

**EXECUTIVE SUMMARY OF THE REPORT**

**ON-BOARD SAFETY EQUIPMENT  
IN OPENED TO COMPETITION  
HIGH-SPEED RAILWAY SERVICES**

**> July 2022**



## Executive Summary

**The safety and performance (frequency and commercial speed, for instance) of the operation of a railway network rely to a great extent on the control-command and signalling systems.** These systems enable a dialogue between the infrastructure and the trains, the transmission of instructions to the driver (especially concerning speed) and, if necessary, the stopping of the train in the event of a safety hazard. They are based on ground and onboard equipment and are essential elements of the railway networks, ensuring safe operation.

**Most European countries have historically developed and implemented specific systems, adapted to national constraints, and referred to as "Class B safety systems".** In France, these are the KVB speed control through transponder - the safety system for running on conventional lines - and the TVM transmission track-machine - the safety system developed for running on high-speed lines (HSL).

**The European institutions have set a target for the deployment of a unified European rail traffic management system, ERTMS<sup>1</sup>, referred to as the "Class A safety system",** to enable the emergence of a single European railway area. Nevertheless, its deployment requires substantial investment, making the historical systems still unavoidable for several decades.

**Several new entrants wishing to offer open-access high-speed services on the French market have informed the Authority of their difficulties in purchasing the necessary onboard safety systems** and ensuring their successful implementation to obtain the required authorisations to operate transport services on the railway network.

**These difficulties may constitute obstacles or even technical barriers to entry, which the ART is responsible for identifying and reducing.** Indeed, Article L.2131 1 of the Transport Code, which defines the general mission of the ART, states that the latter "*shall contribute to the monitoring and proper functioning, in its technical, economic and financial dimensions, of the national railway transport system, in particular the public service and competitive activities, for the benefit of users and customers of railway transport services*".

**In this context, ART decided to conduct a study aimed, on the one hand, at providing transparency and clarity on the procedures for acquiring, integrating, and operating onboard safety equipment and, on the other hand, at making recommendations to the players in the sector** at various stages of the process, in order to facilitate the arrival of new entrants on the French railway market. This work is in line with ART's strategic guidelines, which aim to increase the transparency, effectiveness, and efficiency of the railway system in order to improve its attractiveness and to accompany the opening up of domestic rail passenger transport to competition

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<sup>1</sup> European rail traffic management system.

## 1. While the implementation of ERTMS is likely to be very gradual, European texts require France to implement transitional measures to ensure interoperability in terms of control-command and signalling

### 1.1. European law has provided for transitional measures to achieve interoperability in control-command and signalling, pending the implementation of ERTMS

In Europe, historically, rail transport has grown up within national borders, leading to a relatively heterogeneous and fragmented rail system, which European policies for interoperability aim to unify. From the 1990s onwards, Member States have been promoting the interoperability and safety of the European railway system in parallel with the development of the rail market. The "technical" pillar of the 4th railway package, consisting in particular of Directives (EU) 2016/797 and 2016/798 of 11 May 2016 on, respectively, the interoperability of the rail system within the European Union and the safety of the rail system, aims to:

- enable the development of international railway services within the European Union (EU) and to contribute to the completion of the single European railway area;
- contribute to the progressive creation of the internal market in equipment and services for the construction, renewal, upgrading and operation of the Union rail system;
- develop and improve the safety of the EU railway system.

**ERTMS (European Rail Traffic Management System) is an essential part of the European strategy to achieve the safety and interoperability objectives set out in the 4th railway package.** It aims to replace all existing signalling systems in Europe with a single system designed to promote interoperability. The standardisation of signalling made possible by the ERTMS should also lead to competition between equipment manufacturers, which will help to reduce the costs of rail transport. The ERTMS specifications, published as an annex to Commission Regulation (EU) 2016/919 of 27 May 2016 on the technical specification for interoperability relating to the 'control-command and signalling' subsystems of the rail system in the European Union (hereafter the "CCS TSI") are the result of collaboration between stakeholders in the sector under the auspices of the European institutions.

