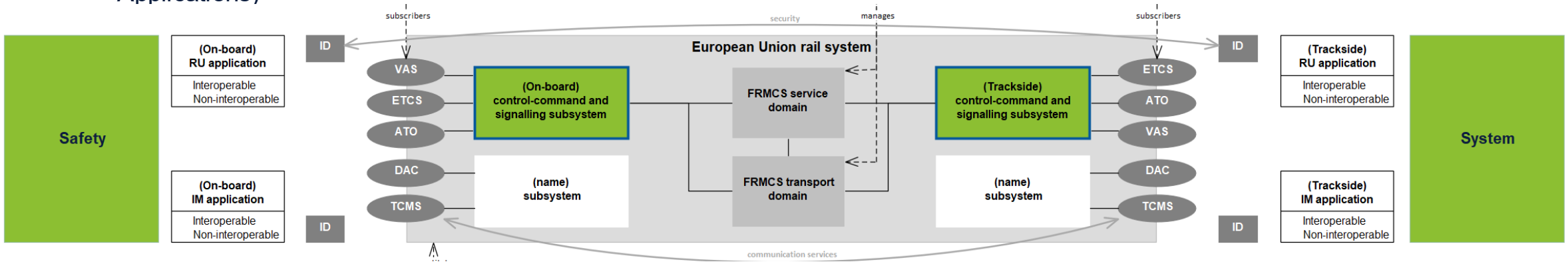
Actors, roles and responsibilities – Introduction towards toolbox

Legal (Member State)
(common targets)



FRMCS deployment and business layer

Business&technology
(Digital infrastructure, ICT Services and ICT Applications)



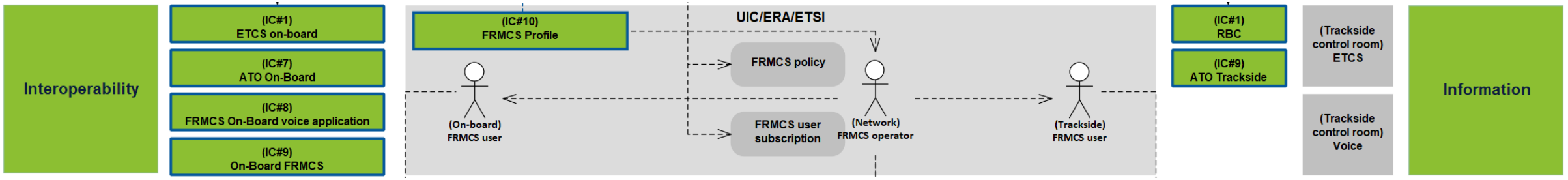
ICT information and communication Technology
RU Railway Undertaking
IM Infrastructure manager

VAS Voice Application Subsystem
ETCS European Train Control System
ATO Automatic Train Operation

DAC Digital Automated Coupling
TCMS Train Control Management System
ID Identifier

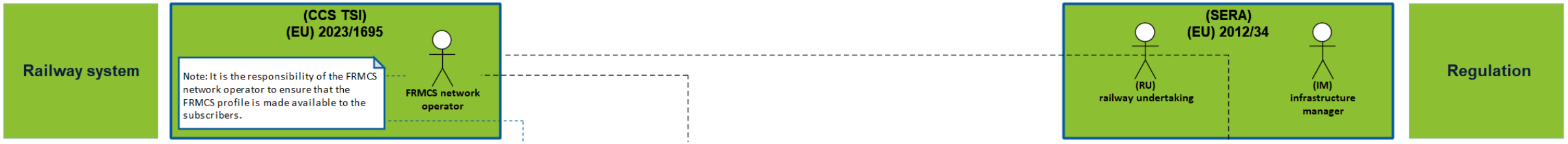
FRMCS deployment and asset management layer

Business
(components and assets)



FRMCS deployment and regulatory layer

Regulatory
(Organisation)
(common
framework)



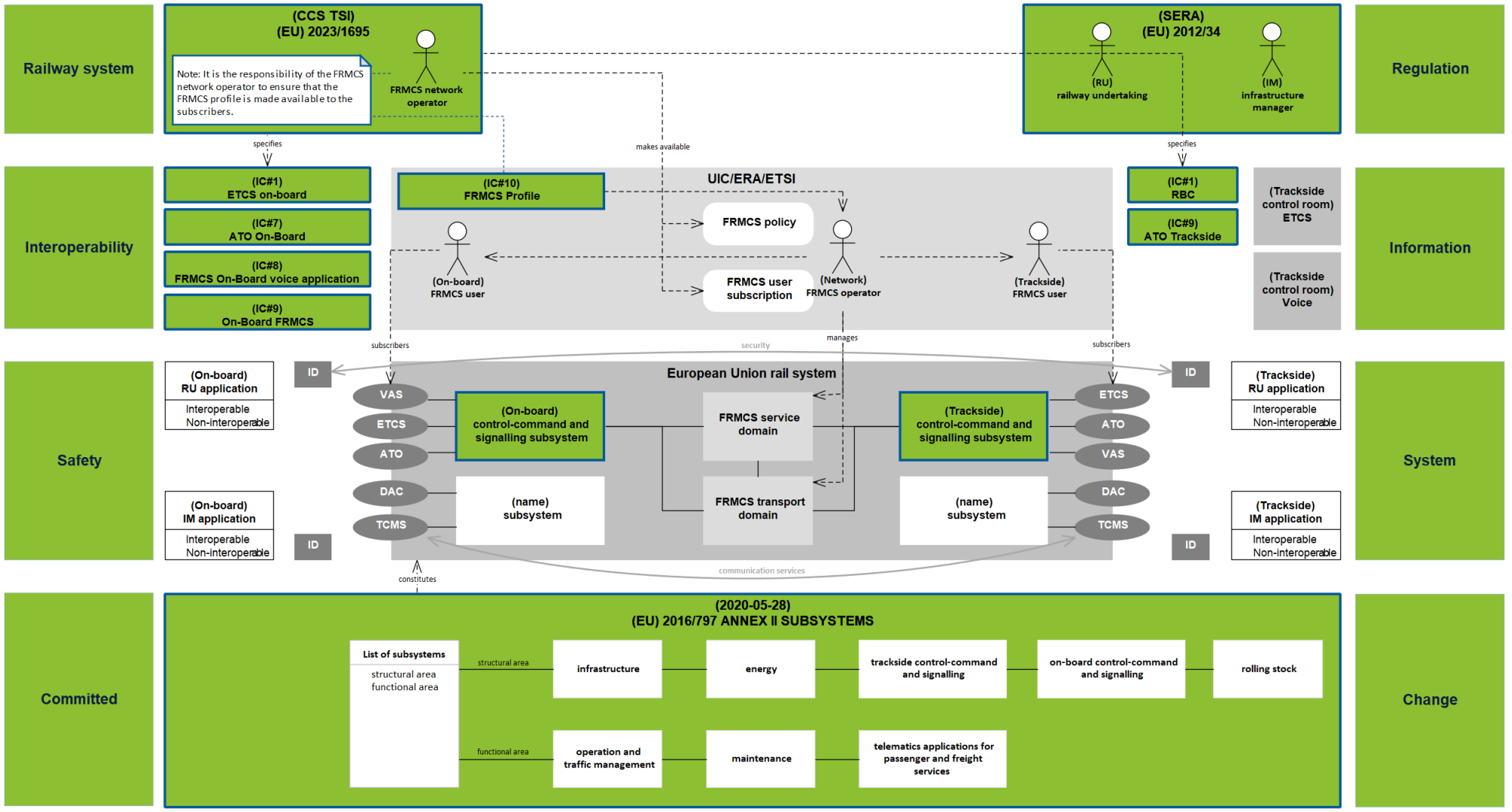
FRMCS deployment and migration landscape

