

Progress report on national actions in the field of Intelligent Transport Systems (hereinafter referred to as the “ITS”) referred to 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

Following the initial report, Member States shall report every three years on the progress made in implementing the measures referred to in paragraph 1 of Directive 2010/40/EU of the European Parliament and of the Council on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport.

With the entry into force of Act No. 317/2012 Coll. on Intelligent Transport Systems in Road Transport and on Amendments to Certain Acts by which the Slovak Republic has transposed the above-mentioned Directive on 15 October 2012. This Act created a legal framework for the deployment of the ITS in Slovakia and for the implementation of the National Traffic Information System (hereinafter referred to as the “NTIS“) project and for the establishment of the National Traffic Information Centre (hereinafter referred to as the “NTIC“).

The said Act has created a space for building a comprehensive system environment for the collection, processing, sharing, archiving, making available, and publishing of traffic information on the current traffic situation on roads and on the environment for managing and operating applications and systems over this traffic information. The Act regulates the method of making available and publishing traffic information to the general public, the provision of traffic information to traffic information providers and natural and legal persons on the basis of a contractual relationship.

In January 2015, the Ministry of Transport and Construction of the Slovak Republic (hereinafter referred to as the “MTC SR”) concluded a contract with a supplier for the construction of the NTIS and NTIC. The project was funded by the EU and was completed in November 2015, when the system was put into operation. During 2016, the gradual connection of traffic information sources from their providers took place. Since January 2017, the NTIS has been made available to the public via the portal and mobile application. The NTIC ensures the provision of guaranteed and verified traffic information for both the general public and the professional public - all steps in data processing that cannot be automated are provided by the NTIC staff. The result is the integration of systems and databases of road owners and administrators and other entities that have relevant traffic information at disposal. The traffic information in the NTIS is located through a single road reference network (hereinafter referred to as the “SRN”). The NTIS covers the road network of the Slovak Republic in its entirety. The system is also prepared for the future development of this network with regard to the scope and quality of ITS equipment in all categories of roads. The integration of cycle paths and rail timetables into the NTIS was also supported to ensure the multimodality of the system, as one of the objectives of the NTIS.

The construction of the NTIS has created an open system environment that contributes to reducing congestion and high traffic on congested roads, as well as an environment that contributes to reducing traffic accidents and increasing the efficiency of authorities,

organizations and institutions activities in the field of road administration and maintenance. The NTIS is a source of necessary traffic engineering information, which is important in traffic management and in the creation of traffic models.

The NTIS operation ensures the generation of the following benefits in particular:

- reduction of traffic accidents and consequences of accidents on lives, health and property,
- increasing the overall safety of roads,
- shortening travel times and increasing traffic flow,
- direct positive influence on the behaviour of road users, motivation for their own responsibility and mutual consideration,
- support for the effective deployment of information technology, ITS and telematic systems in the field of transport,
- ensuring local, regional, national and European interoperability in the field of traffic information and traffic data, in the field of exchange of information on the current traffic situation or information on roads,
- support for intelligent road traffic management and control through technical, technological, and telecommunication systems for efficient traffic management,
- support for the provision of the ITS services for passenger and freight transport in transport corridors and urban/interurban regions, support for traffic management and travel planning and in particular for emergency planning.

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

A. Road infrastructure data (Central Technical Register of Roads)

Pursuant to § 3 para. 3 letter f) of Act No. 135/1961 Coll. on Roads (Road Act), as amended, the Central Technical Register of Roads (hereinafter referred to as the “Central Register”) is provided by the MTC SR and operated by the Slovak Road Administration (Slovenská správa ciest) (hereinafter referred to as the “SSC”) through the department of the road databank. The Central Register represents a summary of activities of obtaining the data and information necessary for the performance of data collection in the field, the performance of the data collection itself, processing of measured data, processing of non-measurable data in the field and providing activities related to data use. The Central Register is currently performed in the range of motorways, Class I, II, III roads and publicly accessible motorized local roads, for which the following basic groups of data are registered, which in the electronic representation form the “Road Network Model“ (hereinafter referred to as “RNM“):

