SEE Use Cases

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1. Introduction

This section is non-normative. It aims to explore potential implementation of Service Oriented Architectures outside of tightly controlled environments. The ultimate goal of SEE TC is to empowered SOA with semantics as a means to deal with heterogeneity of data, protocols, and processes on the one hand and mechanization of service usage (i.e., discovery, adaptation, composition, and monitoring) on the other hand. These use cases are going to provide a justification for the work of this committee and explain what should be expected from the Semantically Execution Environment infrastructure.

2. Use-Cases

These use cases present real-world problems, which aim to be simplified with SEE infrastructure.

2.1. Virtual Internet Service Provider (VISP) in SWS applications

VISP scenario has been defined within DIP project (Data, Information, and Process Integration with Semantic Web Services, more information is available at http://dip.semanticweb.org). It motivates the problems of data and process integration that steam from the heterogeneity of applications utilized by interacting partners in the telecommunication sector with focus on Internet Service Providers (ISP). The main objective of VISP is to integrate services provided by telecommunication partners and to offer them in the form of bundled products. As a bundled product a complex service composed of services provided by various partners is understood. More importantly these bundled products are not specified as hardwired interactions with the services, but are rather composed of semantically specified expectations of the functionalities (Goals) for which the most suitable services can be dynamically discovered and bound to.

One such bundled product concerns ordering broadband Internet by selecting one of the registered ISPs. It is composed of a couple of steps which involve discovery of an appropriate ISP, checking availability of the broadband for the given phone number, selecting the ISP according to the additional criteria (e.g. lowest price, QoS, best coverage in the area, etc.) and finally contracting the broadband set-up.

VISP employs Semantic Execution Environment (SEE) and has the following requirements regarding it's functionally:

- **ISP registration**. Each ISP provider has to provide semantic description for its service in order to enable its dynamic discovery and interaction. This description has to be strongly ingrained in the ontology that provides common conceptualization and relationships between utilized terms. It is worth mentioning that in this scenario the service description cannot contain the entire list of phone numbers for which a broadband line can be provided, therefore a reference to the operation that allows up-to-date checking an availability of the line for the given phone number has to be included in the semantic description.

- **ISP discovery**. Registered ISP services can be dynamically discovered and bound to the bundle. Discovery is goal-driven, i.e. a requestor's expectancy is expressed using a semantic language which allows matching an appropriate service far more adequately then in the case of keyword discovery.
- **Communication with ISP**. Once a given ISP is selected, a back-and-forth communication has to be carried out where SEE acts as an intermediary layer. SEE fulfils a crucial role in this scenario enabling communication between the parties despite of their different expectations regarding the data they are willing to exchange and their external processes. Data heterogeneity problems are reconciled by the ontology mappings and handled by the Data Mediation. Similarly, differences in the external processes (choreographies) of interacting parties are tackled by the Process Mediation.

2.2. SWS applications in B2B (RosettaNet)

As corporations rely more on collaboration with partners to enhance their competitiveness, integration of information systems is important in cutting costs in information exchange and enabling quicker reactions to e.g. demand fluctuations. B2B integration is not however easy as companies have heterogeneous information systems that cannot be integrated easily. There are certain standards for B2B integration such as EDIFACT and RosettaNet that are meant to ease the integration task by providing guidelines how certain processes are integrated. RosettaNet is a newer standard, which is constantly growing in the significance. RosettaNet had over 3000 documented production implementations in 2004 with a big growth on a way [1].

However, the B2B integration even when using an XML-based standard, such as RosettaNet, the integrations can easily take e.g. six months so set up. This is due to the fact, that have reasonable flexibility in them concerning the exchanged message content, message sequencing and message security details. This means that just supporting a same message does not mean that the companies are interoperable, but a significant effort is required to agree and implement exactly how the standard is used. This leads to the fact that current B2B integration partnerships are still quite rigid and longstanding.

To enable faster setting up of B2B integrations, the semantic web service applications running on semantic execution environments could be used. If a business partner gives a more formal description of how to interact with it, it is possible to use mediation technologies to adapt the interaction of the other business partner to be interoperable. Ideally, this would be fully automated, reducing integration time from months to minutes [2].

Another aspect where the semantic execution environments could help is partner discovery. For meaningful integration it is not enough that companies implement a same standard RosettaNet process. E.g. consider a company is looking for a logistics operator to provide a service between Ireland and Austria, who would support the related RosettaNet standards for information exchange. Getting the names of logistics operator companies who support RosettaNet standards for information exchange is not enough, but the service offered should also match the need concerning the services offered between Ireland and Austria. Here, semantic web services applications could help in addressing such issues offer potential in automating also partner discovery processes that nowadays are done with little or no automation.

