Are Web Services the Next Revolution in E-Commerce?

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1 Overview

Electronic commerce in its different manifestations is spreading and rapidly affecting all of us. In most cases we, as individuals, come in touch with it when we purchase goods or services over the web. This practice is usually referred to as "B2C" or business to consumer interaction. Yet, this is only the tip of the iceberg: the real revolution (to use a good cliché) will come when businesses will electronically conduct their business with other businesses over the web. This is known as "B2B" or business to business, and is expected to introduce enormous efficiencies into the market place. Today, the trend is shifting from B2C to B2B and a number of leading companies are already engaged in B2B activities: companies such as Ariba and CommerceOne offer to create and operate marketplaces. Other companies such as BEA, IBM, Vitria, Tibco and others offer the infrastructure software and platforms for these marketplaces. In addition, there is an intensive activity in the creation of standards to enable the exchange of information at the B2B level. According to a recent Gartner report [1], $400 Billion worth of B2B commerce was transacted during the year 2000 and this number is expected to double this year.

Web services (or their close relative, E-services) are presently touted to become the next infrastructure technology that at long last, will unleash these efficiencies and in the process, will transform the web as we know it today, into a distributed application-to-application network with all of the trappings of peer-to-peer architecture. Panel members from industry and from academia, have been asked to state their positions on the following issues:

Proceedings of the 27th VLDB Conference,
Roma, Italy, 2001

- What exactly, are web services?
- Can we learn anything useful from the past e.g., from CORBA services?
- Are there research issues that need to be resolved before the picture painted here can become a reality?
- How critical is the adoption of a common set of standards for web services?
- What is the academic perspective on web services?
- What is the industrial perspective?
- Would it be possible to speculate on a time line for these developments?

This short position paper summarizes the moderator's own views in this respect; they are offered together with the views of the panel.

1.1 Panelists

- Dr. Serge Abiteboul, INRIA and Xyleme, France.
- Dr. Rakesh Agrawal, IBM Research, Almaden CA.
- Dr. Umesh Dayal, HP Laboratories, Palo Alto CA.
- Dr. Johannes Klein, Microsoft Research, Redmond WA.
- Prof. Gerhard Weikum, Univesity of the Saarland, Germany.

2 What are Web Services?

Until now, the Web has provided the functionality for:

- Browsing of linked documents
- Manually-initiated transactions

- Manual downloading of files.

The term "Web Services" is used to denote a model that describes the next evolutionary step in the utilization of the Web. The following features characterize this model:

- Transactions are automatically initiated by other programs over the Web, not necessarily using a browser.
- Services can be described, published, discovered and invoked dynamically over the Web.
- Communication is at the application-to-application level.
- The model is language-independent and platform-agnostic.

As a result, new applications, utilizing this infrastructure, become now feasible: the use of intelligent agents for the discovery of trading partners, the creation of market places for such purposes as auctioning of goods and services and the negotiation of business deals that can be transacted among a multitude of participating partners rather than the traditional one-on-one relationships. This new architecture is built on a number of existing open, cross-platform standards: TCP/IP, HTTP, HTML, J2EE and XML.

2.1 Examples of Web Services

Some examples of Web services include:

- Delivery of Business information with rich content:
  - News feed
  - Airline schedules
  - Stock quotes
  - Credit check
  - Information about the current bidding status in an auction
- Transactional services:
  - Hotel reservations
  - Purchase orders
  - Tendering a bid in an ongoing auction
  - Supply chain management: different orders to the elements of a supply chain
- B2B process integration
  - Linkages at the workflow level
  - Process integration among different businesses

3 Forecast for Web Services

3.1 Simple Web Services

Except for the B2B process integration examples above, the services listed are "simple:" in fact, most of these exist already and are available via a web browser interface. With the acceptance of standards such as UDDI (see below), for the publishing and discovery of web services, these are the first candidates for services to be offered in this new format. We expect to see a modest proliferation of these in the coming year via web services registries that will be established by the leading players.

