ERTMS Deployment RFC RALP

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Rail Freight Corridor Rhine − Alpine

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ERTMS Deployment planning

1. Introduction

In order to keep up with the substantial technical progress in the frame of digitalisation as well as to prepare for the growing traffic demand and to offer the best quality for competitive rail freight services, the establishment of interoperability through a common European train control system is a paramount prerequisite. Subsequently, the implementation of ERTMS is part of the European policy.

The following document describes the ERTMS Deployment plan of RFC Rhine-Alpine, according to Art. 11, 1(b) of the Regulation (EU) 913/2010. Legally the deployment by the Member States along RFC Rhine-Alpine is based on the currently applicable European Deployment Plan ([link to EDP](#)) for the European Rail Traffic Management System which is included in the Commission Implementing Regulation (EU) 2017/6 of 5 January 2017. This Regulation lays down the timetable for the deployment of ERTMS on the Core Network Corridors (CNC) as set out in its Annex I schemes. In this context it has to be mentioned that the railway networks associated to CNCs and RFCs are not fully aligned.

Member States are also obliged to fulfil / implement the Technical Specifications for Interoperability (TSI). Referring to section 7.4.4 of the Annex to the Commission Regulation (EU) 2016/919 on the "Control-Command and Signalling" subsystems (TSI CCS), the Member States were asked to notify their National Implementation Plans (NIPs) to the Commission until 5 July 2017, to update the NIPs at least every five years and to include next generation radio system deployment in the future updates. The collection of the NIPs is published under the following address of the Commission ([link to NIPs](#)).

In addition to the EDP, on 14 November 2017 the EU Commission published a working document on actions and associated objectives to achieve interoperability and drive ERTMS deployment (Delivering an effective and interoperable European Rail Traffic Management System (ERTMS – the way ahead)) also known as [ERTMS Deployment Action Plan](#). Therein it is specified that both, the CNC and RFC, which have as their constituent members certain of the addressed stakeholder groups (Ministries, NSAs and Infrastructure Managers), should also be used effectively to support ERTMS deployment.

With the aim to develop rail freight on its lines, the RFCs defined their role during the consultation phase in a joint statement in September 2017 as follows:

- Be a dialog platform for all stakeholders
- Act as an alert maker & moderator for the issues raised by its stakeholders
- Act as a forum to address technical issues with impact on operations tackled by its stakeholders.

In addition, in May 2020, Matthias Ruete, the ERTMS coordinator of DG Move since January 2019, published a new ERTMS work plan ([link](#)). It gives a serious look on the implementation of ERTMS so far, setting the focus for the future on a more continuous and non-disruptive development. It emphasizes several goals to be achieved:

- Reinforcement of the pace of implementation

- Orientation towards a more European approach

- The need for industrialisation of the ERTMS implementation

- Priority of a consistent and coherent strategy for the vehicle equipment

- Coordination of the decommissioning of the Class-B system

- Inclusion of ERTMS in the national recovery programmes

- Looking on ERTMS also as a traffic management system, not just as a train command system

Matthias Ruete considers the RFC Rhine-Alpine as a key project on European level and regularly participates in the meetings of the ERTMS task force of RFC Rhine-Alpine.

2. Details of the corridor roll-out planning

This chapter contains details of the ERTMS deployment planning on RFC Rhine- Alpine. The information is indicative and can differ from the NIPs due to different update procedures, deadlines, and dates for publication.

RFC Rhine-Alpine is based on the ERTMS Corridor A according to the TSI CCS 2012/88/EU, Chapter 7 (previous EDP), on which the Member States involved had to implement ERTMS on the assigned lines until the end of 2015 (or 2020 as defined in the TSI CCS). Belgium was not part of the ERTMS Corridor A, hence also not the connection from the German-Belgian border to the railway lines in the Rhine valley. This changed with the establishment of the RFC Rhine-Alpine in November 2013.
Joint coordination of trackside deployment on the ERTMS Corridor A started in 2006. In the following years progress developed very differently. Today the ERTMS Corridor A has been merged with the RFC Rhine-Alpine and a new EDP has come into force covering the CNC, but the status of ERTMS deployment in each country along the RFC is still quite different due to the following context.

