Report on National Measures for
Intelligent Transport Systems ("ITS")

planned for the next five-year period by the Slovak Republic for the priority areas identified by the European Commission as set out in Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport

On 15 October 2012, Act No 317/2012, on Intelligent Transport Systems in Road Transport and on an amendment and addition to certain laws by means of which the Slovak Republic transposed Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport (hereinafter referred to as "Directive 2010/40 / EU") entered into force. This Act created the legal framework for the implementation of ITS in Slovakia and the implementation of the National Traffic Information System project (hereinafter referred to as "NTIS") and the establishment of the National Traffic Information Centre ("NTIC").

This Act created the scope for building a comprehensive system environment for collecting, processing, sharing, archiving, accessing and publishing traffic information on the current traffic situation on the roads and on the environment for the administration and operation of applications and systems over this traffic information. The Act regulates the method for making available and publishing traffic information to the general public, providing traffic information to traffic information providers and to natural and legal persons on a contractual basis.

Under the conditions of the Slovak Republic, the Ministry of Transport and Construction of the Slovak Republic ("MTC SR") is the administrator for this issue. In January 2015, MTC SR concluded a contract with a supplier to build the NTIS and NTIC. The project was financed from EU funds and was completed in November 2015, when the system was put into full-time operation. During 2016, traffic information sources were gradually integrated from their providers. Since January 2017, the NTSI has been made available to the public through the portal and a mobile application. The NTIC ensures the provision of guaranteed and verified traffic information to both the general public and to professionals - all steps in data processing that cannot be automated are covered by NTIC staff. The result is the integration of the systems and databases of owners and administrators of roads and of other entities who have relevant traffic information available. Traffic information in the NTIS is located through a single roads reference network ("SRN"). The NTIS provides full coverage of the road network in the Slovak Republic. The system is also ready for any future development of this network in view of the scope and quality of ITS equipment on all road categories. There is also support for the inclusion of basic information on other modes of transport (rail, bus, cycling, aviation, etc.).

The NTIS is an open modular systems environment for the creation, collection, processing, distribution, archiving and post-processing of the traffic information for various modes of transport, namely road, rail and aviation. The designation systems

environment means that this is not one large complex information system but a number of interoperable systems whose mutual compatibility is guaranteed by the use of interfaces according to international standards.

This interconnection of systems provides key core systems such as the NTIC information system, RNM IS localisation services, and Basic Infrastructure Services (CNDN, central organisation and user registers, unified time signal, etc.).

The systems environment thus designed is also open to the future and can have integrated into it other systems involved in traffic information flow processes and are equipped with an interface for insertion into the NTIS systems environment. Implementation in the form of an open environment is essential if we wish to ensure the comprehensive and complete fulfilment of the NTIS's tasks and at the same time ensure its flexibility into the future, i.e. the option for expanding it with functions fulfilling requirements that cannot be known at present.

Building the NTIS has created an open systems environment that will contribute to reducing congestion and high traffic densities on busy roads, as well as an environment that can contribute to reducing traffic accidents and increasing the efficiency of bodies, organisations and institutions in transport administration and maintenance. The NTIS is a source of the necessary traffic-engineering information, which is important for traffic management and traffic modelling.

By operating the NTIS, the following benefits will be generated:

- a reduction in road accidents and the consequences of these accidents on life, health and property,
- an overall increase in road safety,
- a reduction in travel times and an improvement in traffic flow,
- a direct positive influence on the behaviour of road users, heightened responsibility and mutual consideration,
- support for the effective introduction of information technologies, ITS and telematics systems in transport,
- ensuring local, regional, national and European interoperability intraffic information and traffic data, in the exchange of information on the current traffic situation or information on the roads,
- support for intelligent traffic control and traffic flow control through technical, technological and telecommunication systems for efficient traffic management,
- support for ITS for passenger and freight traffic in transport corridors and urban/interurban regions, support for operations management and road planning, and in particular for emergency planning.

The information system created within the project is managed and operated by the project solution provider under the authority of the MTC of the Slovak Republic.

The measures in this report are measures that will be implemented directly by the MTC of the SR or by organisations mandated by the MTC of the Slovak Republic. The activities described in the text are structured according to the individual priority areas identified in Directive 2010/40/EU. The Slovak Republic will carry out the following activities in the area of ITS implementation in line with the above mentioned Directive.