Regulatory (ORG) (common framework)

Business (components and assets)

Business&technology (Digital infrastructure, ICT Services and ICT Applications)

Legal (MS) (common targets)



FRMCS migration scenarios

Scenario 1: Parallel operation with existing GSM-R and FRMCS dedicated networks

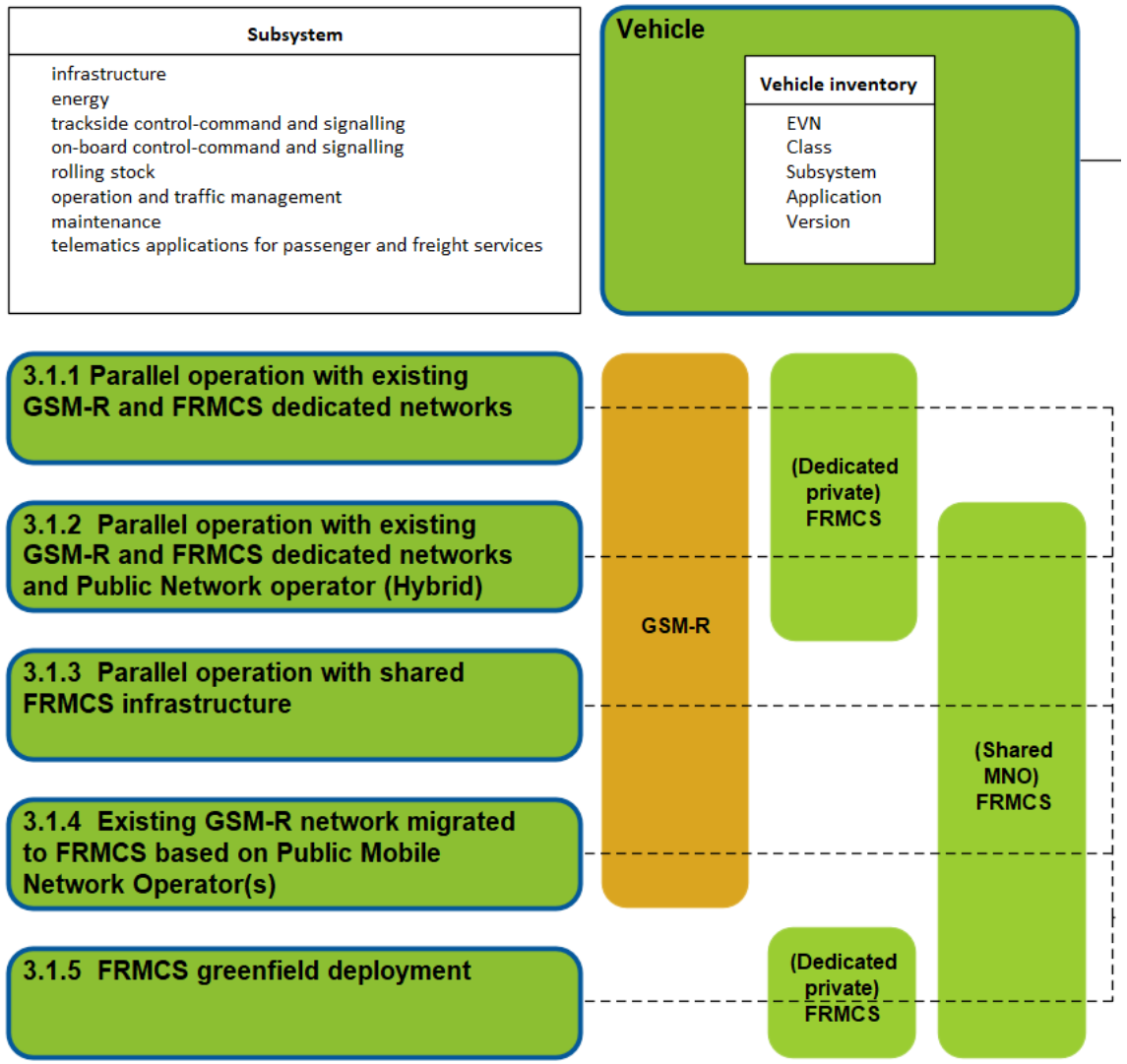
Scenario 2: Parallel operation with existing GSM-R and FRMCS dedicated networks and Public Network operator (Hybrid)

