Status FRMCS Deployment - technical

Webinar

17 June 2026

Europe's Rail

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Mission Critical Networks

Ericsson

EU-Rail FRMCS Deployment Group

Introduction

EU-Rail FRMCS Deployment Subgroup

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EU-Rail / SNCF

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Ericsson

WG3 lead
EU-Rail FRMCS Deployment Group

Agenda

EU-Rail FRMCS Deployment Subgroup

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

EU-Rail

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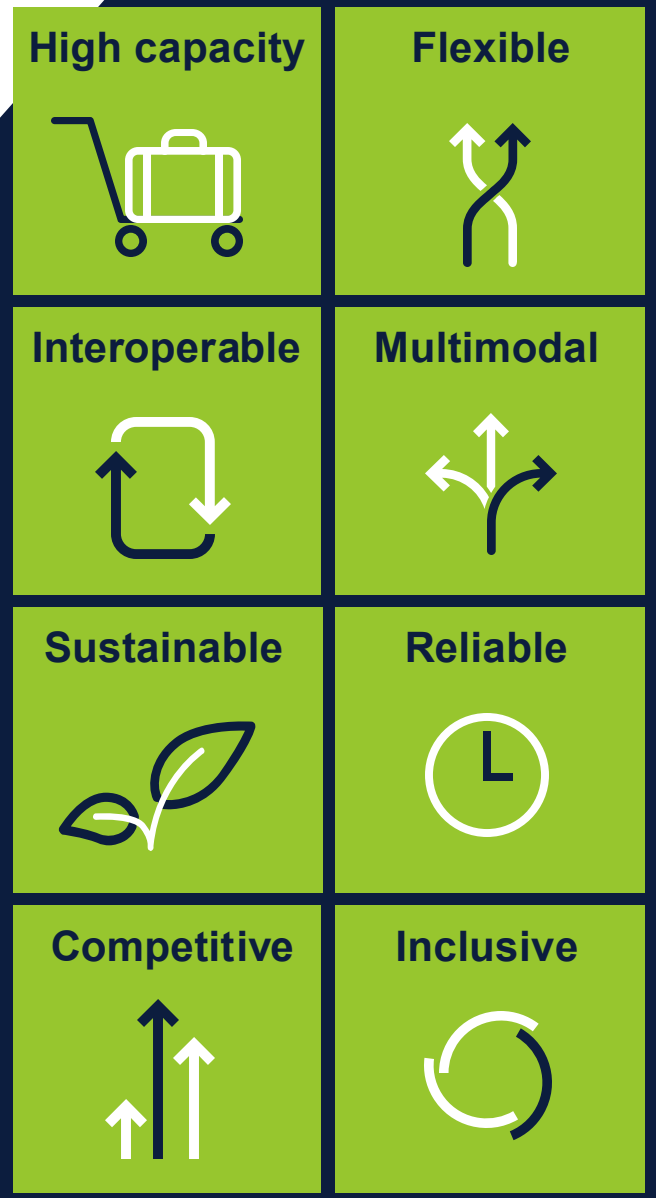
FRMCS European Deployment Group

Vision

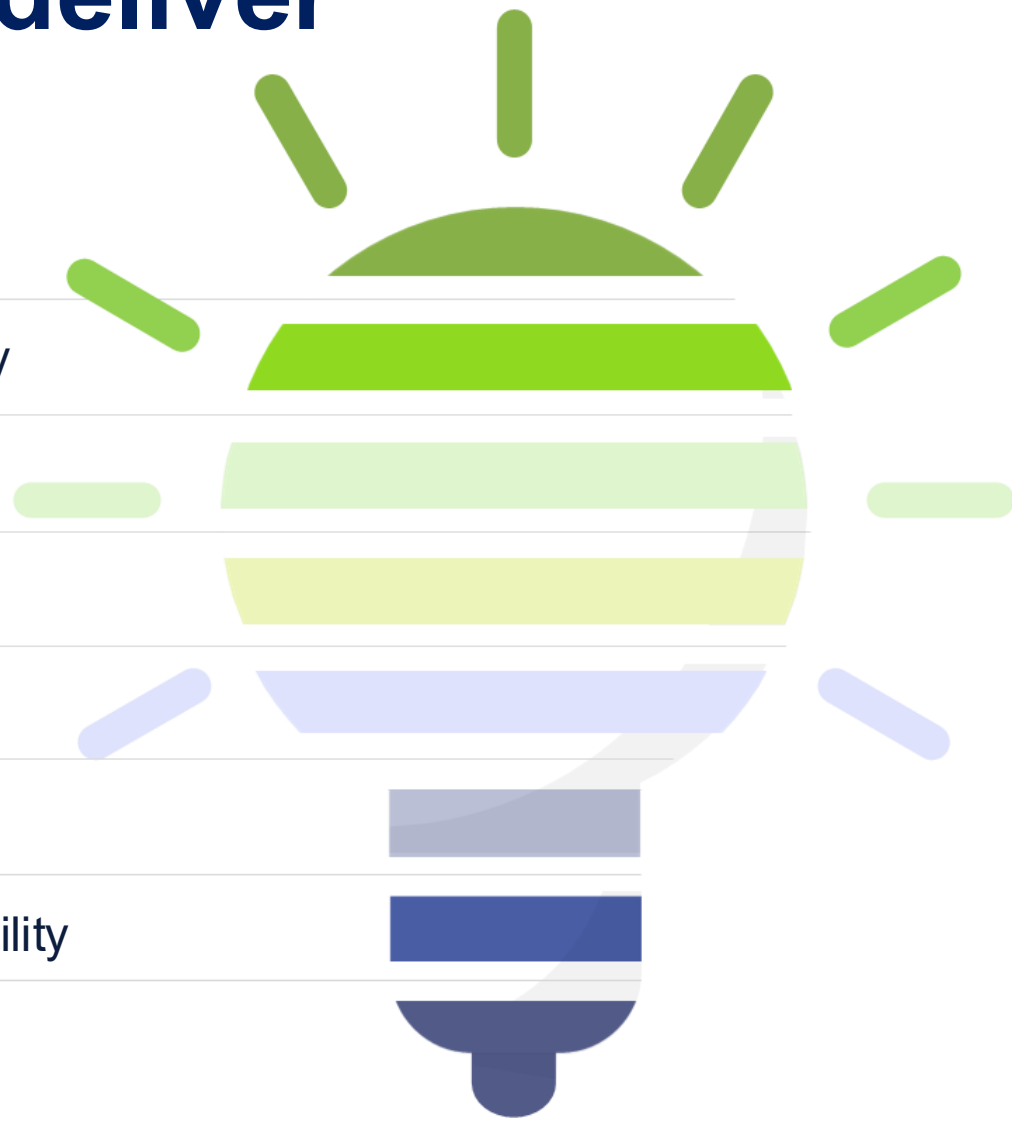
To deliver a **fully integrated European railway network for citizens and cargo.**

Rail Research and Innovation to Make Rail the Everyday Mobility



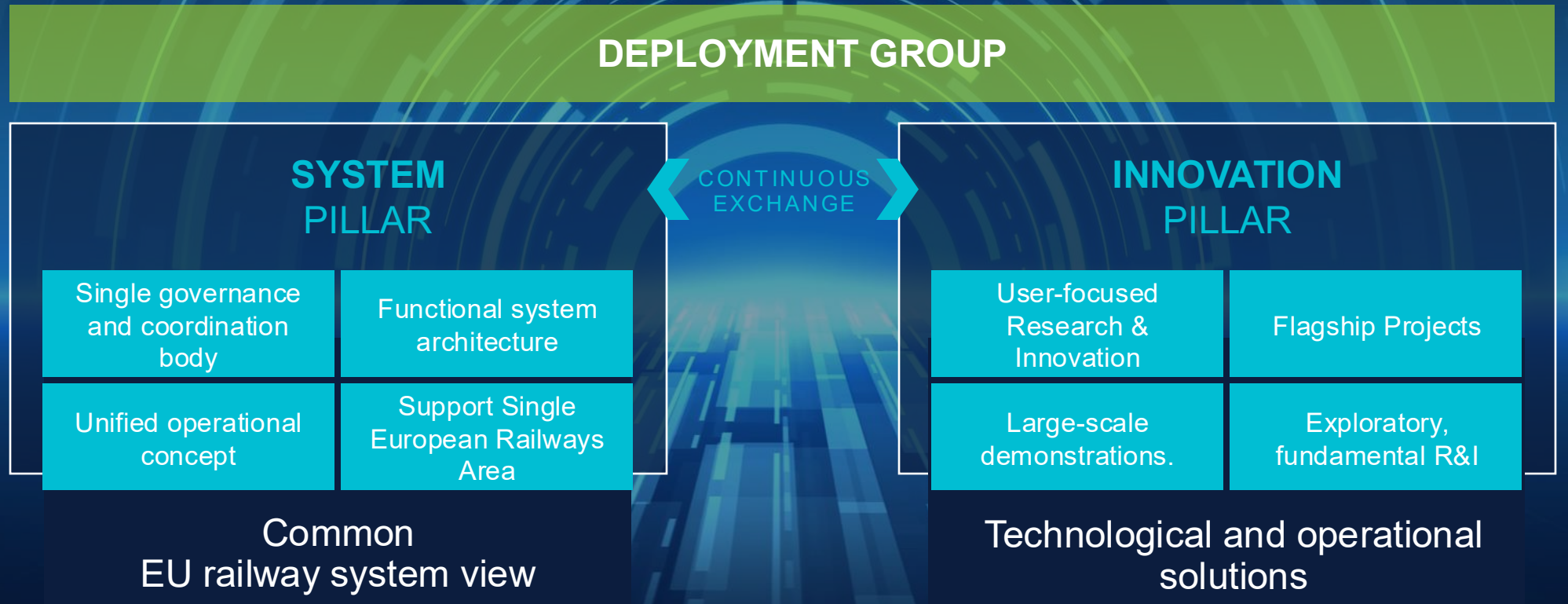
EU-Rail, a R&I integrated Programme and a cooperation to deliver

