



## SOA for Effective Data Integration of Virtual Learning Environment Systems

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**Abstract:** *Services Oriented Architecture (SOA), is important model that changed the traditional development techniques because it allows the systems to be integrated with each other more flexible, which leads to reduce the cost and time in the process of e-learning construction by using the web services technology which are reusable and interchangeable, so the e-learning components and resources will be available and that will reduce the cost of e-learning systems and enhance learning in all, and make the learning environment more better. This paper will use SOA concepts and web services to propose a framework for virtual learning environment systems to provide integrated model.*

**Keywords:** *SOA, Web services, VLE, E-learning, integration*

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### I. INTRODUCTION

To achieve the availability of e-learning resource over the entire world to all kinds of the learners to provide an interoperable and unified platform for all partners which involved in the firm of the learning and education, and the most important things they must concentrate is interoperability and integration of distributed VLEs systems. SOA and web services are important technologies that can help and solve the communication and integration problems of different environments platforms and architectures.

The XML technology is used for message passing across different platforms because of its data format beside the SOAP (simple object access protocol) which is a protocol for exchanging the information in the implementation of the web services, and UDDI(universal description discovery and integration) which are used to describe , publish and access the services. SOA's main benefit is simple integration of different systems and applications. Nowadays there are many VLEs systems over the world which are differ in the platforms, programming languages, data storage format, and structures .so when we want to share or uses a resources from another VLEs system we will face the problem of the interoperability and integration SOA has changed the integration because it's a business centric approach which enable integration issues. Services are standardized which allows developers to make them as reusable. This reduces the cost of solution, development, testing time and speeds up the process of implementing new requirements within the business system. SOA enables exiting VLE systems including legacy systems and applications to integrate without any need for adding any custom code or updating these systems to newer versions, Therefore this paper will use SOA and web services to create framework which allows the resources of VLEs systems to be offered and available to other VLEs to reduce the cost and time of system development and constructions.

**Study Motivation:** The availability of current VLE services has motivated to writing this study to take advantage of existing legacy applications and integrating them with new VLE systems which will makes these application more flexible and available.

**Problem Description:** In the domain of the learning and education we have some separated systems with a common functionality that need to be integrated. Another problem with the existing disparate system is that they are not flexible and they are low in interoperability. Since there's been a problem of disparate legacy and if we have a platform that will integrate these applications could be very productive.

**Objectives:** The main objective of this paper is to integrate the VLE systems by applying SOA technologies. Since these systems have common functionalities, profile, database, user account and authentication services.

### II. SYSTEM REQUIREMENTS FOR DYNAMIC MODEL

To transform traditional virtual learning systems to the new distributed paradigm and in order to achieve the dynamic proposed model there is many requirements must be given a high consideration [5]:

Open architecture and interface: the framework must have an open architecture and open interface to make it easy for the educational systems be integrated with each other and with the services providers in other side.

High interoperability for data exchange: any virtual learning system must have the ability to take its learning components or its services and use them in another system which have different platform to be used and retrieved anywhere anytime.

Flexibility: the learning objects which are sharable between the systems, should be loosely coupled, to allow others developers simply modify the components (add or delete) when they want.

Accessibility: the services and learning objects must be published in clear description in a universal repository to be searched, discovered and retrieved by other remote systems that need it.

Reusability and durability: the system in this model must designed in object oriented framework , in which the services and learning objects or educational materials will be considered as encapsulated components with well-defined interface which are consistent, so the components will resist the changes in the technologies without redesign , reconfiguration and recoding . so like that it can be reused in various applications.

Compatibility with other Systems: the system which is based on SOA model will provide an open standard interface to be easily communicated with other similar systems.

