Research on Cloud Architecture of Enterprise Distributed Business Information System Based on SOA

Hai-rong Hu1,a, Lu-lu Fang2,b*, Chao-hong Yang3, Yang Zhang4
1,3,4Department of Information and Communication, Army Academy of Armored Forces, Beijing, China
2Center of Exercise and Training Army Academy of Armored Forces Beijing, China
a890809long@163.com, b*m18811588031@163.com

Abstract: The current SOA-based Enterprise Distributed Business Information System has poor scalability and low utilization, in order to solve this problem, this article analyzes the possibility of integration between Cloud Computing and SOA after telling the similarities between the two. We proposed a SOA-based Cloud architecture model, and applied it to Enterprise Distributed Information Systems, and proposed SOA-based Enterprise Distributed Business Information System Cloud Architecture Conceptual Model and Operating Model. This scheme can well solve the problems of the current system, and can greatly improve the quality and efficiency of system development, and has guiding significance for the development direction of enterprise information systems.

1. INTRODUCTION
To solve the problem without duplication of investment premise breakthrough between heterogeneous systems, and achieve integration and data sharing between the various sub-systems within the enterprise, we has developed the enterprise distributed systems based on SOA [1]. It has efficiently solved the problem of “Information Island” and system integration. However, with the increasing of data and new applications, the data center space is increasingly scarce. The way of centralized storage has threatened the data’s security. The efficiency of traditional data query will be lower with the increasing amount of data. Deploying new applications will occupy the server’s memory, which makes the system run slower. If we buy a supercomputer to solve the above problem will spend a lot of money. The Cloud Computing [1] which has the performances of high scalability, high availability, high reliability etc. has become the best choice to solve the above problem. So, the studying of Cloud Computing architecture based on SOA reflects its real significance.

2. THE INTEGRATION OF SOA AND CLOUD COMPUTING
2.1. Industry views
SOA and Cloud Computing are two fields that concerned by industry and academy [2]. And SOA is an architecture model proposed to solve the problems of “information islands” and “legacy systems”. Cloud Computing is an IT infrastructure usage and delivery model that acquires resources in an on-demand and expanded manner through the network. But both of them emphasize the concept of service. The component elements in SOA are reusable services; Cloud Computing emphasizes that all resources are services [3]. And both of them promise to provide users with low-cost, highly flexible
applications that quickly respond to changes in business needs. It is because of the similarities and differences between SOA and Cloud Computing that the academic community holds different views on the relationship between them. This article organizes these views into five categories: (1) Cloud Computing will replace SOA. (2) SOA and Cloud Computing are complementary. (3) SOA and Cloud Computing have a certain similarity. (4) Cloud Computing is the realization of SOA. (5) Cloud Computing is the development of SOA[9].

2.2. Analysis of the views
The relationship between SOA and Cloud Computing has different performances at different levels, and the industry has a certain degree of subjectivity about the relationship between them. As shown in Table 1, the article compares the similarities and differences between SOA and Cloud Computing in the four aspects, such as causes, usage scenarios, key technologies, and business models [4], and then gets the conclusion of the relationship between the two.

| Relationship          | SOA                                                                 | Cloud Computing                                                                 |
|-----------------------|----------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Causes                | It is proposed to solve the problems of information islands and legacy systems. SOA can solve the problem of data interconnection and intercommunication between legacy systems, improve operating efficiency, and enable interoperability between systems. | Cloud Computing can solve the problem of rapid growth in data volume and insufficient current processing capacity; it can balance the utilization of computing resources. |
| Usage scenarios       | Mainly used when the business needs of the enterprise often change. | It is mainly used when the enterprise's demand for IT infrastructure frequently changes or is unpredictable. And Cloud Computing can also be used in a large number of batch calculations. |
| Key technologies      | It mainly uses service architecture for system design, which focuses on how to deal with services, focusing on loose coupling, agility, reusability, etc. | It mainly focuses on the provision and use of services. It focuses on how to provide services, but also on-demand expansion, virtualization, etc., with high scalability and availability. |
| Business models       | May reduce the cost of software development and maintenance, the business model is not clear, it is difficult for users to see where the benefits are. | Charge based on the amount of resources used, the business model is clear. |

2.3. Analysis of combination point
The above analysis has analyzed the four differences between SOA and Cloud Computing. Although there are differences, there are still some combination points between the two, and there is the possibility of combination.

