Brussels, 09 January 2026

**SUBJECT:** Advice to ERA regarding the deployment of FRMCS (including ERA/OPI/2024-10, recommendation #6)

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## Table of Contents


1. Introduction ..... 1
2. Advice regarding ERA/OPI/2024-10, #6 ..... 2
   2.1. The added value of supporting specific mandatory features by On-board FRMCS ..... 3
   2.2. The need for granularity of FRMCS usage in Registers of Infrastructure (RINF) ..... 3
   2.3. The possibility to consider non-application of CCS TSI in very specific cases for On-board FRMCS 4
3. Recommendations on top the Advice demanded in the Technical Opinion ..... 5
   3.1. Frequencies ..... 5
   3.2. Use of the application-based system (new features for onboard systems) ..... 5
   3.3. Cybersecurity ..... 5
   3.4. Future proofness ..... 6
   3.5. Additional Advice ..... 7
   3.6. Analysis of questionnaire (Summary) ..... 10
   3.7. EU-RAIL FRMCS European Deployment working groups outcomes ..... 10
   3.8. FRMCS European Deployment Group roadmap 2026 ..... 11


# 1. Introduction

In December 2024, ERA released Technical Opinion ERA/OPI/2024-10 of the European Union Agency for Railways regarding version 2 of Future Railway Mobile Communication System (FRMCS) specifications in Recommendation #6, ERA states:

*''EU-RAIL Deployment Group on FRMCS should provide advice on the aspects indicated in Recommendation #5''.*

The aspects indicated in Recommendation #5 are:

*''There is the need for a deeper investigation on the added value of supporting specific mandatory features by On-board FRMCS, the need for granularity of FRMCS usage in Registers of Infrastructure (RINF), and the possibility to consider non-application of CCS TSI in very specific cases for On-board FRMCS''.*

The EU-RAIL FRMCS Deployment Group has been set-up end of 2024 and to provide advice and recommendations to the High-Level Deployment Group and Sector on the best way to deploy FRMCS. To give thorough advice, The European FRMCS Deployment group has a managing team and three Working Groups (Technology, legal and finance, deployment scenarios).

In Q2 2025, EU-RAIL has conducted an enquiry to get some information from FRMCS stakeholders. Over 67 questionnaires have been received from Infrastructure Managers (IMs), Railway Undertakings (RUs), Trackside suppliers (TSSs), Onboard suppliers (OBSs) and National Safety Authorities (NSAs). For more details, please refer to the Questionnaire Report.

To create the questionnaire template, several interviews have been conducted.

Altogether, the work in the FRMCS Deployment Group and the information from the questionnaires give a strong background to propose advice as demanded in the ERA Technical Opinion ERA/OPI/2024-10.

In this document, paragraph 2, we will answer the TO recommendation #6 advice request.

In addition, based on the questionnaire, the interviews and the work done in Working Groups 1, 2 and 3 of FRMCS European Deployment Group, we also address some new concerns and recommendations that were raised by the Sector, after the publication of ERA TO, and provide guidance and roadmap proposals. In chapter 3 we will give, in addition to the advice to TO, additional recommendations to ERA for further discussions.

## 2. Advice regarding ERA/OPI/2024-10, #6

To ease the reading of the next pages, it is important to understand the context of the FRMCS specification writing and the deployment preparation.

UIC took the responsibility to write the FRMCS specifications in 2018.

The UIC documents will be supplemented by other documents coming from 3GPP, ETSI, ERA, …

This is a very complex process.

In the meantime, Infrastructure Managers (IMs) and Railway Undertakings (RUs) have undefined and/or additional expectations regarding the telecommunication systems. The industrial stakeholders (Suppliers) also have expectations and constraints.

EU-RAIL FRMCS System Pillar report 2.3 makes the link between the specifications work and the expectations of the stakeholders.

The Technical Opinion raises questions to understand what can be done to deploy FRMCS as soon as possible while answering most of the expectations.

As “soon as possible” may have different meanings depending on the countries and the expectations may be different too.

