

Special Report

A single European rail traffic management system: will the political choice ever become reality?

(pursuant to Article 287(4), second subparagraph, TFEU)



EUROPEAN
COURT
OF AUDITORS

Audit team

The ECA's special reports set out the results of its audits of EU policies and programmes or management topics related to specific budgetary areas. The ECA selects and designs these audit tasks to be of maximum impact by considering the risks to performance or compliance, the level of income or spending involved, forthcoming developments and political and public interest.

This performance audit was produced by Audit Chamber II – headed by ECA Member Iliana Ivanova - which specialises in investment for cohesion, growth and inclusion spending areas. The audit was led by ECA Member Ladislav Balko, supported by Branislav Urbanič, Head of Private Office; Pietro Puricella, Principal Manager; Fernando Pascual Gil, Head of Task; Aleksandra Klis-Lemieszonek, Nils Odins, Christian Wieser, Valeria Rota and Guido Fara, Auditors.



From left to right: Aleksandra Klis-Lemieszonek, Fernando Pascual Gil, Ladislav Balko, Branislav Urbanič , Pietro Puricella , Nils Odins.

CONTENTS

	Paragraph
Glossary	
Executive summary	I-XI
About ERTMS	I-III
How we conducted our audit	IV-V
What we found	VI-X
What we recommend	XI
Introduction	1-17
Background	1-4
What is ERTMS?	5-8
The history of ERTMS	9-13
EU financial support for ERTMS	14-17
Audit scope and approach	18-21
Observations	22-87
ERTMS was a strategic political choice and was launched with no overall cost estimate or appropriate planning for its deployment	22-41
ERTMS concept generally is not disputed by the rail sector	22-25
ERTMS deployment was a strategic political choice with no overall cost estimate	26-28
A thicket of legal obligations, priorities and deadlines	29-33
No deadline is set for decommissioning current national signalling systems	34-35
So far limited and patchy deployment of ERTMS	36-41
Many infrastructure managers and railway undertakings have been reluctant to invest in ERTMS due to the lack of an individual business case	42-70

An overall positive outcome of ERTMS at EU level, but only in the long term	42-43
Many infrastructure managers and railway undertakings with diverse needs expected to invest in one system	44-46
ERTMS investments are costly	47-55
Compatibility and stability problems adversely affect the individual business case	56-65
New European Deployment Plan is a step forward but major challenges remain	66-70
EU funding can only cover a limited amount of the costly investment, and has not always been properly managed and targeted	71-87
EU funding available for ERTMS deployment can only cover a limited amount of the investments	71-74
Different issues with ERTMS projects related to the management mode	75-80
EU funding has not always been well targeted	81-87
Conclusions and recommendations	88-92

Annex I – List of national signalling systems in the EU Member States

Annex II – ERTMS technical description

Annex III – List of projects examined

Annex IV – ERTMS deployment in core network corridors by Member States as of end of 2016

Annex V – Methodology for the linear extrapolation of ERTMS deployment cost

Reply of the Commission

GLOSSARY

Baseline: A stable kernel in terms of system functionality, performance and other non-functional characteristics.

Cohesion Fund: The Cohesion Fund aims at strengthening economic and social cohesion within the European Union by financing environment and transport projects in Member States with a per capita GNP of less than 90 % of the EU average.

Connecting Europe Facility (CEF): Since 2014, the Connecting Europe Facility (CEF) has provided financial aid to three sectors: energy, transport and information and communication technology (ICT). In these three areas, the CEF identifies investment priorities that should be implemented in the coming decade, such as electricity and gas corridors, the use of renewable energy, interconnected transport corridors, cleaner modes of transport, high-speed broadband connections and digital networks.

European Deployment Plan (EDP): A document that was finally agreed in 2009 and included in Commission Decision 2009/561/EC on the technical specifications for interoperability. The aim of the EDP is “to ensure that locomotives, railcars and other railway vehicles equipped with ERTMS can gradually have access to an increasing number of lines, ports, terminals and marshalling yards without needing national equipment in addition to ERTMS”.

European Rail Traffic Management System (ERTMS): A major European industrial project which aims to replace the different national train control and command systems. It has two basic components, an automatic train protection system (ATP) to replace the existing national ATP-systems, the European Train Control System (ETCS); and a radio system for providing voice and data communication between the track and the train, based on standard GSM technology, but using frequencies specifically reserved for rail (GSM-R).

European Union Agency for Railways (ERA): Previously European Railway Agency, established in 2004 with the objective of developing the technical specifications for interoperability, including ERTMS and to contributing towards the effective functioning of a Single European Railway Area without frontiers. The ERA’s main task is to harmonise, register and monitor technical specifications for interoperability (TSIs) across the entire

European rail network and set common safety standards for European railways. The ERA itself has no decision-making powers, but it helps the Commission to draw up proposals for decisions.

European Regional Development Fund (ERDF): The European Regional Development Fund aims to reinforce economic and social cohesion within the European Union by redressing the main regional imbalances through financial support for the creation of infrastructure and productive job-creating investment, mainly for businesses.

European Structural and Investment Funds (ESIF): These are five separate funds that aim to reduce regional imbalances across the Union, with policy frameworks set for the seven-year budgetary period. The funds are the European Regional Development Fund (ERDF) the European Social Fund (ESF), the Cohesion Fund (CF) the European Agricultural Fund for Rural Development (EAFRD) and the European Maritime and Fisheries Fund (EMFF).

Incumbent operator: The rail operator with a historically dominant position in the national market, deriving from a single integrated company which used to be responsible for the management of the rail infrastructure and provision of transport services.

Infrastructure manager: A body or undertaking responsible in particular for establishing, managing and maintaining railway infrastructure.

Interoperability: Interoperability is defined as the capability to operate on any stretch of the rail network without any difference. In other words, the focus is on making the different technical systems on the EU's railways work together.

Innovation and Networks Executive Agency (INEA): The Innovation and Networks Executive Agency (INEA) is the successor of the Trans-European Transport Network Executive Agency (TEN-T EA), which was created by the European Commission in 2006 to manage the technical and financial implementation of its TEN-T programme. INEA, with its headquarters in Brussels, officially started its activities on 1 January 2014 in order to implement parts of the Connecting Europe Facility (CEF), Horizon 2020, and other legacy programmes (TEN-T and Marco Polo 2007-2013).

Notified Body: A body designated by a Member State which is involved in verifying conformity of subsystems with technical specifications for interoperability and draws up the EC certificate of verification. The task of the notified body begins at the design stage and covers the entire manufacturing period through to the acceptance stage before the subsystem is placed in service.

Rail signalling system: A system used to manage railway traffic safely and keep trains clear of each other at all times.

Railway undertaking: A public or private rail operator licensed according to applicable EU legislation, the principal business of which is to provide services for the transport of goods and/or passengers by rail. In this report, it also covers fleet owners such as train asset leasing companies.

Trans-European Transport Networks (TEN-T): A planned set of road, rail, air and water transport networks in Europe. The TEN-T networks are part of a wider system of Trans-European Networks (TENs), including a telecommunications network (eTEN) and a proposed energy network (TEN-E). The infrastructure development for TEN-T is closely linked with the implementation and further advancement of EU transport policy.

EXECUTIVE SUMMARY

About ERTMS

I. To run trains on a rail network, a signalling system is needed to manage traffic safely and keep trains clear of each other at all times. However, each European country has developed its own technical specifications for such signalling systems, gauge width, safety and electricity standards. There are now around 30 different signalling systems across the EU managing railway traffic, which are not interoperable.

II. To overcome this and to help create a single European railway area, the European rail industry started developing a European control-command, signalling and communication system - ERTMS in the late 1980s/early 1990s and the European Commission supported its establishment as the single system in Europe. ERTMS' objective is to replace all existing signalling systems in Europe with a single system to foster interoperability of national rail networks and cross-border rail transport. ERTMS is intended to guarantee a common standard that enables trains to travel uninterrupted across different countries and facilitate rail competitiveness.

III. To help the Member States deploy ERTMS, approximately 1.2 billion euro was allocated from the EU budget between 2007 and 2013. 645 million euro came from the Trans-European Network for Transport Programme (TEN-T) and 570 million euro from the European Regional Development Fund and the Cohesion Fund. During 2014-2020, the estimated total is 2.7 billion euro, 850 million euro from the Connecting Europe Facility, which has replaced the TEN-T programme, and approximately 1.9 billion euro from the European Structural and Investments Funds.

How we conducted our audit

IV. To assess whether ERTMS has been properly planned, deployed and managed, and whether there was an individual business case, we examined:

- whether ERTMS had been timely and effectively deployed based on proper planning and cost estimates;

- whether there was a business case for individual infrastructure managers and railway undertakings;
- whether EU funding had been effectively managed to contribute to ERTMS deployment.

V. We visited six Member States: Denmark, Germany, Spain, Italy, the Netherlands and Poland. Altogether these Member States cover partly all nine core network corridors where ERTMS has to be fully deployed by 2030. The audit also covered the role played by the Commission in the planning, management, deployment and financing of ERTMS.

What we found

VI. So far, deployment in the EU is at a low level and represents a patchwork, despite the fact that the ERTMS concept and vision to enhance interoperability is not generally questioned by the rail sector. The current low status of ERTMS deployment may mainly be explained by the reluctance of many infrastructure managers and railway undertakings to invest in ERTMS equipment due to the expense entailed and the lack of an individual business case for many of them. EU funding, even if better managed and targeted, can only cover a limited amount of the overall cost of deployment.

VII. This puts not only the achievement of the deployment targets set for 2030 and investments made so far at risk, but also the realization of a single railway area as one of the major Commission's policy objectives. It may also adversely affect the competitiveness of rail transport as compared with road haulage.

VIII. Despite the strategic political decision to deploy a single signalling system in the whole EU, no overall cost estimate was performed to establish the necessary funding and its sources. The legal obligations introduced did not imply the decommissioning of national systems, nor are they always aligned with the deadlines and priorities included in EU transport policy. As of today, the level of ERTMS deployment across the EU is low.

IX. ERTMS is a single system for multiple infrastructure managers and railway undertakings with diverse needs. However, it entails costly investments with no immediate benefit in general for those who have to bear the cost. Problems with compatibility of the different versions installed as well as the lengthy certification procedures also adversely affect the

individual business case for infrastructure managers and railway undertakings. Despite the new European Deployment Plan, major challenges of successful deployment remain.

X. EU financial support is available for ERTMS investments both trackside and on-board, but it can only cover a limited amount of the overall cost of deployment. It leaves most of the investment to individual infrastructure managers and railway undertakings which do not always benefit, at least immediately, from the deployment of ERTMS. In addition, not all EU funding available for ERTMS was finally allocated to ERTMS projects and it was not always well targeted.

What we recommend

XI. The Court makes a number of recommendations concerning: the assessment of ERTMS deployment costs; decommissioning of national signalling systems; individual business case for infrastructure managers and railway undertakings; compatibility and stability of the system; role and resources of ERA; alignment of national deployment plans, monitoring and enforcement; absorption of EU funds for ERTMS projects and better targeting of EU funding.

INTRODUCTION

Background

1. The mobility of goods and persons is an essential component of the EU internal market and the competitiveness of European industry and services, and has a significant impact on economic growth. Rail is considered to be one of the most environmentally friendly modes of transport and has been promoted by the EU as one of the pillars of European transport policy over the last decades.
2. To run trains on a rail network, it is necessary to have a rail signalling system so that railway traffic can be managed safely and trains kept clear of each other at all times. These systems usually consist of equipment placed both on the tracks and on the locomotives or entire trainsets.
3. Over time, each European country has developed its own technical specifications for its signalling system, gauge width, safety and electricity standards. This represents a significant barrier to trans-European interoperability and results in additional costs and technical constraints. In particular, there are around 30 train signalling systems across the European Union, which are not interoperable (see **Annex I**). As a result, locomotives or trainsets running in several countries or even within a single country need to be equipped with different and multiple national signalling systems.
4. In our previous report on rail freight transport¹, we already highlighted the fact that among other operational obstacles the different signalling systems in place in the European Union rail network hinder interoperability. We also noted that the European Rail Traffic Management System (ERTMS) was being implemented slowly. Furthermore, we reported on the problems related to implementing projects on cross-border sections in two other our reports published in 2005² and 2010³.

¹ Special Report No 8/2016 “Rail freight transport in the EU: still not on the right track” (<http://eca.europa.eu>).

² Special Report No 6/2005 on the trans-European network for transport (TEN-T) (<http://eca.europa.eu>).

What is ERTMS?

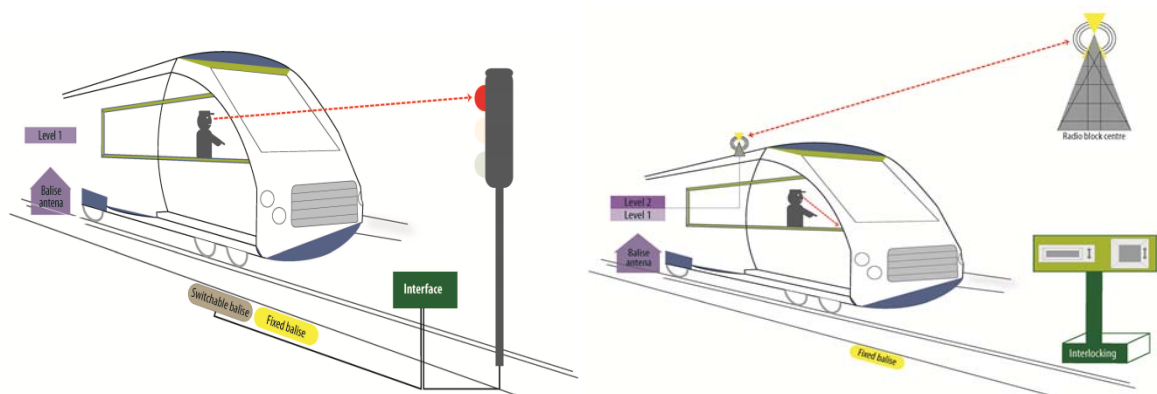
5. In the late 1980s/early 1990s, in order to overcome this situation caused by different national signalling systems and contribute towards the creation of a single European railway area, the European rail industry started developing a European control-command, signalling and communication system – ERTMS, and the Commission supported its establishment as the single system in Europe. The ultimate objective of this was to replace all the existing signalling systems in Europe with a single system designed to foster interoperability among national rail networks and cross-border rail transport. ERTMS is intended to guarantee a common standard that enables trains to travel uninterrupted across different countries thereby facilitating rail competitiveness.

