ERTMS
National Implementation Plan

Prague, September 2007

Content

List of abbreviations

AC	Alternating current
ATP	Automatic Train Protection
ČD, a.s.	Czech Railways, j.s.c. (*České dráhy, a.s.*)
ČR	Czech Republic
DBAG	Deutsche Bahn Aktion Gesellschaft
DC	Direct current
EIRENE	European Integrated Railway radio Enhanced Network
ERTMS	European Rail Traffic Management System
EC	European Community
ETCS LS	ETCS Limited Supervision
ETCS	European Train Control System
EU	European Union
FIDIC	Fédération Internationale des Ingenieurs-Conseils
GSM-R	Global System for Mobile communications – Railway
GVD	Train Schedule (*Grafikon vlakové dopravy*)
kV	Kilovolt
LS	Line System – type of the Czech train control system
MD ČR	Ministry of Transport of the Czech Republic
RBC	Radio Block Centre
SFDI	State Fund for Transport Infrastructure
STM	Specific Transmission Module
SWOT	**S**trengths **W**eaknesses **O**pportunities **T**hreats
SŽDC	Railway Infrastructure Administration, state organization (*Správa železniční dopravní cesty, státní organizace*)
TEN-T	Trans-European Network – Transport
TRS	Trackside Radio System
TSI CCS CR	Technical Specification of Interoperability, Control-Command and Signalling – conventional rail
TSI	Technical Specification of Interoperability
TŽK	Transit railway corridor (*Tranzitní železniční koridor*)

Terms definition

For the purpose of this document following terms have the meaning as follows:

ATP Automatic Train Protection
Train protective equipment enabling transfer of information concerning the movement authority to a person controlling the rail vehicle and checking the specified reaction of a person driving the rail vehicle to the information transmitted. It consists of the trackside and mobile parts.

EIRENE European Integrated Railway radio Enhanced Network
Network technical specifications.

ERTMS European Rail Traffic Management System.
Aggregate title for the joint European system of the rail traffic management, consisting of two basic parts – communication GSM-R system (see below) and the European Train Control System (ETCS) (see below).

ETCS European Train Control System.
Train protective system enabling transfer of information concerning the movement authority to a person driving the rail vehicle and continuous control that the person driving the rail vehicle follows these instructions. It consists of the trackside and mobile parts.
The ETCS system has three application levels that differ as to the functional extent. The simplest is the level 1, nowadays the level 2 is the standard. For the future also the level 3 is considered.
The ETCS system is under a gradual development by means of its individual versions. At present specifications of the 2.3.0 version are valid. A new 3.0.0 version on the basis of the experience gained in systems of the 2.3.0 version is being prepared and its approval in 2010 is proposed. In this version the reverse compatibility should be solved, i.e. the traction units equipped with the on-board assembly of the 3.0.0 version will be synergetic with the trackside part of the 2.3.0 version.

ETCS LS ETCS Limited Supervision
ETCS system, which uses the ETCS on-board part of the vehicles in a simplified way. It does not transfer and display information concerning the movement authority, it only checks, whether a person driving the rail vehicle respects the movement authority given by the main signals in the railway track. Specifications of the system are not available yet, the definition of them is scheduled within specifications for the 3.0.0 version.

GSM-R Global System for Mobile communications – Railway.
Application of the EIRENE system requirements on the GSM technology platform, extended by specific railway requirements. It is a communication system.

LS Line system.
System of the train safety equipment used for the railways in the Czech Republic. It is a system using the continuous transmission of the aspects by means of coded track circuits. In case of transmission of restrictive or prohibitive aspects it controls the specified reaction of a person driving the rail vehicle. According to TSI CCS CR it is a national train protective equipment of the Class B (see below).

RBC Radio Block Centre
Radio Block Centre of the ETCS system, level 2, in which the information is chanelled from the station, track and crossing safety devices and also controller commands from the circuit given to the RBC, where they are processed into the movement authority for the train equipped with ETCS, which is logged in its circuit, their transmission to the train via the GSM-R system is ensured and via the same rout the necessary information from the train may be received and displayed for the controller's need.

STM Specific Transmission Module
Specific transmission module is an on-board part of ETCS equipped with the STM module that enables train movement on railway tracks equipped with national system of train protection the same way as if it was equipped with the national system. One on-board part of ETCS may contain more STM modules.

Class A System
The system of the Class A is an integrated interoperable system specified in the TSI CCS CR Annex A – so that in the area of communication it is the GSM-R system and in the area of the train safety equipment it is the ETCS system.

Class B System
The system of the Class B is a national system for the radio communication with the train or the national system of the train safety equipment. In case of the Czech Republic it is a railway track radio system of the TRS type and the train safety system of the LS type.

TEN-T Trans-European Network – Transport
Priority transport network established by the Decision No 1692/96/EC of the European Parliament and of the Council of 23 July 1996 on Community guidelines for the development of the trans-European transport network, as amended.

TRS Railway Track-side Radio System
National railway track-side radio system for communication between the controller and the person driving the track vehicle. It is a downward system, which should be gradually replaced by the Class A system (GSM-R).

TSI Technical Specifications for Interoperability
Technical specifications for the interoperability of individual subsystems adopted by the European Commission on the basis of the Directive 96/48/EC on interoperability of the high speed railway system and Directive 2001/16/EC on interoperability of the conventional railway system.

Introduction

In 1995 the European Commission defined a global strategy for the development of the European Rail Traffic Management System ERTMS with the objective to prepare its future implementation on the European railway network and incorporated it into the interoperability Directives and subsequently into the Technical Specifications for Interoperability of the Control-Command and Signalling subsystem both for the high-speed and the conventional European railway system.

ERTMS

ERTMS is a project dealing especially with the following areas:

communication – EIRENE project (European Integrated Railway radio Enhanced Network), within which functional and system specifications were created, that lead to the GSM-R (Global System for Mobile communications – Railway) system.
The GSM-R system, as any radio communication tool, consists of an infrastructure part and a mobile part, represented by mobile terminals of the user.

ETCS project – European Train Control System, enabling partly to transfer information on authorized speed to the person driving the rail vehicle, partly to check continuously if the person driving rail vehicle respects these instructions.
By means of the ETCS system the trackside part transfers to the mobile part of the system in the train information allowing continuously ascertaining maximum authorized speed of the given train.

Technical Specifications for Interoperability – TSI

By the decision of the European Commission 2006/679/EC TSI relating to the control-command and signalling subsystem for conventional railway system was issued. Annex of this TSI sets technical specifications of the Class A system. This Annex is, by virtue of the European Commission decision 2007/153/EC, replaced with a new Annex A, which specifies a set of specifications obligatory to ensure the interoperability of the Class A system in 2.3.0 version, strictly required for further constructions of the ETCS system. Therefore this specification will be stabilized on a long-term basis and for the next 3.0.0 version of obligatory specifications, which may be anticipated in the period of 2011 to 2012, the measures will be adopted to ensure the reverse compatibility with the version 2.3.0 systems.

