TN-ITS Ecosystem – Alignment and Harmonisation

Contribution from Sub-Working Group 4.2

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Abstract

This document contributes to Task 4.1 Identification of standards ecosystem and describes the approach of SWG4.2 to feed the WG4 with information regarding stakeholders, focus area, data chain, etc. It clarifies the position of TN-ITS as a road data exchange mechanism in the wider European mobility standard eco system and prepares the definition of the road map for the alignment envisaged in NAPCORE.

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Abbreviations

Abbreviation	Meaning
ADAS	Advanced Driver Assistance Systems
CCAM	Cooperative Connected Automated Mobility
CEN	European Committee for Standardization
CWA	Closed World Assumption
DATEX	DATa EXchange between traffic and travel information centres
eMaPS	eSafety Digital Maps Public Private Partnership Support Action
ERTICO ITS Europe	European Road-transport Telematics Implementation Coordination Organisation
GDF	Geographic Data Files
GML	Geography Markup Language
INSPIRE	Infrastructure for Spatial Information in the European Community
MS	Member States
NAP	National Access Point
NAPCORE	National Access Point Coordination Organisation for Europe
OADF	Open Autodrive Forum
OCL	Object Constraint Language
OWA	Open World Assumption
REST	REpresentational State Transfer
ROSATTE	Road Safety Attributes Exchange Infrastructure in Europe
RTTI	Real-time Traffic Information
SWG	Sub Working Group
TEN-T	Trans-European Transport Network
TN-ITS	Transport Network Intelligent Transport Systems: www.tn-its.eu
UML	Unified Modeling Language
WG	Working Group
XML	Extensible Markup Language
XSD	XML Schema Definition

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1. NAPCORE SWG4 Harmonisation and Alignment

1.1. Context

The SWG4 aims to the development and enhancement of standards and the alignment between current EU actions and the enablement of harmonisation. In this respect, it establishes coordination between the different data standards approaches and defines a common roadmap for data standardisation and publication. In particular considering the current and future needs in the framework of data standards in EU mobility data exchange the following SWGs were defined:

- SWG 4.1: DATEX II
- SWG 4.2: TN-ITS
- SWG 4.3: Multimodal data
- SWG 4.4: Metadata

1.2. Activity 4.2.1 – Harmonisation and Alignment

The alignment challenge is addressed through a common task between all SWGs, where all SWGs will co-design the roadmap for data standards analysis towards harmonisation. In combination with other activities under SWGs, the identification of complementary actions needed (e.g. conversion, choice of one specification/standard etc.) to enable interoperability in EU is another key aspect of SWG4.0.

NAPCORE Task 4.0.1, as defined in the SWG4.0 Work Plan 2022 refers to the identification of the current ecosystem for the provision of changes static road data in the framework of NAPs or other related activities and initiatives. More specifically, this includes:

- Identification of standardisation stakeholders and their role
- Identification of standardisation activities and their scope
- Identification of developed and existing standards linked with services/or data categories

NAPCORE Task 4.0.2 - on the definition of the roadmap for harmonising the way in which mobility data is provided, will be presented in another report by the end of 2022.

Nr.	ECOSYSTEM DESCRIPTION	Due dates
M.4.0.1	**Ecosystem described and role of standards in relation to services documented**	6/2022
	Constitution of a dedicated task force	1/2022
	Definition of the scope of the study	2/2022
	Collection of inputs from different experts	3/2022
	Consolidation of all contributions at task force level	4/2022
	Review between working group and sub working groups leaders	5/2022
	Finalization and submission of the documented cartography	6/2022

Figure 1: Steps towards the description of the NAPCORE standards ecosystem, from the SWG4.0 work plan 2022.

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1.3. Methodology

As mentioned above, this report aims to summarise the contribution of Sub-Working Group (SWG) 4.2 to the aforementioned tasks, from the TN-ITS "data standard" perspective, while presenting the adopted methodology (**Fout! Verwijzingsbron niet gevonden.**). In the context of TN-ITS, the term data "standard" does not refer to a formal international data standard, as for example a CEN EN as European Standard, but to the situation that it is the de-facto European technical description for the exchanges of changes of road data. Essentially, the TN-ITS "standard" is officially a CEN Technical Specification (TS), and was released in December 2018.

Figure 2: Methodology adopted by SWG4.2 Task 4.2.1 to contribute to the definition of the standardisation ecosystem as input to a coordination activity to guide the definition of a roadmap for harmonisation and alignment.

2. SWG4.2 TN-ITS ecosystem description

The objective of this document is to present an overview of TN-ITS in the mobility data standard eco-system and serves as input to an aligned perspective in NAPCORE. The coordination to obtain the aligned perspective is with the French ministry.

The document starts by introducing the key TN-ITS characteristics then continues on the TN-ITS background initiatives, such as ROSATTE and TN-ITS GO, and elaborates on the key elements:

- the community involved in (funded) projects to advance the road data exchange,
- the stakeholders in the data chain,
- a visualisation of the data chain,
- the status of the technical specification.

The document then continues to discuss the current views by presenting different perspectives which are typically use case specific (e.g. with ADAS, Autonomous Driving, C-ITS, CCAM applications in mind).

3. TN-ITS scope, normative references and background

3.1. TN-ITS scope

Key elements of the TN-ITS framework can be summarized as follows:

- **Motivation**: TN-ITS supports the harmonised exchange of changes of road data in Europe, typically between road authorities as data providers and map and service providers as data users, with the goal to facilitate the maintenance of digital map databases – by means of authoritative data - as a basis for serving existing and novel ITS services and applications.

