Transport Network ITS Spatial Data Deployment Platform
Purpose, status and prospects

Kees Wevers, President TN-TS

Joint UNECE-Belgium Workshop on ITS - 18 November 2014, Brussels

Source of image: ROSATTE web site (ertico.com/rosatte/)
ITS digital maps: navigation drives the technology

- routing for vehicles has been driving the technology
- basics of vehicle navigation:
  - search/destination selection/routing/positioning/guidance/map display
  - road-centreline structure of the data underneath

Image: NAVTEQ (Nokia/HERE) / presentation, B. Denaro, 18th ITS World Congress, Special Session 45, Orlando, USA, October 2011
navigation → ADAS → cooperative → automated

- advanced automotive applications require more accurate positioning and thus accurate/precise maps:
  - ADAS Geometry, more detailed lane level modelling
- safety, efficiency and comfort need look-ahead capability
- timeliness of updates

Increasing requirements for the map

- turn-by-turn navigation
  - road centrelines, turn restrictions, speed limits, address ranges, POIs
  - connected networks
  - accuracy 5-20 m

- ADAS (advanced) driver assistance systems (autonomous ADAS)
  - curvature, slope, banking, traffic signs, splines
  - accuracy 1-5 m

- cooperative systems (cooperative ADAS - local dynamic map)
  - lane centrelines, intersection paths, stop lines, traffic lights
  - accuracy ~1 m (in which lane)

- highly automated driving (HAD): driving still requires limited human input as not all driving situations/environments are supported
  - infrastructure objects for positioning (e.g. light poles)
  - accuracy < 1 m (where in lane)

- automated driving (AD): vehicle drives by sensing its environment and navigates without human input

1 alternative term: (highly) autonomous driving (as used in source)

Source HAD/AD definitions: TomTom, presentation, Filip Ballegeer, 20th ITS World Congress, Special Interest Session 56, Tokyo, Japan, October 2013
# 30 years evolution of the digital map for ITS

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1984</td>
<td>foundation of Tele Atlas, Belgium</td>
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<tr>
<td>1985</td>
<td>foundation of Navigation Technologies (NavTech), USA</td>
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<td>1985</td>
<td>start of GDF development (Demeter project)</td>
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<td>1985</td>
<td>start of the development of the Carin navigation system (Philips)</td>
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<td>1991</td>
<td>foundation of European Geographic Technologies (EGT), The Netherlands</td>
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<td>1995</td>
<td>(around this time) first use of term ADAS and gradual start of development (from ~1999 real take-off)</td>
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<tr>
<td>1996</td>
<td>first factory-installed vehicle navigations system (Carin, BMW)</td>
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<td>1996</td>
<td>Philips merges EGT into NavTech, headquarters Chicago</td>
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<tr>
<td>1996</td>
<td>completion of CEN GDF 3.0 as ENV14825:1996</td>
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<td>1999</td>
<td>IN-ARTE project, on integration of ADAS applications</td>
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<td>2000</td>
<td>Tele Atlas acquires Etak (USA) from Sony</td>
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<td>2001</td>
<td>foundation of the ADASIS Forum</td>
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<td>2004</td>
<td>start of EU-funded PReVENT/MAPS&amp;ADAS project (Feb 2004/Jan 2007) - developed ADASIS v1</td>
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<td>2004</td>
<td>start of the work on the Navigation Data Standard (NDS)</td>
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<td>2004</td>
<td>Navigation Technologies renamed to NAVTEQ &amp; NYSE IPO</td>
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<td>2004</td>
<td>completion of ISO GDF 4.0 as ISO14825:2004</td>
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<td>2006</td>
<td>start of SAFESPOT (01/2006-12/2009) and CVIS (06/2009-06/2010) projects on cooperative systems</td>
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<tr>
<td>2007</td>
<td>TomTom acquires Tele Atlas</td>
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<td>2008</td>
<td>Nokia acquires NAVTEQ</td>
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<td>2011</td>
<td>Nokia integrates NAVTEQ as a division</td>
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<td>2011</td>
<td>completion of ISO GDF 5.0 as ISO14825:2011</td>
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<td>2012</td>
<td>gradually increasing interest in automated driving, start WG Automation of iMobility Forum</td>
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<tr>
<td>2013</td>
<td>NAVTEQ renamed to HERE</td>
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<tr>
<td>2013</td>
<td>foundation of the Transport Network ITS Spatial Data Deployment Platform</td>
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</table>

