

A Framework for Facilitating Dynamic e-Business Via Web Services

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Abstract

While Web services provide an essential building block for realizing dynamic e-business by facilitating standards-based program-to-program interaction, they do not address many business aspects of communication such as security, access control, business partner selection, service level agreement monitoring, and logging. In this paper, we propose a service-oriented framework that provides these much needed infrastructure services. Using the framework, service providers can prepare their business applications for publishing as Web services, and specify access controls on their services in the registry while service requestors can find suitable service providers and invoke their services dynamically. The framework ensures that all transactions are secure, monitored for service level agreements and logged for audit purposes. By providing business utility services and automation technology founded on Web services, we believe that, our framework takes Web services to the next level in supporting dynamic e-business.

Keywords

Web services, business-to-business e-commerce, business frameworks and dynamic e-business.

1. Introduction

In the past few years, the Internet has opened up an effective new medium for conducting business electronically. After the initial enthusiasm, anticipation, exploration and a few failures, there is a broad consensus in the industry that electronic commerce brings efficiencies to business-to-business interaction by means of consolidation and aggregation of services and its potential to reach large numbers of potential business partners. One of the important aspects to bringing efficiencies to business-to-business interaction is the need for companies to integrate their business applications with those of their partners in the marketplace. However, without industry-wide standards for integration it is very difficult to achieve efficiencies in the process. The traditional, static, point-to-point communication model using proprietary communication systems between an enterprise and its business partners can no longer meet the emerging needs of the e-Commerce – it is inflexible and costly to maintain. What is required to enable dynamic e-business is a standard mechanism for supporting complete automation through all aspects of the

end-to-end business process that include finding suitable business partners, getting information about their products and service offerings, negotiating and establishing business terms and conditions, service level agreements (SLAs), payment options etc., to use those services, and invoking those services; all automatically.

Industry consortiums have been diligently working on such standards and have made considerable progress. Recent emergence of Web services shows promise in this context. Web services are a set of open standards that facilitate program-to-program interaction by specifying a programmatic means to describe, publish, discover and bind application interfaces. The set of standards include a standard specification for public registries known as Universal Description Discovery and Integration (UDDI) [3], a description language for Web based services namely Web Service Description Language (WSDL) [5], a distributed object communication protocol called Simple Object Access Protocol (SOAP) [6] and a dynamic, self-defining information specification protocol with semantic support known as extended markup language (XML) [4]. These technologies together make the notion of Web services possible. They make sharing information about products and services with business partners possible without heavy infrastructure requirements. However, as with any emerging technology, Web services have their own limitations. Web services single-mindedly focus on the technical aspects of partner discovery and application interfacing while ignoring most business aspects such as security, access control, business partner selection, service level agreement management, monitoring, and payment for those services. In this paper, we examine some benefits, and shortcomings of Web services when applied to business-to-business electronic commerce. We specifically analyze the preparedness or the lack-there-of of these technologies in addressing the business critical issues mentioned above. Finally, we propose a new framework that provides these required infrastructure services to enable dynamic e-business via Web services.

2. Dynamic e-Business and Web Services

The defining capabilities of an environment that supports dynamic e-business are: (1) open application interfaces to enable interaction between trading partners, service

providers, and other entities that enable e-Commerce; (2) communication paths supported primarily by the Internet and extending to other public or private systems; (3) open standards representing business transaction processes that facilitate automated business to business interaction and minimize or eliminate manual intervention; (4) facilities that support dynamic connection while permitting easy reconfiguration of connections and adaptation when market conditions change; and (5) systems that foster automated functions and services such as identification, negotiation and agreement among trading partners and services providers.

Web services enable many of these key prerequisites for dynamic e-business. Based on open standards, they define a means by which business services can be published, discovered and invoked. They support directories of businesses and services where entries are added modified or deleted dynamically, thereby delivering the most current search and identification results to business applications. They define a standard way to describe and invoke a Web service interface so that the business application can easily connect to it. They support an unrestricted message package supporting all forms of business processes and embody an unlimited range of businesses and services.

3. Examining Selected Critical Issues

Despite all the benefits of Web services, there are a number of issues that are hindering its widespread adoption in the industry. Some of the issues are business related while others are engineering and deployment oriented. In this section, we discuss some notable issues that we have been considering.

