

Plan of Modern Train Control System on the Czech Railway Network

Implementation of ETCS

2021

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Introduction

ETCS (European Train Control System) is a European train control system that has become the basic standard for control-command and signalling in railway traffic in European countries and is part of the ERTMS (European Rail Traffic Management System) project together with GSM-R (Global System for Mobile Communication - Railways). Although ERTMS is often associated mainly with the issue of introducing interoperability into the railway environment, its importance for the Czech Republic is much more significant. While the GSM-R communication system has been installed and commonly used on the Czech railway infrastructure and on traction vehicles for many years, the ETCS train control system is only now beginning to be intensively put into operation in the Czech Republic. ETCS is a relatively complex electronic computer system, which, however, has an incomparably higher level of functional characteristics compared to our original LVZ LS-type train control system and it provides a substantially higher train operation safety. It is a key prerequisite for all further technological development of the railway, its automation and digitalization. The ETCS implementation schedule included in this document will also become a guide and a motivating factor for the railway industry when planning capacities and resources for the upcoming period.

ETCS is a train control system that allows the driver to be given detailed information needed to control the train and it also continuously checks that the driver drives the train safely on a well-defined track section, as far as the point where movement authority ends (e.g. the signal at danger)¹. ETCS ensures that the train stops before this point even in the event of driver failure (oversight, medical disability) and also checks that the maximum authorized speed is not exceeded during this journey. In this respect, ETCS represents a fundamentally new functional and safety approach, different from the existing train control equipment used on the railway in the Czech Republic. The existing systems from the 1950s were not able to ensure safe control of compliance with stopping the train before a specified point or not exceeding the authorized speed, and technology-wise they cannot be developed further to ensure these functions (European Union legislation does not allow this). Although technically advanced electronic train control equipment currently exists in the Czech Republic, its primary purpose is to save the path (route) for the train. This is a necessary basis for ensuring the safety of operation, but one more essential function is missing, namely the safe control of the movement of the train itself and any error by the driver in following the instructions (for example, failure to respect the signal at danger). The situation in the Czech Republic is more complex in this respect than in many other countries, as the problem of checking the safe movement of trains and their control by the driver has been dealt with for a long time and relatively advanced systems for this purpose were developed here decades ago.

ETCS consists of a trackside part, which is part of the railway infrastructure, and an on-board part (on-board units) which is installed on the rolling stock. The control of compliance with the stopping of a given train and compliance with the maximum authorized speed is carried out by means of information transmitted from the trackside part of ETCS to the on-board part of ETCS via specific equipment on the trackage, called Eurobalise, or via the GSM-R radio system. It is clear from the above description that both parts must be available and fully operational and must communicate with each other. Therefore, it is an absolutely essential condition for guaranteeing the correct functioning of the whole system and for ensuring all its safety-enhancing functions that all vehicles running on the line equipped with ETCS trackside elements are equipped with a functional ETCS on-board unit. A train that is not equipped with ETCS would become a threat not only to itself but also to all other

¹ In specific cases required by the infrastructure, a low (non-zero) release speed can be applied when the train is emergency braked at movement authority end point. In case of ETCS L1 Limited Supervision Stop function the activation of train emergency braking is ensured at the moment of passing the specified point (movement authority end).

trains on the line around it (in front of it), even if these trains were equipped with ETCS and run safely under its supervision. At the same time, technically and functionally advanced train control equipment such as ETCS introduces new technical and technological requirements, for example in terms of infrastructure configuration, in order to make proper use of its features and minimize any potential constraining effects on the capacity of the railway infrastructure.

1. Objectives of the ETCS Implementation Plan

The objective of the Plan of Modern Train Control System on the Czech Railway Network – Implementation of ETCS (hereinafter referred to as the "Plan") is a complete transition from the national system of train control equipment of the LVZ LS type (class B) to the European Train Control System (ETCS) and its implementation on the entire railway network, with the application of all the benefits of this step in the area of interoperability (operational and technical uniformity in the railway environment), but especially the level of safety and efficiency of railway traffic management in the Czech Republic.

In addition to achieving interoperability and a possible increase in capacity (especially in its second application level when optimizing the infrastructure), the main benefit of the introduction of the ETCS is to **increase the safety of railway operation**. Unlike the current national train control system (hereinafter referred to as "LVZ LS"), the ETCS safely monitors the driver (maximum authorized speed, compliance with the signal at danger) and, should the driver fail to react adequately, intervenes in the control and stops the train. ETCS can also prevent accidents such as:

- frontal collision of a passenger train and a way train between Ronov nad D. and Žleby in March 2019,
- derailment of a freight train due to overspeeding at Mariánské Lázně in July 2019,
- collision of two passenger trains in Brno in March 2019,
- collision of two passenger trains near Pernink in July 2020,
- train derailment at the railway station Lázně Kynžvart in July 2020.

These are mainly incidents caused by disregarding signals on the line, passing the signal at danger, or disregarding other operating regulations of the infrastructure operator.

Reasons for equipping lines with ETCS

- **The need to increase railway traffic safety** – the number of passing the signal at danger has been increasing, the existing national system cannot prevent this to the necessary extent. Unlike in other countries where ETCS is primarily a tool for achieving interoperability, in the Czech Republic it is also a **tool for increasing safety** (see a number of safety recommendations of the Rail Safety Inspection Office).
- **Monitoring of speed and any other restrictions on the line** – ETCS can stop not just trains that do not respect the signal at danger, but it can also monitor authorized speed limits, while the national system cannot prevent these dangerous incidents.
- **Fewer incidents** mean increased transport reliability (e.g. elimination of train delays on the network caused by incidents and handling their consequences).
- **Lower investment costs** for control with optimized equipment of lines with ETCS only (reduced costs for building parallel systems that would have to be implemented).
- **With the implementation of ETCS L2** as part of infrastructure optimization (referred to as "with benefits") directly for the exclusive operation of trains under ETCS supervision, and prospectively also with the implementation of ETCS L3 (or hybrid variant L2/L3), ETCS can **help increase capacity**.

ETCS is a prerequisite for increasing speed on the railways and enables the unification of traffic management principles on conventional lines connecting to high-speed lines.

The exclusive operation of trains under ETCS supervision is a condition for the planned speed increase above 160 km/h:

- upgraded line Brno – Přerov,
- upgraded line Plzeň – Rokycany,

- upgraded line Praha – České Budějovice,
- and others.

ETCS is the only applicable system on newly built high-speed lines.

With ETCS, speeds can be increased on existing lines without the need for curve modifications, thanks to the possibility of using additional speed profiles (taking advantage of the higher cant deficiency).

In other countries (e.g. Luxembourg, Belgium, Italy, Switzerland, Norway), implementation is linked to the decommissioning of national systems and the introduction of exclusive operation of trains under ETCS supervision. The deactivation of the national systems in these countries is generally already underway, even though the national systems in these countries often provide a comparable level of safety and functionality to ETCS.

ETCS on high-speed lines

High-speed lines (hereinafter referred to as "HSL") must already be equipped with ETCS in accordance with the Commission Regulation (EU) 2016/919 of 27 May 2016 on a technical specification for interoperability relating to the 'control-command and signalling' subsystems of the rail system in the European Union (hereinafter referred to as "CCS TSI") and in the context of 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. The preparation and financing of HSL is dealt with separately and therefore high-speed lines and the financial costs associated with the implementation of ETCS on these lines are not included in this Plan.

The vehicles for the high-speed lines, or the entire Rapid Service system (RS), will generally be new or re-routed from lines on which exclusive operation of trains under ETCS supervision will already be in place. The number of vehicles and the financial cost of equipping these vehicles by 2030, as indicated in the Plan, includes the vehicles that will be operating on the first RS sections.

Map of Rapid Service lines currently under preparation and examination



2. Implementation of the trackside part of ETCS

The issue of ETCS implementation has been discussed recently within the Working Commission for Increasing Railway Operation Safety (hereinafter referred to as the "Safety Commission"), whose members include, in addition to representatives of the Ministry of Transport, also representatives of the infrastructure manager Správa železnic, Rail Authority, Rail Safety Inspection Office, carriers, academia and train drivers. Since 2020, the strategy for the implementation of the trackside part of ETCS has been gradually refined, including the gradual introduction of the exclusive operation of trains under the supervision of this system.

At present, almost 650 km of lines are equipped with ETCS application level 2 (ETCS L2), mainly nationwide lines included in the TEN-T trans-European transport network. The total cost of equipping these lines with ETCS exceeded CZK 3 billion. However, the length of the lines on which ETCS is currently being implemented or is being prepared far exceeds these figures.

The Commission Implementing Regulation (EU) 2017/6 on the European Rail Traffic Management System European deployment plan sets out mandatory dates for the implementation of ETCS on selected European railway lines. The Czech Republic, in accordance with Article 3(2) of the Commission Implementing Regulation (EU) 2017/6 on the European Rail Traffic Management System European deployment plan, has notified the Commission of delays in the commissioning of ERTMS/ETCS on certain sections of the TEN-T core network corridors. The sections are listed in the legend in Annex 2: Plan for the implementation of ETCS and the introduction of exclusive operation of trains under ETCS supervision until 2040.

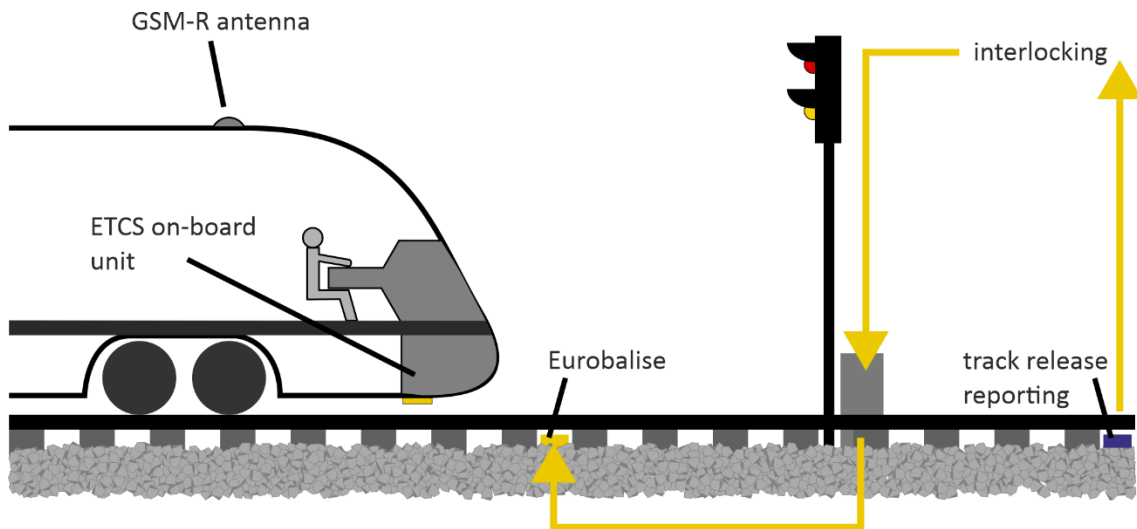
The ETCS trackside section implementation plan at this stage includes nationwide and regional railway lines owned by the state, but not by third parties (natural and legal persons or local governments). The implementation of the trackside part of ETCS on these lines will be addressed with their owners following the approval of this Plan.

2.1 Key principles

Within ETCS, communication always takes place between the trackside part of ETCS and the mobile parts of ETCS (on-board units) on the vehicles. This communication differs for each ETCS application level:

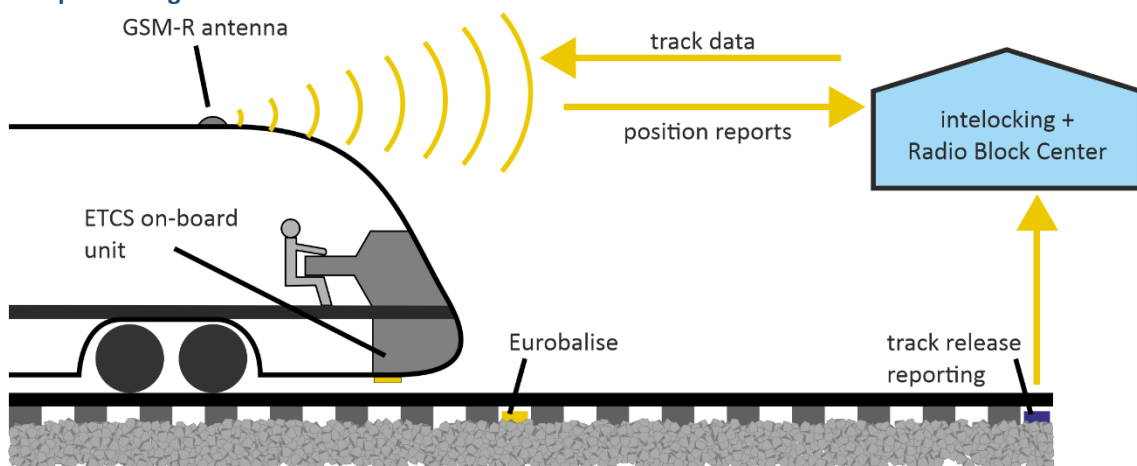
The first ETCS application level (hereinafter referred to as '**ETCS L1**') is a spot train control system which provides one-way spot contactless information transmission from the trackside part of ETCS to the mobile on-board part of ETCS, in particular via switchable and non-switchable Eurobalises. The switchable Eurobalises shall transmit, on the basis of data from the signalling equipment (station, trackside or level crossing equipment) to the mobile part of ETCS, the movement authorities and, where applicable, the necessary profiles describing the track characteristics set within the Route book. The interfaces between conventional signalling equipment and ETCS are Lineside Electronic Unit (LEU) interfaces according to European specifications. **The ETCS L1 Limited Supervision** is based on application level 1 and focuses only on selected functions (e.g. safe control of not passing of signals at danger, etc.) that are necessary from a safety point of view on the line. The main reason is to simplify the technical design of the trackside part of ETCS and thus reduce investment costs, for example on lines with low traffic.

