



European  
Commission

# ERTMS

Second Work Plan of the  
European Coordinator

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## Acronyms and abbreviations

AT	Austria
ATC	Automatic Train Control
ATL	Atlantic Corridor
ATO	Automatic Train Operation
ATP	Automatic Train Protection
B2	Baseline 2
B3	Baseline 3
BAC	Baltic-Adriatic Corridor
BE	Belgium
BG	Bulgaria
CB	Cross Border
CBA	Cost-benefit analysis
CCS TSI	Control Command and Signalling Technical Specification for Interoperability
CEF	Connecting Europe Facility
CH	Switzerland
CINEA	European Climate, Infrastructure and Environment Executive Agency
CN	Core Network
CNC	Core Network Corridor
CTCS	Chinese Train Control System
CZ	Czechia
DAC	Digital Automatic Coupling
DE	Germany
DK	Denmark
DMT	ERTMS Deployment Management Team
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EDP	European Deployment Plan
EE	Estonia
EGD	European Green Deal
EIB	European Investment Bank
EL	Greece
ERA	European Union Agency for Railways
ERDF	European Regional Development Fund
ERTMS	European Rail Traffic Management System
ES	Spain
ESC	ETCS System compatibility
ESIF	European Structural and Investment Funds
ETCS	European Train Control System
EU	European Union
EU-Rail	Europe's Rail Joint Undertaking
EVC	European Vital Computer
FI	Finland



FR	France
FRMCS	Future Radio Mobile Communication Systems
GoA	Grade of Automation
GPRS	General Packet Radio Service
GSM-R	Global System for Mobile Communications – Railway
HR	Croatia
HU	Hungary
IE	Ireland
IM	Infrastructure Manager
IT	Italy
L1	Level 1 of ERTMS
L2	Level 2 of ERTMS
LS	Limited Supervision mode of ERTMS or Czech Class B system
LT	Lithuania
LU	Luxembourg
LV	Latvia
MED	Mediterranean Corridor
MoU	Memorandum of Understanding
MS	Member State
NIP	National Implementation Plan
NL	Netherlands
NO	Norway
NSB	North Sea-Baltic Corridor
NSM	North Sea -Mediterranean Corridor
OB	On-board
OBU	On-board Unit
OEM	Orient/East-Mediterranean Corridor
OPE TSI	Operation and traffic management Technical Specification for Interoperability
OTM	On Track Machine
PL	Poland
PT	Portugal
RALP	Rhine-Alpine Corridor
RBC	Radio Block Centre
RDN	Rhine-Danube Corridor
RFC	Rail Freight Corridor
RISC	Railway Interoperability and Safety Committee
RRF	Recovery and Resilience Facility
RRP	Recovery and Resilience Plans
RO	Romania
RSC	Radio System compatibility
RSO	Rolling Stock Operator
SCM	Scandinavian-Mediterranean Corridor
SE	Sweden



SI	Slovenia
SK	Slovakia
SME	Small and medium-sized enterprises
SSMS	Sustainable and Smart Mobility Strategy
STM	Specific Transmission Module
TEN-T	Trans-European Transport Network
TENtec	European Commission's Information System to coordinate and support TEN-T Policy
UK	United Kingdom

*Table 1 Acronyms and abbreviation*



## 1 Introduction

This is my second work plan since my nomination as European Coordinator for ERTMS in January 2019. The content of this document is a result of discussions with stakeholders with whom, despite the pandemic, I have had more than 200 meetings, many of them in 2021, in the framework of the European Year of Rail. Obviously, since 24 February 2022 all our work is overshadowed by Russia's war of aggression against Ukraine. This has also made palpable and urgent the crucial role of a performing, interoperable European Rail system, whether for transport of people or for supply routes to and from Ukraine. The future will also show how the Ukrainian rail system will be repaired and reconstructed, with the ever closer link to the transeuropean transport network.

This document could not have been produced without the kind of assistance provided by, among others, DG MOVE, ERA, CINEA, S2R/EU-Rail, CER, EIM, UNISIG, UNIFE, EUG, many representatives of national ministries, railway companies, infrastructure managers and rail supply industries and the ERTMS Deployment Management Team. Moreover, I would like to single out the prominent role the European Parliament has had in providing, under the leadership of Izaskun Bilbao Barandica, an own-initiative report and resolution on ERTMS, and my fellow coordinators for their pertinent feedback on the issues relating to their corridors. I wish to thank all, and in particular my advisor, Marcin Wójcik, for their availability, input, the spirit of cooperation and openness.

Since my first work plan (May 2020), the base conditions for the ERTMS deployment have vastly improved and become more favourable for an accelerated rollout. Fighting climate change in the framework of the Green Deal, accelerating digitalisation and mobilising recovery and resilience funds have been endorsed at the highest political level in the EU. ERTMS is widely seen as providing solutions in this context. The European Parliament<sup>1</sup> strongly backed the need for accelerated deployment, better interoperability, sufficient funds, and stronger governance for ERTMS. The Commission, in a series of proposals<sup>2</sup>, communications<sup>3</sup> and action plans,<sup>4</sup> underlined the central importance of ERTMS for sustainable and smarter mobility.

My major message in this work plan is that *we are on the threshold of moving to a Single European Signalling and Safety System*, which will form the basis for a true European Traffic Management System. Major renewal, both of infrastructure and rail fleets, is happening now and over the next fifteen years. If we do not seize this opportunity for a joint modernisation, we are probably, given the long lifecycle for innovation in railways, squandering a once in a lifetime chance. We will then remain with a patchwork of approaches, struggling just to ensure interoperability. Many actors in the railway

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<sup>1</sup> EP resolution of 7 July 2021, P9\_TE(2021)0327

<sup>2</sup> Commission proposal for a regulation on Union guidelines for the development of the trans-European transport network of 14 December 2021, COM (2021)812

<sup>3</sup> Commission Communication on sustainable and smart mobility of 9 December 2020, COM (2020) 789 final

<sup>4</sup> Commission Communication, Action Plan to boost long distance and cross-border Passenger rail, 14 December 2021, COM (2021) 810 final



world have realised this. Our objective must now be to ensure the necessary political backing for what is a major European industrial project for the digitalisation of railways throughout the European Union.

We need accelerated, synchronised deployment of ERTMS for the whole TEN-T network, and the vehicles using it, by 2040, with a strong push on the Core Network already for 2030, a solid move to a radio-based ERTMS, a deadline for phasing out national signalling systems, a major renewal and refurbishment of locomotives and trainsets, better conditions for the mobilisation of public funds (EU, national and regional) and private capital, and better transition management of technological progress ensuring that investments can be made in a predictable environment. This necessary acceleration of ERTMS constitutes a unique opportunity to pursue a broader harmonisation beyond the strict ERTMS with a view to achieving an all-encompassing European rail management system. To further all this, we need better governance of this process, guaranteeing a holistic and synchronised system approach.

Most of the building blocks required have either already been put in place or at least proposed. However, some key elements to ensure this approach are still waiting to be turned into reality. Moreover, the financial situation of both railway undertakings and infrastructure managers has been severely affected by the ongoing COVID-19 pandemic, figures for both passengers and freight are still lower than before the crisis, and the significant increase of electricity prices which creates huge concern regarding the competitiveness of the green electric railway haulage, especially for the rail freight where the public service contracts do not cover the extracosts. Major worries are the timely equipment of vehicles and the rapid transition to a radio-based ERTMS, including the transition to FRMCS, the need to industrialise the deployment, embracing all actors, and stronger coordination and governance of ERTMS rollout everywhere.

My second work plan gives an overview of where we stand exactly (with a cut-off date of June 2022), analyses the next steps, and draws conclusions on what needs to be done and what is still missing.

The **first part** takes stock of the state of play of the ERTMS deployment, both on-board and trackside. The work plan provides both aggregated figures at the EU level and detailed data in a breakdown by Member State and corridor. This information is complemented by an overview of the deployment situation, both on-board and trackside, outside Europe. Then I report on the past ERTMS funding possibilities and lessons learnt. Finally, I outline the new funding sources aimed at supporting ERTMS deployment.

In the **second part**, the focus is on the envisaged next steps both as regards infrastructure and rolling stock. Furthermore, I try to identify challenges and opportunities. This is followed by a description of the envisaged scope of the forthcoming revision of the technical specification for interoperability relating to the CCS and a precis of the ERTMS relevant provisions of the proposed new TEN-T Guidelines. Finally, this part outlines the role of the new Europe's Rail Joint Undertaking and the System Pillar.



In the **third part**, you will find my conclusions as European Coordinator for ERTMS. I sum up the necessary steps that can be taken already in anticipation of political decisions and the actions I will take as coordinator to contribute to the transformation of ERTMS into the single signalling system that Europe needs to make its climate change and digitalisation aspirations a reality.

The **annexes** contain detailed information on ERTMS deployment on the 9 Core Network Corridors; progress of the EDP; analysis of cross-border agreements; ERTMS governance, including a description of the different steps needed to obtain authorisation track-side and on-board; review of EU requirements for ERTMS deployment; an overview of the evolution of ERTMS; a presentation of the portfolio of CEF supported ERTMS actions managed by CINEA; an update on existing national schemes to further on-board deployment; and a glossary of the key notions.





## 2 Stocktaking of the ERTMS deployment

### 2.1 Trackside deployment according to the EDP

The *current* TEN-T Guidelines<sup>5</sup> establish ERTMS as one of the priorities for railway infrastructure development and set out a deadline for its deployment on the Core Network by 2030 and on the Comprehensive Network by 2050. In January 2017, based on the TEN-T Guidelines, the European Commission adopted the ERTMS European Deployment Plan (EDP)<sup>6</sup> that sets out deadlines for deploying ERTMS on some sections of the Core Network Corridors (CNC) covering the 2017-2023 period. The number of km planned for each year in the EDP and the TEN-T Guidelines for the CNC are shown in the figure below.

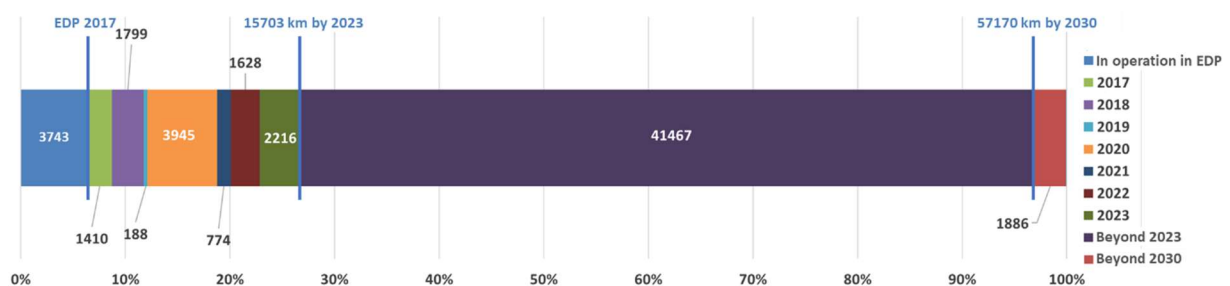


Figure 1 Indicative number of CNC km for each year according to the EDP and the TEN-T Guidelines

The analysis of the progress made, measured against the 2017 EDP, is based on EU-27 alignment and does not cover sections of the CNC that were included by the CEF 2 Regulation<sup>7</sup>.

Overall, it can be ascertained that 48% of the length planned in the EDP by the end of 2022 (i.e. 13 487km) has been already achieved by end-June 2022. At the same time, 42% (or 6 555 km) of the 15 700 km planned to be put in operation by 2023, according to the EDP, have been already commissioned.

In July 2021, the CEF 2 Regulation extended the CNC by 9 680 km. In total, the length of the CNC, including CEF 2 extensions and excluding sections in the United Kingdom, amounts at present to 59 055 km<sup>8</sup>.

<sup>5</sup> Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013 on Union guidelines for the development of the trans-European transport network

<sup>6</sup> Commission Implementing Regulation (EU) 2017/6 on the European Rail Traffic Management System European deployment plan on 5 January 2017

<sup>7</sup> Regulation (EU) 2021/1153 of the European Parliament and of the Council of 7 July 2021 establishing the Connecting Europe Facility and repealing Regulations (EU) No 1316/2013 and (EU) No 283/2014

<sup>8</sup> Sections belong to CNC according to the TENtec Interactive Map Viewer in September 2021, that includes CEF 2 sections, are considered to define the CNC length.



At the end of June 2022<sup>9</sup>, **14% of the revised CNC network (i.e. 59 055km) was in operation with ETCS<sup>10</sup> (i.e. 7 965km) and 60% with GSM-R.**<sup>11</sup> The following charts indicate the current ETCS status of the CNC sections, expected according to the EDP by 2023 (15 700 km) and the TEN-T Guidelines by 2030 (57 170 km), including CEF 2 extension and excluding UK sections, and taking into consideration exemptions.

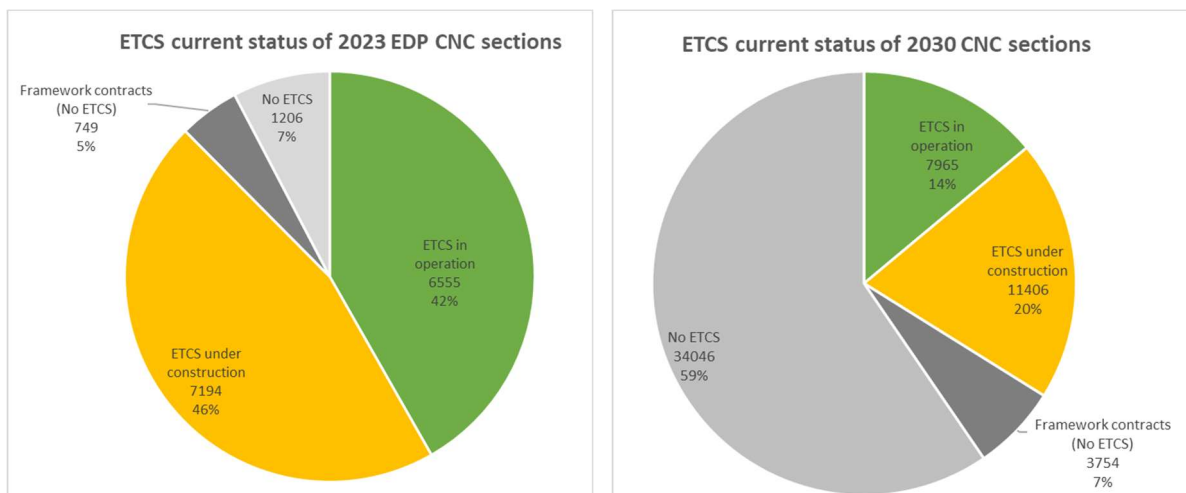


Figure 2 ETCS current status of CNC lengths expected according to TEN-T Guidelines and EDP by 2023 and by 2030

There are 200 km already in operation that was not foreseen in the EDP to be put in operation before 2023, and an additional 1 210 km in operation on sections belonging to the CEF 2 extension. Sections belonging to the CEF 2 extension are, at present, not included in the current EDP.

According to the TEN-T Guidelines, CEF 2 sections belonging to the Core Network should be equipped by 2030 and the remaining CEF 2 sections by 2050.

Based on the Member States data, 14 445 km on the CNC are planned to be equipped with ETCS by 2023, although only 11 645 km of them are legally required in the EDP by 2023. In total 40 875 km on the CNC are planned by Member States to have ETCS in operation by 2030.

The following map presents the current status of the ETCS deployment on the CNC. The dotted lines are those added to the CNC by the CEF 2 extension. According to TEN-T Guidelines<sup>12</sup>, the Irish network<sup>13</sup>

<sup>9</sup> All information related to deployment data are gathered from DMT database. DMT database is based on national implementations plans, official information provided by MS and information gathered from news.

<sup>10</sup> Lines equipped with non-interoperable ETCS baseline (e.g. pre-baseline 2) are not considered as equipped with ETCS in the figures included in this Work Plan.

<sup>11</sup> ETCS and GSM-R constitute at present the two components of ERTMS, see Annex IX. All data provided in this work plan are based on the alignment of the Core Network Corridors and deployment deadlines as set out in the EDP in force.

<sup>12</sup> Regulation (EU) No 1315/2013, article 39. 2 a) "Isolated networks are exempt from (...) full deployment of ERTMS."

<sup>13</sup> Irish network will be equipped with GSM-R. Whilst the Irish network is exempt from mandatory deployment of ERTMS, it is planned that the whole Irish network will be equipped with Level 1 ETCS by 2040. It is not intended to deploy Level 2 or Level 3 on this isolated network.



and lines that do not belong to Rail Baltica in Estonia, Latvia, and Lithuania<sup>14</sup> are exempt from the obligation to fully deploy ERTMS.

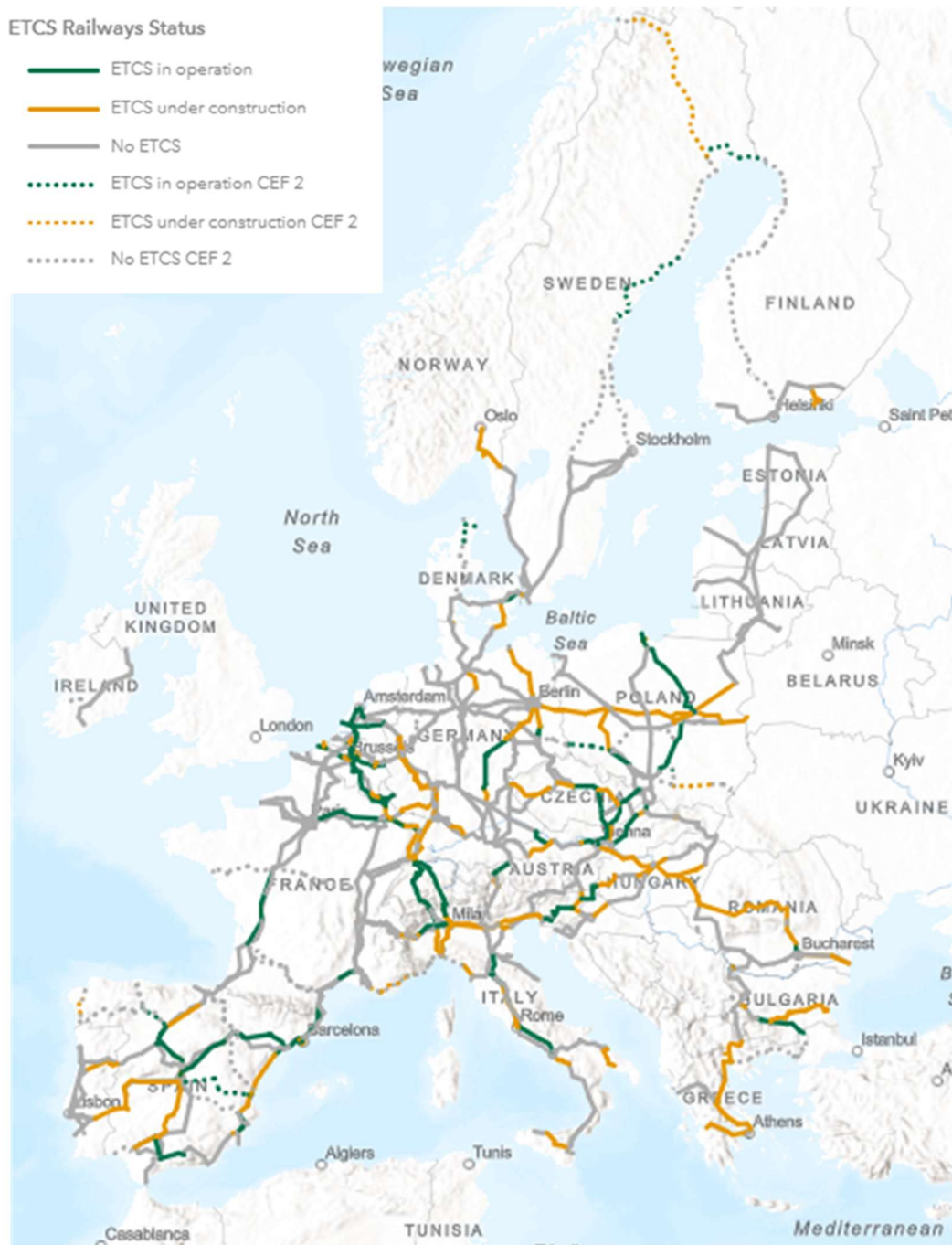


Figure 3 ETCS deployment status in CNC in June 2022

The ETCS deployment per corridor and per Member State is described in the following sections. Regarding the GSM-R deployment, there are 35 509 km equipped with GSM-R on the CNC (60%) and an additional 7 125 km are already covered by contracts signed with suppliers (12%). Out of the nine

<sup>14</sup> Rail Baltica sections in Estonia, Latvia and Lithuania will be equipped with ETCS.



CNC, the most advanced in terms of GSM-R deployment is RALP, with 99% of its length already equipped, while GSM-R deployment on other corridors ranges between 39% and 93%.

The deployment of GSM-R per corridor is presented in the graph below.

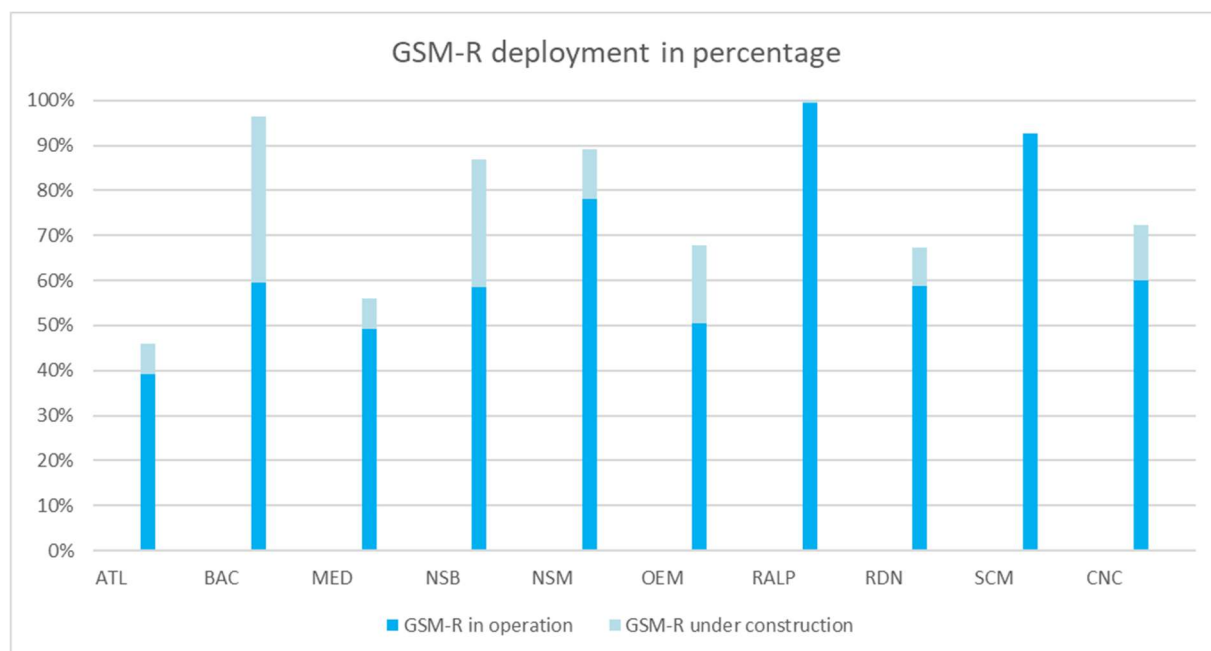


Figure 4 GSM-R deployment by corridor

### 2.1.1 Evolution of the ERTMS deployment

The Commission services closely monitor the ERTMS deployment. The following table summarises the current state of play of the ETCS deployment on the CNC.

KPI	December 2016 (Baseline EDP, including UK)	December 2017 (including UK)	December 2018 (including UK)	December 2019 (including UK)	December 2020 (including UK)	June 2022 (including CEF 2 extension, excluding UK)	2023 (planned) (including CEF 2 extension, excluding UK))	2030 (planned) (including CEF 2 extension, excluding UK))
<b>ETCS in operation (% and km)</b>	7% 3 775 km	9% 4 485 km	10% 5 307 km	11% 5 829 km	12% 6 796 km	14% 7 965 km	31% 15 703 km	97% 57 170 Km
<b>Cross border agreements</b>	0 /46	0/46 + 3 additional	3/46 + 3 additional	3/46 + 4 additional	3/46 + 4 additional	3/49 + 4 additional	21/49	49/49
<b>Cross border status</b>	4/65	5/65	7/65	7/65	7/65	7/70	23/70	70/70
<b>CB status 2017 (EDP)</b>	-	0/1	1/1	1/1	1/1	1/1	-	-



KPI	December 2016 (Baseline EDP, including UK)	December 2017 (including UK)	December 2018 (including UK)	December 2019 (including UK)	December 2020 (including UK)	June 2022 (including CEF 2 extension, excluding UK)	2023 (planned) (including CEF 2 extension, excluding UK))	2030 (planned) (including CEF 2 extension, excluding UK))
CB status 2018 (EDP)	-	-	1/5	1/5	1/5	1/5	-	-
CB status 2019 (EDP)	-	-	-	0/0	0/0	0/0	-	-
CB status 2020 (EDP)	-	-	-	-	0/4	0/4	-	-
CB status 2021 (EDP)	-	-	-	-	-	0/0	-	-
Compliance with EDP 2017	-	74% 1 037 km	87% 1 231 km	91% 1 287 km	93% 1 308 km	93% 1 308 km	-	-
Compliance with EDP 2018	-	-	15% 267 Km	18% 328 km	40% 727 km	40% 727 km	-	-
Compliance with EDP 2019	-	-	-	0% 0 km	0% 0 km	0% 0 km	-	-
Compliance with EDP 2020	-	-	-	-	16% 649 km	18% 712 km	-	-
Compliance with EDP 2021	-	-	-	-	-	0% 0 km	-	-

Table 2 Summary of the state of play of the ERTMS deployment

It should be noted that until the end of 2020, the UK was covered by the monitoring of ERTMS deployment. However, following Brexit, the deployment of ERTMS in the UK has not been monitored anymore. Furthermore, following the adoption of the new CEF 2 Regulation in 2021, the new CNC sections (i.e. CEF 2 extensions) have been included in the monitoring process.

It is important to highlight that five years after the publication of the EDP, there are 4 600 km that are delayed. Most of the delayed sections are under construction (87%). Several Member States have already communicated in their National Implementation Plans (NIPs) a delay for some lines relative to their EDP targets. The km planned by 2021 that are delayed are the following ones:

- 102 km out of the 1 410 km foreseen in the EDP for 2017 are delayed.
- 1 072 km out of the 1 799 km foreseen in the EDP for 2018 are delayed.
- 188 km out of the 188 km foreseen in the EDP for 2019 are delayed.



- 3 233 km out of the 3 945 km foreseen in the EDP for 2020 are delayed.
- 774 km out of the 774 km foreseen in the EDP for 2021 are delayed.

In addition, there are 1 628 km planned to be commissioned with ETCS in 2022 and as of June 2022 most of those lines are not ETCS operational yet. The ETCS deployment progress against the EDP targets per year is presented in the graph below.

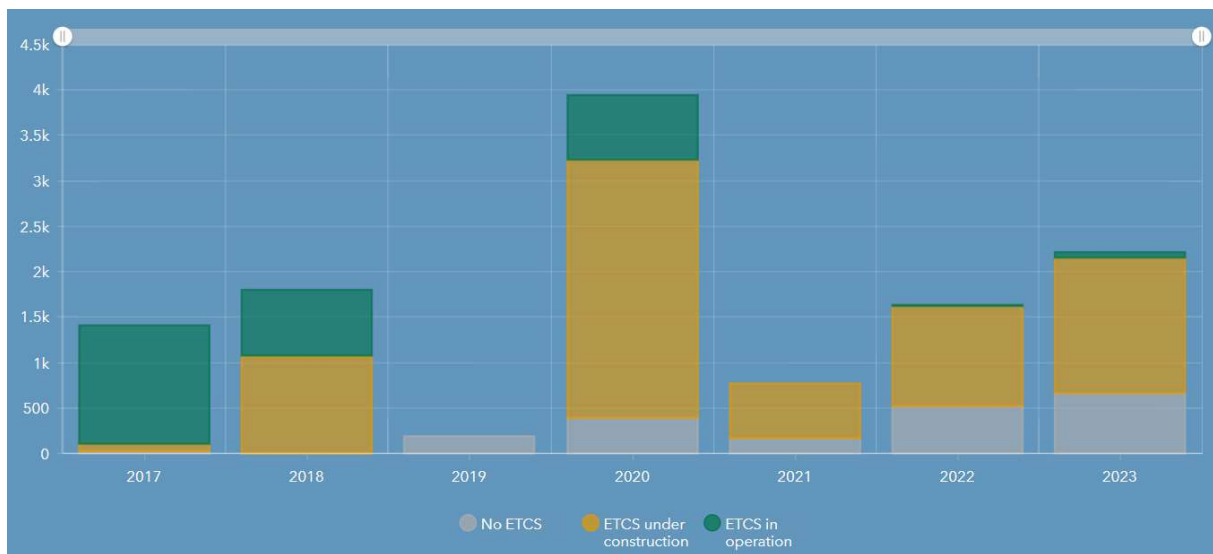


Figure 5 ETCS deployment progress against the EDP targets per year (2017-2023)

Furthermore, the lines delayed (i.e. sections planned in the EDP by 2021 but not in operation yet) are shown in the map below.



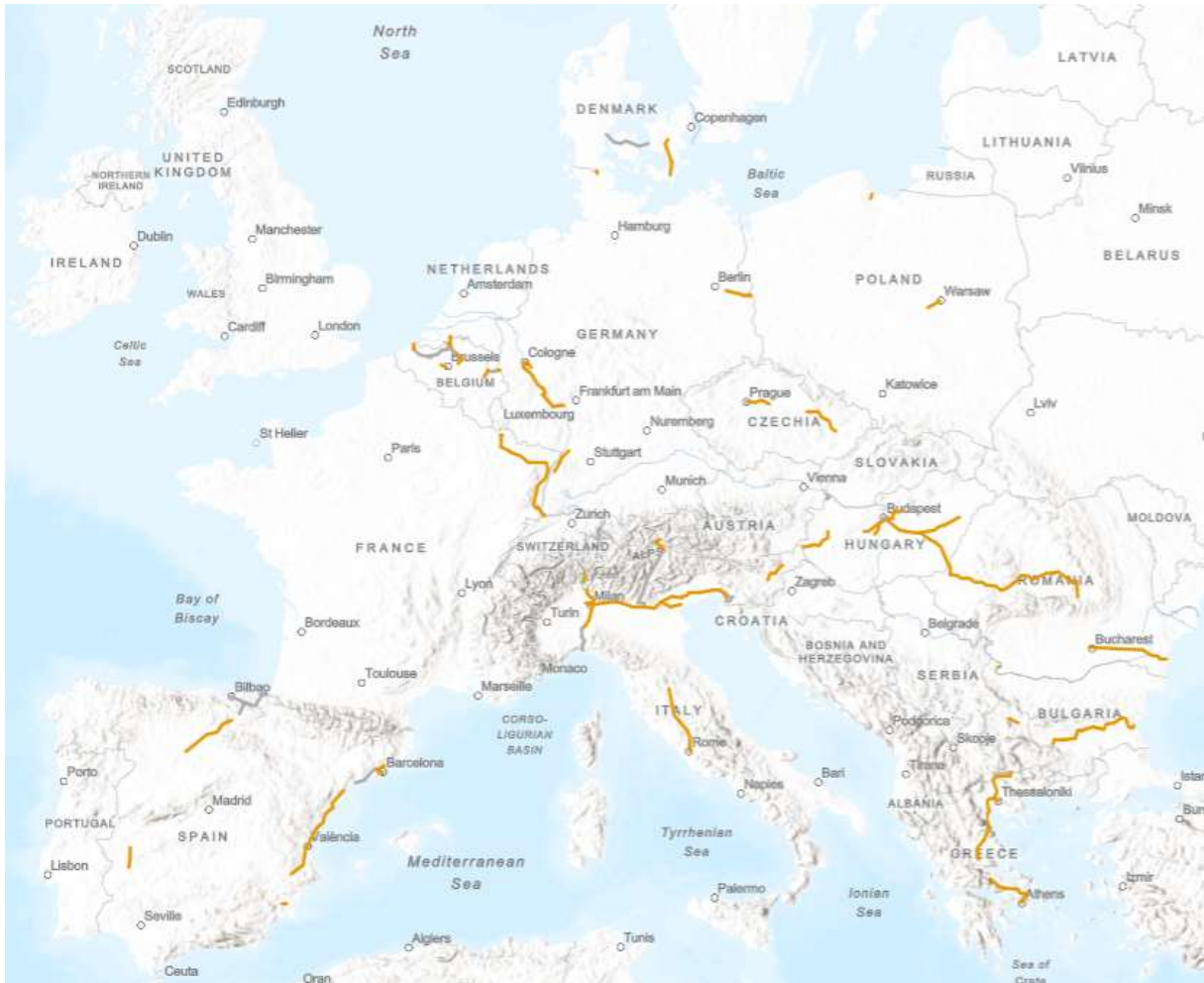


Figure 6 Sections planned in the EDP by 2021 but not in operation yet

The following bar chart presents the number of kilometres of delayed sections with their new delivery deadlines and their current status. The kilometres indicated in the 2020 and 2021 bars correspond to those sections that are still not ETCS in operation, although they were planned for 2020 and 2021 according to the latest available information provided by the Member States.

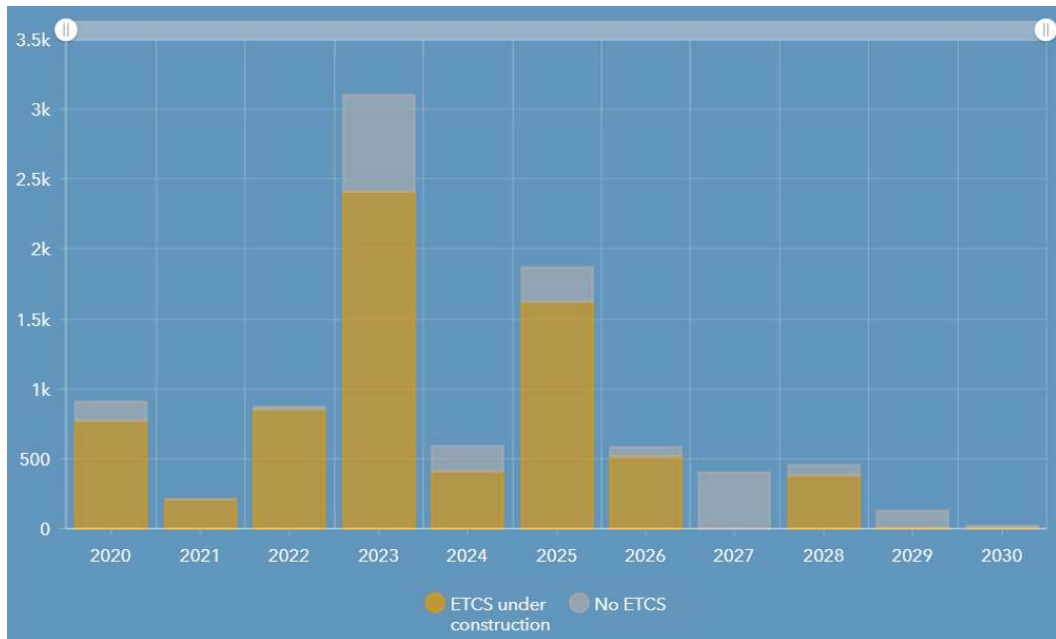


Figure 7 Member States plans per year for delayed sections

The cross-border sections are critical for the deployment of ERTMS, as they impact the business case of railway undertakings. The cross-border sections should allow a seamless connection between national lines and thus a whole origin-destination route with ERTMS as the only signalling system. For this reason, the coordination of deployment dates and technical solutions was set as one of the priorities in the EDP. Despite this and the obligation in the EDP regarding the conclusion of cross-border agreements<sup>15</sup>, only seven cross-border agreements have been notified to the Commission to this date. It should be noted that in the CEF 2 extension, five additional cross-border sections have been included in the CNC. More information on the state of play of cross borders is presented in Annex III.

### 2.1.2 By corridor, in the short term (2023)

The ETCS status on CNC expressed in terms of number and percentage of km to be equipped by 2023 is compiled below by corridor. The CNC with the highest number of km to be equipped by 2023 are highlighted in purple:

<sup>15</sup>Article 2(3) of EDP (Regulation (EU) 2017/6) stipulates that "railway infrastructure managers shall, after having consulted the railway undertakings affected, sign an agreement on technical and operational aspects of the deployment for each cross-border section"... "not later than one year before the earlier of the deployment dates for the given cross-border section", and "Member States (MS) shall notify such agreements to the Commission not later than one month after the conclusion"





KPI	Length to be equipped by 2023 (Km)	Current ETCS in operation (Km)	Current ETCS in operation (%)	ETCS in operation & ETCS under construction (%)	ETCS in operation & Contracts signed (including Framework Contracts) (%)
ATL	1.758,89	1.053,11	60	89	89
BAC	2.100,54	1.284,67	61	86	86
MED	3.134,70	1.654,10	53	96	96
NSB	1.776,45	564,86	32	82	89
NSM	1.565,43	799,14	51	81	100
OEM	2.762,49	673,61	24	91	91
RALP	2.272,89	990,18	44	90	99
RDN	2.062,23	400,57	19	99	99
SCM	1.848,95	687,24	37	71	89

Table 3 ETCS status by corridor - 2023

The CNC with the highest number of km to be deployed by 2023 are MED, OEM and RALP. Their “ETCS in operation” rates are 53%, 24% and 44%, respectively. Nevertheless, when taking into account the km of sections in operation and under construction, the rate increases to 96% for MED, 91% for OEM and 90% for RALP corridors. SCM corridor with 71% has the lowest “ETCS in operation and ETCS under construction” rate of all corridors. The NSM corridor is the only one in which all their sections planned by 2023 in the EDP are already operational or with projects signed, including the framework contracts<sup>16</sup>.

### 2.1.3 By corridor, in the long term (2030)

The ETCS status on CNC in terms of number and percentage of km to be equipped by 2030 is compiled below. The CNC with the highest number of km to be equipped by 2030 are highlighted in purple:

KPI	Length to be equipped by 2030 (Km)	Current ETCS in operation (Km)	Current ETCS in operation (%)	ETCS in operation & ETCS under construction (%)	ETCS in operation & Contracts signed (including Framework Contracts) (%)
ATL	11.103,97	1.183,94	11	26	26
BAC	4.912,91	1.404,94	29	40	40
MED	11.325,00	2.082,16	18	41	41
NSB	7.870,64	952,00	12	28	30
NSM	5.025,54	799,14	16	25	33
OEM	6.478,64	700,32	11	45	45
RALP	3.461,79	990,18	29	65	72
RDN	5.908,22	400,57	7	41	41
SCM	11.913,85	1.244,44	10	26	53

Table 4 ETCS status by corridor - 2030

<sup>16</sup> Framework contracts are contracts covering the deployment of ETCS either on the whole or on significant parts of the network of a given Member State. This is the case of Belgium, Denmark, Norway or Sweden.



The CNC with the highest deployment rate are BAC (29%) and RALP (29%). The remaining CNC have a deployment rate between 7% and 18%. RDN and OEM have very low rates, although some lines on those CNC had been deployed with a pre-baseline 2, which is not a legal baseline anymore and is thus not taken into consideration for statistical reasons in the table above.

Detailed information on the ERTMS deployment on the nine CNC is presented in Annex I.

#### 2.1.4 By Member State, in the short term (2023)

The ETCS status by Member State, including Norway and Switzerland, expressed in terms of number and percentage of km to be equipped on the CNC by 2023, is compiled below. Member States with the highest number of km to be equipped by 2023 are highlighted in purple.

Spain is the country with the greatest number of km to be equipped with ETCS (i.e. 2 294.3 Km) in the short term (i.e. 2023). It has, however, already 62% of them in operation and has gathered great expertise on this system. This should reduce the time needed for the implementation of ERTMS projects that are ongoing.

Next to Spain, Germany and Poland are the Member States which have the second and third highest number of km in operation plus under construction. These Member States are also among the countries with the highest number of km to be equipped by 2023. In contrast with Spain, the percentage of km in operation in Germany and Poland with respect to the number of km foreseen by 2023 is only 13% and 34%, respectively.

There are four countries, i.e. Belgium, Denmark, Norway and Sweden, which have all their lines covered by framework contracts. However, Sweden and Norway have no sections required to be operational by 2023, according to the EDP.



KPI	Length to be equipped by 2023 (Km)	Current ETCS in operation (Km)	Current ETCS in operation (%)	ETCS in operation & ETCS under construction (%)	ETCS in operation & Contracts signed (including Framework Contracts) (%)
Austria	619,41	296,37	48	58	58
Belgium	1.205,67	606,36	50	66	100
Bulgaria	626,12	225,94	36	87	87
Croatia	0,00	0,00	0	0	0
Czech Republic	863,28	474,05	55	87	87
Denmark	503,93	61,16	12	34	100
Estonia	0,00	0,00	0	0	0
Finland	0,00	0,00	0	0	0
France	1.081,04	759,76	70	100	100
Germany	1.560,12	196,11	13	97	97
Greece	627,74	0,00	0	100	100
Hungary	799,59	0,00	0	97	97
Ireland	0,00	0,00	0	0	0
Italy	1.435,28	557,29	39	87	87
Latvia	0,00	0,00	0	0	0
Lithuania	0,00	0,00	0	0	0
Luxembourg	85,69	85,69	100	100	100
Netherlands	307,23	307,23	100	100	100
Norway	0,00	0,00	0	0	0
Poland	1.664,10	559,57	34	89	89
Portugal	0,00	0,00	0	0	0
Romania	740,31	40,15	5	100	100
Slovakia	296,83	186,94	63	97	97
Slovenia	475,01	291,40	61	95	95
Spain	2.294,30	1.411,04	62	88	88
Sweden	0,00	0,00	0	0	0
Switzerland	517,58	495,80	96	100	100

Table 5 ETCS status by country - 2023

ETCS was deployed on the whole network of Luxembourg at the end of 2017. The Netherlands has already finalised the deployment of the sections planned by 2023 as well. Switzerland has all its sections either deployed or under construction (only 4% pending), and operation without restrictions on the whole Swiss network was planned by 2021.

France has already 70% of the km planned in the EDP by 2023 in operation, and the remaining sections planned by 2023 are under construction.

France, Greece, Luxembourg, The Netherlands, Romania and Switzerland have their sections planned by 2023 in the EDP, either in operation or under construction. Bulgaria, Czechia, Germany, Hungary, Italy, Poland, Slovakia, Slovenia and Spain have an ETCS deployment progress rate (i.e. ETCS in operation or under construction) well above 80 %.

The ERTMS deployment in Denmark is the lowest by far, and only one CNC line has been already commissioned. However, Denmark has two framework contracts covering all of its state-owned network with the aim to finalise the deployment on the entire network by 2030. The progress rate for the deployment of ETCS in Austria (below 60 %) leaves a clear room for acceleration in order to meet the EDP deadlines.