**In terms of timetable, the ERTMS deployment requirements were set in the context of the identification of the rail links considered strategic at European level.** The latter constitute the trans-European transport network (TEN-T), which includes:

- the "core" network presenting the highest strategic importance and of which the achievement, including ERTMS deployment, are set for 2030. In France, the core network includes notably the high-speed lines.
- the "comprehensive" network, which aims to ensure the connectivity of all regions in the EU, and which must be achieved, including ERTMS deployment, in 2050.

However, these deadlines are not binding, as the European framework makes the implementation of ERTMS deployment dependent, in particular, on *"their degree of maturity [of the projects] (...) and the availability of financial resources"*. Insofar as the gradual deployment of ERTMS throughout Europe will take several decades, a transitional period during which both Class A and Class B systems will coexist is thus inevitable

**In order to ensure the full interoperability of rail services in Europe and pending the deployment of ERTMS in each Member State, a technical stopgap solution has been provided at European level - the Specific Transmission Modules<sup>2</sup> (hereafter "STM").** Thus, in order to allow access to their infrastructure for operators, including foreign operators, Member States must, in accordance

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<sup>2</sup> An STM is a version of an onboard class B safety system that allows standardised interfacing with the ERTMS and thus allows ERTMS-equipped rolling stock to run on an infrastructure equipped with a class B safety system.

with the CCS TSI, "make every effort to ensure the availability of an external Specific Transmission Module (STM) for [their] legacy Class B train protection system or systems" <sup>3</sup>, when the infrastructure is not equipped with the ERTMS. It is also stated that, for this purpose, the Member States must ensure "an open market for STMs under fair commercial conditions".

**If the availability of an STM cannot be guaranteed, Member States must implement "mitigation measures".**

**1.2. The implementation of these transitional measures is particularly important in France, where the deployment of ERTMS - limited to less than 40% of the high-speed network - is likely to be very gradual**

The ERTMS deployment in France appears to be delayed compared to the rail networks of neighbouring countries and will probably be very gradual, particularly because of the high costs and because of the reliability of the historical French systems. Thus, ERTMS currently equips less than 40% of French high-speed lines (approximately 1,000 km out of 2,814 km of lines), representing the new lines that have been in service since 2007. Regarding conventional lines, only the first sections of the freight corridor between Longuyon and Basle (a few dozen kilometres out of 427 km) have been equipped. Thus, barely 20% of the target set for 2030 (more than 5,800 km of equipped lines) has been achieved to date. Even if the planned lines are added, barely more than a third of the target should be achieved (half for high-speed lines) by 2030. Furthermore, work on the economic model for ERTMS in France has not yet been completed and the visibility of the sector remains uncertain.

**Under these circumstances, the transitional solution provided for in the European texts - i.e. the provision of specific transmission modules or, failing that, the adoption of mitigating measures - is of particular importance.** Due to the limited deployment of ERTMS in France, rail vehicles must be able to operate on infrastructure equipped with the French Class B safety systems: the KVB and TVM. Figures 1 and 2 describe the systems with which trains must be equipped to operate on conventional and high-speed lines respectively. In the light of this, it is essential that the design of safety architectures and the acquisition and integration of Class B safety equipment is facilitated so as not to impede the interoperability of the national rail transport system and the opening up of the rail transport market to competition.