Simplified diagram of ETCS L1



For the purpose of **ETCS in the second application level** (hereinafter referred to as 'ETCS L2'), in addition to the spot transmission of information from the track to the train by means of non-switchable Eurobalises, a continuous bidirectional transmission of information between the trackside and the mobile part of ETCS by means of radio data transmission over GSM-R networks is used. This arrangement makes it possible to keep up-to-date information both in the Radio Block Control Centre (RBC), which is the most important element of the ETCS L2 trackside part, and in the on-board ETCS units on the trains, thus creating a line train control system. The RBC concentrates all the information from the line about the conditions for train movements (determined on the basis of information from station, line and level crossing control equipment, or other specific information given by the staff member in charge of the operation) and registers all trains running under ETCS supervision, which in turn report to this control room basic data about their position on the line and the progress of their journey. One RBC is able to cover a certain section of the line, the extent of which is chosen according to various aspects, but in particular with regard to the number of communicating ETCS trains that may be in its area at any given time.

Simplified diagram of ETCS L2



The Safety Commission agreed that the following application levels and technical variants of the trackside part of ETCS will be further monitored in the Czech Republic:

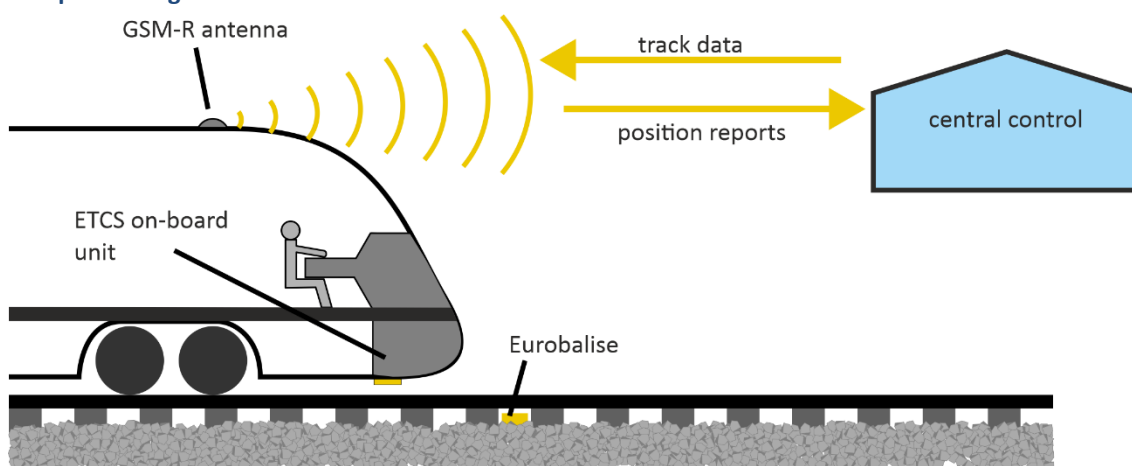
ETCS version	Basic characteristics
L2 <i>(in "without benefits" and "with benefits" versions)</i>	<ul style="list-style-type: none"> – Line train control system, ensures that the end of movement authority is not passed, completely monitors the not overpassing of authorized speed for all defined speed profiles – Radio-block control panels connected to the control system (with two-way communication, or integrated), only non-switchable Eurobalises – The target option, also referred to as the "with benefits" option, includes other related infrastructure improvements: <ul style="list-style-type: none"> – Track section lengths are optimized with respect to the required (usually highest) throughput, as they are not limited either by a uniform stopping distance or by the prescribed visibility of signals. – Only ETCS Stop marker and ETCS Location marker with additional lights (without red light) shall be established) – Operation of trains without an ETCS on-board unit is not possible in this case in normal operation – Maximum speed with no limit – On-board unit version according to specification set 1 (Baseline 2) of the TSI CCS and higher
L1	<ul style="list-style-type: none"> – Spot train control system, ensures that the signal at danger is not passed, fully supervises that the authorized speed is not exceeded for a limited number of speed profiles – Switchable and non-switchable Eurobalises, including line electronic units (LEU) in the trackage – Conventional signals with red light – Max. speed up to 160 km/h – On-board unit version according to TSI CCS Specification Set 2 (Baseline 3) and higher
L1 Limited Supervision	<ul style="list-style-type: none"> – Spot train control system, ensures that the signal at danger is not passed, limited supervision of not exceeding the authorized speed for a limited number of speed profiles – Uses switchable and non-switchable Eurobalises including Line Electronic Units (LEUs) at all main signals – Conventional signals with red light – Max. speed up to 100 km/h – On-board unit version at least according to TSI CCS Specification Set 2 (Baseline 3) and higher
L1 Limited Supervision Stop	<ul style="list-style-type: none"> – Provision of emergency braking of a vehicle equipped with an ETCS on-board unit in the event of its unauthorized passing of a signal at danger – It uses standard non-switchable Eurobalises and switchable Eurobalises at all main signals, controlled by line electronic units (LEUs) capable of transmitting the corresponding data telegrams in accordance with the TSI CCS – Max. speed up to 100 km/h

For (usually regional or nationwide) lines with less traffic, the ETCS L1 Limited Supervision or ETCS L1 Limited Supervision Stop solution was chosen, using switchable and non-switchable Eurobalises connected via line electronic units (LEUs) to the signalling interface. The designation ETCS L1 Limited Supervision, i.e. Class A equipment according to the TSI CCS, is currently in use and has resulted from consultation with the European Commission and the EU Agency for Railways.

In the future, the third application level ETCS (hereinafter referred to as "ETCS L3"), or a hybrid variant of ETCS L2/L3, which *de facto* allows the partial replacement of fixed track sections with moving ones, which will

allow to increase the line capacity, **is not ruled out**. The introduction of this level is conditional, *inter alia*, on the safe control of the integrity of the train within itself, by means of appropriate equipment.

Simplified diagram of ETCS L3



The meeting of the Safety Commission resulted in the task for the infrastructure manager Správa železnic to draw up an Action Plan for the implementation of the trackside part of ETCS, which was adopted by the Safety Commission and its outputs are incorporated into this Plan, which assumes the scope of equipping and equipping lines with the trackside part of ETCS as shown in Table 1.

The table below shows that by the end of 2021, more than 800 km of lines will be equipped with ETCS and by 2030, another 4,600 km of lines will be equipped for a total of 5,400 km, i.e. roughly 60% of the length of the Czech railway network, which, however, provide 98% of the transport performance of the Czech railway. This implies that between 2030 and 2040, by which time the remaining lines should be equipped, the remaining approximately 4,000 km of railway lines will be equipped.

Table 1 Total length of lines on which ETCS will be implemented by 2030 [km]

year	ETCS L1 a L2		ETCS L1 LS		ETCS L1 LS Stop		total
	in operation	increase	in operation	increase	in operation	increase	
by 2021	562	-	0	-	0	-	562
2021	721	159	0	0	97	97	818
2022	1 029	308	0	0	192	96	1 221
2023	1 287	258	0	0	256	64	1 543
2024	1 519	232	0	0	479	223	1 998
2025	1 573	54	21	21	550	71	2 144
2026	1 890	317	55	34	674	124	2 619
2027	2 337	447	97	42	812	138	3 246
2028	2 788	451	245	148	815	3	3 848
2029	3 040	252	678	433	834	19	4 552
2030	3 766	726	753	75	897	63	5 416

The application levels (also known as technical variants) are shown in Annex 1 (in the form of a table, ETCS implementation until 2030) and in Annex 3 (in the form of a map, ETCS implementation until 2040). However, the application levels or technical variants may be higher than currently assumed, especially in relation to future upgrades (electrification, optimization) of the lines concerned or in the context of a change in the operational

concept. Conversely, it may also be admitted that in the event of a major reduction in the operation of the lines, it may be appropriate to implement a lower level (technical variant) if this is practical. However, the technical variants (or application levels) of ETCS must never limit the required operational concepts of the customers. Any changes to the application levels or technical variants will be continuously updated in the ERTMS National Implementation Plan.

If railway operation has ceased on a line, ETCS will not be implemented on that line.

A prerequisite for the implementation of ETCS at application level 2 and 3 is the existence of the interoperable radio system GSM-R, or its successor FRMCS in the future. GSM-R must also be installed as required by the TSI CCS in the case of the first installation of radio communication of the trackside subsystem or its upgrade, when the function or performance characteristics of the subsystem change. These interoperable radio systems are thus the target systems on the entire railway network of the Czech Republic. The implementation plan for the interoperable radio system will be determined by the ERTMS National Implementation Plan, in the context of the ETCS implementation schedule according to this Plan.

2.2 Exclusive operation of trains under ETCS supervision

Analyses and operational experience have clearly shown that **the simultaneous operation of vehicles equipped and not equipped with ETCS does not allow to achieve an adequate increase in safety**, does not allow to eliminate the limitations of the infrastructure capacity, does not reduce the operating costs of the infrastructure manager and carriers, and at the same time discriminates against carriers who have equipped their vehicles with ETCS and devalues their investment by insufficient use of ETCS. A train without ETCS on the line becomes a threat not only to itself but also to all other trains on the line and in stations. Such simultaneous operation of ETCS and non-ETCS vehicles is also an obstacle to the anticipated increase in speed above 160 km/h. It is therefore necessary to ensure that all vehicles operating on a given line equipped with trackside ETCS are equipped with the mobile part of ETCS. This will establish the so-called **exclusive operation of trains under ETCS supervision** on the line in question.

Directive 2016/798/EU of the European Parliament and of the Council of 11 May 2016 on railway safety defines the role of inspection bodies, which in the Czech Republic is the Rail Safety Inspection Office. Based on the investigation of incidents, the inspection body issues safety recommendations, which are then binding for their addressees. In its safety recommendations, the **Rail Safety Inspection Office has repeatedly stressed the need to accelerate the implementation of ETCS on the Czech railway network, while it is obvious that the required safety improvement cannot be achieved without the introduction of exclusive train operation under the supervision of this system.**

Regulation 2016/919/EU, as directly applicable legislation, gives Member States the power to allow access to ETCS-equipped lines only to ETCS-equipped vehicles so that existing national systems can be decommissioned.

As the implementation of ETCS on the existing LVZ LS system in use (and the associated track sectioning) is degrading the line capacity, it has been decided that the LVZ LS system will be decommissioned on the lines to be equipped with ETCS in due course. **The introduction of the exclusive operation of trains under ETCS supervision will start on 1st January 2025 on the first sections** (transit railway corridor I and II and part of transit railway corridor III). On the pilot section on the line Olomouc – Uničov, the exclusive operation of trains under ETCS supervision will start as early as 1st January 2023.

ETCS can also be used in the future to automate train control (with varying degrees of direct involvement in train control and varying degrees of responsibility for providing related functions), thereby reducing energy consumption, increasing capacity, comfort and reliability of railway transport.

ETCS for railways in the Czech Republic can act as a driver for technological progress in general. Especially in the case of upgrading works, together with the electrification of the lines, or the conversion of the traction power supply from a 3 kV DC power supply system to a 25 kV/50 Hz AC power supply system, it will bring better conditions for the passage of heavy freight trains and for dense passenger traffic.

Main principles for the introduction of exclusive operation of trains under ETCS supervision

Interstation sections

The main criteria for setting priorities for the gradual implementation of ETCS and the introduction of exclusive operation of trains under ETCS supervision on individual lines were:

- ETCS implementation deadlines set by European legislation, in particular:
 - 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,
 - Commission Implementing Regulation (EU) 2017/6 of 5 January 2017 on the European Rail Traffic Management System European deployment plan,
- categories of lines,
- expected completion of prepared and planned upgrading and electrification of lines or new lines,
- load on the lines,
- expected date of deployment of vehicles equipped with on-board ETCS units,
- statistical probability of conditions for the occurrence of an incident (number of trains passing signal at danger),
- method of traffic control on the line.

Stations

In addition to the lines (or line sections), it was also necessary to determine the principles by which the level of safety at individual stations would be increased.

If a vehicle enters from a line not equipped with an ETCS trackside or from an ETCS trackside equipped line in mixed traffic into a connecting/junction station on an ETCS exclusive line and continues regularly (in particular in passenger or freight service) on the ETCS exclusive line, the vehicle shall be equipped with a functional compatible ETCS on-board unit and which shall always be active.