European ETCS corridors

To support ERTMS/ETCS implementation in the railway lines of the European conventional railway system and with a view to use this system effectively on the integrated European corridors of the trans-European TEN railway network, the primary core of the ETCS corridors backbone network was defined. The decisions of the European Parliament support the development of the ERTMS system on the primary core of the ETCS network, i.e. on six European corridors:
Corridor A – Rotterdam – Genoa
Corridor B – Stockholm – Naples
Corridor C – Antwerp – Basle – Lyons
Corridor D – Valencia – Lyons – Ljubljana
Corridor E – Dresden – Prague –Vienna / Bratislava – Budapest
Corridor F – Duisburg – Berlin – Warsaw

The main three goals of this approach to support the ETCS implementation are as follows:

- Enable creation of the interoperable backbone railway network within the whole Europe (ETCS network), which would enable the development of new and good quality railway services that could lead to the enhancement of the railway transportation competitiveness (the international freight transportation namely),
- Concentrate on the supra-national coordinating effort and financial resources, which will accelerate and extend utilization of ETCS on the main paths of TEN,
- Overcome the condition of the "critical mass" of the ETCS from market and prices point of view.

For achievement of these goals the European Commission has set an indicative time frame of 10 to 12 years.

Further the European Commission approved a special item for the planning period 2007 to 2013 within the TEN-T fund for co-financing of the ETCS development on this corridors amounting EUR 500 million. The anticipated co-financing will represent 50% of eligible costs. For co-financing of the infrastructure part EUR 250 million are allocated and EUR 250 million for the on-board ETCS parts.

ETCS equipment construction is required according to obligatory specifications of 2.3.0 version.

From the above mentioned corridors the Corridor E, which will be dealt with below, relates directly to the Czech Republic.

Present state

Obligatory ERTMS specifications

The decision of the Commission 2006/679/ES adopted on 28 March 2006, by which TSI is issued for the control-command and signalling subsystem, presumes that in the near future except existing parts also other areas (electromagnetic compatibility, detection systems, hot-box detection) will be solved as a part of the ERTMS system. Nowadays already these areas are a part of TSI, though with a note that it is an open-ended point. Implementation of these areas will result in further investments in the infrastructure and the rolling stock as an integral part of the interoperable system of the Class A, ERTMS accordingly.

The ERTMS system is not stabilized yet in terms of individual versions. The 2.3.0 version, valid at present, was specified by adopting a decision of the European Commission 2007/153/EC, which replaces the Annex A of the TSI for the subsystem control-command and signalling, valid to date. Unfortunately even now it is clear that here stated ETCS specifications of the 2.3.0 version also do not meet the requirements for exact and unambiguous limitation of the required system of the Class A completely. The European Commission has set the action plan to eliminate these problems with the perspective of their solution by the end of 2007 though, but this situation concerning the specifications instability causes serious problems in the process of ETCS system implementation into the national conditions.

Corridor E

Preparation activities for the "**Corridor E** – Dresden – Prague – Budapest – Vienna" started in the end of 2005 with elaborating a study. In April 2006 the Management Committee was established with a view to prepare a proposal for the joint application part concerning the co-financing of the ETCS system development on the Corridor E. In 2007 thanks to the Ministry of transport of the Czech Republic initiative the Executive Board originated for ensuring the enforcement of the considered intentions in individual countries and further components of the Project Management were set up. Concurrently on the level of ministries of the countries concerned the Letter of Intent on the development of the Corridor E was signed and the joint parts of the application for co-financing from a special item of the TEN-T fund were finalized and also the coordination of national applications for this method of co-financing was ensured.
The applications for co-financing of the development of ETCS system on the Corridor E are applied at the European Commission and their approval is expected.

ETCS development on Corridor E:
German party presumes the equipment of its Corridor E part after 2020.
Czech party intends to equip 1. Transit railway corridor (TŽK) with ETCS Level 2, and equipment of 72 locomotives.
Slovakian party intends to equip the national corridor part by the railway track ETCS part, level 2 and further to furnish 122 vehicles in total.
Hungarian party does not assume any further railway tracks furnishing in this planning period as the Hungarian parts of the Corridor E (Budapest – Vienna line) are equipped with ETCS Level 1, which at present is put into service. They presume equipment of 60 vehicles in total however. The co-financing from cohesion funds is considered.
Austrian party has the substantial part of the Corridor E equipped already with the ETCS Level 1 (Budapest – Vienna line), further intention is the equipment of the Vienna – Břeclav line also railway track part of ETCS Level 1. In the area of vehicles the preparations are made for equipment of 185 vehicles in total.

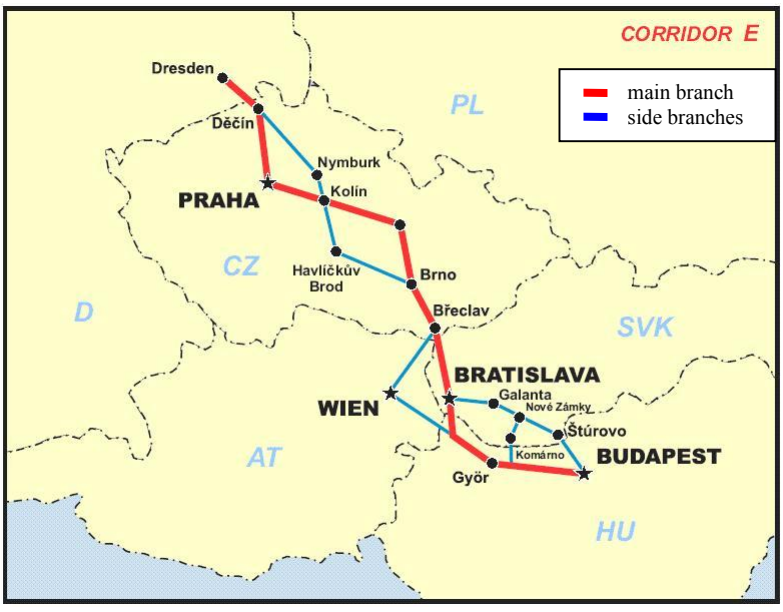


Fig. 1 – Corridor E scheme

ERTMS in the Czech Republic

Introduction of interoperability conditions in the railway system of the Czech Republic is solved on the basis of the system with the active participation of the most important railway partners: SŽDC, s.o. and ČD, a.s. Within the technical assistance from the Phare fund for instance in years 2003/2004 in the Czech Republic a project "Application of the Directive 2001/16/EC on the railway interoperability" was solved. The project succeeded in mapping the state of the railway lines and rolling stock and determined what repairs were necessary to satisfy the conditions of interoperability. It made it possible to calculate the necessary time and expenditure and to set the priorities. The above-mentioned project helped also awakening a wider interest in the object problems in the whole range of concerned railway undertakings and institutions in the Czech Republic.

National structures for the ERTMS implementation support

After application of ERTMS as a most progressive target to reach the railway interoperability, the ERTMS Steering team, which now carries on with the cooperation between SŽDC, s.o. and ČD, a.s., was set up in the beginning of 2002, still in the competency of ČD, s.o. Its structure is illustrated in the scheme in the Figure 2.
Within the work of the Steering team series of studies for ERTMS application in the Czech Republic were prepared and also the pilot projects for GSM-R and ETCS Level 2.
In March 2006 Railway Infrastructure Administration together with Czech Railways prepared, discussed and adopted the document "Development Strategy for ERTMS project in the Czech Republic 2007 – 2013". This strategy is based on the information gathered from the foreign experience and first knowledge obtained within the pilot GSM-R project implementation and start up of the ETCS pilot project in the Czech Republic. This "Strategy" marked out the conception of the approach to the ERTMS system development in the Czech Republic with regard to specific conditions of the national railway and becomes this way a groundwork for the national ERTMS implementation plan elaboration. The conception and the fundamental priorities stay preserved, but the realization of the specific constructions has to be updated on the basis of the developing level of understanding the topic and conditions for financing of the ERTMS system development.

