Original Research Article

Application of Cloud Computing in Telecom Operators

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ABSTRACT

The emergence of cloud computing has brought great changes to the internet. The changes occur due to the effective use of idle resources and more importantly, it is the results of Google, Amazon and other major internet companies to change the desktop form for the PC core software. Firstly, cloud computing can be the development of Distributed Computing, Parallel Computing, and Grid Computing. It can make full use of the Internet's computing resources to provide users with on-demand services. Cloud computing, although from the Internet, but in a long run, we can notice that there is no one type of business other than telecom operators that could be more conducive to develop a complete chain from user end to the internet and to computing. With the introduction of 3G and reorganization of China's telecom operators, operators can build a highly integrated cloud computing chain and its user base and infrastructure construction become obvious advantages for continuous development. As to how to develop the telecom operators and how to establish their own specialty and improvement, is an urgent problem to be solved. Based on the current situation of cloud computing and cloud computing of telecom operators in China, this paper analyzes the advantages and disadvantages of telecom operators 'development of cloud computing by studying the strategy and development of telecom operators' cloud computing in China and abroad. This paper also discuss the insights and proposals to the changes, countermeasure, and strategies towards cloud computing development by telecom operators, in the hope of contributing to the development of China’s cloud computing industry.

KEYWORDS: cloud computing , telecom operators, development strategy, business model

1. Introduction

1.1. Research background and research significance

In cloud computing, software serves as a service (SaaS), platform serves as a service (PaaS), and infrastructure also serves as a service provider (IaaS); which extends cloud computing to a variety of service models and corresponding service providers. Due to the diverse patterns of the cloud computing services, IT companies use it at different levels based on their own advantages resulting to the formation of crowded situation.

IaaS provides customers with rental processing, storage, networking and other basic computing resources that users can deploy and run on any software, including operating systems and applications. Customers do not manage or control the underlying cloud computing infrastructure, but can control the operating system, storage, and deployment of the application. It is possible to select the network components (such as firewall and load balancer). For example, Amazon's AWS and at&t's Synaptic.

PaaS provides customers with the ability to deploy applications created by customers with the development language and tools provided by the vendor to the cloud computing infrastructure. Customers do not need to manage or control the underlying cloud infrastructure, but can control the deployment of applications. Customers may also control the hosting configuration of the application. For exmple, Google's App Engine platform, Saleforce's force.com platform, Facebook’s F8 platoform, and Microsoft’s Azure platform.

SaaS is the service provider running on the cloud computing infrastructure applications and is able to be in a variety of client devices through the thin client interface access, such as the browser. Customers do not need to manage or control the underlying cloud computing infrastructure, requiring only a limited number of customer-configurable configurations. For example, Microsoft's Officelive, Google's online documentation services and Saleforce's online customer management software.

At present, the technology of IaaS and SaaS is relatively mature and has certain commercial cases abroad, but the overall market potential remains to be maximized. PaaS technology has not matured. The cloud computing vendor platforms are not compatible, using proprietary data formats and API (Application Programming Interface, application programming interface), and it is difficult for users to switch from one platform to another. From the analysis of development in cloud computing industry, it is predicted that China will the cloud computing service provider for IDC service providers, traditional IT vendors, and internet companies. With the continuous integration of telecommunications and the Internet, cloud computing will have a significant impact on the traditional telecommunications industry. On the one hand, the traditional IDC (Internet Data Center) has been unable to meet the development requirements. To ride this new wave of computing, as a long term plan, telecom operators has build multi-network integration and cloud computing trends have become obvious. With the release of China's 3G, mobile operators already have the ability to integrate information services.

On the other hand, the trend of internet development is leaning towards high-speed and large amounts of data. Cloud computing lowers cost and improves resource utilization, making the internet into a 'high-speed and large data' era. In addition, the internet terminal has changed from desktop, to laptop, notebook, Tablet PC and smart phones. The aroused problem is the decline of storage capacity and mobile operators have effectively use cloud computing to solve this problem.

1.2. Research content

This paper is divided into five parts, namely introduction, cloud computing overview, telecom operators and cloud computing, ideas on telecom operators cloud computing development, concluding remarks.

Chapter 1: Summarize the development direction of cloud computing and telecom operators.

Chapter 2: Introduce the definition of cloud computing concepts, basic principles, highlighting features, applications and prospects.

