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DEPLOYMENT OF ERTMS IN CZECH REPUBLIC

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Abstract. The article describes current situation and expected deployment of international standard for automatic rail vehicle protection in Czech Republic for period 2014 – 2020. Article introduces expected status in 2020 and subsequent implementation of commitments until 2026. It introduces expected result of gradual implementation for tracks and vehicles. It also displays brief deployment overview of European Rail Traffic Management System in European Union countries for each level of European Train Control System.

Keywords: ERTMS, ETCS, GSM-R, Interoperability.

1. Introduction

The ERTMS is automatic train protection which represents basic part of interoperability in European rail system. The term is abbreviation of "European Rail Traffic Management System" and it was defined to synchronize nationals systems to the one common compatible system. Urgency of the unification and cooperation between European countries caused an increase in freight which had negative impact for environment and ecology. The implementation of interoperability and automatic train protection across European countries allows competition to air and car freight. Implementation of the standard is business initiative that transforms the operation of the tracks, enhance safety, capacity, performance and reliability. It also have impact on reduce of cost of operation and maintenance.

ERTMS is divided into two basic components. The first one is ETCS "European Train Control System" and second GSM-R "Global System for Mobile Communication for Railway".

The ERTMS allow one compatible system for cross-border traffic what reduce cost for implementation several regional stand-alone systems. The synchronization of automatic train protection increase competitiveness of the European rail sector.

GSM-R "Global System for Mobile Communications – Railway" is a radio system based on GSM standard for providing of voice and data communication between vehicle and track.

ETCS "European Train Control System", is an automatic train protection system to replace the existing national systems. The ETCS replaces about twenty different automatic train protections across European track.

It can be configured to operate in one of the following application levels to enable ETCS equipped vehicles to operate in not ETCS equipped system where the safe movement of the vehicle is controlled by the default national control system:

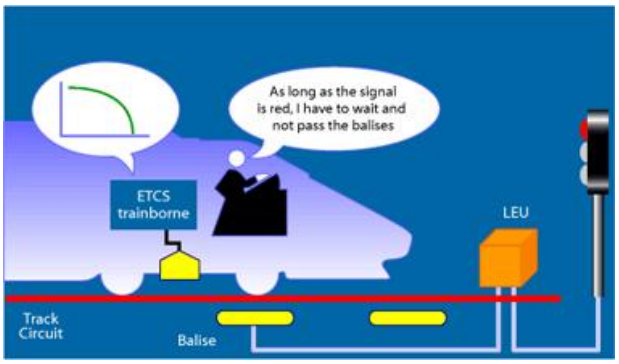

Figure 1. ETCS L1 [1]

- **Level 0** – ETCS equipped vehicles operating on lines without ETCS system,
- **Level 1** – an conventional line-side signal is passed to the train via a switched transmitter on the track, repeating the indication from the conventional signalling system, which continues to be used to support safe train separation. It is the Figure 1,
- **Level 2** – movement authority is passed by the GSM-R radio network from a Radio Block Centre to the train. Conventional train detection systems are utilized in conjunction with interlocking systems used to enforce safe train separation. It is the Figure 2,
- **Level 3** – it builds on Level 2, but increases safe train separation using critical data from the train. It is the Figure 3.

2. Deployment of ERTMS in Czech Republic

The Czech Republic contributing to the fulfillment of legal solutions arising from following documents:

- ***DIRECTIVE 2008/57/EC*** *OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL*

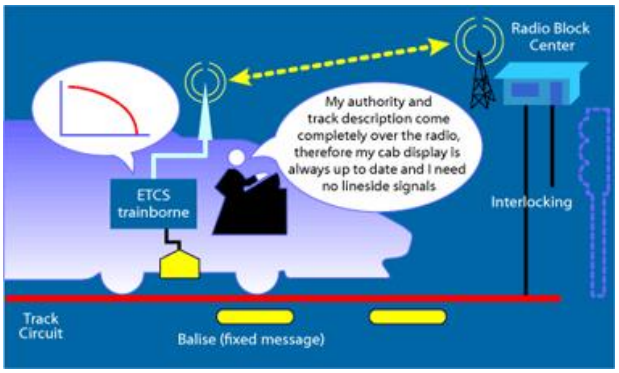

Figure 2. ETCS L2 [1]