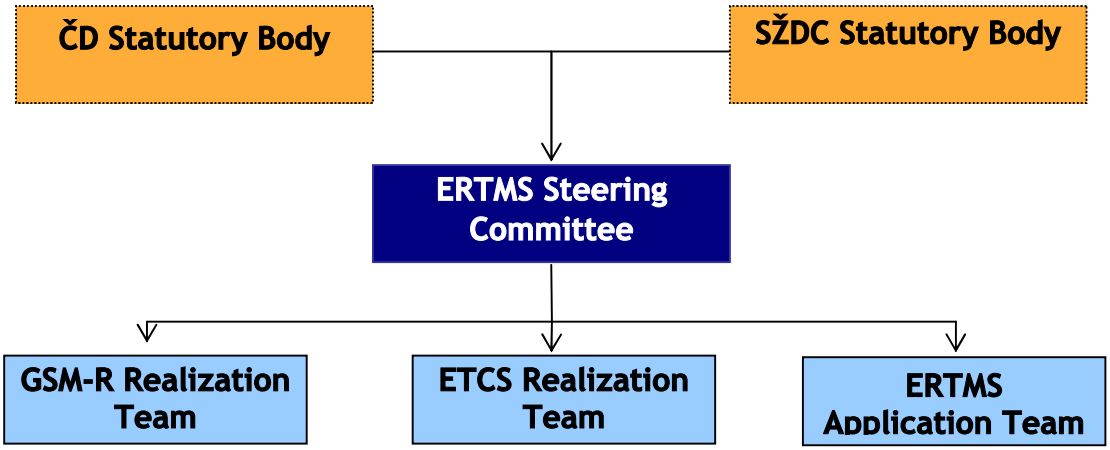


Fig. 2 – ERTMS Steering team scheme

GSM-R Pilot Project on lines in the Czech Republic

In 1999 the national coordination team – as one of the first coordination teams of European railways – submitted the "Draft Procedure of implementing the European standard of the track radio system in Czech Railways operation". The approved draft procedure of GSM-R implementation served as background for the preparation, ordering and evaluation of the feasibility study to the framework draft of GSM-R implementation on national lines in the Czech Republic. The management of the Czech Railways adopted the recommendations of this study in the end of 2000.
The realization of the pilot GSM-R project on the Děčín – Praha – Kolín line, as a section of the pan-European Corridor IV in the territory of the Czech Republic connected to the DBAG lines, the equipment of which with this system was presumed in the horizon of the year 2004, became the priority issue resulting from the accepted international commitments.
Already in the half of the year 2001 the ensuring of the pilot project financing was successful though, but for the reason of different problems related to selection of the most convenient contractor bid, the contract for the pilot GSM-R project implementation in the Czech Republic was entered into as late as in May 2004, the construction was started immediately after that and completed in June 2005. Linking to GVD (train schedule) 2005/2006 the implemented GSM-R system was put into the test operation starting with 9 January 2006.
The selection of the appropriate location and the extent of the GSM-R pilot project itself was not accidental. The selected section on the pan-European Corridor IV was selected as the most suitable environment for the possibility of the comprehensive verification of individual system qualities, functions and services, whether within the own pilot project or in the consecutive applications.
The selected section

- gives a possibility to test in terms of interoperability the transitiveness and the issue of connection to the GSM-R network of the neighbouring railway administration, in this case DB AG,
- covers the GSM-R area of the ETCS (Poříčany – Kolín) pilot project and the test circuit of the Testing Center Velim of the Railway Research Institute, j.s.c (*Výzkumný ústav železniční a.s.*) by the radio signal, which enables practical testing and verification of the tie-in components of the ERTMS project – ETCS system in these locations,
- the section contains also the important Prague railway junction and the railway line passing through a broken topography.

The subsequently performed evaluation of the pilot implementation will also provide the essential technical economic data and parameters for following buil-up and key conceptual decisions above all for the possibility of development and testing of individual national applications within the GSM-R system.
At present the "Application of the GSM-R into the environment of the Czech Republic" proceeds, within which also the equipment of further vehicles operating in this section by vehicle terminals and integration of the controllers terminals into the working places for traffic management in 25 traffic control sites occurs.

GSM-R pilot project characteristics

- The infrastructure part of the GSM-R pilot project consists of switching and supervisory centre, base station controller, transmission technology including cable lines, and 37 base stations located along the railway line.
- The **mobile part** of the system GSM-R equipped in the pilot project 10 railway vehicles of 9 series (471/971, 451, 362, 363, 163, 162, 150, 124) with 10 cab-radio

stations and 100 portable radio stations were acquired, including 80 general versions and 20 with higher mechanical and climatic resistance in the terrain

ETCS pilot project Level 2 on lines in the Czech Republic

In 2001 the Railway Research Institute, j.s.c. prepared a study "Application of the European Train Control System ERTMS/ETCS on the railway network of Czech Railways – ETCS Specifications for the Pilot Project on the Section Poricany – Kolin (outside)". In the end of the same year Railway Research Institute, j.s.c. prepared a feasibility study for the application of the ERTMS/ETCS system Level 2 on railway lines in the Czech Republic. In that year a trilateral discussion started between the Czech Republic, Germany and Austria on ETCS application on pan-European Corridor IV.
The ETCS pilot project Level 2 is implemented with use of financial support from the EC Cohesion fund amounting 75% of expenses; 25% will be covered from SFDI resources. The pre-contracting negotiations with the winner of the international tender for contractor were commenced by the end of the year 2004 and in April 2005 the agreement on the implementation was signed. After all formal terms clarification between the customer and the contractor the construction was started on 1 July 2005, the time limit set for realization of the pilot project was 45 moths.
For coordination and for ensuring activities related to ETCS preparation, realization and operation in the conditions of the railways in the Czech Republic the ETCS Realization Team has been established in February 2005 as a common coordination body of ČD, a.s. and SŽDC, s.o.
At present consultations to the open-ended points of the technical specifications with ERTMS Users Group have started.
Financing of the ETCS pilot project continuation is secured within the program No. 127 330 Interoperability in the railway transport.

ETCS pilot project characteristics

- The section of the ETCS pilot project is covered in the GSM-R pilot project by GSM-R signal for lines equipped with ETCS Level 2 and 3 for speeds up to 220 km/h.
- Near the section of the ETCS pilot project there is the railway test circuit Velim where the implemented system will be tested without affecting regular traffic on the line of the pilot project.
- The trackside section of the pilot project consists of one Radio Block Central connected to station, trackside and crossing safety system for transmission of data to trains via GSM-R. The track part also consists of unswitchable balises.
- The on-board part will be installed in two locomotives and one unit, plus a specific module (STM – Specific Transmission Module) for national rail safety device type LS.
- The ETCS pilot project Level 2 will be realized in the 2.3.0 version.

Pilot project overview

Location of GSM-R pilot projects, ETCS and GSM-R application on the 1st national transit railway corridor (pan-European Corridor IV, or ETCS Corridor E) is represented in Figure 3.