Scenario 3: Parallel operation with shared FRMCS infrastructure

Scenario 4: Existing GSM-R network migrated to FRMCS based on Public Mobile Network Operator(s)

Scenario 5: FRMCS greenfield deployment

FRMCS migration scenarios landscape

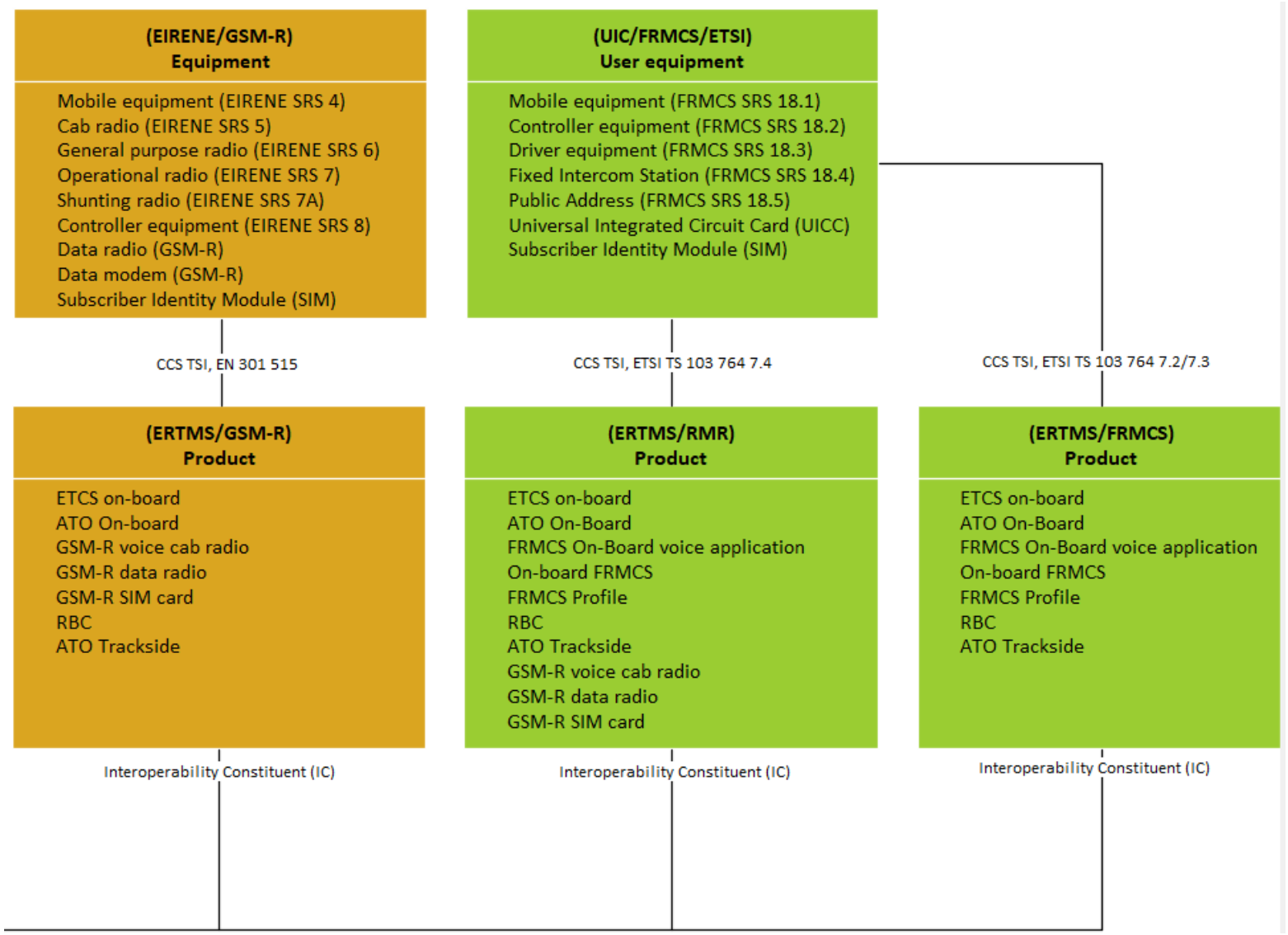


FRMCS migration scenarios landscape

FRMCS service domain (MC System)

FRMCS transport domain (5GC+NG-RAN)

SA/NSA



Railway Mobile Radio (RMR)system components (Trackside)

The following table shows system blocks in FRMCS and GSM-R as parts of the trackside control-command and signalling subsystem for functional equivalence:

FRMCS (IP)	GSM-R (IP + ISDN)	RMR system feature
NG-RAN	BSS	Mobile radio system features: coverage, access control, mobility and capacity
5GC MC System MC Data (IPCon) MC Voice (Ptt) MC Service(s) Functional Aliasing IMS (Optional)	NSS MSS/MGW GPRS GSM ASCI features (VGCS/VBS) GSM FollowMe (USSD/HLR or USSD/IN) PBX/SIP/VoIP/ISDN	Mobile core system features: communication services complementary services NOTE: additional network features are needed for: IT for data management, network synchronization, time synchronization, IP address management, IT/OT for SW maintenance, IT/OT for security management
Controller Equipment	Controller Equipment	voice radio communication
Trackside gateway	GGSN + IP Network(s)	Interfacing features to ERTMS/ETCS
MC Data SDS	SMSC	Messaging services

16

Railway Mobile Radio (RMR)system components (On-Board)

