Experimental verification of the proposed space and topology model for the Traffic Management applications in Switzerland (MDA Trafo) (VSS2009/901)

Experimenteller Nachweis des vorgeschlagenen Raum- und Topologiemsodells für die VM-Anwendungen in der Schweiz (MDA Trafo) / Validation expérimentale du modèle de repérage spatial et topologique proposé pour les applications de la GTT en Suisse

Funding: National (Switzerland)
Duration: May 2010 - May 2013
Status: Complete with results

Background & policy context:
The standard SN 671’941 has defined the overall model for the transformations between coordinate systems and will be further clarified for practical use.

Objectives:
It has to be shown, that and how the general model for reference systems and transformations defined in the standard VSS 671941 is practically be applied. This goal can be divided in three parts:

• To analyze and precisely describe practical realizations of the reference system and transformation types given by the general model according the standard VSS 671941 by means of practical data exchange processes and the use of real data. This task has to take into account the data exchange processes between all the concerned systems and organizational units across all levels of the traffic management, e.g., if automatically recorded traffic events in reference system X have to be distributed by radio and therefore need to be transformed in a reference system Y. To achieve this, transformations between reference systems have to be analyzed for data according to the standards (like GDF, Alert C, TPEG,...) of significant applications of intelligent transportation systems (ITS). With this step, the interoperability of reference systems will be demonstrated, i.e. in practice as well there exist transformations between reference systems of linear (like RBBS), planar (like Swiss coordinates) and topological type (like TMC, RADEF).

• To explain the possibilities and limitations of model-driven approach for the automation of coordinate transformations between different spatial reference systems and topology systems. In this step, the adequate algorithms for the semantic transformation should be integrated.

• To link this research with the international standards (ISO 14,825 GDF ISO 19111 Coordinate reference system, ISO 19,148 Linear Reference Systems, ISO 17572 1,2,3 ITS location referencing according VSS 671941)

Furthermore the project is aimed to propose the basics for the future standards 671941-1 and 671941-2.

Methodology:
The approach of the project is divided into three work packages:

WP1: Basics of the significant applications of the Traffic Management. This WP will select a test area (complex motorway with junctions) for the practical analysis.

WP2: Concept and implementation of a prototype with the procedure of transformation (linear, planar and topological) applied to the test area. The prototype developed in the research project VSS2007/902 will serve as a basis. In parallel, the data on the test area will be provided by the service operator of traffic management.
WP3: Application of the prototype in different use cases based on the test area, and analysis of results. This WP will elaborate proposals for the implementation on the entire Swiss road networks.

**Parent Programmes:**
[ARAMIS - ARAMIS information system](#)

**Institute type:** Public institution

**Institute name:** Swiss Government: State Secretariat for Education and Research

**Funding type:** Public (national/regional/local)

**Other funding sources:** 120'000.00 CHF

**Partners:**

Switzerland

Swiss Federal Roads Office

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**Key Results:**

The full model of the VSS standard SN 671941 provides a theoretical overview of reference systems and transformations. Their practical applications have been systematically analyzed and described using the model driven approach.

First, the basic documents has been analyzed, and the necessary mathematical elements have been selected: The Euclidean space for the spatial reality and the graph for network-type structures. Then the reference systems concerned are called equivalent or interoperable. Unilateral inversible transformations exist as well, i.e.: the reverse transformation provides the initial value only for the start with one of the two reference systems.

An overview is provided of the 5 elements A to E of the model driven approach (MDA) before applying them.

The description of the reality selection (element A of MDA) has shown the necessity to clearly differentiate between the street in the real world on the one side and its abstraction on the other side. Differences between the two become obvious for the street axis. In the real world e.g. the middle line of a street follows this street smoothly, whereas for calculations a polyline in space consisting only of straight line segments is used. Following the overview of the selected practical situation the reference systems are described in detail.

A main result of the project is the description of the algorithms for all transformations and whether these are bijections or at least unilateral irreversible. For the transformations RBBS ↔ CH1903 a pair of algorithms providing a bijection has been invented.

For the conceptual modelling (element B of MDA), new language elements had to be introduced for curvilinear and topological reference systems and their use in application models in addition to the existing language elements for geodetic reference systems. The reference systems RBBS and CH1903 and their use in the application model for traffic accidents have been conceptually modelled in detail as well as the transformations RBBS ↔ CH1903.

The (automatic) description of the transfer format according to the conceptual model (element C of the MDA) needs encoding rules for the new data type GRAPH and for the curvilinear et topologic reference values.

Conclusions: The „full model“ from SN 671941 has to be completed by working algorithms for the transformations, as they are successfully programmed and tested. For a following realization project (e.g. VSS 2011/713) th

**Other results**
- Require the services and the essential functions of traffic management which geo-referenced data

- The applications in the area of traffic data grouping of VM-CH

- The standardization and normalization of reference systems and transformations

- The ASTRA as an operator and creator of the infrastructure NS, which has taken over existing infrastructure on the NS from the cantons.

The cantons and cities (for example, DAV city of Zurich) The research proposed project builds directly on to the following results:

- VSS 1999/261 architecture and time aspects of SVT data, research report December 2005 (1149) contains the basic groundwork for the SN 671 941, the overall model for reference systems and transformations of the project proposal is subject. VSS 1999/261 applies inter alia to assume that applications have contributed to the overall model as.

- VSS 2002/706: NAVAROU - Potentiel d'utilisation des données routières de la Navigation Automobile pour l'entretien routier, mars 2008. Here are among others the transformations between reference systems of the car navigation systems (GDF) and the RBBS analyzed.

- VSS 2007/902: use model-based data transfer standards in the road transport telematics using the example of traffic data, research report April 2009. Of this can, among other things be taken and complements the model-based method and the implemented demonstrator prototype to reference systems and transformations.

Furthermore, the planned works provide essential practical input for the following research package:

- VSS 2009/709 joint research package EK 7.03 / EK 9:03: Benefits increase for users of the road information system. This research package is theoretically always clarify the following issues: "Concepts de Transform entre systèmes de repérage" (# 130), "Etude des conditions de transformation sémantiques avec Conservation de Propriétés" (# 131), "Etude du repérage spatial dans les voies de circulation" (# 132), etc. These supplies our Requested project VSS 2009/901 by the systematic model-based analysis of the practical situation in reference systems and transformations essentially practical input. It is therefore important to start our project quickly and in front of the research package.

Documents:

21446_1421_Inhalt.pdf (Final report)

STRIA Roadmaps:
Cooperative, connected and automated transport, Network and traffic management systems

Transport mode: Road transport

Transport sectors: Passenger transport, Freight transport

Geo-spatial type: Other