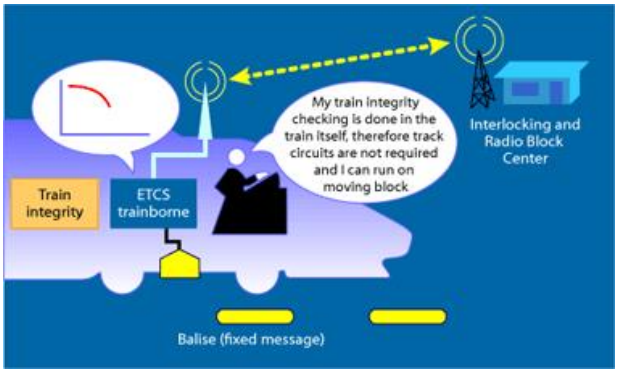

Figure 3. ETCS L3 [1]

Figure 4. Map of GSM-R implementation [2]

Figure 5. Map of ETCS implementation [2]

of 17 June 2008 on the interoperability of the rail system within the Community

- ***DECISIONS 2012/88/EU**, Commission Decision of 25 January 2012 on the technical specification for interoperability relating to the control-command and signalling subsystems of the trans-European rail system (2012/696/EU a 2015/14/EU)*
- ***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*
- ***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*

The deployment is defined in document "Národní implementační plán ERTMS" released by ministry of transport. The document defines maximum amount of payloads for each project GSM-R and ETCS L2 with respect to co-financing from ERTMS funds. It also defines expected deployment schedule of each project.

Between 2005 and 2014 was equipped 1132 km of tracks across of the Czech Republic. It is connected to the GSM-R SŽDC, DB, ÖBB, ProRail and the home network operator.

There are now mobile terminals equipped with GSM-R all ČD vehicles used in regular operation.

Almost all ČD vehicles used in regular operation are now equipped with GSM-R terminals.

The first stage with fully deployed ETCS system at 2021 will be track "Praha – Česká Třebová – Brno – Břeclav".

Following Tables 1, 2, 3 display figures for expected schedule of deployment of GSM-R, ETCS L2 and vehicle on-board equipment for period 2014 – 2020 (– 2026).

The Figure 6 below visualizes data from tables above. It displays total amount of deployments for each year until 2020.

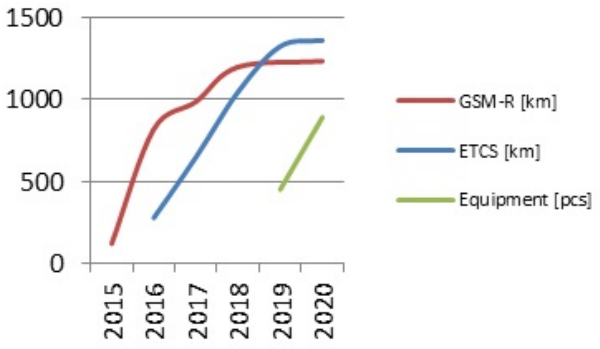

Figure 6. Total amount of expected deployments

No.	Track	Distance [km]	Deployment
1	Uzel Praha (Beroun – Praha – Benešov u Prahy – Lysá nad Labem)	120	2014-2015
2	České Velenice st. hr. Rakousko – České Budějovice – Horní Dvořiště st. hr. Rakousko	110	2015-2016
3	Plzeň – České Budějovice	136	2015-2016
4	Kolín – Havlíčkøuv Brod – Křižanov – Brno	195	2014-2016
5	Benešov – Votice	20	2015-2016
6	Beroun – Plzeň – Cheb st. hr. Německo	169	2014-2016
7	Cheb – Vojtanov st. hr. Německo	20	2015-2016
8	Znojmo – Šatov st. hr. Rakousko	13	2015-2016
9	Ústí nad Orlicí – Lichkov st. hr. Polsko	35	2015-2016
10	Votice – České Budějovice	100	2016-2017
11	Hranice na Moravě – Horní Lideč st. hr. Slovensko	67	2016-2017
12	Ústí nad Labem – Oldřichov u Duchcova/Úpořiny – Most – Karlovy Vary – Cheb	212	2017-2018
13	Pardubice – Hradec Králové	22	2019-2020
14	Zábřeh na Moravě – Šumperk	13	2019-2020
15	Praha – Letiště V. Havla Ruzyně – Kladno	31	after 2020
16	Brno – Přerov	90	after 2020
17	Plzeň – Domažlice st. hr. Německo	72	after 2020
18	Velký Osek – Hradec Králové – Choceň	96	after 2020
	TOTAL	**1521**	

TABLE 1. Expected track deployment with GMS-R [3]