### III. LITERATURE REVIEW OF USED TECHNOLOGIES

#### 3-1 SERVICES ORIENTED ARCHITECTURE

Service-oriented architecture (SOA) is a structural model composed of standard components, such as web service technology. Its purpose is to provide enterprises, systems or web services providers with a flexible, reusable integrated interface that facilitates communication between applications, users and departments, and enhancement of web services [1].SOA presents applications and resources as reusable services. It uses standard protocols for communication, providing a distributed environment with higher flexibility, efficiency and information integration [2].Services are a kind of packaging for applications, and a kind of reusable component in business processes. Services generally have the following characteristics [3]:

Interoperability: Service components are interoperable, saving time on program development.

Loosely-coupled: Conventional systems cut system functional requirements of applications up into interrelated components, modules or objects; developers spend a large amount of time understanding how each component was designed and is used, so that they do not violate restrictions imposed by the component's connections. However, this makes it hard for systems to use different components in replacement. The approach of SOA is to combine systems by defining a standard interface. Components can be replaced at will as long as the replacement meets interface requirements. This significantly enhances system flexibility and further provides a cross-platform mechanism, allowing different services to be used in different environments.

Location Transparency: Transparency means that when the client end calls the server end, the system should automatically handle all affairs related to location search, security and reliability for users. Under SOA, the definition and storage location of services should be registered at a specific location for the client end to access. Users do not need to know the actual location of services.

Well-defined: Uses a common definition independent from any technology and can be used by any technology.

Stateless: Services are stateless; any service is not required to know the contents of the previous step, all services are in an independent state.

SOA defines three roles in services: service broker, service provider and service requester [4] see figure-1:

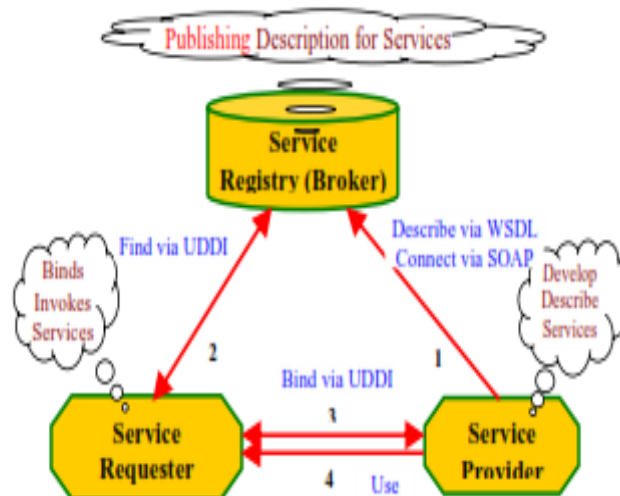


Figure-1 SOA roles [15]

Service broker: Plays the role of a medium for web services. It can accept registration requests from services providers, and can also process query requests from services requesters.

Service provider: Mainly refers to the developer of web service applications; it is also required to describe details of its web services.

Service requester: Sends requests for services; follow-up operations include sending query and linking to the suitable web services.

**3-2 WEB SERVICES**

Web services are independent software components that use the Internet as a communication and deployment infrastructure. The interoperability between different platforms and incompatibility of data still remained an issue. Web service standards were then established to solve this problem. Web services are a set of modular applications based on the Internet that provide simple mechanisms and well-defined user interfaces, and allow different operating platforms or applications to automatically communicate via the Internet to complete certain tasks, as long as they follow the standard protocol [5,6,7].

According to the official definition by W3C [8]: A web service is an application that can be described and queried using XML and recognized using URI. This application’s interface and linkage method should be well-defined; it should support other applications, and can be directly driven by XML messages or network protocols.

Web services allow standard Internet technology to access the source code of applications. It can be used to construct distributed architecture systems, and has the advantage of implementing dynamic integration; balanced load and upgrading individual components [9].According to Sung [10], the main protocols related to web services are briefly described in Table-1:

<b>Protocol</b>	<b>Functional Purpose</b>
Simple object access protocol(SOAP)	Allows two applications that are both providing services to adopt the same standard for communication
Web service description language(WSDL)	This protocol is used to describe which functions the service provides, allowing different services to understand each other.
Universal description, discovery and integration (UDDI)	The main function of this protocol is to publish your own web services on the Internet. It allows people with needs to find services and can also search for services itself.
Extensible markup language(XML)	The main function of this protocol is to publish your own web services on the Internet. It allows people with needs to find

