Solving Semantic Interoperability Conflicts in Cross-Border E-Government Services

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ABSTRACT

Interoperability is one of the most challenging problems in modern cross-organizational information systems, which rely on heterogeneous information and process models. Interoperability becomes very important for e-Government information systems that support cross-organizational communication especially in a cross-border setting. The main goal in this context is to seamlessly provide integrated services to the user (citizen). In this paper we focus on Pan European e-Services and issues related with their integration. Our analysis uses basic concepts of the generic public service model of the Governance Enterprise Architecture (GEA) and of the Web Service Modeling Ontology (WSMO), to express the semantic description of the e-services. Based on the above, we present a mediation infrastructure capable of resolving semantic interoperability conflicts at a pan-European level. We provide several examples to illustrate both the need to solve such semantic conflicts and the actual solutions we propose. [Article copies are available for purchase from InfoSci-on-Demand.com]

Keywords: Data Integration; IT in Public Administration; Knowledge Integration; Ontologies; Semantic Matching; Web Applications

INTRODUCTION

The Web has been continuously growing in the past decade and its growth conveyed to wide use of information systems based on modern Web technologies (e.g. Web services). The distributed nature of the Web challenged the ability of communication amongst independent
information systems based on different technologies and heterogeneous data models. To achieve this communication, integration efforts are required, which usually trigger various types of problems. These problems are often referred to as interoperability conflicts and significant effort has been spent on finding the silver bullet to solve them. One of the most promising solutions, that opens new opportunities and at the same time new challenges, is the use of semantic technologies (Fensel, D., Lausen, H., Polleres, A., de Bruijn, J., Stollberg, M., Roman, D., & Domingue, J., 2006; Yanosy, J., 2005).

Nowadays, Public Administrations (PA), especially in the European Union context, have to integrate their technological infrastructure and the underlying data models in order to provide high quality national and cross-border services to the European citizens (Tambouris, E., & Tarabanis, K., 2004; Tambouris, E., Manouselis, N., & Costopoulou, C., 2007). The European Union is currently advancing in this direction by supporting the research on solutions for solving interoperability issues among cross-border e-services, through a number of public financed projects. Such projects (e.g. SemanticGov, SEEMP, eGovBus, R4eGov2) have been targeting the so called, Pan-European eGovernment Services (PEGS).

This article presents a mediation infrastructure developed in the context of the SemanticGov3 project. This infrastructure is able to solve PEGS interoperability conflicts based on the conceptual model of the Web Service Modeling Ontology (WSMO) (Fensel, D., et al., 2006) and semantic technologies. The identification of the interoperability conflicts to be addressed is based on a well-known work by Park and Ram (2004). We adopt their framework and instantiate it in the PA domain by using a generic PA service model as proposed by the Governance Enterprise Architecture (GEA).

In particular, we analyze a comprehensive set of semantic interoperability conflicts and we present here the SemanticGov technical solutions to solve them. The technical solutions are based on alignments between heterogeneous data models and ontologies. Additionally, we give an overview of the infrastructure needed to semi-automatically derive these alignments, such as the human user can interactively create and validate mappings and mapping rules by using a graphical interface. Once such alignments are created, they are ready to be used whenever at run-time heterogeneous data has to be exchanged and mediation is required. The novelty of our work lies on the fact that we propose a comprehensive framework for semantic conflicts analysis and resolution applicable in a Pan-European context, which builds on emerging technologies for semantic-driven data mediation.

The article is organized as follows: Section Background gives an overview of the background concepts adopted in this article and in Section Overview of Semantic Interoperability Conflicts we briefly review the classification of semantic interoperability conflicts. In Section Solving Semantic Interoperability Conflicts for Cross-Border e-Government Services we analyze the semantic interoperability conflicts introduced in the previous section and we propose a set of solutions able to resolve such conflicts. Section Mediation Services and Solutions: Implementation re-iterates through these solutions and describes our approach which enables such solutions. These two parts are kept separate since our aim has been to propose a set of technology-independent solutions for solving the semantic interoperability conflicts. These solutions may be implemented in different ways depending on the available technology. The specific technology and software architecture we describe in this article is just one possible choice and serves as a proof of concept to show how these solutions can be actually applied in practice.

Section Related Work presents several research efforts related to our work, while Section Evaluation analyzes the evaluation results of our tools obtained during three evaluation workshops which were organized for this purpose in three different PA agencies in Greece and Italy. In Section 8 we draw some conclusion and discuss some future research directions.
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