If a vehicle enters from a line not equipped with a trackside part of ETCS into a connecting/junction station on a line with exclusive ETCS operation and in occasional cases outside regular passenger or freight services it must be driven further along the line with exclusive ETCS operation, e.g. for armament or repair or maintenance purposes, the vehicle must be able to travel under ETCS supervision on ETCS-exclusive sections, whereby another vehicle equipped with an ETCS on-board unit may be used – e.g. by coupling it to another vehicle/train equipped with an ETCS on-board unit which will take it to its destination under ETCS supervision (arranged by the carrier at its own expense). If the vehicle is equipped with a functional compatible ETCS on-board unit, the ETCS on-board unit shall always be active.

Especially with regard to the operational and economic options of carriers and ordering parties in equipping vehicles with on-board ETCS units, it was proposed on the basis of a meeting between the infrastructure manager Správa železnic and the Ministry of Transport that in the cases where vehicles are coming from a line not equipped with a trackside part of ETCS or from a line with mixed ETCS operation to a connecting/junction station on a line with exclusive ETCS operation and returning, not moving towards a line section with exclusive operation of trains under ETCS supervision, that the introduction of exclusive operation and the associated improvement of safety in stations should consist of two-phases:

Phase 1 – introduction of exclusive operation of ETCS in intermediate sections and selected operational points. Vehicles coming from a line not equipped with a trackside part of ETCS or from a line with mixed ETCS operation to a connecting/junction station on a line with ETCS exclusive operation and returning, not moving towards a line section with ETCS exclusive operation, do not have to be equipped with an ETCS on-board unit after the date of commencement of exclusive operation (on the main line) under the following conditions:

- a) For a journey from a given line to a station, entry into the ETCS area is not implemented by automatic switching by the on-board ETCS unit to level 2 when passing an entrance signal (so-called 'automatic entry' is not implemented) and
- b) a speed of more than 60 km/h is not authorized on any entry train path from that line; or
- c) structural or technical measures are applied which prevent a train coming from a connecting line from endangering the passage of another train under ETCS control on the line with exclusive operation, including the possible continuation of the threatening train beyond the end of the train entry path.

Phase 2 – introduction of exclusive operation of ETCS in the connecting stations.

The period of Phase 1 may be a maximum of five years. Two-phase safety upgrades are no longer considered after 2032.

2.3 Line equipping timetable and dates of introduction of exclusive operation of trains under ETCS supervision

In determining the timetable for equipping the lines, the criteria listed above on page 13 were considered. In setting the deadlines for the introduction of exclusive operation, the deadlines were then limited by the following principles:

- length of the migration period (mixed operation of trains without ETCS and with ETCS);
 - generally, as short as possible, preferably zero,
 - on nationwide routes for a maximum of 5 years;
- coupled implementation of ETCS with upgrades of the relevant lines, line sections (or stations);
- expected deployment of vehicles equipped with on-board ETCS units.

When setting the dates for the introduction of exclusive operation, it was therefore necessary to consider influences that are often contradictory. Examples include, on the one hand, multi-year (ten to fifteen years) contracts concluded by transport customers with carriers without the requirement to equip the contracted vehicles with on-board ETCS units and, on the other hand, the complex upgrading of the line, which is already being prepared for exclusive operation of trains under ETCS supervision (without conventional signalling) with a view to efficient use of financial resources and with regard to capacity. In many cases, the deadlines are the result

of a compromise, often conditional on the customers securing the co-financing of the equipment of vehicles with on-board ETCS units from subsidies.

First of all, dates were set for the introduction of the exclusive operation of trains under ETCS supervision on the main lines, from which the dates on other lines were then determined. It applies to the following lines and deadlines in particular:

- Transit railway corridor I and II (hereinafter referred to as TRC) and TRC III in the section Přerov – Česká Třebová as of 1st January 2025,
- Transit railway corridor IV in the section Praha – České Budějovice as of 12/2026,
- Transit railway corridor III in the section Cheb – Beroun as of 12/2027,
- Transit railway corridor III in the section Beroun – Praha as of 12/2028.

The deadlines for the introduction of exclusive operation on other lines were proposed by the Ministry of Transport and, in particular, subsequently discussed and adjusted with individual customers to ensure an acceptable compromise between the above limits.

The timetable for equipping the lines and the dates for the introduction of exclusive operation of trains under ETCS supervision up to 2030 is given in Annex 1 in tabular form and in map form in Annex 2 for the horizon up to 2040.

In many cases, the **implementation of ETCS is linked to the upgrading, optimization, reconstruction and, above all, electrification** of the lines concerned, and may also be linked to a new operational concept. **In these cases, the introduction of exclusive operation of trains under ETCS supervision is therefore closely linked to and limited by possible unexpected** (and out of control of the Ministry of Transport or the infrastructure manager Správa železnic) **effects arising from the process of preparing the construction works**, in particular the Environmental impact assessment processes, and procedures set by the Act No. 183/2006 Coll. (Construction Act), which involves participants and concerned authorities whose interests, or the settlement of their interests, may affect the overall length of preparation and subsequent implementation. Such constructions are identified in the table and **it is possible that the deadline for the implementation of ETCS or the introduction of exclusive operation of trains under ETCS supervision may change over time**. Such a change will be notified in due time by the infrastructure manager Správa železnic and subsequently reflected in the ERTMS National Implementation Plan.

3. Equipping vehicles with on-board ETCS units

The general strategy for equipping vehicles with on-board ETCS units (ETCS OBU) will be set out in the ERTMS National Implementation Plan on the basis of this Plan. It is understood that the equipping of the vehicles with ETCS OBUs is the full responsibility of their owners or operators. The Ministry of Transport, in close cooperation with the infrastructure manager Správa železnic, shall then set binding dates for the exclusive operation of trains under ETCS supervision on the lines concerned, set the framework conditions for the operation and approval of ETCS OBUs and provide subsidy programs.

3.1 Equipping vehicles with on-board ETCS units to date

Subsidy programs for equipping vehicles with on-board ETCS units can be divided into programs administered at national level (Operational Programme Transport, contribution from the State Fund for Transport Infrastructure) and at EU level (CEF instrument).

The use of the **Connecting Europe Facility** instrument (hereinafter referred to as **CEF**) has been made possible progressively since 2015, when the first project applications of Czech applicants were submitted under the CEF call for proposals. Given that at that time the whole process of equipping and approving ETCS OBUs was at an early stage and there was a lack of sufficient experience on the part of both applicants and suppliers, only a part of the vehicles from the submitted applications reached the implementation phase. The main problem proved to be the insufficient capacity of the suppliers, which caused high bid prices and overall low interest of the suppliers with regard to the binding deadlines set for the supported projects. Under the two CEF Cohesion Calls, a total of 4 grant projects of Czech applicants were approved, while 2 projects involving a total of approximately 230 vehicles were taken to the implementation phase with a deadline for equipping them with on-board units by 2022.

In addition, a project concerning 19 prototype equipping of vehicles with ETCS OBUs has been approved under the CEF 2020 general call. 2 projects have also been submitted to the CEF **Transport Blending Call**, with a completion date of 2024.

Under the **Operational Programme Transport 2** (hereinafter referred to as "**OPT**"), two calls were implemented in 2017 and 2019 and a total of 12 projects were approved for support, of which 9 are still ongoing. In total, the projects are expected to include up to 187 vehicles, although the numbers are subject to continuous change as the results of the tenders and the beneficiaries' strategies change. The anticipated completion date for the projects was the end of 2022, but also due to the impact of the anti-pandemic measures, beneficiaries are allowed a delay of up to 6 months.

In 2020, a call for projects was published under the **State Fund for Transport Infrastructure** (SFDI) contribution for equipping vehicles with on-board ETCS units. Applications included a total of 6 projects to equip up to 79 vehicles.

In 2021 it is planned to publish the 2nd SFDI call under similar conditions as in 2020. The first CEF2 cohesion call is also planned. Here, the detailed conditions have not yet been set, but they should be based on the last CEF1 calls, where unit allowances were applied. This means that a fixed amount was allocated for each equipped vehicle, irrespective of the actual cost, depending on the nature of the retrofit (e.g. prototype, retrofitting). The value of the unit allowance should differ and will be higher in the cohesion CEF.

It is currently difficult to assess the progress of individual subsidy projects, as most of them are in the prototype equipping phase and there is no experience with the actual approval process yet. In any case, capacity on the part of suppliers and technological capabilities in terms of equipping older vehicles are proving to be

critical factors. For this reason, even more emphasis will be placed on the overall renewal of the rolling stock of carriers by purchasing new vehicles equipped with on-board ETCS units from the factory. The approval of vehicles with on-board ETCS units for international operation is the responsibility of the European Union Agency for Railways (ERA).

Table 2 Need to acquire on-board ETCS units for vehicles by 2025 (as of 8/2021)

	estimate of need	equipped	contracted	submitted application (OPT, CEF, SFDI)	not ensured
passenger transport	676	35	145	110	440
freight transport	416	63	225	157	42
total	1 092	98	370	267	482

The table does not include special vehicles

At present, approximately 100 vehicles are equipped with ETCS and another 370 vehicles (new or retrofitting of existing vehicles) have been contracted. Approximately 267 vehicles have submitted a request for co-financing. The remaining approximately 476 vehicles identified as needing to be equipped with on-board ETCS units by 2025 remain at this moment unsecured.

Table 3 Overview of subsidy titles for equipping vehicles with on-board ETCS units (as of 8/2021)

subsidy title – call for proposals	number of vehicles	amount [million CZK]
Operational Programme Transport call 43	65	440
Operational Programme Transport call 75	88	700
SFDI 2020	79	551
CEF 2015	230	1 240
CEF 2019	13	160
total	475	3 091

Currently, for the period from 2015 to the present, funds have been allocated or are pending approval for the co-financing of on-board ETCS units for approximately 475 vehicles for a total co-financing amount of almost CZK 3.1 billion. **Despite the initial difficulties in awarding contracts, setting conditions, and finding suppliers, about half of the necessary vehicles that will need to be equipped by 1st January 2025, when the exclusive operation of trains under ETCS supervision will be introduced on sections I and II of the transit railway corridor and section III of the transit railway corridor in the Přerov – Česká Třebová section, are currently secured.**

However, it is important that ETCS is used in normal operation before it becomes mandatory (before the exclusive operation of trains under ETCS control is introduced), in particular to increase safety.

3.2 Equipping vehicles with on-board ETCS units by 2030

With the planned development of ETCS and the plan to gradually introduce exclusive operation of trains under the supervision of this system on the entire railway network in the Czech Republic, greater demands will be placed on carriers not only to equip existing vehicles with on-board ETCS units, but also to upgrade the entire rolling stock with regard to sustainability. According to the legislation in force, new vehicles must be equipped with on-board ETCS units almost without exception when they are approved for operation.

The support of carriers remains essential in this respect and **it is therefore necessary to ensure co-funding in future periods to such an extent that the increase in the level of safety of railway transport, which ETCS undoubtedly brings, does not mean a reduction in the competitiveness of railway transport** but, on the contrary, acts as an incentive for the necessary upgrading of the obsolete rolling stock.

The Ministry of Transport, on the basis of data from passenger and freight carriers, has drawn up this plan for equipping existing vehicles and a plan for renewing the rolling stock of carriers in the Czech Republic, in order to be able to set up appropriate programs for the co-financing of the equipping of vehicles with on-board ETCS units in an adequate amount.

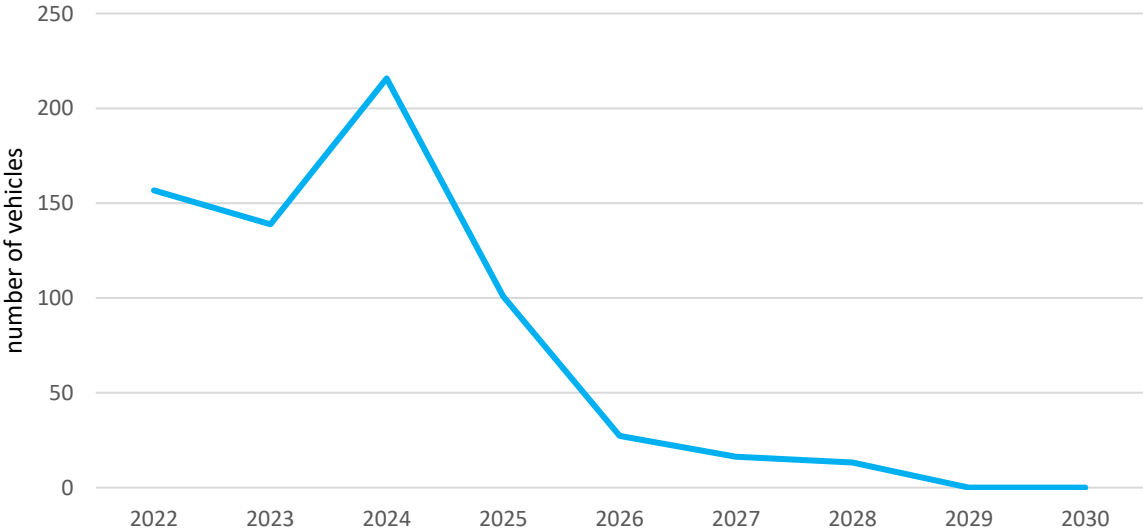
For the co-financing of the equipping of new vehicles, the maximum amount that carriers can already apply for today, i.e. CZK 6.75 million per vehicle, is always considered. For existing vehicles that will need to be retrofitted with on-board ETCS units (retrofitting), two scenarios are considered in the following sections of this document. The **first scenario** corresponds to the current situation, i.e. co-financing up to a **maximum of CZK 6.75 million per vehicle**, while the **other scenario** corresponds to a theoretical increase in the co-financing rate to a level of **CZK 8.5 million per vehicle**.

