

2004

Connectivity via Web Services: An Analysis for Interoperable E-Commerce.

Emmanuel Opara

Prairie View A & M University

Omprakash Gupta

Prairie View A&M University

Follow this and additional works at: <http://scholarworks.lib.csusb.edu/ciima>

 Part of the [Management Information Systems Commons](#)

Recommended Citation

Opara, Emmanuel and Gupta, Omprakash (2004) "Connectivity via Web Services: An Analysis for Interoperable E-Commerce.," *Communications of the IIMA*: Vol. 4: Iss. 4, Article 9.

Available at: <http://scholarworks.lib.csusb.edu/ciima/vol4/iss4/9>

This Article is brought to you for free and open access by CSUSB ScholarWorks. It has been accepted for inclusion in Communications of the IIMA by an authorized administrator of CSUSB ScholarWorks. For more information, please contact scholarworks@csusb.edu.

Connectivity via Web Services: An Analysis for Interoperable E-Commerce.

Emmanuel Opara

Prairie View A&M University, Prairie View Texas
(936) 857-4011, Fax (936) 857-2105; Emmanuel_Opara@pvamu.edu

Omprakash Gupta

Prairie View A&M University, Prairie View Texas
: (936) 857-4011, Fax (936) 857-2105; Omprakash_Gupta@pvamu.edu

ABSTRACT

The Web Services platform depicts a systematic, interoperable, and messaging infrastructure on which enterprise systems build sophisticated and dynamic applications for data mobility on the web. This article examine how scalability and interoperability of data using Web Services can promises a dramatic progression for both the technological and the business aspects of e-commerce.

INTRODUCTION

Global competition, strict regulatory mandates, and the desire for measurable business growth are driving the need for flexible and adaptable systems to support business agility in all types of industries. The ability to quickly access and report information in a consistent and timely manner can ensure that an organization is able to comply and compete with current and future mandates (Agrawal 2001).

Scalability and interoperability of data using Web services show promises of a dramatic progression for both the technological and the business aspects of e-business strategies (Simeon 2001). The procedures and manner that corporate entities are using the World Wide Web varies significantly. Majority of these organizations are starting to identify methodologies that will allow internal applications to interact with enterprise systems at various organizations through the application of Web services.

The 21st century has shown continuous turbulence in the global economy and this has resulted in the focus of industrial leaders to modify their strategies from the busted Internet –based dot.com

strategy to a more focused global strategy that enable businesses to become more dexterous, efficient and effective in their pursuit of excellence and competitiveness.

Enterprise organizations are introducing series of Web services to their information technology (IT) infrastructure so as to integrate applications within the enterprise and to sustain their markets or territories by reaching out to outside clients and customers. The effect of this is to create enterprise efficiencies and expose various organizations to new sources of markets and revenue.

Computing industry leaders are striving for solutions on how to provide high level of interoperability across platforms, programming languages and applications that will enable end-users to solve integration problems easily. The solution seems to be in Web services.

PURPOSE OF THIS STUDY

The purpose of this study is to define and examine how Web services extend the capabilities of current technologies, by identifying innovative methodologies of achieving cross platform interoperability based on Internet standards and to show how Web services can contribute to organizational efficiency.

LITERATURE REVIEW

A Web service is a network accessible function or an application service that can be toggled-on using standards Web protocols. This service is applicable to all types of connectivity or networking environment. Web Services support business-to business, peer-to-peer, business-to-consumer or department-to-department interactions (Coyle 2002).

Studies have indicated that XML Web services are the primary building blocks in the progression to distribute computing on the Web (Teng et.al 2002).

Coyle F (2002), Dornan A (2003), Hooper L (2001) among others noted that Web services are software components that are loosely coupled and distributed, encapsulated business functionality and are programmatically accessible using standards that describe service-oriented, component-based application architecture. Web services are projected to be the next generation in the evolution of software architecture because it represents a new model for software applications with some architectural features that distinguishes the new software applications from the earlier ones (Fan et.al 2000).

