



# **Regulation (EU) 2016/919 from the Commission of 27 May 2016 on the technical specification for interoperability relating to the ‘control-command and signalling subsystems’ of the railway system in the European Union**

## **National implementation plan for France**

*(Version as of 27 June 2017)*

This implementation plan describes the current situation of the signalling systems on the national railway network (1) before specifying the deployment strategy ‘ERTMS’ (*European Rail Traffic Management System*) on this network and for the rolling stock using it (2), and its timetable (3).

### **1. General description of the signalling systems on the French network in 2017**

French railway signalling uses several systems designed to ensure the correct and safe operation of trains. High-speed lines and important freightways are progressively being equipped in compliance with the European signalling system. Today, more than 1,000 kilometres of lines are equipped with ERTMS.

#### **1.1. Conventional network signalling system**

ERTMS Level 1 (full supervision) is being installed on the 427 kilometres<sup>1</sup> of lines between Longuyon and Basel, on the French section of the North Sea – Mediterranean and part of the Atlantic multi-modal corridors, in superposition with traditional signalling. The two pilot sites, 40 kilometres from the Longuyon and Mont-Saint-Martin lines to the Belgian and Luxembourg borders, have already received their Authorisation of Placing In Service (APIS).

On the rest of the conventional network, traffic safety is ensured by:

- Spacing signalling (BAL Luminous Automatic Block) which controls the signals according to the occupation of the track circuits. This signalling covers all 5,800 kilometres of the French part of the Trans-European Transport Network's (TEN-T) core network;
- Speed control by beacon (KVB) which is in charge of stopping the train if necessary (all signals on the French part of the TEN-T core network are equipped with this).

In terms of safety, no accidents can be blamed on a KVB malfunction. The number of KVB train brake controls is decreasing (there were 1,800 transfers in 2015 compared with the 400 million trains passing an equipped signal).

The reliability of the KVB system is also proven.

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<sup>1</sup> The distances are expressed in kilometres of equivalent double-track.

## **1.2. High-speed line signalling system**

For the high-speed network, all new or deeply renewed lines are equipped with the European signalling system.

ERTMS Level 2 is already installed on:

- the 406 kilometres of the European East high-speed line (HSL) linking Paris to Strasbourg;
- the 340 kilometres of the Tours – Bordeaux HSL;
- the 180 kilometres of the Le Mans – Rennes HSL;
- the 25 kilometres of the French part of the Perpignan – Figueras HSL.

ERTMS Level 1 will be in service at the end of 2017 on the 70 kilometres of the Nimes and Montpellier bypass line.

On the East European HSL, since the implementation of ERTMS in December 2014, 200 journeys per week are made exclusively with this new signalling system, and 2 million kilometres had been travelled by March 2017.

The rest of the network – 1,500 kilometres of high-speed lines – is equipped with the "Train-to-Machine Transmission" (TVM) system which provides in-cabin driving instructions. In terms of safety, no accidents can be blamed on the malfunctioning of this system, whose horizon of obsolescence is expected to surpass 2040. The reliability of the TVM system is also proven.

## **1.3. Commercial conditions for existing speed control systems, known as Class B**

To ensure technical compatibility between the infrastructure and the rolling stock travelling on existing, conventional or high-speed networks, several solutions are available.

On the conventional network, compatibility with KVB on the ground can be ensured by the rolling stock equipment with one of the following systems:

- the historical KVB known as "KVB Legacy", whose production ceased in 2013 but whose operating conditions have been maintained since 2015 on the initiative of the French railway sector for the benefit of all railway undertakings and all rolling stock keepers;
- an ERTMS - KVB bi-standard;
- specific transmission modules ("STM KVB", stand-alone STM).

On the high-speed lines, compatibility with TVM on the ground can be ensured by the rolling stock equipment with one of the following systems:

- the historical TVM system;
- an ERTMS -TVM bi-standard (baseline 2 available; baseline 3 undergoing industrial development).

## **2. A national ERTMS deployment strategy to prepare for the future**

### **2.1. A framework defined by the performance contract**

The 2017-2026 multi-year contract, approved by the SNCF Réseau Board of Directors on 18 April 2017 and signed with the French State on 20 April 2017, defines the strategic objectives of the company and the corresponding financial path over a decade. This performance contract retains three strategic orientations, including that of incorporating the management of the network in the European dimension, notably confirming the priority given to ERTMS.

Thus, with the performance objective (IV.3) of "Relying on a reasoned ERTMS, a catalyst for technological breakthroughs", SNCF Réseau is committed to contributing to the definition and optimisation of the ERTMS deployment plan, integrating it into a balanced financial framework and defining a technical migration path to generate synergies with renovation and development projects.

