Action Plan for the Deployment of Intelligent Transport Systems (ITS) in the Czech Republic until 2020 (with the Prospect of 2050)

Original text is written in Czech language
Czech version was translated into English on 1st June 2016

Contents

1 Introduction

The main purpose of transport is to move or carry persons or goods from one place to another, meanwhile the organization of the transport process has the priority over related activities: these play just an auxiliary role, helping to ensure regularity, safety and reliability of the transport process and providing with services of relevant quality. Intelligent transport systems represent the integral part of the transport process. Their function is not only the traffic management but they are also able to analyze data from the past and forecast the future course of traffic-related events. Furthermore, the ITS systems represent the tool allowing to monitor the technical condition of transport infrastructure and to use the gathered data to plan their repairs. Monitoring meteorological conditions at particular spots (or, eventually, effects of these conditions on the transport infrastructure, such as rime or black ice creation) allows to inform the road (or another transport network) users about imminent danger (using traffic information devices or mobile applications) and to order the speed decreasing, preventing from serious accidents. The ITS, mainly in connection with satellite systems, may also monitor the condition of the ground along the transport corridors, inform about land subsidence and prevent from the malfunctioning of the basic function of transport.

The ITS may also help detect serious traffic-related criminal activity. Equipping the transport network with appropriate devices will make it possible to monitor the impact of traffic on the environment (noise, emissions or smog) and to react accordingly when the ITS may be used to divert the traffic out of the most currently affected areas. In order to ensure appropriate function of the ITS, it is necessary to monitor and assess the functionality of individual ITS components and technical equipment of the transport infrastructure (whether they function according to defined requirements /are out of order). As for the telecommunication networks, it is necessary to monitor whether the data are transmitted within the required time limits and in appropriate quality. (Historical) data from the ITS systems may be used to plan the development of transport networks, to optimize maintenance process or to reconstruct particular sections of transport networks, all of this according to priorities defined by the ITS based diagnostic information.

On 12th June 2013, the Government of the Czech Republic approved the *Transport Policy of the Czech Republic for 2014 – 2020 with the Prospect 2050* document. This document is aimed at, besides other things, the question of utilization of the most up-to-date information and communication technologies (ICT), intelligent transport systems (ITS) and global navigation satellite systems (GNSS). The *Transport Policy of the Czech Republic for 2014 – 2020 with the Prospect 2050* is a conceptual document superior to the ***Transport** Sector Strategies 2nd Phase* (TSS-2) document, issued by the Government of the Czech Republic as of 13th November 2013, defining the key national transport constructions and priorities within the new European networks. This is why the ITS deployment within this document aims mainly at the ITS relating to highways, motorways, first class roads and urban road infrastructure. When defining the transport sector strategies, the Government specified financial requirements of the ITS deployment as a part of the whole transport network, with a close link to physical transport constructions. Because of this, the ***Transport** Sector Strategies 2nd Phase* document does not cover all ITS-related issues and this is why the ***Action Plan for the Deployment of Intelligent Transport Systems*** *(ITS AP)* was created. The ***Transport*** Sector *Strategies 2nd Phase* document defines that specific measures will be described in the ***Action Plan for the Deployment of Intelligent Transport Systems in Europe (ITS AP)*.**

Intelligent transport systems (ITS, sometimes called also transport telematics) or their applications are usually the combination of an intelligent vehicle and an intelligent infrastructure and services fulfilling the specific functions what they have been designed for. The ITS are systems which are able to collect and send information (data) on the current condition of a particular vehicle or device to a control unit or to an operator. When certain conditions are met (as soon as the situation has automatically been assessed), the control unit sends back relevant instructions (or, eventually, the instructions are given by the operator) and, resulting from this, a traffic management device is activated, changing the signaling lights, for example, or symbols on variable message signs, information given navigation by the device in individual vehicles, etc.

In order to define professional and qualification standards for ITS engineers, the ETNITE (*European Network on ITS Training & Education*) project was launched, supported by the EU through the Leonardo da Vinci programme. According to the ETNITE, ITS may be defined as follows: "*Technological innovation and Intelligent Transport Systems are concerned with the procedures, the systems and the devices which allow through the collection, communication, analysis, and distribution of information to enhance the transport and mobility of passengers and goods as well as the evaluation and quantification of the gained results."*

The Czech Republic legislation (Section 39 (1) of Act No. 13/1997 Coll., On the Road Network, as amended) defines the Intelligent Transport Systems as follows: *"An Intelligent Transport System is a set of electronic and technical devices, software and other tools enabling to search for, collect, provide access to, use and otherwise process data on roads, traffic, travel, logistics and transport connections. Its purpose, furthermore, is to enhance the safety and coordinated utilization of roads and to reduce the negative impact of road traffic on the environment."*

When implementing the ITS systems, each type of transport defines its own needs and requirements, according to which the particular ITS systems are designed. The following table describes the main components and systems of the ITS.

1. Air transport	SESAR (Single European Sky ATM Research/air traffic management), ATC (Air Traffic Control). To make the ITS work properly, it is important to be able to interconnect/make interoperable information about flight schedules and transported air shipments. Data concerning individual phases of flight are not relevant.
2. Inland navigation	The LAVDIS (Elbe-Moldau Waterway Information System) operates the RIS (River Information Services). The RIS are covering the following: ECDIS (Electronic Chart Display and Information System for Inland Navigation), monitoring the position and navigation of the vessels (with the help of the inland Automatic Identification System/AIS), Electronic message transmission and Messages to ship masters.
3. Sea transport	VTMIS (Vessel Traffic Monitoring & Information Systems), AIS (Automatic Identification System), LRIT (Long-Range Identification and Tracking)
4. Railway transport	a) ERTMS (European Rail Traffic Management System) GSM-R (Global Mobile System – Railways): digital railway radio network, ETCS (European Train Control System)

	b) ATO (Automatic Train Operation) c) telematic apps for both freight and passenger transport d) intelligent traffic control systems and intelligent traffic documentation for railway networks administrators, information systems for both operators and passengers e) intelligent maintenance management systems, intelligent operational diagnostics and asset management systems
5. Road and public passenger transport + interface with other types of transport (according to the EU directive on the ITS)	ITS – intelligent transport systems (road traffic management, increasing its safety, traffic information, logistics and travel information

The ITS include a broad range of applications, subsystems and systems providing with a set of services. Formerly, the ITS were perceived in quite a narrow context, as high-tech accessories in cars or as specific-purpose applications allowing, for example, to find the closest available parking spot. Until recently, they had not been sufficiently interconnected and it was problematic to technically coordinate them. Over time, a need has increased to interconnect the systems and the ITS started being perceived as a complex, systemic issue. The ITS, therefore, ought not to be perceived as individual applications but rather as complex, comprehensive systems (such as a road traffic control systems, etc.).

ITS components used in transport infrastructure and means of transport must be compatible on both national and international traffic level. End users (drivers or passengers, for example) expect to be provided with services on a continuous basis (to be informed about the traffic situation or about bus services, for example), during the whole duration of the journey, regardless of their current location. They also expect to be able to use the services no matter who owns or operates the particular segment of the traffic infrastructure (Technical Administration of Roadways of the Capital of Prague/TSK, the Town of Ostrava Communications, etc.) or who runs the particular passenger transport company. The above taken into consideration, it is evident that it is necessary to align the technical aspects of the ITS infrastructure development with the need to create a complex and coordinated ITS network based on international standards. The requirement for the compatibility of ITS-provided applications became even stronger along with the implementation of the integrated passenger transport systems as well as with the creation of freight transport logistic systems which need to be provided with a comprehensive information or for the purpose of the traffic control.

It is possible to integrate, into the ITS systems other additional systems, such as the Global Navigation Satellite Systems (GNSS), enabling to determine the current location of the particular vehicle. The information about the location determined by the GNSS must be, in most cases, displayed in a map to make it visible to the end user. This is why the satellite systems and digital maps or, as the case may be, sets of spatial data, are also integrated into the ITS.

It is furthermore possible to integrate, into the ITS, other systems, such as various types of mobile communication (ranging from the 1G cellular networks to the current 4G LTE network but also the future 5G network, satellite mobile communication systems, such as Inmarsat, Iridium or Thuraya, etc.), but also other land and satellite mobile radio networks. This is the reason why mobile systems become a part of the ITS.

According to the *Government of the Czech Republic Decree No. 449* issued on 12th June 2013, the *Action Plan for the Deployment of Intelligent Transport Systems* (*ITS AP*) is submitted to be discussed by the Government as a document directly related to the *Transport Policy of the Czech Republic for 2014–2020 with the Prospect of 2050* document. The *ITS AP* sets the goals and conditions governing the implementation of ITS technologies as a tool helping to support the priorities of the Czech Republic's transport policy, emphasizing the necessity to interlink the national transport system to the European system. It defines which steps should be made in a short and medium term perspective in order to fulfill the goals as set by the *Transport Policy of the Czech Republic for 2014–2020* and in the *2010/40/EU* directive. The ITS AP defines specific development needs and how they should be realized and informs about the framework of possible financing of proposed measures.

According to the *Government of the Czech Republic Decree No. 815* issued on 8th October 2014 on the strategy of the development of infrastructure for spatial information in the Czech Republic till 2020 and with respect to the need to provide for a convenient database enabling a proper traffic organization, the *ITS AP* furthermore specifies some development needs in the area of geospatial data infrastructures and geospatial data funds.

The *ITS AP* takes into consideration the role and competencies of particular levels of public administration responsible for operating the road network, controlling and regulating the traffic and informing the traffic participants, as well as the roles and competencies in the area of public non-regional, regional and local passenger transport. Agglomerations are the source of the most serious traffic-related environmental problems, the ITS are used to solve or at least minimize them. Decisions about specific measures in frame of urban agglomerations are made on the level of regional self-governing units, which is the reason why the introduction of ITS in urban agglomerations is not covered in detail by the *ITS AP.*

The ITS AP covers the ITS utilization and implementation within not only the road infrastructure but also within all other types of transport modes which are in the public interest. Investment and operation costs of these systems are entirely or partially covered by the public sector. The European Rail Traffic Management System/European Train Control System (ERTMS/ETCS) and the Global System for Mobile Communication – Railways (GSM-R), both operating in frame of the railway transport system, and investments into the River Information Services (RIS), operating in frame of the waterways transport system, are covered in related conceptual documents to which the measures defined by the *ITS AP* are linked to.

Measures taken to develop the ITS must be, in some cases, interlinked with other, for example construction or organization-related measures to answer the needs of all users, including people with reduced mobility or orientation. Furthermore, it is necessary to ensure that the ITS is linked to the development of relevant telecommunication infrastructure and crisis management systems as well as to critical national infrastructure measures. These types measures are not covered by the *ITS AP* into detail: the Plan propose that they be drawn up if needed. The ITS AP Action Plan is focused neither on information nor traffic control systems using the ITS and providing with a comprehensive support to both public administration information systems and private systems governing operational and business process in private companies. The ITS Action Plan, furthermore, is not focused on the electronic toll systems. A full integration of the above cited systems will be drawn up by means of standardized interface and mutual links towards system users.

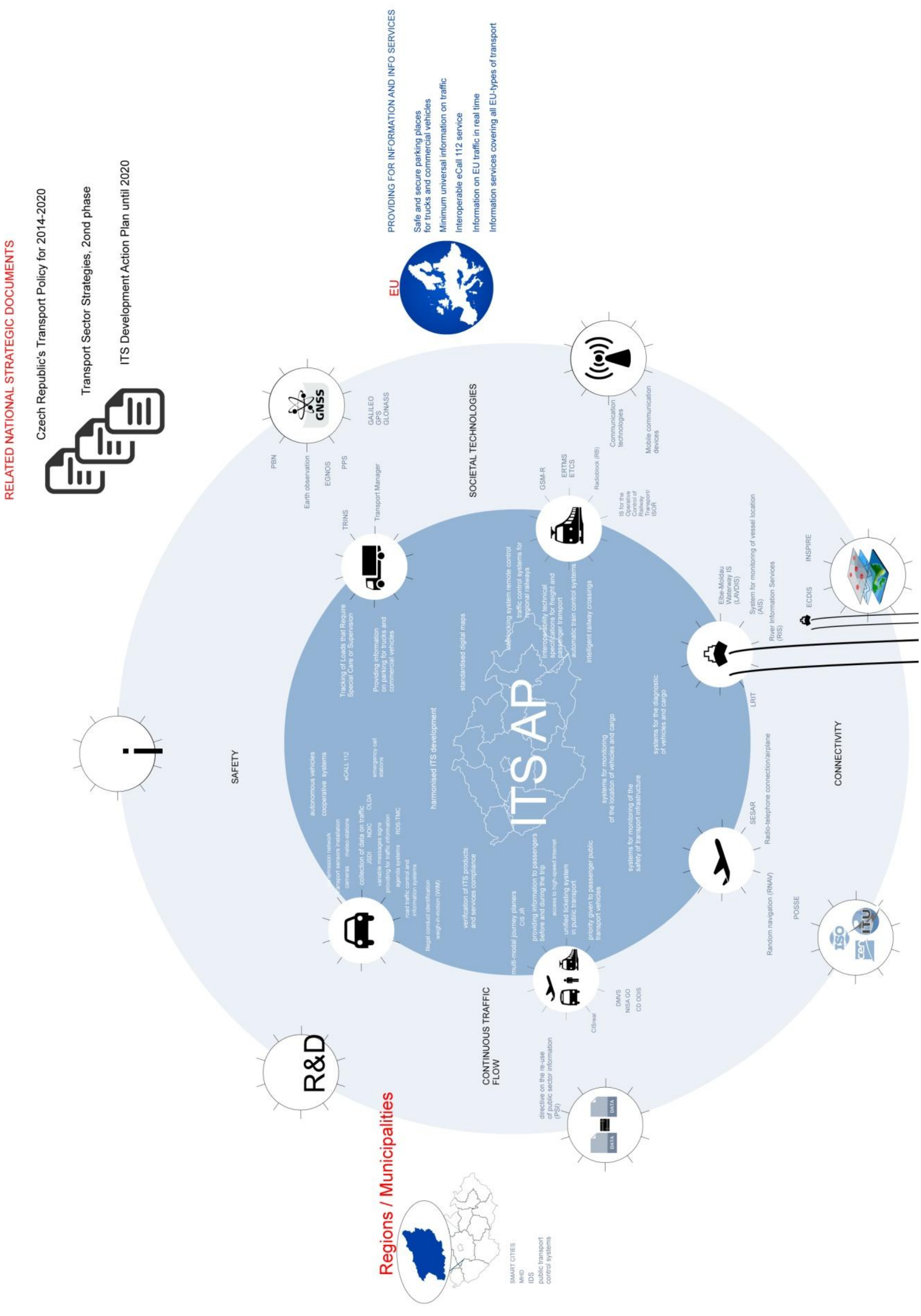


Figure: Areas aimed by the ITS AP (authors: Martin Pichl, Zoltán Horváth)

2 Preparation of the ITS Action Plan, Cooperation with Partners

The initial preparation phase of the ITS AP was under way by the schedule defined by the Coordination Council of the Minister of Transport for the ITS (KR - ITS) constituted in 2010 to ensure sufficient coordination and interlinking of activities related to the ITS development within individual Ministries as well as across them.

One of the main goals of the ITS AP is not only to create new intelligent transport systems but to optimize the currently functioning ones and enhance the utilization/sharing of data in frame of individual applications. It was with respect to the above that the analysis was drawn up to see what the current state of the ITS utilization was, based on the experience of end users with the ITS. This analysis was drawn up by the below mentioned working groups and its results made it possible to propose measures that would allow to provide the end users with ITS-related services according to their expectations. The CC – ITS set up working groups that described the current functioning of the ITS in the Czech Republic from their perspective and to propose a vision and priorities for the ITS development in the particular sector. The following working groups were constituted:

1) WG No. 1: Ensuring the traffic safety and continuous traffic flow. Coordinator: Ministry of Transport
2) WG No. 2: Traffic management and control, provision of information. Coordinator: ITS&S.
3) WG No. 3: Analysis, situation and forecast of traffic. Coordinator: Technical University of Ostrava
4) WG No. 4: Services. Coordinator: Central Auto-Moto-Club of the Czech Republic
5) WG No. 5: Supporting telematic systems. Coordinator: the Road and Motorway Directorate of the Czech Republic.

The working groups took into account the specific situation in the railway and public passenger transport, logistics, urban ITS systems, GNSS systems and geospatial data concentrated mainly on the road transport. The results of their work were presented and submitted to the Coordination Council of the Minister of Transport for the ITS on 7th July 2014.

The first phase of the research, concentrating on finding what the concerned subjects and end users require and demand in the area of the ITS and what their opinions about the ITS development are, was followed by a second phase, starting in autumn 2014, focusing on the creation of the ITS AP document, which took into consideration the opinions of the above listed working groups.

The ITS Action Plan was prepared by regular as well as extra members of the KR - ITS as a permanent coordination, initiation and counseling authority of the Minister of Transport for the systematic ITS deployment. From September 2014 until November 2014, a number of ITS AP drafts were drawn up, edited and specified according to what was agreed during regular meetings with individual departments of the Ministry of Transport, the Road and Motorway Directorate, the Railway Infrastructure Administration (state organization), the Air Navigation Services of the Czech Republic (state organization), the Czech Railways (Ltd.), the Directorate of Waterways of the Czech Republic, the State Navigation Administration and also with the representatives of the Ministry of Industry and Trade, Ministry of the Interior, Ministry of the Interior - Fire Rescue Service of the Czech Republic, the Police of the Czech Republic, ITS&S, Transport Research Centre, the Faculty of Transportation Sciences of the Czech Technical University in Prague, the Jan Perner Transport Faculty of University of Pardubice, the Institute of Geoinformatics and the Faculty of Electrical Engineering and Computer Science of the Technical University of Ostrava, the Faculty of Electrical Engineering and Communication of Brno University of Technology and the Faculty of Electrical Engineering of the University of West Bohemia in Pilsen.

Next to state administrations, transport companies, transport infrastructure administrators, professional and research organizations and universities, end users were also invited to participate in the creation of the ITS AP through various interest groups and civic associations. This is how real demand and real requirements in the area of ITS were researched because skipping this very basic phase of ITS development and implementation would lead into the implementation of systems with limited lifetime period.

The above described procedure created a suitable platform gathering all parties interested in the ITS AP creation, able to recommend ITS-development priorities respecting the technical and economic possibilities as well as the real needs of public administration and ITS users.

The document is written according to the “Methodology of Strategic Documents Preparation” (as defined in the Government resolution No. 318, issued on 2nd of May, 2013.

The contents of the *Action Plan for the Deployment of Intelligent Transport Systems in the Czech Republic until 2020* document does not fulfill the Section 10a, Act 100/2001 Coll. on environmental assessment, which means that it is not bound to undergo the SEA procedure.

3 Opening

The transport sector is a network branch of world-wide importance. As such, it has a specific character: transport systems operated on the territories of various national states must function in harmony and must be interlinked. Transport systems, furthermore, are required to comply with whole range of characteristics and capacities and they develop, stagnate or disappear according to how their segments are able to meet the users' requirements. The term transport is closely related to the term mobility, which is perceived as a capability to transfer persons or goods without major obstacles and with a relevant level of safety and reliability not only with respect to transport technologies but also with respect to socially-defined factors, such as accessibility of transport systems to vulnerable traffic participants, i.e. mostly people with reduced mobility, orientation or communication abilities. The term mobility covers all technically realizable ways allowing people to relocate in order to fulfill their needs. This can be done with the help of transport but also through communication networks (information services and electronic trading services).

Personal mobility is currently undergoing some major changes (and other will follow), caused by an rapid development of information and communication technologies (ICT) and services enhancing mobile connectivity. In the near future, vehicles as well as traffic participants and transport infrastructure will be equipped by millions of sensors able to communicate with each other. The number of smartphones, mobile internet and mobility enhancing applications users will be increasing. Development of mobile (the so called "connected") services in the automotive industry confirms that these technologies are becoming an integral part of vehicles. It is possible to expect that in several years, each vehicle will have a data connection.

Sufficient amount and quality of information used in managing and controlling the traffic is necessary for the correct functioning of traffic systems and correct organization of transport of persons or goods. And it is why an up-to-date, detailed and accurate view of individual traffic situations is needed both in the area of the traffic itself (such as speed and traffic flow density, current situation in particular segments of the transport network, emergency and danger situations such as fog, glaze ice, etc.) and in the passenger transport area: meet the schedules, transfers and connections, emergencies, organization of transport during mass events such as festivals, concerts or sport events or, in the area of freight transport, finding out the current state of the transported cargo. Management, control and decision-making based on accurate data accessible in real time may increase performance of the transport companies, reduce operational costs and help to better manage risks and emergencies.

The road transport development trends copy, to a certain extent, the railway and air transport development which have already been, for some time, monitoring the real movement of individual means of transport, doing so for two main reasons: to manage and control the traffic and its safety and to provide information to clients. Information about the location of a particular train was considered to be the key information even at the very beginning of the development of railway transport. The way this information was obtained depended on technological facilities of the particular era. At the beginning of railway transport, various train movement management and control systems were used. These systems were depended, on available technology, corresponding directly to the current state of technological development. At the very beginning of railway transport, the system of time coordinates was used for example, which means that trains were dispatched in defined time intervals. This way of traffic management and control, however, did not correspond to the increasing intensity of railway transport and did not meet the security requirements. Frequent railway accidents requested the introduction of the new system, the "spatial" system, using sets of railway light signals and based on the transfer of information that gives the authorization to trains. The principle of this new system was based on the idea according to which "only one train is allowed in one block section of the railway". Information about the real location of the train has always been and remains crucial for the management and control of the railway transport. Until recently (some of the lines until today), trains have been located by persons. lines with high traffic intensity, they are located by security systems equipped with detection devices. To ensure the security of the entire railway system it is necessary to equip the railway vehicles with communication, safety and monitoring systems. These systems, placed mainly in railway vehicles, are nowadays important also with respect to the requirement to gradually interlink and integrate individual national systems on the European continent (or, in other words, to ensure the Interoperability). The trend, mainly on regional railways, is to change the current way of railway traffic management and control, exercised through elements placed directly on the railway tracks because it is not economically profitable. Satellite based systems of train localization devices are being implemented, which make it possible to determine the location of rail traction or non-traction vehicle unit without necessarily incorporating the detection equipment directly to the infrastructure. This approach, however, may be adopted only if the entire infrastructure and all vehicles are equipped with a wireless communication technology, able to transfer the information about the train location to the traffic control centre in real time. The air transport used to be the less safe transport mode. Today, on the contrary, it is the safest transport mode, which is due to, besides other things, the implementation of the air traffic control and safety services. Air navigation has also been following the trend of abandoning the conventional navigation and has been transferring to global navigation satellite systems.

The road transport, has been going through the information revolution that took place in the air, railway and waterway transport. In a short time, the isolated road transport participants will be informed about the behavior of the "mass of participants" within their vicinity, meaning that each of them will behave on the basis of knowledge of other road transport participants' behavior. In near future omnipresent all road transport participants will be continuously provided with an up-to-date information generated by constantly working network.

The currently used decision-making based on intuition will thus change into reflexive decision-making based on the knowledge of the circumstances. The informed mass will require more sophisticated and coordinated regulation and centralized control systems (using also the distributive system control methods), replacing today's isolated traffic control systems. When we look at this development from the public administration's perspective, then the above entails a necessity to radically review the current approach to traffic control-related issues (developed for dozens of years). There is a need to come up with mechanisms that will help to sort, analyze and give sense to huge volume of heterogeneous data, distributed in order to help to make decisions in specific situations. Transport systems will have to review their input data paradigm, start working with a new generation of accessible data ("retrain to the new data generation") and reflect the existence of a large group of well-informed traffic participants (which, in turn, entails a necessity to change the mode regulatory interventions are made in space and time).

Transport technologies are comprised of means of transport, transport infrastructure and transport organization. Transport, or transport system, must comply with the principles of technical interoperability and continuity of the transport process. Individual transport mode systems are influenced not only by technological requirements but also by social and political influences and long-term technological and safety trends.

As it was already mentioned, the persons and goods traffic management and monitoring require reliable transfer of information in real time. Looking at the problem from the perspective of classification and description of individual ITS systems, was chosen the sorting according to used transport infrastructure and transport means and opted so to create two separate areas: freight transport logistics and passenger public transport. It has been chosen to do so because passenger public transport systems and logistic systems coordinate, synchronies and optimize the carriage of persons and consignments across the network of individual transport modes, starting with the place and moment of their entry into the complex transport network and ending at the moment at which they leave this network.

3.1 The Current State of ITS Deployment in the Czech Republic

Modern information and communication technologies enabled to create new transport systems and applications, ITS (also called transport telematics). ITS offer a complex view on all transport modes and facilitate the coordinated interlinking of various transport systems. The ITS-related issues are focused on a wide variety of offered services as well as in frame of their specific utilization. In general, it is possible to say that the ITS systems are systems allowing to inform passengers, to manage, control and regulate the traffic flow, to make it safe and continuous.

3.1.1 Road Transport

The Road and Motorway Directorate of the Czech Republic has recently been introducing or developing, in frame of the motorway, expressway and the first class road network, the following basic ITS systems:

1) Road traffic control and information systems (including dynamic management): mainly the dynamic road traffic control systems, implemented on the R1 Prague City Road Ring, and information portals on most motorways. These portals provide the traffic participants with up-to-date traffic information by the means of variable information panels. These panels display text information (three lines of text) and in most localities, they are placed with a variable warning message sign, displaying selected warning symbols;

2) Systems enabling to increase the safety of road traffic: video systems and meteorological stations were installed on most sections of motorways and expressways and warning meteorological systems were installed in selected dangerous localities (such as bridges, flyovers, forest sections, deep notches, etc.);

3) Collecting traffic data: step by step, automatic traffic counters have been installed on motorways and first class roads in order to make it possible to continuously monitor the intensity of traffic and to determine the characteristics of the traffic flow in the particular section;

4) System of emergency reporting stations allowing the road traffic participants to contact the operational dispatch of the Police of the Czech Republic or the Fire Rescue Service of the Czech Republic. At the same time, these emergency reporting stations serve as

connection points for various ITS equipment such as meteorological devices, video cameras, traffic detectors, variable message signs, etc.);

5) Systems for the identification of illegal behavior: in selected localities, dynamic weighing systems were built in order to prevent behavior damaging the road network by overloaded trucks.

The road and street networks of major cities were also equipped with ITS systems and in some cases lower class roads were equipped too, These roads are not administered by the State but by relevant cities or regions.

The creation of the Integrated Traffic Information System of the Czech Republic system was launched in 2005, on the basis of the Government of the Czech Republic resolution No. 590/2005 on the Integrated Traffic Information System of the Czech Republic and according to the stipulations of Section 124 (3) of Act No. 361/2000 Coll. and related implementing legislation No. 3/2007 Coll. These documents defined a complex system for the collection, processing, sharing, publishing and distribution of traffic data from the entire network of road infrastructure. The Integrated Traffic Information System of the Czech Republic is comprised of three main parts:

- The National Traffic Information and Management Centre (NDIC) (processes and evaluates traffic information, monitors the traffic situation on a centralized bases, carries out central traffic management and control and provides the public with traffic-related information and data

- Information providing subsystems

The National Traffic Information and Management Centre (NDIC) is a central technical, technological, operational and organizational point of the Integrated Traffic Information System of the Czech Republic (JSDI). It is an operational department run by the Road and Motorway Directorate, functioning on the 24/7 basis and collecting, processing, assessing, verifying and authorizing traffic information and data. This information and data serve as a basis on which the National Traffic Information and Management Centre operators regulate the traffic by means of variable traffic signs, traffic information devices, the Radio Data System - Traffic Message Channel or through the www.dopravniinfo.cz website and through relevant mobile phone applications.

- Data collection subsystems,

The Police of the Czech Republic represents another important provider of information in frame of the Integrated Traffic Information System, gathering important information mainly through calls to the 158 emergency line or from its patrols. Traffic information does not concern only traffic accidents but also obstacles on roads, current density and speed of the traffic flow (1-5 grades), current restrictions on the road network, accidents and defects, vehicles in fire, bad weather, non-functioning signaling devices or, in other words, any factor that prevents the traffic from being continuous and safe. Traffic information is checked and entered into the Integrated Traffic Information System Ostrava, on the Police of the Czech Republic website and on the Online Traffic Update website: this is done by the integrated operational centers of the Police of the Czech Republic as well as by the Traffic Police units (mainly the Highway department).

According to the contract between private entities and the Road and Motorway Directorate of the Czech Republic, private entities have, in order to provide their clients with information services, the right to use information from the National Traffic Information and Management Centre and from the Integrated Traffic Information System. They are bound to distribute verified, authorized, digitally geographically localized and Alert-C protocol-coded traffic information. Doing so, they have to add value to the basic information. The term added value refers to using the traffic information in the form of web applications, acoustic broadcast, sending the traffic information to the client through a relevant distribution channel (such as SMS), etc. The primary goal of the value added to data taken over from the above mentioned sources as well as to data created by private entities themselves must be provided for a traffic information service aiming to increase the safety and continuous flow of road traffic. The value added by the private company may be used to make profit; meanwhile the traffic information is communicated to clients in the defined data structure, specified before the contract is signed. Private companies do not have the right to transfer the data or provide a third person with the data in their non-altered form, without modifying them by adding additional value to them. The National Traffic Information and Management Centre along with the Czech Radio currently operates the Radio Data System – Traffic Message Channel as an integral part of the Integrated Traffic Information System.

The Integrated Traffic Information System is a project that goes beyond the basic competencies of the Highway and Motorway Directorate of the Czech Republic. It includes the entire road network ranging from highways to publicly accessible service roads. Since the very beginning, it has been implemented, directly or indirectly, by dozens of authorities, organizations and institutions (or their departments) on various state or regional levels or on the level of cities, municipalities, etc. The project was, at the beginning, guaranteed by the Ministry of Informatics (until the end of 2006), Ministry of Transport and Ministry of the Interior. The other authorities, organizations and institutions participating in the project are:

- Police of the Czech Republic
- Fire Rescue Service of the Czech Republic
- Emergency medical service
- Communications administrators
- Road administration authorities
- Municipal police
- Exceptional loads or exceptional dimensions load operators
- Czech Hydrometeorological Institute
- Water management authorities
- River basins management authorities
- Operators of networks of voluntary traffic reporters (such as the Czech Radio, GLOBAL ASSISTANCE, Central Auto-Moto-Club of the Czech Republic)
- Customs administration of the Czech Republic
- Owners and operators of ITS and telematics applications

Individual authorities, organizations and institutions transfer or ought to transfer traffic information and traffic data to the Integrated Traffic Information System according to Section 1 of the regulation 3/2007 Coll. on the national traffic information system.
These data concern:

- Higher traffic intensity, congestion, traffic jams
- Traffic accidents
- Vehicle or cargo in fire

- Fire of objects near the road in case it puts in danger or restrains the traffic flow on the road
- Road closures or detours
- Specific utilization of the road
- Obstacles on roads
- Road repairs or maintenance
- The state of the road and problems related to bad state of roads
- Sections of roads not maintained in winter
- Meteorological and weather conditions influencing the traffic capacity of the roads, safe movement of vehicles on the roads or limited visibility
- Utilities accidents in the earthwork structures of the road or in its vicinity
- Defects of the parts and fixtures of the road
- Waiting times resulting in various administrative or similar measures taken
- Limited possibility to use the road concerning certain types of vehicles, vehicles with a certain equipment, etc.
- Static transport situation, parking possibilities, parking restrictions, current capacity of Park and Ride parking
- Another type of emergency

Information and data on the current traffic situation are transferred to the Integrated Traffic Information System according to current legislation or according to contracting agreements by authorities, organizations or public administration institutions and other public or private persons or subjects. The Integrated Traffic Information System, however, is not finalized in some areas.

On the European level, the following EU regulations were issued on 15th May, 2013 in order to ensure coordinated provision of information about parking places, to optimize and regulate the utilization of parking areas for trucks and commercial vehicles and to ensure coordinated provision of those types of information concerning the situation on the road network that, by its character, helps inform drivers about traffic emergencies:

The 885/2013 EU regulation concerns the area of provision of information about parking places for trucks and commercial vehicles, designed to inform truck drivers about convenient places to park their trucks and about places that will be protected against crime such as theft of transported freight, theft of vehicles or mugging.

The 886/2013 EU regulation concerns the area of provision of road traffic information concerning the situation within the road network, meanwhile this information should attract the drivers' attention to dangerous traffic situations. The provision of „minimum universal traffic information" by public and/or private road operators is to be done in a way that makes it possible to reach the broadest possible range of end users (drivers, for example). This traffic information is to be provided free of charge, which, according to the definition, means with no additional costs for the end users (fees or costs for receiving the information must be relevant to costs for the collection and processing of the information). Public and private service providers are bound to cooperate to harmonies the presentation of the content of information provided to end users.

Both of the above regulations represent the EC specifications as described in Section 39a/2 of Act No. 13/1997 Coll. on the road network as amended.

In order to properly implement the above regulations in the environment of the Czech Republic, it is necessary to extend the number of authorities, organizations, institutions and other persons and entities that will provide with information to be included in the Integrated Traffic Information System. This need was translated into the Section 124 (3) of Act No. 361/2000 Coll. on Traffic on the Road Network.

3.1.2 Public Passenger Transport

The National Timetable Information System (CIS JŘ) provides the public, ordering party of transport services and transport operators with state-guaranteed data on public passenger transport. The timetable data are to be put into the System are provided by transport operators who have the obligation to hand over their timetables to the transport authority to be approved. The data are to be transferred in a format and structure defined by the transport authority or, as the case may be, railway operator. The data are provided by railway operators (trains), rail administrative authorities (trams, trolleybuses, special vehicles /i.e. underground / and cableway) and by the Ministry of Transport (urban, domestic and international bus lines). All the above is done according to the provisions of the Act on Road Transport (Act No. 111/1994 Coll. as amended and its implementing regulation No. 122/2014 Coll.) and the Act on Railways (Act No. 266/1994 Coll. as amended and its implementing regulation No. 173/1995 Coll. as amended). The data from the Nationwide Information System for Public Transport Timetables are publicly accessible through the internet interface. Data on timetables are published on the Internet in the .pdf and .xls formats. They are not, however, published in machine readable formats. This is why in 2013, a new Czech Republic Government regulation on regular public road transport services was introduced. Section 9 (8) of this regulation stipulates that all approved road transport service schedules be immediately published on the Internet in a way that makes it possible to machine process them (database structure). On 9th July 2014, a new Czech Republic Government regulation No. 122/2014 Coll. on Regular Public Transport Timetables was published in the Collection of Laws. A similar adjustment was made in the regulation 7/2015 Coll., which concerned railway transport and which was an amendment to the railway regulation No. 173/1995 Coll.

The above described data on public passenger transport have been used by various search engines helping to find travel connections. Currently, the most often used search engine is the IDOS (www.idos.cz; www.jizdnirady.cz). This engine makes it possible to search for travel connections across the individual types of public transport and it also provides with the information about barrier-free transport.

The functioning of the Nationwide Information System for Public Transport Timetables will be adjusted according to the principles set by the European Directive on the re-use of public sector information (the so called PSI Directive). It will be necessary to define, during this transition that concerns the accessibility and openness of this system to other subjects, the responsibility of participating subjects in a sensitive way in order to prevent the deterioration of the quality of this system and to keep its quality up to the expectations of end users since the current, very complex system represents a unique European project. In order to maintain the stability of the Nationwide Information System for Public Transport Timetables, it is necessary that this system continues to be supported by the state administration, mainly through activities such as gathering of relevant data and providing these data to third parties through a relevant distribution interface. The openness of this system will result in broadening and increase of attractiveness of related systems called multimodal journey planers integrating also information systems for individual car transport. It is crucial to select the right strategy: the process of transferring from the Nationwide

Information System for Public Transport Timetable to a system as defined by the PSI Directive must not be underestimated because if it is, it could result in various problems or even lead to the total collapse of the entire system.

Despite the fact that the functioning of the Nationwide Information System for Public Transport Timetable is not yet completely aligned with the provisions of the PSI Directive, passengers are already being offered applications combining pedestrian navigation with the search for connections applications offered by passenger public transport operators, which makes it possible to plan a journey from one stop to another but also, thanks to the combination of various criteria, also the journey from a particular place to final destination (the so called door-to-door journey planning).

A lot of towns in the Czech Republic have already introduced urban public transport management and control systems enhancing the traffic dispatching process and increasing the quality of information provided to travelling public. These control systems carry out real-time monitoring of the urban public transport network and regional bus lines and trains and, in case of non-respect of bus or train schedules, they help to remove the obstacles causing delays. These systems use different technologies. In Prague, defining of the position of trams is based on the communication of the particular vehicle with beacons operating in the infra-red frequency range (the so called infra-red beacons or IR beacons) placed along the tracks (on pillars at the stops, for example) and the location of urban and suburban transport buses is tracked through GPS systems. The iRIS control system, for example, used by the Transport Company in Brno, for example locates its vehicles (trams, buses and trolleybuses) by the means of the GPS navigation system. This system provides the dispatchers with important operational data and makes it possible to send instructions to individual vehicles' drivers as well as information for passengers to be displayed on the information panels inside the vehicles, at selected stops or in passengers' mobile applications. But not even the most intelligent systems are able to solve, without human assistance, all situations that might occur in traffic. This is why these systems include also radio communication systems or GPRS devices that allow the drivers to directly communicate with the dispatchers. Furthermore, systems in vehicles are able display synchronized time (which is done on time displays as well as on the ticket validators).

The control and information system also enables a continuous movement of trams, trolleybuses and buses through intersections according priority to urban public transport vehicles. This way of ensuring a continuous flow of urban public transport vehicles through complicated traffic spots has been continuously elaborated and combined with warning systems. In Ostrava, for example, there is a system of automatic warning of both drivers and pedestrians about trams arriving to a tram crossing. The system automatically activates and deactivates warning signs for drivers and LED strips installed along pedestrian crossings traversing the tram tracks.

The urban public transport as well as important transfer nodes and regional passenger transport terminals also use the network of intelligent stops. Information panels have been installed at selected urban passenger transport stops in Prague, Pilsen, Ceske Budejovice, Brno, Olomouc and Liberec and around large towns. These panels display the time remaining to the arrival of the next vehicle and the information about the type of the vehicle (such as low floor) or, eventually, inform about the delay. The railway stations and the Integrated system of the South-Moravian region have implemented the 2D codes service. The 2D codes are planned to be introduced on the urban public transport lines in

Prague. This system allows passengers to connect, through an application, to interactive timetables displaying also the information about delays of the particular vehicle or train.

Systems allowing to carry out operational control of vehicles are used not only in frame of the urban public transport but also in regional public passenger transport. The first dispatching unit in the Czech Republic working with the new systems was the Central Dispatching Unit of the Integrated Transport System of the South-Moravia region. The main task of this dispatching unit is to operatively manage the movement of the regional passenger transport vehicles in a way that would guarantee the connection of transfers in transfer nodes (i.e. transfers from bus to bus, or from bus to train). The central dispatching unit plays an especially important role during emergencies, such as road or track closures, accidents and other extraordinary events concerning the traffic. During such event, the priority is to coordinate individual transport service operators participating in the integrated transport system, with the goal to bring the negative consequences of the emergency to minimum meanwhile maintaining the comfort of services provided to the passengers.

On 1st June 2014, a new Czech technical norm (ČSN 01 8245), the *Information System in Public Transport – National Timetable Information System for Real Time* (CISReal) entered into effect. This norm defines the way to exchange data and the minimum requirements governing the communication among dispatching systems of individual public passenger transport operators, transport systems (Urban Passenger Transport, Integrated Transport Systems) and the railway operator (the Railway Infrastructure Administrator). This norm, furthermore, governs the data exchange through a centralized element (the CISReal), with the possibility to use information about current location of the public passenger transport vehicle in multimodal journey planers.

Most public passenger transport operators offer to their customers a possibility to obtain their travel ticket in an electronic form on a data medium (contactless smartcard). Several passenger (mainly urban) transport operators (around Prague and around Ostrava, Brno, Liberec and Pilsen) provide their passengers with the “SMS ticket” service, offered in co-operation with all mobile-phone operators in the Czech Republic. New electronic ticketing standards (EOC) are currently being created: this electronic ticketing (electronic fare management) service will make it possible to check into public passenger transport services through an interoperable electronic media storing the travel ticket. It is expected that this kind of media will become an integral part of the national interoperable concept, which is currently being worked on and which has to be backed by electronic media issuers, applications and products providers, transport operators and clients. The key factors influencing a successful standardization of the electronic ticketing system (electronic fare management) are: consensual approach, coordination of public transport ordering party and efficient support provided by the Ministry of Transport. It is expected that the electronic ticketing standard will be, through the ordering party, consistent with the goals defined by public sector authorities. The opinion of the ordering party represents thus the key factor influencing the final form, extent and content of the project as well as the means used to ensure its sustainability. It is assumed that interoperable applications and products enabling identification, storage of products (travel ticket) or, eventually, other applications, will be an integral part of the electronic ticketing standard.

3.1.3 Accessibility of Public Passenger Transport Services to People with Specific Needs

An increasing range of applications are being designed to assist people with reduced mobility and orientation and to give them more autonomy to move around independently and safely. There has been a real expansion of voice and acoustic information services helping visually impaired people to orientate in urban surroundings, in public passenger transport vehicles, in suburban transport vehicles and in railway transport vehicle, on crossroads, in underpasses, at the stops (equipped with electronic information panels), in the underground and around state administration offices and hospitals.

The IDOS application, for example, providing information about public transport run on the www.jizdnirady.cz website, was adapted to use by people with various phases of visual impairment (www.jizdnirady.cz/blind). Adaptations were carried out according to principles of the “Blind Friendly Web” project introduced by the Czech Blind United Association and to standards issued by the World Wide Web Consortium (W3C) publishing norms applying to internet technologies. Three large LED information panels were placed in the area surrounding Prague in frame of a trial run. These panels provide information about the Prague Integrated Transport System timetables in an acoustic way (the acoustic output is activated through a personal control device). Furthermore, six information stands, currently operating in trial mode, were placed in underground stations situated near important regional bus passenger transport terminals. These transport information stand prototypes were equipped with audio and orientation beacons and operate on the basis of a specific acoustic procedure. Using an electronic speech synthesis, they inform the visually impaired person about the convenient connection. Analogical devices are starting to be introduced as a systematic measure within the railway system.

Information systems implemented in the urban public transport vehicles (underground trams, buses, trolleybuses) were complemented by communication systems allowing to communicate to people with reduced orientation. These systems are called command sets for visually impaired and are also referred to as “talking trams”. When activated at the station, this system informs the blind passenger, through an outside-placed loudspeaker, about the number of the line and direction. If the blind passenger is interested in getting on the vehicle, they press a button informing the driver about their intention and the driver may pay attention to them. (The driver is informed by the means of an inside loudspeaker.) A similar procedure is applied when the blind passenger is getting off the vehicle. Some types of regional Czech Railways trains and Prague trams are equipped with systems that allow the blind passenger to open the vehicle door by the means of their walky-talky and to, parallel to this, set off the sound signal allowing them to find the door so there is no need for them to search for the control buttons on the vehicle. The Prague underground works in a similar way.

There has also been an expansion of acoustic signaling systems on pedestrian crossings and systems of remotely-controlled acoustic orientation and information beacons located in places accessible to the public. It is now obligatory to place acoustic signaling systems for blind people on newly built or reconstructed pedestrian crossing and on railway crossings.

Furthermore, transport companies in some towns, such as the Prague Public Transport Company, have been providing, on their website, with information services enabling to find barrier-free travel connections, including the information whether the particular low-floor vehicle is really deployed at the moment, at which stops it is possible to change in a barrier-free way (or whether extra time is scheduled) or whether the particular connections, stops and stations are accessible to people with impaired mobility. Information about the accessibility of transport connections to wheelchair people is provided also by the IDOS search engine, which also specifies (as a pictogram) whether the vehicles are adapted to transport wheelchair people and whether they are equipped with lifting platforms to facilitate the getting on and off. As for the railway transport, the principles of accessibility of trains to people with reduced mobility and orientation are defined by the EU railway interoperability technical specifications. Czech transport operators have introduced a reservation system allowing people with special needs to book travel assistance.

Deaf and hearing-impaired people represent another group of people with specific needs. People with hearing problems have the possibility to search the Internet for basic information about their trip before they start travelling. Problems, however, occur in case of unexpected changes happening right before the journey or during it. Hearing-related handicaps are not visible at the first sight, which makes other people suppose that while travelling, the deaf and hearing-impaired people will react as it is common for the majority population, meaning that they will react appropriately when given voice information about, for example, the change of the train departure track, train delay or cancellation, diversion of the regular route, replacement of transport means, etc. Visual digital information systems informing not only about planned arrivals and departures but also about all extraordinary changes in transport represent an appropriate solution for deaf and hearing-impaired people, and these devices are useful also for people without hearing problems. Unless the person asked to help explain the situation knows how to use the sign language, they can find it difficult to communicate with a hearing-impaired person. People with hearing impairment do not react to sound stimuli and express themselves in way that it is difficult to understand and may therefore sometimes be taken for people with a mental health issue or can be confused with an intoxicated person (who is having problems to express themselves). This represents a possible cause of misunderstandings and results, quite often, in a situation when the majority population, not having been properly educated, turns away from people with hearing impairments in need of help. Information and communication technologies bring new possibilities to deaf and hearing-impaired people. Applications able to transcribe the everyday conversation in real time have already been introduced on the market. The organization of public transport should therefore carefully provide with verified up-to-date information about visual basis.

The Ministry of Transport has published, on its website (in the section dedicated to international bus transport) a methodological document helping bus drivers approach to passengers with specific needs.

3.1.4 Railway Transport

The Czech Republic started to develop, in frame of the *European Rail Traffic Management System,* various systems allowing to enhance interoperability on all lines of the European Rail System, and, particularly, on lines included in the TEN-T network. The technical aspect of the ITS interoperability, in accordance with the European legislation (i.e. mainly technical specifications enabling the interoperability of signaling, control and train protection systems) resides mainly in the implementation of the ERTMS/ETCS, level 2 (interim priority for international corridors) and of the mobile radio network providing for the ERTMS/GSM-R (*Global System for Mobile Communication – Railways)* voice and data services according to the ERTMS National Implementation Plan. The ERTMS implementation will entail not only a significant increase of safety standards (i.e. the reduction of human errors such as one of the main causes of accidents) but, as soon as it will have completely replaced the current national signaling, control and train protection system, it will be possible to consider, as soon as convenient control equipment has been designed and linked to the new technology, a possible increase of the capacity of relevant sections of the railway network.

The term “railway traffic control” refers mainly to the process of giving instructions (this is done by station inspectors or train dispatchers, for example), concerning the desired characteristics of the driving (such as speed), to the train driver. These instructions are given by the means of traffic route signals operated through the control and signaling equipment. Station inspectors and train dispatchers are informed about the current traffic situation at their station and at adjoining track sections. The train speed increase taken into consideration, it is necessary that the station inspectors and train dispatchers at particular operating points (such as stations and passing or branching-off operating points) be informed about the current situation on a segment of tracks exceeding the length of currently defined sections. This is the reason why new Central Dispatching Units for the Remote Train Traffic Control have been established in the so called controlled areas of selected lines, specifically in Prague (for the Bohemia region) and in Přerov (for the Moravia and Silesia regions). Furthermore, other Regional Dispatching Units were established for the remaining segment of the railway network. Dispatchers control the traffic at the particular segment of controlled area, commanding remotely the control and signaling equipment at both the stations and on the tracks.

As for the international railway freight transport, it has to be said that transport of goods represents a very complicated process from the technical, technological as well as legal point of view. This complicated character is due to issues related to relationship between the consignor and the consignee, to long transport distances and, as a result of this, long keeping of the goods by the rail, and to great number of subjects participating in the transport process (and complex relationships between them).

Various measures related to railway transport were thus introduced in frame of the EU’s effort to remove the obstacles to free movement of goods and persons within the Single European Railway Area. The current routine in international railway transport still consist of technical check-ups of vehicles, check-ups of the current state of transported cargo, administrative checks of the documents accompanying the train or, eventually, border and customs control, carried out when the vehicles, cargo or passengers cross the national state borders in designated exchange or border crossing points. The railway system, furthermore, is specific with respect to the, in many cases, prevailing changing locomotive and crew on the border. The implementation of the EU legislation entails a transfer of the system of unitary national railway administrations (national railway companies playing the role of both railway operator and passenger and freight operator) to a system of independent railway infrastructure operators and railway operators. Except for the aforementioned transformation of the railway sector, further measures have been taken to enlarge the supply of technology providers. This approach, on the European level, aims at approaching the railway transport to the road transport in the sense of the elimination of obstacles related to crossing of the borders (crossing the border on a road is highly noticeable). This is not yet possible in railway transport because individual railway infrastructures and operational procedures set by individual rail operators are not compatible at the moment: in many cases, therefore, locomotives and train crews have to be changed on the borders of the EU member states. The desired state of railway transport adjustments is the existence of an interoperable railway network on which any subject, meeting the defined characteristics, will be able to provide for railway transport.

The technical unification of information and communication systems used by various railway infrastructure operators and railway operators and the cross-border continuity of information services represent the key factor enabling to ensure the quality of planning, administration and provision of services in frame of both national and international railway transport with respect to technical specifications concerning the interoperability in the area of telematics in both passenger and freight rail transport within the EU railway system.