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- **Key drivers**: Right from its start, TN-ITS envisaged road safety (via map-enabled ADAS), efficient and green mobility, by the reuse of authoritative information, as principal drivers.
- **Enablers**: Main enablers are digitalisation, automation (e.g. of the data ingestion technology at data users side), Open Data (as evolution and adoption of OD data licenses), map agnostic location referencing (e.g. OpenLR), community (TN-ITS as member platform), standardisation (CEN Technical Specifications), etc. .
- **Data model:** The TN-ITS model is very generic, with one class representing any road feature and one class representing any property for the feature. Code values from code lists maintained outside of the model are used for describing the type of feature, type of property and also property values. This is inspired by the Open World Assumption (OWA) known from the Semantic Web, see below.
- **Data types**: Whereas the technical specifications support the (revised) RTTI data types 2022/670 and more (e.g. Infrastructure Support for Automated Driving – or ISAD levels), the operational TN-ITS data publishing services typically focus on sharing speed limits and basic road information (name, restrictions, warnings) as point features (signs) and as line features (linear road attributes).
- **Data formats**: Changes of road information are described in XML datasets. Schema files, WADL, code lists, etc are available for developers via the platform website. More advanced Linked Data representations (OWL and RDF) are being explored, more work will be done in NAPCORE A4.2.3.
- **Data standard:** CEN Technical Specification 17268 released in December 2018.
- **Deployment**: The TN-ITS GO project resulted in setting up TN-ITS services or datasets by 13 EU authorities, a majority as pilots, reflected by limited geo coverage and data types, and unclear strategy towards further deployment. About 5 countries are currently running an operational TN-ITS service: road data changes are published frequently and for a vast portion of their road network.
- **Network coverage:** TN-ITS can be used for all public roads, primarily focused on motorized transport, but a minimum of (revised) TEN-T coverage is expected by the European Commission and by the leading map and service providers.
- **Update frequency**: TN-ITS datasets are made available by road authorities typically on monthly basis. In some occasions, daily updates are shared too.
- **Feedback loop:** The TN-ITS specification describes an optional feedback loop mechanism for data users to provide comment back to the authority which provided TN-ITS datasets. This information serves to report back, e.g. on (un)successful processing, spatial matching, non-compliance with technical specification, etc.
- **Normative references**: e.g. GDF, DATEX, GDF (see below) – following INSPIRE requirements.
- **Stakeholders and roles:** road/transport authorities and operators as data collectors, aggregators and TN-ITS data publishers, (commercial) map and service providers as data users, platform organisation as coordinator/custodian (documents, tools, digital files related to the technical specifications, etc.). See below.
- **Governance:** TN-ITS is an innovation platform by ERTICO ITS EUROPE. It is a multi-stakeholder membership organisation, uniting (road) authorities, industry (map and service providers) and A Terms of Reference presents the platform's mission & vision, roles, actions, fees, etc. There is a Management Team meeting every week, a Board meeting every month and a yearly General Assembly.

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- **Standard and standardisation**: the TN-ITS CEN Technical Specification was released as TS 17268 in December 2018. The TN-ITS platform is officially a CEN Liaison Organisation and supports Technical Committee TC278 Work group 7. See below.
- **Regulation**: the RTTI Delegated Regulation 2022/670, supplementing Directive 2010/40/EU, explicitly mentions TN-ITS as the mobility data standard to adopt by authorities to share changes of road data.
- **Overlaps with other Mobility Data Standards:** TN-ITS describes static road data (types) in other mobility data standards as DATEX II, Transmodel/NETEX/SIRI- yet focuses on the changes thereof.
- **Metadata: TN-ITS adopted** ISO 19115:2014 which defines the schema required for describing geographic information and services by means of metadata. It provides information about the identification, the extent, the quality, the spatial and temporal aspects, the content, the spatial reference, the portrayal, distribution, and other properties of digital geographic data and services.
- **National Access Points:** TN-ITS data/services are mentioned on several NAPs in Europe, as more data becomes available by authorities/cities, more NAPs will include this information.

3.2. TN-ITS normative references

The table below indicates some key normative references used in the TN-ITS technical specification.

TN-ITS TS key elements	Referenced norm	TN-ITS Situation
Conceptual data content specification	EN ISO 19109 (INSPIRE requirement)	Part of TS
Road sign types	ISO 14823	In code list
Conditions	CEN TS 16157 - EN 16157	Part of TS
Metadata	ISO 19115 (INSPIRE requirement)	Part of TS
Location Referencing	ISO 17572	Part of TS
UML	ISO/IEC 19505	
OpenLR	Open Industry Standard	
GML	EN ISO 19136	

Table 1: Key normative references used in TN-ITS Technical Specifications.

In general, some or all of the content from the references below were reused for the TN-ITS Technical Specification, see table below.

Standard	Description
EN ISO 14823	Intelligent transport systems - Graphic data dictionary
EN ISO 14825	Intelligent transport systems - Geographic Data Files (GDF)
EN ISO 19107	Geographic information - Spatial schema
EN ISO 19108	Geographic information - Temporal schema
EN ISO 19109	Geographic information - Rules for application schema
EN ISO 19111	Geographic information - Spatial referencing by coordinates
EN ISO 19115-1:2014	Geographic information – Metadata – Part 1: Fundamentals
EN ISO 19115-2	Geographic information – Metadata – Part 2: Extensions for imagery and gridded data
EN ISO 19136	Geographic information - Geography Markup Language

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EN ISO 19148	Geographic information - Linear referencing
ISO 17572-3	Intelligent transport systems (ITS) - Location referencing for geographic databases - Part 3: Dynamic location references
ISO 19103	Geographic information - Conceptual schema language
ISO/TS 19115-3	Geographic information – Metadata – Part 3: XML schema implementation for fundamental concepts

Table 2 : Standards referred to by the TN-ITS Technical Specification 17268:2018

3.3. TN-ITS in the European NAPs

After the TN-ITS GO project was concluded in December 2021, road authorities in 13 MS across Europe had deployed operational or pilot TN-ITS services. At the time of writing, their presence was picked up by a number (6) NAPs. Some countries have indicate that they are redesigning their TN-ITS service and as they are doing so, it is not announced on their respective NAPs.

