BEYOND LANGUAGE AND DISTANCE BARRIERS: A WEB SERVICES MODEL FOR DISTANCE AND DISTRIBUTED LEARNING

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ABSTRACT

Three features are vital to the future of web-based education: *interactivity* between users (students, instructors, and administrators), *speed* of delivery, and *flexibility* in relation to time and location of use. Schools are providing on-line content and services by way of the web, and they are trying to adopt information architecture that can support interactivity, speed, and flexibility. However, most of online programs that are offered are independent applications, frequently operating on independent platforms. The authors propose a web services architecture based model that would not only support interactivity, speed, and flexibility, but also provide a “single system image” to integrate all available services. The proposed model would support services and applications that include conferencing system, chat rooms, bulletin boards, e-mail, "virtual conference" areas, online exams, etc. This model would enhance course communication and collaboration while concurrently improving the quality of learning materials. The paper presents the flexible architecture details of a web service model that could be exploited for web-based education to deliver content in multi-lingual format and outlines the details of a language translator web services model that the authors have developed.

Key Words: Web Services, translator web services, web-based education, online education, Distance Learning, Distributed Learning.

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INTRODUCTION

The rapid expansion of the Internet as a potential course delivery platform has generated tremendous excitement as it offers the opportunity fundamentally to transform learning delivery and the competitive landscape (Volery and Lord, 2000). The teaching environment is undergoing a major shift as programs are offering on-line classes either partially (Web enabled) or totally (Web exclusive) with increasing frequency. This shift is due to rising costs in education, enrollment-management issues, and an evolution in the use of distance learning (Eastman and Swift, 2001). Several well-known non-AACSB accredited and AACSB accredited schools are offering online courses delivered through the Internet (Eastman and Swift, 2001). Web education denotes the processes entailed in distance education where network technologies such as the Internet are used to make connections among students, teachers, and educational materials (Muirhead, 2000). The economic advantages of distance education through web education are substantial (Victor, 1999, Wardrope, 2001). Access, cost and some evidence of superior educational effectiveness are enticing schools and faculty to deliver more educational content through online methods (Eastman and Swift, 2001). The use of sophisticated communication technologies to connect geographically dispersed teachers and students is emerging as an efficient method of delivering academic courses and training programs (Light, 1999, Marshall, 2001). As universities grapple with increasing costs and decreasing enrollments, web based distance education in general can be a lifesaver in extending the reach of the university (Eastman and Swift, 2001; Eisinger, and Smith, 2000). Online education or web-based education is not only a cost effective way of delivering education but is found to be very effective from the student's learning perspective. Distance education using technology-enhanced learning (TEL) strategies is becoming an accepted method to provide educational options (Carlson and Olson, 2001). Today, audio, video, and computer technologies are evolving as common delivery modes for education; thus the Internet is playing a big role in changing the mode of delivery in education (Mangan, 2001; Hiltz, and Wellman, 1997). The online web-based educational delivery method moves courses from a "talking-head," instructor-centered, passive student model to an independent learning, student-centered, empowering model (Rack and Cantu, 2000). The popularity of online courses in business is increasing dramatically as students search for flexibility in scheduling and collaborative learning in today's knowledge economy (Phillips, 1998). In the year 2001, there were at least 1 million students enrolled in courses taught entirely in cyberspace. This amounts to perhaps 5 percent of all enrollments. According to Lowe, 2,000 institutions now offer more than 50,000 online courses to 2 million students (Lowe, 2001).

The driving forces for web-based education are; an increase in population, changing student demographics, demand for learner-centric programs, and the increasing pressure on reducing costs on education (Christner, 2001; Miller, 2002). Web-based education delivery does two important things in regard to offering flexibility; first, it provides better opportunity to reach a wider student community by offering online courses. Second, flexibility can also be based on the "any-device" principle that connects the students to learning channels through the Internet or wireless application protocol. The web is a step toward creating a more 'global student' and a distributed environment

where students can learn not only from instructors but also through exchange of their knowledge or discussing with experts other than their instructors. The is web is an ideal method of connecting students with the distributed learning constituents of instructors, other students, and experts, for a free flow of information exchange.