- 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

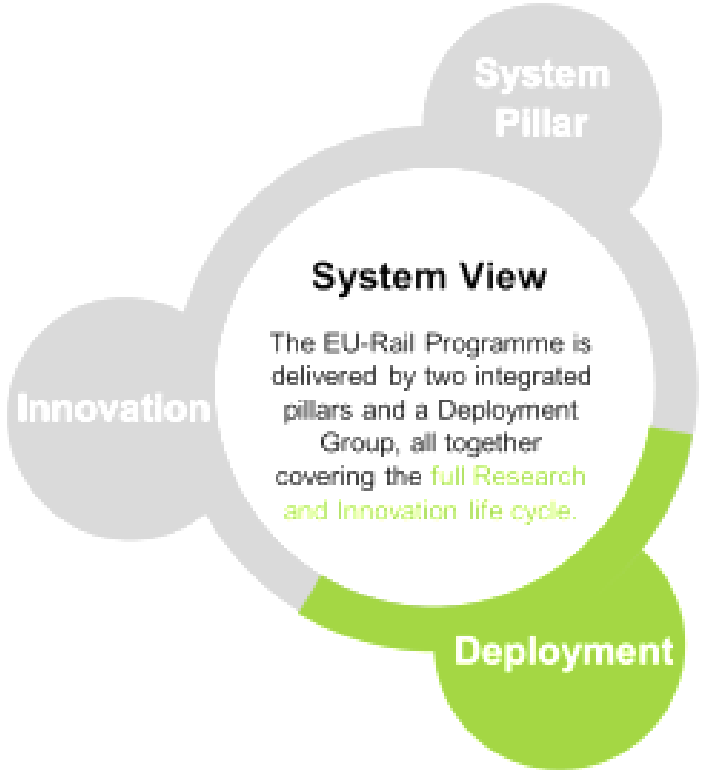
- Objective is to close gap between R&I activities and Deployment and Migration
- Support smooth, fast and cost-effective introduction of Innovations and new architecture
- Open group, contributing to whole railway sector and industry

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

EU-Rail FRMCS 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)

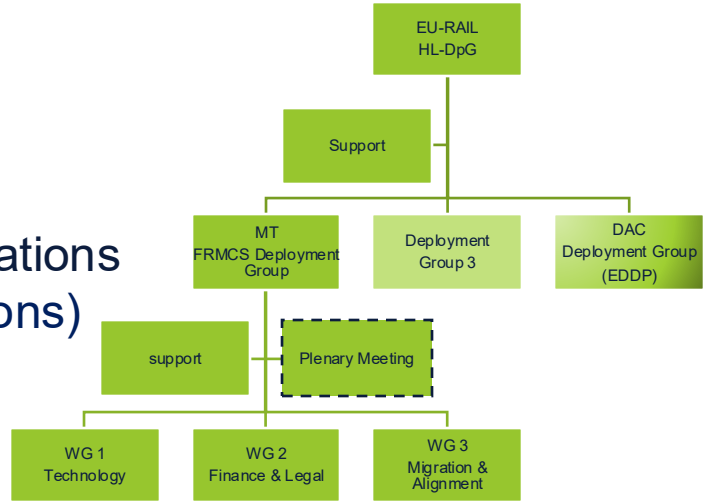
Deliverables

- 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

EU-Rail FRMCS Deployment Group



Working Group 1 (WG1) - Deployment Technology

Practical deployment guidelines on different topics, for example:

- Cross-Border Landscapes / National Investment Plans
- Template for a Service Level Agreement for MNO serving FRMCS
- Practical rooftop antenna coexistence and installation recommendations
- Non-ETCS FRMCS-using applications (survey and recommendations)

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 2026 (questionnaire)

EU-Rail FRMCS Deployment Group

- EU-RAIL FRMCS Deployment Group will conduct a second survey to gather more detailed sector information and to further increase awareness in the sector and Member States

- With the support of several associations, the questionnaire will be distributed to:
  - Infrastructure Managers
  - Railway Undertakings
  - Trackside Providers,
  - Onboard Providers,
  - National Safety Authorities - NSA's
  - Notified Bodies - NoBo's (new)
  - Mobile network Operators - MNO's (new)

- The questionnaire is distributed 2nd June 2026. We expect responses before 15 July 2026 COB

First Publications

EU-Rail FRMCS 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 technical deployment guidelines

Composition of Working Group 1

- deployment technology + cross border topics -

- IMs
- RUs
- Industry

- 37 delegates

Agenda

EU-Rail FRMCS Deployment Group

1. Practical rooftop antenna coexistence and installation
2. Cross-Border Landscapes / National Implementation Plans
3. MNO serving FRMCS Service Level Agreements
4. non-MCX FRMCS-using applications
5. On board FRMCS (OBF) future-proofness

Practical rooftop antenna coexistence and installation

Practical rooftop antenna coexistence and installation

- Many of the MNO radio networks serving passengers along railway corridors use radio spectrum close to the FRMCS spectrum
- UIC Frequency Aspect Group (UGFA) has determined the isolation requirements in order to allow coexistence of the MNO frequency and the FRMCS frequency without mutual interference.
- Isolation can be done either by separation on the rooftop or filtering or a combination of both

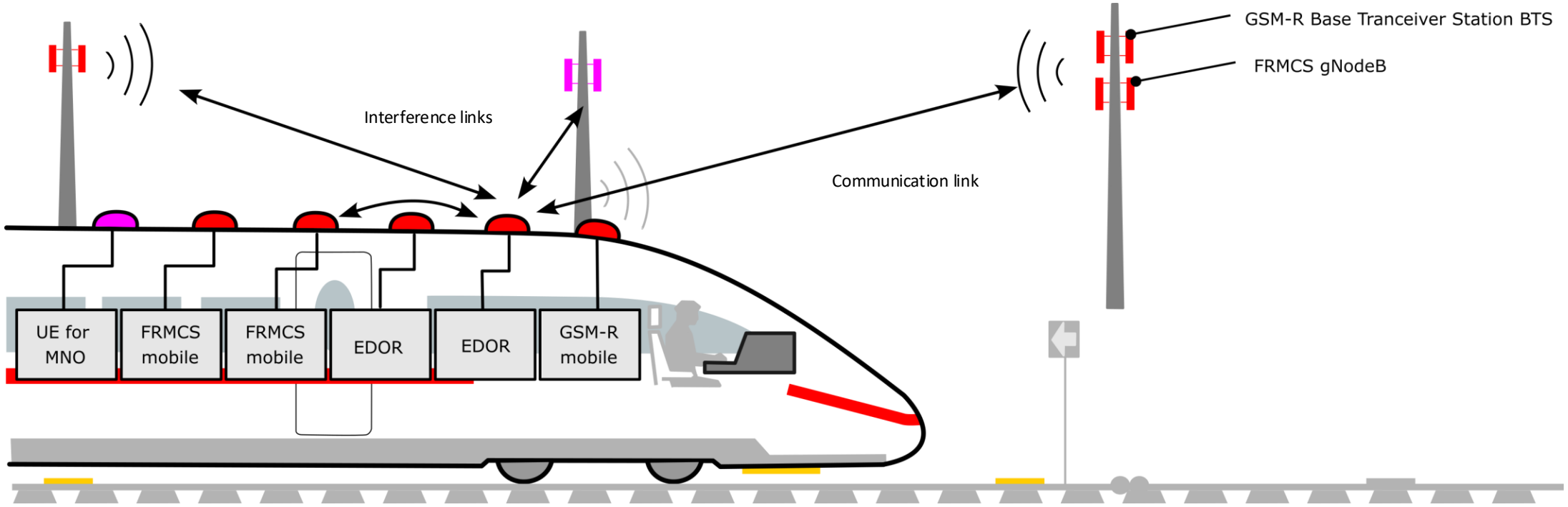
- The purpose of the work item is to determine practical guidelines for the installation of rooftop locomotive antennas
- Focus is on the locomotives with the worst case isolation capabilities:
- Freight locomotives have significantly less “real estate” on the roof to separate the antenna placements
- Siemens Vectron, Alstom Traxx, Alstom Prima are the most common locomotives in Europe
- Report will provide separation techniques , filtering techniques and measurements.