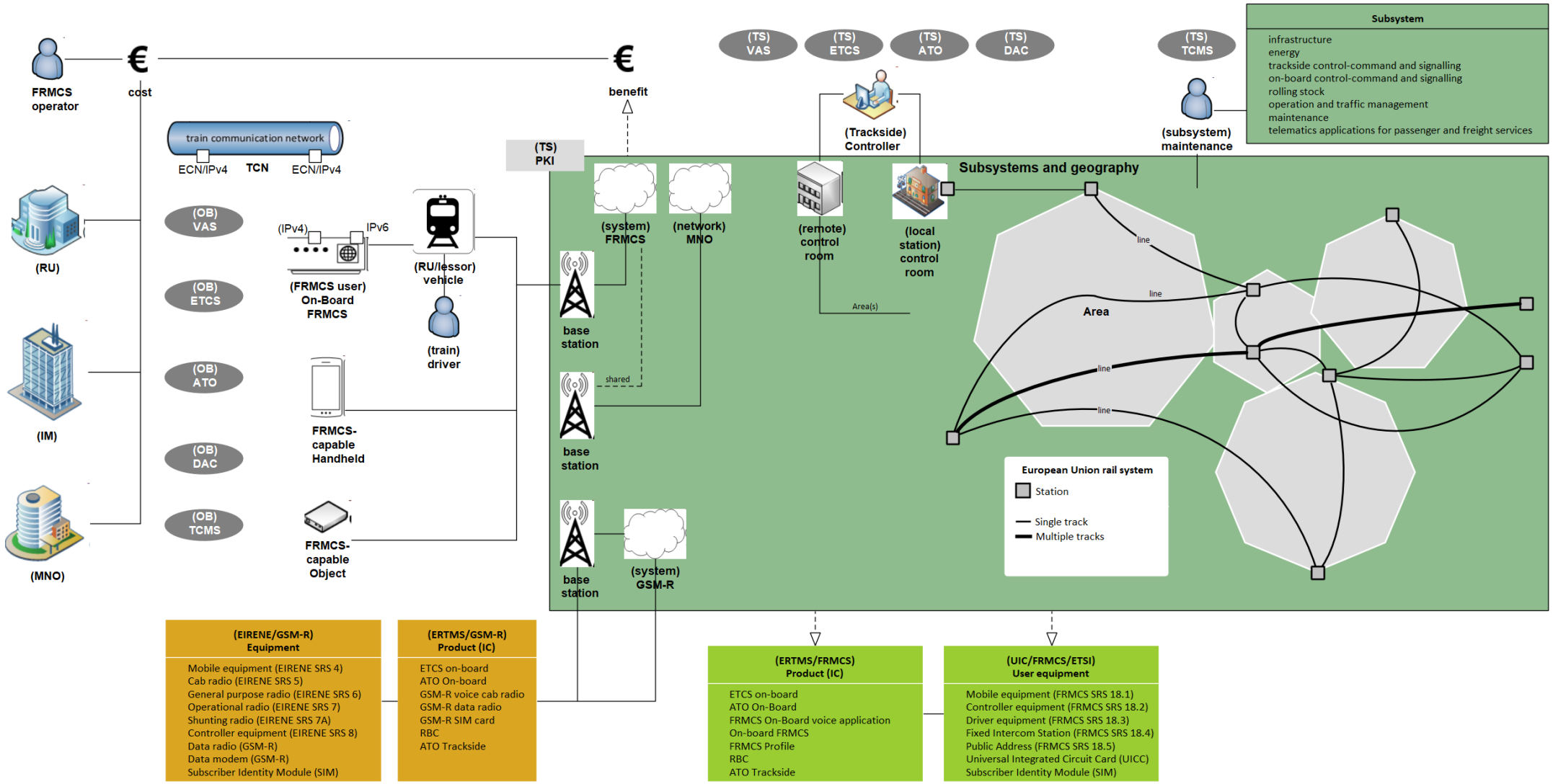
FRMCS European Deployment Group

The following table shows system blocks in FRMCS and GSM-R as parts of the on-board control-command and signalling subsystem for functional equivalence:

FRMCS (IP)	GSM-R (IP + ISDN)	RMR system feature
FRMCS On-Board voice application (VAS) + On-Board FRMCS + FRMCS Profile	GSM-R voice cab radio + GSM-R SIM card	voice radio communication
ETCS on-board + On-Board FRMCS + FRMCS Profile	ETCS on-board + GSM-R data radio + GSM-R SIM card	train protection
Application + Agent + On-Board FRMCS + Application Profile	Unspecified (vendor specific)	data radio communication
ATO On-Board + On-Board FRMCS + FRMCS Profile	ATO On-Board + GSM-R data radio or MNO data radio	Automated train operation