Additional efforts should be made in Italy, Poland and Germany in view of the length of the network to be equipped and the low percentages that are in operation at present.

### 2.1.5 By Member State, in the long term (2030)

The ETCS status by Member State, including Norway and Switzerland, expressed in terms of number and percentage of km to be equipped on CNC by 2030, is compiled below. The Member States with the highest number of km to equip are highlighted in purple:

KPI	Length to be equipped by 2030 (Km)	Current ETCS in operation (Km)	Current ETCS in operation (%)	ETCS in operation & ETCS under construction (%)	ETCS in operation & Contracts signed (including Framework Contracts) (%)
Austria	1.181,62	296,37	25	43	43
Belgium	1.280,65	606,36	47	62	100
Bulgaria	1.246,25	225,94	18	44	44
Croatia	387,14	0,00	0	20	20
Czech Republic	1.541,97	474,05	31	53	53
Denmark	920,45	145,98	16	32	100
Estonia	166,64	0,00	0	0	0
Finland	1.296,75	0,00	0	5	5
France	8.769,70	832,15	9	16	16
Germany	8.502,71	235,58	3	22	22
Greece	1.542,73	0,00	0	58	58
Hungary	1.442,93	0,00	0	53	53
Ireland	0,00	0,00	0	0	0
Italy	5.284,71	557,72	11	39	39
Latvia	189,41	0,00	0	0	0
Lithuania	367,15	0,00	0	0	0
Luxembourg	85,69	85,69	100	100	100
Netherlands	769,96	307,23	40	40	40
Norway	208,26	0,00	0	82	100
Poland	4.526,06	826,70	18	46	46
Portugal	1.534,11	0,00	0	19	19
Romania	1.924,03	40,15	2	43	43
Slovakia	729,35	186,94	26	42	42
Slovenia	555,75	291,40	52	81	81
Spain	8.751,60	1.897,55	22	39	39
Sweden	3.446,68	459,18	13	25	100
Switzerland	517,58	495,80	96	100	100

Table 6 ETCS status by country - 2030

For the Member States with the highest number of km to be deployed, the ETCS in operation rate is generally low (9 % in France, 3% in Germany, 11% in Italy, 18% in Poland, 22% in Spain, 13% in Sweden). Nevertheless, when considering the km of sections under construction and in operation, these percentages increase to 16%, 22%, 39%, 46%, 39%, 25%, respectively. Additional deployment efforts should be made in these Member States, especially in France and Germany, which have the lowest ETCS status rate.

In Ireland, there is no ETCS deployment yet. However, according to the latest Irish deployment plan, the Irish network will be equipped with ETCS Level 1 by 2040. In case of the Baltic States, the lines



outside the Rail Baltica in Estonia, Latvia and Lithuania are at present exempted from the obligation to fully deploy ETCS.

As mentioned in the previous subsection, Belgium, Denmark, Norway, and Sweden have all their railway sections included in framework contracts. Therefore, all their railway sections are considered to be either already in operation or at least covered by a contract.

## 2.2 Rolling stock deployment

ERTMS, as a system, requires a synchronised deployment both trackside and on-board and crucial system benefits only occur when both trains and trackside are equipped. Therefore, rolling stock deployment is essential. Based on the data collected and cross-checked<sup>17</sup>, we estimate that between 2015 and 2019, around 5 700 vehicles were equipped with ERTMS, and at the end of 2020, more than 7 150 vehicles were equipped with ERTMS on a total of 41 665 vehicles in operation.

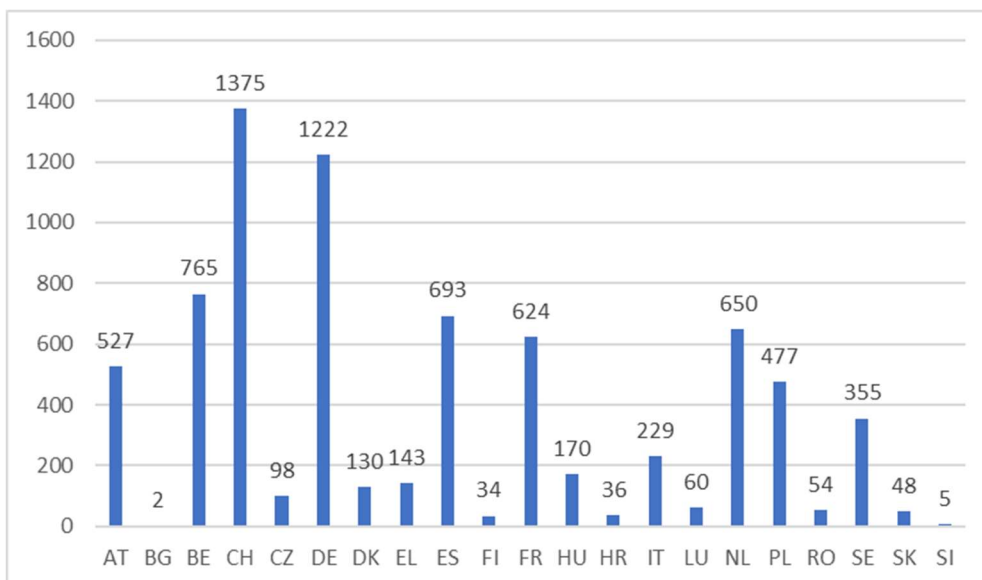


Figure 8 Vehicles equipped with ERTMS per country<sup>18</sup>

Approximately 40% of the 5 700 vehicles equipped between 2015 and 2019 were new, and 60% were retrofitted vehicles<sup>19</sup>. As a result, only around 2 300 new vehicles with ERTMS have been put in operation in Europe between 2015 and 2019.

<sup>17</sup> Data for on-board equipment have been collected from multiple sources to assess the current status of on-board deployment, i.e., data from interviews carried out by Deployment Management Team with railway undertakings, data collected by UNIFE, data collected by ERA and additional desk research.

<sup>18</sup> This figure also includes data for vehicles equipped after 2020. Therefore, total value is 7 787, which is higher than the total fleet equipped at the end of 2020 (approx. 7 150), as it includes also vehicles equipped in 2021 and 2022.

<sup>19</sup> Source: UNIFE



Between 2015 and 2019, there was approximately 5 000 new vehicles that were put in operation in Europe. **Therefore, at least 2 700 new vehicles (around 54%), i.e. a majority, were put on the market without ERTMS during this period.**

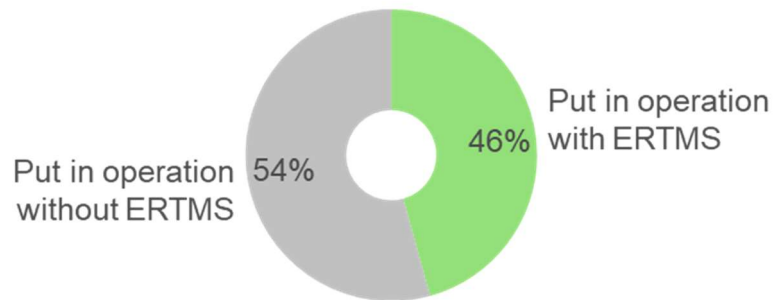


Figure 9 Renewal fleet between 2015 – 2019

Nevertheless, based on the most recent information collected by ERA on vehicle authorization from ERA and NSA, it seems that the trend is getting better, with the number of vehicle authorizations for vehicles equipped with ERTMS increasing in 2020 and 2021, improving the rate of ERTMS deployment out of the total vehicle authorizations requested by vehicle owners (above 50%).

### 2.3 Deployment outside the European Union

More than 53 000 km of ERTMS railway lines and 5 900 vehicles are in service or have been contracted outside Europe<sup>20</sup>. A vast majority of the ERTMS lines located outside Europe are new lines. Deploying ERTMS is indeed technically simpler and faster in green field projects. The following map shows the non-EU countries which have ERTMS installed or planned in the future.

<sup>20</sup> Source UNIFE based on contracts signed by UNIFE Members: [www.ertms.net/deployment-world-map/](http://www.ertms.net/deployment-world-map/)

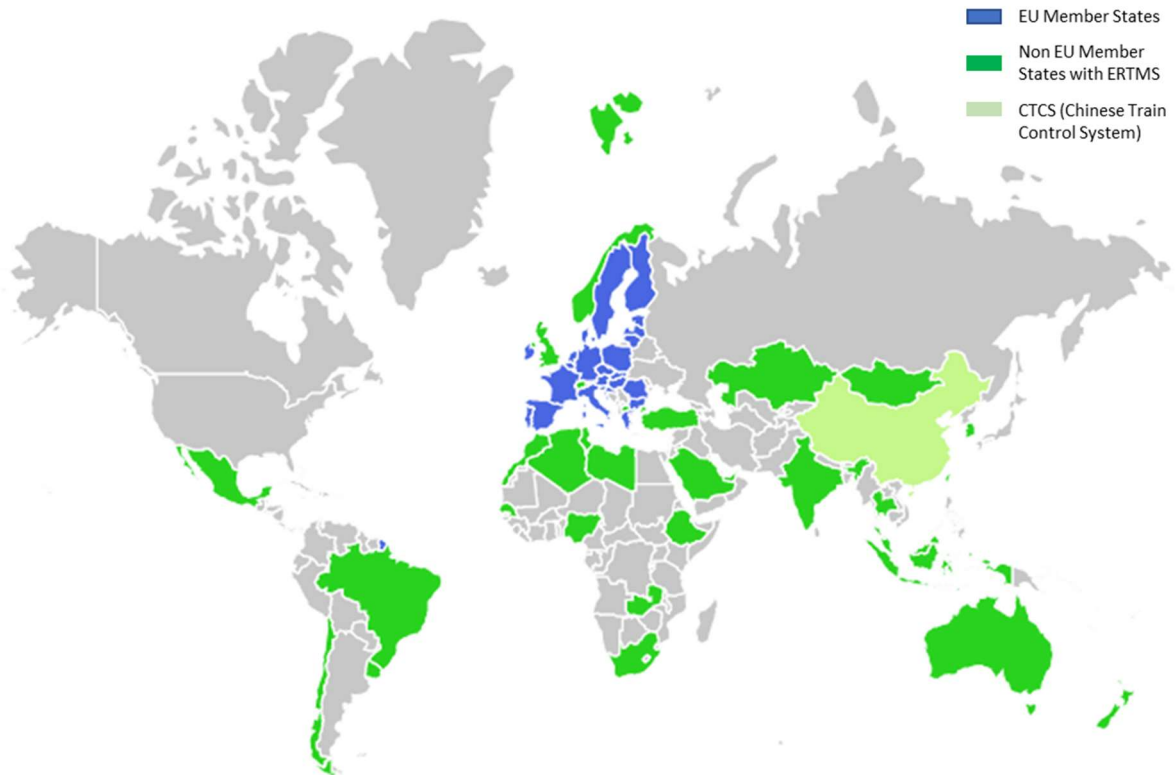


Figure 10 Non-EU countries which have ERTMS installed or planned in the future

Some of the non-EU countries in Europe have also already ERTMS in service, i.e. Switzerland, Norway and United Kingdom. Switzerland and Norway have railway lines that belong to the CNC, therefore, the deployment data for Switzerland and Norway are taken into consideration in the tables and figures included in the different sections of the work plan. United Kingdom has 469 km and 283 vehicles equipped with ERTMS. In addition, North Macedonia and Serbia equip or plan to equip some lines of their network with ERTMS.

Asia is, besides Europe, the most advanced continent in terms of ERTMS deployment. There are thirteen countries in which ERTMS is already installed or under construction, with China being the frontrunner with more than 22 000 km and more than 1 000 vehicles equipped with CTCS (Chinese Train Control System), which was developed on the basis of ERTMS/ETCS but not fully interoperable. After China, Turkey has more than 5 000 km and 330 vehicles, and Saudi Arabia has 4 500 km and 100 vehicles. Some countries, like Israel, have even a network-wide ERTMS deployment plan.

In Africa, there are nine countries with ERTMS in service or under construction. Of those, the countries with the most ERTMS kilometres implemented and with an equipped fleet are Algeria and Morocco. According to the available information, Algeria has more than 2 500 km with ERTMS implemented and 50 vehicles equipped, while Morocco has more than 1 200 km with ERTMS implemented and 100 vehicles equipped.

Four countries in America, i.e. Brazil, Chile, Mexico and Uruguay, are also deploying the system. According to the available information, the country with the highest ERTMS deployment in this region is Brazil, with more than 300 km and 150 equipped vehicles in service, followed by Mexico, with more



than 200 km and 50 vehicles in service. In Uruguay, more than 250 km are foreseen to be commissioned by 2022.

In Oceania, both Australia and New Zealand have ERTMS systems installed in some sections of their networks and vehicles of their fleet.

## 2.4 Funding

### 2.4.1 Funding from 2007 to 2020

Public support for the ERTMS deployment at the EU level, but also in some Member States, has increased over the past years. The EU allocations for ERTMS during the period 2007-2013 amounted to some EUR 1.2 billion (EUR 645 million from the TEN-T programme and EUR 570 million from ESIF funding) and during the last financial perspective (2014-2020), to more than EUR 2.7 billion (EUR 842 million from the CEF programme and EUR 1.9 billion from the ESIF)<sup>21</sup>.

During the first funding period, the TEN-T programme focused on supporting ERTMS trackside deployment, while in the second period, with the CEF programme, the approach was to finance both on-board and trackside.

For the period 2014-2020, a total of 93 Grant Agreements have been signed, including 47 for trackside, 44 on-board and 2 for Memorandum of Understanding activities (MoU, for instance, test campaigns, both in the field and in laboratories). Following terminations and modifications, 36 actions have been actually supported for trackside, representing a total length of 5 861 km of double-track lines equivalent, mostly related to first deployment (85%), with a CEF budget of EUR 508.4 million. For on-board, 36 actions have been supported, representing a total of 2 874 vehicles (1 565 serial retrofits, 637 upgrades, 526 fitments, 146 prototypes both for retrofit and upgrade), with a CEF budget of EUR 327.6 million. 2 actions for MoU activities have been supported with a CEF budget of EUR 5.7 million. As part of the call for 36 actions, one action focusing on prototypes for the on-board deployment was launched in 2019. The objective of this call was to prepare a pipeline of serial deployment projects for the next financing period. 8 projects have been selected under this call for a total amount of EUR 41.9 million of EU support. This call will support the equipment of 68 first in class vehicles and pave the way for an indicative serial retrofitting of more than 2 500 vehicles.

Another action undertaken as part of the CEF programme was the CEF Blending call, launched in 2017, which supported ERTMS through innovative financing mechanisms. As a result, eight projects were selected (7 on-board, one trackside) for a total EU funding of EUR 197 million. This new type of call required the involvement of a financial institution as a debt provider to ensure better leverage of EU funds and a higher maturity of projects. Based on the experience of the Blending Call, a new CEF programme instrument called the CEF Blending Facility was released in 2019, with a budget of EUR 99 million (grants component). It is a mix of CEF grants and debt instruments paired with financing from the EIB or national promotional banks (so-called implementing partners). The CEF Call had five cut-off

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<sup>21</sup> Data from Special Report 13 (2017) by the European Court of Auditors





dates for submitting the proposals during the period of over one year. As an outcome, nine on-board projects have been selected for a total amount of more than EUR 76 million of EU support.

Finally, during the period 2014-2020, EU support was simplified, replacing the concept of ‘eligible cost’ with that of ‘unit contribution’. It implies additional simplifications at the beneficiary level both in terms of application and reporting requirements. Furthermore, it decreases the workload for the final closure of projects and consequently speeds up the payment procedures. Reporting and control of ERTMS deployment actions will focus on the implementation of the supported actions, and the achieved technical outputs rather than on the eligibility of costs incurred, reducing the workload and scope for error of both beneficiaries and CINEA.

Annex VII includes a more detailed overview of the portfolio managed by CINEA with regards to the ERTMS actions supported by CEF for 2014-2020, with an update of the portfolio until the 4<sup>th</sup> quarter of 2021.

#### 2.4.2 Lessons learnt

Under the previous financing period, different approaches aimed at the ERTMS deployment have been tested:

- Trackside projects and on-board projects
- Retrofitting projects and fitting projects
- Regular retrofitting and upgrades of existing ERTMS equipment
- Regular retrofitting and prototypes only
- Dedicated calls for ERTMS only and mixed calls (including the overall track works)
- Grants and blending facility
- Calls based on eligible costs and unit contributions

Significant amounts were allocated to ERTMS projects, but beneficiaries representing a third of the initial budget allocated have already been withdrawn from the approved projects. The main issues faced by project promoters were a lack of maturity of their project, tight implementation framework, cost overruns, and availability and capacity of suppliers.

For instance, in the past, mixed projects (focussing not only on the ERTMS deployment but encompassing overall track works) encountered situations where upstream delays in infrastructure works led to abandoning the part related to the ERTMS deployment as, with the existing rules on project finance, there was no more time to implement ERTMS during the eligible period. Based on this experience, support under CEF 2 will only be granted to the “pure” (and mature) ERTMS projects.

Unit contributions, on the other hand, proved their merits and were appreciated by most of the stakeholders – even though the unit amounts were considered too low for some projects, for instance, in urban nodes. This was also addressed under CEF 2 calls with the new dedicated unit contributions. Furthermore, the successful experience of the ERTMS unit contributions under the General envelope encouraged the development of a similar approach for the Cohesion Fund envelope, which should



further incentivise and facilitate the deployment of ERTMS in the Member States eligible for Cohesion funding under CEF 2.

#### 2.4.3 Connecting Europe Facility 2021-2027, ESIF and Recovery and Resilience Fund

In the new multi-annual programme set out by CEF 2 Regulation<sup>22</sup>, rail transport continues to be a funding priority as the focus on transport shifts to making transport smart, sustainable, inclusive, safe and secure. As before, there are funds available under the general transport envelope (EUR 14.52 billion) and the Cohesion Fund envelope (EUR 11.29 billion). In this respect, CEF will remain the EU's key financial tool to fund ERTMS projects. The 2021 CEF call was launched on 16 September 2021. EUR 550 million has been allocated for smart and interoperable mobility, which encompasses ERTMS: EUR 400 million under the general envelope and EUR 150 million under the cohesion envelope. During the first three years of the CEF2 framework, this type of call will be renewed on a yearly basis to give project promoters a clear perspective on the availability of funding and encourage them to come forward only with mature projects. This addresses concerns voiced by stakeholders in the past as regards insufficient visibility on the future availability of CEF funds.

Both trackside and on-board projects are eligible, and support will again be based on unit contributions – with the addition of a new unit contribution dedicated to urban nodes with a higher level of support. Indeed, ERTMS deployment in urban nodes is complex and costly. As a result, urban nodes often remain unequipped, with a detrimental impact on interoperability. Focusing on urban nodes is therefore of paramount importance for the effective deployment of ERTMS as a system and for making the TEN-T network truly interoperable.

Furthermore, ESIF will continue to play its role in financing ERTMS projects in eligible Member States and regions. In 2021-2027, the Cohesion Fund (under shared management) will be available to support investments in the field of environment and trans-European networks in the area of transport infrastructure: trackside deployment projects for ERTMS could therefore benefit from this source of funding. Over the same period, the European Regional Development Fund (ERDF), with a budget of approximately EUR 200 billion, will enable investments in a smarter, greener, more connected and more social Europe that is closer to its citizens. This is translated into five funding priorities, two of them being directly linked with ERTMS: (i) greener, low-carbon and resilient Europe; (ii) more connected Europe by enhancing mobility.

The Recovery and Resilience Facility (RRF) is also supporting ERTMS deployment in several countries. The Recovery and Resilience Facility Regulation<sup>23</sup> establishes a requirement that the measures supported by the RRF and included in the recovery and resilience plans of the individual Member States should contribute to the green transition and digitalisation. The investment under RRF should account

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<sup>22</sup> <https://eur-lex.europa.eu/eli/reg/2021/1153>

<sup>23</sup> Regulation (EU) 2021/241 of the European Parliament and of the Council of 12 February 2021 establishing the Recovery and Resilience Facility



for an amount that represents at least 37 % of the recovery and resilience plan's total allocation based on the methodology for climate tracking and at least 20 % for the digital target.

Annex VI and Annex VII of the Regulation define dimensions and codes for the types of intervention for the RRF to be used for the calculation of the allocation in the individual plans. According to Annex VI, the coefficients for ERTMS are 40% for both climate and environmental coefficients. In line with Annex VII, the ERTMS coefficient for the digital tagging under the Facility is 100%.

Rail development comprises about 40% (EUR 38.4 billion) of the transport-related reforms and investments of the Recovery and Resilience Plans. The Recovery and Resilience Plans (RRPs) of Austria, Belgium, Bulgaria, Czech Republic, Estonia, Greece, Finland, France, Hungary, Croatia, Italy, Netherlands, Poland, Latvia, Slovenia, Slovakia, Sweden contain various measures to support the upgrade and modernisation of railway infrastructure, including the roll-out of ERTMS. Some countries also included in their RRP the purchase of rail rolling stock, such as Croatia, Hungary and Poland. For example, the latter foresees 500 million euros of loans for new rolling stock for regional passenger rail services.

Together with ERTMS, the digitalisation of rail is prominent in the RRP. For instance, Germany has a fast-track programme to replace the existing signal box and level crossing technology with safety systems of the latest digital generation (EUR 0.5 billion). Poland foresees investments (EUR 341 million) in, among others, the purchase and installation of ETCS on-board equipment and implementation of remote control in 35 rail traffic stations.

Within the overall funding dedicated to rail, at least 30% are planned to be allocated to the TEN-T networks (12 billion euro). The Italian, Spanish, Czech, and Polish RRP, for instance, present ambitious programmes of investments in high-speed railway connections on the TEN-T network, together with cross-border connections, the accelerated deployment of ERTMS, the strengthening of metropolitan nodes and key national links, as well as regional lines.

Finally, ERTMS should also benefit from **the InvestEU Programme**<sup>24</sup>, which provides simplified and streamlined investment support with just one set of rules and procedures and one point of contact for advice. It supports four different policy areas, focusing on where the EU can add the most value by providing a budget guarantee to attract private investment. The InvestEU Fund, which is a market-based and demand-driven instrument, will mobilise both public and private investments through an EU budget guarantee of EUR 38 billion, backing investment projects of financial partners (EIB, EBRD, World Bank, Council of Europe Bank). The policy areas for sustainable infrastructure (EUR 11.5 billion) and research, innovation and digitisation (EUR 11.25 billion) are of particular interest for the financing of railway projects. Member States will have the option to channel some of their allocated Cohesion Policy Funds into the InvestEU budget guarantee. Any funds channelled into the Fund will benefit from the EU guarantee and its high credit rating, giving national and regional investments more leverage. For a project to be eligible, it must address market failures or investment gaps and be economically viable, help meet EU policy objectives and achieve a multiplier effect.

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<sup>24</sup> [https://ec.europa.eu/commission/presscorner/detail/en/MEMO\\_18\\_4010](https://ec.europa.eu/commission/presscorner/detail/en/MEMO_18_4010)



## 3 Next steps

### 3.1 Policy background

The Commission, in its Green Deal and Sustainable and Smart Mobility Strategy (SSMS), laid out measures aimed at promoting a sustainable transport system. This was followed, among others, by the Fit for 55 packages in June 2021 and the December 2021 Transport package.

One of the ambitious objectives for transport decarbonisation is to achieve significant growth in the modal share enjoyed by rail transport (both passenger and freight). To this end, a substantial increase in rail transport capacity is needed, which cannot be obtained without the widespread deployment of advanced ERTMS.

Moreover, ERTMS will become the backbone of railway digitalisation, accelerating the introduction of new technologies, including automatic train operation, satellite positioning and other technologies capable of optimising rail performance and capacity.

Climate change and digitalisation are two major objectives on the European Commission's policy agenda, and ERTMS deployment ticks off all the boxes.

From 2022 onwards, both the revised CCS TSI and TEN-T Guidelines will go through a negotiations process. The adoption of these legal acts in 2022 and 2023, respectively, will set new milestones for the ERTMS deployment.

The revised TEN-T Guidelines should decisively contribute to the objectives of the Green Deal and the SSMS and accelerate the ERTMS deployment. The revision of CCS TSI will address many pending technical issues, including setting out a framework for a more modular and industrial deployment. A key issue in the ERTMS deployment is the improvement on the maturity of the ERTMS concept, focusing on the reliability, availability and maintainability of ERTMS as critical system to ensure European interoperability. This topic is faced by the 2022 CCS TSI revision as indicated in section 3.4.2. Finally, the entry into force of Europe's Rail JU and its System Pillar will pave the way towards a harmonised, robust, and reliable interoperable European railway system based on ERTMS.

### 3.2 Outlook of ERTMS deployment by 2030 and 2040

#### 3.2.1 Trackside

Based on the national plans and information provided by the Member States or collected by the EC, it is estimated that about 48% of the TEN-T network and 67% of the Core Network will be equipped with ERTMS by 2030 and 69% and 84% respectively by 2040<sup>25</sup>. The details per Member State, including Norway and Switzerland, are presented below.

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<sup>25</sup> This value is a low bound, as some Member States might be willing to deploy ERTMS but have no official plans today

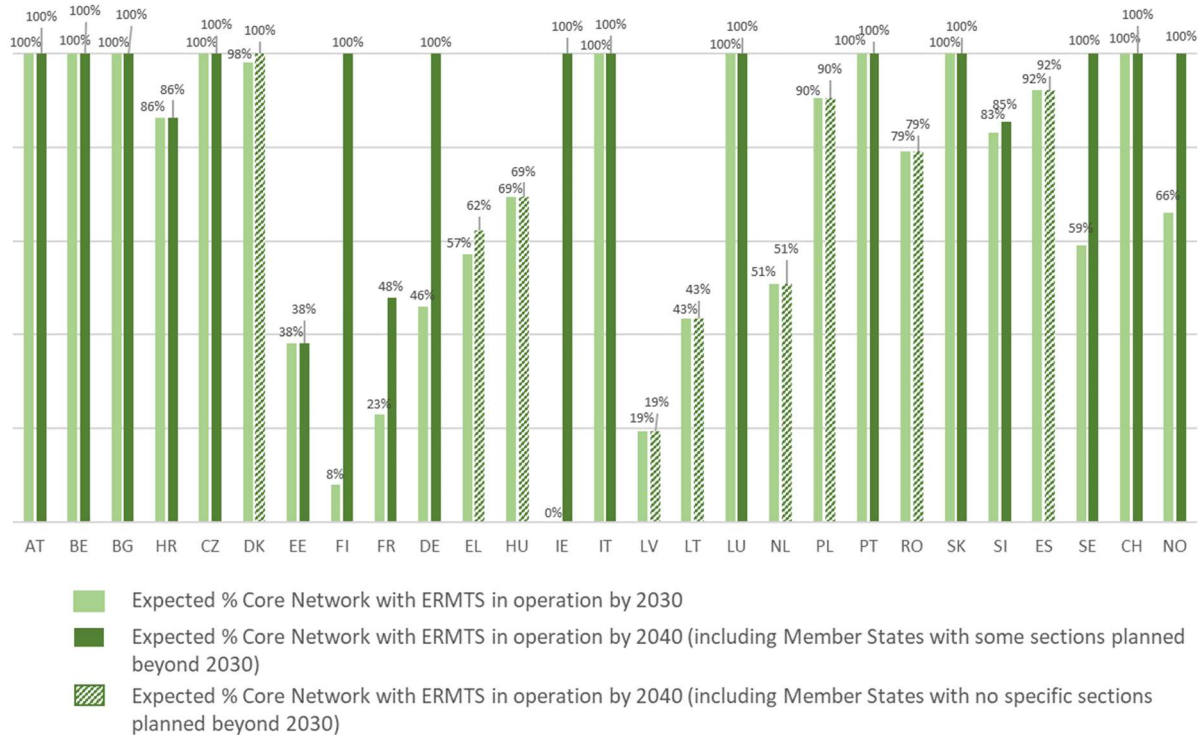


Figure 11 Based on national plans and current progress, expected trackside ERTMS deployment per MS, including NO and CH

Not all Member States limit themselves to the TEN-T network. Indeed, some Member States have chosen a more ambitious strategy and decided to go for a network-wide deployment (see below). In these Member States, their whole network will be equipped with ERTMS.

Overall, based on known Member States' plans, 69% of the whole TEN-T will be equipped with ERTMS by 2040<sup>26</sup>. The remaining 31% include:

- new lines to be built, as they are supposed to be equipped with ERTMS,
- sections that are exempted from deployment (e.g. isolated networks),
- sections to be equipped (both with Class B and without any train protection systems).

<sup>26</sup> It represents 71% of the Comprehensive network to be equipped (if exempted sections are not included)

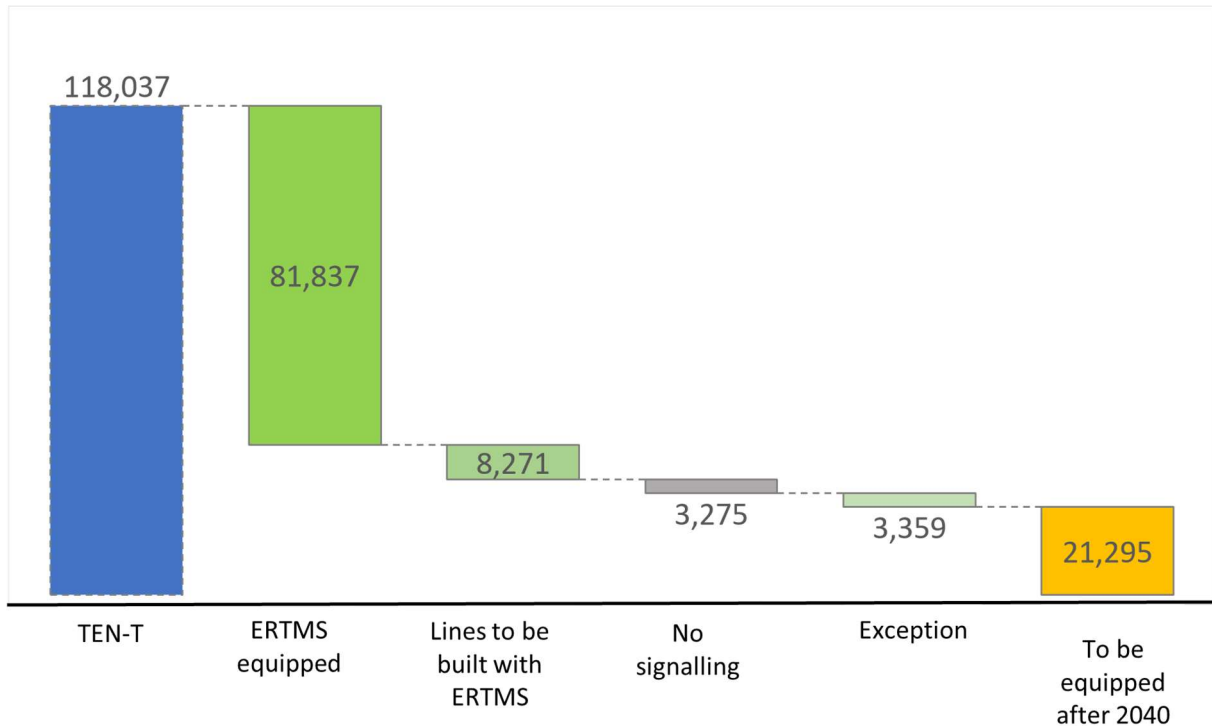


Figure 12 Based on National Plans, expected ERTMS trackside status by 2040

It is worth noting that based on the existing national plans, by 2040, on-board Class B systems will be required only on less than 20% of the current TEN-T Network.

This estimate is both optimistic and conservative. On the one hand, it assumes that Member States will deliver on time what they have planned in terms of ERTMS deployment. On the other hand, a number of Member States do not have plans going beyond 2030. As a result, additional sections could be expected by 2040 in those Member States.

Therefore, it is a reasonable expectation that, in total, a higher percentage of the network would be equipped by 2040.

The countries that have planned to have their entire network equipped with ERTMS by 2040 are **Belgium, Czechia, Denmark, Finland, Germany, Italy, Ireland, Luxembourg, Norway, Sweden and Switzerland.**

**Bulgaria, Greece and Slovenia** do not plan to equip their entire network with ERTMS by 2040, but no Class-B system will be required on-board as the only lines which will be not equipped will not have any automatic train protection system (part of the 3 275 km with “No signalling system” of the figure above).

Among these Member States, some go even further and have already defined their decommissioning deadlines:

- **Belgium**, the whole network is expected to be equipped with ERTMS by 2025. Class B decommissioning is foreseen when lines are equipped with ERTMS, i.e. in 2025.



- **Czechia**, the whole network is expected to be equipped with ERTMS by 2040. The Class B system will be gradually phased-out starting from 2025.
- **Denmark**, lines currently equipped with automatic train protection systems will be equipped with ERTMS by 2030. Class B system will be decommissioned when ETCS is installed trackside.
- **Finland**, the whole network is expected to be equipped with ERTMS by 2040. Class B decommissioning is planned one year after ERTMS deployment on a given line.
- **Germany**, the whole network is expected to be equipped with ERTMS by 2040. The Class B system will be gradually phased-out starting from 2025.
- **Italy**, the whole network is expected to be equipped with ERTMS by 2036. The Class B system will be gradually phased-out starting from 2023.
- **Luxembourg**, ERTMS has been in service since 2019. Class B system decommissioning was finalised at the end of 2020.
- **Slovenia**, the Core Network is expected to be equipped with ERTMS by 2025 and the Comprehensive Network by 2031. The Class B system on the Core Network will be decommissioned by 2025 and on the Comprehensive Network and regional lines by 2031.
- **Sweden**, the whole network is expected to be equipped with ERTMS by 2035. The Class B system will be decommissioned when ETCS is installed trackside.

In summary, the deployment plans of ERTMS on the TEN-T Core and Comprehensive Network by 2040 would look as follows (countries that plan to achieve a network-wide ERTMS deployment by 2040 are highlighted in light green):





## Work Plan 2022 of the European Coordinator for ERTMS



Figure 13 Reviewed ERTMS deployment plans by 2040 in EU27 + NO + CH





### 3.2.2 On-board

A successful deployment plan requires a synchronised deployment strategy between trackside and on-board. Only when the fleet is equipped will it be possible to reap the full benefits of the ERTMS deployment. As a result, a forecast of the total number of equipped vehicles is needed.

This is not an easy task, as there is no single database on the vehicles equipped with ERTMS in Europe. Furthermore, assumptions have to be made as to the end-of-life cycle of existing vehicles. The following sources were used and cross-checked: ERA, Eurostat, UNISIG, UNIFE, NSA, interviews with railway undertakings and leasing companies, publications from Member States and CINEA, industry databases, and press analysis.

According to our estimates, 7 150 vehicles are already equipped with ERTMS by end-2020 (see section 2.2). Altogether, we consider that some 11 500 diesel locomotives, 14 500 electric locomotives and 15 500 passenger trainsets (both high-speed and non-high-speed) are being used in the European Union, Switzerland and Norway. This represents a total of approximately 41 500 vehicles. In addition, shunting locomotives, yellow fleet and historical vehicles may, according to their operations, need fitting with ERTMS.

Based on a study commissioned in 2020<sup>27</sup> by the European Commission, which has been fine-tuned to take into consideration the most recent data available, the **total fleet required by 2030 to operate on the CNC is estimated to be between 27 600 and 34 600 vehicles**<sup>28</sup>. The difference between the low bound and the high bound hinges on the capacity of railway undertakings to optimize the fleet required to operate on the CNC in countries where these corridors do not represent significant parts of the network.

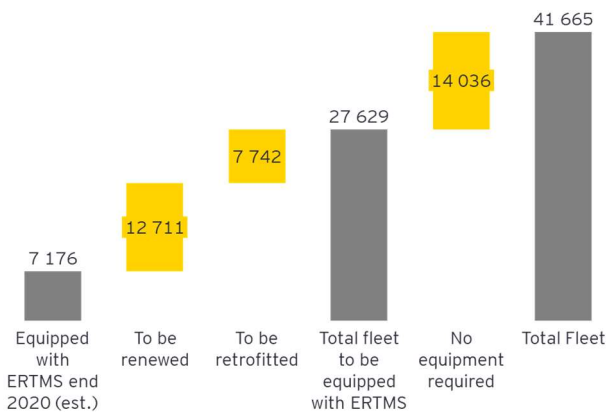


Figure 14 Total fleet to be equipped with ERTMS - low bound

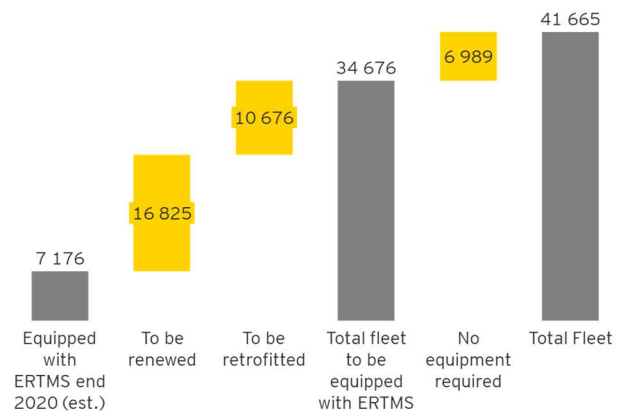


Figure 15 Total fleet to be equipped with ERTMS - high bound

Based on the age of the European fleet and the average lifetime of a vehicle (30 years)<sup>29</sup>, around 20 000 will reach the end of their life and therefore are expected to be renewed between 2021 and 2030<sup>30</sup>.

<sup>27</sup> "ERTMS Retrofitting strategy Funding and Financing – Final Report", June 2020

<sup>28</sup> Non UIC gauge fleet have been excluded from this calculation, though they are eligible for CEF support

<sup>29</sup> Based on information collected in the business case analysis by the Deployment Management Team

<sup>30</sup> Not all those vehicles operate on the CNC



Between 2031 and 2040, an additional 11 000 vehicles can be expected to be renewed. Therefore, up to 90% of the European commercial fleet might be renewed in the upcoming 20 years. If this unique opportunity is missed, the costs of the ERTMS deployment may be much higher, and the transition will be slower.

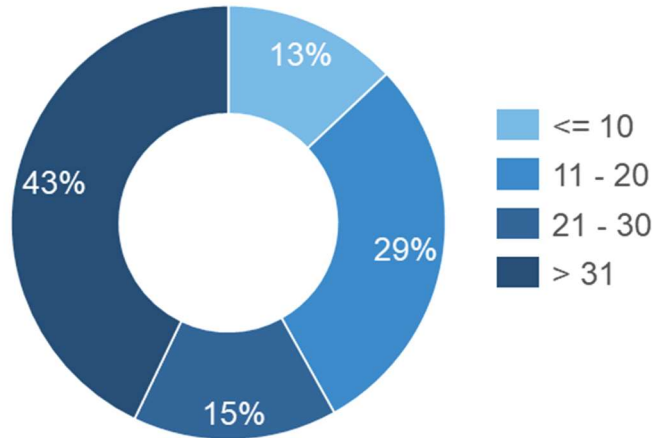


Figure 16 EU fleet per age group

According to the data on vehicles planned to be equipped with ETCS in Europe<sup>31</sup>, from 2021 to 2026, an average of 838 vehicles/year will be equipped with ETCS: 179 new vehicles/year, 639 retrofitted vehicles/year, 10 vehicles/year upgraded from non-interoperable versions (e.g. pre-baseline 2) and for the remaining 10 vehicles/year the type of update is not specified. The average is reduced to 567 vehicles/year if the period 2021-2030 is considered. However, there are 3 377 vehicles expected to be put in operation with ETCS in the following years, but their commissioning dates are not specified in the available sources. These vehicles are categorised as “No date” in Figure 17. If these vehicles are put in operation by 2030, an average of **905** vehicles will be equipped with an interoperable ETCS version per year in the period from 2021 to 2030 (i.e. **9 047** vehicles<sup>32</sup>)<sup>33</sup>. In addition to vehicles presented in Figure 17, 1 532 already equipped vehicles will be migrating to Baseline 3 in the following years.<sup>34</sup>

<sup>31</sup> This section includes the best estimation on vehicles to be equipped with ETCS in the following years based on the available data about OBU deployment plans. The figures are based on national implementations plans, official information provided by MS and information gathered from news.

<sup>32</sup> The 9 047 vehicles that will be equipped with an interoperable from 2021 to 2030 are composed of 2 532 new vehicles, 6 032 retrofitting vehicles, 208 OBU updated from pre-baseline 2 and 275 vehicles planned but without information if new, retrofitted or updated.

<sup>33</sup> According to UNISIG data, there are 14 500 on-board units (OBU) contracted in Europe (EU27+NO+CH+UK), including 9 500 OBU with a contractual completion date prior to 2021. However, UNISIG could only confirm the completion of 4 400 OBU. Therefore, up to 10 000 OBU could be put in operation in the coming years. This figure cannot be translated directly to number of vehicles because some vehicles need two on-board units.

<sup>34</sup> 218 vehicles are planned for 2022, 373 vehicles are planned for 2023, 843 vehicles are planned for 2026 and 98 vehicles are planned without specific migration date in the gathered sources. 227 of those vehicles are currently equipped with Baseline 2; for the remaining 1 305 vehicles to be migrating to Baseline 3, there is no information on the current baseline.

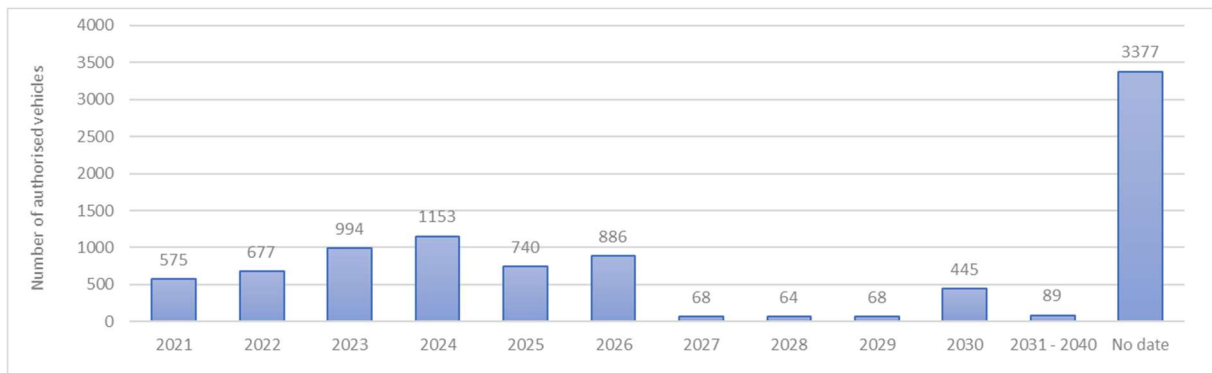


Figure 17 Number of vehicles to be equipped with ETCS planned per year

The highest number of vehicles planned to be equipped with ETCS in the following years, according to the gathered data, will be put in operation in Czechia (i.e. 1 460 vehicles), followed by France (1 283 vehicles), Austria (977), Germany (948 vehicles), Sweden (834), Belgium (610 vehicles), Italy (568 vehicles), Norway (482 vehicles) and Denmark (438 vehicles). The planned vehicles to be equipped with ETCS in the coming years per country are presented in Figure 18<sup>35</sup>. It should be noted that if a vehicle is planned to operate in several countries, this vehicle is counted in all the countries concerned. For this reason, the total of vehicles in Figure 18 is higher than in Figure 17.