2.3. SWS Applications for Telecommunications

Recent advancements in both access and core telecommunications networks (UMTS, SIP, VoIP, IMS, etc..) are opening the door to a vast range of sophisticated, intelligent telecommunications services. Dynamically configurable, multimedia rich, truly mobile, device independent, location and presence aware services are now technically feasible. Service discovery, dynamic composition, user preference modeling, and service inter-operation are, however, set to become key challenges. We plan to address these challenges by deploying cutting-edge Semantic Web Services concepts and technologies to the telecommunication systems in order to enable optimal provisioning of the next generation telecommunication services.

The core interest for SWS applications is to introduce semantics to service broker residing in between *control layer* and *application layer* of the telecommunication network. Semantically enabled service broker built on WSMX execution environment will provide capabilities of dynamic discovery, selection, composition, mediation and invocation of services. With this respect, central to our approach will be the analysis, design, implementation, and verification of a number of use case scenarios. The use cases will be representative in terms of service capabilities, user preferences, and (semi) automated semantic web services execution process whilst at the same time showcasing the types of next generation services possible. The idea is finally to implemented selected scenarios on top of the WSMX Semantic Web Services platform and the latest IMS core.

One of the possible and the most obvious scenarios of SWS applications in telecommunications is the integration of voice services (make a call) with data services (lookup a phone number, select the cheapest operator). Traditionally, call participants‘ numbers as well as a telecommunication operators for making a call are discovered/selected based on pre-defined configurations such as in *clickToDial* or *clickToSms* applications. As an example of use of SWS in such applications, user A who is a subscriber of a 3rd party operator is allowed to specify his/her request such as „I want to make a cheapest call with user B“. 3rd party operator (running so called *VoIP Hub*) takes responsibility of automatic discovery of directory services „lookup a number according to user’s B name“ and telecommunication’s operator service „make a call“ as well as selection, composition of these services and also their mediation in case of terminology mismatches. The selection of services will be based on user’s preferences (in our case price) to select the best service which best satisfies user’s requirements. From the technology point of view, VoIP Hub is built on SIP proxy server as well as WSMX whilst at the same time both sharing responsibility in achieving user's request. WSMX takes care of the whole SWS execution process while SIP proxy takes care of accepting and forwarding user's call to selected operator returned from WSMX. This use case is in detail described in [3].

2.4. SWS in e-Banking

In this use case we introduce an application from the banking industry as an example of how Semantic Web Services can be used to provide an improved customer service. Our aim is to illustrate the benefits offered by Semantic Web Services in a familiar scenario. The application, for this use case, allows the comparison of the mortgage interest rates being offered by banks online. The emergence of internet banking has greatly increased the competitiveness of the market for services such as mortgage lending. Banks within the European Union (EU) can provide online banking facilities to any citizen of the EU. Many offer online tools allowing prospective bank customers to see, at a glance, current mortgage rates and the amount they could borrow. These tools are often constrained by being limited to the mortgage products offered by just one bank.

Third party websites are increasingly available that aggregate information from multiple banks allowing the comparison of the various mortgage products on offer. Different techniques can be used by these websites to retrieve data from the individual banks. In the next paragraphs, we describe three of the most common.

Manual population involves one or more humans researching the products offered by various banks based on telephone calls and investigation of marketing material – both print and internet based. This works best when interest rates are stable and the number of banks in the marketplace remains static. The reality is that neither of these conditions is likely to be true. Interest rates change and new online banks appear regularly.

Screen scraping is where a software application reads the HTML content of a Web page and extracts the required data. For example, the scraper may read the Web page used by a bank to publish details of the mortgage rates the bank is offering. The advantage is that, when it works, the information is always up-to-date. However, the technique tightly links the scraping application with the structure of the HTML page advertising the mortgage rates. These pages change frequently and each change requires the scraping application to be redesigned.

Web Services are where the banks themselves provide an online application using standard Web technology that allows their interest rates to be requested on demand. The advantage is that the interface to this application usually remains quite stable – requiring less ongoing maintenance at the client application side. Another advantage is that Web service technology is increasingly standards based. A drawback with Web Services is that the technology, by itself, does not help service requesters understand the meaning of the data or messages that they should exchange with the service. This must be determined by a human before the service is invoked for the first time.

