D2.3 - Data Store maintenance and TN-ITS service roll-out

(consolidated)

TN-ITS GO

Map Update Exchange

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Abstract
This document identifies the data store maintenance process steps, live cycles and procedures. It reports every member state's actual status on development, availability and future plans for these procedures. Finally, this information is consolidated in a summary overview.

Legal Disclaimer

1 Objective of the deliverable

The procedures for maintaining the spatial road data store for keeping it up to date are investigated and proposals for improvement are formulated. A concise plan for further extending the functionality of the service after the project, based on the experience gained from the implementation and testing will be documented, taking into account spatial data store specifics, to provide guidance to other member States for a future TN-ITS service implementation.

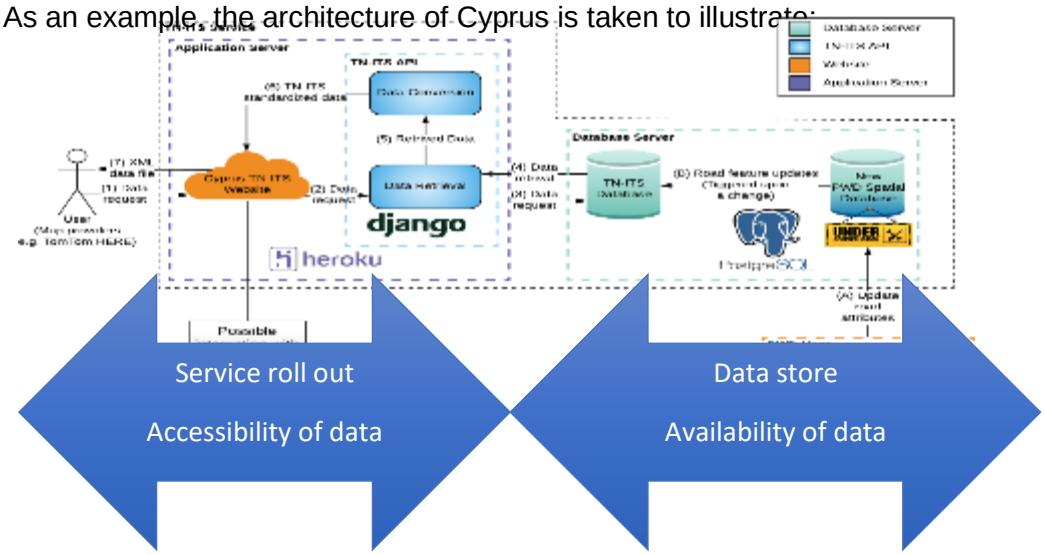
1.1 Applied task process

In a first stage of this task, an alignment took place between all member states to come to a common view and definition and scope of what is meant by 'data store maintenance'. It identified the process steps and detailed the relevant data store live cycles for each. For each live cycle relevant data store maintenance procedures can be identified. Finally, we identified the focus points for the 5 leading countries and the 9 'following' countries of the TN-ITS Go partnership

1.2 Generic TN-ITS data store architectures

This task identified 2 major process steps that member states needs to perform in order to enable their TN-ITS service. One major step is about the 'data availability' and the second one is about the 'data accessibility' The data availability relates to the 'data store, while the data accessibility relates to the 'TN-ITS service roll out' For both parts

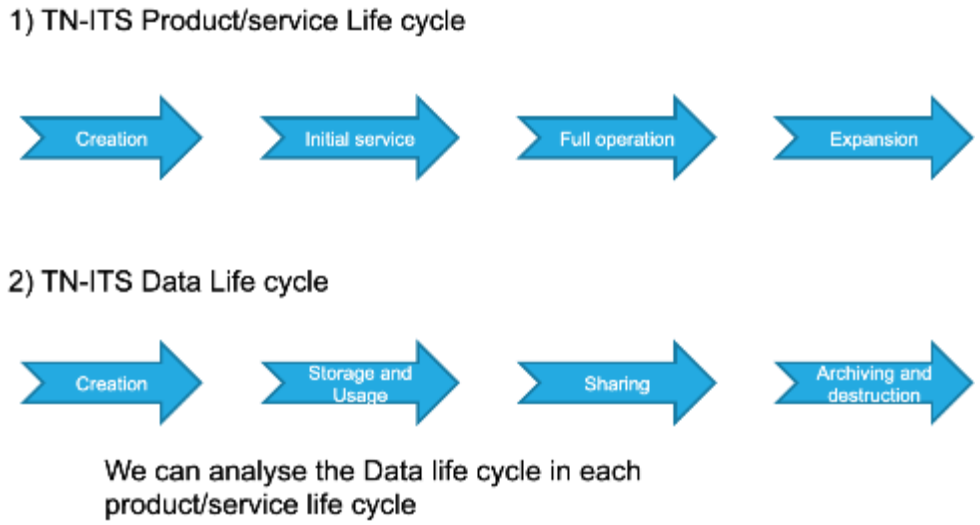
As an example, the architecture of Cyprus is taken to illustrate:



1.3 Live cycles

The data store makes the difference in 2 types of life cycles. One life cycle deals with the TN-ITS product life cycle, while the second life cycle deals with the data itself

The following picture illustrates both life cycles.



1.4 Data Store procedures (Data availability part)

It is the viewpoint that each member state authority needs to establish the necessary internal procedures for maintenance. These procedures can be grouped according the life cycle of the data in each of the product lifecycle status. Many member states have established the technical elements to perform the TN-ITS service but are still in the definition and writing phases of the related procedures to maintain and grow the service. The following picture illustrates a potential cataloguing of the necessary procedures and can explain their status.

	Creation	Initial service	Full operation	Expansion
Creation	*Procedures for gatheringvarious applied data sources and how you maintain them, Own production of data, ...)*			
Storage & Usage		*Procedures for Maintaining quality of data (Methods can include: monitoring of equipment and performance, Maintaining statistics, manual verification, testing, sampling, surveys by users, feedback loop reporting,*	*Procedures for back-ups handling*	
Sharing		*Procedures for Data transformation - Data Validation, Re-formatting, Consistency of data, ...*	*Procedures for Maintaining integrity of data, including Cyber security aspects, root of trust handling, ...*	
Archiving & destruction	*Procedures for archiving and destruction of various applied data sources.)*			

Status indication for each mentioned procedure
*not present
*in creation
*active (ref nr)

Filling in all the table contents for each cell is not really necessary. It is up to the member state to identify their focus points. As a generic guideline we advised the leading countries to focus on the procedures related to the 'Full Operation' part of the table as part of the TN-ITS Go realizations and for the 'expansion part' as the after-project ambitions.

Following member states should focus on the 'initial service part' as TN-ITS Go deliverable and the 'Full operation part for their after-project ambitions.

1.5 Service roll out (Accessibility of data)

The following table illustrates a guideline to member states to report on the procedures for 'service roll out', along the life cycle of the TN-ITS product/ service.

Creation	Initial service	Full operation	Expansion
Initial Procedures for transferring Map update data atributes	*Procedures for NAP handling or any other type of transfers*	*Procedures for trust –integrity handling along the delivery channel*	
		SLA's	
		Licenses	

1.6 Member states 'Followers' reporting section

This section contains the report of the following member states:

- The Netherlands
- Hungary
- Cyprus
- Greece
- Slovenia
- Portugal
- Spain

2 Member State the Netherlands

The picture below provides a schematic representation of the development of products including TN ITS GO.

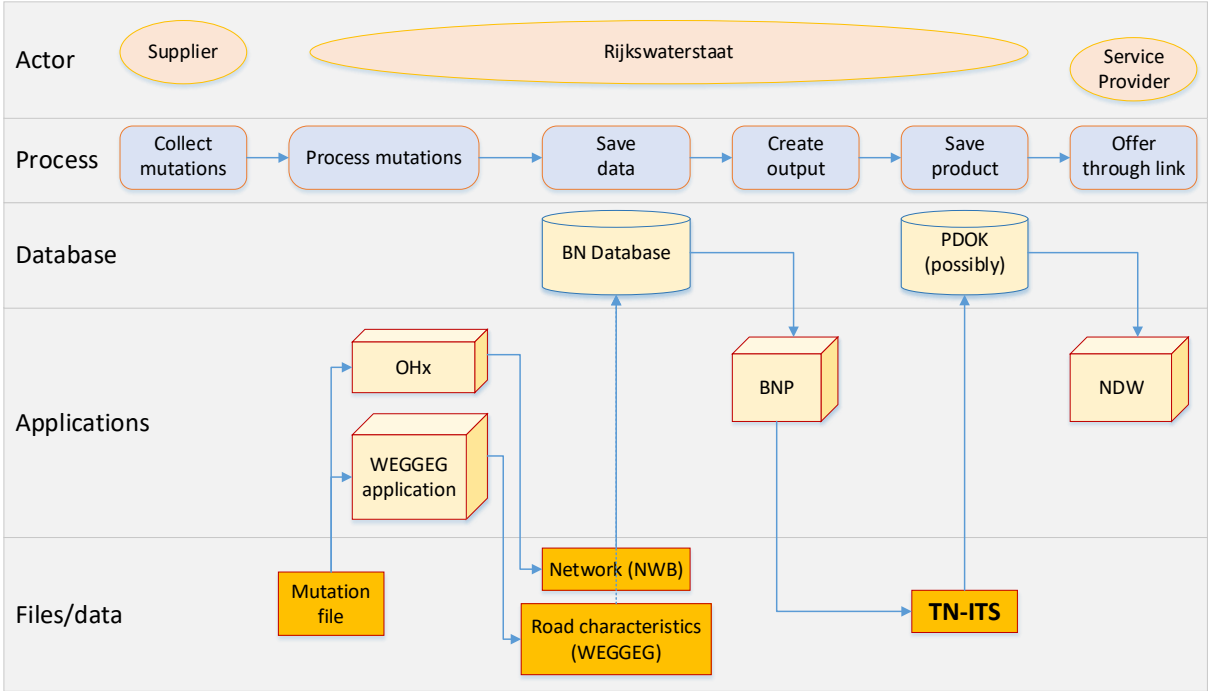


figure 1: Dutch schematic representation of the development of products

Mutations on the network and road characteristics are being processed using different applications. This data is saved in the database (BN). BNP creates Shapefiles using the data from the BN database. One of those files will be the TN-ITS product. This product will be stored on a database (possibly PDOK) from where the service will be hosted. It will then be made available for service providers through a link on the NDW (national access point of Netherlands).