<sup>35</sup> No plans have been found to equip Irish and Lithuanian fleets in the available sources. In the case of Latvia, the NIP envisages equipping trains with ETCS but does not determine any specific deadlines. For this reason, Figure 18 does not report on any Irish, Latvian or Lithuanian vehicles.

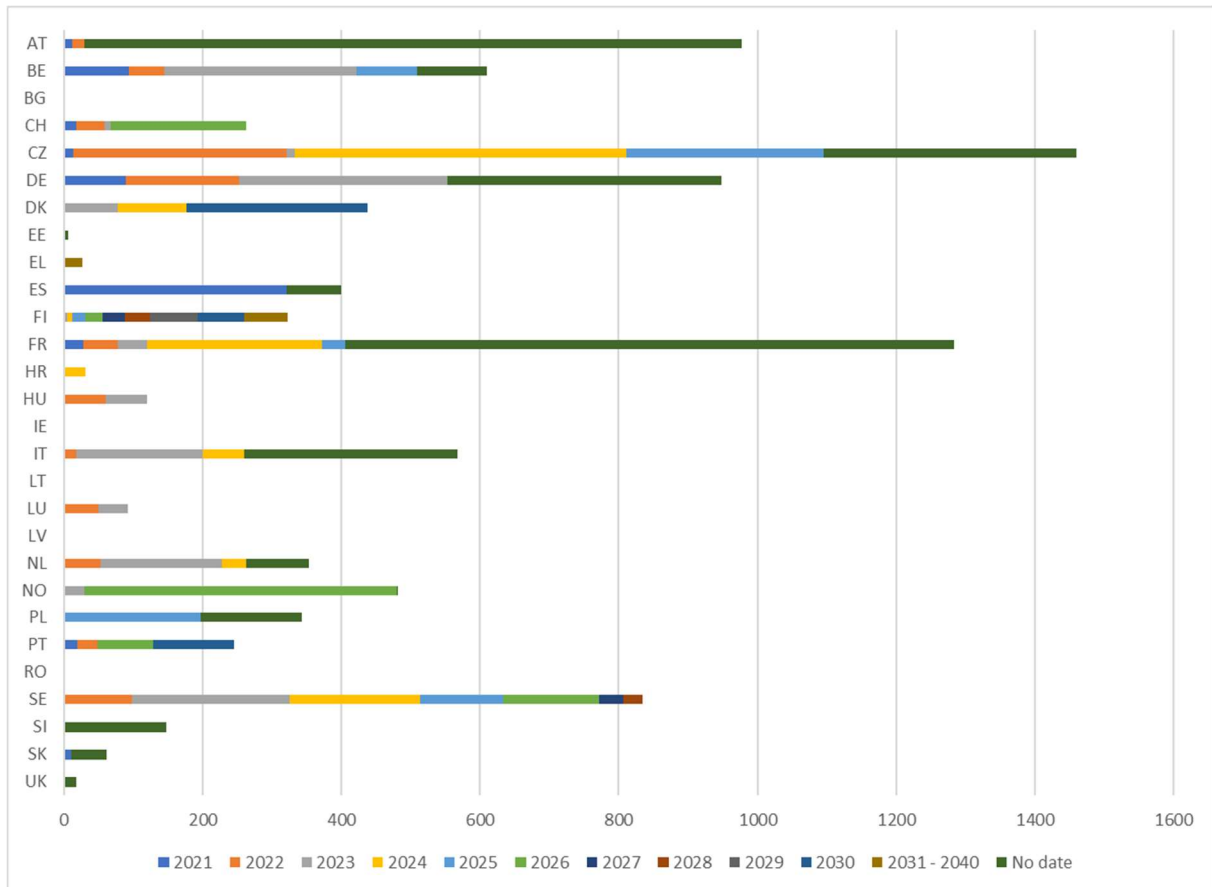


Figure 18 Number of additional interoperable vehicles by year and by Member State

Clustering by type of works in vehicles, among additional equipped vehicles planned in the coming years, 2 532 will be new vehicles (28%), will be retrofitted vehicles (67%), and 208 will be upgraded vehicles (2%), but the respective baseline is not specified. Regarding the remaining 301 vehicles (3%), there is no information on the type of work envisaged. According to the available sources, there are no vehicles planned to be upgraded from pre-Baseline 2 (i.e. from a non-interoperable ETCS baseline). The type of works in vehicles planned to be equipped with ETCS in the following years per county are shown in Figure 19.

The highest number of vehicles planned to be retrofitted with ETCS is foreseen in France (1 029 vehicles), followed by Czechia (1 022 vehicles), Sweden (806 vehicles), Germany (681 vehicles), Belgium (532 vehicles), Norway (452 vehicles) and Denmark (338 vehicles).

In the case of new vehicles, the highest number has also been identified in Austria (859), Czechia (438 vehicles), followed by Italy (233 vehicles) and Switzerland (203 vehicles), Poland (190 vehicles) and Germany (155 vehicles).

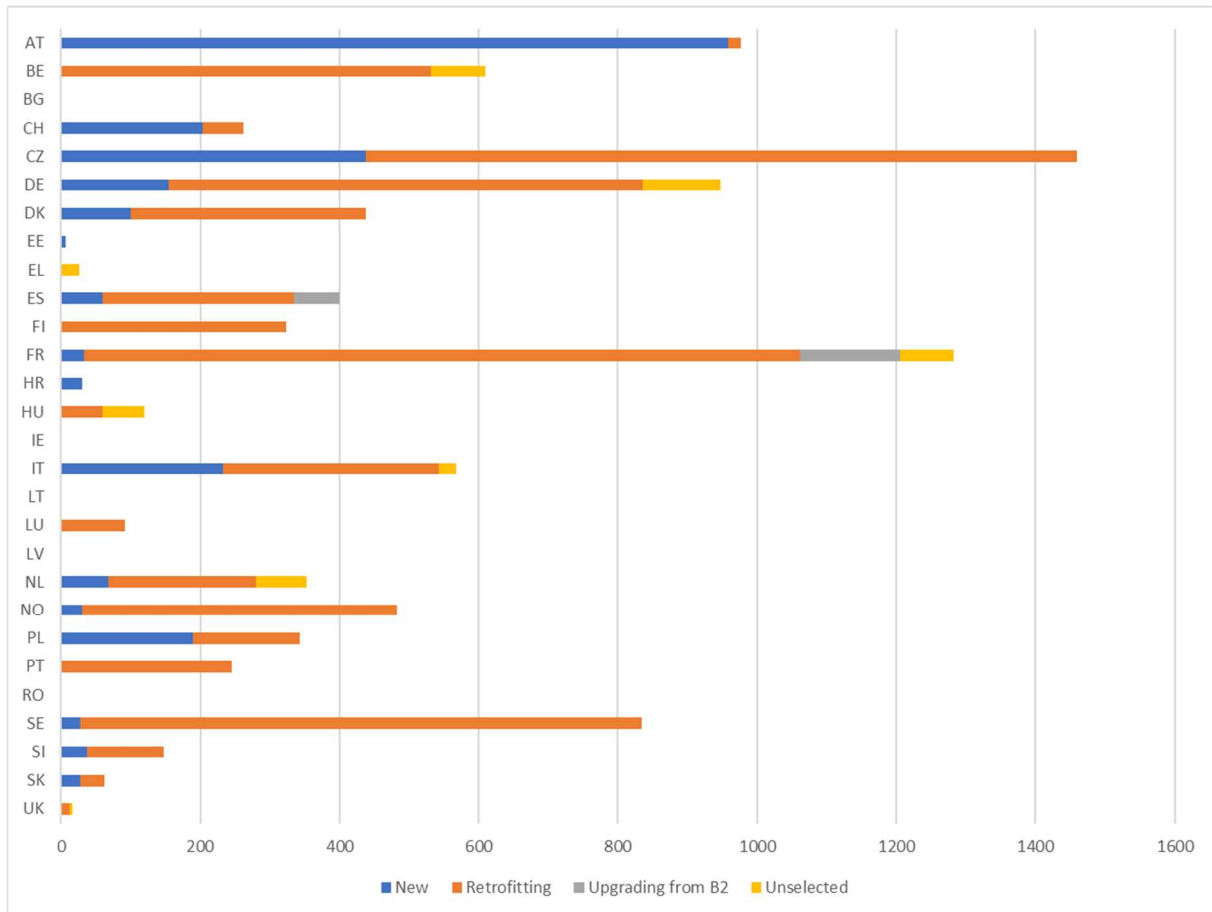


Figure 19 Type of work in vehicles by Member State

Clustering by type of transport, 4% of the vehicles are intended for freight traffic, 23% for passenger traffic, 1% for both passenger and freight traffic and for the remaining 72%, the type of transport is not specified in the available sources.

Based on currently available data, we can say that at least 16 223 (7 176 existing plus 9 047 to be renewed or retrofitted) vehicles will be equipped with ERTMS by 2030. This contrasts with the figure of 27 600 to 34 600 vehicles needed for operations on the CNC as described above. However, this value is a very conservative estimate based mostly on contracts signed. However, as some Member States have announced network-wide deployment plans or even decommissioning of their class B systems (see section 3.2.1), this will definitely lead to additional orders for additional vehicles equipped with ERTMS in the coming years.



### 3.3 Challenges and opportunities

#### **Impact of growing ERTMS deployment on operators**

In 2020, the Commission published a report on on-board and infrastructure deployment strategies.<sup>36</sup> The report analyses the impact of growing ERTMS deployment on operators, specifically on international freight operations. The main conclusions of that study are the following:

- In the coming years, a significant network change will occur with a move from isolated “ERTMS islands” to commercially significant networks equipped with ERTMS within and between countries. For example, in one of the freight networks analysed, the number of kilometres not equipped with ERTMS will decrease from 70% in 2020 to only 15% in 2025.
- Given the decommissioning plans in countries covered by the study, ERTMS should now be standard equipment of the rolling stock for any international rail freight operator.
- Meaningful freight operation using ERTMS will be achieved, and international freight operators will benefit from using ERTMS to significantly increase their commercial range. ERTMS will become a replacement for class B systems rather than an additional system. For example, in 2028, on one of the freight networks analysed, it will be possible to provide 94% of the international rail freight on the routes examined with an ERTMS and just one class B system on-board.
- Prioritisation of ERTMS deployment in specific sections would result in significant benefits for international freight operations. By 2025, for example, a train will be able to reach the North of Italy from the North Sea ports (i.e. more than 1 000 km) with ERTMS-only locomotives or by 2023, from the North of Italy to Hungary. The usage of locomotives equipped only with class B systems is going to be reduced significantly, as national systems will be progressively removed from critical parts of the network. Equipping the fleet will be necessary to enter some key sections of the EU network. For example, a locomotive currently equipped with PZB 90, LZB and RSDD/SCMT can operate on 100% of the routes identified in the second network analysed in the study; however, by 2026, this will be significantly reduced due to decommissioning in Austria and Italy. That study also concludes that though there is, in principle, a sound case for ERTMS on-board deployment, a transitional period with ERTMS and 1 or 2 class B systems is in most cases unavoidable. The analysis shows that no unique class B system can be considered a universal solution within a network; ad-hoc strategies for each operator are necessary depending on the countries where their base of operation is located. However, compared with the current situation, the use of ERTMS will allow a simplified constellation of on-board systems.

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<sup>36</sup> European Commission, Directorate-General for Mobility and Transport (2020). Deployment of ERTMS on core and comprehensive networks: on-board and infrastructure deployment strategies: final report

### The importance of reducing exemptions

Even if the trackside ERTMS deployment is suffering from delays in the short-term, the mid and especially long-term perspective is rather positive: by 2040, some 70% of the whole EU-27+NO+CH TEN-T network is expected to be equipped, and less than 20% of the TEN-T network will still require Class B systems on-board to run.

Findings on ERTMS on-board deployment are less optimistic. They show that despite the current TSI requirements, between 2015 and 2019, the majority of the new vehicles were not equipped with ERTMS. Thus, the pace of the on-board deployment is slower than what was initially expected by the EU and the Member States.

Operators do not fit all their new purchased fleet since they do not see the need to invest in ERTMS as most of the lines in their area of operation are not yet equipped with ERTMS, and/or they can still use Class B systems. At the same time, some infrastructure managers delay deployment as no rolling stock equipped is available, which leads the industry into a vicious circle. This situation might jeopardize trackside deployment or force infrastructure managers to keep two trackside systems for a longer time than initially planned. Some impacts on the initial deployment schedule have been already noted, for instance, in Sweden.

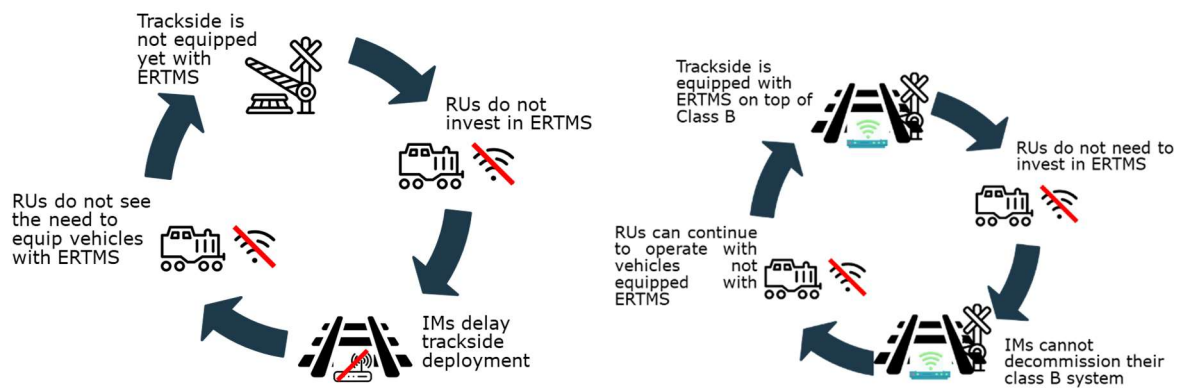


Figure 20 Vicious circle of ERTMS deployment

A continuation of this approach means that it will not be possible to reap the expected benefits from the ERTMS deployment, i.e. a decrease in maintenance costs, interoperability and access to a larger market for rail transportation in Europe, an increase in capacity, and an increase in safety. As the ERTMS business case<sup>37</sup> showed, ERTMS can only bring the expected benefits if both trackside and on-board are deployed in a coordinated way. A dual on-board strategy, which consists in equipping the whole fleet with ERTMS on top of the legacy system, is the best migration strategy. This would allow keeping only one system trackside once ERTMS is deployed on a given line. However, the decommissioning of the Class B systems trackside is only possible if almost the entire fleet is equipped with ERTMS<sup>38</sup>.

Therefore, if a significant share of the new rolling stock continues not being fitted with ERTMS, this situation will adversely impact the business case for ERTMS and the ERTMS deployment overall, as it will lead to additional costs in the short and medium-term (retrofitting costs) and will prevent

<sup>37</sup> DG Move EC. 2019. ERTMS business case on the 9 core network corridors – Second Release

<sup>38</sup> The threshold was set at 90% of the fleet equipped in the ERTMS business case analysis.



infrastructure managers from decommissioning their Class B systems and thus achieving the expected benefits on maintenance.

To analyse the impact of reducing the on-board exemptions set out in the CCS TSI for the ERTMS deployment, their financial consequences on the overall railway system have been assessed by Commission services assisted by DMT through the comparison of three scenarios:

- Scenario 1 “no changes”, which assumes that the exemptions remain and, therefore, the whole EU fleet is not equipped by 2040, full ERTMS benefits will not be achieved.
- Scenario 2 assumes that exemptions remain, but with an ambitious target for full on-board equipment by 2040, vehicles are retrofitted between 2031 and 2040, and ERTMS benefits can be achieved by 2040. This scenario assumes that the EU legal framework is not changed, and it is left to railway undertakings and vehicle owners to decide whether to equip new vehicles or retrofit them at a later stage. ERTMS is deployed, and Class B decommissioned in line with the known national plans.
- Scenario 3, which assumes that exemptions are removed, new vehicles do not have to be retrofitted. ERTMS is deployed, and Class B systems are decommissioned everywhere on the TEN-T.

In both scenarios 2 and 3, the full fleet is considered to be equipped by 2040, which means that all unequipped vehicles which are not renewed before 2040 or all vehicles renewed but without ERTMS have to be retrofitted.

The costs considered in the assessment of scenarios are the fitment costs, the retrofitting costs and the extra maintenance costs of the legacy system for infrastructure managers.

This is a conservative approach, as only savings on legacy system maintenance costs are considered. Other very significant associated benefits such as enhanced interoperability for rail freight and passenger transport at the European level, additional capacity, enhanced safety, improved reliability of rail transportation for passengers, potential obsolescence cost of Class B system, ERTMS as an enabler for ATO, ERTMS Level 3, etc. are not quantified but are surely benefits of widespread ERTMS deployment.

Furthermore, it is assumed that legacy system maintenance costs only grow according to forecasted inflation<sup>39</sup>. However, this is also a very conservative assumption. It is certain that costs will rise when only a few Class B systems are still in operation due to lack of skilled staff, obsolescence issues and a limited interest of suppliers to maintain such systems<sup>40</sup>. Thus, Class B systems will become costly niche markets.

Additional issues and opportunities to be considered are the smart solutions for low-density lines (i.e. cost-efficient regional lines) and the harmonisation of the CCS interfaces on the CCS architecture. Those topics are faced by EU-Rail and System Pillar (see section 3.4.3).

The comparison between scenario one and the two other scenarios shows that there is an economic rationale to further incentivise on-board deployment. Failure to achieve full on-board deployment by

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<sup>39</sup> 1,62% per year

<sup>40</sup> For instance, LZB in Germany is expected to be obsolete by 2030





2040 would prevent IMs from reaping the benefits of savings on legacy system maintenance costs. These represent some EUR 940 million per year, considering that 35% of new vehicles are put in service without ERTMS. Over the period considered, the gap between scenarios 1 and 3 would amount to about EUR 1.9 billion. Nevertheless, even if the target of full on-board equipment by 2040 remains and the EU legislation continues allowing exemptions for new vehicles, retrofitting vehicles before 2040 instead of directly fitting them would result in an additional equipment cost of EUR 1.8 billion, as is shown in the comparison of scenarios 2 and 3.

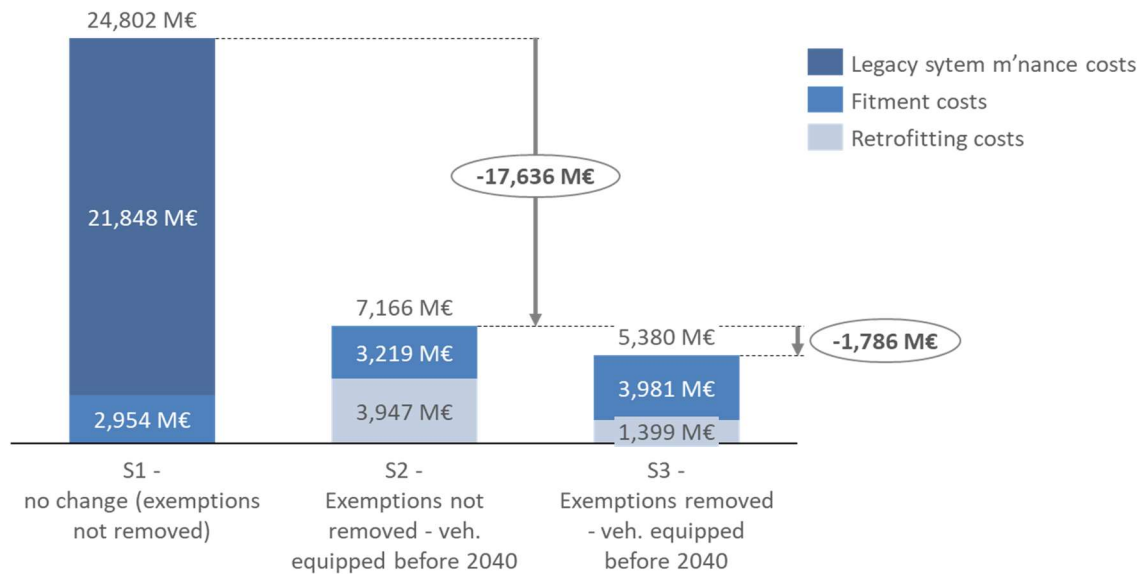


Figure 21 Comparison of financial costs for the railway system in the different scenarios

### **National deployment and decommissioning plans**

As detailed in section 3.2.1, several Member States have decided to equip their entire network with ERTMS by 2040, and some of them have even defined the decommissioning deadlines of class B systems (mostly between 2025 and 2040)<sup>41</sup>. This represents a significant opportunity to accelerate on-board deployment, as the countries with decommissioning targets represent more than 40% (around 17 500 vehicles) of the total EU fleet. Moreover, the fleet from neighbouring countries will also be impacted by the requirement to be equipped, leading to spill-over effects among vehicle owners in Europe and also a need of coordination between countries with cross-border sections before and during decommissioning process.

### **Reason of delays in ERTMS deployment**

The following list includes examples of reason of delays in ERTMS deployment:

- **Changes to national ERTMS deployment strategies**

<sup>41</sup> Luxembourg has already decommissioned its Class-B system in 2020



Changes to national ERTMS deployment strategies affect both ERTMS trackside deployment and on board retrofit projects and have an adverse impact on the industrial capacity.

- **Lack of resources**

ERTMS deployment is being affected by a lack of financial and human resources. This issue affects directly rail infrastructure managers, operators and industry. For an ERTMS deployment to be successful, the necessary products must be available and the industry must ensure skilled staff for their installation. At the same time the European and national authorities should come up with a clear and reliable funding and financing perspective encompassing several years and avoid demand shocks on the market. This will allow building up industrial capacity, attract new players and possibly reduce unit costs of deployment.

- **Delays in works**

Any delays in the infrastructure modernisation, affect subsequent ERTMS deployment.

- **National systems**

In some cases, national systems currently in use have not reached obsolescence and therefore there is a lack of urgency from the Infrastructure Manager's point of view.

- **Fleet equipment**

The delays in equipping the fleet with ERTMS may affect the deployment plans, delaying the progress in rolling out ERTMS trackside.

- **Cross border coordination**

The lack of coordination between Member States in their respective networks leads to delays in the availability of cross border interoperability. Different approaches create gaps in the ERTMS deployment, so that vehicles have to be equipped with Class B system in order to operate on the sections not yet equipped with ERTMS.

- **Issues with public procurement**

Procurement procedures are also a source for a significant number of delays or even project cancellations. Tenders fail because there were **no offers received or only one**. There are also several examples of cases when all received offers exceeded the budget.. Also excessive or demanding **requirements** in some public procurements resulted in lengthy tenders and delays in project delivery.

- **Technical aspects**

There are also **technical aspects** :

- **Maturity of specifications.** Complexity of technical architecture (e.g. interfaces with Class B systems or with existing interlockings) or changes to specifications may impact the procurement process.



- **ETCS Baseline 3.** Lack of experience with the new ETCS Baseline 3 affected in the past the ERTMS deployment.
- **Unavailability of products.** Rail companies and specifically RUs raise the issue of inability of suppliers to deliver certain products. This is due to insufficient industrial capacity or very local/tailored specifications like radio in-fill. Furthermore, in some cases the Specific Transmission Module (STM) units do not exist despite the explicit obligation of Member States set out in CCS TSI to ensure their availability.
- **Lack of product documentation.** This situation can occur during tender or project execution phase. It induces risks of higher costs or exceeding the contractual deadlines. The technical documentation is important for the integration of the ERTMS system into the vehicles and trackside systems (e.g. interlocking). It is however also a challenge to identify which is the level of detail necessary in this documentation making unclear the best way to define system integration roles.
- **Project risks.** There is an initiative to mitigate this by using a common tender format for the ERTMS on-board procurements that was agreed by the sector already in 2018. However, this list has not been used in any of the known ERTMS procurements until present.
- **Lack of software maintenance clauses.** This leads to the need to tender separately the update the software on-board. A regular update for a software-based system such as ERTMS should be considered business as usual and be part of the contract. The commitment of the supplying industry to include such an update clause by default as laid down in the 2016 Memorandum of Understanding<sup>42</sup> is still not being honoured in many cases be.
- **Errors are still found during final testing.** The fact that these problems are encountered just before placing in service often results in major delays and cost overruns. The impact of errors could be mitigated if they are systematically detected by suppliers during the verification and validation processes.

### **On-board migration challenge**

As shown above (see section 3.2.2), and if exemptions are removed, a large part of the vehicles is expected to be equipped thanks to the renewal of the fleet (**between 12 700 and 16 800**); the rest will

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<sup>42</sup> Memorandum of Understanding between the European Commission, the European Union Agency for Railways and the European rail sector associations (CER, EIM, EPTTOLA, ERFA, the ERTMS Users Group, GSM-R Industry Group, UIC, UNIFE and UNISIG) concerning the cooperation for the deployment of the European Rail Traffic Management System. 2016.



have to be retrofitted (**between 7 750 and 10 650**). Between 2021 and 2030, this represents **1 270 to 1 680 vehicles/year to be renewed** and **775 to 1 065 vehicles/year to be retrofitted**. Furthermore, this assessment does not include the required vehicle upgrades from baseline 2 to baseline 3, as well as the need for other periodic updates, which will also affect the industrial capacity of suppliers.<sup>43</sup>

These figures have to be compared with the trends in the past years; the current trend is based on the number of vehicles already contracted:

- Between 2015 and 2019, an average **1 140 vehicles/year** were equipped, including an average of **460 fitted vehicles/year**, out of 1 000 new vehicles/year that has been introduced in Europe in this period, and an average of **680 retrofitted vehicles/year**.
- According to the data on vehicles planned to be equipped with ETCS in Europe from 2021 to 2026, on average, at least **838 vehicles/year** will be equipped with ETCS: **179 fitted vehicles/year**, **639 retrofitted vehicles/year**, **10 vehicles/year upgraded** from non-interoperable versions and 10 vehicles/year for which the type of update is not specified.

Therefore, as regards retrofitting, the deployment is on track to reach the lower bound. However, with respect to the renewal of the fleet and fitting of the new rolling stock, the deployment rate is currently below target. There is also a gap between the number of vehicles that should, in principle, be renewed between 2021 and 2030 (**20 000**) and the new vehicles actually forecasted (**2 532**), according to the available sources.

This raises the question of the actual pace of renewal of the fleet and of the share of new vehicles actually equipped with ERTMS. On the first point, even though most of the stakeholders agree that the rolling stock should be renewed after 30 years of service, in reality, many vehicles that are above 30 years are still in operation at present. The second point emphasises the importance of reducing exemptions, as already explained above. The gap between the actual trend and the one which should be followed in order to achieve the dual on-board strategy by 2030 will also create a major industrial challenge for the railway sector in the coming years – or even a hard bottleneck if exemptions are not removed.

The European Coordinator and the Commission services (DG MOVE and DG GROW) are discussing this issue with the industry and wider railway sector, focussing in particular on the shortage of qualified staff, lack of sufficient workshops for retrofit, stable and predictable budgets to see how to address this major industrial challenge. There is an inherent challenge in the OSS process relating to the certification procedure that deserves to be mentioned as well, as it impacts production as well as the Railway Undertaking's results.

### **Possible measures to address the on-board challenge**

As stated above (see current trends in section 3.2.2), at least 16 223 vehicles will be equipped by 2030, whereas our assumption of the needs for the CNC alone is at least 27 600 vehicles (see Figure 14).

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<sup>43</sup> The work on the revision of the CCS TSI 2022 will duly take this issue into account. It is of paramount importance that the future ERTMS system can be updated in a cost effective and efficient way, whenever needed.



Therefore, a significant effort is still required in order to be able to reap the expected benefits of the ERTMS deployment by 2030.

Given the above analysis, it should be considered to:

1. Remove from EU legislation the possibility to claim exemptions to put new vehicles in operation without ERTMS
2. Shorten the deadline for deploying the Comprehensive Network from 2050 to 2040 to align it with the national plans of most of the EU Member States.
3. Establish decommissioning deadlines to make sure that the Member States and all rail stakeholders reap the expected benefits from ERTMS as soon as possible.
4. Create funding schemes and improve the respective framework conditions to encourage rapid retrofitting and fitment of vehicles and to deal with first-mover disadvantages (see also below).

#### **The Action plan to boost long-distance and cross-border passenger rail and revision of the railway state aid guidelines**

On 14 December 2021, the Commission published the “Action plan to boost long-distance and cross-border passenger rail”<sup>44</sup>. The plan is part of a package of measures for efficient and green mobility and should help the EU meet its strategic milestones of doubling high-speed rail traffic by 2030 and tripling it by 2050. In this document, the European Commission emphasised the need to accelerate the ERTMS deployment and remove legacy signalling systems and proposed a series of new actions to achieve this objective.

The first measure is to exempt the public financing of ERTMS from the notification obligation under state aid rules, which may speed up the rollout of ERTMS. The second is to tackle the issue of rolling stock availability. Indeed, although most long-distance cross-border services can be operated commercially, there is a need to kick-start the availability of rolling stock for these services. Public support for the creation of pools of long-distance cross-border rolling stock or for the mitigation of commercial risks for leasing companies when acquiring and leasing out long-distance cross-border rolling stock could help accelerate the deployment of ERTMS. To preserve a level playing field, such public support should be given under clear and non-discriminatory framework conditions.

The two measures are linked to the current revision of the railway state aid Guidelines. In October 2021, the European Commission carried out a fitness check (evaluation) of the state aid rules for the rail sector. The evaluation showed that the current Guidelines had made an important contribution to encouraging a modal shift to rail, which generates lower external costs than other modes of transport, such as road transport, and to promoting interoperability to ensure the different technical systems of the EU's railways work together. At the same time, the evaluation stressed that adjustments to the existing rules are necessary to reflect the latest market and regulatory developments and enable the rail sector to embrace the green and digital transition in line with the Commission's priorities, in particular those of European Green Deal. Finally, the evaluation demonstrated that the long-standing

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<sup>44</sup> COM(2021) 810 final



lack of interoperability, alongside the strong need for further digitalisation, is holding back the development of seamless, cross-border rail services. State aid can help address these market failures and improve the competitiveness of rail, thus facilitating modal shift, cutting transport emissions and reducing road congestion.

Therefore, a process has been launched to review the Railway Guidelines, with the objective to update the state aid rules. More specifically, the proposed revision considers, among others:

- **Simplifying the rules on aid for coordination of transport** that support the modal shift to more sustainable transport solutions, including by way of a block exemption, which entails the limited risk of competition distortions, based on vast case practice. As the Treaty provides that the Commission can adopt block exemption regulations only relating to the categories of State aid determined by the Council, the Commission will also consider submitting a proposal to the Council for the adoption of a regulation enabling the Commission to block exempt State aid for the coordination of transport pursuant to Article 93 TFEU, as the General Block Exemption Regulation is based on Article 107 TFEU
- **Extending the scope of the railway Guidelines**, in particular, to include all relevant transport operators in the intermodal chain, which contribute to the modal shift of freight from road to less polluting and more sustainable transport solutions.
- **Removing barriers to market entry or expansion** of new market players, in particular as regards access to suitable rolling stock.
- **Ensuring the modernisation of fleets** and the networks' interoperability.

The adoption of the new railway Guidelines is foreseen for the end of 2023.

## 3.4 Preparing future evolution

### 3.4.1 TEN-T Guidelines revision

On 14 December 2021, the European Commission adopted a legislative proposal for the revised TEN-T Guidelines. The proposal is a result of a comprehensive evaluation process of the existing legal framework, extensive consultations of the Member States and other stakeholders, and an in-depth assessment of the impacts of the amendments proposed.

The proposal is accompanied by an update of the 2013 TEN-T planning methodology, a report on the implementation of TEN-T during the years 2018 and 2019, as well as communication on the extension of the TEN-T network to the third countries neighbouring the EU.

To address the objectives of the Green Deal and SSMS adequately, the revision of the TEN-T Guidelines aims at reinforcing the contribution of the TEN-T policy to the decarbonisation and digitalisation of transport. In particular, the revised Regulation makes sure that the appropriate infrastructure will be put in place to address the current congestion of infrastructure and, at the same time, reduce greenhouse gas emissions.



The aim of the Commission proposal is two-fold: to increase the number of passengers travelling by rail through the development of a competitive and seamless high-speed rail network throughout Europe, and to shift a substantial amount of freight towards more sustainable transport modes in the first place to rail.

The revised TEN-T Guidelines introduce a number of new or reinforced rail infrastructure requirements, including regarding ERTMS. It is clear that without an accelerated deployment of ERTMS, achieving the Green Deal and SSMS objectives will not be possible. Indeed, the draft TEN-T Guidelines dedicate a separate article solely to ERTMS. As such, the deployment of ERTMS takes a key place in the revised legal framework.

The new Article 17 sets out an obligation for Member States to deploy ERTMS on the core network, including access routes and last-mile rail connections to multimodal freight terminals, by 31 December 2030. As regards the extended core network and the comprehensive network, the new deployment deadline is set for 31 December 2040. Furthermore, Class B systems on the entire TEN-T network should be decommissioned by 31 December 2040.

Member States should also ensure that as of 31 December 2025, only radio-based ERTMS should be deployed on new lines or in the context of signalling system upgrades, and the entire TEN-T network should be equipped with radio-based ERTMS by 31 December 2050.

One major new element will be the integration of the nine Core Network Corridors with the eleven Rail Freight Corridors in a common set of “European Transport Corridors”. The alignment of these new corridors will be defined in the TEN-T Guidelines and will thus repeal the existing alignment of corridors in the CEF 2 Regulation. While striving for maximum stability of the existing TEN-T network, this merger brings certain changes, such as the identification of an extended core network that will be fully integrated into the corridors.

Similarly, the current system of European Coordinators will be reinforced. Based on their work plans which shall be elaborated every four years, the Commission will adopt an implementing act for each work plan, setting clear milestones to be implemented by the respective Member States. The elaboration of the work plans will be complemented by annual status reports.

Finally, as to governance, the role of the European Coordinator for ERTMS should be enhanced as she or he will receive the prerogative to establish and chair a consultative forum grouping all key stakeholders. Each Member State will designate a national coordinator for ERTMS to attend the consultative Forum for ERTMS. The national coordinator for ERTMS should become an ERTMS one-stop-shop in each Member State. The national coordinator should be a direct discussion partner both for the European Coordinator and for their fellow colleagues from other countries. We experience often a situation that the national authorities do not have a clear vision what happens across the border and whom to contact. Indeed, in many Member States there is no person responsible for the ERTMS deployment. Furthermore, Member States are sometimes implementing scattered projects with an ERTMS component, mostly trackside, but do not have any robust strategy, how, when and by whom this signalling system is going to be used as there is often no rolling stock equipped or the equipped sections do not allow a continuous operation with ERTMS. The new approach should allow





an enhanced, coordinated and synchronised deployment of ERTMS, both on-board and trackside. National coordinator should bring together all relevant national stakeholders, including: public administration, infrastructure managers, railway undertakings, rolling stock keepers and supply industry. The national coordinator should manage the deployment of ERTMS, including supervising drafting of the National Implementation Plan, early identification of problems and ways of addressing them, also in collaboration with other national coordinators. Furthermore, representatives of the relevant rail sectors might be invited to participate in the ERTMS Forum. The European Coordinator for ERTMS will also be granted the right to set up ad-hoc working groups. Finally, the Commission proposal foresees that the European Coordinator for ERTMS should closely cooperate with, the European Union Agency for Railways and EU Rail Joint Undertaking.

The proposal is now being negotiated with the European Parliament and the Council for a possible entry into force of the revised TEN-T Guidelines in the course of 2023.

Following the hopefully rapid adoption of the amended TEN-T Guidelines, the current EDP (2017) will also be revised. The new EDP will cover the ERTMS deployment plan on the newly created European Transport Corridors in the period from 2024 to 2040.

### 3.4.2 2022 CCS TSI revision

For the revision of the CCS TSI that will be adopted in 2022, the underlying objective is to enhance ERTMS as a system and facilitate its deployment.

The revised CCS TSI will set out:

- an interoperable solution for automatic train operation (**ATO**) in its grade of automation 2. This means that the train will be able to operate in an autonomous way while the driver will be present in the cabin to cover specific processes such as the start of a mission or operation in degraded situations.
- technical specifications for the Future Radio Mobile Communication Systems (**FRMCS**) readiness. These will include technical specifications for the ETCS on-board equipment and especially interfaces to the FRMCS products to be manufactured after 2025. FRMCS will gradually substitute the existing GSM-R (2G) that will become obsolete between 2035 and 2040.
- modifications to achieve safe operations of vehicles in ERTMS radio level by using train integrity. Deployment of a radio level based, including train integrity, will boost capacity. Also, with the train integrity, it will allow in future to reduce trackside train detection systems and bring about significant savings for infrastructure managers.
- harmonised interfaces for the ERTMS on-board. Defining additional interfaces will allow for a more modular ERTMS on-board system. It will be Ethernet-based and provide standard interfaces between ATO, ETCS, FRMCS parts and RST-subsystem. This will strongly facilitate the on-board projects, enhance competition between suppliers and ultimately lower prices. Finally, this will allow an enhanced evaluability and maintainability of the system in the future.
- additional technical optimisations (enhancements) for the following existing functionalities as requested by the sector. Some examples are:





- Optimisation of braking curves algorithm for freight trains, mainly allowing some seconds of time savings and improving the ergonomic driving
  - Relocation without linking, mainly for Limited Supervision deployments
  - Supervised shunting under ETCS
  - Non-Leading mode where enhancements are necessary for the on-board equipment not connected to an active cab which is not in the leading engine of the train
  - Security improvement in case of using unlinked balises
  - Increase in driver awareness on approaching the End of Authority
  - Eurobalise for three-rail tracks
- additional technical corrections in the specifications (maintenance of specifications) based on returns of experience due to different interpretations of the current set of specifications by those deploying ERTMS in practice. The maintenance of the ERTMS specifications focuses on the reported issues which could impact the normal service and provides mitigation measures for the existing projects.
  - solutions to the main pain points in retrofitting projects during the migration phase when Class B is still necessary. Specific surveys were addressed to the sector, concluding that there is a need to update the specifications to:
    - clarify the definition of different types of Class B solutions;
    - ensure that an integrated solution (i.e. bi-standard) is not the only available option in a given network;
    - make available the specifications that allow the integration of the available Class B products with any ERTMS on-board equipment and
    - avoid project-specific decisions due to non-compliant systems.
  - updated deployment requirements. The economic assessment conducted points to the need to remove from EU legislation the possibility to request exemptions for new vehicles to be put in operation without ERTMS in 2030. As of 2022, new rolling stock will be technically ready to integrate ERTMS.
  - Harmonisation of the requirements of the National Implementation Plans (NIPs). In particular, it will include the obligation for the Member States to coordinate IMs and RUs as regards the definition of technical and financial migration strategies.
  - updated framework to manage the specification changes, including a single set of ERTMS specifications. The new framework introduces a robust process to update the specifications for error corrections and enhancements. It also includes transition and migration considerations for the introduction of new functionalities trackside and on-board in Europe. The introduction of new functionalities will follow principles of investment protection and fair migration paths. The new process considers distinct specification updates for error corrections or new functions.

The single set of specifications allows all versions to be maintained error corrected with the broad return of experience from projects, including all errors detected from ongoing projects between 2015 and 2021 and potentially those to come.

The new process will also limit the number and the frequency of costly upgrades linked to new functionalities.
  - In addition, it also facilitates the gradual introduction of enhancements. Different system versions will therefore be included in this single set of specifications, corresponding to the



different baselines and releases of the system that will allow for a safe and gradual introduction of new functionalities to the products and contracts. If Member State decides to implement new functions, a minimum timeframe shall be provided, including a minimum guaranteed compatibility window of 7 years after entry into force of the TSI and a minimum notification period of 5 years by Infrastructure Managers.

- The text of the TSI is also updated to ensure fully compliant ERTMS products without deviations/partial fulfilment and allow vehicles to operate across the EU without additional restrictions/modifications if the area of use of a vehicle is extended.

With this change, the TSI enforces the maintainability and responsibility of the trackside and on-board suppliers for addressing appropriately any errors in products and corrections to be done within a well-defined timeframe.

- Most of the actual retrofit and upgrade projects are project specific based on grandfather rights. Ignoring this, or even avoiding, causes a high risks for the vehicle owners regarding the utilisation in the residual life. This measure should be agreed with the industry and the owners before applying.

In 2022 the update of all TSI will be synchronised. For ERTMS, this involves:

- update in the OPE TSI. The update includes a set of harmonised operational rules for radio-based ERTMS. This harmonisation focuses on reducing nationally dependent rules for the driver.
- cross-TSI works for the introduction of Digital Automatic Coupling (DAC). For ERTMS, DAC provides the possibility to enhance functionalities, including:
  - train integrity monitoring, which is key to enabling radio-based operations with higher capacity and reduced train detection systems, mainly for freight
  - automatic train initialisation, allowing the acquisition of ERTMS relevant parameters (e.g. train length or brake parameters) of a newly composed train
  - automatic maximum speed and braking performance determination, reducing driver responsibility and increasing the reliability and correctness of these parameters

By the end of June 2022, the ERA will deliver the final recommendation for the revision of CCS TSI to the European Commission. Then, after the negotiations process, the RISC committee should vote on the revision of CCS TSI on the 23<sup>rd</sup> of November 2022.

### 3.4.3 Europe's Rail JU & System Pillar

Europe's Rail Joint Undertaking (EU-Rail) has been established to address rail sectorial needs and the challenges inherent to the transformation of the rail system. In particular, for ERTMS, EU-Rail will define the next evolution of the system by aligning the needs of the sector and the technological innovations and capabilities that the members of EU-Rail will develop. This next iteration will strive for the achievement of the original vocation of ERTMS as the European rail traffic management system.

The ambition is to create a modern, harmonised, robust, reliable and interoperable European railway system based on the current ERTMS specifications. This new evolution of ERTMS systems, commonly known as CCS+, is necessary for the rail to better address customer needs, maintain safety and digital security, improve operational efficiency and performance, reduce costs, enhance European rail supply



industry competitiveness, and increase the speed of adoption of performance-enhancing improvements.

EU-Rail's governance structure comprises different groups and boards, including a governing board, a States Representatives' Group, Scientific Committee, a Deployment board, a Programme board, and two pillars, i.e. the System Pillar and innovation pillar.

The EU-Rail innovation pillar will develop new digital solutions and the next iteration of ERTMS, including ATO Grade of Automation (GoA) 4 that will allow unattended train operations. The next iterations include trackside and on-board systems for automatic train protection, automatic train control and automatic train supervision systems. The innovation pillar will help dramatically improve the flexibility, efficiency, resilience and capacity adaptation of the European rail network.

While the innovation pillar will develop and demonstrate the next iteration of ERTMS systems, the System Pillar within EU-Rail will provide the system vision and set out detailed specifications updates for the ERTMS next iteration. Starting from the current ERTMS, systems enhancements will be developed and interfaces defined to all other systems that will provide a harmonised and safe European traffic management.