Earlier studies found that enterprise systems have been trying to develop enterprise solutions for automating system-to-system collaborations, within or across respected trusted organizational domains, as these various organizations try to enhance productivity by reducing operation costs (Davis, F et al.1989, Glushko et al. 1999, Hopkins. J, 2000).

Most recent studies by Hampe, J. (2001), Sens, T. (2002), and Dyer. R (2003), have paid considerable attention as to how Web service specifications can offer communication conduit among the heterogeneous computational environments that are used in the development and hosting of system applications.

Sens T (2002) found that enterprise usage of web services will reduce costs of doing business and improve the efficiency of information technology (IT). Coyle F (2002), concludes that by 2005, enterprise systems that have implemented Web services aggressively, could expect a 35 percent increase in the efficiency of various IT development projects.

Kotok, A (2000), McCright, A (2001), Sarvega (2002) among others found that B2B enterprises in the e-commerce environment that implement Web services will benefit by transforming their business processes through which various enterprise collaborate with each other.

Lin J.and Lu. H (2000) noted that Web Services lies at the convergence of two technologies. First among these technologies is the evolution of Service Oriented Computing (SOC) where data and business configuration is open to the elements of the Web system through programmatic interfaces and integration. The authors emphasized that the origin for Service Oriented Computing can be traced to previous distributed component technologies such as remote procedure calls (RPC), interface description language (IDL) and CORBA. Second on the list of technologies is the Web system infrastructure that encompasses worldwide communications technology that uses standard protocols such as hypertext transfer protocol (HTTP), extensible markup language (XML), simple object access protocol (SOAP) as a formatting language.

THE NEED FOR INTEROPERABILITY ACROSS DIFFERENT PLATFORMS

The need for enterprise interoperability has been an issue among several industries that depend on information technology for competitiveness. Interoperability can be achieved using the

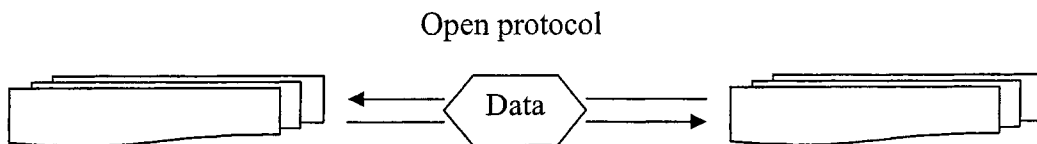


Figure 1 Scalability and Operability of Data

Web Services platform as shown on Figure 1. Here a Web Service application is accessible over open protocols.

Business to Business Integration (B2Bi) and Enterprise Application Integration (EAI) are area of focus for interoperability e-commerce.

Enterprise phases of B2Bi areas represent the business interactions between different enterprises. An illustration can be seen when one business desires to purchase raw materials or business

supplies from another business, both organizations will have to interact and exchange information (Hampe 2001). A problem on connectivity might be that both might not be using the same technology suite and as a result, might not be able to communicate in real time. Another analogy is that many enterprise organizations that are very successful with breakthroughs in a given platform, might want to extend their technologies to end-users. The problem here might be that end-users might not want to be locked into any particular platform or technology suite. As a result, interoperability will become a major challenge for enterprise organizations that are striving for an above average return on investments.

Virtually almost every organization, use the internet to streamline communication and reduce cost with the business partners. Their strategy is to ensure that enterprise systems are secure, reliable and interoperable with little downtime. With systems continuously evolving, successful businesses can grow more rapidly and effectively. The enterprise integration application (EAI) environment create integrated infrastructure for connecting disparate enterprise systems, applications and data sources across organizational system. EAI solutions provide duplex, bi-directional solution to share seamlessly and to exchange data among enterprise resource planning platform (ERP), data warehouses, databases, and other systems within the enterprise (Dornan 2003).

An example can be shown using a system that has a Window® 98 LAN, a Window Millennium Web server running ASP.NET, a Peachtree Accounting System, and several Unix-based MRP and SAP systems. For the system to be effective in meeting the need of the enterprise, these systems need to collaborate by communicating and exchanging information (Kotok 2000). In the past, the problem in this type of operation has been how to make the various components talk to each other in real-time. Most organizations have relied on short term, expensive and ineffective solutions such as using printers and fax machines as part their organizational integration strategy.