The 2017-2026 multi-year contract also sets out the following industrial milestones:

- build the ERTMS economic model for SNCF Réseau and implement, within a concerted framework, the provisions of this plan;
- in 2018, have Baseline 3 technical references for ETCS (European Train Control System) Level 2 and technological building blocks.

The contract provides for the completion of the ERTMS deployment on the Longuyon-Basel route by 2020. It also foresees equipping ERTMS Level 2 on the Paris – Lyon high-speed line<sup>2</sup>, and SNCF Réseau assessing the opportunity of equipping other high-potential sections such as the Marseille – Ventimiglia line.

The contract will be closely monitored during its implementation. It includes an appointment clause every three years.

## **2.2. Definition of a viable economic model for the railway system and financial strategy**

In France, the replacement of Class B systems by ERTMS is not justified by their obsolescence or by their lower level of results in terms of safety and performance, in contrast with the situation faced in some pioneering Member States for which the deployment represented a technical and/or safety issue.

In this context, the French authorities began discussions in 2013 on the development of an economic model for the deployment of ERTMS.

### **2.2.1. Approach on the economic model**

The approach undertaken on the economic model is intended to guide the choices that will have to be made for the deployment of ERTMS on the French network.

It depends on the completion of studies, which will benefit from the feedback from pilot projects.

- **Ongoing studies for the development of an economic model**

The French authorities initially instructed the infrastructure manager of the national rail network to initiate studies so as to develop an economic model for the deployment of ERTMS. On the basis of the initial results obtained, the SNCF Group was subsequently requested to continue this work throughout the national railway system.

The objective of this work is to provide economic insight by identifying the main levers that influence the ERTMS deployment economic model so as to design a deployment strategy that is as economically relevant as possible and consistent with the issues of deployment at European level.

The first studies have identified, as the main levers in France, the synergies with the renewal of signalling, on the one hand, and synergies with modernisation operations with a strong signalling component (block redrawing, permanent counter-direction, etc.) on the other hand.

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<sup>2</sup> All in the framework of the HPGVSE project (High Performance High Speed South East). Beyond signalling, this project also includes power supply reinforcements needed to increase the throughput on the line, the facilities at the terminal stations, and the modernisation of the interlocking stations.

This thought process concluded in a preference for ERTMS Level 2 equipment over Level 1, even if this implies maintaining the conventional signalling while migrating the rolling stock. The complementary studies confirmed the economic need to pool the ERTMS deployment work with the renewal of the BAL (Luminous Automatic Blocks) and the control centres. They also led to the launch of two pilot projects, mentioned in the performance contract: Marseille – Ventimiglia (classic line), and HPGVSE on Paris – Lyon (high-speed line).

The studies are carried out over the entire French part of the European Central Network and are based on the first results obtained under the two pilot projects underway.

- **The two pilot projects**

The two pilot projects are intended to illustrate the benefits of ERTMS in very different configurations:

- on the high-speed Paris – Lyon line, the HPGVSE project aims to increase the line's flow by taking advantage of the possibility of reducing the train spacing allowed by ERTMS Level 2 (which also enforces the robustness of this flow even with temporary speed limits related to maintenance work). This project will also reduce the journey time by about five minutes over the two hours of the Paris – Lyon route.

- on the conventional Marseille – Ventimiglia line, the concomitance of the ERTMS installation with the need to renew all signalling, as well as the suppression of the lateral signalling envisaged in the framework of this pilot project, will optimise the economic balance for the infrastructure manager.

- **Preparation of the transition to ERTMS thanks to the digital block**

Reflections resulted in an innovative element, a "centralised" automatic light block, favouring the transition from the previous signalling system to ERTMS.

Over the entire national rail network, the blocks will be renewed from 2020 with this centralised version, known as digital block, making it possible to better prepare the prospect of migration to ERTMS. The control centre for these centralised blocks can easily be replaced by a Radio Block Centre (RBC).

- **First lessons**

The approach chosen and the first results obtained highlight the following lessons:

- the economic assessment of the investments required for ERTMS equipment on the central network is not sustainable for 2030;

- ERTMS Level 2 equipment comes with significant capacity gains when traffic is homogeneous<sup>3</sup>. However, this situation is rare on the conventional French network;

- the concomitant deployment of ERTMS with the renewal of the signalling could make it possible to create a balanced economic assessment for the infrastructure manager, provided that the historical signalling is quickly removed. However, on the central network, the heterogeneity of the age of this signalling does not make it possible to benefit from a situation as favourable and homogeneous as on the Marseille – Ventimiglia axis. Nevertheless, this lesson must be put into perspective with the economic interest of the railway system as a whole and not just for the sole infrastructure manager;

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<sup>3</sup> The term "homogeneous traffic" means traffic with similar average speeds regardless of the type of traffic (regional trains, international passenger services, long-distance services, freight).