A properly designed radio-based ERTMS can significantly reduce the trackside cost, complexity, and network specificities of classic ERTMS Level 1 and class B lineside signalling and provides the opportunity to streamline the operational principles and technical specifications for ERTMS and wider CCS components and functions – improving interoperability and the overall performance of the system. A further major opportunity is thus to create harmonized operational rules. This will correspond to the system vision that will be developed in the System Pillar and provides an opportunity when migrating to radio-based ERTMS.

On this basis, a converging shared vision for future rail operations based on ERTMS-only Level 2 and Level 3 networks will set the baseline for the operational and technological solutions for the next iteration of the CCS+ systems.

The objectives of the System Pillar as set out in the Single Basic Act are to develop a unified operational concept and a functional system architecture for integrated European rail traffic management, command, control and signalling systems, including, inter alia, automated train operation over ERTMS encompassing:

- definition of the services, functional blocks, and interfaces that form the basis of the rail system;
- development of specifications, including interfaces, functional and non-functional and system requirements to be laid down in the CCS TSI or as standards and would allow higher levels of digitalisation and automation;
- system maintainability, including error-correction mechanisms and adaptability to the different necessary migration paths.
- necessary interfaces with other modes and systems and ensuring that they are assessed and validated, in particular for freight and passenger traffic;



- migration plans that would link research and innovation, industrialisation and deployment of innovative technologies, operational concepts and overall solutions to serve the European citizens.

As network-wide innovation in a shared network such as the European railway system can only work with an appropriate regulatory and standardisation framework, the System Pillar should also significantly accelerate the evolution of those regulations and standards, including ERTMS, while maintaining stability and managing compatibility, including the assessment of cost and benefits of phasing out obsolete systems and the appropriate changes to operational procedures.



## 4 Conclusions of the European Coordinator for ERTMS

Despite the initial widespread concerns, which I also voiced in my first work plan in May 2020, COVID-19 did not bring the ERTMS deployment to a standstill. On the contrary, the pandemic and the European response in the form of the Recovery and Resilience Facility was a further catalyst for the digitalisation of the railways, even though the uptake of the available funds for ERTMS in some of the national recovery plans remains below my expectations. We still need to be prudent in view of the fall in income of infrastructure managers and railway undertakings due to the COVID restrictions.

Over the last two years, we have seen an acceleration in the policymaking process. We have reached a wide consensus with most of the stakeholders to move the gear up for the ERTMS deployment and set out a more ambitious deployment framework. ERTMS is seen increasingly like *the* European System replacing national (Class B) systems rather than an add-on solution permitting interoperable operations.

We still experience a patchwork of approaches, but more and more Member States are taking a decision to opt for a network-wide deployment coupled with decommissioning of class B systems; some are only deploying on the core network; and just very few Member States do not have yet robust plans to deploy ERTMS, not even on the core network. We still have divergent approaches to the retrofitting of vehicles in the different Member States. And we need to be conscious of the repercussions of the ongoing unprovoked aggression war of Russia against Ukraine and the mobilisation of EU solidarity for the availability of EU and national budgets.

At this stage, I am nevertheless convinced that we are reaching a tipping point. The figures presented in this work plan demonstrate this, but we need additional effort in terms of incentives and obligations. The USA managed to mandate the deployment of their—admittedly less complex—system within a decade on their entire network. We should be able to do the same in two decades, at least on the TEN-T. The Commission proposal for the revision of the TEN-T Guidelines sets out appropriate and robust incentives to reach this objective.

We should move from ERTMS islands, not only to entire corridors (with the necessary connections between the Member States) but to whole networks. ERTMS should be deployed not only on the core network, the new extended core network and the comprehensive network, including in the urban nodes but also on access routes to multimodal terminals. As a priority, we need to focus infrastructure deployment on existing gaps and close them as soon as possible. This will enable operations with ERTMS only and boost the business case for railway undertakings. The EDP 2017 is not only a legal obligation but, first and foremost, a promise and contract between the individual Member States and their railway industries.

➤ ***As European coordinator, I will follow up on the timely EDP 2017 implementation and work on its revision, inform in particular the European Parliament on the progress, check individually with the Member States on their plans to meet the EDP deadlines, discuss the deployment strategies they have adopted, follow the cross-border agreements and, where necessary, exchange on how to align national plans with the EDP. In addition, the revised***



***NIPs to be adopted under CCS TSI 2022 will be key ERTMS implementation instruments at national level.***

Member States should ensure that only radio-based ERTMS will be deployed from 2026 and that the entire trans-European transport network is equipped with radio-based ERTMS by 2050. This will increase rail safety, allow uptake of automatic train operations and reduce the application of national rules.

ERTMS deployment should be coupled with a regulatory deadline for the decommissioning of Class B systems trackside. The decommissioning of Class B systems trackside will bring about significant maintenance savings for infrastructure managers, as rolling out ERTMS and keeping additional trackside signalling systems for a prolonged period is very costly and complicated. Class B systems will become more and more costly and obsolete niche products with bespoke solutions, and their market availability will be even further affected by the scarcity of skilled staff. With the forthcoming standardisation, ERTMS will finally become a cheaper product with all its advantages, including interoperability, reliability, capacity and safety. Class B systems should be removed in a coordinated way with a sufficient transitional period, allowing the railway undertakings to anticipate the change and adopt the most suitable migration strategy. I fully support the Commission's proposal for revised TEN T Guidelines and the deadline of 2040. However, the operators cannot be taken by surprise. In some cases, there is not enough coordination between trackside and on-board deployment, including across Member State borders.

➤ ***As a European coordinator, I support acceleration but will listen to all stakeholders to understand their concerns on organising the transition, and I will try to ensure that these are adequately reflected in the outcome of negotiations.***

ERTMS, being a system, requires a synchronised deployment both trackside and on-board, and full system benefits only occur when both trains and trackside are equipped. The rolling stock has to be equipped with ERTMS in order to start the decommissioning of the class B trackside. Even though trackside deployment is progressing rapidly, on-board deployment is going slower than expected, and new vehicles are not systematically fitted with ERTMS. Continuing this approach will undermine trackside deployment plans and the benefits of systemic ERTMS deployment overall. We need to make additional efforts to ensure an accelerated deployment of ERTMS on-board.

Railway undertakings, especially freight operators but also international passenger operators, cannot be left alone with equipping their fleet. It is vital to provide improved support both at the EU and national level for the renewal of the fleet or the retrofitting of existing vehicles, whichever solution has a better benefit-cost ratio in a given context. In principle, retrofitting is several times more expensive than fitting. Thus, the preferred option should be fitting. Equally, state aid rules should not unduly limit funding for on-board equipment but facilitate the move to ERTMS.

We need to implement the European on-board strategy: stable and predictable budgets for retrofitting and upgrading; simplification of the authorization process, in particular for serial vehicles; identification of bottlenecks for on-board deployment, and curb down regulatory exemptions for



newly-built locomotives. Some 20 000 locomotives and trainsets should reach 30 years of age or more by 2030. In many countries, the average age is already close to 40. Thus, we should make use of this opportunity to renew the rolling stock and give rise to a green and digital rail sector. If we continue with the business as usual approach, only half of all vehicles will be equipped with ERTMS, whereas by 2030, we need between 27 500 and 34 600. If we do not impose a hard obligation to equip ERTMS on-board, we will still have a rolling stock with only class B systems on-board fifty years from now, thus, class B trackside would have to be kept. As a result, we would have a dual on-board and dual trackside strategy for decades, which is costly and not very efficient.

- ***As European coordinator, I will organise discussions with railway undertakings, supply industry, leasing companies, infrastructure managers, Member States but also financial institutions to create better framework conditions to better synchronise deployment both trackside and on-board, and in this context to fund, facilitate and accelerate the deployment of on-board equipment. I will involve myself in making sure that EU funding decisions (CEF2 and others) both on-board and trackside reflect this path to a single European system.***

ERTMS already benefits from a significant level of EU support. This support must be preserved and even increased in order to reach the 2030 target for the ERTMS deployment on the Core Network set out in the TEN-T Guidelines and the envisaged new target for the ERTMS rollout on the entire TEN-T by 2040. This will require considerable efforts, also in view of the economic repercussions of the unprovoked aggression war of Russia against Ukraine. However, a large scale industrial project such as ERTMS can also give the right incentives for an economic relaunch, as already demonstrated by a number of Member States using the EU Next generation funds to deal with the effects of the pandemic. Unit contributions should be kept and adapted to incentivise the ERTMS deployment. Railway Guidelines should also be revised with the objective to simplify the rules on state aid to support the modal shift to railways, including via ERTMS deployment.

- ***As European coordinator, I will make sure ERTMS can benefit from all relevant EU funding and financing instruments. I will also further analyse the possibility of using revolving financing schemes and introduction of ERTMS differentiated track access charges. I will also keep on working on the simplification of the applicable rules.***

We should guarantee that evolution will take place in a non-disruptive way. This means that increasingly modular and broader standardisation approaches should be privileged and that future developments leave enough time to amortise current investments. We also need to make sure that delays in obtaining authorisations and safety certificates are reduced to the necessary minimum whilst fully respecting safety.

For rail to embrace digitalisation fully, the system will need to be more flexible and adaptable, with a “plug and play” approach. This should drive the unit costs drastically down and create the conditions for ERTMS to become the backbone of the future digital rail in Europe.

The ultimate objective should be to make ERTMS the sole signalling system in Europe using up to date technologies (DAC, 5G and satellite communications, satellite positioning, fully digitalised





interlockings, new forms of CCS etc.). As a result, we will stop exchanging locomotives at the border or equipping them with several national systems on-board. ERTMS will also greatly improve safety as well as increase the capacity of the network through traffic optimisation. We will thus have more trains on the existing infrastructure without the need to build new lines or additional tracks.

- ***As a European coordinator, I will favour continuous innovation. At the same time, I am convinced that we need appropriate rules for transition, incentivising and protecting investments now.***

We need to make sure that for all this, we have the appropriate governance in place. With ERA, we now have a European ERTMS system authority. ERA, as the ERTMS system authority, prevents national ERTMS deployments from undermining interoperability and especially addresses the issue of implementation of additional national requirements. ERA evaluates the overall testing and validation process, including analysis of the need for ETCS and Radio System Compatibility tests. We need to ensure that it has the adequate resources to do its triple job of preparing the technical rules (TSI), authorising ETCS equipped vehicles and checking the envisaged track-side technical solutions. We also need to make sure that the current ESC/RSC process will result not only in the identification of many ERTMS dialects but also in the identification of shortcomings in the ERTMS testing and validation phases. This should ultimately allow for a harmonisation of the ERTMS deployment in Europe. The development of the System Pillar in Europe's Rail JU should better prepare for future evolutions of ERTMS, and the proposed platform in the context of the TEN-T revision for ERTMS coordination should help to synchronise deployment in the Member States and function as an early warning mechanism for problems along the path to a European ERTMS system.

- ***As European Coordinator, I will work to strengthen ERA as systems authority, especially with a view to providing it with adequate resources to carry out its mandatory tasks. Furthermore, I will reflect on anticipating the setting up of an ERTMS forum, convening responsible authorities for national ERTMS deployment informally to the first meeting in 2022; also prepare for the drafting of the next EDP, including possibly also on-board deployment.***
- ***As European coordinator, I will also, with the help of the concerned actors, keep authorisation, certification and licensing procedures under review to streamline the process and to ensure that deployment is facilitated.***

Finally, as also pointed out in my first work plan; rail traffic management goes beyond what we currently have defined in our technical specifications.

The current harmonisation at the European level, through the CCS TSI, addresses the safety and interoperability requirements, the on-board functions and interfaces between trackside and on-board related to train protection, signalling the permission to move the train and radio communication – ERTMS. This is not the full CCS system, which also includes interlockings, radio block centres, and other infrastructure and on-board assets.

The purpose of the focus on CCS+ is to take advantage of the fact that networks and Member States are migrating to CCS systems with radio-based ERTMS. There is, therefore, an opportunity through the



migration to move to a much more harmonised CCS+ European system beyond the scope currently defined in TSIs.

Success in such an approach would significantly reduce the fragmentation currently observed in CCS+ systems beyond ERTMS, increasing the opportunity for more open and competitive markets across Europe and speeding the deployment of innovation across the system.

We need to make sure that we stay united in defining the other components of a European rail traffic management system, working with a single system authority, and building a common platform under the System Pillar of the EU-Rail to provide an agreed and well researched, detailed strategy for future evolutions.

- ***As European coordinator, I will closely follow the ongoing work in ERA as well as in the Systems Pillar of Europe's Rail JU and the deployment coordination group in order to ensure the most favourable conditions for ERTMS deployment and the future European rail management system.***
- ***Finally I will also engage with all stakeholders to discuss requirements and obstacles for an industrial rollout of ERTMS.***

# Annex I ERTMS deployment on the 9 Core Network Corridors

## Atlantic Corridor

### 1. The ERTMS deployment

The total length of the ATL corridor is 11 295 km, including the CEF 2 extension. According to the EDP, 1 620 km are expected to be operational by 2021 and 1 760 km by 2023. Overall, ETCS is in operation on 10% of ATL, while GSM-R on 39% of the corridor. In June 2022, 60% of the ATL length planned in the EDP by 2023 was in operation with ETCS. Given the current deployment figures and considering that some Member States have already notified delays in implementation, it will not be possible to meet the EDP deadlines in this corridor by 2023. The following graphs show the status of ETCS deployment by the Member States on the ATL as a percentage of the 2023 and 2030 targets.

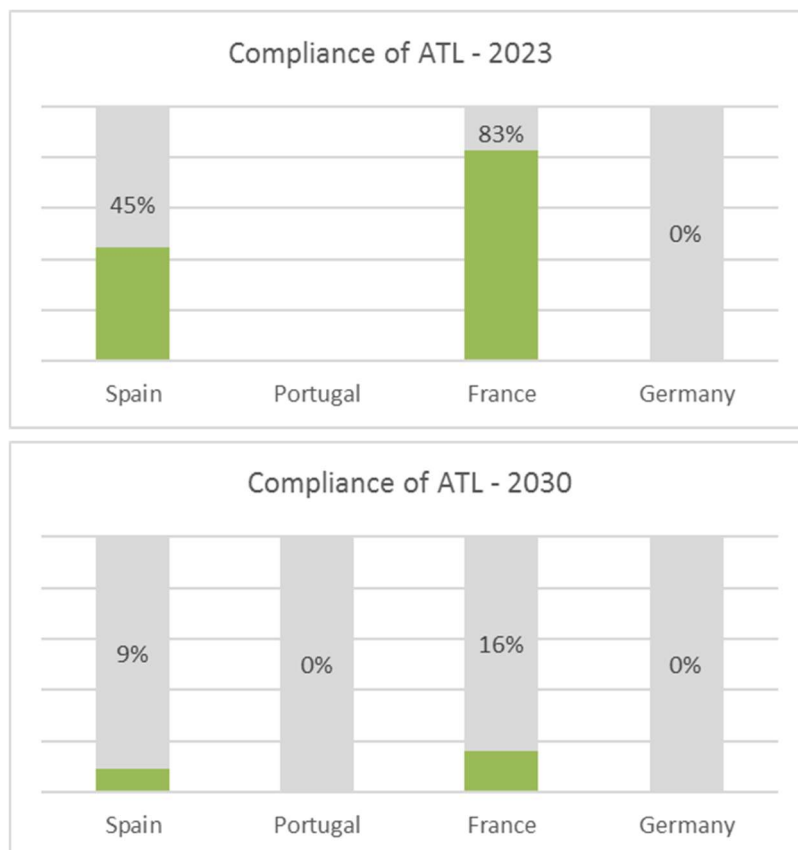


Figure 22 ETCS deployment by Member States on the Atlantic Corridor

The main bottlenecks threatening compliance with 2030 targets are the following:

- The commissioning of the Sevilla – Huelva and León – Gijón lines, and one of the lines that connect Zumárraga with Zaragoza, are not included in the Spanish deployment plan for 2030.
- The commissioning of the line Grândola – Sines is included in the Portuguese deployment plan for 2030. However, another route Grândola – Ermidas Sado – Sines will allow a continuous operation from Grândola to Sines by 2030.



- The French plan does not support lines planned in the EDP beyond 2023 that will be in operation by 2030. For example, the high-speed line between Tours and Paris is expected by 2032.

## 2. EDP compliance

The following scheme shows the state of play and deadlines for the ERTMS deployment in the ATL corridor, considering the dates of the EDP:

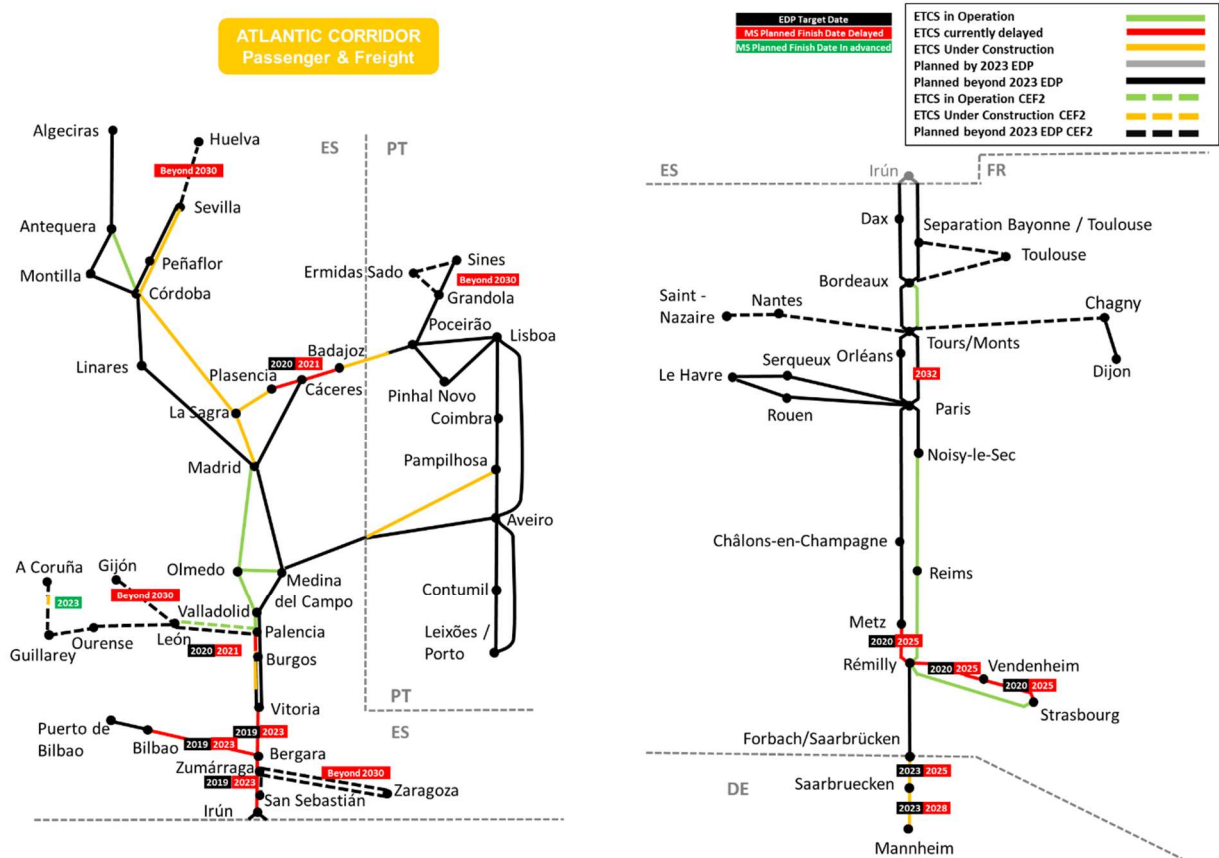


Figure 23 Atlantic Corridor ERTMS deployment plan

In Spain there are already some lines in operation on ATL. The Spanish sections next to the border with France and Portugal (Badajoz), planned in the EDP by 2019 and 2020, are delayed until 2023. ATL sections are planned in the Spanish plan by 2030 except for 3 CEF 2 lines: Sevilla – Huelva, León – Gijón and one of the lines from Zumárraga to Zaragoza.

In Portugal, no lines are planned to be equipped with ETCS by 2023, according to the EDP. The whole core network in Portugal is expected to be equipped by 2030 in line with the Portuguese deployment plan. The Grandola – Ermidas Sado – Sines line, added in the CEF 2 extension of ATL, is included in the Portuguese deployment plan for 2030. However, the commissioning of the new construction Grândola - Sines line will take place beyond 2030.



In France, there are already some lines in operation on ATL. According to the French plans, the Metz – Rémilly – Strasbourg line planned in the EDP by 2020 will be delayed until 2025. Regarding sections planned in the EDP beyond 2023, French plans do not support those lines being in operation by 2030.

In Germany, only one ATL line goes from the French border to Mannheim. According to the EDP, this line was expected for deployment by 2023, but it will be delayed until 2028 according to the latest German plans.

CNC corridors will be extended in 2021. The CEF 2 extension added to the ATL corridor new sections in France, Portugal and Spain that in the framework of CEF 1 did not belong to any CNC. Considering this extension, the total ATL corridor length has been increased to 11 295 km.

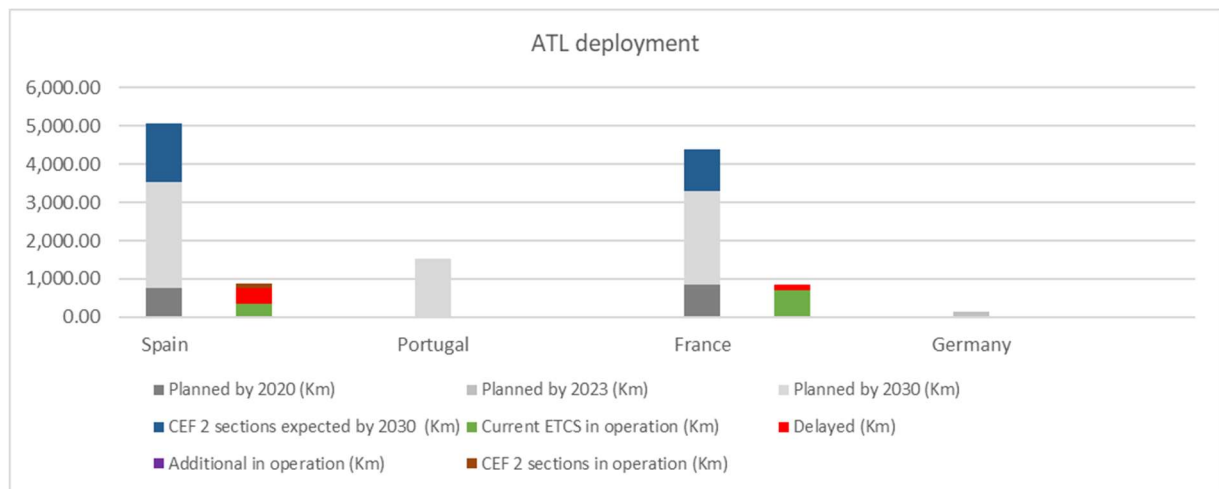


Figure 24 Atlantic Corridor ERTMS deployment status



## Baltic-Adriatic Corridor

### 1. The ERTMS deployment

The total length of the BAC corridor is 4 910 km, including the CEF 2 extension. According to the EDP, 1 485 km and 2 100 km are expected to be operational by 2021 and 2023. Overall, ETCS is operational on 29% of BAC, while GSM-R on 59% of the corridor. In June 2022, 61% of the BAC length planned in the EDP by 2023 was in operation with ETCS. Given the current deployment figures and considering that some Member States have already notified delays in implementation, it will not be possible to meet the EDP deadlines in this corridor by 2023. The following graphs show the status of ETCS deployment by the Member States on the BAC as a percentage of the 2023 and 2030 targets.

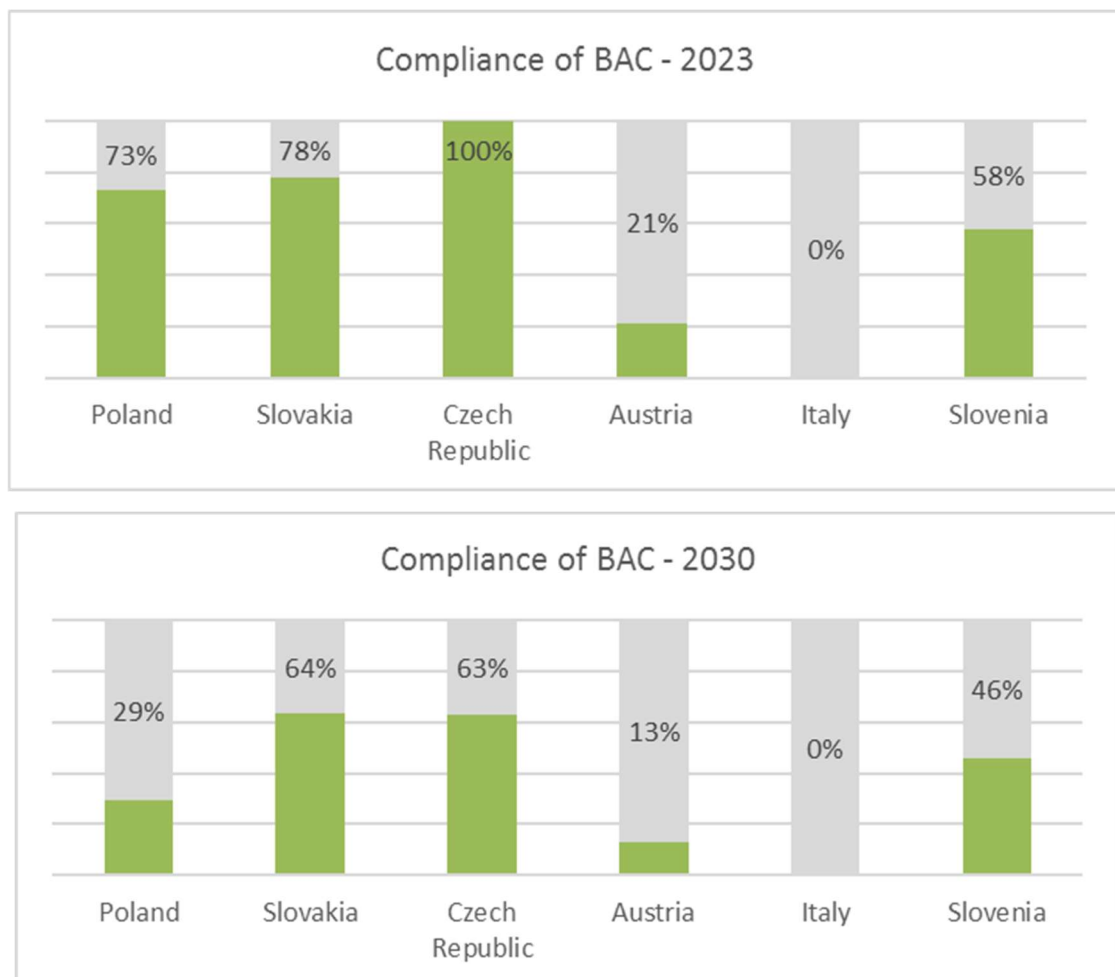


Figure 25 ETCS deployment by Member States on the Baltic-Adriatic Corridor

Only one bottleneck threatening compliance with 2030 targets was identified, in Slovenia: the planned high-speed line between Ljubljana, Divača and the Italian border, which is not included in the Slovenian deployment plan for 2030. However, the conventional line between those cities is already in operation, allowing a continuous operation on BAC by 2030.

According to Member States' plans, the remaining BAC sections will be ETCS in operation by 2030.



## 2. EDP compliance

The following scheme shows the state of play and deadlines for the ERTMS deployment in the BAC corridor, considering the dates of the EDP:

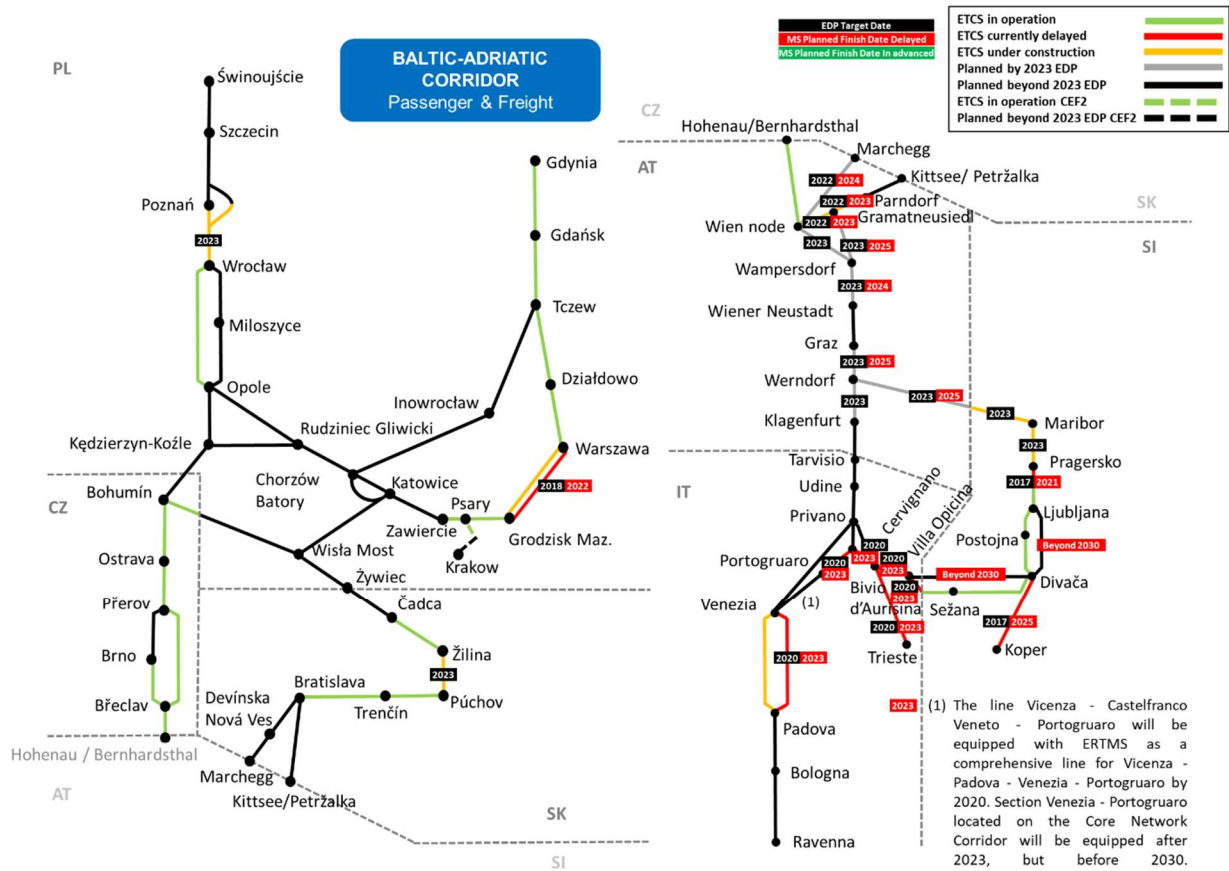


Figure 26 Baltic-Adriatic ERTMS deployment plan

In Poland, most of the lines planned in the EDP by 2023 are already in operation and all the BAC sections will be in operation by 2030 according to the Polish plan.

Czech sections in BAC planned in the EDP by 2023 are currently in operation, including cross-border sections with Poland and Austria. The remaining sections are planned for 2030.

Slovak deployment is also following the EPD deadlines. Slovak cross-border sections with Poland and Slovenia will be in operation by 2030.

There is only one ETCS section in operation in Austria on the BAC, being a cross-border section with Czechia. According to the Austrian plan, lines planned in the EDP by 2023 are delayed until 2023-2025. The remaining sections are planned for 2030.

Most of the lines planned in the EDP by 2023 are already in operation in Slovenia, including the Slovenian section next to the Italian border. BAC sections will be in operation by 2030 according to the Slovenian plan except for the planned high-speed line between Ljubljana, Divača and the Italian border.





In Italy, there are no BAC ETCS lines in operation. According to the Italian plans, lines planned in the EDP by 2020 are delayed until 2023. BAC sections in Italy will be commissioned progressively by 2030. CNC corridors were extended in 2021. The CEF 2 extension added to the BAC corridor new sections in Poland that in the framework of CEF 1 did not belong to any CNC. Considering this extension, the total BAC corridor length has been increased to 4 910 km.

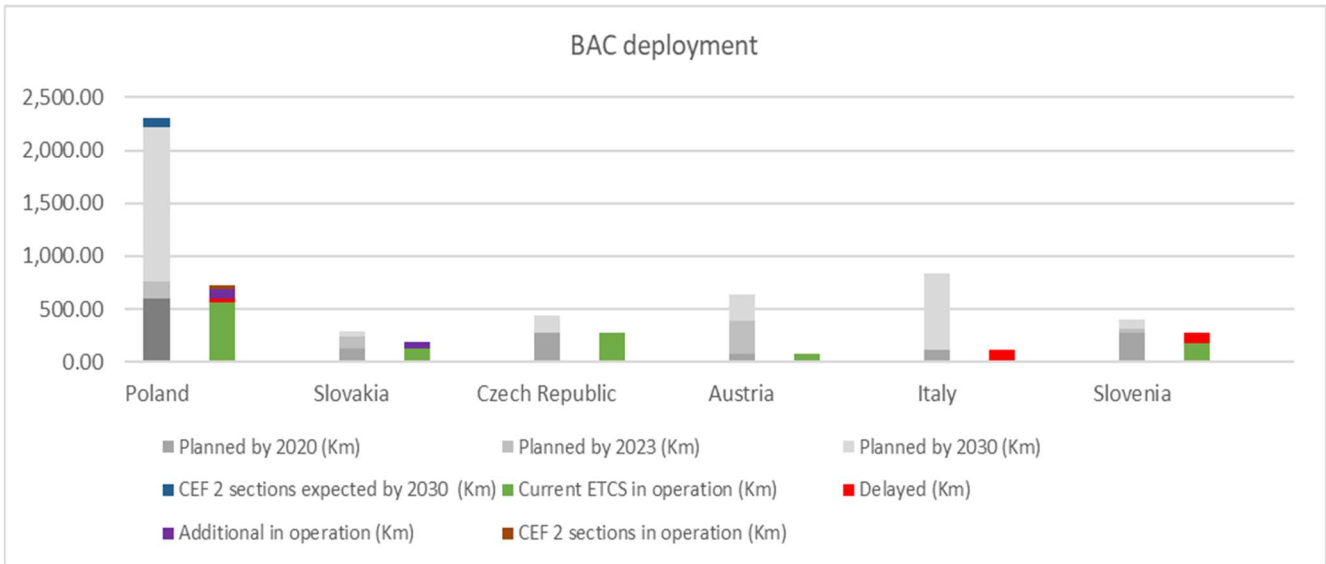


Figure 27 Baltic-Adriatic Corridor ERTMS deployment status



## Mediterranean Corridor

### 1. The ERTMS deployment

The total length of the MED corridor is 11 410 km, including the CEF 2 extension. According to the EDP, 3 080 km and 3 135 km are expected to be operational by 2021 and 2023. Overall, ETCS is operational on 18% of MED, while GSM-R is operational on 49% of the corridor. In June 2022, 53% of the MED length planned in the EDP by 2023 was in operation with ETCS. Given the current deployment figures and considering that some Member States have already notified delays in implementation, it will not be possible to meet the EDP deadlines in this corridor by 2023. The following graphs show the status of ETCS deployment by Member States on the MED as a percentage of the 2023 and 2030 targets.

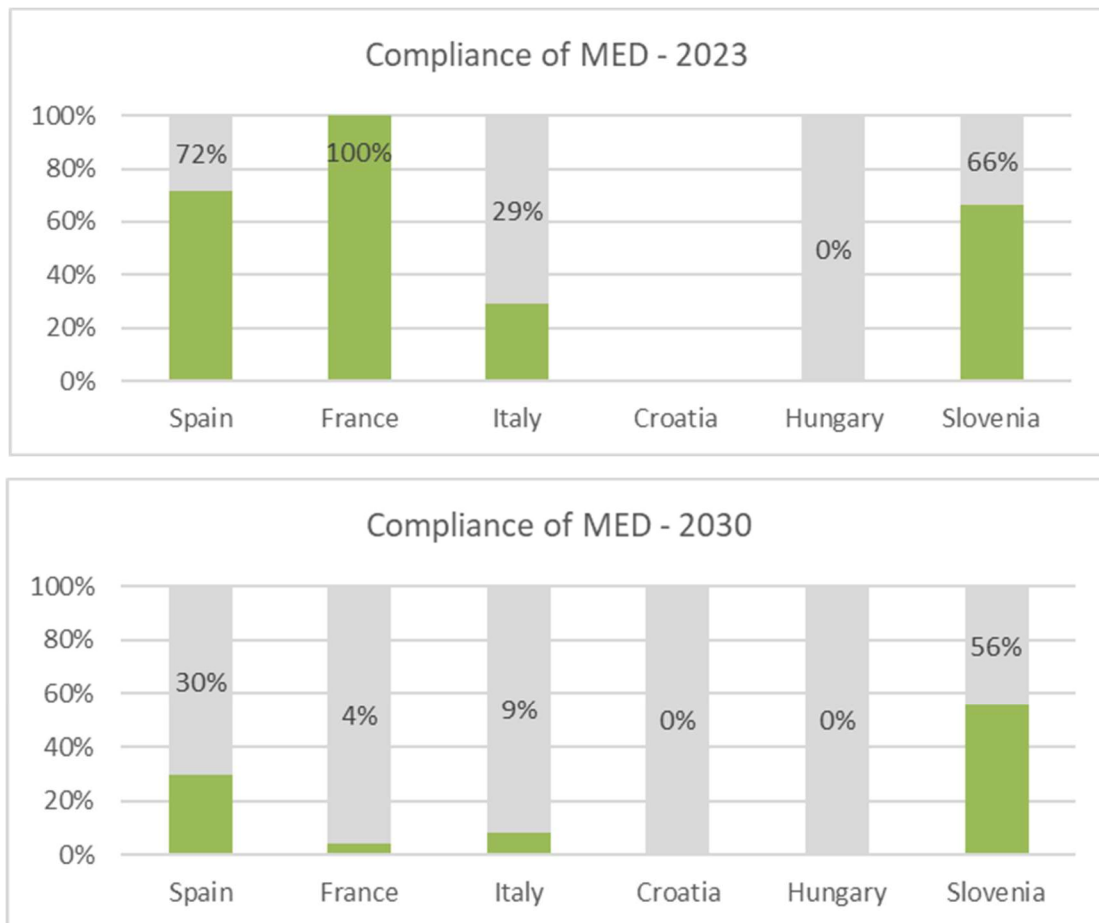


Figure 28 ETCS deployment by Member States on the Mediterranean Corridor

The main bottlenecks threatening compliance with 2030 targets are the following:

- With the exception of the Marseille - France/Italy border line, French plans do not support that lines planned in the EDP beyond 2023 will be in operation by 2030.
- The commissioning of the planned high-speed line between Ljubljana, Divača and the Italian border is not included in the Slovenian deployment plan for 2030. However, the conventional line between those cities is already in operation, allowing for continuous ERTMS operations on the MED corridor.



- The Croatian deployment plan does not include a planned date for planned lines belonging to MED, i.e. the Oštarije - Rijeka line and a bypass line in Zagreb.
- The Hungarian deployment plan does not include a planned date for some MED sections, i.e. the Boba – Székesfehérvár section and the Hungarian sections next to the Croatian and Ukrainian borders.

**2. EDP compliance**

The following scheme shows the state of play and deadlines for the ERTMS deployment in the MED corridor, considering the dates of the EDP:

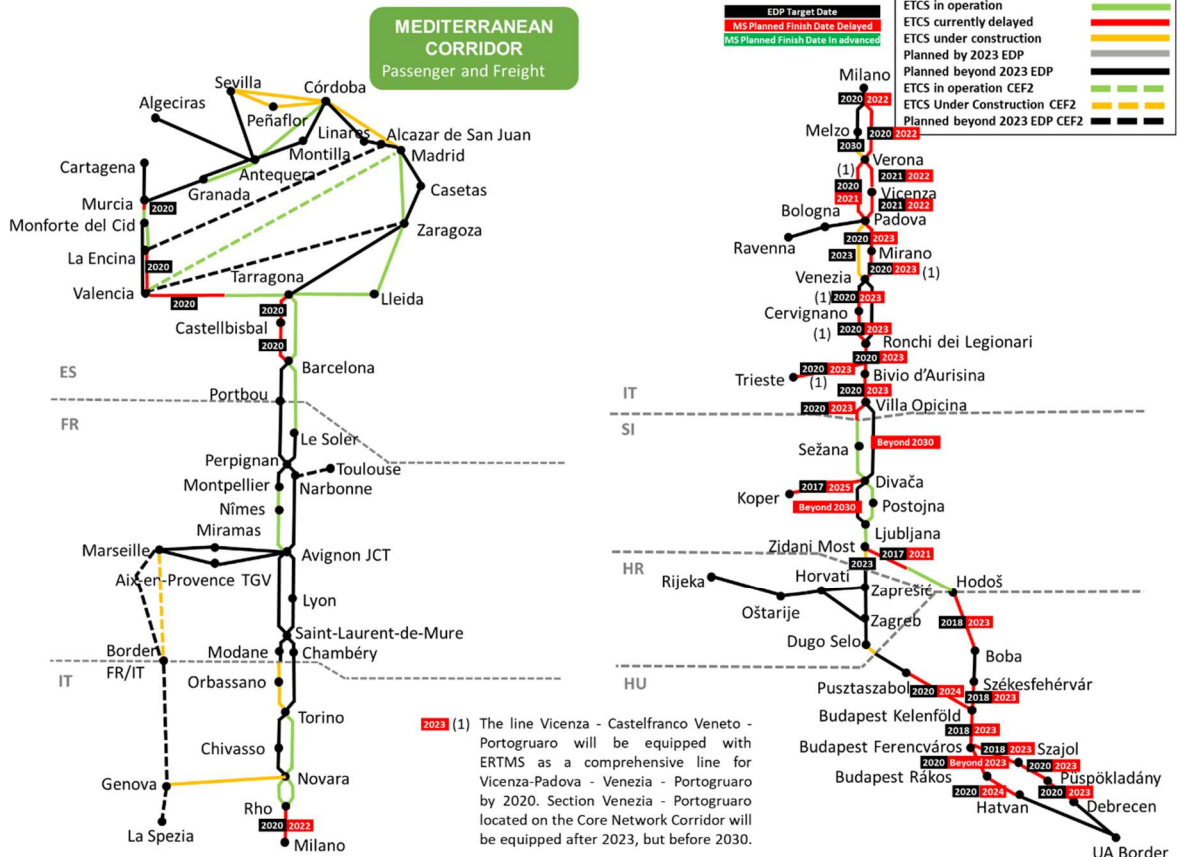


Figure 29 Mediterranean Corridor ERTMS deployment plan

In Spain, most of the lines planned in the EDP by 2023 are already in operation, including one of the cross-border sections with France. According to the Spanish plans, all MED sections will be operational by 2030.

In France, there are already some lines in operation on MED. The Marseille - France/Italy border line is planned to be equipped with ERTMS by 2030, with a first section equipped by 2027. However, French plans do not support that sections planned in the EDP beyond 2023 will be in operation by 2030.

