Towards semantic TV services a hybrid Semantic Web Services approach

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Abstract. We are investigating the current Semantic Web Services approaches in order to select the most appropriate approach to build semantic internet TV services. Two major approaches are prominent which are top-down and bottom-up approaches, the former being heavyweight and supporting complex reasoning tasks and the latter being lightweight with limited reasoning capacity. We defend our assumption that semantic TV services require the strengths of both approaches and introduce a novel hybrid approach.

Keywords: Semantic Web Services, WSMO, IRS-III, Minimal Service Model, iServe, Hybrid Semantic Web Services approach

1 Introduction

Nowadays, we share our knowledge via Wikipedia, our videos via Youtube, our profiles via Facebook, what we are doing via Twitter and our leisure time via Second Life. One of the last entertainment media, which endured resistant to cooperation and interactivity, was TV where the user was still a passive consumer. However the TV concept has evolved recently from the classic sofa TV to mobile and hybrid TV. This evolution has benefited from the bandwith increase and smart phones wide spread use. Just like the Web content expansion phenomena, the evolution was coupled with the scattering of TV and multimedia content, where the user struggles to find a relevant content, which perplexes the leisure time. Hence the need for new TV features : social, interactive, personalised and semantic. Such an ambitious idea requires many contributors to provide multimedia content, enrich the metadata with semantics, propose recommendation systems and build social networks around TV preferences. The NoTube[1] project gathers many partners around the semantic TV idea. As a first step towards collaboration, these partners expose their services via web services endpoints, that, in our vision, should be followed by a brokerage approach mainly aiming at the automation of Web service related tasks such as discovery, orchestration and mediation.

[1] www.notube.tv

2 Problem statement

The actors in the semantic TV challenges, such as content producers, semantic enricher and recommender, have different backgrounds and concerns, which lead to a highly diversified state on choices of paradigms and technologies with three aspects of diversity:

Different multimedia metadata schemas Content producers tend to maintain the format they are already using, as converting their whole multimedia base is expensive and need new expertise. Within NoTube, the main schemas being used are MPEG7, TV-Anytime[2] and Electronic program guides (EPG) implying higher complexity on content processing.

Diverse tasks The exposed services achieve diversified tasks from content processing such as transcoding, scaling, cropping, to profile analysis and metadata semantic enrichment.

Multiple services approaches Moreover, the partners expose their services via multiple means such as Web API, REST [4] or SOAP[3] services.

In a such highly fragmented state, Web services tasks such as services selection, composition, mediation and orchestration, obviously require minimal level of automation. However the restricted machines vision of web services as inputs and outputs, without any consciousness, hinders the automation of these tasks. For instance, messages containing a compression rate from a video compression service or a weight for a recommender service, are syntactically equivalent. Hence the necessity of processing the services messages and operations at the semantic level via shared ontologies. Therefore the past decade has seen a wide range of research efforts in the area of Semantic Web Services (SWS), mainly using semantic annotations in order to automate the mentioned tasks. We split the yield of these efforts into top-down and bottom-up approaches. Actually both approaches are used separately within the NoTube project to semantically annotate the contributors services, specifically a WSMO [8] based approach and a Linked Service [7] approach. We briefly introduce each approach with their respective implementations, IRS-III [2] and iServe [7], discuss the reasons of their insufficiency to solve the semantic TV challenges individually, and defend our motivation for a novel hybrid approach that combines the strengths of both approaches.

2.1 Top-down Semantic Web Services approaches

Top-down approaches provide conceptual frameworks and languages, such as OWL-S [6] and WSMO, to describe the semantics of web services before grounding these descriptions to the services. A considerable research community evolved around these SWS frameworks, providing, for example, annotation and execution

[2] http://www.tv-anytime.org/
[3] http://www.w3.org/TR/soap/

tools based on these formal SWS frameworks. For instance IRS-III is a semantic execution environment that adopts the WSMO approach, *videlicet* that a service description is expressed in terms of Goals, Mediators, Web Services and Ontologies. IRS-III supports capability-based invocation: the request is a goal to be achieved via the following intermediated operations [2]

1. discover potentially relevant Web services;
2. select the set of Web services which best fit the incoming request;
3. mediate any mismatches at the conceptual level;
4. invoke the selected Web services whilst adhering to any data, control flow and Web service invocation constraints.