No.	Track	Distance [km]	Deployment
1	Kolín – Břeclav st. hr. Rakousko/Slovensko	277	2012-2016
2	Kralupy nad Vltavou – Praha – Kolín	110	2016-2017
3	st. hr. Německo – Dolní Žleb – Kralupy	112	2017-2019
4	Petrovice u Karviné st. hr. Polsko – Přerov – Břeclav	206	2015-2017
5	Praha-Uhříněves – Votice	54	2016-2017
6	Votice – České Budějovice	101	2017-2018
7	Česká Třebová – Přerov	110	2016-2018
8	Plzeň – Cheb st. hr. Německo	117	2016-2018
9	Beroun – Plzeň	70	2016-2018
10	Dětmarovice – Mosty u Jablunkova st. hr. Slovensko	53	2017-2019
11	České Velenice st. hr. Rakousko – České Budějovice – Horní Dvořiště st. hr. Rakousko	112	2017-2019
12	Ústí nad Orlicí – Lichkov st. hr. Polsko	37	2018-2020
13	Kolín – Nymburk – Mělník – Děčín východ – Děčín-Prostřední Žleb	159	after 2020
14	Kolín – Havlíčkøuv Brod – Brno	200	after 2020
15	Praha – Lysá nad Labem	35	after 2020
16	Praha – Letiště V. Havla Ruzyně – Kladno	31	after 2020
17	Praha – Beroun	43	after 2020
18	Plzeň – Domažlice st. hr. Německo	72	after 2020
19	Pardubice – Hradec Králové	22	after 2020
20	Plzeň – České Budějovice	136	aftre 2020
21	Brno – Přerov	90	after 2020
22	Hranice na Moravě – Horní Lideč st. hr. Slovensko	67	after 2020
23	Uzel Praha	40	after 2020
24	Český Těšín – Ostrava-Svinov	41	after 2020
25	Velký Osek – Hradeck Králové – Choceň	96	after 2020
26	Cheb – Karlovy Vary – Chomutov	111	after 2020
27	Ústí nad Labem – Chomutov, Ústí nad Labem – Bílina	101	after 2020
	TOTAL	**2603**	

TABLE 2. Expected deployment of equipment upgrade ERTM/ETCS [3]

No.	Track	Distance [km]	Deployment
1	Kolín – Břeclav st. hr. Rakousko/Slovensko	250	2015-2019
2	Kralupy nad Vltavou – Praha – Kolín	100	2016-2019
3	st. hr. Německo – Dolní Žleb – Kralupy	100	2017-2019
4	Petrovice u Karviné st. hr. Polsko – Přerov – Břeclav	130	2015-2020
5	Praha-Uhříněves – Votice	40	2016-2020
6	Votice – České Budějovice	50	2017-2020
7	Česká Třebová – Přerov	50	2016-2020
8	Plzeň – Cheb st. hr. Německo	40	2016-2020
9	Beroun – Plzeň	40	2016-2020
10	Dětmarovice – Mosty u Jablunkova st. hr. Slovensko	20	2017-2020
11	České Velenice st. hr. Rakousko – České Budějovice – Horní Dvořiště st. hr. Rakousko	50	2017-2020
12	Ústí nad Orlicí – Lichkov st. hr. Polsko	20	2018-2020
13	Kolín – Nymburk – Mělník – Děčín východ – Děčín-Prostřední Žleb	100	after 2020
14	Kolín – Havlíčkøuv Brod – Brno	100	after 2020
15	Praha – Lysá nad Labem	30	after 2020
16	Praha – Letiště V. Havla Ruzyně – Kladno	20	after 2020
17	Praha – Beroun	30	after 2020
18	Plzeň – Domažlice st. hr. Německo	40	after 2020
19	Pardubice – Hradec Králové	20	after 2020
20	Plzeň – České Budějovice	50	after 2020
21	Brno – Přerov	60	after 2020
22	Hranice na Moravě – Horní Lideč st. hr. Slovensko	30	after 2020
23	Uzel Praha	20	after 2020
24	Český Těšín – Ostrava-Svinov	20	after 2020
25	Velký Osek – Hradec Králové – Choceň	40	after 2020
26	Cheb – Karlovy Vary – Chomutov	50	after 2020
27	Ústí nad Labem – Chomutov, Ústí nad Labem – Bílina	50	after 2020
	TOTAL	**1550**	

Table 3. Expected track deployment of ETCS L2 [3]

After 2020 will be deployed around 250 km tracks and 150 vehicles every year until 2026.

Strategies transition from the current national system VZ SS to European interoperable system Class A – ETCS consists a combination of investment in track equipment and train equipment. In the first phase will be equipped only international traffic trains.

During migration will vehicles equipped with ETCS parallel with VZ LS that allow operation of both systems together.

ETCS should be fully migrated for first and second rail corridor and the track Přerov – Česká Třebová at the latest to 2030.

After the migration period will be completely decommissioned national systems VZ LS and fully deployed ETCS system.

In some cases can be deployed new special sections equipped solely with ETCS, which will be designed to operate only vehicles equipped with ETCS even before end of migration period. i.e. a railway connection Václav Havel airport Prague and Prague center.