Table 1. Table of main related protocols to web services

**3-3 VIRTUAL LEARNING ENVIRONMENT**

A virtual learning environment (VLE) is a set of teaching and learning tools designed to enhance a student's learning experience by including computers and the Internet in the learning process. [6].A virtual learning environment (VLE), or learning platform, is an e-learning education system based on the web that models conventional in person education by providing equivalent virtual access to classes, class content, tests, homework, grades, assessments, and other external resources such as academic or museum website links. It is also a social space where students and teacher can interact through threaded discussions or chat. It typically uses Web 2.0 tools for 2-way interaction, and includes a system. Virtual learning environments are the basic components of contemporary distance learning, but can also be integrated with a physical learning environment [7] which may be referred to as blended learning

Virtual learning can take place synchronously or asynchronously. In synchronous systems, participants meet in real time and teachers conduct live classes in virtual classrooms. Students can communicate through a microphone, chat rights, or by writing on the board. In asynchronous learning, which is sometimes called “self-paced” learning, students are expected to complete lessons and assignments independently through the system. Asynchronous courses have deadlines just as synchronous courses do, but each student is learning at his own pace. [7].

**IV. RELATED WORK**

In 2007 K.K.Thyagarajan and Ratnamanjari, addresses the problems of automatically selecting and integrating appropriate learning materials for a learner using web services based on the learners initial knowledge, goals, preferences etc[11]. In 2007 Vicenza Carchiolo, Alessandro Longheu, Michele Malgeri, Giuseppe Mangioni, proposed an architecture organized into four layers: a database layer to store, share and reuse courses and teaching materials, an adaptation layer which allow personalized courses generation, a presentation layer that arrange personalized courses into learning paths, and an interface layer to develop several learning interfaces[12]. In 2008 Sandra Aguirre, Juan Quemada, Joaquin Salvachua, proposed a federated service-oriented architecture for e-learning based on web service[13]. In 2008 Zhifen Cheng, Guilin, P.R.China, JiaNong proposed a methodological framework for the development of e-Learning systems based on SOA and Model Driven Architecture (MDA) [14].

**V. METHDOLOGY**

Offering services through web services obviously becoming a trend this days specially in the fields of VLE systems to provide more services such as course management services, registration services and grades web services to other learning systems by giving more integration and interoperability between them to enhance the learning and teaching process by making the data and education services more easily and accessible.

This study is working for integrating distributed VLE systems based on SOA concepts with web services, the VLEs functionalities will be stored as services in repositories which can be easily searched by the services requester. This will be done by designing an integrated architecture, based on SOA model (see figure- 2) and web services technology is involved to implement the services orientation principles.