In Italy, there are already some lines in operation. Most sections planned in the EDP by 2020 are delayed until 2023. According to the Italian plans, other MED sections will be in operation by 2030.

Most of the lines planned in the EDP by 2023 are already in operation in Slovenia, including the Slovenian section next to the Italian border. According to the Slovenian plan, MED sections will be



operational by 2030, except for the planned high-speed line between Ljubljana, Divača and the Italian border.

In Croatia, no lines will be equipped with ETCS by 2023, in line with the EDP deadlines. According to the Croatian plan, MED sections will be in operation by 2030 except for the planned line Oštarije – Rijeka and a bypass in Zagreb.

In Hungary, lines planned in ERTMS EDP by 2020 are delayed until 2021-2030. Sections planned in the EDP beyond 2023 are not included in the Hungarian deployment plan.

CNC corridors were extended in 2021. The CEF 2 extension added to the MED corridor new sections in France, Italy and Spain that in the framework of CEF 1 did not belong to any CNC. Considering this extension, the total MED corridor length has been increased to 11 410 km.

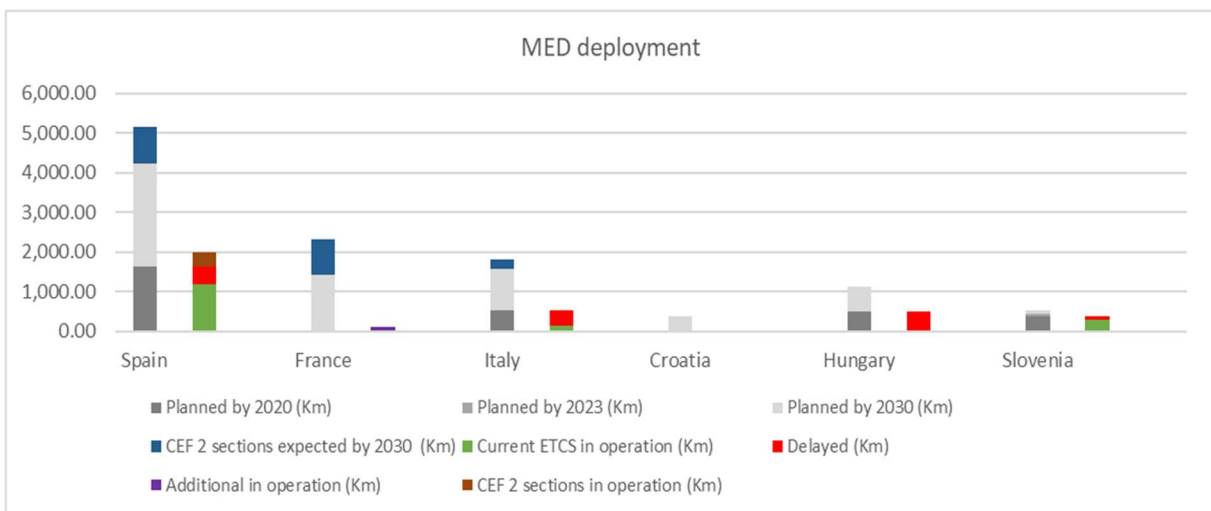


Figure 30 Mediterranean Corridor ERTMS deployment status



## North Sea-Baltic Corridor

### 1. The ERTMS deployment

The total length of the NSB corridor is 9 030 km, including the CEF 2 extension. According to the EDP, 755 km and 1 775 km are expected to be operational by 2021 and 2023. Overall, ETCS is in operation on 11% of NSB, while GSM-R is in operation on 58% of the corridor. In June 2022, 32% of the NSB length planned in the EDP by 2023 was in operation with ETCS. Given the current deployment figures and considering that some Member States have already notified delays in implementation, it will not be possible to meet the EDP deadlines in this corridor by 2023. The following graphs show the status of ETCS deployment by the Member States on the NSB as a percentage of the 2023 and 2030 targets.

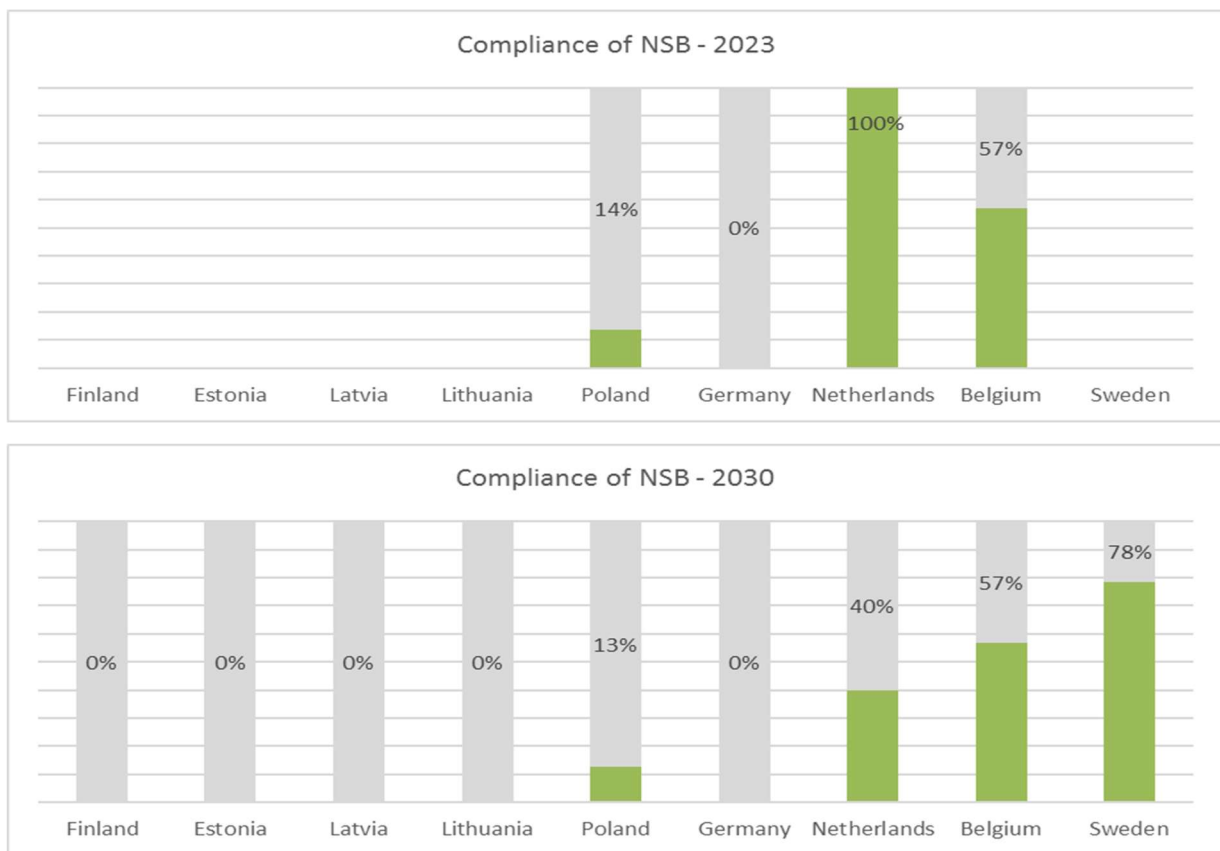


Figure 31 ETCS deployment by Member States on the North Sea-Baltic Corridor

Sections in Latvia, Lithuania and Estonia with a track gauge that is different from the European standard nominal track gauge (i.e., sections outside the Rail Baltic) are exempt from the obligation to deploy ERTMS.

The main bottlenecks threatening compliance with the 2030 targets are the following:

- NSB sections will be equipped beyond 2030 according to the Finnish plan.
- The commissioning of the planned high-speed lines between Poznan/Wroclaw – Kalisz – Łódź – Opoczno / Mszczonow are not included in the Polish deployment plan for 2030.
- The German plan does not indicate a specific deadline for the NSB lines planned in the EDP beyond 2023. German authorities envisage full network equipment with ETCS by 2040, but there is no confirmation if NSB will be equipped by 2030.



- According to the Dutch plan, the line from Rotterdam to the German border (Hengelo) will be deployed beyond 2030.

## 2. EDP compliance

The following scheme shows the deadlines and the state of play for the ERTMS deployment in the NSB corridor:

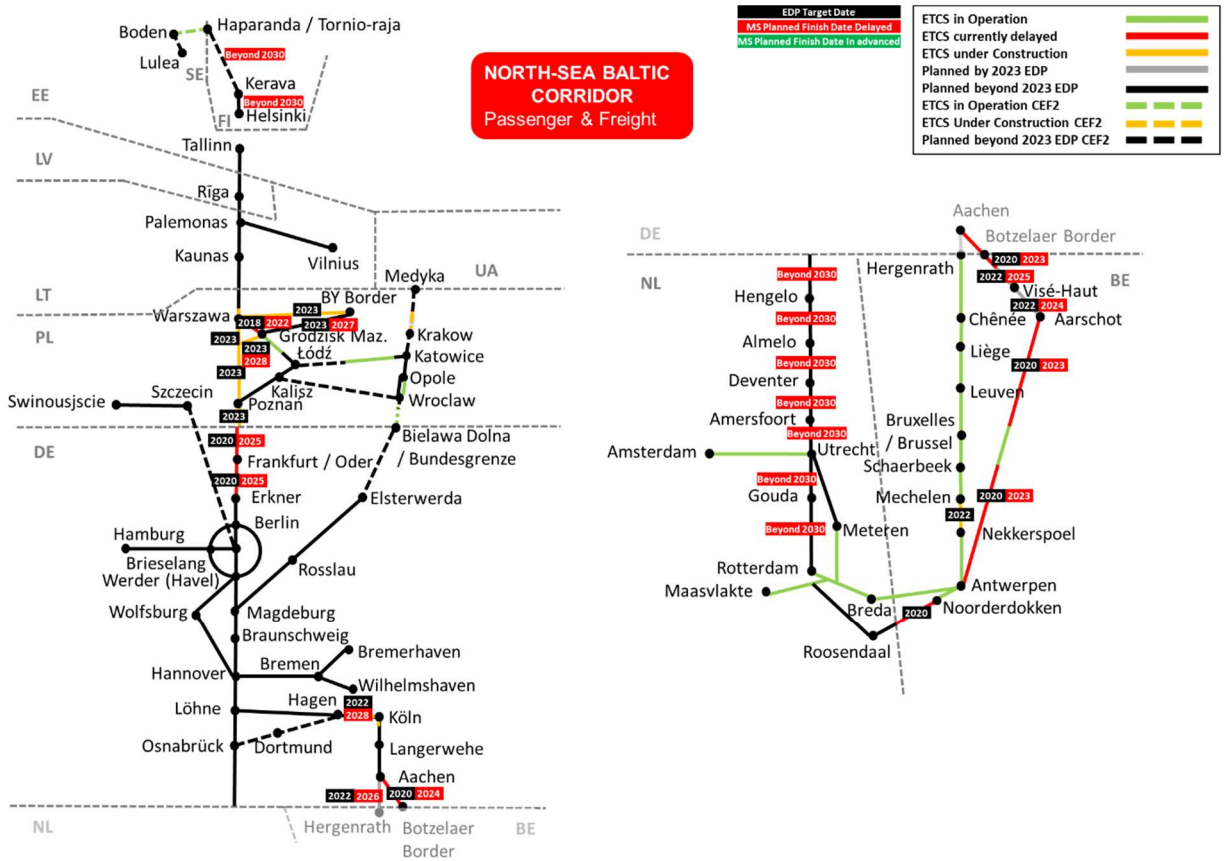


Figure 32 North Sea-Baltic Corridor ERTMS deployment plan

In Sweden, there are two sections of the NSB corridor. One is already operational, and the other is expected to be commissioned by 2027.

According to the Finnish plan, the NSB sections in Finland will be equipped beyond 2030 to 2036.

The Rail Baltica, that is to connect Estonia with Poland through Latvia and Lithuania, will be operational by 2030 according to the official plan. Sections in Latvia, Lithuania and Estonia with a track gauge different from the European standard nominal track gauge (i.e. sections outside the Rail Baltica) are exempt from the deployment of ERTMS.

Polish authorities have reported delays on sections planned in the EDP by 2023. According to the Polish plan, all NSB sections are expected to be commissioned by 2030 except for the planned high-speed lines between Poznan/Wroclaw – Kalisz – Łódź – Opoczno / Mszczonow, for which there are no specific deadlines for NSB sections in the Polish plan.



According to the German plans, German sections planned in the EDP by 2023 will be delayed, and their commissioning is expected between 2024 and 2028. Regarding German sections planned in the EDP beyond 2023, although the entire German network will be equipped by 2040, there are no specific deadlines for NSB sections in the German plan.

The lines currently in operation in The Netherlands had been already commissioned when the EDP was published in 2017. According to the Dutch plans, most of the remaining NSB Dutch sections (i.e., Rotterdam – Utrecht – Hengelo – German border line) are expected to be operational beyond 2030.

In Belgium, most of the NSB sections are already operational, including one cross-border section with the Netherlands and another one with Germany. Although some sections planned in the EDP by 2023 will be delayed, the Belgian authorities still plan the entire Belgian network to be equipped by 2025.

CNC corridors were extended in 2021. The CEF 2 extension added to the NSB corridor new sections in Finland, Germany, Poland and Sweden that in the framework of CEF 1 did not belong to any CNC. Considering this extension, the total NSB corridor length has been increased to 9 030 km.

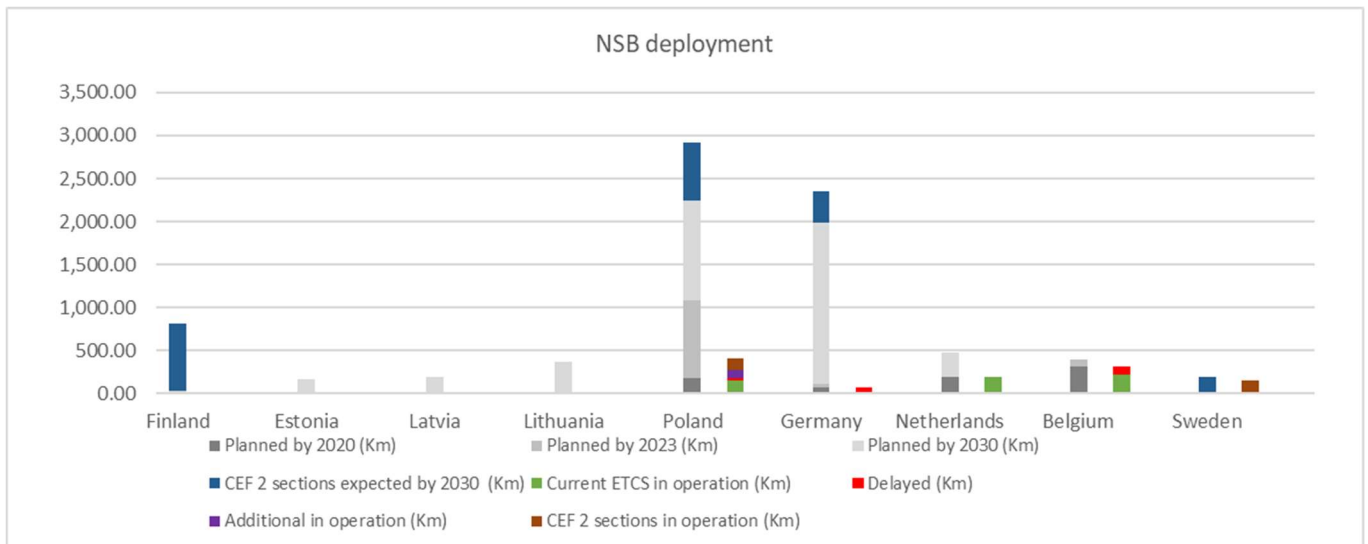


Figure 33 North Sea-Baltic Corridor ERTMS deployment status



## North Sea-Mediterranean Corridor

### 1. The ERTMS deployment

The total length of the NSM corridor is 5 465 km, including the CEF 2 extension. According to the EDP, 1 310 km and 1 565 km are expected to be operational by 2021 and 2023. Overall, ETCS is operational on 15% of NSM, while GSM-R is operational on 78% of the corridor. In June 2022, 51% of the NSM length planned in the EDP by 2023 was in operation with ETCS. Given the current deployment figures and considering that some Member States have already notified delays in implementation, it will not be possible to meet the EDP deadlines in this corridor by 2023. The following graphs show the status of ETCS deployment by the Member States on the NSM as a percentage of the 2023 and 2030 targets.



Figure 34 ETCS deployment by Member States on the North Sea-Mediterranean Corridor

Sections in Ireland are in principle exempted from the obligation to deploy ERTMS. Lines in the United Kingdom do not belong to the NSM anymore.

The following bottlenecks regarding the 2030 compliance have been identified:

- According to the Dutch plans, the line from Roosendaal to Vlissingen will be deployed beyond 2030.





- The French plans do not support that lines planned in the EDP beyond 2023 will be in operation by 2030.

## 2. EDP compliance

The following scheme shows the state of play and deadlines for the ERTMS deployment in the NSM corridor, considering the dates of the EDP:

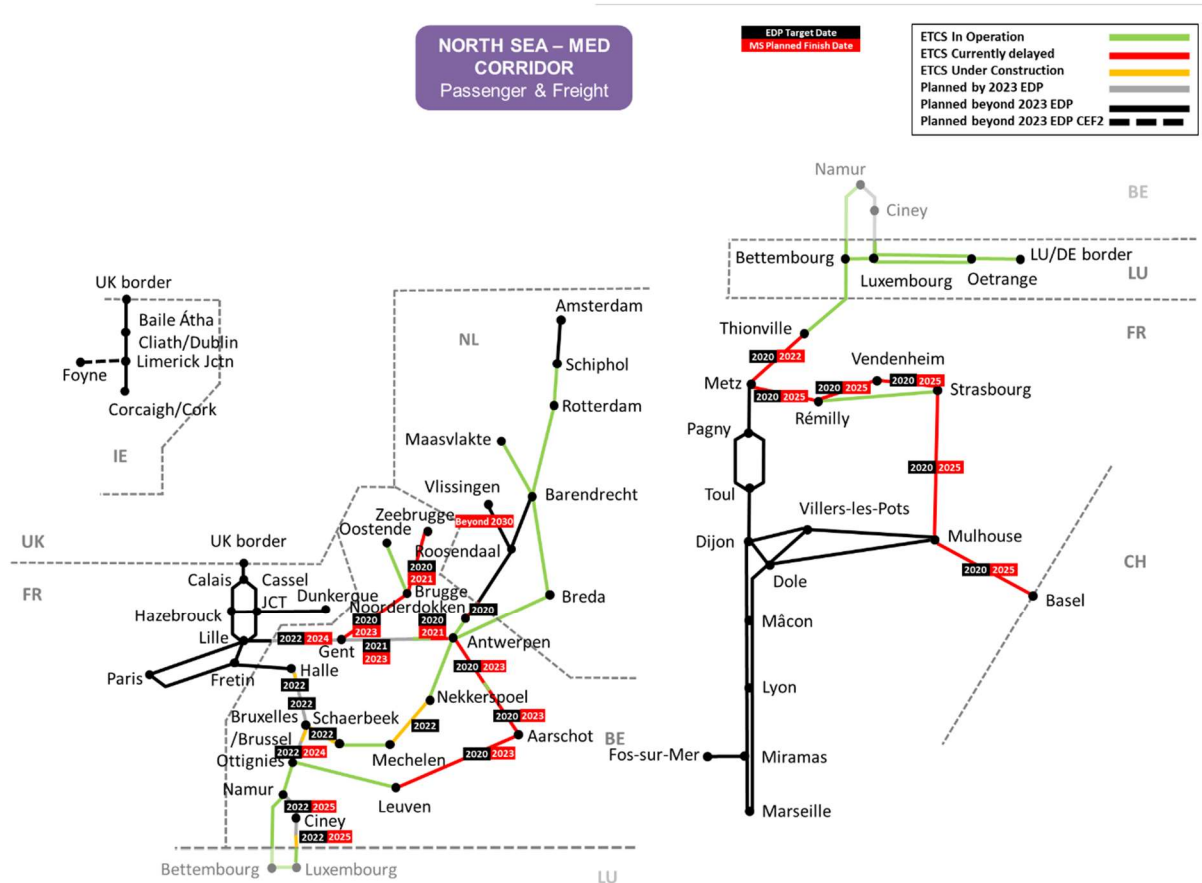


Figure 35 North Sea-Mediterranean Corridor ERTMS deployment plan

According to the national deployment plans, as of 2025 it should be possible to operate in a continuous manner with ERTMS from the North Sea ports to Basel.

The Irish network is exempt but Irish authorities have plans to deploy Level 1 ETCS on the whole network by 2040. A GSM-R voice system is being rolled out to replace the existing analogue radio network by 2025. There are two operational lines on NSM in France: the Rémilly – Strasbourg line and Thionville – Luxembourg border line. According to the French plan, the Thionville – Metz – Strasbourg – Mulhouse – Basel conventional line, planned in the EDP by 2020, is delayed until 2025. Regarding sections scheduled in the EDP beyond 2023, the French plans do not support that those lines will be in operation by 2030.

The lines currently in operation in The Netherlands had been already commissioned when the EDP was published in 2017. According to the Dutch plan, all remaining Dutch sections are planned by 2030 except for the Rosendaal – Vlissingen line.



In Belgium, most of the NSM lines are already in operation, including one cross-border section with the Netherlands and the other one with Luxemburg. Although some sections planned in the EDP by 2023 will be delayed, the Belgian authorities still plan the entire Belgian network to be equipped by 2025.

Luxembourg's entire network is already equipped.

CNC corridors were extended in 2021. The CEF 2 extension added to the NSM corridor new sections in Ireland that in the framework of CEF 1 did not belong to any CNC. Considering this extension, the total NSM corridor length has been increased to 5 465 km.

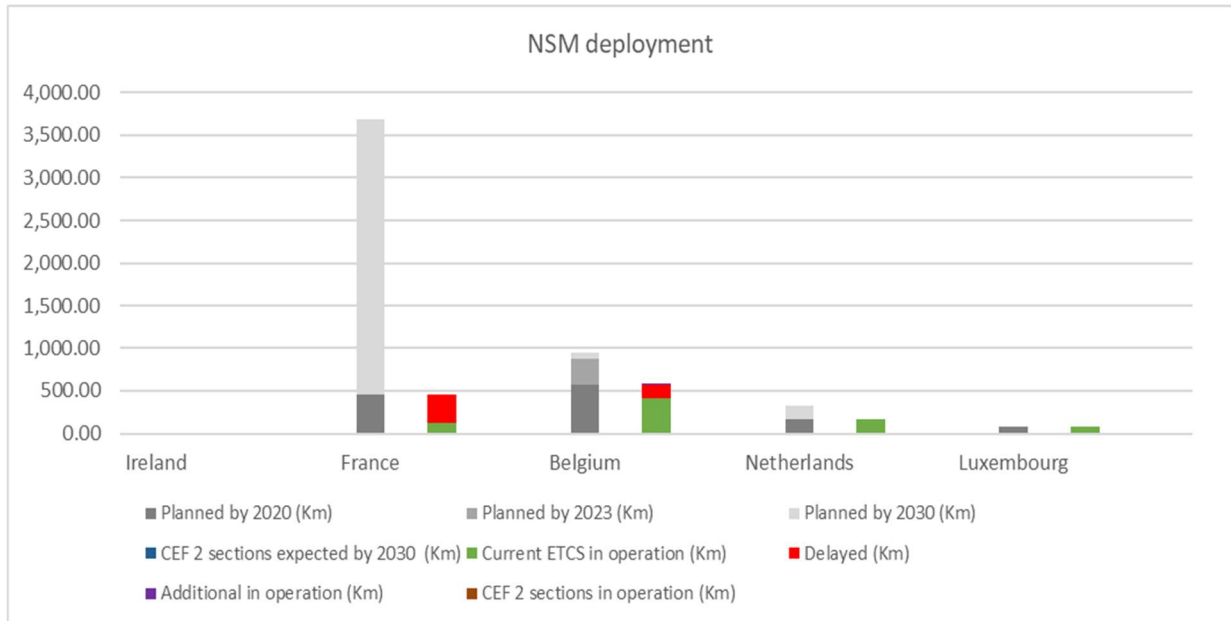


Figure 36 North Sea-Mediterranean Corridor ERTMS deployment status



## Orient/East - Mediterranean Corridor

### 1. The ERTMS deployment

The total length of the OEM corridor is 6 480 km, including the CEF 2 extension. According to the EDP, 1 960 km and 2 760 km are expected to be operational by 2021 and 2023. Overall, ETCS is operational on 11% of OEM, while GSM-R is operational on 51% of the corridor. In June 2022, 24% of the OEM length planned in the EDP by 2023 was in operation with ETCS. Given the current deployment figures and considering that some Member States have already notified delays in implementation, it will not be possible to meet the EDP deadlines in this corridor by 2023. The following graphs show the status of ETCS deployment by the Member States on the OEM as a percentage of the 2023 and 2030 targets.



Figure 37 ETCS deployment by Member States on the Orient/East - Mediterranean Corridor

The main bottlenecks threatening compliance with the 2030 targets are the following:

- The German plans do not indicate a specific deadline for OEM lines planned in the EDP beyond 2023. German authorities envisage full network equipment with ETCS by 2040, but there is no confirmation whether OEM will be equipped by 2030.



- In Bulgaria, the Radomir – Kulata line and the Brusartsi – Mezdra line are planned to be equipped by 2034 and 2037
- In Greece, lines from Thessaloniki to the Turkish border and from Kalambaka to Igoumenitsa are planned beyond 2030 according to the Greece deployment plans.

## 2. EDP compliance

The following scheme shows the state of play and deadlines for the ERTMS deployment in the OEM corridor, considering the dates of the EDP:

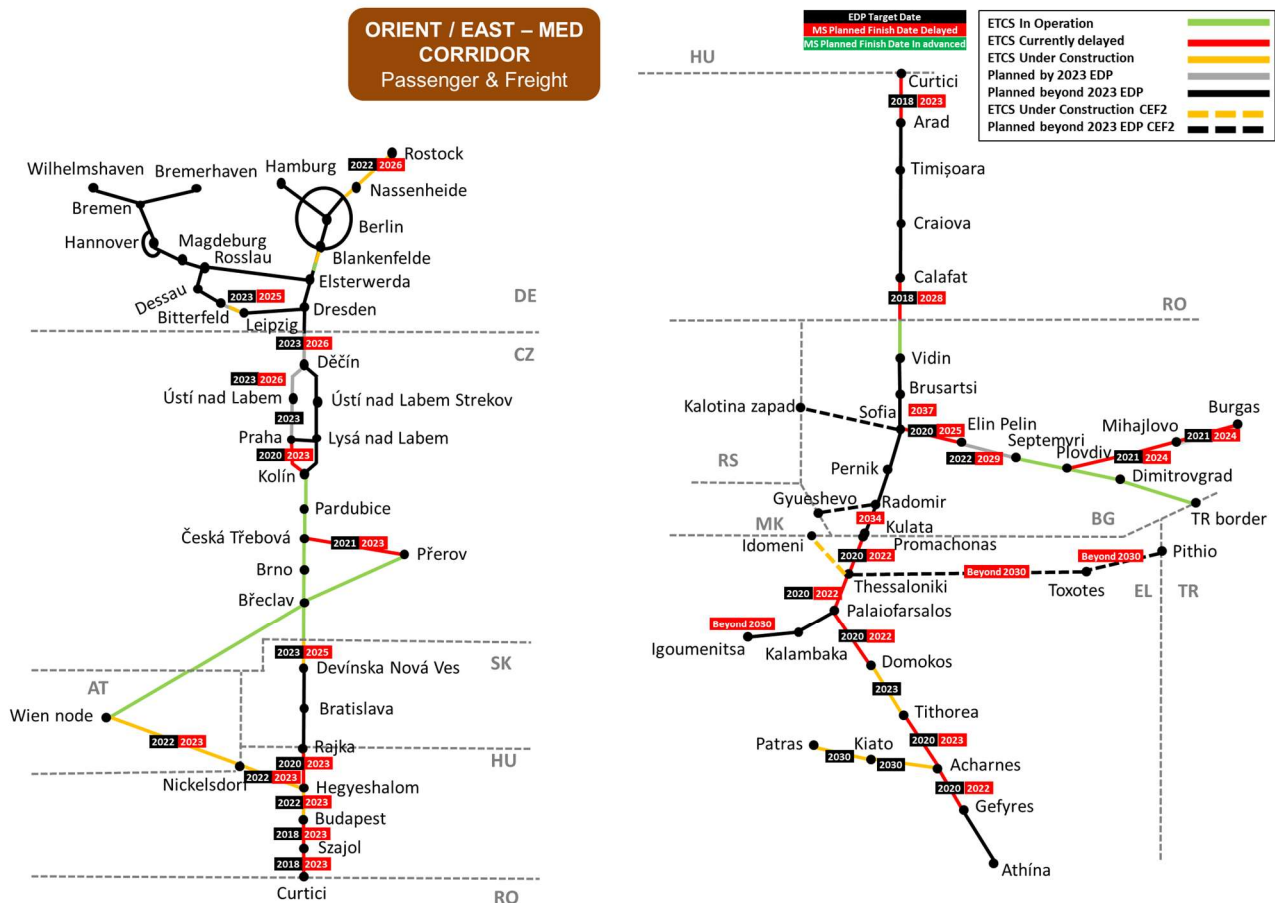


Figure 38 Orient/East - Mediterranean Corridor ERTMS deployment plan

According to the German plans, all German sections planned in the EDP by 2023 will be delayed, and their commissioning is expected by 2025 and 2026. Regarding German sections planned in the EDP beyond 2023, although the entire German network is set to be equipped by 2040, there are no specific deadlines for OEM sections.

In Czechia, most of the lines planned in the EDP by 2023 are currently in operation, including the cross-border sections with Slovakia and Austria. According to the Czech plans, all OEM sections will be operational by 2030.

There are two Austrian lines belonging to the OEM, one of them is in operation (Czech border – Wien), and the other (Wien – Hungarian border) is planned by 2023 according to the Austrian plan.

According to Slovakian national plans, all OEM sections in Slovakia will be in operation by 2030.



According to Bulgarian national plans, all OEM sections in Bulgaria will be in operation by 2030, except for the Radomir – Kulata line and the Brusartsi – Mezdra line which are planned by 2034 and 2037. According to the Hungarian plans, OEM sections in Hungary are planned to be in operation by 2023.

The Curtici – Arad line is currently equipped with ETCS in OEM but not yet in operation in Romania. All OEM sections in the Romania are planned to be equipped by 2026, 2028 and 2030, respectively.

In Greece, sections planned in the EDP by 2020 are delayed. According to the Greece deployment plans, the OEM will be equipped by 2030 except for the lines from Thessaloniki to the Turkish border and Kalambaka to Igoumenitsa.

CNC corridors were extended in 2021. The CEF 2 extension added to the OEM corridor new sections in Bulgaria and Greece that in the framework of CEF 1 did not belong to any CNC. Considering this extension, the total OEM corridor length has been increased to 6 480 km.

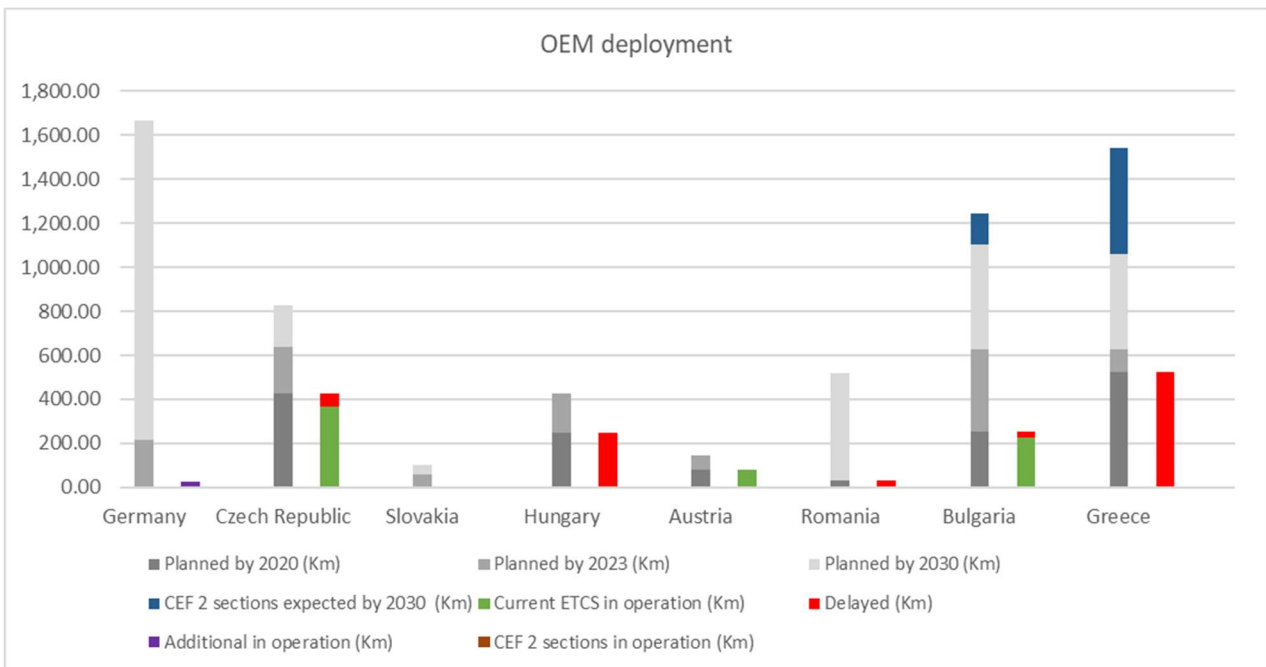


Figure 39 Orient/East - Mediterranean Corridor ERTMS deployment status



## Rhine-Alpine Corridor

### 1. The ERTMS deployment

The total length of the RALP corridor is 3 460 km, including the CEF 2 extension. According to the EDP, 1 640 km and 2 270 km are expected to be operational by 2021 and 2023. Overall, ETCS is operational on 29% of RALP, while GSM-R is operational on 99% of the corridor. According to the EDP, ETCS is planned to be put in operation on 66% of the corridor by 2023 (the highest planned ETCS deployment of the CNC). In June 2022, 44% of the RALP length planned in the EDP by 2023 was in operation with ETCS. Given the current deployment figures and considering that some Member States have already notified delays in implementation, it will not be possible to meet the EDP deadlines in this corridor by 2023. The following graphs show the status of ETCS deployment by the Member States on the RALP as a percentage of the 2023 and 2030 targets.

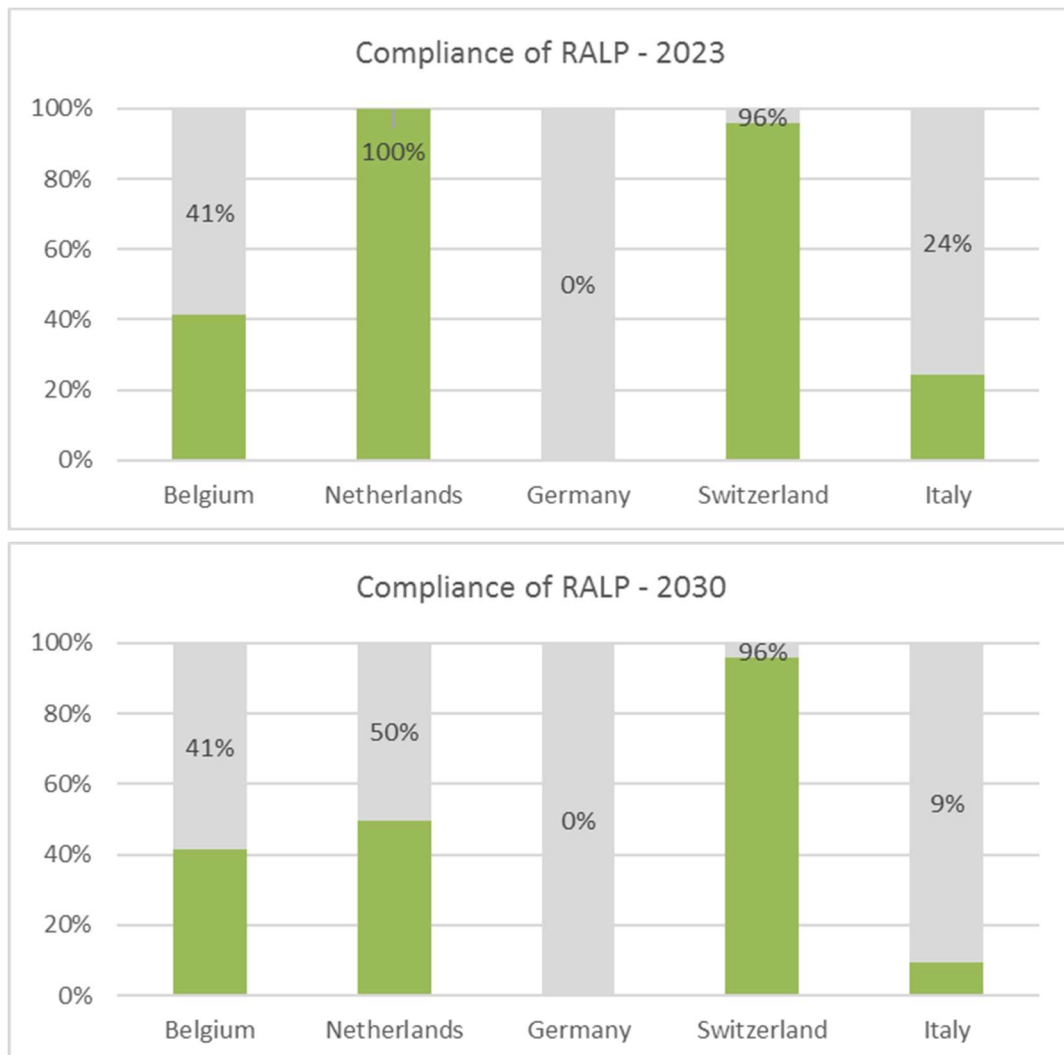


Figure 40 ETCS deployment by Member States on the Rhine-Alpine Corridor

The following bottlenecks regarding the 2030 compliance have been identified:

- According to the Dutch plans, both the Rosendaal – Vlissingen and Utrecht – Zevenaar lines will be deployed beyond 2030. The remaining sections are planned for 2030.



- The German plans do not indicate a specific deadline for RALP lines planned in the EDP beyond 2023 (e.g., Frankfurt, Mannheim and Karlsruhe). German authorities envisage full network equipment with ETCS by 2040, but there is no confirmation whether RALP will be equipped by 2030.

## 2. EDP compliance

The following scheme shows the state of play and deadlines for the ERTMS deployment in the RALP corridor, considering the dates of the EDP:

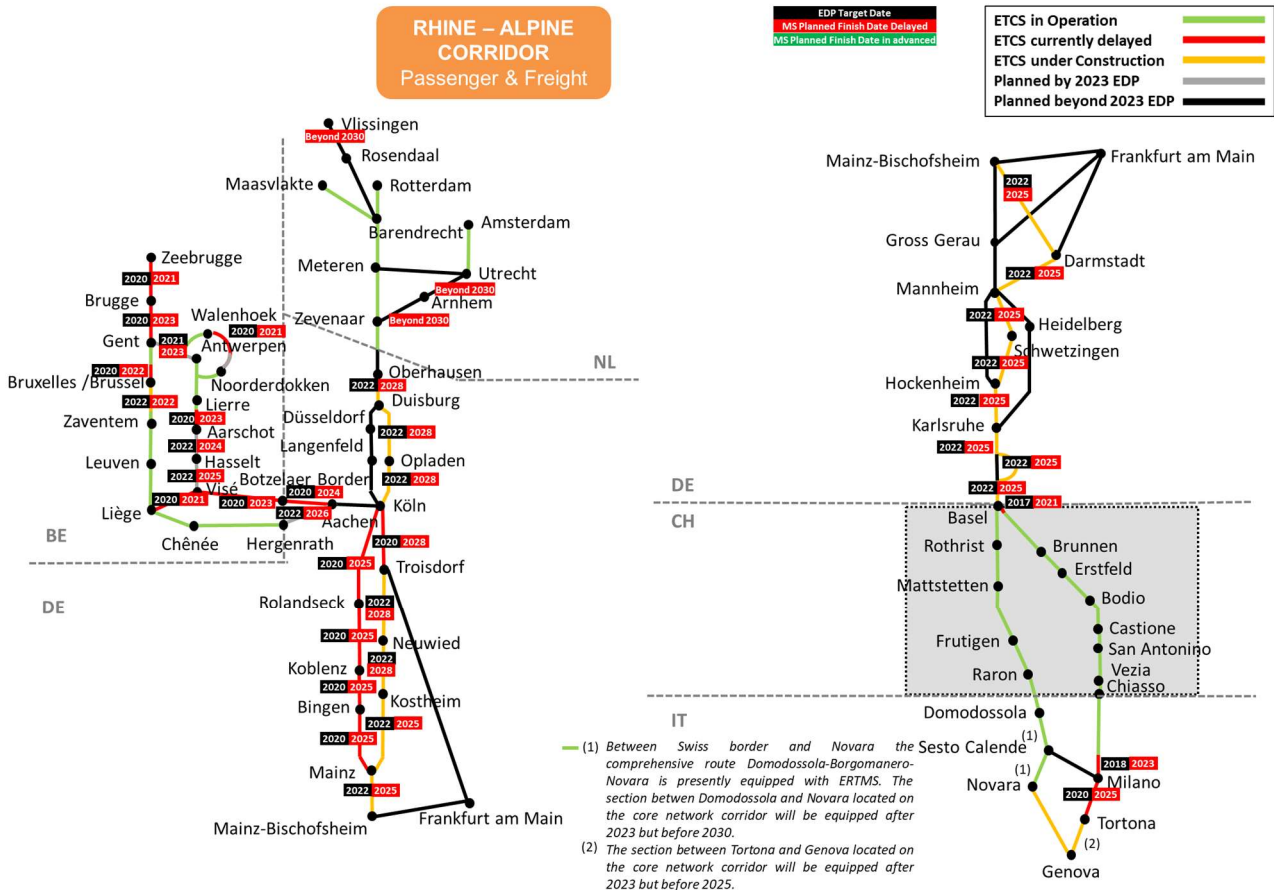


Figure 41 Rhine-Alpine Corridor ERTMS deployment plan

The lines currently in operation in The Netherlands had been already commissioned when the EDP was published in 2017. All remaining Dutch sections are planned by 2030, both in the EDP and in the Dutch plan, except for Rosendaal – Vlissingen and Utrecht – Zevenaar lines.

Although Germany had some sections planned to be in operation according to the EDP by 2021, all German sections planned in the EDP by 2023 will be delayed. According to the German plan, their commissioning is expected between 2024 and 2028. Regarding German sections planned in the EDP beyond 2023, although the entire German network will be equipped by 2040, there are no specific deadlines for some RALP sections in the German plans.

In Belgium, many of the sections are delayed. However, the Belgian authorities still plan the entire Belgian network to be equipped by 2025.





In Switzerland, the deployment is almost finalised, and all its sections will achieve the status of ETCS without restrictions by 2022.

In Italy, most of the sections planned in the EDP by 2023 are delayed, but all sections in the corridor are planned by Italian authorities to be equipped by 2026.