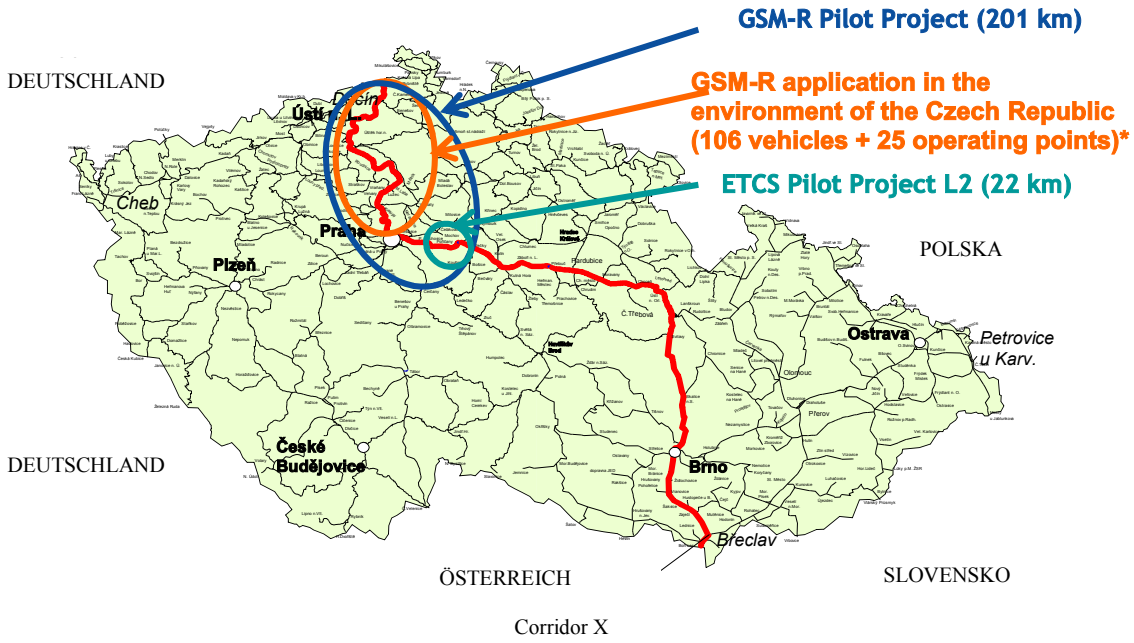


Fig. 3 – ERTMS/GSM-R, ETCS pilot projects and GSM-R application

Next step in the GSM-R implementation

In July 2007 the contract was signed for completing equipment of the 1st Transit railway corridor with the GSM-R system. It will enable to put into operation the GSM-R system on the whole ETCS Corridor E by the end of 2008 and to prepare in ample time the fundamental condition for the ETCS system Level 2 implementation on this corridor.

Overview of lines of the selected network

These are the lines of the selected railway network in the Czech Republic that were included in the European conventional railway network according to the Decision No 1692/96/EC of the European Parliament and of the Council of 23 July 1996 on Community guidelines for the development of the trans-European transport network, as amended, as it is referred to in the communication of the Ministry of Transport No. 111/2004, on specification of the railway lines included in the European railway system. Both these railway lines represent about 26% of the whole railway network of the Czech Republic. The geographic overview is presented in the Figure 4.

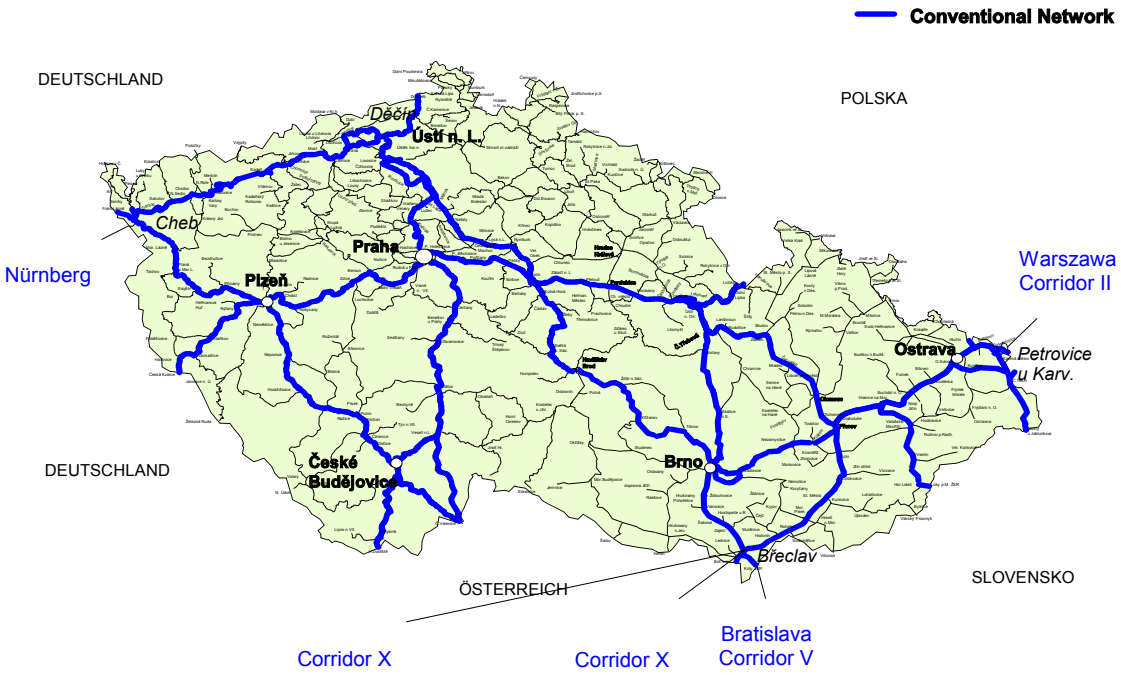


Fig. 4 – Overview of railway lines of the selected network

ERTMS national implementation plan

General principles

TSI "Control-Command and Signalling" for conventional railway subsystems deals in the chapter 7 with the process and methods for transition from national system of Class B to the interoperable system of Class A. At the same time it sets the mandatory rules for GSM-R and also ETCS systems implementation.
In the article 7.2.2.6 the fundamentals for the national ERTMS implementation plans creation are set. The primary goal of the national implementation plan is the realization of the primary core and then the further lines of the backbone ETCS network, as it is stated in the article 7.2.2.4. The implementation of the ERTMS system in wider extent according to the needs of the national railway network operation is the final goal.

National implementation plans must above all set following parameters:

1. Target lines – unambiguous identification of national lines designated for ERTMS system implementation
2. Technical requirements – definition of the fundamental technical requirements of the implementation, e.g. GSM-R Voice/Data, ETCS application level ETCS, present operation of the national ATP system
3. Implementation strategy and planning – proposal for the implementation plan including the procedure and work schedule
4. Transition strategy – the strategy of transition from national systems of Class B to the systems of Class A
5. Potential limitation – overview of potential factors, which could have impact on the implementation progress

National implementation plans will be included into the EU guidance plan, the aim of which is to ensure harmonization of national implementation procedures for support of integrated trans-national section creation using the ERTMS system and to improve this way the affectivity of the European Commission support for the railway projects and the aggregate effectivity of investments. Consequently the national implementation plans will be corrected according to the EU guidance plan. It is necessary to update continuously the whole process, in order that the EU guidance plan and national implementation plans express the real ERTMS system implementation development in every Member state and in the whole European railway network.

