

Semantic Linking of Research Data Publications

Contributing to the FAIRification of Metadata Records – A Proof of Concept



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Abstract We present a proof of concept that follows the vision to make geoscientific research data easily findable. To achieve this, metadata records of research data publications are integrated by means of *Linked Data* principles and semantic technologies. In the course of this, not only the findability of the research data publications is improved, but also the interoperability of the associated metadata. By transforming metadata into the RDF format and integrating this data using semantic mappings, our proof of concept demonstrates what concrete steps can be taken to make research data publications FAIR, with a focus on findability and interoperability.

Proof of concept

Our proof of concept is called the *World Data System Vocabulary Broker*¹. This prototypical demonstrator connects the metadata vocabularies GCMD², SPASE³, ESPAS⁴, UAT⁵ and GEMET⁶. To do so, a for now relatively simple mapping algorithm identifies skos:closeMatch⁷ and skos:relatedMatch⁸ relationships between the terms of the different vocabularies. Data publications can thus be found not only via keywords with which they were originally indexed, but also via equivalent keywords from other vocabularies. In practice, this means improved **findability** of related research data. This is especially the case if they originate from different research projects and are therefore described using different vocabularies. The **accessibility** is ensured by the decentralized repositories that manage the research data publications.

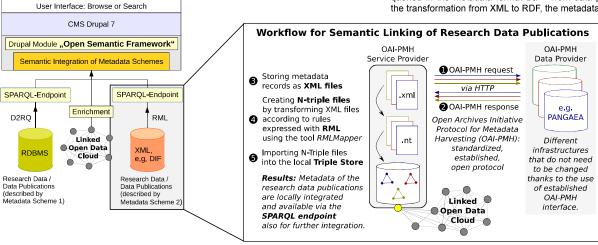
Our semantic search is implemented using the open source semantic content management system *Open Semantic Framework*⁹. It acts as a service provider and has access to the decentralized data providers via SPARQL¹⁰ endpoints. The service provider system contains semantic mappings between different vocabularies as well as between different metadata models. Data providers which do not hold their data in RDF¹¹ format can be integrated without having to change their infrastructure. Access can be provided using a suitable middleware, e.g. D2RQ¹² or RML¹³. [1]

FAIR principles & semantic technologies

Geoscientific research data publications are currently distributed across different repositories and described using different vocabularies. This means that they are accessible, but not easily findable. Therefore, initiatives such as the European Open Science Cloud (EOSC)¹⁴ and GO FAIR¹⁵ promote FAIR data. FAIR refers to a set of four principles: data must be findable, accessible, interoperable, and reusable [2]. Both EOSC and GO FAIR follow the recommendations of the European Commission expert group on FAIR data [3][4]. This expert group recommends, among others, semantic technologies to achieve FAIR data [5]. Following this recommendation, we apply semantic technologies in the workflow presented here. While services like re3data.org¹⁶ enable the findability of data repositories as a whole, our prototype aims at findability on the level of individual data publications.

Objective of the workflow

Main subject of this poster is the workflow illustrated below. It integrates metadata records of research data publications in order to make them available via the *World Data System Vocabulary Broker*. The workflow's objective is therefore to achieve interoperability of metadata by transforming it into the RDF format. The metadata is queried in the metadata format DIF¹⁷ from data providers using the OAI-PMH¹⁸. After the transformation from XML to RDF, the metadata is made available via a triple store.









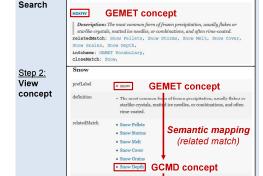
Explanation and implementation of the workflow

First, metadata is harvested via the OAI-PMH using a PHP¹⁹ script. The metadata records received are stored as XML²⁰ files. In the next step, the XML files are transformed into triples according to the RDF data model. To do this, the DIF metadata schema has been represented as an OWL²¹ ontology. Then the XML elements of the metadata records have been mapped to classes and properties of the unofficial DIF ontology. For the mapping of XML to RDF, the RDF Mapping Language (RML)¹³ has been used. The transformation rules expressed with RML are applied by the tool RMLMapper²² which generates the corresponding triples. Finally, the generated triples are imported into a local triple store, where they are available via a SPARQL endpoint. It is intended that the workflow is performed regularly, for example every day at midnight.

In each case, the new metadata is queried, transformed and imported into the triple store. In other words, a bulk transformation takes place – not an on-the-fly transformation.

Outlook

The for now simple workflow presented demonstrates that the principle of using established OAI-PMH interfaces to integrate metadata with the help of semantic technologies works. Remaining challenges are the maintenance of triples, e.g. in case of modifications of existing metadata, as well as the improvement, documentation and publication of the ontologies used for semantic annotation. Our prototype as a whole is already functional and can serve as a proof of concept. Planned improvements will include the optimization of the harvesting and RDF-transformation workflow as well as the integration of more data sources (currently only GFZ Data Services²³ and PANGAEA²⁴ are integrated). Besides, the semantic linking is currently solely based on the mapping of SKOS-concepts via skos:relatedMatch and skos:closeMatch. To increase findability, future work will try to establish a broader spectrum of semantic relations between data sources on the basis of other metadata elements.



Demonstrator: http://wdcosf.fh-potsdam.de/

References

Step 3:

publication

Step 1:

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Publication found

via mapping

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Annotations

Well of this System Vocabulary Borden - Proof of Concept. http://www.ord.new

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