Priority Area I: Optimal use of road, traffic and travel data:

A. Road Infrastructure Data (Central Technical Road Register)

Under Section 3 of Article 3 f) of Act No 135/1961 on Roads (the Roads Act), as amended, the MTC of the Slovak Republic provides the Central Technical Road Register (the Central Register) and it is operated by the Slovak Road Administration ("SRA") through a road database. The Central Register is a body of activities for collecting the data and information needed to perform field data collection, the actual collection of the data, the processing of the measured data, the processing of data which is not measurable in the field, and the provision of data-use related activities. The Central Register currently carried out for motorways, highways, Class I, II and III roads, for which the following basic data sets are recorded and which, in electronic representation, comprise the "Road Network Model" ("RNM"):

- **Data representing the road network** ("RN") / the reference network - points (places of branching from the traffic bands, start and end of the RN, boundaries of the SR territorial units/districts, border of RN ownership and management CK, sections (axes of RN traffic bands), the RN line (derived from the sections), the road route line (derived from the sections). The reference network data is a spatial model, i.e. spatial elements measured by GPS (static and kinetic measurements, real-time differential correction, 1s signal interval, i.e. the measured position is recorded every second).
  These measured data are supplemented by descriptive data (attributes), e.g. the basic attributes of a section include the RN number, the length of the section, the name of the section, the orientation of the section in respect of the RN orientation, the traffic direction, the owner, the administrator of the RN, territorial jurisdiction - district, region.

- **Data of RN components and accessories** that are linearly referenced to sections (that is, their occurrence is measured as the log value - distance from the beginning of the section in metres); these include the full width cross-sectional layout of the RN - lanes, belts, sidewalks paved and unpaved, reinforced part of the road - their occurrence, widths, catchment devices, RN - bus/coach stops, petrol stations, parking spaces, rest areas, technical equipment, etc., traffic signs, road buildings with detailed attribute descriptions.

- **Road characterisation data** that are measured by a diagnostic technique and referenced to the sections in the same way as the components and accessories of the RN. These are the following data: road loading, transverse and longitudinal planarity, longitudinal shear friction and road surface condition.

Pursuant to the Road Act, the Central Register is to be extended by local roads from 1 January 2017. Since 2017 the SRA has performed the production of base data (node sections) of the reference network for publicly accessible local roads. By the end of 2017 data had been created for the regional cities of the SR, by 06/2018 data were created for local roads for the Bratislava, Trnava regions and part of the Nitra region. The basic data of the local road reference network will then be made available to the administrators of these local roads in order to verify them and add the descriptive data. Subsequently, the administrators will record in a unified manner the basic data of the local road components

and accessories.

This will ensure consistency in the creation of reference network data, the creation and management of which will remain within the competence of the SRA. The recording of other data, secured by RNM IS resources used by local road administrators, will guarantee the uniformity of registration and the referencing of data to the local road reference network.

Data collection is performed:

- on new sections of the RN: this information is sent to the road databank in the form of an building approval decision, a decision on premature use of a building, as sent by the RN administrators or investors, or decisions of the MTC of the Slovak Republic on any change to the road network configuration. This process is carried out pursuant to TP 15/2013 Organization of the Road Network,

- on local road sections: against the backgrounds of digital orthophotomaps in comparison with other available backgrounds (cadaster, GIS data, etc.), i.e. they are 2D vectors,

- on existing RN sections, in the event of any change to any of the data being monitored,

- measurement of RN variable technical parameters - diagnostic road measurements are carried out at the road network level - these are carried out on an annual basis, depending on the capacity of the particular diagnostic equipment; measurement for a project level is dependent on the requirements coming from the road management system.

The Central Register records include other "additional" data and materials, e.g. situational sketches of measurement crossroads (important data source for editing attribute data in the office), photos of nodal points, scanned documents (documentation of bridges, decisions on changes in road network layout, building approval decisions, etc.).

The Central Register data also includes processed data resulting of the geoprocessing of basic data. These include spreadsheets, statistical reports, map documents intended primarily for data use by a wide range of users.

The quality of data can be seen at two levels:

- One level is the extent, representation and accuracy of the recorded data, it can be stated that these aspects are at an adequate level, the scope of the data is fully sufficient for the needs of the department (when the need arises for recording of new data types the RNM is updated flexibly, the accuracy of the recorded data is dependent on the collection technology (the GPS technology used provides sub-meter positioning accuracy, the data height accuracy is approx. 2 m, subject of course to sufficient GPS coverage. Linear referencing technology is performed by standard distance tracers that are regularly calibrated and measured with a +/- 0.05% linear accuracy.