Interoperability will become a reality when Web servers and Web browsers can communicate and becomes available to all major platforms. The success of the integrations will mean that all window clients can access applications running on Unix servers while Macintosh clients can exchange information with mainframes. Further, servers running Windows can communicate with clients on Linux machines.

NETWORK TIERS AND SPECIFICATION USED IN WEB SERVICES

Some of the specifications that play great role in Web services include XML, SOAP, WSDL, UDDI (see figure 2). The major network tiers as shown in Figure 2 depict the evolution of Web Services. These layers are TCP/IP, HTTP/HTML and XML. The stacks of layers built successfully on top of each other have the core to data movement on the Web (see figure 2).

The TCP/IP Protocol

This is the first tier among the network. It is the backbone protocol of the Web on which higher-level, standards protocols such as HTTP and XML rely. This layer guarantees the migration of data across the wire in sets of packets. It further enhances transmission of data across public

networks by emphasizing reliability of data transportation and physical connectivity (Kobielus 2003).

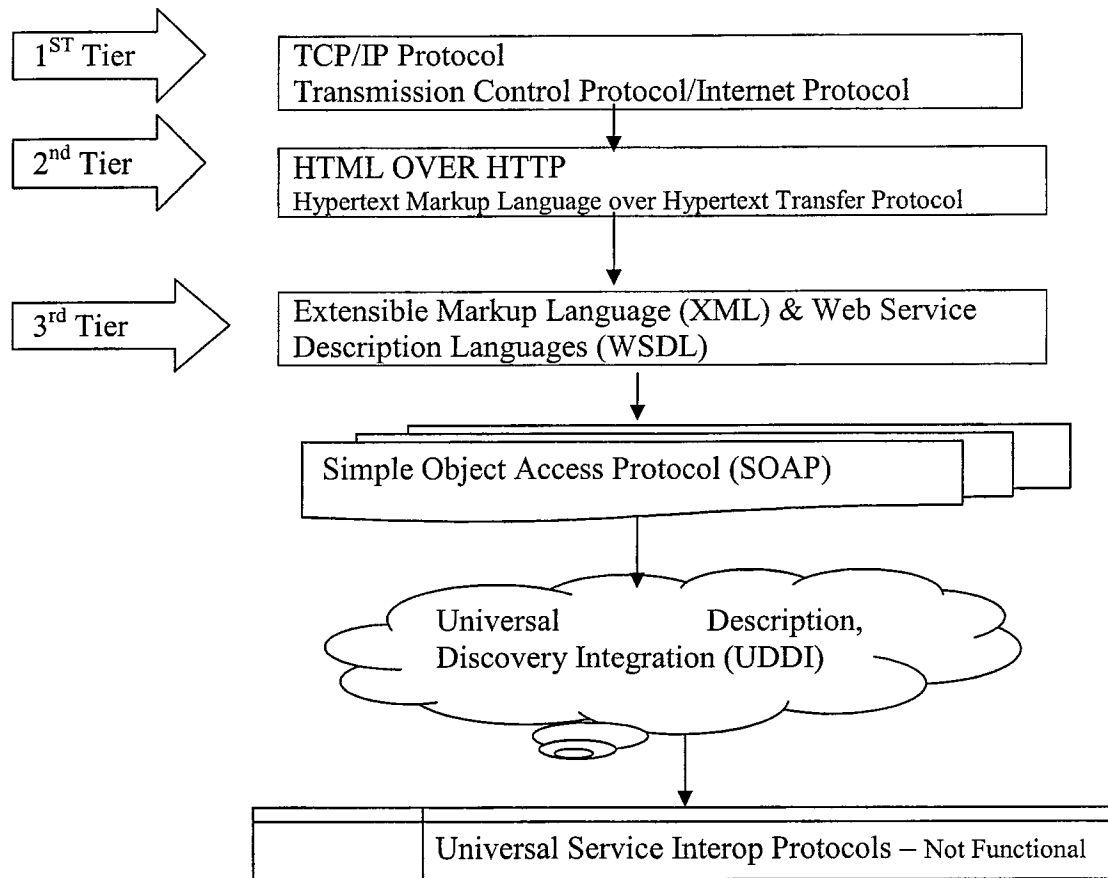


Figure 2 - Network Tiers

HTML over HTTP Layer

This is the second tier among the network tiers. It is a presentation tier that focuses on browser-based search, retrieval and sharing of information on the internet. The HTML over HTTP layer focuses on Graphic User Interface (GUI)-based navigation and also on the manipulation of presentation formats on the World Wide Web (Kobielus 2003).

XML Layer

To achieve scalability and operability, the XML layer which is the third and most compelling tier on the Internet seems to provide the solution for machine to machine (M2M) communication. As a widespread service platform, XML provide a technical specification and a critical stepping stone in Web design and development (Hooper 2001). XML version 1.0 is a published, restricted, open standard that is accessible to developers to build. XML, as syntax for data description, is definition-driven. This process is accomplished by the use of Document Type

Definition (DTDs) and schemas. XML allows information to be manipulated programmatically. This suggests that tags and syntax can be agreed in advance. Further, interfaces can be defined while processing can be standardized. XML strength is shown by its capability in integrating Web-resident data into enterprise applications and also by coordinating enterprise logics that hold component pieces together in a cybernetic system (Jiang 2000). XML is ideal as a transport framework for loosely coupled Web services. The effect of this is that scalability and operability will be achieved. Further, enterprise entities will notice increase in productivity while cost will be reduced resulting in improve services (Roberto et.al 2001).