Beyond the numbers and financial means mentioned below, the **retrofitting with on-board ETCS units and the upgrading of special vehicles of the infrastructure manager Správa železnic** is in progress. Approximately 109 existing vehicles will need to be retrofitted with on-board ETCS units, and the retrofitting of 98 of them (MVTV 2, MVTV 2.2, MVTV 2.3, MTW 100, MUV 75) is underway with a deadline of the end of 2024. 109 vehicles are also expected to be newly procured in the period up to 2030, with the vast majority either already tendered or in the process of being tendered for.

Retrofitting on-board ETCS units to existing vehicles

By 2030, **passenger transport** operators estimate the need to equip nearly **700 more existing vehicles** with on-board ETCS units, not including contracts already awarded. These are still promising vehicles which are not at the end of their technical and moral life and therefore it makes sense to invest in them.

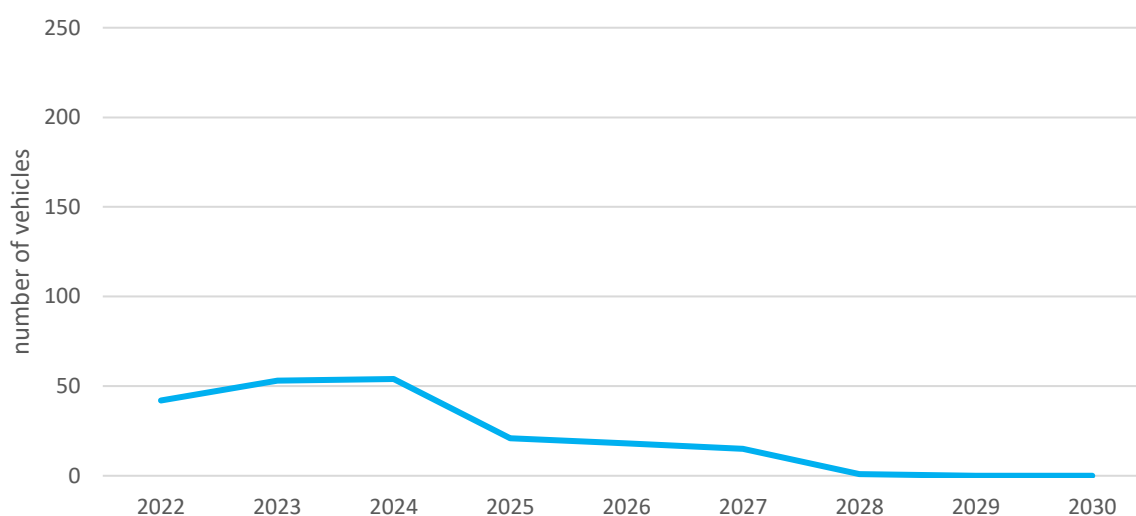
Plan for retrofitting existing vehicles with on-board ETCS units in passenger transport



While considering the level of co-financing at the current level of CZK 6.75 million per vehicle, it is necessary to provide financial resources for co-financing of about **CZK 4.52 billion** for retrofitting existing vehicles with ETCS in passenger transport. If the level of co-financing were increased to CZK 8.5 million, resources of **CZK 5.32 billion** would need to be secured.

In the same timeframe, **freight transport** operators are considering retrofitting around **200 existing traction units** with on-board ETCS units. At the same level of co-financing of between CZK 6.75 and 8.5 million per vehicle, the total financial support required by carriers is almost **CZK 1.37 to 1.62 billion**, again depending on the amount of financial support.

Plan for retrofitting existing vehicles with on-board ETCS units in freight transport



As can be seen from the above graphs, the strongest factor motivating passenger and freight carriers to equip their vehicles with on-board ETCS units is apparently the launch of exclusive operation of trains under ETCS supervision on selected sections of Transit Railway Corridor I and II (hereinafter referred to as "TRC") and TRC III in the Přeřov – Česká Třebová section, which will start on 1st January 2025, and therefore the largest number of vehicles is expected to be retrofitted with on-board ETCS units before this date.

Table 1 Total amount of required financial support of carriers for equipping existing vehicles with ETCS [million CZK]

	2022	2023	2024	2025	2026	2027	2028	2029	2030	total
passenger transport retrofitting (6.75 million CZK)	970	460	1 890	820	180	110	90	-	-	4 520
passenger transport retrofitting (8.5 million CZK)*	970	460	2 380	1 030	230	140	110	-	-	5 320
freight transport retrofitting (6.75 million CZK)	220	160	590	170	120	100	10	-	-	1 370
freight transport retrofitting (8.5 million CZK)*	220	160	740	210	150	130	10	-	-	1 620
Prototype retrofits	-	400	200	-	-	-	-	-	-	600
total with subsidy 6.75 million CZK for retrofitting	1 190	1 020	2 680	990	300	210	100	-	-	6 490
total with subsidy 8.5 million CZK for retrofitting *	1 190	1 020	3 320	1 240	380	270	120	-	-	7 540

*) increase of the support rate is expected only for calls from 2022, where projects can be expected to be reimbursed from 2024 onwards

Approximately **CZK 600 million** over and above these amounts is **aid** to carriers for the **implementation of prototype installations of ETCS on-board units** in existing vehicles. A higher level of support is assumed for prototype retrofits due to the higher financial intensity (unlike series retrofits, it includes more costs resulting from the complexity of the project, including the development and approval of the necessary project documentation, the large scale of retrofit approval, tests and test runs, etc.).

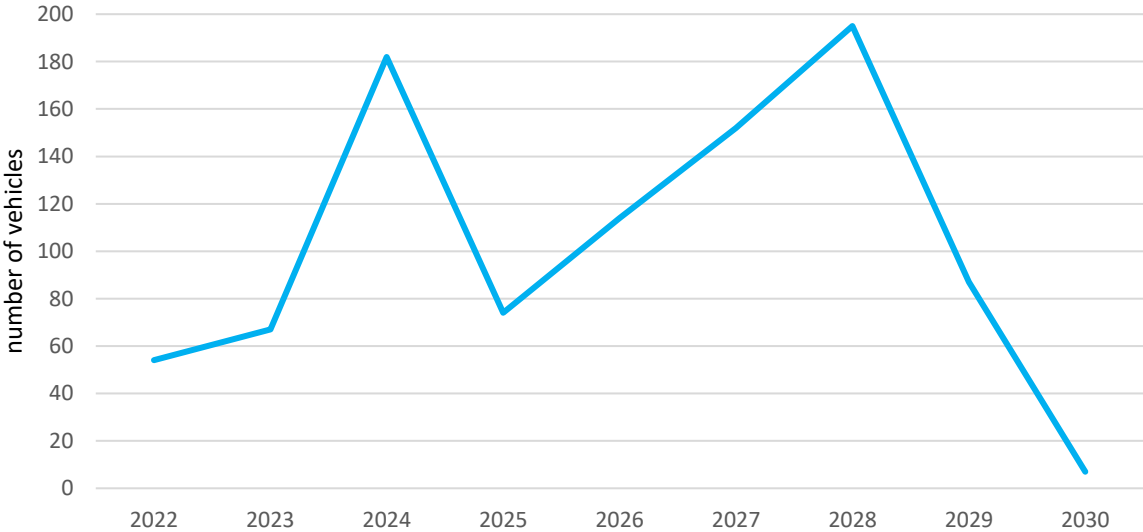
The total amount of financial support required from carriers to equip existing vehicles with on-board ETCS units is therefore approximately CZK 6.5–7.5 billion by 2030, depending on the amount of co-financing provided.

Fitting new vehicles with on-board ETCS units

As the implementation of ETCS is a major stimulus not only for the upgrading of the railway network but of the entire railway system, the purchase of new vehicles will be co-financed in the amount of up to CZK 6.75 million to cover the higher price of newly purchased vehicles already equipped with the ETCS system. Although equipping new vehicles with an on-board ETCS unit is already a legislative obligation in practice, it is advisable to unify the approach to equipping new vehicles and existing vehicles so that those carriers who invest in modernizing their rolling stock by purchasing new vehicles are not disadvantaged.

The objective is the overall modernization of railway transport, i.e. a focus on new emission-free rolling stock. In addition to ETCS equipment from the factory, the new modern vehicles are also characterized by a higher level of passive safety (high strength, high impact resistance, fire resistance), a higher level of active safety (highly efficient brakes) and a higher level of travel comfort. These vehicles are faster, emission-free, less maintenance-intensive and more energy-efficient. It is therefore sensible to encourage investment in the purchase of new ETCS-equipped vehicles both directly (co-financing of on-board ETCS units in new vehicles) and indirectly (e.g. reduction of the charges for the use of railway infrastructure).

**Rolling stock upgrading plan for passenger carriers
(new vehicles with ETCS)**

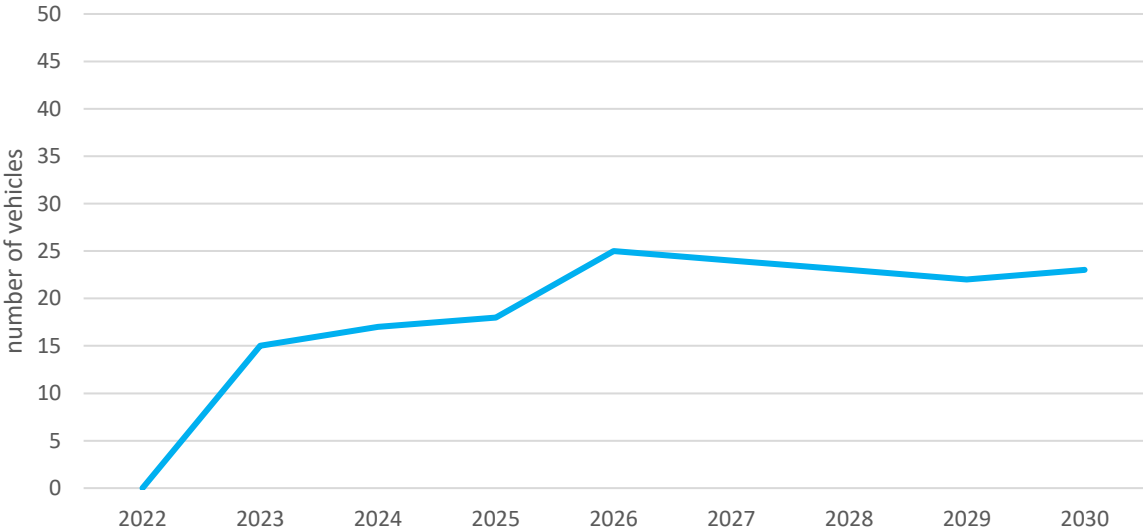


As can be seen from the graph above, **passenger carriers** expect a relatively massive renewal of their rolling stock by 2030, which results mainly from the expected demand of customers for higher quality standards in the newly concluded contracts for providing transport services on rail. In absolute terms, the passenger carriers thus

anticipate the purchase of almost **1,000 new traction vehicles or units** already factory-equipped with ETCS. At the assumed co-financing rate of CZK 6.75 million per traction vehicle or unit, the total amount of support until 2030 is around **CZK 6.3 billion**.

On the other hand, **freight carriers** anticipate a relatively balanced renewal of traction vehicles totalling approximately 170 units. Support for the fitting of ETCS on-board units on these vehicles then represents a financial co-financing requirement of approximately **CZK 1.15 billion**.

**Rolling stock upgrading plan for freight carriers
(new vehicles with ETCS)**



As can be seen from the graphs above, in the next few years there will be a relatively massive renewal of the rolling stock of freight and passenger carriers, which will have a positive effect on deploying of vehicles on lines already equipped with a trackside part of ETCS, thus enabling the gradual introduction of exclusive operation of trains under ETCS supervision on individual lines.

Table 2 Total amount of required financial support of carriers for equipping new vehicles with ETCS [million CZK]

	2022	2023	2024	2025	2026	2027	2028	2029	2030	total
passenger transport	360	280	1 400	500	770	1 030	1 320	590	50	6 300
freight transport	0	100	110	120	170	160	160	150	160	1 130
total	360	380	1 510	620	940	1 190	1 480	740	210	7 430

In total, new vehicles in railway transport, and/or support for their purchase with an on-board ETCS unit represent total co-financing requirements of approximately CZK 7.43 billion.