Prominence of this Work Item

- ERTMS Risk Register
- Stakeholders Alignment Risk Register

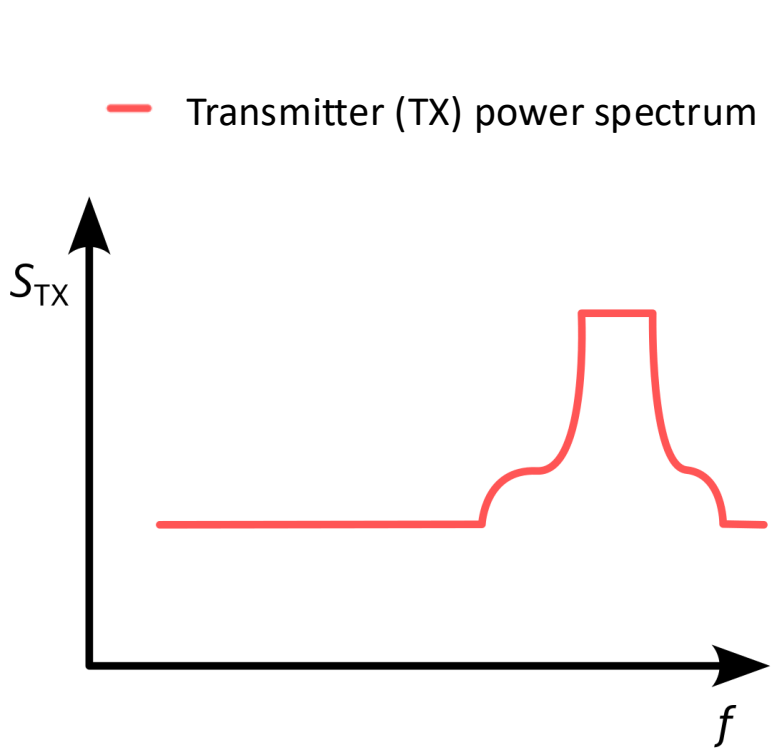
Coexistence Problem Statement

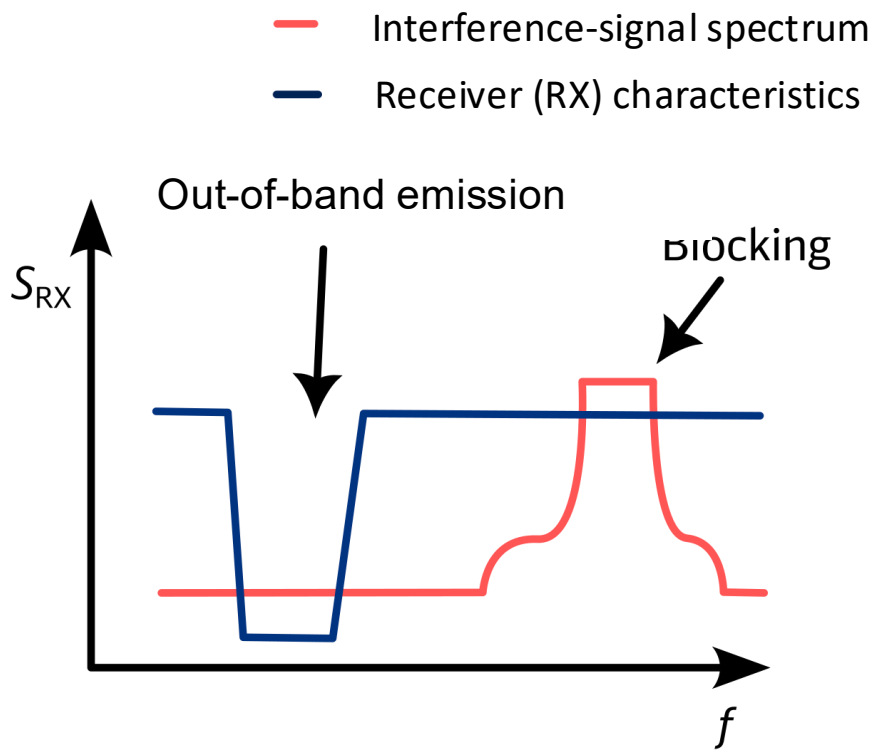
- Railway operation depends on the parallel operation of multiple radio services



Coexistence Problem Statement

- When two radio services operate in parallel, two effects can occur that lead to interference
  - Blocking
  - Interference due to out-of-band emissions

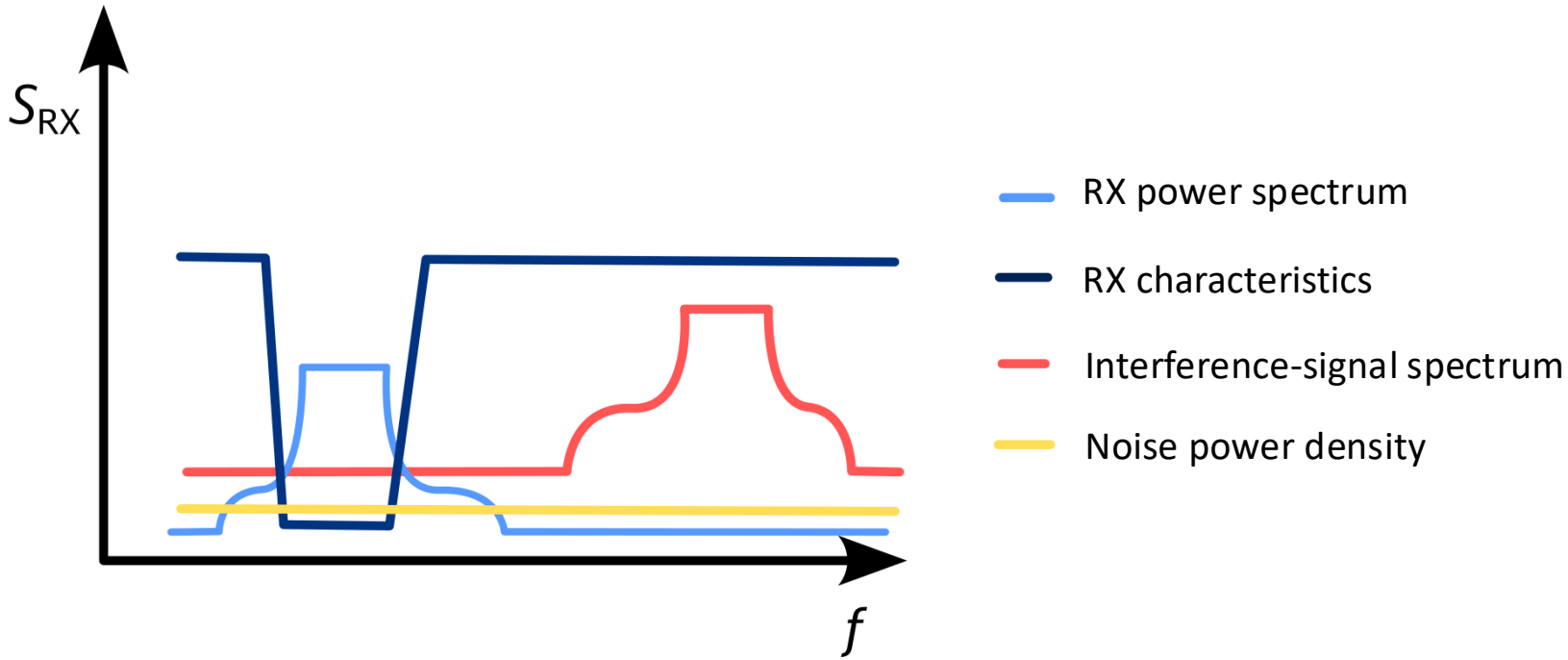




Coexistence Problem Statement

- The impact of the interference depends on several key parameters
  - Signal-to-interference-plus-noise ratio (SINR) at the RX

- and therefore indirectly on many other parameters of the radio systems and the environment
  - Reference Signal Received Power (RSRP)
  - Out-of-band emissions and transmit levels
  - Receiver sensitivity and blocking characteristics
  - Radio-channel characteristics



Problem Statement

From UGFA numerical results, it is noticed that the required isolations are always < 75dB, except for the following scenarios:

- n101 victim and n1 interferer □ isolation 88.7 dB

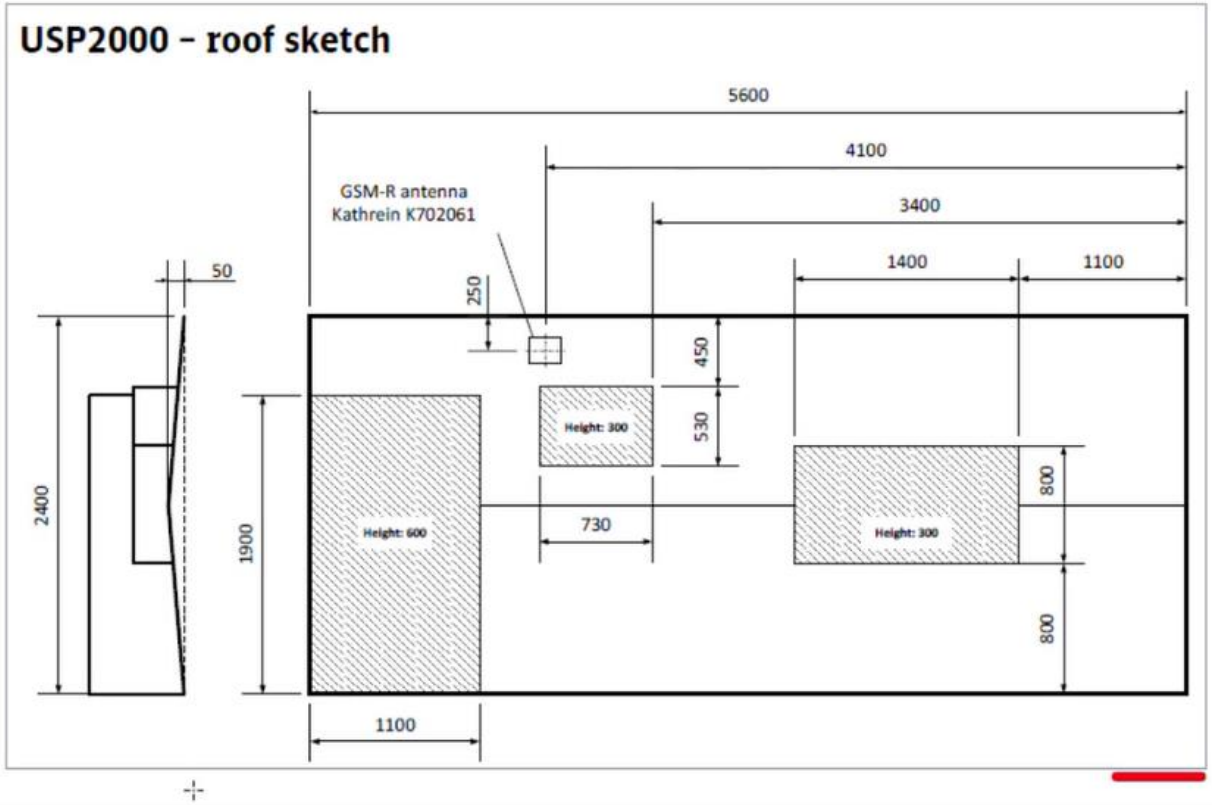
- n100 victim and n8 interferer □ isolation 92.2 dB