- **Data representing the road network** / reference network - points (points of branching of lane axes, beginnings and ends of roads, borders of territorial administrative units of the Slovak Republic / districts, borders of ownership and administration of roads), sections (lane axes of roads), road lines (derived from sections), road route lines (derived from sections). The reference network data represent the spatial model, i.e. they are spatial elements measured by the GPS technology (static and kinetic measurements, differential corrections in real time, 1s signal interval, i.e. the measuring position is recorded every second). Descriptive

data (attributes) are added to the data measured in this way, e.g. the basic attributes of the section include the road number, the section length, the section name, the section orientation in relation to the road orientation, the traffic direction, the owner, the administrator of the road, the territorial affiliation - district, region.

- **Data representing local road networks** / basic data of the reference network - points (points of branching of lane axes, beginnings and ends of local roads, borders of territorial administrative units of the Slovak Republic / districts, borders of ownership and administration of local roads), sections (local roads lane axes). These are data in the working stage that have not been verified by the local roads administrators. As of 30 June 2020, these data cover all regional and district cities of the Slovak Republic and 90% of municipalities with the city status. Data are obtained by editing over digital orthophotomaps of the Slovak Republic.
- **Data of components and accessories of roads**, which are linearly referenced to sections (i.e. their occurrence is measured as the number of kilometres - distance from the beginning of the section in metres); these data include the complete width arrangement of the cross section of the road - lanes, zones, road verges paved and unpaved, paved part of the road - their occurrence, widths, restraint safety devices, road equipment are recorded - SAD (Slovak bus transport) stops, petrol stations, parking lots, rest areas, technological equipment, etc., traffic signs, road objects with a detailed attribute description.
- **Data characterizing the road**, which are measured by diagnostic technology and are referenced to sections in the identical way as the data of parts and accessories of roads. These data include: road load capacity, transverse and longitudinal unevenness, longitudinal shear friction and condition of the road surface.

Pursuant to the Road Act, the Central Register is extended to also include local roads from 1 January 2017. Since 2017, the SSC has been creating basic data (nodes, sections) of the reference network for publicly accessible motoring local roads. The state of registration of these data is within the meaning of the above. The basic data of the local roads reference network are subsequently made available to the administrators of these local roads for the purpose of their verification and supplementation of descriptive data. Likewise, the basic data of the components and accessories of local roads are registered in a uniform manner by the administrators.

In this way, uniformity in the creation of reference network data is ensured, the creation and administration of which will remain within the competence of the SSC. Record-keeping of other data provided by the IS RNM resources used by local roads administrators will guarantee the uniformity of records and referencing of data to the local roads reference network.

Data collection is performed:

- on new sections of roads: this information is sent to the department of the road databank in the form of the approval decision, the decision on early use of the building, which are sent by departments of administrators or investors of roads, or in the form of decisions of the MTC SR on change of the road network arrangement. This process is performed in accordance with the technical specifications TP 15/2013 Road network arrangement,

- on sections of local roads: over the data of digital orthophotomaps in confrontation with other available data (cadastre, data of ZB GIS, etc.), i.e. these are vectors in 2D,
- on existing sections of roads in case of change in any monitored data,
- measurements of variable technical parameters of roads - diagnostic measurements of roads are performed at the level of the road network - these are carried out regularly every year to the extent dependent on the capacity of a specific diagnostic device; the measurements for the level of projects depend on the requirements coming from the road management system.

The data of the Central Register also include other “supplementary” data or materials, e.g. situational sketches of intersection situations during measurement (an important source of data when editing attribute data in the office), photographs of nodal points, scanned documents (documentation of bridges, decisions on changes in the road network arrangement, approval decisions, etc.).

The data of the Central Register also include processed data, which are the result of geoprogressive processing of basic data. These include spreadsheets, statistical reports, map documents designed primarily for the use of data for a wide range of users.