GSM-R national implementation plan

In the sense of the general principles for ERTMS implementation plans creation and on the basis of the approved document "Development Strategy for ERTMS project in the Czech Republic 2007 – 2013" it may be stated:

1. **Target lines designated for GSM-R system implementation**
   These are the lines of the selected railway network in the Czech Republic, included in the European conventional railway network according to the Decision No 1692/96/EC of the European Parliament and of the Council of 23 July 1996 on Community guidelines for the development of the trans-European transport network, as amended, as it is referred to in the Communication of the Ministry of transport No. 111/2004.
   The first phase of implementation, included in this implementation plan, is concentrated on transit railway corridors and their basic alternate roads as follows:
   - Transit railway corridor 1 Kolín – Břeclav – st. hr. A and SK – finalization of the Transit railway corridor 1 equipment
   - Transit railway corridor 2 Břeclav – Petrovice u Karviné.
   - Transit railway corridor 3 Dětmarovice – Mosty u J.; Polanka n.O. – Č. Těšín
   - Transit railway corridor 3 Č. Třebová – Přerov
   - Transit railway corridor 3 Praha – Plzeň – Cheb
   - Transit railway corridor 4 Praha – Tábor – České Budějovice – Horní Dvořiště st. border A
   - Brno – Havlíčkův Brod – Kolín
   - Kolín – Lysá n. L. – Ústí n. L. Střekov – Děčín

   Of these the Transit railway corridor 1 is a national part of the pan-European Corridor IV, which is concurrently a part of the primary core of the backbone network of ETCS corridor – marked as the Corridor E.
   The other transit railway corridors are part of the ETCS backbone network, as it is stated in the Annex "H" of the TSI CCS CR. The essential characteristic of these lines:

   - Mixed traffic,
   - Double-track lines,
   - Lines electrified by the 3 kV/DC or 25 kV/AC system,
   - Maximum track speed 160 kilometres per hour,
   - National analog radio system of Class B – TRS – Trackside Radio System (equipment see the note in Table 1).

2. **Technical requirements for the GSM-R implementation**
   - In the view of the intention to establish gradually the ETCS system Level 2 on selected railway line network, the GSM-R system has to be able beside the voice services to provide also the data transfer services. It appears from this that the coverage of the railway lines with the GSM-R signal must be ensured in the quality for the lines equipped with ETCS Level 2 and 3 for speed up to 220 kilometres per hour according to the EIRENE specifications.

- On the lines equipped with the GSM-R system the concurrent operation of the national TRS analog radio system (if they were equipped with it formerly), enabling equipment of the operators' vehicles with mobile GSM-R terminals, is presumed for a relatively short time (year units) only.

3. **Implementation strategy and planning**
   - Implementation strategy is based on the fact that the GSM-R system creates the communication environment necessary for the ETCS system Level 2. As the intention is to implement explicitly the Level 2 of the ETCS system on the railway lines of the selected railway network included in the conventional railway system, it is necessary to establish beforehand GSM-R on these lines in the quality necessary for its operation on conventional lines according to requirements of the EIRENE specifications.
   - The first implementation phase is concentrated on transit railway corridors and their basic by-pass routes. The plan of the first implementation phase including the presumed workflow is presented in Table 1.
     In the next phase the implementation of the system will be concentrated on the residual lines of the selected network, which means that after its finalization the GSM-R system would cover approximately one quarter of the whole railway network of the Czech Republic. The target state is covering of the whole nation-wide railway, which represents covering of railway lines within the range of 5400 kilometres.
   - Financing of the GSM-R system development in the Czech Republic in the planning period 2007 – 2013 is ensured within the Operational program Transport – Interoperability program
     The Interoperability Program envisages also the possibility of contribution to operators for vehicles equipment, which fact is very important for the migration strategy.
   - Realization of the GSM-R system implementation is envisaged in the form of tenders according to the FIDIC Yellow Book (supply, design and build).

Priority	Line	Length (km)	Workflow		Note
			Preparation	Application	
1	1. TŽK Kolín – Břeclav – st. border A and SK – completing of the equipment of 1. TŽK	327	2006	2007 – 2008	Without TRS
2	2. TŽK Břeclav – Petrovice u K.	216	2007	2008 – 2009	TRS
3	3. TŽK Dětmarovice – Mosty u J.; Polanka n.O. – Č. Těšín	92	2008	2009 – 2010	TRS
4	3. TŽK Č. Třebová – Přerov	104	2009	2010 – 2011	TRS
5	3. TŽK Praha – Plzeň – Cheb	220	2010	2011 – 2016 *)	TRS
6	4. TŽK Praha – Tábor – České Budějovice – Horní Dvořiště st. border A	226	2010 *)	2011 – 2016 *)	TRS
7	Brno – Havlíčkův Brod – Kolín	195	2009	2010 – 2011	TRS
8	Kolín – Lysá n.L. – Ústí n.L. Střekov – Děčín	160	2009	2010 – 2011	Without TRS
Total length		**1540**			

*) depending on the upgrading constructions progress

Table 1 – Plan of the first phase of GSM-R system implementation

Legend: Pilot project, Priority 1, Priority 2, Priority 3, Priority 4, Priority 5, Priority 6, Priority 7, Priority 8

Fig. 5 – First phase of GSM-R implementation

4. Strategy of transition from the national TRS system to GSM-R

- The strategy of transition from the national TRS radio system of Class B to the Class A GSM-R system is on the basis of the approved document "Development Strategy for ERTMS project in the Czech Republic 2007 – 2013" set in the way, where primary investments in railway tracks equipment and vehicles equipment are combined concurrently – see the Figure 6.

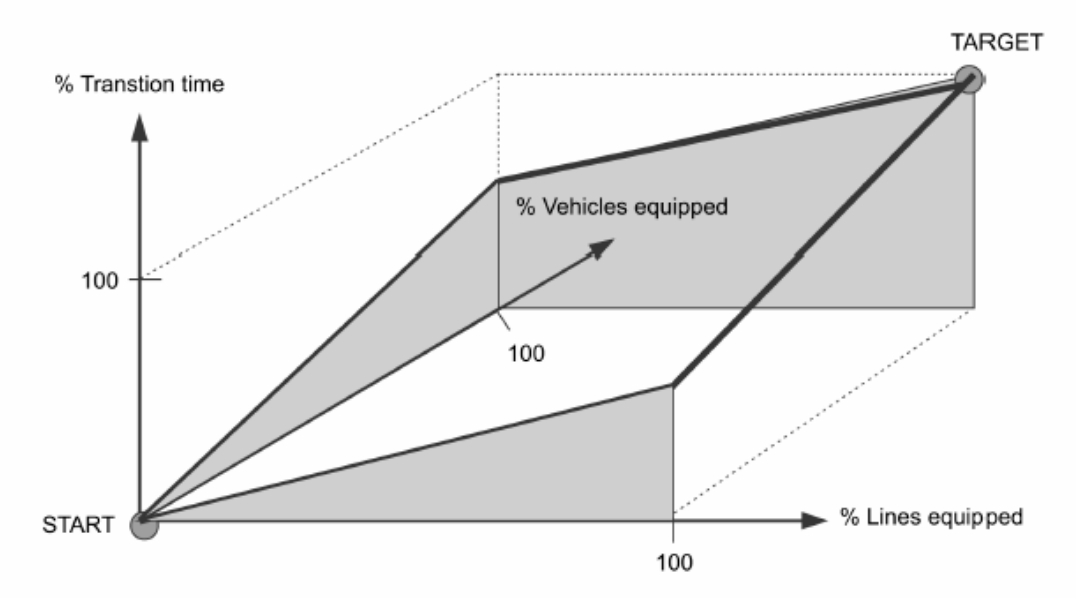


Fig. 6 – Strategy of transition from TRS to GSM-R

The merits of this procedure above all rest upon the fact that:

- As the first one the most exposed backbone line in the railway network in the Czech Republic, the 1.TŽK, which is not continually equipped with the national TRS radio system is being equipped,
- On this corridor the prevailing part of vehicles that are designed for the traffic on corridor and other main lines of the Czech railway network travel,
- The number of vehicles, which necessarily have to be equipped for the operation on other lines in the course of GSM-R implementation, is relatively small compared to the initial investments,
- It is plausible that the accessibility of the support for GSM-R development financing from the Community resources will decline gradually.