3.2 Complex Web Services

Complex web services have the following characteristics: 1. They are *state preserving* (or "stateful" in the J2EE parlance). 2. They are *composable*, meaning that services, offered by independent organizations, can be combined to offer added value to an application, which then in itself may be offered as a web service. A good example of a complex web service would be the electronic filing of taxes. Presently, this service is offered in the US but requires the interaction with an individual via a web browser. In the future, a payroll organization may invoke this service automatically, on behalf of its payees, to prepare all of the required tax documentation. The preparation service requires access to a variety of different sources: W2's at the payee's company web service, investment information for capital gains calculations kept at the payees' bank or investment company, etc. The service is state preserving in that it has access to the tax information of previous years for such calculations as depreciation on equipment, etc.

4 Research Issue: A Shared Context

To combine web services, a user has to present him/herself to each constituent service independently, using a variety of different identities and passwords. This situation is an impediment that prevents the realization of complex services. Other examples would include the need to share privacy information, personalization details essential to all components and other detail. An example of a shared context component is the PASSPORT service, presently offered by the Microsoft corporation.

To implement complex web services it is essential to maintain a *shared context*: a collection of meta data describing, the participating entities, interfaces to services, protocols used and a common vocabulary, maintained via ontologies, thesauri, and other directory information as well as a formal (XML based) specification of the contracts concluded among the participating parties, that provide the legal basis for the transactions executed.

The standards for such a shared context are only now being thought of and are still a number of years away before adoption and implementation. Consequently, complex services are not forecast in the near future i.e., in less than two years hence.

5 Realization of Web Services

The Web Services architecture includes three element types:

- A *service provider*, which publishes the availability and the nature of its services in a registry.
- A *service broker* who provides support, via its registry, for the publishing and the location of services offered by providers. In its simplest form this role can be thought of as that of the yellow pages directory.
- A *service requestor*, who finds services of interest via the service broker and once found, binds to the services via the service provider.

A stated goal is to realize these distributed architectures over the web, in a manner that is platform independent. Hence, compliance with a well-established and generally accepted standard is essential. Presently, a number of concurrent and largely unrelated initiatives are underway to create such a standard. We will briefly describe here the two most visible ones: UDDI and ebXML.

6 Web Services Standardization Initiatives

6.1 The UDDI Initiative

UDDI (Universal Description, Discovery, Integration) [2] is a joint effort, announced in September 2000 by Microsoft, IBM and Ariba to create a Web Services architecture standard. Since then, a large number of companies, particularly those focussed on directory services and enterprise system integration have signed on. The initiative has three principal components:

The UDDI registries act as a directory of available services and service providers. The content of a directory entry is hierarchically structured into White Pages, containing business information (Name, Address, etc.) Yellow Pages, describing the service(s) offered by the business entity and Green Pages, describing how business is to be conducted with this entity. Presently each of the founders has an experimental UDDI site at which interested parties can register. Over time it is assumed that many more will be created and that these sites will be jointly operating in a P2P fashion: one logical directory will be made available to all providers and requestors, the information will be physically distributed over the participating sites.

SOAP (Simple Object Access Protocol) [4] is an XML protocol to invoke a method on a server to execute a requested operation and receive a response in XML. SOAP implements an “envelope and message” model, in which the SOAP envelope wraps the application-specific message that may be in a different vocabulary. The model allows for substitutable transport and language bindings and substitutable data encoding. It is vendor-neutral and independent of the programming language it is used with. It can thus be used with any UDDI directory implementation, J2EE compliant or otherwise.

WSDL (Web Services Description Language) [5] is an XML vocabulary to describe operational information about the service such as access protocols and other implementation details.