In **The Netherlands**, deployment started on the Betuweroute between Kijfhoek and Zevenaar which was inaugurated in 2007 as a dedicated freight line only equipped with ETCS B2, SRS 2.3.0d. Between 2007 and 2015 the connection to the Port of Rotterdam (Havenspoorlijn with ETCS L1) and from Zevenaar Oost to the German border (ETCS L2) have been converted to ERTMS. The further national ERTMS deployment on the main RFC Rhine-Alpine lines has been decided in 2019. On the Brabantroute (Kijfhoek – Breda – Eindhoven – Venlo) ERTMS equipment is under consideration in the Dutch national roll-out plan to be completed by 2029-2031, including continuous ERTMS only operations from that date. In addition, on the Betuweroute an upgrade of the trackside from B2/SRS 2.3.0d to B3/SRS 3.6.0 is in discussion. A schedule is not yet available.
The national migration plan basically provides that the national class B system will be decommissioned in the course of the installation of ETCS. A dual equipment (overlay) is an exception on few lines/line sections, e. g. Amsterdam – Utrecht or Hanzelijn. The deployment strategy in The Netherlands makes the on-board equipment of the vehicles indispensable.
The current national ERTMS roll out plan includes an early equipment of rolling stock with ERTMS B3 on-board units (OBU). Therefore, ERTMS OBU roll out is prepared in a separate programme.

In 2021, the challenge is that the international rolling stock already using the Betuweroute must be upgraded to Baseline 3 SRS 3.6.0, as this is the planned standard for the future ETCS equipment on the Dutch railway network.

In **Belgium**, the outlined ERTMS implementation of the Corridor lines is part of a country-wide migration program by 2025 in order to improve the safety level on the whole network. All vehicles in Belgium have to be operable with ERTMS in the near future, whereby ETCS L1 and L2 FS B2 and B3 infrastructure will be equipped with System Version 1.x to allow B2 and B3 locos. On the other hand, ETCS L1 LS B3 tracks shall be equipped with System Version 2.x in order to allow the operation in Limited Supervision. Consequently, in order to permit B2 vehicles to still run on those lines, the TBL1+ system will be kept until the majority of the RUs running on those lines will have migrated to B3 as well (certainly until end of 2025). Railway operators are strongly encouraged to equip their rolling stock with baseline 3 to accommodate as much as possible future upgrades of the infrastructure, such as the introduction of GPRS for GSM-R.
Since December 2016, the Class B system Memor/Crocodile is put out of service on the lines equipped with ETCS Level 1 FS version 2.3.0d, allowing only trains equipped with ETCS Level 1 (minimum Baseline 2) or under certain exceptions TBL1+ to run on these tracks. Nevertheless, a Royal Decree published in 2018, with the latest revision on 6 December 2020 provides the progressive decommissioning of the Memor/Crocodile Class B system on the main tracks equipped with any level of ETCS by 14.12.2025. On the same date, TBL1+ will be decommissioned on all main tracks and Belgium will become an ETCS only network.

In **Germany,** the release of SRS 3.4.0 was a major factor to start planning on the RFC lines as many interlockings still are not ready for a L2 installation and in SRS 3.4.0 the installation of Limited Supervision is possible. Due to the structure of the existing interlockings a mixed installation of L1 LS and L2 is planned. Nevertheless, corridor lines (more than 1000 km track length) cover only a small part of the whole network. Anyhow, the lines of RFC Rhine-Alpine are the most relevant for international rail freight.
ETCS deployment on Corridor lines in Germany was started in the Basel area in 2019, further awarding of ETCS implementation for the RFC Rhine-Alpine lines in Germany followed subsequently in 2020. Putting into operation is expected stepwise from 2023 to 2028. The first full crossing with ERTMS between the border points Venlo/Kaldenkirchen and Basel is planned to be completed in 2025. Unlike the Netherlands or Belgium, ERTMS on-board equipment of all vehicles is currently not foreseen or mandatory. The existing Class-B systems, especially PZB, are planned to be operational in parallel to an ERTMS installation for a transition period.
Decommissioning of Class-B systems is not yet decided. Nevertheless, the new tunnel in Rastatt and the connecting line to the existing route will not be equipped with Class-B systems.