- GSM-R interferer and n8, n20 or n100 as victims □ respective isolations will be 83, 83 and 90 dB

Isolation Factors

- Radio port isolation
- Antenna separation distance (if possible)
- Diplexer isolation characteristics (optional)
- External filters
- Antenna port isolation

Polomarconi FRMCS Antenna separation study – MNO coexistence study for DB



Polomarconi simulation and antenna placements

Isolation between MNO1 and MNO2:

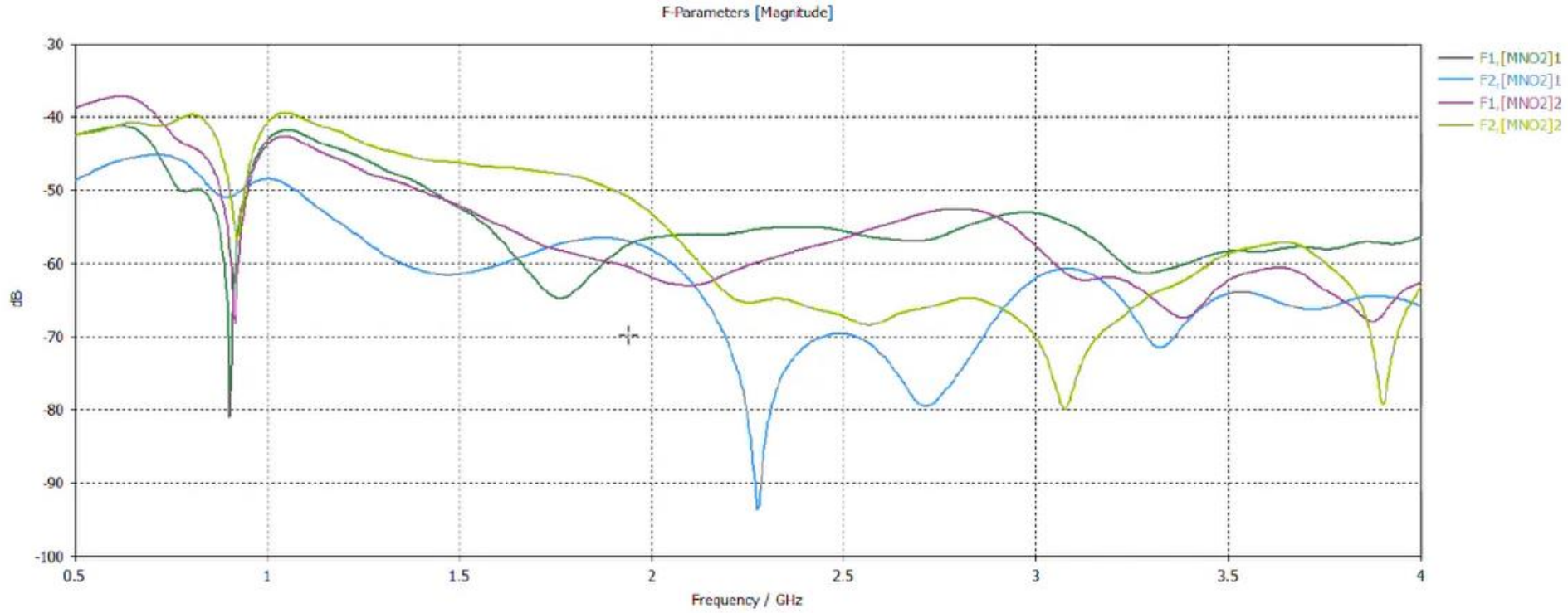


Figure 2 Simulated antenna positions

Polomarconi simulation - Conclusion

3 Conclusion

This simulated scenario confirms how hard it is to achieve the suggested isolation of -85 dB between FRMCS and GSM-R system. The average isolation, achievable without the use of additional filters along the communication chain, is between -50 to -60 dB.

If additional isolation is required the use of one or more filters is advisable.

Siemens Vectron Locomotive Rooftop Topology

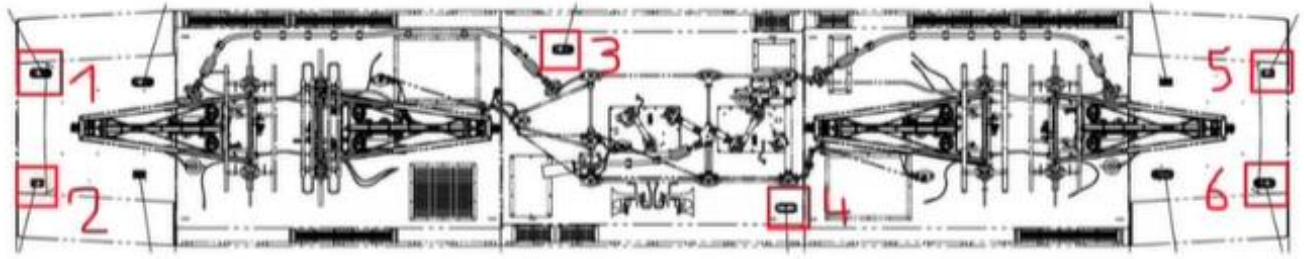


Figure 1 Antenna positions at Vectron

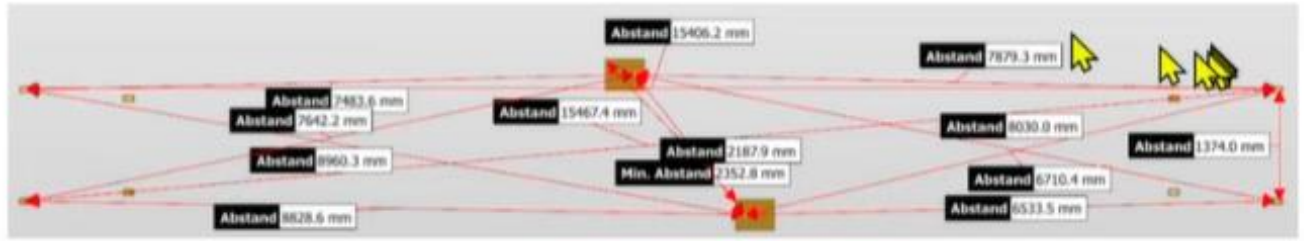


Figure 2 Distance between Antennas at Vectron

Isolation versus Distance

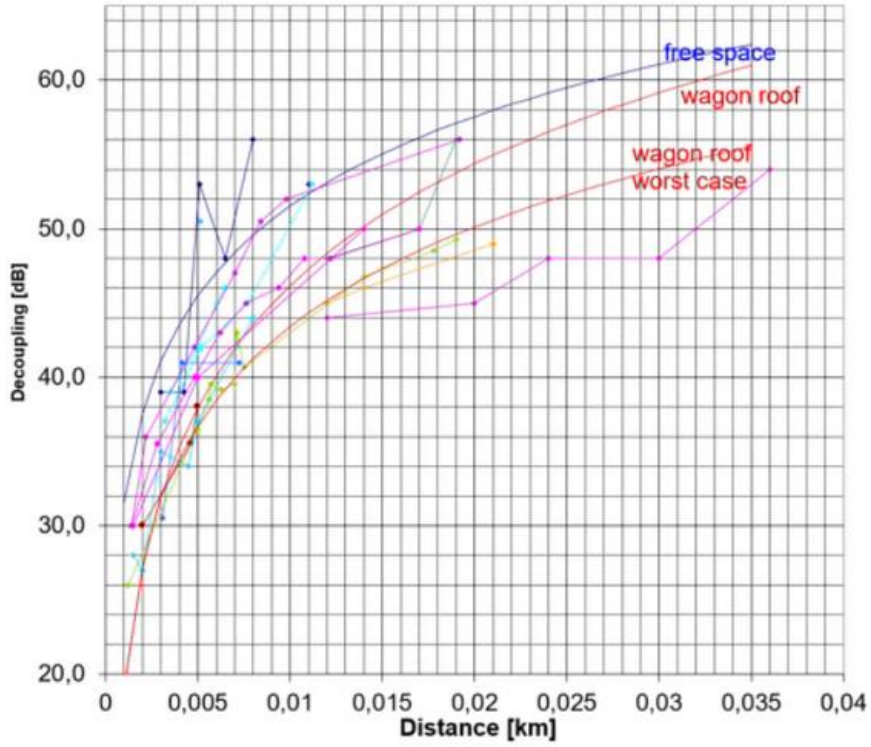
- Siemens Vectron Locomotive

Isolation versus Distance

Distance

- First assumption: free-field path loss
- Measurements on real trains shows high deviations between free-field path loss.
- It is assumed, that the deviations are caused by the closed ground plane between the antennas.