EU NAPS	TN-ITS Mentioned	Link to TN-ITS on the NAP	NAP link
Austria	No		https://www.mobilitydata.gv.at/
Belgium	Yes	https://www.transportdata.be/en/dataset/tn-its	https://www.transportdata.be/en
Bulgaria	No		https://lima.api.bg/dashboard
Cyprus	No		http://www.traffic4cyprus.org.cy/trafficapp/?wp=index-en
Croatia	No		https://www.promet-info.hr/en
Czech republic	No		https://registr.dopravniinfo.cz/en/
Denmark	No		https://du-portal-ui.dataudveksler.app.vd.dk/
Estonia	No		https://tarktee.mnt.ee/#/en
Finland	Yes	https://vayla.fi/en/transport-network/data/digiroad/dat	https://vayla.fi/en/transport-network/data/digiroad
France	No		https://transport.data.gouv.fr/
Germany	No		https://service.mdm-portal.de/mdm-portal-application/index.do
Greece	No		http://www.nap.gov.gr/
Hungary	Yes *	https://napportal.kozut.hu/en/#/search/metadata	
Ireland	No		https://data.gov.ie/
Italy	No		https://www.cciss.it/web/cciss/
Latvia	No		https://lvceli.lv/en/road-network/statistical-data/transport-sector-open-data/
Lithuania	Yes	https://www.visimarsrutai.lt/gtfs/	
Luxembourg	No		https://data.public.lu/fr/
Malta	No		NAP not found
Netherlands	Yes	https://nt.ndw.nu/#/settings/actual-traffic-overview/91	
Norway	No *		https://transportportal.atlas.vegvesen.no/en/
Poland	No		https://kpd.gddkia.gov.pl/index.php/en/homepage/
Portugal	No		https://nap-portugal.imt-ip.pt/nap/home
Romania	No *		NAP not found
Slovakia			https://odoprave.info/wps/portal/pub/Home/uvod
Slovenia	Yes	https://www.ncup.si/en/tn-its-go	
Spain			https://nap.dgt.es/
Sweden	Yes *		www.trafficdata.se
UK	No		https://www.data.gov.uk/

Table 3 Overview of TN-ITS mentioned on NAPs. Orange indicates services in revision, which will be referred to later in the countries' NAPs when these become available.

3.4. Standardisation activities and their scope: ROSATTE

3.4.1. Overview

The concept of the ROSATTE data chain emerged from work in the EU-funded project PReVENT/MAPS&ADAS (February 2004 - January 2007) on safety-related road attributes for ADAS applications, and work in the EU-funded SpeedAlert project (May 2004 - June 2005) on speed limit information in digital maps. ITS applications for enhancing safety, efficiency and comfort of road transport require a highly up-to-date road network database. It was realised that for keeping their map databases up to date, map providers need to cooperate closely with road authorities. Once a road authority stores and maintains its road network data in a digital system, retrieval of any changes entered would be straightforward, and the map providers (and other road data users) could receive immediate updates. See Figure 3 for the data chain as it was envisaged at that time. The concept of a

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data chain from public road authorities to providers of digital maps for ITS applications was further elaborated in the EU-funded ROSATTE project (January 2008 - June 2010).

The ROSATTE project aimed at establishing an efficient and quality-ensured supply chain for information on safety-related road attributes, from public authorities to commercial map providers and other road data users, with a focus on changes in the concerned attributes rather than full data sets. This concerns explicitly static road side information, i.e. road attributes that are of a more or less permanent nature, and not dynamic information, for which other channels are being used. The basic thought behind ROSATTE was that for information on changes in static road attributes, the public authorities, who create the changes, are the most efficient and immediate source. Prerequisites for setting up such a data chain are adequate systems and databases (ICT/GIS), and procedures for data maintenance and quality at road authorities, and an adequate common data exchange infrastructure for extracting and publishing the information on changes (updates), able to cope with the multitude of systems and data models that are and will be in use on the side of public authorities across Europe. ROSATTE worked on both topics, and especially developed, specified and tested an exchange infrastructure.

3.4.2. Project community

The project members consisted of road/transport authorities (federal and regional from Norway, Sweden, France, Flanders, Germany, UK), a road operator (ASFA), ICT and geo technology companies (TRIONA, PTV), map makers (Tele Atlas - now TomTom - and Navteq – now HERE Technologies), research organisations (SINTEF, University of Stuttgart) and the coordinator (ERTICO).

3.4.3. Data chain stakeholders

Involved / Identified stakeholder and their role represent:

- Public organisations – data collector, aggregator and publisher
    - Road administrations
    - Transport ministries
    - Public transport authorities
- Private organisations
    - Motorway operators – data aggregator and publisher
    - Map providers – data user
    - Service providers (ICT) – service developers
    - Service providers (Geospatial) – service developers
- Coordinators
    - Platform / member organisation – coordination and custodian

3.4.4. Data Chain descriptions

The SpeedAlert project was one of the first initiatives which presented a comprehensive description and visualisation of the high level data chain relevant for the exchange of changes of authoritative road data. The bottom half of the figure depicts how updated maps - or map updates - found their way to the system in the vehicle. In later descriptions, this “second” data chain is no longer the focus.

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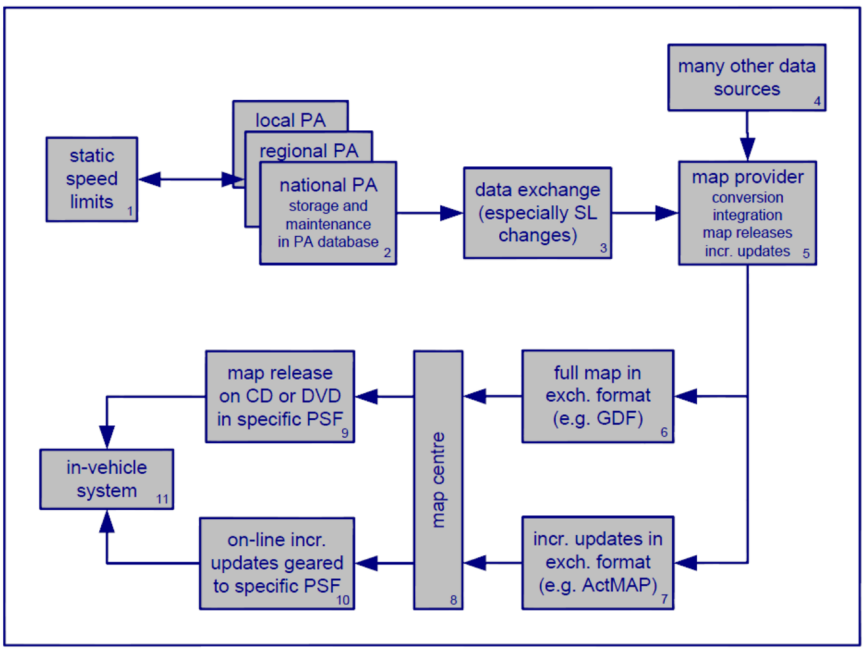

Figure 3 : The data chain for static speed limits as envisaged in the SpeedAlert project. Source [3].