In **Switzerland**, the operation of ERTMS in L2 has already been well proven since years on the HSL line from Rothrist to Mattstetten (2006), as well as on the Lötschberg base tunnel line (2007), since 2016 the Gotthard Base Tunnel and since 2020 the Ceneri Base Tunnel. In addition, miscellaneous conventional ETCS L2 lines have been taken into service, mainly on the Gotthard route and between Lausanne and Brig.
The existing Class B systems ZUB and Signum have been substituted by an economical migration concept based on the deployment of ETCS L1 LS. This concept substitutes the Class B systems in Switzerland without limiting the operation of existing national vehicles and allowing the use of vehicles equipped with ERTMS at the same time (Packet 44). ERTMS only operation with ETCS B3 vehicles is already possible on the Swiss normal gauge network.
Besides this, Switzerland has already completed major investments for equipping their fleet with

ERTMS. Migration to B3 OBUs could also become a challenge due to the cost for retrofit of locos and the radio strategy for replacing GSM-R.

In **Italy,** the successful operation of ERTMS in L2 has already been well proven since years on the HSL network, connecting Torino – Milano – Bologna – Firenze and Roma – Napoli. For the conventional lines during the last years major investments had been made to upgrade the Class B system into SCMT, which is based on the use of balises thus presenting a good basis for the implementation of ERTMS. The corridor lines will be mixed level lines with ERTMS and the existing Class B system. The operational scenario and the relevant risk management for the implementation of ERTMS L1 and L2 (the choice depends on the existing signalling systems) have been defined. Go Live of ERTMS on the Italian RFC lines started on the border sections Iselle - Domo - Domo II and Pino-Tronzano – Luino in 2018 and 2019, equipment of the RFC Rhine-Alpine network is expected to be completed stepwise until 2027.
Decommissioning of the Class-B system is planned stepwise from 2023, depending on the progress of the vehicle equipment.

RFC Rhine-Alpine ERTMS Deployment Planning state of play

Graphical overviews and maps on the state of play of ERTMS deployment planning are provided in the Annex 1 to this document. The corridor sections as well as some subsequent sections of adjacent corridors are shown with their planned completion dates, ERTMS deployment type, the system version planned development of the radio systems (see Topic General issues of importance for the usage of ERTMS on RFC Rhine-Alpine, sub-point 5), expected availability of class B/A-systems and an overview on the border crossings.

Selected information on ERTMS deployment is also available on the map in CIP in the area ETCS Deployment on the bottom of the left-hand side of the screen and in the information documents area ([link](#)). In the period until the next update of the ERTMS Deployment Overview the data base in CIP will regularly be updated.

3. Current challenges:

3.1 Solutions on cross-border sections

Today's existing ERTMS trackside installations in Europe are mostly implemented and managed by one infrastructure manager without crossing borders. On RFC Rhine-Alpine, ERTMS will be applied and operated internationally, including border crossings. However, the installation and authorisation of the trackside part is still in the hands of each Member State. The currently available ERTMS specifications, product developments as well as authorisation rules will be proven on RFC Rhine-Alpine in an international corridor environment. On the cross-border sections the interaction is much more complex due to different national technical requirements and different operational rules. An overview of the cross-border solutions can be found in the figures 14 – 40 of the Annex 1 to this document. These overviews illustrate the expected roll-out on the cross-border sections and the technical transitions to be managed in terms of the command control, voltage, and radio systems. The change in operational rules must also be considered.