4. Need for ETCS implementation financing

On the basis of documents from the infrastructure manager Správa železnic, the total cost of the implementation of the ETCS trackside section until 2030 was estimated. Data on the expected equipment of existing vehicles with on-board ETCS units and information on planned purchases of new vehicles were then obtained from the carriers. This data was analyzed to identify the need to secure financial resources for co-financing the fitting of on-board ETCS units on existing and new vehicles for the period up to 2030.

4.1 Cost of implementing of the trackside part of ETCS

The total cost of implementing the trackside part of ETCS until 2030 is shown in the table below and is estimated at just under CZK 47 billion. This is an expert estimate based on the knowledge and experience of the infrastructure manager Správa železnic from the preparation of investment projects so far and based on the current price level (06/2021). Estimates will have to be updated periodically, primarily due to the time horizon and the assumption of the use of (currently not yet used) ETCS technological implementations.

Considering the fact that in the period until 2030 the busiest lines will be equipped with ETCS (especially nationwide lines included in the trans-European rail network and most of the nationwide lines), it can be expected that after 2030 the financial requirement for equipping the remaining lines with ETCS will be lower.

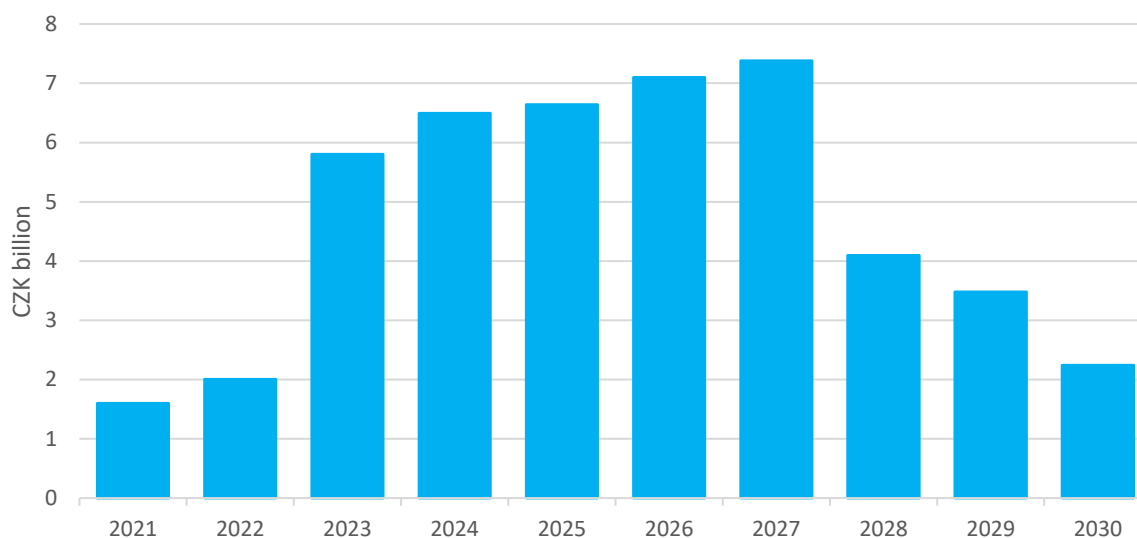
These costs relate to ETCS only, and do not include further upgrades to infrastructure, stations, conventional signalling equipment, etc.

Table 3 Total costs for the implementation of the trackside part of ETCS by 2030 [million CZK]

year	ETCS L1 a L2		ETCS L1 LS		ETCS L1 LS Stop	total
	preparation	implementation	preparation	implementation	preparation and implementation	
2021	309	936	0	0	358	1 603
2022	638	1 142	4	0	224	2 008
2023	440	4 769	15	0	580	5 804
2024	347	4 675	55	25	1393	6 494
2025	496	5 528	129	100	388	6 640
2026	333	6 164	159	282	163	7 101
2027	263	6 070	81	600	368	7 381
2028	12	3 057	8	1 008	10	4 096
2029	0	2 525	0	862	91	3 478
2030	0	2 077	0	130	37	2 244
total	2 687	37 095	451	3 007	3 611	46 850

The above-mentioned costs represent to a large extent investment costs of constructions where the ETCS project involves a complete renovation of signalling equipment at the end of its service life (e.g. Kralupy n. Vlt. – Ústí n. L. – state border Germany), or where the target parameters of the project cannot be achieved without ETCS, which was designed as a technological superstructure of the infrastructure modernization (e.g. increasing speed above 100 km/h on the lines Praha-Horní Počernice – Lysá n. L., Praha-Radotín – Beroun, Pardubice – Hradec Králové, etc.).

Financial resources required for the implementation of the track-side part of ETCS by 2030



4.2 Cost of implementing the on-board part of ETCS

Based on the plans of the carriers, as outlined above, the total cost of the government co-financing until 2030 has then been determined. The co-financing costs in the two scenarios under consideration (co-financing of retrofitting of existing vehicles in the amount of CZK 6.75 million per vehicle and CZK 8.5 million per vehicle) differ by approximately CZK 1 billion over the whole period under consideration (until 2030).

The total cost of renewing the rolling stock and equipping the vehicles with on-board ETCS units is estimated by the carriers at almost CZK 100 billion. Of this sum, the retrofitting of on-board units to existing vehicles alone represents approximately CZK 18 billion. The remaining CZK 82 billion represents mainly natural rolling stock replacement, which the ETCS project can stimulate to some extent.

Co-financing costs

The Ministry of Transport provides public aid on the basis of the approved EC Decision SA.44621 (2016/N) of 4 September 2017, which was extended on 27 February 2020 by Decision SA.55681 (2019/N). The subject of the extension of the current decision was the provision of public aid up to CZK 3.4 billion and the extension of the validity of the measure until 31 December 2022. These public resources are provided under the Operational Programme Transport and by State Fund for Transport Infrastructure. The maximum contribution per vehicle is CZK 6.75 million. The maximum amount for retrofitting or 85 % of eligible costs is CZK 24.3 for prototype retrofitting.

For the programming period 2021–2027, the Ministry of Transport is preparing a new notification in which there is a clear requirement for the Czech Republic to combine national and European resources up to 85% of the eligible costs for the installation of an on-board unit on a vehicle. The Ministry of Transport considers the eligible costs to be CZK 10 million per vehicle in the case of (serial) retrofitting and CZK 45 million in the case of prototype retrofitting. The EU financing for the period 2021–2027 means the already approved CEF2 and OPT3, which is currently under the approval process. The incentive for carriers to participate in CEF2 calls is the co-financing of eligible costs from national sources amounting to up to 85% of eligible costs. The national share will be administered in cooperation with SFDI. This incentive for participation in CEF2 is included in the draft notification. The European Commission itself is interested in the efficient use of the CEF instrument, as it has

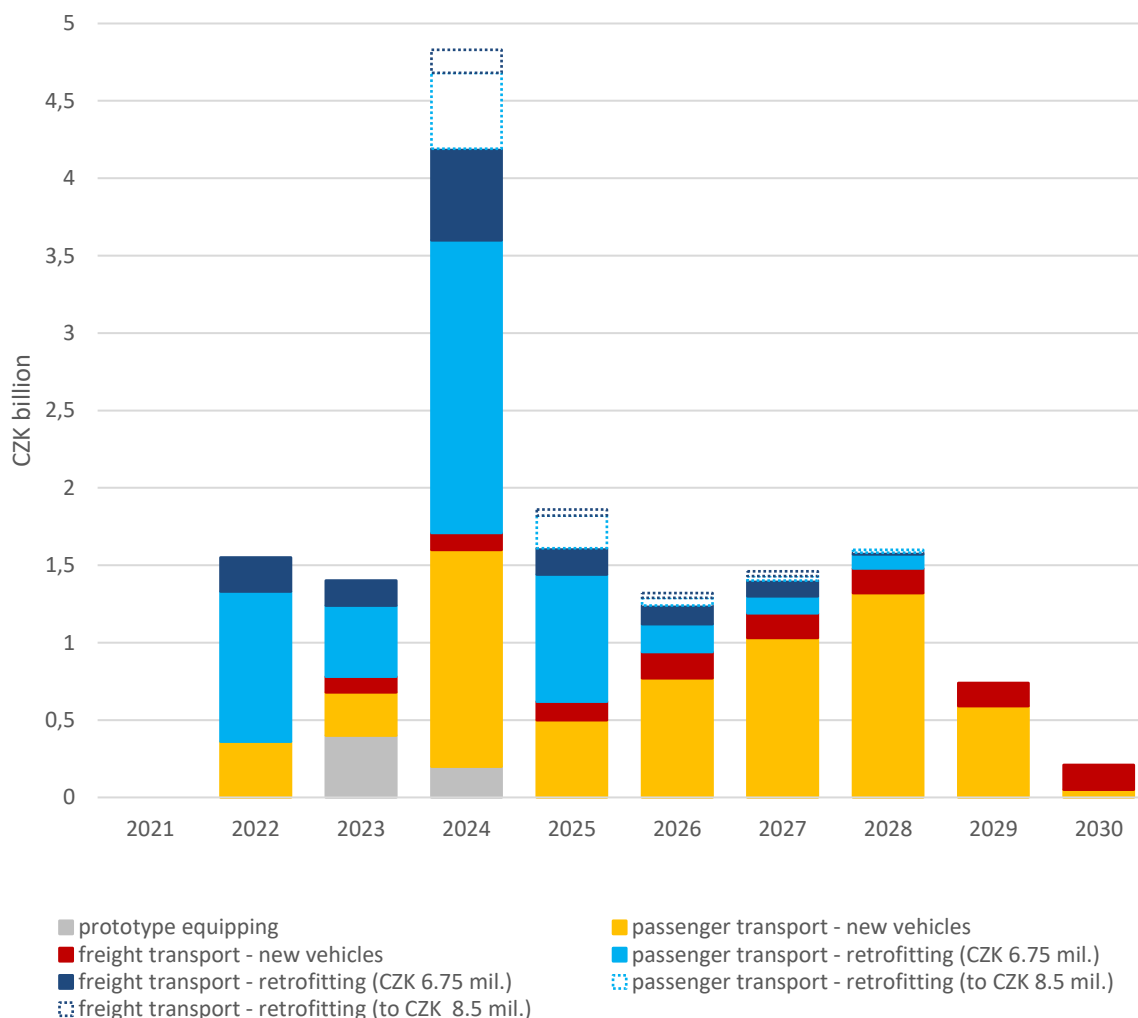
already allowed a similar possibility of national co-financing in Decision SA.55451 (2019/N) issued for the Netherlands.

Table 4 Resources required for co-financing the fitting of on-board ETCS units by 2030 [million CZK]

	2022	2023	2024	2025	2026	2027	2028	2029	2030	total
passenger transport retrofitting (6.75 million CZK)	970	460	1 890	820	180	110	90	-	-	4 520
passenger transport retrofitting (8.5 million CZK) *	970	460	2 380	1 030	230	140	110	-	-	5 320
freight transport retrofitting (6.75 million CZK)	220	160	590	170	120	100	10	-	-	1 370
freight transport retrofitting (8.5 million CZK) *	220	160	740	210	150	130	10	-	-	1 620
prototype retrofitting	-	400	200	-	-	-	-	-	-	600
passenger transport new vehicles	360	280	1 400	500	770	1 030	1 320	590	50	6 300
freight transport new vehicles	-	100	110	120	170	160	160	150	160	1 130
total with subsidy 6.75 million CZK for retrofitting	1 550	1 400	4 190	1 610	1 240	1 400	1 580	740	210	13 920
total with subsidy 8.5 million CZK for retrofitting *	1 550	1 400	4 830	1 860	1 320	1 460	1 600	740	210	14 970

*) the increase in the support rate is expected only for calls in 2022, where projects can be expected to be reimbursed from 2024 onwards

Financing needed to co-finance the fitting of on-board ETCS units to vehicles



The Ministry of Transport will thus need to provide financial resources in the total amount of approximately CZK 14–15 billion for the period 2022–2030, depending on the amount of co-financing provided (CZK 6.75–8.5 million) for retrofitting existing and new vehicles with on-board ETCS units.

In the above graph, the peak in 2024 is mainly due to the fact that the reimbursement of financial amounts under co-financing from European sources and SFDI will generally occur after the completion of the project. It is therefore not the actual number of vehicles equipped in a given year.

Market environment in the Czech Republic

In order to implement the ETCS within the set deadlines and in view of a healthy market environment, it is essential that the portfolio of potential suppliers is as large as possible. This is problematic at the moment, especially in the case of the size of the portfolio of suppliers of the trackside part of ETCS in the Czech Republic. More potential suppliers will both create more supply capacity and have a particularly positive effect on the tendered price for ETCS implementation. It is necessary to take advantage of the open European market environment and thus expand the possibilities that will lead to greater stability and flexibility of the delivered product in the future, as well as options regarding its future efficient management, maintenance or replacement.

A key aspect in this sense is the provision of an open interface between the different elements of the signalling equipment, and other subsystems, in order to guarantee the interoperability of equipment from different suppliers to ensure the safety of railway operations. The infrastructure manager must therefore take all measures to avoid the installation of signalling elements which in any way restrict or favour certain potential suppliers of the trackside part of ETCS.

