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Working Group 2 (WG2): Financial and Legal

Interne

DISCLAIMER

This document is an intermediate report describing thoughts of the WG2 members on the basis of a preliminary analysis of estimated certification and authorization costs and an estimated number of target vehicles. These estimates will be further refined until the final report. Even if figures are estimated or preliminary from the perspective of the authors the conclusions are valuable.

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1. Introduction

FRMCS vehicle rollout by 2035 as a European task

In the EU around 50,000 to 100,000 vehicles and large parts of the more than 200,000 km[1] track network must be equipped with FRMCS by 2035. A very large number of them may receive FRMCS "Voice only" equipment at the start of the migration because ETCS will be rolled out over a longer period of time than FRMCS. Nevertheless financing and certification & authorization aspects - primarily for vehicle retrofitting - are among the greatest challenges for all European railway undertakings. The full FRMCS specifications are not expected before 2028, the first FRMCS components are expected to be available as from 2029. As a result, the remaining retrofit window for vehicles is shortened to around 5 to 7 years. In order to nevertheless achieve the rollout target by 2035, suitable measures must be taken immediately, particularly in the areas of vehicle authorization and financing. The aim of this document is to identify potential improvements concerning both topics and initiate a discussion on improvements with a strong focus on FRMCS vehicle rollout.

Sector view on certification and authorization of vehicles

When it comes to vehicle authorization today´s terms and conditions laid down in Europe's 4th Railway package pose challenges for Railway Undertakings (RU) having their fleets to be retrofitted with FRMCS. The currently applicable legislation is quite complex and includes several Directives and Commission Implementing Regulations[2]. As a result, a large number of vehicle prototypes will probably have to be developed, and several conformity-to-type processes carried out in accordance with the current regulation. This will cause high authorization efforts – in terms of time and costs for all European RUs. Experience gained during the retrofitting of improved GSM-R train radios at numerous RUs throughout Europe shows that lengthy authorization processes and unnecessary duplication of work arose due to not very well coordinated practical working methods between national and European authorities or regulatory texts that could be interpreted differently. The necessary integration of certification bodies for each vehicle type further exacerbates the challenge for RUs. A survey on GSM-R retrofitting carried out in Germany in 2023 identified "Authorization issues" as the top problem from RU perspective A currently carried out survey by EURails FRMCS Deployment Subgroup shows a similar picture: Certification and authorization processes are described as "complex" and "lengthy". The lack of availability of bodies (DeBo, NoBo, AsBo) and long processing time on authority side are described as well as overall timeframes from 3 month to up to more than 4 years.

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[1] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Characteristics_of_the_railway_network_in_Europe#Developments_in_the_extent_and_density_of_the_national_railway_networks; figures for FRMCS equipment to be updated as soon as 2025 ERTMS Coordinator's Workplan will be available.
[2] E.g. (EU) 2016/797, (EU) 2018/545, (EU) 2023/1695, (EU) 2016/919

FRMCS trackside rollout issues not in focus

Trackside issues are significantly different: Implementation costs are expected to be high: ERA's Rail System Data Inventory shows a range of 50 to 130 k€ to implement GSM-R along 1 km of an average railway line: if FRMCS costs the same price, implementing FRMCS along an assumed network of 70,000 km of lines will cost between 3.5 Bn € and 9.1 Bn €.

On the other hand, ERA trackside approval is a much lower issue than vehicle authorization: Actually, current regulation can be requested either for a single line, or for a group of line, and is even possible for a whole network. Therefore, this "overhead" cost of some hundreds of k€ per country is less significant than it is for vehicles.

This is the reason why the current report only focuses on vehicles FRMCS implementation and authorization.