- The second level is the topicality of the data represented in the RNM due to realities in the field. This is dependent on the nature of the data in question and on the responsibilities of the administrators of the RN and, in the future, of the local roads. In this area, current traffic information is not satisfactorily secured. We propose to address the process through a new Roads Act, where this obligation is directly embodied

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in a road administrative authority that approves the designation of traffic signs.

The implementation of the Central Register is to a large extent supported by modern information technologies - under the SRA conditions, a Road Network Model Information System ("RNM IS") is in operation which provides comprehensive functionality not only for the Central Register but also for the system processes for designing and assessing routes for overweight and over-sized loads and for road and bridge management systems, RN capacity calculation system. The RNM IS uses ESRI/ArcGIS technology in a desktop and server architecture custom fitted with advanced tools for managing and using Central Register records. The solution architecture is client/server; the MS SQL relational database system is used in ESRI functionality of ArcSDE, a personnel geodatabase.

The data and information related to the road network inseparably include data processed and distributed within the central dispatching and reporting activities provided within the central dispatching service of the transport reporting service. Its agenda consists of receiving and processing traffic information related to the RN's negotiability and capacity and is based on the use of data, information and thus cooperation between the relevant road administration bodies and information on closures obtained from the relevant road authorities.

The SRA, on the basis of an authorisation from the MTC of the SR also provides for the creation, updating, certification, and distribution of localisation codes for TMC tables (localisation tables). These are intended for use in the transmission of traffic information via RDS/TMC.

Use of road infrastructure data

The use of road infrastructure data is ensured through the provision of services from the road databank which provides for the use of all data and information generated in the Central Register and transport route application system; services are provided at a high level.

For the purposes of accessing and publishing data, the RNM IS has a developed and operating so-called publishing database that combines data from multiple sources, is supplemented with derived data and is in a form suitable for data usage.

The RNM IS includes a wide range of tools for standard data processing and supports the creation of a comprehensive agenda for data reporting in the form of tabular outputs, statistical reports, and map documents. Those that are created on a regular basis (typically once a year, with up-to-date data for the calendar year in question) are available to the general public through the Road Traffic Databank portal (www.cdb.sk).

In addition to static documents, online data (accessing the current state of data stored in the publishing database) is available on the RNM IS web portal through the CDB Maps web browser (https://ismcs.cdb.sk/portal/mapviewer) which allows you to view data, create notes, print maps, and download data in spreadsheet formats. For RN administrators, a feature is available that allows authorised, efficient commentary on the state of the Central Registry data. Through effective co-operation with road administrations a web application (as part of the RNM IS) is operated using data from the Central Registry database for the assessment and design of routes from 40 t to 60 t used by transport companies to determine the appropriate route within the process of granting a special road use permit.

The RNM IS technology using ESRI ArcGIS SW enables data to be made available within the Open Geospatial Consortium (OGC) standards, e.g. Web Map Service (WMS), Web Feature Service (WFS).

Access to Central Registry data secured through WFS, WMS is performed through a licence manager, i.e. software that can be used to manage licences and control user access to those services under the SRA licencing policy.

State and public administration, local authority bodies and bodies set up and managed by them, who are interested in using Central Registry data to perform their work, receive this from the SRA free of charge, on the basis of a licencing agreement which defines the specific ways the data is to be used and protects copyright.

Central Registry records are used by many users, whether within a road transport sector (Central Register data are also provided to the NTIS) and other government departments, self-government entities, municipalities, owners and administrators of the RN, private (especially project) companies, research institutes, science, research and problem-solving organisations as part of education, international projects and tasks.

The road databank provides all users with advisory services on the use of data. Every year the SRA organises workshops for RN administrator organisations to help ensure effective co-operation, transfer of experience, requirements and potential problem mapping.

In order to make the data of the Central Register data available, accessible metadata are available within the RNM IS, containing a detailed description of all data that is part of the Central Register (http://www.cdb.sk/en/metadata.alej).

In order to ensure the development and operation of services, harmonisation and accessibility of spatial data on the road network within the European Union under Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) as amended and Act No 3/2010. on the national infrastructure for spatial information, the SRA has harmonised the data of the road transport network and has established an appropriate service structure for access and use of data. This is available through the RNM IS/INSPIRE Portal (https://inspire.cdb.sk/geoportal).