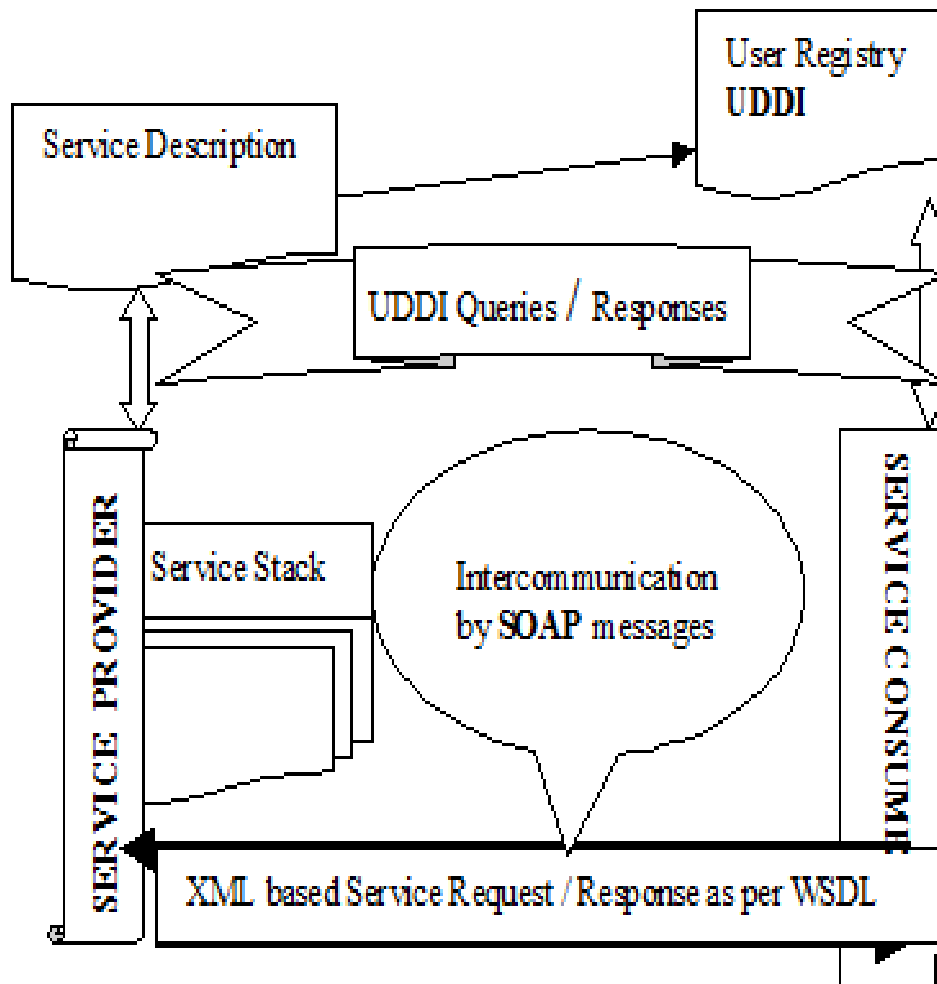


Figure2.Based SO Model

### 3 Integration Approach

According to the SOA based model see Figure-2, basically the model consists of service provider, service consumer and Service registry. A WSDL document describing the service details need to be registered in central database, UDDI registry. Any registered user can search this registry for desired services and download the WSDL file, through the information available in WSDL files the customer can contact service provider directly. All intermediary communication is done via a special protocol Simple Object Access Protocol (SOAP), which basically exchanges messages via TCP/IP [16]. So based on the above model the proposed architecture is designed in multi-tier architecture and it will consist of the following layers:

**The Data layer:** Responsible for the data storage of the learning, teaching resources and the profiles of the learners and users, so we can write database queries or use some procedures stored there to access data from the databases and perform any operation on the databases.

**The Business layer:** Which contains the business rules, and clarifies how data is created, stored and accessed is implemented. And it is very clear that database technologies and business logic implementation are different from one service provider to another.

Accessing the database will be through the business logic layer, and as a result of using SOA other VLE systems can access the database via a service which will be implemented through web services technology by using any form of SOA communication technologies such as SOAP, REST etc., and other open protocols like HTTP, XML, WSDL, all those open protocols and technologies are responsible for providing the integration and interoperability. And the tools of access to the data are the core responsibility of the web services.

**Services repository Layer:** Learning and teaching services are registered in the repository, and after that they can be accessed from it.

**Presentation layer:** Provides the entry point to access the VLE web services, and focuses on the user interface, such as displaying the data to the users or accepting input from them. Also, this layer contains the contacts (services description) that bind service providers and users.

