Applying Semantic Technologies to the Design of Open Service-oriented Architectures for Geospatial Applications

Thomas Usländer

Fraunhofer IITB, Fraunhoferstr. 1, D-76131 Karlsruhe
thomas.uslaender@iitb.fraunhofer.de

1 Research Problem

Up to now, there is no established methodology for the design of a geospatial service-oriented architecture (SOA), e.g., for environmental risk management applications. However, there are key design guidelines and constraints imposed by corresponding standards of ISO and the Open Geospatial Consortium (OGC). Standards exist on both the abstract (i.e. platform-neutral) and the concrete (i.e. platform-specific) level, e.g. Web services, but still focus on syntactic interoperability.

An example motivates the application of semantics: As part of a forest fire risk assessment process in Spain the need to access to "vulnerable infrastructure in Catalonia" has been identified. The abstract service platform offers the capability of a generic feature (object) access service that supports queries with geospatial filters. Currently, it is up to the SOA designer to establish a conceptual connection between "infrastructure in Catalonia" and "features". An ontological approach that knows the subsumption chain ("road" is-a "infrastructure element" is-a "feature") and knows that "Catalonia" is a geographical concept would help in the "early service discovery" and would open up new perspectives for (semi-)automated service engineering.

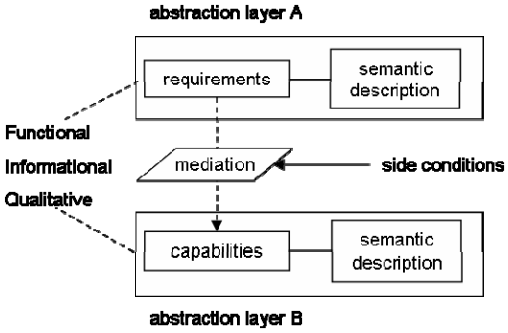

Fig. 1: Mapping of requirements to capabilities

A generic solution to such a design problem leads to the scientific kernel problem of semantically matching requirements of one abstraction layer A to capabilities of another abstraction layer B (see **Fig**. 1), taking side conditions explicitly into account. This kernel problem iteratively occurs when user requirements are broken down to

capabilities of the next level. The task of mediation as a generic mechanism to bridge the gap between heterogeneous descriptions and/or expectations [2] plays a key role.

The thesis proposes a semantic SOA modelling framework (MFgeo) as a solution.

2 Methodology

Five different ontology types are proposed in [1] that contribute to forming a geospatial system. With MFgeo the thesis proposes a complementary, geospatial SOA design ontology as missing link for the design phase targeted at analysts and architects of geospatial applications. Emerging semantic web services frameworks such as WSMO, OWL-S or WSDL-S form the baseline of the methodology and will be considered in the context of existing geospatial ISO/OGC standards. MFgeo will support

1. annotation of informational, functional and qualitative requirements and discovery of capabilities triggered by domain, service and quality of service ontologies,
2. an iterative design process with a flexible mediation technique of requirements and capabilities taking side constraints, e.g. compliance to OGC standards and re-use of existing information and service models, explicitly into account,
3. means to document the design process enabling traceability of the user requirements and validation using reasoning tools, and
4. the specification of policies to monitor and control the operation of deployed service networks.

3 Current Results and Planning

Result so far is the architecture specification of the European Integrated Project ORCHESTRA [3] accepted as OGC discussion paper that has extended the OGC Reference Model by 1) a common meta-model approach for the service and information viewpoint, 2) the modelling of the mapping from the abstract to the concrete service platform, 3) a meta-information schema enabling semantic descriptions of geospatial resources, and 4) the consideration of policies in the engineering step of service networks. The current work focuses on semantic extensions of [3] followed by the design of MFgeo in 2008. The approach will be assessed by using MFgeo for an alternate ontology-driven design of an existing ORCHESTRA pilot application.

References

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