Design of SaaS -based Software Architecture

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Abstract

As rapidly growing software licensing mode contrast to traditional perpetual-use license mode, SaaS users could use any software which they need through subscriptions from software vendors. By means of comparative analysis method, a mould software architecture based on SaaS is proposed after a brief introduction on both ASP concept and a typical ASP architecture. And functions of the architecture moulds are illustrated. As SaaS could help software suppliers and contribute to SMEs' informationizion, it is hoped that the SaaS-based software architecture could give a new path of developing software and change the way of making software available.

1. Introduction

Pearl Brereton (1999), a membership of Pennine Group①, put forward the view of software turning into services, and indicates that the future of software lay not in developing new architecture based on constructional forms, such as objects or components, but in taking a radically different way that any software's functionality is delivered to the user [1]. As a result, ASP (Application Service Provider) applications are emerged. IDC White Paper (1999) points out 5 major desirable criteria of the ASP application: (1) application centric, (2) right of use the software rather than ownership of the application software, (3) centrally managed, (4) one-to-many service; (5) software delivered basis on the contract. However, literature shows that there are a larger gap between the early expectations of those ASP vendors and the success of the ASP applications [3]. Hence, SaaS (Software as a Service), as an improved and expanded ASP, is advanced [4]. Microsoft's Frederick Chong and Gianpaolo Carraro (2006) think that SaaS maturity model could be divided four-level, they are customized SaaS, configurable SaaS, configurable , Multi-Tenant-Efficient SaaS and scalable, configurable, Muti-Tenant-Efficient SaaS [5]. Vidyanand Choudhary (2007) have proved in theory that SaaS model could promote IT software companies to increase investment in product development and improve the quality of software products in most cases and these IT Manufacturers can get a higher profit compared with traditional software licensed model and under some certain conditions [6]. SaaS applications have become a research hot in enterprise and scholars. Although many IT manufacturers have released a lot of software products based on SaaS, such as the U.S. Salesforce online CRM (customer relationship management) system in June 2003, Microsoft Live software services for online in November 2006, Oracle Siebel hosted CRM software in the Chinese market in July 2007, the largest ERP software vendor SAP business management software - named A1S in September 2007, Alibaba Group open platform

① http://www.service-oriented.com

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www.alisoft.com in June 2007, XToolsCRM online CRM software in August 2007, each software vendor 's SaaS product had their own architecture design and business strategy, but academic literatures on the SaaS application architecture are limited with most articles focused on SaaS business model.

In this paper, a kind of SaaS-based application architecture is proposed, and analyzed comparably with that of ASP (Application Service Provider), and then those functions of the layers of the SaaS application architecture are discussed. We hope that the SaaS application architecture could give a new idea to IT organizations' software development and contribute to SMEs' informationization.

2. ASP （Application Service Provider）

ASP does not sell software directly to users, but deploy ASP applications Internet Data Centers. Customs could access these applications at any time according to their service level agreements. ASP is responsible for management,maintenance and updating of these software products dynamically. Customers, ASP operations and service software and products are three elements of ASP business model. The basic operation process is: ISV (Independent Software Vendor), IDC (Internet Data Center), ISP, network infrastructure providers and telecommunications operators provided application software and service infrastructure for ASP, ASP provided services for customers and these customers pay the rent to ASP. Figure 1 shows an interpretation of ASP application architecture.