Data quality can be perceived at two levels:

- One level is the range, representation, and accuracy of the recorded data; here it can be stated that these aspects are at a sufficient level, the range of data is fully sufficient for the needs of the sector (when the need arises to record new types of data, the RNM is flexibly adjusted, accuracy of recorded data depends on the collection technology (the used GPS technology provides sub-meter positional accuracy, the altitude accuracy of spatial data is about 2 m, of course, with sufficient GPS signal coverage. The linear referencing technology is performed by standard gauges of covered distance, which are regularly calibrated and measured with a length accuracy of +/- 0.05%).
- The second level is the timeliness of the data represented in the RNM with respect to the reality in the field. This depends on the character of the relevant data and on the responsibility of the administrators of roads, and in the future also of the local roads. Up-to-date traffic sign information is not being satisfactorily provided in this area. We propose to solve the process through a new road act, where this obligation is enshrined directly for the road administrative authorities, which approve the determination of traffic signs.

The implementation of the Central Register is largely supported by modern information technologies - under the conditions of the SSC, the Information System of Road Network Model (hereinafter referred to as the “IS RNM”) is operated, which provides comprehensive functionality not only for the Central Register, but also for the system processes for designing and assessing routes for transporting excessive and oversized loads and management systems for roads and bridges, system for calculating capacities of roads. The IS RNM uses ESRI/ArcGIS technology in desktop and server architecture, supplemented by tailor-made tools for managing and using data from the Central Register. The architecture of the solution is a client/server, the relational database system MS SQL in ESRI functionality

ArcSDE is used, the data format is mostly a geodatabase (gdb).

Data and information related to the road network also inseparably include data processed and distributed within the central dispatching and intelligence activities provided within the department of the central dispatching of the traffic intelligence service. Its agenda consists in the receipt and processing of traffic information related to the traffic capacity and passability of roads and is based on the use of data, information, and thus the cooperation of organizations of road administrators and information on closures obtained from the relevant road administrative authorities.

Based on the authorization of the MTC SR, the SSC also ensures the creation, updating, certification and distribution of localization codes of the TMC spreadsheets (localization tables). These are intended for use in the transmission of traffic information via the RDS/TMC.

Use of road infrastructure data

The use of road infrastructure data is ensured through the provision of road databank services, when this road databank ensures the use of all data and information created within the Central Register and application systems of transport routes; services are provided at a high level.

For the purposes of making available and publishing data, the so-called publication database is built and operated within the IS RNM, which combines data from several sources, is supplemented by derived data and represents a form suitable for the use of data.

The IS RNM contains a wide range of functionality of tools ensuring standard processing of recorded data and supports the creation of an extensive agenda for reporting data in the form of spreadsheet outputs, statistical reports and map documents. Those that are created periodically (usually once a year, with up-to-date data for the relevant calendar year) are available to the general public through the Internet services of the road databank portal (www.cdb.sk).

In addition to static documents, on-line data are available on the IS RNM web portal (making available of the current status of data stored in the publication database) via the CDB Maps web browser, (<https://ismcs.cdb.sk/portal/mapviewer>), which allows viewing data, creating notes, printing maps and downloading data in spreadsheet formats. Functionality is available for road administrators, which enables authorized effective commenting on the status of the Central Register data. Effective cooperation with road administrative authorities is the operation of a web application (as part of the IS RNM) using the data of the Central Register database for assessment and design of routes from 40 t to 60 t, which is used by transport companies to determine the appropriate transport route in the process of granting permits for special use of roads.

The IS RNM technology using ESRI ArcGIS software enables making data available within the OGC (Open Geospatial Consortium) standards such as e.g. WMS (Web Map Service), WFS (Web Feature Service).

Making the Central Register data available via WFS, WMS is provided through a license manager, i.e. software that can manage (in terms of licenses) and control user access to those services under the SSC's licensing policy.

The SSCs provide them to The entities of state and public administration, self-government and entities established or founded by them that are interested in using the Central Register data in performing their working tasks are provided with these services by SSC free of charge, on the basis of a license agreement, which defines specific ways of using data and protects the authorship of data.

The data of the Central Register are used by many users, either within the sector of road management (the data of the Central Register are provided, inter alia, to the NTIS) or the other sectors of state administration, by entities representing self-government, municipalities, road owners and administrators, private companies (especially project ones), research institutes, entities for science, research and problem solving within the education system, international projects and tasks.