The rules governing technical harmonization are issued by the European Commission in the form of the so called Technical Specifications for Interoperability (TSI), applicable for relevant subsystems of the EU railway system. The conventional railway system is concerned by the following TSIs: 1) rail vehicles – freight wagons, 2) rail vehicles – locomotives and rail vehicles for passenger transport, 3) rail vehicles – noise, 4) infrastructure, 5) energy, 6) track and on-board control and safety equipment, 7) operation and traffic control, 8) telematics applications in freight transport, 9) telematics application in passenger transport, 10) maintenance, 11) accessibility to people with reduced mobility or orientation, 12) safety in railway tunnels.

The implementation of telematic applications, on the EU level, is governed by the TSI-TAF (Technical Specifications for Interoperability for Telematics Applications for Freight Transport) and by the TSI-TAP (Technical Specifications for Interoperability for Telematic Applications for Passenger Transport). These documents define selected processes and information connections between the operators and infrastructure administrators, among individual operators and, to a certain extent, among infrastructure administrators themselves. This includes, except for railway capacity reservations, also the monitoring of actual traffic situation. The goal, in freight transport, is mainly to increase the transport's reliability, to reduce the costs and to improve monitoring of both the vehicles (as the operator's propriety) and transported goods. In the passenger transport area, the goal is mainly to facilitate the cooperation (i.e. remove technical obstacles) during the check-in, to better inform the passengers and to enhance the interconnectivity among individual transport modes.

3.1.4.1 Railway Operator

In the Czech Republic, there is a total of 9 459 km state-owned railway lines and 106 km railway lines owned by other proprietors, such as the Jindřichohradecké místní dráhy, a.s. (a local railway located in the Southern Bohemian region) or the Alliance of Communities of the Valley of the Desná river. The state-owned railway is administered by the Railway Infrastructure Administration, state organization. This administration also operates the lines. The above calculations do not cover industrial tracks, the Railway Research Institute test lines (the Test Centre Velim test lines) and the Prague underground, which has the status of a special railway. Tram lines and cableways do not fall under the jurisdiction of the Act on Railways, along with yet other lines, such as mine or industrial railways. Most of the industrial tracks are owned by companies that are using them and operated by the owner itself or by a subcontractor. Some companies specialize in operating the industrial tracks and the law also allows the Railway Infrastructure Administration to provide for this type of services.

In the Czech Republic's railway network, numerous information and control applications are used or ready to be used, such as the DIS (Dispatching System for Railway Traffic

Control), a traffic control support system for the railway administrator, the so called the Graphical and Technological Layer (GTN), the Automatic Train Route Setting (ASVC), the Automatic Train Operation system (ATO), devices allowing to find the optimal time itinerary, information systems for passengers, information about trains and delays, monitoring the train location through the GNSS, radio block, devices measuring fuel consumption of the traction wagons, the “actively detached train” application, etc.

The Information System for the Operative Control of the Railway Transport (ISOŘ) is one of the tools used by the railway operator.

The Dispatching System for Railway Traffic Control (DIS) is composed of subsystems working in real time and concentrating on collecting primary data, presenting and assessing results related to railway traffic control and providing and processing of data used in performance statistics. Primary data are provided by railway stations, rail vehicles depots, dispatcher railway traffic control centers and other specialized operational units.

In order to keep the railway in a good working condition, the Railway Infrastructure Administration has a number of applications and passports gathering information about the state of particular segments of the line (i.e. the track itself, the track substructure, power supply system, feed lines and information, signaling and control technologies). Data on the working condition of the railway are collected by local administration units, on the scale of the entire network and with help of technical diagnostic tools (diagnostic units, etc.).

Another type of technologies is used to detect serious defects of currently operating rail vehicles, such as hot axle box detector (seized bearings, twisted pivots, derailment), dynamic shocks (track fraction, destruction of parts of switches, etc.). The above defects put the safety of the railway transport in serious danger and cause, each year, great damages on the railway infrastructure and on the vehicles.

Information systems for passengers and operators represent a special area.

The Graphical and Technological Layer (GTN) is a computer application designed to back up the traffic-related processes on the defined segment of the railway network. It can be characterized as a superstructure over the control system equipped with the train numbers transfer. It is preferentially used on lines with remote traffic control equipment.

The automatic train route setting system (ASVC) analyses eventual conflicting train schedules (e.g. optimizes train routes by preventing functionless delays, eliminates risks ran by pedestrians while crossing one-level crossings between the platforms) and tries to define the decisive moment to set the train route. It applies an intelligent algorithm allowing to automatically set the train routes and assesses the proposed route alternatives. ASVC fully substitutes the system of remote train traffic control carried out by the dispatchers from a particular location.

The automatic train operation system (ATO) automatically controls speed, regulates the traction and switches on automated breaking in the destination in order to bring down the number of routine tasks carried out by the driver. At the same time, it automatically controls compliance with the time schedule and optimizes the functioning of the train.

Today, however, it needs to be pointed out that in most cases, these applications are not interconnected and that each of them represents, in fact, a closed system.

3.1.4.2 Railway Passenger Transport Operator

In order to become a rail operator in the Czech Republic (both on the national and regional train lines), a company needs to have a valid license, operator certificate and have entered into agreement with the railway administrator. The RegioJet a.s., LEO Express, a.s., ARRIVA TRANSPORT ČESKÁ REPUBLIKA a.s. or Jindřichohradecké místní dráhy, a.s. are examples of private companies providing passenger with railway transport services in the Czech Republic. The České dráhy, a.s. (ČD/Czech Railways) is the biggest national operator, providing both national and international passenger with railway transport.

The Czech Railways have created systems able to provide with more up-to-date information about the movement, current situation and occupancy of the vehicles in service. The DISOD (passenger transport control) system, for example, has been designed to display the current location of the vehicle according to GPS coordinates and to help the operator's dispatcher react to extraordinary events, such as long and short term line closures, and minimize so the impact that these events have on passengers. The DISOD passenger transport control system has been developed to be able to communicate to both integrated transport systems and with the particular infrastructure operator. Vehicles are furthermore able to, except for the GSM-R communication, send information about their state into the systems governing the fleet administration and active vehicle detachment from traffic. Vehicles are equipped with mobile audio-visual information systems (MAVIS) that are able to inform about the current speed of the vehicle, incidents, train schedule or the next station, which is announced with respect to the current location of the train as defined by the GPS system. The ITS include also the system of Automatic filling stations evidence (EVITA): information about filling activities at the automatic filling stations placed in railway vehicle depots is matched with the information concerning the particular employee and their filling activities. Passenger ticketing service is currently facilitated by the semi-online portable personal registers (POP), used mainly as a device enabling the train conductor to sell tickets and carry out the check-in or as an information channel, providing with information concerning line closures or extraordinary events. When checking the validity of the inland travel documents (tickets), the conductor may control the tickets with the help of a 2D (QR) code, which makes it possible to count the number of passengers.

3.1.4.3 Railway Freight Transport Operator

The ČD Cargo, a.s. company has continuously been developing or, alternatively, updating its information systems to make their processes and functionalities comply with the requirements of the technical specifications for the interoperability of the subsystems for telematic applications in freight transport within the Trans-European conventional railway system (TSI-TAF).

The Upgrade IS was the most important project, introducing the DISC freight transport dispatching on system functioning the basis of online communication with the systems used by the infrastructure administrator (concerns the long-term timetable in graphic mode) forecasting the train journey in relation to its preparation and train composition or train's journey abroad carried out within the Operational and Informational system (PRIS). The ICAR system, furthermore, helps streamline the activities carried out by the operator, collects and assesses data on current restrictions on the infrastructure or on forecasts issued by infrastructure administrators. A new system (KNV) was created to ensure the compatibility with the WIMO (Wagon and Intermodal Operations Database) project, administering a register of data on cargo wagons. Other important implemented systems are: the TMS, allowing to narrow down the ETI and ETA reports during the process of takeover and handover of trains to other operators and to adapt and expand the model with the electronic consignment note that will be used not only for the purposes of inland transport but also for international transport. The rail traction units were equipped with devices for mobile voice and data communication in frame of the GSM-R.

Information systems allowing to support the railway freight transport according to the TSI-TAF requirements were introduced out also by other freight operators, such as AWT Doprava, a.s. or UNIPETROL DOPRAVA, s.r.o.

The systems enumerated in the last two sub-chapters are used by the owner and operator of the railway, i.e. an organization providing with a high quality, safe railway transport route. Rail traffic management and control is a very complex and specific problem, which is why it needs to be supported by ITS technologies. Attention is currently paid mostly to technological equipment of the railway network meanwhile it is necessary to pay strategic attention to equipping the rail vehicles (this needs to be done in well argued cases and on the non-discriminatory basis). Attention needs to be paid also to systems used by the operators. The Operational Programme Transport 2014-2020 is well aware of this, aiming to meet the requirements set by the TSI-TAF and the TSI-TAP or, alternatively, of all TSIs adopted in future.

3.1.5 Freight Transport Logistic

ITS systems have been serving well in freight transport as well. In this area, these systems are usually represented by systems used by individual companies, which means that the state can influence them mainly through research, development and innovations, standardization and legislation meanwhile it does not interfere in the operative management of freight transport itself, with the only exception of cases when the continuity of the traffic flow or the safety of population could be jeopardized. Such cases include mainly the exceptional load and exceptional size load transports, transport of dangerous items transported in line with the ADR/RID agreement and transports of weapons, ammunition and explosives.

The issues related to the process of increasing the efficiency of logistic chains (mainly the visibility of the movement of goods of individual business partners) is closely related with ITS these days and the “Internet of things” might, in future, even accelerate the integration of data from individual sensors into the logistic information systems.

If there is an accident involving dangerous substances on the territory of the Czech Republic, the Fire Rescue Services of the Czech Republic as operational centers of the Integrated Rescue System may ask for help from the Transport Information and Accident System (TRINS), which may provide with advice or practical assistance with the elimination of an incident with the aim to mitigate its impact as much as possible. Three levels of assistance are provided: **level 1** (questions and consultations by phone, including national and international exercises), **level 2** (sending an expert to the place of intervention), **level 3** (technical assistance).

With respect to the above, it needs to be pointed out that on 1st July 2014, an amendment of the Act No. 170/2013 Coll. on weapons and ammunition entered into effect. According to this amendment, any vehicle transporting a specified amount of weapons or ammunition has to be continuously tracked. Any such transport has to be reported to the Police of the Czech Republic through a specialized application. The subject responsible for the particular transport logs into this application on the basis of an form approved by the Police of the Czech Republic. The subject has the obligation to equip the vehicle with a non-stop tracking system (GNSS navigation systems). The subject responsible for the transport (using its own vehicle or a vehicle provided by a subcontractor) has to comply with the defined technical parameters and it's up to them what kind of product they choose to use. Each 15 minutes, the vehicle unit sends information about its current location to the portal of the “Transport Manager” Presidium of the Police of the Czech Republic. It is recommended that data be transmitted in a secured mode.

The GNSS, along with the data transfers through the GSM networks, represents a logical solution allowing to ensure security for a “reasonable price” for any kind of dangerous transports, not only weapons and ammunition. In Italy, for example, dangerous transports GNSS tracking has already been implemented.

3.1.6 Inland Navigation

The river information services (RIS) were established and have been developing according to the Directive 2005/44/EC of the European Parliament and of the Council on harmonized river information services (RIS) on inland waterways in the Community and according to the related EC regulation on the main directions of the RIS. Administration of the system is delegated to the State Navigation Administration and investment activities related to the development of the system are administered mainly by the Directorate of Waterways of the Czech Republic. The Elbe-Moldau Waterway Information System (LAVDIS), operating the RIS, is at its full functionality. It has been implemented by the Directorate of Waterways of the Czech Republic (ŘVC ČR) and the State Navigation Administration (SPS). The Elbe-Moldau Waterway information system is a modular system. Next to the basic general information, it provides, for example, with meteorological information, information about current level of water, footage on the state of selected important objects, information to shipmasters on the state of the waterway. The Elbe-Moldau Waterway Information System also includes a map portal with both online and offline electronic digital navigation plans drawn according to the national model and in the Electronic Chart Display and Information System for Inland Navigation (ECDIS). The Elbe-Moldau Waterway Information System was created and elaborated between 2007 – 2014, also in frame of international projects and operational programmes. Between 2009 and 2011, it implemented, in frame of the IRIS Europe project, services aiming at the collection of statistical and dynamic data on the waterway, monitoring of the location of vessels and freight and wireless access to the RIS at points important for navigation. Furthermore, a Differential Global Positioning System station for the GPS satellite navigation system was established in Obříství.

Activities around the IRIS Europe III international project concentrated on increasing the quality of the already introduced services and on implementing, as pilot projects, transport information services and information services for logistics and administrations. The Automatic Identification System (AIS) allowing to track the vessels was introduced (it gives information about the vessel's location, about the navigation direction and speed, about the type of vessel, about the cargo, target port, etc.). This system is based on the radio waves technology, the vessels being equipped with transponders. RIS dispatchers monitor the movement of the vessels and these records may be used to solve potential accidents or extraordinary events that need to be handled through crisis management. The Czech Republic established a pilot project introducing 2 ground-based AIS stations. The other crucial aspect is equipping a hundred vessels by the AIS board units complying with the International Maritime Organization standards, including the electronic navigation plans viewers used within the Electronic Chart Display and Information System for Inland Navigation (ECDIS).

Other features implemented in frame of the IRIS Europe III project are advanced modeling and locking management of the Prague Smíchov lock chamber, meteorological conditions modeling and statistics assessment.

River Information Services operating on waterways have the character of a public service provided to users mainly with the aim to guarantee the safety and continuous traffic. The Directive 2005/44/EC of the European Parliament and of the Council on harmonized river information services (RIS) on inland waterways in the Community of the 7th September 2005 stipulates the necessity to provide with a high-quality RIS services on the Elbe-Moldau waterway, on the IV and higher categories segments. This implies also an obligation to guarantee a proper functioning of the ECDIS system that needs to get reliable and accurate location data (which is done through the satellite navigation system). The data collection and measuring is provided by the Elbe River Basin Administration, state enterprise, by the means of the *Střekov* measuring vessel. This vessel is equipped with all necessary devices, such as the software allowing to record the measurements in real time while using the current measurement technology (hardware), and the HyPOS, HyMAS and HyDAK software. The vessel is able to gather information about the depth of channel, searches for obstacles, checks the sediments and defines where the riverbed needs to be adjusted. The Elbe River Basin Administration, state enterprise, is also required, in frame of operating and maintaining the systems, to guarantee proper functioning and updating of the navigation levels model. The transfer of the final data from the navigation levels model into the ECDIS and its utilization in the LAVDIS web environment is carried out by the State Navigation Administration. The State Navigation Administration, furthermore, guarantees the overall functioning of the system and distribution of the information to ship masters, provides for access to the RIS services through the WiFi connection and ensures the pilot realization of the operations according to the technical and administrative agreement on the data exchange between the European RIS systems (ELWIS, RoRIS, DoRIS, SlovRIS, etc.).

The system of navigation plans in the ECDIS format makes it possible to consider the current and modeled depths of the navigation channel and help thus the ship master define the needed usable draught and the optimal load of the vessel, meanwhile preventing the vessel from being damaged or stuck even in a situation in which other vessels, not equipped with this system, are not able to navigate or able to use a 100% of their transport capacity. Using modern technologies makes it possible to track, into detail, the movement of vessels on European waterways and record when they cross national state borders. At the same time, this technologies make it possible to improve the provision of information services to ship masters who will thus gain a better access to thorough and up-to-date information. In order to connect to RIS system, the vessels may use the WiFi connection because transmitters have been placed at important spots.

The introduction of the new system will enhance the efficiency and safety of traffic on waterways. The reliability and accessibility of the services is planned to be even increased in future. It is also planned to increase the number of the AIS ground-based stations, broadening the network to the entire TEN-T waterway, and to implement the tools allowing to solve emergencies according to Calamity Abatement standards, including the dangerous transports tracking with the transfer to the Integrated Rescue System. It would be good to gradually interlink the waterway information systems with other transports information systems. This would allow to prevent the need to insert information about the transport two times. It is supposed that the RIS development trend will be going on, mainly with respect to the possible revision of the Directive 2005/44/EC of the European Parliament and of the Council on harmonized river information services (RIS) on inland waterways in the Community.

3.1.7 Air Transport

The “Radio-telephone/traffic information centre connection” project was launched in 2012. Sport aircraft pilots will be offered the tools to use assigned frequencies to immediately transfer information about transport problems, about tailbacks, accidents and about fires and other emergencies. The project should be going on until 2022.

The area (also random) navigation (RNAV) makes it possible to conduct aircraft along any desired flight route through any desired navigation points, not only along the radials and bearings within the radius of ground-based navigation devices.

It is possible to locate the airplane not only by regular navigation devices or satellites (through the navigation sensors) used nowadays (i.e. all current and future satellite navigation systems such as the GPS, GLONASS, Galileo, etc.). The currently used European EGNOS system is able to make more accurate the location information provided by the GPS.

The 2nd of May, 2013, new departure and arrival routes for regional airports were published, using the satellite navigation and requiring the airplanes to be equipped according to the Performance Based Navigation (PBN) standard, the RNAS-1 specification. This new routes implementation represented one step of the ongoing PBN implementation in the Czech Republic. New routes make it possible to use the air space around regional airports more efficiently and they also respect, to a large extent, noise-sensitive area around the airports. During 2013, terminal services projects for the Brno and Ostrava airports using EGNOS European satellite system were being elaborated. They were published at the end of 2013 and entered into effect in January 2014. The EGNOS system allows to increase the accuracy of the approach (under 1,5 m with a 99% likehood) and, in the overall perspective, leads to a great increase in the air navigation safety and improves access to airports in aggravated meteorological conditions, mainly with respect to approach of airplanes not equipped with the ILS system. This project has been partially financed from the ACCEPTA.

The conception of the Czech Republic navigation environment is more thoroughly described in the AIP A 1/12 aeronautical information broadsheet. This conception is based on the „ECAC Navigation Strategy and Implementation Plan“ published by the Eurocontrol.

The Prague Airport corporation introduced, in the Václav Havel Prague Airport, the TEVOGS (TECHNISERV Vehicle Onboard) system with the aim to increase the safety of service (road) vehicles operating on the airport and to prevent possible collision with aircrafts or construction obstacles. This system uses satellite navigation and the WiMAX technology to communicate and transfer the data while using the information about both air traffic and the traffic at the airport. This system is able to inform the drivers, by alerting them visually, that they are approaching a forbidden area, closed because of construction works or other-type closure. In case of a disruption of the runway, the driver is informed by a sound signal. The qualities of the TE-VOGS system become even more apparent in extreme climatic conditions (poor visibility, for example) or in case of other extraordinary circumstances, such as large construction projects going on.

3.1.8 Spatial Data

It is not possible to make competent decisions on the development of the transport infrastructure development and management without the knowledge of descriptive (attributive) information about transport and without knowing how this information is related to particular areas (e.g. receiving an information about traffic accidents is worthy only under the condition that it is concretely located on the infrastructure; it is only worthy to increase the capacity of a transport infrastructure on the basis of a previous analysis of the particular infrastructure usage in specific segments and in specific times). The quality of the traffic organization depends directly on the quality of descriptive information about the traffic, relations in the given area and about the quality of spatial data (i.e. maps).

The Ministry of Transport is the owner of the Unified Transport Vector Map system, which integrates and publishes vector transport-related data. The system is based on the ZABAGED® national map database, frequently used for supporting the agenda of regional and municipal administrations and as an information source used by professions needing this type of information (this mainly applies to a particular tool used for analysis the accident rate in a particular territory, which is operated in cooperation with the Police of the Czech Republic). The Unified Transport Vector Map, however, is currently neither appropriately operated nor developed, for lack of financial means. The Ministry of Transport has been broadening the portfolio of spatial data accessible on the Internet in frame of the implementation of the INSPIRE system (mainly through the National INSPIRE Geoportal).

The Ministry of Transport implements the INSPIRE in close cooperation with the Czech Environmental Information Agency (CENIA), founded by the Ministry of Environment and coordinating the implementation of the relevant Directive on the Czech Republic territory, and with the State Administration of Land Surveying and Cadastre, playing also an important role in the process of the implementation of the Directive. The INSPIRE guarantees the basic compatibility of spatial data in frame of the EU. In order to properly develop the ITS, it will be necessary to adopt the descriptions of objects depicted in spatial data sets (digital maps) to the needs and requirements of the users. The Spatial Data Infrastructure (SDI) related to transport is very fragmented. Each organization subordinated to the Ministry of Transport uses its own system, created to its needs. These systems are not interconnected with the systems of other organizations, which results in their incompatibility. The goal, therefore, is to interlink these systems in a way that would make it possible not only to use data provided by them transversally, across the Ministry of Transport subordinated organizations and the Ministry of Transport itself, but also as the source data for other public administrations bodies and as services offered by the public administrations. Services and applications developed in frame of the Unified Transport Vector Map should become an integral part of the Ministry of Transport Spatial Data Infrastructure. The problem of system incompatibility could be solved by implementing an integration platform including all the existing spatial data administration systems used in the area of traffic management.

The knowledge of the spatial (territorial) context of monitored phenomena represents the basic condition to coordinate the ITS and the functioning of their applications. It is, therefore, necessary to create such spatial data infrastructure that will include appropriately described spatial data of needed quality and scope and that will be able to provide with these data in a convenient format so they can be used in the ITS.

The State Administration of Land Surveying and Cadastre (ČUZK) is responsible for the creation of the national map work (the basic as well as specialized works) and for the elementary basis of geographic data (ZABAGED®), which represents the basic pillar of all information systems based on the principle of georeferencing (i.e. systems working with location and territorial relations).

3.1.9 ITS Deployment by Regions and Statutory Towns

ITS systems have been developed also on the level of Czech Republic regional administrations and by large statutory towns such as Brno, Karlovy Vary, Liberec, Olomouc, Prague, Ostrava, Pilsen, Ústí nad Labem, Zlín, ensuring functions related to safety and traffic control, public passenger transport management, management and safety of municipal tunnel constructions, monitoring the traffic to make sure laws are not infringed (this concerns, for example, respecting the speed limit or jumping a red light). They also provide information to drivers and passengers. Since the ITS development by the regional and municipal authorities does not fall under the competency of the Ministry of Transport, the ITS AP document will not further elaborate on this issue.

3.1.10 Social Significance of the ITS Implementation

3.1.10.1 Reducing the Social Costs of Transport through the ITS Implementation

Next to a whole range of indisputable benefits, the transport also has some negative impact (created by all t transport modes). As for the negative impact of the road transport, it is mainly the noise, irregularities of the traffic flow or increased consumption of the fuel resulting in an increase of emissions.

ITS may reduce the burden of this negative impact on citizens and environment. A driver, for example, has a certain chance to bypass the traffic jam and, therefore, cut down the time loss concerning them, their passengers or transported goods and make sure the goods are delivered in time. The development of information systems based on the ITS that are able to inform the drivers about congestions on their route will bring down the external impact and costs of road transport. The introduction of automatic vehicles (in quite a near future) will significantly help to increase the continuity of the road and railway traffic flow and to develop the largest possible scope of transport in the particular segment and particular time period with respect to given conditions (technical equipment on transport network), manageable in a continuous and long-term perspective.

Accidents represent another serious negative impact of transport. It is very difficult and problematic to quantify the consequences of accidents, mainly the loss of human lives, which it is very difficult to express from the ethical and sentimental point of view and with respect to losses as perceived by victims' families. It is therefore rather a philosophical than economic question to quantify the cost of a human life lost during an accident. The Transport Research Centre, however, thoroughly analyzed a number of accidents and quantified an average price of a human life lost in an accident as 18.5 million CZK, meanwhile pointing out that from the ethical and human point of view, the price of a human life may not be quantified. The calculation was based on the following criteria: immediate damages on vehicles and road infrastructure, cost of intervening medical staff, fire rescue staff and police, insurance companies costs, legal costs, losses that the deceased would produce during the rest of their life for the benefit of the society, taxes that they would pay as well as widow and orphan pensions. The Transport Research Centre has furthermore found out that the average cost per badly wounded person is 4.8 million CZK and per slightly injured person 0.5 million CZK. An accident with no injuries costs, on average, 0.23 million CZK (material damages). The health care costs, calculated per accident, amount to 1,356,212 CZK. The police intervention per accident amounts, on average, to 13,507 CZK. As for the intervention of fire brigade, it is not possible to calculate the costs exactly because it is not only the Fire Rescue Service of the Czech Republic units that intervene on the place of the accident but also corporate fire brigade (such as the Fire Rescue Services of the Railway Infrastructure Administration), local voluntary fire units and other fire units. When we compare the ratio of the annual budget of the Fire Rescue Services of the Czech Republic to the number of interventions in case of emergencies, supposing that not all the costs of the Fire Rescue Services of the Czech Republic result from interventions at emergencies, than the average cost per emergency would be calculated as 71,410 CZK. The Transport Research Centre furthermore defined that insurance companies pay, on average, 352,337 CZK on insurance indemnities per accident.

According to estimates, each 30th accident in the Czech Republic road network per year involves death or serious injury. On the IInd and IIIth class roads outside urban areas, it is even each 3rd accident. In 2013, the Police registered 13,454 cases of (i.e. 15.9% of the total of accidents) of hit-and-run accidents during which 17 persons were killed and 815 injured. The total of economic losses incurred as a result of traffic accidents in the Czech Republic amounts to 33 - 35 billion CZK.

Substantial damages of the road infrastructure also result from the lack of respect of height or weight limits. Exceeding the axle load limits by vehicles in the HGV (heavy goods vehicles) category represents one of the main causes of damages on the road infrastructure and results in an increase of costs for the infrastructure repairs, including auxiliary constructions and bridges. Overloaded vehicles also jeopardize the safety of road traffic, doing this not only by creating ruts and potholes but also by running a higher risk of defects. The drive ability and safety of a vehicle drop substantially when it is overloaded: the breaking system is overloaded and the stability of the vehicle decreases, mainly if the centre of gravity is relocated higher above the ground. A 175tons generator was transported, for example, from the Škoda Plzeň plant in July 2008. During this transport, an accident occurred in Vítov in the region of Central Bohemia. The total cost of the accident amounted to nearly 110 million CZK, concerning both the road network and damaged cargo.

Exceptional load transports and exceptional dimensions load transports represent another risk factor jeopardizing the safety and continuity of road traffic. The 12 October 2011, for example, the traffic on the D1 motorway nearby Ostrava, at the direction of Bohumín, was paralyzed by the accident of an exceptional load carrying vehicle that got stuck under a bridge. In order to remove the vehicle, traffic on the particular segment of the motorway had to be stopped in both directions as well as on the bridge (connecting t Ostrava and Opava) under which the vehicle got stuck. The traffic diversion lead to a traffic collapse in Ostrava. The state of the above mentioned bridge had to be assessed by a structural engineer in order to rule out the possibility of damage by the impact of the vehicle. Or, on the 7th June 2012, the Police of the Czech Republic retained a transport of a generator of exceptional dimensions (94 t) that was not properly registered and, therefore, travelled without permission. Despite this lack of permission, the foreign transporter transported this exceptional load and exceptional dimensions load. The vehicle was checked: its weight was 170 t and the axle load per axle was around 16 t to 17 t. The vehicle was overloaded by incredible 120 t.

A traffic accident is an unanticipated collision of one or more vehicles resulting in material damages and injury or loss of human lives. The probability of the occurrence of an accident is the highest in road transport. Accidents occur also during railway, waterway or air transport. These types of transport, however, have a higher level of safety than the road transport, which is due to the fact that in these types of transport, each vehicle is tracked and has a safety backup by a safety system.

Despite the effort to equip the Czech railway network with safety devices, 84 lines are run without safety devices, through the so called simplified train operation control. The regional railway line Číčenice – Volary is one of them and three serious accidents with grave consequences occurred there during the last ten years.

The first, most tragic train collision took place on 22 July 2004, between the Bavorov and Strunkovice nad Blanicí stations. It was a frontal collision of two passenger trains. Two passengers were killed and 33 injured. The damages amounted to nearly 3.9 million CZK. This accident was caused by non-authorized train departure from the Bavorov station: the engine driver did not wait for the dispatcher's approval to leave the station.

The 1st July 2007, there was another frontal collision between two passenger trains in the Vodňany – Bavorov segment of the rail line. The total material damage on the train amounted to nearly 140,000 CZK. This accident, again, was caused by an unauthorized departure from the Bavorov station. 7 passengers were severely injured and 5 passengers and 1 railway employee suffered minor injuries.

On the 2nd February 2011, there was another frontal collision of a passenger and freight train between the Číčenice station and the Vodňany train movement operating control point. Again, this accident had tragic consequences: 1 passenger was killed, 6 severely injured and 4 suffered minor injuries. The collision caused 4 accidents at work and 1 severe accident at work, suffered by operator's employees. The total damages resulting from the accident amounted to a total of 6.8 million CZK. This accident, too, was caused by human error: one of the train drivers badly assessed the operational situation.

The total amount of material damages of the three above described accidents amounted to 10.8 million CZK. As for the social costs, covered by the public sector, it is possible to conclude, that according to the Transport Research Centre methodology, they amounted around 300 million CZK (meanwhile this number may not represent to final sum).

The Railway Safety Inspection, having analyzed these accidents, issued the following recommendation: *"...to install, on lines with simplified train operation control, technical (safety) equipment that would rule out the chances of possible eventual human error in order to improve the safety of the rail and railway transport and to prevent serious accidents and dangers in railway transport, mainly unauthorized departures of trains from the operating points. This measure should be preferentially applied to the Číčenice – Volary line segment because three serious accidents have taken place there recently and because of the high intensity of traffic on this line."*

The expected price of the installation of the above mentioned security device (working on the GNSS basis) would be, on this line, approximately 50 million CZK, which is six times less than the damages incurred as a result of accidents during the last 10 years.

The problem of unauthorized train departures from operating points does not, however, concern only the Číčenice – Volary segment but also other lines in the Czech Republic where the simplified train operation control system is used or where the lines are not equipped with the line safety and signaling system, which means that there is a threat of human error and train collision.

Serious accidents can also be caused by technical defects on railway lines or vehicles. On the 5th of May, 2012, for example, a four axle high sided freight train wagon, ranked as the 23rd behind the locomotive located in front of the train, derailed from the line and was pulled for another 1.1 km approximately, taking along another four similar wagons. At the moment the train was entering the Liběchov station at the point where the track branches, the first of the derailed wagons turned over. The freight-carrying wagon derailed as a result of a breaking of an axle of the wheelset, meanwhile the direct cause of the accident was the overheating of the axle bearing. This technical defect caused, except for the derailment of the freight-carrying wagons, also the destruction of the railway superstructure and of the contact system. The damage on vehicles and tracks amounted to 38.7 million CZK. Passengers travelling between Mělník and Štětí were provided, during the clearing the railway and repairs, with substitute (bus) transport. But, because of restrictions on the road network, substitute buses were delayed for as much as 40 minutes.

After this accident, the Railway Safety Inspection issued the following recommendation addressed to the operator of the track (Railway Infrastructure Administration, state-owned organization): *“...we recommend that on the national lines with intensive traffic, the diagnostic network be extended, as soon as possible, by diagnostic devices able to diagnose the temperatures of the railway vehicle bearings (such as temperatures of metal wheels and break discs or irregularities of wheel circumferences) in order to increase the chances that the defect be diagnosed on a moving railway vehicle and to notify, through the ROSA system, about eventual defects well in advance. Before this is done, it is recommended that the hot axle bearing temperatures limits should be reset.”*

3.1.10.2 Legal Liability of the Road ITS Operators

ITS technologies represent a great potential for further development of road transport, meanwhile the utilization of these technologies is currently limited by the fact that they represent, more or less, rather an information system, while the users, having been provided with the relevant information, have to decide themselves about their next step and are fully responsible for it. To take full advantage of the ITS potential to improve the security of the road traffic, it is necessary to consider also the question of reliable and secure cooperation of the ITS systems in vehicles and the ITS systems on the road network: any error while running either of the systems or while transmitting the information could result in putting in danger or even destroying human lives.

This is the basic classification of ITS-related legal liabilities:

1) Information and alert systems
These systems provide the driver with particular information, such as a warning pointing out to a critically small length gap between vehicles. They do not physically replace the driver in any activities, the driver keeping full control over the vehicle and being alerted to

carefully listen or read, meanwhile the goal is to help them drive safely and in line with the traffic rules. If an accident or a collision occurs after the device warned the driver and the driver forgets to react in the appropriate way, it means that they have probably violated their obligation to fully focus on driving. In such cases, the driver is responsible for the correct driving.

2) Information systems able to interfere with driving, the functions of which can be disregarded.

Potential liability of the driver for driving carelessly in cases where it is possible to disregard the instructions given by the system is to be defined on an individual basis. The important aspect is the functioning of the system itself (what kind of restrictions it has built in), whether the driver takes on not into account the system warning about possible consequences of these restrictions and acts accordingly and whether, under the same circumstances and in the same situation, a good driver could prevent the collision by not respecting the instructions given by the system. If a driver decides to buy a vehicle with a system the functions of which may be disregarded, they can run a new type of risk because buying such a vehicle, they take the responsibility to use the system's functions in an appropriate way. It is necessary to properly consider the level of information and warnings as described by the producer. When assessing whether the driver paid sufficient attention to driving, it is mainly the driver's ability to properly use the system that is evaluated, while respecting information and instructions given in the instructions for user manual. If case the vehicle does not function properly, the liability may be transferred to the producer, meanwhile it will be explored whether there is a causal relationship between the faulty functioning of the system and the traffic accident.

3) Information systems able to interfere with driving, the functions of which cannot be disregarded.

The ability of the driver to prevent an accident (vehicle collision, for example) is very important. If the driver does not have the chance to switch off or not to use the functions of a system influencing the way the vehicle is driven, then they are not liable for the breach of the rule stipulating that a driver needs to pay full attention to driving because the prerequisite of this rule is that the driver has a direct influence on their driving. If the driver is not able to switch the system off, the liability in case of an accident is transferred to the producer or seller of the device.

Malfunctioning of a safety system without warning and without a timely backup by alternative measures may result in serious injuries or great material damages. This means that the following must be guaranteed:

the provided service must comply with relevant parameters;
these parameters must be designed to fit relevant devices that are sold or available.

A great attention needs to be paid to the creation of relevant frameworks and procedures that would allow to make sure that no low-quality or non-functional components for security applications are introduced on the market. This is why it is necessary to make sure the ITS systems are highly reliable and technologically advanced, which will make it possible to prevent eventual damages and traffic accidents.

3.1.10.3 Legal Issues Concerning Processing and Sharing of Data in the Transport Systems Area

The “Big data” market segment has been developing rapidly. It comes up with new ways to process and analyze large volumes of data meanwhile it is necessary to point out that not only technical issues are to be dealt with in this area: the organizational and legal point of view must not be neglected.
When it comes to questions related to personal data and privacy protection in frame of the ITS applications and services, the solution is to minimize the collection of private data and to promote the anonymization of personal data. The ITS systems use information and communication technologies processing data. Organizations working in this field must be well aware of how they may or may not treat these data, mainly if they are of personal or business confidential character or if they are handed over to a third person. In cases in which data are handed over to third persons, it is necessary to clearly define which data are to be handed over, how they are regulated, what services are to be provided, what subject is going to measure the provided services (their volume, quality, etc.), how to define the guarantees and how to claim responsibility for possible defects.

In cases in which the data are going to be handled by a subcontractor, it is necessary for this subcontractor to submit a proof of its registered office (to be able to enforce the legal requirements, mainly outside the EU countries), to inform where the infrastructure processing the data is based and who controls it (because of the personal data protection, for example) and how the data technical protection system is set (because of, for example, possible release in case of administrative offence related to data leaks). Furthermore, it is necessary to define liability for damages and delay.

When handing over the data to third persons, the contract represents the main tool to protect the data. This is why, contracts governing data processing ought to include stipulations regulating mainly the following:

- scope of authorization to use the provided data: this is important when it comes to repeated utilization of the information gathered by the public sector
- protection of privacy and business confidentiality
- definition of principles governing the transmission of data to third persons
- definition of liabilities when obligations are not met by the third person
- setting guarantees for the provision of services (responsibilities for defects) and setting responsibilities for damages
- definition of the procedure to be followed to terminate the contract (a/consensual termination: agreement, termination by one party by agreement, by expiration or b/conflicting termination: termination by one party or c/termination by circumstances- insolvency).

In cases when a decision is made to cancel the contractual relation, it is necessary to define, both from a legal and factual perspective, how the data are to be returned and make sure that the parties will cooperate.

If the data are to be collected and created through the GNSS or GSM technologies, it is necessary to know the answers to the following:
- whether the data exist and are available
- do the data have a unified format and structure?
- are the data updated on a regular basis?

- the type and accessibility of the communication channel (delay caused by transmission and processing)
- consistency of the service (qualitative level of provided data)
- accessibility of the service

3.1.11 The Imperative to Set and Comply with Technical Norms, Standards and System Parameters while Defining the Procurement Policies

In order to efficiently coordinate the ITS implementation, it is necessary to clearly define the interfaces between the systems and their constituting parts, which, in turn allows to standardize the interfaces and open the market with interchangeable ITS equipment (i.e. equipment independent of the producer). This will ultimately influence not only the price of these systems (this concerns also the public procurement) but also their capacity to be used for other purposes (in connection to other applications), their compatibility and potential applicability in other systems.

The purpose of coordination is not to dictate what kinds of technologies are to be used but to define required technical systemic parameters and standardized interfaces and to make sure systems are compatible and ITS services may be offered on a continuous basis, across individual systems on local, regional, national or European level.

Procurement of ITS is complicated from the technological point of view: technical standards, therefore, play an important, unifying role. If public procurement orders are placed without requiring that ITS-related norms and standards be complied with, supplied solutions are not compatible. It is desirable to use open standards that will limit future costs for connecting incompatible systems. Defining open standards also helps to prevent the restriction of competition to just some providers, or even the “monopolization” of future deliveries, as a result of which the public procurer may be offered better contractual terms.

As for the terms and conditions of contracts, the contracting party ought to reserve sufficient rights to obtain, after the termination of the contract, further fulfillment from another provider. When entering into agreements on provision and administration of information systems, it is necessary to reserve sufficient rights to created SW.

If public procurement authorities open one tendering procedure for both construction and technological aspect (ITS) of transport construction and the lowest price is the main criterion, it is possible that a bid is opted for the price of which reflects the prevailing part of the project (i.e. construction works). This means that it is virtually impossible for even the most advantageous ITS bids (no matter whether the price or other, investor-defined parameters are taken into consideration) cannot be winning in case they are connected with the less advantageous overall offer. This is why norms and standards have been created to govern the ITS purchases that are not legally binding but that guarantee a high quality of delivered ITS systems as well as their interoperability. It should therefore be consistently required that the norms governing the purchases of ITS in frame of public procurement for transport construction be respected in cases when the delivery of ITS represents a part of the procurement.

As mentioned in chapter 4.2, the ITS provider is bound to use only those components of ITS that comply with the specifications as given by the EU Official Journal and provide the ITS services only in a way that responds to these specifications. If the relevant specification says so, only such ITS components may be introduced on the market for which the conformity assessment or suitability for use procedure or has been put in place, respecting the above specification. Principles governing the creation of the EC specifications for the introduction and operational use of the ITS in case of priority actions are set in the Annex II to Directive 40/2010 on ITS.

If this requirement is not complied with that, the procedure can result in creation of future increased (hidden) costs for interlinking incompatible ITS. It is even possible that if requirements and norms are not defined, systems may neither be administered nor developed by a subject other than the original supplier because the technologies developed by other suppliers do not cooperate with the original system. A similar situation may occur in cases when the tendering documentation does not clearly define the way of communication or interfaces with the devices currently used with the investor the technical parameters of which are not aligned with standards.

Another way to proceed, except for undergoing formal and time consuming procedures defined by the national and international norm defining bodies (in the Czech Republic, it is The Czech Office for Standards, Metrology and Testing/ ÚNMZ), is to carry out voluntary certification. Voluntary certification is a procedure ran according to Section 10 (1b) of Act No. 22/1997 Coll. on technical requirements on produce as amended, meanwhile in cases when this Act is not applicable, the voluntary certification can be carried out by non-accredited subjects. The voluntary certification, of course, can be carried out by accredited subjects as parts of authorized and notified bodies. The scope of voluntary certification depends on the client's requirements, i.e. on the purpose for which the certificate is to be used. This procedure does not result in the creation of elaborated technical norms but rather creates open specifications defining technical, quality and functional characteristics.

The efficiency of the above described voluntary approach was analyzed in frame of the European POSSE (Promoting Open Specifications and Standards in Europe/http://posse.intens.cz) project. The analysis showed that associating local administrations in Germany, Austria and Switzerland helped, through the utilization of open specifications and norms during the public procurement procedures, to cut the ITS realization costs by 40% approx. and, in case of the intersection traffic control systems, the savings amount to as much as 80% in some cases. Open systems open the gateway to the market for new participants, they enhance innovative thinking and promote modular development of the already existing systems by adding additional technologies, respecting the open specification requirements.

It is suitable to define, for the ITS used in multiple modes of transport (e.g. management and control of public transport vehicles) not only the technical standards but also systemic parameters. A systemic parameter is defined in order to make sure that it will be possible to use the particular application according to the customer's requirements (user). The Stricter the customer's requirement, the stricter not only the systemic requirements but also investment and operation costs-related requirements. Well set systemic parameters for individual applications and related systems will enable these systems to expand easily. Systemic parameters are to be aligned with individual elements of the application of its entire chain, i.e. requirements concerning the location sensor, data transfer, telecommunication environment, control centre applications or emergency call centers, or, eventually, interfaces providing for interconnections with other systems. The application is assessed as a whole, from the GNSS system to the end device.

When assessing the parameters of a navigation service, 4 basic criteria are to be taken into consideration:
- Accuracy;
- Integrity;
- Continuity;
- Availability.

When assessing parameters of the GNSS using ITS applications, there are two additional criteria:
- Reliability;
- Safety.

The choice of technologies usually represents a compromise between system-related requirements of the applications and technological possibilities with respect to economic aspects.

4 ITS AP in Follow-up to Related Strategic and Legal Documents

The Action Plan for the Deployment of ITS in the Czech Republic was made in follow-up to related legislative or concept documents varying in terms of:
- Territorial extent, i.e. where the document is applicable (EU, national or regional level);
- Subject-matter range (focus on the general concept of ITS as opposed to the focus on individual aspects of ITS, e.g. equipping transport infrastructure with ITS devices).

The top national strategic document relating to ITS deployment is the "Transport Policy of the CR for 2014-2020, with the prospect of 2050", the purpose of which is, among other, to implement a broader context and objectives of the European transport policy and to set out major needs and objectives across the transport sector.

According to the chapter "Modern technologies, research, development and innovation, and space technologies", using and deploying modern traffic management and control systems, information systems, intelligent transport systems and GNSS must become an integral part of transport development. The principal objectives of the Transport Policy, expected to be achieved with the help of ITS, include, among other, ensuring continuity of different modes of transport, including barrier-free connecting services, and improving traffic safety and awareness of traffic users. Also, the Transport Policy supports the development of priority areas and priority actions set out in the ITS Directive (2010/40/EU). The same document in fact implies the need for the ITS Action Plan to be compiled with it, which is to become one of the twelve follow-up strategic documents to the "Transport Policy of the CR for 2014-2020, with the prospect of 2050".

4.1 ITS Directive and Development of ITS Priority Actions Defined in the ITS Directive

The need for a harmonized deployment of ITS within the framework of the EU has led to the making of EU-applicable legal regulations ensuring that newly built intelligent transport systems and ITS applications as well as those already in existence achieve an adequate level of compatibility, both technically and in terms of organization. For this reason, ITS Directive No. 2010/40/EU was adopted to set out priority areas and actions for ITS deployment on the European level. The aim of the Directive is to set frameworks for a coordinated and coherent deployment of ITS across individual EU member states.

The Directive referred to above defines the range of the so-called priority actions in relation to which the European Commission (EC) is to adopt technical specifications issued in the form of a delegated act:
a) Providing multimodal information services relating to travelling within the EU;
b) Providing real-time traffic information services within the EU;
c) Data and procedures designed to provide users (where possible) with free minimum universal traffic information relating to road traffic safety;
d) Harmonized providing of the interoperable eCall service within the EU;
e) Providing information services for safe and secure parking places for trucks and commercial vehicles;
f) Providing booking services for safe and secure parking places for trucks and commercial vehicles.

At present, technical specifications for priority actions c), d) and e) are in place, as opposed to priority actions a), b) and f) where no such specifications have been issued so far.

Detailed information on the existing ITS technical specifications (situation as of 1st December 2014):

1) Commission Delegated Regulation (EU) No. 305/2013 of 26th November 2012, supplementing Directive 2010/40/EU of the European Parliament and of the Council, with regard to the **harmonized provision of an interoperable EU-wide eCall[1]**.
The pan-European system of automatic in-vehicle emergency calls (eCall) is to work on the basis of the single European emergency number 112 built into all new passenger cars and delivery vans as of 1st October 2017 (the original launch date was to be October 2015). The vehicle will communicate with the 112 Public Safety Answering Point (PSAP) from in-vehicle equipment using the mobile telecommunications network. In case of a serious traffic accident, the so-called Minimum Set of Data (MSD) will be transferred to the PSAP, containing information on, among other, the time, current position and travelling direction or the VIN code. Information about the accident will be available to the 112 operator within 14-17 seconds of the time the traffic accident occurred, allowing the operator to decide quickly and initiate adequate rescue action, thus eliminating serious health consequences for those injured in the accident.

<u>About eCall</u>:
- If their state of health prevents the vehicle's driver or passengers from calling for help and/or, at the moment of the accident, the driver and the passengers are in a foreign country, unable to express quickly and accurately by phone what happened and where, the emergency service will receive information about the traffic accident independently of the vehicle's driver or passengers and will be able to respond to the call;
- eCall will localize the place of accident quickly and accurately, sending automatically verified information to the 112 emergency number;
- Time is of the essence – reducing the reaction time of the emergency services will help mitigate serious health consequences for those injured in the accident which might by caused by late medical help;
- By forwarding accident-relevant information from the PSAP to the Traffic Information and Control Centre, drivers heading towards the place of accident will be informed of the incident;
- The deployment of the eCall system within the European Union follows single technical standards;
- The eCall in-vehicle equipment is built into the car in a safe place;
- It activates only if the vehicle electronics assess that an accident occurred. The system activates automatically immediately after the accident, however, manual activation is possible as well;

1 *Note: To make sure that the eCall service using the 112 Public Safety Answering Point is fully functional, the following, mutually supplementing legal regulations have been issued with respect to the individual components of the eCall system: 1) Commission Recommendation No. 2011/750/EU of 8 September 2011 on support for an EU-wide eCall service in electronic communication networks for the transmission of in-vehicle emergency calls based on 112 (eCalls); 2) Decision No. 585/2014/EU of the European Parliament and of the Council of 15 May 2014 on the deployment of the interoperable EU-wide eCall service; and 3) the currently debated proposal for the Regulation of the European Parliament and of the Council concerning type-approval requirements for the deployment of the eCall in-vehicle system and amending Directive 2007/46/EC.*

- If the driver witnesses an accident, he or she may call for help for others as well by pressing a special SOS button.
- eCall is designed for calling rescue services, not for monitoring a vehicle's movement.

In the initial phase of the eCall service deployment, two technology nodes and two regional TCTV (PSAP) 112 call centers will be adapted to receive eCalls. As the up-grading works on the TCTV 112 service (building of the new system) are currently under way, particular regional TCTV 112 centers designed to receive eCalls have not been defined yet. As soon as the call centers are selected, eCalls from across the Czech Republic will be routed to these centers, which will back up for each other in their functioning. Depending on the gradually increasing number of eCall in-vehicle units, the number of designated call centers will be growing so that, eventually, all regional centers receiving TCTV 112 emergency calls will be ready to provide the service.

The testing and issuing of protocols related to the assessment of conformity of PSAP eCall service operations will be arranged by an entity authorized by the Czech Office for Standards, Metrology and Testing (ÚNMZ, hereinafter the "Office") upon compliance with the requirements for authorization, set out in Section 11 (2) of Act No. 22/1997 Coll., on technical requirements on products and on the amendment to and supplementing of certain acts, as amended. If the entity concerned is authorized to assess conformity under the above Act in a different sphere, it will ask for authorization in the sphere of conformity assessment of the operations of eCall Public Safety Answering Points. The requirements for the entities carrying out tests and issuing protocols related to the assessment of conformity of the PSAP eCall service will also include the knowledge of Commission Regulation 305/2013 and the following standards: EN 16454 (to be introduced into the set of Czech standards (ČSN), ČSN EN 16072, ČSN EN 16062, ČSN EN 15722, and ČSN EN 16102. Upon assessment of the standard requirements, the applicant will be authorized and notified by the Office via the Permanent Representation of the Czech Republic in Brussels.

The Czech Republic presumes that the entity to assess conformity of PSAP eCall service operations could be the Czech Technical Institute of Fire Protection (Technický ústav požární ochrany, Písková 42, 143 00 Prague 4 – Modřany). The Technical Institute of Fire Protection is a technical branch of the Ministry of Interior-General Directorate of the Fire Rescue Service of the CR, specializing in research and development in the area of fire protection, testing and conformity assessment of fire-fighting technical equipment and selected fire protection devices and performing fire-protection technical examinations. Without reservation, other entities may acquire authorization for this activity as well.