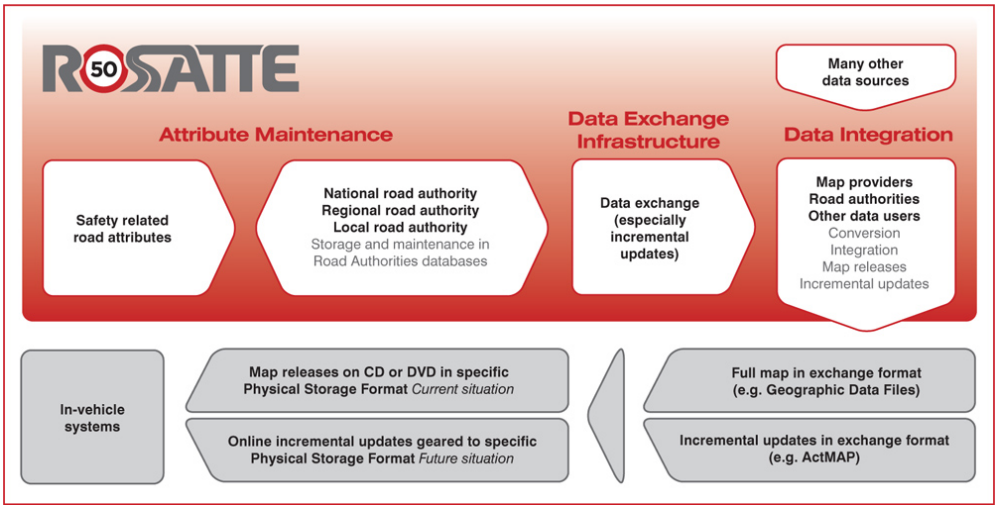

Figure 4 : The data chain according to ROSATTE – shown in the red area.

3.4.5. Status standardisation

By the end of the ROSATTE project, the technical specifications describing the exchange of changes of road data were presented in Deliverable RST-D31-Specification-of-data-exchange-methods-v16 which was produced by TRIONA and NAVTEQ and released on 31-08-2009. This document specifies the general outline of the data exchange methods. The core part of the document provided the specification of a mechanism for data exchange of road safety information. It provided especially:

- A conceptual specification of the data content (information model). This is done using UML (packages, class diagrams, attributes, associations and OCL constraints).
  The data content specification is organized in a number of packages where each package corresponds to a separate subset of the ROSATTE domain.

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- A physical exchange format (structure and coding using GML schema) to specify a coding for the various types of data listed under the conceptual model.
- A service specification is implemented using UML (class diagrams), in order to facilitate the actual data flow between the various actors within ROSATTE. This service specification is inspired by INSPIRE network services architecture.

After full consolidation of these specifications, the data exchange specification was given, which implemented the conceptual specification as XML-schema definition (XSD) and an implementation of the service specification as web-service was provided. An implementation specification according to REST was defined.

This technical specification was the guiding specification for the pilot and later operational ROSATTE services. Much later, in 2018, served as input for a CEN project team, see CEN chapter below.

3.5. Standardisation activities and their scope: TN-ITS Platform

The TN-ITS platform was officially set up in 2013 in Dublin at the ITS Europe Congress. Its creation was prepared in a funded EU project eMaPS (as ROSATTE implementation project). The TN-ITS platform is currently an ERTICO Innovation Platform. Today, its core members (figure below) are complemented by almost all the NAPCORE partners, see figure below. The NAPCORE partners support the definition of the standards ecosystem and the roadmap for harmonisation and alignment of the mobility data standards.

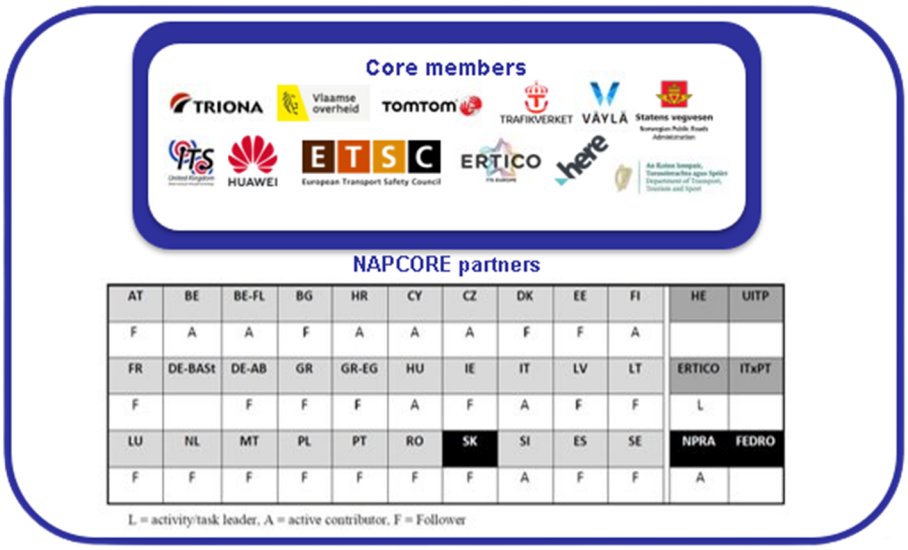

Figure 5: The data chain according to ROSATTE – shown in the red area.

3.6. Standardisation activities and their scope: EU-EIP Sub Activity 4.7

The findings of the European ITS Platform (EU-EIP) are bundled in a book, see sources. The contribution of TN-ITS is reflected in Chapter 8.