CNC corridors were extended in 2021. However, the CEF 2 extension did not add to the RALP corridor new sections that in the framework of CEF 1 did not belong to any CNC.

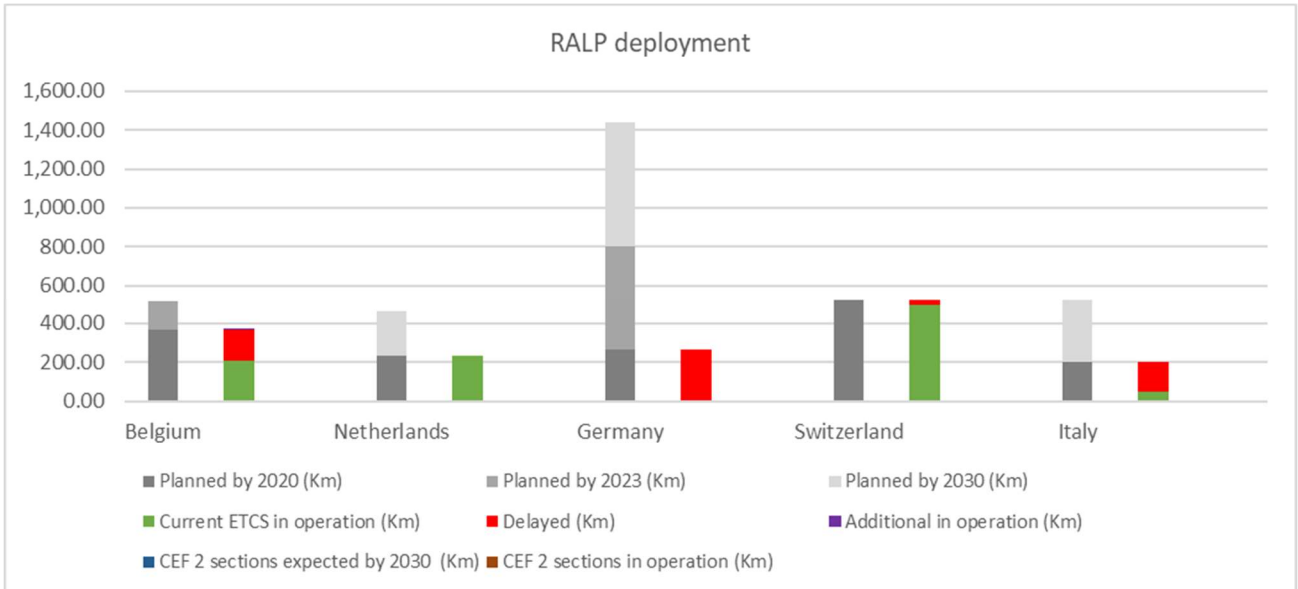


Figure 42 Rhine-Alpine Corridor ERTMS deployment status



## Rhine-Danube Corridor

### 1. The ERTMS deployment

The total length of the RDN corridor is 5 910 km, including the CEF 2 extension. According to the EDP, 1 570 km and 2 060 km are expected to be operational by 2021 and 2023. Overall, ETCS is operational on 7% of RDN, while GSM-R is operational on 59% of the corridor. In June 2022, 19% of the RDN length planned in the EDP by 2023 was in operation with ETCS. Given the current deployment figures and considering that some Member States have already notified delays in implementation, it will not be possible to meet the EDP deadlines in this corridor by 2023. The following graphs show the status of ETCS deployment by Member States on the RDN as a percentage of the 2023 and 2030 targets.



Figure 43 ETCS deployment by Member States on the Rhine-Danube Corridor



The following bottlenecks regarding the 2030 compliance have been identified:

- The German plans do not indicate a specific deadline for RDN lines planned in the EDP beyond 2023. German authorities envisage full network equipment with ETCS by 2040, but there is no confirmation if RDN will be equipped by 2030.

## 2. EDP compliance

In the following scheme, the state of play and deadlines for the ERTMS deployment in the RDN corridor are shown:

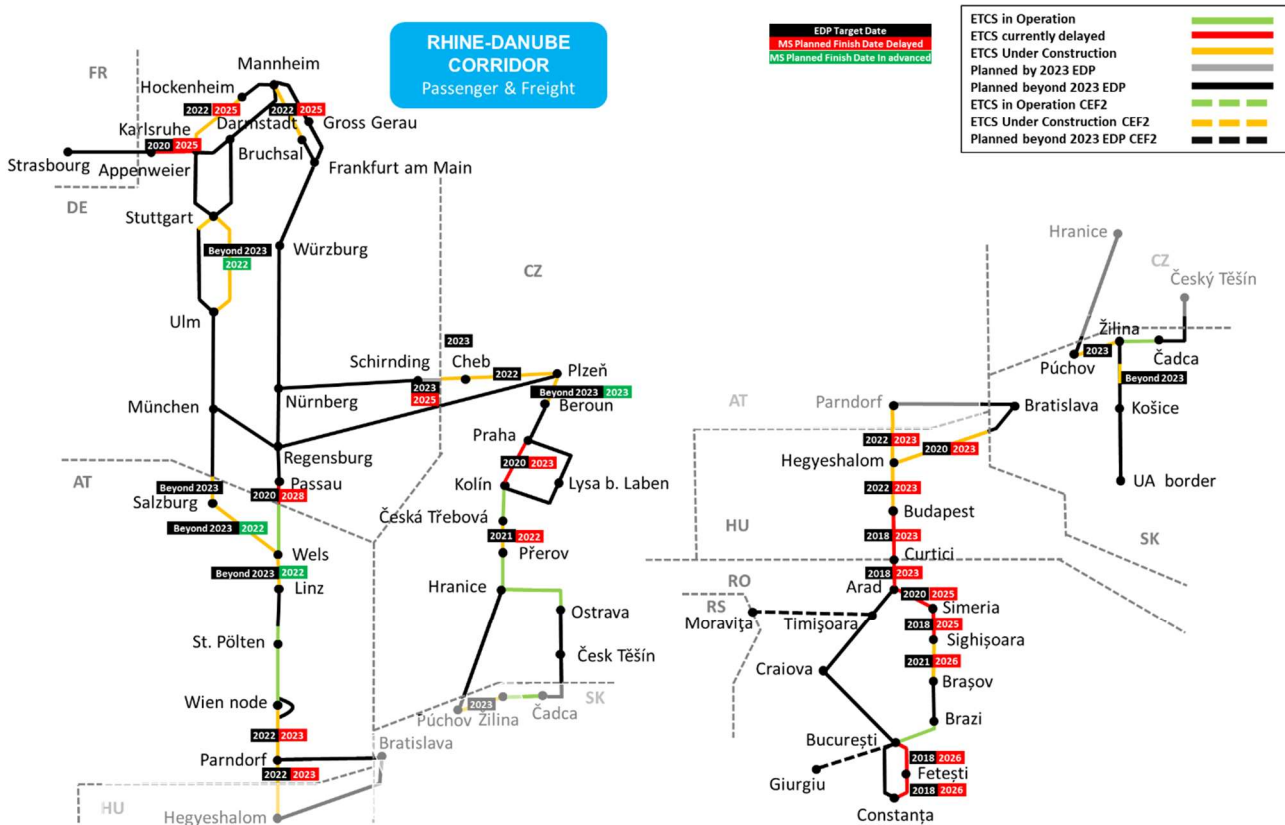


Figure 44 Rhine-Danube Corridor ERTMS deployment plan

In France, only one line is included on the RDN corridor, from Strasbourg to the German border, whose commissioning is expected by 2025 according to the French plan.

In Germany, there are no lines ETCS in operation yet. According to the German plan, German sections planned in the EDP by 2023 will be delayed, and their commissioning is expected by 2025. Regarding German sections planned in the EDP beyond 2023, although the entire German network will be equipped by 2040, there are no specific deadlines for RDN sections in the German plans.

In Czechia, there are some lines in operation on RDN. The Czech sections planned in the EDP for 2020 and 2021 will be delayed until 2023 and 2022, respectively. The commission of the Czech section of



the cross-border between Czechia and Germany is planned by 2022, however this is technically possible only in cooperation with Germany, whose section is planned by 2025. Other RDN sections are planned by 2030 according to the Czech plans.

Austria's lines currently in operation had been already commissioned when the EDP was published in 2017. The Austria sections planned in the EDP by 2022 will be delayed until 2023. All remaining Austrian sections are planned by 2030, both in the EDP and the Austrian plan.

The line currently in operation in Slovakia had been already commissioned when the EDP was published in 2017. The Slovak deployment plan is in line with EDP. Therefore, all RDN sections will be commissioned by 2030.

In Hungary, there are no lines in operation on RDN. According to the Hungarian plan, RDN sections will be commissioned by 2023.

In Romania, there are some lines currently equipped with ETCS on RDN but only the Brazi – Buftea line (closeto Bucharest) is in operation. According to the Romanian plans, all the Romanian lines in the RDN will be in operation by 2030.

CNC corridors were extended in 2021. The CEF 2 extension added to the RDM corridor new sections in Romania that in the framework of CEF 1 did not belong to any CNC. Considering this extension, the total RDN corridor length has been increased to 5 910 Km.

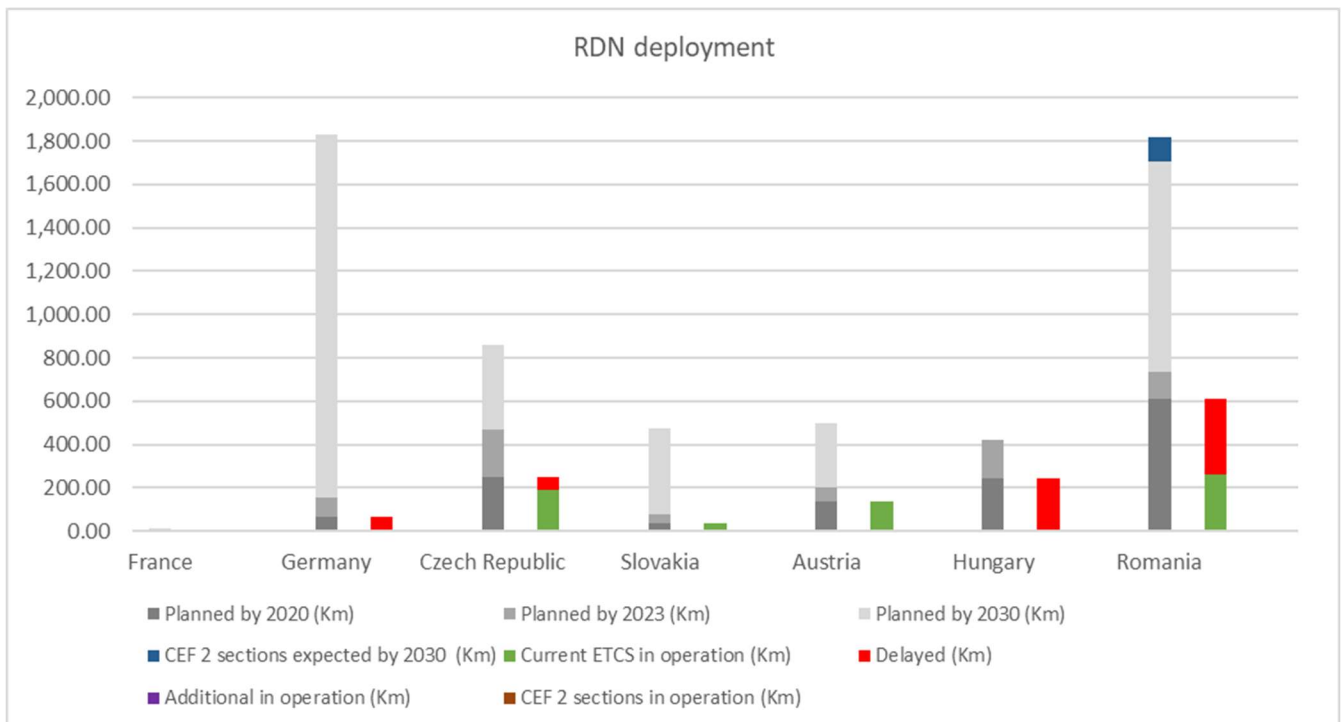


Figure 45 Rhine-Danube Corridor ERTMS deployment status



## Scandinavian-Mediterranean Corridor

### 1. The ERTMS deployment

The total length of the SCM corridor is 11 925 Km, including the CEF 2 extension. According to the EDP, 1 255 Km and 1 850 Km are expected to be operational by 2021 and 2023. Overall, ETCS is operational on 10% of SCM, while GSM-R is operational on 93% of the corridor. In June 2022, 37% of the SCM length planned in the EDP by 2023 was in operation with ETCS. Given the current deployment figures and considering that some Member States have already notified delays in implementation, it will not be possible to meet the EDP deadlines in this corridor by 2023. The following graphs show the status of ETCS deployment by Member States on the SCM as a percentage of the 2023 and 2030 targets.

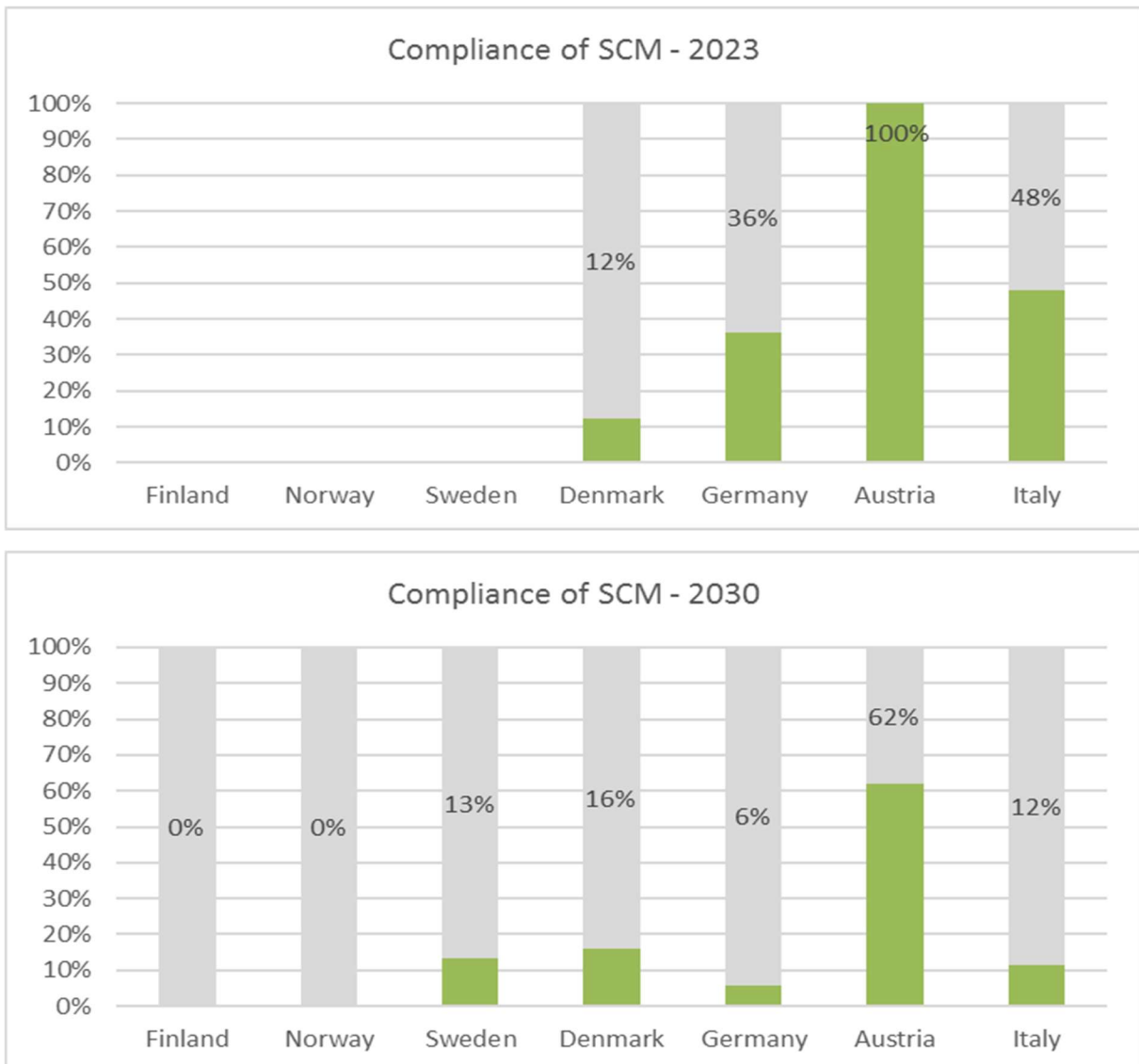


Figure 46 ETCS deployment by Member States on the Scandinavian-Mediterranean Corridor

The main bottlenecks threatening compliance with the 2030 targets are the following:



- In Finland, the commissioning of all SCM sections is planned by 2034 and 2036, except for the line from Turku/Naantali to Karjaa (located between Turku and Helsinki) that is planned by 2029.
- In Norway, the cross-border section between Sweden and Oslo is expected to be commissioned with ETCS by 2034, according to the Norwegian plan.
- The Swedish plans do not indicate a specific deadline for the SCM lines included in the CEF 2 extension. Swedish authorities envisage full network equipment with ETCS by 2035, but there is no confirmation if the SCM lines will be equipped by 2030.
- The German plans do not indicate a specific deadline for SCM lines planned in the EDP beyond 2023. German authorities envisage full network equipment with ETCS by 2040, but there is no confirmation if SCM will be equipped by 2030.

## 2. EDP compliance

The following scheme shows the state of play and deadlines for the ERTMS deployment in the SCM corridor, considering the dates of the EDP:

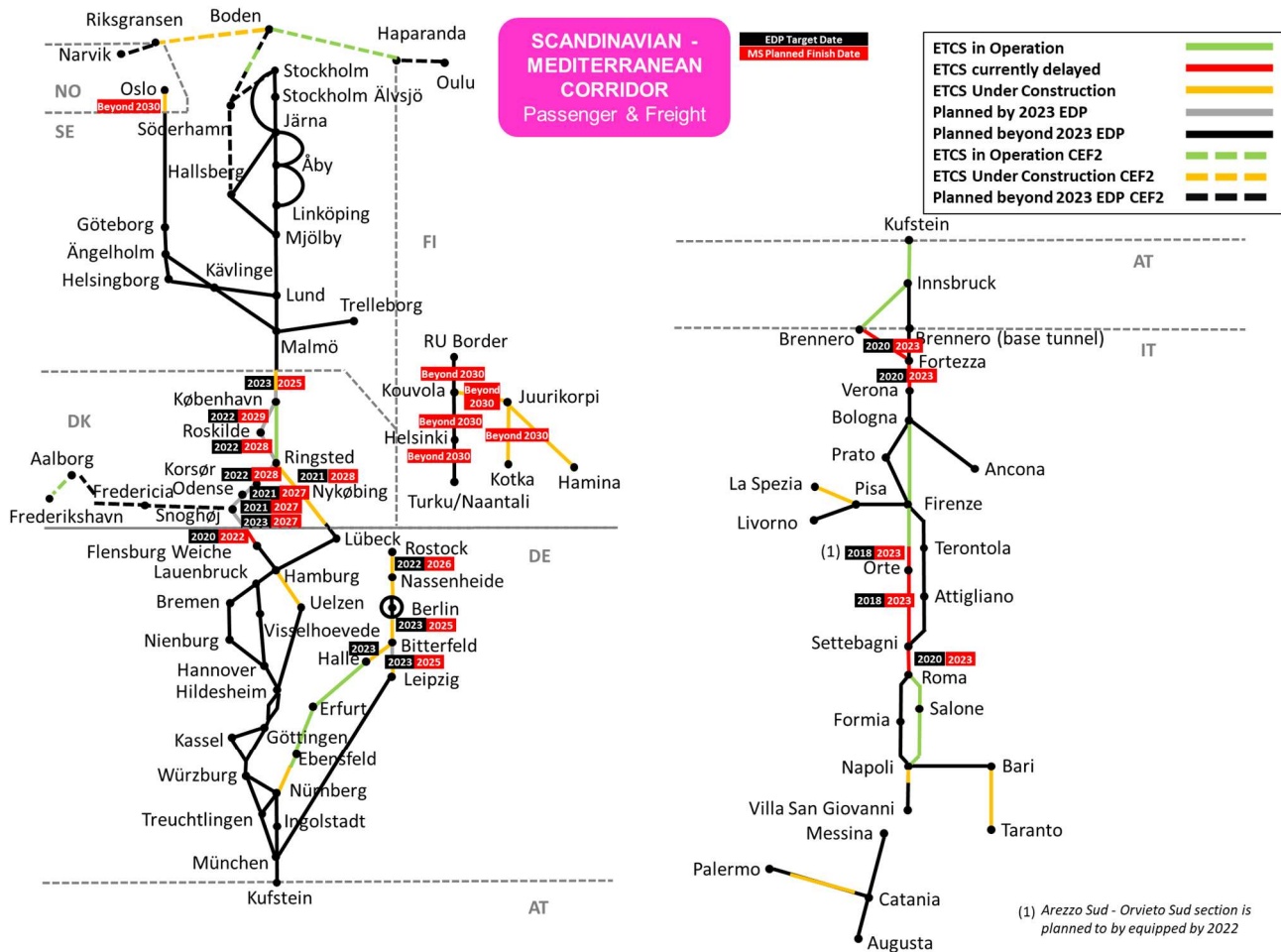


Figure 47 Scandinavian-Mediterranean Corridor ERTMS deployment plan

According to the Finnish plan, the commissioning of most SCM sections is planned by 2034 and 2036. Only one section, from Turku/Naantali to Karjaa (located between Turku and Helsinki), will be commissioned by 2030.



In Norway, there are two lines on the SCM corridor. Both lines connect Norway with Sweden. According to the Norwegian plan, the commissioning of the Narvik – Swedish border is planned by 2027 and Oslo – Swedish borderline is planned by 2034.

In Sweden, there are already some lines in operation in SCM. According to the Swedish plans, the remaining sections are planned by 2030, except for sections included in CEF 2 extension. Swedish authorities envisage full network equipment with ETCS by 2035, but there is no confirmation if CEF 2 sections will be equipped by 2030.

In Denmark, there are already some lines in operation on SCM. The remaining sections will be commissioned between 2022 and 2030, except for the line currently equipped with no train system protection, i.e., the last mile of Hjørring - Hirtshals section in the north of Denmark.

In Germany, there are already some lines in operation on SCM. According to the German plan, some sections planned in the EDP by 2023 will be delayed, and their commissioning is expected between 2025 and 2026. Regarding German sections planned in the EDP beyond 2023, although the entire German network will be equipped by 2040, most SCM sections have no specific deadlines.

In Austria, the line from the Italian cross-border (Brennero) to the German cross-border (Kufstein) had been already commissioned when the EDP was published in 2017. According to the Austrian plans, the remaining SCM section will be commissioned by 2030.

In Italy, there are already some lines in operation in SCM. According to the Italian plans, some sections planned in the EDP by 2018 and 2020 are delayed, and their commissioning is expected by 2023. The remaining lines are planned to be equipped by 2030.

CNC corridors were extended in 2021. The CEF 2 extension added to the SCM corridor new sections in Denmark, Finland, Norway and Sweden that in the framework of CEF 1 did not belong to any CNC. Considering this extension, the total SCM corridor length has been increased to 11 925 Km.

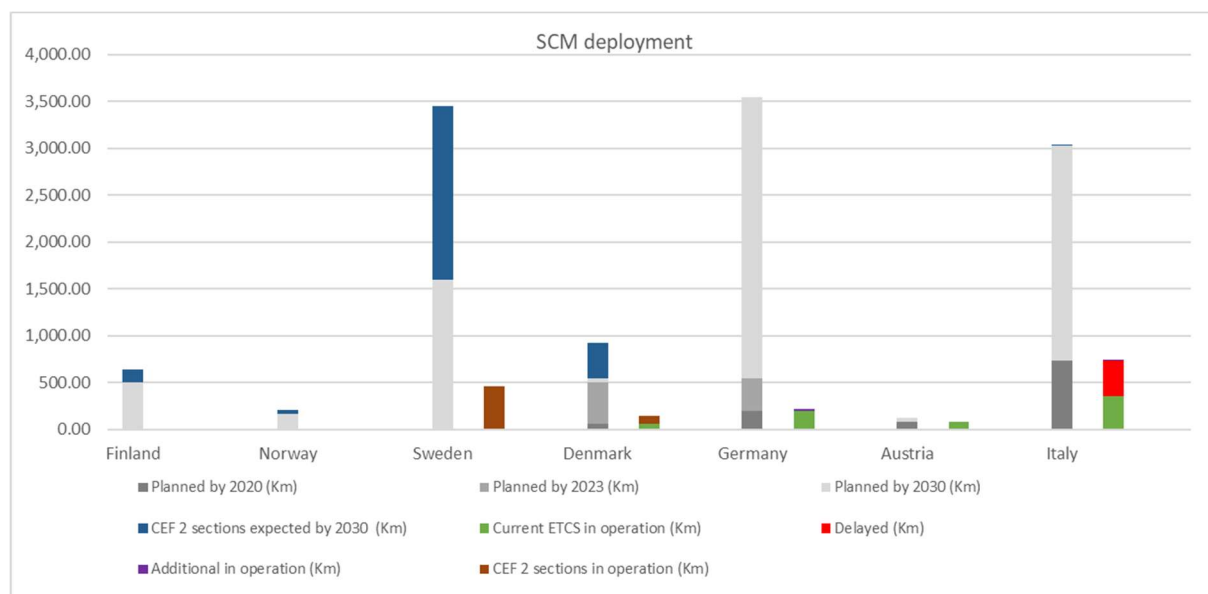


Figure 48 Scandinavian-Mediterranean Corridor ERTMS deployment status





## Annex II State of play of EDPs

At the time of publishing the EDP, around 3 700 km were in operation with ETCS.

According to the EDP, around 1 400 km should have been put in operation in 2017 in the following countries.

Country	Km to equip in 2017	Comments	Km pending
Belgium	78.27	Already in operation end 2017	0
Bulgaria	213.94	157.77 Km in operation end 2018 and 56.17 Km in operation end 2019	0
France	307.98	Already in operation end 2017	0
Italy	49.15	28.15 Km in operation in 2018 21.00 Km in operation in 2020	0
Luxembourg	11.79	Already in operation end 2017	0
Slovenia	389.40	291.40 Km already in operation end 2017	98
Switzerland	359.56	347.93 Km already in operation end 2017 7.28 Km already in operation end of 2018	4.35
<b>Total</b>	<b>1410.09</b>		<b>102.35</b>

Table 7 EDP overview 2017

According to the EDP, around 1800 km should have been put in operation with ETCS in 2018.

Country	Km to equip in 2018	Comments	Km pending
Czechia	267.15	In operation end 2018	0
Denmark	61.16	In operation in May 2019	0
Hungary	384.75		384.75
Italy	288.40	57.83 Km in operation in 2020	230.57
Poland	383.21	341.27 Km in operation in 2020	41.94
Romania	414.52		414.52 <sup>45</sup>
<b>Total</b>	<b>1799.19</b>		<b>1 071.78</b>

Table 8 EDP overview 2018

According to the EDP, in 2019, only the following kilometres from Spain should have been put in operation.

Country	Km to equip in 2019	Comments	Km pending
Spain	188.19		188.19
<b>Total</b>	<b>188.19</b>		<b>188.19</b>

Table 9 EDP overview 2019

<sup>45</sup> There are 410 Km in Romania already equipped with ETCS but not authorised.



According to the EDP, around 4000 km should have been put in operation in 2020 in the following countries.

Country	Km to equip in 2020	Comments	Km pending
<b>Belgium</b>	277.64	2.5 Km in operation since 2016. 11.5 Km in operation since 2020. 53.9 Km in operation in 2021.	209.75
<b>Bulgaria</b>	24.80		24.80
<b>Czechia</b>	270.72	206.9 Km in operation since 2020.	63,83
<b>France</b>	321.27		321.27
<b>Germany</b>	446.20	113 Km in operation since 2017.	333.21
<b>Greece</b>	523.29		523.29
<b>Hungary</b>	238.18		238.18
<b>Italy</b>	680.91	33.48 Km in operation in 2020	647.43
<b>Romania</b>	158.54		158.54
<b>Spain</b>	985.54	37.4 Km in operation since 2018. 121.3 Km in operation since 2019. 68.9 Km in operation since 2020. 62.8 Km in operation in 2021.	695.07
<b>Switzerland</b>	17.44		17.44
<b>Total</b>	3944.52		3 232.79

Table 10 EDP overview 2020

According to the EDP, around 800 km should be put in operation in 2021 in the following countries. It is noted that no section has been put in operation yet.

Country	Km to equip in 2021	Comments	Km pending
<b>Belgium</b>	58.31		58.31
<b>Bulgaria</b>	295.66		295.66
<b>Czechia</b>	102.23		102.23
<b>Denmark</b>	190.69		190.69
<b>Romania</b>	127.10		127.10
<b>Total</b>	773.99		773.99

Table 11 EDP overview 2021

The following table includes the delayed lines that should be already in operation according to the EDP. The lines in the table are sorted by country, then by new target date and finally by CNC information.



Work Plan 2022 of the European Coordinator for ERTMS

Country	CNC	Length (km)	Line	Comments	EDP target date	New target date
Belgium	NSB - NSM	21.38	Noorderdokken - Border BE/NL (Essen/Roosendaal)	The section Y.Luchtbal <--> Y.Sint-Mariaburg is already operational. The commissioning for the rest of the line is expected by 2020.	2020	No date
Belgium	RALP - NSM	9.68	Antwerpen port	This line has already three sections in operation with ETCS L1, these sections are Y.Walenhoek <--> Waaslandhaven Noord, Antwerpen-W.H.-B.Kallo <--> Y.Kattestraat and Waaslandhaven Noord <--> Y.Beverenpolder. The commissioning of the ETCS L1 for the section Antwerpen - Y.Walenhoek is planned by 2021.	2020	2025
Belgium	RALP	20.60	Visé - Liège		2020	No date
Belgium	RALP	16.56	Gent - Bruxelles/Brussels	Most of the line is already equipped with ETCS. Only both connections -with Gent and Brussels- are not operational.	2020	2022
Belgium	NSM	15.13	Aarschot - Leuven		2020	2023
Belgium	NSB - RALP - NSM	41.82	Aarschot – Antwerpen	The section Y.Nazareth <--> Lierre is already equipped with ETCS L1.	2020	2023
Belgium	RALP - NSM	58.00	Zeebrugge - Brugge - Gent	This line could be divided into two sub-lines: Y.Noord Driehoek Ledeborg - Brugge and Zeebrugge-Vorming – Brugge, which commissioning dates have been delayed until 2023 and 2021, respectively.	2020	2023
Belgium	RALP	26.58	Visé-Haut - Border BE/DE (Botzelaer)		2020	2023
Belgium	RALP - NSM	58.31	Gent - Antwerpen		2021	2023
Bulgaria	OEM	24.80	Sofia - Elin Pelin		2020	2025
Bulgaria	OEM	295.66	Plovdiv- Mihaylovo - Burgas		2021	2024
Czechia	OEM - RDN	102.23	Česká Třebová - Přešov		2021	2023
Czechia	OEM - RDN	63.83	Praha - Kolin		2020	2023
Denmark	SCM	82.73	Ringsted - Mogenstrup - Nykøbing	Mogenstrup – Nykøbing section (60 km) is planned by 2022 and Ringsted – Mogenstrup section is planned by 2028	2021	2022/2028
Denmark	SCM	107.97	Korsør - Odense - Snoghøj		2021	2027
France	NSM	31.42	Thionville - Metz		2020	2022
France	ATL - NSM	28.12	Metz – Rémyilly		2020	2025
France	ATL - NSM	122.86	Rémyilly - Strasbourg (conventional)		2020	2025
France	NSM	138.88	Strasbourg - Mulhouse - Border FR/CH (Basel)		2020	2025
Germany	SCM	6.08	Border DK/DE (Padborg) - Flensburg Weiche		2020	2023



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Country	CNC	Length (km)	Line	Comments	EDP target date	New target date
Germany	NSB	4.80	Border PL/DE (Bundesgrenze/Oderbruecke) - Frankfurt/Oder		2020	2025
Germany	NSB	56.22	Frankfurt/Oder - Erkner		2020	2025
Germany	RALP	89.78	Koblenz - Bingen - Mainz		2020	2025
Germany	RALP	87.99	Köln - Rolandseck - Koblenz		2020	2025
Germany	RALP - RDN	63.54	Appenweier - Karlsruhe		2020	2025
Germany	RALP	18.08	Köln – Troisdorf (Conventional)		2020	2028
Germany	RDN	0.43	Passau - Border DE/AT (Passau/Ingling)		2020	2028
Germany	NSB - RALP	6.28	Aachen - Border DE/BE (Botzelaer)		2020	2029
Greece	OEM	1.93	Acharnes - Gefyres	According to the Greek NIP, the installation is completed. However, it will be ETCS in operation without restrictions by 2022.	2020	2022
Greece	OEM	343.17	Border BG/EL (Kulata/Promachonas) - Thessaloniki - Palaiofarsalos		2020	2022
Greece	OEM	21.14	Palaiofarsalos - Domokos		2020	2022
Greece	OEM	157.05	Tithorea- Acharnes		2020	2023
Hungary	MED	58.31	Székesfehérvár - Budapest Kelenföld		2018	2023
Hungary	MED	96.09	Border SI/HU (Hodos) - Boba	Migration from ETCS L1 PreBaseline to ETCS L2 Baseline 2.	2018	2024
Hungary	MED	47.95	Pusztaszabolcs - Budapest Kelenföld		2020	2024
Hungary	MED	57.65	Budapest Rákos - Hatvan		2020	2024
Hungary	MED - OEM – RDN	9.59	Budapest node	The section Budapest Kelenfold <--> Budapest Ferencvaros is in operation. On the remaining sections of the line, the commissioning is expected by 2023.	2018	2023
Hungary	OEM – RDN	116.78	Szajol - Border RO/HU		2018	2023
Hungary	MED - OEM – RDN	103.99	Budapest - Szajol		2018	2023
Hungary	OEM - RDN	14.24	Border HU/SK (Petrzalka/Rajka) - Hegyeshalom	This line is already in operation with ETCS L1 PreBaseline.	2020	No upgrading planned for the time being
Hungary	MED	108.53	Szajol - Püspökladány - Debrecen		2020	2023
Hungary	MED - OEM - RDN	9.81	Budapest Ferencváros - Budapest Rákos	According to the HU NIP, this line should have been commissioned by 2019.	2020	No date
Italy	MED	132.61	Milano - Verona		2020	2022
Italy	MED - RALP	29.84	Rho - Milano		2020	2022



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Country	CNC	Length (km)	Line	Comments	EDP target date	New target date
Italy	RALP	48.53	Milano - Chiasso		2018	2023
Italy	SCM	185.56	Direttissima Roma – Firenze (Settebagni - Orte - Arezzo)	The section from Firenze Statuto to Arezzo Nord Junction is in operation. On the Arezzo - Orvieto section, the commissioning is planned by 2022, and the Orvieto - Settebagni section the commissioning is expected by 2023.	2018	2023
Italy	SCM	26.95	Settebagni - Roma		2020	2023
Italy	BAC - MED	17.01	Bivio d' Aurisina - Villa Opicina - Border IT/SI (Sežana)		2020	2023
Italy	BAC - MED	55.55	Portogruaro - Cervignano - Bivio d' Aurisina		2020	2023
Italy	BAC - MED	16.58	Ronchi dei Legionari Sud - Bivio d'Aurisina		2020	2023
Italy	BAC - MED	29.09	Venezia – Padova (Freight)		2020	2023
Italy	BAC - MED	(108.42)	Vicenza - Portogruaro (diversionary line)	(*)	2020	2023
Italy	MED	14.23	Bivio d' Aurisina - Trieste		2020	2023
Italy	MED	83.40	Verona - Vicenza - Padova		2020	2022
Italy	RALP	75.62	Milano - Tortona		2020	2025
Italy	RALP	(57.89)	Tortona - Genova (Diversionary line)	(*)	2020	2025
Italy	SCM	(42.44)	Border AT/IT (Brennero) - Fortezza	(*)	2020	2023
Italy	SCM	181.44	Fortezza - Verona		2020	2023
Poland	BAC – NSB	32.81	Warszawa - Grodzisk Maz.		2018	2022
Poland	BAC	9.13	Gdynia/Gdańsk - Warszawa	Branch from Gdansk to the port of Gdansk	2018	2022
Romania	OEM – RDN	26.22	Border RO/HU (Curtici) - Arad	Section already equipped with ETCS but not authorised	2018	2023
Romania	OEM - RDN	219.06	Bucureşti - Feteşti - Constanţa	Section already equipped with ETCS but not authorised	2018	2022
Romania	RDN	165.67	Simeria- Sighişoara	Section already equipped with ETCS but not authorised	2018	2025
Romania	RDN	127.10	Sighişoara - Braşov		2021	2026
Romania	RDN	158.54	Arad - Simeria	Arad - Km. 614 section already equipped with ETCS but not authorised	2020	2025
Romania	OEM	3.57	RO/BG Border (Vidin) - Calafat		2018	2028
Slovenia	BAC-MED	74.23	Pragersko - Zidani Most	ETCS authorized but temporary out of use.	2017	2022
Slovenia	BAC-MED	23.76	Divaca - Koper		2017	2025
Spain	ATL	62.94	Cáceres - Mérida		2020	2022



Country	CNC	Length (km)	Line	Comments	EDP target date	New target date
Spain	ATL	167.34	Valladolid – Burgos (High-speed)	The section Valladolid Campo Grande <--> Venta de Baños is in operation (not included in the 167.34 Km). For the rest of the line, its commissioning is expected by 2021.	2020	2022
Spain	MED	103.67	La Encina - Valencia (High-speed)		2020	2022
Spain	MED	10.49	Murcia - Elche - Monforte del Cid	It is just a side of this line (Monforte del Cid <--> Murcia (part 3)). The rest of the line is already operational.	2020	2022
Spain	MED	105.51	Tarragona - Castellbisbal - Barcelona		2020	2022
Spain	MED	212.80	Valencia – Tarragona (high-speed)	The section Vandellos <--> Camp de Tarragona is in operation (not included in the 212.80 Km). For the rest of the line, its commissioning is expected by 2021.	2020	2022
Spain	MED	7.99	Barcelona - Border ES/FR (Figueras) (Barcelona El Prat de Llobregat <--> Barcelona Sants)	According to the ES NIP.	2020	2022
Spain	MED	24.33	La Llagosta - Nudo Mollet - Castellbisbal	According to the ES NIP.	2020	2022
Spain	ATL	94.82	Bergara - Irún (Border ES/FR)	According to the ES NIP.	2019	2023
Spain	ATL	93.37	Vitoria - Bergara/ - Bilbao	According to the ES NIP.	2019	2023
Switzerland	RALP	4.35	Border DE/CH - Basel	This section will be in operation without restrictions by 2021.	2017	2022
Switzerland	RALP	17.44	Sant' Antonino – Vezia (Giubiasco <--> Vezia)		2020	2022

Table 12 Summary of current status sections delayed

(\*) These lines are not included in the CNC in TEN-T but are planned by 2020 in the EDP.

Legend:

Delayed but still by 2023
Delayed beyond 2023
No date

## Annex III State of play of cross border sections

The ERTMS EDP, drafted in 2017<sup>46</sup>, stipulates in Article 2(3) that railway infrastructure managers should, after having consulted the railway undertakings affected, sign an agreement on technical and operational aspects of the deployment for each cross-border section. There should be a common effort in cross-border agreements to avoid bottlenecks at the operations stage. The agreement should be signed no later than one year before the deployment dates for the given cross-border section, and the Member States should notify such agreements to the Commission no later than one month after the conclusion.

According to data gathered until June 2022, seven cross border sections are currently equipped with ETCS (i.e. sections on both sides of the border are equipped with ETCS), 15 cross border sections have ETCS on just one side of the border, and 48 cross-border sections are not equipped with ETCS at all. Of the latter, 20 cross-border sections do have at least one side of the border under construction.

The following figure indicates the ETCS status of the 70 CNC cross border sections:

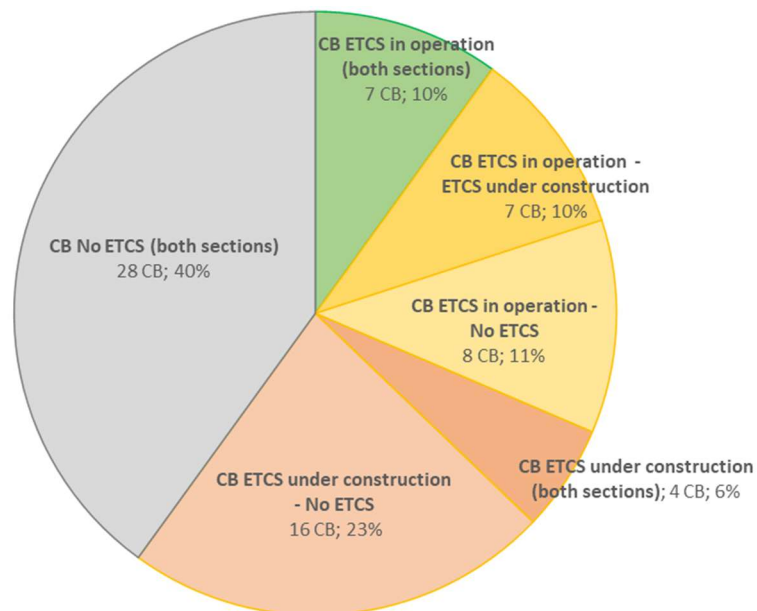


Figure 49 ETCS deployment status in CNC in June 2022

According to the EDP, 23 cross border sections should be equipped with ETCS by 2023<sup>47</sup>.

<sup>46</sup> Commission Implementing Regulation (EU) 2017/6 of 5 January 2017 on the European Rail Traffic Management System European deployment plan.

<sup>47</sup> Cross borders belong to CEF 2 extension are not included in the EDP. Therefore, due to all of them belong to the Core Network, they should be commissioned by 2030 according to TEN-T Guidelines.





Work Plan 2022 of the European Coordinator for ERTMS

Classification category	C-bs to equip by 2023 (ud)	c-bs with ETCS in operation	c-bs with ETCS in operation status (%)	Classification category	C-bs to equip by 2030 (ud)	C-bs with ETCS in operation	C-bs with ETCS in operation (%)
TOTAL	23	7	30	TOTAL	70	7	10

Table 13 Summary CB expected by 2023 and 2030

49 cross-border agreements are expected by 2030; 21 of them are expected by 2023, according to the EDP. Currently, seven cross-border agreements have been received: 2 of them belong to the 21 cross border agreements expected by 2023, 1 of them belong to cross border agreements expected beyond 2023, and 4 of them were not expected because at least one of their border sections were equipped with ETCS when the EDP was published, have 2017 as EDP deadline or, in case of cross-border sections added to CNC by CEF2 extension, at least one of their border sections was equipped with ETCS in 2021 when the CEF2 extension was published.