6. ERTMS is composed of two software-based sub-systems: trackside and on-board, and both the infrastructure and the train must be equipped⁴ for the system to work. The trackside system and the system installed on the vehicles exchange information (see ***Figure 1*** and ***Box 1***) enabling continuous supervision of the maximum speed allowed for operation and gives the driver all the information needed to operate with cab signalling. Detail description of the ERTMS system is outlined in ***Annex II***.

³ Special Report No 8/2010 “Improving transport performance on trans-European rail axes: Have EU rail Infrastructure investments been effective” (<http://eca.europa.eu>).

⁴ The two main components of ERTMS are the European Train Control System (ETCS) deployed on trackside in the form of a balise and the Global System for Mobile communications-Rail (GSM-R), a radio system providing voice and data communication between the track and the train. In this report, we use the word “ERTMS” even though, in some cases, we are referring exclusively to ETCS equipment.

Figure 1 – ERTMS functioning (level 1 and 2)



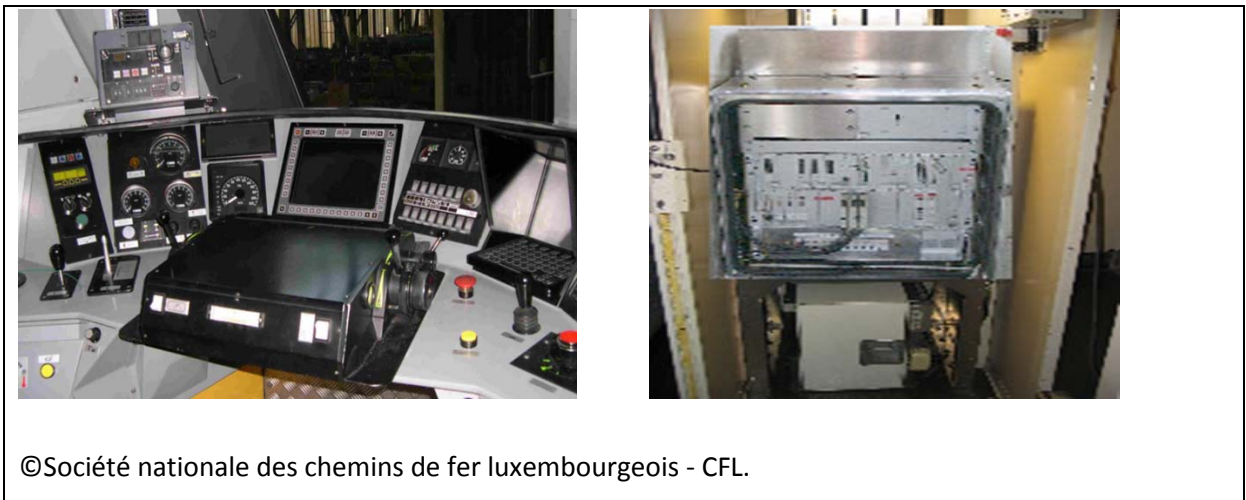
Source: European Court of Auditors.

Box 1 – ERTMS track side and on-board components

Trackside: A Eurobalise is a passive device that lies on the track, storing data related to the infrastructure, such as speed limits, position references and gradients.



On-board: Driver Machine Interface, which is the interface between the driver and ERTMS, and Euro Vital Computer – a unit with which all the other train functions interact.

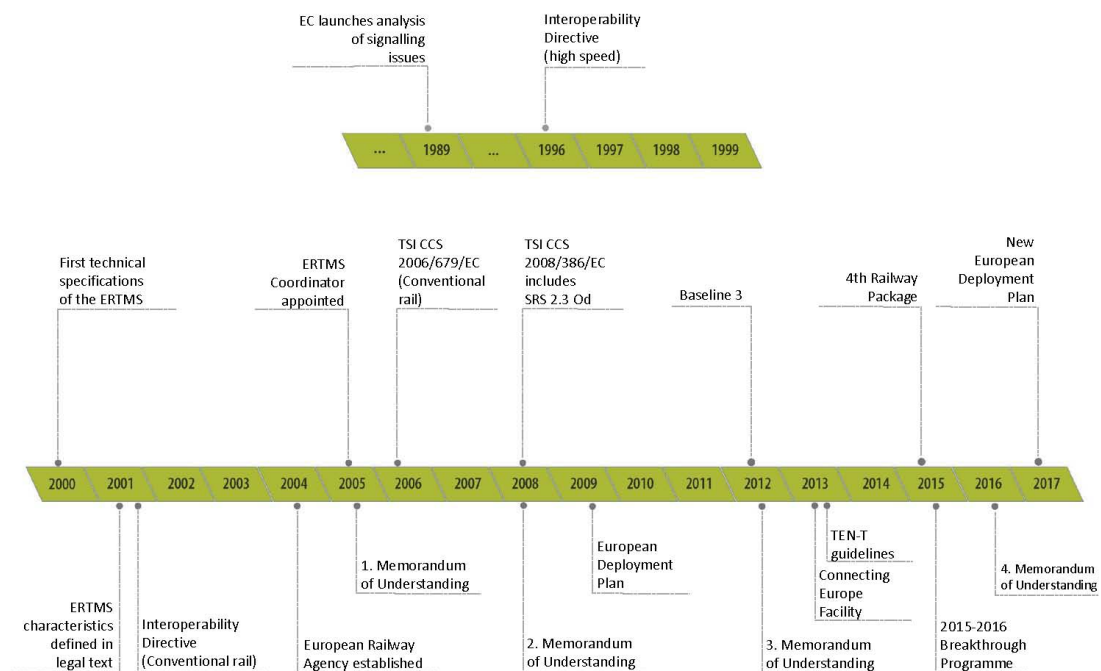


7. The successful deployment of ERTMS depends on various stakeholders. While the Commission is responsible for the policy, which it executes together with the European Coordinator and the European Union Agency for Railways (ERA), the product itself is delivered by the rail manufacturing industry according to procurement specifications and contractual requirements. Before being put into operation all the equipment must be tested and certified by notified bodies and authorised by national safety authorities or ERA.

8. Physical deployment requires both infrastructure managers and railway undertakings to invest in ERTMS. Infrastructure managers, usually operating under the umbrella of the ministry responsible for transport and infrastructure in each Member State, have to deploy ERTMS trackside infrastructure. Railway undertakings (including fleet owners), which after the rail market liberalisation in the EU may be both public and private companies, have to invest in ERTMS on-board.

The history of ERTMS

9. The concept of a single EU signalling system to enhance interoperability dates back to 1989, when the rail industry and the Commission launched an analysis of rail signalling issues across the EU Member States, and, since then, it has constantly evolved, as summarised in ***Figure 2***.

Figure 2 – Timeline of ERTMS history

Source: European Court of Auditors.

10. The first legislative acts serving this objective were issued in 1996, with the “interoperability directive” on a high-speed rail system⁵ and in 2001, with the interoperability directive on the trans-European conventional rail system⁶. In 2004 the European Railway Agency (ERA)⁷ was established with the objective of developing the technical specifications for interoperability (“TSIs”). In July 2005, a European ERTMS Coordinator was appointed⁸. Between 2005 and 2016 the Commission (and ERA since 2008)

⁵ Council Directive 96/48/EC of 23 July 1996 on the interoperability of the trans-European high-speed rail system (OJ L 235, 17.9.1996, p. 6).

⁶ Directive 2001/16/EC of the European Parliament and of the Council of 19 March 2001 on the interoperability of the trans-European conventional rail system (OJ L 110, 20.4.2001, p. 1).

⁷ The European Union Agency for Railways since 15 June 2016 (Regulation (EU) No 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 (OJ L 138, 26.5.2016, p. 1)).

⁸ Decision C(2005) 2754 of 20 July 2005 designating six European Coordinators for certain trans-European transport network projects.

signed four Memoranda of Understanding with the rail stakeholders, aiming at strengthening cooperation and speeding up ERTMS deployment.

11. In 2009, based on the information provided by the Member States⁹, the Commission adopted an ERTMS European Deployment Plan (EDP)¹⁰. This decision set out the detailed rules for ERTMS deployment and identified six ERTMS corridors and a number of main European ports, marshalling yards, freight terminals and freight transport areas to be covered by ERTMS connections, together with their respective timetables, between 2015 and 2020.

12. Another important step was the adoption of the TEN-T guidelines in December 2013¹¹. These guidelines stated that the trans-European transport network should be developed through a dual-layer structure consisting of a comprehensive network (123 000 km), which includes a core network (66 700 km), comprising in itself nine core network corridors (51 000 km, which had been aligned with the ERTMS corridors included in the European Deployment Plan). These guidelines envisaged that the core network and the comprehensive network should be equipped with ERTMS by 2030 and 2050 respectively. **Figure 3** shows the nine core network corridors.

⁹ In accordance with Article 3 of 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 (OJ L 284, 16.10.2006, p. 1) the Member States established a national implementation plan for the Control Command and Signalling TSI and sent this implementation plan to the Commission.

¹⁰ Commission Decision 2009/561/EC of 22 July 2009 amending Decision 2006/679/EC as regards the implementation of the technical specification for interoperability relating to the control, command and signalling subsystem of the trans-European conventional rail system (OJ L 194, 25.7.2009, p. 60).

¹¹ 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 and repealing Decision No 661/2010/EU (OJ L 348, 20.12.2013, p. 1).

Figure 3 – Map of the nine core network corridors



List and length of the nine core network corridors according to Regulation (EU) No 1315/2013:

- ATL – Atlantic (8 188 km)
- BAC – Baltic-Adriatic (4 588 km)
- MED – Mediterranean (9 355 km)
- NSB – North Sea-Baltic (6 244 km)
- NSM – North Sea-Mediterranean (6 791 km)
- OEM – Orient-East Mediterranean (5 830 km)
- RALP – Rhine-Alpine (2 994 km)
- RDN – Rhine-Danube (5 802 km)
- SCM – Scandinavian-Mediterranean (9 290 km)

Source: European Commission.

13. On 30 January 2013, the Commission adopted its proposal for the Fourth Railway Package to complete the single European railway area. The technical pillar which entered into force in June 2016 covers elements directly linked to ERTMS such as rail governance issues and the reinforcement of the role of the ERA, which will become the system authority

for ERTMS¹² as from mid-2019. Finally, in January 2017, a new ERTMS European Deployment Plan¹³ was adopted (see also [paragraph 63](#) and [67](#)).

EU financial support for ERTMS

14. In order to help the Member States deploy ERTMS on their rail networks, EU financial support is available for both trackside and on-board investments. Approximately 4 billion euro has been earmarked from the EU budget for this purpose between 2007 and 2020 from two main sources: the Trans-European Network for Transport (TEN-T) Programme¹⁴, replaced for 2014-2020 period by the Connecting Europe Facility¹⁵, and the Cohesion Policy (the European Regional Development Fund (ERDF)¹⁶, the Cohesion Fund¹⁷ and the European Structural and Investment Funds (ESIF)¹⁸) (see [Table 1](#)).

¹² The three texts comprising the technical pillar of the Fourth Railway Package were published in the Official Journal of the European Union on 26 May 2016. They include: Directive (EU) 2016/797 of the European Parliament and of the Council of May 11 2016 on the interoperability of the rail system within the European Union (recast) (OJ L 138, 26.5.2016, p. 44); Directive (EU) 2016/798 of the European Parliament and of the Council of 11 May 2016 on railway safety (recast), (OJ L 138, 26.5.2016, p. 102) and 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 (OJ L 138, 26.5.2016, p. 1).

¹³ Commission Implementing Regulation (EU) 2017/6 of 5 January 2017 on the European Rail Traffic Management System European deployment plan (OJ L 3, 6.1.2017, p. 6).

¹⁴ Decision No 661/2010/EU of the European Parliament and of the Council of 7 July 2010 on Union guidelines for the development of the trans-European transport network (recast) (OJ L 204, 5.8.2010, p. 1).

¹⁵ 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 (OJ L 348, 20.12.2013, p. 129).

¹⁶ Regulation (EC) No 1080/2006 of the European Parliament and of the Council of 5 July 2006 on the European Regional Development Fund and repealing Regulation (EC) No 1783/1999 (OJ L 210, 31.7.2006, p. 1).

¹⁷ Council Regulation (EC) No 1084/2006 of 11 July 2006 establishing a Cohesion Fund and repealing Regulation (EC) No 1164/94 (OJ L 210, 31.7.2006, p. 79).

¹⁸ Regulation (EU) No 1303/2013 of the European Parliament and of the Council of 17 December 2013 laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund and laying down general

Table 1 – Main EU financial support in 2007-2020 (in million euro)

	2007-2013	2014-2020	Co-financing rate
TEN-T/CEF	645	850	Up to 50 %
ERDF/Cohesion Fund/ESIF	570	1 900	Up to 85 %
Total	1 215	2 750	

Source: European Court of Auditors based on the data from the European Commission.

15. The two main sources of EU funding for ERTMS projects are managed under direct or shared management:

- (a) Under direct management (TEN-T and CEF) the Commission is responsible for approving each individual project submitted by the authorities of the Member States. Technical and financial implementation of co-financed projects is the responsibility of the Innovation and Networks Executive Agency (INEA), under the supervision of the Directorate-General for Mobility and Transport of the European Commission.
- (b) Under shared management (ERDF and Cohesion Fund) projects are generally selected by the national managing authorities. The Commission (the Directorate-General for Regional and Urban Policy) examines and approves the financial contribution to major projects, i.e., projects whose total eligible cost exceeds 50 million euro for the period 2007-2013 and 75 million euro for the period 2014-2020.