Web Service Language (WSDL)

WSDL technology is part of the XML family that is used for describing network services which act as a set of endpoints that operate on messages which contain either document-oriented or procedure-oriented information. WSDL reinforces the description of endpoints and corresponding behaviors. This technology is an additional re-enforcement layer over XML schema definitions that describe the actual messages transmitted over the net.

Simple Object Access Protocol (SOAP)

Soap is a frivolous, extensible, XML-based protocol for information substitute in a decentralized, distributed environment. It defines the formatting of a message and the basic delivery options independent of programming language, operating system, or platform. Soap is the communication protocol for XML Web services. It is a specification that defines the XML format for messages. SOAP introduces an extensible framing apparatus for XML messages. Its similarities are illustrated by the distinction involving the headers and body (payload) as shown in the example below.

```
<soap: Envelop
  xmlns:soap="...">
  <soap: Header>
    <!-- extensible headers -->
  </soap:Header>
  <soap:Body>
    <!--Payload -->
  </soap:Envelop>
```

This section illustrates a “GetSpringSemesterGrade” Web request from the Records Department of Prairie View A&M University Registrar’s Office.

```
<SOAP-ENV: Envelope
  xmlns:
    SOAP-ENV="http://schemas.xmlsoap.org/soap/encoding/"
  SAOP-ENV:
    encodingstyle="http://schemas.xmlsoap.org.soap/soap/encoding/"
    <SOAP-ENV:Header>
      <t:Transaction xmlns:t="some-URI">
        SOAP-ENV:mustUnderstand="1"
```

```
</t:Transaction>
</SOAP-ENV:Header>
<SOAP-ENV:BODY>
  <m: GetSpringSemesterGrade xmlns:m="some-URL">
    <symbol>DEF</Symbol>
  </m: GetSpringSemesterGrade >
</SOAP-ENV:BODY>
</SOAP-ENV:Envelope>
```

Below is a short illustration of the above request that is based on the “Body” content of the request.

```
</SOAP-ENV:Header>
<SOAP-ENV:BODY>
  <m: GetSpringSemesterGrade xmlns:m="some-URL">
    <symbol>DEF</Symbol>
  </m: GetSpringSemesterGrade >
</SOAP-ENV:BODY>
```

Below is the response from the record department of the university on student grade that was queried.

```
<SOAP-ENV:BODY>
  <m: GetSpringSemesterGradeREsponse xmlns:m="some-URL">
    <grade>A</Grade>
  </m: GetSpringSemesterGradeResponse >
</SOAP-ENV:BODY>
```

This example shows how SOAP operates. Here the request prompted the GetSpringSemesterGrade request operation. Note that the response defines a “GetSpringSemesterGradeResponse” operation. A practice common to SOAP calls appending “Responses” to the end of a “Request” operation create a “Response” structure. The output structure contains an element called the “Grade” which returns the results of the method invocation, possibly as a float.