Currently, some methods in the typical web-based class represent a strictly "presentational" method of course delivery that may involve nothing more than cutting-and-pasting lecture notes into an on-line format. Much of this is simply navigational, in which the user is merely clicking on hyperlinks to be taken to the next page. The presentational design is similar to traditional paper-based correspondence courses: materials are provided (online or on paper); students work independently at their own paces to read these materials and complete assignments; and student/teacher interactions are restricted, for the most part, to student-initiated questions and teacher feedback on assignments (Cook, 2000). Other programs have taken it a step further by adding functional features to the learning system such that the user can work together with the computer to achieve some goal (e.g., a business simulation). In the future there will be a need for an additional step in student learning: interactive collaborative methods. Collaborative methods would allow students and their instructors to work together to create new knowledge, in ways that could not otherwise be possible. The interactive design, in contrast, employs three additional communication features-a bulletin board, a chat room, and peer evaluation software-in the course's delivery mix. In the interactive design, students are required to interact with each other as well as with the instructor on a regular basis. Although students using the interactive design work at their own pace, their interactions with the instructor and other students create a learning environment similar to that of an onsite classroom (Cook, 2000). Interactivity features designed in the delivery method should promote class discussions, interaction among students and instructors, and collaboration. Currently, most schools use software packages such as Blackboard and Web CT for delivery of web-based educational. Many of these software tools are platform-specific and do not integrate the full range of application software packages or services that may be offered by universities. Students need not only course contents, but also other services. Many of these services are platform specific, thus creating a problem for integration. On one hand, students want to receive web-based education (lectures, notes, assignments, exams, projects etc.) through interactive web based delivery mode. On the other hand students need a tool to communicate with instructors and other students. This tool should be in real time and should include language translation options, in order to regain some of the communication richness that is lost when face-to-face communication is not possible.

The concept of web services architecture allows for the development of a single software package that can deliver education in multi-lingual formats simultaneously. Additionally, a central home page that allows for synchronous group meetings, instant messaging, and a gateway to other real-time audio/video applications for multiple interactions would not be possible without using the concept of web services architecture. The authors propose a web services based model for web-based education that provides a layer of interoperability so that applications can be described, published, located, and invoked irrespective of underlying architectures. Using this model, education can be delivered in flexible formats such as mobile, home based or any other traditional method.

Additionally, all content can be delivered in multi-lingual format. The proposed model can support truly distributed and interactive environments - unbounded by time and location. To illustrate the proposed architecture, the authors have developed a flexible services architecture based translator web service that could be helpful in delivering the same program of study in multiple languages. Away from home, the students can receive their education using Personal Digital Assistants (PDAs) or other mobile devices. This paper presents the flexible architecture details of a web service model that could be exploited for web-based education and outlines the details of a translator web services model that the authors have developed.

Web services are self-describing applications that reside online and that, using standards such as Simple Object Access Protocol (SOAP), Web Services Description Language (WSDL), and Universal Description, Discovery and Integration (UDDI), can be accessed and used by any client.

The web-services architecture model proposed here will help students in two ways. First, it will provide access to a central home-page that allows for synchronous group meetings, instant messaging, and a gateway to other real-time audio/video applications such as Microsoft's NetMeeting, Netscape's CoolTalk, or cu-see-me. Second, it will deliver education in multi-lingual formats simultaneously.

DISTANCE AND DISTRIBUTED LEARNING – A NEW PARADIGM OF EDUCATION

Distributed learning refers broadly to features of a learner-centered environment, which integrates a number of technologies to enable opportunities for activities and interaction in both asynchronous and real-time modes (McIntyre and Wolff, 1998). Distributed learning is becoming a more pervasive feature of the academic landscape as it provides opportunities for collaboration and communication among the participants in a shared learning experience (Volery and Lord, 2000; Campbell, 1996). Student-driven learning, and collaborative interactions are new concepts in a web-based environment and will be in great demand in the future (Chester and Gwynne, 1998). New learning paradigms are possible whereby students become partners with instructors in the learning process and behave as contributors to the instruction, in addition to being a recipient of that instruction (Kochtanek and Hein, 2000). This may motivate both students and instructors with challenges and opportunities accompanying the move toward facilitated group learning in distributed environments. This may result in the revelation of a new type of student, such as "self-directed e-learners" (Neorman and Spohrer, 1996), New teaching and learning models present opportunities to learn with others and to share experiences and discoveries with those collaborators. Many schools have already been using major commercial packages such as WebCT, BlackBoard, and eCollege. These packages have email, chat, and discussion lists that support synchronous and asynchronous communications among students and educators (Tidd, 2001). These tools are not sufficient enough to create effective distributive interactive learning. More useful tools may be needed for instant messaging and chatting for synchronous communications, discussion lists for asynchronous communications, and file sharing for collaborative work

Tidd, 2001). Distributed learning technologies have to contain collaborative tools for sharing virtual workspace for interactions and interpersonal communication, among students, teachers and other members. The interaction can be synchronous (i.e. in real time) with, for example, a chat forum or video conferencing, or it can be asynchronous. Learner-centered environments require interactive tools such as simulations or self-administered quizzes that allow the student to progress at his or her own pace through required exercises and self-assessments (Volery and Lord, 2000).