EU-RAIL FRMCS Deployment Group worked to build advice taking the global context into consideration while preparing for a smooth and cost-efficient deployment.

## 2.1. The added value of supporting specific mandatory features by On-board FRMCS

The question raised by ERA can be understood from different manners and the meaning of the question can fluctuate depending on the maturity of the stakeholders regarding the deployment of FRMCS.

The question we will answer is: “Should features providing more service that GSM-R replacement be mandatory”?

The questionnaire and the interviews show that the Railway Undertakings are expecting more that GMS-R replacement from FRMCS.

The capacity of the system to replace several onboard equipment is expected to create the possibility of a possible return on investment.

This includes:

- Possible use of the FRMCS Onboard equipment as a modem to carry data for different (non-safety and non-interoperability) applications (Impact on OB App),
- Possible use of Public MNO to benefit from larger bandwidth and network coverage in low-density area (low-density from a railway perspective),
- Possible use of future telecommunication systems (6G, Satellite communication, ….) (Impact on OB Rad),
- Possible use of GMS-R in parallel with FRMCS specifically in case of delay in the availability of the Onboard equipment for the ERTMS.

Advice 1: FRMCS should be based on European harmonised requirements. For future proofness reasons, the system should allow new (software and app-based) -national- functionalities based on stable hardware. Test &Validation and Authorisation processes should be as lean as possible.

## 2.2. The need for granularity of FRMCS usage in Registers of Infrastructure (RINF)

The question raised by ERA has been analysed after a review of the existing GSM-R description in the RINF.

The basis for the Advice is that the aim of the RINF is to enable the Route Compatibility Check (RCC).

Necessary detailed information necessary for the Infrastructure Managers to get a knowledge of their installation is not considered as it does not bring added value to the RCC.

Assuming that the onboard equipment will use a standard set of frequencies that will cover all the possible frequencies that could be used by the infrastructure, there is no need to describe the frequencies deployed on the infrastructure.

To make the RINF as simple as possible, the advice is to describe a limited number of cases.

As an example, these cases could be (To be discussed with the Infrastructure Managers):

| | GSM-R Voice | GSM-R REC | GSM-R ETCS | GSM-R Apps | FRMCS Voice | FRMCS REC | FRMCS ETCS | FRMCS Apps MCX | FRMCS Apps Non-MCX |
|---|---|---|---|---|---|---|---|---|---|
| Case 1 | Yes | Yes | Yes | Yes | No | No | No | No | No |
| Case 2 | No | No | No | No | Yes | Yes | Yes | Yes | Yes |
| Case 3 | Yes | Yes | Yes | Yes | No | No | No | Yes | Yes |
| Case 4 | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Case 5 | Yes | Yes | No | Yes | No | No | Yes | Yes | Yes |
| Case 6 | No | No | Yes | Yes | Yes | Yes | No | Yes | Yes |

Case1 will operate only with GSM-R without FRMCS systems

Case 2 will operate only with FRMCS equipment, where GSM-R is already phased-out, or in greenfield developments.

Case 3 and 4 are mixed solutions where for some functionalities GSM-R will be used and FRMCS for others.

Case 5 will only use FRMCS for ERTCS corridors, and Voice and REC operate via GSM-R.

Case 6 will only use GSM-R for ERTCS corridors, and Voice and REC operate via FRMCS.

The scenarios described above may be challenged.

Again, the assumption would then be that all TOBA boxes can manage all RMR and MNO frequencies.

The benefits of having limited number of scenarios are:

- Ease the Route Compatibility Check by the Railway Undertakings,
- Define scenarios that Infrastructure Managers should stick to.

Advice 2: based on on-board systems managing RMR and MNO frequencies, RINF should describe only few -exhaustive- case for usage of different radio systems for voice and/or data functionalities.

## 2.3. The possibility to consider non-application of CCS TSI in very specific cases for On-board FRMCS

The analyses of the Questionnaire and the interviews have not highlighted specific demands for non-application of CCS TSI.