THE UNIVERSAL DESCRIPTION DISCOVERY OF INFORMATION (UDDI)

This technology is an industrial-wide registry where available services about the Web are published. It is an example of a yellow or white page directory that holds listings of services available on the net. UDDI server provides a single point of reference to all available services within an organization. The process standardizes how Web services are discovered. UDDI accomplishes this objective by defining a SOAP-based application program interface (API) for querying centralized Web service repositories. With this technology, developers and programmers can appreciate the technical details of Web services.

Web Services in Action

The illustration below shows Web services for an IT firm in an Enterprise Resources Planning (ERP) and Enterprise Application Integration (EAI) platform (Figure 3). The sequence of the steps is as follows: First, the user logs on to the organizational portal to request information. Here, the portal application running within an application server collects information about Web services from multiple internal applications. These applications are made possible by the customer relations management (CRM) and ERP applications by querying the private UDDI registry. Next, the portal application receives information about Web services offered by internal applications using private UDDI registry and invokes these services over the intranet. The location and WSDL binding information of the Web Services is sent to the application server. Binding information for frequently used Web Services are cached by the application, to avoid the resource intensive and time consuming dynamic binding. The diagram shows that the Web Services loosely integrate portal with CRM and ERP applications. See table 1 for a step by steps narration for Web Services.