2.1 Data store Maintenance procedures

To improve readability, the paragraph has been divided into sub-paragraphs. Overall it's worth mentioning:

- NWB is the network to which the road characteristics from, among others, WEGGEG are linked. Both the network and the characteristics form input for the TN-ITS product;
- The data collections discussed below have a traffic management approach. Meaning they are collected when they affect traffic. Features are always shown on the road instead of where they actually are outside. Rijkswaterstaat (RWS) also collects data for the purpose of construction, maintenance and asset management. This data is not mentioned in this document and is assigned to a different department;

2.1.1 Principles

- Data must be findable, traceable, accessible, interpretable and reusable;
- Best practice: The ITIL service chain is used;
- Architecture: Data is stored as close to the source as possible;
- History is built up in the database. Everything gets a start and end date;
- Changes: Nothing will be removed or changed;
- Link: All (core registration) data is (hard-) linked to the BN (database);
- Data model: We use a normalized data model;

2.1.2 Data collection

- NWB:

  1. Suppliers send changes to the NWB.

  2. When there are changes in the key registers (e.g. BAG and BGT), these are entered in the NWB. Mutations are entered by the supplier using ArcGIS. BN is the database in which the data is stored. NWB is only the administrative data of the network (no characteristics);

- WEGGEG:
  1. The supplier inspects every road section at least once every 3 years and records everything with cameras. The information that is relevant to RWS is translated.
  2. After opening major road changes (e.g. to a road or junction), the supplier immediately collects the data. They produce a file (which road characteristics along/above which point of the road). This file is read into the WEGGEG application and is stored in the database. Each characteristic is linked to the road section from NWB;
- TN-ITS is a product that uses the same data source as NWB and WEGGEG.

2.1.3 Data quality

- All traffic management data uses a normalized data model (geometries are part of the data model);
- WEGGEG: has a data model where a Shapefile is created for each characteristic, which is delivered monthly;
- Business rules are present in the OHx (maintenance) application and on the databases;
- NWB is mutated daily and delivered monthly. WEGGEG is also delivered monthly and has an actuality of 2 months up to a maximum of 3 years, but major changes are implemented immediately;
- Version control: new WEGGEG data gets a timestamp of the moment it's processed into the application. NWB has a second timestamp, that's based on when a road is opened for traffic. The NWB thus has an increased actuality. Because future roads can be recorded today;

- WEGGEG validate/check process: A control run is executed before anything is read into the WEGGEG application. The result is a complete list of possible errors. This list is checked against BN and business rules. If the type and number of errors are extensive, it is returned to the supplier. If data does not match the BN, the data cannot be linked and the data will not be recorded. The mutation file is also randomly checked by RWS. Checks are also performed on the database and Shapefiles. If errors still occur, RWS can be informed by users;
- NWB and WEGGEG: we have an SCB contract with the supplier and agreements have been made about the quality standard. This means the supplier has to prove the quality. The supplier needs to show that they comply with monthly quality reports regarding actuality, accuracy and routability. We assume that what the supplier delivers complies, but RWS also carries out random checks;
- For maximum speeds, there is no structural quality control on the content yet. This means that we do not know for the entire file whether everything is correct and whether it is complete;
- For TN-ITS GO we assume that what is already being done in the chain guarantees sufficient quality for the TN-ITS product. If this is not the case, the Services Desk Data is available;
- The source data of which TN-ITS consists is up to date. Because the various attributes do not all have the same actuality, it will not be described in this document;
- When high availability is required, for example the INSPIRE guidelines, PDOK [1]is used which can assure these availability. TN-ITS is likely to be stored at PDOK;
- The INSPIRE test tool checks whether the product meets the INSPIRE standards.

2.1.4 Storage

- BN is the Oracle database with batch processing in which all normalized networks are collected. The BN contains the complete history and is fed by key registries (BAG with an actuality of one day and BGT with an actuality of half a year). Normally deliveries are made monthly, but it can also be done more often. However, not all changes have been implemented, as this is done monthly;
- BNP is a custom ETL tool used for orchestration, where FME (part of BNP) translates data from the database into Shapefiles (geographic format of ESRI with lines, points and attributes);
- NWB is the product with networks. Traffic management related road characteristics are linked to this network. WEGGEG is the file with road characteristics;
- Users have access to the Shapefiles, but no direct access to the BN database;
- Changes to the database can only be made by authorized users. This is done based on “Role Based Access Control”;

[1] https://www.pdok.nl/: PDOK is a platform used by different Dutch government agencies for processing geo-datasets with high availability requirements

- After TN-ITS has been created as a product, it will be stored on PDOK (database) and will be made available through a link on the NDW (national access point (NAP) of the Netherlands);
- Life cycle management is applied to every form of storage relevant to the TN-ITS product;
- The use of the data is separate from the database, which benefits continuity in the event of failure;
- Business rules have been implemented in the database. If the data does not meet this requirement, it will not be committed;
- Every day a backup of the database is being made, with a retention period of six months;
- A full backup is being made regularly.

2.1.5 Data integrity and security

- Rijkswaterstaat has to commit to the BIO (Baseline Informatiebeveiliging Overheid). The BIO is the government baseline for Information security based on the ISO2700x series;
- TN ITS GO is also assessed to the BIO through the Security by design process.

2.1.6 Archiving and destruction

- All outdated elements are signed with an end date;
- Logically these elements are archived;
- No data is destructed physically.

2.1.7 Sharing of data

- All data relevant to TN-ITS is open data. Open data is available to everyone. Users have to commit with an open data license. This license is to prevent commercial parties from making money from the data that RWS offers for free. And stimulates to enrich the data and offer it with added value to end users.

2.2 Service roll-out procedures

- Based on the Data mapping, our Service Integrator has written a query in BNP that results into the TN-ITS product (comparable to NWB and WEGGEG);
- The product may be stored and hosted on PDOK;
- Through (our NAP) NDW the product is offered to users, by linking to the product;
- We will not set up a separate feedback loop. For the time being, we choose to use our existing Service Desk Data, which is available during office hours;
- We provide a monthly mutation file and periodically an initial file;
- TN-ITS only contains the corridors requested from Europe, for the Netherlands this is the complete Ten-T road network;
- The TN-ITS product consists of “network-” and “road features”. The TN-ITS product consists of the following objects:
    - Road;
    - Road Link (geometry and connectivity of a road network between two points);
    - Road Node (point spatial object used to either represent connectivity between two road links or to represent a significant spatial object);
    - Marker Post (disabled);
    - Functional Road Class (importance of the role the road performs);
    - Number of Lanes;
    - Road Surface Category ((un)paved);
    - Traffic Flow Direction;
    - Transport Network (collection of network elements that belong to a single mode of transport);
    - Maintenance Authority;

TN ITS GO will fit within existing procedures as mentioned in the previous chapter. To show a quick overview, see following figure.

	Creation	Initial service	Full operation	Expansion
Creation	*Data needed for TN ITS GO is already gathered*			
Storage & Usage	*Gathered data is stored the BN database*	*From the BN database, TN ITS GO data should also be stored at PDOK for GEO components and high availability*		
Sharing		*TN ITS GO data stored at PDOK will be made available for Service providers via our NP.*		
Archiving & destruction		*TN ITS GO data will follow the procedures accordingly*		

2.3 Experiences gained

2.3.1 Implementation experiences

RWS already had experiences (e.g. NWB, WEGGEG) with the way we want to make TN ITS GO available. The way we enclose the TN ITS GO data did result in more efficient way on how we process the INSPIRE data.

A new standard automatically results in different meaning and interpretations to some of the of the TN ITS GO elements. We consulted multiple MS within the TN ITS platform on how they interpret the specific elements and made our own conclusions based on that knowledge.

2.3.2 Testing experiences

Testing the TN ITS GO product is planned to start at Q4 2020.

2.4 Future proof

2.4.1 Proposals for improvement

- There are regular processes to improve/optimize the quality of data;
- All road characteristics of WEGGEG are updated at least once every 3 years. This duration will be reduced in the future, thus increasing current actuality. There are also plans to include a second timeline and to increase actuality;
- At the moment there is still a lot being redrawn. In the future, this will be more automated by means of an import option for the key registries;

2.4.2 Planning for introduction

Most important at this moment is the implementation of TN ITS GO in our regular processes. Improvements will be planned as of 2022.

3 Member State Hungary

3.1 Data store Maintenance procedures

3.1.1 Main database and data sources

The road attributes published by Magyar Közút Nonprofit Zrt. (hereinafter referred to as “MK”) in the TN-ITS service is based on the internally monitored MK country wide road axis database (hereinafter referred to as: “OKA”). Complying to internal ordinances this database is being manually verified every month. Based on these regulations no data entry gets deleted, it only loses its validity to provide base for versioning and backup.

The database of the TN-ITS service only accepts a standardized version of any road attribute provided by road data store operators (MK, Budapest Közút Zrt., Ministry for Innovation and Technology, municipalities). These operators are liable for the consistency and validity of the provided data. Currently only the internal MK database is utilized for the service, but a cooperation with Budapest Közút Zrt. is being negotiated.

3.1.2 Data validation

As a part of data validation beyond the internally dictated one, sample data was manually inspected by other departments at MK also by TomTom and HERE representatives for feedback on the test release of the service. The development of the automatic feedback loop report service is under development and scheduled for release in 2021.

The hardware and software requirements of TN-ITS service are parts of the normal IT infrastructure at MK. Maintaining and operating these components along the normal operation practices is performed by the IT operation department of MK.

3.1.3 Data security

To maintain the integrity and security of the database and published attributes, only contracted partners get access to the encrypted data entry form. As a company-wide data security specification every attribute field has a set maximum length to avoid a SQL injection attack and regular backup saves are performed complying to these same specifications.

Any future extension to the database or the published content will be done appropriately to the currently valid standard TN-ITS technical specification to avoid any compatibility errors. The future development and operating costs are accounted in the future yearly budgets. In Decree 27/2019 (VIII. 26.) of Ministry for Innovation and Technology[2] about Intelligent Transport Systems, institutions are appointed for operating the TN-ITS service, and methods for storing, validating and publishing data are defined.

[2] https://net.jogtar.hu/jogszabaly?docid=A1900027.ITM

3.2 Service roll-out procedures

The pilot 1.0 version of the TN-ITS service launched in November 2018 with a publication of speed restrictions for the whole OKA database. This pilot service has been since part of the National Access Point (hereinafter referred to as: “NAP”) alongside with a DATEX and a GeoServer based version of road attributes for registered users.

- Version 1.0 (November 2018): publication of the full OKA road database with speed limit and vehicle condition attributes
- Version 1.1 (April 2019): adding vehicle type and dimension restriction attributes such as weight, width, length and height to the published line data
- Version 1.2 (August 2019): introduction of parking lots as point data with availability and other informative attributes
- Version 1.3 (November 2019): introduction of traffic signs as point data from the MK road sign database (JTÁR) with the conventional traffic sign name and free text value attributes

3.3 Experiences gained

3.3.1 Implementation experiences

The XML and XSD schemas provided in the CEN/TS 17268 Technical Specification documents were in some cases outdated and had to be amended to match the other packages and classes.

Some difficulties were faced when the MK road sign database was matched with the TN-ITS code list as not every traffic sign in use on the Hungarian roads had a counterpart in the standard.

3.3.2 Testing experiences

After fixing the provided XML and XSD schemas during the implementation, the testing procedures were without errors and bugless.

Numerous registered users of the NAP have been actively utilizing the service to get published road attribute data for offline applications.

3.4 Future proof

3.4.1 Proposals for improvement

The main direction for proposed improvements is the involvement of new data store suppliers and expanding the list of published road attributes based on the road data of these new partners.

