

## Study and Design a Dynamic E-business Application Framework Based on Java EE and Web Service

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### **Abstract**

*With the rapid development of Internet and information technologies, E-business is rapidly becoming the focus of business activity. However the traditional E-business application system exists the non-unitary technical standards, lack of unified commercial release mechanism, difficult information exchange and cooperation, long development time, difficult reconstruction and upgrading maintenance. A large number of Web services, JAVA EE technology has become more mature and stable. So the key techniques of XML, SOAP, WSDL and UDDI in Web service are analyzed in detail, then a new E-business application framework based on Java EE and Web services is proposed to overcome the shortcomings of the traditional E-business application system. In the this E-business application framework, the characteristics and architecture of Web service are used to realize the standard and loosely coupled application architecture and guarantee compatible information exchange and cooperation. The Java EE framework is use to ensure the more strong security and better stability for E-business application framework. So the new E-business application framework takes on crossing platform, flexibility and easy expansion, and can meet the openness, complexity, distribution, dynamic and customization of E-business.*

**Keywords:** *E-business application framework, Web Services, Java EE, information exchange, interface*

### **1. Introduction**

E-business is a new business transaction process based on combining network environment and business operation by using information technology. It is a main model of the business operation of the market economy in the 21st century. It is also a major economic model of growth and development potential under the new economic meaning [1]. E-business has become the engine of economic growth with its unique advantages, and it has a great impact for improving the market competitiveness of enterprises in our country. E-business system based on Internet and other networks is used to achieve the enterprise E-business activities, meet the production and management needs of production, sales and service, support the external business cooperation of enterprises, comprehensively improve the informatization level of enterprise from the aspects of operation, management and decision making, and provide business intelligence information system for enterprises [2]. E-business pursuits the business process reengineering of enterprises by integrating and completing the business process, and full uses the information resources of the enterprise to enhance the competitive advantage of the enterprise.

The traditional E-business technologies use the program codes to realize the complex application connection, in order to connect the users, E-business application as well as other information systems [3]. This development mode based on independent solution scheme does not have the better integration ability, exists the disadvantages of long

development time, difficult maintenance, poor reusability and so on, which can not adapt to changing business strategy. With the rapid development of E-business, these enterprises more and more need to integrate resources to realize the dynamic integration between applications of different enterprises, support the changing business environment, realize the instant fast assembly of business application, and reflect the true value of E-business [4-6]. These demands promote the development of dynamic E-business. Web service provides a new method to achieve business objectives, operate and build business, and find new application of the management business. It provides a technical basis to build a dynamic E-business platform. Web service is a dynamic interactive software component based on the open standard, Internet and Intranet, it is a kind of low wind technology which is easy to implement. It is widely used in the development of E-business system. So a lot of scholars have studying E-business system in recent decades. Many E-business systems are proposed. Althammer and Pree [7] proposed a straight-forward way to smoothly enhance Java libraries in this direction independently of the particular graphic user interface (GUI) library. Chen [8] proposed a technology adoption life cycle model to analyze various stages of standards adoption by discussing the XML and Web Services standard-related technologies in the context of E-business systems. Based on our study of e-business standards and research of relevant literatures, several factors that affect the adoption decision of e-business standards are identified. Lee and Park [9] proposed a solution to the discovery of Web services based on the capabilities and properties of published services and the composition of business processes based on the business requirements of submitted requests, which comprises multiple matching algorithms, a micro-level matching algorithm, which matches the capabilities of services with activities in a process request, and macro-level matching algorithms, which are used to compose a business process by identifying services that satisfy the business requirements and constraints of the request. Kloppmann *et al.* [10] proposed the IBM J2EE™ application server to be used to leverage the additional capabilities of J2EE and WebSphere. Kulkarni *et al.* [11] proposed an instantiation of service-oriented architecture (SOA) that strictly follow XML standards for messaging and invocation. It is found that by providing web services to implement existing applications. De Bruijn *et al.* [12] proposed the Web Service Modeling Ontology (WSMO) to enable semantic e-business is discussed. A higher degree of automation in the location and use of Web Services can be achieved by adding explicit semantics to Web service description. Li *et al.* [13] proposed an architecture of dynamic e-business system based on grid technology and a new way in detail to build novel dynamic e-business system using grid technology. Khalaf *et al.* [14] proposed an XML-based language for defining business processes that provides an interoperable, portable language for both abstract and executable processes and that was designed from the beginning to operate in the heterogeneity and dynamism that is commonplace in information technology today. Grefen *et al.* [15] analyzed Web Services support for the dynamic process outsourcing paradigm and proposed an approach to fill these gaps based on a business process support application layer implemented on Web Service technology. Chen *et al.* [16] proposed a model to evaluate an organization's position in a technology adoption space by evaluating its current level of information technology (IT) sophistication. The model identifies critical factors necessary for the successful adoption of Web services technology along three dimensions-intranet, extranet, and Internet. Papazoglou and Kratz [17] proposed a business-aware Web services transaction model and support mechanisms, which is driven by common business functions. The model allows expressing business functions such as payment and credit conditions, delivery conditions, business agreements stipulated in SLAs, liabilities and dispute resolution policies. Chen *et al.* [18] proposed an architecture for Web services enabled BPM in C-Commerce and provided technical insights into why Web services can enhance business process coordination. And an implementation of a dynamic e-procurement application based on the proposed architecture is proposed. Boulianne [19]