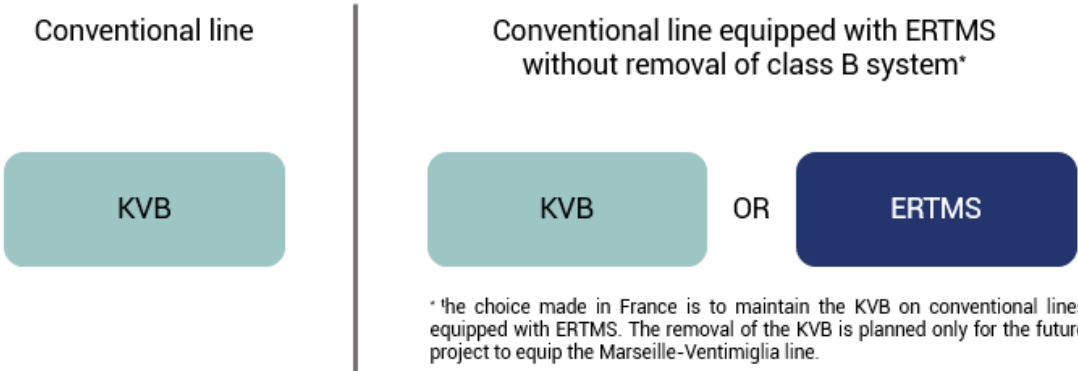


Fig. 1 Onboard safety equipment required to operate on conventional lines in France

<sup>3</sup> Commission Regulation (EU) 2016/919 of 27 May 2016 concerning the technical specification for interoperability relating to the control-command and signalling subsystems of the rail system in the European Union, Annex, point 7.2.3.

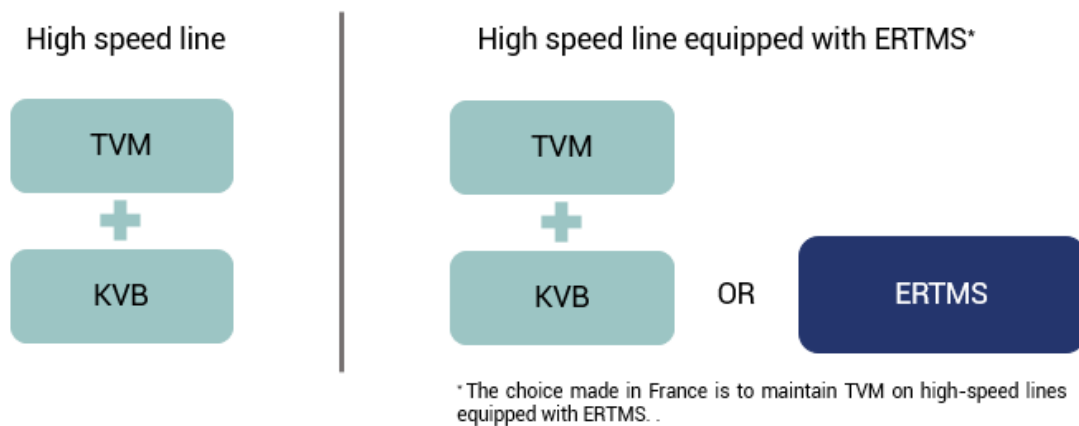


Fig. 2 Onboard safety equipment required to travel on high-speed lines in France

## 2. The ART formulates 18 recommendations in order to lift the barriers to entry identified in the lack of measures taken by France to ensure interoperability for the control-command and signalling systems

The study conducted by ART aimed at identifying the barriers to entry at each stage of the implementation of an onboard safety architecture on the national rail network (see Fig. 3 below).



Fig. 3 The different stages of the implementation of an onboard security architecture in France

In the absence of measures taken to date by France to ensure interoperability in the area of control-command and signalling, ART's study leads to the identification of 18 short- and longer-term technical recommendations to remove these barriers to entry, grouped around five general recommendations.

- **Recommendation 1:** Give a "system authority" responsibility for the legacy Class B safety systems in France.

The age of the French Class B safety systems and the changes in the railway sector explain the absence of a real "leader" for the implementation of legacy safety systems in France. The competences and responsibilities for legacy safety systems are thus divided between the EPSF (the French Railway Safety Authority), SNCF Réseau, SNCF Voyageurs and the industry, thereby strongly complicating the task of identifying the right contact for new entrants.

In this context, it appears necessary to appoint an entity responsible for the French legacy safety systems. In the short term, it would be responsible for accompanying the entry of new operators and monitoring developments for the benefit of the entire sector. In the longer term, it will have to ensure the opening up of class B systems in France and ensure that the products available meet the interoperability challenges and the needs of new entrants.