3.4.2 Planning for introduction

The next release scheduled for the first half of 2021 will implement a feedback loop. It will allow users to send feedback of every dataset and road attribute, and for the data store operator to browse, query and read these logs.

4 Member State Cyprus

4.1 Data store Maintenance procedures

The TN-ITS service for Cyprus is generating data derived from the “GNOSIS” spatial database of the Public Works Department (PWD) which is based on the INSPIRE data model. “GNOSIS” database holds spatial and tabular data for the main road network of Cyprus which includes the interurban road network, motorways, main roads, secondary interurban roads, and main roads connecting villages or residential areas to the cities.

The main road network is maintained by the Public Works Department. Therefore, the PWD is responsible for any changes in the road network and to keep the “GNOSIS” database up to date. The TN-ITS Cyprus service, was designed in order to be directly linked with the “GNOSIS” database and automatically generate the standardized TN-ITS without creating any additional workload for the PWD employees which ensures that the service will be running without any disruptions as long as the GNOSIS database is updated accordingly.

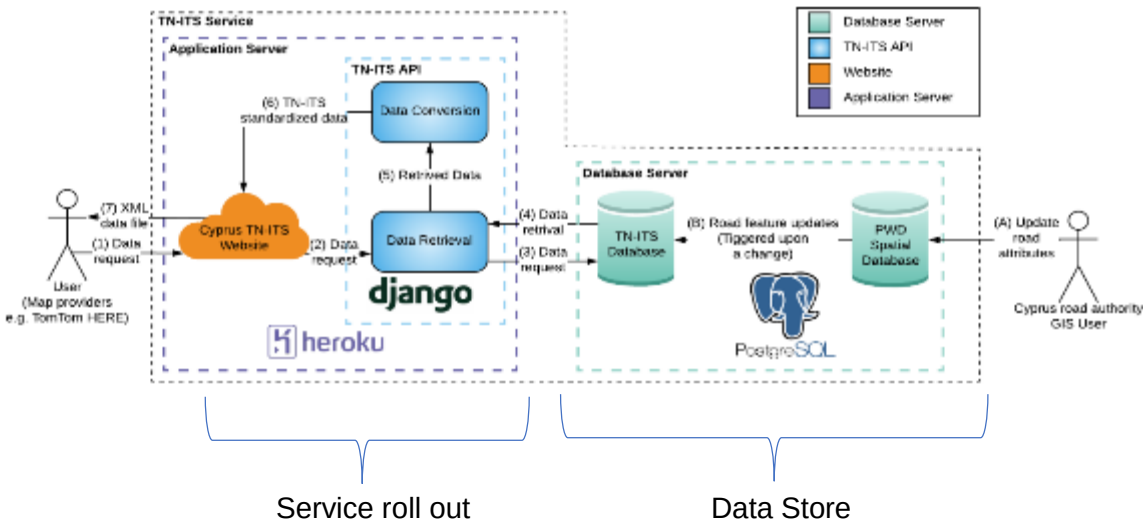


Figure 1: TN-ITS Cyprus architecture – Data Store and Service roll out

4.1.1 Data creation

Incremental updates

The PWD is in the process of using a newly developed GI System which was introduced during November 2020. To keep the data up to date in the new GIS and consequently to the “GNOSIS” and TN-ITS database, several processes are drafted to ensure the seamless dataflow from the field to the GIS. Since the new GI System is not yet fully integrated with the PWD day to day activities, the following processes are not established yet and they might change once the new GIS is fully integrated. An overview of the proposed process is described in the diagram below, while more detailed processes related to data life circle are described in the following chapters.

Figure 2: Data flow of changes in the road network

Once a decision for a change in the road network is taken, a PWD field team is assigned to implement it. Then, the field team needs to report the completion of their task through a mobile app (owned by the PWD) to the GIS team of the PWD who **review, approve, and then record** the change to the "GNOSIS" database through the PWD GIS. At the same time, any changes on the "GNOSIS" database are recorded to the TN-ITS database. The goal is that this process will take place within 24 hours from the actual change on the field. The user of the website can request data from the previous day or from any day since the launch of the service.

Snapshot data set

Once every 3 months, a snapshot dataset is automatically generated. This snapshot contains information about all road features with the associated referencing. The snapshot data set can be generated more frequent if needed.

4.1.2 Data Integrity & Security

The following procedures have been established to secure the validity, integrity, and accuracy of the TN-ITS data.

- Once a decision is made for a change in the road network a new task should be created for the change through the GIS and assigned to a field team to perform the change. Once the change is completed the filed team mark their task as completed and then the GIS team review and approves the change. Once the change is completed and approved only then is stored in the GNOSIS database.
- Any changes in the GNOSIS database are automatically stored in the TN-ITS database as updates.
- Any changes in the "GNOSIS" database can be done only through the PWD GIS. The PWD GI System has several access levels and only authorised PWD personnel can have the appropriate access level.
- Any data entry to the database is subject to restrictions (specific datatype, while when it is possible only a value from a predefined list can be accepted).
- A middleware has been developed to handle any changes before they are send to the database. At that stage, the data can be rejected by the middleware if they are not in the expected form or structure adding an additional level of security.
- Any change in the "GNOSIS" database is logged. As long a change is submitted, all the details of the change (previous value, new value, timestamp, etc.) and the ID of the user who performed the change is stored in a log/audit database.
- The server load is constantly monitored to identify any unexpected overload.

- A feedback loop process will establish to get feedback from the map providers about any issues with the provided TN-ITS data sets.

4.1.3 Data storage and usage

As mentioned earlier, any data to the TN-ITS Cyprus service are generated through changes in the "GNOSIS" spatial database. Regarding the storage and uptime, the following procedures have been established:

- The "GNOSIS", as well the TN-ITS databases are currently located in an on-premises server at the University of Cyprus.
- Both databases are automatically backup once a week. The frequency of the backup can be increased anytime if it is need.
- In addition, it is important to note that by the end of 2021, the databases, and the TN-ITS service will be moved to a Tier 3 data centre which will support redundant and dual-powered servers, storage, network links ensuring higher uptime (up to 99.9%).

4.1.4 Data sharing

Regarding the data sharing the following procedures have been set:

- Each day (at 00:00) a link for is generated for the previous day's changes. Once the link is accessed, an XML file is produced with the changes of the previous day according to the TN-ITS standard. This link can be accessed through the TN-ITS Cyprus website.
- The links for every day since the initiation of the service can be accessed through the TN-ITS Cyprus website as well.
- Through the TN-ITS Cyprus website the users can also access a snapshot of the data set which is generated once every three months. The frequency of the snapshot data set generation can be increased if needed.
- The current website for the TN-ITS Cyprus is here: https://pwdgis.ucy.ac.cy/tnits/
- Once the NAP is published TN-ITS Cyprus data would be connected to the NAP as well.

4.1.5 Data archiving and destruction

Regarding the archiving procedures, retention, and destruction procedures the following procedures have been set:

- The data in the "GNOSIS" database cannot be deleted. The structure of the database allows for any feature or value to have a "valid from" and a "valid to" value. These two values indicate the period of which a feature or value is active. For example, if a speed limit in a road link changes from maximum speed 50km/h to 80km/h on the 01/09/2020 then the previous speed limit (maximum speed 50km/h) will become inactive by changing its "valid to" value to 01/09/2020 while the new value (maximum speed

80km/h) will get a “valid from” date the 01/09/2020. This helps to keep in track all the changes which have happened in the database.

4.2 Service roll-out procedures

The TN-ITS Cyprus service was developed in order to ensure that any attributes related to the road network in the PWD can be published through the service. Once the new GIS for the PWD is integrated to the PWD day to day activities, is expected that more road network attributes will be collected, consequently, as long as new attributes are collected to the PWD database, the TN-ITS Cyprus service will be able to support the publishing of additional data which can be used from the map providers to create more detailed maps.

A summary of the Cyprus TN-ITS service implementation phase in regards to data store maintenance can be found in the figure below.

	Creation	Initial service	Full operation	Expansion
Creation	*Procedures for gatheringvarious applied data sources and how you maintain them, Own production of data, ...)*			
Storage & Usage		*Procedures for Maintaining quality of data (Methods can include: monitoring of equipment and performance, Maintaining statistics, manual verification, testing, sampling, surveys by users, feedback loop reporting,*	*Procedures for back-ups handling Procedures on security, storage on premise or cloud, integrity procedures, version control, backup procedures, , procedures on updating data*	
Sharing		*Procedures for Data transformation - Data Validation, Re-formatting, Consistency of data, ...*	*Procedures on access rights Procedures for Maintaining integrity of data, including Cyber security aspects, root of trust handling, ... Include information about how data will be shared, including when the data will be accessible, how long the data will be available, how access can be gained, and any rights that the data collector reserves for using data.*	
Archiving & destruction	*Procedures for archiving and destruction of various applied data sources)*			

Status indication for each mentioned procedure

- not present
- in creation
- active

4.3 Experiences gained

4.3.1 Implementation experiences

Through the implementation, Cyprus gained valuable experience on the specifications of the TN-ITS service which can shared with other member states who would like to create their own service.

4.3.2 Testing experiences

Output files from the TN-ITS Cyprus service are send to map provides for testing.

4.4 Future proof

4.4.1 Proposals for improvement

The TN-ITS Cyprus service has been developed by keeping in mind the potential expandability of the service. A future expansion of the service can support additional attributes as well as additional roads which are maintained by other road authorities in Cyprus.

In addition, in the efforts for further improvements of the service, if it is needed, the snapshot data set, can be published in a higher frequency.

Furthermore, it is expected that once the Cyprus (National Access Point) NAP is published, the data from the TN-ITS will be available through the NAP as well.

4.4.2 Planning for introduction

N/A

5 Member State Greece

5.1 Data store Maintenance

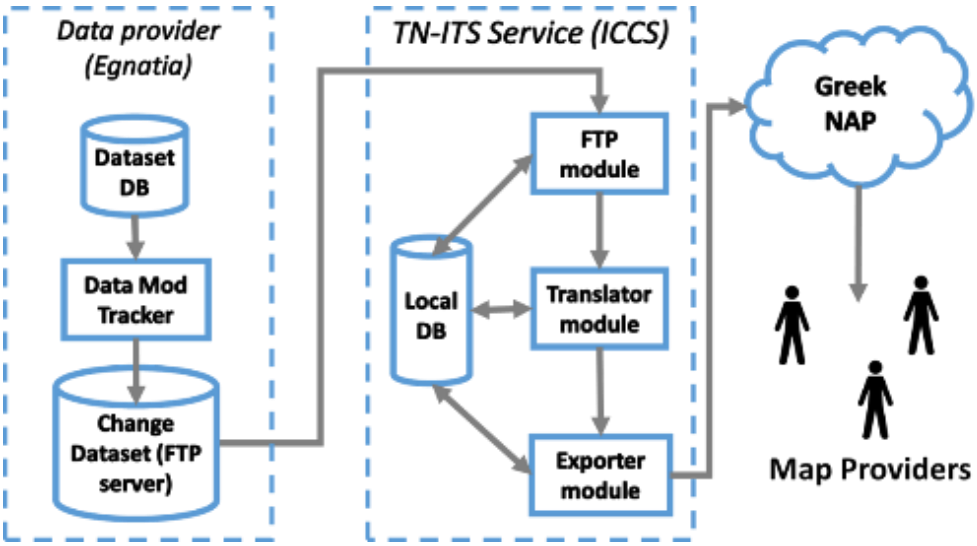


Figure 3. Greek TN-ITS Go Pilot implementation

The Greek TN-ITS Go pilot implementation consists of three major components (**Figure 1**); 1) Egnatia Odos SA (Egnatia) provides and acquires road data. 2) The Institute of Communication and Computer Systems (ICCS) is in charge of the technical implementation of the TN-ITS Go service, mainly data handling and translation, and 3) The Greek National Access Point (Greek NAP) publishes the processed data sets. Lastly, the Ministry of Infrastructure and Transport (MIT) acts as a general supervisor between the other relevant parties, consulting in legal and technical issues.