- Migration strategy in the GSM-R system is based on utilization of dual equipment on the vehicles enabling concurrently the GSM-R operation also in the national TRS analog system to ensure the transition of the vehicles to the lines, the equipment of which with the GSM-R system will be realistic as late as in a longer time horizon.

5. **Overview of potential factors, which might have impact on the implementation progress**

- The pilot GSM-R project was realized in the Czech Republic to identify the risks, their minimization or elimination; all the knowledge and experience will be evaluated and used for further GSM-R system implementation in the Czech Republic.
- The critical factor is the question of GSM-R system development financing both in the area of the railway track part and the vehicle radio stations and portable terminals.
  - Financing of the GSM-R system development in the Czech Republic in planning period 2007 to 2013 depends on the approval of the Operational program Transport – Interoperability Program;
  - Interoperability program envisages the possibility of contribution also to the operators for the vehicles equipment; this fact is very important for the selected migration strategy and it is evident that if it were not so, the development of the GSM-R system would be several times slower.

- The delays in the selection of the contractor within the public commercial tender caused by protests of the unsuccessful applicants represent further factor with negative impact on the time schedule of the GSM-R implementation; this factor may lead up to one year delay of the intended implementation schedule.
- Delays of the infrastructure upgrading constructions, within which the fundamental conditions for following line construction of the GSM-R system are prepared (laying optical fibre cables, power supply ensuring for the base radio stations etc.) may also have a negative influence on the GSM-R implementation schedule.

Summary

In the planning period 2007 – 2013 it is presumed to ensure the implementation of the GSM-R system on 1540 kilometres of the conventional railway system. This conclusion is subject to the approval of the Operational program Transport and its Interoperability Program, within which its financing is ensured.

In the second phase, i.e. in the following planning period, the effort will be aimed above all to provision of the GSM-R system implementation on remaining lines of the selected network and further achievement of the target state of all the nation-wide railways in the Czech Republic equipment will be monitored. Achievement of the target state is nevertheless contingent on implementation of further investment projects in the area of infrastructure upgrading, above all extension of transmission routes network including laying optical fibre cables.

ETCS national implementation plan

In the sense of general principles for creation of ERTMS implementation plans and on the basis of the approved document "Development Strategy for ERTMS project in the Czech Republic 2007 – 2013" may be stated:

1. **Target lines designated for ETCS system implementation**
   These are the railway tracks of the selected railway lines network in the Czech Republic included in the European conventional railway network according to the Decision No. 1692/96/EC of the European Parliament and of the Council of 23 July 1996 on Community guidelines for the development of the trans-European transport network, as amended, referred to in the Communication of the Ministry of Transport No. 111/2004.
   The first phase of the implementation, included in this implementation plan, concentrates on TŽK and their basic by-pass routes. It concerns following railway line sections:
   - Transit railway corridor 1 Děčín – Prague – Kolín – Břeclav – st. border. A and SK
   - Transit railway corridor 2 Břeclav – Petrovice u K.
   - Transit railway corridor 3 Č. Třebová – Přerov
   - Transit railway corridor 3 Dětmarovice – Mosty u J.; Polanka n.O. – Č. Těšín
   - Transit railway corridor 3 Prague – Plzeň – Cheb
   - Transit railway corridor 4 Prague – Tábor – České Budějovice – Horní Dvořiště st. border. A

   From these, the 1. TŽK is a national part of the pan-European corridor IV, which is concurrently part of the primary core of the backbone network of ETCS corridor – marked as Corridor E.
   The other Transit railway corridors are part of the backbone ETCS network, as it is stated in the Annex "H" TSI CCS CR.

   The fundamental characteristics of these lines is following:
   - Mixed traffic,
   - Double-track lines,
   - The lines electrified with the 3kV/DC or 25kV/AC system,
   - Maximum track speed of 160 kilometres per hour,
   - National ATP system of Class B – LS (equipment see the note in Table 2).

2. **Technical requirements for the ETCS implementation**
   - ETCS application Level 2
     - On the basis of studies prepared by the Railway research institute (*Výzkumný ústav železniční, a.s.*) in the years 2000 and 2001 for the purpose of the pilot project specification for the ETCS system implementation in conditions on the railways in the Czech Republic, it was decided to use for the equipment of national railway corridors, i.e. the most exposed lines of the conventional railway system on the territory of the Czech Republic, the ETCS system Level 2 and this way also the ETCS pilot project was commissioned and started in the Poříčany – Kolín section;
     - Concurrently the operation of the national Automatic Train Protection (ATP) type LS will be secured, which will enable to ensure the operation in the migration period;

  - In this planning period the ETCS system Level 2 in 2.3.0 version will be implemented, which holds also for the Czech part of Corridor E;
  - Equipment of these lines with the GSM-R system, which is necessary for the function of the ETCS system Level 2, is already established on the part of the lines concerned (201 km) and on the rest it will be performed beforehand in accordance with the GSM-R implementation plan; the GSM-R system is and will be realized on the stated lines in accordance with the requirements of the EIRENE specifications for ETCS data transmission;
  - On the infrastructure of the lines stated the upgrading already was performed or would be finalized before the ETCS system implementation and a new signalling equipment was established. (Except some junctions, the upgrading of which is being performed at present.) The new signalling devices are full-electronic or with the electronic controlling level enabling the cooperation with RBC of the ETCS system Level 2;
  - mode detailed reasoning of the ETCS system application level selection is presented in Appendix 1.
- transient system of Class B – ATP, type LS – on railway tracks equipped with the ETCS system the concurrent operation of the national automatic train protection system is envisaged (ATP) LS during the whole service life of existing track and station signalling equipments for following reason:
  - national LS system is an integral part of existing track and station signalling equipments, its switching off would mean the interference with existing device circuits and approval of this change,
  - LS system switching off will not bring any operating costs economy,
  - LS system function will enable use of older traction units on these tracks also, where the additional equipment with the ETCS mobile part would not be effective in terms of economy,
  - LS system function may be, in accordance with TSI CCS CR, used as a backup system in case of ETCS outage.

3. Implementation strategy and planning

- Implementation strategy is based on the fact that the ETCS system will be implemented markedly slower then GSM-R system. The implementation rate is limited first of all by the accessible volume of financial means, not only in the track part area, but above all in the area of vehicles equipment with the mobile part of the system. In the view of ETCS system implementation expensiveness it is necessary to measure the implementation effort in this planning period in accordance with TSI CCS CR, in particular on tracks of the primary core of the ETCS corridors network – in our case the Corridor E. Subsequently on further tracks of the ETCS corridors network – here it concerns the TŽK.
- For operational reasons in the view of reaching the target state of ETCS Level 2 implementation it will be necessary to consider also equipment of alternative branches and by-pass routes transit railway corridors roads if appropriate, but in any case it is not subject to this planning period.
- For future equipment of further tracks out of the ETCS corridors network use of markedly less expensive ETCS LS (Limited supervision) system is presumed, the specifications of which are expected together with the specification version 3.0.0 in period 2011 – 2012. Right this step may, beside the interoperability effect achievement, bring expressive increase of railway transport safety on these lines, as mostly they are not equipped with the national LS system. This step nevertheless may

bring benefits as late as in the period, when more vehicles will be equipped with on-board ETCS part.