3. Deployment of ERTMS in other European countries

Unification of Europe requires to all transport systems operates without restrictions and time losses, especially when crossing borders.

The Deployment started in most of European Union countries. Following countries started participation on deployment of the ERTMS standard: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Luxembourg, Netherlands, Poland, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom.

The Figure 7 displays amount of kilometers contracted tracks for each country.

The Figure 8 displays covering of the ERTMS divided by level of tracks.

The Figure 9 displays amount of deployed on-board equipment of vehicles for each country.

The Figure 10 displays levels of on-board equipment implemented in vehicles.

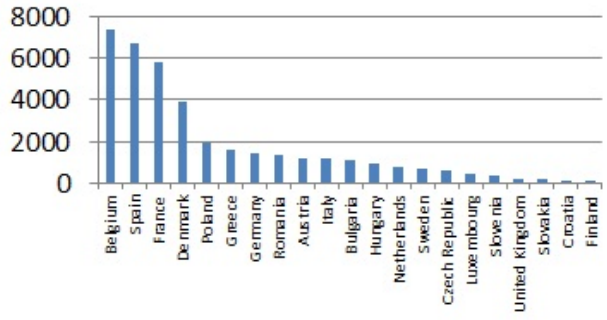

FIGURE 7. ERTMS contracted tracks [km] in EU

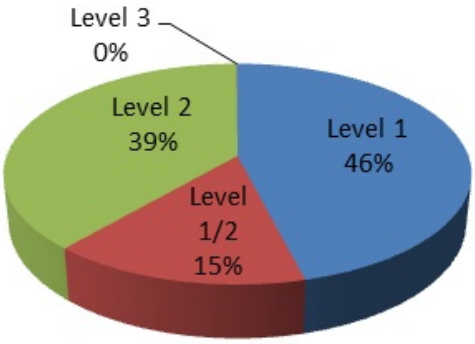

FIGURE 8. TRACKS in EU separated by level

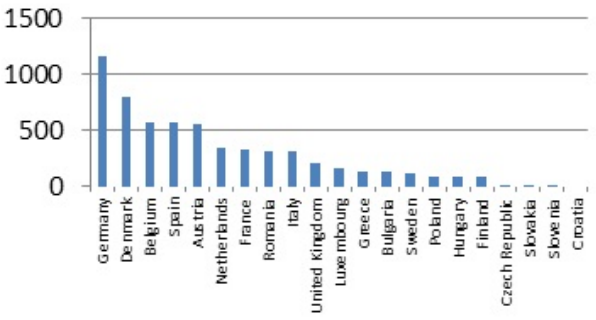

FIGURE 9. Global ERTMS vehicles contracted in Europe

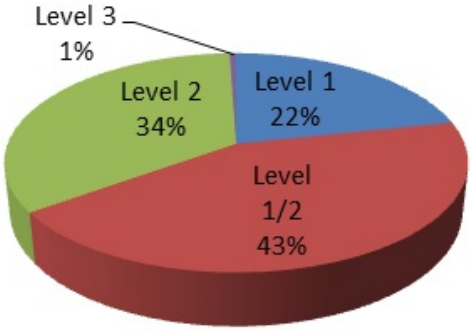

FIGURE 10. Vehicles in EU separated by level

4. CONCLUSIONS

By 2020 the GSM-R will cover major sections of the Rail Freight Corridors in the Czech Republic. The system will be further deployed progressively on all 3700 km of national routes in order to create comprehensive operational tracks.

ETCS deployment priority by 2020 is Rail Freight Corridor 7, partially corridors 8, 9, 5 and the track Přerov – Česká Třebová.

By 2020, it is necessary to ensure the development of the ETCS about 1350 kilometers of tracks and 890 vehicles, ie. for additional six years, around 250 km of tracks and 150 vehicles every year, but this is conditional on the timely implementation of the modernization infrastructure.

This requires the necessary financial resources for the trackside and on-board ERTMS and creating motivational factors and efficient financial support equipping vehicles with on-board equipment of GSM-R and ETCS.

REFERENCES

[1] The European Rail Traffic Management System, Portál ERTMS [online]. [2016-02-12], http://www.ertms.net/?page_id=42.

[2] Národní implementační plán ERTMS 2014-2020, Portál ACRI [online]. [2016-02-12], http://www.acri.cz/uploads/acri-akademie/15-06%20ETCS/2015_Cech,%20Varadinov.pdf.

[3] Národní implementační plán ERTMS, Portál ministerstva dopravy [online]. [2016-02-12], http://www.mdcr.cz/NR/rdonlyres/7FF4FAF1-1EBE-4116-BF90-808EC7306E04/0/NIPERTMSNPweb.pdf.