5.1.1 Data Creation

Pilot data is provided by Egnatia and refer to road attribute changes from the Vertical Axis (VA) A25 Thessaloniki – Serres – Promachonas [1]. Egnatia holds internal mechanisms to identify data changes in its databases (DBs) (data mod tracker module in **Error! Reference source not found.**). Whenever a change occurs, a dataset (in kml format) with all the relevant information is uploaded into the change-dataset server, which can be accessed via File Transfer Protocol (FTP). The FTP server is the sole endpoint to any third-party access to the initial datasets. For the duration of the Greek pilot, the FTP server's data will only be accessed by ICCS's TN-ITS service. Egnatia is responsible for the overall provision of data creation, dataset update according to road data changes, maintenance and security of the dataset (FTP) server.

5.1.2 Storage and Usage

The datasets created by Egnatia are stored in its FTP server for reference at all times. From that point onwards, the TN-ITS service operator (ICCS) is responsible for i) monitoring Egnatia's database and obtaining newly created datasets, ii) validation of dataset content and translation to TN-ITS specification, as described in [1] and finally iii) publishing the translated datasets to the Greek NAP.

The TN-ITS service uses Egnatia's FTP server as its reference to synchronize its local database (**Error! Reference source not found.**). The service implementation includes a fail-safe (recovery) mechanism to account for corrupted or lost data during the translation/exportation process. If any dataset loss occurs (e.g. due to hardware failure), this will be identified during the validity check and the recovery mechanism will be triggered. At such an event, the service will repeat the dataset processing (i.e. dataset download from FTP server, translation, exportation), using the metadata stored in the synchronized local DB.

The service is implemented as a dockerized web application in a protected (ICCS) network, i.e. in a virtual-machine (VM) located in ICCS's servers. The VM characteristics are the following: 1 Central Processing Unit (CPU) core, 4 Gigabytes (Gb) Ram, 50 Gb Hard-Disk capacity. The service obtains datasets only from Egnatia's FTP server and uploads it to the Greek NAP endpoints, exposing no other endpoints. Therefore, no security breach can occur, unless with physical access to ICCS's hardware.

A logging mechanism is also employed, to monitor all the processes of the service and any potential errors/exceptions, as well as to maintain statistics. This also includes all communication links (interfaces): i) data taken from Egnatia's FTP server ii) data sent to the Greek NAP. The above-mentioned logs can be employed to manually test and validate the consistency and transformation of data. No backup mechanism is currently implemented since ICCS's service acts as an intermediate system service, thus all translation and exportation files are recoverable, using the FTP reference database.

5.1.3 Data Sharing

Users (i.e. map providers) can access the exported datasets only via the Greek NAP interface (http://data.nap.imet.gr/). The Greek NAP platform offers a web link for manual access and a relevant web application programming interface (API) to access the datasets in an automated manner if needed. Security mechanisms are handled by the Greek NAP platform, including a credential authentication (username/password) for manual access provided by the NAP administration team and an API token authentication for automation, which can be set by the authenticated user.

TN-ITS datasets in NAP are administrated by ICCS. Their privacy level is set to "private" by default, meaning that each authenticated user who wishes to gain access, needs to be approved by ICCS administrators. However, a public dataset reference guide, containing metadata information (e.g. number of uploaded datasets, upload date, etc.) exists to facilitate easier browsing.

5.1.4 Archiving and Destruction

The TN-ITS service holds no procedures for data archiving/destruction. That can only be performed indirectly, using its data recovery mechanism (see **Sec.** Error! Reference source not found.). ICCS's local DB always uses Egnatia's FTP server as a reference. If a dataset is deleted from the reference server, the ICCS's local DB will be synchronized accordingly and initiate a deletion process of translation and exportation files.

A summary of the Greek TN-ITS service implementation phase in regards to data store maintenance is presented in **Error! Reference source not found.**.

	Creation	Initial service	Full operation	Expansion
Creation	*Procedures for gathering various applied data sources and how you maintain them (D2.3 - Data Creation)*			
Storage & Usage		*Procedures for Maintaining quality of data. Methods include: monitoring of equipment and performance, Maintaining statistics, manual verification, testing (D2.3 - Storage and Usage)*	*Procedures on security, storage on premise or cloud, integrity procedures, procedures on updating data (D2.3 - Data Sharing).*	
Sharing		*Procedures for Data transformation - Data Validation, Re-formatting, Consistency of data (D2.3 - Storage and Usage)*	*Procedures on access rights, including Cyber security aspects, information about how data will be shared, including when the data will be accessible, how access can be gained, and any rights that the data collector reserves for using data (D2.3 - Data Sharing).*	
Archiving & destruction	*Procedures for archiving and destruction of various applied data sources)*			

Status indication for each mentioned procedure

- not present
- in creation
- active

Figure 4. Greek TN-ITS Pilot - Data Store Maintenance

5.2 Service roll-out

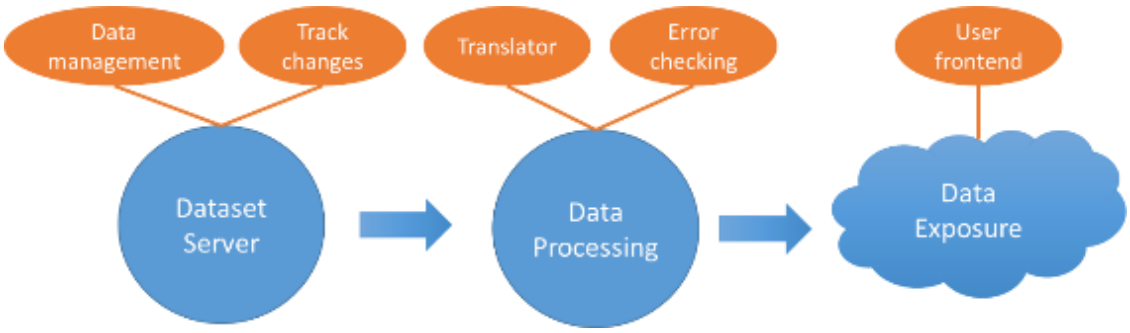


Figure 5. Service roll-out architecture

The implementation and roll-out of the TN-ITS service in regards to the Greek pilot, as described in **Sec.** Error! Reference source not found., involves various parties with different roles. Currently, Egnatia is the sole data provider with data taken from a specific road segment, ICCS is in charge of the intermediate data processing layer services (**Error! Reference source not found.**) and the Greek NAP is used for data exposure. This toolchain has allowed the full operation of the service.

As the TN-ITS service evolves on a long-term basis, additional data sources can be included, while data processing, validity and maintenance can be performed by a centralized public entity, in charge of all technical and administrative issues.

5.3 Experience gained

5.3.1 Implementation experiences

As far as TN-ITS service technical challenges are concerned, the translation module is regarded as the most complicated module of the implementation, since a thorough understanding of the specifications and data model is required. The remaining work is limited to the implementation of a web service, with standard mechanisms, such as security, privacy, data handling and endpoint exposure.

On the other hand, administrative and legal challenges can be time-consuming, since in most cases the coordination of several different parties is required, especially when the level of maturity in intelligent transport systems (ITS) services is low.

5.3.2 Testing experiences

Currently under pre-evaluation phase - TBD

5.4 Future proof

5.4.1 Proposals for improvement

The Greek TN-ITS service underwent its pilot phase. Several improvements can be introduced to extend its use, which include the implementation of a feedback loop service.

5.4.2 Planning for introduction

- Allowance for currently excluded road attributes (e.g., warning signs)
- Extension to other road segments, outsides Egnatia's network

6 Member State SI – Slovenia

6.1 Data store Maintenance procedures

Slovenian TN-ITS GO pilot activities resulted in pilot TN-ITS service roll out for motorway road network and the concise plan for future permanent full TN-ITS service deployment for state roads, based on the experience gained from the designing, implementation and testing deployed pilot solution, taking into account data sources specifics and service chain specifics.

Deliverable is the report of Slovenian TN-ITS GO pilot activities for the period 2018 – 2020 and planned provision of 2021 – 2022 planned permanent TN-ITS service deployment at National Access Point (https://www.ncup.si/en) at National Traffic Management Centre NCUP (NTMC).

Targeted TN-ITS GO pilot road network is Slovenian primary motorway road network part of TEN-T Network V and X corridors (A1, A2, A3, A4 and A5 motorways) now part of the Mediterranean and Baltic–Adriatic Core Network Corridors. Pilot is extended with high speed roads H1, H2, H3, H4, H5, H6 and H7.

Motorway (primary) road network in Slovenia (source Wikipedia)

Several stakeholders are involved in various aspects of public road network management:

The **Ministry of Infrastructure** exercises the role of national coordinator in the fields of transport and energy. Land Transport Directorate is affiliated division for primary road transport network and secondary road transport network is in the domain of DRSI (Slovenian Infrastructure Agency).

National Traffic Management Centre NCUP (NTMC), an internal organisational unit of Land Transport Directorate at the Ministry of Infrastructure, has the task to control the implementation of the Action as authority responsible for strategic traffic management at state level. NTMC is also responsible for the deployment of National Access Point in 2019.

Motorway operator DARS is state owned motorway concessionaire responsible for motorway network infrastructure which is also part of TEN-T (primary road network).

DRSI - the **Slovenian Infrastructure Agency** is a body within the Ministry of Infrastructure and performs expert technical, development, organisational and administrative tasks for the construction, maintenance and protection of main and regional roads and some expressways (secondary road network).

National Road Registry keeper is unit within DRSI with the responsibility to maintain official National Road Database BCP. Available is the public road network collection of road labelling and network geometry as well as vertical and horizontal traffic signage. Official referencing is linear referencing based on kilometre (defined as a mileage).

Slovenian partner in TN-ITS GO project is **AVP** the **Slovenian Traffic Safety Agency** (STSA), a legal entity of public law which operates in the field of traffic safety as implementing body (affiliated to the Ministry of Infrastructure) with the support and collaboration of NTMC – National Traffic Management Centre.