2) Commission Delegated Regulation (EU) No. 885/2013 of 15th May 2013, supplementing ITS Directive 2010/40/EU of the European Parliament and of the Council, with regard to the **provision of information services for safe and secure parking places for trucks and commercial vehicles**;

The Regulation governs the provision of information on parking places for trucks and commercial vehicles, notifying truck drivers of places suitable for truck parking and places secured against crime – theft of transported consignments or vehicles and protection of drivers against robbery. The service providing parking place information is to facilitate optimization and regulate the use of parking places for trucks and commercial vehicles. Every EU Member State will be encouraged to define priority zones (particular sections of TEN-T) where, in addition to static information, dynamic information should be also

provided for operational and safety reasons. As part of the service, operational data and data on facilities available at the relevant parking places including contact details of the operators will be collected. Operational data include:
- Static information: location of the parking places, including entrance and exit, number of parking places for trucks and the parking fee;
- Dynamic information about availability of the parking places: number of vacant parking places or information that the parking is occupied or closed.

Data concerning facilities available at the parking places include information on the equipment and security of the parking area: specification of the facilities and security provisions against serious crime, number of parking places for refrigerated trucks, special equipment or services for vehicles carrying oversize loads, high consequence dangerous goods under ADR, etc.

Data concerning the parking places should be available through national/international access points (interface). The creation and administration of a central national /international access point is in the competence of national authorities of individual Member States. The central access point receives information from all (national) operators of parking places or providers of information services relating to safe and secure parking of freight vehicles. Both public and private service providers must make sure that the published data are updated and in high-quality.

The State will appoint an impartial and independent national entity, which is to assess whether or not public and private operators of parking places and providers of information services meet the requirements set out in the above Regulation.

3) Commission Delegated Regulation (EU) No. 886/2013 of 15th May 2013, supplementing ITS Directive 2010/40/EU of the European Parliament and of the Council, with regard to **data and procedures for the provision, where possible, of road safety-related minimum universal traffic information free of charge to users**;

This Regulation governs the provision of traffic information on the situation of the road network. By its nature, this information warns drivers against dangerous situations in road traffic. In order for the provided traffic information to be classified as “minimum universal traffic information”, the provided data must cover at least one of the following events:
- temporary slippery road;
- animal, people, obstacles, debris on the road;
- unprotected accident area;
- short-term road works;
- reduced visibility;
- wrong-way driver;
- unmanaged blockage of road;
- exceptional weather conditions.

“Minimum universal traffic information” by public and/or private operators should be available to as wide a range of end users (e.g. drivers) as possible. The traffic information should be provided free of charge, which, by definition, means without extra cost on the part of end users (fees/costs of obtaining the information must be adequate to the costs of collecting and processing the same), however, not for free. Public and private service providers are to cooperate to harmonies the contents of the information/data provided to end users.

“Minimum universal traffic information” is to be provided on sections of the TEN-T where launching of the relevant service is required by operational and safety requirements. Both public and private service providers are required to share and exchange data collected for the purpose of providing “minimum universal traffic information” in the DATEX II (CEN/TS 16157) format or another format compatible with this standard. The relevant data must be made accessible through a “national” access point and must be available for repeated use of data on a non-discriminatory basis. Both public and private service providers must make sure that the data published at the national access point are updated and in high-quality.

The state will appoint an impartial and independent national entity, which is to assess whether or not the public and private managers of transport infrastructure, providers of information services and broadcasters meet the requirements set out in the above Regulation.

4.2 Implementation the ITS Directive in the CR

As already referred to above, the EC is gradually adopting, based on the ITS Directive (40/2010/EU), particular technical specifications for individual ITS priority services. The Directive expects that conformity should be assessed not only in respect of products, but also in respect of services, i.e. the use of ITS technical equipment and information links to support controlling and information processes through ITS applications.

In case of ITS applications where errors in the system’s functioning do not entail a risk for human life or a substantial risk of damage on property, a simplified process of conformity assessment is expected, i.e. submission of the declaration of conformity certifying that the requirements set out by the relevant EC Regulation have been met. These declarations will be assessed by an impartial and independent national entity appointed by the state.

First and foremost, the Directive implies the obligation for the Member States to adopt measures ensuring that relevant technical specifications are applied to ITS applications, systems and services. In the context of the Czech legislation, this obligation has been embedded in the Roads Act (Section 39a of Act No. 13/1997 Coll., on roads, as amended). According to this regulation, entities launching ITS components onto the market or into operation (both public and private entities) are responsible for making sure that, if the specification of the EC so requires, the relevant components are assessed in terms of their conformity or suitability for use in line with the specification.

An amendment to the Act also defines the reviewing role of the Ministry of Transport as well as the maximum amount of penalty for a breach of the stipulated obligations. Whenever the MoT finds out or has a reason to suspect that an ITS component is not compliant with the EC specifications, it will impose a protective measure pursuant to Section 18a of Act No. 22/1997 Coll., on technical requirements for products and the modification of, and amendment to, certain acts, as amended. Where the MoT has a reason to suspect that the product fails to meet the requirements set out by this Act, it forbids the product or the product line from being launched onto the market or into operation or from being distributed for a period long enough for a check to be performed.

In doing so, the Ministry of Transport proceeds in line with the legislation applicable to state supervision, specifically in line with Chapter 9 of the Roads Act. As the competent authority, the MoT imposes protective measures in respect of ITS components (Section 40 (1) (j) of the Roads Act). An entity appointed to exercise supervision on behalf of the state checks whether or not ITS service providers meet the obligations set out by the Roads Act. Upon finding out a breach of the stipulated obligations, the entity appointed to exercise state supervision decides in writing, if necessary and depending on the nature of the shortcomings found, on the way of, and time-limit for, the removal of these shortcomings and their causes (Section 41 (2) of the Roads Act). A legal entity or a self-employed individual acting as ITS service provider commits an administrative infraction by using an ITS component that does not meet the EC specifications or by providing the ITS service in a manner non-compliant with these specifications. Such administrative infraction may be subjected to penalty of up to 500,000 CZK.

The state exercises public administration through administrative authorities or, where applicable, through appointed individuals or legal entities. In relation to ITS, there are two different positions of the state in legal relations. First, the state acts as holder of the executive power, i.e. as an entity authorized to order, forbid, instruct, permit something or similar. Second, when dealing in private relations during the building or operating of ITS, the State acts as an equal to the other contracting party.

4.3 Other Related Strategic and Legal EU Documents

White Paper "Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system" COM(2011) 144 proposes a more efficient use of transport and infrastructure through improved systems of transport management and information systems (e.g. ITS, SESAR, ERTMS, SafeSeaNet, RIS). The White Paper's objectives include, without limitation:
- introducing modernized infrastructure for air traffic management (SESAR) in Europe by 2020 and complete the common European aviation area;
- deploying relevant systems for surface and water-borne transport (ERTMS, ITS, SSN and LRIT, RIS);
- completing the European global navigation satellite system (Galileo);
- creating by 2020 a framework for information, controlling and payment system of European multimodal transport;
- supporting, on the part of the EU, the development and deployment of technologies which improve the efficiency of infrastructure use and decarbonization (new charging systems for the use of roads and toll collection, ITS and capacity improvement programmes).

Action Plan on Global Navigation Satellite Systems (GNSS) Applications COM(2010) 0308: Its aim is to expand the use of satellite navigation, particularly through the use of new guaranteed services of EGNOS and Galileo, on a much wider basis than would be possible using the existing systems.

Action Plan for the Deployment of Intelligent Transport Systems in Europe COM(2008) 886 sets a series of short to mid-term steps leading towards fulfillment of the objectives set out by Directive 2010/40/EU. The Action Plan covers six priority areas with specific measures and a fixed time-schedule, its aim being to speed up and coordinate the deployment of ITS in road transport and, by defining specific interfaces with ITS systems, in other modes of transport as well. The Action Plan for the Deployment of ITS in the EU draws on a series of ongoing EC initiatives, including, without limitation, the Freight Transport Logistics Action Plan, the Action Plan on Urban Mobility, Galileo deployment, the Greening Transport Package, the i2010 initiative on Intelligent Cars, eSafety initiative, the 7th Framework Programme for Research and Technological Development, eCall service, European Technology Platforms and their strategic research agendas or CARS 2020 initiative.

A Digital Agenda for Europe COM(2010) 245 sets a series of short to mid-term steps leading towards enhancing the development and global deployment of ICT-based systems offering potential for a structural shift to less resource-intensive products and services, for energy savings in buildings and electricity networks, as well as for more efficient and less energy consuming intelligent transport systems. As for ITS, the areas supported include, in particular, deployment of real-time traffic and travel information (RTTI) and dynamic traffic management systems to relieve congestion and encourage greener mobility, while improving safety and security.

Directive 2008/57/EC of the European Parliament and of the Council **on the interoperability of the railway system within the Community**, as amended. Commercial operation of trains throughout the rail network requires excellent compatibility between parameters of the infrastructure and those of the vehicles, as well as efficient interconnection of the information and communication systems of the different infrastructure managers and railway undertakings. Performance levels, safety, quality of service and cost depend upon such compatibility and interconnection, as does the interoperability of the rail system. In view of the extent and complexity of the rail system, it has proved necessary, for practical reasons, to break the system down into the following subsystems: infrastructure, control-command and signaling, energy, rolling stock (noise, freight wagons, locomotives and rail vehicles for passenger transport), operation and traffic management, telematics applications in passenger and freight services, safety in tunnels and accessibility of the EU rail system for people with disabilities and people with reduced mobility and orientation. For each of these subsystems, essential requirements must be specified and technical specifications determined so that the essential requirements can be met. The same system is broken down into fixed and mobile elements comprising on the one hand, the network, composed of lines, stations, terminals, and all kinds of fixed equipment and, on the other hand, all vehicles travelling on this network.

Directive 2004/49/EC of the European Parliament and of the Council of 29th April 2004, **on safety of the Community's railways** (…), as amended, setting, among other, common safety targets (CST), common safety methods (CSM) and common safety indicators (CSI) leading towards a common approach to railway safety and security and requiring technical support on the Community level.

Directive 2007/2/EC of the European Parliament and of the Council of 14th March 2007, **establishing an Infrastructure for Spatial Information** in the European Community (INSPIRE): its aim is to integrate specifications of individual transport networks into a single system to ensure inter-compatibility of databases.

Commission Decision 2008/671/EC of 5th August 2008, **on the harmonized use of radio spectrum** in the 5875 – 5905 MHz frequency band for safety-related ITS applications.

Regulation (EU) No. 1315/2013 on Union guidelines for the development of the trans-European transport network (TEN-T), the principle aim of which is to create and develop a comprehensive transport network comprising rail, road, inland waterway, maritime and air transport infrastructure as well as infrastructure for combined transport, and thus to facilitate proper functioning of the internal market and strengthening of economic and social cohesion. Based on this Regulation, the TEN-T is newly defined as a dual-layer structure. The first layer is the "core network" established by interconnecting "primary nodes" defined on the basis of the EC methodology, the completion of which is expected by 2030. The core network is a subsystem to the "comprehensive network" to be completed by 2050. One of the important measures both in terms of development of the TEN-T as such and its connection to regional and local infrastructure as defined by the TEN-T Regulation is the deployment of telematic applications (ITS/ERTMS/RIS/VTMIS/SESAR) and the support of innovative technological development.

A considerably large number of legal regulations relating to rail transport have been issued by the EU, which set out single technical standards. The trend in enforcement and implementation of single technical standards in railway transport has a long tradition. Back in 1882, the "Agreement on Technical Uniformity in Rail Transport" was made on the initiative of the Swiss Federal Railways, which united basic technical parameters for vehicle compatibility between two railway networks. Over the time, other intergovernmental organizations have been established to deal with the same, e.g. UIC (International Union of Railways) since 1922. Only now, European countries have started to create an environment under which the operation of transport and providing of transport services is separated from transport network maintenance and management or traffic management and control.

In the area of rail transport, technical regulations are gradually being harmonized on the EU level in order to achieve mutual interoperability of individual rail systems of the respective EU Member States. The overarching documents include the Interoperability Directive and the Railway Safety Directive. The first directive adopted was Council Directive 96/48/EC on the interoperability of the trans-European high-speed rail system, followed in 2001 by Directive 2001/16/EC on the interoperability of the trans-European conventional rail system, both of which were replaced by the common Directive 2004/50/EC on the interoperability of the trans-European rail system. The currently valid documents are: **Directive 2008/57/EC on the interoperability of the rail system within the Community**, as amended, and **Directive 2004/49/EC on safety of the Community's railways**, as amended, the latter being relevant in terms of the ITS AP in relation to accident and emergency investigation, including single recording and calculation of the cost incurred. Pursuant to the above directives, technical specifications for interoperability of the individual subsystems of the rail system have been formed as well as those for the system's structural and functional areas. The follow-up EU legislation relevant for the ITS AP includes, among other, the following documents with EU-wide binding effect and direct applicability:

Commission Regulation (EU) No. 454/2011 on the technical specification for interoperability relating to the subsystem "telematic application for passenger services" on the trans-European rail system, as amended by **Commission Regulation (EU) No. 1273/2013**. The systems involved include ticketing, booking and payment systems for passenger, issuing of transport documents (at a ticket office, in a ticket machine, on the train, online) and partly also train documentation.

Commission Regulation (EU) No. 1305/2014 on the technical specification for interoperability relating to the telematic applications for freight subsystem of the rail system in the European Union. The systems involved include a system for freight transport planning, online communication with the carrier systems and the railway infrastructure administrator systems, monitoring current train position, operative control of locomotives and staff management, information systems for freight wagons and systems for electronic customer communication.

Commission Decision (EU) No. 2012/757/EU concerning the technical specification for interoperability relating to the "operation and traffic management" subsystem of the rail system in the European Union as amended by Commission Decision (EU) No. 2013/710/EU. In terms of the ITS AP, the relevant issues include, without limitation, traffic planning, train identification, traffic management as such, transmitting information relating to a running train between the infrastructure manager and the carrier (railway undertaking), traffic planning and management under degraded conditions or in extraordinary events.

Commission Regulation (EU) No. 1300/2014 concerning the technical specification for interoperability relating to accessibility of the Union's rail system to persons with disabilities and persons with reduced mobility and orientation. In terms of the ITS AP, the relevant provisions relate to visual, dynamic and audio information.

Commission Decision (EU) No. 2012/88/EU concerning the technical specification for interoperability relating to the control-command and signaling subsystems of the trans-European rail system, as amended by **Commission Decision (EU) No. 2012/696/EU**. In terms of the ITS AP, the relevant issues include, without limitation, checking defect diagnosis in running rail vehicles (hot axle boxes, braked wagons and flattened wheels) which may, in consequence, result in train derailment as well as damage to the rail track.

Commission Regulation (EU) No. 1303/2014 concerning the technical specification for interoperability relating to "safety in railway tunnels" of the rail system of the European Union. In terms of the ITS AP, one of the relevant issues is the communication system in tunnels over 1 km long.

4.4 Related Strategic and National Legal Documents

Transport Sector Strategies 2nd Phase – Medium-term plan for the development of infrastructure with a long-term prospect: The strategies define priorities and objectives in the area of infrastructure development over the medium term until 2020, generally also over the long run until 2050. In relation to ITS, the relevant part concerns, among other, the implementation of "priority actions" as defined by the ITS Directive 40/2010/EU. In terms of ITS deployment, priority actions according to the Transport Sector Strategies include actions aimed at a coordinated deployment and application of ITS on a European-wide level. The strategies outlined the main financial criteria for equipping infrastructure with ITS systems in different modes of transport, to be funded by the Ministry of Transport or, as the case may be, its subordinate organizations including the State Fund for Transport Infrastructure (SFDI), the Road and Motorway Directorate (ŘSD), the Railway Infrastructure Administration (SŽDC), and the Directorate of Waterways (ŘVC).

National Road Traffic Safety Strategy (BESIP) for term 2011 to 2020: The strategy addresses the most problematic aspects of road traffic safety by combining separate measures applied in relation to road infrastructure and road vehicles, education and training, penalization and legislation as well as ITS technologies. The measures applied under the BESIP national strategy include the application of ITS in road traffic monitoring and management, in-vehicle ITS application (especially the so-called cooperative systems). Other measures applied under the strategy focus on improving drivers' awareness of the existence and potential of new traffic safety technologies, or on reducing traffic accidents caused by risk drivers, with the help of ITS components.

National ERTMS Deployment Plan
The European Commission has defined the global strategy for the development of the European Rail Traffic Management System with the aim to prepare its future implementation on the European railway network. The strategy has been reflected in the Interoperability Directive and, subsequently, in the technical specifications for interoperability of the subsystems "command-control and signaling" applicable to the European rail system. Another important document is Directive 2004/49/EC on safety of the Community's railways, as amended. The National Implementation Plan proposes specific steps and conditions for the deployment and building of the system. It contains plans for the implementation of GSM-R and ETCS systems on the rail network in the Czech Republic until 2020.

National Development Programme – Mobility for all
The programme supports the implementation of complex barrier-free travel routes in cities and municipalities, i.e. eliminating barriers in buildings of state and public administration institutions as well as eliminating barriers in transport. One of the specific objectives to achieve the fundamental objective of the Mobility for All programme is the deployment of signaling and information devices in transport.

Public Transport Concept (under preparation – comments to the White Paper are being discussed)
The system of public passenger transport in the Czech Republic has been set to accommodate the passenger's need for a satisfactory functioning of the system. One of the conceptual issues that still remain open include the funding of public passenger transport, which presents an essential criterion for long-term sustainability of the system of public passenger transport in the CR. Based on discussions with partners, e.g. respective regions or the expert public, the "Public Transport Concept" is being formulated (the so-called White Paper) which is to define the new organization structure of public transport, necessary legislative changes and a proposal for the system's financing.

National Electronic Communications Policy – "Digital Czech v. 2.0, A Way to Digital Economy"
The policy outlines a strategy for the Czech Republic's next course in digital agenda and is aimed at the utilization of synergy effects generated by information and communications technologies. Digital Czech policy defines several main objectives: strengthening digital economy in general, emphasizing market self-regulation, building fast Internet, strategy for radio spectrum management, diffusing ICT and digital services among all users, digital literacy, free Internet access, information provided by public authorities in digital form, free information for media, supporting legal online supply of audio-visual contents.

National Plan for the Development of Next-Generation Networks
The aim of the National Plan for the Development of Next-Generation Networks is to define the strategic approach of the CR to the building of next-generation networks and, in particular by way of providing support, to implement the development of next-generation access networks.

National Spatial Data Policy (GeoInfoStrategy)
The efforts to formulate the national spatial data policy have been substantially affected by the adoption of the INSPIRE Directive in 2007. The need to transpose the Directive into Czech legislation and to implement the principles defined by INSPIRE into national context has facilitated the start of the process leading to the defining of the concept of coordinated development in the sphere of spatial data. In this context, the Ministry of Interior

has, in cooperation with other departments and public authorities involved (including the Ministry of Transport), prepared the Strategy for Development of Spatial Data Infrastructure in the CR until 2020 ("GeoInfoStrategy"), as adopted by Government Resolution No. 815 of 8 October 2014. The principle objectives of the GeoInfoStrategy include, among other, effective coordination and integration of the individual activities of both public administration authorities and the commercial sphere as concerns spatial data in general, building a single information basis by interconnecting territory-oriented data from different sources, and creating conditions for cost efficiency and savings in public administration in the process of acquiring, processing and sharing spatial data.

At present, ITS applications acquire data from a number of information systems, using often disparate and incompatible data/information bases. In this context, the main benefit of the actions following from the GeoInfoStrategy implementation will be the consolidation and harmonization of spatial data in transport infrastructure in general. Considering the fact that ITS and the use and acquiring of spatial data/information as part of individual mapping as well as detection, communication and control systems are closely connected, it is vital, in terms of sustainability of ITS development, to benefit from the GeoInfoStrategy for ITS and ITS-related information systems purposes. Also, it is necessary to stress that newly built ITS data infrastructure is to be formed in line with the GeoInfoStrategy principles.

National Space Plan

The National Space Plan, as adopted by Government Resolution No. 872 of 27 October 2014, presents the Czech Republic's strategy for further development in the capacities of the Czech industry and the Czech academic sphere and for maximizing the return on public investment into space activities. The main objective of the National Space Plan 2014 is to increase the Czech Republic's international competitiveness as well as its technology and innovations standard. The Plan contains recommendations for the development of space activities of the Czech Government, including, among other, development of space technologies, some of which may be of use on the ground as well, or development of applications based on satellite systems products, i.e. satellite navigation, satellite telecommunications and remote Earth sensing.

The examples of space technologies applied in transport include, among other, impact detection sensor systems activating airbags in cars, robotic solutions applied in car production or operation. As for applications, satellite navigation is applied for LBS purposes, services (e.g. eCall), tracking position of cars with consignments of interest (hazardous, sensitive, valuable, etc.). Satellite communication will be used mainly in civil aviation. Considering the improved availability of data, remote Earth sensing is a technology on the rise to be benefited from in, e.g., monitoring of transport infrastructure and risks in areas in close vicinity of the infrastructure.

The most significant instruments allowing for the development of the above technologies and applications include the optional programmes of the European Space Agency, EU space programmes, Horizon 2020, operational programmes and, last but not least, national frameworks such as the Czech Technology Agency (TAČR) programmes.

Personal Data Protection Act

The Act deals with the aspects of deploying technical devices enabling personal data processing and the obligations relating to personal data protection when making records, transmitting and storing data if, on the basis of such data, though indirectly only (e.g. in connection with other data or records) individuals could be identified.

In order to provide for sufficient protection of privacy when processing ITS-based records and data against misuse by unauthorized access, modification or loss, it is the aim of the Act to ensure maximum anonymity of such records or data as possible.

5 Persisting Problems in ITS Operation in the CR

Intelligent transport systems in the CR often lack sufficient informational interconnection. At present, there are enormous quantities of diverse data, and in some cases public administration authorities collect data with similar content. In order to allow, e.g., spatial data from different databases to be applied and shared and interconnected more efficiently with other ITS applications and public administration information systems, a uniform data format must be set.

The development, deployment and application of intelligent transport systems (e.g. traffic management systems on motorways and high-capacity roads) is insufficient and fails to meet the present needs, all this despite the fact that ITS have a high potential in increasing the transportation capacity of roads and continuity of traffic and in reducing congestions and incidence of traffic accidents. Currently, technological systems collecting traffic data are installed but on a marginal part of the entire road network of the Czech Republic, **the acquired data being used separately for individual intelligent transport or telematic systems or for statistic and planning purposes**. It has been estimated that, in order to acquire sufficient information on vehicles movements, these technologies need to cover at least backbone roads, bypass routes, selected urban roads and Ist class roads, i.e. approx. 7,000 km of the total number of 56,000 kilometers of motorways, expressways and Ist, IInd and IIIrd class roads.

A significant, yet still rather underestimated source of information important in terms of traffic safety is the surveillance systems. Though urban agglomerations are monitored by various surveillance systems, data acquired from these systems fail to be shared. Motorways are a similar case. Video-data are centralized under the Road and Motorway Directorate (ŘSD) and shared with the Police of the CR, in some cases even with the Fire Rescue Service of the CR (HZS ČR), whether directly at the relevant local headquarters or centrally. As soon as the Police of the CR are directly connected to the National Traffic Information and Management Centre (NDIC), they will even be able to work with the Centre’s records. As for private providers of transport services, video records, data from variable traffic information panels (via the National Traffic Information Centre) or numbers of vehicles passing through monitored roads are currently not available. Railway infrastructure offers similar possibilities as well (stations, level crossings, foot level crossings, etc.).

The D1, D2, D5 and D8 motorways are currently equipped with travel time predicting systems which, however, are able to calculate the destination time only if the traffic is continuous. As soon as a traffic situation occurs, the system does not react fast enough, which needs to be corrected.
In the Czech Republic it is still necessary to continue in accomplishing and perfecting the functionalities of the National Traffic Information Centre and to ensure its interconnection with regional traffic information centers (DIC) so that both sides may profit from the traffic information available. Compatibility between the individual existing centers must be ensured, along with substitution if needed. There is insufficient interconnection between the National Traffic Information Centre systems and the Road Administration and Maintenance (SÚS) and other municipalities throughout the Czech Republic, with the National Traffic Information Centre receiving merely information on road closures and lacking any other telematics information, including real time images from surveillance systems. In principle, the structure of the Integrated Traffic Information System of the Czech Republic has been set correctly, however, the system’s potential remains unexploited in full. It seems desirable to interconnect the Integrated Traffic Information System with the existing

and the newly developed partial intelligent transport systems which not only collect, but also distribute traffic information (e.g. integrating the weigh-in-motion system). These partial systems are also necessary for supplementing the distributed data with information on how the traffic situation is affected. One of the main objectives for the National Traffic Information Centre is to start cooperation with similar centers in foreign, in particular neighboring, countries.

The present state of implementation and operation of the Integrated Traffic Information System as well as that of the National Traffic Information Centre correspond to the real situation in this field that has evolved over the last few years. The competent authorities for coordination of the Integrated Traffic Information System project were the Managing Committee and the Project Team (until around 2008). Later on, the only coordinating authority left was the interdepartmental coordinator responsible for communication with all authorities, organizations and institutions according to the progress of the systems and applications preparation who arranged their involvement in the project. The coordinator's tasks also included communication with ordering party, solving possible ways of involvement in various projects and activities and coordinating the systems and applications development on interdepartmental level. In this form, the coordinator's position functioned until November 2011. Over time, the interdepartmental nature of the project as well as the staffing needed for coordination of activities and operations in the area of traffic information and traffic data transmission between individual authorities, organizations and institutions of different departments, has gradually faded out. Over the last years, the development has either slowed down to a great extent or, save for few exceptions, has come to a near halt.

Car navigation systems currently using GPS are a frequent component of additional car equipment. Navigation systems also process TMC information. Based on the initiative of the Škoda Auto company, a report assessing RDS-TMC reporting in the Czech Republic was compiled in April 2013, one of the reasons for making of this report being the frequent complaints about quality of the navigation service using RDS-TMC in Škoda cars. Customers visiting the garage complained about the information service working badly in their navigation devices. Up to two-fifths of the drivers questioned used TMC rarely. Also, only one third of them allow the messages to affect their decision-making on a few rare occasions. Those not using TMC at all do so because of bad functioning, uselessness or simple unawareness of TMC information. Mostly, drivers would appreciate if the information was more up-to-date. Moreover, the system shows poor performance in cities. Also, more up-to-date and accurate information would be appreciated, whereas two-fifths of the drivers lacked correct data on the length of tailbacks. The volume of information transmitted via RDS-TMC is limited in capacity by the current technical parameters and coverage of the service provided by current broadcasters. The present distribution radio network is unsatisfactory in terms of coverage and regional character of the messages distributed. The assessment shows that drivers do not perceive TMC systems as a reliable adviser. Only a marginal share of the drivers questioned are completely satisfied with the RDS-TMC system.

As already said, ITS generated information may be used also for planning construction, maintenance and upgrading works on the transport network. At present, there is no national-level centre responsible for coordinating individual closures and transport network lockouts, whether between individual institutions operating the road network (Road and Motorway Directorate, regions, cities) or between individual transport route managers and operators of individual modes of transport (road and rail network, etc.). An example of the serious consequences of non-existent coordination of road closures and rail interruptions may be the situation on the route between Brno and Olomouc or Ostrava dating from autumn 2014. In this corridor, closures were commenced at a single time, covering both the main as well as the by-pass routes (an extensive closure on the D1 motorway nearby Vyškov was introduced simultaneously with a closure near Rousínov with temporary two-way traffic signals). This situation was made even worse by closures on the R46 between Vyškov and Olomouc which, at rush hours, resulted in a complete collapse of the road network between the two towns. At this time, real travel time was entirely unacceptable for users: between Ostrava and Brno, it often exceeded 4.5 hours as opposed to 1.5 hours under normal circumstances. Users who, after their negative experience, decided not to use their cars and travelled between the two towns by train instead, were affected by a week-long service interruption on the railway, being forced to use standby coach transport, which, due to the above combination of road closures, was also affected by serious delays (up to several hours). In the end, the poor coordination of these events resulted in an absolute collapse of the given section of the transport network.

Some transport companies offer SMS travel ticket service to their passengers in cooperation with all Czech mobile operators. Passengers are informed they will receive the SMS ticket within two minutes of sending the request for purchase of the relevant ticket. It is no exception, however, that passengers receive their SMS ticket with delay or not at all. SMS tickets become valid travel vouchers only after they have been delivered. Only then are the passengers entitled to get on the vehicle which, in case of evening or late night connecting services, may mean waiting for the next service, a situation which may be unacceptable for most passengers. Though the ticket inspector may check if the request for purchase of the SMS ticket was sent before getting onto the vehicle, unpleasant situations arise. The system is not passenger-friendly. The delivery time of the SMS ticket is not guaranteed which reduces the value of this technology in the eyes of the travelling public.

While some urban transport companies own data on the current position of urban public transport vehicles, they use them only for internal needs. At present, passengers may receive information concerning the current position of public transport vehicles only via an application covering the vehicles of the Transport Company of Brno. This information is valuable also for passengers with reduced mobility or orientation, for which reason information of this kind should be available to the wider public as well. As for rail transport, information on delayed trains in passenger transport are available, for instance, in the so-called GRAPP systems (providing graphic presentation of vehicle position of the trains of all carriers within the Railway Infrastructure Administration network), in the Babitron system (a private project) monitoring the Czech Railways trains or in the Multimodal Journey Planner (IDOS) as part of the searched connecting service.

In the Czech Republic the blind and visually impaired people travelling by public passenger transport use a radio system at the 86.79 MHz frequency for orientation and information purposes. The system has been in operation since 1996 and enhances spatial orientation of the blind by providing acoustic information about the situation at a given place (an important orientation point or landmark, a stop or means of public transport) or by providing acoustic information on the vehicle's direction, the passengers' intention to get on/off, etc. At present, however, the selected 80 MHz frequency band is jammed by external radio sources which are very difficult to isolate in order to make sure sensitivity of the system receiver is not substantially reduced. The reduced coverage by the above system due to interference occurs mostly in those means of urban public transport where fast data bus devices (intranet), fast time multiplexing information panels, new fast-processor on-board units, radio systems for vehicle preference on cross-roads, vehicle control systems, etc., are increasingly used. As a result of the ever evolving information technologies, interference in the frequency band up to 100 MHz is not going to reduce. A systemic solution would be to supplement the existing 80 MHz frequency band radio module of the relevant devices with a radio module at 434 MHz (433.9 MHz), and thus allow the user of the controlling transmitter to choose one frequency from both bands. In the Czech Republic, this means costs spent on partial reconstruction of the orientation and information system for the visually impaired. Specifically, more than 10,000 remote-controlled acoustic orientation signals would have to be added or replaced that are installed in various transport structures (including the Prague underground), on the premises of buildings open to the public, in ticketing and dispatching systems for passengers in public transport vehicles, in regional railway vehicles operated by the Czech Railways, at pedestrian crossings controlled by traffic lights, at selected level-crossings, in electronic information devices installed in railway and bus stations.

In 2006, the Czech transport institute “Institut Jana Pernera” launched a survey examining the accessibility of public transport for the hearing-impaired. According to the survey made among deaf users, the equipment standard of urban public transport vehicles (buses, trams, trolleybuses) varies in individual cities, the situation being considered best in bigger towns. According to respondents, only 48.6 % of the installed information panels were actually functioning. In some cases, the information panels showed only where the vehicle is bound (terminus) which is insufficient information for hearing-impaired passengers. Also, respondents stressed that sufficient contrast between colors of the text and its background or, more specifically, combination of the two colors would deserve more attention (for instance, yellow or green on black, not the commonly used red on black). Despite the deployment of ITS in public passenger transport systems, the deaf and hearing-impaired need to acquire information through personal contact with the carrier staff. Most of the staff is untrained for communication with passengers with hearing impairment. There are different categories of the hearing-impaired requiring different ways of communication. Choosing the right communication means is therefore very difficult. Different rules apply in lip-reading as opposed to speaking and listening. Some of the hearing-impaired are unable to lip-read while others use sign language. If the ticket office, where travel tickets are purchased for travelling by a means of public passenger transport, is a glass box, problems arise when the staff sitting behind the counter are turned sideways to the passenger, looking at the PC monitor. While speaking, they sometimes never turn their head to the passenger, expecting communication via the microphone. This may be very difficult for the deaf as the sound may get distorted. Upon being alerted that the deaf passenger needs to lip-read, the carrier staff often turn nervous, yet still are unable, or even willing, to facilitate their communication with the deaf or hearing-impaired person.

In the past, several successful ITS prototypes were implemented as a result of international cooperation, which were designed to monitor excess weight or oversize loads and to monitor transport of hazardous goods. However, none of these prototypes has been developed fully for commercial purposes, the reason being that all were developed to reflect technical parameters only, without considering organizational and legislative aspects applied in individual countries.

Outdated and non-uniform interlocking and signaling devices or communication equipment on many crucial railway tracks, together with their high operational costs, do not meet the standards of a modern, interoperable (i.e. connectible), high-performance and safe railway transport. The up-grading of railway transport management is focused primarily on TEN-T tracks. To improve security of railway transport, it is necessary to test whether modern technologies (including applications using space systems or, more specifically, data generated by such systems) can be used also on tracks outside of the TEN-T. Here, it needs to be considered whether the tracks in question are completely isolated or if they lead to railway junctions where ERTMS will be launched. It is crucial that ERTMS supports localization of trains using GNSS in the future, thanks to which the deployment of ERTMS would prove economically more feasible even on tracks outside of TEN-T corridors.

At present, the crucial obstacle for ensuring compliance with all system requirements of ITS on the railway is the absence of ETCS and ATO on-board systems in rail vehicles. ETCS is present in none of the commercial vehicles, including the newly acquired, for both passenger and freight transport. The number of vehicles equipped with the ATO system is higher, mainly thanks to their systematic installing to the 471 vehicle line (City Elefant) or the 380 locomotives. However, the ATO system does not substitute the function of ETCS. Another essential requirement for ensuring compliance with, and use of, the properties of ITS is that all tracks and vehicles are covered and equipped with radio systems enabling data transmission. Currently, GSM-R system is installed mainly on the TEN-T, whereas on the remaining national-wide tracks TRS (450 MHz) is maintained and partly expanded, which, however, enables audio communication only, not data communication. The number of vehicles equipped with GSM-R end terminals is increasing gradually. As the ETCS and GSM-R systems are gradually launched on the TEN-T, the number of trains entering this technologically equipped network will be growing substantially. To ensure safety and continuity of transport it is desirable that all vehicles are equipped with adequate on-board ETCS and ATO components as soon as possible. This way, an increase in the safety parameters and operation optimization with direct impact on the capacity, efficiency and competitiveness of rail transport will be possible to achieve in the future.

The consolidation of SDI and related consolidation and development of data stock containing sets of spatial data describing transport infrastructure (i.e. digital maps of transport infrastructure) is one of the basic conditions for ITS development. Information that is fundamental and of key importance to transport is that which concerns position or, more accurately, the position of a means of transport on the transport infrastructure (mainly in land transport).

Although the present SDI in the transport sector meets the functions for which the respective departmental organizations are operating them, as a whole SDI within the transport sector is fragmented.

The Ministry of Transport needs a global SDI instead of the existing isolated local SDIs. Although a local SDI may be able to cover the needs of its (local) users, the systems are not interconnected. The existing isolated solutions are not implemented in the extent meeting the needs and tasks of the Ministry of Transport. The situation is growing ever more pungent and demands adequate solution, namely considering the tasks of the Ministry of Transport in terms of developing the sphere of spatial data, which are a standard means to support decision-making, as well as considering the trend of ever wider interconnection of spatial and attributive data for more efficient organization of transport and events occurring in a particular territory.

Most of the spatial datasets (i.e. stock of data, digital maps) are compiled by subordinate organizations who have their own SDIs available which had been established independently over nearly 20 years and, in most cases, fully cover the needs of these organizations, including their integration into the other systems of the respective subordinate organization. Mutually, however, these spatial data infrastructures are interoperable to a little degree only. Still, their interoperability plays a substantial role for the efficient use of spatial data not only for the needs of transport, but for other industries as well. Another important task for the future shall also be the development of public services as add-on to spatial data in transport.

Also, the Ministry of Transport needs to finalize the implementation of Directive 2007/2/EC of the European Parliament and of the Council (INSPIRE) and related regulations.

6 Development of International ITS Cooperation

ITS is a globally affected industry which, considering its geographic complexity as well as the wide interests of different participants, requires certain basic rules and parameters for products, technologies, systems and services to be set out. This is why ITS are so closely connected to international activities, whether carried out only within the territory of the Czech Republic or abroad.

The Czech Republic will intensify its engagement in international scientific, research and implementation projects in the field of ITS and will continue in supporting international data exchange and cross-border cooperation.

A very important aspect of international cooperation is the testing of product or complex system prototypes, aimed at testing their expected functionality in real environment. In such cases, the requested product (system, etc.) finds itself at a stage when the initial research of the issue has been completed (analytical, conceptual and defining stage) and the research results are to be tested in reality using prototypes in real environment (in practice), and thus either confirm the correctness of the designed technical parameters or induce further modifications and testing based on such practical tests.

International cooperation has major significance for the support of gaining industrial know-how, for stimulating development and deployment of systems and ITS applications of scale or for adopting standards. Intense cross-border cooperation may help initiating EU pilot projects, which address transport issues of individual countries or regions with cross-border relevance and relating to EU financial help. Also, more emphasis should be placed on cooperation in the standardization of intelligent transport systems.

In terms of building necessary infrastructure, in particular wireless electronic communication systems, more room should be given to opinions and needs of the transport sector within international, global and European organizations and EU structures in the area of radio spectrum and Internet administration and in the area of standardization of tools for implementation of ITS communications systems (e.g. International Telecommunications Union or the Electronic Communications Committee and the European Conference of Postal and Telecommunications Administrations/CEPT).

For these reasons, the Czech Republic will benefit from engaging in European activities and initiatives as part of which joint proposals of ITS development solutions are often formulated on the basis of pilot projects.

7 SWOT Analysis

During the compiling and discussions of the ITS AP data have been collected which were used for laying down the following SWOT analysis:

Strengths

- In the area of ITS deployment both on national and European level, the Czech Republic counts among the more advanced EU countries thanks to the high potential of scientific and private spheres in developing ITS technologies and products and in participating in international projects.

- ITS-related needs and measures are laid down in top strategic documents including, without limitation, the “Transport Policy for years 2014-2020 with the prospect of 2050”, “Transport Sector Strategies” and the follow-up implementation documents “Action Plan for the Deployment of Intelligent Transport Systems in the CR until 2020”, and the “Public Transport Concept”. Hence, coordination of ITS activities has been outlined to ensure sustainable development both on national and European levels.

- Individual transport modes in the Czech Republic perceive ITS as a very important tool for the implementation of measures, resolving both present and future problems, their development and the interconnection of individual modes of transport.

- Data sets (mainly the national map work) created and maintained by the State Administration of Land Surveying and Cadastre (ČUZK) (e.g. Digital Surface Map, road map of the Czech Republic at a 1:50 000 scale and road map of the regions of the CR at a 1:200 000 scale, and other); network of permanent GNSS stations – CZEPOS – providing products and services locating position in real time with a whole range of applications, with accuracy from a few millimeters to several meters (GBAS).

Weaknesses

- Missing long-term outlook for ITS deployment and implementation, including the financial framework and binding methodical procedures. The current state of implementation is fragmented, the major institutional entities cooperating with each other insufficiently.

- There is no real ITS connection between individual and freight road transport with public transport, due to which a tool for multimodal integration of transport is missing. There is no coordination framework for connecting points of ITS technologies between customer and ITS operator liability.

- In road transport, there is no clear framework for active traffic management using ITS in cooperation with transport infrastructure managers and the Integrated Rescue System services.

- ITS projects are part of a set of supplies which are implemented in aggregate in a public tender. As a result, it is difficult to make sure that legislation and standards are observed during the design of the ITS project.

- The implementation of supplies of intelligent transport systems and ITS services is hindered by legislative requirements for funding from European structural funds.

- There is no legislation assisting to the needs of state organizations subordinated to the Ministry of Transport, which act as authorities assigning tenders for implementation of ITS supplies and as operators of ITS and ITS services.

- There is little emphasis on the initiative of state organizations and the private sphere in relation to systematic fulfillment of the basic conditions for ensuring sustainable ITS development (ITS interoperability, standardization of technological procedures and equipment, conformity with standards, etc.) in designing research equipment, projects, in the development of ITS services, coordination of ITS activities and setting of functional processes between other organizations (the Ministry of Transport, Road and Motorway Directorate, State Navigation Administration, etc.).

- No evaluation criteria assessing the efficiency of ITS measures installed have been set (Key Performance Indicators).

- There is no unifying concept or unifying standards or application thereof on the methods of data collection ensuring that sufficient data coverage, data structure, up-to-date nature and sharing of data meet the needs of the users of such data and that, via standardized interfaces, such data are efficiently (in terms of financial cost and complexity of the interface design) shared across all intelligent transport systems on both national and European levels.

Opportunities

- European funds as well as national financial resources are employed to support research in ITS, international cooperation in innovation projects and ITS supplies. This encourages perfecting of products or services and contributes to the expansion of present, and the acquiring of new, knowledge in the field. As a result, the Czech industry grows along with export competitiveness and new tools for increased reliability and quality of services are introduced.

- A proposal of required legal regulations may help subordinated state organizations to eliminate ITS problems or further develop the ITS area in line with sustainability principles (interoperability, standardization, declarations of conformity, etc.).

- Increase the share of more environmentally-friendly transport modes on transport outputs of passenger and freight transport.

- Ensure continuity of transport by offering traffic and travel information in real time to ITS users via individual services.

- Increase traffic safety by collecting data on traffic conditions and unusual situations on the traffic route and subsequently creating traffic and travel information for ITS users; monitor carriage of hazardous substances, etc.

- ITS and ITS services are also a tool for increasing attractiveness of public passenger transport through services offering real-time travel information, integrated transport systems, unified ticketing systems or seeking preferences in modes of public transport, all on regional, national as well as cross-border levels.

- An integrated approach to collecting and sharing traffic and travel data that perceives and reflects upon the needs of ITS users as well as users from other transport fields or, for instance, users involved in zoning, may to a great extent help with such data becoming a highly efficient basis for solving related issues (such as mobility modeling, zoning, etc.).

- In consequence of implementing the INSPIRE Directive, increased compatibility and interoperability of individual spatial datasets (map works) applicable in transport. However, a description of individual datasets extended to particular applications will be needed for ITS purposes according to the needs of individual user groups.

Threats

- In the Czech Republic, ITS will be limited due to missing or incompatible strategy of financing (R&D and supplies of ITS, ITS applications, services, equipment and technology). As a result, the implementation of individual measures may be at risk and, along with it, the future development of ITS alone, which is currently conditioned by regulations of the EC.

- The industrial sphere will be unable to keep up with the development in ITS technologies and products, the present trend in R&D being slow. This might result in the Czech industry producing internationally non-competitive and expensive products, with ITS alone and ITS services based on inefficient technologies and technical equipment.

- Inappropriate attention will be paid to protection of personal data and data of industrial businesses and companies employed in business relations. This will lead to unauthorized infringement of privacy and other related unwanted consequences, all resulting in major financial losses. Preventing the risk of insufficient personal data protection will thus strengthen user confidence in information technologies.

- The Czech Republic’s involvement in international projects will not reach a level high enough to stimulate acquiring of knowledge and developing ITS and ITS services with cross-border relevance. For the Czech Republic, being involved in such projects is highly important; for this reason, it is vital not only to support international cooperation but in effect also to use the same in order to solve ITS issues.

- The present situation may result in a failed transport regulation due to missing feedback and due to lack of wider understanding of the trends in transport and, in final effect, to inefficient utilization of the investments into the currently developed transport infrastructure. The interconnection of traffic management systems used in cities and among them will continue to suffer from insufficient integration, leading to more intense congestion and problems in safety. Innovative ITS services will continue to struggle with inadequate access to data, making the quality and continuity of services questionable.

- Inadequate education and training of the ITS-handling staff will not bring the efficiency expected from the deployment and operation of such systems.

8 Global Objective, Strategic and Specific Objectives of the ITS Action Plan

The mobility of people and goods is one of the fundamental prerequisites of successful functioning of today's economy, as well as a key condition of life quality improvement in modern society. On the other hand, the increasing volumes of traffic burden the environment and are energy-demanding. The basic aim of the ITS Action Plan is to find a balance between advantages and drawbacks of increasing mobility and to systematically build an intelligent transport system; the Action Plan will allow to embark on processes that lead to optimal use of traffic networks capacities, it will allow to optimize the impact of traffic on the environment and to introduce user-oriented systems so as to increase the safety of users.

The ITS development must focus on users – particularly on end users – and on understanding their needs and identifying their view of functionality and usability of the ITS systems and services, all this involving people with reduced mobility or orientation. The needs of end users in the Czech Republic were examined in research projects or in thematic workshops such as Galileo User Forum (GUF). The ITS Action Plan must take into account the complexity of ITS which is reflected in the expected ideal outcome. On the other hand, the Action Plan cannot ignore the fact that some of the ITS have already been built. In their case, the focus is on improving the technical condition, if it is efficient.

8.1 Vision: Ideal Resulting Situation of ITS Development

The ITS will become a crucial tool for integrating individual transport modes in the Czech Republic, for ensuring interconnectivity between transport in cities/regions and neighboring countries, for managing transport infrastructure and related services and for finding solutions with respect to static traffic. The transport will be organized into a coherent interconnected system consisting of intelligent transport infrastructure, safer and more environmentally friendly vehicles and better informed users – drivers and passengers. Public and private sector will have access to reliable information on up-to-date state of traffic flows in the Czech Republic and on prediction of their behavior. The ITS will be a tangible and measurable contribution to the national economy. The Czech Republic will become one of the most advanced European countries in door-to-door mobility; this type of mobility organizes travel itineraries containing interchanges so as to efficiently use passengers' time, if possible without unnecessary time losses for passengers while waiting for connection. In the freight transport, a comprehensive logistics service will benefit from electronic data transmission based on interconnected information systems in all modes of transport. Information systems will be more widely used for planning and deployment of vehicles so as to improve the use of vehicle fleets. New business opportunities will open up abroad for the Czech ITS field.

From the perspective of end users, drivers and passengers, the above-mentioned vision will lead to the following specific benefits:

1) Thanks to the availability and timely delivery of appropriate and technically harmonized static or dynamic information/data (including spatial data) from relevant sources, users of the ITS can have an insight into the current traffic situation or can use such information (including their current location data) while travelling, without being burdened with redundant information. Based on these available high-quality data, users can obtain information on traffic and travelling before departing and when on journey and also in the case of

unexpected changes in traffic, preferably via mobile applications and systems in vehicles designed in a unified format, all based on the data availability in one or more standardized central databases. Based on available high-quality spatial data continuously stored in a manner allowing for their spatial and temporal analyses, it is also possible to develop dynamic multi-modal transport models and predict the development of traffic in the Czech Republic for several dozens of minutes in advance.

2) Road network is additionally fitted with sensors (such as traffic detectors and video-detection systems). The current profile measurement and sample surveys are complemented with time-continuous and at the same time nationwide accessible data coming from sampling technologies – working with GNSS data for traffic monitoring or with signal data from mobile networks. This is the way to ensure inputs of sufficient quality for models calculating the current traffic situation and geographic mobility of people, which support innovative control systems, information and support systems and other advanced applications.

3) Active elements of the ITS (such as light signals, variable traffic signs, information panels) are implemented in high-capacity roads with heavy traffic, or in the sections with the risk of tailbacks, traffic accidents or reduced possibility to ride due to adverse weather conditions. In the sections which are not equipped with these elements and on lower class roads the traffic flow may be influenced by means of variable message signs and information or instructions transmitted through on-board equipment in vehicles which will result in increasing the use of GNSS systems and mobile applications.

4) All processes in the ITS related to data collection (including spatial data) are protected against the risk of misuse of personal data or information obtained in the course of trade.

5) Data collected in the public sector are made available to other customers both from the public and the private sector, which strengthens the development of new services with added value, such as information on availability, accessibility and mapping of public buildings and publicly accessible places in a convenient form. Based on defined conditions, the applications based on open data are also used by the public sector, for consideration related to the data provided.

6) High-quality fundamental spatial data associated with traffic which has a uniform format is available. Other spatial data from various databases may be used and more efficiently interconnected with other public administration information systems. Other entities which do not make part of the transport system, such as the IRS, can also use spatial data related to traffic through standardized reference interface, preferably free of charge. However, it is essential to provide financial resources to administer, update and develop the data stock and related spatial data infrastructure. Spatial data serve as a basis for the development of services to meet the needs of different user groups, such as transport infrastructure managers and users, people with reduced mobility or orientation, etc., as well as for the needs of e-Government and to solve critical life situations. The database containing fundamental spatial data related to transport is administered, expanded and improved in a long-term, sustainable manner, in consistence with the needs of various user groups and e-Government.

7) ITS applications are created based on customers' (users') requirements and system parameters, i.e. based on such setting of system properties ensuring that information delivered by the system is reliable, trustworthy and available at a specified time to ensure

target application functions throughout the whole chain of transmitted information and not only for an individual subsystem (i.e. only as a locator) or part of the service (e.g. displaying the location of tracked vehicles). Assessment of system parameters ensures that provided services are of specified quality and the acquisition and operating costs of the ITS are efficient.

8) Recording traffic conditions in space and in real time allows for the collection and evaluation of important developments in traffic. This information is correspondingly processed in traffic models and after that distributed in real time in order to improve the flow continuity for transport users.

9) Transport infrastructure managers can monitor in real time conditions in the traffic network and provide for the safety and continuity of the traffic flow.

