

**Analysis of application possibilities of linked information (Linked Data) and ontologies and related technologies (Semantic Web) in the road sector**

**Summary**

Within the framework of this project, the data exchange standard OKSTRA for the description of road data, defined in XMI, was converted into a representation based on the Ontology Web Language (OWL). This means that Semantic Web methods and techniques are now also available for OKSTRA data sets. In particular, the Linked Data approach makes it possible to link data sets with other schemata or domains. This can be done by using the SPARQL query language for the integrative analysis of the data of various ontologies.

As shown in case studies, data from the Dutch road ontology CB-NL/OTL-RWS can be retrieved and analysed together with OKSTRA data. This makes a range of cross-border application scenarios possible, such as the planning of heavy load transports. Other applications of Linked Data in the road sector include the integrated analysis of 3D city models in CityGML format with OKSTRA data or the linking of existing data with design data in OKSTRA format. Of special potential is the use of spatial operators provided by the query language GeoSPARQL, which can be used to establish connections between objects of different data models based on their geographical context.

For the conversion of OKSTRA into okstraOWL, a multitude of different mapping options were available, the respective advantages and disadvantages of which are explained in detail in the report. Certain characteristics of the OKSTRA standard, such as the Fachbedeutungslisten (technical definition tables), make mapping more complex, but in principle a conversion that preserves the semantic structures is possible.

The consistent use of description frameworks (RDF) and query languages (SPARQL) for both schema and instance data across all subject models represents a significant advantage over other approaches such as programming interfaces (APIs, web services, etc.). In other heterogeneous information networks, format-, syntax- and structure-specific adapters, converters and interfaces must usually be created for the source systems, which cannot be processed uniformly. On the other hand, existing information can be provided consistently in the form of RDF and be processed efficiently with the help of Triplestores and/or graph databases using universally standardised query interfaces (SPARQL) without having to deal with the respective ins and outs of each system in detail.

Although Linked Data functionalities using the okstraOWL are now available in principle, it became apparent in the course of the project (especially when working with real data sets) that the real challenge in linking different ontologies lies in the different semantic structure and granularity of the different data models. Methods of semi-automatic matching based on textual matches are also of limited help here. Instead, the user of the query mechanisms needs to have detailed knowledge of the semantics and structure of the ontologies involved and must create implicit or manual links based on this, the design of the query and the result they wish to achieve.

Despite the availability of Semantic Web and Linked Data technologies, the consistent, possibly pan-European use of street information databases therefore requires a fundamental harmonisation of data structures, especially with regard to their semantic structure and granularity.