The overall costs for the FRMCS vehicle migration are characterized by seven main cost drivers

Item	Explanation
Cost driver 1: Equipment and Installation	• Components delivered and installed on board • Including antennas, cabling, engineering, workshop • Assumption: as for GSM-R 72.000€ [3]/ driver cab. This cost applies to all vehicles, once corrected by 1.6 to take into account part of vehicles where the 2 drivers cab are equipped. • Vehicles with ETCS: 400.000€ ETCS upgrade[4]. This cost applies to all ETCS vehicles (13% of the fleet)
Cost driver 2: ESC / RSC costs and timeframe (part of certification process)	• ERTMS System Compatibility checks (ESC) and/or Radio System Compatibility checks (RSC) • E.g. on-track testing for ESC or lab testing for RSC • ESC: from 300 to 700 k€ lasting from 1 to 12 months [5]. This cost applies only to ETCS prototypes. • RSC: from 50 to 300 k€ lasting from 1 to 6 months[6]. This cost applies to every prototype.
Cost driver 3: Other certification costs	• Conformity checks from accredited or recognized conformity assessment bodies (NoBos, DeBos, AsBos) lasting 30 months and costing 2.5 M€.[7] This cost applies to every prototype.

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[3] According to working group members Return of Experience. This figure is "all included": engineering, products, cabling, installation and workshop rent.

[4] DMT report 2025; assumed shares vehicle equipment: 87% FRMCS Voice only, 13% FRMCS + ETCS upgrade

[5] ERA's Economic Survey Group (ESG): ranges from a 2025 survey; does not apply for FRMCS Voice Only

[6] ERA's Economic Survey Group (ESG): ranges from a 2025 survey

[7] ESG Range for certification and authorization cost: 2 to 5 Mio € per prototype during 1 to 4 years. This cost is splitted according timeframe: 6 months for ERA authorization process leading to 500 k€. As a consequence, rest of certification process las 30 months and costs 2.5 M€.

Cost driver 4: Authorization process	• Authorization process dedicated to ERA/NSA checks, lasting around 6 months costing 500 k€. This cost applies to every prototype.
Cost driver 5: Percentage of prototypes	• Prototype-series ratio: Number of prototypes compared to assigned series vehicles in % • In average: 20 trains per prototype, leading to a percentage of prototypes of 5% • Assumption: average between 100 % (yellow fleet) and less than 1% (large series e.g. suburban trains)
Cost driver 6: CTT (Conformity To Type)	• Authorization for Placing On the Market (APOM) by validated Conformity To Type (CTT) by ERA: ~1.000 € fee per vehicle. This cost applies to every vehicle out of prototypes. • Maximum timeframe: 1 month; ERA (for international trains) needs often less • Average assumption: 1 week
Cost driver 7: Immobilization of vehicles	• Downtime for equipping prototype and trains, assessing their conformity and authorising incl. CTT • Assumed cost of downtime: 2,400 € per calendar day of 8 hours (agreed by DMT[8]). This cost applies to every vehicle.

Taking the figures above into account and applying them to a theoretical fleet of 10,000 vehicles (which may fit to larger railway systems of European member states), results in a cost range of 3.5 Bn € to 7 Bn €.

This theoretical fleet of 10,000 vehicles is homogenous to the European-wide challenge:

- 87 % of the fleet to be equipped with Voice only FRMCS Radio[9],
- 13% to be equipped with Voice + data radio, triggering and upgrade or the first installation of a new ETCS System Version able to manage FRMCS data communications.

This cost range of 3,5 Bn € to 7 Bn € covers all cost for vehicles to be operated: not only implementation costs, but also every "overhead" costs such as engineering, ETCS and Radio and Radio Compatibility checks, conformity assessments (by NoBos, DeBos and AsBos), authorization for placing on the Market (ERA), and immobilization of the related fleet during all the implementation and checks.

The main result of this calculation is that of that costs 45% to 70% are caused by certification, ESC, RSC and authorization processes incl. CTT and include costs for immobilization of vehicles.

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[8] Figures approved by DMT when preparing ERTMS cost drivers report.
[9] Same footnote as above: DMT report 2025; assumed shares vehicle equipment: 87% FRMCS Voice only, 13% FRMCS + ETCS upgrade

2. Cases Studies GSM-R Vehicle Retrofit

In recent years many vehicles across Europe had to be equipped with improved GSM-R receivers to avoid interferences with public mobile networks at 900MHz. One important part here were certification and authorization.