B. Collection technology for data collection for the Central road Register

In 2017, the delivery was arranged of a new mapping technology, so-called mobile mapping based on spatial scanning of roads and their surroundings. The goal is to achieve more efficient, but in particular safer, data collection and to move data evaluation into an office environment. During 2018, staff training is being carried out to operate this technology and for its pilot operation. In the future, it will be necessary to ensure the implementation of the data obtained in the Central Technical Records Roads Database.

C. RNM IS - securing SRN and localisation services

The exact location of traffic information is an essential prerequisite for its usefulness, i.e. identification of that part of the road network to which the information relates. Without localisation, traffic information is of no value, with the prerequisite for this localisation being that of being "understood" by all interested parties, that is to say, localisation is

interpreted by all in the same way.

Pursuant to Section 3(3)(j) of the Roads Act the main localisation methodology is implemented into the RNM IS, enabling the RN Central Technical Data to release out an SRN localisation database, to provide to the traffic information service data services for work with localisation information and to provide users with a universal interactive component for the creation and editing of localisation information.

In addition to the primary static localisation methodology, the localisation service has also created a dynamic localization methodology that searches buildings within SRN.

The basic localisation static method is linear localisation in respect of SRN; the basic dynamic method is <u>TPEG ILOC</u>.

Continuous operation and availability are ensured for SRN localisation.

Together with localisation interface services SRN is provided to NTIS.

D. Traffic Intelligence Information System (hereinafter "TIIS").

In 2003, the Slovak Republic set up a unified system for the creation, processing and distribution of information on the state of traffic flow: RN - IS ZSS, which was upgraded to TIIS in 2010-2013. This involves organisations of administrators of all RNs (motorways, high-speed roads, I., II and III class roads) in the Slovak Republic, as well as local roads in Bratislava and Košice, who report under the established rules on weather condition and traffic flow on roads under their management and the occurrence of any extraordinary situations on them. The Central Office, the so-called central dispatching, is operated by the SRA. The system operates continuously during the winter period, usually from 1 November of the calendar year concerned until 31 March of the following calendar year; for the remainder of the year it operates to the normal working hours of the individual organisations (so-called summer regime).

In addition to weather and traffic flow monitoring, the TIIS also provides for the recording and processing of all kinds of in-situ traffic information and traffic data. In situ traffic information includes the recording of situations that affect the safety or flow of road traffic, where for each situation a classification can be made of the event or events leading to the situation, the measures taken by the authorities, the consequences of the event and the measures as well as recommendations and instructions for drivers. Events are for example accidents, road works, infrastructure damage, public events, failures of RTS (road traffic signalling), road crossings and other technical facilities, oversized loads, etc. Measures taken are closures, changes to widths, changes to traffic signs (including limitation on the maximum allowable speed), diversions, etc. Consequences are in particular the various degrees of abnormal traffic flow (queues, slow traffic, dense traffic), blocked lanes, blocked sections and restrictions.

The TIIS is equipped with a data interface in line with the European CEN/TS 16157-1 to -3 (DATEX II) standard, through which it is possible to receive and distribute traffic information from/to other information systems. It is also equipped with an RDS-TMC subsystem to distribute traffic information to compatible end-user TMC receivers, in particular to navigation devices. RDS-TMC broadcasting has been in routine operation since 1 June 2015 with nationwide coverage of the Slovak Republic.

With TIIS operation are used data and data services of the Central Road technical records, supplemented by data on significant local roads for regional and district cities (operated by the SRA, the roads databank department), information on road closures sent to the SRA sent by the road administrations. Cooperation with the National Motorways Company ("NMC") covers receipt of traffic information from the NMC traffic information system to the SRA TIIS at the data interface level.

Data on long-term restrictions on Class I routes are provided by the TIIS to the NTIS.

E. NTIS

Construction of the NTIS in the Slovak Republic will secure a continuous technical evaluation of the existing road infrastructure, in particular motorways, high-speed roads and Class I roads.

The solution implements collection and publishing of traffic information and the traffic situation.

The collection of traffic information refers to the area oflogic modules that are directly involved in the collection of traffic information. The following modules are the basis for the collection of traffic information:
- NTIC Žilina (Call Centre),
- mobile application,
- public portal,
- contributor portal,
- SRA integration,
- NTS integration,
- Granvia integration,
- RTVS integration
- Telekom integration

The modules are connected to the Enterprise Service Bus (ESB). In appropriate cases, the NTIS will be able to connect to an external system.