3.2 Development of an ERTMS network and terminal connections

ERTMS is only beneficial for vehicle owners and railway undertakings when they can remove Class B equipment. This requires a seamless ERTMS network of lines between the major ports, terminals, and industrial loading facilities. The extension of trackside equipment on RFC Rhine-Alpine lines will constantly increase from 2023. While Switzerland has already equipped the entire

network and Belgium will do so by 12/2025, the ETCS deployment process will continue in the Netherlands, Germany, and Italy after the completion of the corridor lines. Operationally usable international sub-networks will, however, be available from 12/2022. The connection of terminals is taken into account up to the last transfer points of the national infrastructure manager, equipped with an interlocking system. Further ETCS equipment that may be required in the area of a third party IMs is not part of this overview.

3.3 Equipment of rolling stock with B3 on-board

Vehicle equipment is not part of the infrastructure manager's ERTMS implementation strategy. Nevertheless, the success of ERTMS is heavily depending on the availability of vehicles with the necessary on-board equipment. In this respect, the ministries and infrastructure managers of RFC Rhine-Alpine support the vehicle owners by a regular monitoring of the ETCS deployment, by participation in selected sector working groups and other initiatives. In September 2020, DG Move published a study on the on-board equipment strategy (link to Final Report, link to Executive Summary). Ministries and EU are discussing coordinated funding programmes. In the Netherlands a retrofitting project has already been started.

Different ETCS System Requirements Specifications (SRS versions) can be used on the vehicles and on the trackside. Therefore, it is important to understand their compatibility. Annex 2 to this document includes an overview of main definitions and schematic illustrations in this context. Based on the NIPs, ERTMS-only operations on the whole corridor cannot be expected before 2030.

4. General issues of importance for the usage of ERTMS on RFC Rhine-Alpine

The following topics – which are naturally not part of the ERTMS deployment monitoring of an RFC – are relevant to achieve a fully workable interoperable ERTMS system and proper preparation of B3 OBUs for ERTMS operations.

4.1 Vehicle authorisation process (in the frame of the 4th Railway Package)

Under the following link the Implementing Regulation (EU) 2018/545 establishing practical arrangements for the railway vehicle authorisation and railway vehicle type authorisation process can be found. The European Union Agency for Railways developed a guideline for the vehicle authorisation process. This document and further explanations on the vehicle authorisation regime that applies as of 16 June 2019 are available on the ERA website.

Overview on the technical pillar of the 4th Railway Package regarding vehicle authorisation:
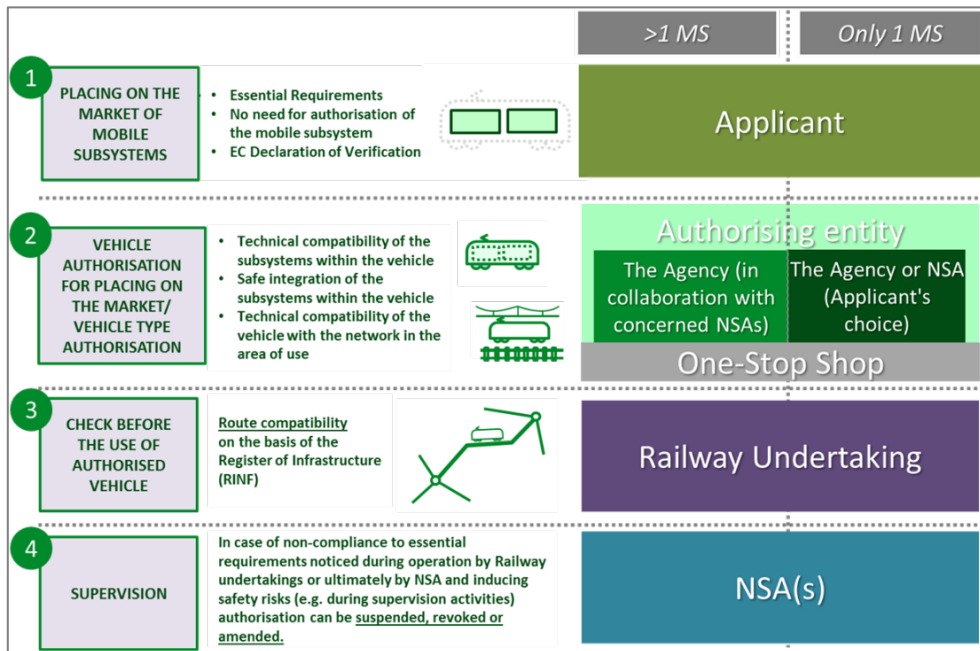
ERA recommends conducting a "pre-engagement" for the preparation of an application before official starting the official process via the ERA One Stop Shop.