While Web services enable businesses to offer their services on-line, they do not specify business essentials such as how those services can be configured, monitored, metered, and protected. More specifically:

- Current lack of standardization around Web service specification for each business process in each industry leads service providers to publish similar Web services with different parameters and signatures. The implication of this is that when a Web service client (also referred to as service requestor) receives a WSDL specification for a Web service from a public registry, developers need to specially implement each Web service call to support each service provider's method.
- In the current specification of UDDI registry, once published, the business information and the business service descriptions are available for anyone to view and invoke. There is no notion of security and access control on the information posted in the public registries supported by UDDI. It is seldom the case that the services to be offered by an enterprise can all be made public and can be accessed

by anyone. While the individual service provider's Web service applications can implement their own security within their domain and prevent unwanted parties from making use of their services, the security exposures and overheads in scanning and parsing all incoming requests (including Spam) is discouraging many businesses from publishing any mission critical services on the public registry.

- Finally, lack of standardization surrounding subscription and authentication for Web services is causing clients to implement multiple Web service calls to support different service providers' methods of authentication. [1]

4. Related Work

Solutions have been proposed to address or to bypass issues related to Web service adaptation for e-business. These include adaptation of Web services for intra enterprise application communication that preempts the need for security and access control. However, the fullest benefits of open standards-based technology such as Web services can be reaped only when they are adapted for both intra as well as inter-enterprise communication.

Recently, a standards body known as e-business XML (ebXML) sponsored by UN/CEFACT and OASIS, has created a modular suite of specifications that can enable enterprises of any size and in any geographical location to conduct business over the Internet [7]. ebXML provides a standard method for companies to exchange business messages, conduct trading relationships, communicate data in common terms and define and register business processes. It shows much promise in addressing some of the issues mentioned in the previous section. By means of its standard specifications, ebXML provides a way of using Web services for communicating with business applications. It also alludes to the concept of an intermediary that can manage business partner agreements. However, ebXML does not address issues such as suitable business partner selection, engineering problems associated with Web services, and supporting process-oriented service framework that can help service providers and requestors in creating, deploying, invoking multiple Web services to accomplish a business process.

In the context of related work for invoking multiple web services to accomplish a business process, one must look at an emerging standard known as Web service flow language (WSFL). This 'language describes how Web services may be composed into new Web services to support business processes. Composition comes in two types: The first type allows specifying the logic of a business process; the second type allows defining the mutual exploitation of Web services of participants in a business process' [7]. However, even WSFL does not facilitate selection of suitable partners, monitoring, and managing the service level

agreements for the end-to-end business process that could potentially include multiple Web services.

Therefore, we believe that neither the Web services technology nor the current proposed approaches satisfactorily address the business needs for its adoption for dynamic e-business. This calls for a new framework that can not only provide protection to the information published on the public registries and a model for security and authentication but also offer a suite of tools that can support construction, deployment and invocation of web services; all automatically. In this section we propose our framework that we believe can address some of these issues.

5. Our Proposed Framework

We propose a service-oriented Web service enablement framework that acts as an intermediary between service providers and service requestors to facilitate business partner discovery, suitable business partner selection based on service requestor's preferences, configurable Web service creation by means of Web service syndication, and automatic Web service invocation, built on foundations of secure authentication and data protection features. It encapsulates the above mentioned value-add business utilities as services that can be subscribed by both service providers and requestors. In a way, it is a network that connects its users by means of its services.

The framework supports dynamic e-Business by providing a comprehensive platform that manages and facilitates the use of Web services by business applications. External to the framework a business application manages the high level objectives of a business process. As services are needed, the application utilizes functional components within the Web service enablement framework. Through its interfaces, the framework is organized to provide an integrated and self-contained set of functions, thereby simplifying the use of Web services supporting dynamic e-Business tasks that are directed by business applications. Figure 1 shows a conceptual layout of the functions of our Web service enablement framework, followed by a brief description of the key components.