In building the NTIS, the Slovak MTC has tried to take into account the trends in ITS and the generation of traffic information. For data collection traffic event data from roads administrators, the police, fleet GPS monitoring, anonymised mobile carrier (SIM card) data, and traffic events entered by telephone through a portal or mobile application are used. These data are used primarily to obtain traffic flow data and to provide information on the immediate situation and on route delays. In the future, it will also be possible to include data obtained under the eCall system, or from other sources of organisations/businesses working with the data (transport services, Green Wave roadside assistance, etc.). Historical data can be used to plan the expansion of transport and evaluate measures taken.

The publication of traffic information refers to the area oflogic modules that are directly involved in the collection of traffic information.
Information is published:
- system users and the public (portals, mobile application, call centre),
- an external system (DATEX2-supporting systems) using an information
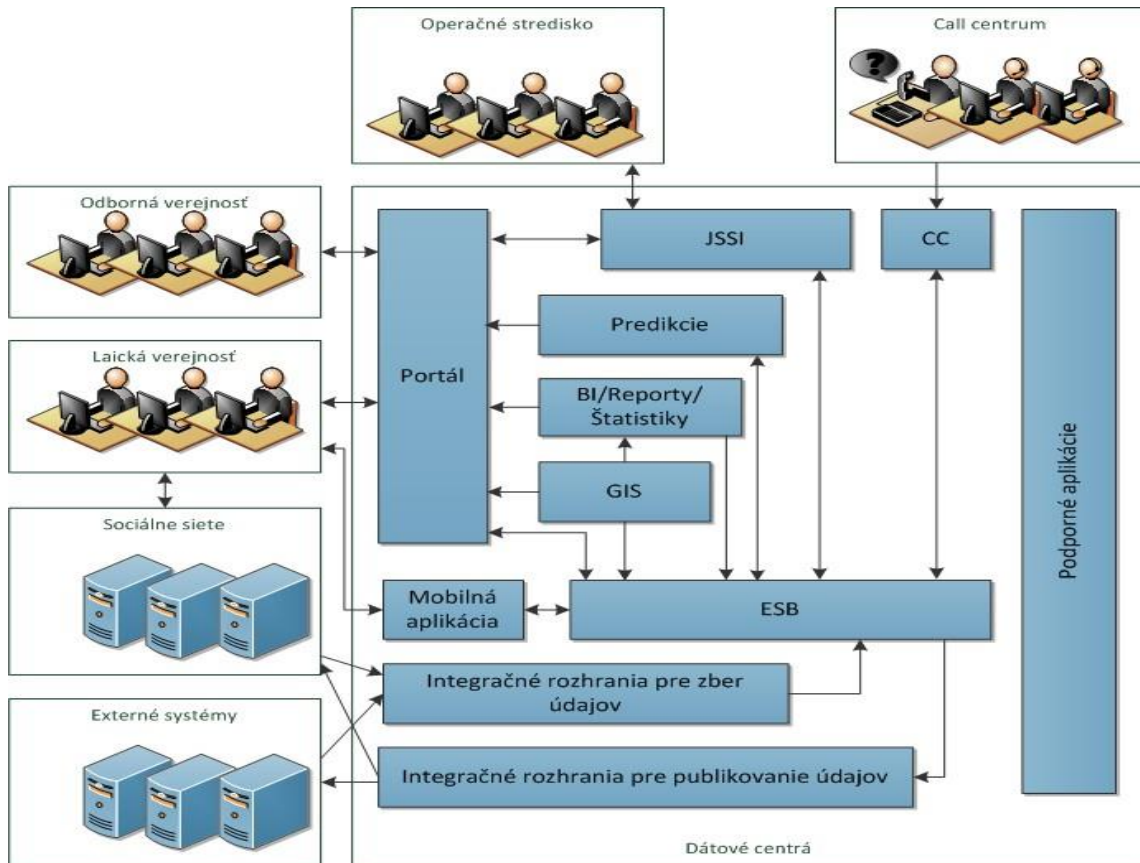
publication integration interface.

Fig.: NTIS Application architecture.