- on lines requiring renewal of the historic signalling before being ERTMS-equipped, the renewal will be predisposed using the digital blocks, with a view to the subsequent arrival of the European signalling system.

- concerning the equipment used for maintenance and construction work machinery, SNCF Réseau is considering a solution suited to this type of machinery at the fairest price. These reflections are being developed in the framework of the Marseille – Ventimiglia pilot project.

The next stages in the economic model approach are aimed at finding the best combination of the various identified levers:

- optimisation of synergies with the renewal of historical signalling, as well as with modernisation projects, including those with deadlines after 2030;

- valuation of capacity gains where they are proven and correspond with market demand;

- search for an optimal date, from the point of view of the entire national railway system, for the removal of the historic signalling.

It is also expected that industry will benefit from the railway system's savings through the announced stability of the specifications and the scaling effects of increasingly massive orders.

### **2.2.2. Financial strategy**

As explained in point 2.2.1, the ERTMS deployment strategy in France is still being studied in order to arrive at an economic model that will define conditions for a realistic, i.e. an economically balanced deployment.

In France, the replacement of existing signalling systems by ERTMS is not justified by their obsolescence or by their lower level of results in terms of safety and performance, in contrast with the situation faced in some pioneer Member States for which the deployment of ERTMS represented a technical and/or safety issue.

Due to these national specificities, the financing arrangements for the necessary investments (infrastructure and rolling stock) are not yet determined at this stage and are proving to be delicate. It is necessary to wait for the conclusion of the ongoing work on the economic model for the entire railway system, which will benefit in particular from the lessons learned from the pilot projects mentioned in point 2.2.1.

However, it is already apparent that, in order to achieve ambitious objectives for equipping the corridors of the TEN-T core network, the investment needs (particularly for retrofitting existing rolling stock) will be significant and financial support from the European Union will be paramount.

## **2.3. Technical migration strategy**

### **2.3.1. Infrastructure**

- **Conventional network equipment**

ERTMS Level 1 (full supervision) is being installed over 427 kilometres of lines between Longuyon and Basel, on the North Sea – Mediterranean and Atlantic corridors, in superposition with traditional signalling. The equipment of the cross-border sections is coordinated with neighbouring infrastructure managers (Longwy in Belgium, Zoufftgen in Luxembourg, Kehl in Germany, Basel in Switzerland).

Studies are under way concerning the equipment of the cross-border point located at Forbach, in consultation with the German partners.

However, the maturation of economic thinking concluded in a preference for ERTMS Level 2 equipment for the future over Level 1 (with the exception of certain nodes that might prove too complex to deal with in level 2).

This equipment is set to be superimposed over the historical signalling until an optimal date yet to be determined, taking into account the entire national railway system. After this date, the infrastructure manager will cease maintaining the historical signalling. An accelerated transition to an ERTMS system without maintaining the historical signalling will be studied on certain sections where it may be possible to gain on capacity or regularity, among other aspects, that can be used for the national railway system.

Studies have already been launched by the infrastructure manager to establish the generic reference system for ERTMS ground equipment (in particular RBC) on conventional lines that incorporate all the variety of train movements<sup>4</sup> and all the complexity of the track plans specific to these lines.

- **High-speed line equipment**

The adopted strategy recommends equipping these lines in ERTMS Level 2, keeping the historical signalling pending the technical migration of the rolling stock. This signalling will be removed on the optimal date for the entire railway system.

In order to meet the high-bandwidth transmission requirements for ERTMS data depending on the traffic, the GSM-R will be competed with a GPRS module, and high-speed trains will require the Baseline 3 Release 2 version of ERTMS.

In the future, the development of train automation (ATO) and ERTMS Level 3 will make the signalling systems more efficient.

### **2.3.2. Rolling stock**

As explained in the previous point, the deployment of ERTMS across the infrastructure will initially be carried out in superposition with the existing system (KVB on conventional lines and TVM on high-speed lines) so as to allow rolling stock not yet equipped with ERTMS to continue to use the lines concerned.