proposed a comprehensive contingency framework that summarises those contexts in which certain types of IS design and e-business applications are reported to be effective. Song and Chen [20] proposed a distributed E-Business System based on conic curve. This scheme is composed of two parts, constructing license and validating license. Song *et al.* [21] proposed a layered metamodel and an integrated modeling process that can hierarchically build a GUI-business component model based on MDD and MVC. Towards this end, the GUI metamodel and the component metamodel hierarchically established based on the PIM/PSM (MDD) and MVC styles are first defined. Kwon *et al.* [22] proposed using agent-based web services to better support collaboration within a supply chain. An advantage of agent-based web services is that they combine the strengths of both web services and multi-agents. Lee, [23] proposed an integrated model of virtual experience as it relates to the strength of brand attitude by combining discursive and imagery processing streams. Huang [24] proposed the impact of providing Web Services on the business model innovation and operating performance of the hotel industry in the customer-oriented point of view. This study distributed questionnaires to tourist hotels in China and analyzed 375 valid questionnaires. Zhang *et al.* [25] proposed a Dynamic Scanning approach for XML structural clustering based on Trie Matching (DSTM). The extensive experiments on XML documents in e-business is conducted in order to demonstrate the effectiveness and efficiency of DSTM. The experimental results show that DSTM is approximately linear to the size of XML documents. Li *et al.* [26] proposed a logic framework for asynchronous negotiation and update based on Answer Set Program (ASP), in which the above negotiation scenario in electronic commerce is distinguishingly discussed. And a method for the seller to make a decision on price is proposed. In addition, the other new methods are proposed in the recent years [27-29].

With the rapid development of Internet and information technologies, E-business is rapidly becoming the focus of business activity. Aiming to the deficiencies of the non-unitary technical standards, lack of unified commercial release mechanism, difficult information exchange and cooperation, long development time, difficult reconstruction and upgrading maintenance, Web services and JAVA EE technology are introduced into E-business application framework in order to propose a new dynamic E-business application framework based on combining the advantages of Web services and JAVA EE in this paper. And the key techniques of XML, SOAP, WSDL and UDDI in Web services are analyzed. Finally, the dynamic E-business application framework is designed in detail.

The rest of this paper is organized as follows. Section 2 briefly introduces Web service, including Web service and its hierarchy framework, key technologies of Web service and Characteristics of Web service. Section 3 briefly introduces Java EE. Section 4 gives the framework of Dynamic E-business application system. Section 5 designs and describes the dynamic E-business application framework. Finally, the conclusions are discussed in Section 6.