## Technical recommendations:

In the immediate future	In a ramp-up phase
<p>1. Appoint an entity responsible for class B security systems in France, grant it, initially, the task of supporting new entrants and informing the sector, and ensure that it has the necessary resources to fulfil these tasks.</p> <p>As such, consider two options:</p> <p>Option 1: The role of the responsible entity is given to SNCF Réseau [DGITM, SNCF Réseau].</p> <p>Option 2 (preferred): The role of the responsible entity is given to EPSF, possibly in the form of a dedicated entity attached to the latter [DGITM, EPSF].</p>	<p>2. Expand the missions of the entity responsible for Class B safety systems to ensure the availability of the equipment needed for new entrants. To this end, ensure that it has the legal, technical, and financial means - the recruitment and training of experts being a key point - required to fulfil these missions [DGITM].</p>

- **Recommendation 2: Implement a transparent framework for new entrants, right from the design of safety architectures**

**New entrants are confronted with a lack of transparency regarding legacy safety systems in France due** to poorly accessible documentation, scattered among many players and sometimes insufficiently updated. For example, some technical documents relating to onboard safety equipment, listed in particular in the S706 and S707 rolling stock authorisation specifications (SAM), can only be provided as part of a project that has been duly contracted with the manufacturers of this equipment. However, this documentation could be useful to a manufacturer as early as the design stage of his onboard safety architecture.

**It is therefore necessary for the entity responsible for Class B safety systems to take measures to ensure timely access to the documentation required for the design of onboard safety architectures to operate on the national rail network.**

## Technical recommendations:

In the immediate future	In a ramp-up phase
3. Set up a technical committee under the auspices of the entity responsible for Class B safety systems in France, bringing together all relevant stakeholders, in order to identify the documents relating to signalling and onboard safety systems whose timely publication would be essential for access to the national rail network under transparent, fair and non-discriminatory conditions. The entity responsible should then ensure the centralised publication of documents useful to the sector as well as the monitoring of the necessary updates [Entity responsible for SSCB in France].	

- **Recommendation 3: Favour the opening up of legacy systems to ensure the availability of safety equipment.**

Although, in theory, it is possible to replicate the architecture of the trains used by SNCF Voyageurs to provide domestic high-speed services, this architecture is nevertheless "locked" and requires the use of manufacturers with a monopoly on each of their equipment: Hitachi for the ERTMS/TVM bi-standard and Alstom for the legacy KVB.

Thus, since the opening of the market, new entrants have had difficulties in acquiring the "onboard" equipment necessary to replicate the proven high-speed architecture of the incumbent operator in order to operate on infrastructure equipped with transponder-based speed control (KVB). Alstom stopped selling the KVB legacy in 2013, well in advance of the opening up of passenger rail transport in France to competition. Although Alstom has subsequently developed solutions that suit the market's needs - in this case, a bi-standard ERTMS/KVB and a KVB STM - which is likely to mitigate the acquisition difficulties mentioned above, the high-speed version of the KVB STM has not yet been tested: it will be deployed for the first time in the future TGV M trainsets that will be operated by SNCF Voyageurs from 2024.

Similar to what can be observed in other European countries, the opening up of the KVB "onboard" equipment market could prove useful in the case of the development of "France" STM-type equipment integrating both KVB and TVM, to fulfil the needs of the market, especially the difficulties linked to the lack of a TVM STM.