Chapter 3: Analyze the development strategy and development status of cloud computing in telecom operators in the country and abroad, the advantages and disadvantages of telecom operators to develop cloud computing, and focus on the development of cloud computing in international and domestic telecom operators.

Chapter 4: Based on comprehensive analysis and current status, to provide views on the development direction of China's telecom operators in cloud computing development

2. Cloud computing overview

2.1. Cloud computing definition and basic principles

Cloud computing is an internet-based computing which shares hardware and software resources and information can be provided to the computer and other equipments. The whole operation is much like the grid.

Cloud computing will be the next major change since the big change to client-server in the 1980s. Users no longer need to understand the details of the infrastructure, does not require the professional expertise and does not need direct control.

Cloud computing describes an Internet-based new addition in IT services, usage and delivery model that typically involves the use of the Internet to provide dynamically scalable and often virtualized resources. Cloud is actually a metaphor of the Internet. As cloud is previously often used to represent the telecommunications network, it is later also used to represent the internet and the underlying infrastructure. Typical cloud computing providers often provide common network business applications that can be accessed through software such as a browser or other Web services, while software and data are stored on the server. Among the key elements of cloud computing, it also includes a personalized user experience.

Cloud computing can be considered to include the following levels of services: infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS). Cloud computing services typically provide a common online business application that is accessed through a browser, and software and data can be stored in the data center.

2.2. The basic characteristics of cloud computing

There is a certain similarity between cloud computing and nature's cloud and water cycle, which made 'cloud' a fairly appropriate metaphor. According to the American National Institute of Standards and Technology, cloud computing services should have the following characteristics:

• On-demand self-service.

• Able to access any network device anytime, anywhere.

• Sharing of resource pool by multiple users.

• Flexibility in quick re-deploying.

• Services that can be monitored and measured.

• Quickly deploy resources or get services based on virtualization technology.

• Reduce the processing burden on the user terminal.

• Reduced user reliance on IT expertise.

2.3. Core features of cloud computing

• Agility enables users to quickly and easily acquire technical resources at low prices.

• Accessibility of the application interface (API) refers to the ability to allow software to interact with the cloud in a way that is consistent with the 'human-computer interaction'. Cloud computing systems typically use APIs based on Representational State Transfer (REST) network architecture.

· In the transmission mode of the public cloud, support has been transformed into operating costs, so the cost has dropped significantly. It is clear that the entry into the hurdle is due to the fact that the architecture is typically provided by a third party and does not require a one-time purchase and does not have the pressure of a rare centralized computing task. The principle of general computing based on computational resource packs is implemented internally on a fine-grained basis based on user actions and less IT skills.

Device and local dependencies allow users to access resources through a web browser without having to worry about what devices they are using, or where to access resources (such as PCs, mobile devices, and so on). Often facilities are in a non-local (typically provided by a third party) and are accessed via the Internet, and the user can connect from anywhere.

• A software architecture technology called multi-tenant allows resources and consumption to be shared under a multi-user pool:

The centralization of the architecture makes local consumption less (e.g. real estate, electricity, etc.).

Peak load capacity increases (users do not need to build the highest possible load level).

The original utilization rate of only 10-20% of the system efficiency increased.

• Improved reliability if multiple redundant sites are used, which allows us to design cloud computing to meet business consistency and disaster recovery.

• Extend the resources according to reasonable granularity, close to real-time self-service, without the need for the user to construct the peak load.

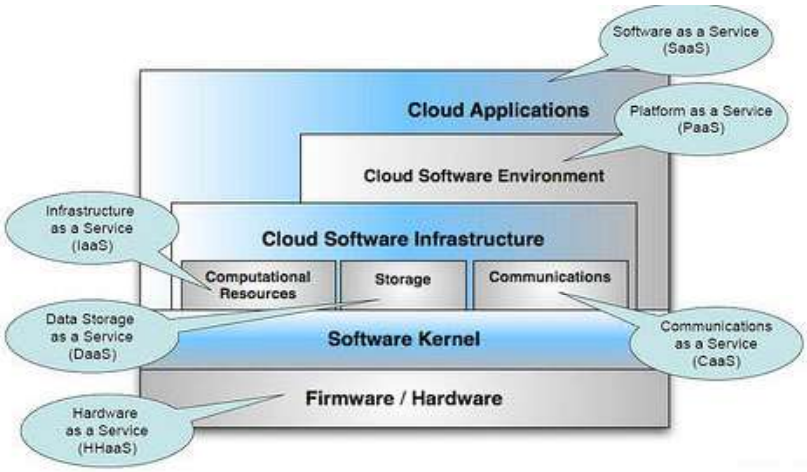
• Performance is monitored, and consistency and loosely coupled architectures are built through web services as a system interface.