16. The EU budget mostly co-finances two types of project in relation to ERTMS: trackside (equipping rail tracks with the necessary equipment), and on-board (equipping locomotives with ERTMS units). Other co-financed projects consisting of testing, developing specifications or corridor approach projects may also be eligible for support.

provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund and the European Maritime and Fisheries Fund and repealing Council Regulation (EC) No 1083/2006 (OJ L 347, 20.12.2013, p. 320).

17. Moreover, in addition to the sources previously mentioned, additional funding can be provided by the Shift2Rail Joint Undertaking¹⁹ which was established in 2014 (see **paragraph 65**). It aims to invest almost one billion euro in research and innovation in 2014-2020 (450 million euro from the EU budget, supplemented by 470 million euro from industry). ERTMS research projects are eligible within the scope of its activities. The European Investment Bank (EIB) provides loans and guarantee schemes for ERTMS trackside deployment and purchase of new rolling stock equipped with ERTMS.

AUDIT SCOPE AND APPROACH

18. In this audit we assessed whether ERTMS had been properly planned, deployed and managed and whether there was an individual business case. To do this, we examined:

- whether ERTMS had been deployed in a timely and effective manner based on proper planning and a proper cost estimate;
- whether there was a business case for individual infrastructure managers and railway undertakings;
- whether EU funding had been effectively managed to contribute towards ERTMS deployment.

19. During our audit we visited six Member States: Denmark, Germany, Spain, Italy, the Netherlands and Poland. Altogether, these Member States partly cover all nine core network corridors where ERTMS has to be fully deployed by 2030. We held interviews with the authorities of Member States (ministries in charge of transport and infrastructure investments, infrastructure managers and national safety authorities), passenger and freight rail operators, fleet owners and other stakeholders (notified bodies, various national and European rail associations).

20. We also examined the role played by the Commission and ERA in planning, managing, deploying and financing ERTMS. We held interviews with the Commission (Directorate-

¹⁹ Council Regulation (EU) No 642/2014 of 16 June 2014 establishing the Shift2Rail Joint Undertaking (OJ L 177, 17.6.2014, p. 9).

General for Mobility and Transport, Directorate-General for Regional and Urban Policy and INEA), the European ERTMS Coordinator and ERA. Additionally, public information on ERTMS deployment outside the EU (e.g. Switzerland) was also examined.

21. Our assessment of ERTMS planning, deployment and management in the EU and, in particular, in the six Member States visited, is also based on a review of a sample of 51 EU co-financed projects related to ERTMS from the 2007-2013 programme period. The total EU-co-financing allocated to the ERTMS component of these projects amounts to approximately 540 million euro, which is around 14 % of all estimated ERTMS funding for the years 2007-2020. Out of 51 projects, 31 projects related to trackside investments and 20 projects to on-board equipment. **Annex III** contains the list of projects examined.

OBSERVATIONS

ERTMS was a strategic political choice and was launched with no overall cost estimate or appropriate planning for its deployment

ERTMS concept generally is not disputed by the rail sector

22. Notwithstanding the big challenges presented in this report, during the audit we found that the idea of a single signalling system, to foster rail interoperability, as the backbone of the single European railway area, was generally not disputed by the rail sector (infrastructure managers, railway undertakings, national safety authorities, suppliers and other stakeholders). Depending on the performance and obsolescence of the existing national signalling systems, ERTMS has a potential to improve the capacity and speed of rail transport. If fully deployed, ERTMS would contribute towards making rail more competitive compared with other modes of transport in accordance with the objectives of the 2011 White Paper²⁰ and would help achieve EU environmental targets.

²⁰ COM/2011/0144 final of 28 March 2011 “White Paper Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system”.

23. In addition to enhanced interoperability, and depending on the performance of the existing national signalling systems and their varying degree of obsolescence, other potential advantages are the following:

- increased capacity: ERTMS can reduce the minimum distance or time between vehicles in commercial service allowing more trains to be run on highly congested rail lines;
- increased commercial speed;
- continuous supervision of train speed with benefits for safety;
- lower maintenance costs for infrastructure managers and
- increased product harmonisation and competition among suppliers

24. We found that in the visited Member States ERTMS is already now resulting in some benefits for the infrastructure manager and/or the railway undertakings. For example, in Spain, ERTMS performs better than the national signalling system in terms of speed (300-350 km/h as against 200 km/h) and capacity, especially on suburban commuter lines in Madrid and Barcelona.

25. Moreover, ERTMS is being deployed in other European countries outside the EU, such as Switzerland (see **Box 2**), as well as in a number of countries worldwide, usually without EU funding. ERTMS investments outside Europe represent 59 % of the overall ERTMS investment in terms of rail lines and 33 % in terms of on-board units. Unlike in the EU, ERTMS deployment projects abroad are generally greenfield investments (i.e. no previous signalling system was in place) made within one single country and by one railway company. This significantly facilitates its deployment.

Box 2 – ERTMS deployment in Switzerland

Switzerland has launched an ambitious ERTMS investment plan to increase capacity and train speed on the busiest segments of the national railway network. For instance, the 45 km-long Mattstetten-Rothrist line is a strategic bottleneck for traffic from Bern to Basel, Zurich, and Lucerne. Equipping this section with ERTMS level 2 has reduced journey time between Zurich and Bern by 15 minutes (from 70 minutes to less than one hour) and headways between trains have been reduced to 110 seconds and train speeds have increased to 200 km/h.

ERTMS deployment was a strategic political choice with no overall cost estimate

26. The ERTMS concept as a single signalling system in Europe stems from the strategic political choice, made in the 1990s, to create a single European railway area. The first legal obligation was included as early as 1996 and this was followed by multiple legislative acts making ERTMS deployment compulsory for both high-speed and conventional rail. However, these legal obligations were not based on an overall cost estimate establishing the necessary funding and its sources²¹.

27. It was only in 2015 that the Commission started to assess the cost of ERTMS deployment (see [paragraph 47](#)). This exercise was limited to assessing the equipment and its installation cost and was restricted to the core network corridors. The Commission made no assessment for the entire core and comprehensive network, where ERTMS is to be deployed by 2030 and 2050 respectively.

28. We found that the deployment of ERTMS (in combination with the required associated works²²) both on tracks and on-board turned out to be a costly exercise. The extrapolation of the cost of two visited Member States (Denmark and the Netherlands), which opted for ERTMS on a network scale shows that the overall cost of deploying ERTMS could be up to 80

²¹ Only limited analyses were done in 2000 by the Association Européenne pour l'Intéropérabilité Ferroviaire (AEIF) for high-speed lines.

²² In order to put ERTMS fully into operation on trackside, the total cost to be borne by the infrastructure managers is not necessarily limited to the cost of equipment and installation, but may also include other associated works required to migrate from a fully-functional national signalling system to a fully-functional ERTMS system.

billion euro by 2030 for the core network corridors or up to 190 billion euro by 2050 when the comprehensive network is expected to be equipped with ERTMS (see [**paragraph 55**](#)). Such works, however, may also be required if systems other than ERTMS replace obsolete signalling equipment or to address maintenance backlogs. The overall cost may decrease over time due to future technological development, economy of scale and increased competition among ERTMS suppliers.

A thicket of legal obligations, priorities and deadlines

29. In the course of the last 20 years, numerous legal documents have set obligations related to the deployment of ERTMS. There have also been attempts to prioritise specific lines and set differentiated deadlines. However, there has been little coordination between these obligations, priorities and deadlines and this has hindered a coherent deployment of ERTMS (see also [**paragraph 36**](#) and [**40**](#)).

30. The obligation to deploy ERTMS starts with Directive 96/48/EC, which makes it one of the basic principles for the interoperability of high-speed lines. The same principle is included for conventional rail in Directive 2001/16/EC, which states that “all new infrastructure and all new rolling stock manufactured or developed after adoption of compatible control and command and signalling systems must be tailored to use of those systems”. The first technical specifications for interoperability concerning ERTMS, which are compulsory for both high-speed and the conventional rail, were made legally binding in 2002; these were followed by subsequent technical amendments. Furthermore, Decision 2012/88/EU²³ requires the installation of ERTMS for all rail projects funded with EU money regardless of their location. New or renovated lines have to be equipped with ERTMS even where the deadline for deployment of such lines is 2050 or beyond, according to the TEN-T regulation (see [**paragraph 75**](#)).

²³ 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 (OJ L 51, 23.2.2012, p. 1).

31. As far as on-board deployment is concerned, the decision requires new locomotives and other new railway vehicles ordered after 1 January 2012 or put into service after 1 January 2015, to be equipped with ERTMS, with the exception of regional traffic.

32. The first official deadlines for ERTMS deployment are set out in the 2009 European Deployment Plan (EDP), which was limited to six ERTMS corridors, indicating that 10 000 km of trackside should be equipped with ERTMS by 31 December 2015 and 25 000 km by 31 December 2020. As of late 2016 only around 4 100 km were equipped with ERTMS (see [paragraph 36](#)). In early 2017 the Commission revised these targets in the new European Deployment plan (EDP) and postponed the deadlines beyond 2015, up to 2023, whereas the remaining sections will only be deployed after 2023, without any fixed and coordinated deadlines (with the exception of the overall deadline of 2030).

33. In addition, the TEN-T regulation established a deadline of 31 December 2030 to equip the entire core network of 66 700 km with ERTMS (including nine core network corridors accounting for approximately 51 000 km) and 31 December 2050 for all 123 000 km of the comprehensive network (see [Table 2](#)). We found that no interim targets for monitoring have been set for overall ERTMS deployment by 2050. These deadlines and specific sections of lines to be equipped with ERTMS may be subject to change and moving targets as it is envisaged that the newly adopted European Deployment Plan and TEN-T regulation will be revised by 2023.

Table 2 – Deadlines for ERTMS deployment

	Core network corridors	Core network	Comprehensive network ¹	Whole EU rail network
Length (km)	51 000	66 700	123 000	217 000
Deadline	2030	2030	2050	No deadline

¹ The comprehensive network includes the core network and the core network corridors (see [paragraph 12](#)).

Source: European Court of Auditors based on data of the European Commission and TEN-T Regulation (EU) No 1315/2013.

No deadline is set for decommissioning current national signalling systems

34. The EU Member States have adopted different strategies for the deployment of ERTMS on their rail network. Among the Member States visited only Denmark has chosen to dismantle its national system and roll-out ERTMS as a single signalling system on the majority of its national rail network, taking into account shortcomings and obsolescence of its current national signalling system. All the other Member States visited have opted for ERTMS as an add-on software based-system for their national signalling systems, in particular where their remaining lifetime is 15-20 years (for example, in Germany).

35. For ERTMS to be a single signalling system in the EU, national signalling systems must be decommissioned. Neither 2009 EDP nor the new EDP includes any strategy for decommissioning national signalling systems. At the time of the audit, no deadline for decommissioning the national signalling systems in the Member States had been established. However, the Member States are obliged to inform the Commission about their deadlines of decommissioning via national implementation plans, due to be submitted to the Commission in July 2017²⁴. Notwithstanding the challenges of introducing a coordinated obligation binding on all the Member States, the absence of such information is a significant obstacle that stands in the way of long-term investment planning by railway undertakings nor does it help to accelerate ERTMS deployment across the EU.

So far limited and patchy deployment of ERTMS

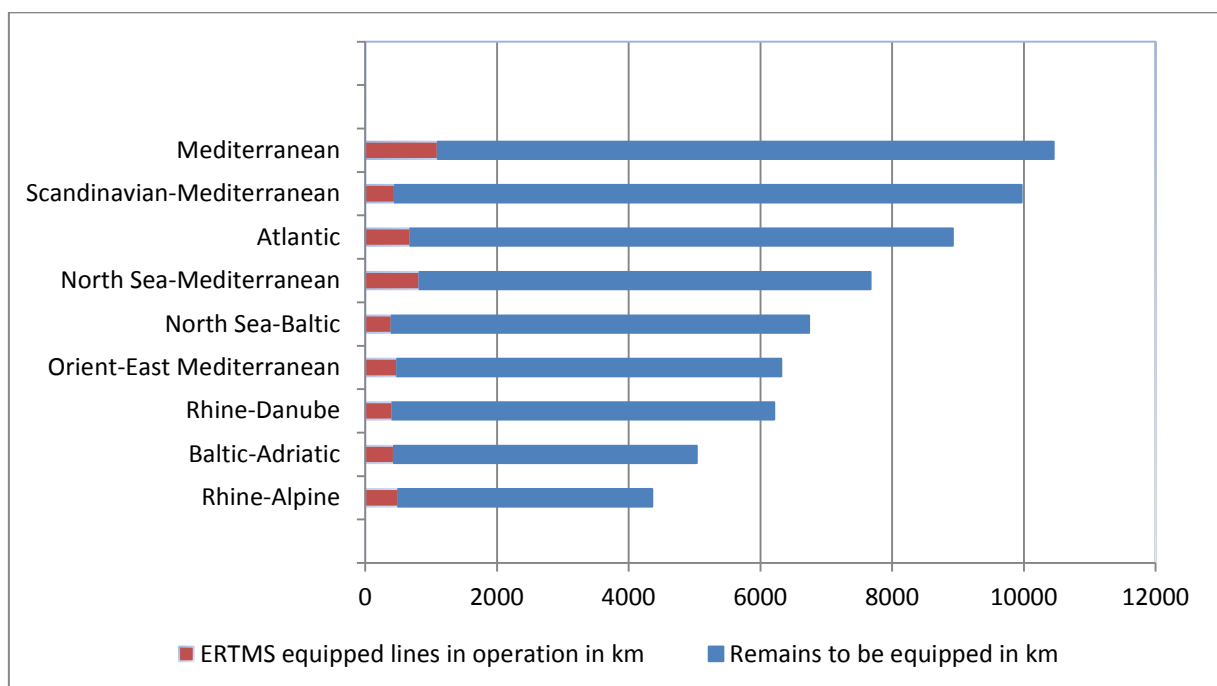
36. As compared with the targets set (see [paragraph 32](#)), out of 51 000 km of core network corridors to be equipped by 2030, only 4 121 km of ERTMS were in operation as of the end of 2016. This only represents around 8 % of the core network corridors. Out of nine core network corridors the most advanced is the Rhine-Alpine corridor with 13 % of lines already

²⁴ The Member States should include the indicative dates of decommissioning of national systems on the different lines of the network. If decommissioning of national systems is not foreseen within a period of 15 years, these indicative dates are not required (Commission Regulation (EU) 2016/919 of 27 May 2016 on the technical specification for interoperability relating to the 'control-command and signaling' subsystems of the rail system in the European Union (OJ L 158, 15.6.2016, p. 1)).

equipped. ERTMS deployment in other corridors ranges from between 5 % and 12 % (see **Figure 4**).