3.6.1. Overview

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Sub-Activity 4.7 of the EU EIP project (2016 - 2017) was called "Provision of updates of ITS spatial road data" and was closely connected to the work of TN-ITS. The objectives of the sub-activity were the following

- First basic TN-ITS implementation in each of the five Member States involved in this sub-activity, addressing a limited set of attributes, and addressing only the main corridors, to gain experience for future further roll-out of the service to the comprehensive network, and to get a thorough understanding how the service can be modelled in relation to the existing infrastructure for storing spatial road data
- Identification of enhancements needed for the existing infrastructure to better accommodate the intended service
- Investigation of existing procedures for the instantaneous updating of the stored spatial road data for changes in the real world, and proposals for improvement

The work of this Sub-activity concerned the implementation of the TN-ITS exchange framework infrastructure in the five involved EU Member States: Finland, Flanders/Belgium, the United Kingdom, Ireland and France. In the pilot TN-ITS implementations were realised in Norway and Sweden, which are currently operational. It should be noted that each of the Member States had a different starting point. In Sweden, a first TN-ITS service was up-and-running in 2014. Finland finalised its implementation by May 2016.

The TN-ITS sub-project started January 2016. The ITS map providers HERE and TomTom were again involved for testing their part of the data chain for each of the five Member States, as well as for advice, while TN-ITS (through ERTICO-ITS Europe) acted as the coordinator of the Sub-activity. The pilot also involved exploration of the use of INSPIRE data through the European Location Framework (ELF) platform, especially for solving difficult cases of TN-ITS updates in terms of failing interpretation of the location code in the update message. For this, the option to add an INSPIRE-based linear reference code to TN-ITS update transactions, to enable quick access in the originating map database for visual inspection of the local situation, was considered.

The EU EIP action has enabled TN-ITS to progress towards a pillar in the today's European public mobility data space, accessible in today's and future deployed NAPs, being organised by each Member State.

3.6.2. Project community

EU EIP Sub Activity 4.7 project partners were ERTICO/TN-ITS (project leader), Finland (FTA), Flanders (MOW), United Kingdom (DfT), Ireland (DTTaS and NUIM), France (IGN), HERE (The Netherlands), TomTom (Belgium).

3.6.3. Data chain Stakeholders

Involved / Identified stakeholder and role present:

- Public organisations – data collector, aggregator and publisher
  - Road administrations
  - Mapping agency
- Private organisations – data user
  - Map & service providers
- Coordinators
  - Platform / member organisation – coordinator and custodian

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3.6.4. Data Chain visualisation

The overall data chain SA4.7 shown below is a generalisation. Each project partner shared their specific data chain offering more details, e.g. on the architecture reflecting the infrastructure to collect changes as and process them in a central database from which TN-ITS updates are then generated.

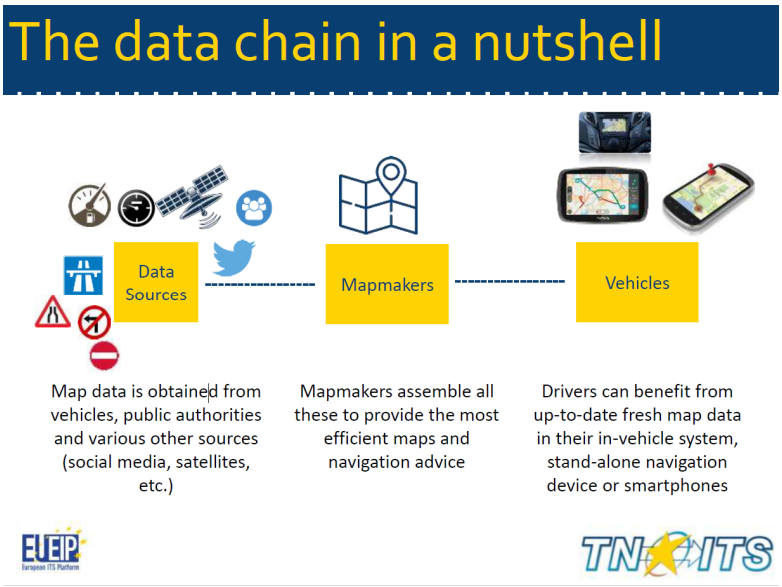

Figure 6 : EU-EIP data chain

3.6.1. Status standardisation

No formal standardisation activity was taken up during the EU EIP project, yet relevant project findings were considered in the development of the CEN Technical Specification in the year after the project had ended, see below.

3.7. Standardisation activities and their scope: CEN Technical Specification (TS)

In 2018, with financial support by the Commission and under responsibility of the a National Standards Body (NEN), a dedicated project team of mobility data experts joined forces to bring the ROSATTE specification to the level of a CEN Technical Specification and taking into account the conclusions formulated in eMaPS deliverable D2.32 "Report on standardisation activities of ROSATTE framework". A second task was the alignment of the specification with INSPIRE according to the recommendations formulated in the report of the study carried out in the EU-funded project eMaPS on technical alignment of ROSATTE with INSPIRE (eMaPS deliverable D2.41). The CEN Technical Specification 17268 was released in December 2018. In June 2022, the outcome of a ballot by CEN related to the Systematic Review (SR) of a TS, recommends the revision of the TS. This revision will require 18 months and therefore allows for the findings of NAPCORE on SWG4 to be addressed.

In 2021 TN-ITS (GO) became an official CEN Liaison Organisation – strengthening the link between the organisations. It offers TN-IT'S access to the relevant CEN documentation directory, the Technical Committee 278 W7, and provides information to CEN regarding the platforms' strategic aspects, activities, members, cooperations, etc.

The TN-ITS model is very generic, with one class representing any road feature and one class representing any property for the feature. Code values from code lists maintained outside of the model are used for describing the type of feature, type of property and also property values. The standardized

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codelists are available at http://spec.tn-its.eu/codelists/. The generic model with external code lists is a very flexible approach, inspired by the Open World Assumption (OWA) known from the Semantic Web. The code lists can be extended without the need for a revision of the CEN/TS, and providers can create specific national code values if needed. At the same time, the specification has a stable set of standardized code values.

The OWA-based approach of the TN-ITS specification differs from the INSPIRE and DATEX II specifications, where more specific classes are defined, with more specific properties. INSPIRE has external code lists defined in the INSPIRE Registry, while DATEX II model even has code lists and enumerations included in the UML model. The DATEX II model can therefore be considered to be according to the Closed World Assumption, which makes it more stable, but also less flexible. The INSPIRE specification with external code lists is less closed, while the TN-ITS specification is the most open and flexible model, yet stable due to the standardized code lists.

