Preface to the Special Section on Web Services

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OVER VIEW

Backed by major IT vendors, Web services have received wide attention during the past years in which the basic set of standards was agreed upon, middleware products were designed, and the concept was intensely marketed. Technically, Web services promise to facilitate the integration of distributed systems within and across the boundaries of an organization by using standards from the Web environment such as HTTP and XML as a basis for the interaction between applications. They provide additional mechanisms to describe and publish interfaces to interacting applications forming simple and composite Web services based on expressive description languages. From a business point of view, Web services bear the potential to increase strongly the use of online services from outside an organization in a dynamic way, which used to be implemented within a company or have not been available at low cost. This potential opens the path to cost savings on the one hand and new business opportunities for service providers on the other hand. Now, with the basic technology in place and the deployment starting beyond the early adopters and simple solutions, we want to use the focus area of this edition of Electronic Markets to revisit the current state of the art, investigate current issues in building and using Web services, and discuss future developments – from a technology point of view but also in particular from its impact on doing business online.

Development

The development of Web services started with approaches by multiple vendors, e.g., IBM and Microsoft to implement a simple mechanism for method invocation over the HTTP protocol using an XML-based encoding format for the messages. This resulted in the submission of the Simple Object Access Protocol (SOAP) version 1.1 to the World Wide Web Consortium (W3C) in 1999. Web services do not represent a completely new approach to distributed systems. They extend known approaches from the field of distributed systems such as ANSAware, CORBA, and Java RMI by a service perspective, base description, and message encoding in XML. The technical objective of Web services is to provide an integration mechanism facilitating the loose coupling of systems and hence the dynamic replacement of a service with another one of the same characteristics.

The technology development trajectory for online or eServices
reaches from little-standardized and often bilateral eServices based on proprietary solutions via Internet-based solutions with common communication infrastructure standards to Web services with an increasing level of global standardization and the potential to configure and use services dynamically. Web services can be applied to address integration challenges due to their platform and language independence. However, Web services can potentially support more than technical integration. From increased support of the typical service processes, they can be extended to support all business process scenarios. The two dimensions are depicted in Figure 1, which summarizes that the key differentiator of Web Services is the set of Web service standards. They can be applied to solve integration tasks as well as to enable or support all kinds of business processes.

Standards

Currently, a number of open standards are evolving to address aspects such as interface description (WSDL), discovery (UDDI), wire line encoding and transport (SOAP), coordination (WS-Coordination), transaction (WS-Transaction), processes (BPEL), and others (see paper by Hündling). These standards are backed by the major players in the industry such as Microsoft, IBM, BEA, Sun, SAP and Oracle, which are organized in the WS-I industry body. This body decides which standardization forum, e.g., the World Wide Web Consortium (W3C) or OASIS provides a suitable process and intellectual property policy for a particular aspect of Web services standardization.

Adoption

There are a number of reasons to assume that the Web services technology will have a stronger impact than earlier approaches to distributed systems:

- The technology is based on standards that are widely deployed in the context of the World Wide Web and development know-how is readily available.
- A high awareness of service-based models including orchestration of processes by third parties (Hagel III 2002a) and Web services (Hagel III 2002b) within management consultants educating and advising business people about the potential.
- Leading software providers like Microsoft, IBM, SUN, BEA, Oracle, SAP and others strive to enable their application servers to deal with Web services without strong tendencies to define not interoperable sub-standards. Furthermore, they offer applications that provide the basic functionality to enable service differentiation, usage metering and billing.
- Early users start with internal projects that use parts of the Web service functionality to facilitate integration projects.

Importance and Potential

The issue of business alignment with information and communication technology (ICT), combined with a trend towards outsourcing is very important because Web services may facilitate solutions in industries for both those who, traditionally, do not invest heavily in ICT and those who can still use current investment and enable their software by adding Web service wrappers. However, it is challenging to identify the optimal timing for launching a cross-organizational Web service from a provider, user or broker perspective.