10) So as to minimize disruptions to traffic flow continuity and traffic safety, the movement of oversized and overweight loads as well as of high consequence dangerous goods is monitored in real time (Article 1.10.3.1.1 of ADR Agreement). Incidents during the transport of such goods, if any, are adequately addressed as quickly as possible, and at the same time, information on and navigation for barrier-free transport (i.e. allowing safe and independent unassisted movement for all users) is provided in a manner accessible to all affected parties.

11) Information about emergencies (such as serious traffic accidents, natural disasters, etc.) and relevant instructions for their solution are presented to transport users in a timely and understandable manner by means of internationally used and recognized pictograms and voice messages for the visually impaired including people with hearing disabilities, which thus reduces the risk of inadequate behavior or panic.

12) Users of public passenger transport can obtain necessary information about the manner, conditions and planning of emergency measures related to travelling thanks to the compatibility of individual existing systems. While travelling, the passengers have an overview of traffic irregularities (such as delays and closures due to incidents) in real time, as well as of adopted corrective measures. Information can be distributed through different channels and is also available at selected transfer terminals with barrier-free access. Public transport vehicles are being equipped with passenger information systems and operative traffic control systems; thanks to them, continuity during transfer can be ensured in case of a defined delay. The straightforward and clearly structured system for operative traffic management and for passenger information makes public transport more attractive and reliable; it is then used more often, too.

13) The existing electronic ticketing systems have been unified and electronic ticketing systems for passengers in public passenger transport have been interconnected. Users of public passenger transport will be able to purchase a universal multi-modal ticket at one point of sale (but not necessarily a single one). It could be acquired online at the very moment of journey planning and could exist only as a soft copy (e.g. on a contactless smart card, in a mobile phone, tablet, etc.). Ordering party of public transport also benefit from interconnected ticketing systems because they lead to more efficient processes, as well as to cost reductions, optimization, and more efficient management and auditing of financial processes associated with providing transport as a public service. Ordering party of public transport can also use these systems to calculate and distribute fare revenue among individual carriers. The increased accessibility of cashless fare payments helps to

accelerate the process of ticketing particularly in suburban bus transport where passengers buy tickets from the driver when boarding the bus.

14) Road traffic safety has significantly improved as the risk of accidents has been reduced thanks to reliable warning systems alerting road users on non-standard conditions on their route (localization of congestions, information about road surface conditions, etc.) The ITS also improve safety of vulnerable road users.

15) All newly manufactured vehicles are fitted with vehicle technologies which will warn drivers in time of dangerous situations; if the situation cannot be averted, the system will automatically report a serious traffic accident to the public safety answering point (line 112). Procedures for removing obstacles from roads have been transparently set up allowing to provide assistance to individual road traffic information centers.

16) Drivers are assisted by on-board systems which use modern cooperative ITS solutions in difficult traffic situations, in intersections and in merge lanes and help prevent traffic accidents that occur in emergency situations. Semi-automatic and fully automatic driving (under specific conditions) help reduce the number of accidents which would result from drivers' failures.

17) Products and services of space systems are used in the transport sector for the purposes of normal traffic. Applications based on space systems are used for all transport modes according to specificities of individual transport modes so as to increase transport efficiency and safety and last but not least, to reduce the operational costs of transport networks. As an example, we can cite the use of satellite systems for the purposes of regional railways for safe localization of trains within railway traffic control systems; satellite systems will also facilitate approaching and landing of air rescue service helicopters in difficult terrain, and in conjunction with other decision support systems they will help to conduct rescue operations in dangerous conditions (especially in poor weather) without jeopardizing the lives of the person being rescued and also of the crew, as well as the helicopter safety. Inland navigation also benefits from satellite systems. Applications based on space systems can help improve the accessibility of information for users of public passenger transport and provide better opportunities for ensuring continuity during transfer, including integrated transport systems (multi-modal integration). Last but not least, space systems can contribute to more frequent use of urban public transport when efficient for the users with respect to current traffic situation, and to increased safety of the transport infrastructure.

18) Ensuring the availability and wider use of meteorological forecast and warning services for effective control and increased traffic safety. Meteorological forecast and warning services are among key factors for the control and safety of traffic (during maintenance of transport infrastructure and for traffic control both under normal and emergency conditions, etc.). To be able to provide the above meteorological services, it is important to ensure in the future the access to satellite data and to services which are based on this data; this data represents a necessary input for meteorological models which are successfully used in transportation.

19) The implementation of the ITS in cities will be supported by the Smart City concept which is a modern urban concept. The fundamental vision of this concept is to effectively and systematically promote the development and interconnection of high-quality energy,

telecommunications, transport and environmental infrastructures, education, culture and business with high added value.

20) Gradually, autonomous (robotic) vehicles are being put into operation in the transport network, which results in automated road traffic control. Road traffic continuity thus improves, and unnecessary congestions and resulting economic losses are minimized, as well as harmful pollution with CO_2, for example. Autonomous vehicles are capable of responding to threats; as a result, it is possible to completely eliminate fatal accidents. Deployment of autonomous vehicles will support unassisted mobility of the elderly and of people with reduced mobility or orientation.

21) The ITS are able to record and evaluate traffic data for the purposes of transport operation, as well as of automated transport organization planning and of development of conceptual changes.

22) International cooperation in the field of ITS is developing and various Czech organizations take part in international innovation projects, which results in the refinement of products and services as well as in advancements in knowledge in this field. Czech industry is developing, its export competitiveness is improving and the transport system in the Czech Republic provides most up-to-date and very reliable services of high quality.

23) The above-mentioned situation is achieved by joint efforts of all stakeholders, administration bodies, industrial facilities, service providers and other private organizations, all this thanks to the implemented technical basis and support of an information platform which disseminates information about the ITS and serves as an educational source especially for public procurers.

Based on this vision, the ITS Action Plan was drafted and further elaborated in more details into the strategic objectives. Strategic objectives, which are consistent with the priorities of the national transport policy, are subsequently divided into specific objectives that will be implemented through individual measures.

8.2 Global Objective

The global objective is to continuously increase the efficiency of the transport system in the Czech Republic through the ITS. This specifically means to increase traffic safety and traffic flow continuity, to coordinate, synchronize and optimize the transport of passengers and movement of consignments across the network of individual transport modes, to further reduce the impact of transport on the environment and thus to help improve the life quality for all inhabitants.

In the times when still separated national economies are being more and more interconnected and the integration of Central and Eastern European countries results in new demands on the performance of the transport systems, the implementation of modern methods of organization and management is also crucial to maintaining the competitiveness of the Czech Republic. In today's globalised world, we can no longer rely on the fact that competitiveness is primarily based on good transport infrastructure. We also need to take into account the very traffic on that infrastructure which must provide appropriate services to the transport users.

The ITS are among the important solutions to deal with the problems of increasing mobility both now and in the future. They allow for a comprehensive overview of all modes of transport and help coordinate interconnecting of different transport systems. They help to better manage stressful situations stemming from the ever increasing traffic intensity and the resulting critical events.

The ITS Action Plan describes the will of the government to develop cost-efficient and technically scalable ITS implemented in a harmonized way. This approach will have several benefits. Thanks to it, we will avoid isolated solutions which would be incompatible with other systems and therefore would have high operating costs. It will allow for future cooperation among individual systems and it will significantly reduce the costs of this process. With unified data formats, data from the ITS (including spatial data) will be more often used in various applications and the costs of sharing the data will decrease. Thanks to the implementation of the ITS, we will avoid solutions which would not enable interoperability (interconnectivity) of systems and continuity of services provided by the ITS (continuous provision) at the European, national and regional levels. Ultimately, the approach using open system and open specifications will significantly influence the acquisition and operating costs of the ITS. Last but not least, it will provide for the desired functionality of transport systems as a part of the state's critical infrastructure.

Thanks to rapidly evolving technologies, the ITS Action Plan proposes to build the ITS on existing technologies and on those to come, too. As for the very implementation of the ITS, their development will mainly focus on the systems whose implementation will be essential for target groups in terms of social benefits and which will be feasible from the technical (compatibility of systems), and also organizational point of view (setting adequate information relations and using relevant telecommunications infrastructure).

8.3 Strategic and Specific Objectives

8.3.1 Strategic Objective No. 1: Efficient and Intelligent Transport Infrastructure with Qualified Service Staff

This objective is primarily focused on managers and operators of transport infrastructure or transport services, rather than directly on end users such as drivers or passengers. While building new systems and integrating the existing and new technologies, it is important to provide for harmonization of the ITS taking into account their international character.

So as to prevent to the maximum possible extent the creation of mutually incompatible solutions and also fragmentation of individual systems and ITS applications, it is necessary to ensure the compatibility of systems and continuity of ITS services among individual systems at the local, regional, national or European level.

To effectively coordinate ITS implementation, it is vital to define interfaces among systems and their components so that these interfaces could be standardized; this would "liberate" the market with ITS devices which would be technically substitutable, i.e. independent of the manufacturer (concept of technological neutrality). Ultimately, this fact will significantly affect the price of the systems (also for public ordering party), their usability for other purposes (applications), and their compatibility and potential extensibility (within other systems). This coordination does not result in orders to use a particular technology, but in determining necessary system parameters and standardized interfaces and in providing for the systems compatibility and continuity of ITS services among individual systems at the local, regional, national or European level.

In this context it is useful to define system parameters for individual applications, taking into account the ratio between the level of required reliability and safety of the application and its acquisition and operating costs. The aim of defining system parameters is to provide for the usability of a specific application by setting the properties of the system according to the requirements of the customer (user). The more stringent the requirements of the user are, the higher the demands both on the system parameters and on the investment and operating costs. It is necessary to establish validation procedures for devices on which the highest demands on reliability and accuracy are imposed. Besides system parameters provided by satellite navigation services, attention needs to be paid to the data stocks for related applications such as digital maps, data layers, points of interest, including data updates and verification.

For this reason, it is necessary to support the standardization process so as to comply with technical standards; this will ensure both the functionality and mainly further modular extensions of the ITS. A standard is always a voluntary act and compliance with it can only be enforced by legislation or through a market-based force. In railway transport, the technical standards or their parts defined in the Technical Specifications for Interoperability (TSI) become binding upon publication of the relevant TSI. Existing legal regulations will have to be changed or new ones will have to be elaborated in the areas where it is vital (e.g. to provide for safety and eliminate the threats to human lives). With this approach, the ITS can be extended without additional funds which would otherwise be needed to overcome technical barriers and to more efficiently use the allocated funds.

Given the fact that the ITS may be built by a group of various stakeholders, interoperability (cooperation) among systems and subsystems is important. The following types of interoperability must be considered while building the ITS:
1) Technical interoperability: the interconnection of computer networks and information services;
2) Information (semantic) interoperability: well defined meaning of shared data and information that is unambiguous for all connected systems;
3) Organizational interoperability: cooperation of various private and public entities based on mutually agreed procedures and objectives in order to provide continuous information support for the process of moving things;
4) Legal (contractual) interoperability: the development of relevant national and international legal frameworks to ensure that data such as electronic data from GNSS and their related applications are recognized as legally relevant;
5) Political (conceptual) interoperability: support of the ITS development based on a shared vision and common priorities.

It is necessary to address other important issues such as permissions to use the obtained data, because when using public funds, it must be ensured that other entities can also benefit from the data obtained by the public sector (Directive 2013/37/EU and Directive 2003/98/EC). The protection of privacy and commercial secrets must also be addressed, and transmission of data to third parties must be sufficiently legally protected, too. Furthermore, guarantees for service provision (liability for defects) must be defined as well as unambiguous liability for damage.

When developing and applying innovation technologies, experts and end users must be consulted, including people with reduced mobility or orientation and the elderly, so that these groups can make a full use of the innovations potential as well. As an example, we can cite electric and hybrid vehicles whose operation has become so quiet that it poses a direct threat to the visually impaired (but by no means only to them).

As a result of this approach, the ITS will become a tool for quality management of the provided service that is called "Efficient, smart and living traffic route". Directive 40/2010 on the ITS provides for the assessment of conformity of products and also services, i.e. the use of ITS technical equipment so as to ensure the control and information processes through the applications of the ITS. In the case of the applications of those ITS whose system error (when in operation) would endanger lives of people or pose a substantial threat to property, the so-called simplified conformity assessment is recommended; it is a submission of a declaration indicating that all requirements provided for in the relevant EC regulation are met. These declarations will be assessed by an impartial and independent national body selected by the state.

8.3.2 Strategic Objective No. 2: Ensuring Continuity of Traffic and the Associated Reduction of Total Time Losses in Traffic

To ensure traffic flow continuity, it is essential to provide traffic participants with information, both for the planning purposes before their departure and in real time when on journey. We particularly need to provide information on emergencies to participants located at the very place of the emergency or nearby, or to participants who are expected to head in that direction. The information should provide an overview of the current situation and its expected development, but sometimes it is needed to send specific instructions to traffic participants or passengers. Time has become an important variable while travelling, and non-verbal (mainly visual) simple basic information are the fastest way to quickly, cost-efficiently and understandably convey information or instructions. Thanks to the technical principles of the ITS, information and instructions can be presented to all participants in the language of their choice and best in combination with an internationally recognized and used pictograms; other manners can be used based mainly on the needs of various groups of people with reduced mobility or orientation (e.g. voice messages for the visually impaired). This matter should be consulted with representatives of these groups. Pictograms can be easily understood by people who cannot read messages because they do not master the language (foreigners) or because their intellectual abilities have not been developed yet (commuting pupils of first grades of primary schools). Visual information systems such as the symbols on variable traffic signs should have unified style and content.

In the case of an emergency, there is very little time during which a quick and appropriate decision about subsequent steps to take needs to be made. Practice shows that informed people cope with emergencies better. To address such situations, timely provision of information about possible threats and of instructions on how to behave is essential. Otherwise, there is a risk that due to the stress caused by the lack of information, emotions of people will burst and such a reaction may be disproportionate to the gravity of the situation. People may start panicking which is a dangerous phenomenon in relation to traffic and as such it must be prevented. The ITS have a significant potential to address stress, conflict and emergency situations in traffic more effectively.

To be able to provide the above information and instructions, we need to have all the input data necessary for the analysis and evaluation of such a situation. Sufficient high-quality information allows for faster and more appropriate decisions of traffic management personnel to address and manage the situation. The ITS reduce the likelihood of subsequent related multiple emergencies. In public passenger transport, the ITS reduce the impact of traffic irregularities.

Implementing and using control and information technologies based on detailed analyses of the state and prediction of traffic flow dynamics in real time, the ITS will help to increase knowledge about the state and behavior of traffic, and to reduce time losses caused by congestions by up to 10% by 2020; it will further help to reduce societal losses (e.g. losses incurred from secondary accidents which happen due to lack of information about tailbacks, losses due to missed connecting services, etc.).

To be able to regularly assess traffic flow situation in the monitored areas and to foresee their imminent development (in the range of tenths of minutes to hours), it is important to regularly collect, store, process and analyze the necessary data on the state of traffic flows. Regular recording of the movement of vehicles in a specific location is made by automatic transport counters which continuously count and classify vehicles; they also count on-board units in vehicles for satellite tracking nationwide or for other nationwide sampling technologies.

Time and economic losses may also be significantly reduced thanks to more effective and faster removal of obstacles. We need to implement a functional system solution based on close and permanent cooperation between national traffic information centers, authorized call centers, volunteer traffic "reporters" and the network of entities which remove the incurred traffic incidents (the circumstances having a negative effect on flow continuity and road safety). The selection of such contractual entities that have special technical equipment to remove the incident and its negative effects and consequences must be non-discriminatory and must be based on the following criteria:

- Expertise and technical/technological skills and equipment
- Distance from the specific incident
- Current traffic capability of the road network at issue
- Number of cases solved in the past (effort to allocate the cases among the entities as fairly and equally as possible).

Traffic flow continuity also needs to be improved through the deployment of management systems for overburdened road sections, sections under reconstruction and other identified bottlenecks of the road network. Improved flow continuity will automatically result in lower total time losses in road traffic.

Congestions may result not only from accidents or incidents which require flexible closures of road network sections, from incidents on railways, or from railway line closures requiring flexible railway passenger traffic restrictions. Unplanned events such as failures, accidents and natural disasters, etc. cannot be foreseen. On the other hand, foreseen traffic restrictions due to construction works, which include modernization, maintenance and refurbishment of lines, railway stations and stops can be planned and effectively coordinated.

We also need to create a work centre which will see the transport network in a holistic perspective and particularly from the user's perspective. Users hardly ever care who runs what part of the network, but they want a basic level of services, i.e. safety and also traffic flow continuity. The above work centre will see the transport network holistically and will primarily assess the impacts of individual traffic measures on the living traffic route.

The work centre will be equipped with a range of modeling tools and will have a rather quick access to all relevant historical traffic data describing typical phenomena and related traffic problems. It will be responsible for the following basic tasks:

1) Collection of information about all planned traffic restrictions in the relevant transport networks (particularly road and railway networks and in case of some urban transport operators also in networks of trams and trolley-buses);

2) Assessment (based on historical data) of impacts of individual restrictions and their combinations on the level of provided services in the transport network;

3) Issuing recommendations regarding measures which would mitigate the impacts of planned restrictions (as for awareness, implementation of control systems, etc.);

4) Issuing recommendations regarding potential optimization of the schedule of individual activities;

5) Continuous financial evaluation of the impacts of implemented restrictions, both in terms of potentially increased costs of implementation for network managers and operators, and in terms of costs transferred to the user.

8.3.2.1 Specific Factual Objective No. 2.1: Increasing Awareness of Traffic Participants

Suitable information sources are the following: the so-called agenda systems, the ITS detection elements in the transport network, and nationwide accessible data from sampling technologies; the systems can work with GNSS data for traffic monitoring, with signal data from mobile networks, or with data from additional sources. Traffic information can also be obtained from other (additional) sources which report traffic incidents seasonally, intermittently or voluntarily (such as reporters of Český rozhlas radio, GLOBAL ASSISTANCE service and "Green angels" of Central Auto-Moto-Club of the Czech Republic). Another important group of traffic information providers consists of entities operating traffic information services. Coherence and interconnection of existing systems and a holistic approach to the collection, processing, storing, analyses and distribution of traffic information within the ITS need to be ensured. Currently, ample data is available, but staff assessing this data is often missing, as well as tools and mechanisms for using the analyses outputs for current dispatching control or for planning. The timeliness of data is an important area of interest. We have methodologies to respond to emergencies, to take appropriate measures, and to provide information about emergencies, but we often lack guidance in terms of revocation of the measures and restoration of the initial state.

8.3.3 Strategic Objective No. 3: Increasing Traffic Safety

In the field of transport, safety is understood as a safe operation of a vehicle on a traffic route so as to avoid death or injury of people or damage to property or transported goods in direct connection to the operation of the vehicle in motion. The safety is also related to the protection of traffic participants or users of the transport system against crimes. This issue is covered by Strategic Goal No. 4. The ITS working with vehicle technologies and equipment installed on transport infrastructure allow to timely detect and inform drivers of dangerous situations, and if an accident cannot be averted, to automatically report a major traffic accident to the public safety answering point (number 112). The ITS also improve the safety of vulnerable road users, particularly of people with reduced mobility or orientation.

Currently, the character of road traffic does not require (to ensure the safety of vehicles on the road) such interlocking and signaling equipment as railway or air transport use. Driving and ensuring safe transport of people or goods on the road is the driver's responsibility. It has been so far only the driver's task. However, systems similar to those in railway and air transport are beginning to appear in road transport, i.e. anti-collision systems, automatic vehicle control systems, traffic situation detection systems, etc. Information about current locations plays a crucial role in these systems. Use of autonomous vehicles (vehicles without drivers) in traffic requires both the autonomous vehicle platform and the creation of supporting infrastructure allowing for the operation of such vehicles. The supporting infrastructure will involve appropriately adjusted orientation systems including navigation, customized maps, and associated cooperative communication systems for vehicle-to-vehicle and vehicle-to-infrastructure communication (C-ITS), i.e. highly reliable telecommunications infrastructure. The development of the autonomous vehicle platform requires new specialized components and technologies to be developed, which will enable the transition from the current phase of prototypes created by adapting people-driven vehicles to the sustainable production of safe and fully autonomous vehicles, which will represent a new and revolutionary form of transport.

We have recently seen a growing demand for inexpensive portable devices to support the driver when driving, which would not be supplied directly by the car manufacturer (e.g. PDA-based systems). However, such equipment can jeopardize the safety of drivers, passengers and other road users if due to poor interface design the information in the device distracts the user and if he thus does not pay attention to the task he is performing. A well designed human–machine interface/interaction is an essential element contributing to road safety.

The safety of transport infrastructure forms an integral part of traffic safety and needs to be monitored and ensured.

8.3.3.1 Specific Framework Objective No. 3.1: Reducing Number of Dead and Seriously Injured People in Road Traffic

The use of the ITS will help to reduce the number of killed and injured people. One of the groups of ITS users are vulnerable road users. These are cyclists, pedestrians, the elderly and people with reduced mobility or orientation. The essential aim of the ITS is to improve the safety of these groups of users through warnings about dangers or potential obstacles on the infrastructure, while taking into account their special needs.

As regards visually impaired people, navigation and acoustic systems should be implemented to help orientation in public passenger transport, public buildings, urban areas, underpasses and intersections. The ITS can also inform people with reduced mobility about the best barrier-free route. And hearing-impaired people are supported by signs, images and pictograms.

New technologies at pedestrian crossings, such as motion detectors which are independent of traffic lights, help to reduce the number of injured pedestrians. Pedestrians' safety can be improved by in-vehicle warning systems which can warn the driver about the risk of collision with a pedestrian, even if it the pedestrian is dressed in dark clothes at night or in bad weather.

Attention will also be paid to the use of modern technologies within cooperating ITS which are based on vehicle-to-infrastructure and vehicle-to-vehicle communication (C-ITS); these should help to:
- Reduce the number of accidents and their consequences caused by speeding
- Reduce the number of accidents and their consequences caused by violating the right of way
- Enhance the protection of vulnerable road users
- Improve road users' compliance with legal regulations

The number of multiple-vehicle collisions (i.e. accidents caused when cars cannot stop in time behind a tailback) in motorways and expressways may be reduced by informing drivers through in-vehicle systems directly and well in advance about the occurrence and location of a queue within their direction; this information can also be disseminated thanks to dynamic road traffic management systems which are activated in case of an emerging tailback and are able to consolidate the traffic flow or reduce the speed of the traffic flow before arriving to the dangerous place.

Drivers can also be informed and warned about a danger through cooperative ITS by automatic anticipation of other drivers' mistakes. This technology is based on wireless communication between (road) vehicles and is intended to detect potential risks in traffic, thus preventing accidents.

8.3.3.2 Specific Framework Objective No. 3.2: Reducing Risk of Emergencies while Transporting Loads that Require Special Care or Supervision (Dangerous, Oversized and Overweight Loads)

We have already implemented several ITS applications for planning and monitoring of transportation. These are closed systems usually operated by one organization and only customers have access (usually limited) to them. Neither rescue services nor road traffic management centers have access into these systems. In the case of an accident or emergency, integrated rescue system (IRS) units cannot be automatically informed so as to intervene in a fast, adequate and qualified manner.

The services within road freight transport include ensuring high quality of transport in its course. Therefore, a constant overview of the status and progress of transport processes must be available. To inform about the progress of transport in real time between the points of loading and unloading, location of the transported goods or of the vehicle needs to be known. In road freight transport, information systems informing about the location of vehicles or loads are mostly used by medium and large carriers. There is no connection to the rescue system. In the event of an accident, the intervening unit must either rely on the information of the person who reported the accident or determines the seriousness of the situation not earlier than on the spot. The ITS could therefore mitigate potential negative impacts of traffic accidents involving dangerous goods. Vehicles carrying high consequence dangerous goods should be equipped with a GNSS receiver allowing to receive GPS and Galileo signals (or GLONASS and Beidou as well) and EGNOS signals for more accurate information on the vehicle location; vehicles should also be equipped with means for communicating the location information.

In addition to normal (text or table) description (bill of lading and related documentation of carriers and their customers, transport contractors), comprehensive information support of special loads tracking (dangerous, oversized and overweight and other loads) also involves features closely related to the spatial description of transport networks, especially maps and other graphic documents.

8.3.3.3 Specific Framework Objective No. 3.3: Increasing Awareness of People Located in the Area of Natural Disaster or Other Emergency or Approaching That Place

To increase the use of ITS in this field, it is important to develop plans for management of traffic on the main routes connecting major agglomerations in the Czech Republic, as well as on the routes heading to major agglomerations in neighboring countries; these plans should include procedures for normal situations, emergencies and critical events which would provide for planning, acquisition and subsequent use of the ITS deployed in emergencies and critical scenarios, across individual sectors and all IRS services.

In the case of natural disasters or other large-scale emergencies, information about the current state of transport infrastructure and potential restrictions of its use need to be disseminated.

8.3.3.4 Specific Factual Objective No. 3.4: Improving Safety in Road Freight Transport

This specific objective is dedicated to providing information on parking places for trucks and commercial vehicles (with potential booking of places); truck drivers will be informed about locations suitable for parking their road freight vehicles and about locations that will be protected against crime, such as thefts of transported cargo and of vehicles; at the same time, drivers should be protected against robbery.

8.3.3.5 Specific Factual Objective No. 3.5: Reducing Risk Behavior of People Approaching the Railway Tracks

Despite functioning technical equipment at railway crossings (e.g. crossing barriers, warning lights), drivers and pedestrians behave dangerously at railway and pedestrian crossings and in the proximity of tracks, which often results in tragic consequences. Between 2005 and 2014, there were about 2,500 collisions with vehicles or pedestrians out of which 1,754 were fatal. Implementation of ITS video systems equipped with infra-red barriers and other modern technologies at railway crossings, pedestrian crossings and in other selected areas in the proximity of tracks (i.e. automatic warning system) can reduce risky behavior of drivers and pedestrians on parts of the railway infrastructure where this danger may occur. The system will among others build on the "Amelia" project which was implemented within the support programme for applied research and experimental development (ALFA) funded by the Technology Agency of the Czech Republic.

8.3.3.6 Specific Factual Objective No. 3.6: Reducing Risk of Jeopardizing Railway Transport Safety due to Technical Defects in Vehicles

The direct result of defects (particularly of freight trains) are large-scale accidents entailing material damage to vehicles and cargo, as well as considerable damage to transport infrastructure and significant threat to the safety of railway transport depending on the train speed and place of derailment (direct collisions between a car and an approaching train can also occur, among others). In such cases, there is a dramatically increased risk of major consequences such as rail fractures, wrenched off axle pivots, released tyres and teared monoblock wheels at the so-called corridor lines, and due to the increase of line speed to 160 km/h also on other lines. There is still also a significant risk of collisions between railway vehicles due to poor quality and maintenance of sandboxes; this results in insufficient sand delivery and therefore loss of "train trash" and impaired functioning of signaling equipment.

The potential risk of these defects is increased not only by a higher line speed and permitted speed, but also by running through long line sections without stopping (mainly shuttle container trains between inland terminals and sea ports) and by increase in axle load; still, the number of employees who monitor the train movement throughout the transport process has been decreasing which therefore reduces the likelihood of detection of the above defects by visual checks of passing trains. For this reason, we use devices that try to replace the human factor and allow for the detection of such defects even at high speeds and low visibility, i.e. under conditions when human senses only discern the defects with difficulties. The basic precondition for the diagnostics of these defects is that it must be carried out when the train is in motion because when still, the defects manifest themselves less (temperature of bearings) or not at all (mechanical shocks of flat wheels). Although hot box detectors started to be implemented in the ČSD network in 1969, a network of digital devices for the diagnostics of defects on vehicles in motion which has been implemented on railways in the Czech Republic since 1999 has still not been finished. The current network of indicators only diagnoses 12% of the total output of railway vehicles and individual indicators only work locally.

Expansion of the network and implementation of a telematics add-on (ROSA) providing communication between individual checkpoints with online evaluation of the defect development will substantially reduce the number of undetected serious defects of the rolling stock which jeopardize the safety of railway traffic. If we identify a vehicle in motion whose condition does not comply any more with technical requirements but does not yet jeopardize traffic safety, it will be from then on constantly monitored, which will reduce the damage incurred by technical defects of rolling stock deployed in the Czech railway network. To determine the location of vehicles, the ROSA system will also use European satellite positioning systems EGNOS and Galileo. Interlinking with similar systems in neighboring European railways in the form of exchange of alerts and of related data is also being prepared.

8.3.3.7 Specific Factual Objective No. 3.7: Improving Safety and Flow Continuity of Railway Transport through ITS – Control-analysis Centre for Railway Traffic Management

Railway transport is managed in continuous operation on a large area and it is connected to railway networks of neighboring countries. Railway traffic is protected against accidents or collisions through interlocking and signaling equipment and defined administrative procedures; its organization is also supported by a range of information systems. Signaling and supporting information systems contain a lot of valuable information about railway traffic or detailed information on each train in motion, such as time of arrival in and departure from individual stations, number of the open line track or station track on which the train runs, which wagons make part of trains and their order, the train speed, occurred incidents, etc. Based on this information, it can be evaluated if during the journey of each train, conditions laid down by internal regulations were fulfilled or whether these regulations were not seriously violated. This information can also be used to evaluate current situation in railway traffic and to adopt control measures in real time in the case of irregularities in traffic. This mainly relates to situations when traffic flow continuity is hampered above tolerable limits and it sets off a chain of similar events within the system, as well as to gridlocks due to traffic accidents or devices failures, etc. The above historical data can also help to balance and plan the capacity of railway network and model optimal modes of operation of railway stations and line sections. For this reason, a comprehensive and sophisticated set of technical resources will be created, which will provide access to all information needed to optimize and secure the process of railway infrastructure management. First of all, a unified environment for data collection and recording will be created forming a subsystem of the main traffic management system; in this way the individual systems that provide key information for railway traffic management (these systems are currently dispersed in various places and the technology is not unified) will be interlinked and put together. New features of the system will simplify the procedures in the area of management and organization of railway infrastructure, particularly processes related to planning, organization and surveillance. In this way we will create an environment in which a realistic and up-to-date model of operational conditions for trains running on the transport infrastructure will be built; it will also result in more flexible approach to managing and organizing the traffic both on line sections and on the whole railway network. This system will also provide evidence for investigation and clarification of causes of accidents. The implementation of the above comprehensive system will provide a well-defined unique approach to information and data provided by the above information systems; we will thus maintain the required level of accessibility within the limits set forth by relevant legal regulations.

8.3.3.8 Specific Factual Objective No. 3.8: Reducing the Risk of Jeopardizing Railway Traffic Safety due to Damage or Theft of Technical Devices and Equipment on Railway Infrastructure

Every year, large-scale thefts of equipment on railway infrastructure are committed and damage is incurred. Mainly metallic (copper) cables and other parts of interlocking, signaling and communication equipment controlling the operation, sequences, speed and crossings of trains in stations, etc. are stolen. In addition to considerable material damage, adverse impacts on railway traffic, long delays and irregularities in passenger and freight transport and high costs of eliminating these illegal acts, the greatest risks are the disruptions of integrity of the interlocking and signaling equipment, interferences into this systems and potential major accidents (collisions of trains running against each other on one line track, running on an occupied or dead end track in a station, etc.).

Most modern detection systems for line protection can provide online information about interferences, damage, thefts, illegal activities, even prior to the very "physical" interference in the parts or equipment on the railway infrastructure. The ITS will analytically evaluate information and define precise location, type and manner of the potential disruption of the integrity of equipment, identify its damage or suspicious activities preceding such disruptions. Thanks to an intelligent operational and graphic add-on, employees in the surveillance centre will be able to take appropriate measures to prevent or reduce the occurrence of damaging activities, all that in cooperation with operational and law-enforcement units of the Czech Republic so as to minimize the impact of emergencies. We expect that the preventive concept of the system will significantly reduce the frequency of these cases on the Railway Infrastructure Administration's (SZDC) network, as well as material damage, delays, operational problems, expenses necessary to eliminate the defects and in particular the risk of jeopardizing railway traffic safety.

8.3.4 Strategic Objective No. 4: Reducing Serious Violations of Traffic Rules and Avoiding Serious Law Violations in Traffic

The ITS applications related to the monitoring of drivers' behavior in traffic are an effective prevention and the ITS can prevent aggressive behavior on the road. Crime may or may not be primarily related to road traffic. Still, risk areas need to be identified and their monitoring ensured for example through video surveillance of rest areas and license plates checks (stolen vehicles, unregistered vehicles on the roads, insurance frauds, etc.). To ensure appropriate response of law-enforcement units, interconnection of security applications needs to be provided for in legislative amendments.

8.3.5 Strategic Objective No. 5: Development of ITS in a Harmonized Manner

To fully exploit the potential of the ITS, the existing applications and systems as well as those under development need to achieve appropriate level of compatibility, interoperability and continuity of services provided to end users at the local, regional, national or European level. Such a comprehensive system requires that the proposed solution covers technical, organizational, economic and operational aspects and therefore achieves maximum compatibility; considering and understanding users' needs, the solution also needs to be adjusted for the relevant application. An important prerequisite is the mutual interoperability of the ITS, possibility to electronically share telematic information among various transport modes **which significantly contributes to improving traffic safety** and also among entities involved in the whole transportation process, influencing traffic flows, performing logistic operations or providing technical supervision of these activities. As for the development of new devices and their implementation respecting new European directives, technical specifications and standards (whose objective is to gradually establish technically compatible European transport system) are the essential condition.

Fundamental spatial data – standardized digital maps – are an important support material for the ITS. Requirements for quality, level of detail, accuracy and timeliness of the spatial data (i.e. mainly for digital maps) in relation to today's ITS applications are high and will only continue to rise in the future, also due to the development of car2car and car2x cooperative systems. The importance and usefulness of spatial data has also been rapidly growing for people with limited mobility or orientation. Acquiring, updating and providing spatial data and spatial information is a part of the industry with growing potential and importance for the national economy.

The field of transport in particular requires that attribute information (properties, values of variables, calculations, etc.) be understood and processed both in the territorial (or spatial) and temporal contexts. The relation of a specific piece of information to a certain territory is ensured by linking an attribute with location information (i.e. extending descriptive attribute information using spatial information), including its quality, which means accuracy of coordinates. This information is needed also for independent movement of people with reduced mobility or orientation, for example. Only then can we provide data analyses in relation to a specific area and therefore successfully plan, develop and manage transport infrastructure and monitor phenomena which occur on it. There is currently no unified platform which would integrate spatial data for all modes of transport, fully cover the requirements of users and meet the requirements we impose on interoperability. Along with the development of the stock of spatial data about traffic, spatial data infrastructure and public services based on these data also need to be developed. Spatial data sets showing and describing the transport infrastructure must be seen as its integral part, which is perceived today primarily in terms of transport structures.

8.3.5.1 Specific Framework Objective No. 5.1: Creating Transparent Market of ITS Mobility as a Service

Unified legal and regulatory frameworks and technical standards frameworks need to be improved so as to allow sharing of the obtained data (including spatial data) under non-discriminatory conditions. Through standardization, certification and training, we also need to ensure compliance with applicable data structures and therefore interoperability in the Czech Republic as well as within the EU. The final effect will be achieved by:
- Ensuring the interoperability and continuity of services (based on standardization);
- Actively promoting more and more open access to the data and services;
- Adapting the relevant frameworks for public procurement;
- Active involvement of users in the process of developing new services and increasing cooperation with users with reduced mobility or orientation.

8.3.5.2 Specific Framework Objective No. 5.2: Creating Standardized ITS Interfaces for Technically Similar Systems in Other Modes of Transport

Standardized interfaces among individual ITS systems, subsystems and applications are an essential prerequisite for harmonized ITS development. To create a standardized interface we need to:
- Define the specifications of the individual relationships among ITS applications, subsystems and systems;
- Specify the requirements for individual interfaces of the relations;
- Define interface standards;
- Support the use of standards by legislative measures;
- Establish uniform terminology.

Unified manner of describing and exchanging traffic information among public administration entities and towards the public will be ensured. We also need to adapt the formats of shared information to the possibilities of automated checks of their accuracy and ensure the organizational and formal aspects of data sharing and exchanging process so that it can be used to link the technical systems without involvement of the human factor in this process (apart from conclusion of contracts).

Besides personal prerequisites, a person's mental state has important influence on one's behavior in traffic; mental state is particularly affected by attention defined as "*focus and concentration of mental activity on a certain action or an object“*. Human mental capacity for receiving and processing information is limited and can lead to insufficient perception and processing of information important for safe driving. While driving, drivers are provided with a lot of information about the traffic situation, whether it is through a variety of information services or through the systems installed directly in the vehicle. Information communicated by on-board systems and requiring driver's response or manipulation with the devices installed in the vehicle represent an information burden for the driver, which can result in the driver looking away from the outside traffic. Operators of control systems in surveillance and traffic control centers face similar information burden, which needs to be considered as well. This issue is closely related to methods for evaluating human behavior in human-device interactions and to the design of user interfaces of information systems and of dashboards in vehicles or supervisory and control centers. For this reason, we need to focus on verification of the impact of devices on traffic safety in terms of human factor.

8.3.5.3 Specific Factual Objective No. 5.3: Creating an Integrated Technological System of the Railway Infrastructure Manager

Railway transport system is very all-embracing. It is interconnected at the international level (with railway systems abroad) and it is also linked with systems of regional and urban passenger transports at the national level and in some cases also across borders; it is further interconnected with logistic systems. Currently, a broad range of control and information systems have been built in railway transport. It is very important to ensure their interoperability so that different systems are mutually supportive. Intelligent Transport Systems offer a large variety of applications for infrastructure managers, carriers and transport users. By creating standardized interfaces among individual systems, subsystems and applications providing diagnostic, defectoscopy and technical data about the condition and operability of railway infrastructure, by defining the specifications of the individual relationships among applications, subsystems and systems, and by specifying the requirements for individual interface links, we will create conditions for the development of the ITS. Thanks to the implementation of the system, the railway infrastructure manager will be able to optimally allocate resources and capacities in order to increase the safety and continuity of the works on the railway network and to ensure optimal operational parameters for the use of individual parts of the infrastructure, taking into account existing and prospective operational needs. Being connected to the operation, this application will make the planning of train transport and closures easier and more efficient; timely information and reduction of the number of irregular and emergency interventions on train routes will allow for overall reduction in delays and irregularities in the operation.

The integrated system of the infrastructure manager should also involve standardization, allocation of responsibilities for given sets of data and for their updates, and uniform descriptions of the infrastructure including interfaces of information, control and interlocking and signaling systems. The main aim is to solve and prevent any irregularities in systems interfaces which may occur due to inconsistency and difficult interconnection of systems of various suppliers.

While implementing the integrated system of the railway infrastructure manager, we will create conditions and interfaces allowing for the use of EGNOS, Galileo and systems of applications based on satellite systems so as to monitor the safety of railway infrastructure and to forecast the impacts of winds, landslides, soil erosion and floods.

8.3.5.4 Specific Framework Objective No. 5.4: Development of the Spatial Data in Transport

Spatial data and information are essential for organizing transport and planning constructions and maintenance of the transport infrastructure.

Spatial data associated with the transport field is acquired by the Ministry of Transport (MoT and its subordinate organizations), as well as by regions, municipalities and other public administration entities.

Every subordinate organization uses its own self-built system which fully meets the requirements and needs of the given entity. Interconnection of the systems and the use of the data by a manager of a different transport infrastructure are difficult due to technical and particularly organizational reasons. Therefore, the existing spatial data infrastructures in the transport sector need to be consolidated and the interoperability with other related spatial data infrastructures outside the field of transport or with related information systems needs to be ensured. We also need to provide for standardization and appropriate description of spatial data so as to meet the demands and requirements of various infrastructure managers (state, regions, municipalities, private owners), as well as of other user groups (e.g. IRS services); however at the same time, we must also focus on the usability of the data in practice and on performing their updates in a continuous and sustainable manner. The development of the stock of spatial data associated with transport needs to be ensured at the national level and at the level of regions and cities.

To localize (assign coordinates to) spatial data, GNSS technologies have been commonly used. The use of the CZEPOS network is an important qualitative contribution as it increases the accuracy of spatial data coordinates, the resulting accuracy being in the range of several centimeters (or decimeters). It is necessary to always have funds in the future to modernize the CZEPOS network systems so that they still follow the current developments of GNSS and IT technologies.

The development of sustainable public services working with spatial data which will be targeted at different user groups also needs to be ensured. Presentation of attribute data associated with a specific location (i.e. geographic relation) should be provided in a format that will allow to perform spatial and temporal analyses of the data (statistics of traffic, traffic accidents, etc.).

Due to the increasing need for central registers in the area of roadways (the planned Central Register of Roads - CEPK) as well as of the railway infrastructure, we will have to create appropriate record-keeping systems. Given the nature of the items which are to be recorded and their strong geographic relation, the designed systems will have to focus on the spatial component (i.e. will have to be geographically oriented) and will have to be compatible from the very beginning with the planned spatial data infrastructure of the transport sector. In the case of the railway infrastructure, there are two types of owners: private and state. The provision of the necessary data to the system will thus have to be set forth by the law and the administrator of this register will have to be determined. The extent of registered items and their description will need to be defined, too.

The development of spatial data and related infrastructures is dealt with in more detail in the Strategy of Spatial Information Infrastructure Development in the Czech Republic up to 2020 (GeoInfoStrategy) managed by the Ministry of Interior and drafted in cooperation with other affected ministries (including the Ministry of Transport) and in the GeoInfoStrategy Action Plan defining concrete measures to implement the GeoInfoStrategy.

In the long term (after 2020), we plan to create a National Infrastructure for Spatial Information (NIPI) which should integrate all national spatial data, and we also foresee sharing and efficient use of spatial data and information. The "transport" spatial data infrastructures should then provide data to the National Infrastructure for Spatial Information, too.

In relation to European projects focusing on spatial data exchange, it is important to support the use of a unified spatial reference system and to ensure the transformation of spatial data acquired in the reference systems used in the Czech Republic for the purposes of the above reference system.

Such an approach will enable interconnection of complex dynamic ITS without complicated conversions of various formats of map data. In the case of other ITS applications, it is necessary to prepare the planned transition to a new version of spatial data.

The main benefit of the ITS deployment is the increased traffic safety which will be ensured through warnings about dangerous situations or through prevention of their occurrence. Nevertheless, accidents may occur. In such a case, the ITS applications in connection with GNSS applications working with spatial data and information can be of benefit to the rescue services because they can provide timely information identifying the location of the incident, pass as precise instructions for the rescue vehicle crew as possible, and navigate anyone to the location of the incident. Although the intervention area of rescue units is defined and units usually do not intervene in unfamiliar areas, interventions may also be needed in spots inaccessible on standards roads (but on field or forest roads, for example). In such cases, different types of deployed vehicles use different access roads (rapid intervention passenger cars, heavy fire trucks, etc.).

With regard to technical and organizational complexity of some tasks within the field of spatial data and to their follow-up to other strategic documents (such as the GeoInfoStrategy), these initiatives may extend even beyond 2020.

8.3.5.5 Specific Factual Objective No. 5.5: ITS Development in Connection with the Development of Clean Mobility

The following benefits are among the reasons to support clean mobility: improved air quality, improved quality of life and reduced noise levels thanks to the reduction of pollution generated by vehicles of individual and also public passenger transport, especially in the most affected urban areas. Other important reasons to support clean mobility include accelerating the development of clean technologies and reducing the dependence of the Czech Republic on petrol. It is the use of natural gas and mainly of electric drive in transport which will help the Czech Republic to gradually break away from the dependence on supplies of this strategic raw material. Due to the environmental concerns and also to this reason, we need to primarily focus on the development of electro mobility and on the support for vehicles running on natural gas.

Energy efficiency, i.e. the lowest energy input per unit of transport capacity, is an important prerequisite for clean mobility implementation. Fuel consumption can be effectively influenced by better traffic control enabled by the ITS. Following the development of smart grids and installing charging and filling stations on the infrastructure, we will need to provide road users with information particularly about location, type and equipment of the charging and filling stations. To provide this information, a national access point seems to be the most suitable tool; it should provide "minimum universal traffic information", i.e. information about road traffic situation, which will at the same time warn drivers about dangerous situations in traffic. The aforementioned national access point will also serve as a source of information about the road network coverage with charging and filling stations. Related information services will provide drivers before and during the journey with information about available stations and about driving distances to the nearest charging or filling stations. The ITS will help to interconnect the networks of charging stations and payment systems and support the development of smart services such as roaming and electronic payments with authentication and timestamps of the financial transaction performed when recharging.

8.3.5.6 Specific Framework Objective 5.6: Development of Space Technologies

The Czech Republic has a great potential in modern technologies which has already been proven many times in history. The greatest potential for innovations lays in space activities, both in the field of building new space systems and mainly in space systems applications and services. In this way, the public sector can motivate Czech industrial and academic capacities to actively work on space applications in downstream systems, i.e. also on the ITS.

The ITS work with data about locations of vehicles from the GNSS. With regard to trends in the development of global navigation satellite systems, we need to consider the use of GPS receivers and of combined receivers for GPS, Galileo (or GLONASS and Beidou as well). Such receivers will greatly benefit from the use of satellites from multiple satellite systems, which will increase the availability of the basic service. For this reason, it would be appropriate that the requirements for EGNOS (due to increased accuracy and integrity) and Galileo (due to independence, possibility to verify the authenticity of signal) gradually start to appear among requirements for GNSS receivers, i.e. we talk about multi-constellation receivers here. If we need very precise localization of spatial data, the requirement for multi-constellation receivers would also apply to the CZEPOS network, which currently provides services and products based on signals from GPS and GLOSNASS; in this network, the use of signals from Galileo and Beidou has been under preparation.

Many applications from various economic sectors – and most of them will likely be from the transport sector which has been the largest user of the data from the Global Navigation Satellite Systems (mainly the GPS) – will soon depend on Galileo Open Service (OS). Galileo system and its services which are currently under development are not fully resistant (just like any other system) to intentional jamming and consequent disabling of reception, or to spoofing which may influence the final location determined by the receiver. The issue of jamming could be prevented to some extent by the so-called authentication; it has been considered that this feature could be implemented within the whole Galileo system. Still, this will always be a constant race with those who try to abuse and influence GNSS signals or applications. Attention will therefore focus on measures to mitigate the threat of jamming and spoofing so as to obtain, maintain and develop the capabilities needed to ensure the proper functioning of GNSS applications.

For the monitoring of undesired movement and deformations of the transport infrastructure, particularly satellite radar interferometry (InSAR) can be used. When processing time series of shots, this system allows motion detection in the range of centimeters to millimeters. Due to overaged transport infrastructure (which, in some cases, is in such a technical condition that it almost cannot be used anymore) in many places in the Czech Republic, regular monitoring of the condition of the infrastructure is an appropriate prevention to detect unwanted movement or deformations of infrastructure elements (such as bridges). The advantage of remote sensing, in this case through radar interferometry methods, is the fact that monitoring can be performed continuously over a vast territory and that from a long time series of radar images we can evaluate the trends of continuous undesired movement and deformations that precede virtually all static problems of buildings and structures; in this manner, we can predict future developments or determine the time horizon over which the relevant building or structure could achieve the limit for movements or deformations for which it was designed. Radar interferometry can however also bring important benefits when used for long-term evaluations of the state of "settlement" of new transport structures or for evaluations of their stability after natural disasters such as floods. This technology can also be used for planning repairs of the transport infrastructure, or for setting priorities of repairs (on the basis of trends in undesired movement or deformations we can determine when the limit state will be reached). As a "by-product", we can benefit from the possibility to track potential movements in the vicinity of transport infrastructure (such as the risk of landslides, in cases where this is relevant).

To effectively manage traffic and to increase its safety, we can also use information from the meteorological forecast and warning services.

8.3.5.7 Specific Decisive Objective No. 5.7: Supporting Development of Autonomous (Robotic) Vehicles

Technology for manufacturing of autonomous vehicles already exists. In most cases, standard cars are rebuilt and used for the testing of the concept of autonomous car traffic in the form of pilot (demonstration) projects. Several successful tests of autonomous vehicles in real traffic have been carried out, but mass use of autonomous vehicles in real traffic is hindered partially by technical and mainly by legal obstacles. The ultimate vision is to construct a fully autonomous vehicle where the driver will not be able to interfere with the driving, i.e. vehicles without conventional controls.

In the near future, the deployment of partially autonomous vehicles needs to be expected; in this type of vehicle, the driver has at all times full control over driving. They provide optimal support to the driver in all stages of driving, from parking assistance to normal operation (these are for example cars controlling appropriate spacing between vehicles or those keeping the driver in the correct lane, as well as cars automatically braking in front of obstacles) to critical moments before an accident or after it (e.g. eCall 112 initiative). For this reason, we need to define various levels of autonomous (robotic) vehicles, from simple to nearly autonomous vehicles which still require the driver's attention, to fully autonomous vehicles.

The operation of partially or fully autonomous vehicles must also be allowed by the road and street network, enabling communication and interaction of these vehicles both among themselves and with the devices (stations) on the transport infrastructure (e.g. when driving through intersections). This means that the development of the so-called cooperative systems must be ensured as a prerequisite for the deployment of autonomous vehicles.