The new model for web-based education would not be free from barriers and challenges. In fact, it may require many changes to be incorporated at the school, instructor, and student levels. There would be pedagogical changes to deliver a distributed learning course using a web services model (Cook, 2000). The time commitment associated with the development of any distributed learning course is substantial. The initial time spent creating an online course, especially for creating lecture material, collecting URLs/pointers to outside supplementary resources, and assignments, etc. is phenomenally high. The student community may demand answers almost on a real time basis and try to reach instructors at odd hours. The requirements for communications placed on both the instructor and the students for continued interaction during the course of the learning can be quite demanding (Kochtanek and Hein, 2000).

WEB SERVICES MODEL FOR DISTANCE AND DISTRIBUTED LEARNING

In this paper, we propose web services architecture for web-based education that supports distributed learning. Web services are a new form of communication system that will help schools deliver education in a much more open and flexible manner (Meehan, and Copeland, 2002). Web services are primed to be the next big development for Internet-based applications and transactions. The aim of Web services is to seamlessly integrate systems and applications that communicate over a network (Andress, 2002). Web services are designed to bring disparate information sources together (Johnston, 2002; Sharma et al., 2002). It would enable universities to build extranets that link students and other partners with the rest of their value chains by integrating data from their disparate applications. Web services provide interactive functionality such as report listing, viewing, refresh, and drill-down through a portal interface (Gibbs, 2002). The basic flexible services architecture of web services that would support web-based education is shown in Figure 1.