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TN-ITS concept: immediate updating of ITS maps

- Public road authorities control road network changes:
  - traffic signs/regulations, public transport information
  - other road attributes
  - even geometry
- If well organised, the most efficient source for information on changes
- Updates that can be incorporated largely straight away (and overnight) in the ITS digital maps
  - trusted source, high reliability
  - single data points (no big data processing)
  - immediate availability
- Highly up-to-date ITS maps increasingly important
  - ADAS, Cooperative ITS, Automated Driving
  - multimodal applications
- Concept: set up a data chain for ITS spatial data serving immediate propagation of updates
- Issue: multitude of solutions on the side of authorities
  - need for common exchange infrastructure
The vision of the data chain: 2005

Overview of the data chain for static speed limits

Source: Wevers, K., Lu, M. "Provision of in-vehicle speed limit information", ITS World Congress, San Francisco, November 2005 (with acknowledgement of the EU-funded SpeedAlert project)
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Origins of TN-ITS

- **PReVENT/MAPS&ADAS project** (Feb 2004/Jan 2007)
  - apart from the important work on the ADAS Interface Specification, this project extensively addressed safety-related road attributes for ADAS applications

- **SpeedAlert project** (May 2004/Jun 2005)
  - work on speed limit information in digital maps

- **ROSATTE project** (Jan 2008/Jun 2010)
  - 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

- **Digital Maps Working Group of the iMobility Forum** (Sep 2011/May 2013) and eMaPS project (same period)
  - prepared the creation of TN-ITS (as a deployment platform for roll-out across Europe)
ROSATTE infrastructure still in place

Source: TomTom / presentation M. Flament 15-04-2013
TN-ITS - basis, objective and mission

- ITS Action Plan (16 Dec 2008) priority actions
  - (1.2) optimisation of the collection and provision of road data
  - (1.3) procedures for ensuring the availability of accurate public data for digital maps and their timely updating through cooperation between the relevant public bodies and digital map providers

- ITS Directive (7 July 2010) specification (b) items
  - (3) National access points
  - (4) Accessibility, publication, exchange and re-use of static road data
  - (8) Updating static road data

- INSPIRE Directive (March 2007)
  - infrastructure for Spatial Information in the European Community
  - Transport Networks (TN) specification

- TN-ITS objective
  - to give support, on a permanent basis, for the implementation of priority actions 1.2 and 1.3 of the ITS Action Plan of 16 December 2008

- TN-ITS mission
  - to facilitate and foster, throughout Europe, the exchange of ITS-related spatial data between public road authorities as data providers, and map makers and other parties as data users
TN-ITS working groups

- **WG 1 - Location referencing**
  - dynamic methods not (always) sufficiently accurate for road data exchange
  - improve performance using current methods, additional attributes and elements of linear referencing

- **WG 2 - Specifications and standardisation**
  - bring the TN-ITS specification to a formal status
  - close cooperation with CEN/TC 278/WG 7

- **WG 3 - Implementation support**
  - provide guidelines, best practices and Q&A
  - support new implementation of road data maintenance and the TN-ITS framework
  - produce quality process for TN-ITS data suppliers (certification)

- **WG 4 - Generic tools and reference implementation**
  - provision of generic tools (interoperability testing, quality control and location referencing conversion) and a reference implementation

- **WG 5 - Policy, awareness and dissemination**
  - policy contributions along the current EU Directives: ITS, INSPIRE, PSI
  - promotion and dissemination actions
ROSATTE exchange specification

- The ROSATTE project developed and tested specification for exchange infrastructure for static road data

- Components of the ROSATTE specification:
  - 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.
  - 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.