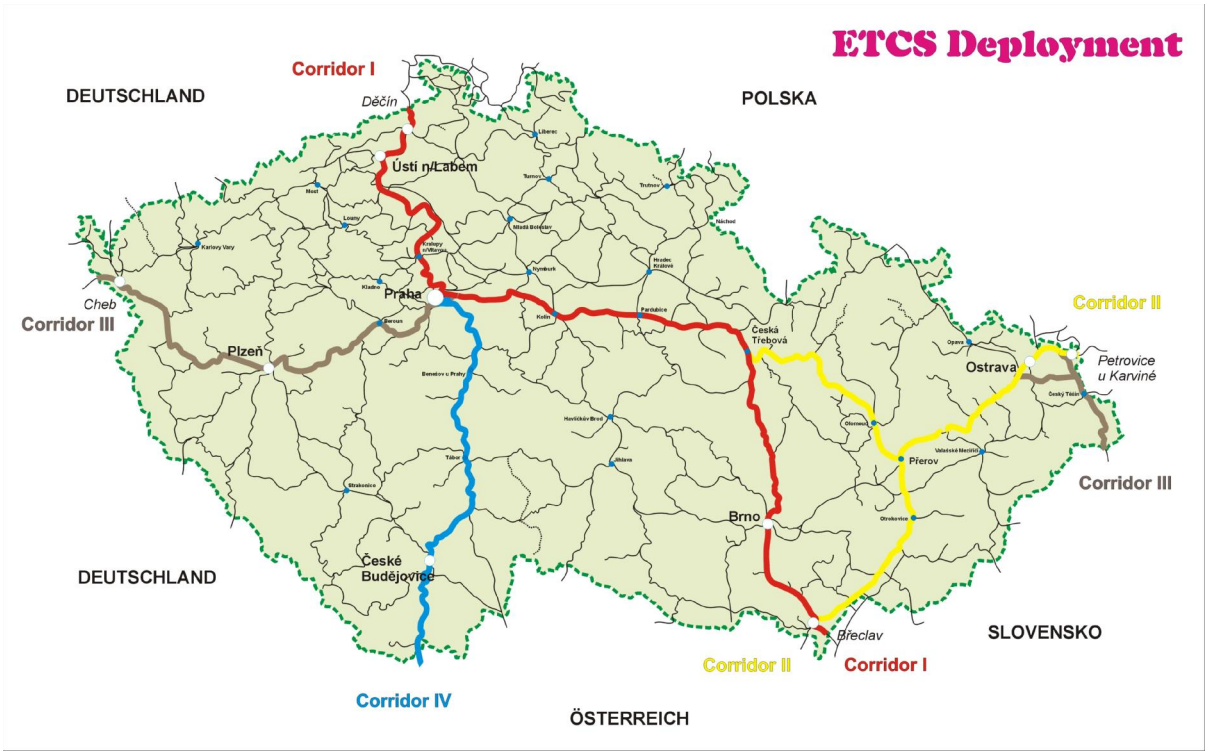
- First ECCS implementation phase in this planning period concentrates on the 1. TŽK, i.e. on Corridor E, which is part of the primary core ETCS corridors network and subsequently the preparation and in optimum case also start up and implementation execution on further national transit railway corridors (*NTŽK*).
- Financing of the ETCS system development in the Czech Republic is in the planning period 2007 – 2013 presumed with use of the Cohesion Fund resources, financial resources within the "ETCS Corridor E" project, i.e. co-financing from a special account of the TEN-T fund for support of the ERTMS/ETCS system development and national funds (SFDI resources). For the eventual commencement of further ETCS building within this planning period it will be necessary to look for further resources.
- It is presumed that realization of the ETCS system implementation will occur in the form of the public tender according to FIDIC Yellow Book (supply, design and build).

Plan of the first phase of implementation is including the presumed workflow presented in the Table 2.

Priority	Line	Length (km)	Workflow		Note
			Preparation	Application	
1	**1. TŽK**	**478**			
	Kolín – Břeclav – st. border. A/SK	277	2008 – 2009	2010 – 2011	LS
	Kolín – Praha – Děčín st. border. D	201	2010 – 2011	2012 – 2013	LS
2	**2. TŽK + Č.Třebová – Přerov**	**316**			
	Břeclav – Přerov	100	2010 – 2011	2012 – 2013	LS
	Přerov – Petrovice u K. – st. border. PL	106	2011 – 2012	2013 – 2014	LS
	Č. Třebová – Přerov	110	2011 – 2012	2013 – 2014	LS
3	**3. TŽK *)**	**312**			
	Praha – Plzeň	114	2012 – 2013	2014 – 2015	LS
	Plzeň – Cheb	106	2012 – 2013	2014 – 2015	LS
	Dětmarovice – Mosty u J.	53	2013 – 2014	2015 – 2016	LS
	Polanka n.O. – Český Těšín	39	2013 – 2014	2015	LS
4	**4. TŽK *)**	**226**			
	Praha – České Budějovice	169	2012 – 2013	2014 – 2015	LS
	Č. Budějovice – H. Dvořiště – st. border. A	57	2013 – 2014	2015 – 2016	Without LS
	Total length:	**1332**			

*) depending on the upgrading constructions progress

Table 2 – Plan of the first phase of the ETCS system implementation



Legend: Priority 1 – Corridor E Priority 2
Priority 3 Priority 4

Fig. 7 – First phase of the ETCS Level 2 implementation

4. Strategy of transition from national ATP LS system to ETCS

- Strategy of transition from national ATP system of Class B – LS to the system of Class A – ETCS is on the basis of the approved document "Development Strategy for ERTMS project in the Czech Republic 2007 - 2013" set in the way, where the primary investments in the tracks equipment and in the vehicles equipment are combined concurrently – see the Figure 6. In comparison to the GSM-R system implementation the procedure of vehicles equipment by the mobile ETCS part proceeds markedly slower. It is caused above all by the fact that the expensive furnishing by the mobile ETCS part will be installed only in the vehicles for the trans-border traffic and as for the vehicles, the service life of which exceeds 25 years, – furnishing of those probably will not be effective at all. It means that the growth of quantity of vehicles equipped with ETCS will occur above all due to new vehicles, or upgraded vehicles, if appropriate.
- Migration strategy in the ETCS system is based on use of dual equipment on the track enabling concurrent operation of the vehicles equipped with ETCS and the vehicles equipped with national LS system only, where the national LS system may have the important role as a backup system for cases of ETCS system outage.

5. Overview of potential factors, which might have impact on the implementation progress

- After identification of risks, their minimization or elimination the pilot ETCS project Level 2 realization started in the Czech Republic, all the knowledge and experience

would be evaluated and used for further ETCS system implementation in the Czech Republic.

- The critical factor is the question of ETCS system development financing both in the area of the railway track part and the mobile part on vehicles.
    - Financing of the ETCS system development on Corridor E in the Czech Republic in planning period 2007 – 2013 depends above all on the approval of the Railway Infrastructure Administration application for co-financing from the EU budget for granting financial support of the Community in the area of trans-European transport networks TEN-T for support of ERTMS development.
- The delays in the selection of the contractor within the public commercial tender caused by protests of the unsuccessful applicants represent further factor with negative impact on the time schedule of the ETCS implementation.
- Delays of the infrastructure upgrading constructions, within which the fundamental conditions for following line construction of the ETCS system are prepared (new signalling devices, laying optical fibre cables, power supply ensuring etc.) may also have a negative influence on the ETCS implementation schedule.

- Considerable risk in the timely preparation of the ETCS system implementation execution is the instability of the mandatory specifications; for the successful implementation progress it is necessary to finalize the corrections of version 2.3.0 specifications and their stabilization.