The core of SOA is service. It encapsulates all components into services [1]. Enterprises use SOA to obtain multiple services from multiple service providers through different combination mechanisms to form the service which they need. Service providers of the Cloud Computing publish resources as a service, and enterprises purchase services such as hardware, platforms, and software from them. Cloud Computing provides a large number of remote services that can be integrated for SOA. Because enterprises generally need applications that integrate multiple services together, Cloud Computing often provides a single service that cannot meet the requirements of the enterprise; and SOA happens to be able to effectively integrate services. Moreover, as one of the implementation mechanisms of SOA, the Web Service specification has the characteristics of standard, simplicity, cross-platform, cross-operating system, and cross-language, and is generally followed by grid computing and Cloud Computing.
Therefore, Cloud Computing, as a new Web Service based on the SOA architecture, can easily coexist with other Web Services and achieve interoperability. For users, they only need to know what kind of service they need and how to get the service, without knowing whom is providing the service [2]. Literature demonstrates the possibility and necessity of the integration between the two from the aspects of enterprise business requirements, software development costs, and service quality.

3. DESIGN OF CLOUD COMPUTING ARCHITECTURE BASED ON SOA

Cloud Computing is similar to other distributed computing in the integration and collection of resources to provide application services to the upper layer. However, distributed computing generally needs to integrate complex heterogeneous resources, so it needs to be based on a large number of protocols and standards. SOA uses Web services as the low-level implementation technology to realize the integration of heterogeneous resources in distributed computing [5], and has formulated a series of protocols and standards, such as service registration protocol, service description protocol, resource description framework, and service communication protocol etc. Although Cloud Computing is oriented to massive data storage and large-scale computing, when building cloud architecture and accessing interfaces, standard protocols established by SOA can still be used, such as UDDI, WSDL, SOAP and Web2.0 technologies such as RSS, AJAX, and REST [6].

3.1. Use SOA to Integrate SaaS (Software as a service)

Since the enterprise distributed business information system is a software system developed based on a service-oriented architecture, how to build this system on the cloud is the key problem to be solved in this article. The key to solving this problem lies in how to use SOA to integrate SaaS (Software as a service).

As shown in Figure 1, the existing system can be transformed into a corresponding standard Web service through SaaS service tools, and published to the service registry to provide consumers with service description information that they can find. Service consumers can issue service composition requests to build a new system, such as the combination of service 1, service 2, and service 3 as shown in the figure. The search process of service 1 is shown by the dotted lines 1 and 2 in the figure. The service is searched from the service registry through the service description information, and then the corresponding service provided by the service provider is bound. The other service processes are the same. The newly constructed system can also be published to the service registry for consumers to use after being serviced by SaaS. It can be seen that integrating SOA with SaaS can quickly integrate existing services to produce new software systems that meet demand.

![Figure 1 SOA Integrates SaaS](image)
3.2. Cloud Computing architecture design based on SOA

According to the combination characteristics of SOA and Cloud Computing, when designing an SOA-based Cloud Computing architecture, multiple levels including application systems and hardware systems will be included. Architecture for reference is shown in Figure 2. It can be divided into: Hardware platform layer, Cloud Management layer, Application Service layer, Service Scheduling layer, Service Interface layer and SOA Construction layer [7].

![Figure 2 Model of Cloud Computing Architecture based on SOA](image)

1. Hardware Platform layer: This layer includes the physical service layer and the virtual service layer, and it is the basic layer of the Cloud Computing service structure. Its main function is to provide virtualized storage resources, computing resources, network resources, and communication resources to clients.

2. Cloud Management layer: This layer includes account management, user interaction management, resource deployment, performance optimization management, identity authentication, access authority management, server deployment, database scheduling management and so on.

3. Application Service layer: This layer encapsulates various applications or software into services provided for consumers. Consumers can enter the Cloud Computing center through a specific portal to customize or obtain the services they need.

4. Service Scheduling layer: This layer performs scheduling and management of service resources and responds to the service submitted by the service interface layer and then detects its legitimacy. If it is legitimate, it detects whether the resources required for this request still exist in the current cloud system resource pool. It will reject the request if the resource has been allocated.

5. Service Interface layer: This layer provides users with a standard and unified service interface and is a channel for calling services. Consumers enter the Cloud Computing service center through a dedicated entrance to customize and consume required services.

6. SOA Construction layer: This layer can publish the services provided by cloud service providers through the WSDL protocol and then publish them in the cloud service platform center through the UDDI protocol. Users search the service in the service platform center through the WSDL protocol. When find the required service, users will interact with the service providers through the SOAP protocol, and bind the service, use the service.