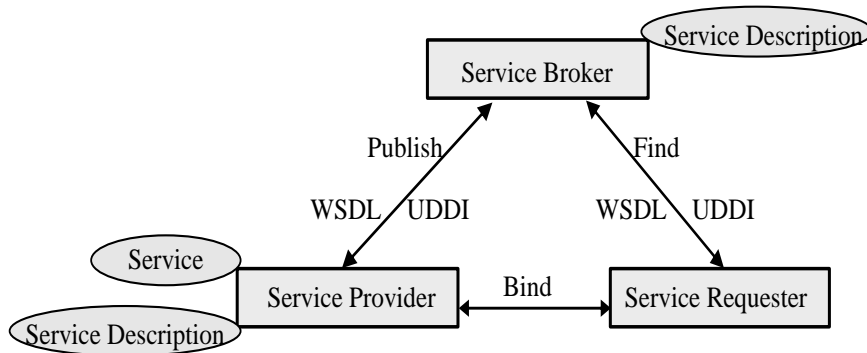
## **2. Web Services**

### **2.1. Web Service and its Hierarchy Framework**

Web service is a class of general service names from the Internet. It is used to encode data and decode data by using Extensible Markup Language (XML). Web service is a new distributional application platform based on the network. It is based on a lot of common protocols, such as Hyper Text Transfer Protocol (HTTP), Simple Object Access Protocol (SOAP), Web Services Description Language (WSDL), Universal Description Discovery and Integration (UDDI) and so on. These protocols can be used in any operating system, object model, and programming language. Whether the system uses ASP, C++, C, Java or the mix of several languages, users can deploy and operate these programs by using Web service in order to avoid the repeated development of the

function and improve the development efficiency of the program. Web service provides the general open API interface. The developers can realize the function service without programming by using Web service.

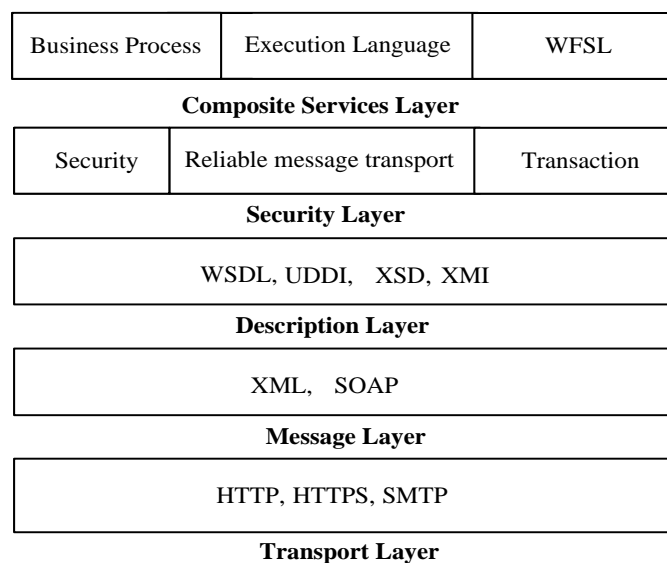
Web Service uses the service-oriented architecture (SOA), which is composed of service provider, service broker and service requester. The structure of Web service is described in Figure 1.



**Figure 1. The Framework of Web Service**

In the Figure 1, Service provider publishes its own service, and also makes response to the request. Service broker registers and makes classifications of the published service providers, it also provides search service. Service requester seeks requisite service by using service broker, and uses the service. These roles are realized by using the publish operation, find operation and bind operation. The publish operation helps service provider to register its own function and interface. The find operation helps service requester to find special service aid by service broker. The bind operation helps service requester to use the provided services in deed.