From the technical perspective, issues of reliability of autonomous vehicles need to be solved: localization and orientation of autonomous vehicles in the case of failure to receive signal from global navigation satellite systems, possible narrowing of roads when snow ploughs remove snow, reliable on-board sensors to operate vehicles in dense fog, unpredictable development of all possible safety-critical situations on the road which cannot be accurately modeled for subsequent automation of these scenarios in order to completely eliminate accidents. It will also be important to predict with sufficient reliability behavior of pedestrians walking at the border of sidewalks and roads or on road shoulders. If autonomous vehicles will be operated based on the principle of electric vehicles and will thus move noiselessly, we will have to warn pedestrians of approaching vehicles; this especially concerns visually impaired people.

Another issue to be tackled is the security of protection systems in autonomous vehicles, from privacy protection to criminality directed against autonomous vehicles (such as vehicle thefts) to crimes committed by means of autonomous vehicles (e.g. possible terrorist attacks using autonomous vehicles laden with explosives and programmed to drive into the target of the attack).

Full deployment of vehicles in real traffic will require a rather important modification of the national and international legislation and traffic rules. Furthermore, legal regulations do not specify who would be responsible for accidents involving fully autonomous vehicles.

At the beginning, the pace of the deployment of autonomous vehicles in real traffic will be rather slow due to high acquisition costs. The development of this technology could also be helped by the public sector, which could support their deployment in the services of public interest such as the transport of the elderly to preventive health care, to rehabilitation, provision of transportation for the blind, etc.

Compared to cars, railway vehicles benefit from the fact that the track both carries and guides them. Since 1991, Automatic Train Operation (ATO) has been gradually implemented on the Czech railway network.

8.3.5.8 Specific Decisive Objective No. 5.8: Supporting Research, Development and Innovations

In respect of the new technologies development, we need to provide equal Internet access to all information (except for information that constitutes a trade secret or to which intellectual property rights apply) related to research, development and innovations from all entities involved in this field. Providing both public and private sector with more information on innovations should help improve the implementation of research results into practice; in this way, public funds allocated for scientific and research project will result in higher values. Sharing innovative knowledge and providing access to the results of research financed from public funds should be a priority for further efficient opening of the access to public sector information; training seminars should also be organized. Another priority is the very implementation of research, development and innovation results and avoiding duplication of research and development projects.

Innovations are developed on the basis of research and development results. Another factor for the development of innovations is the demand for refined products or technologies, or the pressure to increase the efficiency and competitiveness of companies. Innovation can be seen as the engine of economic growth, therefore environment supporting their development needs to be created.

As for research and development activities, we need to support pilot projects to test the functioning of new innovative systems in operation, especially at the international level. This approach helps to increase the compatibility and interoperability of the ITS at the national or at the European level; in the case of European projects, it increases the possibility of providing harmonized services on the EU territory. Pilot projects can help to start massive production and installation of ITS systems and equipment in the national transport network or in a network of several EU member states; in this way, the projects can also expand into other markets, which they tend to do anyway.

A lot of attention needs to be paid to providing scientific and research teams with better access to spatial data obtained from traffic monitoring. Only then we will enable the dynamic growth of innovations in the field of modeling the traffic flows behavior, prediction of traffic development, planning the transportation of people and goods in an environment when various modes of transport are interconnected, creation of entirely new services for customers, etc.

Research and development activities also need to focus on the development of space technologies and their applications, particularly on innovation applications for monitoring of deformations of the transport infrastructure and its surroundings using methods of remote sensing (InSAR) and on kinematic positioning using GNSS, including the establishment of a metrological support system (i.e. for calibration) of satellite apparatuses used in transport (GNSS receivers, for example). In the field of metrology, it is recommended to use the expertise of the accredited calibration laboratory of the Research Institute of Geodesy, Topography and Cartography (VÚGTK), as well as the bases and reference standard for position created by this Research Institute for the purposes of validation of devices determining location using GNSS.

8.3.6 Strategic Objective No. 6: Supporting the Development of Social Technologies and Services

Nowadays, we can commonly use smartphones or tablets which can connect to the Internet. Thanks to modern communication technologies, we can have information about traffic conditions every single minute. Rapid implementation of mobile digital technologies has also been changing the manner of providing information on traffic conditions or on current changes that affect our travelling in public passenger transport.

Besides information on timetables and connecting services, users of public passenger transport also need (at least basic) information on tariffs, i.e. on types of tickets and fares, provided in a form available also to passengers with specific needs. The above systems will also be connected to dispatching systems of transport companies providing public passenger transport for the purposes of actual deployment of specific types of vehicles for individual connections; this particularly affects the sale of tickets (ship and airline tickets as well) and reservation systems.

When ensuring access to data and information, both their readability and content are important because passengers with specific needs (people with reduced mobility or orientation, the elderly, parents with prams, etc.) need more detailed information which would be more adapted to their mobility needs than the rest of the population. The needs of these groups of people are consulted with entities that represent and organize them. With no consultations with experts in the field, available information will not be sufficient for passengers with specific needs and will not be of enough high quality.

Investments in the ITS will be economically efficient and the costs associated with their implementation will be offset by measurable economic or socio-economic benefits. The ordering party and operators will develop and operate ITS systems and services transparently and with due diligence; they will use open interfaces and already existing standards to the maximum possible extent. The ITS will be compatible and interoperable both in the national and international scale.

The ITS will be used to manage the quality and availability of the transport infrastructure, from planning to construction and to operation. Through the ITS, transport infrastructure managers will guarantee to the users minimum defined quality and availability of the infrastructure. The ITS will reduce the operating costs for transport network managers and vehicle operators.

8.3.7 Strategic Objective No. 7: Supporting Educational and Training Programmes

Recently, we have been witnessing a rapid and massive implementation of new systems and modern technologies in all industries including the transport sector, and the ITS are being implemented as well. For this reason, it is necessary to address the issue of education. However, the creation of top-level ITS applications requires sufficient high-quality knowledge and skills. Design, development, operation and maintenance of the ITS requires a lot of new technical methods and innovative technologies. Czech technical universities guarantee and provide education in terms of compulsory and compulsory elective courses of bachelor, master's and doctoral studies which are partially or wholly focused on the ITS. Technical innovations in the ITS are a continuous and never-ending activity. For this reason, it is important that graduates from secondary vocational schools, secondary technical schools and accredited educational programmes in the field of engineering science continuously follow the developments in the ITS and related fields and pursue further education through lifelong learning. Targeted educational programmes will enable us to accelerate the deployment of ITS applications in the long term.

In relation to the development of automation in transportation, routine human activities are being automated which reduces employees' workloads; incorrect human interventions are corrected, occurring errors are eliminated and systems performance increase. On the other hand, employees lose their working habits and flexibility, particularly in situations when the automated system does not ensure required activities or if unusual or emergency situations must be solved in a flexible manner. People operating or using automatic electronic systems have to be sufficiently and continuously trained so as be able to handle traffic situations (controlling automated electronic equipment and cooperating with these devices), as well as extraordinary situations involving emergency and crisis situations that are not addressed by automatic systems. The ongoing automation could lead to a situation when people only use the devices, completely rely on them, and because they lack skills in terms of work with the automated systems, they will not (without automatic evaluation and decision-making) recognize at all that there is a system failure or a critical situation, which they need to understand and handle. So as to cope with critical and dangerous situations, people can be trained on equipment that realistically simulates emergency situations occurring in the real traffic. This approach prevents the loss of ability to handle critical situations due to the lack of practice.

8.3.8 Strategic Objective No. 8: Supporting Development of Standardized ITS in Railway Transport within the EU and of Standardized Data Exchange among Infrastructure Managers and Operators

Railway traffic is supported by control and information systems having different technical nature and different level of technological advancement. From the perspective of the railway infrastructure manager and the operator, these systems are also developed in an international context. With regard to the implementation of the trans-European railway system, we need to focus while developing the ITS in particular on passenger transport, i.e. ticketing systems, reservation and payment systems, as well as on issuing transport documents (at box offices, vending machines, in trains and on the Internet) and partly also on systems for train documentation. Railway transport is specific because train staff from various carriers may work on different parts of the same journey (e.g. in international passenger transport). Therefore, the implemented solution must enable passengers to travel with one e-ticket across borders and must be compatible with international systems. E-tickets can also be accessed on personal media, such as mobile phones and smartphones. According to the position of the user, mobile applications can provide additional services, such as buying specific tickets, directions planning, navigation and information from timetables. The essence of railway transport is the movement of vehicles on a track, which both carries and guides the vehicle. For this reason, it is necessary to balance the technical parameters of the railway infrastructure and railway vehicles so that the technical possibilities of (modern) vehicles are not limited by the state (not upgraded) of the railway, and on the other hand, so that due to their condition, the (older) vehicles are not limited in using the technical possibilities of the lines equipped with modern diagnostic, control and information systems. Besides the railway infrastructure, the development of advanced technology systems including the ITS will therefore be extended to include railway vehicles, so that railway does not lag behind other modes of transport from the technical point of view. For the purposes of railway traffic control, we need to ensure that the very transportation process is not disturbed. The arrangement of the traffic control system as well as the operation of subsystems will be directed towards information support of the operational management. In the case of operational anomalies, the system will enable regulatory interventions without undue delay in order to minimize disturbance to traffic flow continuity or to mitigate to the maximum possible extent negative consequences of such disruptions or interruptions of traffic. Operational dispatching railway traffic control will use the ITS and GNSS systems as well as elements of telecommunication, control, communications, interlocking, safety, diagnostic and computer technologies.

9 Follow-up Measures

The entire process of intelligent transport systems functioning shall cover the technical, organizational (competence) and if possible also the research and development aspects (if the system is not yet available on the market).

9.1 Measures Related to Data Sources and Ensuring the Transmission and Quality

Technical Measures	Contributes to objectives:
1) Installation of detection points on the transport network; for the road network both on the network of national importance and within important urban agglomerations, in particular connecting to the backbone TEN-T road network, including solutions for an appropriate data transmission network.	**Strategic Objective No. 2** Specific Objective No. 2.1
2) To continuously collect sufficient volume of input data describing the behavior of traffic flows, to store them and to analyze the development in transport volumes aimed at early prevention of expected congestions.	**Strategic Objective No. 1 and 2** Specific Objective No. 2.1
3) To define the minimal level of equipment by transport sensors of the existing and new infrastructure: - To carry out the analysis of sensor systems - To connect sensors that are not yet connected to the NDIC - To plan the further development of sensor systems and their integration into the NDIC control system.	**Strategic Objective No. 1 and 2** Specific Objective No. 2.1
4) To integrate a source of information on traffic flows dynamics into the NDIC. As part of this measure, a general source of information on the state of traffic flows based on full-area sampling technologies using the GNSS systems for monitoring of vehicles by satellite systems (data source based on floating vehicles) shall be integrated into the NDIC.	**Strategic Objective No. 1 and 2** Specific Objective No. 2.1
5) To include a module into the NDIC allowing for spatial conversion among individual sources so that they can be connected to a single spatial base used by the NDIC.	**Strategic Objective No. 5** Specific Objective No. 5.2 Specific Objective No. 5.3
6) To define in the NDIC the data input formats, including spatial description, and to enable automatic validation of these input data.	**Strategic Objective No. 5** Specific Objective No. 5.2 Specific Objective No. 5.3
7) To add all significant meteorology data to the data set.	**Strategic Objective No. 1 and 5**
8) To support data connection of municipal traffic information centers with the NDIC as an important element for complex evaluation of the transport situation on the Czech territory.	**Strategic Objective No. 5**
9) To provide support to mobile network operators when de-	**Strategic Objective No.**

ploying telecommunication networks on railway corridors, on motorways and expressways to ensure access of passengers to high-speed internet.	**5, 7 and 8**

Organizational Measures (Competence)	Contributes to objectives:
1) To include into the NDIC a source of information provided voluntarily by traffic participants. This is already partially in place (for example from the radio station Český rozhlas). As part of additional sources of data collection to be introduced, a platform for cooperation with other providers of such information shall be set up, thus adding to the RDS-TMC system inputs from the general traffic flows monitoring system on the Czech territory. .	**Strategic Objective No. 2 and 6** Specific Objective No. 2.1
2) To integrate into the NDIC other data from existing systems which are absent so far, such as position data for public transport vehicles. As part of this measure, data from existing ITS technologies shall be integrated into the NDIC, in particular tunnel sets, ITS on some lower class road and in cities: - Integration of data from tunnels into the NDIC - Integration of new meteorology station products into the NDIC.	**Strategic Objective No. 5**
3) To support the development of municipal traffic information centers and ITS on the territory of important urban agglomerations with links to high-capacity TEN-T roads as an source of important traffic information from major cities selected for integration with the NDIC (see Point 6).	**Strategic Objective No. 2 and 5** Specific Objective No. 2.1
4) To define the minimum level of equipment by basic ITS elements of the existing and new infrastructure on the territory of important urban agglomerations connected to important high-capacity TEN-T roads.	**Strategic Objective No. 2** Specific Objective No. 2.1
5) To define the electronic communication infrastructure envisaged for data transmission and how this transmission network shall be dimensioned.	**Strategic Objective No. 2** Specific Objective No. 2.1
6) To add the source of information on equipment of the road network by charging and feeding stations into the national access point that allows to access information on road traffic and travel conditions.	**Strategic Objective No. 5** Specific Objective No. 5.5

9.2 Measures Related to Data, Storage, Evaluation and Processing and Subsequent Provision of Information

Technical Measures	Contributes to objectives:
1) To ensure archiving of all relevant data for the needs of prediction models and systems assisting in decision making based on defined retention times.	**Strategic Objective No. 1, 5 and 6**
2) To ensure optimum access to historic data or their subse-	**Strategic Objective No.**

quent aggregates for follow-up systemic modules.	**1, 5 and 6**
3) To perform continuously and on a cross-sectional basis the control of quality (in time, accessibility, integrity,…) of the collected and provided data from internal and external audits; based on these audits, to carry out activities contributing to better quality of provided data.	**Strategic Objective No. 1, 5 and 6**
4) To continuously collect metadata of spatial data in order to facilitate the reliability assessment, for example of future transport development predictions or quality of services provided based on processing of spatial data acquired through traffic monitoring.	**Strategic Objective No. 1, 5 and 6**
5) To continuously assess the state of traffic flows in the Czech Republic, in particular with regard to traffic flows dynamics and automatic monitoring of traffic flow collapses leading to congestions, based on collected data. To ensure continuous monitoring and evaluation of traffic flows in real time, uninterrupted 24/7 on national level. Based on these measurements, to follow the impact of ITS technologies and services implementation.	**Strategic Objective No. 1, 5 and 6**
6) Based on evaluation of data on traffic flows and other inputs (for example meteorology data), to generate forecasts of situations aimed at limitation of critical events in busy areas or hours.	**Strategic Objective No. 1, 3, 5 and 6**
7) To ensure optimal access to monitoring outputs in real time and to transport development forecasts for related control and information systems.	**Strategic Objective No. 1, 5 and 6**
8) To create a central database of traffic signs.	**Strategic Objective No. 1, 5 and 6**
9) To continuously expand the source of information of road traffic data with information on the coverage of the road network by feeding and charging stations and to provide information services on the accessibility of these stations to road traffic participants.	**Strategic Objective No. 2, 3 and 5** Specific Objective No. 5.7

Organizational Measures (Competence)	Contributes to objectives
1) To develop conditions for collection and verification of traffic information from direct road traffic participants, either directly or through organized reporting networks, and to create conditions for improving the quality of information provision through the RDS-TMC channel service, including issues such as geographical coverage, regionalization and possibilities to engage various providers into this service.	**Strategic Objective No. 1, 2, 5 and 6**
2) To support owners of the road networks on territories of important urban agglomerations connected to major high-capacity TEN-T roads when developing and equipping of this network by basic ITS components for data collection.	**Strategic Objective No. 2** Specific Objective No. 2.1
3) To provide on-time, verified and sufficiently spatially precise information on standard and extraordinary traffic situations. The drivers shall be informed about traffic events and situations on the roads where there is no imminent danger but the	**Strategic Objective No. 2** Specific Objective No. 2.1

provided information might allow them to choose a different route, a different mode of transport, use a different parking space and thus avoid complications. The following types of information are to be provided: - Temporary slippery road: this type of data is provided by the ŘSD (danger of skidding) Animals, persons, obstacles, debris on the road: possibility to add information from drivers - Unprotected accident area: possibility to add information from drivers motorist- - Short-term road works: this type of data is provided by the ŘSD - Reduced visibility: possibility to add information from drivers - Wrong-way driver: this type of data is provided by the ŘSD on motorways D1, D2, D5 - Unmanaged blockage of the road: possibility to add information from drivers - Exceptional weather conditions: this type of data is provided by the ŘSD.	
4) To make all available NDIC data accessible to third parties in a machine-readable format.	**Strategic Objective No. 1, 2, 5 and 6**
5) To create a data interface allowing for a (non-discriminatory) integration of available road traffic data into mobile applications and other information devices (for example navigations) of third parties. To provide information to drivers directly into devices located in the vehicle (with a filtering option based on the driver´s needs) and to set up an alternative information system to ground-based telematic components located on roads.	**Strategic Objective No. 1 and 5**
6) To set up a multi-lingual call centre for traffic information in line with specifications included in respective technical and legal regulations. The call centre shall collect information from all available sources in the Czech Republic and provide verified information to drivers on an uninterrupted basis 24/7 in Czech, English and German language. At the same time, the call centre shall become part of the information media system for cases of crisis management or natural disasters (floods etc.). The phone number of the call centre must be easy to remember. The monitored areas shall work with information prior to and during the journey. This topic must be discussed with the MIT and Czech Telecommunication Office (national numbering plan)	**Strategic Objective No. 2** Specific Objective No. 2.1
7) To provide on-time information about occurrence of an accident and to ensure timely and appropriate reactions to save human lives. Complex and timely information support shall be provided in case of exceptional events and accidents requiring an intervention of the IRS. The flow of information necessary to save and protect lives and health of traffic accident participants must be ensured in order to enable timely activation of rescue teams. Prevention of subsequent accidents shall be ensured by fast removal of obstacles and allowing the traffic to resume,	**Strategic Objective No. 3** Specific Objective No. 3.1

with priority given to the backbone road network.	
8) To ensure that information about the exceptional event is provided in time to other road traffic participants; this not solely through ITS information elements, but also via mobile applications, GNSS systems and other suitable means. These include also telephonic communication systems operated by specialized call centers and dispatching centers of traffic information and assistance services providers. The interactivity of such information represents an undeniable benefit. Direct contact with the users allows for delivery of targeted information, relevant as for to time and location.	**Strategic Objective No. 2, 3, 5 and 6** Specific Objective No. 2.1
9) To prepare a functional interconnection of ITS with information media and to use appropriate information channels available within the ITS to inform traffic participants (driver, passenger, citizen) during critical events.	**Strategic Objective No. 3** Specific Objective No. 3.3
10) To adjust the functioning of the Nationwide information system for timetables to align with the principles of the Directive on the re-use of public sector information.	**Strategic Objective No. 1, 5 and 6**
11) To provide a broad spectrum of services and to develop applications based on data on public passenger transport timetables.	**Strategic Objective No. 1, 5 and 6**
12) To integrate information on tariffs, also in forms accessible for passengers with specific needs, with information on timetables and public transport connection options.	**Strategic Objective No. 6**
13) To ensure interconnection of public passenger transport travel systems with ticketing systems of transport companies providing public passenger transport in relation to specific types of vehicles to be used for individual journeys which has an impact on selling of tickets (also for boats or airplanes) or the reservation systems.	**Strategic Objective No. 6**
14) Any information that is to be made available to users must be provided in such a form so that it can be received in full also by users with disabilities, for example visually or hearing impaired. Such users also might have specific requirements related to the data, for example the level of precision (e.g. ability to distinguish public transport stops with the same name) or accessibility assessment of a specific place based on different handicaps, interconnection with assistance services etc. It is necessary to ensure the setting up and operation of a central database of works in course affecting transport and mobility of users when travelling from one place to another, including walking (earth works, barriers, scaffoldings etc.).This information from the central database shall be accessible for all users so that it can be further processed and applied by users with special mobility needs (visually impaired, passengers on wheelchairs and older passengers).	**Strategic Objective No. 6**
15) Announcing of changes and incidents in transport via radio systems in railway stations, airport radio systems, radio systems in underground station, urban public transport stops with	**Strategic Objective No. 6**

high frequency of passengers and public passenger transport terminals to be complemented by content- and style-harmonized visual information (signals) on platforms, in waiting rooms and in the means of transport.	
16) To introduce - as part of professional preparation and regular trainings for acquiring, maintaining or broadening of professional competences of operators' employees or managers and operators of railway infrastructure that are in direct contact with the passengers – training of principles of communication with persons that are deaf, have lost hearing or are hearing impaired; knowledge of principles of communication with and assistance to blind persons and persons with limited mobility; knowledge of principles how to approach persons with mental disabilities and how to communicate with them aimed at not showing any impatience, not limiting of the communication but trying to find ways how to communicate better not just through ITS.	**Strategic Objective No. 5 and 6**
17) To ensure standardization of information connection interfaces.	**Strategic Objective No. 5** Specific Objective No. 5.2
18) To provide for a single format of spatial data that will comply with the requirements of the Directive of the European Parliament and of the Council EC/2/2007 INSPIRE and of key user groups (transport network managers, IRS, infrastructure users etc.) across individual modes of transport.	**Strategic Objective No. 5** Specific Objective No. 5.3 Specific Objective No. 5.4
19) To ensure consolidation of spatial data infrastructure within the transport sector, to ensure interoperability of spatial data about transport infrastructure and to ensure conditions for provision of public services that will be based on this type data.	**Strategic Objective No. 5** Specific Objective No. 5.3 Specific Objective No. 5.4
20) To ensure free access to the data for ITS research and development purposes, in particular new services and also multimodal models of mobility of persons and of logistic processes in freight transport.	**Strategic Objective No. 5** Specific Objective No. 5.1 and 5.8

9.3 Measures Related to Traffic Control

Technical Measures	Contributes to objectives:
1) To interconnect traffic information systems with crisis management systems.	**Strategic Objective No. 3 and 5** Specific Objective No. 5.4
2) To support the equipment of SSÚD by portable/mobile ITS control and information systems for management of traffic flows and informing of road traffic participants in places of road closures.	**Strategic Objective No. 2** Specific Objective No. 2.1
3) To support the equipment of the public passenger transport	**Strategic Objective No.**

vehicle fleet with ITS on-board and information systems.	**2** Specific Objective No. 2.1
4) To introduce higher-level control algorithms for detection of events on defined sensors and to perform automatic interventions in the traffic in the given area.	**Strategic Objective No. 2** Specific Objective No. 2.1
5) To support use of dynamic multimodal transport models for directing of traffic flows.	**Strategic Objective No. 1 and 2** Specific Objective No. 2.1

Organizational Measures (Competence)	Contributes to objectives
1) To prepare road traffic control plans for main routes among important cities within the Czech Republic and also with important cities in neighboring countries – these plans shall include organizational procedures for ordinary, extraordinary and critical events for planning, acquisition and subsequent use of ITS in extraordinary and crisis traffic situations, across all sectors and all IRS services.	**Strategic Objective No. 2 and 3** Specific Objective No. 3.3
2) To support solving of critical events related to traffic control on the territory of important cities that are directly affected by non-standard traffic situations on motorways or expressways leading through their territory or in its vicinity.	**Strategic Objective No. 3** Specific Objective No. 3.3

9.4 Measures Related to Service Provision

Technical Measures	Contributes to objectives:
1) To require integration of ITS sensors and services for newly built parking places.	**Strategic Objective No. 5 and 6**
2) To create conditions for allowing reservation of a parking place on parking sites for trucks and commercial vehicles.	**Strategic Objective No. 5 and 6**

Organizational Measures (Competence)	Contributes to objectives:
1) To provide information services on safe and secure parking places for trucks and commercial vehicles, also on the territory of important cities.	**Strategic Objective No. 2 and 6**
2) To prepare and to introduce (based on transparent and non-discriminatory rules) a systemic solution for removal of obstacles to road traffic based on cooperation of traffic information and assistance services providers with the IRS (both in the case of serious traffic accidents but also, and in particular, in case of traffic accidents not requiring a direct intervention of the IRS, or in case of removing of an obstacle caused by other extraordinary road traffic events).	**Strategic Objective No. 2, 5 and 6**
3) To support projects aimed at improving the quality and efficiency of services for drivers through faster interventions enabled by road vehicles localization technologies.	**Strategic Objective No. 6**

9.5 Measures Related to Respecting of Road Traffic Rules

Technical Measures	Contributes to objectives:
1) To identify high-risk areas on the Czech road network managed by the ŘSD or in the ownership of important cities and to equip them with relevant sensors compatible with ITS devices which will significantly improve road traffic safety in the given areas and will contribute to reducing of the number of accidents.	**Strategic Objective No. 3** Specific Objective No. 3.1
2) To put into operation monitoring systems to ensure prevention of criminal activities and obtaining of elements of proof.	**Strategic Objective No. 4**
3) To add the following ITS safety applications to the equipment of the road network managed by the ŘSD or in the ownership of important cities: - Devices for identification of vehicles exceeding the speed limits - Sectional speed measurement Detection of driving when the red light is on – warning lights and railway crossings - Automatic high-speed weighting - Lane keeping assist function for vehicles - Monitoring of safe distance - Video systems	**Strategic Objective No. 2** Specific Objective No. 2.1
4) To identify in time possible security threats and to ensure protection against these.	**Strategic Objective No. 4**
5) To notify about severe breaches of road traffic rules and to ensure an adequate reaction of law-enforcement units.	**Strategic Objective No. 4**
6) To notify about danger or safety violation in case of damage to road traffic control devices (consequences: death, injury and material damage).	**Strategic Objective No. 4**

9.6 Systemic and Cross-section Measures

These are measures that affect two or more of the above-mentioned areas.

Technical Measures	Contributes to objectives:
1) To create a national/international access point (data distribution interface) for provision of data on safe and secure parking places and on minimal traffic information.	**Strategic Objective No. 2, 5 and 6**
2) To introduce the European standard for provision of traffic information DATEX II into the practice in the Czech Republic.	**Strategic Objective No. 5** Specific Objective No. 5.2
3) To expand options offered by IRS dispatcher centers including information support to and coordination with its units.	**Strategic Objective No. 5 and 6**
4) To join the EUCARIS system	**Strategic Objective No. 4 and 5**
5) To introduce the European system of automatic emergency call from the vehicle (eCall 112).	**Strategic Objective No. 3** Specific Objective No. 3.1

6) To interlink the existing systems of traffic data collection (Weighting-in-motion systems /WIM/, automatic traffic sensors, meteo-stations etc.) into big data and harmonies the use thereof for existing systems and for systems under development.	**Strategic Objective No. 5**
7) To introduce procedures and data collection for provision of information on irregularities in railway transport for passengers and for railway companies, for example information about the running of a replacement bus service etc. and to integrate this data into the NDIC.	**Strategic Objective No. 7and 8**
8) To mutually interconnect electronic ticketing systems for passengers in public transport. A standardized communication among individual components within the vehicles and with external systems is necessary to ensure interoperability of individual ticketing, information and control elements in public passenger transport.	**Strategic Objective No. 5** Specific Objective No. 5.2
9) To remove barriers to accessibility of public passenger transport for persons with limited orientation, mobility or communication capacities by supporting the introduction of systems for improved orientation and navigation in an unknown space (open to the public).	**Strategic Objective No. 2 and 6** Specific Objective No. 2.1
10) When introducing solutions based on data on vehicle position from GNSS, to support equipping of vehicles by multi-constellation receivers enabled for GPS, Galileo and EGNOS (and if possible also GLONASS or Beidou) in order to achieve the best possible reach of signal and position definition precision, including the possibility to use GBAS.	**Strategic Objective No. 5 and 6**
11) To support implementation of systems of dynamic route planning for integrated rescue system vehicles to reach the place of intervention in exceptional situations that will take into account the actual immediate times needed to reach the destination.	**Strategic Objective No. 3 and 6**
12) To develop and support systems (including applications based on satellite systems such as remote Earth sensing) for monitoring of transport infrastructure safety – to forecast the impacts of weather, floods and inundations; monitoring, forecasting and warning systems for landslides or land movements on transport infrastructure or in its immediate surroundings; monitoring of the condition of transport infrastructure and controlling if its condition complies with requirements set by technical regulations in place.	**Strategic Objective No. 3 and 5** Specific Objective No. 3.8 Specific Objective No. 5.4
13) To ensure support for development of ITS and of applications and services related to usage of data from satellite navigation, telecommunication and Earth remote sensing by gradual development of a sufficiently robust spatial data infrastructure, appropriately dimensioned communication environment, cooperative infrastructure and distribution systems.	**Strategic Objective No. 5** Specific Objective No. 5.3 Specific Objective No. 5.4
14) To support introduction of cooperative systems for public passenger transport vehicles preference in larger agglomerations.	**Strategic Objective No. 1, 5 and 6**

15) To support systems for preference of integrated rescue system vehicles.	**Strategic Objective No. 1, 3, 5 and 6**
16) To support development of systems for automatic train operation.	**Strategic Objective No. 6**
17) To develop and support systems for a harmonized and precise description of transport infrastructure for detailed localization and display of traffic information and events to the level of visualization in maps. To ensure consolidation and development of the data fund of transport-related data both on the level of the state and of regions and cities.	**Strategic Objective No. 5** Specific Objective No. 5.3 Specific Objective No. 5.4
18) To support the development of systems for tracking of the status and location of sent consignments, means of transport and mobile devices that would also allow for assessment of defects on the vehicle or change of status of the consignment that could endanger the safety of road or railway traffic.	**Strategic Objective No. 3, 5, 6, 7 and 8**
19) To support development and installation of “smart” devices on railway crossings that will adjust the start of functioning of the signal warning to the speed of the approaching train.	**Strategic Objective No. 3 and 6**
20) In addition to deployment of interlocking and signaling on railway crossings, to support development of cooperative warning information systems for informing road traffic participants in real time about movement of rolling stock approaching the railway crossing by variable traffic signs and through personal or on-board navigation devices. It is necessary to accentuate in this regard that these are only secondary supporting warning information systems that are not reliable or safe when assessed against requirements for interlocking equipment. Therefore, if these are to be introduced and will not meet the strict safety and reliability criteria, it will be necessary to launch a BESIP information campaign for drivers explaining that they cannot rely solely on information from personal or on-board navigation devices when driving through a railway crossing as these are just complementary systems that do not replace the interlocking and signaling equipment.	**Strategic Objective No. 3 and 6** Specific Objective No. 3.5
21) To improve safety of railway operation on regional lines by supporting the development of safe train localization systems based on GNSS, using of satellite systems for monitoring the position of the train, communication with the train by wireless transmission networks, centralized driving system with automatic right of way and velocity profile control. If possible, these systems should use existing infrastructural elements, interlocking and signaling, traffic information systems and information systems for passengers, GNSS.	**Strategic Objective No. 3, 6, 7 and 8**
22) To support systems for performing of rescue operations by air ambulance helicopters (LZS/HEMS) under risky conditions that will not put into danger either the life of the person being rescued, or of the rescue crew, or the safety of the helicopter by using of EGNOS, Galileo and other systems to assist the decision-making of the helicopter chief during approach of LZS/HEMS helicopters for landing in difficult landscapes or	**Strategic Objective No. 3 and 6** Specific Objective No. 3.1

bad meteorological conditions (low visibility, heavy rain, strong gust wind and clouds at low altitude, night).	

Organizational Measures (Competence)	Contributes to objectives:
1) To create conditions for verification of ITS products and services compliance with the aim to fulfill requirements of the EU Directive on deployment of ITS in road transport and to guarantee superior professional and technical approach to ITS designing and supplying.	**Strategic Objective No. 4 and 5**
2) To prepare a strategic plan for further NDIC development with an outlook for 10 years. The document shall further specify the NDIC role and set up the vision for its development. The functional scope of NDIC shall be defined as well as its cooperation with other systems providing similar or complementary functions operated by public or private entities on regional, national and international level.	**Strategic Objective No. 5 and 6**
3) To clearly define functional processes and cooperation of the NDIC and other public and private institutions. The NDIC shall become the communication node for exchange of road traffic information among similar public and private entities on regional, national and international level. The NDIC shall become the basic platform for providing of traffic information, ensuring dispatcher supervision, coordination of traffic control and management of traffic on the Czech road network. The potential of the site shall be used to the full, thus allowing its use for controlling that the ŘSD infrastructure is made available to the users in the minimal defined quality standards. The central role of NDIC is important with regard to information sharing. The road traffic control itself should be done in line with rules set by regional control centers in the given areas (DIC regional control or traffic information centers).	**Strategic Objective No. 5 and 6**
4) To set up a system for controlling the quality of provided information; to focus on relevance of provided information. Currently on some sections, drivers are overwhelmed by numerous traffic information messages. It is therefore necessary to analyze not only if the respective information has been provided correctly and in time, but also if the driver has noticed the information and interpreted it correctly. In the negative case it is necessary to look for causes (if this is for example caused by information not being provided in the right form or by excessive amounts of provided information).	**Strategic Objective No. 2 and 6** Specific Objective No. 2.1
5) To define areas on the TEN-T network that require introduction of services for safe and secure parking places and for providing of minimum traffic information because of traffic or safety situations.	**Strategic Objective No. 5** Specific Objective No. 5.3 Specific Objective No. 5.4
6) To define the lines (in the context of their classification) where the use of GNSS will bring about rapid improvement of safety and efficiency of operation at appropriate cost.	**Strategic Objective No. 5** Specific Objective No.

	5.3
7) To ensure availability of real time location information of all public transport vehicles based on an open interface, in particular by implementing the standard ČSN 01 8245 “Information system in public passenger transport – Nationwide system for real time information (CISReal)”.	**Strategic Objective No. 5** Specific Objective No. 5.1 Specific Objective No. 5.2
8) To integrate into the NDIC real-time data on movement of public transport vehicles via an open interface of public passenger transport vehicles control systems.	**Strategic Objective No. 1, 2 and 5**
9) To ensure the preparation of a unified digital register of railway crossings. This important register contributes to elimination of a serious safety risk. Both crossings on railways administered by SŽDC and also by other railway and siding owners are to be included.	**Strategic Objective No. 5** Specific Objective No. 5.3 Specific Objective No. 5.4
10) To ensure interoperability of various format of spatial data sets (map works), GIS and information managed while taking into account spatial, object-related and time-related synchronization.	**Strategic Objective No. 5** Specific Objective No. 5.3 Specific Objective No. 5.4
11) To ensure development of a consolidated spatial data infrastructure across the transport sector.	**Strategic Objective No. 5** Specific Objective No. 5.3
12) For purposes of navigation of rescue units on routes that are not part of the road network, to ensure a uniform digital register of special purpose roads, field roads and forest roads; to ensure also a register of anti-noise walls including information on places where emergency exits or access sites are located and that can be in case of need accessed by vehicles of the FRS, allowing thus to shorten the intervention time by the period needed for searching of a suitable place for passing or driving through the anti-noise wall.	**Strategic Objective No. 3 and 5** Specific Objective No. 3.1 Specific Objective No. 5.3 Specific Objective No. 5.4
13) Communication with the general public is also necessary in the area of systems for mobility support and control. The success of projects implementation depends on acceptance of the proposed solutions by final users. It is therefore necessary to responsibly, objectively, correctly and transparently explain why specific projects are implemented and what is expected in result. In parallel, future users must be listened to and this important feedback shall be assessed and used when designing solutions.	**Strategic Objective No. 6**
14) In public tenders, terms of reference shall be prepared with reference to appropriate standards and regulations; for existing devices where parameters and interphases do not follow specific standards, the terms of reference shall contain adequate exhaustive technical descriptions of the communication or	**Strategic Objective No. 5** Specific Objective No. 5.1 Specific Objective No.

connection method. This shall minimize issues with compatibility of systems in the future while open competition will prevent the need for additional financial resources for resolving of technical obstacles.	5.2 Specific Objective No. 5.8
15) To ensure education of drivers or other road traffic participants in ITS technologies so that they can react to gradual development of new technologies. This education should be provided mainly through driver´s schools before obtaining of a driving license, but also as part of life-long learning for drivers or thematically focused information courses and awareness campaigns. In addition, the education focusing on new technologies should include the possibility to practically test these technologies with the aim of better mastering of behavior and skills (for example how to correctly mount the portable device so that it does not distract from driving etc.). Such an approach can contribute to achieving of the necessary awareness and at the same time will help in dispersing psychological barriers when using new technologies.	**Strategic Objective No. 6**

Research and Development Measures	Contributes to objectives:
1) The paradigm shifts that we could observe – from meticulously controlled valid data to major flows of real-time data of unknown quality – will require new scientific foundations. An increasing number of aspects of scientific research in transport require sophisticated computation methods to be able to face the complexity of the dynamic environment.	**Strategic Objective No. 5 and 6** Specific Objective No. 5.8
2) To ensure active participation in standardization and setting of conditions for ITS certification which shall guarantee correct functioning of individual components or parts of the system and open communication among individual system modules themselves and with the control/information centre. In parallel, compatibility of individual HW/SW versions shall be ensured, thus the possibility to use the system over a longer period of time.	**Strategic Objective No. 5** Specific Objective No. 5.2
3) To support research and development activities in the area of man-machine interaction in transport (HMI - Human-Machine Interface/Interaction, MMI - Man-Machine-Interface).	**Strategic Objective No. 5 and 6** Specific Objective No. 5.8
4) To carry out preparation for deployment of cooperative intelligent transport systems. Cooperative solutions are now focused in particular on support of pro-active driving and timely detection of dangers and risks, allowing the driver to adjust the vehicle speed in order to increase the distance between vehicles. This is done through vehicle on-board and communication systems that expand the information horizon of the drivers and inform about potentially dangerous situations ahead. The main expected areas for application of cooperative systems are the following - Vehicle preference systems - Timely warning systems for drivers	**Strategic Objective No. 3 and 6**

- Exchange of traffic information between vehicles and infrastructure-based system. - Assisting the driver when moving through traffic flows. - Autonomous driving on specialized infrastructure. - Assisting the driver passing across a railway crossing.	
5) To get involved internationally in the development of cooperative ITS corridors on the TEN-T network within the Czech Republic with connection to corridors developed in neighboring countries, thus ensuring interoperability of cooperative ITS networks operation. In parallel, this shall support future introduction of robotic vehicles.	**Strategic Objective No. 5 and 6**
6) To support research and development of automatic and autonomous systems able to flexibly react to incidents on the infrastructure, with equipment both in vehicles and on the infrastructure, and to create conditions for setting up of cooperative ITS enabling cooperation between the infrastructure and navigation systems of autonomous vehicles etc.	**Strategic Objective No. 5 and 6** Specific Objective No. 5.7
7) To provide for testing of proposed research and development ITS solutions in test/verification operation.	**Strategic Objective No. 5 and 6** Specific Objective No. 5.8
8) Research in spatial data, for example the possibility to share geo-data and metadata from various sources without transformation (i.e. without conversion from one reference system into another) for ITS services and applications; use of large-scale spatial data sets (maps) as basis for development of new ITS services.	**Strategic Objective No. 5** Specific Objective No. 5.4

10 ITS Funding

Intelligent transport systems represent a complex part of transport. Currently, the vehicles and devices on transport infrastructure are supported by numerous intelligent transport systems. A large number of these systems are intended for commercial purposes and the public sector does not contribute financially to the implementation thereof.

The funding of **ERTMS/ETCS** and **GSM-R** systems **on the railway** and the funding of planned investment projects of the **RIS** system **for inland navigation** is covered **in other documents** listed in Chapter 3 and therefore the ITS AP **does not address** the issue of funding of the mentioned systems.

The ITS AP proposes to support from public budgets those implementation projects that will contribute to:

- Collection and subsequent open publication of transport data in machine-readable format pursuant to EU standards, if such standards exist, and development of data platforms for provision of real-time information on traffic and travelling;
- Improved traffic control and improved management of incidents;
- More efficient control of respecting of road traffic rules;
- Reduced accident rate and reduction of consequences of severe injuries caused by traffic accidents;
- Better quality and attractiveness of public passenger transport;
- Improved management of freight logistic processes for consignments that can affect the safety and continuity of road traffic when transported;
- Efficient detection of serious cases of illegal behavior in traffic;
- Improved safety and accessibility of public passenger transport; accessibility of public passenger transport for persons with reduced mobility or orientation and for vulnerable road traffic participants;
- Preparing and using of standardized digital maps appropriate also for persons with reduced mobility or orientation.
- Using of the EGNOS and Galileo systems (or also of the CZEPOS network) for improving the safety of railway transport on regional lines;
- Using of the EGNOS and Galileo systems for approaching of air emergency rescue helicopter for landing, in particular in bad visibility conditions;,
- Using of specific services of the Galileo system for more efficient navigation and management of IRS services.

ITS design, development, operation and maintenance require numerous new professional methods and innovative technologies. Technologies are developing fast and therefore the public sector also needs to financially support research and development activities in ITS and implementation of pilot applications, in particular internationally, that are used to verify the theoretically set technical principles so that the new ITS applications being introduced can be implemented without any serious obstacles or problems.

Multi-source funding is crucial for ITS development, combing sources from the state budget, the budget of the State Fund for Transport Infrastructure (SFDI), budgets of regions and statutory cities with sources from corresponding EU financing instruments and with private funds of the business sector and users (market-oriented ITS applications and projects, for example ITS devices for vehicles, ITS services of electronic communication providers). The issue of state aid must be analyzed in this regard as it could constitute an economic advantage for some entities active on the market.

Future ITS deployment can follow two main directions:
1) More expensive infrastructure – cheaper vehicles: ITS equipment preferentially deployed on transport infrastructure. For example in dynamic road traffic control, the respective section is equipped with variable traffic signs. This method shall be used mainly on high-capacity sections of the network and on lines that are part of the European railway system;
2) More expensive vehicle – cheaper infrastructure: ITS devices preferentially installed in vehicles. This direction is based on the use of satellite systems.

10.1 Financial Aspects of ITS Deployment

Intelligent transport systems are composed of the following basic parts: components and devices on the infrastructure, communication environment (transmission network for data, voice or also image), on-board systems and control and information centers. The estimated lifecycle is about 100 years for transport constructions, about 30 years in case of railway vehicles, about 10 years for road vehicles and about 18 months for ITS technologies. In the area of smart technologies, it is generally true that a newer component reduces the operation costs (experience shows that by 30-40 % compared to the older solution).

Data transmission together with digital transmission of voice and image require high-quality telecommunication connection, with individual systems having different requirements as for the transmission parameters (for example it is not possible to control traffic or efficiently react to a serious situation based on information received several dozen minutes ago). Public or private communication networks (for example for railway traffic control) can be used for ITS.

On-board ITS shall be financed from public resources only for public passenger transport vehicles (information systems for passengers, ticketing systems, dispatcher control systems). Railway vehicles shall also be equipped by mobile interlocking components. For global navigation satellite systems to be used for controlling the movement of railway vehicle or navigation of vessels, it will be necessary for this purpose to prepare map documentation (GIS) with strict parameters, draft name “safe map”.

The financial requirements for ITS development were set based on data from projects that are already under preparation and further based on information from the project “Complex analysis of the current state of deployment and real functioning of ITS in the Czech Republic with a further development outlook” that has been prepared in 2011 by ASSECO CE, CDV and INTENS. ITS prices were set based on data available from infrastructure managers and SFDI. Further information was provided by SŽDC, ČD, ŘSD, ŘVC and SPS.

In any case, the price of implementation of individual ITS shall be set based on feasibility studies and specifically determined based on bid prices from procurement procedures.

The cost of ITS development as well as benefits for the society resulting from deployment of these systems may be affected by factors described in the following chapter.

10.1.1 Estimated Financial Requirements for ITS Deployment

10.1.1.1 Estimated Financial Requirements for ITS Deployment in Road Transport

Based on the analysis of traffic density on the transport network in the outlook for 2020, 2035 and 2050 using the transport model and based on the bottlenecks analysis carried out in "Transport Sector Strategies, 2nd Phase", sections were set that should in line with the TSS be given priority in deployment and development of control and information intelligent transport systems due to insufficient capacity thereon.

The sections are as follows:

No. of the motorway/road	Beginning of section	End of section		Road No	Beginning of section	End of section
D1	km 0	km 18		I/7	R7 exit 18	Panenský Týnec
D1	km 18	km 182		I/7	Toužetín	Bitozeves
D1	km 182	km 203		I/8	R63 exit 1	Teplice křiž. S I/13
D1	km 203	km 230		I/9	Junction with II/268	Jiřetín pod Jedlovou
D5	km 0	km 28		I/11	Junction with I/59 Šenov	Junction with II/475 Havířov
R10	km 39	km 46		I/20	Junction with D5 km 76	Junction with I/19
R35	km 281	km 290		I/33	Junction with I/35	Jaroměř
R1	Junction with D5 km 0	Junction with D1 km 10		I/33	Jaroměř	State border CR/Poland
I/2	Uhříněves	Mukařov		I/34	Junction with D1 km 90	Junction with I/19 Pelhřimov
I/3	Junction with D1	Junction with D3 km 62		I/35	Holice	Junction with II/366
I/27	End of 4 lanes	Švihov		I/38	Kolín (junction with I/12)	Habry (junction with II/346)
I/3	České Budějovice	Junction with II/155		I/43	Lelekovice	Junction with I/19
I/4	R4 exit 41	Milín				

Financial needs estimates are set for ITS to be operated and managed by the ŘSD (outside of cities).

Using the approved official price standards for road and motorway construction that are used for pricing of investment intentions, ITS investment represents approx. 2.5 million CZK for 1 km of new motorway of design category D33.5 built outside of cities in a flat and hilly landscape and approx. 1.4 million CZK for 1 km of a new Class I road of design category S24.5 built outside of cities in a flat and hilly landscape. These figures do not include the costs of reconstruction and repairs of the road network and further do not reflect the current requirements on equipment of newly built road and motorway sections.

For motorways and expressways outside of cities, the objective is to achieve the standard level of the road network equipment by ITS applications used for monitoring of the actual traffic/weather situation and for collection of data for statistical/transport-engineering analyses. The above mentioned study shows that the average length of a motorway section between two exits is approximately 7 km and 5 km for an expressway section.

The emergency call stations system DIS-SOS is one of the most important part of ITS deployed on the Czech road network. This system is used to create the backbone communication network through which the other ITS communicate; the emergency call station itself represents the access point for other devices such as surveillance cameras, traffic counters, meteo-stations etc. It is necessary to upgrade approx. 33% of the emergency call stations that for technical reasons are not able to serve as elements of the backbone communication network or access points. The average emergency call station installation price for one site is estimated at 1 million CZK. Approx. 240 million CZK should thus be necessary for this upgrading. Approx. 780 million CZK will be needed to complete the emergency call stations system over the entire planned road network.

To complete the system of automatic traffic counting, approximately 60 sections would have to be equipped with induction detection technology based on expert estimates (on the currently operated motorway and expressway network). To equip the planned road network that should be composed of approx. 150 sections as estimated, 150 automatic traffic counting devices will be necessary. As average investment costs for one counting site range between 500,000 and 750,000 CZK, the costs for completing the equipping of the current road network are estimated at 30-45 million CZK. For completion of the planned Czech motorway and expressway network, it is possible to expect costs of 75-115 million CZK.

The video surveillance system is used for monitoring of the current state of traffic and supervision for provision of winter maintenance. On a standard equipped motorway, camera points should be located every 2-3km. To complete this system, it will be necessary to install approximately 135 camera points in the price range of 75-135 million CZK on the currently operated motorway and expressway network. The deployment of such a system on the road network that is planned or under construction would require some 200 camera points with a corresponding investment of 100–200 million CZK.

Portal or semi-portal variable message panels (in the majority of cases, these are also equipped with a variable message sign) with the minimum/optimum spacing of the information panels of 20 km. Taking into account the current state, at maximum 15 additional panels would be necessary to develop the current system into an optimized form. Estimated investments costs for these additional devices amount to 150-170 million CZK. For the future and the planned extent of the road network, investments costs of approx. 500-600 million CZK are expected for approx. 50 of these devices.

The financial costs estimate for completion of the meteorology system is done based on the target state of 500 meteo-stations that should sufficiently cover the Czech road network. Currently, in total 385 meteo-stations exist and are operated. To achieve that, approx. 100 stations must be installed which represents a total investment ranging between 240 and 380 million CZK. The installation of the so called small-scale alert meteo-systems is planned as well to cover dangerous places where accidents are caused mainly by bad weather conditions.

The introduction of dynamic weight-in-motion systems is being envisaged to reduce the negative impacts on roads of overweight freight vehicles. From the ITS point of view, an automatic weighting site is an application with complex equipment as it includes detection technology for road freight vehicles weighting and passage/classification/speed recording with a surveillance camera. The estimated target state of the system is 100 weighting sites (on Class I roads). The investment costs for one dynamic weight-in-motion site on two lanes amount to 5 million CZK, therefore the estimated investment needs for completing the system to achieve the target state are 450 million CZK.

Basic investment cost estimates for the dynamic traffic control system amount to 3.6 billion CZK.

Provision of information on parking places and optimized and controlled use of parking areas for trucks and commercial vehicles and provision of traffic information about the situation on the road network shall be ensured; this information by its nature informs the drivers in particular about dangerous traffic situations. The introduction of the DATEX II data transmission protocol is planned as well as the NDIC modernization using current possibilities offered by information technologies consisting in the upgrade of the control system and dispatcher and data centre technology renewal. It is planned to build a back-up centre. Permanent administration, servicing and maintenance of information systems in these centers will have to be ensured.