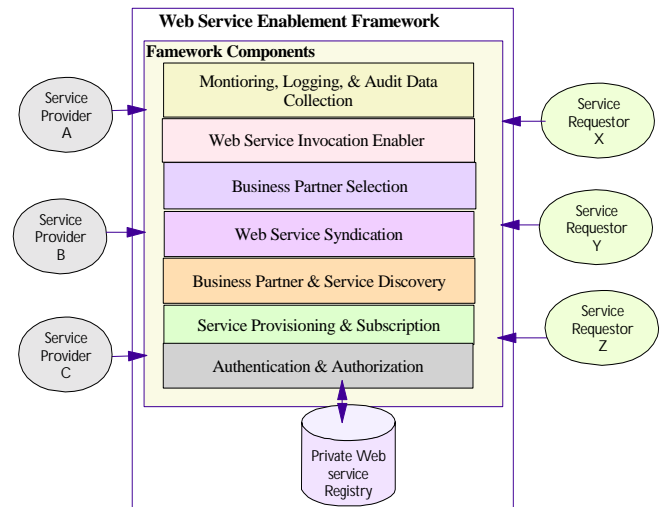


Figure 1. Web service enablement framework

- The authentication and authorization module addresses security and access control requirements of all the services supported by the Web service enablement framework. It ensures that only registered members of the network can use the services of the framework. It also enforces access controls on the data available in the framework.
- The service provisioning and subscription framework manages services in the framework. There are two types of services that the framework manages: (1) services provided by the framework such as business partner discovery, partner selection, and Web service syndication; and (2) the services provided by the service providers.
- Business partner and service discovery module provides the functions necessary to facilitate the search of business partners and their services.
- Web service syndication module provides Web service creation tools that can help a business application create new Web services automatically.
- Web service invocation enabler module provides a user interactive mechanism by means of which clients can automatically invoke a Web service.
- Monitoring, logging and data collection module provides the logging and monitoring capability for all the services managed by the Web service enabler framework.
- The framework also deploys a private Web services registry to enable service providers to publish their Web services. The services published in this registry are protected from viewing or invocation by unwarranted parties by means of strict access control measures imposed by the authentication & authorization module of the framework.

Fig 2 illustrates the interactions between a service provider and a requestor via the framework. A service provider A and service requestor X sign up with Web service enablement framework and subscribe to its services (subscription not shown in the diagram). Service provider

A prepares her business application to be published via web service syndicator. After preparing the application for publication, Syndicator uses an internal web service assistant module to publish the service to a registry within the framework. Service provider A can interact with the registry and specify access control permissions on the service to limit its visibility only to intended parties. Service requestor X requests business partner selector to help find suitable business partners by specifying preferences. Partner selection module invokes the search services of the framework to find partners that meet the requestor's preferences. Once chosen, it evaluates the partner service quality based on some external as well as user input quality criterion and presents a filtered set of suitable partners to the requestor. Service requestors can set up partner agreements using the partner agreement assistant module built on ebXML specifications. When agreements are established, service requestor can proceed to set up Web service invocation for the preferred services by using the Web service invocation enabler module. Web service invocation enabler module assists the requestor in providing the required parameters to the chosen Web service (this is a one-time set up for each Web service invocation). Next, service requestor can invoke the Web service set up earlier via the framework. Framework provides security, agreement monitoring and logging services for each transaction.

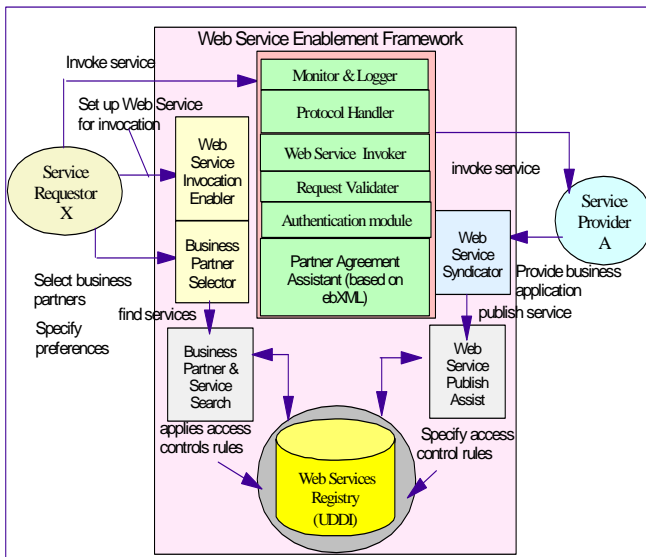


Fig 2. Service provider and service requestor interactions with the Web service enablement framework.

At IBM research labs in New York, we have implemented prototype versions for some of the functions of our framework using IBM technologies such as WebSphere Application Service, Policy Director, Web Sphere Business Integrator, and Web Services Tool Kit (available for free download on IBM's alphaworks web site at <http://www.alphaworks.ibm.com/webservices>). Parts of this

work have been showcased at the XML developer's conference (XMLDevCon 2001) in New York and at the JavaOne 2001 conference in San Francisco.

6. Future Research Directions

In our opinion, the following research areas warrant further discussion and advancements in the state-of-the-art.

- Development of new Web service standards addressing critical business concerns such as security, service level agreement management, and access control.
- Development of new specifications for standardizing Web services for each industry.
- Explore Web services support for collaboration and assistance in complex business negotiations cross multiple business processes and service providers.
- Explore support for business process choreography and workflow within a Web service.
- Research in creation of protocols and methodologies to enable automated integration of business applications and dynamically discovered web services.

7. Conclusions

In this paper we have presented a service-oriented framework that supports dynamic e-Business by providing a comprehensive platform that manages and facilitates the use of Web services by business applications. The framework that can be managed by an intermediary addresses some business critical issues such as security, access control and service level agreement management. Realizing that this is a small step toward dynamic e-business, we proposed some areas that need further research contributions.

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