Web service includes the advantages of component-oriented methods and web techniques. It can publish, locate and transfer modularized application in the web. Although the Web service function is simple, it contains the extraordinary complicated business logic. In Web service, there have some standardized techniques. The hierarchy framework of Web service includes the transport layer, message layer, description layer, and composite service layer, shown in Figure 2.



**Figure 2. The Hierarchy Framework of Web Service**

In the Figure 2, the function of each layer is described as follows:

**(1) Transport layer**

Web service transmits messages and send the data by the network in order to realize the interactive purpose of the service request. So the kernel communication mechanism is defined between web services. The key technologies include HTTP, HTTPS, and SMTP and so on.

**(2) Message layer**

It describes how to deal with message format. XML is a key technology of Web service that uses XML to describe the operation and data. SOAP is capable of permeating firewall breezily.

**(3) Description Layer**

It mainly provides the service interface description information and service deployment information and so on. WSDL is a XML standard supported by a lot of business associations, such as Microsoft, IBM. UDDI is a project developed by Microsoft, Arriba, IBM and other IT companies. At present, it is becoming the standard for client applications to find web service and publish its own web service.

**(4) Security layer**

It deals with the security and coordinated transaction which related with web service calling, and guarantees the reliable message transmission of Web service. Security is the basic security component of Web service, supports the security model for Kerberos, X509 and so on. At present, the development of this implementation technology is imperfect.

**(5) Composite service layer**

It is the top layer of Web service application enterprise integration. Because a service flow is usually finished by using the mutual cooperation between Web services. It associates with Web services, completes the system goal according to the service flow logical sequence succession calling.

## 2.2. Key Technologies of Web Service

The key technologies of Web service are described as follows:

**(1) XML**

XML is a technology with cross platform and depending on the content in the Internet environment, which is a powerful tool for processing structured document information. It strictly defines the transplanted structure data and is not attached to the particular browser. Web service provider and requester use XML to transmit messages and data streams. XML is independent on the platform, its data format ensures the interoperability of heterogeneous platform of Web service.

**(2) SOAP**

SOAP is a lightweight, simple, XML-based communication protocol, which is used to transmit the messages between the client and Web service. SOAP is completely independent to any vendor, it may be used by combining existing Internet protocols and formats. So all messages of SOAP support publishing, binding and finding operations in the architecture of Web service.

**(3) WSDL**

WSDL is a standard language based on XML, which is used to describe Web service and explain how to communicate with Web service. WSDL hides the implementation details of Web service. The Web service are described as three basic questions, what does the service, where is the service, what protocols are used and how to access the service.

**(4) UDDI**

UDDI defines the specification standard of the description and discovery of Web service. Web service uses UDDI mechanism to find Web service on the Internet. After the WSDL file is acquired, the call format of SOAP is used to request the corresponding Web service.

### 2.3. Characteristics of Web Service

#### (1) Communication striding over firewall.

Web service exchanges data by using SOAP-based XML documents and ordinary communication mode, such as HTTP, FTP, and SMTP and so on. Therefore, the communication mode based on Web service can breezily permeate the firewall. Each device could access to Web service by using HTTP and XML, and each Web service could access to other Web service.

#### (2) Loosing coupling

Web service has a loosing coupling structure. Each one of Web services can change its own operation mechanism, and it cannot affect other service. When Web service is updated, the clients who call the service can get the updating.

#### (3) Easy realization

A large number of free tools are provided by many IT companies, including IBM company and Microsoft company, to establish and deploy Web service. At the same time, the existing JavaBeans and COM components can be easily translated into Web service in order to provide the service.

#### (4) Reused software

Web service allows codes to be reused, as well as data that behind the codes.