## Technical recommendations:

In the immediate future	In a ramp-up phase
<p>4. Publish regular monitoring and projections of SNCF Voyageurs' KVB legacy stock to inform the industry of potential equipment availability and leasing solutions where appropriate [SNCF Voyageurs, Entity responsible for SSCB in France and SNCF Réseau (PSEF <sup>4</sup>) pending the establishment of the responsible entity].</p> <p>5. Ensure the availability of the high-speed compliant KVB STM for the whole sector and follow up its integration in the safety architectures of high-speed trains [Entity responsible for the SSCB in France and DGITM pending its implementation].</p>	<p>6. In the event of the development of an STM France integrating KVB and TVM, favour the opening up of the KVB system, in particular by publishing the detailed functional (or even technical) specifications of the system, for example within a technical committee placed under the auspices of the entity responsible for Class B safety systems in France and gathering the experts on the subject [Entity responsible for SSCB in France].</p>

**The implementation of an architecture complying with the objectives set by the European texts on interoperability (i.e. organised around the ERTMS) is also hampered by the absence of a TVM STM, which is particularly detrimental to international traffic.** This is linked to the late emergence of effective competition on high-speed rail links, the lack of anticipation from the State and technical obstacles. To ensure cross-border traffic, several alternatives are possible in terms of onboard safety architecture. However, they all raise issues of cost, operation and availability of equipment. The development of a TVM STM, or a "French" STM providing TVM and KVB functions, or an interfaceable version of TVM, has not been promoted by the public authorities, because of the technical and commercial difficulties of such an undertaking and the choice to maintain the legacy system.

**The development of interfaces between TVM and ERTMS-compatible onboard equipment (EVC<sup>5</sup>) from manufacturers other than Hitachi would open up the market for high-speed onboard equipment in France.** To this end, cooperation between manufacturers seems necessary to develop viable technical solutions.

<sup>4</sup> Service platform for railway undertakings.

<sup>5</sup> European Vital Computer (part of the European train control system data processing computer installed onboard the trains).

**Technical recommendations:**

In the immediate future	In a ramp-up phase
<p>7. Promote the collaboration of manufacturers, possibly within the strategic contract for the rail industry, to develop, at the very least, interfaces between TVM and ERTMS "onboard" equipment other than that of Hitachi [DGITM with the support of the DGE, the entity responsible for SSCB in France].</p> <p>8. Strengthen, within the revision of the CCS TSI planned for 2022, the provisions fostering the development of interfaces between ERTMS and Class B systems, in particular by making the use of "non-STM" interfaces between Class B safety systems and ERTMS (especially within the scope of a bi-standard) conditional on the availability of STM versions of the systems or on the accessibility by third parties of their detailed specifications [ERA, DG MOVE].</p> <p>9. Monitor TVM obsolescence and increase transparency on TVM system production capacity and commercial conditions, eventually as part of the update of the "national implementation plan" provided for by the CCS TSI [DGITM, Entity responsible for SSCB in France].</p>	<p>10. Promote the validation of interfaces between Hitachi's TVM and other manufacturers' ERTMS, especially by publishing the detailed functional specifications of the system, for example through a technical committee under the auspices of the entity responsible for class B safety systems in France and gathering experts on the subject [Entity responsible for SSCB in France].</p> <p>11. If necessary, ensure the provision of a TVM STM (or alternatively a "France" STM6 or ad hoc equipment that interfaces with third party EVCs) through a call for tender [DGITM, Entity responsible for SSCB].</p>

- **Recommendation 4: Maintain access to the know-how and skills needed to implement safety equipment.**

**Because of its historical collaboration with manufacturers and its experience as a rail operator, SNCF Voyageurs has a number of skills in the field of safety equipment which seem difficult to replicate in the short term, thus creating a temporary asymmetry between the new entrants and the historical operator.** In particular, it seems that the issuing of a "qualification opinion" on a vehicle or sub-system by SNCF Voyageurs' equipment engineering centre (CIM), or at least a second review by CIM experts, makes it easier to obtain the authorisation for placing on the market (AMM) from the EPSF or, at least, its favourable opinion on compliance with national rules transmitted to the European Union Railway Agency (ERA) in charge of issuing the AMM, particularly for vehicles intended for high speed and deviating from proven architectures<sup>7</sup>. There is no legal requirement for this qualification opinion.

<sup>6</sup> A "France" STM is an STM that integrates, in the same equipment, the functionalities of TVM and KVB.