➔ I = 18.86 + 27.3 * LOG10(D) for 900 MHz



Isolation measurements on train roofs at 900 MHz
Source: DBAG, AG Funk

SIEMENS

Simulated vs Measured Isolation

- Siemens Vectron Locomotive

	ETCS1->Cab	ETCS2->Cab	ETCS1->ETCS2
	4-5	1-5	1-4
Distance	6,24 m	15,42 m	9,56 m
Spurious Emission, Limit	**-113,00 dBm**	**-113,00 dBm**	**-113,00 dBm**
Spurious Emission (Tx)	-72,00 dBm	-72,00 dBm	-72,00 dBm
Attenuation (necessary)	-41,00 dB	-41,00 dB	-41,00 dB
Attenuation Downlink (918-925 MHz)			
Attenuation Tx Cable	-1,72 dB	-1,20 dB	-1,72 dB
Attenuation Antennas	-40,57 dB	-51,29 dB	-45,63 dB
Attenuation Rx Cable	-1,42 dB	-1,42 dB	-1,20 dB
Attenuation (calculated)	-43,71 dB	-53,91 dB	-48,54 dB
Evaluation	-2,71 dB	-12,91 dB	-7,54 dB
Attenuation (measured)	-54,52 dB	-67,88 dB	-61,83 dB
Deviation	-10,81 dB	-13,97 dB	-13,29 dB
Freefield	-50,57 dB	-57,90 dB	-54,05 dB
Diviation	-3,95 dB	-9,98 dB	-7,78 dB
		-65,26	
freefield		-55,28 dB	
calculation		-51,29 dB	
measured		-65,26 dB	

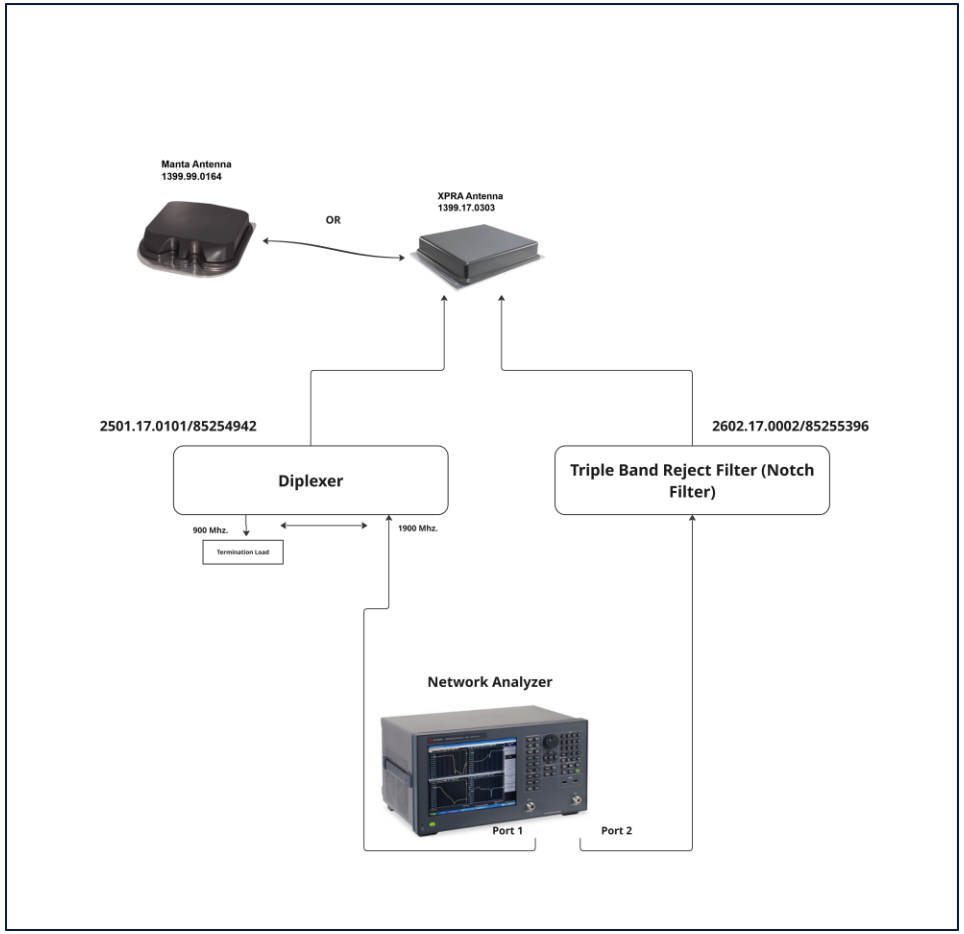
	New1->Cab	New2->Cab	New1->ETCS1	New2->ETCS1	New1->ETCS2	New2->ETCS2	New1->New2
	3-5	2-5	3-4	2-4	1-3	1-2	2-3
Distance	7,88 m	15,47 m	2,19 m	8,83 m	7,48 m	1,37 m	7,64 m
Spurious Emission, Limit	**-113,00 dBm**	**-113,00 dBm**	**-113,00 dBm**	**-113,00 dBm**	**-113,00 dBm**	**-113,00 dBm**	**-109,00 dBm**
Spurious Emission (Tx)	-42,00 dBm	-42,00 dBm	-42,00 dBm	-42,00 dBm	-42,00 dBm	-42,00 dBm	-57,00 dBm
Attenuation (necessary)	-71,00 dB	-71,00 dB	-71,00 dB	-71,00 dB	-71,00 dB	-71,00 dB	-52,00 dB
Frequency (Rx):	900 MHz	900 MHz	900 MHz	900 MHz	900 MHz	900 MHz	900 MHz
Attenuation Tx Cable	-0,64 dB	-0,64 dB	-0,64 dB	-0,64 dB	-0,64 dB	-0,64 dB	-0,64 dB
Attenuation Antennas	-43,34 dB	-51,33 dB	-30,57 dB	-44,68 dB	-42,72 dB	-27,48 dB	-42,97 dB
Attenuation Rx Cable	-1,42 dB	-1,42 dB	-1,72 dB	-1,72 dB	-1,20 dB	-1,20 dB	-0,64 dB
Attenuation (calculated)	-45,40 dB	-53,39 dB	-32,94 dB	-47,04 dB	-44,56 dB	-29,31 dB	-44,26 dB
Evaluation	25,60 dB	17,61 dB	38,06 dB	23,96 dB	26,44 dB	41,69 dB	7,74 dB
Attenuation (measured)	-51,54 dB	-69,46 dB	-49,37 dB	-59,31 dB	-50,00 dB	-34,61 dB	-62,77 dB
Evaluation	-6,14 dB	-16,07 dB	-16,43 dB	-12,27 dB	-5,44 dB	-5,30 dB	-18,51 dB
	-51,52 dB	-57,37 dB	-40,70 dB	-52,80 dB	-50,84 dB	-36,09 dB	-50,47 dB
	-0,02 dB	-12,09 dB	-8,67 dB	-6,51 dB	0,84 dB	1,48 dB	-12,30 dB
	-49,48			-56,95	-48,16	-32,78	
	-49,45 dB			-50,44 dB	-49,00 dB	-34,26 dB	
	-43,34 dB			-44,68 dB	-42,72 dB	-27,48 dB	
	-49,48 dB			-56,95 dB	-48,16 dB	-32,78 dB	

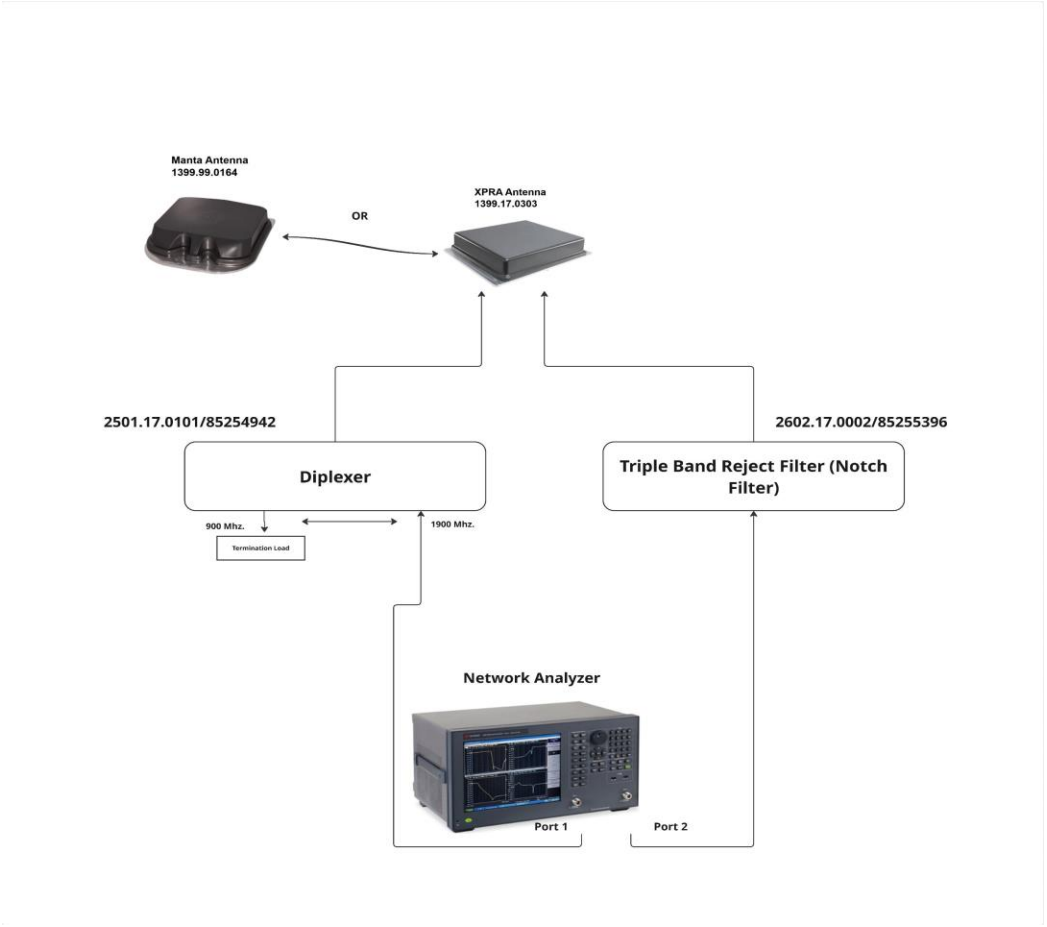
Huber + Suhner locomotive rooftop multi-port antennas