Summary of Survey "Lessons Learned GSM-R Retrofit Germany"

The German rail sector has retrofitted its fleets to interference-resistant GSM-R train radio between 2019 and 2024. The German government's GSM R funding program has been running since 2019. This funded the replacement of individual radio modules (known as module replacement) and the replacement of entire train radio systems (known as system replacement) with interference-resistant variants. The purpose of retrofitting the vehicles was to enable mobile network operators to bring 4G to the tracks without compromising rail operations.

In order to be better prepared for the implementation of similar projects in the future and to be able to carry them out more efficiently and effectively, a survey was conducted among the participants of the aforementioned device replacement project. The topics asked were financing, technical solution (incl. authorization), procurement and implementation of the GSM-R retrofit.

The number of participants was 114, 93 of which came from RUs. Almost all of the companies involved have their headquarters in Germany.

Among other things, there is a great deal of uncertainty and unfamiliarity with the authorization and certification requirements. Overall, the authorization and certification procedures and the authorities receive low ratings. The complete process is almost universally considered to be too work-intensive and mostly lacking in transparency. Authorizations were often not granted within the announced time frame. Certification bodies lack available resources. Feasible, practice-oriented and complete proposed solutions were missed.

- It is becoming clear that conformity assessment and authorization processes are among the main problem areas in the GSM-R conversion process. 40% of respondents mentioned "problems with authorization procedures and certification procedures,". Followed by "problems with delivery, material procurement" with 32% and "problems with funding" with 19% (TOP3, open question, multiple answers possible).
- The availability of certification bodies was predominantly rated as average: Only 30% were "very satisfied" or "satisfied". 39% were "not very satisfied", "dissatisfied" or "very dissatisfied".
- Above all, the scope and effort required to create the documentation was rated as inappropriate by the majority. 67% considered the time frame for submitting the documentation to be inappropriate. 72% considered the scope of the documentation to be too large.
- The authorization process itself received very poor ratings, particularly for the scope of work. In 56% of cases, the authorization was granted (approximately) within the time frame provided. 72% rated the conformity assessment process as lacking transparency or not transparent at all. As many as 90% rate the amount of work required on the part of the applicant for the authorization as not very or not at all appropriate.

- Accordingly, 47% of respondents see the need for improvements, particularly in "authorization and certification procedures". Followed by "Other" with 45% and "Funding" with 24% (TOP3, open question, multiple answers possible).

Lesson learned: The following recommendations emerged from the survey: First and foremost, the communication between the applicants, conformity assessment (certification) bodies and authorising entities should be improved (accessibility, practical and comprehensive information, transparent licensing procedures, clearer notification patterns) and licenses should be issued within the announced timeframe. In the European context of FRMCS, the following conclusions can be drawn: A fundamental simplification of the conformity assessment and authorization processes is essential for respondents in the German sector. Particularly in the case of massive rollout projects such as the FRMCS vehicle migration, the approval processes can have a central influence on the success and timely implementation of the migration by 2035.

Lessons learned from GSM-R radio module modification in France

The project consisted of a modification of the previous dual mode (analog/GSM-R) radio-module by a mono-mode radio module, which is interference resistant. The same Interoperability Constituent (as defined in CCS TSI) is bought for the whole SNCF fleet (5,000 vehicles).

These 5,000 vehicles were splitted in 132 types which triggered the need of 132 different authorization cases, even if in 90% of the cases, the module was only used for voice radio application.

The adopted simplification was to merge these 132 vehicle types in 12 categories (according to integration characteristics (Voice only/ ETCS+ voice, height of electronic rack (major specificities of vehicle: high speed, regional Diesel or Electric Multiple Units, locomotives or yellow fleet): the benefit is to get 12 NoBo "multi-types" certificates instead of 132.

Lesson learned: One common authorization process would have been sufficient, but that was not legally possible. The solution of merging types in categories was useful to simplify conformity assessments by NoBo, but should be expanded to the whole authorization process. When the same modification applies to multiple types, a "multi-type authorization process" should be put in place. Expected savings of a "multi-type authorization process" are the following:

- Assuming number of prototypes is divided by 10 (realistic because above case divided the number of NoBo certificates by 11: 132/12) Conformity and types authorization costs should be divided by 10 accordingly
- Authorization to Put on The Market (APOM) costs will increase by 10 % (less prototypes leads to more series train)
- As a result, **the global "overhead" of conformity + authorization process for the whole fleet should be divided by more than 3**

Lessons learned from a member of the Association of European Rail Rolling Stock Lessors (AERRL)

This section refers to a recent GSM-R upgrading project run by an AERRL member. The project started in 2022 and should end in 2026. The AERRL member noted a) an important difference between Domestic / Cross Border Locomotives and b) between "Non-TSI"- and TSI-Locomotives. Non-TSI locomotives are locomotives which had a multi-national homologation, but were engineered, produced and homologated prior to the 1st TSI being in place (no "TSI Certificate").