The vision of the final stage of development of traffic information in the Czech Republic is based on the availability and timely provision of correct and technically harmonized static or dynamic data from relevant sources which will allow the users of the traffic information provision systems to get an overview of the traffic situation that corresponds to the real state without being overburdened by excessive information, ideally through mobile applications and on-board systems developed using available data in a uniform format from one or more standardized central databases. Data collected by the public sector are made available for other clients, which helps to develop new services with added value, for example information on availability and accessibility of public buildings. Open-data applications are also used by the public sector under specific conditions reflecting also the value of data provided in exchange. Floating Car Data (FCD) can be used for monitoring the real traffic situation. This data can also be used for modeling of conditions on the road network, thus helping to improve the quality of real-time traffic information and contribute to better safety and continuity of the traffic.

Cooperative systems (C-ITS) that are based on communication (data exchange) between the vehicles, but also between vehicles and infrastructure, represent another major challenge for the car electronics and ITS. Cooperative systems allow for direct communication between the vehicles themselves and between vehicles and ITS components on transport infrastructure; the data are subsequently transferred to transport control or information centers. There are several advantages of C-ITS communication, for example enabling safer driving of the vehicle by providing on-time and precise information to the driver about the traffic situation, dangerous places or other issues occurring near to them. For example, the traffic control and information centers will receive precise and complete information on the current traffic situation directly from the vehicles which will allow them to efficiently and quickly manage the traffic flow and thus improve the safety and continuity of traffic and reduce the negative environmental impacts (for example CO_2) on roads. Intelligent mobility going beyond the national borders is one of the basic objectives of the EU, with activities contributing to this objective as the foundations for a pan-European deployment and usage of cooperative systems. Cooperative systems technologies were developed by European research and scientific projects and were verified in pilot tests throughout Europe. The majority of suitable and necessary cooperative systems technologies have already been standardized on the level of CEN, ETSI or ISO.

The transport ministers of the Netherlands, Germany and Austria have signed a Memorandum of understanding and cooperation in development of cooperative intelligent transport systems, more specifically by developing of an international ITS corridor connecting Rotterdam, Frankfurt am Maine and Vienna. This corridor shall be equipped with ITS devices on transport infrastructure along the entire corridor at latest during 2015. At least two ITS services shall be provided on the corridor:

- Road Works Warning (including the monitoring of maintenance vehicles/information carts movement on roads via GNSS technology, transmission of their location into the monitoring system (located on the respective SSUD) via 3G/4G technologies and in parallel informing the vehicles approaching the area where maintenance vehicles are in motion or where information carts are stationed via 5.9GHz (802.11p);

- Data from vehicles – "Probe" data (maintenance vehicles and other vehicles equipped with ITS devices are sending information on their speed, direction of movement, acceleration or deceleration or weather conditions into infrastructure-based ITS units via 5.9GHz and these transmit them further to the control/information centers or direct communication with these centers via 3G/4G services is also possible. This information is then used to inform other drivers or for direct management of the traffic flow leading to improved safety and continuity of traffic.

In both cases, the vehicle-to-vehicle or vehicle-to infrastructure communication should primarily be based on WiFi (5.9GHz, 802.11p), while 3G/4G communication should be used only as the second option. 802.11p is an IEEE approved standard for wireless communication with vehicles (Wireless Access in Vehicular Environments WAVE) that supports ITS applications. This standard supports data exchange between high speed vehicles, between vehicles themselves and vehicles to infrastructure in a licensed band for ITS applications at 5.9 GHz (5.85 – 5.925 GHz). The communication and interconnection of individual elements is shown on the picture below (picture based on the document ITS Corridor).

The estimated financial costs for installation of ITS stations on all Czech motorways using in particular the emergency call stations system represent 40 million CZK. Costs of C-ITS integration into NDIC amounting to approx. 8-10 million CZK must be also taken into account. Annual operating costs are estimated at 4-8 million CZK.

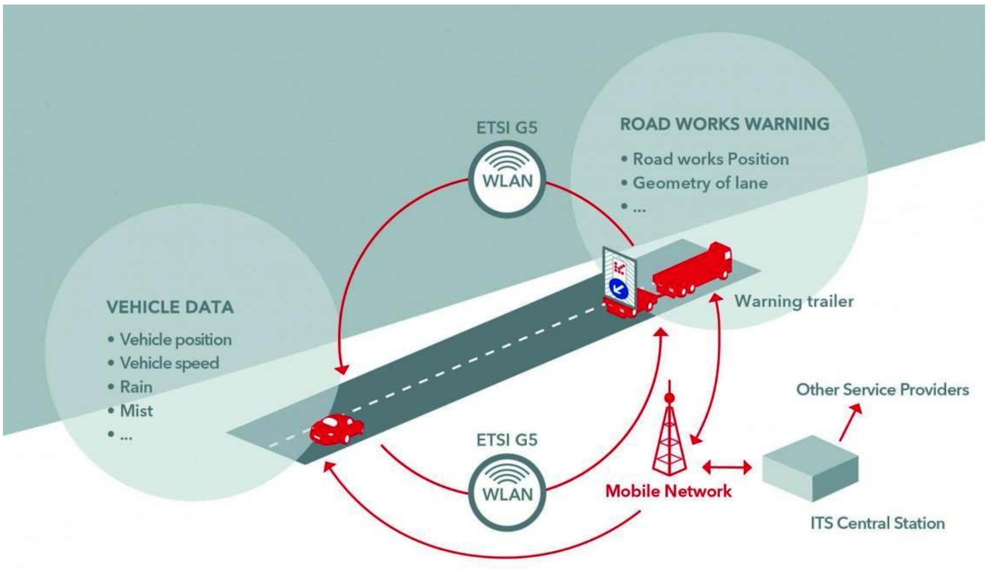


Figure: Interconnection of individual elements (source: www.c-its-korridor.de)

10.1.1.2 Estimated Financial Requirements for ITS Deployment in Public Passenger Transport

In line with legislative obligations, the National Timetable Information System (CIS JR) and the additional National Timetable Information system for Real Time (CISReal – pursuant to standard ČSN 01 8245) shall be operated. CISReal operation includes activities related to timetable data collection in line with Act No. 111/1994 Coll., on Road Traffic, as amended, and Regulation No. 122/2014 Coll., on public regular transport timetables. The CISReal manager shall be responsible for collection and publication of public passenger transport timetable data.

CISReal operation also includes the setting up and operating of the Central Component that is compatible with the CIS JR system and complements it with current real-time location information about public passenger transport vehicles. Conditions for functioning of the CISReal system are defined by the standard ČSN 01 8245. The CISReal system will allow for interconnection of carriers or integrated transport systems not linked so far without any major investments into adjustment of the existing systems. The Central Component will thus enable interoperability of individual local public passenger transport control centers and at the same time allow for information exchange with other information centers in the Czech Republic or even abroad. The CISReal manager shall be responsible for:

- Running of an open-interface server farm (import and export) defined by the standard ČSN 01 8245
- Managing and running of SW allowing to do real-time pairing of data with planned CIS JR timetables
- Running of a SW verifying the syntactic and semantic correctness of data provided by individual systems (servers) connected into CISReal
- Real-time data collection and distribution among all connected systems of carriers, organizers etc.

The centralized layout of both systems allows for organizational and economic modesty when developing new public transport information systems in regions and cities and complies with the interoperability requirements. These include technical interoperability aspects, i.e. the ability of different information systems to communicate with each other and also in real-time via shared interfaces, and semantic interoperability – the ability to understand the content and quality of data. Procedure for assessing compliance shall be introduced also for electronic ticketing systems.

10.1.1.3 Estimated Financial Requirements for ITS Deployment for Ensuring Accessibility of Public Passenger Transport for Persons with Specific Needs

This will require detailed maps adjusted to the needs of users (barrier-free routes) to facilitate movement of persons with reduced mobility (persons on wheelchairs, older citizens, mothers with baby prams) or with reduced orientation (visually-impaired or blind, hearing impaired). The needs differ based on requirements of individual users and updating of data on time and verification of information to make sure it is reliable are of crucial importance. For example, visually impaired passengers need up-to-date information about passage through an area (for example earthworks in progress, installed scaffoldings, where is the pavement located in the direction of walking), about configuration of stops in a place of transfer (for example urban public transport stops used for both directions of the line, with the same name but different end stop etc.). Wheelchair users require information about access ramps etc. In railway transport, technical specifications for interoperability on accessibility of the EU railway system for persons with disabilities and persons with reduced mobility or orientation capacities must be met.

10.1.1.4 Estimated Financial Requirements for ITS Deployment in Railway Transport

Upgrading of both HW and SW equipment of train staff will be necessary to ensure online on-board ticketing and information services for passengers that will allow to provide up-to-date information on exceptional situations, traffic conditions or to provide information to persons with reduced mobility or orientation. The estimated investment costs for equipment to meet the specified requirement amount to approx. 120 million CZK and to approx. 50 million CZK for works on applications. The systems maintenance and operation cost are estimated roughly at 10-20% of the investment costs; costs of ensuring online communication must be added to this. The part related to international electronic issuing and control of tickets equipped with QR codes should maximally amount to 12 million CZK. The implementation of a fully electronic ticket would require an investment not exceeding 48 million CZK. On-board ITS upgrading is related to ITS development on railway infrastructure – Czech Railways are interested in increasing of the safety and continuity of passenger and freight transport which requires upgrading of vehicles that only comply with safety requirements that were in place at the moment of introducing these into operation.
For maximum usage of technologies such as ATO, AO or other and meeting requirements for potential analysis of exceptional situations such as the Speed-metering server, investments into railway vehicles and associated systems are estimated at 220 million CZK and the increase of operating costs is estimated at 99 million CZK over 6 years; this includes both ITS operation and ensuring of the online communication. Investments into improving of the DISOD dispatcher system and its input parameters, also using GNSS including connection to information systems of neighboring dispatcher sites of other carriers or transport infrastructure managers represent a crucial element for improving of safety and continuity of operation. Estimated investment costs for ensuring GNSS coverage of all vehicles and adjustments of related systems and interfaces amount to 120 million CZK. Adjustments of the dispatcher system and system of online information provision to all units and services (security bodies, the public or companies and entities in charge of passenger or freight transport) should require estimated investments not exceeding 100 million CZK.

Diagnostic, information, warning, control and interlocking systems (including Automatic train operation) and radio data transmission systems shall be installed on railway infrastructure. The carriers shall install ETCS and ATO on-board systems. If all vehicles are equipped with ETCS (ideally also with ATO), it is necessary to consider the verification and implementation of data transmission technology on the infrastructure and select the optimum level of control and interlocking without the need to install infrastructural elements (signals, detection devices) on national and regional lines outside of TEN-T. The proposed amount for introduction of satellite systems on regional lines is based on the following economic and technological requirements.

In addition to other parameters, the capacity of the railway is affected by the method of traffic control. On 44 regional lines with the total length of 1,218 km (38.6% of the total length of regional lines), traffic is controlled using a system where the lines are divided into track sections between operating posts with rail branching and into tracks within operating posts. The operating posts are permanently occupied by staff of the railway operator (for example dispatchers, signalers, points operators, signal block operators etc.) that is in charge of transport control and organization. For this type of lines, investment cost shall amount to 50 million CZK for one standard line, including adequate interlocking and equipping of 10 vehicles providing basic transport service coverage.

On 44 lines with the total length of 1,939 km (61.4% of the total length of regional lines), traffic is controlled in line with the regulation on simplified railway traffic control. On such lines, only one train or one shunting rail vehicle is moving on defined line sections. The operating posts are not permanently occupied by the railway operator staff. Railway transport is usually controlled from one place and train crew (for example conductor) communicates at defined operating posts with the person in charge of traffic control via a suitable signaling device. In situations of crossing or overtaking of trains, the arrival track must be defined or it must be decided which train will enter the operating post first. Train departure is conditioned by approval of the person in charge of traffic control (controlling dispatcher – can be described as in charge of the area) or other approval of the railway operator. For this type of lines, investment cost shall amount to 20 million CZK for one standard line, including adequate warning information system and equipping of 10 vehicles providing basic transport service coverage.

The Automatic Train Operation (ATO) system is designed for automatic control of rail vehicles on SŽDC railway lines. This equipment is part of a superior system of driving regulation of engine and control vehicle - CRV&ATO, i.e. Central Regulator of Vehicle and Automatic Train Operation. The equipment is linked to the dynamic train interlocking protection LS 90 with prepared connection to the European train control system ERTMS-ETCS.

The set of devices is composed of mobile and track-side parts. The track-side part consists of a system of specific track information points – magnetic information points (MIB) placed in the railway yard. The information point is composed of two prisms placed longitudinally in the rail. These prisms contain 8 permanent magnets in total. ATO also allows for obtaining of location data via the GNSS system, thus eliminating the need for the costly and complicated installation of magnetic information points. This method of ATO system location called GIB (geographic information point) has been successfully introduced and tested on vehicles running mostly on non-corridor lines. ATO also allows reading location information from the Eurobalise system in case the line is equipped with it. The information points thus provide definite information on the immediate position of the train. In case of MIB, the specific information is coded using a secure code and is transmitted to the vehicle through direct-current magnetic field. Other non-variable information necessary for train operation control, such as line speed, position of signals, line gradient and others are taken by the ATO system from the Route Map in the mobile part. The mobile part is composed of a computer for control, track information points readers, entry keyboard and display at the conductor´s site, this display being shared with the vehicle control system. The data part – Route Map – contains track descriptions and data from train timetables and it is loaded in the mobile part of the equipment. The CRV&ATO system provides functions of vehicle control with automatic speed regulation (basic vehicle control mode), automatic braking at target position, travel time regulation and manual vehicle control.

ATO brings about savings in particular through reduced traction energy needs by 10-30%. The return of investments into MIB installation is very short, ranging between 1 and 3 years. The ATO system contributes to stricter respecting of travel times, thus running in line with timetables. Functional ATO systems enable trains to stop precisely in stations and stop on predefined positions. Other benefits of the system are improved rail traffic safety through better working environment for train conductors (safety of vehicle movement must however be ensured via ETCS train interlocking protection). Introduction of on-board interlocking and automatization systems is a basic prerequisite for improved competitiveness of railway transport. Optimum usage of ATO system capacities would require provision of information about the defined train route from the interlocking and signaling system which would help to achieve higher control automatization through ATO (at present, the missing information must be added by the conductor based on immediate assessment of the situation) and also to increase the efficiency of traction energy savings algorithm.

The implementation of the track-side part of ATO on SŽDC railway network is planned for 2015 with expected financial costs of 155 million CZK. In the following period from 2016 on, it is planned to continue equipping lines with ATO based on cooperation with carriers, taking into account the numbers of their traction units equipped with the mobile part of ATO. Currently, mobile parts of ATO are installed in electric double-decker units of series 471 (CityElephant) and traction units of series 380 and vehicles of series 163, 362, 750.7, 842, 961, 363.5. As lines are being gradually equipped with ETCS, in line with the deployment concept defined in the National ERTMS Deployment Plan, it is planned to remove the MIB information points from lines where ETCS will be deployed and subsequently install them on other selected railway lines where their use will be beneficial for operation, taking into account the equipment of traction units by ATO. The option of installing of a unit for reading of GIB information points based on GNSS into all vehicles equipped with ATO can also be considered.

Traffic on the railway network is controlled non-stop and over a large territory and it is interconnected with railway networks of neighboring countries. Railway traffic is secured against accidents or collisions through the interlocking and signaling equipment and its organizing is supported by numerous information and communication systems. Strengthening of the inadequate transmission infrastructure through elements of modern communication technologies represents the basic condition for setting up of the “Control and Analytic Centre for Railway Operation Control”. The estimated costs of this step amount to 350 million CZK and the measure shall also contribute to improved safety and reliability of the existing systems. Costs of creating of a single environment for communication and recording of data from audio, video, diagnostic, dispatcher and interlocking systems (SW, HW) are estimated at 90 million CZK. Cost for setting up of the add-on control, surveillance and analytic system for the “Control and Analytic Centre for Railway Operation Control” are estimated at 100 million CZK. New system functionalities shall ensure simplification of railway infrastructure control and organization procedures, in particular in relation to processes of control activities planning, organization and execution methods.

Defects of rail vehicles undercarriage (in particular in freight wagons) can directly lead not only to major accidents with material damage to the vehicle and transported cargo, but depending on the train speed and exact place of derailing severe damage can be caused to transport infrastructure and major risks for rail transport safety can occur (possibility of a direct contact of the vehicle with the train running in the opposite direction etc.). The risk of major consequences of defects such as rail break, axle pivot shear, loosening of a wheel, fracture of a full wheel is growing not only on corridor lines, but also on other lines in the context of line speed increase to 160 km/h. The costs for completing the track-side part of the network of digital devices for diagnostic of defects on vehicles in motion – i.e. approx. 64 checkpoints – are estimated at 400 million CZK. Development of a thematic superior layer ensuring communication between individual checkpoints with online assessment of the defect´s development shall lead to further reduction of undetected serious defects – *affecting the safety of railway operation* – of rail vehicles in motion. The costs for development of this ITS together with preparation for connection to similar systems of neighboring European railways by exchanging warning notifications and related data and preparation for use of vehicle location information from European satellite positioning systems EGNOS and Galileo are estimated approximately at 110 million CZK.

Implementation of the “Automatic warning system” (SAV) aimed at reducing risky behavior of drivers and pedestrians on dangerous parts of railway infrastructure involves protection of some 500 selected dangerous sites, ensuring connectivity, surveillance centers and access of rescue and enforcement services of the Czech Republic to the system via a “thin client”. Expected costs of full implementation in 2020 amount to 520 million CZK.

Railway transport safety is also significantly affected by damages to or theft of railway infrastructure technical devices and equipment – mostly theft of metallic (copper) cabling and other interlocking and signaling equipment components used for controlling of the trains running, sequence, speed, crossing in stations etc. A major reduction of these criminal activities is expected from modern dynamic protection detection systems for railway infrastructure components or equipment. It is expected that some 2,000 km of lines shall be covered by the detection system, with connection of selected key structures, by 2020. The described network shall be supervised from a monitoring work post. The expected costs of 1 billion CZK include costs for ensuring connectivity of the equipment and communication interface for access of enforcement units.

Currently, numerous information systems exist in relation to managing and maintaining railway infrastructure. Intelligent transport systems offer a large scale of applications for infrastructure managers, carriers and transport users. Conditions for ITS development are created through setting up of standardized interfaces between individual systems, sub-systems and applications running on diagnostic, defectoscopy and technical data on the condition and operability of railway infrastructure; defining specification of individual connections between applications, sub-systems and systems; specification of requirements on individual connection interfaces. By implementing the system, the railway infrastructure manager will be able to allocate capacities and resources in an optimum way with the aim of improving safety and continuity of works on the railway network, ensuring of optimum operability parameters for using of individual infrastructure parts while taking into account the current and outlook transport needs. Interlinking of this application under preparation to operation will facilitate and render more efficient the planning of railway transport, line closures and will, through on-time indication and reduction in irregular and emergency interventions on the infrastructure, contribute to an overall reduction of delays and irregularities in transport. Implementation of the software for the integrated rail infrastructure management system is planned in phases through modules “Economy of tracks” for 78 million CZK, “Interlocking and telecommunication technology” for 34 million CZK and “Electro-technics and energy” for 38 million CZK. In parallel, conditions and interfaces shall be created enabling the use of EGNOS and Galileo systems and applications systems based on satellite systems for monitoring of railway transport infrastructure safety to forecast impacts of the weather situation, landslides or movements, floods and inundations.

10.1.1.5 Estimated Financial Requirements for ITS Deployment in Freight Transport Logistics

The current information systems for tracking of the transportation of special consignments are being developed in a dispersed way, be it by individual industrial companies or operators, or even in different countries. The information and corresponding applications cannot be shared between the companies themselves or between the companies and rescue services. Therefore, in case of an accident, the rescue services cannot use the information on the nature of transported goods, even if this would be possible from the technical point of view. The potential of these systems – to provide relevant information within a very short time to those who might need it for rescue activities – is thus not being used fully. Critical events often require re-directing of traffic flows outside of the affected area. Serious problems in organization of traffic can occur on the road network as it is the truck driver who decided about the route to take, unless a specific route is defined or on the contrary passage banned on some sections by a specific implementing act. In case of a critical event, a vehicle with an oversized or very heavy load can act as an obstacle for other vehicles. Precise information about these obstacles provided on time to respective units can improve the efficiency of transport organizing in situations of crisis.

10.1.1.6 Estimated Financial Requirements for ITS Deployment in Inland Navigation

The development of the dispatching centre and applications connected to river information services shall be ensured and the access of lock chambers staff to RIS will be introduced. The following shall be supported as well: transmission of meteorological information (current and forecast data) from CHMI to RIS; operation of AIS transmitters, of a differential GPS with receptions of the IALA system correction signal; upgrade of the measuring HW and SW for measuring vessel Střekov; HW and SW renewal of the LAVDIS system; ensuring of data transfer from the national geo-database into the S-57 system for navigation of vessels.

10.1.1.7 Estimated Financial Requirements for ITS Deployment in the Area of Spatial Data

Currently, the MoT does not own almost any spatial data infrastructure (SDI). Only partial exceptions exist in the form of isolated solutions. This situation is becoming more pressing and not sustainable for the future. The need to interlink and combine infrastructure data for different transport modes is becoming more urgent and therefore such an environment needs to be created where the existing systems will be interconnected to create a complex data source for the development of those services that use spatial data as the basic input, i.e. above all for achieving an economic approach to organizing and controlling of transport and related ITS introduction, etc. The existing SDIs, operated within individual subordinate organizations, shall be therefore consolidated. SDI shall be set up at the MoT where this type of infrastructure is missing. An integration platform shall be set up as an expansion of the MoT SDI which shall integrate data from all transport modes and enable their simple and efficient use across the transport sector, but shall also serve as the single access point for transport spatial data and as support for execution of transport-related and territorial agendas of public administration central bodies, regional and municipal authorities or the expert public.

In the context of preparation of the Central Register of Roads (CEPK) and the function it should play, it is important to develop it as an information system with strong accentuation of the spatial component and its spatial precision, i.e. as a geographic information system. At the same time, the system must be correctly interlinked with the planned SDI for the transport sector. An analysis and survey will be necessary – to collect the attributes to attributes that should be registered in the CEPK so that the information contained in CEPK meets the requirements of various user groups (for example infrastructure manager, infrastructure users, IRS etc.). It is also necessary to define the basic spatial data parameters to ensure that a connected roads data set (layer) is created.

There is a growing need for a central register of railway infrastructure and therefore an adequate information system shall be set up. Also this system shall be designed with a strong accentuation of the spatial component and as fully compatible with the planned SDI for the transport sector. The transmission of such data into the system will have to be provided for in the legislation as both private and public railway infrastructure exists; the register manager will have to be selected. The scope and description of items in the register also needs to be defined.

It is also necessary to consolidate and develop the data fund of transport spatial data, both on the state level and regional and urban level. Interoperability of spatial data needs to be ensured as well as the possibility to easily interconnect spatial data infrastructure with other similar systems when suitable. Public services based on transport spatial data shall be developed.

10.1.2 Defining the Sources and Structure of Funding for Individual Items

A framework estimate of potential planned expenditure has been drawn in order to identify the funding volumes necessary for implementation of measures defined in the ITS AP and to analyze the possible sources of funding from public sector budgets. Therefore the ITS AP does not specify the sources and structure of funding (MoT chapter No 327, EU resources, TAČR, regional and municipal budgets etc.) or the respective shares of the state budget and EU (if applicable for the specific expenditure) for specific costs. As the figures presented are rough framework estimates, it is not specified if the amounts are including or excluding VAT.

The ITS AP implementation shall not mean increase of the number of MoT employees or of costs spent on wages.

Based on the ITS AP, an implementation plan shall be drafted subsequently that will contain a more detailed framework for the subject matter, schedule and financial aspects of individual projects.

Funding of ITS development by the MoT, SFDI, SŽDC, ŘSD, ŘVC and SPS:

	Total [mil.CZK]	2015 Investment costs [mil.CZK]	2015 Operating costs [mil.CZK]	2016 Investment costs [mil.CZK]	2016 Operating costs [mil.CZK]	2017 Investment costs [mil.CZK]	2017 Operating costs [mil.CZK]	2018 Investment costs [mil.CZK]	2018 Operating costs [mil.CZK]	2019 Investment costs [mil.CZK]	2019 Operating costs [mil.CZK]	2020 Investment costs [mil.CZK]	2020 Operating costs [mil.CZK]
ITS in road transport													
Data sources and ensuring the transmission and quality													
Universal deployment of detection technologies on road transport infrastructure in the CR	1,910	20	0	525	0	500	0	25	0	420	0	420	0
Development and upgrading of the communication network for data transmission and for the communication system for the cooperative vehicles concept	662	7	0	140	0	65	0	10	0	220	0	220	0
Acquisition and incorporation of a general data source on traffic flows dynamics and costs of repository operation	331	1	55	0	55	0	55	0	55	0	55	0	55
NDIC	400	100	30	50	30	50	30	20	30	0	30	0	30
National access point	75	20	5	5	5	0	10	0	10	0	10	0	10
Information service for truck parking	550	20	20	40	40	60	50	40	80	20	80	20	80
DATEX	20	10	0	5	0	5	0	0	0	0	0	0	0
Compliance	120	20	10	10	10	0	15	0	15	0	20	0	20

	Total [mil.CZK]	2015	2016	2017	2018	2019	2020						
		Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]
assessment													
Total costs [mil.CZK]	4,068												
- of which total investment costs [mil.CZK]	3,068												
- of which total operating costs [mil.CZK]	1,000												
Traffic control													
Installation of dynamic traffic control systems on road transport infra-structure of the CR	3,610	5	0	200	5	800	20	1,500	80	500	0	500	0
Cooperative systems	62	0	0	5	2	5	2	10	4	10	6	10	8
Total costs [mil.CZK]	3,672												
- of which total investment costs [mil.CZK]	3,545												
- of which total operating costs [mil.CZK]	127												
Improved safety													
Installation of sensors and active elements into high-risk areas to in-crease road traffic safety and reduction of the acci-dents´ rate (warning in case of bad	160	30	0	32	0	35	0	30	0	30	0	30	0

	Total [mil.CZK]	2015	2016	2017	2018	2019	2020						
		Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]
weather conditions)													
Automatic weighting of trucks	505	50	5	50	5	100	10	100	10	100	10	50	15
Total costs [mil.CZK]	665												
- of which total investment costs [mil.CZK]	610												
- of which total operating costs [mil.CZK]	55												
ITS for public passenger transport													
Harmonisation of ticketing services for passengers in public transport	130	0	0	25	0	25	10	0	10	25	0	25	10
CIS JŘ	65	0	0	15	10	0	10	0	10	0	10	0	10
Assessment of compliance of electronic ticketing systems	85	20	5	10	5	0	10	0	10	5	10	0	10
Total costs [mil.CZK]	280												
- of which total investment costs [mil.CZK]	150												
- of which total operating costs [mil.CZK]	130												
ITS in railway transport (outside of the scope of ERTMS – ETCS and GSM-R) – **railway operators**													
Online ticketing systems and services and information for passengers in	254	50	5	60	11	60	17	0	17	0	17	0	17

	Total [mil.CZK]	2015	2016	2017	2018	2019	2020						
		Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]
the vehicle													
International electronic ticket	64	2	0	18	2	10	3	10	3	5	3	5	3
ITS upgrading on the railway vehicle and communication systems	319	30	9	30	12	40	15	40	18	40	21	40	24
Passenger transport dispatching centre	112	12	2	30	2	22	2	12	2	12	2	12	2
Using of GNSS for monitoring of the train position	147	20	2	20	3	20	4	20	5	20	6	20	7
Total costs [mil.CZK]	896												
- of which total investment costs [mil.CZK]	660												
- of which total operating costs [mil.CZK]	236												
ITS in railway transport (outside of the scope of ERTMS – ETCS and GSM-R) – **railway infrastructure manager**													
ATO – automatic train operation	210	155	0	15	0	10	0	10	0	10	0	10	0
KAC – Control and analytic centre for railway operation control	559	20	5	89	5	100	5	110	5	110	5	100	5
ROSA – Indication of dangerous technical defects on rolling stock in	539	50	5	120	5	120	5	120	5	79	5	20	5

		2015	2016	2017	2018	2019	2020						
	Total [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]
motion													
SAV – Automatic warning system	579	40	0.5	80	1	200	3.5	100	4	100	5	40	5
Devices for monitoring of electric traction units counters	410	42	1	56	1	73	1	75	1	78	1	80	1
Integrated technology system for the railway infrastructure manager	278	78	3	34	3	37	3	37	3	37	3	37	3
CDP – Central traffic control service Centralisation of railway operation control to selected centres.	1 660	300	10	300	10	300	10	300	10	200	10	200	10
Railway infrastructure monitoring system	188	10	1	10	1	10	2	20	2	20	2	100	10
Development and upgrading of complex, high-quality and interoperable railway systems for intelligent operations control. Development of intelligent, automated and flexible	590	40	10	100	20	100	25	100	25	60	25	60	25

	Total [mil.CZK]	2015	2016	2017	2018	2019	2020						
		Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]
dispatching control systems for railway operation and intelligent systems for improved safety on regional lines.													
Consolidation of information systems for passengers on infrastructure managed by SŽDC	800	130	25	200	25	180	25	100	25	20	25	20	25
Spatial and technical description of the railway network infrastructure + GIS	403	45	8	85	20	75	25	25	30	10	35	10	35
Detection systems of dynamic protection of components and devices on the railway infrastructure to reduce the risk of safety and security threats due to damage or theft of railway technical equipment or devices.	1,075	0	0	100	10	300	15	250	20	250	20	90	20
Total costs [mil.CZK]	7,291												
- of which total	6,592												

		2015	2016	2017	2018	2019	2020					
	Total [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]
investment costs [mil.CZK]													
- of which total operating costs [mil.CZK]	699												
ITS in inland navigation (outside of the scope of RIS development)													
Maintenance and development of the dispatching centre and of the applications connected to river information services	3	0	0.5	0	0.5	0	0.5	0	0.5	0	0.5	0	0.5
Access points for reception of RIS information	3	0	0.5	0	0.5	0	0.5	0	0.5	0	0.5	0	0.5
Differential GPS with reception of the IALA system correction signal	15	0	2.5	0	2.5	0	2.5	0	2.5	0	2.5	0	2.5
Transfer of data from the national geodatabase into the S-57 system for navigation of vessels	15	0	2.5	0	2.5	0	2.5	0	2.5	0	2.5	0	2.5
Operation of AIS transmitters	27	0	4.5	0	4.5	0	4.5	0	4.5	0	4.5	0	4.5
Upgrading of the measurement HW and SW for the measuring vessel Střekov	6	3	0	0	0	0	0	0	0	0	0	3	0

		2015	2016	2017	2018	2019	2020						
	Total [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]
Upgrading of HW and SW of the Lavdis system	2.4	0	0.4	0	0.4	0	0.4	0	0.4	0	0.4	0	0.4
Total costs [mil.CZK]	71.4												
- of which total investment costs [mil.CZK]	6												
- of which total operating costs [mil.CZK]	65.4												
ITS for freight logistics													
Information site for transportation of oversized and overweight loads	24	3	2	1	2	0	4	0	4	0	4	0	4
Total costs [mil.CZK]	24												
- of which total investment costs [mil.CZK]	4												
- of which total operating costs [mil.CZK]	20												
ITS for ensuring accessibility of public passenger transport for persons with specific needs													
Detailed maps reflecting the needs of users (barrier-free routes)	200	20	10	20	10	20	15	30	20	10	20	5	20
Total costs [mil.CZK]	200												
- of which total investment costs [mil.CZK]	105												

		2015	2016	2017	2018	2019	2020						
	Total [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]	Investment costs [mil.CZK]	Operating costs [mil.CZK]
- of which total operating costs [mil.CZK]	95												
Spatial data infrastructure for ITS													
SDI for the transport sector	150	5	5	35	7	25	8	10	10	10	10	15	10
Central register of roads (the part on spatial data)	30	5	2	5	2	1	3	1	3	1	3	1	3
Development of the fund, updating of spatial data, development of public services	195	10	10	30	10	30	10	25	10	20	10	20	10
Total costs [mil.CZK]	375												
- of which total investment costs [mil.CZK]	249												
- of which total operating costs [mil.CZK]	126												

Expected absorption capacity for ITS deployment in regions and cities until 2020:

Intended ITS deployment in regions and cities until 2020	Average allocation/year [mil.CZK]
Systems for motionless transport / at standstill	**5**
ITS for road traffic control in urban agglomerations	**600**
ITS for public passenger transport dispatching centres	50
Monitoring systems for freight transport	20
Provision of information to traffic participants in real time	70
Systems for traffic control in cities	300
Devices for collection and assessment of traffic data – DIC	160
ITS in public passenger transport	**320**
Ticketing and information systems	150
Intelligent stops and information panels for passengers	100

Improved attractiveness and continuity of public passenger transport – preference for urban public transport vehicles, information on connections with barrier-free vehicles.	70

10.2 Public Financial Resources for Funding of ITS Implementation Projects

Investments in intelligent transport systems are paid from the state budget, via the State Fund for Transport Infrastructure or through EU programmes co-financed from Czech public budgets. Individual regions and cities also have their own budgets that are used for investments into ITS.

10.2.1 State Budget

It is expected that the budgetary chapter of the Ministry of Transport will be used to fund activities related to the National Timetable Information System (CIS JR); activities related to spatial data infrastructure consolidation within the transport sector, including operation and incorporation of the geographic information system Unified Transport Vector Map (JDVM) and database of transport infrastructures; issues related to harmonization and accessibility of the obtained spatial data (for example sets of spatial data (map layers), other structures or elements on maps and their description including information on their location – coordinates) in line with requirements of European legislation on development of European spatial data infrastructure, i.e. in line with the Directive of the European Parliament and of the Council EC/2/2007 INSPIRE and related regulations. Also activities related to compliance assessment of ITS products, devices and services pursuant to Act No. 13/1997 Coll., on Roads, as amended, aimed at creating framework conditions allowing ITS end users to rely on guaranteed and critical applications, i.e. such applications when an error in functioning of the system would mean serious threat to health or life of persons, or a substantial financial loss, shall be supported from the state budget. Co-financing for the MoT participation in European projects of common interest for ITS development and deployment is also planned.

10.2.2 State Fund for Transport Infrastructure (SFDI)

Expenditure for ITS funding, both for investments and maintenance and operation of systems, in particular ITS operated by the ŘSD, represent one of mandatory expenses of the SFDI. The ŘSD is the investor in majority of cases, but other organizations can be investors too, such as for example SŽDC, SPS or important cities, in particular those connected to the backbone road network.

Maximum drawing of EU resources is the primary priority for the MoT and for the Czech Government. From the financial perspective, ensuring of sufficient sources for national co-financing is a necessary precondition for maximum drawing of allocated resources from EU funds.

Some ITS projects are perceived by the EU as priority ones. ITS projects with European added value where large scale application in several member states is expected can be defined for two different scopes of impact:

<u>1) Geographic definition</u> – for example ITS for road traffic control (or other relevant systems and applications) can be preferentially deployed on TEN-T networks of individual states with a given interface to related systems on regional, local or large cities level, or to private sector systems;

2) Definition based on the specific type of service with European added value - ITS that should be expanded across Europe, but cannot be defined solely for the TEN-T network (for example multimodal travel planning, automatic emergency call from the vehicle eCall 112, navigation devices for persons with reduced orientation etc.).

10.2.3 Operational Programme Transport 2014-2020 (OPD2)

Intelligent transport systems and services development funding from Operational Programme Transport in programming period 2007-2013 was rather low. This situation was caused by delays in adopting of international standards, low maturity of ITS projects and also delays in issuing of specifications for ITS priority services by the EC.

OPD2 supports ITS development in all transport modes. The list of specific objectives and supported ITS activities with the proposed total financial allocation for individual priority axes is presented in the table below. Specific Objectives No. 1.1, 1.3, 1.5, 2.1, 2.2, 2.3 and 3.1 are based on the use of latest available technologies and global navigation satellite systems (GNSS). For entirely new motorways or expressways, the cost of ITS equipment installation can be included in total project costs.

Priority Axis	Specific Objective	Supported ITS Actions	Proposed allocation for the given PA [bn.€]	Proposed allocation for the given PA [mil.CZK]	Proposed allocation for ITS in CZK [mil.CZK] (1 € = 28 CZK)
PA1	SO 1.1	TSI implementation; telematic systems development; introduction of remote-controlled interlocking system and ATO together with deployment of other modern technologies (including space technologies) to increase the safety of railway transport and related development of information bases (incl. railway network description)	2.819	78,932	7,900
	SO 1.3	ITS deployment for better use of multimodal transport including support for door-to-door mobility			
	SO 1.5	Works on railway vehicles aimed at ensuring interoperability and TSI implementation, includ-			

		ing on-board parts of ERTMS			
PA 2	SO 2.1	Support for deployment of new technologies and applications for protection of transport infrastructure and traffic optimization	1.561	43,715	4,400
	SO 2.2	Equipping public transport infrastructure by feeding and charging stations for alternative fuels, also as part of existing Park&Ride sites or paid parking places			
	SO 2.3	Development of systems and services on the TEN-T Network and in cities, including ITS, for traffic control and traffic flows management on the urban road network Support for development of spatial data infrastructure and deployment of new technologies and application for protection of transport infrastructure and optimization of traffic, incl. application based on satellite systems data and services (for example Galileo, EGNOS, Copernicus and other) Development of ITS, GIS and SDI, networks and services for provision of information on traffic and travelling in real time, for dynamic traffic control and management of traffic flows, provision of information and services to drivers and passengers in cities and on			

		the TEN-T network and related infrastructure.			
PA 3	SO 3.1	Reconstruction, upgrading, renewal and construction of roads and motorways owned by the state outside of TEN-T including ITS deployment, interconnection of regional traffic control and information centers with the National traffic control and information centre, including spatial data infrastructure development	1.062	29,723	3,000
PA 4	SO 4.1	Supporting and preparatory studies, expert workshops, publicity	8.287	23,203	23

10.2.4 Integrated Regional Operational Programme (IROP)

The IROP will be implemented in the programming period 2014-2020 and there is complementarily in Thematic Objective 7 – Upgrading of regional road infrastructure networks (PA 1 in IROP and PA 1 in OPT2) as follows: OPD2 shall be used to support investments into the TEN-T road network while interventions on connecting lower class roads should follow from the IROP. The IROP shall also support development and capacity increase of public passenger transport as a sustainable form of transport; development and interlinking of intelligent transport systems in road traffic in cities and agglomerations; equipping of all types of transport infrastructures for all transport modes with ITS technologies (for improved comfort and safety of travel, optimized transport infrastructure capacity, provision of real-time traffic information etc.). The IROP shall also support activities aimed at introducing standards for electronic ticketing systems for passengers, integrated tariffs and a single travel ticket. The IROP further supports activities aimed at introducing preferential passage for public passenger transport vehicles in traffic and at creating conditions for making public transport accessible for persons with reduced mobility or orientation or for example developing of an information system for this category of passengers.

Possible beneficiaries of assistance: regions and organizations established or founded by regions, municipalities and organizations established or founded by municipalities, railway or railway transport operators, regular public transport operators, MoT of the CR and entities in charge of ensuring transport service coverage. The programme is aimed at the territory of the Czech Republic excluding the Capital City of Prague. The programme has received funding from the European Regional Development Fund and its total allocation amounts to approx. 4.63 billion EUR. The expected amount of assistance for the whole programming period for Priority Axis 1, with Thematic Objective No 7 as part of it, should be approx. 1.6 billion EUR. Support for Specific Objective (SO) 1.1 (Interventions into lower class roads) should amount to 945 million EUR). Details for SO 1.2 are provided in the table below.

Priority Axis	Specific Objective	Supported ITS activities	Proposed allocation for the given SO [mil.€]	Proposed allocation for the given SO [mil.CZK] (1 € = 28 CZK)	Proposed allocation for ITS in CZK [mil.CZK] (1 € = 28 CZK)
PA1	SO 1.2	Deployment and operation of complex control, information and payment systems Installation of transport telematic devices in cities (navigation, information and dispatching systems with preference for public passenger transport within integrated transport systems or similar systems). Development or upgrading of information and ticketing systems in public transport and ITS supporting direct Door-to-Door mobility. Improving transport safety (for example crossings roads/rail, coexistence with cycling, barrier-free access, interface for informing persons with reduced mobility and orientation).	473	13,244	500

10.2.5 Operational Programme Enterprise and Innovation for Competitiveness 2014 – 2020 (OP EIC)

Under this programme, financial support can be provided to activities from the following investment priorities:

a) Investment Priority 1 of Priority Axis 1 – "Promotion of research and development for innovation":

Under Specific Objective 1.2, support can be provided to projects aimed at manufacturing of new products and their introduction on the market. Projects include equipping of the site by necessary equipment needed to introduce the innovation and specialized counseling that may involve services in the area of technology transfers, support for entry on a foreign market, counseling in relation to standards and rules and access to patents.

b) Investment Priority 2 of Priority Axis 4 – "Development of products and services in the area of information and communication technologies, electronic commerce and increasing the demand for ICT":
Under Specific Objective 4.2, support is available for projects creating new sophisticated ITC solutions (in particular ERP systems, CRM systems, payment and card systems, data safety, HR systems, B2B systems, B2C systems, IS for the non-profit and public sector, power management, process-oriented web applications, solutions for mobile devices, Business Intelligence solutions, software simulations, cloud computing), i.e. creating modern and advanced digital services and applications for communication, leisure, trading, education, healthcare, access to work or for cultural and creative industries. Solutions for data security promotion, development of mobile devices, introduction of open standards and enhanced interoperability shall be supported.

10.2.6 Operational Programme Research and Development for Innovation (2008-2015)

The project Transport Research Centre (CDV PLUS) was funded from EU resources and the Czech state budget through the Operational Programme Research and Development for Innovation; the total amount was 463 million CZK, of that the EU share amounted to 390 million CZK. The project was implemented by the Centre for Transport Research; the implementation ended in December 2014. The project Transport Research Centre (CDV PLUS) included five research programmes: In-depth analysis of traffic accidents, Human synergies in transport, Safety in road traffic, Transport Infrastructure and Transport and environment. The aim of the project was to develop a high-quality research environment with laboratories, equipment and know-how that shall serve to provide complex conditions for research in selected fields of applied transport sciences. The equipment of the Transport Research Centre (CDV PLUS) meets the highest current standards and trends in transport research.

10.2.7 Integrated Tools

Broader usage of ITS shall also be achieved due to measures implemented through Integrated Territorial Investments (ITI) and Integrated Territorial Development Plans (IPRÚ) – two of the integrated instruments that exist in the programming period 2014 – 2020.

ITI/IPRÚ shall contain the key investments addressing the issues of the given territory from more than one priority axis or from more ESIF programmes. Transport is one of the key themes in connecting of core cities and the most important centers of the Czech Republic with their functional areas, as in these metropolitan areas/settlement agglomerations, transport often has to face very high requirements for transport performance and service quality.

Measures related to ITS shall be integrated in Operational Programme Transport in particular through SO 1.4. Measures aimed at creating conditions for increased use of public transport in electric traction in cities and within the Integrated Regional Operational Programme shall be supported under SO 2.1 – Increasing the share of sustainable transport modes (among other by ITS development, deployment, reconstruction or upgrading).

10.2.8 Connecting Europe Facility (CEF)

The Connecting Europe Facility (CEF) represents another important source of EU funding for ITS development. The programme supports projects of European common interest as part of the trans-European networks policy in the sectors of transport, telecommunications and energy. As intelligent transport systems are using information and communication technologies, some ITS projects can be aimed at development or upgrading of telecommunication infrastructure.

The CEF functions based on work programmes and calls. There are two types of work programmes. The Multiannual work programme has already been announced for larger projects on the core TEN-T network. This programme shall be complemented by annual work programmes announced for implementation of smaller projects on the core network and in very limited scope also of projects on the comprehensive TEN-T network. A part of CEF funds is allocated exclusively for the needs of cohesion countries; these funds have been transferred to the CEF from the Cohesion Fund. Specific rules are in place for the "cohesion envelope" of CEF, different to the standard rules. First in relation to the co-funding rate (theoretically can be up to 85%) and second the fact that none of the cohesion countries can receive more financial resources in support for presented projects than the amount available in its national envelope. However this does not mean that allocation of these financial resources is automatic, without an assessment of the projects by the EC. Nevertheless the EC role will gain even more in importance after 2016, as the projects from cohesion states will be directly competing for the remaining CEF cohesion financial resources.

ITS projects that are in line with the following priorities shall be implemented under the Multiannual work programme:
1) New technologies and innovations in all transport modes, including sustainability, operation, control, accessibility, multi-modal approach and transport network efficiency;
2) Safe infrastructure including safe parking and provision of related services;
3) Intelligent transport services for road traffic;
4) Actions focused on large urban agglomerations (junctions), including interfaces of long-distance and urban/regional transport.

The following priorities for ITS have been set in the Annual work programme:
1) Other technologies than the technologies covered by the Multiannual work programme;
2) Other telematic applications than the applications covered by the Multiannual work programme;
3) Actions focused on large urban agglomerations (junctions), including interfaces of long-distance and urban/regional transport.

The above listed priorities include:
1) Cooperative systems (communication between the vehicle and a device on the infrastructure – C2I – including demonstration of long-term sustainability of the project and possibility to expand it in the future for mass deployment);
2) Systems for traffic control and optimization on the core pan-European transport network;
3) Safety-enhancing systems (for example eCall).

EU member states are beneficiaries of support. The maximum possible co-funding rate depends on whether the project is implemented from the non-cohesion or from the cohesion part of CEF. In the latter case, the EU co-funding rate can reach up to 85%. Support is intended mainly for railway projects; for road projects, the maximum implemented volume is limited to 10% of the allocated resources in the "national envelope" and to projects implemented with the participation of at least 3 EU member states. Railway transport is the backbone transport mode in integrated transport systems and it will be therefore possible to submit ITS projects for public passenger transport.

For larger ITS projects, various European funding sources can be structured and interconnected without creating undesired duplicity in funding of individual parts or stages that could be thus mutually interlinked as for their subject-matter and their funding should be coordinated. The CEF financial instrument could be used for actions on EU level, for example for cross-border verification and testing operations of intelligent transport systems and applications for European priority services that have not been fully deployed yet. The aim is to test their expected functionality in a real environment using prototypes in order to either confirm the correctness of the proposed technical parameters or to proceed to a modification of ITS components as a consequence of this practical testing.

Primary candidates for ITS implementation from the CEF are the following: data collection and publication in priority ITS actions; expanding the eCall system with information on transport of high-risk dangerous goods; development of cooperative ITS, also for railway/road level crossings (railway crossings).

10.2.9 Expenditure for Projects of Common Interest that are Partially Financed from European Funds

Introducing of the latest technologies into transport, including intelligent transport systems and satellite system (GNSS, remote sensing of the Earth, satellite communication) have a significant international, or in certain cases even global, impact. In many cases, there are solutions that have already been designed on the technical level, but the respective standards, despite being already available, have not been approved yet, the solution has not been tested in practice, if it were the case, the deployment and operation of the solution is not backed up by implementing legislation nor is it clear how the operative control will be organized, in particular with regard to responsibilities, decision-making and communication.

If European or international consortia of transport ministries or road network managers etc. are being established, the Czech Republic (similarly to any other country) has the possibility to be there from Day 1 and participate in such a project. Projects are aimed at supporting those investment actions, research works and testing projects where the research-development stage has already been completed but the application of the technology still needs to be verified in practice. This verification stage allows fine-tuning the solution so that it best meets the users´ needs. In case of EU projects, the needs and requirements for technical and organizational solutions that vary across member states must be taken into account. The aim of the proposed solution is to ensure the deployment of the system in question in a compatible form from the international, technical and organizational perspective. The results are then presented to the EC for preparation of legislative and non-legislative documents.

If the Czech Republic decides not to participate in projects as described above, it will not have the possibility to propose solutions complying with the conditions, needs and possibilities of our country. If the resulting solutions are reflected in draft EU legislation, even if only in the form of principles, it is usually rather difficult to substantially modify the proposed direction of development during official meetings of EU institutions. For example, the pilot verification of the eCall system functioning in international traffic has been tested by European project HeERO (Harmonized eCall European Pilot), running till the end of

2013 also in the Czech Republic. A fleet of project´s testing vehicles was simulating traffic accidents on the territory of the Czech Republic and other selected EU countries to verify if the transmission of data about the accident and voice communication with the emergency call centre 112 is flawless, including testing of the interface with the Integrated traffic information system JSDI/NDIC Ostrava. The test operation of eCall system was implemented onto the testing platform of the Telephone centre for the Public Safety Answering Point 112 (TCTV 112). Based on testing results, parts of the system were modified to ensure a fully functional and stable performance. This test operation and its results contributed significantly to improvement of the eCall system in Czech conditions and to the preparation of the Czech Republic for deployment of this system. The test and verification operation of the eCall 112 system as part of the HeERO project allowed to better specify the technical parameters in European technical standards so that the eCall service can be provided in a harmonized way across the whole EU.

Project results were also used for preparation of the Commission Delegated Regulation (EU) No 305/2013 of 26 November 2012 supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the harmonized provision for an interoperable EU-wide eCall. Under the eCall system, it is planned to expand the minimal set of data (MSD) on traffic accidents also with data on transport of dangerous goods. Therefore a new project is being prepared on EU level - draft name "I_HeERO" – that should verify in practice the possibility to use the eCall system when transporting dangerous goods. The main aim of the projects is not to monitor the transport of dangerous goods or the transport technology itself (in particular pursuant to ADR), but to serve as information support for rescue services and the NDIC in case a traffic accident happens, this through the eCall system. The proposed European standard FprCEN/TR 16405 "Intelligent transport systems. ESafety. ECall additional optional data set for heavy goods vehicles eCall" expands the MSD message with additional data on transport of dangerous goods, thus making it possible to warn the emergency call centre 112 operator in case of an accident. Based on the test operation, European standards for eCall would be adjusted and the project results would be presented to the EC to be used for preparation of legislative and non-legislative documents.