37. We consider that this low level of deployment of ERTMS puts the achievement of the targets set for 2030 at risk as these targets are unlikely to be met and significantly undermines potential interoperability benefits. A close follow-up by the Commission of the recently adopted EDP is necessary, as it is a prerequisite of successful deployment.

Figure 4 - ERTMS deployment in core network corridors as of end of 2016 (in km)



Source: European Court of Auditors based on data of the European Commission.

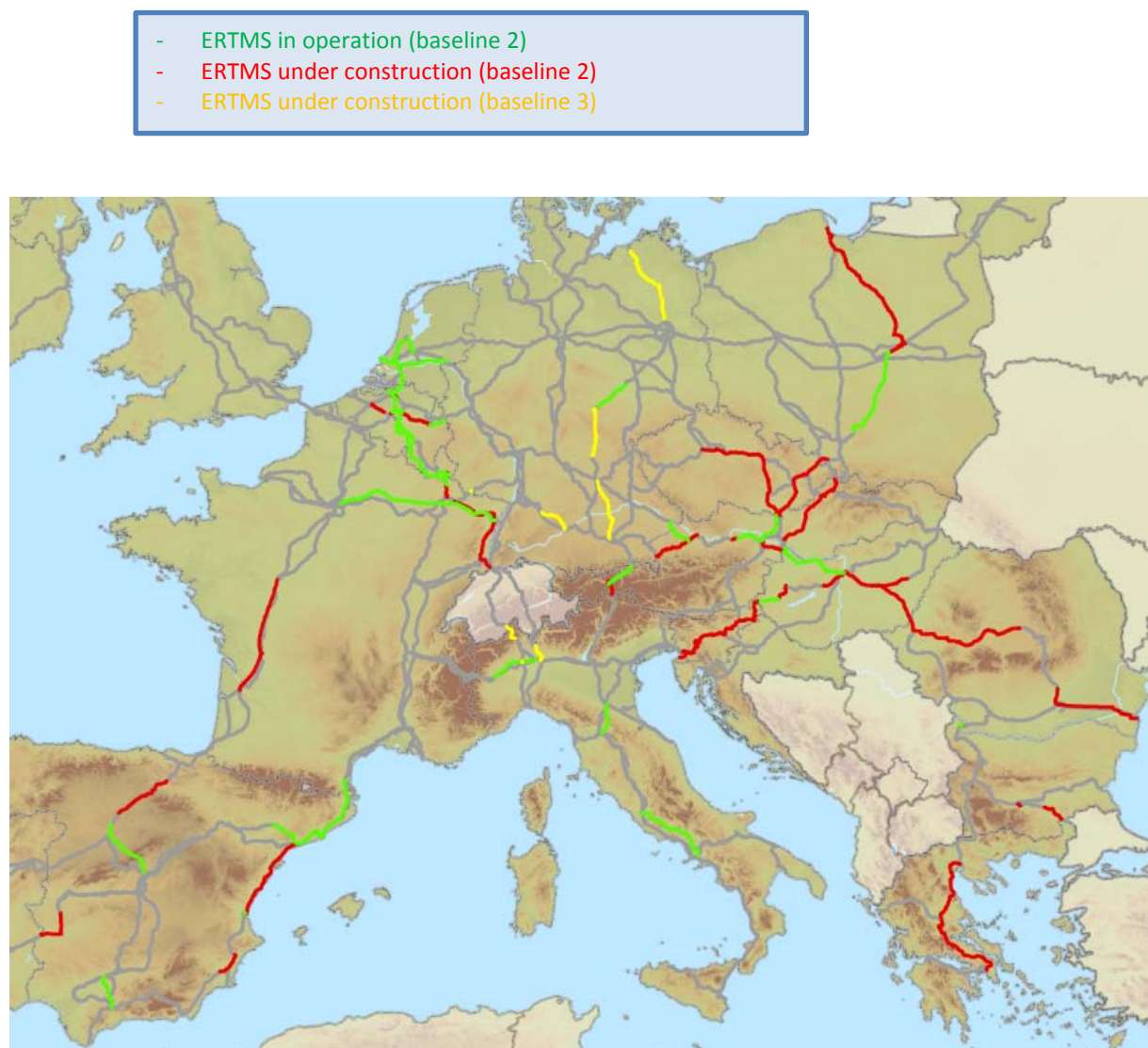
38. The status of ERTMS deployment within the core network corridors varies significantly in the EU Member States (see **Annex IV**). Out of the six Member States visited, the Netherlands and Spain were the only ones that fulfilled the targets set for 2015 in the 2009 EDP.

39. The deployment of ERTMS in the rolling stock in the EU is also low, amounting to around 2 700 units, i.e. 10 % of the total EU fleet. Most of the vehicles already equipped belong to the high speed passenger fleet operating mainly in domestic markets.

40. Currently ERTMS is deployed in a patchy way, with many stretches not connected to each other (see **Figure 5**). In addition, although, according to EU policy, the core network

corridors should be the main focus of investments, we found cases of single lines outside the core network with no connection to the rest of the respective network or the cross-border section. Although the Commission is the initiator of the ERTMS concept, it has no precise overview of the overall deployment on the European level as its monitoring is limited to the core network.

Figure 5 – ERTMS patchwork deployment on core network corridors



Source: European Commission.

41. In some cases we found a lack of coordination between trackside and on-board ERTMS deployment. For example, in Poland, the rolling stock equipped with ERTMS has been purchased but, in reality, it only actually works on 218 km (out of 3 763 km of its core

network corridors), and trains can run at 200 km/h on just 89 km of these. In the remaining cases, trains run with ERTMS switched off, as the remaining trackside infrastructure is not equipped with ERTMS. In practice, the use of ERTMS is as low as 6.5 % per day. In Italy the effective use of ERTMS equipped trains varies between 19 % and 63 % in terms of train/km and it is limited to high speed lines only.

Many infrastructure managers and railway undertakings have been reluctant to invest in ERTMS due to the lack of an individual business case

An overall positive outcome of ERTMS at EU level, but only in the long term

42. Possible benefits of ERTMS generally concern society or the rail sector as a whole rather than the individual infrastructure managers and railway undertakings that have to take the investment decision as to whether or not to install ERTMS, and bear its cost.

43. In 2016, the Commission developed a positive aggregate business case for ERTMS deployment at the level of each corridor in a business case report on the nine core network corridors²⁵. However, this business case demonstrates that potential benefits will only materialise, in general, in the long term. In addition, this analysis does not indicate if the benefits of ERTMS deployment will make up for its cost for infrastructure managers or railway undertakings, considered individually or even as a category.

Many infrastructure managers and railway undertakings with diverse needs expected to invest in one system

44. Based on the current legislation (see **paragraph 30** and **31**), ERTMS is a compulsory investment for different rail stakeholders with very diverse needs: infrastructure managers with obsolete and under-performing signalling systems, infrastructure managers with relatively new and well-performing signalling systems, freight operators, passenger operators, high-speed rail operators, international and domestic rail operators and others. They are all expected to invest in ERTMS as a single signalling system according to the same

²⁵ Business case on the nine core network corridors, July 2016, prepared by EY and INECO for the European Commission.

statutory deadlines, whereas investments in rail infrastructure and rolling stock are usually made on a long term basis, as the average useful lifetime is around 30 years.

45. The willingness of infrastructure managers to invest in ERTMS depends on their starting points. Some infrastructure managers already have well-functioning and relatively new signalling systems which has made them reluctant to invest in ERTMS (for example in Germany), whereas in other Member States, the signalling systems were coming to the end of their life-cycles or their performance in terms of safety or speed was no longer sufficient (for example Denmark, see also **Box 3**). According to the stakeholders interviewed, the obsolescence of national signalling systems will eventually trigger the overall deployment of ERTMS; however, coordinated timing is a decisive factor for ERTMS to be successfully deployed (see **paragraph 70**).

Box 3 – Two examples of factors determining the decision of infrastructure managers whether to deploy ERTMS or not

In Denmark, an analysis was carried out in 2006 to assess how to re-invest most effectively in the signalling system for the state railway. It concluded that the national system was obsolete and it could only be kept in operation until 2020 at the latest. Hence Denmark was the first country in the EU that decided to roll out ERTMS across the whole state-owned railway network without a fall-back to the national signalling system.

In Germany, it is difficult for the infrastructure manager to build a business case for ERTMS deployment as there are already two well performing systems, LZB and PZB. The LZB system, installed on 2 600 km of tracks, already enables trains to run at a speed of around 300 km/h on lines with high traffic density, even if it is progressively reaching the end of its life cycle, expected around 2030. The PZB system, covering 32 000 km of conventional tracks, is also considered by the German infrastructure manager to be well-performing in terms of safety, capacity and other performance indicators and it will be available for a longer period of time even though it allows lower speed.

46. As regards railway undertakings, the need to have ERTMS depends on the types of operations and business that they have. Significant differences are, for example, noted between the needs of ERTMS for high speed and conventional traffic (especially freight for which a maximum speed of around 100 km/h is needed), and between railway undertakings

operating almost exclusively in one country and those operating international freight and passenger traffic.

ERTMS investments are costly

47. It was only in 2015 and 2016 that the Commission started to assess the cost of ERTMS deployment in two studies²⁶. This assessment was limited to the cost of ERTMS equipment and installation and restricted to the core network corridors. Based on this cost category, the trackside deployment cost could range between 100 000 and 350 000 euro per kilometre, i.e. 5-18 billion euro respectively.

48. In order to put ERTMS fully into operation on trackside, the total cost to be borne by the infrastructure managers is not however limited to the cost of equipment and installation, but also includes other associated works required to migrate from a fully-functional national signalling system to a fully-functional ERTMS system. According to the Commission these works are a pre-requisite for deployment, even though they are not formally a part of ERTMS.

49. The two Member States visited (Denmark and the Netherlands) which opted to deploy ERTMS on a large scale on their rail network have designed their ERTMS national deployment programmes and drafted their estimated budgets. Based on their estimates, we assessed the magnitude of the investments that may be required in order to have a fully-functional ERTMS trackside across the EU. The total estimated cost includes all necessary components, such as: the renovation of the interlocking system, the design, testing and authorisation of the system, project management, investments related to the telecommunication and radio block centres, the training and re-deployment of staff or migration management. Moreover, ERTMS deployed trackside as an additional system may entail further maintenance costs until the national system is not needed any more and is decommissioned.

²⁶ “Study to develop tailor-made solutions for use of innovative financing to support deployment of ETMS, in particular along nine core network corridors” (November 2015) and “Business case report on the 9 core network corridors”, July 2016.

50. In these two Member States, the total cost of ERTMS deployment trackside amounts to 2.52 billion and 4.9 billion euro for 2 132 and 2 886 km of lines respectively, or an average cost of 1.44 million euro per kilometre of line (see more details in **Annex V**). A linear extrapolation of these estimates indicates that the total cost of ERTMS deployment trackside throughout the core network corridors or the comprehensive network could range between 73 and 177 billion euro, depending on the extent of the deployment (see **Table 3**). Technological development and economy of scale might reduce in future the overall cost of the ERTMS deployment.

51. In addition to the cost of ERTMS deployment on trackside, which is borne by the infrastructure managers, ERTMS must also be installed on the locomotives, at the expense of railway undertakings. The situation differs for existing locomotives, which have to be retrofitted to be able to run on ERTMS equipped lines, and new locomotives, which are purchased with the ERTMS already installed on-board.

52. In the case of existing locomotives, the two aforementioned Commission studies refer to a cost per locomotive between 375 000 euro and 550 000 euro, including ERTMS equipment and installation, testing and authorisation and unavailability of the vehicle. In addition, associated training costs are estimated at 20 000 euro per locomotive. Considering that the number of on-board units to be retrofitted is estimated at 22 000 (see **paragraph 39**), these figures could translate into an average cost of 11 billion euro for the entire fleet (see details in **Annex V**). Moreover, the additional ERTMS on-board equipment may result in further maintenance cost per locomotive until the national signalling system is decommissioned.

53. During the audit we found that the retrofitment cost varies a lot depending on the number of locomotives to be retrofitted and the number of countries in which they operate. In addition, subsequent statutory ERTMS upgrades, resulting from the constant evolution of the system and the correction of errors in the software, entail further significant costs. In some cases we found that the total cost amounts to almost one million euro per on-board unit, and this excludes the unavailability cost, as shown in **Box 4**.

Box 4 – Example of the total cost of the retrofitment of several series of locomotives

In the Netherlands, one of the reviewed projects concerned the retrofitment of several multi-system freight locomotives with ERTMS, baseline 2.3.0d. The cost of the retrofitment, including compulsory upgrades, ranged between 663 000 and 970 000 euro per locomotive. As soon as the infrastructure manager deploys baseline 3 another compulsory up-grade is expected.