6.2 The ebXML initiative

ebXML [3] is a joint initiative by the Organization of the Advancement of Structured Information Standards (OASIS) and the Center for Trade Facilitation and Electronic Business of the United Nations (UN/CEFACT). Its aim is to create an open XML-based infrastructure for business-to-business communication, thus taking worldwide e-commerce to the next level of cooperation. The initiative is further led by a number of corporate partners, including Cisco systems, Sun Microsystems and XML Solutions, along with fifteen other industry leaders. Microsoft is not a partner in this initiative; IBM seems to follow the development of the standard despite its heavy involvement in UDDI. It lists over 1000 active participants and over 85000 companies have opted so far to use the ebXML standard for their Internet transactions. The complete specification of the standard is expected by May 2001. ebXML goes a number of steps further than the UDDI initiative and offers the means for businesses to:

- Discover each other and the products and services they have to offer.
- Determine which shared business processes, and associated document exchanges, to use for obtaining these products or services from each other.
- Determine the contact points and the correct modes of communication for the exchange of information.
- Agree on the contractual terms on the above chosen processes.
- Optionally, exchange information and services in an automated fashion in accordance with these agreements.

The ebXML technical architecture is designed to meet all of these requirements. Clearly, there is an overlap in the objectives of the UDDI and ebXML initiatives, especially in the areas of the registry and repository of business information. Another overlapping area is that of message transport: the UDDI/SOAP proposal was offered as a transport protocol standard to ebXML and rejected because it was deemed to lack the required depth for transacting the required information.

Draluk [6] provides a more detailed overview and comparison of the approaches taken by these initiatives

7 Can UDDI and ebXML co-exist?

Politically speaking, the two initiatives strive to improve global connectivity for business purposes. UDDI, which offers only a modest functionality by comparison, seems to gain more rapidly a following at this moment. The strategy seems to first, build markets and to use the position to force UDDI as a standard (SOAP has already been submitted to W3C for consideration as the XML transport protocol standard) and then to complete the specification to add more of the ebXML-like features. UDDI is proprietary and presumably, it gives its founding companies a significant lead in the development of tools and other software for serving the markets. Microsoft views UDDI as a major component in its .NET strategy and an opening into the B2B software marketplace. ebXML on the other hand, is non-proprietary and will be made available to all and sundry when it is complete later this year. At this stage it is hard to predict the outcome of this play; some of the larger players (IBM, Sun Microsystems) back both of the initiatives.

From a functional perspective both standards could co-exist: UDDI would be used for the initial, top-level lookup of partners. After discovery the parties would be referred to an ebXML site for the completion of the binding process.

8 Research Issue: Informational Web Services

The tax example presented earlier is an example of an informational web service. We will also refer to this concept as an *intangibles web service* or simply an *i-service*. This is a service in which the added value is in the *derived information* produced, which has a production cost and needs to be priced. Contrast this to the "traditional" model of web services, which involve the selling or buying of goods and services (*t-services*). In this case "tangibles" are involved and the cost of producing additional intangible information such as pricing or billing are absorbed in the cost of the tangible itself.

The business model that has governed the production and consumption of information on the web is rapidly changing. Until recently, production and consumption costs were expected to be absorbed by revenues obtained from advertising and no cost was passed on to the user. This model is rapidly making way for a pay-per-use model, in which the consumer pays, based on some measure of consumption e.g., time, units of information passed, number of forms filled out etc. In this model, web based information becomes a commodity and there is a need to measure the consumption, charge and bill for it. In addition to this new requirement, a number of horizontal business-supporting facilities will be required of an infrastructure supporting informational services. These include: Pricing, Billing, Customer Care and Systems Management.

8.1 The opportunity for infrastructure SW

In an infrastructure which supports a pay-per-use model, runtime data gathering activities, used for the price calculation and billing of consumption, are tightly intertwined with the other functionality that web service provides. Service configuration information (customer profiles, pricing schemes) becomes highly structured and complex, requiring separation from their processing algorithms. Web services, along with their supporting facilities, require tight integration with configurable portals. We expect that web services in all of their manifestations will offer increasingly personalized content to their customers. They will also handle all of the data access and security controls so that different parties will have selective access to different parts of the web service information. The lack of a comprehensive and widely accepted access control model, which will be included in the common context discussed earlier, inhibits this development today. We expect that with the advent of complex web services, this feature will be offered as well.

References

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