However, a demand for limited use of On-board FRMCS has raised (for example, limited to the use of voice only functionalities for vehicles which will become out-of-service in the foreseeable future).

As a significant portion of the rolling stock fleet will be equipped with FRMCS but not with ERTMS On-board Units (EVC), there is a demand for a specific way of deploying on-board equipment especially on the authorization side.

Advice 3: FRMCS Deployment Group considers CCS TSI topics out of their scope. However, considering the current compatibility issues, we advise better (governance) alignment between ETCS and FRMCS developments and deployment programmes. Authorisation and certification processes for FRMCS without ETCS or any other applications than voice related ones should be investigated.

# 3. Recommendations on top the Advice demanded in the Technical Opinion

## 3.1. Frequencies

In the questionnaire The Infrastructure Managers have expressed multiples ways of using the frequencies and the telecommunication networks.

Most of the Infrastructure Managers plan to use either P-MNO in addition to RMR or even plan to use P-MNO only. Both 900 and 1900 MHz are expected to be used. Some Infrastructure Managers plan to use 1900 MHz spectrum during the migration phase only whereas others want to keep it after migration phase.

Regarding P-MNO some Infrastructure Managers want to use it alone, some as a backup to FRMCS, others as additional capacity.

During the interviews, Railway Undertakings and Infrastructure Managers also expressed some concerns about the readiness of the FRMCS architecture to use 6G and/or satellite telecommunication. Their fear is that these technologies will be the most UpToDate one in the coming years where FRMCS V3-specifications are mainly focusing on 5G. To mitigate this risk, the implementation of OB-Rad must be considered.

## 3.2. Use of the application-based system (new features for onboard systems)

As stated before, some Infrastructure Managers and Railway Undertakings have implemented specific GSM-R versions to cover “local” functionalities.

On top of that, most of the Railway Undertakings see the FRMCS as a cost with no benefit (“sunk costs”) because the current focus on 1:1 replacement of GSM-R functionalities.

The main opportunity for Railway Undertakings to de some savings thanks to the deployment of FRMCS is to use an application-based system. Such an application-based system can be the basis for installing –software based- new functionalities and systems (see 2.1, Advice 1).

This means that some functionalities other than Voice, ETCS and Radio Emergency Calls could use the benefit of the system and onboard functionalities through the TOBA Box. As an example, Railway Undertakings could remove existing telecommunication systems implemented onboard to upload the Passenger Information Service data. Many other applications can be developed for the benefit of the quality of service to the passengers (Refer to Annex 1 of the EU-RAIL FRMCS 2.0 Report).

The number of antennas on train roofs is a key point for the installation of FRMCS. Reducing the number of antennas would make the installation in trains easier not to say possible.

To ensure that the telecommunication for Non-Safety-Relevant will not consume too much capacity of the MCX servers, the application structure should enable both MCX and NON-MCX applications.

## 3.3. Cybersecurity

Cybersecurity has been of growing interest in the last months.

Part of the cybersecurity is ensured by MCX.

MCX is in the service layer of FRMCS.

In the coming years, MCX may not be enough to ensure and demonstrate the security of the communications because of the new cybersecurity threats.

It is important that the FRMCS architecture respects the limits of the layers (Communication, service, application) for the sake of future developments.

The connection between GSM-R and EVC did not respect this basic rule. This is now generating a big concern when implementing FRMCS.

New threats are appearing because of the growing calculation capacities of the computers. Quantum computing will soon become reality. The European Commission, ETSI and National IT Safety Authorities are raising growing concerns about this and are strongly recommending companies to consider Post-Quantum Cryptography (PQC).

This point should be investigated in the development of FRMCS on-board units.

## 3.4. Future proofness

FRMCS stands for Future Railway Mobile Communication System.

The future proofness of the system is important.

It has been decided that FRMCS Edition 1 will be based on 5G technology. In the meantime, new technologies are investigated by the European Railway Sector through different programmes (EU-RAIL Innovation Pillar for example). The FRMCS system architecture must reflect the possibility to migrate to 6G, Wi-Fi, satellite communications, … without heavy modifications. This topic is linked to OBRAD.