1399.99.0164

1399.17.0303

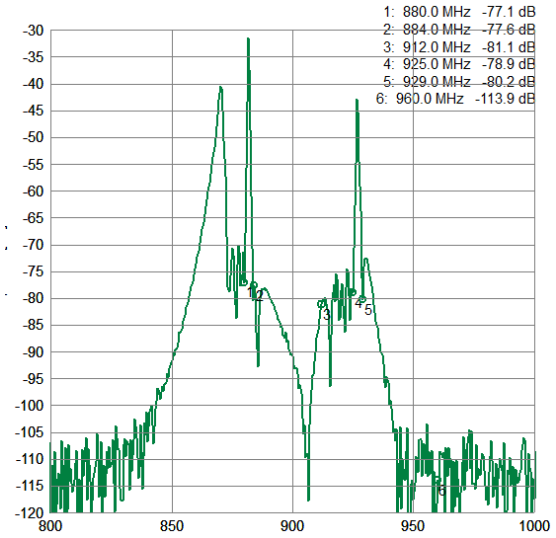
Antenna test Measurement Setup



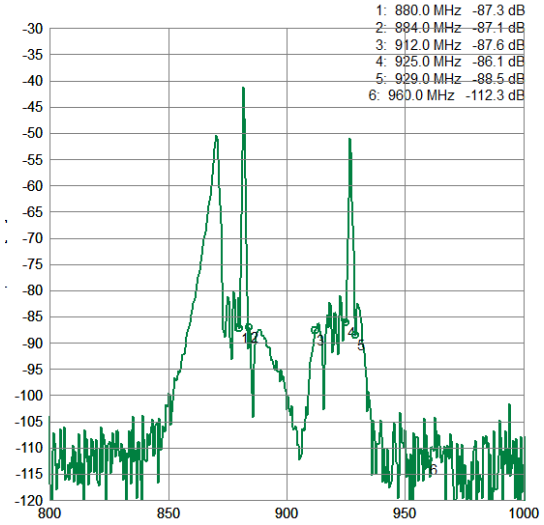


Locomotive rooftop multi-port antennas S21 results

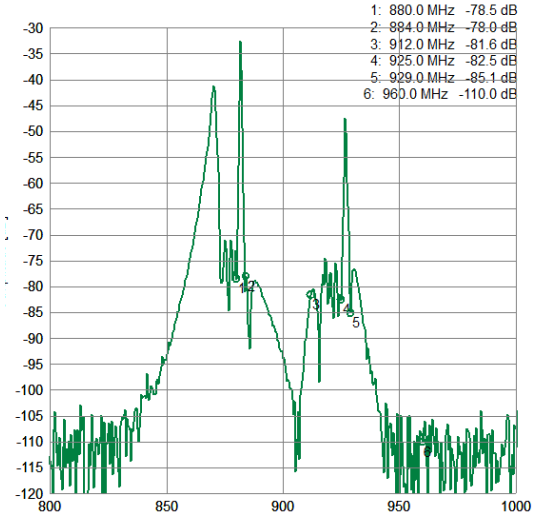
- Huber + Suhner 900 MHZ Diplexer-Filter -Antenna



C1+C2



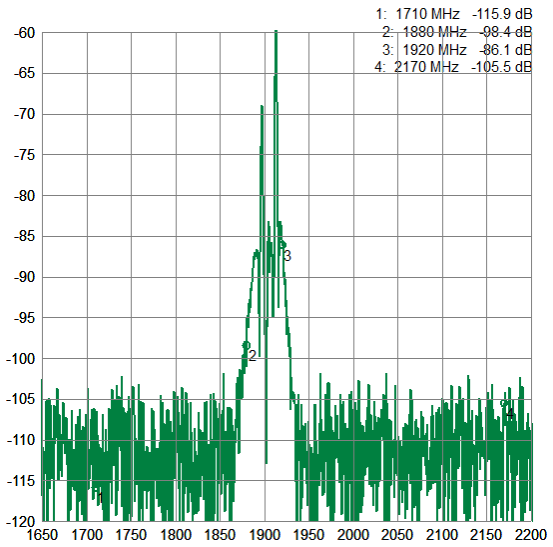
C1+C3



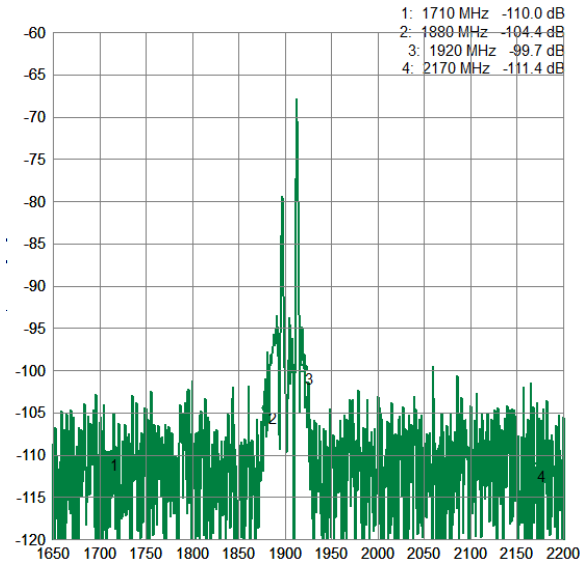
C1+C4

Locomotive rooftop multi-port antennas S21 results

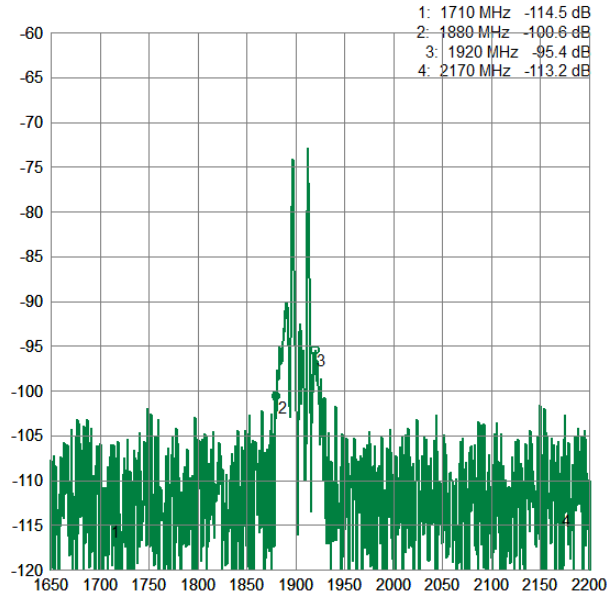
- Huber + Suhner 1900 MHZ Diplexer-Filter -Antenna



C1+C2

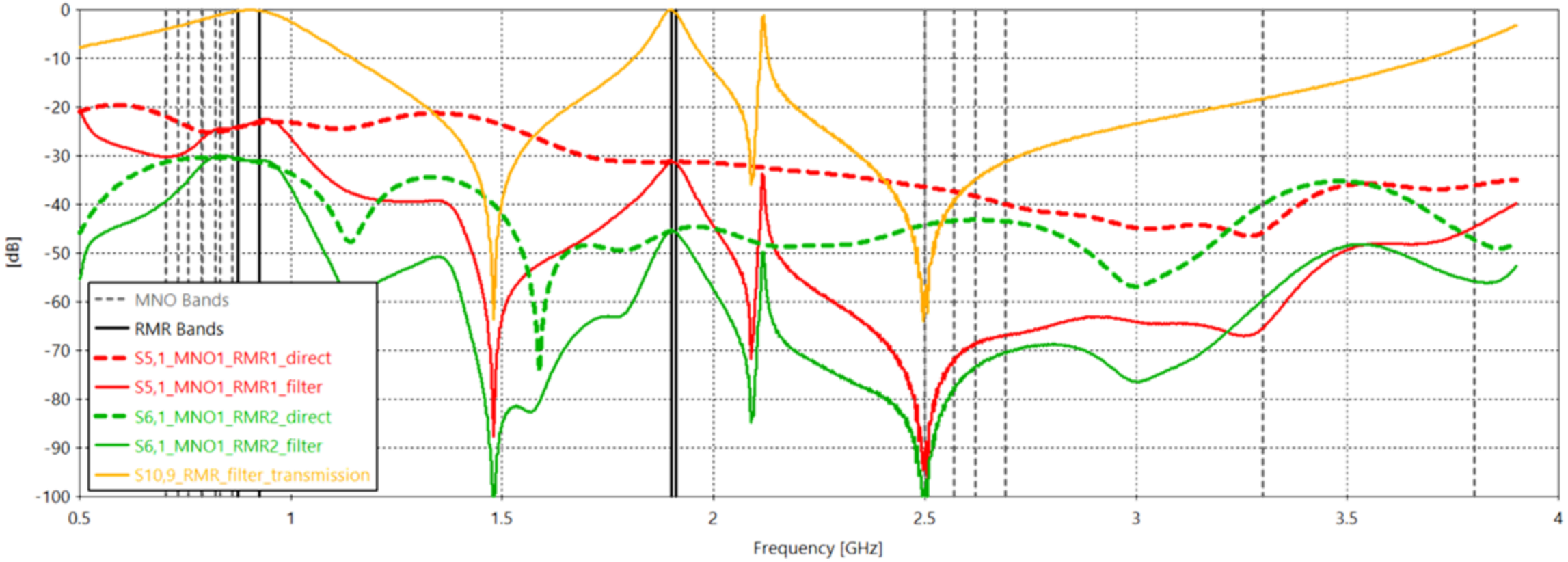


C1+C3



C1+C4

Implementing RMR Filters Inside Antenna (4x MNO + 2x RMR) – RMR-MNO Isolation for 6 port antenna product under development