3.8. Standardisation activities and their scope: TN-ITS GO

3.8.1. Overview

TN-ITS GO was an EU funded project which started in January 2018 and ended in 2021. The project vision was to bring updated map data to intelligent transport services and continued on the work performed in ROSATTE, EU EIP S4.7 and CEN TS 17268. The project aimed to further facilitate and foster the exchange of ITS-related spatial road data between road authorities as trusted data providers, and, data users as map makers and other parties. TN-ITS GO aimed to enhance the quality of existing TN-ITS services. In total 13 TN-ITS services were developed or matured in EU countries, most considered in pilot phase sharing changes of road data for a limited geographical coverage (TEN-T – or part of it) and limited set of data types. The project described detailed implementation plans and realisations at the side of road authorities, including the steps towards operational services. Important results relate to the evaluation of the services by leading map and service providers, the advance in technical specifications (new datatypes, updates for the CEN TS), a guideline for implementation, and the definition of the data chain requirements.

3.8.2. Project community

Partners in the project were: ERTICO ITS Europe (coordinator), IGN (FR), MOW (FL), RWS (NL), KOZUT (HU), PWD (CY), LRA (LT), STA (SE), DFT & DTTAS (IE), FTA (FI), IP (PT) AVP (SI), DGT (ES), ERA (EE), ICCS & ERA (GR), ETSC, TomTom, and HERE.

3.8.3. Data chain Stakeholders

Involved / Identified stakeholder represented:

- Public organisations – data collector, aggregator and publisher
    - Road administrations
    - Mapping agency
    - Research organisations – supporting road authorities
    - Commission (guiding regulations and funding)
- Private organisations – data users

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    - Map & service providers
- Associations
    - Coordinator – ITS Platform / member organisation – coordinator and custodian
    - Road safety association – define and promote TN-ITS implementation guidelines

Liaisons established during the project:

- CEN – officially connected as Liaison Organisation
- SENSORIS – (vehicle) sensor interface specifications : innovation platform of actors committed to defining this global standardised interface that will result in new services and increased business opportunities.
- DATEX2 – dynamic traffic information
- OADF – Open AutoDrive Forum : platform for cross-domain topics in the area of autonomous driving that require cooperation throughout the industry

3.8.4. Data Chain visualisation

The discussion of the TN-ITS data chain was reported upon in a dedicated deliverable (D5.5 Data Chain Requirements).

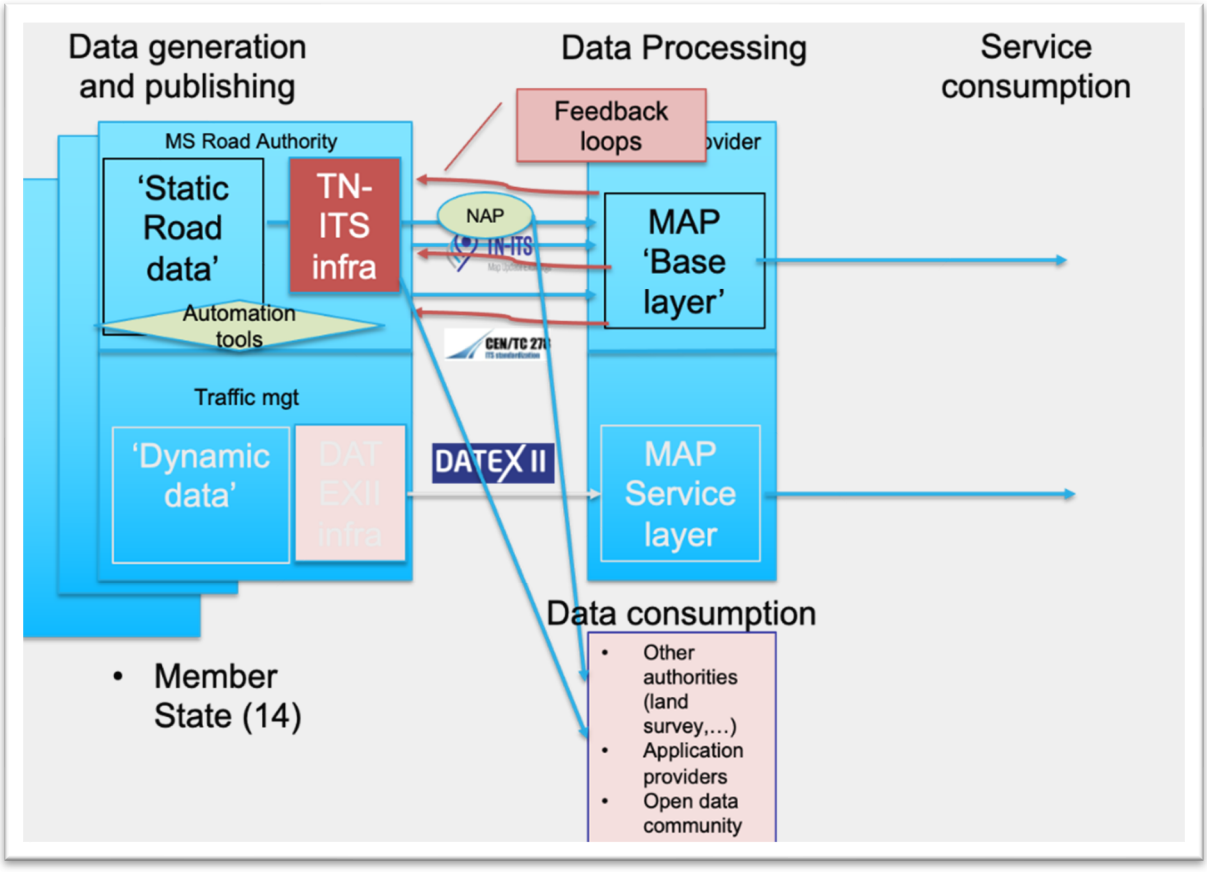

Figure 7 : TN-ITS data chain at the end of TN-ITS GO project 12/2021

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3.8.5. Status standardisation

The CEN TS 17268 was used as the reference standard for the implementation of TN-ITS data publishing services. However, some service remained using the older ROSATTE specification and made the switch to CEN TS at the end or shortly after the projects' end (December 2021). The TN-ITS GO project further revealed:

- A need for better technical support to implementers of TN-ITS data publishing services
- Corrections and improvements for the CEN TS 17268 document
- Extensions for data types that could be supported via code list updates

A comprehensible overview is given in a paper by T'Siobbel and Jetlund (2022), published in the proceedings of the ITS Congress in Toulouse in 2022.