In parallel, new functionalities may occur and the trains may require higher volumes of data exchanges to increase performances of operations (Automated Train Operations, Digital Automatic Coupling, Over-The-Air maintenance data, …). Single European Railway Area being the target, it is important to prepare for potential evolution of the systems to ensure higher interoperability with these new features. Properly designed communication systems are key for that. The capacity to use TOBA boxes for more functionalities will help to improve the implementations business case (Less antennas, less modems, …). This topic is linked to "Application-based" architecture, OBapp.

Over the past year, remote diagnosis systems have improved a lot. The capacity of the systems to measure the quality of their performance and to provide efficient performance indicators is now basic in modern systems. Based on the performance indicators analysis, it is possible to generate improved software versions and download them "over the air" on the embedded equipment. This topic is linked to OBOM.

Globally speaking, it is vital to provide Railway Undertakings with the guarantee that the systems they will purchase to deploy FRMCS as soon as the Infrastructure Managers will require it will be capable of receiving future software versions without hardware modifications.

## 3.5. Additional Advice

### 3.5.1 Vehicle Authorisations and Certifications (during life cycle)

**Authorisation and certification processes** have been mentioned by most of the stakeholders contributing to the survey as a point that requires attention both because of the cost and the workload. National surveys carried out formerly (e.g. France, Germany) underline that need.

Current work on authorisation, on certification and authorisation for other technologies raise the question on whether the aeronautics approach should be considered i.e. certify the equipment (even if it is in a reinforced manner) to make the authorisation of the trainsets very quick and simple.

This point is under discussion based on the work conducted by the FRMCS European Deployment Group working group 2. First intermediate results and proposals of possibilities are:

- Regroup the train types in categories to decrease the number of authorization procedures.
- Enable some qualified companies (Railway Undertakings, train manufacturers, ...) to perform self-assessment for some categories of modifications. The NSA would then check the process rather than the technical points.
- For VOICE only FRMCS specifications at start migration (50% of the fleet): Design a configuration management that would not necessitate authorisation assuming the components are “certified”
- Prepare a process to use the “application-based” FRMCS to enable new applications either interoperable or non-interoperable.

Additional Advice 1: The developed ideas should be discussed further together with all entities in charge, especially ERA, which is already working intensively on process improvements and is part of FRMCS Deployment Working Group 2.

### 3.5.2 Technology and Test &Validation and authorisation processes

From a Deployment perspective on technology and test &validation it is now clear that several Infrastructure Managers want to use RMR and MNO at the same time.

The application-based architecture allows good flexibility in the design of the functionalities that can be implemented on a train.

Additional advice 2: The possible evolution of the FRMCS system to fulfil the future demands is highly expected and based on stable hardware and software updates. OBapp needs to be fully described in CCS TSI FRMCS Edition 1 specifications.

### 3.5.3 Mandatory and voluntary functionalities

It is important to define which **functionalities are mandatory and which are left to a voluntary decision**.

The mandatory functionalities should be a few as possible (Voice, Radio Emergency Calls, ETCS, Energy consumption transmission, …).

Because of the most-likelihood that some corrections will need to be implemented in the TOBA boxes after Edition 1 release, it is important to give the possibility of Over-The-Air monitoring and software download for the companies which will have large FRMCS equipped fleets.

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| Additional advice 3: New functionalities must be easily implemented thus requiring the possibility to update and monitor the TOBA boxes “over-the-air”. The Railway Undertakings are expecting the TOBA boxes to be capable of receiving new functionalities without hardware modifications. OBOM should be part of the CCS TSI FRMCS Edition 1 specifications. |

### 3.5.4 Upgrade to new technologies

The urgency to deploy FRMCS to prevent major disruptions because of GSM-R obsolescence must not come at the expense of the **ability to easily upgrade to new technologies**. The promises made by the FRMCS Specification Group on the possibility of evolution of the systems must be fulfilled.