The road database department provides all users with advisory services focused on the use of data. In order to ensure effective cooperation, sharing of experience, mapping of needs and possible problems, the SSC organizes workshops every year for representatives of road administrator organizations.

To make the content of the Central Register data available, metadata containing a detailed description of all data that are part of the Central Register are available within the IS RNM (<http://www.cdb.sk/sk/metadata.alej>).

In order to ensure the development and operation of services, harmonization and making available of spatial data of the road transport 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 Coll. on the National Infrastructure for Spatial Information, the SSC has harmonized the data of the road transport network and set up the relevant infrastructure of data making available and using services. This is available through the IS RNM/INSPIRE Portal (<https://inspire.cdb.sk/geportal>).

Since 2019, the Slovak Road Administration has been publishing datasets of the Central Register via the open data portal (<https://data.gov.sk>).

B. Collection technologies for the field of data collection for the Central Register of Roads

In 2017, the delivery of a new mapping technology, the so-called mobile mapping, was ensured, based on spatial scanning of the road and its surroundings. The aim is to achieve more efficient, but mainly safer data collection and transfer of their evaluation to the office environment. During the years 2019–2020, a methodology for spatial evaluation of measured data and a data model for data vectorization is being developed. In future, it will be necessary to ensure the implementation of the obtained data into the database of the Central Technical Register of Roads.

C. IS RNM - providing the SRN and location services

A necessary prerequisite for the usefulness of traffic information is its exact location, i.e. identification of the part of the road network to which the information relates. Without location, traffic information is worthless, and it is a necessary precondition that this location is “understood” by all parties interested, i.e. to interpret the localization in the same way. In addition to the primary static localization methodology, a dynamic localization methodology was also created within the localization service, which is used to search for objects in the SRN. The basic localization static method is linear localization to the SRN and the basic dynamic method is TPEG ILOC. Continuous operation and availability is ensured for the SRN localization interface. The SRN, together with localization interface services, is provided to the NTIS.

D. Information system of the Transport Intelligence Service (hereinafter referred to as the “IS TIS”).

In addition to the monitoring of weather and road passability, the IS TIS also ensures the registration and processing of all types of situational traffic information and traffic data. Situational traffic information includes a record of situations that affect the safety or flow of road traffic, and for each situation it is possible to classify in detail an event or events which caused the situation, the measures taken by the authorities and bodies, the consequences of the event and measures, as well as the recommendations and instructions for drivers. Such events are, for example, accidents, roadworks, damage to infrastructure, public events, failures of RTS (road traffic signals), crossings and other technical facilities, oversized transports, etc. The measures taken are closures, width arrangement changes, changes in traffic signs (including speed limits), detours, etc. The consequences are mainly different degrees of abnormal traffic (tailback, slow traffic, heavy traffic), blocked lanes or zones, impassable sections and delays.

Within the operation of the IS TIS, the data and data services of the Central Technical Register of Roads are used, supplemented by data of transport-significant LRs of regional and district cities (operated by the SSC, Road Databank Department), information on road closures, which are sent to the SSC by road administrative authorities. Cooperation with Národná diaľničná spoločnosť a.s. (National Motorway Company) (hereinafter referred to as “NDS”) represents the reception of traffic information from the information system of the NDS traffic service to the IS TIS SSC at the level of the data interface. In the years 2019–2020, an update of the IS TIS is being carried out, within which a technological update took place, a redesign of the public portal zjazdnost.sk was implemented and a responsive design was also implemented, enabling data viewing also on mobile devices. Data on long-term restrictions on Class I roads are provided from the IS TIS to the NTIS.

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

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

The traffic information system installed on motorways and expressways, in the operation of which the NDS participates, has the following elements:

- Communication and transmission system
- Operator departments
- CCTV (camera system)
- Variable traffic signs
- Dynamic and static measurement of axle pressures
- Vehicle speed measurement
- Vehicle maintenance monitoring system
- Traffic counters
- Weather equipment
- Tunnel control systems
- Pumping station control systems
- Emergency telephone systems

The ITS consists of a data backbone infrastructure as well as a power supply network, to which individual technological devices (cameras, traffic counters, weather stations, variable traffic signs) are connected via technological nodes.