The CROCODILE project is another important EU project aimed at coordinated introduction of ITS for road traffic management, in particular through high-quality traffic information services. The project also focuses on common approach to implementation of the EC regulation on provision of information services for safe and secure parking places for trucks and commercial vehicles and further on provision of minimum traffic information that have an impact on traffic safety. At present, the CROCODILE II project is under preparation aimed in particular at completion of the implementation of the DATEX II protocol for exchange of available traffic data. The project shall also focus on setting up of a national access point for provision of minimum traffic information, provision of information on truck parking and of real-time traffic information. The project CROCODILE II under preparation shall also focus on provision of traffic information services to end users in neighboring states and on the process of compliance verification in line with requirements defined in the above-given Regulations.

10.3 Public Resources for Support of ITS Research and Development

Intelligent transport systems cannot be purchased as ready adjusted solutions and technologies and innovative solutions are advancing very fast, therefore research, development and innovation activities are crucial for ITS deployment in the Czech Republic.

ITS research projects can draw national resources from programmes of the Technology Agency of the Czech Republic (TAČR). These are existing programmes or programmes under preparation aimed at supporting research, experimental development and innovations for research organizations, companies or public institutions.

10.3.1 BETA

The public sector can currently use the BETA programme (coming to its end) that supports projects falling under objectives specified for the transport sector based on MoT conceptual and strategic documents, including the ITS AP. Currently works on the follow-up TAČR programme for the public sector needs are in progress.

10.3.2 GAMA

The main objective of the programme is to support the verification of the R&D and Innovations' programme results as for their practical application and for preparation of their subsequent commercialization. The programme is divided into two sub-programmes. Sub-programme 1 focuses on supporting the verification of practical applicability of R&D results coming from research organizations and that show a high potential to be applied in practice. Sub-programme 2 focuses on support to applied research projects, in particular experimental research projects contributing demonstrably to commercialization of the obtained results in practice. The programme is not sector-specific; it is therefore possible to present applications for projects focusing on ITS which were or are being implemented as part of previous programmes ALFA and EPSILON through the opened calls; the aim of this programme is to forward the results of these projects into the innovation stage and thus implicitly support ITS AP measures.

10.3.3 DELTA

This is a programme supporting cooperation in applied research and experimental development through joint projects of technology and innovation agencies. Similarly to programme GAMA, programme DELTA is not sector-specific and it can therefore be used for support of ITS projects. It focuses on supporting common projects of Czech companies and research institutions with foreign technology and innovation agencies. The programme is planned for the years 2014-2019.

10.3.4 EPSILON

The main aim of the programme is to support in particular industrial applications when using new technologies and materials in energy, environmental and transport sectors, including ITS. The programme is planned for the years 2015-2025.

10.3.5 OMEGA

The programme focuses on support for projects from the social sector. Adaption of people to new technologies is an ITS-related subject that can be covered from the programme. The programme is planned for the years 2012-2017.

10.3.6 Centers of Competence

The Centers of Competence programme focuses on supporting the setting up and functioning of research, development and innovation centers in progressive fields with a high potential of application and perspective major contribution to growth of Czech competitiveness. The established Centers should offer conditions for development of long-term cooperation in research, development and innovations between the public and private sectors. The main objective of the programme is to increase competitiveness of the Czech Republic; the programme aims at stimulating cooperation of companies and research organizations in setting up of strategic partnerships, improved transdisciplinary of research, development and innovation and increased horizontal mobility of researchers (in particular new researchers). Real implementation of results in practice is accentuated.

More specifically, projects “Centre for development of transport systems (RODOS)” scheduled until end 2018 and “Centre for efficient and sustainable transport infrastructure (CESTI)” scheduled until end 2019 are funded from this programme.

10.3.7 Horizon 2020 (H2020)

Horizon 2020 is the new European framework programme for research and development that follows on from the 7th Framework Programme of the EU (7th FP). Unlike the 7th FP, H2020 promotes the bottom-up approach when formulating the research themes – the themes are defined less specifically, with a bigger accent on the expected impact of the proposed projects. H2020 is planned for the period 2014 - 2020 and has a total budget of 77 billion EUR. ITS projects can draw support from calls in the area “Smart, ecological and integrated transport” or from the priority “Industrial leadership” in the area “Space Applications” of Galileo calls.

10.3.8 SHIFT2RAIL (S2R)

The Shift2Rail project was approved by the Council Regulation (EU) No 642/2014 of 16 June 2014 establishing the Shift2Rail Joint Undertaking (Shift2Rail JU). The members of the Joint Undertaking are the European Commission (50%) and railway industry stakeholders (50%).

Increased mobility and better, higher-quality and simplified services for passengers and transport contractors (transport contractor = client of a railway carrier in freight transport, i.e. the consignor or consignee of the transported item) constitute the key objectives.

The objective of the Shift2Rail is to contribute to the following through targeted research, development and innovation:
- Reducing the life-cycle cost of railway transport (i.e. costs of building, operating, maintaining and renewing infrastructure and railway vehicle) by as much as 50%;
- Total railway capacity increase by as much as 100%;
- Increasing reliability in various segments of the railway market by as much as 50%.

The project will be organized around 5 key "Innovation Programmes" (Innovative Package – IP):
IP 1 - Cost-efficient and reliable trains, including High Speed trains and high-capacity trains; IP 2 - Advanced traffic management & control systems;
IP 3 - Cost-efficient and reliable high capacity infrastructure;
IP 4 - IT Solutions for Attractive Railway Services in passenger transport;
IP 5 - Technologies for Sustainable & Attractive European Railway Freight transport.

The following directions shall be given preference from the scientific and research perspective:

- Developing prototypes;
- Integration;
- Virtual validation (assessment);
- Implementation of successful technologies.

Shift2Rail JU research and innovation activities shall be covered approx. 50% from public sources (450 million EUR), from the HORIZON 2020 programme and approx. 50% (470 million EUR) from private financial sources of founding and associated members of the joint undertaking.

Currently, temporary bodies of the joint undertaking Shift2Rail are in place and shall be replaced by permanent bodies during the first half of 2015 (i.e. the Executive Director and the Governing Board, advisory bodies – i.e. a States' Representatives Group and a Scientific Committee). The States' Representatives Group is fully operational; the Czech Republic is represented by permanent member Ing. Miroslav Haltuf (independent consultant) and alternate Ing. Michal Pavel (AŽD Praha s. r. o.). Both representatives were nominated by the MoEYS based on recommendation for professional railway associations.

In line with the rules for HORIZON 2020 and the States´ Representatives Group, the Reference Group has been established in the Czech Republic composed of representatives of entities involved directly or indirectly in Shift2Rail activities – public administration bodies (MoT, MoEYS), industry associations (ACRI, Technological platform for railway infrastructure) and companies that are interested in direct cooperation with Shift2Rail and submitted an application to become Associate member of Shift2Rail, i.e. AŽD Praha and OLTIS Group, a.s. that submitted applications as independent legal entities, and ČD, a.s. that applied under the EUROC consortium, and potential future applicants to open calls of projects announced by Shift2Rail. The academia is also represented, either individually or through associations.

Shift2Rail represent so far the biggest project in rail transport where Czech companies are actively involved for the first time in history with the aim to participate in development of innovative technologies. For funding of Shift2Rail needs, additional sources will be used, not only from the Horizon 2020 budget, but also from the CEF, regional development funds and other actions.

11 Monitoring the Progress in Fulfillment of ITS AP Objectives

Annex No. 1 hereto contains the list of indicators for monitoring and assessment of the progress in fulfillment of objectives of the Action Plan for the Deployment of Intelligent Transport Systems in the Czech Republic until 2020 (with the Prospect of 2050). The indicators were set based on the study (under preparation) for the European Commission called "Study on Key Performance Indicators (KPIs) for Intelligent Transport Systems (ITS)". The main objective of the study is to define the use of indicators across EU member states, across different types of participants and also across 6 priority areas defined in the Action plan for deployment of intelligent transport systems in Europe. To be able to assess and evaluate the achieved results, such indicators were proposed and such measurement units were defined for the ITS AP for which source data are or will be available allowing regular monitoring and detection of the required change. If necessary, the indicators shall be further adjusted, this also based on available data and its quality and informative value. In addition to indicators, the progress in fulfillment of the Action Plan shall be assesses also with regard to quality or impacts for example.

To assess the suitability of a specific project intention of ITS deployment as the most beneficial solution of a given transport problem (when compared with other possible measures), detailed indicators shall be defined breaking down both costs and benefits, this for ex-ante situations as well as after introduction into operation (ex-post). Such a detailed assessment cannot be performed on the ITS AP level; this must be done on feasibility study level.

An Implementation Plan shall be drafted subsequently based on the ITS AP that will contain a more detailed factual, time and financial framework for individual projects, including sources and structure of funding for the planned expenditure. The Implementation Plan shall be drafted in 2015 and updated as necessary once in two years.

As ITS, GNSS and Earth observation technologies are developing continuously, the ITS AP efficiency shall be assessed in 2018 (for the period 2015 – 2017) and the interim ITS AP assessment report shall be presented to the Government by June 2018. The overall ITS AP fulfillment assessment report (for the whole implementation period), this including the proposed update of this Action Plan or a new draft document related to ITS, GNSS and Earth observation for the next period, shall be submitted to the Government in 2020.

12 Conclusion

Intelligent transport systems or their applications are in most cases based on the combination of an intelligent vehicle, intelligent infrastructure and services that are fulfilling the specific functions for which they were designed. The mutual connection of components vehicle-infrastructure-application/service in implementation of ITS applications showed that for the ITS advantages to be provided and benefited from in full, not only superior public administration bodies must be involved, but also all other institutional entities, i.e. the public sector (owners and managers of transport infrastructure, rescue system), logistic companies, operators, drivers and other traffic participants as well as the private sector (manufacturers of cars and ITS applications). For the ITS potential to be used in full, it is necessary to achieve the required level of compatibility, interoperability and continuity of services provided to users on the local, regional, national or European level for existing and developed systems and applications.

Systematic development of an intelligent transport system that will allow for safe, continuous, economically balanced and environmentally friendly movement of persons and goods represents a major challenge for the current society. The only solution to address this challenge is to establish a strong and long-term partnership of responsible bodies, research institutions and private businesses that will contribute to shifting the development of technologies and transport systems to such a point where their daily used will make it possible to implement even the longer-term visions related to intelligent and sustainable mobility described in the document.

But, at the end, once the proposed measures are implemented, the end users themselves should be able to experience a real improvement in quality and safety of travel or transportation of goods. Transport must be focused around the traffic participants and any system (or combination of systems) ignoring this fact shall only last for a limited time and the provided financial resources would thus be spent inefficiently. Benefits for the society shall represent a real and tangible result in the long term and the present document aims at contributing thereto.

The ITS AP replaces the document “Innovation technologies in transport strategy – INOTECH”, approved by the Government Resolution No. 12/2009

Annex No. 1: List of Indicators for Monitoring the Progress in Fulfillment of the ITS AP Objectives

Objective	Indicator	Specific indicator
Improved awareness or traffic participants through ITS	Number of providers of information services on road traffic pursuant to the EU Regulation No. 886/2013	Number
	Number of methods used for providing road traffic and travel information	Number
	Number of nationwide road traffic information and control centers	Number
	Number of regional road traffic information and control centers	Number
	Number of links between road traffic information and control centers	a) Number on national level b) Number on international level
	Public information system open for other entities in line with principles of the European directive on repeated use of public sector information	Number
	Applications made accessible to passengers with specific needs (persons with reduced mobility and orientation, older citizens, parents with baby prams etc.)	Number
Reducing the seriousness of consequences for persons injured in road traffic via ITS	Number of Public Safety Answering Point Centers 112 capable of responding to an emergency eCall	Number
	Share of traffic accidents notified by the eCall 12 system out of the total number of serious traffic accidents	a) % of automatically activated notifications b) % manually activated notifications
Improved safety of road freight transport operation	Number of parking sites (parking) providing safe and secure places (spaces) for trucks and commercial vehicles pursuant to the EU Regulation No. 885/2013	a) Number of parking sites (parking) b) Total number of parking places (spaces)
Level of equipment of road	Dynamic traffic control	Section in km

infrastructure by ITS	Automatic traffic counters	Number of pieces
	Meteo-stations	Number of pieces
	CCTV camera posts	Number of pieces
	Portals with variable message signs and variable information boards	Number of pieces
	Variable boards with meteo-data	Number of pieces
	Emergency call stations	Number of pieces
	Dynamic weighting site	Number of pieces
	Technology equipment of tunnels	Number of tunnels
Level of equipment of railway infrastructure by ITS	Lines with deployed GSM-R	Section in km
	ETCS system on national lines	Section in km
	Equipping of regional lines with systems for safe position and speed control of trains via GNSS	Section in km
	Length of lines covered by the automatic route setting system	km
	Length of lines covered by ATO	km
	Number of railway vehicles equipped with ERTMS	Number of pieces
	Number of railway vehicles equipped with systems for safe position and speed control of trains via GNSS on regional lines	Number of pieces
	Length of lines equipped with defects diagnostic technology of running vehicles	km
	Length of lines under operative control of CDP	km
	Length of lines with wireless coverage for broadband internet	km
Level of equipment of inland waterways by ITS	Expanding the infrastructure for radiophonic operation	Section in km
	Expanding the RIS system	Section in km
Deployment of the Galileo and EGNOS systems in Czech Republic	Deployed applications of national (international) importance; in air traffic number of procedures/instrument approaches, for example LPV	Number

Annex No. 2: Acronyms and Glossary of Terms

Acronyms

Acronyms in brackets are Czech acronyms, in cases when English acronyms are missing	
(ASVC)	Automatic Train Route Setting
(BESIP)	Road Traffic Safety Department - an integral part of the Ministry of Transport of the Czech Republic
(CDP)	Central (Rail) Traffic Control Service
(DC)	Surveillance centre
(DO PČR)	Motorway Department of the Police of the Czech Republic
(DOZ)	Interlocking System Remote Control
(DŘD)	***Decree No*. *173/1995 Coll*.**, issuing Railway Transport Regulations, as amended
(GTN)	Graphical and Technological Layer
(HDŘÚ)	Main Traffic Control Centre in Prague
(HZS ČR)	Fire Rescue Service of the Czech Republic
(IDOS)	Multimodal Journey Planner
(JDVM)	Unified Transport Vector Map
(JSDI)	Integrated Traffic Information System of the Czech Republic
(KOPIS)	Regional Operations and Information Centre of Fire Rescue Service of the Czech Republic
(KR-ITS)	Coordination Council of the Minister of Transport for Intelligent Transport Systems
(LAVDIS)	Elbe-Vltava Waterway Traffic Information System
(LRIT)	Long-Range Identification and Tracking (of ships)
(MHD)	Urban Public Transport (consists mainly of fleet of underground, trams, suburban trains, buses, trolley buses and less often funiculars and boats or ferry)
(MU)	Railway Accident or Road Traffic Collision
(NDIC)	National Traffic Information and Management Centre
(NIPI)	National Infrastructure for Spatial Information
(ODIS)	Integrated Public Transport System of the Moravian-Silesian Region
(OLDA)	Online Traffic Update Site (application of the Police of the Czech Republic providing information about traffic situation in the CR)
(OOSPO)	Person/people with Reduced Mobility or Orientation
(PIT)	Variable Information Panels
(PMD)	Shunting Movement Between Railway Stations or Passing Loops
(PP)	Implementing Rule
(PZZ)	Level Crossing Safety Installation
(ŘLP ČR)	Air Navigation Services of the Czech Republic
(ŘSD ČR)	Road and Motorway Directorate of the Czech Republic
(ŘSDP PP)	Directorate of the Traffic Police Service of Czech Police Presidium
(ŘVC ČR)	Directorate of Waterways of the Czech Republic
(SFDI)	State Fund for Transport Infrastructure
(SONS)	Czech Blind United (organization for visually impaired people in the Czech Republic)
(SPS)	State Navigation Administration
(SSÚD)	Motorway Management and Maintenance Centre
(SSÚRS)	Expressway Management and Maintenance Centre

(SSZ)	(Road) Traffic Control Signals
(SÚS)	Road Administration and Maintenance
(SŽDC)	Railway Infrastructure Administration, state-owned organization
(SZZ)	(Railway) Station Interlocking and Signaling
(TCTV 112)	Public Safety Answering Point, number 112 (Fire Rescue Service of the Czech Republic)
(TP)	Technical Conditions
(TRINS)	Transport Information and Accident System - connected with transportation or storage of dangerous substances in the Czech Republic
(TTP)	Track Bulletin
(ÚAMK ČR)	Central Auto-Moto-Club of the Czech Republic
(VŠB-TU Ostrava)	VŠB – Technical University of Ostrava
(ZDD)	Rail Traffic Movement Documentation
(ZPI)	Traffic Information Panels
(ZPK)	Roads Act
(ZZS)	Emergency Medical Services
AIS	Automatic Identification System
API	Application Programming Interface
ATO	Automatic Train Operation
Augmentation **- GBAS** **- SBAS** **- ABAS**	Various augmentation systems (methods) intended to improve the quality of the navigation system: - Ground Based Augmentation Systems – GBAS - Satellite Based Augmentation Systems – SBAS - Airborne Based Augmentation Systems – ABAS
B/L	Bill of Loading
CAN	Controller Area Network
CCS	Command Control and Signaling
CCTV	Closed Circuit Television
CDV	Transport Research Centre
CEF	Connecting Europe Facility. It is one of the most important programs; it makes part of the EU financial framework for the years 2014-2020. The budget of this tool will support strategic projects in transport, energy and telecommunications infrastructure.
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CHMI	Czech Hydrometeorological Institute
CIS JR	National Timetable Information System
CISReal	National Timetable Information System for Real Time
C-ITS	Cooperative ITS
CR	Conventional Rail
ČSD	Czechoslovak State Railways. The company was established on 28 October 1918. It took over the part of the railway network of the former Imperial Austrian State Railways (kkStB) and Hungarian State Railways (MÁV) situated in the territory of the newly founded Czechoslovakia. From the early 1920s, private railways were being nationalized by law and integrated into the ČSD network. In the years 1927-1948 (excluding the period of the II World War), ČSD also operated a national bus transportation network. In 1949, all bus transport was transferred to the newly established Czechoslovak Automobile Transport (ČSAD). Č SD definitively ceased to

	exist on 31 December 1992.
DG CNECT	Directorate General for Communications Networks, Content & Technology
DG ENTR	Directorate General for Enterprise and Industry
DG MOVE	Directorate General for Mobility and Transport
DG REGIO	Directorate General for Regional and Urban Policy
DGPS Satellite, e.g.: - WAAS - EGNOS or Ground-based, e.g.: - CZEPOS	Differential GPS receiving correction signal. A system of differential corrections providing improved accuracy of calculated GPS locations using a network of base stations, pseudolites and communications satellites. The aim is to ensure 100% signal integrity (which is, among others, important for automatic landing systems in air transport, where even a very short time with insufficient number of satellites to calculate the position of the plane can result in a disaster). Name WAAS refers to the system (which uses geostationary satellites to broadcast the correction signal) in North America where it has been used for longer time. The name EGNOS refers to the same system in the territory of Europe.
DI	Digital Infrastructure
DIS	Dispatching System for Railway Traffic Control (former CTC system)
DI-SOS	Motorway Information System for Emergency Calls
DME	Distance Measuring Equipment - device mostly for aircraft use; it measures the slant range distance between an aircraft and a ground station. It is used for navigation on the track or for determining the distance of an aircraft on the approach to landing from an airport.
DoRIS	Das Digitale Oberösterreichische Raum-Informations-System
DSRC	Dedicated Short Range Communication
EAN	European Article Number
EC	European Commission. It is the EU's executive body and it represents the interests of the Union as a whole, not the interests of individual member states. The term European Commission (and also Commission) refers to the College of Commissioners and also to the institution itself (group of Directorates General). It proposes legislation and policies, implements adopted policies (strategies), initiatives and EU programmes, and manages funds for these programmes. Along with the Court of Justice of the European Union, it enforces European law. Represents the EU in external affairs. It represents the EU in the foreign policy field. It includes various departments and services. The most important departments of the EC are Directorates-General which are similar to national ministries.
ECDIS	Electronic Chart Display and Information System for Inland Navigation
EETS	European Electronic Toll Service
EGNOS (see DGPS)	European Geostationary Navigation Overlay Service
EIA	Environmental Impact Assessment
ELWIS	Elektronischen Wasserstraßen-Informationsservice
EP	European Parliament
ERTICO - ITS Europe	European Road Transport Telematics Implementation Coordination Organisation
ERTMS	European Rail Traffic Management System
ESA	European Space Agency
ESIF	European Structural and Investment Funds
ESO	European Standardization Organization

ETCS	European Train Control System
ETSI	European Telecommunications Standards Institute
GLONASS	Globalnaja Navigacionnaja Sputnikovaja Sistěma – system of the Russian army which is currently the only functional GNSS besides the GPS
GNSS	Global Navigation Satellite System – a generic term used to refer to the GPS, Galileo, GLONASS and BeiDou systems.
GPRS	GSM Packet Radio Service
GPS	Global Positioning System – global satellite positioning system operated by the U.S. Department of Defense. It provides location and time information anywhere on or near the Earth with 10 meters precision. In 2000, intentionally random errors stopped being added and since then the system has been massively used by civilians. Before the term GNSS was implemented, the term GPS was used in the same meaning as GNSS.
GSA	European GNSS Agency. The EU regulation authority defending and representing all public interests related to the European GNSS programmes: Galileo and EGNOS.
GSM	Global System for Mobile Communication
GSM-R	Global System for Mobile Communication – Railways
GUF	Galileo User Forum
GVD	Long Term Timetable (in graphic mode)
H2020	Horizon 2020
HeERO	Harmonized eCall European Pilot
HW	Hardware
ICAO	International Civil Aviation Organization
ICT	Information and Communication Technologies
IDS	Integrated Public Transport System
IDS-JMK	Integrated Public Transport System of the South Moravian Region
IMO	International Maritime Organization
INEA	Innovation & Networks Executive Agency. Unlike EU bodies and institutions, this EU agency is an independent legal entity established to perform specific tasks pursuant to EU legislation. INEA manages infrastructure and research programmes in the field of transport, energy sector and telecommunications. INEA started its activities on 1 January 2014 and it is the successor of the Trans-European Transport Network Executive Agency (TEN-T EA).
INSPIRE	Infrastructure for Spatial Information in the European Community
IRS	Integrated Rescue System - determined for coordination of rescue and clean-up operations in case, where a situation requires operation of forces and means of several emergency services, e.g. firefighters, police, medical rescue service and other emergency services.
ISO	International Organization for Standardization
ITS&S	Intelligent Transport Systems and Services
AP ITS	Action Plan for the Deployment of Intelligent Transport Systems in the Czech Republic until 202 (with the Prospect of 2050)
ITU	International Telecommunication Union
LTE	Long Term Evolution
M2M	Machine to Machine
MoT	Ministry of Transport
NtS	Notices to Skippers
NUTS	Nomenclature of Territorial Units for Statistics

OBU	On-Board Unit
OSS	One Stop Shop
PBN	Performance Based Navigation
PCR	Police of the Czech Republic
PID	Prague Integrated Public Transport
PP CR	Police Presidium of the Czech Republic
PPS	Precise Positioning Service. Non-public positioning service of the GPS system; available to the military of the USA and to their allies. It provides more accurate location data, it is resistant to jamming and encrypted.
PSI	Public Sector Information Directive (the EU **Directive** on the re-use of **public sector information**)
RB	Radioblock (Control and signaling system for regional/secondary railway lines)
RBC	Radioblock Centre Office (and other technical facilities at the train dispatcher´s workplace)
RBV	Radioblock On-Board Unit and Communication Facilities on the Railway Vehicle
RDS - TMC	Radio Data System - Traffic Message Channel
RFID	Radio Frequency Identification
RIS	River Information Services
RIS3	Strategies for Smart Specialization (in the Czech Republic)
RNAV	Area Navigation, also referred to as RNAV (Random Navigation). It is a method of navigation in instrument flight rules (IFR), which permits aircraft operation on any desired course within the coverage of ground-based or spatial navigation beacons, or within the limits of a self-contained system capability or a combination of these, rather than navigating directly to and from the ground-based navigation beacons.
RoRIS	Sistemul de Informare si Management al Traficului pe Sectorul Romanesc al Dunarii
SDI	Spatial Data Infrastructure
SEA	Strategic Environmental Assessment
SESAR	Single European Sky ATM Research
SlovRIS	Slovak River Information Services
SPS	Standard Positioning Service. Standard positioning services of the GPS system. It is available for public, neither its availability nor accuracy are guaranteed.
SSN	SafeSeaNet
SW	Software
TAF	Telematic Applications for Freight Services
TAP	Telematic Applications for Passenger Services
TEN-T	Trans-European Transport Networks
TI	Transport Infrastructure, Traffic Information
TIC	Traffic Information Centre
TIC PCR (CDI)	Traffic Information Centre of the Police of the Czech Republic
TSI	Technical Specifications for Interoperability
UNECE/ECE	United Nations Economic Commission for Europe. One of the five UN Regional Commissions having its secretariat in Geneva, Switzerland.
V2D	Vehicle-to-Device Communication – data exchange between a vehicle and a device, i.e. mobile device or a PDA

V2G	Vehicle-to-Grid Communication – data exchange between an electric vehicle and a smart power grid which allows to regulate the production and consumption of electricity
V2I	Vehicle-to-Infrastructure Communication – data exchange between a vehicle and the infrastructure, i.e. equipment installed on the road infrastructure or in a traffic control centre
V2V	Vehicle-to-Vehicle Communication – data exchange between vehicles
V2X	Umbrella term for V2I, V2V, V2D and V2G
VMS	Variable Message Signs
VTMIS	Vessel Traffic Monitoring & Information Systems
W3C	World Wide Web Consortium
WAAS (see DGPS)	Wide Area Augmentation System
WAP	Wireless Application Protocol
WGS 84	World Geodetic System 1984 – globally recognized geodetic standard issued by the United States Department of Defense in 1984; it defines the coordinate system and the reference ellipsoid for use in geodesy and navigation
WIM	Weigh-in-Motion

Glossary of Terms

The development in the sphere of transport also entails development in transport terminology. Over time, certain terms may partially change their contents, in effect resulting in potential communication misunderstandings, especially between different generations of experts. When adopting terminology from foreign languages into the Czech language, terms are sometimes translated verbatim, thus giving rise to numerous inconsistencies and neologisms. Also, the current trend gives modern technical terminology international validity through adopting foreign language terms, mostly English. Czech definitions of basic transport terms, along with the English, German, French and Russian indexes of the terms' equivalents, are set out in ČSN 018500 standard "Basic Transport Terminology".

1G		Refers to the first generation of telecommunications systems, i.e. analogue radio-telephone mobile systems.
2D code		Two dimensional rectangular bar code carrying data both in horizontal and vertical directions.
2G		Refers to the second generation of telecommunications systems. This category also includes digital cellular mobile radio-telephone systems. Compared to 1G systems, this communication method is more advanced and characterized mainly by greater system capacity, stronger resistance to monitoring and interference, possibility of international roaming, smaller and more economical terminals (handsets), wider offer of functions, better compatibility with ground and satellite systems, etc.
3G		Refers to the third generation of telecommunications systems. These systems work in a 2 GHz broadband that will connect different present-day wireless access technologies into a single flexible and efficient infrastructure, able to offer a broad range of multimedia services in guaranteed quality.
4G		Standard for the fourth-generation networks referred to as IMT – Advanced (International Mobile Telecommunications – Advanced), complying with the requirements of the International Telecommunication Union.
Action Plan	**Akční plán**	Set of planned projects and activities aimed at fulfilling the strategy objectives. The Action Plan may be part of a strategy (or its implementing document) or may present a separate document tying into such documents.
Active Elements (also actors)	**Akční členy (aktéry)**	Technical devices transmitting visual instructions or providing information to road traffic users, eventually affecting the pattern

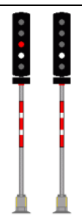
		of traffic flow on a designated road section (flash signboards, variable message signs, information panels, variable traffic information signboards etc.).
Activity	**Činnost**	Actions or behavior of a particular part of the system.
Adhesion	**Adheze**	In order to be able to move on rails without skidding on their smooth surface, driving wheels need friction. The friction between wheel and rail results from the vehicle's weight, the friction level affecting also the pulling power. Adhesion, too, is needed for making the vehicle stop without going into a skid.
Alert - C		Structured language (protocol) for language independent coding of traffic events.
Architecture	**Architektura**	Conceptual design determining the structure, behavior and integration of the relevant system into the surrounding environment.
Attribute	**Atribut**	Characteristic that can be specified using the characteristics of a natural language.
Automated	**Automatizovaný**	Relating to activities performed or devices working automatically but requiring human attendance.
Automatic	**Automatický**	Relating to activities performed without human interference.
Automatic Traffic Counter	**Automatické sčítače dopravy**	Transport detector used for automatic counting and classification of vehicles.
Autonomous (Robotic) Vehicle (in road traffic)	**Autonomní (robotické) vozidlo (v silničním provozu)**	A vehicle designed to carry out all critical security functions and to monitor road surface conditions throughout the travel time. This design expects the driver to merely set the travel destination and navigation data, but does not require him or her to be present to control the vehicle at all times during the journey. The same applies both to occupied and unoccupied vehicles.
Autonomous Operating Control Point (in rail traffic)	**Autonomní dopravna**	Railway station, train loop, junction point (or main signal) where service is provided under "SŽDC D1" Railway signaling and operating rules of the Railway Infrastructure Administration and which connects, at the (home) entry main signal position, to the RB-technology controlled section. Independent train station may simultaneously be used as the RB dispatcher's workplace.
Balise (also track antenna or beacon)	**Balisa (traťový maják)**	Device located at an information point used in point-to-point systems of data transmission which transmit data between the rail

		vehicle and the track.
Bottom-Up		Planning method used for setting objectives and methods of accomplishing the objectives in a bottom-up way. First, relatively detailed partial objectives are set at the bottom levels of the organizational hierarchy, being gradually integrated at higher levels until general global objectives and global strategies are formed. A convergent approach.
Car2Car (also V2V)		This technology is based on wireless communication between individual (road) vehicles (traffic participants) and is supposed to spot potential risks in traffic, i.e. to prevent accidents.
Transport Operator	**Dopravce**	Person or organization arranging transport for third-party needs in return for consideration under terms and conditions published in advance.
Cellular Network	**Celulární sít**	Mobile network. Area covered by a signal is divided into smaller parts or “cells”, covered by individual transmitters. Mobile telephone networks consist of roughly several thousands of cells.
Chip	**Čip**	Miniature silicon plate with connected integrated circuits.
Clearing		Distribution of sales among transport contractors in public passenger transport on a designated territory under specific, contract-based terms.
Train Dispatcher with lead responsibility for train movements supervisory operations	**Dirigující dispečer**	Qualified employee authorized to organize railway traffic and to provide train movement control over an assigned D3 railway line (by simplified operating procedures).
Controlling		Collecting, showing and analyzing accounting data, including but not limited to costs and revenues, as basis for decision-making.
D1 Railway Signaling and Operating Rules of the Railway Infrastructure Administration	**Dopravní a návěstní předpis SŽDC D1**	Basic internal regulation on railway operation by Railway Infrastructure Administration. The regulation contains national safety regulations within the meaning of EU legislation applicable to railway management and organization of rail transport on railways operated by Railway Infrastructure Administration. Individual provisions of the regulation are derived from the implementing regulation of the Ministry of Transport (“Railway Transport Regulations”), supplemented with further internal instructions applicable to railway management-related

		and rail transport organizing activities.
D3 Operating Control Point	**Dopravna D3**	Railway station on a D3 railway line for providing train movements or shunting operations between D3 train stations which are unstaffed by a local train dispatcher.
Data	**Data**	Information or formalized characteristics of a certain process or effect in a form allowing processing by information technologies. Data have an exact form and a set structure.
Data Distribution Interface (DDR)	**Datové distribuční rozhraní**	Part of the editorial dispatching and controlling system of the National Traffic Information Centre. The interface allows, based on assigned access rights, traffic information and traffic data to be taken over from the central repository of the Integrated Traffic Information System of CR via standard web services.
Data Network	**Datová síť**	Telecommunications environment for data transmission. Most data networks do not guarantee the time of the data delivery (due to applied communication protocols). Data networks support a number of interfaces and may have a number of protocol virtual layers of logical networks. Data networks are often interconnected or, on the contrary, particularly for safety reasons, separated in which case communication is possible through network crossings points via special systems (routers).
Database	**Databáze**	Set of data (information) from a specific area organized and stored in digital form.
Delegating	**Delegování**	Process of dividing activities (work), powers or responsibilities among organization units down to individual workers.
Detector	**Detektor**	Device used for detecting or identifying input data and information for intelligent transport systems. The measuring is done through detectors, or sensors.
Digital	**Digitální**	Manner of storing information (data, images, sounds) in a form readable or allowing further processing by a computer (in a numerical code).
Centralized Traffic Operative Management and Control	**Dispečerské řízení dopravního provozu**	Type of operative traffic management the main purpose of which is to control in an operative way the activities of all organization units involved in traffic in order to meet all tasks set for the accomplishment of the transport or carriage process.
Display	**Displej**	Displaying device used for optic depiction of

		data. The display shows individual symbols in lines, the same as on a TV screen. The smallest displayed point is called a pixel.
Division of Labor	**Dělba práce**	Relation between individual elements of a community system, determining their respective shares in a collectively performed activity.
Door-to-Door (seamless mobility)		Principle based on scheduling the travel route with transit nodes in order to economies on passenger travel time, possibly without delays resulting from waiting for a connecting service.
Signal Availability	**Dostupnost signálu**	Percentage of time during which signal transmitted from external sources can be used for navigation purposes.
Rail Vehicle (also Rolling Stock)	**Drážní vozidlo**	Transport unit dependant during its movement on a set part of the railway; save for vehicles used for technical attendance of production that are operated on specially assigned industrial tracks.
Methodical Management	**Metodické řízení**	Indirect form of management where the managing component formulates binding instructions for subordinate components, however, without having the executive power to implement, check or, if necessary, impose sanctions for non-fulfillment of such instructions.
Railway Vehicle	**Železniční kolejové vozidlo**	Transport unit which is carried and guided by railway tracks on a defined part of the railway, excluding vehicles providing technological support of a manufacturing process which are operated on industrial tracks reserved for such purpose.
Level Crossing	**Přejezd**	Specifically marked crossing of the railway and road at the track level. Foot crossings in railway stations used by passengers or the railway operator or carrier staff are not considered level crossings.
Bill of Lading (Connaissement)	**Náložný list (též konosament)**	Freight document certifying that a contract of carriage was made between the consignor and the carrier (ship operator). Used in sea transport. Each original sea bill of lading is also a negotiable security confirmed by the carrier and represents the goods indicated on the document. By means of the sea bill of lading, the carrier undertakes to hand out the transported goods at the given destination (port) to the consignee (owner of the bill of lading).
“Attention” (Sound)	**Návěst „Pozor“**	A single long blow of a locomotive’s horn

Signal		lasting at least two seconds or a single long whistle blow warning passengers of moving vehicles. This signal may be repeated.
"RB Operating Control Point number" Signal Board 	**Návěst „Číslo dopravny"**	On RB railway lines, this signal informs the engine driver of the RB train station number, which the driver enters into the RB terminal of the leading traction unit to allow for identification of the train's position.
Train Reception (as internal telephone communication between stations (local train dispatchers) as the safe working procedures for the operation of the train movement control)	**Přijetí (vlaku)**	(Local) train dispatcher's consent to the train's arrival (entering into the (single-track line) track section towards the station controlled by him), given in a prescribed form.
Access Network	**Přístupová síť**	Network enabling the participants' and users' end stations to get connected to the backbone telecommunications network.
Accuracy	**Přesnost**	Degree of conformity between measured location or speed at a given time and real location or speed.
Answer Back Signal (as internal telephone communication between stations (local train dispatchers) as the safe working procedures for the operation of the train movement control)	**Odhláška**	Message (given by local train dispatcher or by track block operator) in a prescribed form passed to the rear train movement operating point informing that the whole train (train integrity check by watching the rear end marker or tail light) has vacated the block section (track section in rear released/clear).
Amendment	**Novela**	Regulation in which modifications were made by means of subrogating, amending or changing certain provisions.
Approaching Section	**Přibližovací úsek**	Defined section of a track which, when occupied by a train approaching to an train movement operating point or level crossing, initiates the activity of the relevant interlocking and signaling system.
Availability	**Dostupnost**	Percentage of time during which the system services are ready for use. The figure illustrates the system's ability to provide useful service within a territory it is covering.
Axle Counter (or Wheelsets Counter)	**Počítač náprav (též počítač dvojkolí)**	Device checking the vacancy of a track section by counting axles (wheelsets) at the borders of this section.
Axle Load	**Hmotnost na nápravu**	Weight of one rail vehicle axle affecting the track. The weight limit on the Czech railway network is 22 tones.
Rail Traffic Movement	**Základní**	A term collectively referring to station

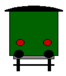
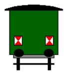
Documentation	**dopravní dokumentace (železniční provoz)**	timetables, operating procedure rules, implementing acts, operating rules for connecting services and those for industrial tracks.
Bill of Lading (in railway Consignment Note)	**Nákladní list**	Freight document in domestic and international transport certifying that a contract of carriage was made between the consignor and the carrier. It accompanies the consignment from the moment it is accepted by the carrier until it is handed out to the consignee. As a freight document, the bill of lading is a mere evidentiary document, not a security, and cannot be assigned.
Block Section	**Prostorový oddíl**	Part of the open (railway) line between two adjoining train movement operating points or between a train movement operating point and the end of a line at a (cul-de-sac built) train-stop or loading point.
Excluded Track	**Vyloučená kolej**	A track temporarily out of order due to technical, operational or transport reasons.
Bypass (Train) Path	**Objízdná trasa vlaku**	Train route necessary for a train to run along a different track or into a different perimeter of the railway station other than scheduled by the train's tabular timetable. Trains going on bypass routes run under their original numbers according to terms set out in Table 3 of the working timetable (travel times, set speed, prescribed brake mass percentage, etc.).
Calling-on Signal (permissive stop signal passing)  **(long flashing white light)**	**Přivolávací návěst**	Signal authorizing a train to run past the main signal displaying the "Stop" signal or giving no signal (with the lights out), or authorizing a train to run past a mechanical main signal emitting a doubtful signal.
Carriage of Persons and Goods	**Přeprava osob a věcí**	The carrier transports a person who asked for carriage at an agreed price, accepting also their luggage (at the agreed price) and consignments submitted for carriage provided that the contract terms of carriage and the terms set out by special regulations were fulfilled.
Carriage Operating	**Přepravní provoz**	Sum of all activities of a carrier and a transport contractor or entities through which transport is procured.
Transportation Chain	**Přepravní řetězec**	Intentional sequence of partial processes in transport, handling, packing and storing, necessary for transferring goods from the

		manufacturer to the consumer.
Switch to Telephone Communication	**Přechod na telefonické dorozumívání**	Measure taken by (local) train dispatchers of adjoining train movement operating points to interlock moving trains by request, acceptance and advice of train arrival instead of using the line interlocking and signaling line block system.
Combined Transport	**Kombinovaná přeprava**	Intermodal transport where most of the route is covered by railway, inland waterway or by sea while the initial or final (pre-carriage or on-carriage) sections of the journey are covered by road and, in general, are as short as possible.
Communication	**Sdělování**	Transmission, recording or reproduction of signals.
Compatibility	**Kompatibilita**	General capacity of a device or system to work with another device or system without any modifications.
Competence	**Působnost (též kompetence)**	Aggregate of tasks, powers and responsibilities of a specific organization point.
Concept	**Koncepce**	In the context of strategic management, a concept refers to a structured outline of the general course of a given field. Whereas a concept contains basic starting and orientation points, a strategy is more specific, defining particular targets and their values. A concept may be similar in nature to a policy, the main difference being, in particular, the time horizon of their implementation (as opposed to the concept's mostly short- to mid-term implementation horizon, a policy is implemented on a medium to long-term basis).
Concession	**Koncese**	Official permit (license) to pursue a certain activity – e.g. to establish a transport link – under specific, predefined terms.
Congestion	**Kongesce**	Queue of standing or slow-running vehicles causing delays to drivers or passengers.
Connecting Service, Connection	**Přípojný spoj, přípoj**	A connecting service which, at the point of transfer, follows, within reasonable time intervals, the arrival of another means of transport (incl. an airplane).
Connecting Services	**Návaznost spojů**	Arranging two or more connecting links in the timetable (air schedule) with reasonable time intervals to allow transfers of passengers or reloading of luggage/goods.
Connection	**Spoj**	Particular transport connection between given destinations, determined by the timetable or using other time and place

		specification, available within the framework of transport service provided in the given area.
Railway Interchange Point	**Styk drah**	Connecting, parallel or crossing lines and relations resulting therefore.
Consignee	**Příjemce**	Organization or entity (person) indicted in the bill of lading to whom the consignment is designated pursuant to the contract of carriage and to whom the carrier is obliged to hand over the consignment.
Consignment	**Zásilka**	A thing or a set of things that the carrier took over from the sender for transportation, usually with a relevant transport document, which are to be transported to the recipient at the destination.
Consignment Note/Freight Document	**Přepravní listi-na**	Document certifying that a contract of car-riage (e.g. ticket, air ticket, bill of lading) was made between the carrier and the transport contractor (in freight transport) or between the carrier and the passenger (in passenger transport).
Consignor	**Odesílatel**	Organization or entity indicated in the bill of lading entering into a contract on the car-riage of goods with the carrier.
Contact System	**Trakční vedení**	Set of electrical wiring and all devices for their attachment and division, which is used to power the electric drive vehicle through a pantograph.
Continuity	**Kontinuita**	Probability that the system's functions (ac-curacy, availability) will be maintained over time. Expressed as the probability of func-tion failures occurring over a given period of time.
Contract of Carriage	**Přepravní smlouva**	Contract made between the carrier and an organization or entity for whose sake the carriage (transport) is implemented.
Control/Management	**Řízení**	Information process through which the con-trolling entity restricts the number and ex-tent of possible ways of behavior of the con-trolled entity to achieve desired behavior.
Coordination	**Koordinace**	Controlling procedure where a factually co-ordinating organization point exercises au-thority over other locations that are not func-tionally subordinate to it.
Council of the European Union	**Rada Evropské unie**	Principal decision-making body of the Euro-pean Union, representing its Member States. The EU Council does not meet in a fixed configuration, the meetings are at-tended by ministers responsible for the area under discussion and authorized to act on

		behalf of their governments.
Train Crossing	**Křižování vlaků**	Avoidance of two trains running in opposite directions, in two-way traffic using one track, at an operating post with appropriate track layout.
Data Format	**Formát dat**	Summary of information concerning the number and type of signs comprising individual data components.
Data Sharing	**Sdílení dat**	Same data used by more applications.
Departing Section	**Vzdalovací úsek**	A defined section of a track whose occupancy will influence the activities of the relevant interlocking and signaling equipment during the run from one train movement operating point or from a level crossing.
Diesel Traction	**Motorová trakce**	A traction unit's drive using the main combustion engine to transform thermal energy into mechanical energy.
Domestic Line Using Part of Foreign Network	**Peážní trať**	Part of the railway passing through the territory of a foreign country and returning to the original territory that is used, based on agreement, in regular transport by more railway operators (including foreign operators). The current situation of these lines is not in line with the trend in European railways towards a Single European Railway Area.
Domestic Traffic Transiting over Foreign Territory	**Peážní doprava**	Domestic transport between two destinations on the territory of the same country where part of the traffic route transits the territory of a foreign country.
Doubtful Signal	**Pochybná návěst**	A signal that is unclear, questionable, uncertain or posted in breach of the SŽDC D1 rule.
Level Crossing Supervision Signal  **("Following level crossing is not secured" sign)**	**Přejezdník**	Fixed signal informing the train driver of the operating mode of the level crossing protection system.
Dynamic Road Traffic Control	**Liniové řízení silničního provozu (též dynamické řízení)**	Intelligent transport system for traffic control on high-capacity roads (e.g. motorways) using gates with commanding or prohibiting variable message signs posted above or beside the road. The system also includes detectors monitoring characteristics of the traffic flow, such as traffic density, intensity or average speed. According to the momentary state of conditions, the dynamic

		road traffic control system automatically gradually reduces speed or changes the organization of lanes to ensure as continuous and safe traffic flow as possible.
eCall 112		The pan-European eCall system is defined as an automatic or user-launched system for sending calls and relevant coordinates of a car accident to the 112 emergency call centre via the Global System for Mobile Communications (GSM), carrying a defined minimum set of data informing that an accident occurred that requires the intervention of rescue units. If possible, the system picks up voice communication with the vehicle. eCall is designed to send for rescue service, not to monitor the vehicle's movements. Immediate warning of a serious accident and the knowledge of the exact location of the accident reduces time necessary for providing effective help.
Efficiency	**Efektivnost**	Describes the relation between outputs from business activities (generally meaning profit) and inputs (generally meaning invested or tied capital or, if relevant, costs).
EGNOS		"European Geostationary Navigation Overlay System" is the European form of SBAS or Satellite Based Augmentation System which is used to augment the accuracy of GPS (including Galileo up from Version 3) and also allows the system to be used for applications critical in terms of safety (airplane or ship navigation).
Electric Traction	**Elektrická trakce**	Drive of a traction unit using transformation of electric power from an external source or an accumulator to kinetic energy or vice versa.
Electric Equipment	**Elektrická výzbroj**	Traction device in an electromobile.
Electric Power	**Elektrická energie**	Capacity of the electric current to perform work.
Electrified Line	**Elektrizovaná trať (též elektrifikovaná trať)**	Track fit for operation of rail traction units with dependant electric drive
Electromagnetic Compatibility (EMC)	**Elektromagnetická kompatibilita (EMC)**	Capacity of an equipment, system or device to work correctly even in environments that are affected by other sources of electromagnetic signals (both natural and artificial) and, on the contrary, to shield the environment from the undesired impact of its own

		“electromagnetic activity”, i.e. not to emit signals interfering with other systems.
Electromobile	**Elektromobil**	Car driven by electric power. The power source may include accumulators, sun batteries or hydrogen and oxygen fuelled fuel cells.
Electronic Ticketing System (E-ticketing System)	**Elektronické odbavení cestujících**	System enabling ticketing services for passenger in public passenger transport via electronic media.
Emergency Call Stations	**Hlásky tísňového volání (SOS hlásky)**	Communication equipment installed on road infrastructure allowing drivers to communicate with the Police of the CR in case of emergency or another traffic accident. Also helps to collect, evaluate and control technical equipment (active components and sensors).
Tail Light or End Marker   **(„End of Train“ signal)**  **(„End of Train Part“ signal)**	**Koncová návěst**	Common designation for the signals “End of train” and “End of train part” (indicating the train integrity).
Engine Driver	**Strojvedoucí**	Collective term for the staff qualified to drive a rail transport vehicle (special traction vehicle) that provides the motive power regardless of the vehicle type.
Entity	**Subjekt**	Bearer and source of activity or learning in the basic category of relations.
European Space Agency (ESA)	**Evropská kosmická agentura**	Intergovernmental organization for the development of space research and space technologies, based in Paris. At present, ESA counts 20 European countries. Joined by the Czech Republic in 2008.
European Train Control System (ETCS)	**Evropský vlakový zabezpečovací systém (ETCS)**	Project designed for safeguarding and controlling rail transport. It enables transmitting information on permitted speed to the engine driver and monitors constantly whether the instructions are complied with by the engine driver.
External Costs	**Externí náklady**	Costs incurred by consumption of products, work and services provided by other entities.
FIATA		International federation of freight forwarding associations uniting national forwarding unions and related industrial branches (e.g.

		warehouses) (in French: Fédération Internationale des Associations de Transitaires et Assimilés)
Floating Car Data	**Data z plovoucích vozidel**	Data collected from vehicles equipped with respective in-vehicle units forwarded to traffic information and controlling centers for assessment and defining of basic trends in road traffic development.
Forwarder	**Zasílatel (též speditér)**	An organization procuring and providing transportation and related tasks for a customer in an agreed scope and under specified conditions.
Forwarding	**Zasílatelství**	Organization of the transport of goods or of other tasks related to the transport, in one's own name and on someone else's account.
Freight Transport	**Nákladní doprava**	Transport the fundamental aim of which is to carry goods (freight).
Galileo		Galileo is a global navigation satellite system owned by the European Union which offers precise global positioning service. Galileo is interoperable with GPS, the US global navigation satellite system.
Geostationary	**Geostacionární**	Stationary in relation to the Earth surface. Geostationary satellites orbit the Earth at an altitude of 36,000 km directly over the equator, as a result of which they seem stationary seen from the Earth.
Global System for Mobile communications – Railway (GSM-R)		Based on GSM standard; however, it uses its own frequencies and offers several extended functions specific for rail transport. It is a radio system designed mainly for exchanging audio (voice) information and data between rail and mobile components.
Global Objective	**Globální cíl**	Specific (clear, matter-of-fact and comprehensible) description of a future state through which a set vision will be accomplished. A summary of the results and impacts of strategic objectives. Applies to the strategy as a whole. Similarly to a vision, a global objective should be met within a mid-term or long-term horizon (not necessarily immediately upon conclusion of the strategy implementation).
Gradient Profile of a Line	**Podélný profil tratě**	Set of data relating to a section of the line, specifying the respective gradients and indicating the locations and radiuses of curves or the line speed and points of change in speed. The set also includes data concerning the stationing and location of operating posts, stops and signals.