Deployment landscape conditions

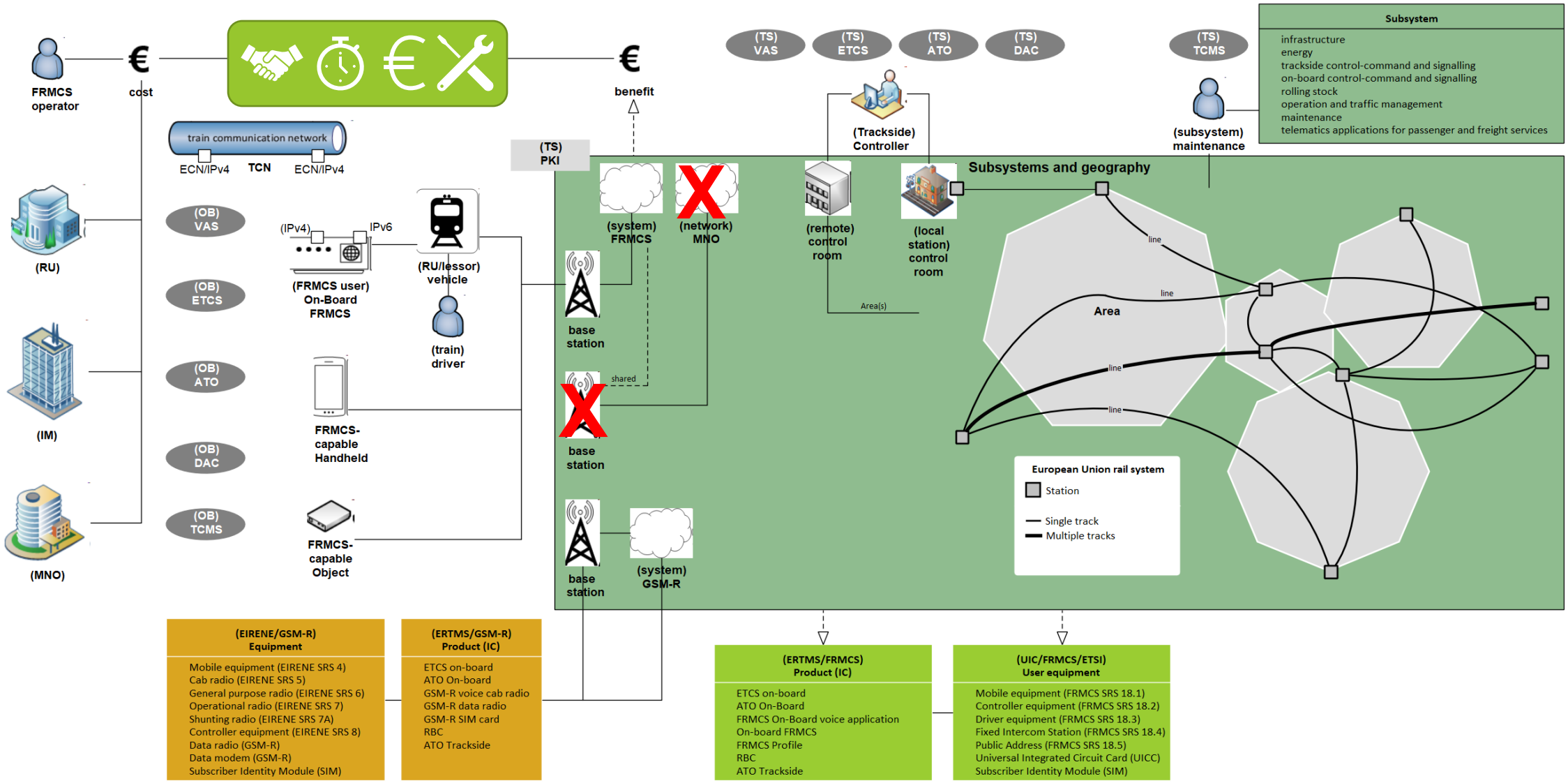
FRMCS European Deployment Group – Scenario template



Scenario 1: Parallel operation with existing GSM-R and FRMCS dedicated networks

Vehicle	FRMCS operator	Infrastructure	Spectrum	Risk	Migration approach
Dual Mode, retrofit if needed, inventory of used applications	Infrastructure manager (IM)	Dedicated FRMCS, radio and core owned by IM ETCS (IM)	900 MHz (GSM-R) 1900 MHz (FRMCS)	Low	Voice first Data (ETCS/ ATO) when compatible Line-by-line Pilot → High-speed → Conventional → Hubs → Borders

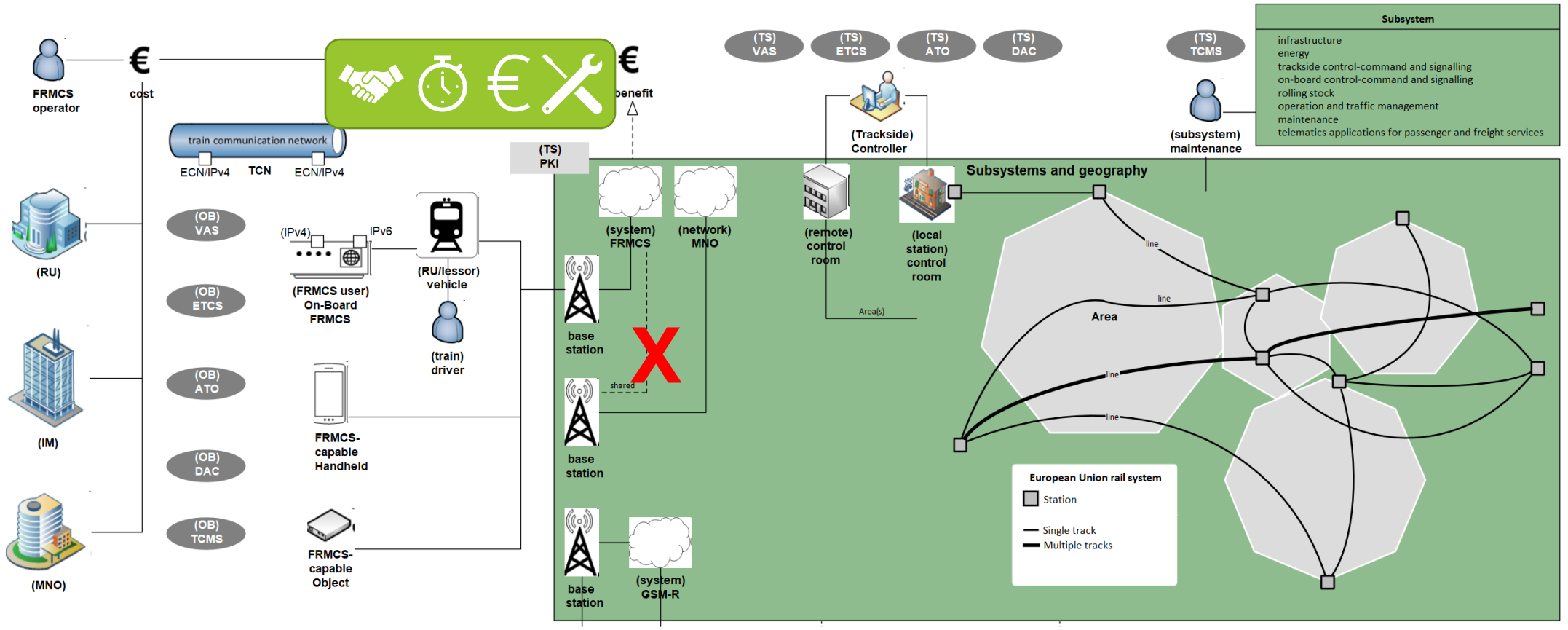
Scenario 1: Parallel operation with existing GSM-R and FRMCS dedicated networks