In Germany, another selected project consisted in the retrofitment of several freight locomotives with ERTMS baseline 2.3.0d. The cost ranged between 420 000 and 630 000 euro per locomotive. An up-grade to baseline 3, needed to operate in Germany, would on average result in an additional cost of 270 000 euro per locomotive.

54. New locomotives or trainsets have to be equipped with ERTMS irrespective whether they run on ERTMS equipped lines or not. The average cost of an on-board unit is estimated by railway undertakings in the Member States visited at approximately 300 000 euro (around 15 % of the cost of the whole locomotive). This investment cost is not included in the overall cost estimate for on-board deployment included in the aforementioned studies.

55. Hence, ERTMS, together with the required associated works, entails costly investments which have to be covered by infrastructure managers and railway undertakings. The overall cost of ERTMS deployment, both trackside and on-board, could be up to 80 billion euro for the core network corridors or 190 billion euro for the comprehensive network (see **Table 3**). Such works, however, may also be required if systems other than ERTMS replace obsolete signalling equipment or to address maintenance backlogs. Since infrastructure managers plan their investments over the time horizon of 30-50 years, and while acknowledging the difficulties in anticipating future technological evolution over such a long period, it is of critical importance to have a cost estimate for the deployment and a reliable planning, including financing coverage, as the EU funding cannot be expected to cover the deployment cost and other sources of funding have to be found (see **paragraph 73**).

Table 3 – Cost extrapolation of ERTMS deployment trackside based on the Danish and Dutch cases

	Core network corridors	Core network	Comprehensive network
Length (km)	51 000	66 700	123 000
Cost extrapolation trackside (billion euro)	73	96	177
On-board retrofitment (billion euro)	11		
Total (billion euro)	84	107	188

Source: European Court of Auditors based on a linear extrapolation of the existing national estimates in Denmark and the Netherlands.

Compatibility and stability problems adversely affect the individual business case

Problems of compatibility between different versions of ERTMS

56. Compatibility problems may arise mainly as a result of two major factors: the integration of ERTMS with the existing national signalling system in each Member State and the deferred deployment of ERTMS across the borders.

57. In the EU ERTMS is embedded in the national rail networks and their signalling systems (i.e. brownfield projects). Due to tailor-made ERTMS solutions in the national rail networks there is currently no ERTMS on-board unit in the EU able to run on all rail sections equipped with different versions of ERTMS. Interoperability issues occur not only in the cross-border sections between Member States, but even within one country (for example, the Netherlands). In addition, we noted that, so far, ERTMS deployment has been limited to lines whereas train stations and hubs have not yet been equipped with ERTMS.

58. The Member States opted for the deployment of the ERTMS system at different stages of its development and on various railway lines within their national networks. The technical specifications for interoperability have evolved at a very rapid pace hampering the overall stability of the system (on average they have been changed every two years) and resulting in the need for subsequent upgrades. For example, although baseline 2.3.0d was issued in

2008, and is still valid today, baseline 3 was being developed and prioritised for deployment in the meantime²⁷. Locomotives equipped with ERTMS baseline 2 will not be able to run on tracks equipped with baseline 3. The stakeholders expect that this problem will be mitigated in the future as baseline 3 on-board units should be able to run on baseline 2 trackside (see **Box 5**).

Box 5 – Examples of compatibility problems

In Italy, 366 km of high-speed lines are equipped with baselines preceding baseline 2.3.0d and will have to be upgraded in the near future to enable new trains to run on them. In addition, conventional lines are supposed to operate with baseline 3. The locomotives equipped with baseline 2.3.0d will not be able to run on these lines. Some of them have already been upgraded with the support of EU co-financing.

In Spain, the first lines were equipped with baseline 2.2.2+. Spain has already upgraded some but further efforts will have to be made to migrate these lines to 2.3.0d. At the time of the audit, 1 049 km out of 1 902 km of lines still needed to be upgraded (55 %). Similarly, 158 out of 362 already equipped vehicles now need to be upgraded to be kept operational.

Need for the industry to deliver a harmonised version

59. The lack of compatibility of the ERTMS equipment is also the result of the fact that the industry prepares tailor-made solutions adapted to the specific requirements of each Member State, which are not always compatible. Potential problems and errors are usually not publicly communicated and this affects the learning curve and makes it difficult to find common solutions.

60. Additionally, taking into account the large scale of the investments that are planned in the near future under the new EDP, there is a risk that the industry may not be ready to deliver a stable harmonised version of the equipment. The capacity of the industry to deliver the product will depend on the customisation level of the specific tenders launched by the

²⁷ The revised TSI for the onboard and trackside control-command and signalling subsystems was adopted by Commission Regulation (EU) No 2016/919 published on 15 June 2016, establishing baseline 3, release 2 as the current standard. However it is still not free from bugs and errors that need to be remedied.

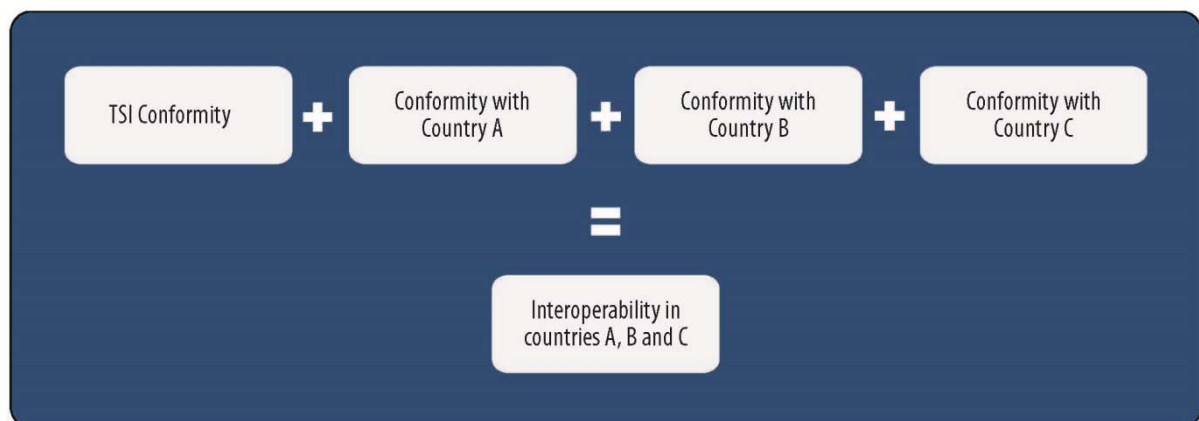
infrastructure managers and railway undertakings. National variations may further increase both costs and risks to interoperability.

Lengthy certification procedures to ensure compatibility

61. The certification of ERTMS involves notified bodies, which are responsible for testing and certification, and national safety authorities, which issue authorisations. In order to obtain a certificate for a line or an on-board unit the infrastructure managers and railway undertakings usually cooperate closely with the national safety agency from the very beginning of the project, before a formal application is submitted (the so-called pre-engagement procedure).

62. During the audit we found that the certification and authorization processes were relatively lengthy and required on average one-two years, depending on the length of these unofficial technical pre-engagement procedures. In the case of cross-border operations we found that the certification of on-board units was particularly complex and costly due to national variations which also hindered the cross-acceptance of work performed by the national safety authorities in other Member States (see **Figure 6**).

Figure 6 – Cross-acceptance of vehicle



Source: European Court of Auditors.

Enhanced role of ERA a positive move towards the single European railway area

63. The recent legislative developments, resulting in a stronger role for ERA are a positive move towards a single European railway area. The Fourth Railway Package entrusts ERA, as a formal system authority for ERTMS, with the tasks of issuing EU-wide safety certificates for railway undertakings and authorisations for vehicles and ERTMS subsystems used in more than one Member State, as well as verifying technical trackside solutions included in tenders submitted by the infrastructure managers from mid-2019 onwards. In addition, ERA will have an increased supervisory role over the notified bodies and national safety agencies and assess tender documentation for trackside deployment in the EU.

64. However, there are still significant challenges which put the deployment of ERTMS at risk. These particularly concern:

- ERA's administrative capacity as the ERTMS system authority for an overall project amounting to hundreds of millions of euro and its enhanced role under the 4th Railway Package;
- the need for practical guidelines and training reducing the steep and costly learning curve in the practical design and deployment of ERTMS in the Member States;
- the increased ERA's role in the supervision of notified bodies and national safety agencies and its ability to verify ERTMS technical trackside solutions as it might not be possible for ERA to anticipate any compatibility issue with applicable TSIs from tendering documents;
- the mechanism for appeals and reporting on low quality certificates, which needs to be standardised as do the ERTMS tests to be performed on tracks at EU level as is already the case for rolling stock.

65. In 2014, a joint undertaking Shift2Rail was established as a public- private partnership to contribute towards the achievement of a single European railway area. We noted that ERA has a limited observer role in its governing board and that there is a need for closer cooperation between Shift2rail and ERA. Therefore, there is a risk that ERA may miss the opportunity to act early when monitoring and consulting Shift2Rail on its deliverables,

particularly taking into account that, in addition to primary research, the joint undertaking is also involved in developing products, such as an automatic train operation for future ERTMS baselines. The compatibility of the development of new ERTMS functions with current technical specifications for interoperability is vital to ensure interoperability in the future.

New European Deployment Plan is a step forward but major challenges remain

66. Although it turned out that the deadlines set in the 2009 European Deployment Plan for ERTMS deployment were unlikely to be met, the Commission decided not to enforce infringement procedures against any Member States that had not fulfilled their obligations in terms of deploying ERTMS on the corridor sections. Instead, in December 2014, the Commission and the European Coordinator for ERTMS launched the Breakthrough Programme²⁸ to accelerate ERTMS implementation across the EU with a view to adopting a new deployment plan.

67. This programme was negotiated with the Member States at a high level. The discussions were held between the European Coordinator and national ministries and infrastructure managers. Based on the Breakthrough Programme and following the negotiations the Commission drafted the new European Development Plan in the form of a legislative act directly applicable to the EU Member States. It was officially published on 5 January 2017²⁹.

68. The new European Deployment Plan, which is supported by the Member States, is a step towards more realistic deployment, but major challenges remain. Firstly, as in the past, it does not include any overall cost assessment for ERTMS deployment. Secondly, it is in no way linked to any dedicated funding nor is the source of this funding defined; hence other incentives have to be found for the sector to meet its targets. In addition, there is still no legally binding deadline for decommissioning the current national systems with a view to making ERTMS a sole (and not additional) signalling system.

²⁸ It was based on four principles: (1) “users first” and not “designers first”; (2) standardised on-board equipment; (3) entire priority and focus on deployment and (4) ERTMS system cost reduction.

²⁹ Commission Implementing Regulation (EU) 2017/6.

69. As regards the long-term predictability needed for the railway undertakings to plan their investments, the new EDP only refers to specific trackside deployment targets between 2017 and 2023, whereas the remaining sections to be equipped are only shown as “beyond 2023”, with no fixed deadline (except for the general deadline of 2030). This affects the coordination of deployment among Member States and discourages railway undertakings from planning their on-board investments accordingly. We also found that over the next five years the expected revisions of the legislative acts (see **paragraph 33**) make it particularly difficult for railway undertakings to make a long term investment decision.

70. Moreover, the planned deployment set out in the newly adopted EDP is affected by a lack of time alignment between Member States on cross-border sections. This shows that Member States plan their deployment according to their national needs, regardless of any commitment made in relation to EU priorities. For example, according to current plans, Germany intends to equip only 60 % of its railway lines on core network corridors by 2030, without reaching 100 % completion on any of them.

EU funding can only cover a limited amount of the costly investment, and has not always been properly managed and targeted

EU funding available for ERTMS deployment can only cover a limited amount of the investments

71. Approximately 1.2 billion euro was allocated from the EU budget for ERTMS trackside and on-board investments between 2007 and 2013 from two main sources: TEN-T Programme, which amounted to 645 million euro and the Structural Funds (the ERDF and the Cohesion Fund), estimated at 574 million euro (the ERTMS component is estimated at 10 % of major rail investments).

72. During the 2014-2020 programme period the EU budget continues to support ERTMS deployment with an estimated total budget of 2.7 billion euro. Regarding the CEF, there have been three dedicated calls for project applications, for an overall amount of 850 million

euro from the CEF for ERTMS projects until 2020³⁰. ERTMS projects can also benefit from the European Structural and Investments Funds (ESIF) support, in the eligible regions, up to 1.9 billion euro³¹.

73. EU funding available for ERTMS only represents a limited percentage of the overall cost of deployment with most of the financing to be found from other sources. As described in **paragraph 55**, the cost of ERTMS deployment on core network corridors (both trackside and on-board) is in the order of 90 billion euro. EU financial support for ERTMS projects during the 2007-2020 period amounts to 4 billion euro, or less than 5 % of the total cost of ERTMS deployment on core network corridors.

74. In the last two CEF calls for project applications, the value of submitted project proposals exceeded the available funding by 5.6 and four times respectively (the third call for applications had not yet been evaluated at the time of the audit). Thus, even if 100 % of the EU funding is successfully taken up, the infrastructure managers and railway undertakings will still need to cover the outmost majority from other financing sources in order to deploy ERTMS across the EU.

Different issues with ERTMS projects related to the management mode

Lack of monitoring and limited use of EU funding in shared management

75. We found that, unlike INEA for TEN-T and CEF projects, the Directorate-General for Regional and Urban Policy does not involve ERA or external experts in order to assess the compliance of implemented projects with the technical specifications for interoperability. Therefore there is a risk of potential problems involving the compatibility of the different versions of ERTMS installed.

³⁰ In addition to ERTMS specifically dedicated projects, ERTMS components can be co-financed by the CEF as a part of larger rail projects. Such allocations to ERTMS amounted to 56.5 million euro in 2014 and to 37.8 million euro in 2015.

³¹ During the 2014-2020 period the ESIF support to rail amounts to 18.7 billion euro, out of which roughly 10 % or 1.9 billion euro would benefit ERTMS deployment.