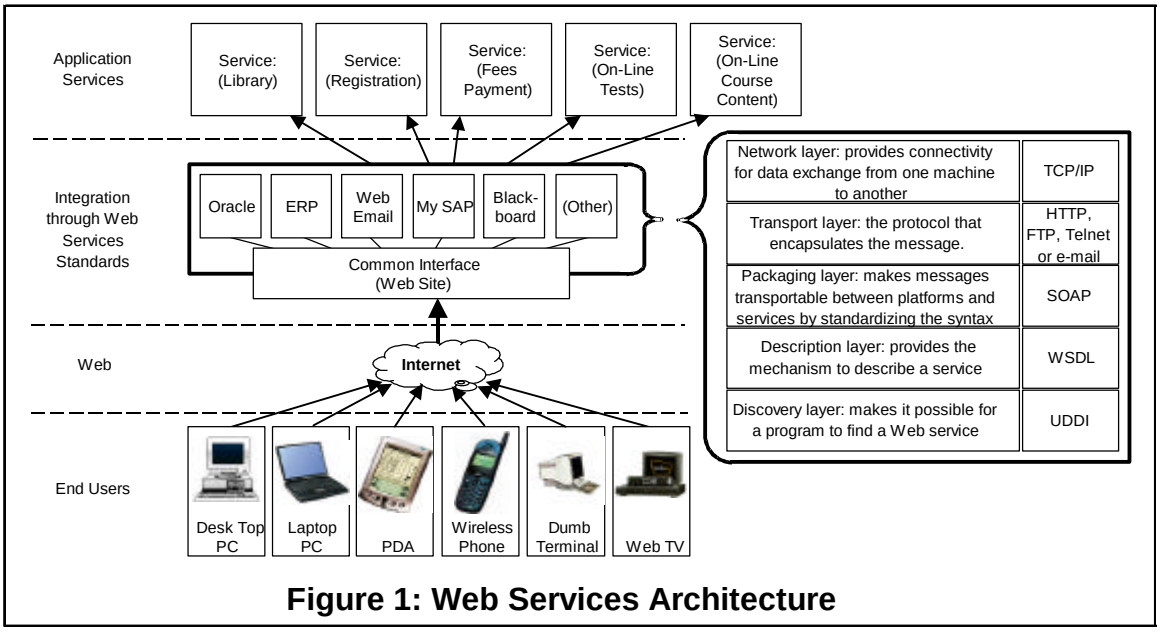

Figure 1: Web Services Architecture

The proposed web services model environment can support student-driven learning that can be both synchronous and asynchronous. Web service based tools can create a learning community that can support one-to-many and one-to-one interactions. These interactions are essential for the establishment of a truly distributed and interactive environment, one unbounded by time and location. It will foster a new learning experience for the educational community (Gabelnick et al., 1990). The proposed web services model could also help create a community of networks that could speed up the pace of learning itself. For example, by participating in communications networks through the web services approach, individuals can accelerate their individual learning and break the constraints of a lockstep education in which everyone does the same work at the same rate, at the same time, students can collaborate asynchronously (Kochtanek and Hein, 2000). Web-based applications can run on everything from mobile phones to desktops. Regardless of language - Cobol, Fortran, C, C++, C#, VB, or Java (i.e., J#) - one can write web services in Visual Studio .Net. Web Services Toolkit for Office XP can also be used. XML Web services can be easily integrated into Office XP, allowing business data to be fed directly into Excel and other applications automatically. The logical architecture for the flexible services architecture based web services model is shown in figure 2. The concept of web services aims to democratize distributed computing by reshaping the once-closed HTTP server into a programmable application server accessible by any authenticated client, written in any programming language, running on any platform. Applications can be integrated regardless of implementation language or operating environment (Morgan, 2002; Schultz, 2002).

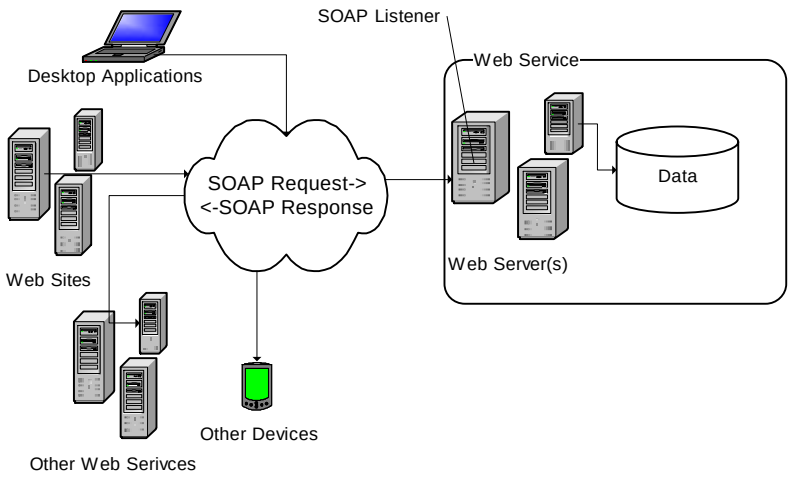

Figure 2-Logical Architecture of a web service built on the Flexible Services Architecture

Web services architecture, as a set of emerging protocols and standards, offer a different approach to enterprise integration and development. Architecturally, web services are typically made available by use of a common transport mechanism, namely SOAP, through which agreements and binding can be universally facilitated. The directory, or repository, is accomplished through UDDI. The interface is described in WSDL, and the transport is managed seamlessly using SOAP, allowing companies to communicate with the outside application regardless of what platform, system, or standards are being used behind the scenes at either company (Schultz, 2002).

OVERCOMING DISTANCE AND LANGUAGE BARRIERS – A FLEXIBLE SERVICES ARCHITECTURE BASED TRANSLATOR WEB SERVICES

Geography becomes irrelevant through the use of a "real-time" or synchronous e--learning forum. Asynchronous learning and a high level of student teacher interaction can be achieved through whiteboards/smart boards, or electronic boards. (Internet-based whiteboards are essentially visual or graphic versions of the more familiar Internet Relay Chat (IRC) or chat-room functions. In both synchronous and asynchronous learning, using graphics, animation and other interactive feature etc., the courses can be made interesting and stimulating to the learning process. It certainly would enhance learning skills and at the same time would provide flexibility in relation to time required to learn (Asirvatham, 2000). To demonstrate the principles of flexible services based architecture, the authors have created a web service that is both technically powerful and able to provide real value to a provider. This web service attempts to help reduce the communication problems that occur between languages. Language can be a big barrier for anyone who travels or does business internationally or wants to receive education in a foreign language. A web service could be a powerful solution for this problem. Perhaps a traveler needs to translate a word or phrase while traveling or while talking on the phone. The traditional method would be to use a book to translate the word and then try to pronounce it properly. A web service could do much more; it could also provide an

audio translation and image representations of a word or a phrase, making it much more powerful than a standard dictionary (Morgan, 2002). For example, a language instructor may use the web service to help students understand how to pronounce words properly. Based on the proposed model, a data store containing words in different languages would be located on the provider's servers. Next, the provider would have to create objects that search the database and return the word or words that match; these objects must have at least one method that is exposed publicly to be invoked from the SOAP listener. The requested XML for a typical word lookup might be as follows:

```
<translator>

        <class>translator</class>
        <method>search</method>
        <baselanguage>English</baselanguage>
        <foriegnlanguage>Spanish</foriegnlanguage>
        <word>bread</word>
</translator>
```