3.9. Summary

The previous chapters discussed the TN-ITS standardisation scope and elaborated upon the evolution of the TN-ITS related "data chain" and "data standard" over the different initiatives, many of them EU funded innovation and deployment projects, standardisation effort, the creation of a member platform, etc.

These activities were supported by many relevant organisations and the stakeholders, from public sector, private sector, associations and standardisation bodies. The overview also presented the TN-ITS data chains across the different initiatives. An important evolution to highlight is the introduction of a feedback loop from data users to data providers, allowing a channel for reporting back on provided data, e.g. related to technical compliance, data quality, processing status, etc.

The advance of the technical specifications describing the data model and the data exchange was shown and it was indicated that the NAPCORE harmonisation and alignment action (coordinated in SWG4.0) coincides opportunistically with the planned systematic review (SR) of the CEN Technical Specification 17268.

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4. TN-ITS and the wider standardisation landscape

4.1. Intelligent Transport Systems perspective

A comprehensible, yet possibly not exhaustive, overview of TN-ITS in the wider ITS standardisation landscape by ERTICO ITS Europe is shown in the figure below. It depicts the players, the infrastructure and data streams relevant within the ERTICO partnership. It positions TN-ITS as an interface between Public (Road) Authorities and a service cloud operated by map and service providers, which is also connected to other clouds.

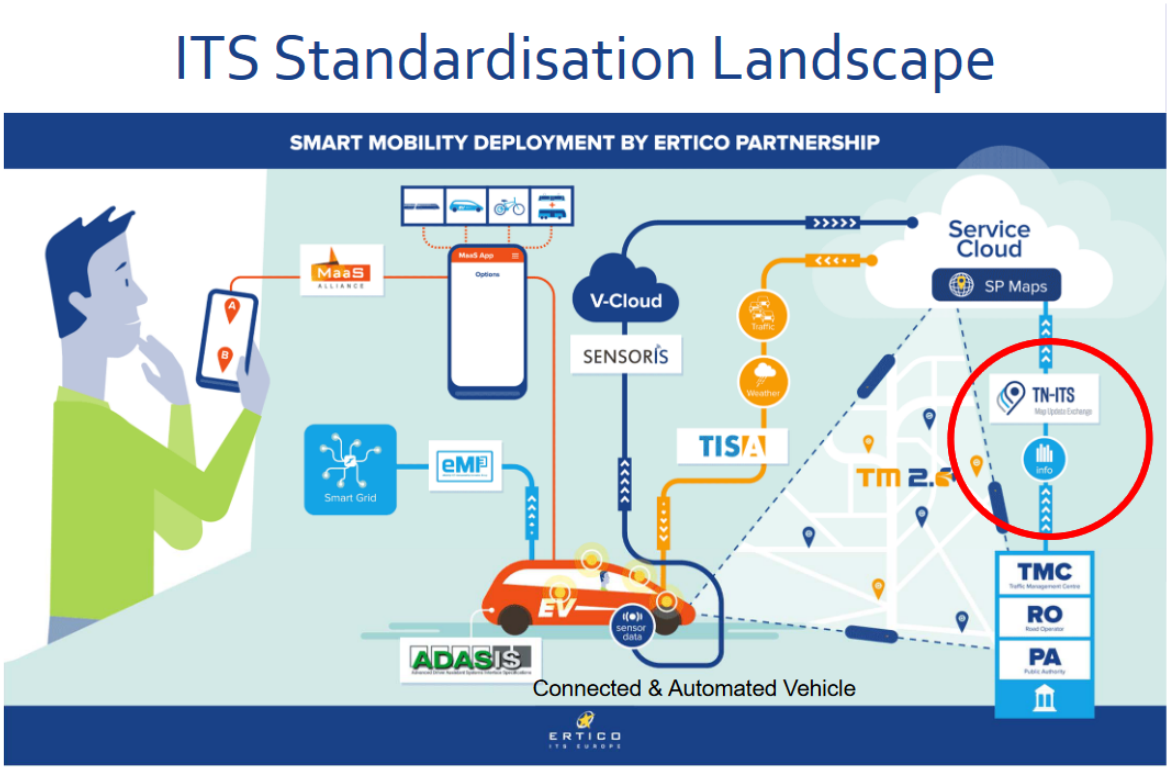

Figure 8 : The ITS standardisation landscape as seen by ERTICO ITS Europe

4.2. Automated Driving - the Open Autodrive Forum (OADF)

The OADF is an open, cross-domain platform supporting just that: standardization for autonomous driving. It gives all stakeholders the opportunity to present their latest progress and challenges. OADF members jointly work on solutions across different standardization organizations and companies. The forum organizes meetings every three months on different continents. In between, task forces address challenges that have been identified previously. The forum meetings are open to all companies, consortia, academia, and individuals that are active in the field of automated driving. Participation is free. Some of the most important topics the OADF is currently discussing are:

- A commonly accepted ecosystem architecture overview which identifies the building blocks needed for autonomous driving and the main interfaces.

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- First cross-consortium solutions for specific interfaces, e.g. regarding local live maps, live map updates, and localization approaches.
- Understanding functional safety issues involved in using HD maps for autonomous driving as well as providing first solutions.