In Germany, the AERRL member could benefit from a public subsidy; the subsidy regime was set in a quite typical way: cost of the GSM-R System taken as cap for the subsidy (simplified: 30k€ per loco).

The AERRL member referred to three different cases:

- Case 1: Slovenja and Slovakia NSAs blocked the whole authorization process for more than 6 months. It was initially planned for a ZFM21 to MESA26 GSM-R upgrade project that the creation of a safety assessment report by an AsBo was not required due to the assumed "simple" nature of the project. This view was supported (and, indeed, informed) by the ERA and some NSAs during early discussions and was deemed appropriate to obtain the vehicle type-approval. As such, a safety assessment report by an AsBo was excluded from the contracted scope of the project. Only after the target decision date had passed for the relevant Type Authorization application did the NSA Slovakia declare that a safety assessment report was mandatory for this modification. This led to several intensive discussions with the NSA SK, as well as with the ERA who revised its own earlier evaluation, and other NSAs such as that from Slovenja came to share this stance. As a result, a full safety assessment and report was retrospectively required from an AsBo, after which the Type Authorization application assessment period restarted, ultimately resulting in a project delay of over six months.

- Case 2: Italy NSA asked a specific investigation for replacement of GSM-R equipment on locos with CGR3000 radios due to interface with SCMT (safety alert trigger function). The process chosen by Independent Bodies and approved by the Italian DeBo was rejected by the ERA. ERA explanation: since the SCMT is almost fully integrated in the ETCS System, ERA requested a so called "umbrella-certificate" which is mentioned in section 6.4.1 of TSI CCS 2023 i. e. an EC certificate of verification of the CCS on-board subsystem covering all parts. This caused a delay of approx. 6-9 months. The process is still ongoing.

- Case 3: in the case of DE/FR homologated TRAXX Locomotives, there was a different interpretation between both NSAs at the beginning of the GSM-R-replacement project. Entry into force of 4th Railway package initiated a complete restart of the Process with, for example, the need to prepare French version of some documents, etc.

According to the AERRL member, the impact in terms of costs was the following: On average, the factor of costs vs. subsidy was more than triple. The main reason was an increase in certification and authorization costs. The additional costs (due in some cases to interventions of NSAs) resulted on average in 150-200k€ extra per Type Authorization.

According to the AERRL member, the impact on time for conformity to type authorization was the following: There was a "Learning curve" for each project due to new legislation. It started with one week on average between the end of the physical upgrade and authorization for placing on the market and went down to 1-3 days in each project.

However, the efforts to declare conformity to the type and with regards to the certification of the quality management system ("Module SD" for the integration of the radio components in the vehicles) were high due to the following reasons:

- Necessity to audit and certify every single workshop involved in the Upgrade, and this for every new project. These audits started even with a short "ISO-9001-check" although the workshops already got an ECM certificate.
- the upgrades as such took each approx. 5 to 10 days (depending on the individual workshop)
- in the case of Italy, the Italian DeBo insisted on performing its own audits and certification of the workshops in addition to the NoBo audits and certifications.

The AERRL member also noted the following issues:

- Role of NSAs: when starting the authorization process of cross-border non-TSI-Locomotives, each NSA acts very independently;
- Role of ERA: there is no guidance from ERA, no requirements of "go or no go" during these individual checks by NSAs. ERA is only entitled to wait for the result and is not entitled to act like an independent assessor (i.e. like a "referee"), when NSAs block the process;
- Problem of integration: although an already certified Cab Radio had to be integrated with defined interfaces into an already certified loco, each interface (in a wider interpretation, including e.g. EMC = Electromagnetic Compatibility) was subject to deeper evaluations.