<sup>7</sup> In order to operate within the railway system to provide rail transport services, any new or modified railway vehicle must have an approval by type or an authorisation for placing on the market (AMM).

Consequently, it seems necessary to ascertain that new entrants have access to the skills relating to safety equipment currently held by SNCF Voyageurs' equipment engineering centre and to contemplate, in the longer term, operational changes to the vehicle authorisation process, so that it no longer relies in practice on the expertise of the incumbent operator.

Technical recommendations:

In the immediate future	In a ramp-up phase
<p>12. Ensure transparent, fair and non-discriminatory access to the skills and know-how of the incumbent operator relating to onboard safety systems. If necessary, consider the transfer to SNCF Réseau of certain cross-cutting skills in onboard safety systems [DGITM, SNCF, SNCF Réseau, SNCF Voyageurs].</p>	<p>13. Consider the role of EPSF in the new competitive context in which the use of the public rail group's expertise is likely to entail risks in terms of access to the rail network [DGITM, EPSF].</p>

- **Recommendation 5: Accelerate the deployment of ERTMS on the national rail network and provide stakeholders with visibility on the schedule.**

Less than 40% of high-speed lines (and almost no conventional lines) are currently equipped with ERTMS in France, whereas European law stipulates that more than 5,800 km of lines (including all high-speed lines) must be equipped by 2030 (TEN-T core network). Although equipping the entire high-speed network with ERTMS would facilitate access to the French market for new entrants, particularly for international links, the - admittedly still limited - discussions on the economic model for ERTMS in France do not seem likely to accelerate its deployment throughout the core network to meet the 2030 deadline.

In this context, a good visibility on the ERTMS deployment schedule and the removal of Class B safety systems would enable operators to anticipate the equipment of their rolling stock, which is of utmost importance for the operators of international high-speed links in order to plan their entry into the rail transport market, as it is for the infrastructure manager, for better management of its assets.

In any case, the deployment of the ERTMS in France must not lead to the creation of new barriers to entry for rail operators. In particular, the State must ensure that independent expertise is available to new entrants on the functional and technical characteristics, testing and trial facilities, attached to the ERTMS system deployed domestically, in order to ensure fair and non-discriminatory access to the French rail network.

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- For vehicles whose use is limited to the French railway system, the applicant has the choice of applying either to the European Union Agency for Railways (ERA) or to EPSF.
  - For vehicles with a scope of use that extends over the network of another Member State or Member States, the Agency alone is competent to issue the authorisation, the national aspects of the applications being assessed by EPSF, which provides its conclusions to the Agency.

In both cases, the processing of the application for an approval by type or AMM is subject to the submission of the relevant file to the "One Stop Shop" (OSS) run by the Agency.