On top of this, European Commission rules impose re-entering competition for the procurement of systems when awardeed business duration are long. So, it is important to push for non-vendor-locking solutions

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| Additional advice 4: The system must be capable of evolution to other radio systems that 5G (6G, Wi-Fi, Satellite communication) with as low as possible impact on the onboard systems (and especially hardware). OBrad should be part of the CCS TSI FRMCS Edition 1 specifications. |

### 3.5.5 Respect for the architecture layers

The openness of the system for future evolution imposes respect for basic rules in the design such as the **respect for the layers** in the architecture. The impact of these basic rules on the ongoing specification works must be evaluated. Whenever there would be a major impact, a way forward should be prepared to make sure that possible evolutions are feasible.

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| Additional advice 5: Assessment of the respect of the layer limits Communication-Service-Application must be conducted, and way forward must be defined. |

### 3.5.6 Cybersecurity

Cybersecurity is a growing concern. The FRMCS specification work is conducted in parallel with the definition of cybersecurity standards.

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| Additional advice 6: An assessment, independent from the specification writers, of the FRMCS architecture regarding its cybersecurity should be conducted prior to the release of Edition 1 specifications. |

### 3.5.7 Future application-based developments

From a deployment perspective future application-based developments are a basis for introducing new functionalities, updates and fixes –cheap, simple and fast.

The need for non-application of the CCS TSI for On-board has not been evaluated by the EU-RAIL FRMCS European Deployment Group because no such case has been detected.

The way the application-based system will be implemented may be an answer to such demands. ERA will have to give guidance on what is an interoperable application and what is a “voluntary“ application.

To implement the voluntary applications in a safe manner, the development of an application design FRMCS process should start as soon as possible. This process will describe who is responsible for what regarding the development and the verification of non-mandatory applications.

Annex 1 of the EU-RAIL FRMCS Report V3 should be used to list the mandatory and non-mandatory, safety relevant and non-safety relevant and interoperable and non-interoperable functionalities.

The aim is that the application development process should be included in the CCS TSI.

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| Additional advice 7: Work should start as soon as possible, under ERA responsibility, to further develop the application-based future, including Application Store process, onboard application authorization and over-the-air update process from an authorization point of view. |

### 3.5.8 Deployment of different frequencies

Advice from deployment perspective on simplifying **deployment of different frequencies** cross-border and/or national.

To enable a possible simplification of the RINF, it would be good to impose that all the trainsets should be equipped with 900MHz/1900MHZ/MNO compatible modems and antennas. From the technical point of view, there is no extra cost by imposing this. Railway Undertakings may ask for derogations in certain areas to authorize the simplification of maintenance operations in regions where it is certain that some frequencies are not used.

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| Additional advice 8: For the sake of the RINF simplification, for the first phase of deployment, the standard onboard equipment must be 900MHz/1900MHz/MNO compliant. |

### 3.5.9 GSM-R and FRMCS parallel use

That use case needs to be further evaluated. The capacity of the trains to run under GSM-R for Voice and FRMCS for data of vice-versa needs to be investigated. Additional advice 9: There should be an in-depth global assessment of the possibility to use GSM-R and FRMCS in parallel and a defined process on the local assessment that shall be performed if necessary.  Further use of questionnaires and Deployment Working groups

In the previous paragraphs the European FRMCS Deployment Group replied to the recommendation #6 of ERA’s TO on FRMCS.

Next to this specific answer, the Group works on technical deployment topics, cost and authorization issues and provide deployment scenario’s. All from migration and deployment perspective. These studies, strategies and information can be useful for further development of the system and towards an easy, simple, cost effective and fast implementation.

Also, the information from the survey in the railway sector to the current ideas and knowledge on FRMCS Deployment issues is highly valuable for the upcoming phases. In this paragraph the main areas of interest will be addressed. Additional information is available with the members of the FRMCS European Deployment Group. The survey report is published on the EU-RAIL website.