Green Paper	**Zelená kniha**	The purpose of a Green Paper is to provide the public with material gathering proposals in a selected area so as to spark off a debate. Green Papers are followed by White Papers, which already contain specific proposals for action in specific policy areas.
GS1		International organization specialized in drafting or proposing and implementing global standards, procedures and solutions to improve efficiency and transparency of the supply and demand relationship in global terms and across industrial branches.
GS1 System	**Systém GS1**	Global standard for identification, automatic data collection and communication of data between business partners.
Handling Equipment / Transport Facility	**Dopravní zařízení**	Equipment used for ensuring operation of transport means, unloading and loading, informing the transport operator staff, drivers, passengers, dispatchers and consignees, treatment and maintenance of transport means and traffic routes. Traffic routes as such, other transport structures and means of transport are not considered handling/transport equipment.
Service Track	**Manipulační koleje**	Tracks used for handling of vehicles (e.g. loading or unloading) or, as the case may be, other purpose tracks.
Hardware		Technological equipment of a computer, individual structural components (motherboard with a microprocessor, power supply unit, graphic card, etc.)
Heavy Consignment/Load	**Těžká zásilka**	Loads whose weight exceeds the values given in the table of car load limits, or whose weight will cause that weight per axle or weight per running meter of the car are exceeded, even only on one section of the transportation route defined for the shipment.
Homeostasis	**Homeostáze**	Mechanism of community systems facilitating target behavior and creation of inner balance which is a precondition for efficient accomplishment of selected targets.
Horizon 2020	**Horizont 2020**	Framework Programme for Research and Innovation (H2020) is to be the biggest and most important programme to fund European science, research and innovation in the years 2014-2020. The H2020 programme continues in the research framework programmes declared by the EU since 1980, specifically the Seventh Framework

		Programme for research, technological development and demonstration (2007-2013).
Impossible Communication	**Nemožné dorozumění**	Situation in which, due to malfunction of the telecommunication equipment (mutual communication of the staff attending adjacent operating posts is made impossible) and simultaneous breakdown of the interlocking and signaling equipment (if in place), it is impossible to ensure safe running of a train between adjacent operating posts.
Incident (also Accident)	**Mimořádná událost (též nehodová událost)**	Event occurring in connection with the operation of a means of transport, resulting in death or damage to health, property or transported goods or threatening life, health and property or putting at risk the safe operation of buildings and facilities or, if applicable, gross violation of safety standards and/or continuity and regularity of traffic that might result in the above consequences.
Indicator	**Indikátor**	Quantified target or rate measuring the level of a target's accomplishment or an activity's implementation. Indicators are used to monitor the process and result of implementation of a strategy (programme, project).
Industrial Track	**Vlečka**	Track which serves the needs of the industrial track owner or other entrepreneur and runs into a national or regional line or into another industrial track.
Information	**Informace**	Describes events in verbal or visual form, thus it cannot be expressed in an exact way: 1. Message, advice or data concerning a specific part of objective reality that is necessary for the management process. 2. Meaning attributed to data (figures, numbers, signs, orders, instructions, commands, reports, etc.) There are various types of information: up-to-date, reviewing, primary, continuous, controlling, external, internal, input, output, etc.
Information System	**Informační systém**	Aggregate of means providing visual and acoustic information to drivers, road users, passengers and transport contractors (customers of a freight carrier).
Information Technology	**Informační technologie**	Technical aspect of information, separate from the contents of the message, information, data and their significance (issues involving also psychology, sociology and other fields).

Inland ECDIS	**Vnitrozemský ECDIS**	International data standard for the creation of inland navigation maps for water transport.
Inland Waterways	**Vnitrozemské vodní cesty**	Rivers and other areas where boats can navigate.
Integrated Traffic Information System of the CR (JSDI)	**Jednotný systém dopravních informací pro ČR (JSDI)**	Complex system environment collecting, processing, sharing, publishing and distributing (road) traffic information and traffic data primarily (but not exclusively) from public administration authorities, organizations and institutions as well as from other public and private entities pursuant to Resolution of the Government of CR No. 590 of 18 May 2005 "Draft implementation plan for the Integrated Traffic Information System of the CR" and in compliance with Act No. 361/2000 Coll., as amended. The Integrated Traffic Info. System is a joint project of the Ministry of Transport of the CR, the Ministry of Interior of the CR and the Road and Motorway Directorate.
Integrated Transport System	**Integrovaný dopravní systém**	Public Transport Service provided on a particular territory by several carriers subject to agreed contractual terms.
Integration	**Integrace**	State of the process of enhancing a system's organization, integrity, adaptability and homeostasis.
Integrity	**Integrita**	Capacity of a system to send early warnings to users if its signals cannot be applied for navigation purposes. Expressed by probability of incorrect information provided at a given period of time.
Intelligent Infrastructure	**Inteligentní infrastruktura**	Complex of ITS applications integrated into transport infrastructure based on which ITS services are provided to users. Intelligent transport infrastructure can be understood as transport infrastructure enabling, for instance, traffic and travel information to be conveyed in real time.
Intelligent Stop	**Inteligentní zastávka**	Public passenger transport stop equipped with information panels supplying real time travel information.
Intelligent Transport Systems (ITS)	**Inteligentní dopravní systémy**	Advanced applications designed to provide innovative services relating to various modes of transport and traffic control, without being intelligent themselves. ITS allow for improved awareness of various user groups, enabling a safer, better coordinated and more "intelligent" use of transport networks.

Intelligent Vehicle	**Inteligentní vozidlo**	Vehicle equipped with a technical system allowing it to make decisions on the vehicle's running without human intervention. The decisions are made at different intelligence levels and thus are capable of affecting the vehicle as a whole (autonomous vehicle) or individual systems of the vehicle (ABS, ESP, ASC and other systems).
Interface	**Rozhraní**	Mechanism working between systems, ensuring the systems' interconnection and interaction.
Interlocked Route	**Zabezpečená jízdní cesta**	A track section which is supported by an interlocking and signaling equipment to comply with the conditions for safe run of railway vehicles. Interlocked route is bounded by a place from where a permission to proceed is valid (usually from a signal) and a place to which the permit is valid (usually the next signal). Interlocked routes are either train routes or shunting routes.
Interlocking and Signaling Equipment	**Zabezpečovací zařízení (železniční)**	Equipment which helps to ensure safe movement of railway vehicles through surveillance and replacement of the operation performed by people, automation and increase of railway stations and tracks performance. The system is designed to control the traffic and technological processes in real time. Given that an error in the management of this process can lead to very serious consequences, i.e. to loss of life, injuries and considerable damage to property or the environment, this process (or some of its functions) is considered to be safety-critical. For this reason, requirements are imposed both on the correct operation of the plant in defect-free state, and on the so-called fail-safe, too. Fail-safe means that no potential failure of the plant nor of its parts can result in a safety hazard.
Securing of Train Movement	**Zabezpečení jízdy vlaku**	Set of operating tasks to secure the run of a train to or from a neighboring train movement operating point with track development, or to a defined place on an open track and back. Different categories and types of track interlocking and signaling equipment are used to secure the movement of trains. In addition to the track interlocking and signaling system, also train movement without interlocking and signaling devices or telephone communication is used.
Intermodal Transport	**Intermodální**	Several transport modes are used in

System	**přepravní systém**	carriage of goods. Lorries, trailers, semi-trailers, detachable add-ons or containers use roads for the initial and/or final sections of the journey whereas for the remaining part, they are shipped, with or without the tow (traction) vehicle, by railway, waterway or by sea. Only unified units are transported under this system, not undergoing any change in terms of weight or form during the carriage (e.g. ISO containers). As opposed to the multimodal transport system, a separate consignment note is issued for each transport mode (CMR for road transport, CIM for rail transport, etc.).
Internal Rate of Return	**Vnitřní výnosové procento**	The rate of interest at which the present value of cash income from investments is equal to capital expenditure on the investment.
Internet		Worldwide interconnected data network generally operating using the TCP/IP protocols, equipped with information servers with a range of extensive services. In common sense, the Internet is primarily understood as the access to such information and services, regardless of their actual global location and manner of implementation of the data connection.
Internet of Things (IoT)	**Internet věcí**	Communications network of a broad range of “embedded” devices (devices equipped with software and hardware for a specific purpose, e.g. sensors, navigation or GPS modules) accessible via the Internet. In transport, the principle and the purpose of IoT is similar to the principle and the purpose of the V2X concept.
Interoperability	**Interoperabilita**	Capacity of a product or system (whose interface is in full public domain) to communicate and work with other products or systems without any limitations in access or implementation.
Interoperability Components	**Prvky interoperability**	All basic structural parts, groups of structural parts, substructures or full structures of equipment included, or to be included in the future, into the subsystem of the European Railway System that are crucial, directly as well as indirectly, for the system’s interoperability. The concept of “component” includes both tangible as well as intangible property (e.g. software equipment).
In-vehicle (On-board) Unit	**Vozidlová (palubní) jednotka**	Technical equipment installed in a vehicle, which enables the electronic exchange of

		data between the vehicle and the equipment on transport infrastructure in order to automatically identify the vehicle.
In-vehicle RB Terminal	**Radioblokový terminál vozidla**	Aggregate of technical devices on the leading rail traction unit ensuring that the transmitted permissions are displayed to the engine driver. The terminal also passes information on the condition and location of the train to the RBS with respect to the engine driver's operation of and interference with the vehicle's control systems, and their compliance with the issued permissions.
ITS Application	**Aplikace ITS**	Intelligent transport system implemented and operated in real environment for the purpose of providing services to users of intelligent transport systems.
ITS Service	**Služba ITS**	Deployment of an ITS application through a correctly defined organizational and operational framework with the aim to improve safety, efficiency and user comfort or to facilitate or support operational activities related to carriage or travelling.
ITS Services Interconnection	**Návaznost služeb ITS**	Capacity to ensure continuous connecting ITS services on transport networks across the EU.
ITS Users	**Uživatelé systému ITS**	All users of ITS applications or services including drivers, passengers, vulnerable road users, carriers, managers and operators of the transport infrastructure, managers of vehicle fleets and integrated rescue services.
Legislation	**Legislativa**	Creation of legal rules laid down in writing.
Level Crossing Protection System	**Přejezdové zabezpečovací zařízení**	Interlocking and signaling equipment informing road users of a rail vehicle heading towards the level crossing and simultaneously informing the engine driver or relevant rail traffic service staff if the train is allowed to run at the permitted line speed before reaching the level crossing.
Line	**Linka**	Aggregate of connecting services on a given route.
Line Closure	**Výluka koleje**	Temporal interruption of train service or shunt on a track (section of the track), on an open track or in an operating post with track development; it can also be due to long-term impassability, in order to perform necessary repairs or other activities.
Interlocking System Remote Control Supervisor	**Traťový dispečer**	An employee with the competence to organize and control train movements, except train dispatchers for centralized traffic

		control, who remotely controls an area or its part on a defined track section.
Line Speed Limit	**Největší traťová rychlost**	Speed allowed on a track (track section) with respect to its constructional layout and equipment.
(Railway) Line with Simplified Operating Procedures	**Trať se zjednodušeným řízením drážní dopravy**	Railway line on which the service is provided under "SŽDC D3" rule for simplified operating procedures (D3 line) and which is limited by home (entry) signals of the station with lead responsibility for controlling train movements over an assigned dispatching section or by home (entry) signals of an adjacent station or by the buffer post in the cul-de-sac built "D3" station.
(Railway) Line	**Trať**	A defined part of the railway designed for trains movement (or for shunting operations between train movement operating points), divided into line sections between train movement operating points with track development and into tracks in train movement operating points on which the transport service is provided under "SŽDC D1" Railway signaling and operating rules. A line can also be a substructure and permanent way including structures and fixed railway facilities between two designated points. It can be open, standard gauge, narrow gauge, broad gauge, with reversible tracks, with privileged transit traffic, electrified, rack railway line, frontier, main, secondary, controlled, high-speed.
Loading Gauge	**Průjezdný průřez**	Defines the free space along the track enabling the safe passing of rail vehicles.
LTE		Technology designed for high-speed Internet in mobile networks (abbreviation of Long Term Evolution).
M2M Mobile Data Telecommunications Service	**Mobilní datová telekomunikační služba M2M**	Mobile data telecommunications service of the Machine-2-Machine (M2M) type with limited quantity of transmitted data. This type of service is used to ensure specific, mostly technological communication between two and more devices where usually various weather-related data are transmitted, placing minimum demands on the quantity of the transmitted data.

Main Light Signal (Railway)  **(Main light signal with integrated shunting movements signal)**	**Hlavní návěstidlo (železniční)**	Fixed signal controlling a train's ride or, if relevant, shunting operations between train movement operating points or shunting alone. Main signals include home (entry) signals (protecting the station or junction point and permitting the train's arrival or shunting between train movement operating points to the station or junction point), intermediate interlocking signals (outer home, inner home) signals (used for moving from one track to another - connecting one - within the circuit of the station or junction point), starting (exit) signals (used for departures from the station or junction point), section signals (used on open lines for trains arriving at the next track section), protection signals (protecting loading points, industrial track turnouts branching off the open line, level crossings with level crossing protection system, etc.) and temporary signals (note: signals temporarily left in operation).
Permissible Train Speed	**Stanovená rychlost**	Permissible train speed is set by the composer of the train's timetable and is laid down in the Working Timetable. The permissible speed must neither exceed the basic train speed pursuant to the transport regulations nor the line speed or construction speed of the traction vehicle set for the respective train.
Means of Transport	**Dopravní prostředek**	Technical means which, by moving, accomplish transfers of passengers and goods.
Measure	**Opatření**	Instrument for implementing strategies by means of which individual objectives are fulfilled. The form of measures may vary: legislative changes, programmes or projects, investments and facilities, providing of information or training, and other.
Ministerial/Sector Strategy	**Resortní/sektorová strategie**	Ministerial strategy refers to a strategy processed at ministerial level (or at the level of another central public administration body) concerned with the relevant sector (sphere) of the given ministry, as stipulated by the Act on Competencies.
Model	**Model**	Demonstration maintaining, in terms of its purpose, the substantial characteristics of the original.
Multimodal Mobility	**Multimodální mobilita**	Integration of mass passenger transport systems with other modes of transport (e.g.

		car sharing) with the aim to reduce individual car transport.
Multimodal Transport System	**Multimodální přepravní systém**	This system does not deal with the carriage of unified units (i.e. units undergoing no changes during the carriage process) – these are used in the so-called intermodal transport system. A single bill of lading (FIATA) is issued for all modes of transport which covers the entire carriage section. The multimodal transport operator (e.g. forwarder) assumes responsibility for implementing the entire process of the combined transport, even if implemented by various means of transport. As for mass passenger transport systems designed to provide high-quality transport service within a given territory, the so-called Integrated Public Transport Systems are created that work under single carriage and tariff terms and endorse a single transport solution, including the coordination of timetables comprising several modes of public passenger transport operating at a given territory, e.g. underground (Metro), trams, trolleybuses, railways, urban and suburban bus service, cable car and ferries.
National Traffic Information and Management Centre (NDIC)	**Národní dopravní informační a řídicí centrum (NDIC)**	Subsystem for review, authorization and verification of traffic information from diverse sources. The National Traffic Information Centre is operated by the Road and Motorway Directorate of the CR by force of the Czech Government's resolution as part of its branch in Ostrava, Slovenská 7/1142, Ostrava-Přívoz. It is a round-the-clock operations centre.
Navigation	**Plavba**	Operating vessels on waterways.
Navigation Network	**Plavební síť**	Technical base of inland navigation consisting of a network of waterways and ports.
Nomadic Device	**Přenosné zařízení**	Portable communications or information device that can be taken by the driver into the vehicle and used when driving or accomplishing transport, e.g. PDA or smartphone.
Non-interlocked Running	**Jízda bez zabezpečovacího zařízení**	Manner of securing running trains where the trains' rides are organized by a single train dispatcher.
One Stop Shop		1) In rail freight transport a one stop shop is a point of contact allocating railway infrastructure capacity of international freight train paths. Either, a single stop is

		established in each respective rail network to offer paths to international trains, able to arrange for an international train's path from the starting point to its destination, regardless of the number of rail networks passed on the way, or a single point of contact is established for the entire corridor as part of the given railway freight corridor. 2) In public passenger transport, a one stop shop means providing comprehensive, specific area-related information through on-line or mobile applications, informing about timetables of public passenger transport, walking distances to stops, navigation to the point of destination, comparing the travelling conditions to individual car or cycle transport, or providing information on carriage and tariff terms.
Open Line	**Širá trať**	Line section delimited on each side either by a station, a D3 operating post, an RB operating post or the end of the line (end of track at, e.g., a stop or loading point). The border between the open line and a station is delimited by a home signal; in case of tracks with no home signal, the border is at the home signal level of the right track. The border between the open line and a D3 or RB operating post is the trapezoid sign board.
Open Line Track	**Traťová kolej**	Track on an open line.
Train Movement Operating Control Point	**Dopravna**	Railway point used to control train movements and shunting operations between train movement operating points. There are train movement operating points with track development (railway station, passing loop, junction point, D3 train station, etc.) or without track development (train announcing point, track block operating post with block apparatus, automatic block section signal or section signal of the automatic line block system).
Operational Programme	**Operační program**	Operational programme is the fundamental strategic document of financial and technical nature focusing on a specific sphere (e.g. employment and social affairs) or a specific cohesion region (e.g. Moravian-Silesian region) that is compiled by the Member States of the EU. Operational programmes contain detailed descriptions of the objectives and priorities which the

		particular Member States want to achieve in the given sphere over the given programming period. The Programmes contain descriptions of type activities for which funds may be allocated from EU Structural Funds. An Operational Programme also includes a list of those eligible for applying for such funds.
Operative Traffic Control	**Operativní řízení dopravního provozu**	Constant everyday activity carried out according to concept models of operative process management, respecting the immediate needs of and possibilities in the transport, carriage and service processes of traffic.
Organized State	**Organizovanost**	State of a system different from chaos showing traits of a structure in the relations between the system's components, according to certain criteria.
Out of Gauge	**Překročení ložné míry**	Consignment exceeding the prescribed profile of the route at any point of its length the dimensions of which exceed the loading gauge of the relevant track in the defined travel path of the consignment.
Out-of-Gauge Load	**Zásilka s překročenou ložnou mírou (též zásilka PLM)**	Exceptional consignment whose dimensions exceed prescribed loading gauge, transported separately under specified conditions.
Overtaking of Trains	**Předjíždění vlaků**	Two trains bound for the same direction passing at a train movement operating point with a track development where the train arriving at the train movement operating point with a track development later departs from (or passes through) the train movement operating point and enters the next block section earlier than the first train. Also, two trains bound for the same direction passing at a double or multiple track line.
Part-Load Consignment	**Kusová zásilka**	Consignment of limited weight and dimensions which needs no separate rail wagon or separate road vehicle for being transported.
Passenger	**Cestující**	A person transported by a transport contractor in compliance with Carriage Regulations and the Tariff.
Passenger Transport	**Osobní doprava**	Transport the fundamental aim of which is the carriage of persons and their luggage.
Permissible Braking Distance	**Zábrzdná vzdálenost**	Distance determined for a particular section of the track, on which any train has to safely stop from the greatest speed authorized at the given section. Braking distance is

		determined uniformly according to the technical parameters of the track and is reported in the route book containing the line characteristics.
Maximum Permitted Line Speed	**Nejvyšší dovolená rychlost**	Set speed restricted at a given track section by the line speed limit, by a temporary restriction of the line speed limit (e.g. due to construction works on the track), by main signals or by a message informing the engine driver of the restricted speed limit. In road transport the maximum permitted speed is restricted by Act No. 361/2000 Coll., on road traffic, as amended. On motorways, the speed limit is 130 km/h, on roads outside of municipalities 90 km/h, in municipalities 50 km/h, whereas in pedestrian and residential areas the speed limit is 20 km/h.
Person (people) with Reduced Mobility or Orientation	**Osoba s omezenou schopností pohybu a orientace**	People whose mobility when using a means of transport is reduced due to any physical disability (sensory or motoric, permanent or temporary), mental disorder or incapacity or due to any other handicap resulting from health or age and whose state requires that adequate attention is paid to their special needs and that services available to all passengers are adapted to meet their needs as well.
Personal Digital Assistant	**Osobní digitální pomocník (PDA)**	Small pocket computer.
Pilot Solution (test operation)	**Pilotní řešení (též pilot, poloprovoz nebo zkušební provoz)**	Temporary version of a system showing basic features of the system to be implemented later on.
Platform	**Platforma**	On-board unit or other device enabling implementation, providing, use and integration of ITS applications and services.
Point Machine	**Přestavník**	Device placed next to the points (diamond junctions, catch points) the main function of which is to reset, consequently fix and monitor the position of the movable components of the switch panel, crossing or catch point.
Portal	**Portál**	A website enabling quick access to a great amount of information in one place. In order to be able to efficiently work with such amounts of information, each portal has a browser. Browser is a programme able to

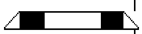
		search through all of its records upon the users' entering their requirements and to offer the corresponding result information.
Power Industry	**Energetika**	Field of human activity focusing on the extraction of primary energy sources and the transformation, transport, storage and use of energy.
Primary Data	**Primární data**	Basic data used as input reference data for messages or as basis for a system's functioning and for computation of derived data.
Pseudolite	**Pseudolit**	Surface device simulating and emitting GPS signals. Used for making the GPS satellite network denser at places where 100% integrity and availability of the signal is crucial for navigation purposes (i.e. at airports when navigating airplanes before landing).
Public Carriage	**Veřejná přeprava**	Transport provided to meet the general transport needs and available to everyone under uniformly applicable terms and conditions or under specifically agreed transport conditions.
Public Transport	**Veřejná doprava**	Transport for users, during which a legal relationship between the operator of the means of transport and an organization or person, whose transportation needs are satisfied, is established. The service is available to everyone under the defined terms and conditions.
Qualified Person Authorized to Organize Rail Transport and to Provide the Safe and Efficient Train and Shunting Movements	**Odborně způsobilá osoba k organizování a řízení drážní dopravy**	Person assigned by the railway operator or carrier to carry out, as part of the railway or rail transport operating, activities having direct effect on safe working procedures for the operation of the train and shunting movement control. The person must have a professional qualification as required by legal regulations and the railway operator's or the carrier's internal rules applying to activities carried out in railway, or rail transport, operating.
Queue	**Kolona**	Row of road vehicles in a traffic lane with no possibility of overtaking, affected by the first vehicle. In terms of mutual influencing, two vehicles are involved. In terms of evaluating congestions, a queue involves 20 and more vehicles moving at varying speed or alternatively going to a full stop.
Quick Response Code	**QR kód**	System for automated data collection. Matrix code arranged in a square consisting of black and white modules (square dots), which form images. One QR code – image

		– can contain great amounts of stored information.
Radio Data System - Traffic Message Channel (RDS-TMC)	**·**	Service for drivers designed to provide traffic and travel information before and during travelling. Uses standard radio signal for data transmission. Among other, RDS is also used for acquiring information on the current radio station, name or text of the music currently on air. The same method can be applied in traffic data distribution. These include, among other, data concerning unexpected changes and accidents occurring on the transport network, congestions and exceeded capacity of the transport network. Traffic information may show on the radio display, however, it is more efficiently applied when used in connection with navigation systems. Individual traffic incidents have a standardized code designation, i.e. RDS-TMC works all across Europe regardless of the localization.
Radioblock (RB)	**Radioblok (RB)**	Technical device enabling the providing of train movement in a defined area by means of granting permissions (movement authority) communicated to the rail traction vehicles via radio networks, transmitting data and subsequently checking the movement of rail traction vehicles based on the issued permits.
Rail	**Kolejnice**	Ensures guiding of rail vehicles and transfer of force generated by running trains onto rail supports. Rails are components of the track carrying the greatest strain, being in direct contact with the wheels of vehicles.
Rail Traction Unit	**Hnací vozidlo**	Railway vehicle capable of generating tractive force on the wheel circuit designed for traction of trains, transport of passengers or goods or for moving other rolling stock, save where such motion is produced by a special tractive vehicle.
Rail Transport Management on RB lines through Dispatching	**Organizování drážní dopravy na trati RB dispečerským způsobem**	Operating and management of rail transport by means of granting permissions (movement authority) to proceed to trains or shunting sets of cars, issued by Radio Block Centers based on advance reservation of the movement path by an RB dispatcher which workplace is located at the RBC and transmitted to the leading rail traction unit through a radio data network. Leading

		tractive vehicles with no RB equipment receive permissions to proceed from the RB dispatcher in the verbal form (voice instructions).
Rail Transport Operating	**Provozování drážní dopravy**	Activity carried out by the carrier to transport persons, animals or goods based on a legal relationship or to meet its own operational needs.
Rail Vehicle	**Železniční vozidlo**	Vehicle whose movement is carried and guided by a railway track.
Rail-Road vehicle	**Dvoucestné vozidlo**	Means of transport equipped for moving on a railway and other designated traffic route.
Railway	**Dráha**	Traffic route used for transferring rail vehicles plus fixed equipment needed for such transfers, ensuring safety and continuity of rail transport. In terms of purpose and importance, railways differentiate between national and regional railways and industrial tracks.
Railway Node	**Železniční uzel**	Important place in the railway network, transportation-wise, where several lines converge and which includes several stations and connecting lines.
Railway Network	**Železniční síť**	Set of individual railway lines in a territorial unit, mostly within a city, region, country, or a continent.
Railway Operability	**Provozuschopnost dráhy**	Technical condition of the railway enabling its safe and continuous operation. Railway operability is a basic precondition for the railway's operating.
Railway Operating	**Provozování dráhy**	Activities safeguarding and maintaining the railway and organizing rail transport.
Railway Station	**Železniční stanice**	An train movement operating control point with track development allowing crossing (meeting) and overtaking of trains and having a defined scope of provided transport services for passengers or transport contractors (in freight transport).
Railway Substructure	**Železniční spodek**	The construction of an earthwork structure of a railway (excavation, embankment, sidehill cut). This term further includes drainage facilities (ditches, subsurface drains), objects in the earthwork structure (walls, culverts, bridges, tunnels), platforms, ramps and other special-purpose facilities and equipment of lines and stations.

Railway Superstructure	**Železniční svr-šek**	A superstructure receives the load stress from the rolling stock and guides the vehi-cles' movement.
Railway System Interop-erability	**Interoperabilita železničního systému**	Operational and technical interconnection of the European railway system.
RB Line	**Trať vybavená radioblokem (trať RB)**	Railway line on which the train service is provided under "SŽDC D4" rule for train movement operation control on lines equipped with Radio Block, with borders at entry signals of independent train stations or at the end of the track in the final RB cul-de-sac built train station.
RB Train Operating Con-trol Point	**Dopravna RB**	Train movement operating point with di-verged tracks on the RB line, designed for train movement control and shunting opera-tions between train movements operating points, unstaffed by a local train dispatcher, signalman or track block operator.
RB Dispatcher	**Dispečer radi-obloku**	Qualified employee authorized to organize railway transport and to provide train and shunting movements on a designated line/lines equipped with a radio-block who operates the train control system equipment based on the radio-block switchboard tech-nology.
RB Switchboard	**Radiobloková centrála**	Set of the radio-block system supporting technical devices at the workplace of the RB dispatcher. RBS checks movement paths locked by the RB dispatcher and en-ables data or voice transmission of permis-sions (movement authority). RBS is con-nected to a system used for keeping and making records on rail traffic movement documentation.
Reduced Visibility	**Snížená vidi-telnost**	Visibility where objects and persons are not clearly visible at a distance of no more than 100 m (e.g. from twilight to dawn, at dark, in snow or heavy rain, in a tunnel or in a se-cluded unlit area).
Regional (Secondary) Line	**Regionální dráha**	Line of local importance used for public (passenger and goods) rail transport, inte-grated into the national or other regional lines.
Regulation	**Regulace**	Component of the control process, respond-ing to identified deviations from the course of a controlled process as opposed to the initially set intentions (plans).

Repository	**Datový sklad**	Integrated, subject oriented, permanent and time-variable set of data organized to support management needs. Data are connected on the basis of specific rules to provide the end user with a general view of his or her area of interest.
Request (for permission for a train to proceed) (as internal telephone communication between stations (local train dispatchers) as the safe working procedures for the operation of the train movement control)	**Nabídka**	A (local) train dispatcher's request for permission for a train to proceed (entering into the (single line) track section towards the station controlled by the next local train dispatcher), having a prescribed form.
Reversible Track Line	**Banalizovaná trať**	Railway lines where all track rails are equipped with an interlocking and signaling system for two-way traffic.
Track Bulletin	**Tabulky traťových poměrů**	Handbook containing construction relevant technical parameters of railway structures and structures built on the railway, along with technical and operational data having direct effect on the safety and continuity of rail transport.
Running Ahead of Schedule	**Náskok**	Agreed, ordered or achieved arrival, passage or departure of a train ahead of the relevant train's timetable.
Sight Driving	**Jízda podle rozhledových poměrů**	Manner of running a train using only the sight of the engine driver (employee positioned at the head of the shunted train or the shunting set of cars) so that the train or shunting set is able to stop in front of another vehicle endangering its driving and, if possible, to stop in front of a different obstacle, while the permitted line speed is not to be exceeded. In case of oncoming vehicles, the engine driver must be able to employ all means available to stop the train or shunting set of cars (fast brake, sand dispersion, dynamic brake, etc.).
Running Track	**Dopravní kolej**	Tracks used by arriving, passing or departing trains.
Train Movements May Only Continue with Restrictions Imposed	**Jízda se zvýšenou opatrností**	Manner of running a train when the engine driver must repeatedly sound signal "Attention" starting at least 250m ahead of a level crossing until the train head (head of the shunting set of cars) passes the level crossing. The maximum permitted speed of the train reaching the point of 60m ahead of the level crossing until the train head (head of

		the shunting set of cars) passes the level crossing is 10km/h. In case of a sudden obstacle blocking the level crossing, the engine driver must be able to employ all means available to stop the train or shunting set of cars.
Interlocking and Signaling System Remote Control	**Dálkové ovládání zabezpečovacího zařízení**	Add-on to railway interlocking and signaling system enabling the system's control from another place via a transmission device.
Interlocking and Signaling Systems	**Zabezpečovací zařízení**	Part of transport equipment used to ensure the security and control automation and to improve the performance of transport.
Satellite	**Družice**	A body orbiting another, more massive body. Man-made satellites are bodies weighing hundreds to thousands of kilograms put to the Earth's orbit by a spacecraft. Satellites travel in different altitudes above the Earth's surface, depending on type. In terms of purpose, we differentiate between telecom, navigation, remote Earth observation, meteorological, intelligence and scientific satellites.
Setting-Back	**Úvrať**	Change of the direction of a train, shunted vehicle or special vehicle to the opposite direction.
Ship Operator	**Rejdař**	Operator of (also inland) water transport for third party purposes.
Shunting	**Posun**	Each intentionally made and organized movement of vehicles that is not the movement of a train, shunting operations between train movement operating points or a run to or from a blocked track.
Shunting Operations between Train Movements Operating Points	**Posun mezi dopravnami**	Each intentionally made movement of rail vehicles to, from or on the open line that is not the run of a train, shunting or a run to or from a blocked track.
Fouling Point Marker 	**Námezník**	Fixed signal used to define the limit between two tracks not to be exceeded by a vehicle in order to ensure safety of vehicles running along the adjacent tract.
Signal	**Návěst**	Visible or audible expression of an order, message or information by means of a set signal. Signals may be expressed using colors (red, green, yellow), motions (circling of a hand or other), sound intervals (short and long whistle/horn blow, etc.) or light intervals (calm, flashing light), images ("work site" – works on the track), numbers

		(speed indication signal) or letters (start and end of speed restriction, etc.).
Signal	**Návěstidlo**	Technical device, tool or item used for signaling.
Guidance Board for Missing Distant Signal  **(At the next signal expect Stop - “Caution signal”)**	**Tabulka s křížem**	Fixed invariable sign functioning as a permanent “Caution” signal. On D3 or RB lines, in specifically set cases, this sign notifies the engine driver about the following trapezoid board sign.
Signal Code	**Návěstní znak**	Simple and clear expression of a signal by means of a certain shape, color, size or sound.
Signaling	**Návěstění**	Passing of orders, messages or information by way of signals.
Signaling (Interlocking) System Failure	**Selhání návěstních (zabezpečovacích) systémů**	Situation in which, due to a defect on a component of the interlocking and signaling system, the interlocking and signaling system fails to switch over to a state ensuring the safe operation of rail transport or preventing the occurrence of any rail transport risks.
Interlocking and Signaling Failure	**Porucha zabezpečovacího zařízení**	Change in at least one parameter of a part of the interlocking and signaling system that change the system’s features to an extent past the defined technical conditions.
Signaling System	**Návěstní soustava**	Set of defined signals, signal codes, signal terms and the ways of their use in the implementation and safeguarding of transport.
Simplified Train Operating Procedures	**Zjednodušené řízení drážní dopravy**	A method for providing the train movements operating and shunting operations between train movement operating points on the lines with simplified train operating procedures (D3 lines) with maximum speed of trains being 90 km/h.
Simulation	**Simulace**	Process of creating a real system using a model corresponding to real conditions, followed by conducting of experiments with the model to achieve better understanding of the examined system or to evaluate different alternatives of the system’s activity.
Smart City		Community of people communicating and benefitting from flows of energy, material, services and financing in order to speed up sustainable economic development, stability and high quality of life. These flows and interactions become smart through strategic

		use of information and communication infrastructures and services in the process of transparent zoning and zoning procedures sensitive to social and economic needs of the society.
Smart phones		General term for phones typical for their following characteristics: a relatively large display, easy-to-control keyboard or a touch screen, above-standard software for, among other, electronic mail, fax or Internet.
Software		Computer programme equipment.
Special (Rail) Vehicle	**Speciální (drážní) vozidlo**	Rail vehicle built for the purpose of railway construction, maintenance, repair or upgrading, for checking the condition of the track or removing the consequences of extraordinary events/accidents.
Special Load	**Mimořádná zásilka**	Consignment containing goods the dimensions, weight or design of which might cause difficulties in transport with regard to the facility or operational capacity of the railway or which might present a risk for traffic safety.
Specific Objective	**Specifický cíl**	Description of the outputs of specific measures and activities or, as the case may be, description of the desired target state. Each specific objective relates to the respective strategic objective. Specific objectives are accomplished by implementation of specific activities in course of the strategy implementation. Upon the accomplishment of all specific objectives, the strategy implementation is completed.
Specification	**Specifikace**	Binding measure setting out criteria, procedures or any other relevant rules.
Supervision Signal for Trailable Turnouts  **(White short flashing light indicating that the turnout may be passed facing by “Movement secured” signal)**	**Světelné návěstidlo výhybky se samovratným přestavníkem**	Fixed signal advising of the correct position of the points, reset into normal position, alerting trains running in the trailing direction. This light signal informs the engine driver of the correct position of the switch with a resetting point operating mechanism that is reset into normal position.
Station Interlocking and Signaling	**Staniční zabezpečovací zařízení**	Interlocking and signaling system used for safeguarding movement paths at train movement operating points with track development and at junction points.
Strategic Document	**Strategický dokument**	Any document setting out a vision, objective

		or measure in the given sphere. Strategic documents include, without limitation, strategies, concepts, action plans or development plans.
Strategic Objective	**Strategický cíl**	Description of the future state of individual partial areas of the relevant problem through which the global objective will be met. An aggregate of the results and impacts of individual specific objectives. Each strategic objective relates to a particular part of the strategy. A strategic objective is accomplished as soon as the strategy implementation reaches its end, or over a short or medium term.
Points	**Výhybka**	Rail equipment enabling the passage of vehicles from one track to another without interrupting the ride. Part of the points equipped with switch blade is called a switch.
Trailable Turnouts	**Výhybka se samovratným přestavníkem**	These points are mainly used in railway stations on tracks with simplified train operating procedures as provided for in the "SŽDC D3" Rule, on industrial tracks, etc. Trailable turnouts mechanisms enable railway vehicles to run across a points from three directions without any assistance of the points operator or of the interlocking and signaling system. The fourth direction is operated in a traditional way by manual adjustment of the points mechanism.
Target Group	**Cílová skupina**	In terms of the strategy set-up (its objectives and measures) a person, group of persons or an institution to be affected by the implementation of the strategy as planned. In terms of communications, a person, group of persons or an institution that can or should be informed (through various means, tools and at a different intensity) of the progress, outputs and results of strategy formation. The target group in terms of strategy set-up does not necessarily have to be the target group in terms of communications, and vice versa.
Tariff	**Tarif**	Scale of prices for individual carriage acts performed as part of carriage services, and the terms and conditions of their use.
Technical Specifications for Interoperability (TSI)	**Technické specifikace pro interoperabilitu (TSI)**	Set technical requirements for the subsystems of the European rail system: infrastructure, energy, rolling stock, control-command and signaling, traffic and traffic management and telematics applications in

		passenger and freight transport, including the respective deployment procedures.
Telecommunications	**Telekomunikace**	Set of methods, equipment and measures through which one participant may communicate to another participant (one or more) any information at any distance using any form of an appropriate telecommunication system.
Telecommunications Network (also Electronic Communications Networks)	**Telekomunikační síť (též sítě elektronických komunikací)**	Functionally interconnected set of telecommunications equipment, which enables the transfer of information between end points of the network, or a set of radio equipment for the transmission of information, or their combination. Telecommunications network is a mobile network of an operator and telecommunications equipment is a mobile terminal. Telecommunications networks are built to provide services such as voice, television, and Internet access.
Telecommunication Equipment	**Telekomunikační zařízení**	A set of equipment for processing and utilization of telecommunications signals which carry information in different forms.
Ticket	**Jízdenka**	Type of consignment note entitling passengers to transport.
Timetable	**Jízdní řád**	Summary of information concerning services operated on a given line and connecting services running at given times and in given locations. Contains, at least, information on the departure and arrival times from/to respective stops and stations.
Top-Down		Planning method which sets out objectives and ways to achieve them proceeding from top to bottom. First, global (framework) strategic objectives and manners to achieve them are defined. These are subsequently split into lower and lower levels of the organizational hierarchy and are further elaborated and specified. It is a concept of divergence, its disadvantage being that the planning method lacks feedback.
Track	**Kolej**	Two rails fixed on sleepers at a distance called the track gauge.
Track Circuit	**Kolejový obvod**	Electric set comprising electric components of track circuit and the track circuit section used for identifying if the relevant line section is clear of railway vehicles or occupied. The status of a clear or occupied line is identified on the basis of a conductive connection of compact rail strings and the rail vehicle axle.

Track Interlocking and Signaling	**Traťové zabezpečovací zařízení**	Interlocking and signaling equipment used to secure the movement of trains on a track between train movement operating points with track development.
Traction	**Trakce**	Set of devices and activities associated with propelling a vehicle in the form of exerting tractive force, of dynamic braking or of propulsion. Traction in railway transport: steam, diesel and electric.
Traffic	**Dopravní provoz**	Aggregate of activities accomplishing the transport process (vehicle movement).
Traffic Accident	**Dopravní nehoda**	Emergency event involving damage to personal health or property in direct connection with the operation of a means of transport or a transport facility.
Traffic Control Centre	**Dopravní řídící centrum**	Using sensor-collected data, the centre performs traffic control via end devices such as traffic controllers, variable messages signs, etc.
Traffic Data	**Dopravní data**	Data outputs mainly from ITS applications (including telematics applications) and traffic information systems, interpreted into comprehensible form, characterizing the traffic situation, and suitable for distribution to road users and traffic participants.
Traffic Detectors	**Dopravní detektory**	Technical devices collecting data on traffic flow and transport infrastructure (inductive loops, automatic traffic counters, video-detection systems, weather stations, etc.).
Traffic Dispatching	**Dopravní dispečink**	Professional operating control or, if necessary, also checking of the transport process in a particular organization or on a particular territory from a single point.
Traffic Flow (Road Traffic)	**Dopravní proud (silniční provoz)**	Sequence of all vehicles and pedestrians moving in one lane one after another or alongside each other in parallel lanes following the same traffic direction; the traffic flow may consist of several running or pedestrian flows.
Traffic Information	**Dopravní informace**	Information on the traffic situation having direct or indirect impact on road traffic safety and continuity.
Traffic Information Centre	**Dopravní informační centrum**	Regional or national centre providing traffic information before or during travelling which relate to road traffic or the traffic route conditions. The Centre is attended by staff.
Traffic Information Device	**Zařízení pro provozní informace**	An active element which enables the exchange of information about traffic conditions on roads (traffic accidents, traffic obstructions, etc.) on a defined road section.

Traffic Intensity (Road Traffic)	**Intenzita dopravy (silniční provoz)**	Number of vehicles running or pedestrians walking through the cross-section of a road at a given period of time.
Train	**Vlak**	A series of rail vehicles (also of special vehicles) consisting of at least one driving and one towed vehicle, marked with defined indicators, having a train crew and running based on a timetable or instructions of a competent person controlling railway transport. A train can also consist of only one locomotive (special as well).
Train Dispatcher	**Výpravčí**	A term referring to all staff authorized to organize rail transport and provide safe and efficient train and shunting movements.
Train Dispatcher for Centralized Traffic Control	**Výpravčí DOZ**	An employee who provides safe and efficient train and shunting movements over an assigned small-scale dispatching district (one train movement operating point locally or more train movement operating points remotely).
Train Diversion Route	**Odklonová trasa vlaku**	Train route necessary for a train to run along a diversion route. Trains going on diversion routes run under their original numbers and according to the timetable set for this route.
Train (Cab) Interlocking and Signaling	**Vlakové zabezpečovací zařízení**	Interlocking and signaling equipment for securing reliable and safe control of the train. In this apparatus, some functions of the station, track, or level crossing signaling equipment may be part of the devices situated on the locomotive itself. Part of the equipment on the locomotive or control vehicle is called the mobile part of the train protection system (train control) and is used to receive and evaluate information transmitted from the track. It also serves to periodically check the alertness of the person controlling the railway vehicle. This part can be operated independently without coordination with other interlocking and signaling equipment.
Train Timetable	**Jízdní řád vlaku**	Specific time location of a train at a specific section of the train line.
Train Traffic Diagram	**Grafikon vlakové dopravy**	Summary of measures and tools related to train traffic. Prepared and issued for a time-period set in line with international railway agreements and treaties. Introduced across the entire network at a single time. Train traffic diagram tools contain instructions for organizing rail transport and train running.

Telephone Communication (as the safe working procedure for the operation of the train movement control)	**Telefonické dorozumívání**	Train movements are interlocked by telephone communication by a telephone advice or, in specified cases, by telephone request and acceptance.
Transport	**Doprava**	Intentional activity involving spatial transfer of persons and items via traffic routes, using means of transport, energy and labor force.
Transport Contractor	**Přepravce**	Carrier’s customer in freight transport. Aggregate designation for consignor and consignee of the consignment. A customer of the carrier in passenger transport is referred to as passenger. This concept dates back to 1964 when a single term for all carrier customers was introduced. However, based on linguistic sense, the wider public regards a transport contractor as an active participant in the transport process rather than a user of the results of transport/carriage.
Transport Mode	**Druh dopravy**	Transport characterized by a specific common feature (e.g. means of transport, traffic route, transport equipment) regardless of organizational and local integration.
Transport Branch	**Obor dopravy**	Sphere of transport characterized by a specific organizational complex and management, using primarily a specific type of transport means.
Transport Network	**Dopravní síť**	Aggregate of transport routes delimited by a territory.
Transport Process	**Dopravní proces**	Aggregate of time-connected, factually relevant acts accomplishing and securing transport.
Forwarding Process	**Přepravní proces**	Sum of subsequent, factually and time-related acts through which carriage is implemented and safeguarded.
Transport Route	**Dopravní trasa**	Setting the route in terms of direction, altitude or even position, if necessary.
Transport System	**Dopravní systém**	Aggregate of interconnected elements (means of transport and transport equipment/facilities, transport infrastructure and traffic organization) on a designated territory (e.g. region, country or continent) where transport process is taking place (carriage of passengers, goods and information).
Transport Terminal	**Dopravní terminál**	Area where consignments are loaded, unloaded or reloaded or the mode of transport is changed. In individual car transport, a terminal may be, for instance, a car park, in public passenger transport a bus/coach or train station, in air transport terminals are

		airports and in water transport they are ports. Multi-mode terminals are used for several modes of transport at a time.
Transportation/Carriage	**Přeprava**	Transferring of passengers and goods as a result of transport.
Stop Board for Indicating the Stopping Point at a Control Point 	**Lichoběžníková tabulka**	This trapezoid board is posted on railway lines with simplified train operating procedures (on stations without home (entry) signals) at a point where given trains are to stop before getting permission to move to the station.
Travel Information Centre	**Centrum informací o cestování**	The Centre provides information on timetables and suggests transport routes, including multi-modal transport.
(Rail) Movement Path	**Jízdní cesta**	Common designation for train and shunting paths.
Travel Voucher	**Jízdní doklad**	General designation for tickets, passes or other documents (seat reservation vouchers, sleeping-car or sleeping couchette vouchers) allowing passengers, their luggage and dogs to be transported according to the Tariff.
Validation	**Validace**	Legalization, ratification, authorization, entry into force.
Variable Message Sign	**Proměnné dopravní značení**	Active elements enabling the passing of instructions (e.g. no entry, speed restriction) to all drivers within a given section of transport infrastructure.
Vision	**Vize**	A description of the desired future state, which we want to achieve through implementation of the strategy. It is the very impact of the achieved global objective. It refers to the strategy as a whole. The vision should be fulfilled in the mid-term or long-term horizon (which may not be immediately after the completion of the strategy implementation).
Vulnerable Road Users	**Zranitelní účastníci silničního provozu**	Non-motorized road users such as pedestrians and cyclists, as well as motor-cyclists and persons with disabilities or reduced mobility, orientation and communication.
Wagon Load	**Vozová zásilka**	Load which is transported on at least one independent vehicle; a wagon load is also a wagon of transport contractors (private) and a railway vehicle running on its own wheels being transported with a bill of lading.

Distant signal  **("Caution" signal indicating "be prepared to stop at next signal" - yellow light)**	**Předvěst (samostatná)**	Fixed signal located at a permissible brake distance before the next main signal. Used to warn the engine driver of the oncoming main signal.
Website	**Webová stránka**	Internet site containing information (text, images, animations, voice) as well as links which easily refer the user from one page to another. Every website is hosted on a server and has its own unique URL (Uniform Resource Locator) address. Websites can be displayed using browsers (e.g. Netscape Navigator or Internet Explorer).
White Paper	**Bílá kniha**	Report or hand-book designed to help resolve a particular issue and to facilitate decision-making. Contrary to Green Papers, White Papers contain specific proposals for adopting measures in specific policy areas. White Papers reflect upon results of public consultations on the proposals and outline possible legislative measures. White Papers are submitted for debate to political representatives (the College of Commissioners of the EC).
WiFi		Wireless networking technology that allows you to connect to the Internet in the vicinity of a required transmitter / access point.
Wireless application protocol (WAP)		Protocol for wireless communication, designed to provide access to Internet services through various wireless communication network solutions. WAP is primarily designed for mobile devices.

Technical terms with the adjective "spatial" are used in many fields and thus have multiple definitions and interpretations. In this document, the term "spatial" is a synonym for "geographic". Similarly, the prefix "geo" in some of the terms which were used herein replaces the adjective "geographic" or "spatial".

In the case of some general terms, we chose those definitions (from all that exist), which are directly associated with the field of infrastructure for spatial information.

Infrastructure for Spatial Information	**Infrastruktura pro prostorové informace**	Set of principles, knowledge, institutional measures, technologies, data and human resources to enable sharing and effective use of spatial information and services.
Interoperability	**Interoperabilita**	A capability of systems to provide services to each other and to work effectively.
Data Set	**Datová sada**	Identifiable data put together.
Guaranteed Data	**Garantovaná data**	Spatial data with the corresponding quality certificate; public authorities conduct transparent decision-making processes with subsequent legal responsibility with respect to this data.
Metadata	**Metadata**	Data which describe the structures and content of spatial data sets, spatial services, and other components of the IS. They enable and simplify their search, sorting and use.
Spatial Data	**Prostorová data**	Data which cannot lack information on the geographic location usually expressed as coordinates and topology.
Spatial Information	**Prostorová informace**	Information obtained by interpreting spatial data and the relationships between them.
Reference Interface	**Referenční rozhraní**	A set of legal, technical, organizational and other measures forming a unified integration environment of public administration information systems (PAIS), which provides a high-quality set of common services including the exchange of information (requested in accordance with law) between the information systems of public administration bodies and other entities, including systems abroad.
Thematic Spatial Data	**Tematická prostorová data**	Spatial data describing / representing a particular type / group of natural or socioeconomic phenomena (e.g. traffic data, demographic data, nature protection data).
Fundamental Spatial Data	**Základní prostorová data**	Spatial data with basic, universally usable content, collected and managed under unified rules. They are created in the public interest and serve as reference data for decision-making processes of the public administration, for example, as a source for the state map series, for other thematic spatial data, etc.
Spatial Reference System	**Prostorový referenční systém**	A set of rules that define unambiguous association of locations to spatial data and to the information from the real world.