Scenario 2: Parallel operation with existing GSM-R and FRMCS dedicated networks and Public Network Operator (MNO) (Hybrid)

Vehicle	FRMCS operator	Infrastructure	Spectrum	Risk	Migration approach
Dual Mode, retrofit if needed, inventory of used applications Usage of MNO	Infrastructure manager (IM)	Dedicated FRMCS, radio and core owned by IM + Public MNO Integration ETCS (IM)	900 MHz (GSM-R) 1900 MHz (FRMCS) + MNO spectrum for redundancy	Low Medium	Voice first Data (ETCS/ ATO) when compatible Line-by-line Pilot → High-speed → Conventional → Hubs → Borders

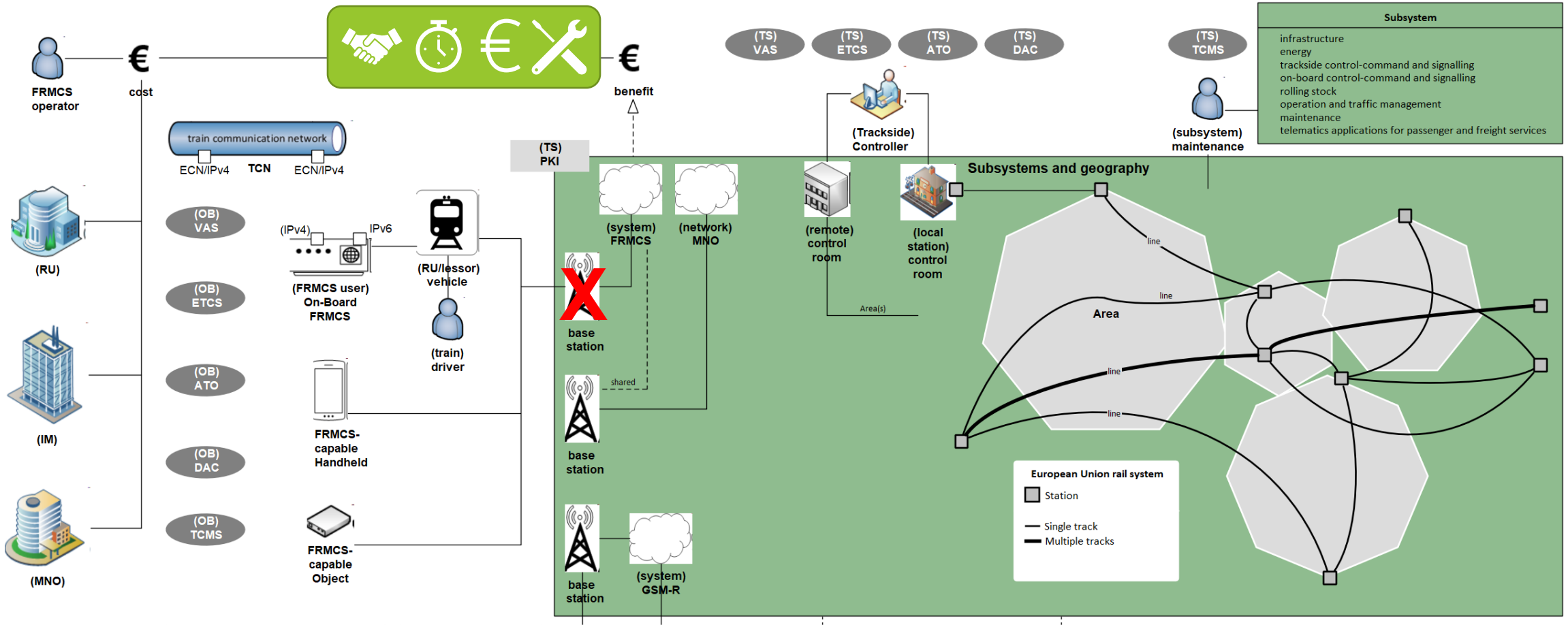
Scenario 2: Parallel operation with existing GSM-R and FRMCS dedicated networks and Public Network operator (Hybrid)



Scenario 3: Parallel operation with shared FRMCS infrastructure

Vehicle	FRMCS operator	Infrastructure	Spectrum	Risk	Migration approach
Dual Mode, retrofit if needed, inventory of used applications Usage of MNO	Infrastructure manager (IM)	FRMCS core owned by IM + Public MNO provides radio ETCS (IM)	MNO spectrum	medium	Voice first Data (ETCS/ ATO) when compatible Line-by-line Pilot → High-speed → Conventional → Hubs → Borders