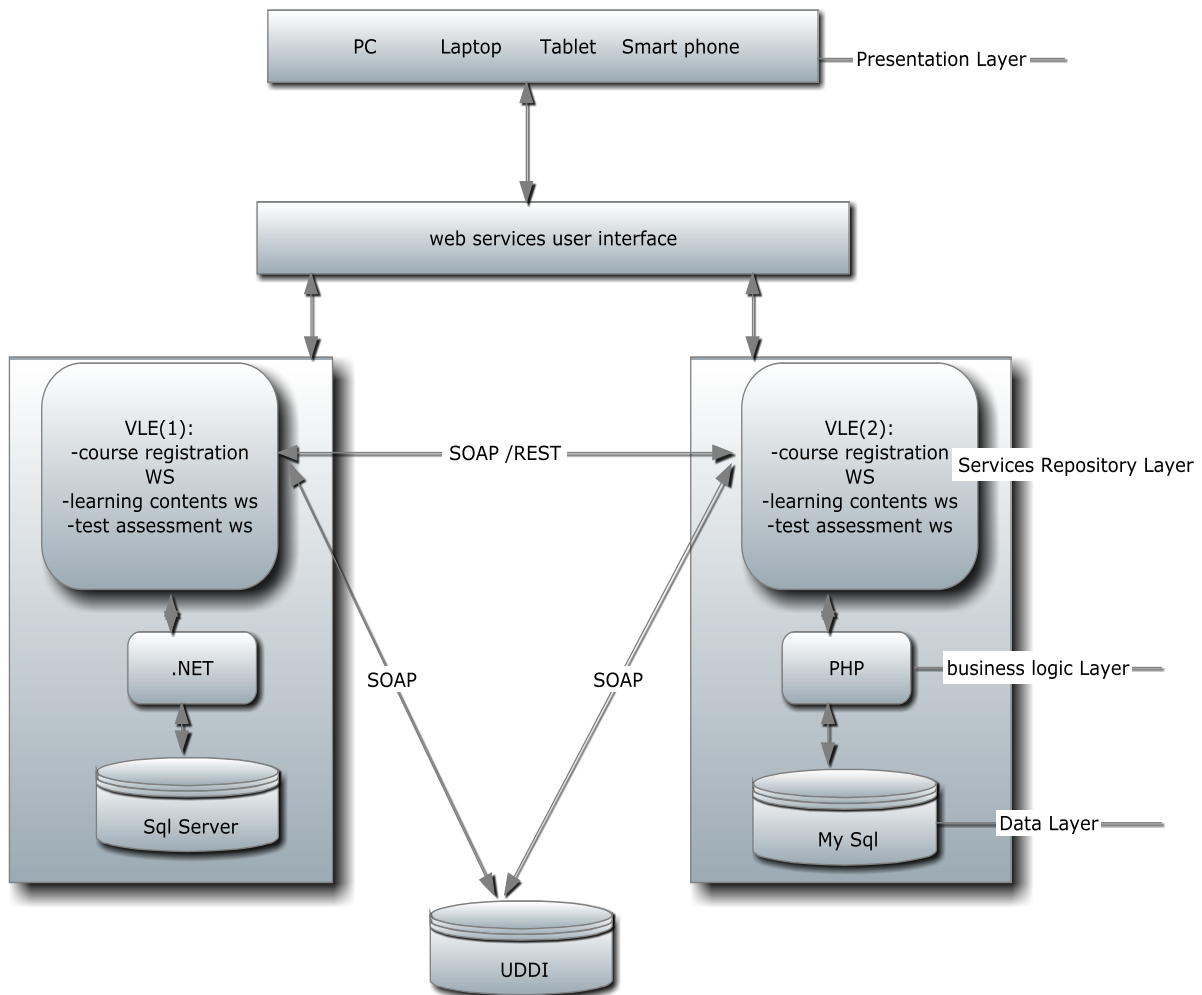


Figure 3- the proposed architecture for VLEs integration

Services providers use a universal web services registry called UDDI to publish learning services to be available to the services requesters to find desired services. So when the learning objects content or application are created as services they will be described by a WSDL document to let the services requesters know how to use them, after that the WSDL and XML metadata of the services will wrapped in a SOAP message and the sent to UDDI . all the important information needed for discovering the services will registered in the UDDI the directory and keyword which will be used by learning services requester ,to find the learning services providers and their services will be by sending a SOAP request over HTP protocol.

The UDDI will simplify the loose connection between the applications, because the services are registered in UDDI will be determined by universal unique ID so when the services provider wants to send a particular services to another server it need only to update the linking information of the services such as URL from the UDDI and the services provider will obtain the up to date information without changing anything.