Key:

Operačné stredisko	Operations Centre
Call Centrum	Call Centre
Odborná verejnosť	Professional/expert public
Laická verejnosť	General public
Sociálne siete	Social networks
Externé systémy	External systems
Portál	Portal
Mobilná aplikácia	Mobile application
Integračné rozhrania pre zber údajov	Data collection integration interface
Integračné rozhrania pre publikovanie údajov	Data collection publication interface
Predikcie	Forecasts
BI/Reporty/Štatistiky	Business Information/Reports/Statistics
GIS	GIS
ESB	Enterprise Service Bus
JSSI	
Podporné aplikácie	Support applications

The NTIC is the central technical, technological, operational and organisational workplace of the NTIS. This is an operating centre that secures the processing, evaluation, verification and authorisation of traffic information and traffic data 24 hours a day, 7 days a week.

The National Transport Information Centre:

- monitors the quality and accuracy of the traffic information and transport data provided, the transfer of information from authorities, organisations and institutions, and in the case of failure to comply with obligations or methodological procedures, resolves the problem,
- is responsible for the consolidation of information in the event that the same or similar traffic information arrives at the system for the same event within the same time interval from the same point of the road network,
- monitors the life cycle of the development of events until their termination and full restoration of traffic, supplements unauthorised or incomplete information with attributes from other sources and performs verification of them,
- provides traffic information and traffic data to all subscribers, ensures the operation of systems for the publication and distribution of traffic information and traffic data, operates other applications and NTIS systems, addresses any technical and technological problems,
- manages and maintains an archive of historical traffic data and information.

The NTIS also includes a portal solution for collecting and publishing traffic information. This is a classic WEB portal solution that uses a thin client - a standard web browser - on the client side, so there is no need to install additional software on client stations. The solution supports multilingual content and switching between different language versions. The portal solution publishes information through a publishing system that is part of a unified data processing system.

The portal solution is multichannel - it allows for the provision of traffic information in various categories and levels of detail for different target groups. These are the distribution channels:

- a portal for road managers and solution contributors,
- a portal for the professional/expert public,
- a portal for the general public.

The portal solution includes route planner functionality that takes into account the current traffic situation and restrictions, or more exactly, the anticipated traffic situation and planned traffic constraints.
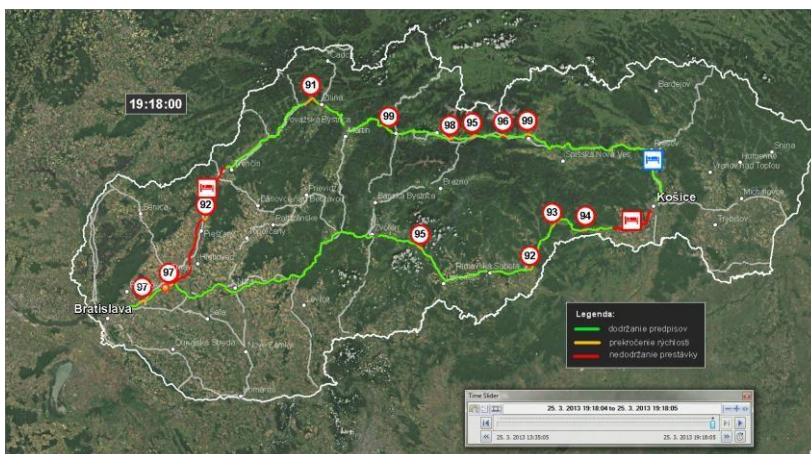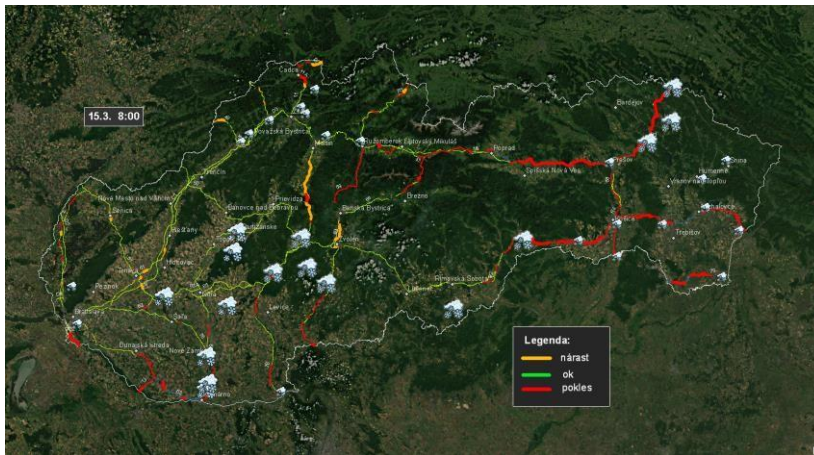
Fig.: Demonstration of possible traffic and meteorological depiction in Slovakia.