## 3.6. Analysis of questionnaire (Summary)

Thanks to the high number of respondents to the EU-RAIL FRMCS European Deployment Group questionnaire, some concerns and demand have been raised on deployment topics.

Here is a summary of the main points:

- Most of the Infrastructure Managers intend to use MNO and there are multiple intended ways of using RMR and MNO.
- There is globally no financing plan.
- Infrastructure Managers' schedules and Railway Undertakings' schedules generally do not match. We note very little awareness of the FRMCS deployment in great parts of the Railway Undertakings (e.g. smaller companies)
- Deployment will not/is not foreseen to be completed before the 2040 deadline in several countries. Despite global obsolescence and fade out of 2G technology, railways are still deploying on new (TEN-T) and retrofitted lines.
- Railway Undertakings are expecting more than "GSM-R replacement''. The future proofness of FRMCS shall/must be considered because of business economic reasons.
- There are significant concerns about availability of resources and competences for the deployment.
- IM's and RU's wait for TSI before starting Request for Quotation processes.

These points will be considered by the different working groups of FRMCS Europe Deployment Group and included in their future activities and analyses.

## 3.7. EU-RAIL FRMCS European Deployment working groups outcomes

In parallel to the questionnaire, the EU-RAIL FRMCS European Deployment subgroups have conducted workshops and produced intermediate results and reports. (see EU-RAIL website).

They enable the detection of major deployment topics to be addressed in the coming months

Working Group (WG) 1 (Technical): The subgroup analysed the current NIP's (National investment plans) on FRMCS deployment topics. Result was a very broad variety of suggested deployment timelines. Also, it became clear that awareness of the upcoming complex transition towards the new radio system is very limited in large parts of the sector (in particular with smaller countries, RU's and lessors). The subgroup highlighted necessary work to be done on Cross-Border and usage of MNO's (during and after migration) and suggested first possible ways to solve.

WG1 released the first version of its report in September 2025.

Working Group 2 (Legal and authorization): As first remit the subgroup analysed the current authorization processes and cost drivers of the current radio system. Also, the subgroup has initiated works on disruptive authorization processes and has started analysing a way to reduce complexity of the onboard and infra deployment, Testing & Validation and authorization, leading to cost efficiency.

Based on WG2 findings, these extra pieces of advice are addressed to ERA :

| Additional advice 9: WG2 released a first version of its report in September 2025. To reduce costs and simplify process, following possibilities could be further investigated (based on first focus on On-Board units): |
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- A mechanism of “multi-type” (or “cluster”) authorisation relying on categories of “similar” trains. The “minimum” expected is to reduce number of type authorisation, and so, the number of prototypes removed from commercial service in the meantime (some years…)
- A mechanism of “Self-authorisation” by the realizer needs to be considered. Even if as a counterpart the realizer should obtain a certificate of “entity in charge of changes” (Similar to Entity in Charge of Maintenance (ECM) certificate).

| Additional advice 10: For efficiency reasons, some regulations shall be modified accordingly, even if it is a long process. Coordination with the ERA TWG on simplification of T&V and authorisation processes is foreseen |
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Working Group 3 (Deployment scenario’s) : This subgroup has prepared a first document with a toolbox filled with different deployment scenarios and guidelines for the IM’s and RU’s. Scenarios depending on starting position of current radio use, legal and financial topics, risk appetite and political willingness.

WG3 will release the first version of its report end 2025.

## 3.8. FRMCS European Deployment Group roadmap 2026

The FRMCS European Deployment Group was installed end of 2024. The first half year can be considered as start-up, creating awareness, doing first analysis on the complex topic of FRMCS migration and coming up with first proposals for migration and deployment.

Based on this information the Group created a roadmap for next year, 2026, based on following highlights (all within the agreed remits for the FRMCS Group):

- Detailed proposals for technical cross border and MNO alignment topics (WG1)
- Proposals for simplification T&V and authorization and cost reduction (WG2)
- Toolbox filled with deployment/ migration scenarios (WG3)
- Survey on Deployment / Questionnaire II (Q2 2026)