4. CONCEPTUAL MODEL OF ENTERPRISE DISTRIBUTED SYSTEM CLOUD ARCHITECTURE

This paper combines the service-oriented enterprise distributed system architecture model and the
SOA-based Cloud Computing architecture model to design the cloud architecture conceptual model of the enterprise distributed system, as shown in Figure 3.

 Clients are cloud service users. They connect to the cloud service platform registry through computers, PDAs and other terminal devices to query the services they need, and then bind to the service interface layer. The cloud service platform registry can be managed by a high-performance computer. Users find the location of the service according to the description of the service through the corresponding protocol, and then select the service interface. The selection of the service interface layer is managed by a node server computer. After receiving the client's request, the service interface layer forwards the request to the service scheduling layer. The service scheduling layer verifies the user's identity information. If the user information is valid, the service scheduling layer searches for the corresponding service. If the service does not exist or is being occupied, user will be prompted with failure information of service-called, and if there is a service and is in an idle state, the service is provided to the user. This layer is managed by multiple distributed computers. The application service layer and cloud management layer select corresponding services to provide to users according to the scheduling algorithm of the service scheduling layer. This layer is also managed by multiple distributed computer servers, including personnel management, communication services, security services and other services. The hardware platform layer uses virtualization technology, the core technology of Cloud Computing, to virtualize hardware devices such as CPU, memory, and servers to provide customers with powerful computing and storage capabilities [8].
5. CLOUD ARCHITECTURE OPERATION MODEL OF ENTERPRISE DISTRIBUTED BUSINESS INFORMATION SYSTEM

From the conceptual model of the cloud architecture of the enterprise distributed business information system, it can be seen that all service requests need to be completed through the cloud service platform center. The Cloud Computing system architecture proposed in this paper needs to combine users, service providers, and resource providers to form a completed development organization; this process also needs to be implemented in the cloud service platform center. Its cloud architecture operating model is shown in Figure 4.

Figure 4 Cloud Architecture Operation Model of Enterprise Distributed Business Information System

The cloud service platform center supports resource sharing and development inside the system or between systems. Users can find and subscribe to the required services through the service catalog; the cloud platform center merges the services requested by the users according to the merger rules to form a service request list. Then the cloud platform center through the service request list searches for service resources, and finally completes the service combination through the service process orchestration protocol and returns it to the user.

The foundation of the enterprise distributed business information system based on Cloud Computing is the shared resource pool encapsulated by virtualization technology. All resources are autonomous, heterogeneous and distributed. The system organizes all distributed resources together to complete Service development and deployment. In the service using process, in order to ensure the orderly invocation of services, it needs to perform service modeling, description, and formulation of composition relationships; it is also necessary to monitor the runtime status of various services or resources in real time to ensure the effective use of services.

6. CLOUD ARCHITECTURE IMPLEMENTATION MODEL OF ENTERPRISE DISTRIBUTED BUSINESS INFORMATION SYSTEM

Use the SOA technology system to realize the service functions of Cloud Computing, and propose an implementation model of the cloud architecture of the enterprise distributed business information system based on SOA, as shown in Figure 5.
This model develops the service-oriented architecture toward the direction of Cloud Computing services, and uses the technical architecture advantages of SOA to integrate resources outside the existing system, not only can directly call a local single-function service, but also integrate services with remote functions to create more complex multi-functional applications, and finally form a standard, protocol-independent, loosely coupled distributed computing architecture.

Since SOA is the main technical architecture for realizing Web services, the cloud architecture implementation model comprehensively uses Web service technology on the basis of SOA technology. It uses the message-based ESB (Enterprise Service Bus) to implement the deployment and management of heterogeneous systems, and use an event-driven model to implement service changes on demand. ESB is responsible for service control and message conversion. All applications are scattered in the network in the form of services and deployed in each independent service container. These service containers provide functions such as service deployment and runtime environment, implementation of service interfaces and so on.

CONCLUSIONS
As a new and promising service model, Cloud Computing is the inheritance and development of SOA in some respects. Its emergence will surely promote the transformation of the entire computer application. This paper analyzes the current development status of enterprise distributed business information system and its existing problems, combines with the most advanced theory and technology of Cloud Computing and SOA, designs a SOA-based Cloud Computing architecture model, and applies it to enterprise distributed Business system. This solution can well solve the problems of the current system, and can greatly improve the quality and efficiency of system development; it can integrate the existing legacy systems and cloud services of single function provided by the cloud platform, and improve resource utilization. It can form a certain open information environment, supporting the dynamic expansion of the system, and flexibly responding to rapidly changing business needs. It has guiding significance for the development of enterprise information systems.

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