

Ontology-Driven Management of Space Middleware

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Abstract. Recent work in the field of middleware technology proposes semantics-aware tuplespaces as a tool for coping with the *scalability*, *heterogeneity* and *dynamism* issues arising in distributed environments such as the (Semantic) Web. The fact that (Semantic) Web services communicate by synchronous message exchanges initiated *triplespace computing*. The aim was to bring the Web's "persistently publish and read" paradigm to service computing. Based on experiences with ontologies in traditional middleware we argue that ontology-driven management will be a major asset of semantic tuplespaces compared to traditional ones. In this research we look at ontology-based metadata to enhance semantic space infrastructures to become reflective middleware.¹

1 Introduction

Middleware is software that connects distributed components and applications. (Semantic) Web services are seen to be a promising and currently widely researched middleware approach in particular for large scale systems. Unfortunately Semantic Web services have inherited the Web service communication model, which is based on synchronous message exchange, thus incompatible with the architectural model of the Web. Analogously to the conventional Web, truly Web-compliant service communication should be based on persistent publication in order to allow the communicated data to outlive the services publishing or consuming it. Recent middleware technology proposes semantics-aware tuplespaces as a tool for coping with the *scalability*, *heterogeneity* and *dynamism* issues of large scale open systems. Our proposition is *triplespace computing*: RDF *triples* create a natural link from the *space*-based *computing* paradigm into the (Semantic) Web.

2 Research Problem

Various semantics-aware space projects matured the semantic coordination and data models; see TSC [1], Semantic Web Spaces [4], and the joint successor TripCom. These projects do however not yet sufficiently address the non-functional properties of middleware, e.g. distribution, scalability, reliability or dynamism.

A critical concept to deal with management issues in the absence of centralized control is metadata. Ontology-based metadata seem to be the natural choice for triplespace computing. In fact ontology-driven middleware management is seen to be one of the

¹ Supported by TSC (FIT-IT, tsc.deri.at) and TripCom (IST-4-027324-STP, www.tripcom.org)

major assets of semantics-aware tuplespaces over traditional approaches. Still, the aforementioned projects largely neglect this fact or have failed to show the procedures. This leads to our main research question:

Main Question: *what does an ontology-based metadata vocabulary have to incorporate and how can it be modelled in order to enhance triplespaces to become reflective for large scale open systems?*

The main question is divided into three sub-questions:

Q.1 *how to ontologize the space middleware and the data in order to provide reflective management of core non-functional properties, in particular distribution?*

Q.2 *what requirements result from personalization and usage-awareness and which additional metadata modules are needed?*

Question Q.3 is concerned with the application of the vocabularies to an existing implementation and the evaluation of its usability to the distribution property:

Q.3 *how can metadata be acquired and provided to participating nodes in order to improve the data distribution within the reflective middleware?*

Improving the distribution influences at ones the overall performance (network-driven distribution) and the search efficiency (usage-driven distribution).

3 Expected Contribution

First ideas for a management ontology were developed in TripCom [2]. In [3] we outline key factors for context modeling ontologies: traceability, comparability, logging and quality of data, extensibility, genericity, completeness and scalability. Similar criteria will form the basis for our management ontologies. To increase the interoperability and adoptability we investigate the mapping of our vocabularies to foundational ontologies. Such mappings foster wider understanding which is crucial for data coordination.

As outcome of this research we expect a metadata infrastructure that is tailored to the management processes present in reflective space middleware. We seek ontologies in the domain of distributed (semantic) information management on the one hand and adaptability, personalization on the other. As it is advisable to use small and simple ontologies that are easier adopted and reused in the large, we will come up with well-integrated, but distinct ontologies for the respective tasks – in particular distribution. Therewith we expect to significantly contribute to the success of triplespace computing by enhancing the management procedures with our ontologies that go beyond the ones of TripCom.

References

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