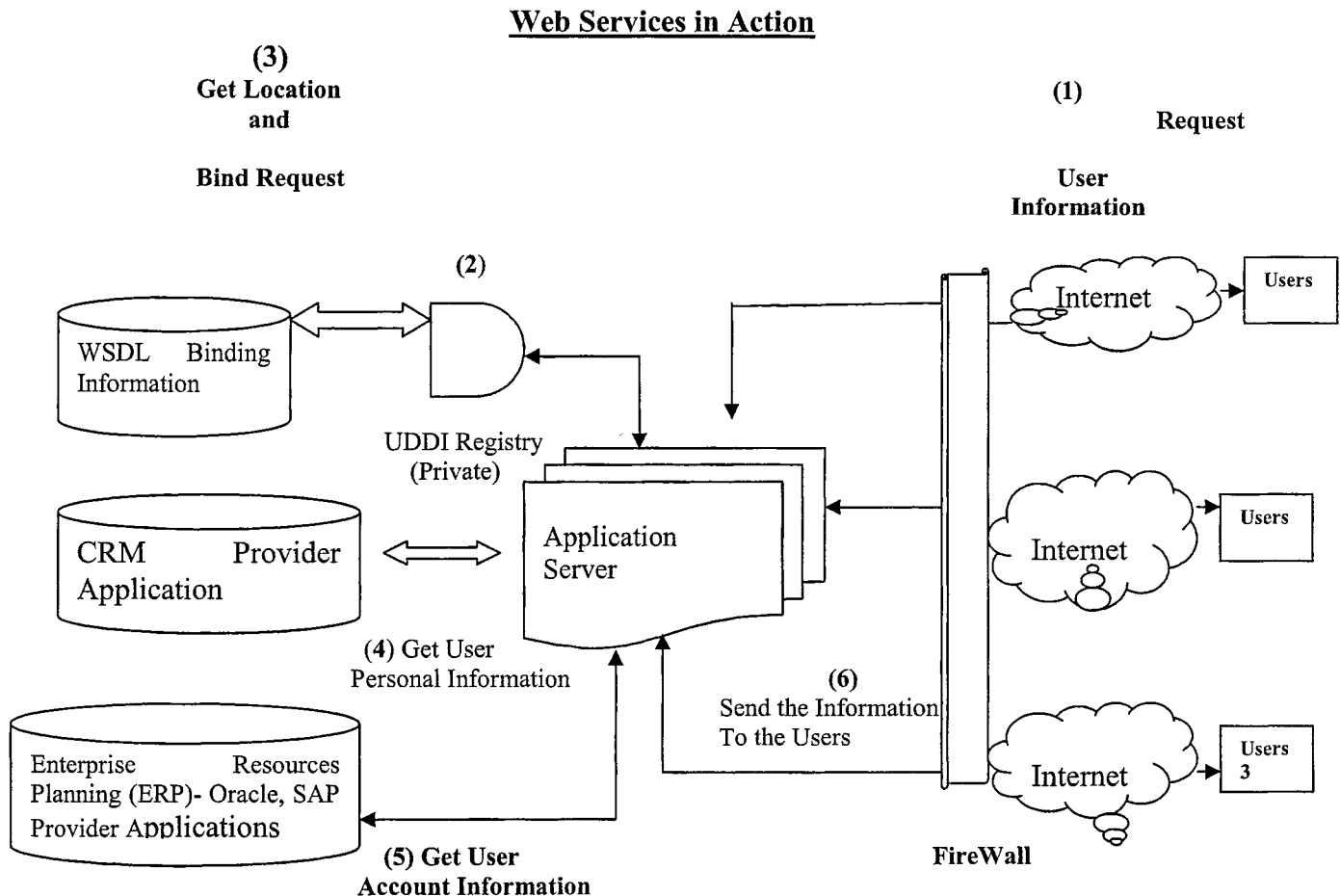


Figure 3 – Lim et al. (2002)

Logical Procedure for Web Services
(1) Client logs on to the enterprise portal and query for information
(2) The application supporting the portal framework retrieves information about Web Services provided by the CRM and ERP applications through the private UDDI registry
(3) The location and WSDL binding information of Web Services is sent to the application server
(4) The application invokes the Web Services published by the CRM application and retrieves the personal information, such as name, social security number, mailing address and email of the user. The communication is based on SOAP
(5) The application invokes the Web Services published by the ERP application and retrieves the account information such as account number, balance and transaction history of the user. This communication is based on SOAP
(6) The information is then formatted and sent to the user.

(Table 1: The Cycle for Web Services - Kobiellus, 2003)

IMPLICATION TO DEVELOPERS

The study found that most of the peripheries needed for web services such as XML, WSDL and SOAP especially SOAP's simple, real-time, RPC-style components are already integrated on every computing platform. Most of the benefits B2B enterprises etc. acquired through e-commerce proprietary protocol will instead be delivered as web services that are based on XML and HTTP. Further, full integrated suite of XML, SOAP and WSDL will be used to enhance scalability and interoperability of data on the Web. Example of processing entities that can benefit from this services include credit card processing institutions, Google use of SOAP for its search-engine API, Amazon.com offering catalog queries by either SOAP or by using less complicated HTTP GETs and POSTs protocols.

CONCLUSION

In this study, we have demonstrated that Web Services can offer a platform neutral approach for integrating applications, so that various entities will be able to integrate diverse systems in a manner supported by standards rather than proprietary systems. The capability of an entity to migrate to real-time information straddling across multiple machines, platforms, and peer-to-peer systems is one of the most important driving forces behind the adoption of Web services. Organizations who have not migrated into the Web service platform, should do so now because it will enhance the scalability and operability of data across various platforms resulting in improved productivity and reduction in cost of doing business

Further, we have established that Web services is one of the keys to data scalability and operability on the Web as B2B enterprise entities try to maintain an above average return on their

investments and sustain competitive advantage as they pursue for excellence in the global economy.

We also established that a sustain success of an e-business application requires the aptitude to execute prolonged, system to system, peer-to peer collaboration among the participating entities, within or across trusted domain of a business. Enterprise systems should start using Web services in internal applications integration projects at the programming interface, remote procedure call (RPC) and application programming interface levels. This process will acquaint the information technology team with the technology issues involved in using Web services for external application integration (B2B integration) projects.