Priority Area II: Continuity of traffic and freight management ITS services

Telematic systems on motorways and expressways and ITS in regional and larger cities of the Slovak Republic

In order to alleviate traffic problems in the regional and bigger towns burdened by transit freight transport, it is necessary to implement a partial transport solution in the form of:

- removing road infrastructure collision points using intelligent transport system elements,

- design solutions giving preference to public passenger transport (reserved lanes, preference at crossroads, etc.)

- technical solutions to promote traffic flow and transport safety (monitoring systems, intelligent crossroad systems, variable traffic signs, etc.).

During the process of preparation of this programme, a basic analysis of traffic processes (accident rate, frequent interruptions of traffic flow, environmental damage, traffic intensity) was carried out in the individual regional and some other larger cities. Based on this analysis, selected cities (Prešov, Košice, Poprad, Banská Bystrica, Zvolen, Žilina, Trenčín, Prievidza, Ružomberok, Martin, Nitra and Trnava) were chosen where growing traffic problems will have to be resolved by implementing ITS. The actual solution will be based on an elaborated project- and investor-based preparation of specific measures, in particular in the form of building technology and city traffic management centres. Traffic information from these systems will be integrated into the NTIC. However, this originally planned list of cities will need to be reassessed having regard to planned and implemented road infrastructure construction in the near future. However, this issue is planned as a follow-up to the establishment of the initial phase of the NTIS for the ensuing period.

Priority Area III: ITS road safety and security applications

Exact localisation of traffic accidents, recovery of accident sites

In order to eliminate traffic accidents and rehabilitate accident sites, it is necessary to evaluate accident-prone areas based on a long-term determination of the exact sites of accidents.

A special NTIC module provides the following reports to the public:
- Traffic density - the number of vehicles in selected sections of a linear section at a given time, their average speed and deviation from the standard capacity of the section,
- Accident-prone areas - the number of accidents in selected sections of a linear section at a given time, by type, cause and severity and the type of source reporting the accident,
- Accidents - executive summary of the number of accidents in individual geographical locations over a given period, by severity,
- Section capacity - the number of accidents at a given time and place by cause and severity and the type of source reporting the accident,
- Cause and Impact - list of published traffic events on selected road sections or locations, by type of traffic situation for the selected period, with classification of the cause of the traffic event and its impact on road traffic flow.

The definition of measures to increase the safety of road users includes the National Road Safety Plan for 2011-2020, approved by the Government of the Slovak Republic in Resolution No 798 dated 14 December 2011. The National Road Safety Plan for 2011-2020 includes a framework objectives and associated measures related to the specifications of Directive 2010/40/EU.

After the implementation of the initial NTIS project, it will be possible to provide information on traffic events to the police and to link the Mobile Police project currently being implemented under the auspices of the Slovak Ministry of Interior with the NTIC systems.
However, this will only be possible based on outputs from both projects in the next period as development activities.

The main objective of the Mobile Police project is:

- to optimise and reduce the administrative burden on police officers, which means more time spent on their duties,
- automation of information processing processes in the police,
- building effective anti-corruption and control tools,
- provision of electronic police services to citizens,
- supporting operational police force management,
- support for the analytical and statistical processes of the police,
- optimising the work of police officers in gathering and using data and information.

Priority Area IV: Linking the vehicle with the transport infrastructure

In NTIS the following information provided by NTS is currently being used or will be utilized within the agreed range of other sources:

- information from traffic counters,
- information from weather stations (not yet integrated into NTIS, in planning),
- reports of diversions, works and restrictions on motorways, tunnels and high-speed roads provided by the Central Operator's Office,

- camera output from rest areas,
- outputs of some information cameras at the SSAS and SSAD centres.

This information is provided on the basis of the Agreement on the Integration Plan between Slovak MTC and the NTS, operational data part no. ZM/2016/0013 dated 8 January 2016 and the Data Cooperation and Data Protection Agreement for NTIS Project No 65/D140/2016 dated 8 February 2016, concluded between the Slovak MTC and the NTS.

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