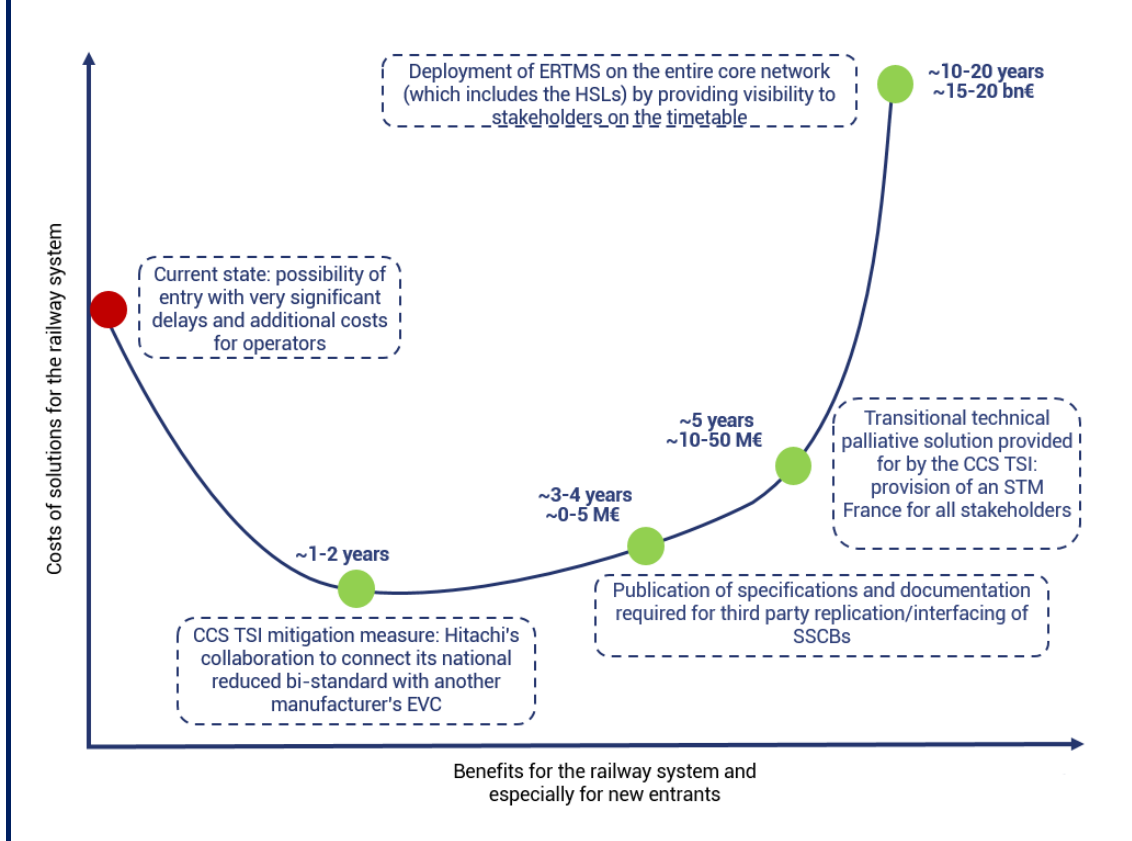
**Technical recommendations:**

In the immediate future	In a ramp-up phase
<p>14. Finalise the work carried out to develop the economic model for ERTMS deployment, taking into account (i) the benefits of accelerated deployment for the opening up to competition, particularly for international high-speed services, and (ii) the potential gains from the removal of class B safety systems [DGITM, SNCF Réseau].</p>	<p>15. As part of the updating of the ERTMS "implementation plan", propose a "national ERTMS deployment strategy" to give stakeholders visibility on ERTMS deployment and Class B safety system removal schedules, particularly for the entire TEN-T core network, which includes high-speed lines. The new entrants (through AFRA or UTP, for example) should be consulted on the development of this strategy [DGITM, SNCF Réseau].</p> <p>16. Mobilise, as far as possible, charging for access to the national rail network (charging based on long-term costs) in order to generate resources for financing the ERTMS [ART, DGITM, SNCF Réseau].</p> <p>17. Include in the multi-annual performance contract between the State and SNCF Réseau, as of its next update (scheduled for 2024), and in the national CCS TSI implementation plan, the commitments made in terms of ERTMS deployment and ensure their financing [State, SNCF Réseau].</p> <p>18. Ensure that independent expertise is available to new entrants on the functional and technical characteristics, testing and trial facilities, attached to the ERTMS system deployed domestically, in order to ensure fair and non-discriminatory access to the national rail network [DGITM].</p>

## Economic comparison of the different solutions

Maintaining the status quo on the deployment of ERTMS in France and the French SSCBs (in particular the absence of an STM for TVM or an interface between Hitachi's TVM and another manufacturer's EVC) hinders the opening up of open-access services market to competition. The difficulties experienced by the new entrants lead them to postpone or even abandon the launch of new services on the French market. Those that do manage to do so face very substantial costs, up to several million euros per train set.

The different solutions outlined in this study provide answers to the difficulties experienced. The figure below summarises the main solutions identified, indicating their costs and timeframes.