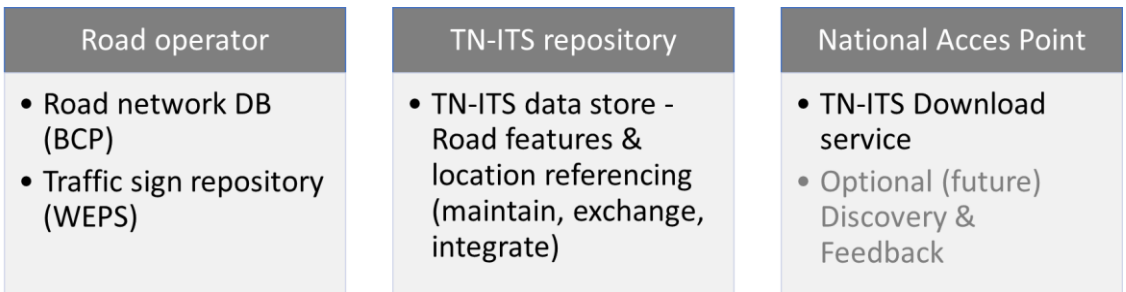
For the successful implementation of TN-ITS service cooperation among all relevant listed stakeholders and affiliated divisions is needed as well as consultation with implementation companies that deployed and maintain existing system and services in the field of ITS. Various actors' systems and services should be consolidated and upgraded for future automated permanent TN-ITS service.

Pilot deployment of TN-ITS service (minimum full data set motorway road network (>600km) geometry with speed limits road attributes, speed limits and other vertical traffic signage, general rules for trucks, update sets were transformed for the purpose of concept validation). Service or pilot result is published at National Access Point for traffic data and information as download service (https://www.ncup.si/en).

Deployed TN-ITS GO pilot service is the base for the future full deployment of permanent automated TN-ITS service for state road network covering state road network (primary motorway road network and secondary road network with regional and main roads) after 2021.

Pilot design follows detailed service specification in TN-ITS deliverable D5.3 - Implementation Guidelines - Data Sender.pdf (October 2018 release). System design is considering composite use cases:

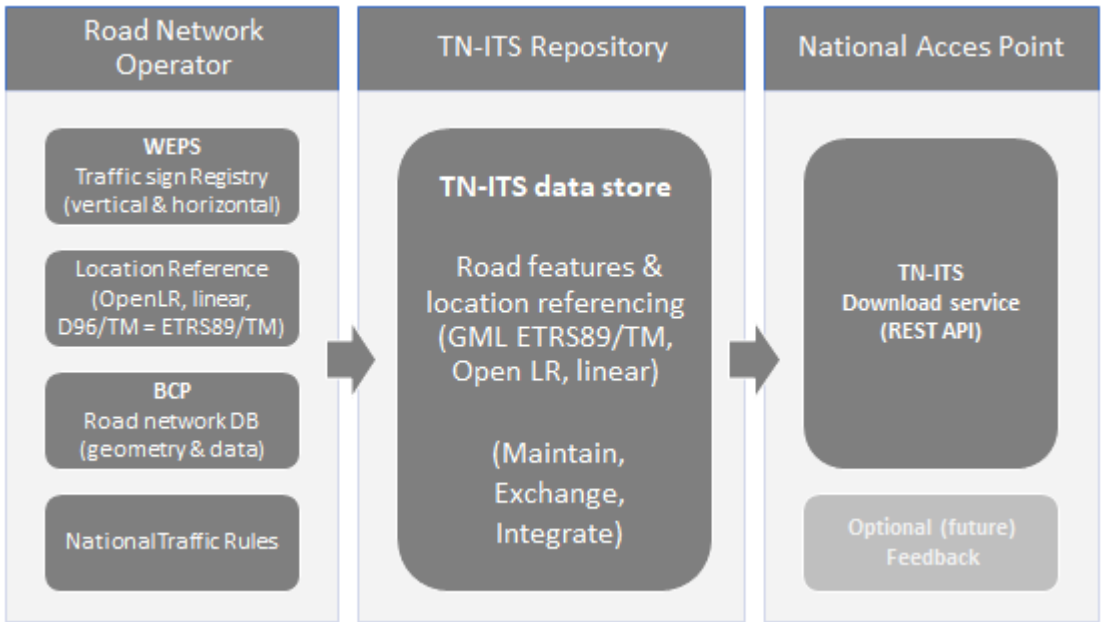
- **Maintain attributes**, which is mainly about keeping Data Store up to date (one-time pilot deployment includes state road database motorway road network (>600km) geometry with speed limits road attributes, speed limits vertical traffic signage and general rules for season viable truck restrictions on weekends). Other vertical signage included in the pilot is extracted in regard to available attributes and simple transformation/automation of existing data to TN-ITS format.
- **Exchange attributes**, which describes the data flow from Data Store to Information Provider.
- **Integrate attributes**, which describes finding and using road safety attributes.



Functional design diagram from data source to National Access Point

6.1.1 Principles

TN-ITS service infrastructure & architecture is based on transfer, extract, transformation and load of existing data from road network operators and public bodies. Central point of TN-ITS service deployment is **TN-ITS repository** (middleware) designed in regard to data structures described in standard SIST-TS CEN/TS 17268:2019 Intelligent transport systems - ITS spatial data - Data exchange on changes in road attributes. In that way close resemblance with needed data for physical exchange format - structure and encoding is achieved. TN-ITS publishing service is deployed in NTMC and available on National Access Point. Full TN-ITS service implementation with discovery and download service scope is deployed according to the specification based on REST interface.



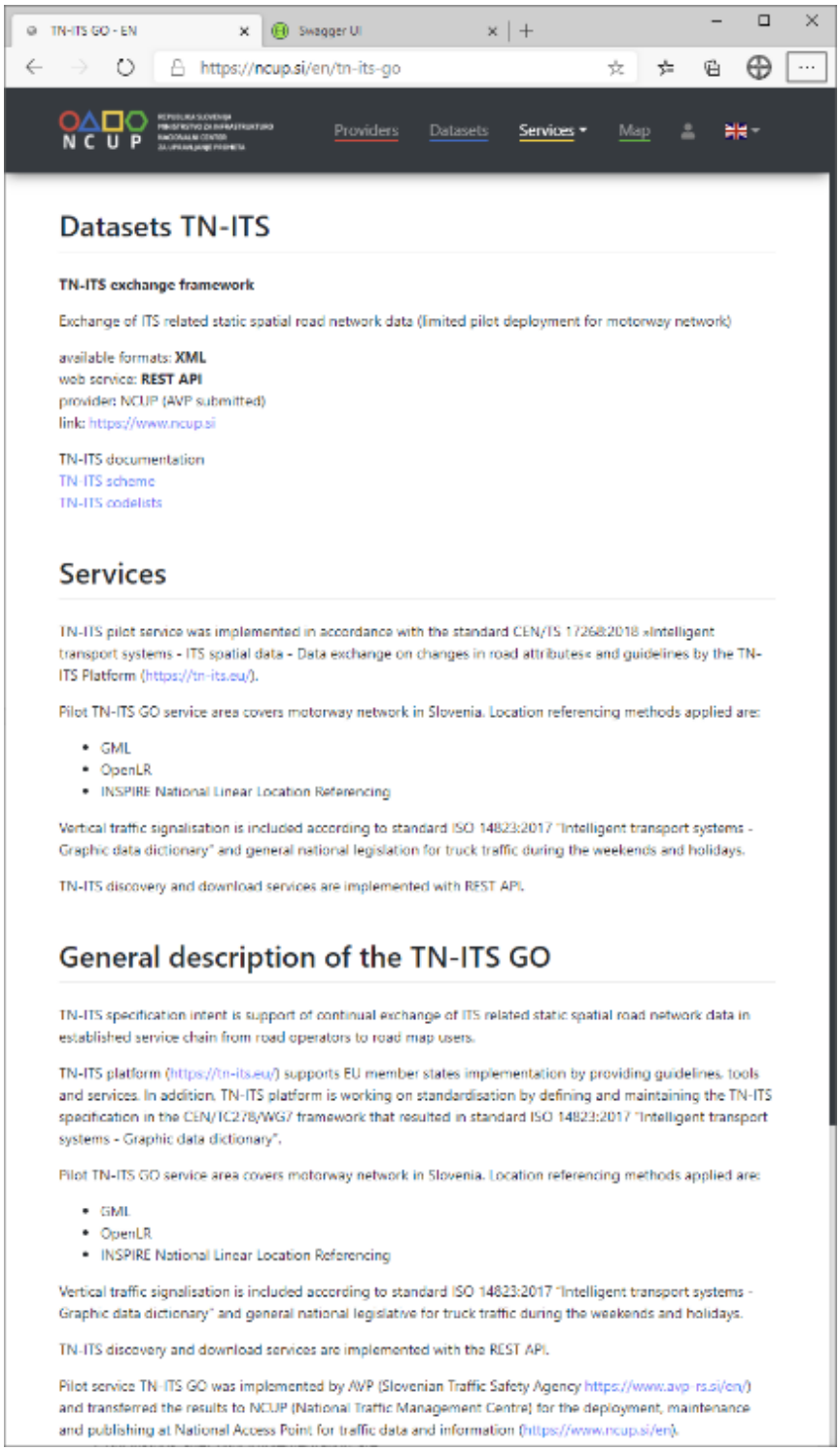
TN-ITS data repository is the core service for the provision of TN-ITS Download service at National Access Point

Data integration is process of TN-ITS repository and involves data transfer, extraction and data transformation.

In pilot phase simple data transformation with limited scope and attributes was planned and delivered, focused to the speed limits and the general rules. Existing vertical signalisation collection is coded in national specific format and needed is coupling to EN ISO 14823 format. Required were specific additional digital attributes, so manual intervention was used during the pilot.

During pilot also analysis of needed source data upgrades was taken for later full TN-ITS service deployment with envisioned automatic transfer of data with the full set of required attributes. Proposal to upgrade source data systems and procedures to consolidate TN-ITS service chain at the point where data are collected, maintained and verified by traffic engineers at road operators is crucial for future TN-ITS deployment. Input by dedicated professionals contributes also to data and service quality and consistency.

For later full implementation of TN-ITS service maintenance and exchange functions of TN-ITS Repository CRUD (Create, Read, Update, Delete) operations through dedicated APIs is envisaged. In pilot phase used will be one-time manual transfer, transformation and integration of source data.



TN/ITS service dedicated page on National Access Point

6.1.2 Data Collection

Compliance to SIST-TS CEN/TS 17268:2019 for the planned TN-ITS Repository and for the output download service is mandatory. The TN-ITS service data source is state road network database and its collections:

- State road database motorway road network (>600km) geometry (road shape) with speed limits road attributes,
- WEPS (Application for evidence of traffic signalization) speed limits vertical traffic signage in line with national Policy for Traffic Signalisation and Road Traffic Equipment ("Pravilnik o prometni signalizaciji in prometni opremi na cestah« trenutno aktualna objava: Uradni list RS, št. 99/15, 46/17, 59/18 in 63/19).