76. In the case of Cohesion policy projects, ERTMS investment is usually part of the renovation or construction of a rail section. The signalling equipment is only installed at the final stage of the process. Such projects may experience delays, reaching in some cases the end of eligibility period. As a result, the projects need to be financed from the next programme period as happened in Poland. Therefore, in practice, the use of EU funding for ERTMS investments in the 2007-2013 period was limited (see **Annex III**).

Significant decommitment levels in direct management

77. Although the value of submitted project applications exceeded the available funding (see **paragraph 74**), the original TEN-T allocations³² to ERTMS projects had been subject to significant decommitments during the 2007-2013 programme period. Overall in the EU, 50 % of TEN-T funds originally allocated to ERTMS projects were decommitted (see **Table 4**) and only 218 million euro out of 645 million euro (34 %) had already been paid out at the time of the audit. The decommitment rate goes up to 86 % for the six Member States selected for the audit³³.

Table 4 – Provisional decommitments related to TEN-T support for ERTMS projects (2007-2013 programme period)

	Denmark	Italy	Germany	Spain	Poland	Netherlands	Six Member States selected	Total EU
Ratio of decommitment	100 %	94 %	92 %	83 %	75 %	38 %	86 %	50 %

Source: European Court of Auditors calculations based on data of INEA as of January 2017.

78. The main reason for these decommitments is the fact that EU financial provisions are not aligned with the life cycle of ERTMS projects, which can be affected among others by long

³² During the 2007-2013 programme period, there were five dedicated ERTMS calls, with an overall budget of around 770 million euro. However, only 645 million euro was allocated as some actions were terminated by the beneficiaries even before the Commission decision had been adopted.

³³ The figures may change subject to completion of pending final payment procedures of TEN-T actions retained for funding during 2007 – 2013 financial framework.

testing and certification procedures or changes in the technical specifications and national implementation strategies. Delays in implementation or reductions in the original project scope resulted in the full or partial decommitment of funding, as it was not possible for the beneficiaries to complete the project within the eligibility periods set in the calls for proposals.

79. There is a risk that CEF funds may also be decommitted during the 2014-2020 programme period. At the time of the audit, the payments made amounted to 50 million euro out of the 689 million euro allocated (7.3 %). Four projects, accounting for a total EU support of 30.7 million euro, were cancelled even before they had obtained any pre-financing and the grant agreement had been signed due to a change of implementation plans or excessively high costs requested by suppliers.

80. EU funds that have been decommitted at an early stage of the programme period can be used again to finance other ERTMS projects. However, the Commission does not have a clear view of how much of the amounts recovered from ERTMS actions were actually re-allocated to ERTMS. All EU funds already decommitted or to be decommitted at a later stage in the programme period (i.e. after 2013), are transferred back to the general EU budget, thus reducing the availability of EU funds for ERTMS deployment.

EU funding has not always been well targeted

On trackside, limited focus on cross-border sections and core network corridors, especially in Cohesion policy

81. The EU funding was not always concentrated on core network corridors as is shown in our analysis of the projects selected for the audit (see **paragraph 86**). This is particularly the case for Cohesion policy support as installing ERTMS is compulsory whenever renovating or building a new rail line regardless of the project location. This does not comply with the prioritisation of corridors (i.e. ERTMS corridors or core network corridors) promoted by the Directorate-General for Mobility and Transport (see **paragraph 30**) and may lead to ineffective use of EU funds, as a line which needs to be equipped under Cohesion policy might not use ERTMS in practice for a long time and then need a subsequent upgrade of the signalling system.

82. As regards border crossing, only limited EU support was allocated for cross-border trackside sections despite EU policy and the Court's recommendations in 2005 and 2010: in six visited Member States out of 31 trackside projects selected for the review only six concerned cross-border sections, however, two of these projects were cancelled (Germany).

83. As far as the Member States selected for this audit are concerned, in Germany ERTMS has not been put into commercial operation on any cross-border section, whereas Austria, Belgium and the Netherlands have already equipped some sections at their borders with Germany. The Netherlands have also equipped the cross-border section with Belgium and Spain has one operational cross-border section with France whereas at the time of the audit, Denmark, Italy and Poland had not yet equipped any of their cross-border sections on core network corridors.

EU funding available for on-board units mostly taken up by domestic traffic

84. EU financial support allocated to on-board units is mostly taken up by the railway undertakings which for passenger traffic run almost exclusively on domestic lines. In the case of the six Member States visited, 70 % of TEN-T and CEF support for on-board units during the 2007-2015 period was allocated to railway undertakings operating passenger domestic traffic. Rail freight traffic, which is more likely to be involved in international traffic, accounted for the remaining 30 % of the available support.

85. In addition, freight locomotives are not supported by Cohesion policy funding for retrofitment. Only passenger vehicles, used for domestic traffic under the public service obligation scheme and generally owned by the incumbent rail operator, can potentially benefit from this source of EU support for the purchase of new or upgrade of existing rolling stock.

Status of EU-co-financed projects examined during the audit: delays, decommitments and inaccurate targeting

86. At the time of the audit, 14 out of 31 trackside projects selected had been completed, although five were late and one had been completed with a reduced scope. 13 projects were on-going, including three that were subject to delays which, in one case, had led to the full

decommitment of the EU funding. Four projects were cancelled and the EU funding was consequently decommitted. Six out of 31 trackside projects were not or only partially implemented on TEN-T corridors. This was particularly the case for Cohesion policy projects (four out of 11 projects).

87. As regards on-board equipment, 16 out of 20 projects had been completed, including nine with delays and three with a reduced scope. Two projects were on-going, but in one case the delay resulted in EU funding being decommitted and in another case the project was both delayed and had had its scope reduced. Two projects were cancelled and the EU funding was fully decommitted. For detailed information see **Annex III**.

CONCLUSIONS AND RECOMMENDATIONS

88. Overall, the Court found that the deployment of ERTMS had been based on a strategic political choice and had been launched with no overall cost estimate or appropriate planning for a project worth up to 190 billion euro by 2050. Despite the fact that the ERTMS concept and the vision of enhancing interoperability are not generally questioned by the rail sector, so far ERTMS deployment has been low and patchy. The current status of ERTMS deployment can mainly be explained by the reluctance of many infrastructure managers and railway undertakings to invest in ERTMS equipment due to the costly investment entailed and the lack of an individual business case for many of them (for example in the Member States with well performing national systems and significant remaining lifetime). Even if EU funding could be better managed and targeted, it can only cover a limited amount of the costly investment.

89. This creates risks not only for the achievement of the ERTMS deployment targets set for 2030 and the investments made so far, but also for the realization of a single European railway area which is one of the major policy objectives of the European Commission. It may also adversely affect the competitiveness of rail transport as compared with road haulage.

ERTMS was a strategic political choice and was launched with no overall cost estimate or appropriate planning for its deployment

90. Despite the political decision to deploy a single signalling system in the whole of the EU, no overall cost estimate was performed to establish the necessary funding and its sources, even though the project is costly. The legal obligations introduced did not require the decommissioning of the national signalling systems, and these obligations are not aligned with deadlines and priorities included in the EU transport policy. At the time of the audit, the level of ERTMS deployment across the EU was low.

Recommendation 1 – Assessment of ERTMS deployment costs

The Commission and the Member States should analyse the total cost of ERTMS deployment (both trackside and on-board) by Member State, taking into account the core network and comprehensive network in order to introduce a single signalling system throughout the EU, given that the time horizon for this type of investment is 30-50 years. The assessment should not only include the cost of ERTMS equipment and its installation, but also all other associated costs based on the experience gained in front runner Member States deploying ERTMS on a large scale.

Deadline: by the end of 2018.

Recommendation 2 – Decommissioning of national signalling systems

The Commission should seek agreement with the Member States on realistic, coordinated and legally binding targets for decommissioning the national signalling systems so as to avoid ERTMS becoming just an additional system to be installed.

Deadline: by the end of 2018.

Many infrastructure managers and railway undertakings have been reluctant to invest in ERTMS due to the lack of an individual business case

91. Even though ERTMS could result in an overall positive outcome at EU level in the long run, many infrastructure managers and railway undertakings have been reluctant to invest in it because of the lack of an individual business case. ERTMS is a single system for multiple infrastructure managers and railway undertakings with diverse needs, but it entails costly investments with, generally, no immediate benefit for those who have to bear the cost. Problems with the compatibility of the different ERTMS versions installed and the lengthy certification procedures also adversely affect the individual business case for infrastructure managers and railway undertakings. Notwithstanding the new European Deployment Plan, major challenges to successful ERTMS deployment remain. It is important that ERA has the administrative capacity to act as the ERTMS system authority, taking into account its enhanced role and responsibilities under the Fourth Railway Package.

Recommendation 3 – Individual business case for infrastructure managers and railway undertakings

The Commission and the Member States should, together with rail stakeholders and the ERTMS supply industry, examine diverse financial mechanisms to support individual business cases for ERTMS deployment without any further excessive reliance on the EU budget.

Deadline: by mid-2018.

Recommendation 4 – Compatibility and stability of the system

(a) The Commission and ERA should, with the support of the supply industry, keep the ERTMS specifications stable, correct the remaining errors, eliminate the incompatibilities between the different ERTMS trackside versions already deployed and ensure future compatibility for all ERTMS lines. In order to do so, ERA should proactively engage in co-operation with the infrastructure managers and national safety authorities prior to the legal deadline in June 2019.

Deadline: with immediate effect.

- (b) The Commission and ERA should, in strong coordination with the supply industry, set a road map for developing a standardised on-board unit able to run on all ERTMS equipped lines.

Deadline: by mid-2018.

- (c) The Commission and ERA should work together with the industry to initiate and steer the development and promote the use of standard tendering templates for ERTMS projects available to all infrastructure managers and railway undertakings to ensure that the industry only delivers compatible ERTMS equipment.

Deadline: by mid-2018.

- (d) The Commission and ERA should facilitate the learning process for persons involved in ERTMS deployment and operation in each Member State so as to reduce the steep learning curve, by exploring different solutions, such as coordinated trainings or exchange of information and guidelines.

Deadline: by mid-2018.

Recommendation 5 – Role and resources of ERA

The Commission should assess whether ERA has the necessary resources to act as an efficient and effective system authority and fulfil its enhanced role and responsibilities on ERTMS under the Fourth Railway Package.

Deadline: by mid-2018.

Recommendation 6 – Alignment of national deployment plans, monitoring and enforcement

(a) Member States should align their national deployment plans, in particular, when a deadline shown in the new European Deployment Plan is beyond 2023. The Commission should closely monitor and enforce the implementation of the new EDP. Whenever possible, Member States should synchronise the deployment deadlines for earlier cross-border projects, so as to avoid a patchwork deployment of ERTMS.

Deadline: with immediate effect.

(b) In view of long planning horizons in the ERTMS sector (going up to 2050), the Commission, in consultation with the Member States, should set milestones to allow proper monitoring of the progress.

Deadline: for the core network, by the end of 2020. For the comprehensive network, by 2023.

EU funding can only cover a limited amount of the costly investment, and has not always been properly managed and targeted

92. EU financial support is available for ERTMS investments both trackside and on-board, but it can only cover a limited amount of the overall cost of deployment. It leaves most of the investment to individual infrastructure managers and railway undertakings, which do not always benefit, at least immediately, from the deployment of ERTMS. In addition, not all EU funding available for ERTMS was ultimately allocated to ERTMS projects and it was not always well targeted.

Recommendation 7 – Absorption of EU funds for ERTMS projects

The Commission should adapt the CEF funding procedures to better reflect the life-cycle of ERTMS projects so as to significantly reduce the level of decommitments and maximise the use of EU funding available for ERTMS investments.

Deadline: starting from 2020.

Recommendation 8 – Better targeting EU funding

The Commission and Member States should target EU funding available for ERTMS projects better in cases of both shared and direct management:

- (a) when allocated to trackside equipment, it should be limited to cross-border sections or core network corridors, in line with the EU transport policy priorities;
- (b) when allocated to on-board equipment, priority should be given to rail operators who are mostly involved in international traffic so as to encourage intramodal and intermodal competition.

Deadline: with immediate effect for new project applications.

This Report was adopted by Chamber II, headed by Mrs Iliana IVANOVA, Member of the Court of Auditors, in Luxembourg at its meeting of 12 July 2017.

For the Court of Auditors

Klaus-Heiner LEHNE

President

ANNEX I**List of national signalling systems in the EU Member States**

Member State	Name
Belgium	Crocodile, TBL 1, TBL 2, TVM 430, TBL1+
Bulgaria	EBICAB 700
Czech Republic	LS
Denmark	ZUB 123
Germany	INDUSI/PZB, LZB
Estonia	ALSN
Ireland	CAWS, ATP
Greece	CLS
Spain	ASFA, EBICAB 900, LZB, SELCAB
France	Crocodile, KVB, TVM 300, TVM 430, KVBP, KCVP, KCVB, NEXTEO, DAAT
Croatia	INDUSI/PZB
Italy	BACC, RSDD/SCMT, SSC
Latvia	ALSN
Lithuania	ALSN
Luxembourg	MEMOR II+
Hungary	EVM
Netherlands	ATB First generation, ATB new generation
Austria	INDUSI/PZB, LZB
Poland	SHP, PKP RADIO SYSTEM WITH RADIOSTOP FUNCTION
Portugal	EBICAB 700
Romania	INDUSI
Slovenia	INDUSI/PZB
Slovakia	LS
Finland	ATP-VR/RHK
Sweden	EBICAB 700
United Kingdom	GW ATP, RETB, TPWS, TVM 430, Chiltern-ATP, Mechanical Trainstops, KVB

Source: ERA.

ANNEX II**ERTMS technical description**

ERTMS is based on the Technical Specification for Interoperability for “Control-Command and Signalling” (TSI CCS), developed by ERA. It can be installed both as an add-on (or overlay) to an existing signalling system or as a single system to be installed for new radio-based infrastructure.