For risk assessment purpose the SWOT analysis for the ETCS implementation on Corridor E was elaborated, which is presented in Appendix 2.

Summary

In the planning period 2007 – 2013 the provision of the ETCS system implementation on 478 kilometres of the Czech part of Corridor E is presumed, which part belongs to the ETCS corridors primary core; in optimum case also starting the ETCS implementation on the Transit railway corridor 2, which belongs to the ETCS network of corridors Katovice – Břeclav.

This intention is conditioned by approval of the application for co-financing of the Corridor E Czech part from the EU budget for granting financial support of the Community in the area of trans-European transport networks TEN-T to support the ERTMS development, within which its financing is ensured. Start up of implementation on the 2. TŽK depends on national funds and at present it seems rather less probable.

In the second phase, it means in the following planning period, the effort will be aimed above all to provision of the ETCS system implementation on the other transit railway corridors.

Achievement of the target state is nevertheless contingent on realization of further investment projects, above all junctions upgrading, which is performed at present.

Conclusion

The approach of the railway organizations in the Czech Republic to the ERTMS system implementation is active and it is supported by the state administration authorities.

An accelerated realization of the ERTMS project in the Czech Republic will contribute especially to:

- Preserving an economically important position of the railway in transit transport
- Increasing the safety level of railway transport
- Increasing speed and capacity of lines
- Effective traffic control
- Fulfilling interoperability conditions pursuant to EU Directives
- Access of the rolling stock of Czech operators to the railway network of neighbouring countries
- Using GSM-R for other applications, improving services for customers
- Developing Czech railway industry with a positive impact on employment

Implementation plan for ERTMS in the Czech Republic is based on today well-known documents and calculations especially of foreign partners and documentation of the European Commission. Due to the fact that ERTMS specifications are not fully stabilized yet and fluctuations are expected as far as unitary costs related to acquiring basic components are concerned, it is necessary to update continuously this strategy.

Conditions of the suggested time schedule are as follows:

- Successful realization of ERTMS pilot projects (it will have to be continually updated according to acquired experience from these projects)
- Necessary financial resources provision

Appendix 1

Reasoning of the application level of the ETCS system selection

On the basis of studies elaborated by the Railway Research Institute (VÚŽ, a.s.) in the period 2000 – 2001 for the purpose of the pilot project specification for ERTMS/ETCS system implementation into Czech railways conditions the decision was made to use the ETCS system Level 2 for equipment of the national railway corridors, i.e. the most exposed tracks of the conventional railway system on the Czech Republic territory. So also the Pilot ETCS project in the section Poříčany – Kolín was contracted and started up.
Concurrently the traffic of the national train control system (ATP) LS type operation will be secured and it will enable to provide the traffic in the migration period. The track part of the national ATP LS system is an integral part of existing station track and signalling devices.

- Equipment of the Czech part of the Corridor E will be performed with the ERTMS/ETCS system Level 2, version 2.3.0.
- Equipment of these tracks with the GSM-R system, which is necessary for the ETCS system Level 2 function, is already performed on a part of the tracks concerned (201 kilometres) and on the remainder (277) it will be realized in ample time by the independent construction with the presumption of putting into operation by the end of 2008, the GSM-R system is and will be realized on the mentioned tracks according to requirements of EIRENE specifications for ETCS data transfers.
- On the tracks concerned infrastructure the upgrading already was performed and new signalling equipment was established (except the big junctions, the upgrading of which starts presently). New signalling devices are full-electronic or with the electronic controlling level enabling cooperation with RBC for the ETCS system Level 2.
- Realization of the ETCS system implementation is envisaged in the form of tender according to the FIDIC Yellow Book (supply, design and build).

ETCS system Level 2 was selected above all for following reasons:
- National corridors infrastructure upgrading was performed or would be performed in ample time before the ETCS system constructions;
- Within the upgrading the electronic signalling devices, or formerly the signalling devices with electronic controlling level, are built, which enable the cooperation with RBC of the ETCS system;
- Track signalling systems are used, the technology complexes of which are centralized to the neighbouring stations;
- Information on the grade-crossing signalling devices on the track is downloaded to stations;
- ERTMS/GSM-R system, which is necessary for the ETCS Level 2, is established ahead of schedule before the ETCS system constructions and with parameters required by the EIRENE specifications for the ETCS system Level 2 operation;
- Level 2 system has the continuous data transfer via GSM-R, which is able to update continuously the data transferred between the track and the train that is very important in conditions of mixed traffic and trains operated at different speeds not to allow limitations of the track capacity;
- Level 2 system allows to implement temporary operation limitations (slow drives etc.) by the MMI RBC attendance;
- Level 2 system brings wider possibilities for optimization of the operation control;

- Level 2 system utilizes unswitchable balises, which markedly decreases demands for provision of the connecting routs for individual system components;
- In terms of further development possibility the system Level 2 is in comparison to the system Level 1 markedly more opened as it utilizes information transfer from the train to the track, i.e. the up-to-date data on the real train driving is accessible in RBC and usable for the optimum traffic control.

By contrast in case of the ETCS Level 1:

- For providing the transfer of the acceptable information volume for train driving control it is necessary to ensure the connecting routes between the switchable balises by their controlling units (LEU) and signalling device. If the signalling device is centralized to the neighbouring stations, then it represents necessity of new cables laying in the sections between the stations that would lead in many cases to the devaluation of some works performed within the upgrading and loss of guarantee for them;
- In conditions of the mixed traffic the timely update of movement authority is necessary for traffic fluency securing, which requires the realization of the infill function, except further entitlements to connecting routes this device (loops – cables laid on the rail base) belongs to the most sensitive devices on the transport route, most often damaged by vandalism;
- Level 1 system does not enable simple (only via the device operator) operation limitations, e.g. slow drives;
- Level 1 system is certainly an excellent interoperable automatic train protection device (ATP), but from the possibility of further development point of view it is a markedly more closed system in comparison to the Level 2 system, as the data on the real train drive is not centralized (the transfer from the train to the track does not exist).

This comparison leads unambiguously to confirmation of the decision to build the ETCS system Level 2 on national corridors of the Czech Republic, though it requires higher expenses compared to the Level 1.

Appendix 2

SWOT analysis for the ETCS system implementation

Strengths	**W**eaknesses
• Equal transport conditions for all transportation systems' operation without limitations and delays • Enhancement of the traffic in the railway corridor • Possibility of more effective use of the corridor capacity • Elimination of the engine swap on the border • Shortening of the international trains' travelling time • Increase of reliability and safety of the railway transport • Project realization in existing technological buildings and on existing tracks • Minimum influence on the environment • Zero influence on the landscape pattern • EU and railway sector project support	• Possible change of the investment costs amount after signing contracts for realization • Concurrence of ETCS 2 with GSM-R system – possible delay of the realization deadline • Different realization period of this system in follow up sections • Long migration period between existing national signalling systems and ETCS • Lack of contemporary transport means capable to use this system
Opportunities	**T**hreats
• Increase of competitiveness of the railway freight transport towards the road transport • Possibility of existing road transport modulation in connection with transport transfer to the railway Corridor E • General development of the railway transport • Customer services enhancement • New quality offer for the railway operators, corridor attractivity enhancement	• Protraction of the accessibility of interoperability specifications, which have to be realized • Economic and legal questions connected with contracts granting • Possible technical problems of new products feasibility • Problems during installation and testing in practice, which cause difficult ensuring of lockings on the track that is in operation • Non-decision on the financial backing from EU • Lack of financial resources for realization in acceptable time horizon • Possible change of political opinion in relation to the interoperability implementation process