Conclusion

EU-Rail FRMCS Deployment Group

We can expect antenna vendors to provide RMR/GSM-R/MNO antennas with the required isolation to supplement the distance isolation and meet the required isolation requirements

Mid-term Report to be ready mid-summer of publication

Cross-Border Landscapes / National Investment Plans

Problem Statement

Can we predict the timeframe of FRMCS cross-border?

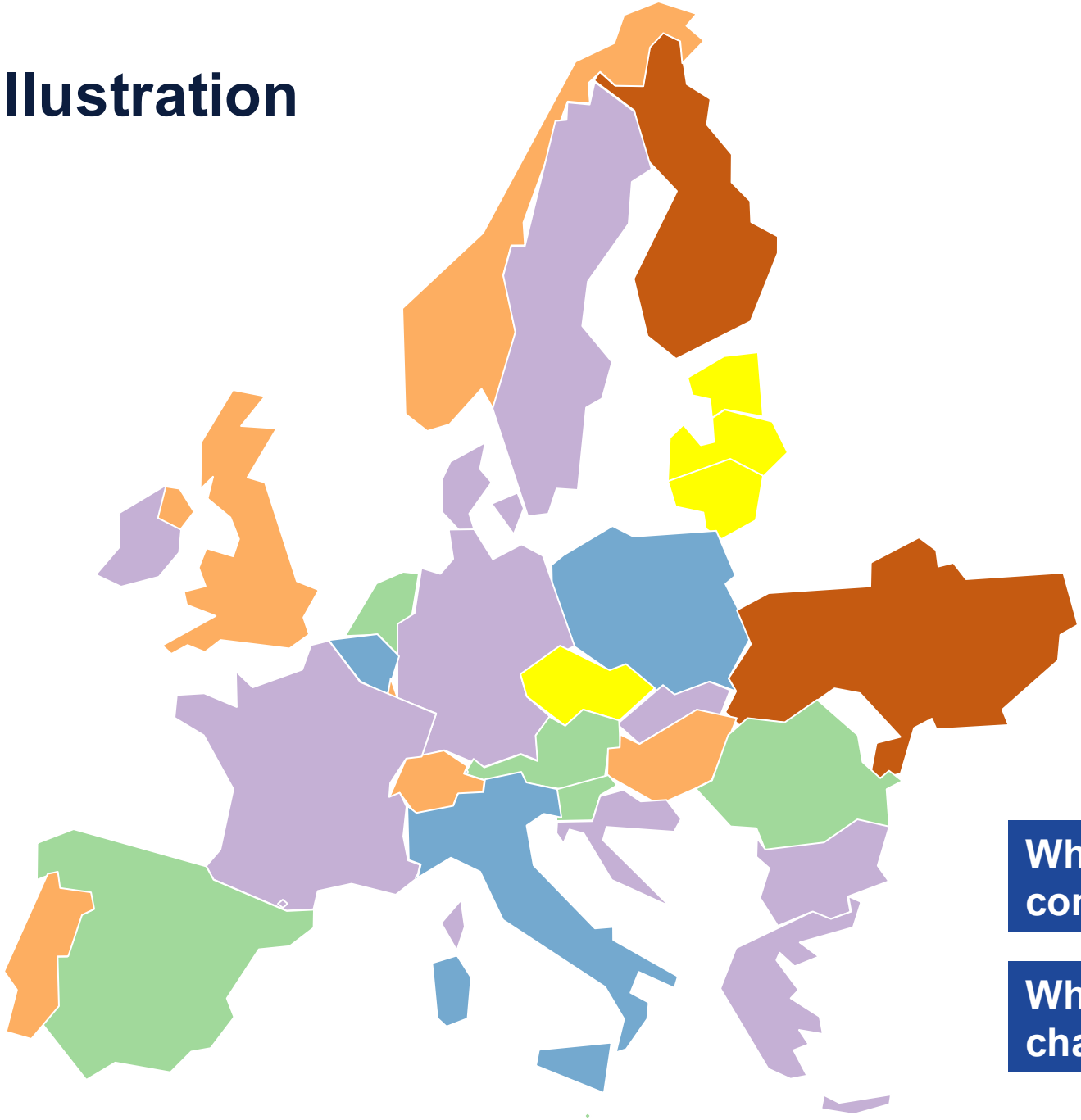
Which borders first?

What is are the RMR/GSM-R/GPRS/MNO combinations anticipated?

Walk through analysis of all strata on network transition

- Each IM will have a different deployment timetable for FRMCS in border regions
- Some IMs may choose MOCN or National Roaming utilizing MNO access

Illustration



FRMCS RMR /MNO Nat Roam

FRMCS RMR /MNO MOCN

GSM-R

FRMCS voice only ETCS over GSM-R

FRMCS MNO only

Voice and ETCS over FRMCS

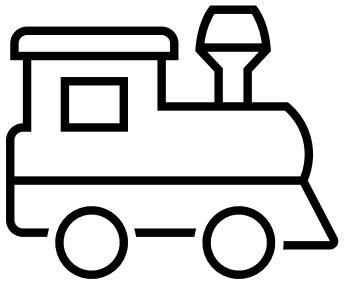
Which Cross-Border combinations will appear first?

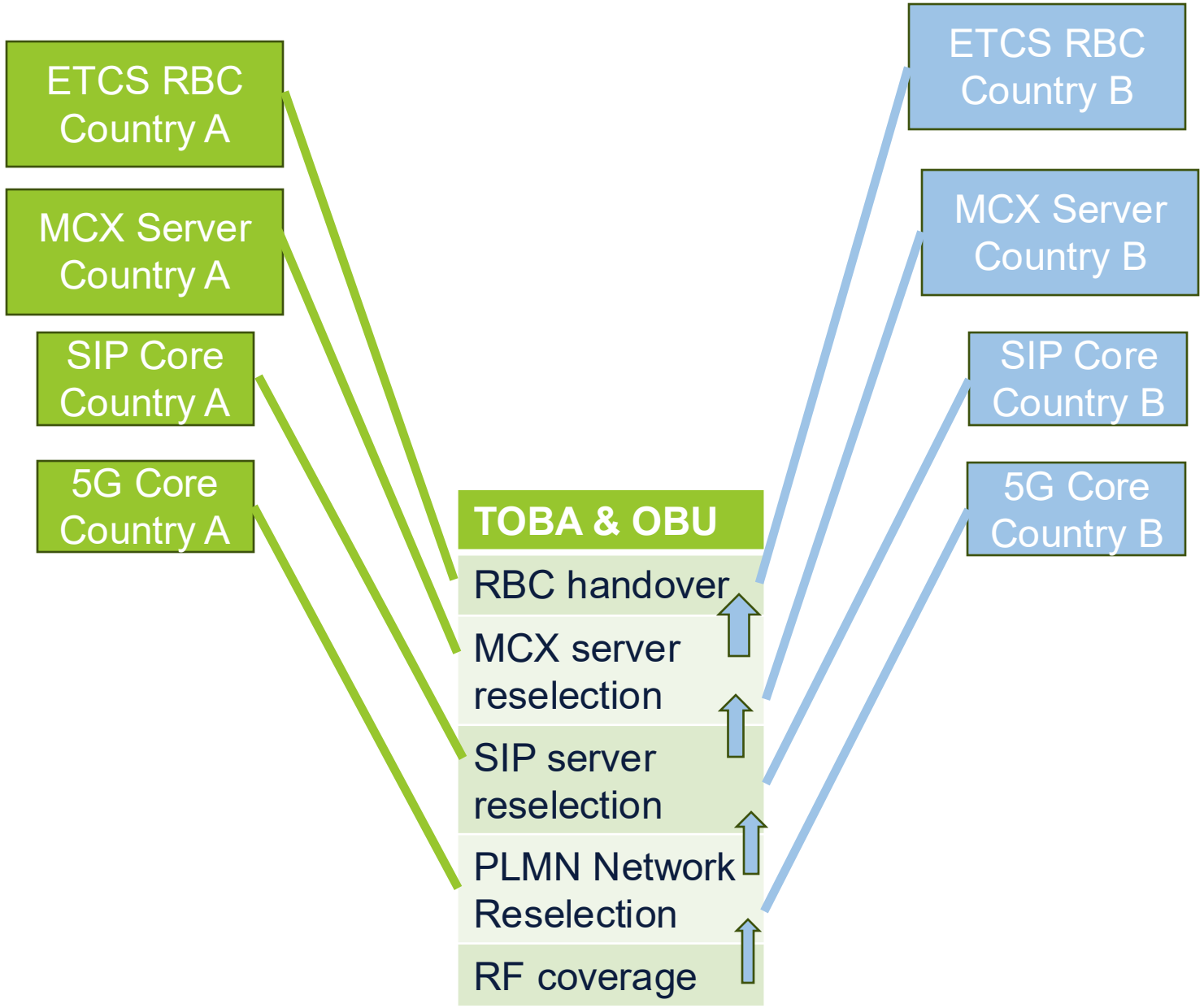
What are the technical challenges?