A National Road Registry includes data about national road centrelines and intersections, technical characteristics of national roads and road facilities. It includes traffic signs information as well. The registry core is a graphical layer of national road axis including attributes about roads, road links, and road links mileages. Other road characteristics (like road width, number of driving lanes, road surface material, traffic load, etc.) are kept as an attribute data, the location of characteristics is defined as a mileage. A separate graphical layer of intersection points is also kept in the registry. Intersection point is defined for each crossing of categorized roads with other categorized or non-categorized roads, as well as for every point where road link characteristic is changed.

The most important source for vertical and horizontal signage is **WEPS - Application for evidence of traffic signalization** which is part of the National Road Registry Information Database. This web-based application enables the keeping of road signs and road surface markings cadastre directly through the internet. Attribute as well as spatial data for each element of traffic signs are being monitored. Several competent authorities can use the application (service for planning, subcontractors, controllers, etc.). The application enables tracking of all phases: planning, installation and the actual realization and subsequent maintenance. The application also enables the maintenance and display of historical data, attaching images and documents, performance of analyses and preparation of different reports, which also include the actual graphic image of every element in space. National Rules on Traffic Signalling and Traffic Equipment on Public Roads (Pravilnik o prometni signalizaciji in prometni opremi na javnih cestah Uradni list RS, št. 99/15, 46/17, 59/18) are not in accordance with EN ISO 14823, so transformation of codes (mapping) and additional processing for descriptive fields is needed for compliance with the interfaces, classes and datatypes, attributes and relationships of the TN-ITS service specification, as specified in CEN/TS 17268:2019. With the translation procedure more than 90% of vertical traffic signalisation were successfully transformed, and are included in the pilot with speed limits signs (line segments are mock-up data). Multiple location referencing methods are used: GML WGS84 String, INSPIRE linear location and OpenLR Location String.

General rules were taken from applicable regulation for season viable truck restrictions on weekends and were attached to the road segments.

Pilot solution is composed of modules: TN-ITS middleware repository and TN-ITS services.

Pilot TN-ITS middleware repository function is transformation and store of data in line with available input data formats and TN-ITS specification (CEN/TS 17268:2019) in relation to data types and used methods of location referencing.

6.1.3 Data Quality

TN-ITS service is available as is and data quality depends on quality of the sources and their maintainers which are trusted sources (state road database and motorway operator) and data from operational use was delivered. Some inconsistencies noticed by pilot implementer were removed and implementer stated that are the best available data for pilot network.

6.1.4 Data Storage

Central point of TN-ITS service deployment is **TN-ITS repository** (middleware) designed in regard to data structures described in standard SIST-TS CEN/TS 17268:2019 Intelligent transport systems - ITS spatial data - Data exchange on changes in road attributes. In that way close resemblance with needed data for physical exchange format - structure and encoding is achieved.

TN-ITS repository (middleware) is implemented in MS SQL server and dotNET technologies.

6.1.5 Data Back-up

TN-ITS service is implemented on National Traffic Management Centre (NTMC) IT infrastructure that offers high availability and security with regular back-up services.

6.1.6 Data Integrity and Security

Pilot TN-ITS service is available as is and as a snapshot of transformation of the state-of-the-art of the source data available at the end of 2020.

TN-ITS service is implemented on National Traffic Management Centre (NTMC) IT infrastructure that offers high availability and security according to security plan compliant with ISO/IEC 27001 standards.

6.1.7 Open Data

TN-ITS service is for now published free as open data and as the re-use of public sector information with the need for registration and access permission is granted from National Access Point personnel.

Licence details will follow in the process of the upgrade to the full TN-ITS implementation and will follow the Directive on open data and the re-use of public sector information, also known as the 'Open Data Directive' (Directive (EU) 2019/1024) entered into force on 16 July 2019..

6.2 Service roll-out procedures

Planned pilot phases for Slovenian TN-ITS GO pilot deployment were:

Phase 1: System design and development:

M1: TN-ITS service plan concept and initiation (Stakeholder consolidation Q3 2020 **done**)

M2: System analysis and Requirements with system design (available Q3 2020 **done**)

M3: Development and delivery of pilot TN-ITS service (available Q3/Q4 2020 **done**)

M4: Implementation plan for permanent TN-ITS service on state road network (Q4 2020 **done**)

Phase 2: Test and evaluation

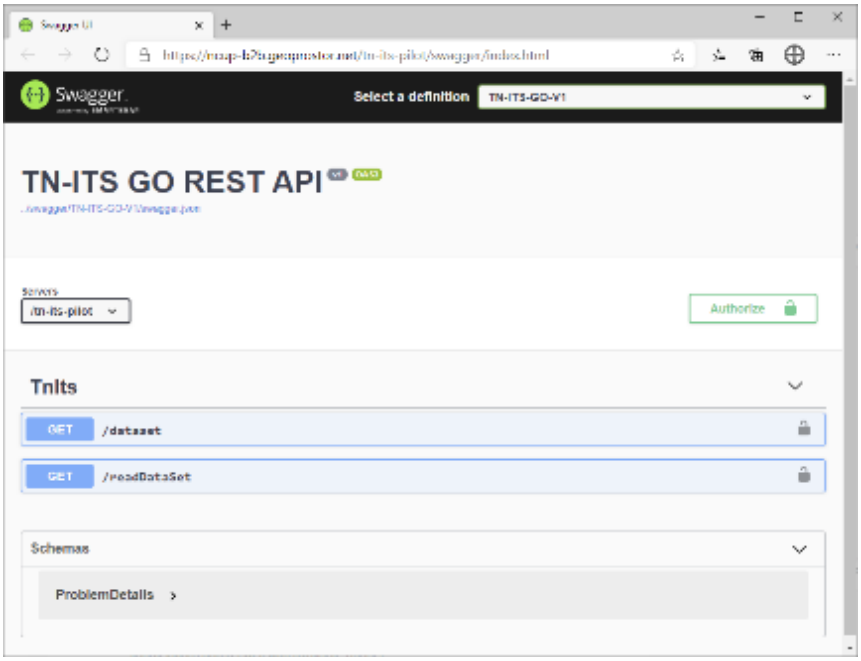
M5: Test activities (available by end of Q4 2020 **done**)

M6: Project (contracted deployment) closure by December 2020 (**done**).

Deliverables: Pilot deployment of TN-ITS service

- Analysis of data content and structure of available data for the deployment of TN-ITS service;
- Proposal for pilot deployment of TN-ITS structures on primary motorway network;
- Pilot deployment of TN-ITS service for motorway network (TN-ITS data sets: full data set minimum motorway road geometry with speed limits road attributes, speed limits and other vertical traffic signage, general rules for truck traffic limitations on weekends);
- Plan for the full deployment of TN-ITS service on the state road network (primary and secondary road network full TN-ITS service in compliance to SIST-TS CEN/TS 17268:2019 with the proposal for content and structural upgrades of road database parts for envisaged automatic fetch, extract, transform, load for TN-ITS service);

“Data Sender” TN-ITS pilot result sets download service is published at National Access Point for traffic data and information (https://www.ncup.si/en) operated and maintained by National Traffic Management Centre NCUP (NTMC). NTMC IT infrastructure will be used for the TN-ITS Repository which is part of the National Data Warehouse, since the transfer of pilot results. National Access Point was deployed in 06/2020 and is in full operation since the end of 2020.



Slovenian pilot TN-ITS download services are available at National Access Point

Deployment of the pilot TN-ITS GO services for Slovenian motorway network was implemented by the end of 2020 is available and will be evaluated in first half of 2021.

6.3 Experiences gained

Experiences gained during the preparation, designing, implementing and deployment of TN-ITS pilot in Slovenia are:

- Acknowledgement with the Rosatte and TN-ITS achievements.
- Acknowledgement with the Standard SIST-TS CEN/TS 17268:2019 Intelligent transport systems - ITS spatial data - Data exchange on changes in road attributes (Inteligentni transportni sistemi - Prostorski podatki ITS - Izmenjava podatkov o spremembah atributov cest) since its availability at “Slovenian Institute for standardisation” on 1/02/2019.
- Cross-institutional organisational, communication and legal issues challenging process of neglectable changes where multiple stakeholders are involved in collecting, maintaining and providing data (public sector, road operators, suppliers) with different competences, interests and cultures that impacts consolidated cooperation.
- Insight into state of the art of actual maturity level of national road data bank and national ITS systems and services with the vision of upgrades to achieve full TN-ITS service deployment in the future.
- Planning and the deployment of EU wide traffic information service on international level.

6.3.1 Implementation experiences

Full implementation experience will be available after the evaluation in 2021.

Pilot implementation was limited in scope (high level motorway network) in dependence of technical complexity of available data transformations (ETL: extract, transform, load of vertical signalisation) and as well with available budget.

Conclusions after pilot implementation are:

State Road Network in the road database contains all needed data attributes and is well documented for TN-ITS application; like geometry, direction and other attributes needed for location positioning (MultiLineString, INSPIRE linear location and OpenLR Location String). State Road Network is updated quarterly, while INSPIRE state network is updated yearly, for permanent TN-ITS service there is a need for at least monthly regular upgrades. Extraction possibilities for automation are also limited. Noticed are also some inconsistencies between map data and vertical signalisation regarding speed limits (missing data, different values or no attributes) that are eliminated.

Pilot TN-ITS service is implemented with discovery and download service scope according to the specification based on REST interface (available in 2020 at https://ncup-b2b.geoprostor.net/tn-its-pilot/swagger/index.html) and will be published at National Access Point (https://www.ncup.si/en).

6.3.2 Testing experiences

Testing experiences will be available 1Q of 2021 after successful pilot implementation with deployment on National Access Point and evaluation delivery. Planned is internal evaluation with testing of pilot activity results and later testing with map provider or providers.

6.4 Future proof

6.4.1.1 Proposals for improvement

During the TN-ITS GO pilot, data were fetched as available as one-time activity for the purpose of pilot delivery in 2020 and for the detailed insight into needed improvements in service chain to assure future planned permanent automatic TN-ITS service after 2021. Source data enhancements are needed in regard to missing digital attributes for vertical traffic signalisation, which were listed and described during the pilot for needed future upgrades of national road data bank to assure automatic transfer and simple transformation of road attributes to TN-ITS data warehouse.

6.4.1.2 Planning for introduction

Pilot deployment of TN-ITS service (minimum full data set motorway road network (>600km) geometry with speed limits road attributes, speed limits and other vertical traffic signage, general rules for truck traffic limits). Service or pilot result set will be published at National Access Point for traffic data maintained by National Traffic Management Centre (https://www.ncup.si/en).

TN-ITS service upgrades and service chain consolidation toward the full operational TN-ITS service is envisaged as permanent activity of National Traffic Management Centre after the transmission of TN-ITS GO pilot results in 2021.

Afterwards steps toward motivating or to commit municipalities will be necessary for covering whole public network of relevance and where transit or specific destination traffic appears.

Pilot TN-ITS GO results will be transferred to National Traffic Management Centre (NTMC), an internal organisational unit of Land Transport Directorate at the Ministry of Infrastructure, anticipated an as authority responsible for strategic traffic management at state level and the maintainer of the National Access Point for traffic data and information.