One major element in the authorisation process are test cases for the ETCS and the Radio System Compatibility (ESC/RSC). The development of ESC/RSC tests descriptions is in the responsibility of the IMs. Finally approved, ESC/RSC test will be published on the ERA website. Until then, they will be published in advance on the IM's website (as far as available).

For vehicle owners it is important to know that new vehicles must be equipped with B3 OBUs. Derogations need to be requested beforehand. IMs strongly recommend purchasing and registering vehicles with SRS 3.6.0 as the targeted configuration.

4.2 Security of the on-board – trackside communication (Key management)

ETCS L2 uses GSM-R for the exchange of data. GSM-R is an open mode of transmission which needs to be protected. This is done by encrypted codes (keys). IMs organise Key Management Centres (public KMC) for the generation, distribution, storage and communication of the keys. Users shall take care of the procedures on a national level. In general RUs/vehicle owners have to choose a Home KMC for their purposes which will get in contact with the IMs.

Key management can be done offline or online. Currently only offline key management is offered by the IMs, although the technical specifications for online key management have been released (SRS 3.6.0, subset 114, 137). This may change due to an increase of ETCS vehicles. Also limited lifespan of keys will raise efforts for the involved parties. This will support migration to online key management.

The development of an online key management has been started at DB Netz and Infrabel, but it may be available only in certain areas of the network (WiFi-hotspots or lines equipped with GPRS, see point 5). Usage of online key management requires rolling stock equipped with SRS 3.6.0 and a server based online Home KMC.

Infrastructure Manager	Also Home KMC for RUs/vehicle owners	Key Lifespan	Link or contact person
ProRail	No	Unlimited	kmc@prorail.nl

Infrabel	No	Limited	kmc@infrabel.be
DB Netz	Yes	Limited	link
SBB / BLS	Yes	Unlimited	kmc-ch@sbb.ch
RFI	Yes	Unlimited	kmc@rfi.it

Experts of the infrastructure managers along Corridor Rhine-Alpine participate – amongst others – in a working group to discuss key management issues. This may lead to more common solutions and processes.

4.3 Driver Machine Interface (DMI) language

The DMI as part of the on-board equipment is an essential element of ERTMS operations. Regarding the display of text information, the RU can order different language packages depending on the operational area of the rolling stock and drivers. The DMI language is part of the settings a driver must type in during the start-up procedure of his locomotive. The basic settings remain until the end of mission. Nevertheless, the DMI language can be changed manually on demand, e. g. at borders. Nevertheless, regarding text messages transmitted by balises, the infrastructure managers can pre-set a language on their behalf. In addition, different expressions might be used for the same set of facts within a common language (e. g. "Rangieren" vs. "Verschub" (German used in Germany vs. Austrian German, Swiss German). On RFC Rhine-Alpine the following languages are used by the infrastructure managers for the transmission of text messages from balises to the DMI:

The Netherlands:	English
Belgium:	Dutch, French
Germany:	German
Switzerland:	German, French, Italian (change of language inside CH)
Italy:	Italian

Engine drivers shall be able to understand the content and communicate accordingly with the operational staff of the infrastructure manager when applicable. The RUs must take this into account in their SMS and instruct the drivers accordingly in their company regulations as misunderstandings between driver and operation centre can lead to safety issues.

