Cloud Computing and Cloud Security Challenges

Zhang Yandong, Zhang Yongsheng
School of Information Science and Engineering of Shandong Normal University
Shandong Provincial Key Laboratory for Novel Distributed Computer Software Technology
Jinan 250014, China
zhangyandong_2008@126.com

Abstract—**Cloud computing is setting off great changes in the IT industry. There are more and more researches on cloud computing. And this paper focuses on cloud computing too. At the beginning this paper describes the characteristics and definitions of cloud computing, and then introduced its services patterns (including SaaS, PaaS and IaaS) and deployment patterns(including public cloud, private cloud and hybrid cloud), at the end lists the cloud security challenges that cloud computing faces.**

Keywords- Cloud computing; SaaS; PaaS; IaaS; Cloud Security

I. INTRODUCTION

Cloud computing is a brand-new computing model which is based on distributed computing, parallel processing, virtualization and grid computing and is the commercial implementation of the concepts above. Since Eric Schmidt, the CEO of Google, first openly used the concept of "cloud computing", cloud computing have swept the Internet and triggered a global research and development boom. Now cloud computing is in a period of rapid development, so it is obvious that new contents and features continue to emerge. Foreign large companies such as Amazon, Google, IBM, Microsoft and Yahoo are pioneers in cloud computing. Many other companies like Salesforce, Facebook, Youtube, Myspace also make a success in cloud computing.

II. CLOUD COMPUTING

For the cloud computing is a new thing, some people have confusion with it and even some people equate it with the grid computing. In order to enable the reader have a clear understanding of cloud computing, this section focuses on its features and definitions.

A. Characteristic of Cloud Computing

For a new computing-cloud computing, it is essential to understand its features which distinguish cloud computing from other network patterns. Its characteristics summarized by literature [1] are: Separate the computation and the storage from the original software on a single computer, and finish those on user terminals and network servers. That is, this model store the major software (including system program, application procedure and data) in the network, and user terminal is only responsible for the user interaction as well as access to service. Computing services provided for users can be done on a compute server on the network as well as in the user terminal. In literature [2], the characteristics of cloud computing are described as follows: The cloud computing (1) provides reliable and secure data storage centers, by using cloud computing, users do not have to worry about data loss, software updates, viruses attacks and other issues; (2) requires low about the initial configuration of customers' equipment and is also easy to use; (3) realizes processing documents between different places as well as achieves document sharing and applying among diverse devices. In literature [3], the characteristics of cloud computing are summed up as follows: Multi-tenancy (share resources), large-scale scalable, flexible, pay as you use and self- allocation of resources. This article uses the overview summarized by cloud computing network (http://www.cloudguide.com.cn/viewhelp.php?id=68&site= help&cat=rumen)features : (1) Integrate resources to improve the computing power of devices (2) Use distributed data centers to ensure system disaster recovery capabilities (3) Separate hardware and software from each other to reduce device dependence (4) Design platform modular design to ensure the high scalability (5) Deploy virtual resources pool to provide users with flexible services (6) Low use cost as pay-as-use lower. From the summary above, we know that the most notable feature of cloud computing is to pay as you use and provide flexible expansion of resources usage.

B. Defination of Cloud Computing

Cloud computing is an emerging term, whose definition and connotation have no universally accepted definition among industry and academia. Many researchers and research institutes have given their own definitions. Vaquero et al gave the definition in literature [4] as follows: A large pool of easily usable and accessible virtualized resources, which can be dynamically reconfigured to adjust to a variable load (scale) allowing also for optimum resource utilization. This definition is given based on how to allocate and share computing resources effectively and dynamically. Literature [5] gives the definition as follows: The cloud computation is one kind large-scale distributed

computing pattern driven by the economies of scale actuation, through this kind of computation pattern, we can realizes abstract, virtual, dynamic expansion and administrable computation, memory, platform and service can manage the resource pool of compute, storage, platform, services and other resource pools can be provided by Internet to external users on demand. From the above definitions which focus on different aspects, we know that the cloud computation is not a concrete technology, but a kind of emerging computation pattern, which based on many existing technologies such as virtual technology, distributed computing, effectiveness calculate, network technology, web and software service technology, grid technology, and it distributes its computational tasks in resource pool constituted by a large number of computer, enables various application systems obtain the computing power, storage space and a variety of software services needed. In this paper, we use the definition given by the US National Institute of Standards and Technology Bureau, whose definition covers the most important features of cloud computing: Cloud computing is a model for enabling convenient, on-demand network access (for example, networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model promotes availability and is composed of five essential characteristics on-demand self-service, broad network access, resource pooling, rapid elasticity ,and measured service, three services models[cloud software as a service, cloud platform as a service, and cloud infrastructure as a service],and four deployment models private cloud, community cloud, public cloud and hybrid cloud.