The next step towards effective public procurement is to use the options under Act No. 134/2016 Coll., on Public Procurement, as amended, in the form of so-called **preliminary market consultations**. These market consultations should also lead to healthy market competition and at the same time to a more efficient implementation of the whole ETCS system. In addition to the objective of setting the terms of reference, the object of the pre-market consultation is to inform potential suppliers of the contracting authority's requirements. Thus, the technical proposal proper should be discussed and obstacles leading to limitations of entry of supplier capacities into the Czech market should also be identified.

4.3 Resources

Trackside part

In addition to national (government) resources (**SFDI**), European resources will be used to finance the implementation of the ETCS track section, actions involving the complete upgrading of lines (including the implementation of ETCS) and separate technological constructions (within the 2021–2027 programming period **CEF2** and **OPT3**, and possibly others). Thus, for individual investment projects (both technological and upgrading), primarily European resources will be used (with the financial participation of the state through SFDI resources), but also national resources.

On-board part

Under the forthcoming **CEF2** instrument, the Ministry of Transport will primarily support projects for equipping vehicles with on-board ETCS units. A combination of resources from CEF2 with a contribution from the SFDI is also being considered. The CEF2 is planned to be called annually in September-January of the following year, when the Czech Republic has an allocation of CZK 5 billion in the Cohesion envelope. CEF2 is the primary source of European funding for the fitting of OBUs to vehicles. The first CEF2 call will be launched in September 2021.

Another instrument to support on-board ETCS units within the 2021–2027 program period will be **OPT3** (up to CZK 2 billion). The involvement of **SFDI** funds is also envisaged. Other European funds may also be considered.

The tables below show the expected drawing of the funds for on-board ETCS units from co-financing calls up to 2024 (Table 8), the expected drawing of the funds for on-board ETCS units from co-financing calls from 2025 onwards (Table 9) and the overall table of expected drawing of the funds for on-board ETCS units from co-financing calls up to 2030, broken down into European funds and national funds (Table 10). **The breakdown of the expected drawing of the funds** has been simplified. It assumes that the funds will be spent within about 2-3 years after the call is launched. In reality, the drawing of the funds will be spread more evenly over the years according to the timetables of the projects approved in the calls.

Table 5 Matrix of expected financing from calls announced up to and including 2024 [million CZK]

	2022	2023	2024	2025	2026	2027	total
CEF, OPT2	2 000		-	-	-	-	2 000
CEF2	-	-	2 200	1 130	740	820	4 890
OPT3	-	-	1 830	-	-	-	1 830
national funds	551	400	800	730	580	470	3 531
total	1 551	1400	4 830	1 860	1320	1290	12 251

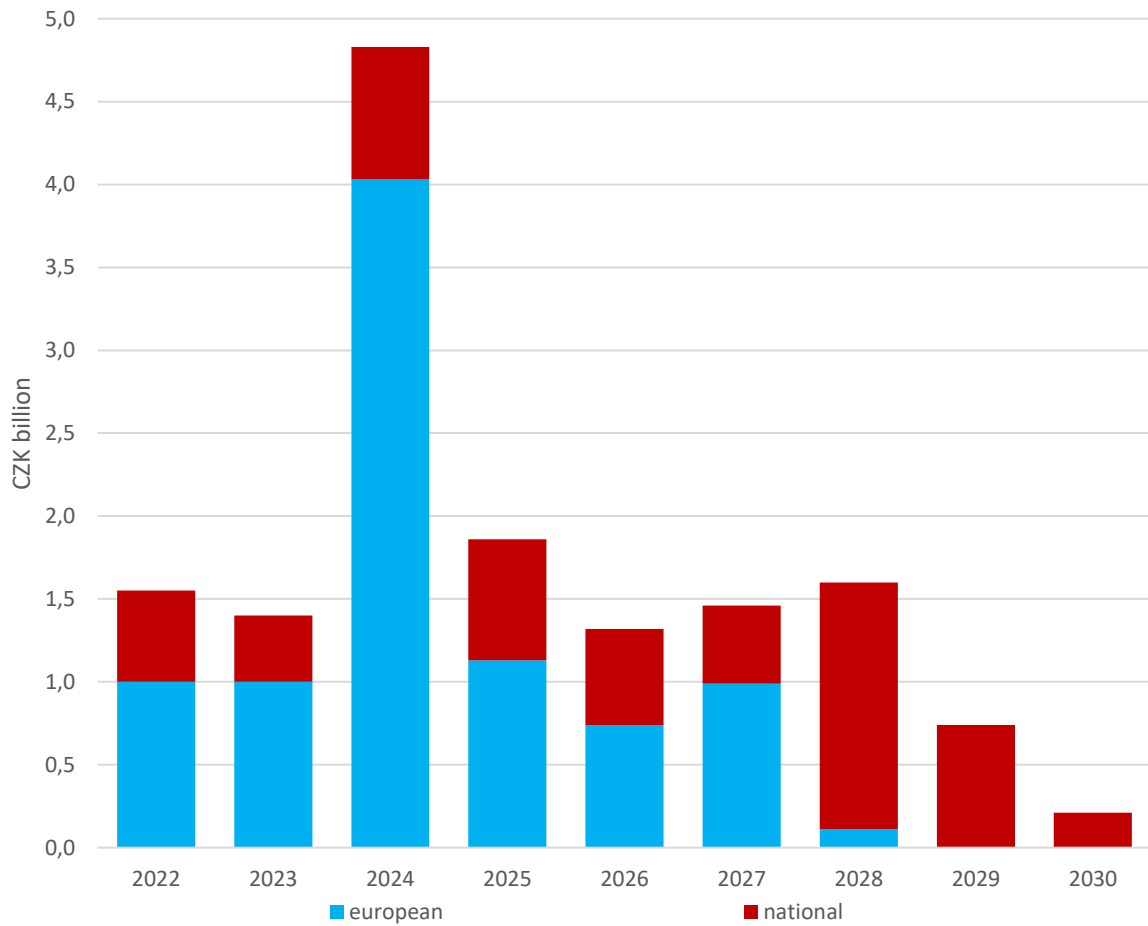
Table 6 Matrix of expected financing up to 2030 from calls launched from 2025 [million CZK]

	2027	2028	2029	2030	total
European funds	170	110	-	-	280
national funds	-	1 490	740	210	2 440
total	170	1 600	740	210	2 720

Table 7 Overview of expected co-financing sources for on-board ETCS units until 2030 [million CZK]

	2022	2023	2024	2025	2026	2027	2028	2029	2030	total
European funds	2 000		4 030	1 130	740	990	110	-	-	9 000
national funds	551	400	800	730	580	470	1 490	740	210	5 971
total	1 551	1 400	4 830	1 860	1 320	1 460	1 600	740	210	14 971

Overview of expected co-financing sources for on-board ETCS units until 2030



5. ETCS – assumed automation and digitalization of the Czech railway network

According to current strategies, railway transport is set to play a much more important role in the future transport system than it does now. One of the prerequisites for achieving this goal is a substantial increase in all the parameters that play a role in the choice of transport mode (travel time, safety, reliability, etc.).

By its very nature, the railway is predestined for the introduction of **automation and digitalization**. Given the long-life cycle of railway structures and vehicles and the preference for other modes of transport in previous periods, the railway has gradually lost its position in terms of the introduction of technological innovations. Rather, it has become a mode of transport based on outdated technologies with a high proportion of manual labour. This needs to change in the future and rail transport needs to regain a leading role in the introduction of digital technologies such as autonomous driving.

The first step for this will be the widespread introduction of modern ETCS train control, which will change the current level of safety and create conditions for more efficient traffic management with a reduction of possible human error in train control. The first phase will involve the introduction of ETCS L2 with fixed track sections as well as the protection of less busy regional lines with a simplified version of ETCS. In the longer term, once the relevant specifications have been approved, the implementation of ETCS L3 using movable track sections may then proceed. This solution will allow a further increase in the capacity of the existing infrastructure, but is subject to the resolution of a number of technological issues. At the same time as ETCS is implemented, the prerequisites will be created for greater automation of train operation (ATO), for which rail transport is ideally suited. This will both reduce operating costs and further increase safety, productivity and reliability of railway transport.

Wider use of ATO as a superstructure of ETCS (ATO over ETCS) on the Czech railway network will require the deployment of completely new technologies, especially a new method of data transmission, as the existing GSM-R standard no longer corresponds to the latest available technologies in the field of radio data transmission. The replacement of GSM-R will also have to be addressed in terms of capacity constraints and limited support after 2030. The new standard in radio communication is referred to as the Future Railway Mobile Communication System (FRMCS).

The use of moving track sections and automation systems (ATO) is already common practice in modern public transport systems such as the metro. The use of moving track section in conventional rail is conditional on the provision of a safe train integrity check function, which is not a major problem for single vehicles or permanently coupled units. However, it will be a challenge especially for freight trains. One possible solution is to switch to a new way of coupling vehicles using automatic couplers, a system that is already quite common in passenger transport and is standard in freight transport worldwide.

Elements of digitalization will be possible to use in other areas such as automated railway traffic management (from the perspective of dispatcher control) or increasing the level of safety of level crossings, the complete elimination of which will not be possible even in the future.

The digitalization of the railway, which the implementation of ETCS undoubtedly includes, will bring the Czech Republic the boom of new technologies, new opportunities for the industry and new job opportunities with high added value. However, this also brings with it additional requirements for the education of current and future employees in both technical and computing fields. For these reasons, it will be necessary to adapt the fields of study at secondary and higher education institutions in the Czech Republic.

Conclusion

As it follows from the above, it is necessary in the following period to ensure adequate financial resources from the state, or the Ministry of Transport, for successful implementation of the Plan for an Advanced Train Control on Czech Railways, both for the implementation of the trackside part of ETCS and for co-financing the equipment of vehicles with on-board ETCS units. Without securing the necessary resources, it will not be possible to achieve the required increase in the level of safety of the Czech railway network and the investments already made in the trackside and on-board part of ETCS will be lost.

This Plan must also be seen in the context of train control systems across Europe. **While the countries of Western Europe in particular have had their own train control equipment for decades, which has a comparable level of safety to ETCS, and this system is thus primarily a tool for ensuring interoperability for these countries, for the Czech Republic ETCS is a great leap forward, especially with regard to the level of safety.**

Considering the fact that only in the case of introduction of exclusive operation of vehicles under ETCS supervision can the required objective of a substantial increase in railway operation safety be met, the Plan envisages gradual introduction of exclusive operation of trains under ETCS supervision on all nationwide and regional railway lines on the railway network in the Czech Republic. In order to make this process successful and acceptable in time, the Plan assumes close coordination of the equipping of vehicles as the deployment of ETCS on individual lines is foreseen and as the exclusive operation of trains under ETCS supervision on these lines is launched. In this context, the infrastructure and vehicle fitting plan has been coordinated with public transport customers and with passenger and freight carriers. Further cooperation and coordination will continue to be necessary as the Plan is implemented. An important aspect is to continue to secure appropriate funding from European and national sources to help carriers co-finance the fitting of on-board ETCS units, including increases in such funding.

The Plan will be reflected by the Ministry of Transport in the ERTMS National Implementation Plan and by the infrastructure manager Správa železnic, state organization in the Network Statement. Also important is the cooperation of other ministries and selected central administrations in ensuring the objectives and measures of the Plan and in securing funding or co-financing of the trackside and mobile parts (on-board units) of ETCS.

No less important partners are the ordering entities of public transport, i.e. besides the Ministry of Transport, which orders long-distance transport, mainly regions in the case of regional transport. The plan was coordinated with carriers and ordering entities during its preparation and considers their current requirements and the planned outlook as far as possible. It is necessary for the ordering entities of public transport to respect the ETCS implementation plan and the introduction of exclusive operation of trains under the supervision of the system and to require carriers to provide transport exclusively by ETCS-equipped vehicles. At the same time, it is necessary for the ordering entities of public transport to guarantee that the investments made by the infrastructure manager Správa železnic in the lines and by the carriers in the vehicles will be properly used by the ordering entities for the duration of their economic life.