The services requester can be any client application or any VLE system request or asks for a certain services from other systems, and the request system services may be learning content, grading services, course management services etc. so according to the linking information of the services which is available in the UDDI the request application can contacts the services regardless of the platform has been used in both side because of using SOAP protocol.

The proposed work will provide a real integration and interoperability model between VLEs systems in universities or high institutes which will enhance the learning process in general.

## VI. CONCLUSION

In this paper, we proposed a service-oriented architecture model for virtual learning data and application integration system. We used Web services technology in order to provide a flexible integration model in which all the learning services and applications are well defined and loosely connected that would increase the reusability, interoperability, flexibility and interactivity in heterogeneous software. and allows system developers to avoid incompatibility of data formats caused by different development platforms or programming languages and achieving the integration of heterogeneous software components, So this paper is one of a lot of efforts done in the domain of systems integrations.

In future, the application can be improved in several ways improving integration with Module LMS and trying to let the proposed system be integrated with wireless LAN technology so that users will be able to access the virtual learning system at anytime and anywhere using their PDA's or smart phones.

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**REFERENCES**

- [1] B.C. Tseng, "Introduction to service-oriented architecture: What is SOA?" 2014 available online at <http://searchdatamanagement.techtarget.com/feature/Introduction-to-service-oriented-architecture-What-is-SOA>
- [2] K. F. Wang, Planning and Constructing a High School Collaborative Operation System Based on SOA, Master's Thesis, Department of Information Management, National Kaohsiung First University of Science and Technology, Taiwan, 2006.
- [3] M. N. Huhns and M. P. Singh, "Service-oriented computing key concepts and principles," IEEE Internet Computing, vol. 9, no. 1, pp. 75-81, 2005.
- [4] Y. L. Chi, Introduction to Web Service Technology, Chiun-Hua Publishing Company, Taipei, 2004.
- [5] Zhengfang Xu, Zheng Yin, and Abdulmotaleb El Saddik. A Web Services Oriented Framework for Dynamic E-Learning Systems
- [6] S. Vinoski, "Web services interaction models part 1: Current practice," IEEE Internet Computing, vol. 6, no. 3, pp. 89-91, 2002.
- [7] D. Clark, "Next-generation web services," IEEE Internet Computing, vol. 6, no. 2, pp. 12-14, 2002.
- [8] World Wide Web Consortium, "Web services activity," 2002 (available online at <http://www.w3.org/2002/ws>).
- [9] J. Snell, D. Tidwell and P. Kulchenko, Programming Web Services with SOAP, O'Reilly, California, 2001.
- [10] L.-W. Sung, The Research of Applying Expert Systems and WLAN to Web Services: A Case of Computer System Maintenance, Master's Thesis, Department of Information Management, Chinese Culture University, Taiwan, 2008.
- [11] K.K. Thyagarajan and Ratnamanjari Nayak "Adaptive Content Creation for Personalized E-Learning Using Web Services" Journal of Applied Sciences Research, 3(9):828-836, 2007.
- [12] Vincenza Carchiolo, Alessandro Longheu, Michele Malgeri, Giuseppe Mangioni "An Architecture to Support Adaptive E-Learning" IJCSNS International Journal of Computer Science and Network Security, VOL.7No.1, January 2007
- [13] Sandra Aguirre, Juan Quemada, Joaquin Salvachua "Developing Joint Degrees through E-Learning Systems" ASEE/IEEE Frontiers in Education Conference 2008.
- [14] Zhifen Cheng, Guilin, P.R.China, JiaNong "An Extensible Development Platform for SOA- Based E-Learning System," International Conference on Computer Science and Software Engineering, 2008
- [15] SOA roles 2014 available online at : <http://www.w3.org/TR/2002/WD-ws-arch-20021114/>
- [16] ZHU Zhen, Design and Implementation of Web-services based E-Learning System, 2009 First International Workshop on Education Technology and Computer Science.