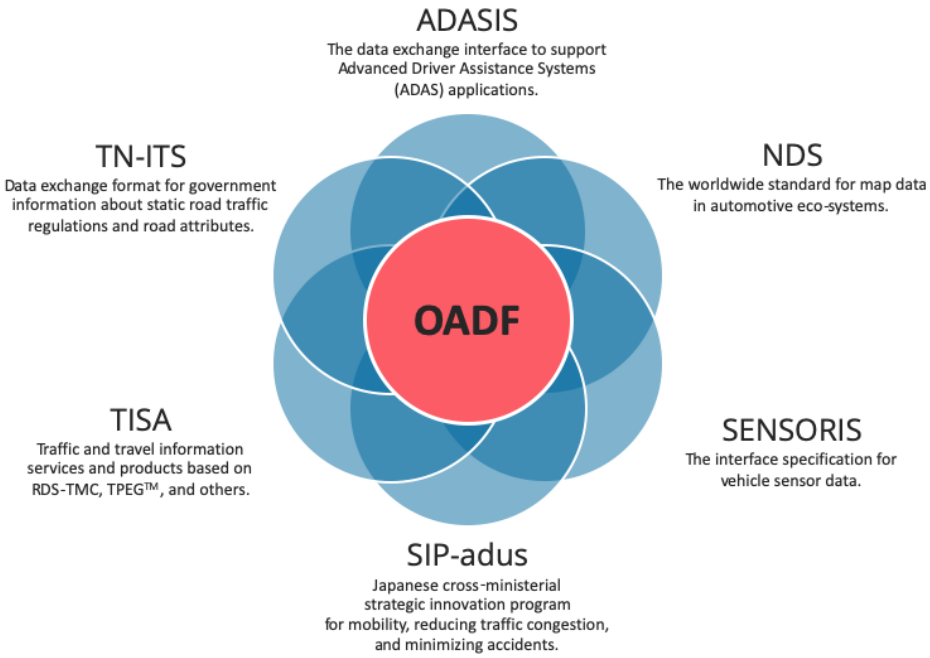

Figure 9 : The key members of the Open Autodrive Forum.

The OADF currently counts six members:

- ADASIS, specifying the data exchange interface to support Advanced Driver Assistance Systems (ADAS) applications
- NDS Association, the worldwide standard for map data in automotive eco-systems
- SENSORIS, the interface specification for vehicle sensor data
- SIP-adus, the Japanese cross-ministerial strategic innovation program with the focus on mobility, reducing traffic congestion and accidents
- TISA, specifing standards for traffic and travel information services and products based on RDS-TMC, TPEGTM, and others
- TN-ITS, which is concerned with the exchange of government information on changes in static road attributes, e.g. based on road traffic regulations

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4.3. Cooperative and Connected Driving ISO/TC211 Geographic Information / Geomatics

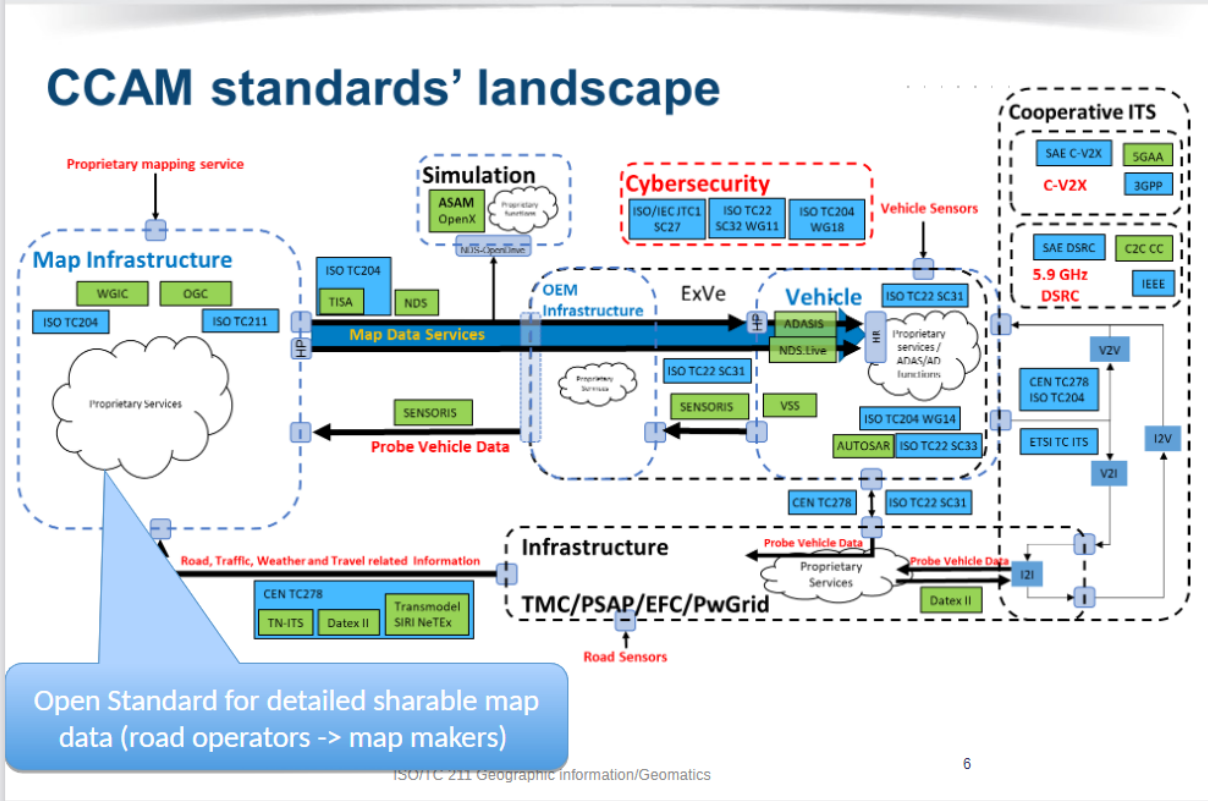

Figure 10 : The standards landscape related to the Connected Cooperative Automated Mobility – according to ISO TC211. CEN TC278 standards / technical specifications shown on the lower left.

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5. Consolidated conclusions

This report discussed the wider scope of TN-ITS, as a platform and technical specification, in the European mobility data standards ecosystem. It serves as input to develop an harmonised view considering the other mobility data standards included in NAPCORE. Which in turn supports the roadmap towards harmonisation and alignment of those standards.

With its focus on facilitating the exchange of changes or road data between authorities and industry, its strong support by EU regulation (RTTI 2022/670), its complementary position related to other mobility data standards as DATEX and Transmodel, its recognition in the (C)-ITS/ADAS/AD ecosystem, its emerging visibility on the NAPs in EU member states, its strong governance, etc., TN-ITS has established its position in the European mobility data landscape.

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