REFERENCES

- Agrawal, V., et al. "E-Performance: The Path to Rational Exuberance." *McKinsey Quarterly* 1 (2001).
- Anonymous, "What the Next-Generation Web Means for Managers," *Harvard Management Update*, 1-2, November 2000.
- Simeon Simonov, "A Framework for Using Web Services," *XML Journal*, Vol. 2, Issue 6, 2001
- Bischoff, H. Netfish White Paper. *Inter-Enterprise Integration: Creating Partner Intimacy*, March 2000
- Caswell, S. "Credit Card Fraud Crippling Online Merchants." *E-Commerce Times* (March 2000).
- Coyle, Frank, P. *XML, Web Services and the Data Revolution*. Boston. Addison- Wesley Information Technology Series, 2002.
- Dornan, Andy. "XML: The End of Security Through Obscurity?" *Network Magazine*, April 2003 Issue
- Dyer, Russell. "The XML.com Interview: Liam Quin." *O'Reilly XML.com* April 6, 2003
- Fan, M.,J. Stallaert and A.B. Whinston. "The Adoption and Design Methodologies of Component-based Enterprise Systems," *European Journal of Information Systems*, 9, 2000, pp.25-35
- Hampe, J.F. "Standards and XML: Special Section." *Electronic Markets* Vol. 11, No. 4 (2001).
- Hoffman, D.L., and T.P. Novak. "How to Acquire Customers on the Web." *Harvard Business Review*, Vol. 78, No. 3 (May-June 2000): 179-187
- Hooper,L., "Cisco Adds XML-based IP Telephony to the Mix," *CRN*, No. 949:91-92,2001
- Jiang, J.J., M.K. Hsu, G. Kline, and B. Lin, "E-Commerce User Behavior Model: An Empirical Study," *Human Systems Management*, Vol. 19, No. 4:265-276, 2000
- Kobielus, James. "Web Services Work, But Will They Scale?" *Business Communications Review*, April 2003
- Kotok, A., "Making XML Work in Business," *XML.COM*,
<http://www.xml.com/pub/a/2002/01/02/bizvalue.html>, O'Reilly & Associates, Inc., 2000
- Lim, G., and J.K. Lee. "Buyer-Carts for B2B EC: The B-Cart Approach." *Organizational Computing and Electronic Commerce* (June 2002)
- Lin, J.C. and H. Lu, "Towards an Understanding of the Behavioral Intention to Use a Web Site," *International Journal of Information Management*, Vol. 20, No.3:197-208, 2000
- Linthicum, D.S. "Application Servers and EAI," *EAI Journal*, July-August, 2000
- Lu, E.J.,R.H. Tsai, and S. Chou, "An Empirical Study of XML/EDI," *Journal of Systems and Software*, Vol. 58, No.3:271-279, September, 2001

- Sliwa, J., "OnStar Takes Voice XML for Drive," *Computerworld*, Vol. 34, No. 21:1 & 16, 2000.
- McCright A, "Writing Your First Web Service," *Web Services Journal*, Preview Issue, June 2001
- Roberto Chinnici and Rahul Sharma, "SOAP 1.1 in the Java Platform: Introducing the JAX-RPC Technology," from a talk at the JavaOne developer conference, June 2001
- Sarvega, ZapThink Briefing Note. " *Intelligent XML and Web Services Switching.*" November, 2002
- Teng, J.T.C., V. Grover, and W. Guttler, "Information Technology Innovations: General Diffusion Patterns and Its Relationships to Innovation Characteristics," *IEEE Transactions on Engineering Management*, Vol. 49, No. 1:13-27, 2002
- Travis, B, " *XML and SOAP Programming for BizTalk Servers,* ", Microsoft Press, 2000
- Vidgen, R. and S. Goodwin, "XML: What is it Good for?" *Computing & Control Engineering Journal*, 119-124, June 2000
- McCright A, "Writing Your First Web Service," *Web Services Journal*, Preview Issue, June 2001
- Zarowin, S. and W. Harding, "Finally, Business Talks the Same Language," *Journal of Accountancy*, 24-28, August 2000.