Although Web Services provide the best solution of the three approaches described above, human intervention is still required to find services offered by banks online, interpret the data and the messages that the various banks' services can support, and know how to invoke those services. Semantic Web Services address these problems by providing machine-understandable descriptions of what the service can do (capability) and how to communicate with it (interface). The use of ontologies as the basis for the descriptions guarantees that they are unambiguous and machine-understandable. In our banking example, an application would automatically discover new Semantic Web Services offering mortgage rate information as they became available. When such a service is located, the description of the interface would be examined automatically to determine how the application and service should communicate. Once data mismatches have been resolved, the application retrieves the information about mortgages as required. The whole operation is transparent to the customer and is always up-to-date.

2.5. SWS applications in Bioinformatics

Bioinformatics is concerned with storage, retrieval, comparison, analysis and simulation of the composition or structure of biomolecules that contain the genetic material and the product of such molecules. According with Fredj Tekaia, Pasteur Institute, bioinformatics is related to "the mathematical, statistical and computing methods that aim to solve biological problems using DNA and amino acid sequences and related information." Thus, a primary scope of bioinformatics is sequence analysis.

With the development of human genome project, new directions are opening towards comparative genomics, functional genomics and structural genomics. They aim to draw particular conclusions about species and general ones about evolution, characterize interactions between all gene products, and predict the structures of all proteins (in humans)

Such goals may be achieved only by countless computations and data operations driven by various mathematical models spread over many machines, software systems and institutes and summing impressive hours of computer processing time and laboratory time. However, to combine and use efficient the wealth of biologic data (raw or computed) created or in process to be created, there are going to be encountered the same technological issues as the ones currently faced by industry: data heterogeneity, weak system integration or software incompatibilities, various legacy systems and various different taxonomies and conceptualizations between research groups and researchers.

Therefore, semantic web services applications could help in addressing such issues by automating processes that nowadays are manually or semi automated done, by integrating systems that otherwise wouldn't be interoperable and by providing a network where biologic data can be handled, accessed and transformed without facing operational and technical IT problems that would hamper and slow significantly the biologic research.

In this respect data storage, retrieval, comparison and analysis processes, can be encapsulated into semantically described web services. Then, semantic execution environments can be aware of such web services and be able to provide researchers with composite services, based upon the composition of the available web services. Complex goals and queries may be achieved once such semantic execution environment systems have access to the vast resources and knowledge that for now is broken in parts that are isolated (from the network and machines point of view) in offices and laboratories around the world.

2.6. SWS for E-Government

This use-case aims to show the need for a Semantic Web Services (SWS) architecture in the E-Government sector. The aims of E-government are to allow citizens access to information and services provided by their respective governments. Examples of these types of services that a given government would make available are services for applying for birth certificate or passport, paying of motor tax or viewing tax histories. These services began there lives as single services aimed at particular users in particular areas, however as these services are extended and expanded the need for higher levels of automation in certain tasks, for example service discovery, composition, selection, mediation and invocation, is becoming more obvious.

The European Union (EU) has two levels of strategies for E-Government services, at the *global* and the *national* level. At the national level the aim is build an infrastructure within which the citizens of that country can quickly, simply and securely access the services provided by their governments. At the global level the aim is build a *European Interoperability Framework* ultimately resulting in E-Government services being available across borders so that citizens from a given country can access the services of their government no matter where they are. The initiative aiming at this interoperability framework is called IDABC and was established in 2004. The national E-Government efforts ongoing in many of the EU member states aim to be compatible with the IDABC European Interoperability Framework while at the same time creating a *National Interoperability Framework* within their country.

It can be seen that the national interoperability framework aims to bring individual services provided within a given country together and allow them to interoperate. This is by no means an easy feat as each of these services will use different data formats and business processes to fulfil their tasks. The resulting effort involved in integrating all of these services at the national level is a daunting task involving huge quantities of human effort. The introduction of semantics to these services allows for many of these tasks to be automated. Technologies like WSMO can be used to semantically describe the data that is used as input and output of the services and can also be used to describe the external (or public) business processes of the service.

[1] Damodaran, S., “B2B Integration over the Internet with XML – RosettaNet Successes and Challenges”, *Proc. of the 13th int. World Wide Web conference*, New York, USA, 2004.
[2] Preist, C. et al: "Automated Business-to-Business Integration of a Logistics Supply Chain using Semantic Web Services Technology", *4th International Semantic Web Conference, Galway, Ireland, 2005.*
[3] Vitvar T., Viskova J.: “Semantic-enabled Integration of Voice and Data Services: Telecommunication Use Case”, *IEEE European Conference on Web Services (ECOWS2005), IEEE Computer Society, November, 2005, Vaxjo, Sweden.*