The chances are that, based on these standards and the corresponding middleware, electronic relationships between service providers, customers and intermediaries can be established more rapidly than ever before since less technical details must be negotiated on a case-by-case basis. In addition, due to reduced effort and widely available middleware, we can expect the costs associated with the establishment of a service relationship to drop sharply.

If potential providers of Web services and intermediaries accept this rationale, new opportunities for new business models may be created. This may occur due to the creation of new services, the digitalization of services, the digitalization of control workflows, and the conversion of products to digital products that can be exchanged via Web services or supported by Web services without or with far less integration costs.

Technical Potential:

- Utilizing existing development staff skills.
- Minimized Total Cost of Ownership (TCO) and development costs.
- Reduction of complexity of integration projects and need for complex EAI projects.
Business Potential:

- Reduced time to market by using and enhancing existing services.
- Better alignment between business goals and the IT solution.
- Increased flexibility.
- Reap new opportunities through increased functionality and lower costs.

CURRENT ISSUES AND PAPERS IN THE FOCUS AREA

To start off with the current state of the art in this focus area, the paper by Hündling and Weske provides an introduction to the main concepts of Web services and the related standards. In addition, it addresses the basic mechanisms of Web service composition.

Given the current degree of standardization, the status quo of implementation of those standards and the current extent of industry support, what are the open issues that need to be addressed for using Web services for either intra-organizational integration or cross-organizational integration? Currently, the most important issues regarding the wide adoption of Web services are in the areas of still outstanding or insufficient standardization, low acceptance of service consumers, and critical mass of available useful services.

Standardization and Technology

While WSDL provides a means of describing interfaces to services and BPEL can be used for the description of service composition, other aspects of services must also be described in a standardized way. This extends in particular to the following areas:

- **Security**: There is no means to express which security technologies can be used to access a service, e.g., a protocol to be used (SSL) or the certification authority that is recognized. Also using the standard http port without further amendments might expose companies to some security risk.
- **Quality of Service**: Performance criteria of services, e.g., average response time, throughput, and availability of a service cannot be expressed.
- **Transactions**: While there are specifications such as WS-Transaction that define models and interfaces for services participating in a transaction, there is no way to describe for a service which types of transactions (ACID or compensation-based) it supports.

These and other aspects are relevant for loosely coupled, internal application integration as well as for cross-organizational services. In particular, a consistent mechanism for adding a new dimension of description is necessary. WS-Policy is a newly published approach by Microsoft, IBM and others to describe additional properties of a service and usage requirements. WS-Policy provides a basic mechanism to add description elements. Domain-specific standards for security etc. can build on this basic mechanism.

In addition to those issues mentioned above, we need to describe what a service actually does, e.g., a payment transaction, to be able to choose dynamic services. To fully automate the search and deployment, not only the meaning (semantics) but also the intention and process characteristics (pragmatics) should be explicit, unambiguous and machine-readable. Currently, UDDI does not support sophisticated, formal description of service semantics that can be processed automatically. There is no accepted Web service standard for representing ontological information. While initiatives exist in the context of the Semantic Web, it is not quite clear yet how to connect Semantic Web or other ontological information to Web services. In addition to the particular mechanism, ontologies for the relevant services need to be created by domain experts. When using Web services semantic integration problems may occur if for example the exchanged products are not harmonized or the process properties are not defined. Standards like UN/SPSC are a starting point but do not sufficiently offer the required depth, cover all industries and logistical aspects to enable fully automated transactions.

There are a number of open issues regarding the technology that implements and makes use of the standards. This applies in particular to technologies that make use of the potential dynamics of Web services, e.g., finding suitable services using a directory service and composing them on the fly in a meaningful way to achieve an application’s objective. The paper by Zeng et al. in this focus area addresses this issue by proposing a system for dynamically assembling Web services in a goal-driven way.