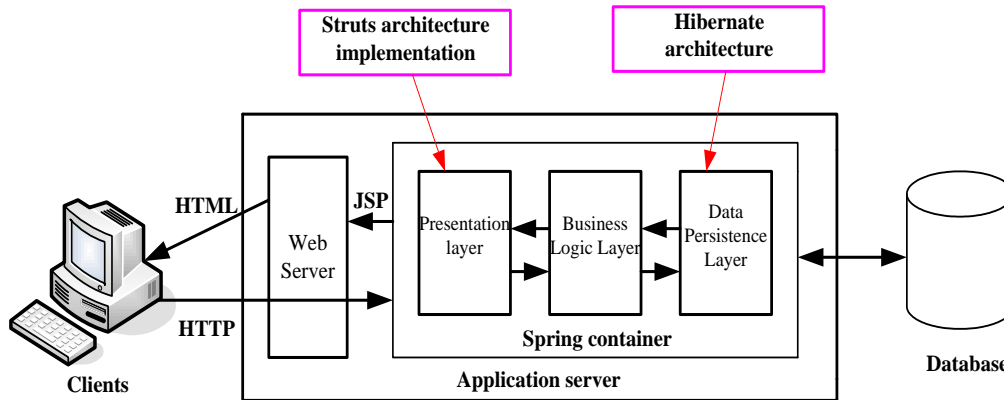
These characteristics of Web service can expand greatly the Web service function, truly implement the mutual operation, and it can use the loosing coupling model to expand each kind of data and the service resource. The specific function is completed by using the dynamic binding different service. In researching and designing the dynamic E-business application framework, an almost perfect solution for many existing and likely-to-appear problems are found in here.

## 3. Java EE

Java EE is a simplified enterprise solution scheme by using Java platform, which is used to develop, deploy and manage the system architecture of the related complicated problem. The core of Java EE technology is Java platform or Java SE. Java EE consolidates many advantages of the standard version, such as CORBA technology, JDBC API, Java Servlet, API, JSP and XML. Java EE stressed the layered structure design, distributed component, unified standard and platform, and so on, in order to obviously describe the advantages of Java EE in developing enterprise level application system. These features can build the scalability, stable availability and efficient development.

Java EE is a set of completely different technical architecture with the traditional application development. Its core idea is the component thought and layering thought. It is different with object-oriented technique, which emphasizes the abstraction of the individual. The component emphasizes the existence form of the entity in the environment. It generalizes the connotation of the object encapsulation and focuses on the coordination of the components in the complex system.

Java EE refines the layering thought of software engineering. The layering is to achieve the low coupling and high cohesion between each part of the system. The ideal layering system architecture should be alternative and extractable drawer architecture in the support system. Java EE divides the application logic into client layer, Java EE application server layer and back-end layer according to the function. Each layer of the system defines the corresponding component development specification except for database layer. In the development and application of the system, several layers are selected to develop according to the system need, then these components are combined in order to realize the system function. The typical architecture of Java EE is shown in Figure 3.



**Figure 3. The Typical Architecture of Java EE**

#### **4. Dynamic E-Business Application Framework**

Because the traditional E-business application framework does not take on better integrated ability, which can not validly decrease development cost due to changing business flow. So the traditional E-business application framework can not meet the demand of each user. And the implementation of dynamic E-business application framework could these existing problems. The dynamic E-business is a complex E-business based on the comprehensiveness and infrastructure architecture of B2B, it is the goal of the next generation E-business development. It can create the best benefit to the interior and exterior enterprises by adjusting the Internet standard and general infrastructure. Enterprises can reconstruct applications and business processes by using Web service, dynamically integrate the business applications on the Internet under the real-time condition, constantly look for new partners in order to take the preemptive opportunities in the market. Web service is used, Enterprises no longer need to know who and where the user is, and other information to create the applications. Web service can realize the data and business connection between the systems. Web service is designed and the other information system can get the basic information by using Web service in order to get the basic information from the information system. And all business functions and service forms in Web service layer is exposed to the outside of system. The other information systems can access the Web service by using the service agreement in order to get an ideal scheme, which to realize the seamless connection between data and service. Java EE is the first choice for enterprises to implement E-business. Except for the use of advanced development technology, the development of E-business system is related to the constraints of other industries and standards. So the Web service and Java EE are into the E-business application framework in order to propose a dynamic E-business application framework in this paper. The dynamic E-business application framework is shown in Figure 4.