Source: ART

## Table of acronyms and abbreviations

AFRA	Association française du Rail <i>French Rail Association</i>
AMM	Autorisation de mise sur le marché <i>Authorisation for placing on the market</i>
ART	Autorité de régulation des transports (anciennement Arafer) <i>Transport Regulatory Body</i>
CCS	Contrôle commande signalisation <i>Control command signalisation</i>
CIM	Centre d'ingénierie du matériel <i>Equipment Engineering Centre</i>
DGE	Direction générale des entreprises <i>Directorate General for Enterprises</i>
DGITM	Direction générale des infrastructures, des transports et de la mer <i>Directorate-General for Infrastructure, Transportation and the Sea</i>
EPSF	Établissement public de sécurité ferroviaire <i>French Public Establishment of Rail Safety, acting as French NSA</i>
ERA	European Union Agency for Railways
ERTMS	European Railway Traffic Management System
EVC	European Vital Computer
HSL	<i>High Speed Lines</i>
KVB	Contrôle de Vitesse par Balise <i>Speed control through transponder</i>
SAM	Spécifications d'autorisation du matériel roulant <i>Rolling stock authorisation specifications</i>
SNCF	Société nationale des chemins de fer <i>National society of French railways</i>
STM	Specific Transmission Module
TEN-T	Trans-European Transport Networks
TGV	Train à grande vitesse <i>High speed train</i>
TSI	Technical specification for interoperability
TVM	Transmission voie-machine <i>Track-to-train transmission</i>
UTP	Union des transports publics et ferroviaires <i>Public and Rail Transport Union</i>

## Glossary

**Control-command and signalling subsystems:** train protection systems consisting of the trackside signalling systems of the rail network and the onboard signalling systems of the vehicles intended to be operated on that network.

**Control, Command and Signalling Technical Specifications for Interoperability (CCS TSI):** Commission Regulation (EU) 2016/919 of 27 May 2016 on the technical specification for interoperability relating to the 'control-command and signalling' subsystems.

**Onboard safety systems:** the "onboard" component of train protection systems, which includes one or more onboard safety equipment.

**Class A safety system:** European Train Protection System, otherwise known as European Rail Traffic Management System (ERTMS).

**Class B safety systems (SSCB):** legacy systems (placed into service before 20 April 2001) for train protection, each Member State having its own system(s). On the French national rail network, there are two Class B systems:

- KVB: Transponder-based speed control is deployed on the main conventional lines of the RFN. The onboard subsystem continuously monitors the speed of the train and receives information from the ground via beacons placed along the tracks (spot transmission).
- TVM: track-to-machine transmission is deployed on high-speed lines. The onboard subsystem continuously monitors the speed of the train, displays speed instructions in the cab (onboard signalling) and receives information from the track via the track circuits (continuous transmission).

The term **legacy** refers to the historical versions of such equipment.

**Specific Transmission Module (STM):** an STM is a version of an onboard SSCB which allows a standardised interface with the ERTMS and thus allows rolling stock equipped with ERTMS to run on an infrastructure equipped with SSCB.

**Trans-European Transport Network (TEN-T):** the TEN-T, defined by Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013 on the Union guidelines for the development of the trans-European transport network, comprises "*transport infrastructure [railway, inland waterway, road, maritime, air and multimodal] and telematic applications as well as measures promoting the efficient management and use of such infrastructure (...)*". The gradual development of this network involves the implementation of a dual-layer structure consisting of the comprehensive network and of the core network, the latter being established on the basis of parts of the comprehensive network with the highest strategic importance.

**Bi-standard:** a bi-standard combines ERTMS with a Class B safety system, the two systems being nested within a single piece of equipment. It allows safe dynamic transitions between the two systems thanks to an interface which is not, however, standardised like an STM. The ERTMS within a bi-standard cannot be replaced by another manufacturer's ERTMS.



11, place des 5 Martyrs du Lycée Buffon  
CS 30054 - 75675 Paris Cedex 14  
Tél. +33 (0)1 58 01 01 10

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