4.4 Operational Rules

A train operated in ERTMS-mode, must respect the national operational rules. On cross-border sections additional or deviating rules may apply for the use of ETCS. The relevant provisions can be found in the bilateral cross-border agreements which are available at the national infrastructure managers (part of the operational regulations relevant for network access).

International ERTMS users have to take into account that the level of integration and harmonisation of operational rules is much lower in L1 than in L2 (e.g. change of braking curves at borders is included in L2).

With ETCS B3, the braking curve of a train depends on train data and the parameters (national values) transmitted by the trackside. This is independent of ETCS L1 or L2. The main issue is how the brake percentage λ is calculated and the braking mode of the train (P or G).

4.5 Radio technology

a) GSM-R, GPRS, FRMCS

GSM-R is currently the standard communication technology for railway applications along Corridor Rhine-Alpine lines. As ETCS Level 2 is a digital radio-based signal and train protection system, all trains automatically report their exact position and direction of travel to the RBC (Radio Block Centre) at regular intervals, through the GSM-R network. This functionality is supported by the SRS 3.4.0.

GSM-R is a circuit switched connection, through which a continuous channel is set between the base station and the moving unit. This ensures a high Quality of Service, but not a very efficient usage of the connection, as the amount of data exchanged is rather low. GSM is still a second-generation mobile radio standard (2G). In areas of the railway network with high traffic density the transmission capacity of GSM-R, which is still used for voice communication, is not sufficient.

Therefore, there is a need for a more powerful radio system. Basically, the replacement of GSM-R with a 5-generation radio technology is planned and in preparation (Future Railway Communication System - FRMCS). However, the completion of the technical specification and the product development of FRMCS will take a few more years. Planning of a network-wide implementation trackside and on-board is not yet possible. Authorised products may not be available before 2025. In most countries, a nationwide roll-out cannot be expected before 2030. ProRail, Infrabel, DB Netz and RFI have therefore decided to upgrade their GSM-R network partially or completely with General Packet Radio System (GPRS) as a bridge technology and thus to install significantly higher transmission capacities. You will find overviews in Annex 1, figures 8-10.

A corresponding GPRS-compatible radio module is required on the vehicle if the RU or the vehicle owner want to benefit from the additional transmission capacities, e. g. for the usage of SRS 3.6.0 and online key management. It should be noted that vehicles with SRS 3.4.0 can continue to be used on lines equipped with GPRS. Nevertheless, from a capacity point of view the infrastructure managers are striving to ensure a high proportion of vehicles with SRS 3.6.0 from 2025 onwards until FRMCS is available.

In respect of recent decisions of the Radio Spectrum Committee on Railway Mobile Radio additional frequency band will made be available for the migration from GSM-R to FRMCS. (from January 1, 2022, the frequency bands 874.4-880.0 MHz 919.4-925.0 MHz and - depending on national requirements - from January 1, 2025, the 1900-1910 MHz frequency band). Dynamic spectrum sharing will be possible.

Ministries have been asked to develop plans how to use these additional frequencies in the next 10 years.

b) Transmission of information in L1 mode

In L1 mode, data can be transmitted to an OBU by balises, Euroloop or Radio Infill. Transmission by balises is the standard configuration. On RFC Rhine-Alpine, Switzerland and Italy have chosen additional options. Switzerland uses Euroloop and Italy Radio Infill. In Italy, rolling stock equipped with B2 and an STM (SCMT) does not need the Radio Infill

functionality until SCMT will be decommissioned. Rolling stock with ETCS Baseline 3 OBUs need the Radio Infill functionality independent from an equipment with NTC SCMT. Regarding "Radio Infill" a 'Notified National Technical Rule' (NNTR) has been opened at ERA.