III. THE TYPE OF CLOUD COMPUTING SERVICES AND DEPLOYMENT

Service model and deployment model is a vital outcome of the development of cloud computing concept. View from the current state of development, industry and academia generally agreed that cloud computing service model can be divided into the SaaS (Soft as a Service), PaaS (Platform as a service) and IaaS (Infrastructure as a Service), and the deployment mode can be divided into the public cloud, private cloud and hybrid cloud.

A. Cloud Computing Service Model

At present, almost all the well-known IT providers, Internet providers, and even telecommunications operators march toward cloud computing, and launch their own cloud services. As mentioned earlier, the current cloud computing service model can be divided into three categories: SaaS, PaaS, and IaaS, which is recognized as SPI, as Fig.1 shown below.
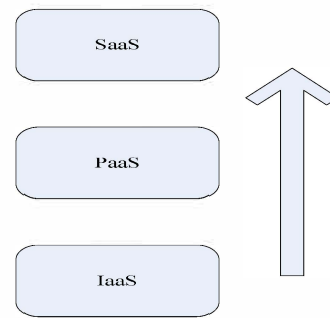

Figure 1. Example of Cloud Computing Service Model:Higher Up,the Development Is More Mature

1) SaaS (Software as a Service)

SaaS (Software as a Service) is a new form by which user access to software service and SaaS itself also obtains more mature development in the cloud service. Under SaaS model, it does not require users to purchase software products installed on their own computer or server, but by order or with the use of the payment model, that is to lease software. In some cases the software is free, but users have limited right to use the software. Essentially, software as a service is a computing power which is provided by software service provider to meet with the users' some kind of need.

At present, the typical application of SaaS are online services such as e-mail services, web conference, network fax, online antivirus and on-line entertainment applications such as Web search, online games and online video and management services such as online project management and online ordering platform.

Frankly speaking, SaaS model dose reduce the deployment cost for business and individuals. SaaS is the development trends of future software industry development. These days not only Microsoft, Salesforce and other major software giant launched its own SaaS applications, but also YongYou and Kingdee, domestic software giant, launched their own SaaS applications.

2) PaaS (Platform as a Service)

As a service to customers, PaaS (Platform as a Service) can provide a complete computer platforms, including application design, application development, application testing and application hosting. By using this service mode, the client can build web applications without deploying the hardware and software facilities on their own computer. Compared to software development platform based on the data center, the cost of PaaS is much lower. Indeed, the lower cost is also the maximum value of PaaS.

The typical application examples of PaaS are the Facebook development platform and Microsoft Windows Azure platform. PaaS has a good market prospect, at the same time it can promote SaaS. For providers who want to enter the SaaS space, PaaS can lower the threshold for them to develop and deliver SaaS service; for providers who offer SaaS services, PaaS can help them diversify their product and carry out custom-built services. At the same time, PaaS, reduces the cost of the SaaS application development and improves the efficiency of development.

3) IaaS (Infrastructure as a Service)

IaaS (Infrastructure as a Service), refers that businesses or individuals can use cloud computing technology to access to remote computing resources, which include computing, storage, and application virtualization technology-related functions. IaaS mode is similar to utility computing. The basic idea of the latter is to provide computing services as to provide the tools. This means users only pay for the actual consumption of processing power, disk space and so on. No matter end-users, SaaS providers or PaaS providers can obtain computing power they need from the infrastructure services provider, without paying the original investment cost for the basis of IT hardware and software.

At present, Microsoft, Amazon, Century Internet and other providers can provide IaaS services based on hardware. Through cloud computing technology, they can collect memory, I/O devices, storage and computing capacity together into a virtual pool of resources to provide services for end users and SaaS, PaaS providers. Of course, compared to SaaS, the application of IaaS is not very mature, because many key technologies need further research and development.

B. Cloud Computing Deployment Model

For providers, cloud computing has three deployment models, those are the public cloud, private and hybrid clouds.