Border Crossing Scenarios Combinations

		GSM-R voice and GPRS	FRMCS voice GSM-R CS ETCS	FRMCS voice and ETCS	FRMCS ETCS and GSM-R voice	FRMCS using MOCN	FRMCS using national roaming	GSM-R voice and CS ETCS
GSM-R voice and CS ETCS								
GSM-R voice and GPRS								
FRMCS voice GSM-R CS ETCS								
FRMCS voice and ETCS								
FRMCS ETCS and GSM-R voice								

Conclusion




ETCS RBC Country A
MCX Server Country A
SIP Core Country A
5G Core Country A
TOBA & OBU
RBC handover
MCX server reselection
SIP server reselection
PLMN Network Reselection
RF coverage
ETCS RBC Country B
MCX Server Country B
SIP Core Country B
5G Core Country B

MNO Service Level Agreements for serving FRMCS

MNO serving FRMCS Service Level Agreements

- Problem statement

In the 2025 EU-Rail FRMCS Deployment Group questionnaire 12 of 17 respondent IMs indicated interest in utilizing MNO access for FRMCS

Problem Statement

- What does an MNO need to know to commit to serve FRMCS?
- What should an IM ask an MNO to commit to?
  - Passive infrastructure sharing
  - MOCN (Multi-Operator Core Network)
  - National Roaming
  - Critical Services – certification requirements
  - Non-critical services

6 SLA models: FRMCS over MNO: sharing model vs. application criticality

Indicative positioning for railway corridors

Application criticality / **MNO sharing methods**

Use case	MOCN Shared RAN, separate core/services	National roaming Visited MNO RAN under roaming agreement	Passive sharing Shared site/power/transmission, separate active network
Critical	**Best fit** Most suitable where FRMCS traffic needs deterministic radio behavior, priority/QoS and controlled coverage along the corridor.	**Conditional** Possible only with strong SLA, priority/pre-emption, coverage guarantees and tightly managed handover/security arrangements.	**Enabler** Useful for cost-efficient corridor rollout, but criticality is carried by dedicated active FRMCS RAN/core rather than by sharing itself.
Non-critical	**Suitable** Good option when operational data or passenger-adjacent services can coexist with shared radio infrastructure and separated service control.	**Suitable** Often viable for less demanding applications where roaming latency/operational dependency are acceptable within corridor design limits.	**Suitable** Straightforward for site and civil-work efficiency when each party keeps independent active equipment and service policies.

Read-across: critical FRMCS functions generally favor MOCN or dedicated active networks; national roaming becomes more acceptable as application criticality decreases; passive sharing is mainly an infrastructure efficiency model.

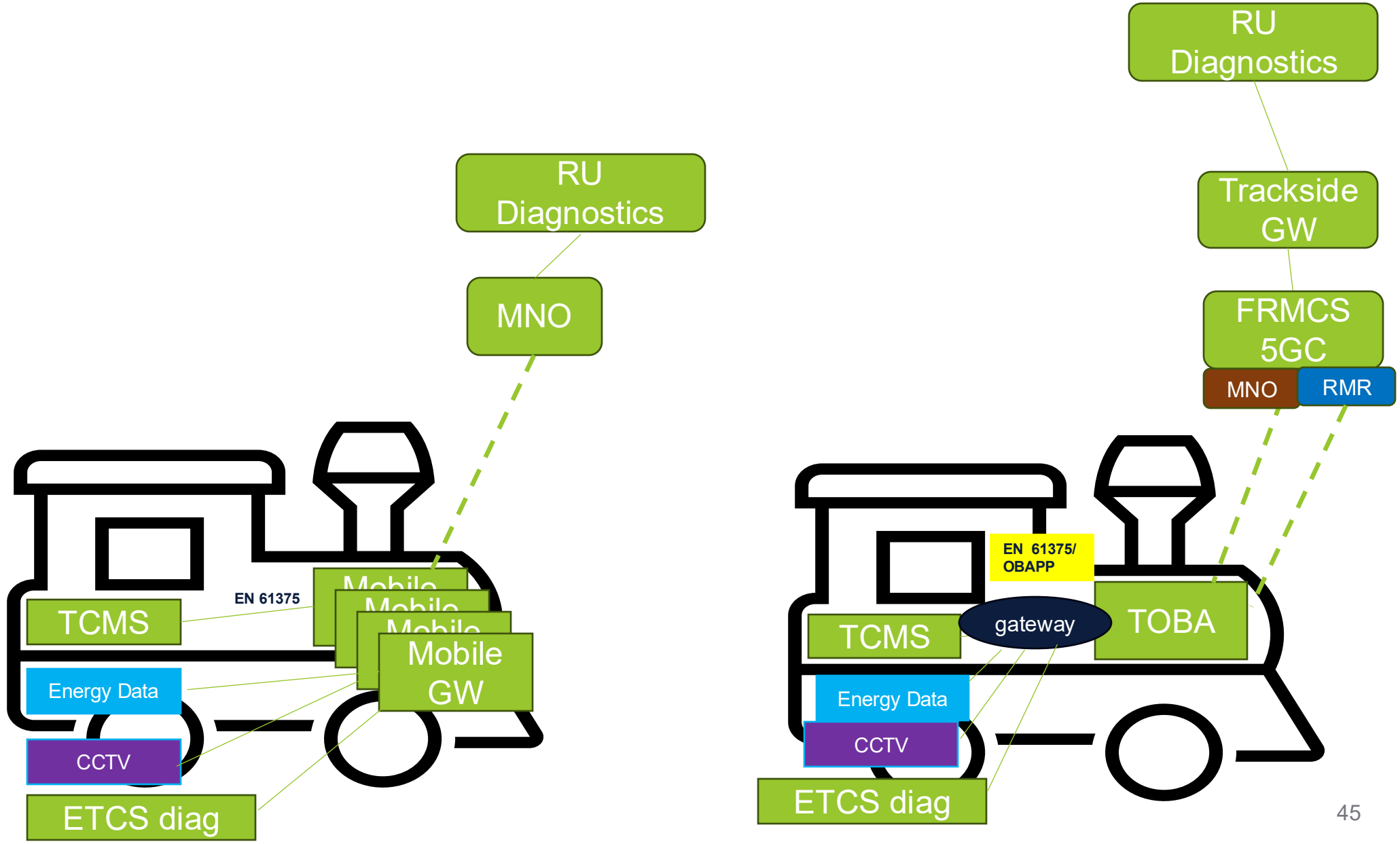
Illustrative matrix – refine per SLA, spectrum rights, QoS/priority, resilience and railway safety case.

non-ETCS FRMCS-using applications

Problem Statement

- Primary focus of FRMCS in V3 is GSM-R replacement
- RUs may not see sufficient business value to replace GSM-R before the 5-year mandatory ERA clock expires
- Since FRMCS provides a 5G pipe with significantly larger uplink throughput and RUs already have digitization programs in place where this uplink throughput can be utilized instead of dedicated mobile gateways
- Study of applications providing value to FRMCS before ETCS baseline 4 is available

- The work item will provide a list of use cases which can utilize this new FRMCS “pipe” for the benefit of RUs
- On-board architectures using Mobile Gateways to be merged into the FRMCS pipe
- EN 61375-6 interfaces using OBApp interface to TOBA


RU Diagnostics
MNO
EN 61375
TCMS
Mobile
Mobile
Mobile
Mobile GW
Energy Data
CCTV
ETCS diag
RU Diagnostics
Trackside GW
FRMCS 5GC
MNO
RMR
EN 61375/ OBAPP
TCMS
gateway
TOBA
Energy Data
CCTV
ETCS diag

Preliminary report

Mid summer

Applications using mobile gateways today

RUs encouraged to share their digitization requirements

How OBApp gateway can interface to train consist network

TCMS / EN 61375 domain

|

TCMS gateway / MCG / application agent

|

OBAPP over onboard IP/Ethernet connectivity

|

FRMCS onboard gateway

|

FRMCS train-to-ground bearer

On board FRMCS (OBF) future-proofness workgroup

Problem Statement

On request of the sector, EU-Rail initiated a workgroup to analyse onboard FRMCS (OBF) units future proofness

- 4 Railway Undertakings
- 4 Industry partners

Purpose:

To give advice/recommendations to RU's how to include futureproof OBF in RFQ's (Request for Quotation)

Results published Q4 2026

On board FRMCS (OBF) future-proofness workgroup

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

You are invited to join the upcoming webinar

"FRMCS Deployment Questionnaire 2026 — Open Information Session"

The purpose of the session is to clarify the structure and content of the questionnaire and to ensure a common understanding of the questions.

Register now to attend the session!

https://ec.europa.eu/eusurvey/runner/FRMCS-Deployment-Survey

Please do not forget to fill out and return the FRMCS Deployment Questionnaire 2026

(distributed to you by the associations)

The more responses are received, the better the EU-Rail FRMCS Deployment Group can develop targeted recommendations and support informed decision-making on FRMCS deployment topics.
The results of the survey will be consolidated and published in September 2026.

Information

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

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