Dissemination activities for general professional community were delivered in the period of 2018-2019. By the end of 2020 and in 2021 all service chain stakeholders (public bodies, concessionaires and implementing bodies) will be notified of requested needed changes for source data to achieve permanent TN-ITS service for state network. After 2021 local 'comunites' (bigger cities) will be consulted to join the service with local level network.

7 Member State Portugal

7.1 Data store Maintenance procedures

Portugal's TN-ITS data service is derived from Infraestruturas de Portugal (IP) Enterprise GIS database national roads feature class and comprises the Portuguese Trans-European Global Network (TEN-T) road network, and Lisbon's metropolitan area high-performance road network information, presented in the next figure.

Figure 6: Portugal's TN-ITS road network

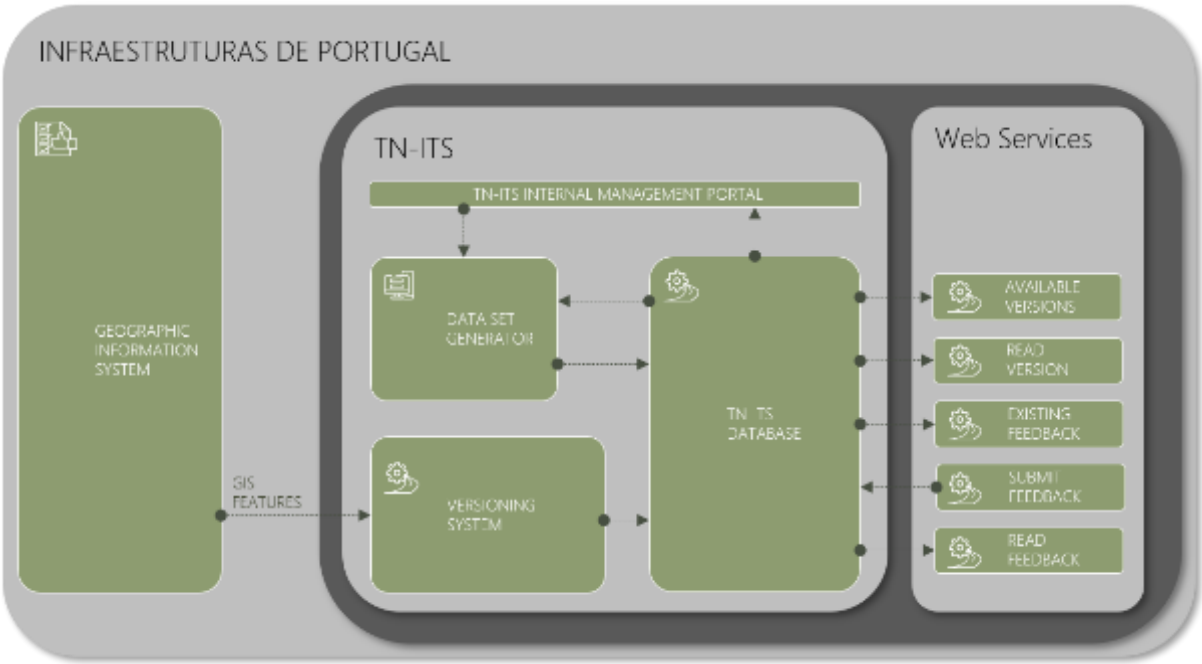


Figure 7: TN-ITS Portugal architecture

Portugal's TN-ITS system periodically fetches the up-to-date GIS features from the Infraestruturas de Portugal GIS service and incorporates them in its database. This process' frequency is customisable and is currently set to once per day.

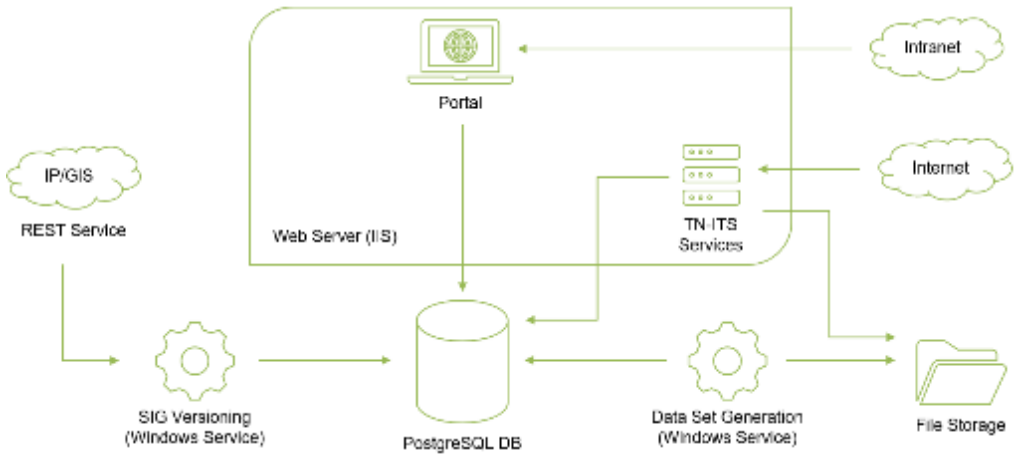


Figure 8: TN-ITS Portugal conceptual architecture diagram

Versioning the data and checking its consistency is part of the GIS feature importing process. Every batch of imported features constitutes an import version; these versions are used in the features' versioning, so that there is a history of the imported data.

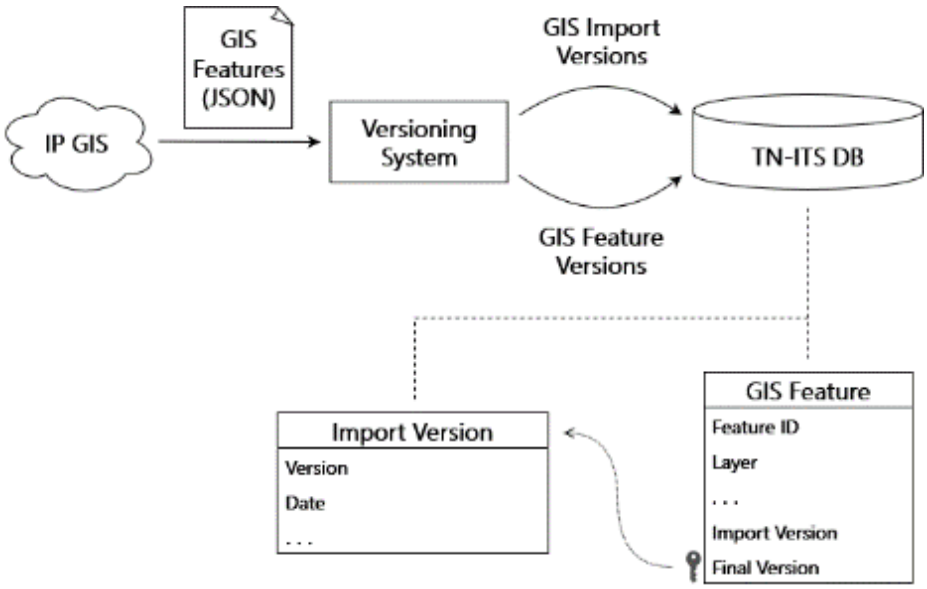


Figure 9: TN-ITS Portugal GIS data import and versioning process

7.1.1 Data creation

The actual PT road network is a wide and geographically dispersed network with more than 26.000 km. This network, owned by IP, is stored on a PostgreSQL database, periodically updated, mainly because of jurisdiction changes. The road network is a unique geographic table with more than 50 fields with multiple domains each one.

Municipal roads are not included. manages exclusively the National Road Network, which consists of motorways, main routes, complementary routes and national roads.

The publication of a single snapshot data set is currently planned, after which every publication shall be of an update data set.

- The first snapshot data set is generated manually and published.
- Periodically (at the moment, in a weekly fashion), an update data set containing the past week's modifications to the data is generated and published.
- Every published data set's URL is supplied through the TN-ITS Portugal web services.

7.1.2 Data Integrity & Security

The following procedures have been established to secure the validity, integrity, and accuracy of the TN-ITS data.

- All modifications to Infraestruturas de Portugal's GIS data are regularly versioned and stored in the TN-ITS database, provided the modified data is consistent.
- If the imported GIS data is not consistent, it will not be used in the generation of data sets, and alert e-mails are sent to the responsible parties, so that the issues can be fixed in a timely fashion.
- The TN-ITS feedback loop allows the TN-ITS data consumers to report any detected issues with the provided data sets.

7.1.3 Data storage and usage

The actual PT road network is stored on a PostgreSQL database, periodically updated, mainly because of jurisdiction changes.

7.1.4 Data sharing

Regarding data sharing the following procedures have been set:

- Periodically (at the moment, in a weekly fashion), an update data set containing the past week's modifications to the data is generated and published.
- Every published data set's URL is supplied through the TN-ITS Portugal web services.

7.1.5 Data archiving and destruction

The data in the TN-ITS database cannot be deleted. The obsolete data is versioned as such and is replaced by the updated data in subsequent data sets.

7.2 Service roll-out procedures

The Portuguese TN-ITS service was developed to ensure that a selected set of attributes related to the road network in IP's Enterprise GIS can be published through the service.

7.3 Experiences gained

7.3.1 Implementation experiences

Through the implementation, IP gained valuable experience on the specifications of the TN-ITS service which can shared with other member states who would like to create their own service.

7.3.2 Testing experiences

Output files from the TN-ITS Portugal service are being sent to map providers for testing.

7.4 Future proof

7.4.1 Proposals for improvement

IP's roadmap and long-term visions include the next steps to full coverage and full functionality.

IP's vision on the long run for such a service will enable a data chain for timely provision of information on changes in road attributes and other elements of the physical national road network infrastructure (about 14.000 km), and geometry, for inclusion in digital maps for ITS applications.

IP's actual and future framework comprises collection and maintenance of road network spatial data in an adequate digital map infrastructure and using adequate procedures, extraction at regular intervals of information on related changes, publication of such changes as sets of updates, implementation of the updates by ITS map providers in their digital maps, and provisioning of updates of ITS maps to end-users at similar regular intervals.
Furthermore, it is expected that once Portugal's National Access Point (NAP) is ready, TN-ITS data will be available through the Portuguese NAP as well.

8 Member State SPAIN

8.1 Data store Maintenance procedures

8.1.1 Procedures for Gathering / Deleting data / Data creation

To obtain the data from the Ministry of Transport, a web service has been provided from the Ministry itself, which can be accessed via a link, and from which data files can be downloaded in json format.

To obtain data from other operators, for the time being the regional government of the autonomous community of Galicia has been contacted, and the data is stored in an Excel file, which they shared by e-mail.

In the first case, the Ministry's data is downloaded weekly and stored on an own web server shared with DGT.

The own generated data is also currently stored on an own web server. It is expected that in the future this data will be stored on a DGT server.

8.1.2 Maintaining Data Quality

To monitoring and control the quality of the data, the generation of the file is checked manually every week.

In addition, weekly statistics are obtained on the number of signals contained in each file, the number of entries, the number of changes and the number of deletions. This is checked so that the numbers remain within a range and are consistent with current reality.