As a conclusion, the AERRL member proposed: When an equipment is certified it should be possible to integrate it without further checks; ERA needs empowerment to act as a "strong" mediator (in case of doubt) or another neutral institution should play that role.

Lessons learned: Too many additional unexpected costs, too many interventions by national authorities, too many national rules, lack of trust by authorizing entities that often require additional documentation on assessments already done by others, too many certifications (staff, workshop, equipment, etc.)

Lessons learned – Past (before 4th Railway Package)

GSM-R first implementation took place in many countries before the 4th Railway Package (published on the 26th May 2016 in the OJEU). GSM-R replaced former country specific analog radios and was designed for both Voice Radio Communication and Data radio-communication for ETCS in an harmonized way. As such it is interesting to remember the way this implementation was authorized, in order to highlight differences with the current situation.

In France this implementation began in 2006 (first line operated with GSM-R voice radio) and 2016 (last line equipped), with in the meantime, the first line in France with ETCS L2 over GSM-R (Paris-Strasbourg Highspeed, 400 km of newly built line with newly designed trains). In the rest of France GSM-R replaced 16 000 km of voice analog radio.

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Before any implementation SNCF performed an up-front analysis concluding that on-board implementation of a dual mode cab radio was a non-significant modification, analysis validated by the French NSA (EPSF). As a result, the different implementation phases were performed internally while updating information transmitted to the French NSA.

Prototype phase:

- Each prototype vehicle was equipped with a dual-mode cab-radio operated as usual on analog radio lines (giving confidence on non-regression) and tested during commercial operation with GSM-R on dual on trackside equipped lines.

- For each software upgrade an EC certificate of interoperability was required from the supplier, and then, implemented.

Series phase: Once prototype checks were satisfying, series trains were implemented and returned afterwards to commercial operation.

NSA information: Once the series train came to an end, SNCF sent a letter to EPSF :

- Informing of the series equipped with dual cab radio

- Sharing the results of integration tests

- and, if relevant, sharing the EC certificate of interoperability of the implemented software version.

Lesson learned: While no safety event was reported in relation to this way of performing implementation of dual-mode GSMR + analog cab-radio, current EU legislation needs to be modified in order to achieve a similar process for FRMCS implementation.

3. Conclusions

Downtime induced costs need to be reduced significantly

Regarding the overall costs for the FRMCS vehicle rollout the effort share of 45% to 70% for certification/authorization and immobilization of 10,000 vehicles fleets is quite high. Taking a closer look, it becomes clear that the main driver of these high costs is vehicle downtime and immobilization, which is caused by certification and authorization processes. As a result, there is a need to significantly reduce these expenses in cost and time without impacting safety.

Right time: Starting discussions on changes to legislation can lead to relevant solutions in time

Authorization processes should be optimized while integrating the European sector transparently within the actionable timeframe. Having in mind that GSM-R will be taken out of service by 2035 from now there are 10 years left to simplify certification and authorization processes and retrofit 50,000 – 100,000 vehicles. All involved European players and authorities should start working together on suitable and feasible improvements.

The FRMCS subgroup WG2 offers to work intensively on the analysis and improvement of authorization processes and the associated regulation. Already today there is a dedicated ERA group in charge with improving the current vehicle authorization process without modifying the interoperability directive but updating the Commission implementing regulation on vehicle authorization. Any concrete proposal to change EU legislation, such as the Interoperability Directive, with a view on 402/2013 (CSM-RA) and ERA Regulation 2016/796 should go directly to the Commission (DG MOVE) as such changes might require the involvement of other stakeholders (MS, Council, EP, etc.) and take several years.

4. Way forward

1. Reducing the number of vehicle prototypes by applying generic approaches

Instead of having to carry out a separate authorization procedure for each vehicle type, those responsible for the conversion must be given the legally secure option of forming modification clusters that include different or several vehicle types or variants. Only one First-of-Class modification is then required per cluster. This will have a huge positive impact on certification costs, safety assessment costs incl. RSC and ESC tests and test runs, authorization costs and vehicle downtime costs. One necessary next step should be defining criteria for such clusters.