The Information and Management System of Motorways is currently developing several actions related to the modernization of transport information systems (hereinafter referred to as the “TIS”).

- Modernization and completion of TIS in the section of motorways D1, D2
- Equipment of rest areas with a camera monitoring system (at the rest areas of Jarovce, Zlaté Piesky, Červeník, Hrádok)
- Equipping of the motorway with a pre-selection high-speed weighing system in front of the rest areas of Sekule, Jarovce, Hrádok, Petrovany
- Modernization of the TIS in the city of Bratislava

In accordance with EU rules, the Slovak Republic, through the MTC SR, ensured the creation of the transport model of Slovakia, which by integrating individual types of transport enables a more comprehensive creation of traffic forecasts for individual periods in cooperation with the NTIS. Improving road safety is one of the strategic goals of the NTIS. Optimizing the existing infrastructure by using the possibilities provided by intelligent transport systems can thus increase the capacity, safety and flow of traffic on existing roads.

The vision remains to have user-friendly motorways, expressways and Class I, II, III roads to ensure ecologically and economically efficient operation of roads.

In order to alleviate traffic problems in regional and larger cities burdened with transit freight transport, it is still necessary to implement a partial transport solution in the form of:

- Elimination of road infrastructure collision points using elements of intelligent transport systems
- Preference for public passenger transport (reserved lanes, preference at intersections, etc.)

- Technical solutions to support traffic flow and safety (monitoring systems, intelligent intersection systems, variable traffic signs, etc.).

Priority Area III: ITS applications in the field of road safety and security

Precise location of traffic accidents, rehabilitation of accident sites

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

The special NTIC module provides the following reports to the public:

- Traffic density - the number of vehicles on selected sections of the linear display at a given time, their average speed and deviation from the standard passability of the section,
- Accident sections - the number of accidents on selected sections of the linear display at a given time, according to their type, cause and severity and the type of source that reported the accident,
- Accidents - managerial overview of the number of accidents in individual geographical locations for a given period, according to their severity,
- Passability of sections - the number of accidents at a given time and geographical affiliation, according to their cause, severity and the type of source that reported the accident,
- Cause and impact - a list of published traffic incidents on selected road sections or localities, according to the type of traffic situation for the selected period with a classification of the cause of the traffic incident and its impacts on road traffic.

Priority Area IV: Connection of vehicles with transport infrastructure

In the NTIS, the following information provided by the NDS is currently used or will be used to the extent agreed within other sources:

- information from traffic counters,
- information from weather stations (not yet integrated into the NTIS, planned),
- reports of traffic closures, works and restrictions on motorway sections, tunnels and expressways provided by the Central Operator's Office,
- camera outputs from rest areas,
- outputs of some information cameras at administration and maintenance centres for motorways (SSÚD) and expressways (SSÚR).

The above information is provided on the basis of the Agreement on Integration Plan between the MTC SR and the NDS, part of operational data No. ZM/2016/0013 of 8 January 2016 and the Agreement on Cooperation and Data Protection for the NTIS project No. 65/D140/2016 of 8 February 2016, which were concluded between the MTC SR and NDS.

Based on the above-mentioned Agreement on Integration Plan and Agreement on Cooperation and Data Protection for the NTIS project, the Interface Agreement NDS - FCD is signed: Maintenance vehicles, which is the basis for the technical implementation of the connection of the SMART TDM system of the NDS provider with the NTIS. The Interface Agreement sets out the precise specification of the type and extent of the data transmitted,

the handling of such data, as well as other specific conditions and parameters in relation to the transmission and processing of such data by the acquirer.

In line with the broadening of a more comprehensive view of intelligent transport, there has been a demand for a broader strategy and conceptual approach to intelligent mobility, which has shown an opportunity to cooperate with the NTIS as a source databank for traffic information. The Slovak Republic has thus committed itself to supporting cross-border cooperation in the development and testing of new technologies, communication networks and data services for interconnected autonomous vehicles in order to increase road safety and ensure the flow of traffic while the information from the NTIS will make up a large part of the data acquisition for the connection of vehicles with the transport infrastructure.

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