Other issues relate to the performance aspects of Web services. While there is potential for performance improvement in current SOAP engines, e.g., Apache’s Axis or Microsoft’s .Net implementation of a SOAP engine or the reduction of the size of SOAP messages in particular environments (wireless), it is again particularly important to deal with performance issues in compositions of Web services. Chandrasekaran et al.’s paper addresses this issue. It discusses performance analysis and simulation and provides guidance to address the assessment of Web service performance. The authors present a simulation environment to optimize Web service performance before actually presenting it to customers.

Acceptance and Critical Mass

Robust functionality, but often even more importantly, business modelling and domain expertise as well as an overview of the acceptance levels and IT-Infrastructures
in specific industries is required. As with the World Wide Web (WWW), the rate of acceptance is dependent on effects like critical mass of users, providers and developers but the de facto acceptance is difficult to forecast.

The best drivers for acceptance of a new technology are good prototypes to study the technology and successful real-life implementations to prove business cases. While there is a sufficient number of prototypes, provided by middleware vendors, to prove that the basic technology is useful and also there are some cases of successful intra-organizational use of Web services for system integration, there are not many cases to study have used Web services for cross-organizational integration or even running a Web service as a successful business. The paper by K wok et al. on digital rights management with Web services offers a suggestion for a Web service. It presents an offering of Web services based solutions for the distribution of digital products like music. In this case study they identify two processes to manage the rights of digital products within a complex business setting with several partners involved.

Another contribution to higher acceptance is the availability of a set of basic services that can be used and incorporated by service customers and providers to build up offerings on their own. Microsoft went in this direction and created its authentication service Passport, a calendar service and others. However, they are not in widespread use by organizations not affiliated with Microsoft. The reason may be that there are still too little service opportunities discovered. However, another important aspect is the level of trust that service users have in the service providers, particularly from a privacy and data ownership point of view. There is reluctance to entrust another organization with valuable customer data. Good models for terms of use are an important next step.

Finally, organizations need to build technology know-how, deploy Web service infrastructures, and skills to manage Web services projects and running services. However, both from a technical and from a business point of view, we can benefit from experiences from the Web as well as the EDI area.

OUTLOOK

We observe, in the discussion above and in the papers in this focus, that the basic concepts and standards have been developed but a number of issues both technological and organizational have to be addressed for Web services to be used as tools for infra-organizational integration as well as for cross-organizational service outsourcing and integration. But what are the next steps after the current issues have been resolved?

An important next step will be to offer good support to find and decide about offering and buying services dynamically. This may open opportunities for intermediaries to offer advice on good service customers and providers and facilitate setting up a service relationship on the fly. In the case of time-critical services, we may see service customization that opens the door to trading futures and forwards of online services, hence requiring the organization of electronic marketplaces. Furthermore, complex and business critical applications using Web service standards are needed to avoid an ensuing phase of disillusion.

In another development, the Open Grid Services Architecture (OGSA) (Foster et al. 2002) represents an interesting extension to the Web services architecture. The Grid was founded as an initiative and technology platform to share computing resources, particularly in the scientific domain. While initially it was based on the Grid-specific Globus toolkit technology (www.globus.org), OGSA has been proposed as a Web services extension to make use of existing Web services technology. There are some interesting conceptual extensions being proposed such as service factories and instances. Beyond the technology aspects, however, the types of services being developed in this context – high-performance computing applications – are good examples of online services provided across organizational boundaries. Services in the areas of life sciences (Bio Grid) and a number of national Grids are currently being set up.

An interesting field to apply Web services on a large scale is the connection of organizations in a supply chain. The global logistics industry is characterized by millions of independent actors of heterogeneous sizes and a relative low IT-investment since many of the information flows are still exchanged via telephone or fax. Robust Web services could be an ideal offering to connect the different players via third party services and little integration costs for both highly IT literate global companies as well as small shippers with a few vehicles. The need for a better electronic integration even increases with some logistic companies positioning themselves as fourth party logistics providers.

Given the current attention to the field, from academic, industry and user sides, there is the potential for finding a viable and appealing way of cross-organizational integration and online services at reasonable costs, if the expectations of both suppliers and users of this technology are managed well.

References