	November			
	Sem 2-8 nov	Sem 9-15 nov	Sem 16-22 nov	Sem 23-29 nov
Nº of signals in each file	*82493*	*82502*	*82527*	*82566*
Nº of entries	*131*	*68*	*135*	*80*
Nº changes	*34*	*353*	*21*	*19*
Nº removed	*99*	*59*	*110*	*41*

figure 2: weekly record of updated datasets

8.1.3 Data Sharing

TN-ITS Spain service is based on transfer, translation, and load of existing data from the Ministry of Transport and Mobility. These datasets are obtained from a web service and store on a TN-ITS repository after being translated. After that, TN-ITS publishing service will be

deployed on National Access Point, maintained by traffic engineers from the General Traffic Directorate.

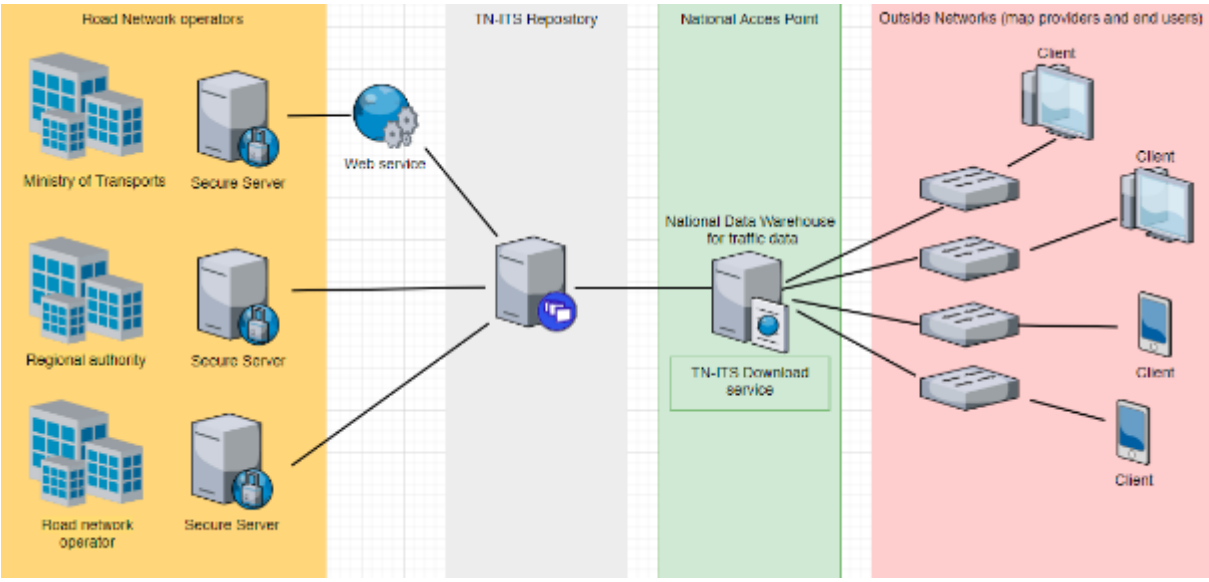


figure 3: TN-ITS data repository Spain

8.1.4 *Storage and usage*

For backing up database and log files are copied to an offline storage area. To create an offline backup, the procedure is as follows:

- Stop all on-going transactions.
- Pause all database writes.
- Copy all files to the backup location.

8.2 Service roll-out procedures

Currently, Ministry of Transports and Mobility is the unique data provider. In consequence, TN-ITS contains TEN-T road network in Spain, and the main road network (own by the state).

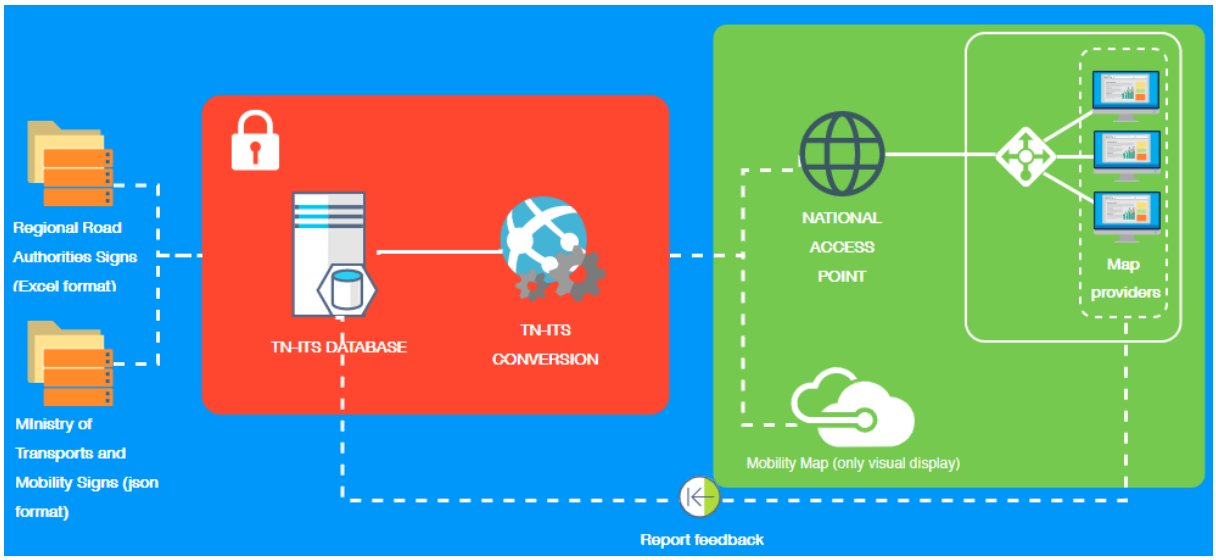


figure 4: TN-ITS Spain global procedure

Datasets contains the following objects:

- Road
- Road link
- Id
- Provider Id
- Signal position
- Signal value (maximum speed limit)
- Direction

From this point on, the information undergoes the following process:

- Every Monday, we access the web service that contains the information on vertical signage.
- http://export.fomento-inca.com/R-301.json
- A .json file is downloaded from this web service. Once this file is obtained, an .xml file is produced with the changes recorded according to the TN-ITS format.
- Subsequently, the link to this file will be accessible from the NAP of DGT.

8.3 Experiences gained

8.3.1 Implementation experiences

The experiences gained in Spain during the process are:

- Knowledge of the Rosatte standard, especially with regard to translation process.
- Cross-institutional communication barriers between stakeholders involved in collecting, maintaining and providing data with different systems for information exchange.
- Coordination of different parties, for legal and administrative issues.
- Knowledge of current state of national road data bank related to vertical speed limitation signs.

8.3.2 Testing experiences

Currently under evaluation. Some output files from the TN-ITS Spain service are sent to map provides for testing. Feedback has been received from Here that they need the direction or orientation of the signal to be indicated, i.e. instead of Points Format, Linear Format is needed, and if it is on the main road or at exits or entrances as well. Already included in the files as Linear reference:


```
my-file: Bloc de notas
Archivo  Edición  Formato  Ver  Ayuda
<rst:GenericSafetyFeature gml:id="948524">
    <rst:id>
        <rst:SafetyFeatureId>
            <rst:providerId>ICEACSA</rst:providerId>
            <rst:id>d5e4afee-0c50-485e-bd99-a450d584d724</rst:id>
        </rst:SafetyFeatureId>
    </rst:id>
    <rst:locationReference>
        <rst:INSPIRELinearLocation gml:id="7487">
            <net:SimpleLinearReference>
                <net:element xlink:href=""/>
                <net:applicableDirection>Increasing</net:applicableDirection>
                <net:fromPosition uom="meter">355.906</net:fromPosition>
                <net:toPosition uom="meter">356.103</net:toPosition>
            </net:SimpleLinearReference>
        </rst:INSPIRELinearLocation>
    </rst:locationReference>
    <rst:locationReference>
        <rst:OpenLRLocationString  gml:id=""/>
    </rst:locationReference>
    <rst:locationReference>
        <rst:AgoraLocationString gml:id=""/>
    </rst:locationReference>
    <rst:updateInfo>
        <rst:UpdateInfo>
            <rst:type>Modify</rst:type>
        </rst:UpdateInfo>
    </rst:updateInfo>
    <rst:source>Regulation</rst:source>
    <rst:encodedGeometry>
        <gml:LineString gml:id="7487" srsDimension="2">
            <gml:posList>39.0117311384927 6 ,39.0117311384927</gml:posList>
        </gml:LineString>
    </rst:encodedGeometry>
    <rst:type>SpeedLimit</rst:type>
    <rst:properties>
Ln 329448, Col 37
```

8.4 Future proof

8.4.1 Proposals for improvement

The TN-ITS service in Spain will be expanded along two lines. On the one hand, a future expansion of the service will include more attributes. In this sense, the next attribute that is expected to be incorporated is related to vehicle restrictions.

On the other hand, it is intended to incorporate additional roads that are maintained by other road authorities in Spain, in particular, regional roads.

In addition, if it were needed to improve the service, the frequency of the snapshot data set could be published daily instead of weekly.

8.4.2 Planning for introduction

At the moment, there is no time planning for the introduction of new attributes and roads.

During 2021 regional authorities will be consulted to join the service as the introduction of new roads depends on other owners and operators, but it is complicated to have a temporary schedule of when they could provide the information.

9 ‘Leading’ Member states reporting section

This section contains the report of the following member states:

- Flanders (Belgium)
- France
- Finland
- Sweden
- UK

CHAPTERS TO COME

10 Summary and Conclusion

This section is an analysis of all member states inputs and tries to formulate an overall conclusion and guidance. (Lead Editor is task lead with co-operation of task contributors).

10.1 Data store Maintenance

All MS have setup a solid process for gathering and processing TN-ITS GO data. Most of the MS have processes ready for the different states TN-ITS GO data can be processed. Also ensuring data quality by having good security practices are in place. Although not every MS has shown that data integrity and availability is part of the assurances. Depending on the technical set up, data integrity and availability is necessary to uphold good and up-to-date TN-ITS GO data.

10.2 Service roll-out

Just like the data-store maintenance, there is a solid understanding of service roll-out. Every MS has a good process to ensure the TN-ITS GO roll-out. Although most of the MS are in the middle of developing and/or implementing the TN-ITS GO pilot, the service roll-out is under construction as we speak.

10.3 Experience gained

The implementation experience shows that the development of TN-ITS GO is not a one organization process. Every MS has to cope with different stakeholders with different reasons. Other implementation experiences are technical related.

Test experience is not yet fully gained, because not all MS are in the test phase. Only a few MS are in process with the mapmakers.

10.4 Future proof

Most of the MS are planning attribute extensions are developing more automation in the TN-ITS GO process. The road authority in every country is organized in a different way. Not all highways or TN-ITS related roads are owned by the participated road authorities. But it is expected that roads owned by related authorities will be added to the TN-ITS GO datasets.

Future proof enhancements are to be expected after the pilot phase is completed. Not all MS have concrete timelines for implementing the enhancements.

11 Status overview

The following picture gives a visual status overview of the established data store maintenance.

procedures per country (Status 8-12-2020)