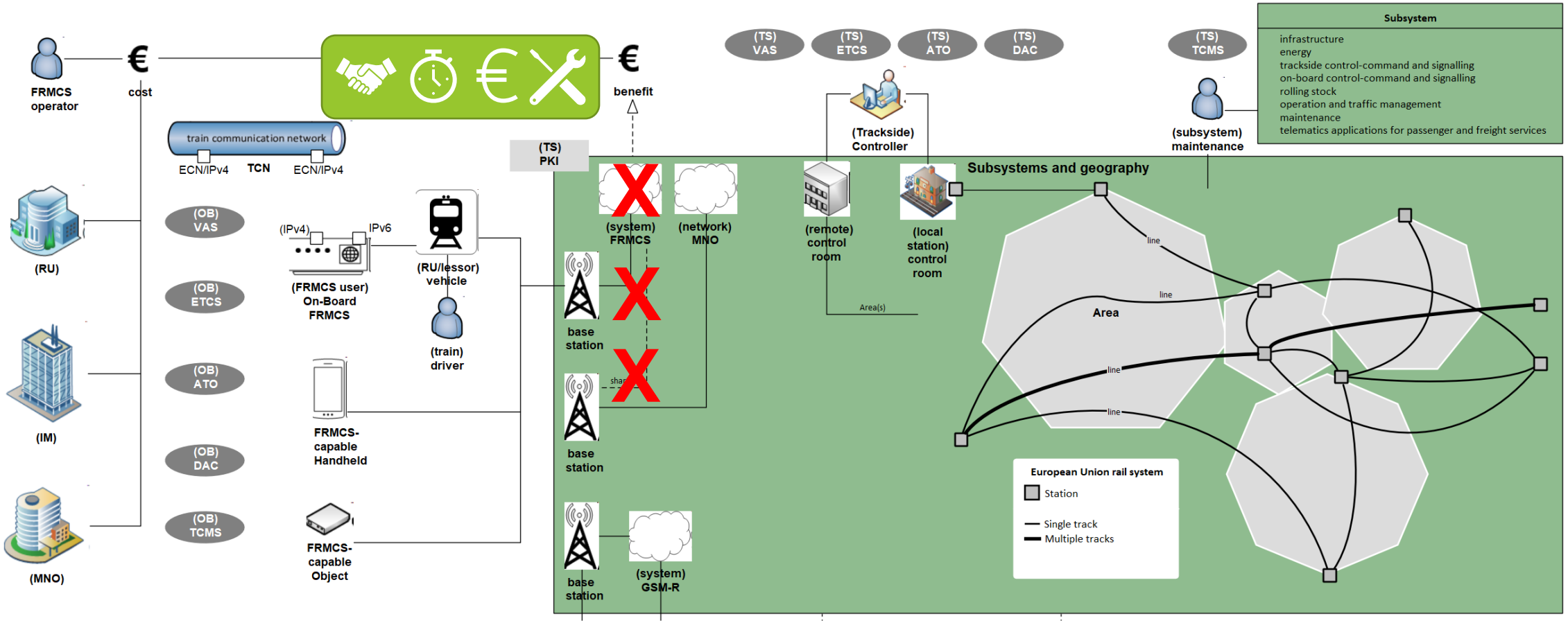
Scenario 3: Parallel operation with shared FRMCS infrastructure



Scenario 4: Existing GSM-R network migrated to FRMCS based on Public Mobile Network Operator(s)

Vehicle	FRMCS operator	Infrastructure	Spectrum	Risk	Migration approach
Dual Mode, retrofit if needed, inventory of used applications Usage of MNO	MNO (delegated)	Public MNO radio and core ETCS (IM)	MNO spectrum	high	Voice first Data (ETCS/ ATO) when compatible Line-by-line Pilot → High-speed → Conventional → Hubs → Borders

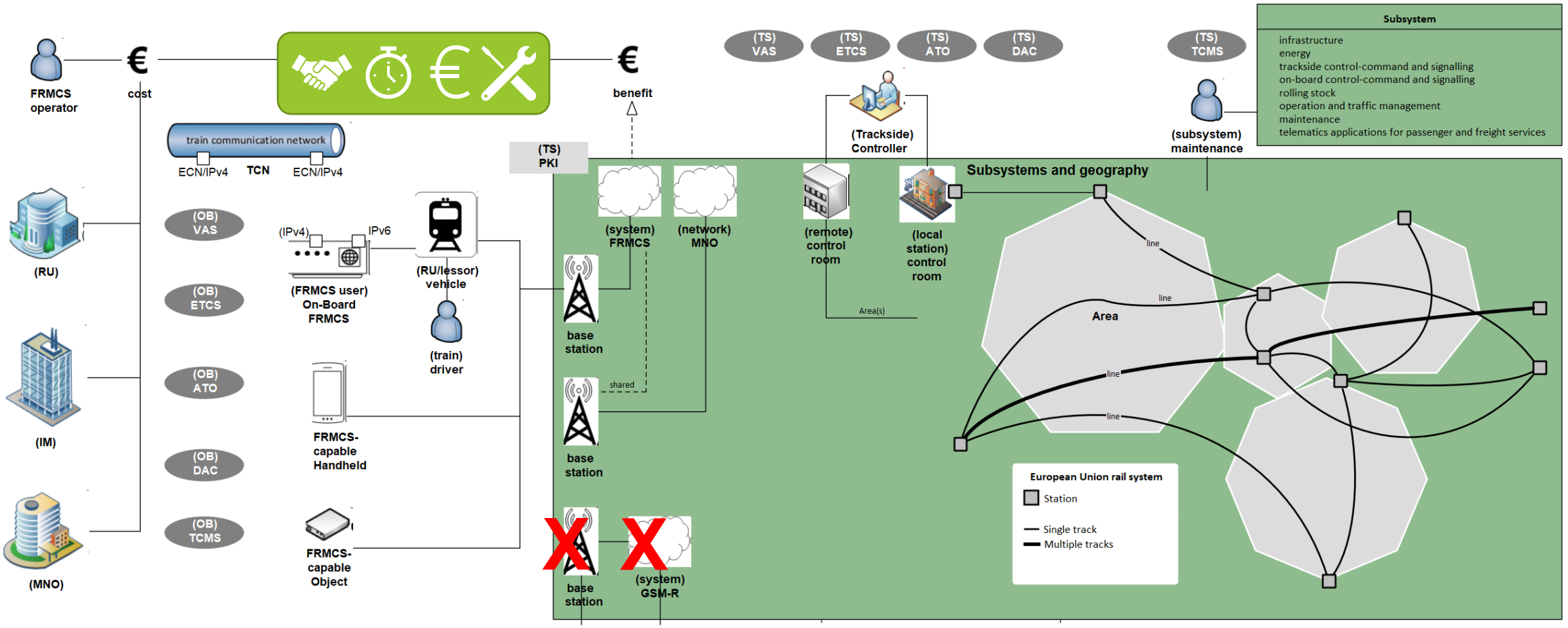
Scenario 4: Existing GSM-R network migrated to FRMCS based on Public Mobile Network Operator(s)



Scenario 5: FRMCS greenfield deployment

Vehicle	FRMCS operator	Infrastructure	Spectrum	Risk	Migration approach
New installation Coordinate ETCS Usage of MNO	Depending on business model, either IM och delegated MNO	New installation upon chosen business model ETCS (IM)	900 MHz 1900 MHz MNO spectrum	Low Medium	Line-by-line Pilot → High-speed → Conventional → Hubs → Borders