1) Public Cloud

Public clouds, also known as external cloud, provide services for external customers; all of its services are available for others to use, rather than for their own. The public cloud is built in one or more data center by the third-party vendors to operate and manage. Services through the public infrastructure available to multiple users, as Fig.2 shown below
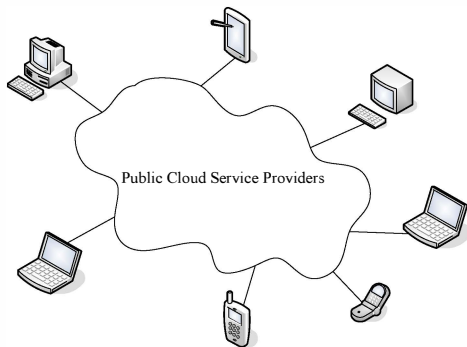

Figure 2. Example of Public Cloud Deployment

For the user, the public cloud's biggest merit is that its application program, the service and the correlation data are deposited in the public cloud and the users do not need to make the corresponding investment and the construction. At present, the data is not saved in their data centers, meanwhile certain secure risk exists. At the same time, the public cloud's usability is not under the control of the customer, so there is the possibility of data leaking.

2) Private Cloud

Private cloud, also can be called internal cloud, whose services are not available for others, but for their own

internal staff or affiliates to use. The deployment of private clouds is more suitable to enterprises or government departments with many branches. With the centralization of these large corporate data centers, the private cloud will become their mainstream mode of IT systems deployment. Relative to the public cloud, private cloud deployments is within the enterprise itself, so its data security and system availability can be controlled by them. While its drawback is that the investment is large, especially in a one-time capital investment. But in terms of security, private cloud behaves well.

3) Hybrid Cloud

Hybrid clouds are the combination of public cloud and private cloud that means the hybrid cloud can provide services for both the creator themselves and their customers. In order to ensure security, agencies should run the non-core applications on public cloud and use private cloud to support its core program and store internal sensitive data, when they use of hybrid cloud computing model,. In comparison, the hybrid cloud needs the higher cost of deployment for providers and faces more complex security problems.

IV. THE SECUTITY CHALLENGES OF CLOUD COMPUTING

Cloud computing, cloud software, cloud storage, cloud operating software, cloud security ... in a word, cloud has become the buzzword of the IT industry. Cloud computing provides a virtual infrastructure and services to external user by service submitted. Cloud computing reflects the idea of IT infrastructure as a service, which enables computing services like water, electricity and other public services, access resource on-demand and pay for use. So it was regarded as the third revolution of the information industry, and it will be the main form of the future information society.

Cloud computing is the development trend of IT industry. However, let the user move to "cloud" also faces a considerable number of problems. Security concerns become one of the most important reasons that hinder the sustainable development of cloud. Some people believe that in the cloud era, data and applications are stored in the "cloud" and public cloud provider or private cloud provider offer technical support, so the centralized control management is beneficial to the information security; Generally speaking, internal private cloud is more safety, economy and efficiency when compare to multiple business units operate and maintain system separately; Through the deployment of centralized cloud computing, cloud service providers with professional equipment and professional security personnel can offer comprehensive security protection, and ensure security of information better and more economical. But there is a reality that can not be ignored: the centralized management of cloud computing center will become the major targets of hacker attacks; coupled with magnitude system and unprecedented openness, sharing, and complexity, so its security problems are more severe than ever.

As known to all, the cloud era is in possession of the cost advantages and a certain security advantages, but new

security issues brought by cloud computing also should not be ignored. And for enterprise security it is not a small challenge. According to reports, the cloud computing service providers have been subjected to a lot of security threats from different factors to different levels. For example, in October 2007 and February 2008, Amazon's EC2 presented the wide range breakdown. The Amazon cloud computing service once presented a breakdown because of the thunder stroke, and in March 2009, Google's disclosure of customer private information event emerged. In July 2009, cloud computing services of Amazon, including EC2 have security failure leading to its website can not be accessed.

Security problems faced by the cloud system about in the following five aspects:

- First, face more security attacks: due to the vast amounts of user data stored in the cloud system, for attackers there has greater allure. If the attacker in some way successfully attack cloud systems, it will bring devastating disaster for both cloud providers and users; On the other hand, in order to ensure flexibility and versatility services of the cloud, cloud systems provide users with more open access interfaces, which also bring greater security threats.

- Second, virtualization technology: it not only brings cloud computing platform flexibly resources configured, but also brings new security challenges. There is a need to solve the problem that secure deployment of cloud platform based on the virtual machine architecture. In a virtualized environment, the server is like a file which is taken away easily, so the risk of disclosure increases. When many virtual machines running on physical servers, the administrator's work often take over the management of the virtual network environment. In that case, the administrators' privileges increase, so it is necessary to regulate the administrator's privileges. The introduction of the virtualization platform has become a new security vulnerabilitie. Once be hacked, all the virtual machines running on the virtualization platform will be under control of attackers. By that time, the cloud providers and users will suffer huge loss.