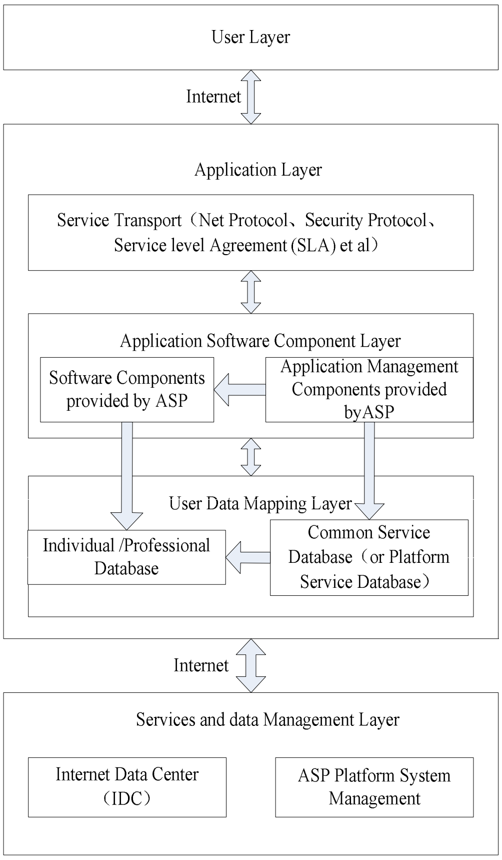
User Layer
Internet
Application Layer
Service Transport（Net Protocol、Security Protocol、Service level Agreement (SLA) et al）
Application Software Component Layer
Software Components provided by ASP
Application Management Components provided byASP
User Data Mapping Layer
Individual /Professional Database
Common Service Database（or Platform Service Database）
Internet
Services and data Management Layer
Internet Data Center（IDC）
ASP Platform System Management

Figure1. ASP Application Architecture

User layer The layer is the entrance which user login into an ASP application system. It required high stability and easy to manage network security technology. They were net security, data security, authentication, digital signatures, rights management, concurrency control, reliability, load balancing, and so on.

Application Layer The layer is the destination where user utilize those software applications provided by ASP platform, it has thre, they are service transport layer, application software components layer and user data mapping layer.

a. Services Transport Layer The layer ensure that those services which user request, could be accurate transported and interpreted by selecting and confirming net protocol, security protocol and service level agreements .

b. Application Software Components Layer Application software component library was deployed in a centralized server (server cluster) and accessed remotely by users. According to those interface protocols, which have been reached by ASP vendors and ISVs, application component library was provided by or to meet users' service demand. ASP application management component library took charge of building the application components and load balancing, and other personality system management.

c. User data mapping layer Users accessed their personal data through this layer to protect system data.

Services and data management layer The modular is an infrastructure of resources provided by ASP platform, which include data center and ASP platform management system.

a. Internet Data Center is responsible for the management of user data storage, backup and 7-24 maintaining management.

b. ASP Platform Management System undertakes the follow tasks, they are searching, evaluation and selection of resources for the needs of users and optimized them; real-time measurement and collection of log data about networks, systems, application reliability, user operations; payment of rent charge; support for the on-line services and so on.

Although ASP application could help to reduce users' initial investment on software and hardware, but from technical point of view, each application tenant had to have their own application instance, which must be developed according to individual demand respectively by ASP vendors or another ISVs. So each customer had a database or instance, a Web site or virtual directory. As a result, Data structure in the database and application of the code may be customized according to special customer demand, the system scalability incurred greater restrictions and more cost of maintenance and upgrades were needed.

3. Design of SaaS Platform Architecture

The basic performance of SaaS applications are that application software, developed accordance with the SaaS provider agreements (including network protocol, security, service level agreements, etc.), deployed in any internet servers, and users needn't buy software licenses, but lease software modules through Internet based on their actual demands, they pay SaaS vendors according to the type of subscription service or the number of users to rent or using software time. According to the idea of SaaS, we have built a SaaS application framework shown as Figure 2.