In order to make ERTMS function both the trackside and the train must be equipped with it. The system installed on trackside and the system installed on the vehicles exchange information which makes it possible continuously to supervise the maximum speed allowed for operation, giving the driver all the information needed to operate with cab signalling. The two main components of ERTMS are the European Train Control System (**ETCS**), deployed trackside in the form of a balise and the Global System for Mobile communications-Rail (**GSM-R**), a radio system providing voice and data communication between the track and the train.

Currently there are three **levels** of ERTMS, depending on how the trackside is equipped and the way in which the information is transmitted to the train, and several versions, known as “**baselines**”, as the system is constantly evolving as the result of technological development.

The ETCS levels are as follows:

- Level 1 involves the continuous supervision of train movement but a non-continuous communication between the train and trackside (normally by means of Euro-balises). Lineside signals are necessary.
- Level 2 involves continuous supervision of train movement and continuous communication, provided by GSM-R, between both the train and the trackside. Lineside signals are optional.
- Level 3, provides continuous train supervision with continuous communication between the train and trackside and no need for lineside signals or train detection systems on the

trackside other than the Euro-balises. This level was not yet operational at the time of the audit.

A baseline is a set of documents with a concrete version listed in the TSI CCS, i.e. the specifications for many aspects, components, interfaces, etc. concerning ERTMS. Baseline 2, was the first complete set of requirements to be adopted at European level that was considered to be interoperable. Baseline 3 is a controlled evolution of Baseline 2 which includes new additional functions and has been designed to provide backward compatibility with Baseline 2.

ANNEX III**List of projects examined****A - Trackside projects:**

Member State	Project	Value of EU support for ERTMS component (approx. in euro)	TEN-T Corridor /cross-border	Status
DK	2012-DK-60002-P Line Langaa–Frederikshavn covers: double track section	11 945 000	Yes	On-going with delay but EU funds have been fully decommitted.
	2014-DK-TM-0183-W ERTMS Trackside deployment along the section Copenhagen H - Køge Nord - Ringsted in East Denmark (East Project)	10 998 469	Yes	On-going.
DE	2006-DE-PP402b ETCS Pilot POS Nord (section between Saarbrücken and Landstuhl)	8 900 000	Yes	Completed with a reduced scope.
	2007-DE-60080-P "Deployment of ETCS on railway section from Aachen West (border) to Oberhausen as a part of corridor F: Aachen – Warschau"	9 000 000	Yes	Cancelled.
	2007-DE-60320-P "Deployment of ETCS on railway section from Emmerich (border) to Basel (border) as a part of corridor: A Rotterdam-Genoa"	5 775 000	Yes	Cancelled.
	2011-DE-60004-P Upgrade of the Berlin-Halle/Leipzig (VDE 8.3) track from ETCS Level 2, SRS 2.2.2+ to ETCS Level 2, SRS 2.3.0d	2 535 000	Yes	Cancelled.
	2014-DE-TM-0057-W ERTMS-deployment on the German section of core network (Rhine – Alpine corridor) from Oberhausen Sterkrade to Swiss border (Weil), including cross-border section and deployment of ERTMS in Basel Badischer railway station	53 720 339	Yes	On-going.
	2010DE161PR002 major project "VDE 9, ABS Leipzig - Dresden, measure under 3 rd construction stage" – (proportion of ERTMS not designated)	5 000 000	Yes	On-going.
	2012DE161PR006 major project "Measure Network 21, Corridor 101, Equipping the section Rostock – Berlin, Module 2"	2 100 000	Yes	On-going.
	2011-ES-60002-P ERTMS Deployment on the Madrid-Castilla la Mancha-Comunidad Valenciana-Murcia high speed line. Albacete-Alicante section	4 438 000	No	Completed with delays.
ES	2010ES161PR011 High-speed line Madrid — Castilla La Mancha — Community of Valencia — Region of Murcia. Sections: Torrejón de Velasco — Motilla del Palancar, Motilla del Palancar — Albacete. Installation — Phase I	32 628 928	No	Completed with delay.
	2011ES161PR001 High speed line Madrid-Segovia — Valladolid/ Medina del Campo. Various measures on platform, track and installation works. Phase I	7 440 000	Yes	Completed with delay.
	2011ES162PR001 High speed line Madrid-Segovia — Valladolid/ Medina del Campo. Various measures on platform, track and installation works. Phase II	5 340 000	Yes	Completed with delay.
	2014-ES-TM-0510-W ERTMS deployment on Barcelona commuter lines	5 200 000	Yes	On-going.
	2014-ES-TM-0512-W Upgrade of Spanish high speed lines to ERTMS 2.3.0.D. Phase II	4 190 000	Partially	On-going.
	2014-ES-TM-0514-W ERTMS deployment on the section Valladolid – Burgos	7 783 767	Yes	On-going.

IT	2007-IT-60360-P Trackside ERTMS equipment on Italian part of Corridor A (600 km)	33 000 000	Yes	Cancelled.
	2012-IT-60009-P Off-site and field testing to support Italian ERTMS migration strategy	2 411 000	Yes	Completed.
	2012-IT-60018-P Upgrade of Roma – Napoli high-speed line in order to ensure compatibility with ERTMS baseline 2.3.0d	3 000 000	Yes	Completed.
	2014-IT-TM-0058-W Trackside ERTMS SRS ETCS Baseline 3 implementation on Italian sections of the Corridor A (Rotterdam-Genoa)	13 691 000	Yes	On-going.
NL	2007-NL-60060-P Deployment of ERTMS/ETCS Level 2, SRS 2.3.0, at the section Zevenaar -border/Germany and at the section/location Kijfhoek shunting yard.	4 650 000	Yes	Completed with a delay.
	2007-NL-60310-P Deployment of ERTMS in section Port Railway of Rotterdam of Betuwe freight line	4 500 000	Yes	Completed.
	2009-NL-60123-P Upgrade ERTMS on the Betuwe freight line	1 000 000	Yes	Completed.
	2012-NL-60005-P Connection of the railway infrastructure in Maasvlakte 2 with the main railway infrastructure Hoofdspoorweginfrastructuur and the Betuwe Line	900 000	Yes	Completed.
PL	7.1-1.4 Modernisation of line E65/C-E65 Warsaw – Gdynia (ERTMS/ETCS/GSM-R, DSAT Phase I)	48 732 000	Yes	On-going with delays.
	7.1-15.1 Modernisation of line E30, stage II. Pilot project ERTMS/ETCS and ERTMS/GSM-R Legnica-Węliniec-Bielawa Dolna	6 190 000	No	Completed with delays.
	7.1-14 Modernisation of line E30, stage II. ERTMS/ETCS and ERTMS/GSM-R Legnica-Wrocław-Opole	22 905 000	No	On-going with delays.
	7.1-25 Construction of GSM-R network on line E20/CE20 Kunowice – Terespol	71 000 000	Yes	Completed.
	7.1-24.1 Modernisation of line Warsaw-Łódź, stage II, Lot A – Warsaw – Miedniewice (Skierniewice), phase 1	23 383 000	No	On-going (phased into 2014-20 period).
	7.2-4.1 Improvement of access to the Port of Gdańsk Phase I	1 900 000	Yes	On-going.
	2009-PL-60151 Project and development of ETCS level 1 system at the section of the E 65, CMK, railway line Grodzisk Mazowiecki – Zawiercie	6 349 204	Yes	Completed.
Total		420 605 707		

B - On-board projects

Member State	Project	Value of EU support for ERTMS component (approx. in euro)	Status
DK	2013-DK-60015-P Activity 1 - Prototyping of 3 locomotives with ETCS Level 2, Baseline 3. Activity 2 - Retrofitment of 49 locomotives with ETCS Level 2, Baseline 3.	3 960 185	On-going with delay but EU funds fully decommitted.
	2014-DK-TM-0300-W Activity 1 covers testing and software upgrades of the ETCS Level 2, Baseline 3 on-board units Activity 2-Retrofitment of 106 train units	7 966 100	On-going with delay and reduced scope.
DE	2007-DE-60490-P Installation of ETCS in the locomotives owned by Railion Deutschland AG	4 800 000	Completed with a reduced scope.
	2009-DE-60120-P Installation of ETCS in the freight locomotives, version 2.3.0.d	850 000	Cancelled.

	2012-DE-60013-P ETCS installation in DB Schenker Rail locomotives for core network line PP17 and corridor B	1 125 000	Completed with delays.
	2012-DE-60014-P ETCS installation in DB Schenker Rail locomotives for cross border rail freight operations in Corridor A	4 425 000	Completed with reduced scope and delays.
	2012-DE-60025-P Retrofitment, development of prototype, upgrading of LOKOMOTION locomotives with ETCS 2.3.0d / Baseline 3	1 800 000	Completed with delays.
ES	2011-ES-60001-P Upgrade of Spanish high-speed lines and trains to ERTMS 2.3.0.d	18 386 000	Completed with delays.
IT	2007-IT-60030-P Migration towards ERTMS/ETCS for Trenitalia on board-equipment	7 000 000	Completed with reduced scope.
	2011-IT-60002-P Upgrading of ERTMS system on Trenitalia fleet to 2.3.0d version	4 593 000	Completed with reduced scope.
	2012-IT-60012-P Equipment of ETR 1000 trainsets with ETCS Baseline 2 release 2.3.0d	1 429 000	Completed.
NL	2007-NL-60160-P Serial fitment of ETCS Level 2 equipment in 109 locomotives	7 750 000	Completed with delays.
	2007-NL-60380-P Serial fitment of ETCS Level 2, baseline 2.3.0d in 90 type ES64/F4/BR189 multi-system electrical locomotives	9 000 000	Completed with delays.
	2009-NL-60124-P Upgrade existing locomotives to ensure compatibility with baseline 2.3.0d for 120 locomotives owned by various operators	2 000 000	Completed with delays but EU funds decommitted.
	2009-NL-60128-P Upgrading on-board equipment to ETCS Level 2, SRS 2.3.0.d, for 10 Traxx locomotives	500 000	Cancelled.
	2009-NL-60142-P Retrofitting (19 locomotives) and upgrading (95 locomotives) previously co-funded under project 2007-NL-60160-P and 2007-NL-60380-P	3 300 000	Completed with delays.
	2012-NL-60006-P Installation of ETCS baseline 2.3.0d in 20 new locomotives	1 000 000	Completed with delays.
PL	07.01.00-00-010/09 Purchase of rolling stock for long-distance travels, type Pendolino	7 500 000	Completed with delays.
	07.01.00-00-044/13 Purchase 20 electric trainsets, type Flirt	15 600 000	Completed.
	07.01.00-00-069/14 Purchase of 20 electric train sets , type Dart	13 660 000	Completed.
	Total	116 644 285	

ANNEX IV**ERTMS deployment in core network corridors by Member States as of end of 2016**

Member State	Total length in km	ERTMS equipped lines in operation in km	ERTMS equipped lines in operation in %
Belgium	1 279	482	38
Bulgaria	1 120	206	18
Czech Republic	1 464	0	0
Denmark	539	0	0
Germany	8 193	80	1
Estonia	443	0	0
Ireland	362	0	0
Greece	1 057	0	0
Spain	6 289	1 071	17
France	6 999	455	7
Croatia	476	0	0
Italy	5 116	417	8
Latvia	594	0	0
Lithuania	948	0	0
Luxembourg	86	75	88
Hungary	1 441	247	17
Netherlands	822	359	44
Austria	1 220	340	28
Poland	3 763	218	6
Portugal	1 535	0	0
Romania	1 805	40	2
Slovenia	556	0	0
Slovakia	745	129	17
Finland	509	0	0
Sweden	1 596	0	0
United Kingdom	1 956	0	0
Total	50 914	4 121	8.09

Source: European Commission.

ANNEX V**Methodology for the linear extrapolation of ERTMS deployment cost****A. Trackside**

	Total cost of ERTMS deployment trackside (billion euro)	Lines length (km)	Unit cost (million euro per km of line)
Denmark	2.52	2 132	1.18
The Netherlands	4.90	2 886	1.69
The average used for extrapolation on EU level			1.44

Source: European Court of Auditors based on a linear extrapolation of the existing national estimates in Denmark and the Netherlands.

B. On-board deployment***B.1 Retrofitment of existing locomotives***

- Cost of retrofitment per locomotive, based on the 2015 and 2016 studies contracted by the European Commission:

	Unit cost (euro)	
	Innovative financing study (2015)	Business case report study (2016)
ERTMS equipment and installation	350 000	375 000
Testing and authorisation	150 000	
Vehicle unavailability	50 000	
Training	20 000	
Total unit cost	570 000	395 000
Average unit cost	482 500	

- Total cost of retrofitment:

Units to be equipped	Average unit cost (euro)	Total cost of retrofitment (billion euro)
22 391	482 500	10.8

B.2 Cost of equipping new locomotives or trainsets with ERTMS

For new locomotives or trainsets, the average cost of on-board units is estimated at approximately 300 000 euro per on-board unit in the visited Member States.

REPLIES OF THE COMMISSION TO THE SPECIAL REPORT OF THE EUROPEAN COURT OF AUDITORS

“A SINGLE EUROPEAN RAIL TRAFFIC MANAGEMENT SYSTEM: WILL THE POLITICAL CHOICE EVER BECOME REALITY?”

EXECUTIVE SUMMARY

II. The European Rail Traffic Management System (ERTMS) is acknowledged and confirmed by the Member States and the rail sector as *the* universal signalling system in Europe.

The European railways started developing a European command/control and signalling (ETCS) and communication system (GSM-R) in the late 1980s/early 1990s. This activity was subsequently merged together (mid-90s) with other related industrially-led research work supported by the Commission within the ERTMS programme placed under the aegis of the Commission.

ERTMS' ultimate objective was to replace legacy railway signalling and telecommunication systems in Europe with a single standard to foster higher quality and cost-effective railway services, notably cross-border, through increased interoperability and reducing the fragmentation of operational capabilities across the European rail network.

