Integration of Business Applications using Semantic Web Technologies

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1 Problem Statement

Success of large-scale, industry-wide enterprise integration efforts depends on the enterprise application integration (EAI) standards. Examples of such EAI standards include Open Applications Group (OAGIS) [1], RosettaNet [2], and Universal Business Languages (UBL) [3]. Currently, these standards are based on XML specifications that are syntactic formalisms. Capabilities of these standards and testability of integration results based on these standards are significantly limited as a consequence of the limited reasoning capabilities supported by syntactic formalisms. This follows from the fact that syntax-based approaches to define structure of business documents do not impose a common interpretation of the data and there is no way to achieve a repeatable and a verifiable procedure to recognize a semantic unit from a domain of interest [4].

Take, for example, the Schematron rules that are typically used to encode constraints for the application content of the messages exchanged among applications. These rules, however, cannot be reasoned about and compared in a context of some integration problem. Consequently, two rules that are perfectly valid syntactically may be conflicting with each other within a certain integration context.

The advent of Semantic Web offers opportunities for more capable EAI standards to capture and manipulate semantic relationships. Semantic formalisms at the foundation of these technologies allow use of computational approaches to reason about formally expressed concepts and make inferences that are useful, yet beyond the capabilities of the syntax-based approaches. Consequently, testability of the application integration efforts may become equally more powerful. Essentially, the reasoning methods, such as satisfiability and consistency checking, may be readily used to perform various types of validations, such as whether two ontologies are compatible and whether a specific business document instance has sufficient and necessary data to belong to a specific class of documents.

In principle, the Semantic Web technologies today enable one to draw automated inferences about relationships between conceptual structures using a subset of the First Order Logic formalism called Description Logics. As an example, it is possible to express constraints on existence of an element in a document schema (e.g., 'The access rights element will appear only if the sensitivity type element appears') and to reason about possible conflicts of such a rule with other document rules (e.g., 'Either the access right or sensitivity type element, but not both, will appear'). These types of reasoning are not possible using purely syntactic approaches.

2 An Approach

This effort develops an approach to evaluate capabilities of the Semantic Web technologies for EAI and, particularly, how it affects integration testing capabilities. The specific objectives that drive this work are (1) to develop an experimental tool enabling assessment of Semantic Web technologies for EAI and (2) to design and execute a series of experiments to effectively perform such an assessment. To accomplish these objectives, the work posits Semantic Web-based integration architecture and an integration methodology that is enabled by such architecture. In particular, we are interested to investigate possible advances in testability of integration efforts using the new technologies. This novel integration methodology includes a collection of integration and validation steps that are performed both at design time and run time of an integration process. During design time, the methodology supports development of generalized and normalized ontologies (that describe application interface models) and allow model-based similarity analysis of these ontological models. During run time, the methodology enables semantic translation of instances of business documents (conforming to the developed ontologies) using the previously developed ontologies and automated reasoning tools.

Initial experimental results in testing the methodology show interesting capabilities such as the ability to perform individual equivalence test that is content based. Through experimental work, we have also gained a significant number of insights into the issues of necessary and sufficient conditions for achieving interoperable data exchange.

Our future work will focus on experimental assessment of the initial ideas for Semantic Web-based EAI standards. We expect to identify key technical issues for the proposed approach, and through experimental demonstration show how such issue may be addressed by extending the proposed approach. Our key contribution, we anticipate, will be to increase significantly understanding of whether and how Semantic Web technologies may be applied in a near future to realistic industrial integration efforts.

References

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