Annex 1: Plan for the implementation of ETCS and the introduction of exclusive operation of trains under ETCS supervision by 2030

Track category	section	section length [km]	implementation ETCS	introduction of exclusive operation of trains under ETCS supervision	ETCS level ^{*)}	note
A	Kolín – Břeclav – state border Austria/Slovakia	270	completed	2025	L2	
A	Petrovice u Karviné state border ČR/Poland – Přerov – Břeclav	210	completed	2025	L2	
A	(Praha) – Praha-Horní Počernice – Lysá n. L.	35	2024	2027/2029 ^{***)}	L2	
A	Praha-Uhřetěves – Praha hl. n. (excluding)	204	2023	2026	L2	
A	Praha Masarykovo n.		2027	2027	L2	M
A	Praha hl. n. – Smíchov / Krč – Praha Radotín		2030	2030	L2	
A	Further constructions in the transport hub Praha		2030	2030	L2	
A	Praha-Libeň – Kralupy n. Vlt.	32	2023	2025	L2	
A	Kralupy n. Vlt. – Ústí n. L. – state border Germany	120	2025/2026	2025/2026	L2	partial track equipment can be expected (and introduction of exclusive operation of trains under ETCS supervision) in 2025, partially in 2026
A	Praha-Veleslavín – Praha-Airport Václava Havla	40	2029	2029	L2	M
A	Praha-Radotín – Beroun	30	2028	2028	L2	M
A	Beroun – Ejpovice	53	2022	2027	L2	
A	Ejpovice – Plzeň	11	2023	2027	L2	

Track category	section	section length [km]	implementation ETCS	introduction of exclusive operation of trains under ETCS supervision	ETCS level *)	note
A	Plzeň – Cheb – state border Germany	106	2021	2027/2032 ***)	L2	
A	Praha-Uhřetěves – Votice	60	completed	2026	L2	
A	Votice – České Budějovice	110	2022	2026	L2	
A	České Budějovice – Horní Dvořiště/České Velenice – state border Austria	110	2024	2027	L2	
A	Český Brod – Kolín	28	2023	2025	L2	
A	Ústí nad Labem – Most	78	2030	2030	L2	
A	Most – Kadaň-Pruněrov (including Jirkov)	21	2030	2030	L2	
A	Kadaň-Pruněrov – Karlovy Vary	59	2028	2028	L2	
A	Karlovy Vary – Cheb	52	2028	2028	L2	
A	Plzeň – Stod (new track)	25	2026	2026	L2	M
A	Plzeň – Chotěšov	22	2025	2026	L2	M
A	Stod – Domažlice	33	2029	2029	L2	M
A	Domažlice – state border Germany	10	2029	2029	L2	M
A	Plzeň-Koterov – Horažďovice předměst.	55	2026	2026	L2	M
A	Horažďovice předměst. – Protivín	40	2027	2027	L2	M
A	Protivín – Výh. Nemanice	35	2029	2029	L2	M
A	Děčín-Prostřední Žleb – Děčín východ	7	2026	2026	L2	M
A	Děčín východ – Ústí n. L.-Střekov	25	2026	2026	L2	M
A	Ústí n. L.-Střekov – Litoměřice-Dolní n.	25	2027	2027	L2	M

Track category	section	section length [km]	implementation ETCS	introduction of exclusive operation of trains under ETCS supervision	ETCS level *)	note
A	Litoměřice-Dolní n. – Mělník	36	2027	2027	L2	M
A	Mělník – Lysá n. L.	33	2027	2027	L2	M
A	Lysá n. L. – Nymburk	15	2027	2027	L2	M
A	Nymburk – Kolín	23	2030	2030	L2	M
A	Modřice u Brna – Adamov	22	2025	2025/2030 ***)	L2	M
A	Kolín – Havlíčkův Brod – Brno	200	2030 (2025)	2030	L2	M (partially) ETCS implementation can be gradual
A	Ústí n. Orlicí – Lichkov	40	2024	2029	L2	
A	Č. Třebová – Brodek u Přerova	99	completed	2025	L2	
A	Brodek u Přerova – Přerov	9	2023	2025	L2	
A	Brno-Černovice – Blažovice	14	2027	2030	L2	
A	Blažovice – Nezamyslice	81	2030	2030	L2	M
A	Nezamyslice – Přerov	27	2027	2027	L2	M
A	Dětmarovice – Mosty u Jablunkova – state border Slovakia	60	2023	2028	L2	
A	Výh. Polanka n. O./Ostrava-Svinov – Ostrava-Kunčice	17	2028	2028	L2	
A	Ostrava-Kunčice – Český Těšín	29	2028	2028	L2	M (partial)
A	Hranice na Mor. – Vsetín	45	2026	2026	L2	
A	Vsetín – state border Slovakia	25	2026	2026	L2	M (traction supply system conversion)
B	Kralupy n. Vlt. – Neratovice	17	2029	2029	L2	M
B	Kralupy n. Vlt. – Kladno-Ostrovec	21	2029	2029	L2	M
B	Praha-Ruzyně – Odb Jeneček	9	2028	2028	L2	M

Track category	section	section length [km]	implementation ETCS	introduction of exclusive operation of trains under ETCS supervision	ETCS level *)	note
B	Odb. Jeneček – Kladno-Ostrovec	15	2026	2028	L2	M
B	Kladno – Rakovník	42	2029	2029	L1 LS	M
B	Praha-Smíchov – Hostivice	19	2028	2028	L2	M
B	Praha (odb. Skály) – Neratovice	26	2030	2029	L2	M
B	Neratovice – Všetaty	6	2029	2029	L2	M
B	Most – Most n. n.	3	2030	2030	L2	
B	Most n. n. – Třebušice	15	2030	2030	L2	
B	Cheb – Fr. Lázně	7	2024	2029	L2	
B	Fr. Lázně – Vojtanov – state border Germany	15	2030	2030	L1 LS	
B	Plzeň – Žatec-západ	107	2028	2028	L1 LS	M
B	Plzeň – Klatovy	48	2028	2028	L2	M
B	Zdice – Písek	90	2029	2029	L1 LS	M
B	Písek – Protivín	13	2029	2029	L2	M
B	Veselí n. Lužnicí – České Velenice	55	2027	2027	L2	M
B	Nymburk – Poříčany (incl. Veleliby)	15	2030	2030	L2	M (HSL Praha-Běchovice – Poříčany)
B	Nymburk – Ml. Boleslav	30	2028	2028	L2	M
B	Brno Horní Heršpice – Zastávka u Brna	26	2023	2028	L2	M
B	Havlíčkův Brod – Jihlava	27	2030	2030	L2	
B	Blažovice – Veselí nad M.	70	2027	2027	L2	M
B	Nezamyslice – Olomouc	39	2027	2027	L2	M
B	Otrokovice – Zlín	11	2027	2027	L2	M

Track category	section	section length [km]	implementation ETCS	introduction of exclusive operation of trains under ETCS supervision	ETCS level *)	note
B	Hradec Králové – Jaroměř	17	2028	2028	L2	
B	Hradec Králové – Pardubice	22	2024	2028	L2	
B	Pardubice-Rosice nad L. – Žďárec u Skutče	39	2030	2030	L1 LS	
B	Velký Osek – Chlumeck nad C.	24	2028	2028	L2	M
B	Chlumeck nad C. – Hradec Králové	27	2028	2028	L2	M
B	Hradec Králové – Týniště nad O.	21	2028	2028	L2	M
B	Týniště nad O. – Choceň	24	2028	2028	L2	M
B	Týniště nad O. – Častolovice	8	2028	2028	L2	M (Velký Osek – Hradec Králové)
B	Stará Paka – Chlumeck nad C.	52	2029	2031	L1 LS	
B	Stará Paka – Trutnov-Poříčí	50	2029	2031	L1 LS	
C	Rakovník – Louny	45	2029	2029	L1 LS	
C	Praha-Smíchov – Rudná u Prahy – Beroun	34	2030	2030	L2	M
C	Rudná u Prahy – Hostivice (odb. Jeneček)	10	2030	2030	L2	M
C	Rakovník – Beroun-Závodí	42	2027	2029	L1 LS	
C	Planá u Mar. Lázní – Tachov	12	2026	2027	L1 LS	
C	Praha-Braník – Vrané nad Vltavou	11	2030	2030	L1 LS	
C	Čerčany – Vrané nad Vltavou	37	2028	2029	L1 LS	
C	Tábor – Písek-město	60	2029	2029	L1 LS	
C	České Budějovice – Český Krumlov	27	2026	2029	L1 LS	
C	Karlovy Vary/Chodov – Nejdek	16	2026	2029	L1 LS	

Track category	section	section length [km]	implementation ETCS	introduction of exclusive operation of trains under ETCS supervision	ETCS level *)	note
C	Sedlo u. Lokte – Loket	3	2028	2029	L1 LS	
C	Fr. Lázně – Tršnice	4	2028	2028	L2	M
C	Fr. Lázně – Aš	21	2025	2029	L1 LS	
C	Staňkov – Poběžovice	22	2026	2029	L1 LS	
C	Volary – Český Krumlov	62	2027	2029	L1 LS	
C	Ražice – Putim	4	2029	2029	L2	M
C	Číčenice – Temelín	10	2026	2029	L1 LS	
C	Písek – Písek-město	4	2029	2029	L2	M
C	Lysá n. L. – Milovice	5	2024	2027	L2	M
C	Milovice – Čachovice	8	2030	2030	L2	M
C	Přelouč – Prachovice	22	2023	2029	L1	
C	Svitavy – Žďárec u Skutče	53	2030	2030	L1 LS	
C	Skalice nad Svitavou – Boskovice	5	2030	2030	L1 LS	M
C	Břeclav – Znojmo	69	2029	2029	L2	M
C	Křižanov – Velké Meziříčí	10	2030	2030	L1 LS	
C	Olomouc – Senice na Hané	19	2026	2029	L1 LS	
C	Senice na Hané – Litovel	15	2026	2029	L1 LS	
C	Hulín – Kojetín	17	2030	2030	L2	M
C	Veselí nad M. – Kunovice – Staré Město u Uh. H.	19	2028	2028	L2	M
C	Kunovice – Uherský Brod	18	2030	2030	L2	M
C	Uherský Brod – Újezdec u Luhačovic – Luhačovice	10	2030	2030	L1	M

Track category	section	section length [km]	implementation ETCS	introduction of exclusive operation of trains under ETCS supervision	ETCS level *)	note
C	Bzenec – Moravský Písek	4	2027	2027	L2	M
C	Rohatec – Sudoměřice nad M. – Veselí nad M.	19	2029	2029	L1 LS	
C	Veselí nad M. – Velká nad V. – state border Slovakia	25	2029	2029	L1 LS	
C	Zábřeh n. M. – Šumperk	13	2024	2029	L2	
C	Šumperk – Uničov	27	2023	2025	L2	M
C	Uničov – Olomouc	30	2022	2023	L2	M
C	Ostrava-Kunčice – Frýdek-Místek	14	2027	2027	L2	M
C	Frýdek-Místek – Frýdlant nad O.	10	2030	2030	L2	M
C	Zlín – Lípa nad Dřevnicí	8	2027	2027	L2	M
C	Liberec – Tanvald	25	2029	2029	L1 LS	
C	Tanvald – Železný Brod	18	2029	2029	L1 LS	M
C	Smržovka – Josefův Důl	7	2029	2029	L1 LS	
C	Rumburk – Šluknov	34	2026	2031	L1 LS	
C	Chlumec n.C. (odb. Křinecká) – Odb. Obora	29	2027	2028	L1 LS Stop	M (Velký Osek – Hradec Králové)
C	Častolovice – Solnice	14	2028	2028	L2	M (Velký Osek – Hradec Králové)
C	Vrchlabí – Kunčice nad L.	4	2028	2031	L1 LS	
D	Nýřany – Heřmanova Huť	10	2025	2026	L2	M
D	Lípa nad Dřevnicí – Vizovice	6	2027	2027	L2	M
D	Frýdlant nad Ostravicí – Ostravice	7	2022	2030	L1 LS Stop **)	TS (2022) / M (2030)
D	Studénka – Bílovec	8	2021	2029	L1 LS Stop	

Track category	section	section length [km]	implementation ETCS	introduction of exclusive operation of trains under ETCS supervision	ETCS level *)	note
D	Lanškroun – Rudoltice v Čechách	5	2022	2025	L1 LS Stop	
D	Chornice – Třebovice v Č.	36	2024	2025	L1 LS Stop	
D	Studenec – Velké Meziříčí	24	2024	2029	L1 LS Stop	
D	Havlíčkův Brod – Humpolec	25	2022	2029	L1 LS Stop	
D	Teplice nad Metují – Trutnov střed	33	2023	2031	L1 LS Stop	
D	Suchdol nad Odrou – Fulnek	10	2029	2029	L1 LS Stop	
D	Suchdol nad Odrou – Nový Jičín město	8	2029	2029	L1 LS Stop	
D	Vsetín – Velké Karlovice	25	2027	2027	L1 LS Stop	
D	Chrudim – Borohrádek	34	2022	2029	L1 LS Stop	
D	Litovel předměstí – Červenka	3	2026	2029	L1 LS Stop	
D	Choceň – Litomyšl	24	2025	2025	L1 LS Stop	
D	Louka u Litvínova – Osek město	5	2023	2028	L1 LS Stop	
D	Mariánské Lázně (excluding) – Karlovy Vary dol. n.	57	2024	2029	L1 LS Stop	
D	Nejdek – Potůčky st. hr.	27	2023	2029	L1 LS Stop	
D	Šluknov-Dolní Poustevna – D. Poustevna st. hr.	26	2024	2031	L1 LS Stop	
D	Mikulášovice dolní nádraží – Panský – Rumburk	19	2024	2031	L1 LS Stop	
D	Panský – Krásná Lípa	5	2024	2031	L1 LS Stop	
D	Tanvald – Harrachov státní hranice	13	2024	2029	L1 LS Stop	
D	Rybník – Lipno nad Vltavou	22	2027	2029	L1 LS Stop	
D	Temelín – Týn nad Vltavou	8	2021	2029	L1 LS Stop	