	CB agreements not covered by Article 2 (3) EDP	CB agreements are expected by 2023	CB agreements expected beyond 2023
CB agreements expected according to EDP	21 cross-border agreements	21 cross-border agreements	28 cross-border agreements
CB agreements received	Four cross-border agreements: <ul style="list-style-type: none"> <li>• Hodos (HU/SI)</li> <li>• Karlsruhe – Basel (DE/CH)</li> <li>• Raron – Domodossola (IT/CH)</li> <li>• Chiasso (IT/CH)</li> </ul>	Two cross-border agreements: <ul style="list-style-type: none"> <li>• Budapest – Curtici (HU/RO)</li> <li>• Malmo – Kopenhagen (DE/SE)</li> </ul>	One cross-border agreement: <ul style="list-style-type: none"> <li>• Oslo – Goteborg (NO/SE)</li> </ul>
% of CB agreement received	Percentage is not relevant because these agreements are not expected	10 %	4 %

Table 14 Summary CB agreements expected by 2023 and beyond 2023



## Annex IV ERTMS governance

### ERA

The European Union agency for railways (ERA) is the system authority for ERTMS, ensuring the specifications are maintained and managed in accordance with the requirements of stability and compatibility and helping the implementation of the system.

Since the 2016 Interoperability Directive, ERA has additional roles for ERTMS to system authority which are:

- **Delivering vehicle authorizations.** ERA is the authorising entity of any new or modified international vehicle. This includes vehicles equipped with ERTMS or retrofit projects where ERTMS is equipped in already existing vehicles. For vehicles that operate within a single Member State, the applicant for the authorisation may choose between the national safety authority and ERA as authorising entities.
- **Approvals of the ERTMS trackside projects.** ERA checks that the technical solutions envisaged in ERTMS trackside projects are interoperable to ensure the harmonised implementation of ERTMS and interoperability at Union level. This approval is part of the application file that infrastructure managers need to provide to the national safety authorities to authorise the ERTMS subsystem installed in their networks.

In railway communications, the Agency defines the roadmap for the evolution of the operational rail radio system given the expected end of GSM-R life expectancy. 2022 CCS TSI will contain the specifications to achieve a future radio mobile communications system compatible with ETCS.

The Agency is also in charge of preventing additional national requirements in relation to the ERTMS from jeopardising its interoperability. Stakeholders can request ERA advice to solve specific challenges regarding technical compatibility in ongoing ERTMS projects. In addition, the Agency has a role in helping stakeholders implement projects and render them compliant with CCS TSI.

Furthermore, the Agency chairs an ERTMS group of notified conformity assessment bodies that checks the consistency of application of the procedure for assessing the conformity or suitability for use of an interoperability constituent and of the 'EC' procedures for verification ERTMS subsystem. ERA also supports accreditation bodies by giving appropriate guidelines and supporting the harmonised accreditation of ERTMS laboratories.

ESC and RSC checks demonstrate the technical compatibility between the on-board and trackside CCS Subsystems. These checks are only necessary to increase confidence in the CCS subsystems' technical compatibility. ERA assesses the differing types of ESC and RSC and analyses the potential for reducing the underlying technical divergences of ESC and RSC types.



## EU-Rail

Europe's Rail Joint Undertaking (EU-Rail) is the new European partnership on rail research and innovation and the universal successor of the Shift2Rail Joint Undertaking.

Europe's Rail Joint Undertaking is responsible for the next iteration of ERTMS systems. The Governance and bodies of EU-Rail as defined in the single basic act are:

- (a) the Governing Board takes the overall direction of the activities of the Joint Undertaking, transparently monitoring the progress of the master plan implementation.
- (b) the Executive Director
- (c) the states' representatives group, including representatives of all Member States
- (d) the System Pillar steering group as an advisory body of Europe's Rail Joint Undertaking in charge of providing advice on System Pillar issues.
- (e) the Deployment Group, which advises the Governing Board on the market uptake of rail innovation

A central task of the System Pillar is to coordinate and deliver the needed inputs to CCS TSI and harmonised standards.

## European Commission

European Commission sets out the policies for the ERTMS system, including requesting to the Agency the updates of the technical specifications of interoperability and setting the priorities in the CEF funded calls. The Commission supports the deployment of ERTMS through the ERTMS Deployment Management Team.

## European Coordinator for ERTMS

The European Coordinator for ERTMS is designated by the European Commission to facilitate the coordinated implementation of ERTMS, with a special focus on the core network corridors. The responsibilities include drawing a work plan collaborating with the Member States, and monitoring the EDP. The Coordinator reports to the Parliament, and the Council on the development or difficulties encountered to find appropriate solutions.

## Bodies issuing ERTMS vehicle and trackside authorisations

Any new or modified railway vehicle must be authorised to operate on the EU railway network. An authorisation is granted for a vehicle and/or vehicle type (vehicle type authorisation) or for individual vehicles that conform to an already authorised vehicle type (vehicle authorisation for placing on the market). For international vehicles, the authorising entity is ERA, while for national vehicles, the applicant can choose between ERA and the NSA.

A short description of the vehicle authorisation process is drafted in the flowchart, including the stakeholders involved in each stage.

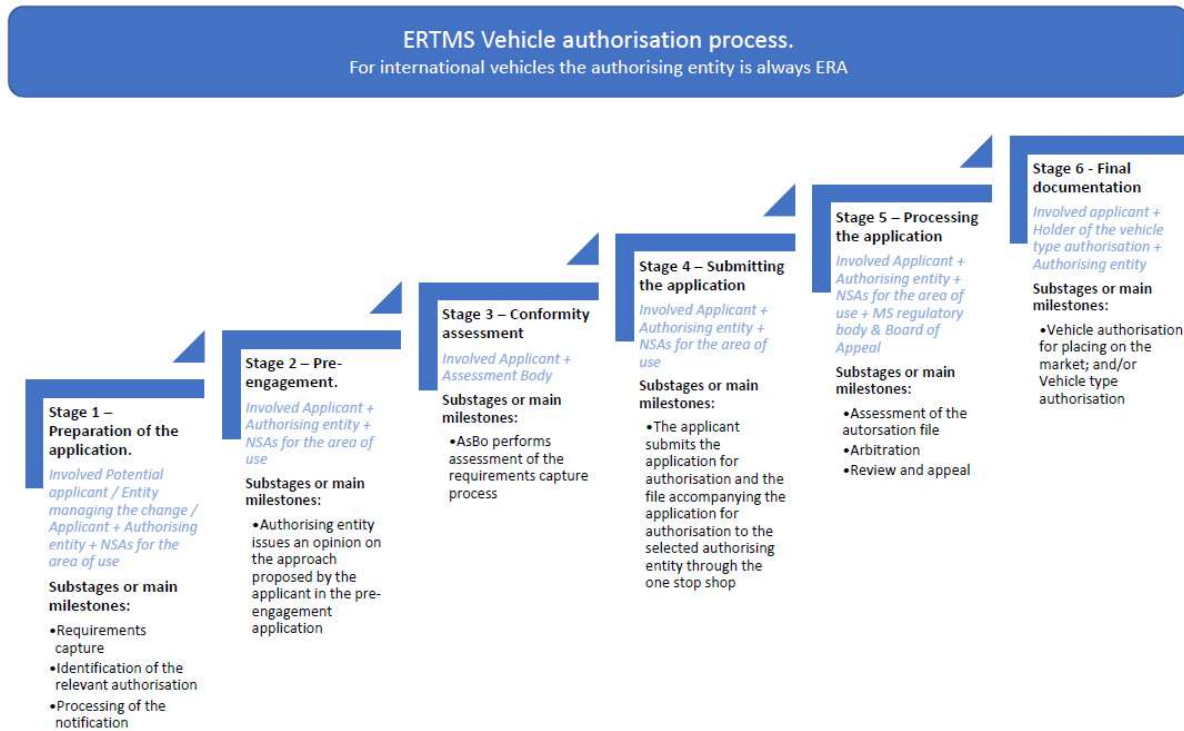


Figure 50 ERTMS vehicle authorisation process

Each national safety authority (NSA) authorises the placing in service of the trackside control-command and signalling subsystems located or operated in the territory of its Member State. For this, they must provide detailed guidance on obtaining the authorisations.

ERA conducts the ERTMS trackside approval to ensure a harmonised implementation of ERTMS and interoperability at Union level. The ERTMS trackside approval is part of the application file for authorisation for placing in service trackside control-command and signalling subsystems involving the ETCS and/or the GSM-R equipment.

A short description of the trackside authorisation process is drafted in the flowchart, including the ERA trackside approval and the stakeholders involved in each stage.

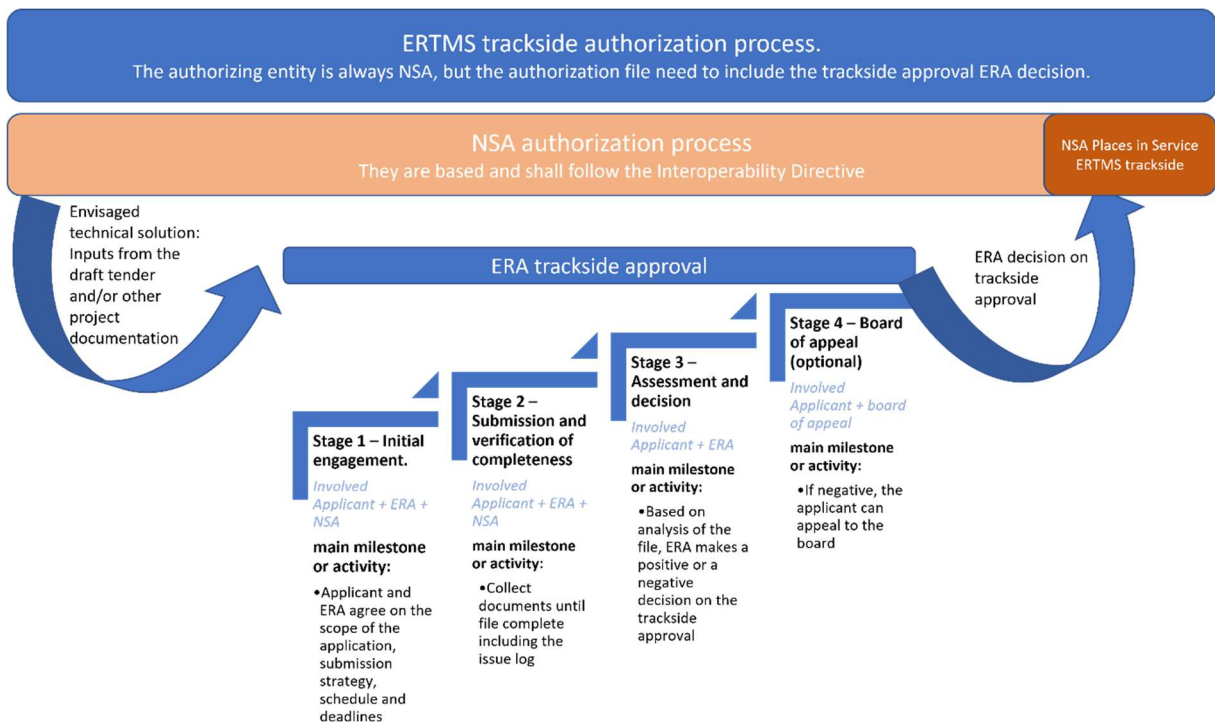


Figure 51 ERTMS trackside authorisation process

## Annex V EU requirements for ERTMS deployment

Requirements and technical specifications related to ERTMS were introduced progressively since the beginning of 2000 and have been amended over time.

Since they are not comparable, Trackside and on-board requirements should be analysed separately. There are deployment obligations for all the high-speed lines and the sections part of the TEN-T network. In contrast, there are different types of obligations for on-board deployment according to the status of the vehicle (new, upgrade, area of use).

### Trackside

The TEN-T Guidelines set a deadline for the ERTMS deployment on the Core Network by 2030 and the Comprehensive Network by 2050. Based on the TEN-T Guidelines, the ERTMS European Deployment Plan (EDP) sets deadlines for deploying ERTMS on some sections of the Core Network Corridors (CNC) covering the 2017-2023 period.

Furthermore, ERTMS trackside deployment is also based on the CCS TSI (Regulation 2016/919/EC), establishing obligations for fitting ETCS and GSM-R. In the case of ETCS, two main obligations are presented in the following figure.

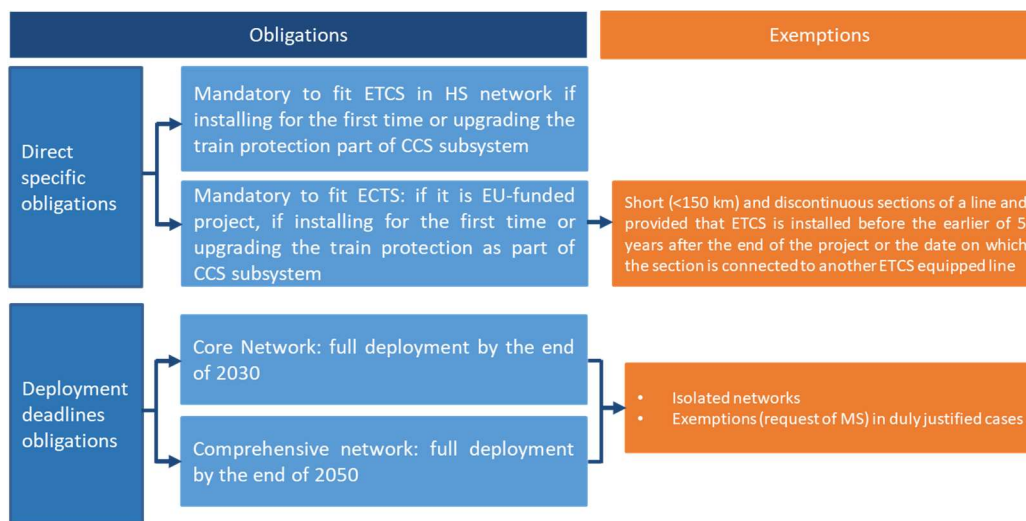


Figure 52 Trackside ETCS – EU obligations and exceptions

As shown in Figure 52, the TEN-T Guidelines set out that the Core Network should be fully equipped by 2030,<sup>48</sup> with some sections exempted<sup>49</sup>. The Core Network, i.e. 62 863 km without sections exempted, represents 55% of the TEN-T Network<sup>50</sup>. The remaining TEN-T Network, i.e. 51 095 km without considering exemptions, should be equipped by 2050.

<sup>48</sup> Regulation (EU) No 1315/2013, article 38, 3. “Member States shall take the appropriate measures for the core network to be developed in order to comply with the provisions of this Chapter by 31 December 2030.”

<sup>49</sup> Regulation (EU) No 1315/2013, article 39, 2a). “Isolated networks are exempt from requirements (i) to (iii). [(iii) full deployment of ERTMS]”.

<sup>50</sup> EU 27 + NO + CH

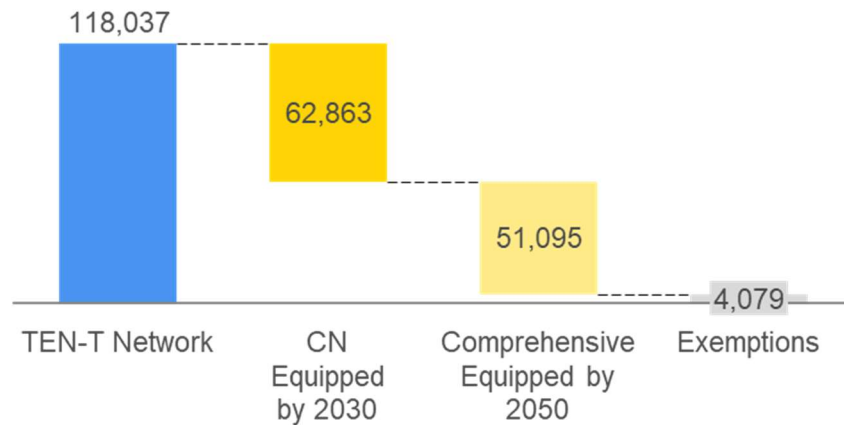


Figure 53 According to EU legal obligations, expected ERTMS trackside deployment in line-km<sup>51</sup>

## On-board

The first obligations to fit new vehicles date back to the 2006 Commission Decision on CCS TSI for the **high-speed rail** system<sup>52</sup>.

Regarding the **conventional rail** system, the first obligations date back to the 2009 Commission Decision on CCS TSI for conventional rail<sup>53</sup>.

Afterwards, the Commission Decision on CCS TSI of the trans-European rail system<sup>54</sup> unified the technical specification for high-speed and conventional rail systems in 2012.

<sup>51</sup> Countries considered: EU 27, UK, NO and CH.

<sup>52</sup> Commission Decision 2006/860/EC of 7 November 2006 concerning a technical specification for interoperability relating to the control-command and signalling subsystem of the trans-European high-speed rail system and modifying Annex A to Decision 2006/679/EC concerning the technical specification for interoperability relating to the control-command and signalling subsystem of the trans-European conventional rail system, §7.2.2. *“It is mandatory to fit an ETCS on-board assembly when:*  
— *any new train protection part of a CCS on-board assembly is installed, or*  
— *any existing train protection part of a CCS on-board assembly is upgraded, where this would change the functions, performances and/or interoperability-relevant interfaces of the existing legacy system (as referred to in annex B of this TSI). This excludes those modifications that might be deemed necessary to mitigate safety related defects in the legacy system;”*

<sup>54</sup> Commission Decision 2012/88/EU of 25 January 2012 on the technical specification for interoperability relating to the control-command and signalling subsystems of the trans-European rail system, §7.3.3. *“New locomotives, new railcars and other new railway vehicles able to run without traction equipped with a driving cab, ordered after 1 January 2012 or put into service after 1 January 2015, shall be equipped with ERTMS. This requirement does not apply to new shunting locomotives or to other new locomotives, new railcars and other new railway vehicles equipped with a driving cab, if they are designed exclusively for national service or regional border crossing service. Member States may however introduce additional requirements at national level, in particular with a view to:*

- 1. allowing only ERTMS equipped locomotives to access ERTMS-equipped lines, so that existing national systems can be decommissioned;*
- 2. requesting that new shunting locomotives and/or other new railway vehicles equipped with a driving cab, even if designed exclusively for national service or regional border crossing service, be equipped with ERTMS.”*





The latest version of CCS Technical Specifications for Interoperability<sup>55</sup> establishes three types of obligations for ERTMS fitment:

- For new vehicles, all new vehicles should be equipped with ERTMS.
- For upgrades: it states that it is only mandatory for high-speed vehicles.
- For extension of the area of use: it states that it is mandatory for all vehicles that are not already equipped.

However, the CCS TSI also includes several exceptions for on-board ERTMS deployment<sup>56</sup>, and the Member States may decide to be exempt from the obligation to equip<sup>57</sup>.

Similar exclusions apply to extensions of the area of use for existing vehicles: if a new vehicle benefitted from an exemption thanks to its area of use, and is then used in an area, which would have made it ineligible for an exemption, then the vehicle should be equipped with ERTMS.

On-board obligations and exceptions are summarised in the following figure.

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<sup>55</sup> 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, amended by Commission Implementing Regulation (EU) 2019/776 of 16 May 2019, and by Commission Implementing Regulation (EU) 2020/387 of 9 March 2020.

<sup>56</sup> Commission Regulation (EU) 2016/919, §7.4.2.1 (2). *"The requirement to be equipped with ETCS does not apply to:*

*(1) new mobile railway infrastructure construction and maintenance equipment;*

*(2) new shunting locomotives;*

*(3) other new vehicles not intended for operating on high-speed lines;*

*(a) if they are intended exclusively for national service operated outside the corridors defined in point Annex I of Implementing Regulation (EU) 2017/6 and outside the lines ensuring the connections to the main European ports, marshalling yards, freight terminals and freight transport areas defined in Article 2(1) of Implementing Regulation (EU) 2017/6; or*

*(b) if they are intended for off-TEN cross-border service, i.e., service until the first station in the neighbouring country or to the first station where there are connections further in the neighbouring country utilising only lines outside of the TEN."*

<sup>57</sup> Commission Regulation (EU) 2016/919, §7.4.3 (2). *"Member States may decide to exclude from the obligation set out in the first paragraph of point 7.4.2.1 all new vehicles intended exclusively for national service except when the area of use of those vehicles includes more than 150 km of a section currently equipped or to be equipped with ERTMS within 5 years after the authorisation for placing in service of those vehicles. Member States shall publish their decision for implementing this provision, notify such decision to the Commission and include it in the National Implementation Plan referred to in point 7.4.4."*



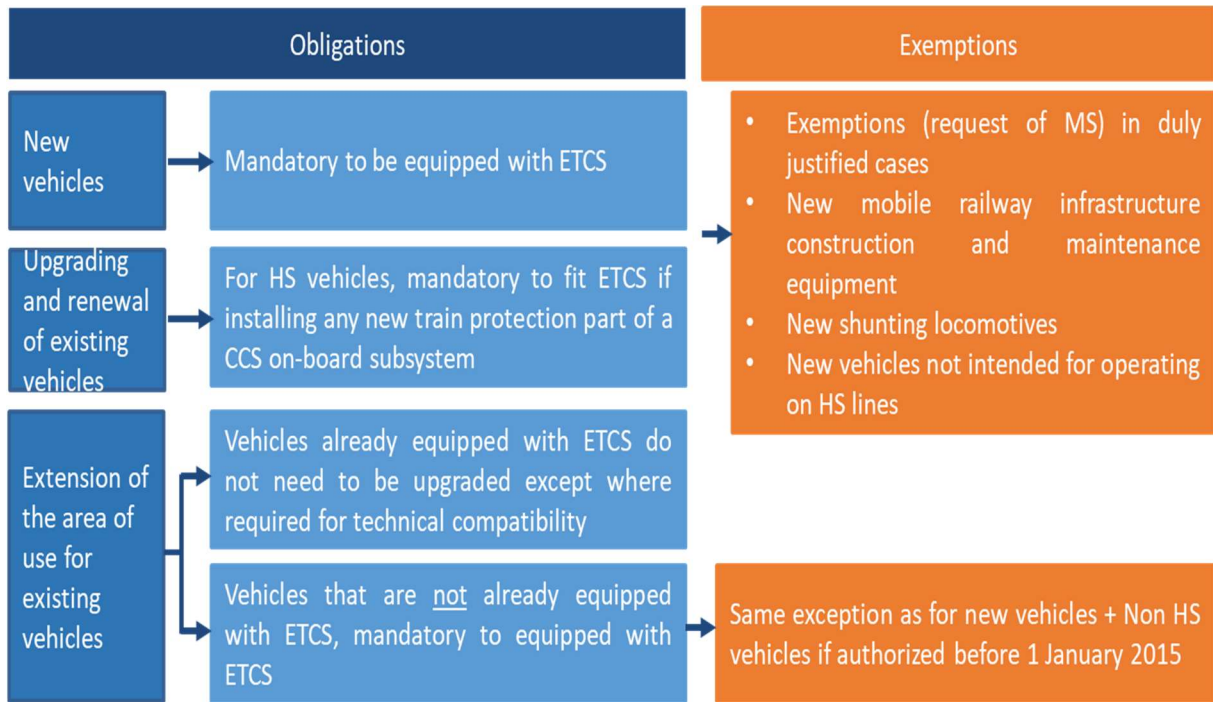


Figure 54 On-board ETCS – EU obligations and exceptions

Even though the current EU legal framework seeks to reinforce on-board deployment, it also includes several exemptions that slow the progress to achieving full equipment of the EU fleet.

Regarding the GSM-R, the latest version of CCS TSI establishes the obligations presented in the following figure.

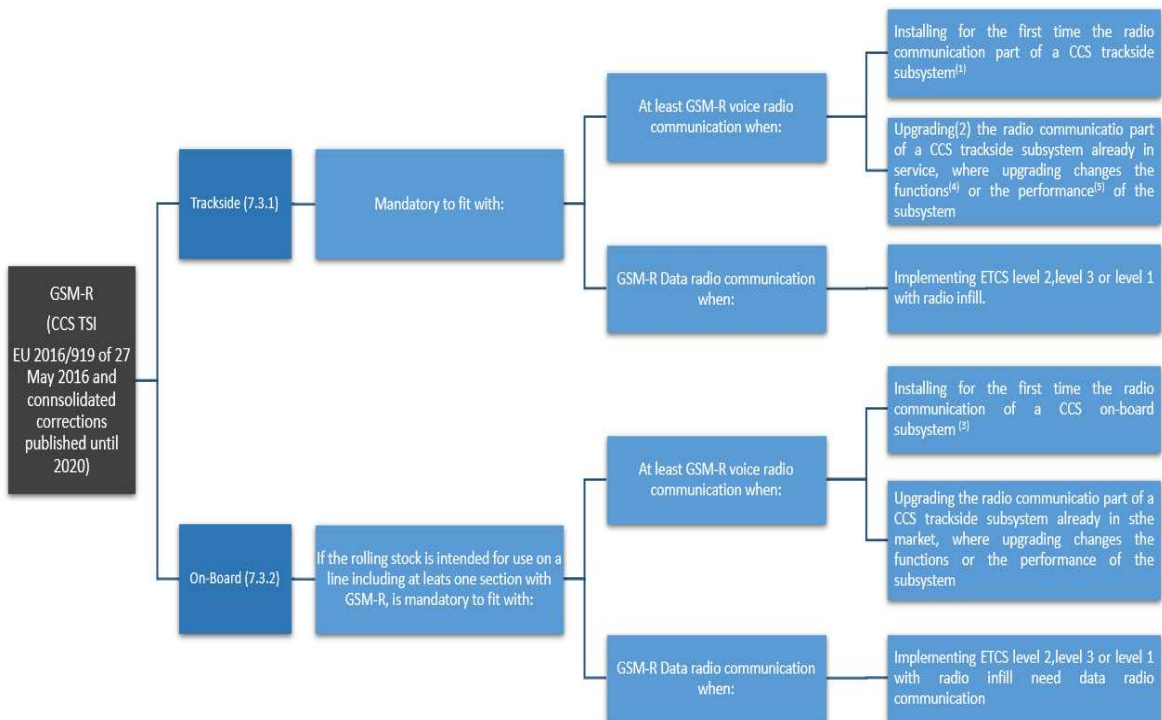


Figure 55 Trackside and on-board GSM-R – EU obligations



## Work Plan 2022 of the European Coordinator for ERTMS

- (1) *Note: Only in case of installing for the first time the radio communication part of a CCS trackside subsystem, which excludes installing for the first time the train protection or the train detection part of the CCS trackside subsystem or other subsystems than the CCS trackside subsystems. Being the definition of trackside CCS according to the Directive 2016/797 as follow: “All the trackside equipment required to ensure safety and to command and control movements of trains authorised to travel on the network.”*
- (2) *“All the on-board equipment required to ensure safety and to command and control movements of trains authorised to travel on the network”*
- (3) *‘Upgrading’ means any major modification work on a subsystem or part of it which results in a change in the technical file accompanying the ‘EC’ declaration of verification, if that technical file exists, and which improves the overall performance of the subsystem. (Article 2 Directive 2016/797*
- (4) *Note: Only in case of installing for the first time the radio communication part of a CCS on-board subsystem, which excludes installing for the first time the train protection of the CCS on-board subsystem or other subsystems than the CCS on-board subsystems*



## Annex VI Evolution of ERTMS

In the 1980 first discussions took place between European railways on a harmonised approach to train management systems in Europe. Research projects were launched by the European Communities and implemented by stakeholders. The 1996 EC Directive on interoperability for high-speed rail<sup>58</sup> introduced an interoperable control and command system and signalling and defined the characteristics of ERTMS, albeit limited to high-speed rail.

At the end of 1990, a group of infrastructure managers with common interests (ERTMS Users' Group) created the initial version of ERTMS as we know it to demonstrate the feasibility of railway interoperability. At the outset, the ERTMS User Group (EUG) consisted only of experts from infrastructure managers. Still, they quickly detected the need to involve the signalling suppliers in finalising the ERTMS technical specifications. The organisation of signalling companies, i.e. UNISIG, produced the first ERTMS technical specifications in 2000.

In 2002, the European Commission included the ERTMS specifications in the control command and signalling technical specifications for interoperability of the trans-European high-speed rail system<sup>59</sup>. Afterwards, in 2006 the first control command and signalling technical specifications for interoperability of the trans-European conventional rail system<sup>60</sup> were issued by the European Commission. Only in 2012 the command and signalling technical specifications for interoperability<sup>61</sup> were merged, covering both the high-speed and conventional railways.

In 2005, the sector produced the first ERTMS Memorandum of Understanding (MoU) focused on deployment strategies. To facilitate the implementation of that MoU, also in 2005, the European Commission appointed Karel Vinck as the first European Coordinator for ERTMS.

Three other MoUs have followed that first MoU, addressing the main challenges at the given stage. The last MoU adopted in 2016 established a framework providing legal and technical certainty for a train equipped with the latest ERTMS release to run on any compatible line equipped with ERTMS.

Throughout these years of ERTMS development, the technical specifications have included two different Baselines, i.e. two stable kernels of system functionality, performance and other non-functional characteristics. The first reference version of the system was Baseline 2. In 2015 the revised CCS TSI<sup>62</sup> included additional functions to the system kernel referred to as Baseline 3 maintenance

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<sup>58</sup> Council Directive 96/48/EC of 23 July 1996 on the interoperability of the trans-European high-speed rail system

<sup>59</sup> Commission Decision 2002/731/EC of 30 May 2002 concerning the technical specification for interoperability relating to the control-command and signalling subsystem of the trans-European high-speed rail system referred to in Article 6(1) of Council Directive 96/48/EC

<sup>60</sup> Commission Decision 2006/679/EC of 28 March 2006 concerning the technical specification for interoperability relating to the control-command and signalling subsystem of the trans-European conventional rail system

<sup>61</sup> Commission Decision 2012/88/EU of 25 January 2012 on the technical specification for interoperability relating to the control-command and signalling subsystems of the trans-European rail system

<sup>62</sup> Commission Decision (EU) 2015/14 of 5 January 2015 amending Decision 2012/88/EU on the technical specification for interoperability relating to the control-command and signalling subsystems of the trans-European rail system



release 1. Then, in 2016 Baseline 3 release 2 was issued with the inclusion of GPRS in the GSM-R specification<sup>63</sup>.

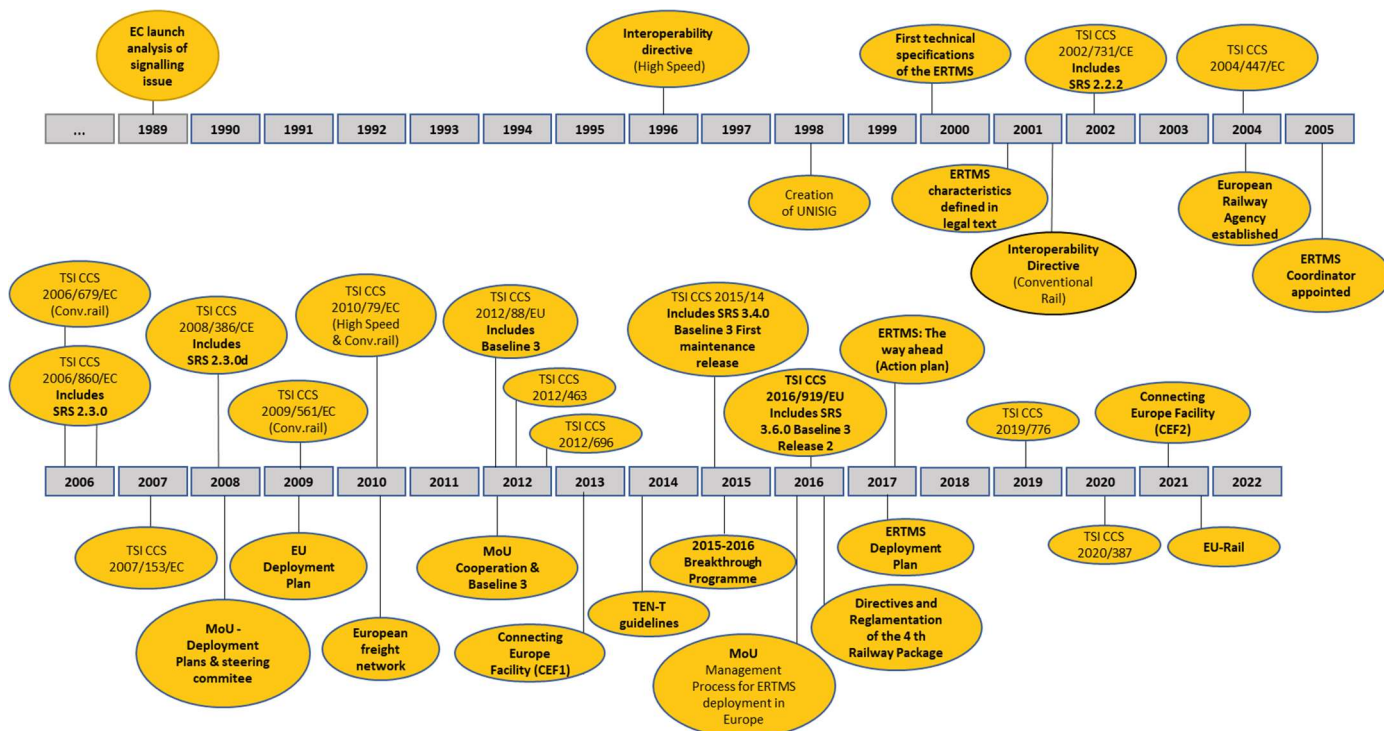


Figure 56 ERTMS milestone timeline

In 2017, two relevant documents were published. Firstly, the ERTMS European Deployment Plan (EDP)<sup>64</sup> laid down target dates until 2023; about 30-40% of the Core Network Corridors should be equipped. Secondly, the ERTMS: The way ahead<sup>65</sup>, the action plan that sets out the steps beyond the legislative framework to address challenges to interoperable deployment.

A significant step toward achieving an interoperable rail system based on ERTMS was the Fourth Railway Package, adopted in 2016<sup>66</sup>. The technical pillar of the Fourth Railway Package provides for important changes concerning ERTMS. It enhances the role of the European Union Agency for Railways (ERA) as the ERTMS system authority. The set of measures introduced by the Fourth Railway Package and the 2019 revision to the CCS TSI<sup>67</sup> enables more efficient authorisation processes. It leads to

<sup>63</sup> 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

<sup>64</sup> Commission Implementing Regulation (EU) 2017/6 of 5 January 2017 on the European Rail Traffic Management System European deployment plan

<sup>65</sup> Commission Staff Working Document (2017) – Delivering an effective and interoperable European Rail Traffic Management System (ERTMS) – the way ahead

<sup>66</sup> The ‘technical pillar’ includes: Regulation (EU) 2016/796 of the European Parliament and of the Council of 11 May 2016 on the European Union Agency for Railways and repealing Regulation (EC) No 881/2004; Directive (EU) 2016/797 of the European Parliament and of The Council of 11 May 2016 on the interoperability of the rail system within the European Union; Directive (EU) 2016/798 of the European Parliament and of The Council of 11 May 2016 on railway safety

<sup>67</sup> Commission Implementing Regulation (EU) 2019/776 of 16 May 2019 amending Commission Regulations (EU) No 321/2013, (EU) No 1299/2014, (EU) No 1301/2014, (EU) No 1302/2014, (EU) No 1303/2014 and (EU) 2016/919 and Commission Implementing Decision 2011/665/EU as regards the alignment with Directive (EU) 2016/797 of the



enhanced interoperability and compatibility between on-board and trackside subsystems. Based on the Fourth Railway Package, ERA has issued vehicle authorisations and safety certificates in the European Union and pre-authorising ERTMS trackside equipment since 2019.

In 2020, the rules for extending the area of use for existing vehicles were amended in the CCS TSI<sup>68</sup>.

In 2021, the Connecting Europe Facility (CEF 2<sup>69</sup>) extended the Core Network Corridors defined in the Connecting Europe Facility (CEF 1<sup>70</sup>) in 2013.

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European Parliament and of the Council and the implementation of specific objectives set out in Commission Delegated Decision (EU) 2017/1474

<sup>68</sup> Commission Implementing Regulation (EU) 2020/387 of 9 March 2020 amending Regulations (EU) No 321/2013, (EU) No 1302/2014 and (EU) 2016/919 as regards the extension of the area of use and transition phases

<sup>69</sup> Regulation (EU) 2021/1153 of the European Parliament and of The Council of 7 July 2021 establishing the Connecting Europe Facility and repealing Regulations (EU) No 1316/2013 and (EU) No 283/2014

<sup>70</sup> Regulation (EU) No 1316/2013 of the European Parliament and of The Council of 11 December 2013 establishing the Connecting Europe Facility, amending Regulation (EU) No 913/2010 and repealing Regulations (EC) No 680/2007 and (EC) No 67/2010



## Annex VII CEF supported ERTMS Actions' portfolio managed by CINEA

In the period 2014-2020, the following areas of intervention were the three principal ERTMS priorities receiving CEF support:

1. ERTMS **trackside** deployment, including:
  - a. **First deployment**, i.e. first installation of ERTMS on a railway line already in operation.
  - b. **Upgrade**, i.e. equipment of the legally binding baseline on a railway line already in operation and equipped with ERTMS compliant with a previous baseline.
  - c. **Preparatory actions**, i.e. activities preparing ERTMS deployment. The outcome of preparatory actions is a basis for launching a tendering procedure for ERTMS works.
2. ERTMS **on-board** deployment, including:
  - a. **Retrofit**: i.e. first installation of ERTMS on existing vehicles, including prototypes and serial retrofit.
  - b. **Upgrade**: i.e. installation of ERTMS Baseline 3 on existing vehicles equipped with pre-Baseline 3, including prototypes and serial upgrade.
  - c. **Fitment**: installation of the ERTMS on new vehicles at the time of their manufacturing.
  - d. **Training activities**: i.e. specific ad-hoc expertise to assist small and medium-sized enterprises (SME) beneficiaries.
3. **Memorandum of Understanding (MoU)**: activities contributing to the fulfilment of MoUs signed between the European Commission and the railway sector. Related activities covered in particular test campaigns (both in the field and in laboratories), assistance to ERA regarding the development and maintenance of ERTMS specifications. MoU actions were only eligible under the 2014 dedicated ERTMS call.

Overall, 93 grant agreements aimed at CEF support to ERTMS-related actions have been signed under the general and cohesion CEF envelopes until present, including:

- **75 actions** under the dedicated ERTMS calls. These calls aimed predominantly at the ERTMS deployment and covered additional necessary works, notably interlockings' modernisation. The initial CEF support for ERTMS deployment only within these actions amounted to EUR **1.13 billion** out of the total EUR 1.45 billion (including other necessary works like interlockings). Within this portfolio, there is a group of 18 actions retained under blending calls with the support of EUR 176.1 million. These calls cover the particular involvement of financial institutions in ensuring the budget to implement the Actions.
- **18 actions** under the general Core Network Corridors (CNC) calls. These calls addressed railway infrastructure works predominantly but covered, among others, the deployment of ERTMS through so-called "combined" actions encompassing both modernisations of rail infrastructure and the ERTMS deployment. The initial CEF support for the ERTMS deployment only within these actions amounted to EUR **121.6 million** out of the total EUR 3.7 billion.

By the 4<sup>th</sup> quarter of 2021, the actual portfolio of CEF supported actions with ERTMS component stands at 74 ERTMS-related actions (both ongoing and successfully closed), including:

- **64 actions** under dedicated ERTMS calls with EUR **797.8 million** for ERTMS deployment only out of the total CEF support amounting to EUR 1021.2 million.





- **10 “combined” actions** under the CNC calls with EUR **44.0 million** for ERTMS deployment only out of the total CEF funding of EUR 1.5 billion.

The decrease in the number of respective actions and related CEF funding is due to the termination or modification of the signed grant agreements, resulting in the cancellation or reduction of the CEF support for ERTMS activities.

The actions contribute predominantly to the ERTMS deployment and cover the following activities: i) trackside or on-board ERTMS installation and ii) Memorandum of Understanding (MoU) tasks.

Figure 57 shows that 36 actions contribute to trackside deployment (including studies), 36 actions to on-board deployment and two actions to MoU. The bulk of CEF funding, EUR 508.4 million (60%), is allocated to trackside, while the funding for on-board amounts to EUR 327.6 million (39%). Activities related to MoU received EUR 5.7 million (1%) from CEF.

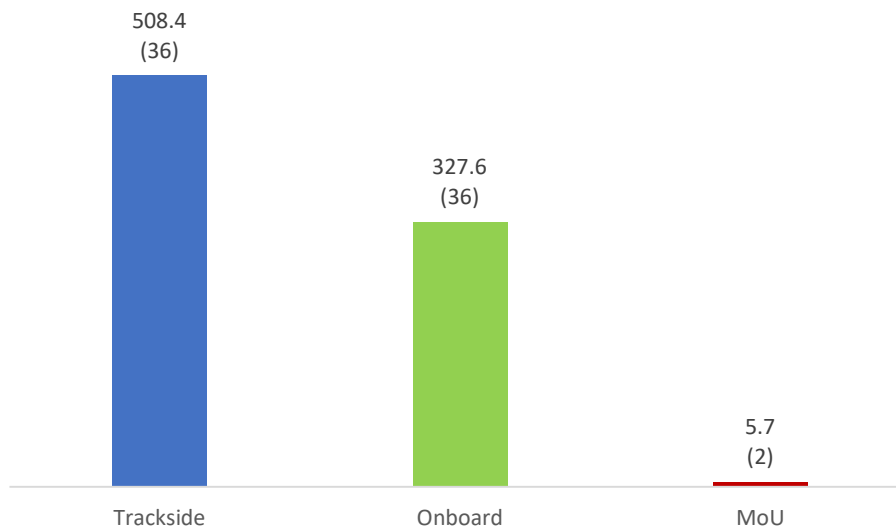


Figure 57 Actual CEF funding for ERTMS Actions per component, EUR million (number of actions)

As far as the **trackside** is concerned, the 36 actions help deploy ERTMS on a total of **5861 km** of double-track lines equivalent, with the following breakdown between the first deployment and upgrade:

1. First deployment along lines (4976 km, 85%)
2. Upgrade of already equipped lines (885 km, 15%)

As far as the **on-board** component is concerned, the 36 actions contribute to the deployment of ERTMS on a total of **2874 vehicles**, classified as follows:

1. (serial) retrofit (1565, i.e. 55%)
2. upgrade (637, i.e. 22%)
3. fitment (526, i.e. 18%)
4. prototype (146, i.e. 5%, both for retrofit and upgrade).

Figure 58 shows the actual distribution of CEF grants at the Member State level. A difference between the involved Member States regarding the strategy of benefiting from the CEF fund for ERTMS can be





noted. Whereas Bulgaria, Greece, Poland and Slovenia concentrate on trackside deployment, Luxembourg, the Netherlands and Slovakia focus on on-board deployment. At the same time, other Member States adopted a more balanced approach. Considerable parts of MoU activities are implemented within multi-beneficiary actions gathering stakeholders from the different Member States.