2. Simplify certification and conformity assessment processes

A second approach is that an applicant should be enabled to declare verification for the subsystem integration without involving again an assessment body. This would require an "SA Module" which is actually not existing in the Module Decision of the Commission. This would allow a self-declaration by applicants without involvement of a NoBo. For FRMCS the relevant conformity assessment should be done as much as possible at component level by manufacturers.

3. Further Simplification of the authorization process

A next step should be the application of the "*prima facie*" principle on IC-level, hence that authorities should accept a valid certificate delivered by any accredited or recognized certifying entity in EU (such as AsBo, DeBo and NoBo) as correct without any further technical assessments until proved otherwise. As a result authorities should assess the same IC only once. ERA is already implementing IT tools where assessors can check if ICs were already checked by other assessors.

4. Streamlining authorization processes for the rollout of FRMCS into vehicles
4.1. Avoiding authorization triggered by Art. 21(12) Interoperability Directive (EU) 2016/797

RUs could be enabled to decide on carrying out the FRMCS implementation for voice only as a non-safety related activity if it is considered that the implementation of FRMCS does not adversely affect safety pursuant to article 21 (12)(b) of Directive (EU) 2016/797. In this case FRMCS implementation would be recognized as a change ((EU) 2028/545 Art 15(1)b or c) requiring a new version or just an update of an existing type in ERA-TV.

In this case the complete retrofitting can be done by an "Entity Managing the Change"[10] as quoted in (EU) 2018/545 or the vehicle type holder without involvement an authorization entity.

4.2. Simplyfing authorization processes for ETCS vehicles

Furthermore implementing FRMCS on ETCS vehicles could be done using a "self-authorization process". The idea is to expand the responsibility of the Entity Managing the Change for specific changes (e. g. integrating FRMCS on ETCS vehicles) by giving it the responsibility to issue the authorizations for this change. It is suggested that this Entity Managing the Change must be recognized by an authorizing entity (ERA or any NSA). In that way RUs could be enabled to process changes to their vehicles completely on their own responsibility. That would take resources away from authorizing entities as well as certification bodies and could accelerate massive vehicle rollout approaches. This idea must be further explored, including its impacts on all legal aspects.

4.3. Automated CTT process

The CTT process shall be automated completely without human checks. This would require digitally readable certificates as well as IT-connections between OSS and ERADIS. ERA is already working on an approach like this that shall reduce the time effort for carrying out CTT processes in general significantly.

It is clear that all the approaches described require close coordination with and between the European authorities. This may also help NSAs to ensure their regulatory readiness to support FRMCS deployment in terms of capacity. Regarding the survey of EURails FRMCS Deployment Subgroup capacities are limited at all participating NSAs, i.e. actually, NSAs who responded to the survey of the EU Rail FRMCS Deployment subgroup are afraid of a future lack of capacity to face FRMCS implementation.

Potential savings of the mentioned proposals

A major improvement is to be seen in the reduction of the number of necessary First-of-Class projects. Dividing the number of prototypes by 10 (from "1 prototype per 20 vehicles" → to "1 prototype per 200 vehicles") divides the global conformity assessment and authorization costs by 10. That reduction may trigger a total cost reduction for the migration of a whole fleet by a factor near 2. For a theoretical fleet of 10,000 vehicles costs of migration can be downsized from the range 3.5 Bn € to 7 Bn € to a range of 2 Bn € to 4 Bn. €.

Furthermore, if the certification and authorization process is simplified by allowing the "self-certification" (SA Module) and the "self-authorization" of the vehicle-integrated sub-systems (CCS Onboard and rolling stock) by applicants can lead to another reduction of the certification costs (only costs to establish the evidence for certification remain). Applying this to European vehicle fleets means the cost range can be further downsized.

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[10] Art 2 Pt 5, Art 14 Pt 4, Art 16 Pt 3 & 4 of (EU) 2018/545 defines „Entity Managing the Change"

An early adoption and simplification of certification and authorization approaches may not only help NSAs and European Authorities processing all applications but may also improve cost and downtime issues for RUs, lessors and vehicle keepers as well as ensure the timely migration success of the FRMCS vehicle rollout by 2035.