- Third, ensure continuity of the cloud platform services and high availability of user data and business: Amazon data center downtime event, Google's Gmail failing to use event and so on are associated with cloud computing availability. To a certain extent, the events above discourage the enthusiasm of the enterprise to use public cloud. Cloud computing service need to provide a fault-tolerant mechanism to backup user data to reduce the impact in application when the original data is destroyed. In addition, the software itself may have loopholes and a large number of malicious attacks happen, all these above greatly increase the possibility of service interruption. How to protect the high availability of software services and user application and how to provide convenience security management to the thin-client user have become one of the biggest challenges of cloud security.

- Fourth, ensure the safety and privacy of user data: user data stored in the cloud system, for malicious attacks, the primary purpose is to get user privacy, and then to obtain economic benefits. In this case, laws, regulations and processes are the problems that are the most urgent to be solved, and relevant laws and regulations should be established and improved to protect third-party security, to meet requirements listed by companies, especially to clear responsibility division when problems arise and to provide protection mechanisms as cloud service providers exit. In the domestic, most businesses are reluctant to store sensitive information in third-party, and they still focus on building private cloud. Only Security system and regulations gradually be perfected and security technology continues to progress, the future of public cloud services will get a sustainable evolution.

- Fifth, perfect the cloud standards: Interest-oriented IT development process leads to cloud standards exist everywhere. Many manufacturers have defined their own application standards and data formats, forcing the user deploying IT system and their own business in accordance with the framework set by different service provider. Ultimately, all of this leads to business fragmented and chaotic system which are adverse to users' application. In cloud computing, cloud computing security standards and evaluation system provides an important technical and management support. And interoperability between varieties of cloud services is essential to ensure the cloud not to fall into isolated development situation and then promote common progress. To a certain extent, the establishment of cloud standards decides the future evolution of cloud computing.

The above analysis is mostly based on the public cloud, and less involve in the private cloud. In security issues, private cloud are mostly inherited the advantages of cloud computing. In addition to the traditional security issues, the private cloud main face internal supervision problem. Despite the stronger security, private cloud has the higher deployment cost and large enterprises have the ability to invest. The public cloud is still very beneficial to the vast number of small and medium enterprises and individual users. Therefore speed up the research of the related security technology solutions to enhance safety of the public cloud, and public cloud will obtain broader market.

V. CONCLUSION

As a new technology is expected to significantly reduce the cost of existing technologies, cloud computing is the development trend of IT industry. For information security, there are both favorable factors and negative factors brought by cloud computing. The final effect depends on whether

we can develop its strengths and avoid its disadvantages. Only in this way, the cloud can become a real cost savings, improving productivity efficiency and secure platform.

REFERENCES

[1] Zhang Yaoxue and Zhou Yuezhi, "A New Cloud Operating System:Design and Implementation Based on Transparent Computing," Acta Electronica Sinica, Vol.29,May.2011,pp.985-990,doi:0372-2112(2011)05-0985-06.

[2] Li Chunlan and Deng Zhonghua,"On the Value of Cloud Computing," Library and Information,No.4,2009,pp.42-46,doi:1003-6938(2009)04-0042-06.

[3] Tim Mather, Subra Kumaraswamy and Shahed Latif(Liu Gezhou,Yang Zeming and Liu Baoxu translation),"Cloud Security and Privacy"[M],Mechanical Industry Press, Beijing , May 2011.

[4] Vaquero L M, Rodero-Merino L and Caceres J, "A break in the clouds:Towards a cloud definition ,"ACM SIGCOMM Computer Communication Review, vol.39, Jan.2009,pp:50-55,doi: 10.1145/1496091.1496100.

[5] lan Foster and Yong Zhao,"Cloud Computing and Grid Computing 360-Degree Compared," Grid Computing Environments Workshop, 2008. GCE '08, Nov.2008,pp.1-10,doi: 10.1109/GCE.2008.4738445.

[6] Liu Peng,"Cloud Computing"[M], Electronics Industry Press, Beijing , Mar 2010.

[7] Feng Dengguo, Zhang Min, Zhang Yan and Xu Zhen,"Study on CloudComputingSecurity"Journal of Software,vol,22,Jan.2011,pp.71-83,doi:10.3724/SP.J.1001.2011.03958.

[8] George Pallis,"Cloud Computing:The New Frontier of Internet Computing," Internet Computing, IEEE,vol.14,Sept.2010,pp.70-73,doi：10.1109/MIC.2010.113.