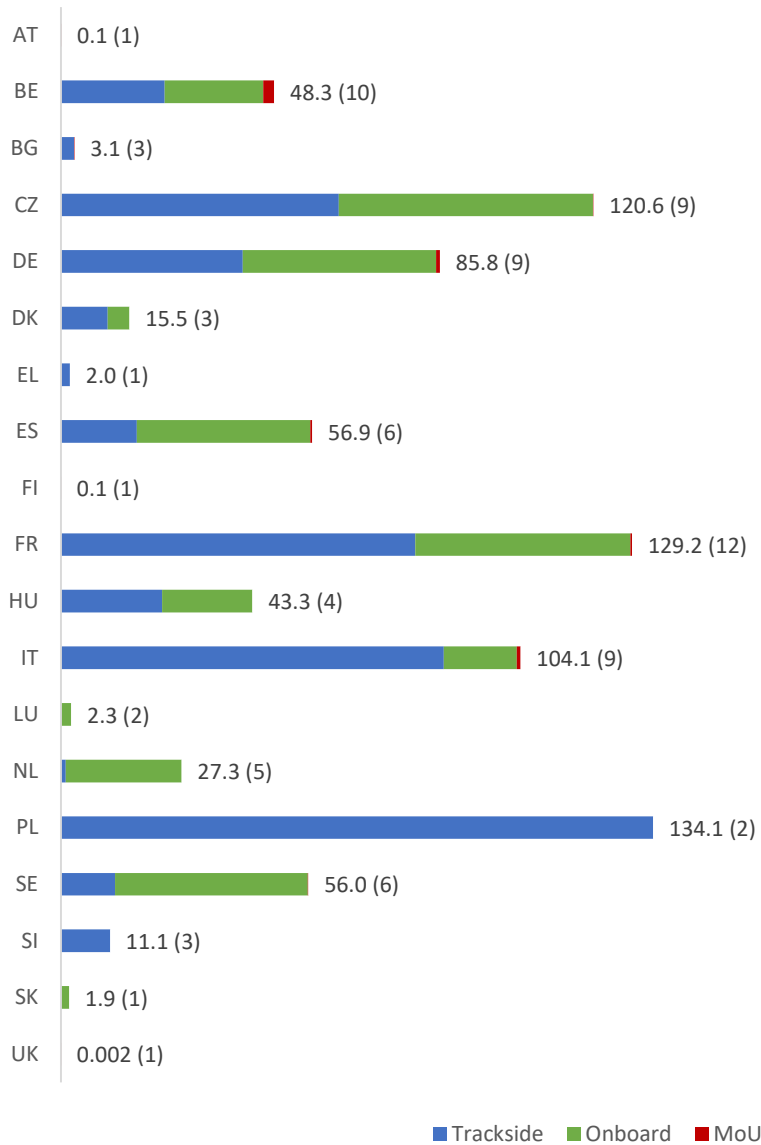


Figure 58 Actual CEF ERTMS funding per Member State and component, EUR million (number of actions)

Figure 59 shows the Member States with ERTMS CEF actions distinguishing between trackside and on-board actions.



Figure 59 Member States with ERTMS CEF actions



## Annex VIII Examples of national schemes addressing the challenge of retrofitting

### Norway

Norway decided to implement ERTMS Level 2 on its national railway network with a view to implementing the new signalling system on the entire railway network by 2034. Taking into consideration the available resources, the deployment will be done gradually. By the end of 2022, the Nordlandsbanen north, from Grong to Bodø and the northern part of the Gjøvik line, from Roa to Gjøvik, will have ERTMS deployed. Four years later, in 2026, the new signalling system will be used in Oslo S. By 2034, all line sections will use the new signalling system.

#### **Key facts**

Type of support	National grant
Time period	2014-2023
Total grant	EUR 750 million (NOK 6 billion) <sup>71</sup>
Aid design	Maximum 50% of the eligible costs, with a maximum of: NOK 5 million (EUR 502.720) per first of class installation; NOK 2 million (EUR 201.088) per serial installation

The total cost of the deployment of ERTMS is estimated to be between EUR 1.7 and EUR 2.2 billion, of which the Norwegian government approved NOK 6 billion (EUR 750 million) for the period 2014-2023 in the national transportation plan. The aid scheme supports 50% of eligible costs up to a maximum of NOK 5 million (EUR 502.720) per first in class installation and NOK 2 million (EUR 201.088) per serial installation. The aid under the scheme cannot be combined with other forms of state aid if it would result in rail vehicle owners receiving a higher level of aid than 50% of the eligible costs.<sup>72</sup>

#### **Description of the framework**

Implementing ERTMS would require the retrofitting of around 550 vehicles of approximately 56 different types. All vehicles will also be provided with Specific Transmission Module (STM) units. However, since railway interoperability already exists between Norway and Sweden, Norway's implementation of ERTMS will be synchronized with the Swedish one.

Norway has decided to assist railway undertakings (RU) in the project with a Financial Aid Scheme (FAS) for which the Norwegian Railway Directorate is responsible and which is funded on the basis of the Parliaments' annual budget decisions. The Railway Directorate has delegated the management and

<sup>71</sup> Rate of exchange used: reference date 13/12/2018 1 EUR = 9.94588 NOK

<sup>72</sup> Financial Aid Scheme for ERTMS Onboard Implementation – Jernbanedirektoratet approved as State aid by the EFTA Surveillance Authority with Decision 2016/C 357/09 [https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:E2016C0929\(01\)&from=LV](https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:E2016C0929(01)&from=LV)



administration to Bane NOR, which leads the procurement and coordinates the implementation of ERTMS onboard.

Bane NOR has entered into an on-board agreement with a single provider of ERTMS on-board equipment selected based on an open tender procedure. The generic application is a system version that fulfils the Bane NOR requirements and can be adapted to different vehicle types. This leads to economic efficiencies and enables the deployment of ERTMS. Currently, the contract covers retrofitting of 274 trains worth NOK 665 million (EUR 66 million). Bane NOR has entered into “Cooperation Agreements” with each participating rolling stock owner (RSO) (currently, 14 RSOs are involved)<sup>73</sup> to regulate roles and responsibilities and the intention to execute a joint acquisition led by Bane NOR. The RSOs remain responsible for purchasing the necessary Specific Applications to retrofit their fleet within the foreseen schedule. Therefore, each RSO needs to sign a separate “Specific Onboard contract” contract with Alstom to cover their specific scope.

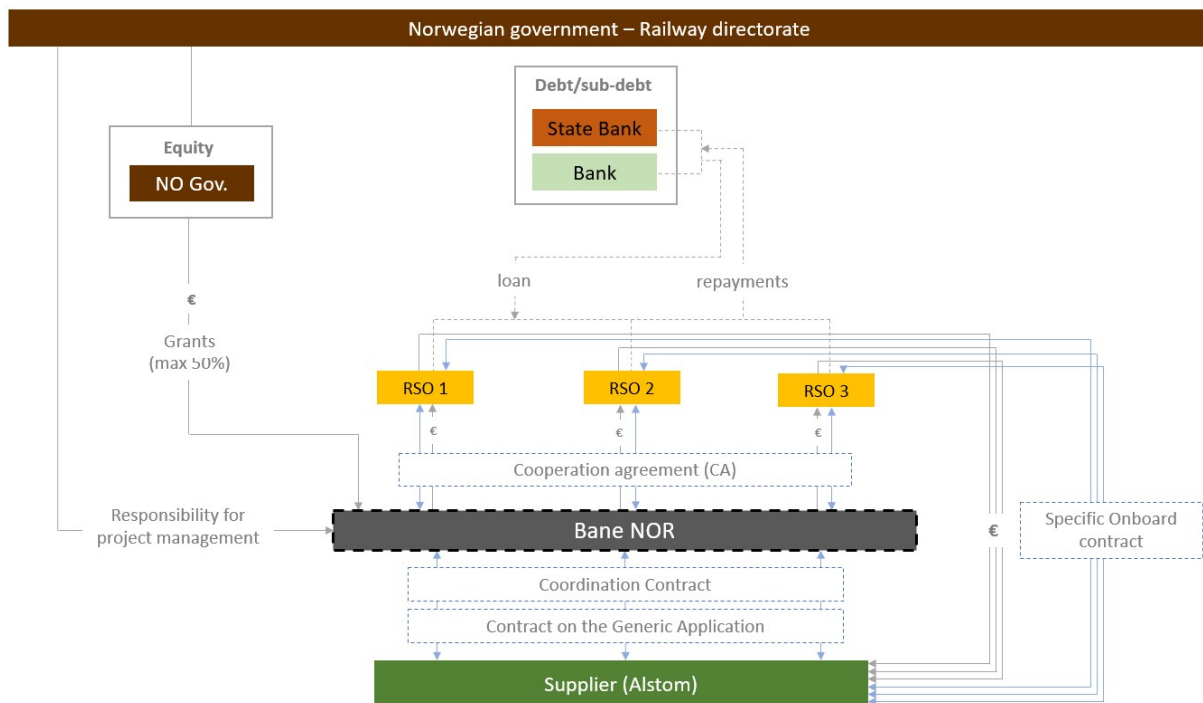


Figure 60 Norwegian financial scheme

To be eligible for the Financial Aid Scheme, both passenger and/or freight RSOs will have to meet the below criteria:

- Own vehicles that operate on the Norwegian railway network (operated on the Norwegian national railway network during 2016);
- Have signed a Cooperation Agreement with Bane NOR;
- Have signed the Onboard Contract with the supplier of ERTMS Onboard equipment.

<sup>73</sup> <https://www.banenor.no/Prosjekter/prosjekter/ertms/innhold/2018/alstom-to-deliver-ertms-onboard-equipment/>



## The Netherlands

The Netherlands decided to roll out ERTMS Level 2 Baseline 3 as the sole signalling system on most of the network (trackside). As a result, both passenger train sets and freight locomotives will have to be upgraded under this scheme. The track-side upgrade is fully state-funded. The on-board deployment of ERTMS on passenger train sets may be compensated fully via public service concessions.

Privately owned freight locomotives and On Track Machine (OTM) machines (yellow fleet) which are built before July 2017 are in principle also eligible for state funding up to 50% of the eligible costs in accordance with the European Commission's guidelines on state aid for railway undertakings.

In addition, a dedicated funding scheme has been developed to support the owners of freight locomotives whereby national funding is combined with CEF funding. In this scheme, 90% of the eligible costs for the first in class (the prototype) and 50% for the serial upgrades was made available for the freight locomotive owners. Additionally, a pre-condition of the CEF scheme was the option to each a senior facility agreement (loan) at a national bank to finance the investment under attractive conditions.

### **Key facts ERTMS BL3 upgrade for freight locomotives**

Type of support	<p>Combined national / CEF Blending scheme for ERTMS BL3 upgrade</p> <ul style="list-style-type: none"> <li>- First in class upgrade co-funded up to 90% of the eligible costs</li> <li>- Serial upgrades co-funded up to 50% of the eligible costs</li> <li>- Senior loan facility agreement at Bank Nederlandse Gemeenten (BNG) bank as option</li> </ul>
Timeline	2018-2024
Total CEF budget	EUR 23.81 million
Fleet	<p>4 first-in-class international multiple system locomotives (DANLP, DABNL, DACHINL and DABNLCZSKHU)</p> <p>4 first-in-class international diesel locomotives (DBNL)</p> <p>139 serial BL3 upgrades</p>

Two CEF blending grants are currently in action: the scheme 2017-NL-TM-0046-W (EUR 17.74 million<sup>74</sup>) and the scheme 2017-NL-TM-0101W (EUR 6.07 million<sup>75</sup>).

The amount granted by the Ministry of Infrastructure and Water Management (Min I&W) through the Dutch Enterprise Agency (RVO) is capped every year. The maximum budget available for ERTMS grants

<sup>74</sup> <https://ec.europa.eu/inea/en/connecting-europe-facility/cef-transport/2017-nl-tm-0046-w>

<sup>75</sup> <https://ec.europa.eu/inea/en/connecting-europe-facility/cef-transport/2017-nl-tm-0101-w>



was EUR 15 million in 2018, while in 2019, this was EUR 10 million. The Ministry confirmed that the maximum budget available for ERTMS from 2020 to 2022 will be EUR 59.3 million<sup>76</sup>.

In November 2019, the European Commission approved EUR 22.2 million of public support to be provided by the Dutch government under European state aid rules to upgrade 99 cross-border freight locomotives to ERTMS Baseline 3. The support will take the form of direct grants from the government to the owners of the locomotives, covering prototyping and serial upgrades. This will be further complemented by grants of EUR 23.8 million financed through the Connecting Europe Facility.<sup>77</sup>

In the established scheme, the Ministry of Infrastructure and Water Management acts as the project promoter and beneficiary of the CEF funding, concluding CEF grant agreements with CINEA. The Ministry provides also the national funding and is the guarantor of an amount of debt taken by RSOs.

In addition, the Ministry is contributing in-kind with the ERTMS program Project Management Team for which ProRail has been appointed. This team develops terms of reference for the framework agreement, to achieve scale effects and provides technical support for ERTMS installation. After consultation with the suppliers, RSOs develop their budget for the ERTMS deployment, and every RSO signs their own agreement with their respective suppliers. The cooperation of multiple RSOs and the Project Management Team results in reducing costs and economies of scale.

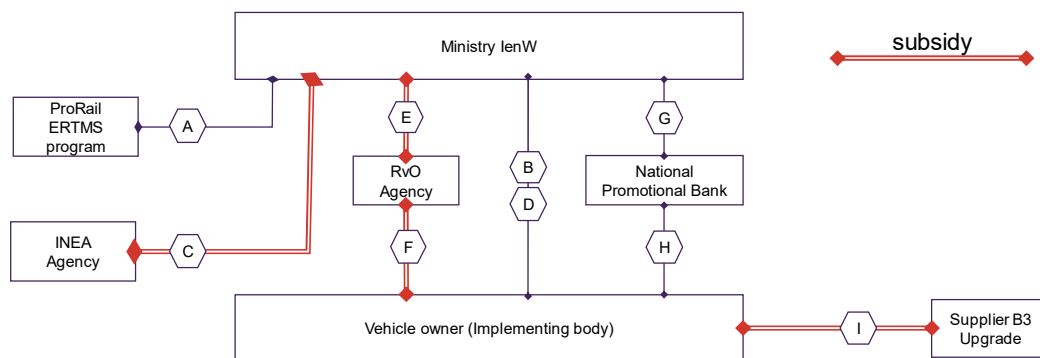


Figure 61 Dutch financing scheme (Source: Dutch ERTMS programme)

Additional support for the RSO's was launched last year when CINEA launched a new CEF 2 ERTMS call. Here the owners were invited to join a CEF application organised by the Project Management Team on behalf of the ministry. As a result an application was forwarded to CINEA for the retrofit, upgrade and new build of 661 passenger, freight and OTM vehicles.

Finally, the Netherlands is preparing a new national call for the retrofit and upgrade of (shunting/short range) locomotives and OTM machines. The call is expected for end of 2022/early 2023, possibly in combination with future CEF funding.

<sup>76</sup> Subsidieregeling ERTMS – 07/02/2019 – Overheid - <https://wetten.overheid.nl/BWBR0041878/2019-02-07>

<sup>77</sup> Commission Decision not to raise objections to State aid, case SA.55451 (November 2019) [https://ec.europa.eu/competition/elojade/isef/case\\_details.cfm?proc\\_code=3\\_SA\\_55451](https://ec.europa.eu/competition/elojade/isef/case_details.cfm?proc_code=3_SA_55451)



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## Denmark

Denmark concluded that the national system in place was obsolete. As a result, Denmark was the first country in the EU to decide to roll out ERTMS (Level 2, Baseline 3) across the whole state-owned railway network.

### **Key Facts**

Type of support	National grant
Time period	2017–2025
Total grant	DKK 55 million (EUR 7 million)
Aid design	Max 50% of the eligible costs per unit
Fleet	up to 30 locomotives (Estimated by the Danish authorities) <sup>78</sup>

The total budget for the entire duration of the scheme is DKK 55 million (EUR 7 million)<sup>79</sup>. The cost of purchase and installation of Danish STM is eligible up to 100%. Costs for purchasing and installing ETCS equipment are up to 50%. However, the total compensation cannot exceed 50% of the total direct costs of purchasing and installing ETCS and Danish STM.

### **Description of the framework**

To facilitate the implementation of ERTMS, the EC approved a scheme for partial compensation of rail freight operators' investments in on-board ERTMS equipment in 2017. The **beneficiaries** will be the RUs, regardless of whether the locomotive concerned is owned or leased by the operator. Compensations are granted in an open, transparent and non-discriminatory manner. The financial scheme, **funded** by the Danish Government, uses direct grants to eligible freight operations from Denmark's national rail Infrastructure Manager Banedanmark. This government agency reports to the Danish Ministry of Transport.

Existing freight RUs with freight locomotives that have driven 50.000 train km or 5.000 operational hours over the last five years are eligible but obliged to continue this operation in the following five-year period. New railway undertakings must document that beneficiary locomotives will drive the required number of kilometres/hours as stated above, plus a funding guarantee is required.

Apart from the financial aid scheme where a 50% state aid for freight RUs is provided by Denmark, a different set-up for passenger RUs has been realised, a leasing scheme whereby Banedanmark purchases OBU and leases them to passenger RUs. In the case of the RU, including DSB (Danske StatsBaner), the national train operating company, and regional operators, the **leasing** fee is 0 EUR<sup>80</sup>.

<sup>78</sup> Rate of exchange: reference date 13/12/2018 1 EUR = 7.46550 DKK

<sup>79</sup> State Aid SA.38283 (2015/N) – Denmark – Scheme for partial compensation of rail freight operators' investments in on-board ERTMS equipment – July, 2017

[https://ec.europa.eu/competition/elojade/isef/case\\_details.cfm?proc\\_code=3\\_SA\\_38283](https://ec.europa.eu/competition/elojade/isef/case_details.cfm?proc_code=3_SA_38283)

<sup>80</sup> Interview conducted on 21/06/2019 with members of the DK ERTMS Programme



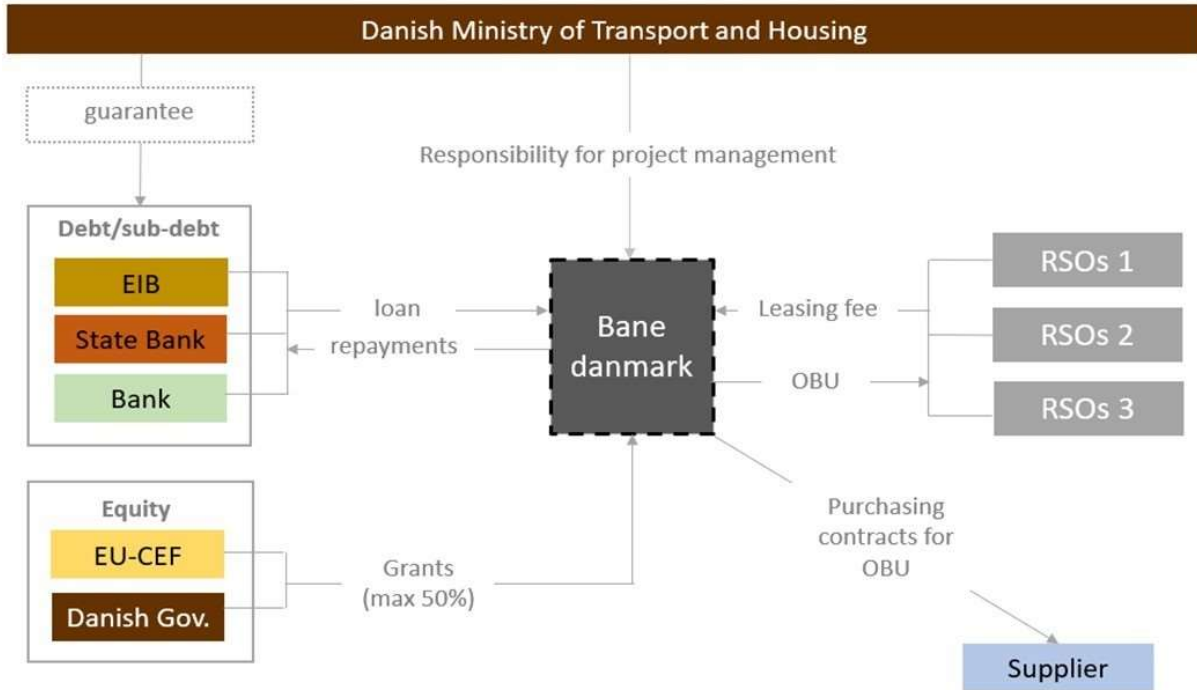


Figure 62 Danish financing scheme

Note that Denmark received a CEF grant for onboard ERTMS deployment in 2015. Below is an overview of CEF funded onboard ERTMS deployment project.

Project:	Period	CEF Funding	% funded
2014-DK-TM-0300-W Retrofitment of vehicles with ERTMS baseline 3 - Level 2 Retrofitting of 6 DSB IC3, 14 DSB MQ, 8 Nordjyske Jernbaner's Desiro (hereafter Jernbaner's) and 31 ARRIVA Lint41 train units with ETCS Level 2, Baseline 3, including a prototype for each unit type	07/2015 - 12/2019	4.96 M€	50%

## Czechia

Czechia's deployment of ERTMS is based on the target of full network coverage by 2040, ahead of the current EU deadlines.

In 2021, under EU State assistance regulations, the European Commission granted EUR 134 million (CZK 3.4 billion) in public funding to improve traffic management equipment for train rolling stock in Czechia.



The support scheme aimed at equipping the rolling stock with ERTMS, which the Commission earlier approved, was extended until 2022. The Commission decided that the measure's extension until 2022 and the increased public support comply with EU State aid laws<sup>81</sup>.

Before this, the support was conducted through the TEN-T Guidelines<sup>82</sup>. This support was aimed at the implementation of ERTMS on Corridor E and the European freight corridors RFC 5 (Baltic Sea–Adriatic Sea), RFC 7 (East-Mediterranean into which the original Corridor E has been integrated), and RFC 9 (Czech–Slovak corridor). These lines targeted for ERTMS development represent approximately 26% of the Czech network. To achieve this, Czechia was also partly funding the ERTMS deployment on-board.

### Key Facts

Type of support	National grant
Time period	2017-2021 (TEN-T) 2021-2027 (State aid for railway undertakings)
Total grant	TEN-T: CZK 1 billion (EUR 39 million) State aid for railway undertakings: CZK 3.4 billion (EUR 134 million)
Aid design	TEN-T: Maximum 50% of the eligible costs; 100% for Správa železnic (except for sub-programmes 3 & 5)
Fleet	TEN-T: Approximately 1200 rail vehicles will be equipped with ETCS by 2022. (under the 2 <sup>nd</sup> stage)

The previous round of state aid that applied to 2017-2021 included up to 4.4 billion CZK (EUR 173 million)<sup>83</sup>, covered in two different State Aid schemes in the period 2017-2021.

The first scheme, State aid SA 35948, started in 2009 with an initial duration of 5 years. The Commission approved a request for prolongation till the end of 2013<sup>84</sup>. The overall budget under this scheme, CZK 1 billion (EUR 39 million)<sup>85</sup>, remained unchanged. Note that 85 % of this scheme is from the Cohesion Fund and 15% from the Czech state budget.

Moreover, another state aid scheme, SA.44621 “Individual subprograms for ensuring interoperability in railway transport”, was approved in 2017 to ensure interoperability in railway transport. The notified scheme aims to achieve interoperability through five sub-programmes with a total financial volume of CZK 2.5 billion (EUR 97 million) and annually CZK 500 million (EUR 19 million), financed from the

<sup>81</sup> [CCT, 2021](#)

<sup>82</sup> Regulation of the European Parliament and of the Council (EU) No 1315/2013

<sup>83</sup> Rate of exchange: reference date 13/12/2018 1 EUR = 25.7067 CZK

<sup>84</sup> State aid SA 35948 (2012/N) December 2012 – Czech Republic - Prolongation of the interoperability scheme in railway transport (ex N 469/2008)

<sup>85</sup> Rate of exchange: reference date 13/12/2018 1 EUR = 25.7067 CZK



Cohesion Fund.<sup>86</sup> The scheme's duration is from the beginning of 2017 until the end of December 2021. The duration and financial volume of this scheme have been amended by the state aid scheme SA.55861 (2019/N), in which the timeframe prolonged until the 31<sup>st</sup> of December and an increase in the budget of CZK 3.4 billion (approximately EUR 134 million), and annually CZK 500 million (approximately EUR 20 million).<sup>87</sup>

### Description of the framework

The state will support the fitting of vehicles with on-board ETCS by combining two basic tools:

- funding of purchase and installation of on-board ETCS to RUs and primarily covered from EU funds (basic measure);
- granting a discount on the charge for the use of railway infrastructure (complementary measure).<sup>88</sup>

All RSOs, who have rolling stock operating in Czechia, will benefit from this aid in a non-discriminatory way. The scheme benefits both licensed rail transport undertakings (passenger and freight) and the railway Infrastructure Manager Správa železnic, a state entity to upgrade the rail network. To apply for grants, individual calls are published for several sub-programmes separately or together. The conditions, duration, and the number of funds to be shared out (broken down by sub-programme) will be duly published on the contractor's website, including all required content.

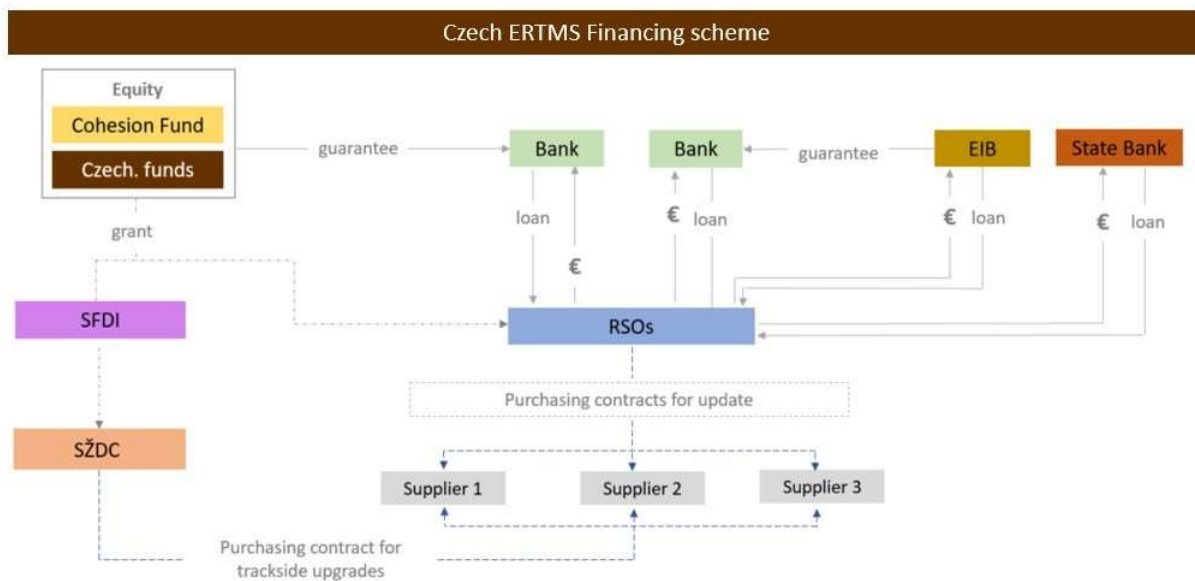


Figure 63 Czech financing scheme

Below is an overview of the main CEF funded projects related to the on-board ERTMS deployment of Czechia.

<sup>86</sup> State aid SA.44621 (2016/N) – Czech Republic – Individual subprograms for ensuring interoperability in railway transport. April 2017 [https://ec.europa.eu/competition/elojade/isef/case\\_details.cfm?proc\\_code=3\\_SA\\_44621](https://ec.europa.eu/competition/elojade/isef/case_details.cfm?proc_code=3_SA_44621)

<sup>87</sup> State aid SA.55861 (2019/?) – Czech Republic – CZ ERTMS Prolongation. February 2020 [https://ec.europa.eu/competition/state\\_aid/cases1/202013/283390\\_2142283\\_100\\_2.pdf](https://ec.europa.eu/competition/state_aid/cases1/202013/283390_2142283_100_2.pdf)

<sup>88</sup> National Implementation Plan ERTMS – Czech Republic - 2017



Project:	Period	CEF Funding	% funded
<p>2015-CZ-TM-0057-W</p> <p>Deployment of ERTMS/ETCS onboard components compliant with ETCS Baseline 3 in ČD CARGO, a.s. vehicles on the Rail Freight/Core Network Corridors</p> <p>128 ČDC vehicles (3 prototypes + 125 vehicles) will be fully interoperable for smooth international cooperation.</p>	<p>03/2017</p> <p>-</p> <p>12/2022</p>	27.5 M€	85%
<p>2015-CZ-TM-0136-W</p> <p>Deployment of ERTMS/ETCS onboard components compliant with Baseline 3 in ČESKÉ DRÁHY</p> <p>Update of 99 vehicles of ČD (4 prototypes and 95 retrofits), circulating on the Orient/East-Med, Rhine-Danube and Baltic-Adriatic Core Network Corridors (CNC)</p>	<p>04/2017</p> <p>-</p> <p>12/2022</p>	21.2 M€	85%
<p>2016-CZ-TMC-0293-W</p> <p>ERTMS in RegioJet</p> <p>On-board equipment of 9 locomotives Type Škoda 162 from RegioJet a.s. with ERTMS/ETCS Level 2, Baseline 3, so that these can seamlessly operate within Czechia, over the Rhine–Danube and the Orient/East-Med corridors into Slovakia before end of 2020, and later to Poland over the Baltic–Adriatic corridor.</p>	<p>01/2018</p> <p>-</p> <p>12/2020</p>	2.1 M€	85%

## Italy

As affirmed by the Italian Ministry of Sustainable Infrastructure and Mobility,<sup>89</sup> implementing the ERTMS system is one of the three pillars on which the technological transformation of the Italian railway infrastructure is based. Article 3 of the Law Decree 121/2021 called for establishing a fund that will provide EUR 60 million annually from 2022 to 2026 for the deployment of on-board ERTMS<sup>90</sup>.

### Key facts

Type of support	<ol style="list-style-type: none"> <li>1. Federal funding</li> <li>2. CEF</li> </ol>
Timeline	<ol style="list-style-type: none"> <li>1. 2018-2023</li> <li>2. 2021-2027</li> </ol>

<sup>89</sup> Ministry of Sustainable Infrastructure and Mobility (MIMS), 2021

<sup>90</sup> [Ferrovie.it](https://www.ferrovie.it), 2021



Total annual budget	1. EUR 60.7 million 2. EUR 60 million (includes other onboard technologies)
Aid design	- unknown

The goal of Italian authorities is to improve the performance and accessibility of Italy's railway system by extending the use of ERTMS to the whole Italian network. While today ERTMS is in operation on 758 km of lines, the objective is to equip 100 percent of the network and fleet with ERTMS by 2036, far ahead of the current European deadline for the TEN-T network of 2050, to make the Italian railway system one of the most modern in the world.

The on-board retrofitting on the Italian network is pursued, taking the Core Network Corridors into account. The vehicles used in these corridors are given priority. This approach allows for reaping the maximum ERTMS benefits during the migration period and shortening the payback period. Some of the examples of retrofitting vehicles operating on the Core Network Corridors are shown below:

#### **Connecting Europe Facility (CEF) 2021-2027**

In the summer of 2021, the multiannual framework covering CEF calls in the first three years was approved. Among the different proposals for the CEF 2021 presented to the Ministry of Infrastructure and Transport, three projects on the ERTMS on-board system and railway interoperability amount to 60.7 million euros<sup>91</sup>.

#### **RFI Tender**

The total cost of RFI's ERTMS implementation plan, covering the entire Italian network, is estimated at around EUR 13 billion. The National Recovery and Resilience Plan will enable a first, important phase (2020-2026), with funding equal to EUR 3.0 billion for equipping approximately 3400 km of track by 2026.

The financial sources scheme displayed in the ERTMS Implementation Plan in Italy is shown below.

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<sup>91</sup> [Ministry of Sustainable Infrastructure and Mobility \(MIMS\), 2021](#)

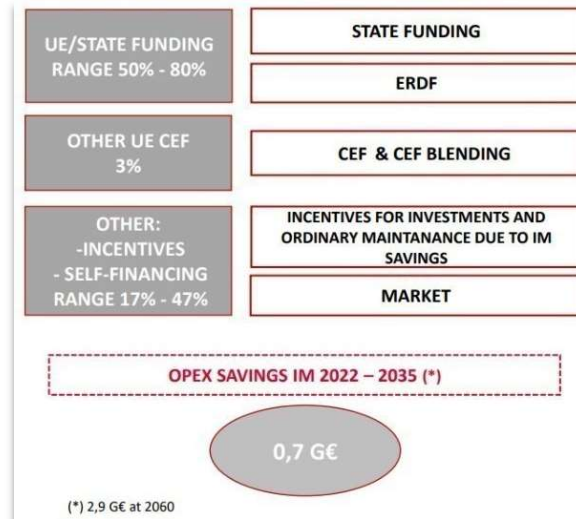


Figure 64 Prospective Financials for Onboard ERTMS equipment according to the Italian ERTMS Deployment Plan<sup>92</sup>

### Trenitalia

The primary train operator in Italy, Trenitalia, obtained more than EUR 6 million of loans from the European Investment Bank and Cassa Depositi e Prestiti to install the ERTMS system in its trains. Specifically, the EIB provided EUR 4 million to equip 76 regional hybrid trains. Cassa Depositi e Prestiti contributed EUR 2.2 million to upgrade 12 high-speed trains destined for cross-border and international traffic.<sup>93</sup> Thanks to these loans selected through the CEF programme, the High-Speed trains will benefit from the ERTMS Baseline 3.

<sup>92</sup> [ERA, 2019](#)

<sup>93</sup> [Ferrovie.it, 2021](#)

## Germany

Due to its central location Germany constitutes the rail hub of Europe and, as such, plays a crucial role in the ERTMS deployment. In the coming years, Germany will provide substantial financial resources for modernising the rail system. One of the measures aims at retrofitting vehicles operating in the Stuttgart metropolitan region (Stuttgart Digital Node). This pilot project is part of the starter package for the national rollout of ERTMS (Digital Rail Germany).

### Key Facts

Type of support	Grants
Time period	2021-2025
Total grants	2021 – EUR 197 million
Aid design	The prototypes are supported with up to 90% of the eligible costs, and the series fleet with up to 50%.
Fleet	Prototypes: 10 vehicles and 14 service vehicles Series fleet: 323 local transport vehicles and 11 service vehicles

The German Transport Ministry has been running a flagship Digital Rail program since August 2021 to turn the Stuttgart metropolitan region into a fully digital rail centre. The total investment will exceed 500 million euros by 2025. The new signalling system will improve the Stuttgart network's capacity, sustainability, and frequency. In the Stuttgart Digital Node flagship project framework, Baden-Wuerttemberg State Institute for Rail Vehicles (SFBW) has tendered the retrofitting of 118 regional trains produced by several manufacturers. In parallel, Deutsche Bahn's DB Regio has also contracted installation of ETCS on 215 Stuttgart S-Bahn trains<sup>94</sup>.

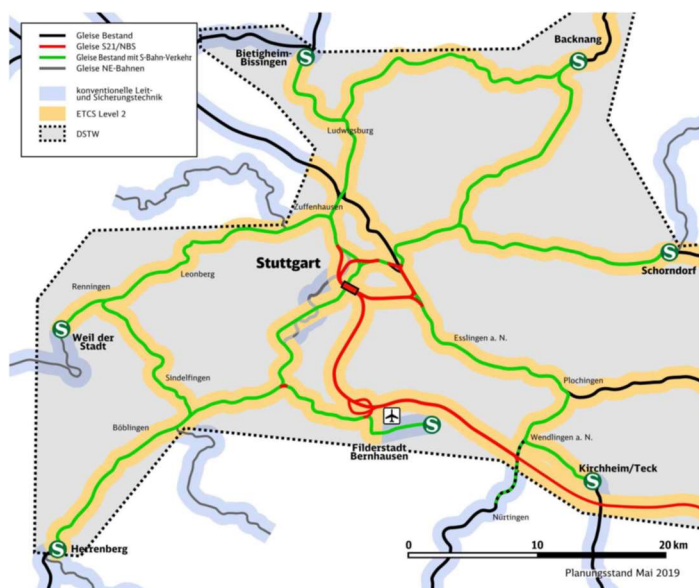


Figure 65 Stuttgart Digital Node Project Map

<sup>94</sup> [Railway Technology, 2020](#)



## Annex IX Glossary

- **ERTMS - what is it about and how does it work?**

ERTMS stands for ‘European Railway Traffic Management System’. It is a control, command, signalling, and communication system adopted by the European Union as a standard, allowing an interoperable rail framework in Europe. It enables a train equipped with an ERTMS on-board, produced by any supplier, to run on track sections equipped with ERTMS, made by other suppliers. This also implies the ability for any on-board equipment installed on any train to behave the same in the same circumstances.

ERTMS consists of two systems:

- The ETCS (European Train Control System), a train control standard based on in-cab equipment, can supervise train movements and stop them if the permitted speed on a given section is exceeded. Information is received from the ETCS equipment on the trackside (Eurobalises or radio) depending on the applicable level (see below). The driver’s response is continuously monitored, and if necessary, the emergency brakes are activated automatically.
- GSM-R (Global System for Mobile Communications - Railways) is the second ERTMS system, the European radio communications standard for railway operations. GSM-R uses exclusive frequency bands and is based on GSM radio technology. GSM-R enables the communication between the train driver and the traffic control centres and between the ETCS on-board system and the Radio Block Centres (RBCs).

- **ERTMS - Set of specifications and Baselines**

A set of specifications is a list of documents with their versions as laid down in the Technical Specification of Interoperability for Control-Command and Signalling (CCS TSI), i.e. the specifications of components, interfaces, etc., concerning ERTMS. Each set of specifications includes both an ETCS and a GSM-R Baseline.

A Baseline is defined by a stable kernel in terms of system functionalities. A new Baseline implies significant changes to the kernel by changing existing or adding new features. Baseline evolution should be backwards compatible, i.e. on-boards compliant with newer Baselines can run on a track compliant with an older Baseline.

- **ETCS - System Versions**

The System Version is a concept of the ETCS system that refers to the version of the ETCS language in the information exchanged between both trackside and on-board subsystems (i.e. packets, telegrams and messages).

The System Version identifies the functionalities available to be used by these subsystems.



- **ETCS - Levels**

The level is a fundamental concept of the ETCS system. A short definition can be given as follows:

**Level 1** allows continuous supervision of train movement (i.e. the on-board computer continuously supervises the maximum permitted speed and calculates the braking curve to the end of movement authority) while non-continuous communication between train and trackside, generally through Eurobalises. Lineside signals are necessary. Train detection and train integrity (i.e. verification that the train is complete and has not been accidentally split) is performed by the trackside equipment outside the scope of ERTMS.

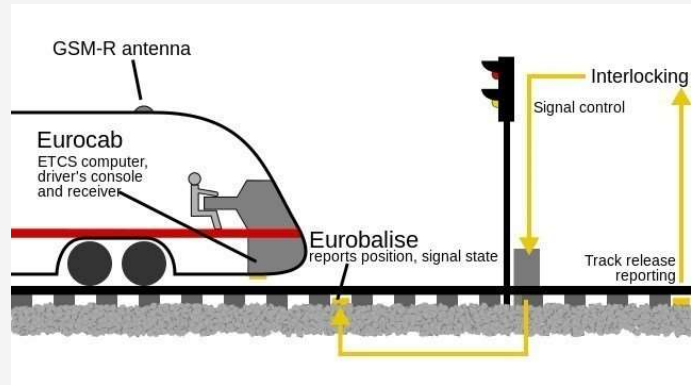


Figure 66 Level 1

**Level 2** allows continuous supervision of train movement with constant communication via GSM-R between the train and trackside (i.e. between ETCS on-board system and Radio Block Centres). Lineside signals are optional in this case, and train detection and train integrity checks are performed by the trackside equipment outside the scope of ERTMS.

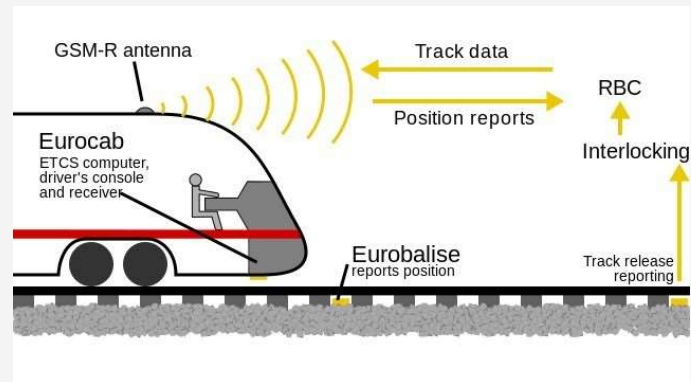


Figure 67 Level 2

**Level 3** allows continuous train supervision with continuous communication between the train and trackside (i.e. between ETCS on-board system and Radio Block Centres). The main difference with Level 2 is that ERTMS manages the train location and integrity, i.e. there is no need for lineside signals or train detection systems trackside other than Eurobalises. Train integrity is supervised by the train.

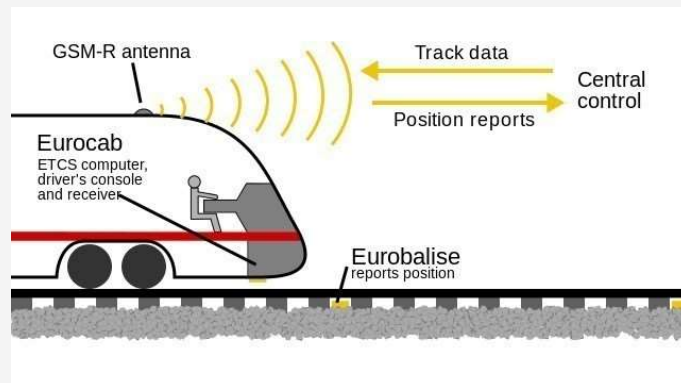


Figure 68 Level 3

In addition, there are two more levels defined: **Level 0**, which applies to trains equipped with ETCS running on non-equipped lines; and **Level STM**, which is meant for trains equipped with ETCS running on lines where the Class B system needs to be operated. Regarding the STM level, ETCS acts as an interface between the driver and the national ATP.

### ETCS - Modes

Operation modes can be defined as conditions required for managing different situations regarding the status of the trackside and the train. Unlike the ETCS levels (associated with train-trackside communication), ETCS modes are related to the operational circumstances of the line or the on-board equipment status.

The primary ETCS mode is Full supervision. The ETCS on-board equipment will be in Full Supervision mode when all train and trackside data required for complete supervision of the train are available on-board. In this mode, the on-board ETCS equipment is responsible for the train protection (always ensuring that the maximum permitted speed and the end of movement authority are not exceeded).

The trackside ERTMS subsystem can also send modes related to specific information (e.g. the 'Limited Supervision mode' allows the system to supervise train movements fully and enables the train to operate in areas with incomplete available trackside information). In contrast to Full Supervision mode, in Limited Supervision mode, the information is simplified (especially the description of the speed restrictions on trackside), and the driver is responsible for the train's movement.

There are also other modes for different operational situations. The following are some examples: 'shunting mode' (which is used in the shunting yards), 'on-sight mode' (which allows the train to enter an occupied section) and a 'staff responsible mode' (which is a transition mode that allows train movement when it is acquiring data from the trackside under driver's responsibility).



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