To determine the optimal date for the end of Class B signalling, the French authorities have chosen to adopt a global approach taking account of the entire railway system, particularly the life-cycle of renewal of rolling stock operating on these lines, the *retrofitting* costs for existing rolling stock, and the additional cost to the infrastructure manager of maintaining several systems simultaneously. The dates determined to end maintenance on the existing signalling will be sent upstream to provide visibility to stakeholders.

For new rolling stock, the position of the French authorities is to move towards the systematic equipping of new vehicles following the stabilisation of the specifications made in the latest revision of the STI CCS in 2016.

However, it will be possible – though only for a transitional period and under strict conditions – to make use of the derogation provided for in point 2 of point 7.4.3 of the Appendix to the STI, which makes it possible not to equip new vehicles intended solely for national services on lines that are not

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<sup>4</sup> Arrivals and departures from storage, movements in stations, reversal of trains, etc. (the manoeuvre modes are not implemented on the RBC of high-speed lines).

equipped over a distance of at least 150 km or that are not foreseen to be equipped within 5 years of the authorisation of placing in service for the vehicles concerned. The details of the implementation of this possibility will be specified in the national law.

For existing equipment, the question of economic rationality arises even more acutely than for new equipment. Thus, the *retrofitting* requirements for equipment using lines after the end of the lateral signalling period will require investments which have not been yet determined, pending their assessment in the context of ongoing analysis on the economic model.

The deployment of ERTMS may be able to find significant levers for acceleration if the common effort is shared and accompanied by European support (stability of specifications, support for investments, for example, under the Connecting Europe Facility). It must also be fostered by the resolute action of the sector (see 2.2.1 on increasingly massive orders and scale economies).

### **3. Schedule of ERTMS equipment and dismantling of Class B systems**

In addition to the 1,000 km of ETCS-equipped lines in service in 2017, the following sections will be put into operation by 2023.

#### **3.1. Schedule of line equipment up to 2023**

##### **3.1.1. On conventional network**

- Complete ERTMS Level 1 equipment, superimposed on the class B system

Longuyon – Basel (427 kilometres): foreseen for 2020

- Frontier sections

The following frontiers will be equipped in superposition with the Class B system.

In the context of the Longuyon – Basel project, the equipping dates are as follows:

- the Franco-Belgian frontier at Longwy: 2017;
- the Franco-Luxembourg frontier of Mont-Saint-Martin and Zoufftgen: 2017;
- the Franco-German frontier at Kehl: 2021;
- the Franco-Swiss frontier at Mulhouse: 2021.

The French part (2 kilometres) of the Geneva-Annemasse frontier section will be equipped in ERTMS Level 2.

- the Franco-Swiss frontier at Annemasse: 2019

In addition, the equipment for the Franco-German border at Forbach is envisaged by 2023.

- Launch of work on the Marseille – Ventimiglia line

By 2023, deployment work for ERTMS Level 2 could be launched on the 280 kilometres of equivalent double-track lines from Marseille to Ventimiglia.

- Removal of Class B Systems (BAL + KVB)

No dismantling of the KVB is scheduled at this stage on the conventional network, awaiting the information that will be provided by the studies underway, except on the Marseille – Ventimiglia axis, where it is planned for the commissioning of the line.

### **3.1.2. High-speed lines**

- Bypassing Nimes and Montpellier

ERTMS Level 1 will be in service at the end of 2017 on the 70 kilometres of the Nimes and Montpellier bypass line.

- Launch of work on the Paris – Lyon line

By 2023, deployment work for ERTMS Level 2 will be underway on the 420 kilometres of lines from Paris to Lyon.

- Removal of Class B Systems (TVM)

There are no plans to dismantle the TVM on the high-speed network before 2030. Beyond that, studies in progress will make it possible to determine the optimal date for dismantling this system across the various lines.

### **3.2. Schedule of line equipment beyond 2023**

The French authorities will rely on the economic studies carried out by the SNCF Group to construct a medium-term deployment strategy.

The French part of the TEN-T core network has been broken down into different axes to match market needs. These axes will be the subject of more targeted economic analyses.

Initial results have highlighted higher synergy rates with the renewal of the signalling on the Le Havre – Metz and Perpignan – Metz axes. Preliminary studies will be launched on these two axes, with a view to:

- identify a more precise scope, and determine the involvement of the stakeholders concerned;
- identify the issues and potential operating profits;
- verify the synergies identified in the overall model.

Studies are also planned to determine the effect of removing the historical signalling over certain areas. For example, the current studies on the Marseille – Ventimiglia axis will help clarify the identification of areas with potential for ERTMS Level 2 installation without maintaining the historical signalling, so as to constitute an alternative or an addition to increase more conventional capacity (redistribution of blocks, or construction of a third track, for example).