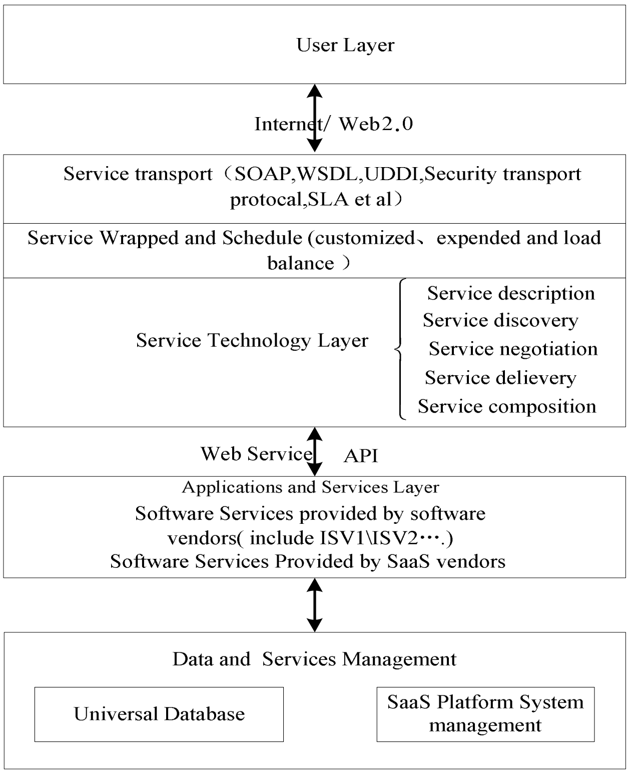
User Layer
Internet/ Web2.0
Service transport（SOAP,WSDL,UDDI,Security transport protocal,SLA et al）
Service Wrapped and Schedule (customized、expended and load balance ）
Service Technology Layer
Service description
Service discovery
Service negotiation
Service delievery
Service composition
Web Service
API
Applications and Services Layer
Software Services provided by software vendors(include ISV1\ISV2….)
Software Services Provided by SaaS vendors
Data and Services Management
Universal Database
SaaS Platform System management

Figure 2: SaaS Application Architecture

Service Transport Layer SOAP, Web Service and XML and relational network security protocols are adopted in order to ensure the accuracy of information analysis and delivery.

Service Wrapped and Schedule Layer Costumers could apply some effective technology, such as parametric application, customized and connector, to expand SaaS application by the way of self-defining custom fields, menu , report, formulas, privilege, views, workflow and approval flow, integrating individual service components to meet users' personalized demand according to the user's business processes. SaaS application multi-tenant on-line running at the same time is different from ASP application and service load balancing and responding timely are better than ASP coordinate. And all users UI and application data are isolated through the authorization and security policy, etc.

Service Technology Layer SaaS applications provided by software vendors or ISVs are closely linked through service description, service discovery, service negotiation, service delivery, service composition, and so on.

Applications and Services Layer Not alike deployment of ASP software and services, SaaS software can be installed on anywhere, including service providers, ISVs, or the server located on the Internet. These software and services are linked through the appointment APIs or special Web Services.

Data and Services Management Layer Shared database and isolation data structure make all users access their private datum in same database or database cluster with a different data set, so that each user can design different data models. SaaS platform system management take charge of all system basic functions

4. Discussion

From the view of technical framework, there is an obvious distinction between SaaS and ASP, in the SaaS model, the software was designed to multi-user structure, an application instance can provide services for multiple users at same time, an intermediate layer is added to deal with the customization, scalability and load balancing. On the other hand, ASP preferred to provide one-on-one service, each user has a database instance and a virtual directory, ASP and hosting don't fundamentally change the architecture of application software, it just provides a kind of software deployment environment where different users could utilize their special software.

From the view of business model, SaaS and ASP have some essential distinctions. In ASP model, users should pay nonrecurring payment to purchase a permanent software license (not including the fees of upgrading the software and server management). But with the advent of Web 2.0 and the new software programming, SaaS users would just lease some software modules over the Internet according to their the actual situation and pay vendors or manufacturers based on the number of leased services or the use of these services time, as different from ASP users, they could access freely these application software modules upgraded and maintained by SaaS and need no any server hardware facilities IT investment. So they may invest little but get more and better services. SaaS is not limited to the deployment of software applications hosting, but focus more on providing business support services over Internet and the custom application and scalability. SaaS emphasize service but ASP pay attention to the concept of application. SaaS has expanded the scope of application of the ASP.

5. Conclusion

In the SaaS model, customers need not spend a lot of investment for hardware, software customization and maintenance engineers and do not have to buy software, but switch to lease those Web-based software functions and pay only certain fees for these leasing services, these tenants could use the hardware and software and enjoy the relevant maintenance and software updating services through Internet. Based on the analysis of the ASP application framework, combined with the idea SaaS, a kind of SaaS application architecture was designed and gave a brief elaboration on its composition and module functions. The paper made an useful exploration for the research and application of SaaS. But some questions, such as how to meet optimally the individual needs of users; how to eliminate the user's doubt for data security and system reliability; how of the in the system to form a highly efficient and virtual enterprise alliance formed by SaaS platform participants and so on , are still further explorated.

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