As a common standard, ERTMS should also facilitate rail competitiveness in particular by reducing product diversity and pushing for economies of scale, leading ultimately to lower costs. Further, combined with increased standardisation for other railway products as a result of EU legislation, it will allow production of trains of a single specification suitable for use in many networks (even if they do not cross borders) thus significantly reducing costs for railway undertakings and infrastructure managers, while allowing manufactures the benefit of much longer production runs.

ERTMS provides not only interoperability which is the main objective to achieve in Europe by replacing the national systems, but it guarantees safety and has also economic, social and environmental benefits through time saving, thanks to its increased punctuality and reliability. It also supports the transition from "analogue" to "digital".

VI. The rate of deployment of the ETCS has indeed been conditioned by the weight of the existing legacy systems. One of the reasons for the slower than expected deployment is the complexity of transition and interfacing with existing national systems. Further, close cooperation and agreement with multiple stakeholders (for example Member States, suppliers, railway undertakings, infrastructure managers, national safety authorities) is needed to achieve consensus and preserve interoperability.

Business case benefits occur not only at system level but also for individual stakeholders. However, the Commission acknowledges that for certain stakeholders the individual financial case may be challenging. This varies based on particular deployment scenarios rather than being a general case.

The Commission notes that, at system-level, the timeframe for the turnout of the benefits is comparable with other infrastructure projects.

VIII. Deployment of ERTMS as a single signalling system in the whole EU, was a strategic political decision, based on works carried out by the industry, including the AEIF (Association européenne pour l'interopérabilité ferrovaire: an association of infrastructure managers, railway undertakings and suppliers).

The Commission considers that it was not necessary to make an overall cost estimate at the initial stages since ERTMS was being specified as the required system for new lines or, in the case of replacement of signalling, on existing lines, and in this case the cost of the ERTMS were not higher than the costs of the alternatives.

Significant steps have been taken in recent years to address core issues relating to the deployment of ETCS and the achievement of an interoperable rail system, such as the stabilisation of ERTMS specification (Baseline 3), adoption of the technical pillar of the Fourth Railway Package, a realistic European Deployment Plan, and the signature of several Memoranda of Understanding (MoUs) with all stakeholders. These achievements provide solid building blocks for an accelerated ERTMS deployment in Europe and the timely implementation of the reviewed European Deployment Plan (EDP).

IX. The costs sometimes cited for ERTMS include associated costs (up to 2/3) beyond what relates directly to ERTMS, for example power supply, hardware, and interlockings. The investments reflect a general upgrading of the signalling infrastructure, including addressing past maintenance backlogs, which go beyond "ERTMS investment" alone. Such works may also be required in the event of replacement of obsolete signalling systems other than ERTMS or to address maintenance backlogs. Finally, the overall cost may decrease over time due to future technological development, economy of scale and increased competition among ERTMS suppliers.

See also Commission reply to paragraph VI.

XI. The Commission accepts the ECA recommendations to the extent that they are within its remit with the exception of recommendation 8, which is partially accepted.

INTRODUCTION

5. ERTMS is about interoperability but also covers other aspects such as highest standards of safety and effective use of the infrastructure, and reduces system costs by allowing the development of standardised products.

OBSERVATIONS

26. ERTMS has been available on the European market for more than 20 years and has gone through a continuous development process from technological and institutional point of views.

The European railways started developing a European command/control and signalling (ETCS) and communication system (GSM-R) in the late 1980s/early 1990s.

The Commission considers that it was not necessary to make an overall cost estimate at that stage since ERTMS was being specified as the required system for new lines or, in the case of replacement of signalling, on existing lines, and in this case the cost of the ERTMS were not higher than the costs of the alternatives.

35. A comprehensive plan for decommissioning Class B systems can significantly accelerate migration procedure; however, currently no relevant legislation could force decommissioning of national systems. In addition larger Member States would likely have a more complex decommissioning process due to the size of the existing networks and therefore greater reluctance on agreeing on ambitious target dates.

Common Commission reply to paragraphs 42 and 43:

On the issue of benefits materialising in the long term, at a system-level the benefits are comparable with other infrastructure projects.

Business case benefits occur not only at system level but also for individual stakeholders. However, the Commission acknowledges that for certain stakeholders the individual financial case may be challenging. This varies based on particular deployment scenarios rather than being a general case.

Common Commission reply to paragraphs 47 to 55:

The figures quoted include required associated costs (up to 2/3) beyond what relates directly to ERTMS investment, for example power supply, hardware, and interlockings. The investments

reflect a general upgrading of the signalling infrastructure, including addressing past maintenance backlogs, which go beyond "ERTMS investment" alone.

50. The Commission notes that the costs of Denmark and Netherlands are higher than those from other Member States – perhaps in part reflecting high local wage costs.

54. The strategy to equip vehicles first is consistent with, and a prerequisite to, the objective of deploying ERTMS-only lines, enabling the decommissioning of class-B systems.

This strategy has been consistently chosen by Member States migrating to ERTMS.

As for all new locomotives standard provisions of the interoperability (IOP) directive applies (derogations when justified economic reasons), and TSI specifically excludes purely domestic, off-TEN vehicles.

68. The European Deployment Plan is a Commission Implementing Regulation based on the TEN-T Regulation, which is linked to the CEF Regulation, which provides for inter alia funding support to ERTMS deployment on Core Network and indirectly linked to the Regulation on Cohesion Fund. As for the cost assessment the Deployment Management Team is carrying out a business case analysis for ERTMS deployment on Core Network Corridors including such an analysis.

70. In order to ensure proper ERTMS implementation on cross-border sections with different implementation dates, agreements will be signed by the infrastructure managers clarifying technical and operational aspects in advance.

75. For cohesion policy, the technical characteristics of projects are assured and verified by the Member State authorities, in the frame of shared management.

Having said that, it is noted that the Directorate-General for Regional and Urban Policy does use experts for the assessment of major projects. These may be either independent experts from the market or experts from Jaspers. From June 2019 ERA will become responsible for approval of all track side ERTMS and therefore this issue will be fully addressed from that point.

80. The financial means of the decommitted projects usually flow back into the next Call published also for other priorities than ERTMS. Nevertheless, ERTMS – as horizontal objective with high priority - is always part of the Calls.

81. As set out in paragraph 30, the requirement that “all new infrastructure and all new rolling stock manufactured or developed after adoption of compatible control and command and signalling systems must be tailored to use of those systems” emerges from Directive 2001/16/EC and not from cohesion policy.

82. Under CEF, criteria for the selection of applications applied by the Commission take into account different priorities, in particular contribution to cross-border sections, international freight traffic, etc.

Within Title XVIII TFEU regarding "economic, social and territorial cohesion", Article 176 TFEU set outs that the ERDF "is intended to help redress the main regional imbalances in the Union through participation in the development and structural adjustment" of regions lagging behind. Article 177 sets out that the Cohesion Fund shall "provide a financial contribution to projects in the fields of environment and trans-European networks in the area of transport infrastructure."

In order to deliver the above provisions, cohesion policy support also outside border-crossing sections is necessary.

84. It should be noted that especially in the early phases of deployment equipping domestic fleets is also a valuable investment in particular in countries with significant infrastructure deployment but where neighbouring countries may not yet have equipped.

86. The Commission refers to its reply to paragraph 81.

CONCLUSIONS AND RECOMMENDATIONS

Common Commission reply to paragraphs 88 to 91:

Deployment of ERTMS as a single signalling system in the whole EU was a strategic political decision, based on works carried out by the industry, including the AEIF (Association européenne pour l'interopérabilité ferroviaire: an association of infrastructure managers, railway undertakings and suppliers).

The Commission considers that it was not necessary to make an overall cost estimate at the initial stages since ERTMS was being specified as the required system for new lines or, in the case of replacement of signalling, on existing lines, and in this case the cost of the ERTMS were not higher than the costs of the alternatives.

The figures quoted include required associated costs (up to 2/3) beyond what relates directly to ERTMS investment, for example power supply, hardware, and interlockings. The investments reflect a general upgrading of the signalling infrastructure, including addressing past maintenance backlogs, which go beyond "ERTMS investment" alone. Such works may also be required in the event of replacement of obsolete signalling systems other than ERTMS or to address maintenance backlogs. Finally, the overall cost may decrease over time due to future technological development, economy of scale and increased competition among ERTMS suppliers.

Business case benefits occur not only at system level but also for individual stakeholders. However, the Commission acknowledges that for certain stakeholders the individual financial case may be challenging. This varies based on particular deployment scenarios rather than being a general case. The Commission notes that, at system-level, the timeframe for the turnout of the benefits is comparable with other infrastructure projects.

Recommendation 1 – Assessment of ERTMS deployment costs

Insofar as it is within its remit, the Commission accepts the recommendation as outlined below.

Building on the submission of the National Implementation Plans of the national cost-benefit analysis and the work on the ERTMS business cases provided by DMT, the Commission will provide a cost estimate on the basis of this documentation.

Recommendation 2 – Decommissioning of national signalling systems

The Commission accepts this recommendation.

As a first step, it will work with Member States to establish target dates for decommissioning based on the submitted national implementation plans as a first step to generating consensus on legally binding targets. Whether these targets become legally binding depends on the outcome of the necessary steps preceding the legislative proposal (in particular the impact assessment) as well as the agreement of the legislator.

Recommendation 3 – Individual business case for infrastructure managers and railway undertakings

Insofar as it is within its remit, the Commission accepts this recommendation.

Recommendation 4 – Compatibility and stability of the system

(a) Insofar as it is within its remit, the Commission accepts this recommendation.

(b) Insofar as it is within its remit, the Commission accepts this recommendation.

(c) Insofar as it is within its remit, the Commission accepts this recommendation and will work with the industry to facilitate the usage of a common tendering template developed by the Community of European Railway and Infrastructure Companies (CER) with the focus on on-board unit.

(d) Insofar as it is within its remit, the Commission accepts this recommendation.

Recommendation 5 – Role and resources of ERA

Insofar as it is within its remit, the Commission accepts this recommendation.

Recommendation 6 – Alignment of national deployment plans, monitoring and enforcement

(a) Insofar as it is concerned by it, the Commission accepts this recommendation in particular in the frame of the European Coordinator's work; however, formal negotiations on post-2023 EDP deployment will not take place until 2021.

(b) Insofar as it is within its remit, the Commission accepts this recommendation and will implement it as outlined below.

For the Core Network, the Commission will set milestones in order to allow a detailed monitoring of individual sections up till 2023 in accordance with the EDP. A new EDP for the remaining sections is foreseen to be adopted by 2023 for implementation of the rest of the Core Network until 2030.

The Commission will consider the deployment plans set out in National Implementation Plans as a basis for a longer term, wider deployment.

92. The Commission considers that funding is targeted in line with the objectives and priorities of the different instruments and programmes.

The Commission has put forward an EDP and a detailed ERTMS Action Plan in order to ensure a continuous stream of support (in terms of grants, blending and long-term financing) to ERTMS deployment, notably on the higher EU added-value components (cross-border sections and on-board units) and for the cohesion countries, to facilitate strong coordination and to fully seize the advantages of ERTMS deployment while minimizing its costs.

Recommendation 7 – Absorption of EU funds for ERTMS projects

The Commission accepts the recommendation and notes that it is adapting its CEF funding procedures, as much as possible, within the current legal framework, including the financial regulations.

Recommendation 8 – Better targeting EU funding

(a) Insofar as it is within its remit, the Commission partially accepts this recommendation.

For CEF funding, the Commission accepts this recommendation and notes that the criteria for selection of applications applied by the Commission take into account different priorities, in particular contribution to cross-border sections, international freight traffic.

As concerns Cohesion policy, within Title XVIII TFEU regarding "economic, social and territorial cohesion", Article 176 TFEU sets out that the ERDF "is intended to help redress the main regional imbalances in the Union through participation in the development and structural adjustment" of regions lagging behind. Article 177 sets out that the Cohesion Fund shall "provide a financial contribution to projects in the fields of environment and trans-European networks in the area of transport infrastructure."

In order to deliver the above provisions cohesion policy support also outside border-crossing sections and the core TEN-T network is necessary. Therefore, the Commission does not accept the recommendation for cohesion policy.

(b) Insofar as it is within its remit, the Commission partially accepts this recommendation.

For CEF funding the Commission accepts this recommendation and notes that the criteria for selection of applications applied by the Commission take into account different priorities, in particular contribution to cross-border sections, international freight traffic.

The Commission does not accept the recommendation for Cohesion policy and refers to its reply to recommendation 8 (a).

Event	Date
Adoption of Audit Planning Memorandum (APM) / Start of audit	20.4.2016
Official sending of draft report to Commission (or other auditee)	29.5.2017
Adoption of the final report after the adversarial procedure	12.7.2017
Commission's (or other auditee's) official replies received in all languages	2.8.2017

We assessed whether the European Rail Traffic Management System (ERTMS) has been properly planned, deployed and managed. ERTMS is designed to replace the diverse railway signaling systems around Europe with a single system that enables trains to travel uninterrupted across different countries and facilitates rail competitiveness. We found that deployment so far is at a low level and represents a patchwork, despite the fact that the ERTMS concept to enhance interoperability is not generally questioned by the rail sector. Infrastructure managers and railway undertakings are reluctant to invest due to the expenses entailed and the lack of an individual business case (for example in the Member States with well performing national systems and significant remaining lifetime). EU funding can only cover a limited amount of the investments. We make a number of recommendations to the European Commission, the Member States and the European Union Agency for Railways to help improve the deployment and financing of the system.



EUROPEAN
COURT
OF AUDITORS



Publications Office

EUROPEAN COURT OF AUDITORS
12, rue Alcide De Gasperi
1615 Luxembourg
LUXEMBOURG

Tel. +352 4398-1

Enquiries: eca.europa.eu/en/Pages/ContactForm.aspx

Website: eca.europa.eu

Twitter: @EUAuditors

©European Union, 2017.

For any use or reproduction of photos or other material that is not under the European Union copyright, permission must be sought directly from the copyright holders.