Track category	section	section length [km]	implementation ETCS	introduction of exclusive operation of trains under ETCS supervision	ETCS level *)	note
D	Ejpovice – Radnice	23	2025	2027	L1 LS Stop	
D	Pňovany – Bezručice	25	2025	2027	L1 LS Stop	
D	Zadní Třebañ – Liteň	5	2022	2029	L1 LS Stop	
D	Březnice – Blatná	22	2021	2029	L1 LS Stop	
D	Blatná – Strakonice	28	2022	2029	L1 LS Stop	
D	Nepomuk – Blatná	25	2021	2029	L1 LS Stop	
D	Bělá nad Radbuzou – Tachov	39	2024	2029	L1 LS Stop	
D	Domažlice – Bělá nad Radbuzou	29	2024	2029	L1 LS Stop	

*) ETCS of a higher technical or application level may be deployed if deemed appropriate

**) ETCS of a higher application level will be deployed after the line has been upgraded and electrified

***) see Annex 2 for details

M implementation of ETCS is linked to upgrading (electrification, optimization or other construction activity) the line or the line indicated in brackets, the horizon of which may vary depending on external circumstances

TS ETCS separate construction

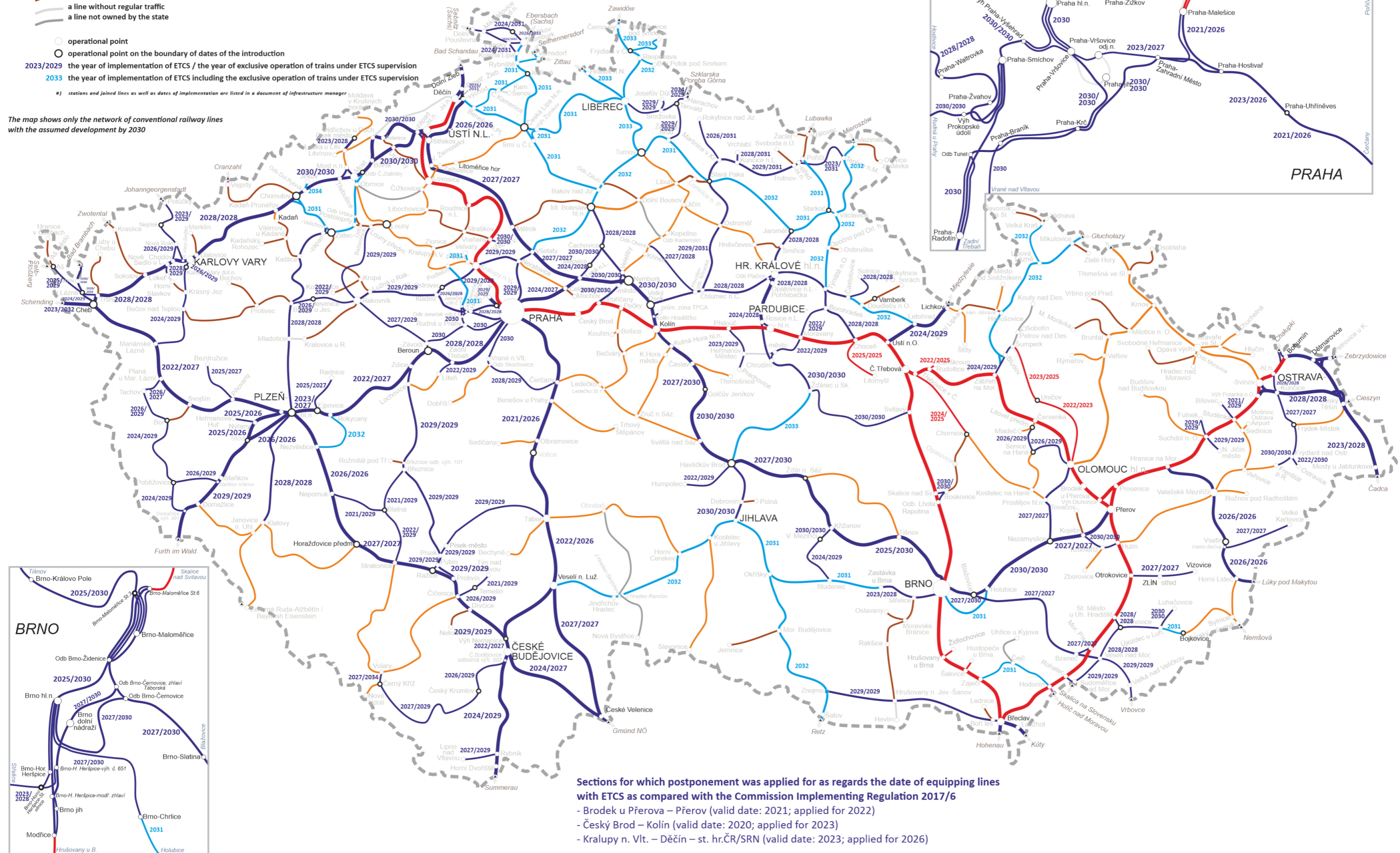
Annex 2: Plan for the implementation of ETCS and the introduction of exclusive operation of trains under ETCS supervision by 2040

Plan for the implementation of ETCS in the Czech Republic

- Exclusive operation of trains under ETCS supervision from 2025
- Implementation of ETCS by 2023, the year of the exclusive operation of trains under ETCS supervision behind a slash
- Implementation of ETCS in 2031 – 2033 including the exclusive operation of trains under ETCS supervision
- Implementation of ETCS in 2034 – 2037 including the exclusive operation of trains under ETCS supervision
- Implementation of ETCS in 2038 – 2040 including the exclusive operation of trains under ETCS supervision
- a line without regular traffic
- a line not owned by the state

- operational point
- operational point on the boundary of dates of the introduction
- 2023/2029 the year of implementation of ETCS / the year of exclusive operation of trains under ETCS supervision
- 2033 the year of implementation of ETCS including the exclusive operation of trains under ETCS supervision

The map shows only the network of conventional railway lines with the assumed development by 2030

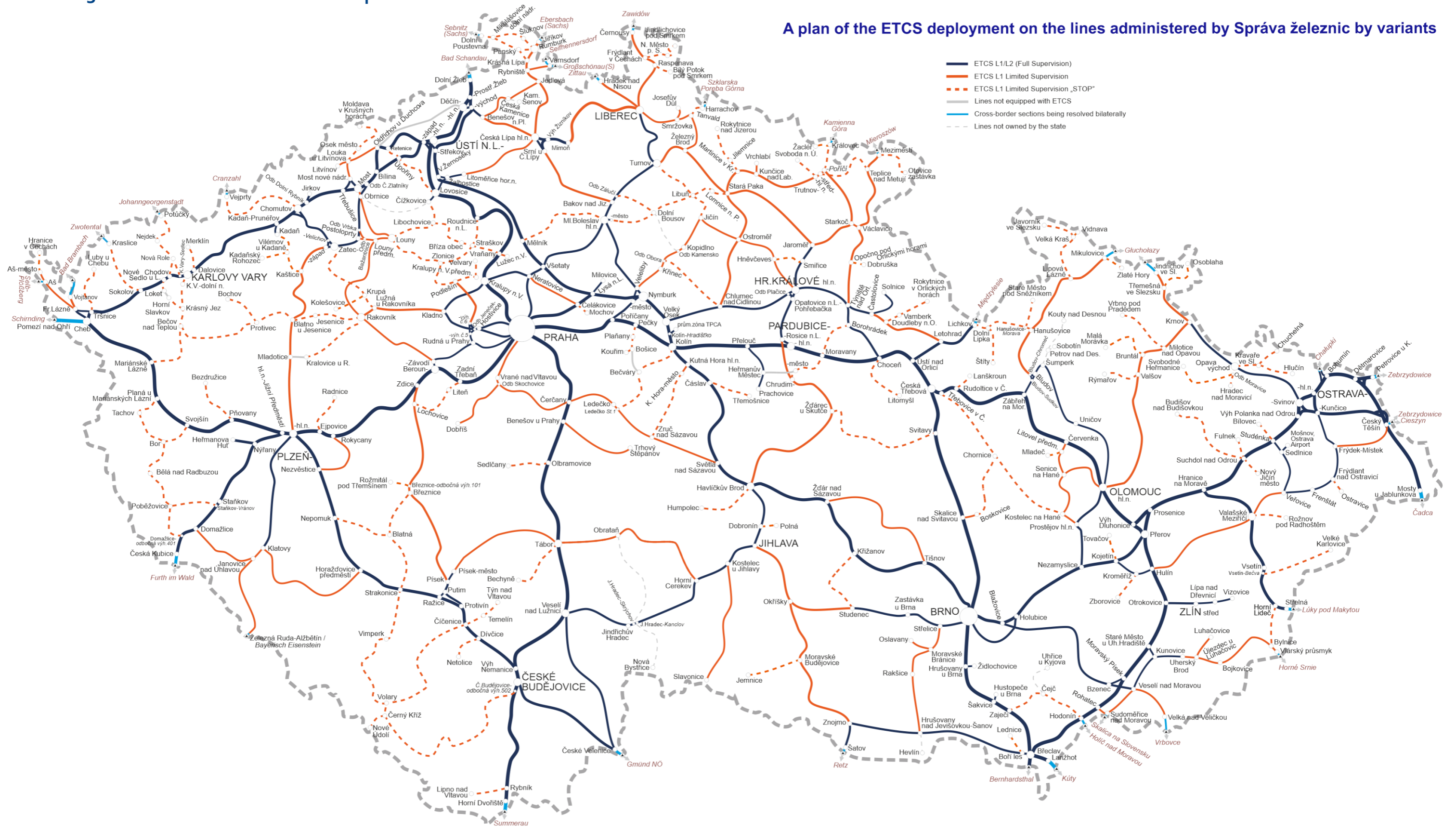


Sections for which postponement was applied for as regards the date of equipping lines with ETCS as compared with the Commission Implementing Regulation 2017/6

- Brodek u Přerova – Přerov (valid date: 2021; applied for 2022)
- Český Brod – Kolín (valid date: 2020; applied for 2023)
- Kralupy n. Vlt. – Děčín – st. hr.ČR/SRRN (valid date: 2023; applied for 2026)

Annex 3: Technical variants of ETCS implementation

A plan of the ETCS deployment on the lines administered by Správa železnic by variants



- ETCS L1/L2 (Full Supervision)
- ETCS L1 Limited Supervision
- - - ETCS L1 Limited Supervision „STOP“
- Lines not equipped with ETCS
- Cross-border sections being resolved bilaterally
- - - Lines not owned by the state

Annex 4: Summary

ETCS is a train control system that allows the driver to be given detailed information needed to control the train and it also continuously checks that the driver drives the train safely on a well-defined track section. In this respect, ETCS represents a fundamentally new functional and safety approach, different from the existing train control equipment used on the railway in the Czech Republic.

ETCS consists of a trackside part, which is part of the railway infrastructure, and an on-board part (on-board units) which is installed on the rolling stock. The control of compliance with the stopping of a given train and compliance with the maximum authorized speed is carried out by means of information transmitted from the trackside part of ETCS to the on-board part of ETCS via specific equipment on the trackage, called Eurobalise, or via the GSM-R radio system.

Implementation of ETCS on the main lines included in the trans-European transport network is required by the European Union, as is the installation of ETCS when the train control equipment (meaning the ETCS) is installed on the line for the first time. In the Czech Republic, this means that the national LVZ LS system will no longer be extended in order to spend funds efficiently and the national LVZ LS system will be phased out on lines where ETCS is implemented.

Implementation of ETCS stems from the need to increase the safety of railway operation, as the number of incidents of passing the signal at danger is increasing over time and the existing national system (which is not even sufficiently widespread) cannot prevent this to the extent required. Unlike in other countries where ETCS is primarily a tool for achieving interoperability, in the Czech Republic it is also a tool for increasing safety and is required in safety recommendations by the Rail Safety Inspection Office, which is the inspection body authorized to issue these binding safety recommendations on the basis of the Railway Safety Directive.

The required safety improvement cannot be achieved without the introduction of exclusive train operation under the supervision of this system. Regulation 2016/919/EU of 27 May 2016 on the technical specification for interoperability relating to the ‘control-command and signalling’ subsystems of the rail system in the European Union, as directly applicable legislation, gives Member States the power to allow access to ETCS-equipped lines only to ETCS-equipped vehicles so that existing national systems can be decommissioned. The Czech Republic is making full use of this possibility and, for the reasons mentioned above, the exclusive operation of trains under ETCS supervision will be introduced on individual lines gradually from 1st January 2023, which will bring a completely substantial increase in the level of safety.

The implementation of the trackside part of ETCS on approximately 4,800 km of lines will require investment costs of approximately CZK 45 billion between 2022 and 2030, and support for carriers to equip their vehicles with on-board ETCS units will require approximately CZK 15 billion by 2030. These funds will be drawn primarily from European sources (CEF, CEF2, OPT2 and OPT3) and also from national sources through the State Fund for Transport Infrastructure.

The digitalization of the railway, which the implementation of ETCS undoubtedly includes, will bring the Czech Republic the boom of new technologies, new opportunities for the industry and new job opportunities with high added value. However, this also brings with it additional requirements for the education of current and future employees in both technical and computing fields. For these reasons, it will be necessary to adapt the fields of study at secondary and higher education institutions in the Czech Republic.