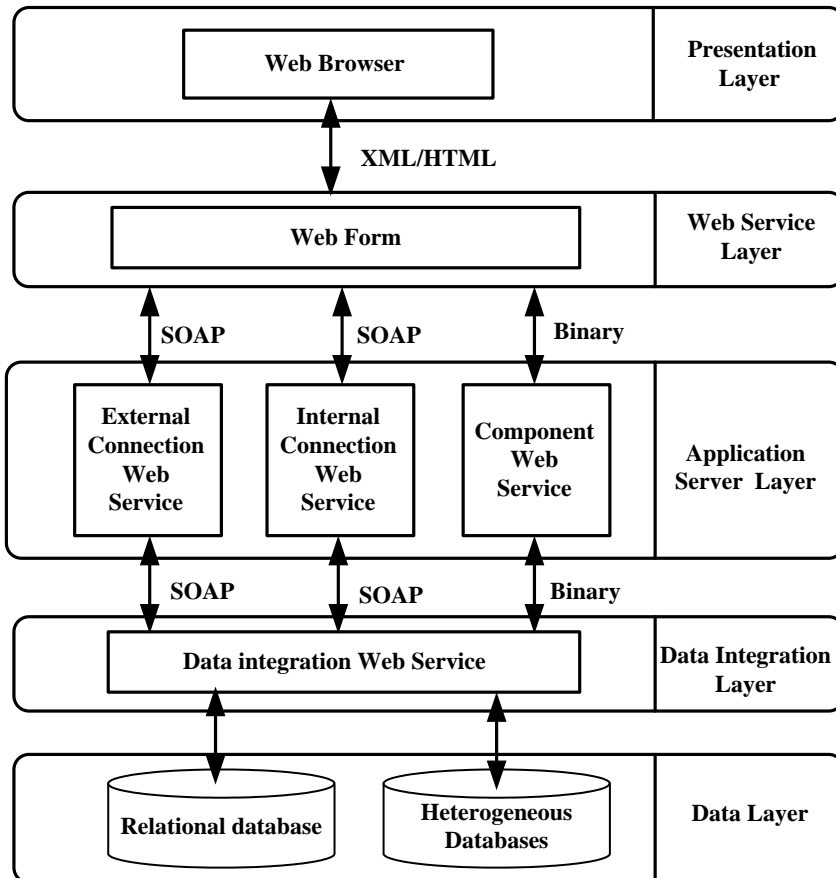


Figure 4. The Dynamic E-Business Application Framework

## 5. Design and Describe the Dynamic E-Business Application Framework

In order to realize the dynamic E-business application framework, the enterprises can establish the massive mutual applications between the service flows and the partners in the B2B. The service application can directly interact by using agreeing interaction or integrated protocol on both sides. This kind of dynamic E-commerce architecture has some advantages of the relative independent and convenient operation. The dynamic E-business application framework can be divided into presentation layer, Web service layer, application server layer, data integration layer and data layer from function logic.

### (1) Presentation layer

This layer is composed of Web browsers of clients. The system data can be configured into a represented format, which provides to read. Its main functions are to provide the common interface of the reasonable use style, convenient application and unified format to users. The main implementation technology is Struts2 (MVC), JSP, HTML and Servlet are also used in the Web. Currently, more commonly used browsers include Internet Explorer, Maxton Browser, Apple and Firefox and so on. Of course, some mobile devices can also access Web browser.