Formalising these operations requires the use of rich knowledge representation languages and complex reasoners. However, the need to capture comprehensive and meaningful service semantics to allow reasoning-based automation of web services related tasks, contrast the requirement to lower the costs for providing services descriptions in order to simplify the modeling process for non SWS experts.

2.2 Bottom-up Semantic Web Services approaches

Based on the dictum that the top-down approach assumption, that the service engineer describes semantics for the service before grounding these descriptions to the services, is counter-intuitive, the bottom-up approach builds incrementally upon existing Web services standards. Bottom-up or 'lightweight' SWS approaches such as WSMO-Lite [9] or the Micro-WSMO/hRESTs [5] approach use less comprehensive and less costly service models. This approach was recently dubbed Linked Service approach [7] by analogy to the Linked (Open) Data (LOD) term [1] as it reuses the lessons learnt from the Web of data in the services field, in order to facilitate the service annotations production and thus addressing a much wider audience and allowing even non-SWS experts to describe and annotate services. iServe adheres to the Linked Services approach and provides seamless publication and discovery of services by transforming service annotations expressed in a variety of formats into Linked Services data describing services and processable by the Semantic Web technologies. Services are expressed in terms of a simple conceptual model, the Minimal Service Model (MSM), conceived to be the largest common denominator between various annotating approaches formalisms to ensure interoperability.

However, while those models are easier to produce [3], they merely aim at enabling structured, semantics-enabled search by humans or automated service clustering, and more expressive solutions are required to achieve greater levels of automation when carrying out tasks such as the fully automated discovery or orchestration of services.

3 Main questions of the thesis

But we enquire about : the real need of this automation, what are the most important tasks to be automated, their feasibility, the worth estimation compared

to the investment cost, the benefits of an hybrid approach, could it maintain lower annotation costs while providing higher level of reasoning and how.

4 General approach

The actors in the semantic TV challenges are rarely SWS experts, and therefore adopt the handy approach, namely Linked Services to annotate their services. However brokering such diversified and complex services as TV recommender and TV social services requires more exhaustive descriptions of the services and complex reasoning. Hence we aim to combine the strengths of both distinctive approaches into a coherent SWS framework.

5 Proposed solution

As a first step towards hybridization we investigated top-down and bottom-up approaches in order to predict the feasibility and cost of our approach. We sketch in Figure 1 a conceptual comparison between WSMO and MSM to evaluate the overlaps and differences between both.

6 Evaluation

As we predicted there are a few overlaps, *Web service* and *Ontology*. WSMO high level concepts such as *Goal* and *Mediator* have no equivalent in MSM, likewise the *Operation* concept in MSM is omitted in WSMO as it uses more abstract concepts such as *Choreography*. However we dressed functional similarities in the properties that we drew close, such as *has-condition* and *has-assumption*, *has-effect* and *has-postcondition*. Besides many concepts model close notions such as *Capability* and *Functional classification*, *Method* and *Choreography*. Since the ambition for a possible interoperability between both approaches.

7 Future work

We will pursue our models investigation by a translation mechanism to allow IRS-III and iServe annotations interoperability.

8 Conclusion

In a highly complex and fragmented services pool such as the TV services, neither heavyweight nor lightweight semantic services approaches fulfil service tasks automation, hence our motivation for a hybrid approach that provides handy services annotation and complex reasoning.

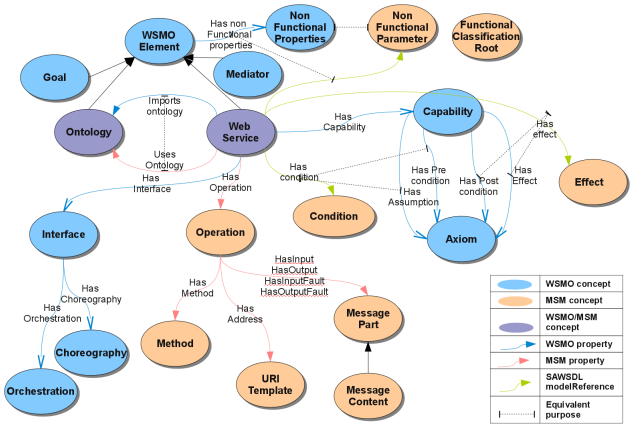

Fig. 1. Conceptual comparison between WSMO and MSM

Acknowledgments. We kindly thank the NoTube project for generously funding this research and being a validation framework for the discussed ideas.

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