This XML code includes the service class to invoke and the parameters necessary to perform the search. This requested XML would be packaged inside a SOAP message to allow the SOAP listener to interpret and authenticate the message. When the listener received this message it would look for the translator class and invoke the search method with the parameters specified (Vizard, 2002). When the method had finished executing, it would return a response XML in the following format, such as:

```
<word>
        <foriegnword>pan</foriegnword>
        <part>noun</part>
        <image_url>http://translator.net/pan.jpg</image_url>
        <audio_url>http://translator.net/pan.mp3</audio_url>
</word>
```

This XML has the translation of the word (bread/pan), its part of speech, and the URLs to both an image of the word and an audio clip of the word being properly pronounced. The client now has all of the needed information and can process the results accordingly. The authors' translator web service meets the criteria of a powerful web service because it is: based on standards, rich, and consumer independent. First, the service is built on the XML standard using the SOAP protocol. Second, the service is rich because it provides enough information to support a client with audio and video capabilities. But, a client that does not support audio and video will still be able to use the service. If a user's cell phone does not support images, it can still use the service, disregarding the image. Third, this web service is valuable in a business model because it provides critical information to many users and can provide a steady revenue stream to its providers. Frequent business travelers may subscribe to the site for use during their travels. Language instructors may subscribe to the service to utilize it in a classroom setting (Morgan, 2002, Vizard, 2002).

CHALLENGES FOR WEB SERVICES

The flexible services architecture based translator web service proposed in this paper to deliver content in multi-lingual format still has many challenges to face. For example, questions about end-to-end security, contractual agreements over service use, and QoS (quality of service) reliability are unanswered. The first and the foremost challenge for the providers of web services is to keep the service up and running and make them work in any environment. It would need an operational infrastructure robust enough to guarantee the uptime and the availability of web services. It would also require extensive monitoring and testing of services for its quality and guaranteeing uptime.

Security concern is another major challenge that the web services model faces. Security issues, authentication, authorization, and protection of the server, are important areas that remain unresolved. The web services may need one means of authentication that can work across all the components of web applications. At the most basic level, Web services security can require a user ID and password for authentication, access control lists or file permissions for authorization, message digests for integrity, and SSL (Secure Sockets Layer) encryption for confidentiality. Digital signatures and time stamps can be used for non-repudiation, but implementing these is a very complex task (Andress, 2002). Extensive authentication, credentialing and access control technologies are needed to ensure that only valid users can access Web services**.** Companies may have to use two firewalls: one to separate its Web server from its back-end systems and one between the Web server and the Internet. Any data requested from the back-end system has to pass through both firewalls before users can access it. Organizations may also have to use public-key infrastructure services and passwords.

The author's translator web service code is written in the programming language C#. The communication is all done through SOAP, which is a subset of XML. The database used is SQL Server 2000 database, which is a relational database management system. The experience of developing this web service model is unique from other software development projects. The end user is usually known prior to development as well as the device/application that will be used. In this case, there was no specifically defined user, therefore multiple devices and consumers had to be considered. From a development standpoint, the challenge is to build a dictionary database. Setting up a database that can contain audio, video and text data, and to allow data to be retrieved quickly upon request is a challenge. The most difficult task of developing such a service is how to handle the multimedia files. One can store the multimedia files in the database as binary data, but every time somebody requests them, the program must build a temporary multimedia file, which is expensive from a processing standpoint. Also, if the consumer were using a cell phone, such multimedia files are unusable making this development effort pointless. To access data from a cell phone would require at least 2 interfaces, one for the cell phone, and one for a multimedia device. This opposes the idea of "transparency" where everybody accesses the service in the same way. The authors created "virtual files" for this purpose, and then passed around the URL to those files.

CONCLUSION

A web services model for web education would offer many value-added services to students that could enhance their learning experience. It would not only increase accessibility to more students by removing distance barriers, but also provide opportunity for receiving education in a language of their own choice. The web services model for web based education has a high degree of interactivity and can promote a faster and cheaper method of delivering knowledge to students who are not able to be physically present in the classroom, or those who need flexible "classroom" hours. Web services provide a means of integrating applications via the Internet. By using XML messaging to exchange data, Web services allow universities to link applications and offer online programs regardless of the computing platforms and programming languages involved.

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