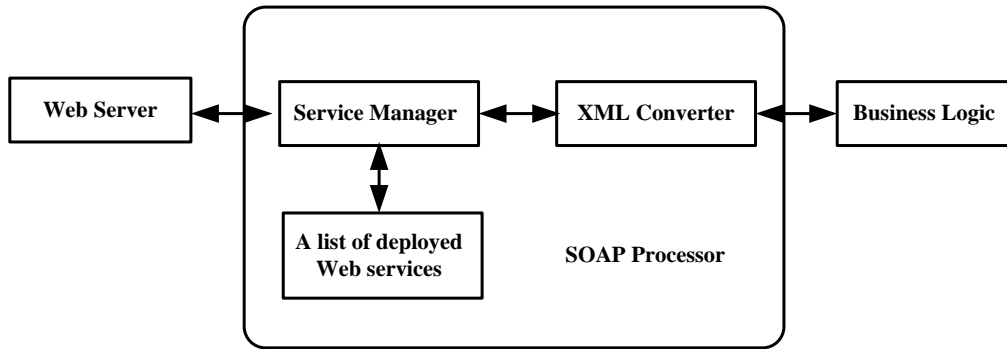
### (2) Web service layer

This layer is composed of Web server and SOAP processor. It is an important logic layer in the model. Its main functions provide interactive web page, manage and memory system and server software, are responsible for transmitting the request on the last layer to SOAP processor. Spring framework is used in this layer. And HTTP, SSL and SOAP



processor are used to communicate. Currently, the software of Web server includes Weblogic, WebSphere, Tomcat and IIS on Windows platform and so on.

SOAP processor mainly consists of service manager, a list of deployed Web services and XML converter. The service manager is responsible for managing service according to the request, and a list of deployed Web services are a list of all hosted services. The architecture of SOAP processor is shown in Figure 5.



**Figure 5. The Architecture of SOAP Processor**

### **(3) Application server layer**

This layer is composed of the internal connection Web services, external connection Web services and component Web services. Its main function is to achieve the business logic of E-business. The logic function of E-business is realized by using the internal connection Web services and component Web services. The internal connection Web services can only be called within the system. The external connection Web service is a logical interface to external liaison and responsible for information interaction of E-business enterprises on supply chain. Hibernate architecture is used to solve the matching problem between the object-oriented application program and relationship-oriented database system, and provide the method of data query and retrieval data in order to greatly reduce the development time by using manual SQL and JDBC processing data. At the same time, the enterprise can also the third Web services by using the external connection Web service in order to improve its own business functions.

### **(4) Data integration layer**

The main function of this layer is to convert the heterogeneous data in the E-business application into XML format. In addition, because the data integration uses the Web service, it can make the enterprise to exchange the internal data with other enterprise on the Internet in order to improve the working efficiency of the enterprise, enhance communication between enterprises and ensure the data security.

### **(5) Data layer**

This layer mainly includes the relational database and other heterogeneous data sources. The database manager is mainly used to query and modify the data in the database.

## **6. Conclusion**

E-business is a new business transaction process based on combining network environment and business operation by using information technology. It has become the engine of economic growth with its unique advantages. E-business pursuits the business process reengineering of enterprises by integrating and completing the business process. But the traditional E-business technologies does not have the better integration ability, exists the disadvantages of long development time, difficult maintenance, poor reusability and so on. Therefore, the dynamic E-business is the goal of E-business development, and Web services and Java EE technology are the key techniques, which can not adapt to changing business strategy. However, with the rapid development of E-business, these

enterprises more and more need to integrate resources to realize the dynamic integration between applications of different enterprises, support the changing business environment, realize the instant fast assembly of business application, and reflect the true value of E-business. So the Web service and Java EE technology are used to overcome the shortcomings of the traditional E-business application system. A new E-business application framework based on Java EE and Web services is proposed in this paper. In the framework, the characteristics and architecture of Web service are used to realize the standard and loosely coupled application architecture and guarantee compatible information exchange and cooperation. The Java EE framework is used to ensure the more strong security and better stability. Finally, the dynamic E-business application framework is designed and described in detail. The new E-business application framework takes on crossing platform, flexibility and easy expansion, and can meet the openness, complexity, distribution, dynamic and customization of E-business.

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