Scenario 5: FRMCS greenfield deployment



Scenario	Vehicle	FRMCS operator	Infrastructure	Spectrum	Risk	Migration approach
1. Parallel operation with dedicated GSM-R och FRMCS	Dual Mode, retrofit if needed, inventory of used applications	Infrastructure manager (IM)	Dedicated FRMCS, radio and core owned by IM ETCS (IM)	900 MHz (GSM-R) 1900 MHz (FRMCS)	Low	Voice first Data (ETCS/ ATO) when compatible Line-by-line Pilot → High-speed → Conventional → Hubs → Borders
2. Existing GSM-R and FRMCS dedicated networks and Public Network Operator (MNO) (Hybrid)	Dual Mode, retrofit if needed, inventory of used applications Usage of MNO	Infrastructure manager (IM)	Dedicated FRMCS, radio and core owned by IM + Public MNO Integration ETCS (IM)	900 MHz (GSM-R) 1900 MHz (FRMCS) + MNO spectrum for redundancy	Low Medium	Voice first Data (ETCS/ ATO) when compatible Line-by-line Pilot → High-speed → Conventional → Hubs → Borders
3. Shared FRMCS with MNO	Dual Mode, retrofit if needed, inventory of used applications Usage of MNO	Infrastructure manager (IM)	FRMCS core owned by IM + Public MNO provides radio ETCS (IM)	MNO spectrum	medium	Voice first Data (ETCS/ ATO) when compatible Line-by-line Pilot → High-speed → Conventional → Hubs → Borders
4. Only public MNO	Dual Mode, retrofit if needed, inventory of used applications Usage of MNO	MNO (delegated)	Public MNO radio and core ETCS (IM)	MNO spectrum	high	Voice first Data (ETCS/ ATO) when compatible Line-by-line Pilot → High-speed → Conventional → Hubs → Borders
5. Greenfield	New installation Coordinate ETCS Usage of MNO	Depending on business model, either IM och delegated MNO	New installation upon chosen business model ETCS (IM)	900 MHz 1900 MHz MNO spectrum	Low Medium	Line-by-line Pilot → High-speed → Conventional → Hubs → Borders

Handhelds for FRMCS

Vehicle	FRMCS operator	Specification	Spectrum	Risk	Migration approach
Inventory of existing and active GSM-R capable handhelds and applications	Inventory of existing and active GSM-R capable handhelds and applications	Standardization of FRMCS capable handheld, either as application based and/or a dedicated Hardware terminal	900Mhz 1900 Mhz MNO spectrum	Medium	Boost innovations related to FRMCS capable handhelds, potentially a dual mode handheld supporting necessary GSM-R and FRMCS voice applications during transition

Scenarios explored however not recommended

“Big bang” – complete transition of the entire network to FRMCS at one time

Not feasible due to the need to keep GSM-R in operation on lines with ETCS L2. Not feasible in terms of available spectrum in the 900 MHz band. Inability to verify the functionality of such a solution in real operation in a timely manner. NOTE: This scenario is valid only in a Greenfield situation.

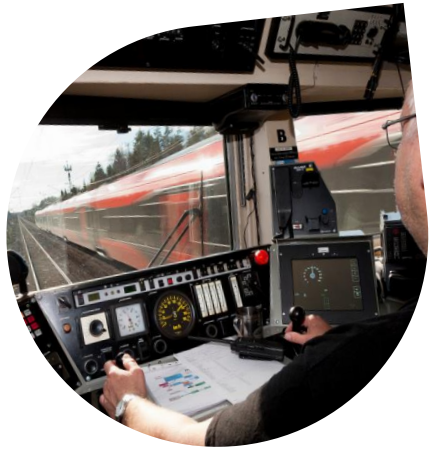
FRMCS only in the 900 MHz band (n8) with existing GSM-R infrastructure using 900MHz band

Spectral collision with GSM-R, impossibility of coexistence on one infrastructure. Insufficient spectrum in an environment with dense traffic and ETCS. Need for parallel existence of GSM-R and FRMCS in different bands (e.g. n101) and using potentially mobile network operators as an alternative during the transition period.

Points to be further explored during 2026-2027

FRMCS European Deployment Group

- Operation of FRMCS exclusively through public mobile operators (MNO-only model)
- Assessment of public mobile operators' involvement in FRMCS deployment
- Lifecycle management of FRMCS specifications during the active deployment period
- Study on multimodal services during transition period
- Continue study on the value chain and business perspectives
- Migration scenarios for the control rooms
- Additional benefits of FRMCS



Next steps

FRMCS European Deployment Group

- Preparation of the new FRMCS questionnaire 2026, including questions to NoBo's and Mobile Network Operators (MNO's)
- Creation of a toolbox for FRMCS deployment
- Update of the migration scenarios report during 2026
- Start working with alignment with other major railway programs
- Estimation of capacities activity for FRMCS deployment

Summary

The Railway sector is on a critical path to transition from legacy networks to future proof networks enabling the key principle of FRMCS, namely enabling digitalization of the railways and increase the possibilities to use different types of applications and business models for the operators.

With a joint effort and believing on the vision on the sector, the FRMCS deployment will be successful in Europe.

Q & A

Information

More detailed information can be found on the EU-Rail website:
https://rail-research.europa.eu/about-deployment-group/

pipsa.hallner@trafikverket.se
Joachim.Eriksson@trafikverket.se
karel.vangils@rail-research.Europa.eu

Europe's Rail Members

acciona
adif
ALSTOM
MERMEC AN ANGEL COMPANY
CAF
ceit MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE
DB
DLR
eSGR European Smart Green Rail
Faiveley Transport A Wabtec Company
FERROVIE DELLO STATO ITALIANE
FREQUENTIS FOR A SAFER WORLD
HITACHI Inspire the Next
indra
Talgo
Infraestruturas de Portugal
Jernbane-direktoratet
KNORR-BREMSE
kontron The Power of IoT
ÖBB
PKP
ProRail
SIEMENS
XLAB
SNCF
Strukton Rail
THALES
TRAFIKVERKET
RAILWAY SYSTEMS by voestalpine
Slovenske železnice
VIAS