The ROSATTE exchange framework: 2009

Conceptual and concrete levels of the ROSATTE data exchange framework

TN-ITS: flow of specifications

**DG ENV + JRC**
- INSPIRE
  - TN Specifications
  - TN-ITS extension
    - Proposal for formal extension

**DG MOVE**
- ITS Directive
  - Action 1.3
  - Specification (b)
    - Adoption in Specs (b)
    - By End 2013

**TC278 WG7**
- New PWI adopted
  - by early 2015

**TN-ITS SDIC**

**TN-ITS Specs WG**
- 90%
- ROSATTE Specification

**TN-ITS Deployment Platform**

Source: Maxime Flament, ERTICO, adapted version of 17-10-2013.
Transportation Pilot

- Joint collaborative effort of the JRC (through their EULF project), TN-ITS and the ELF project, to test the usability of INSPIRE for the transport sector

  - EULF: European Union Location Framework, a concept for an EU-wide, cross-sector interoperability framework for the exchange and sharing of location data and services; mission of the EULF project is to test this concept, inter alia by bringing INSPIRE to other sectors

  - ELF: European Location Framework, three-year EU-funded project aiming at delivering a pan-European cloud platform and web services building on INSPIRE to enable access to harmonised data in cross-border applications

- Phase 1: September 2014/March 2015

- Phase 2: March 2015/ December 2015

- Benefits for TN-ITS in Phase 1

  - Boost for implementation: NO/SE, HERE/TomTom
  - Enabling of linear referencing, testing of dynamic linear referencing
  - Quick progress with the TN-ITS specification
  - One or two other (less advanced) countries in Phase 2
Transportation Pilot

[Diagram showing the relationship between Public Road Authorities, TN-ITS Attributes, HERE Demonstrator, TomTom Demonstrator, and National Mapping and Cadastral Authorities.]
Physical Storage Format

- the run-time format for the map db that is used in the navigation system
- each system vendor used its own proprietary PSF
- disadvantages:
  - for each different PSF a specific compilation process is needed
  - map data can only be used in the specific system, no interchangeability
  - many different PSFs, therefore small series per vendor (CDs, DVDs)
  - even worse if incremental updating becomes a must
  - ERTICO "Committee for Global Standardisation of Digital Map Databases for ITS" looked into this topic (second half 1990s)
- in 1999 NavTech released its SDAL format for PSF
  - this format was not widely adopted and did not become an industry standard
Navigation Data Standard

- industry initiative, started 2004, to develop a new standardised Navigation Map Format (or PSF)
- now a registered association with paying members
- will overcome the disadvantages mentioned
- will especially allow for incremental updating (tiled layers)
- each NDS db consists of different components stored in separate files

Source: Alexander Bracht (Daimler), presentation, 20th ITS World Congress, Special Interest Session 06, Tokyo, Japan, October 2013
Navigation Data Standard

Important features
- efficient mechanism for incremental updating
- use of SQLite database allows fast data access at small memory footprint
- digital rights management to prevent illegal copying
- sophisticated versioning for on-demand online updates
- building blocks allow flexible product configuration
- compatibility and interoperability

However
- not a public standard, but an industry standard
- substantial admission and annual membership fees (EUR 60,000)
- map providers cannot deliver NDS formatted data to non-NDS members
  - it is permitted that navigation system vendors deliver NDS-based systems to non-NDS OEMs, and this does happen already

Source: Alexander Bracht (Daimler), presentation, 20th ITS World Congress, Special Interest Session 06, Tokyo, Japan, October 2013
Drivers for TN-ITS

- Speed Assistance Systems in Euro NCAP protocol
  - map-based, camera-based or combination
  - may be a driver for accelerated introduction of such systems
  - this in turn may be a driver for the TN-ITS activities

- Transportation Pilot
  - showcase that INSPIRE (environmental) can be used in other sectors
  - JRC (EULF project) teams up with TN-ITS and ELF project
  - promising activity in terms of:
    - strengthening the links with the European Commission and INSPIRE
    - doing some actual roll-out of TN-ITS services

- In general: ADAS, cooperative ITS, (Highly) Automated Driving
- Strong involvement of and support from the ITS map providers

However,

- Increased involvement of public road authorities of countries across Europe is a must
TN-ITS membership - current members
TN-ITS membership - prospects
In conclusion

- **Status of TN-ITS and membership**
  - substantial progress was made in starting up and establishing the platform, and in initiating its core activities
  - to make TN-ITS sufficiently interesting for members to be part of it, a significant increase of the membership is required
  - more involvement in the working groups is needed
  - especially membership of the other "big four" is a must (DE/FR/IT/ES)
  - this is a long-term effort with substantial potential benefits for public authorities and society in general, to enable highly up-to-date ITS digital maps for advanced mobility applications
  - TN-ITS exists primarily to facilitate member states in implementation of an important part of specification (b)

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