· Because the data is centralized, security is improved and resources concerning to security is increased. However, loss of specific sensitive data will continue to be of concern and there is lack of concern towards the core storage. Compared with the traditional system, the security requirements are higher. Part of the reason is that the provider can focus on the security solution that the user can not provide. However, when the ‘data is distributed over a wider range and to a larger number of devices’ and the 'multi-terminal system used by unrelated multiple users', the complexity of security is greatly increased. It is not possible for a user to obtain a security audit log. Part of the development of the private cloud is derived from the customer's control of the equipment and to avoid loss of safety information.

· Maintenance of cloud computing applications is very simple because it is clear that users no longer need to install on the device. Once the changes have reached the user, the maintenance will be easier to support and improve.

2.4. Form of cloud computing services

Cloud computing can be considered to include the following levels of services: infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS).



Infrastructure as a service

Infrastructure-as-a-Service (IaaS) is a service. Consumers can access services from a complete computer infrastructure over the Internet.

Platform as a Service

Platform-as-a-Service (PaaS) refers to the software development platform as a service to SaaS model submitted to the user. Therefore, PaaS is also an application of the SaaS model. However, the emergence of PaaS can accelerate the development of SaaS, especially to speed up the development of SaaS application speed.

Software as a Service

Software-as-a-Service (SaaS) is a way to provide software through the Internet. Users do not need to buy software, but to rent Web-based software from the provider to manage business activities.

2.5. Features of cloud computing business model

Cloud computing is so fast to develop, and there is a continuous heat because of its clear business model.

Firstly, cloud computing reduces the absolute cost, allowing users to share resources and reduce waste, thus maximizing resource utilization.

Secondly, through cloud computing, companies can have the flexibility to acquire the corresponding services and get more agile service.

Thirdly, cloud computing has changed the structure of IT industry. When communications are conducted inside into the cloud, it has a great impact to the IT department, and provides a higher service capacity to the operators.

2.6. China cloud computing development

Development stage analysis

China's cloud computing industry is divided into three stages: market preparation period, take-off period and maturity stage. At present, China's cloud computing industry is still in the preparation stage, in the eve of a large outbreak.

Preparatory phase (2007-2010): mainly focus on technical reserves and conceptualization stages, solutions and business models are still being tested. Users are still less aware of cloud computing, and successful cases are less. Initial construction is based on the government public cloud construction.

Take-off stage (2010-2015): the rapid development of industry, ecological environment construction and business model construction has become the key words of this period, entering the ‘golden opportunity’ in the cloud computing industry. During this period, successful cases gradually increased, and users understanding and recognition have continuously improved. More and more manufacturers began to intervene, there are a lot of application solutions, and users take the initiative to consider putting their own business into the cloud. Public cloud, private cloud, and mixed cloud are built.

Mature stage (2015-): cloud computing industry chain and ecological environment basically stable; vendor solution is more mature and stable, providing a wealth of XaaS products. User cloud computing applications achieve good performance, and become an integral part of IT systems, cloud computing has become an infrastructure.

3. Telecom operators and cloud computing

3.1. Overview

In foreign countries, in addition to providing ISP network services to the public, Orange, O2 and other large telecommunications companies also serve as a 'cloud computing' service providers. These companies provide IDC equipment rental and SAAS product application services to different industries. Through their innovative products to improve services and provide a strong boost to the rapid development and growth of public clouds. Therefore, in the future, the domestic telecom enterprises will become one of the main beneficiaries of the cloud computing industry, receiving large revenues from various types of paid services, achieving profit growth, building their own brand of cloud service system through the analysis of user needs from different domestic industry and cloud computing service provider research and development.

In the field of telecommunications applications, cloud computing should be 'even more powerful'. Traditional telecommunications industry re-established; operators who obtain the 3G license have the ability to develop integrated information services. Foreign large-scale telecom operators have already started the cloud computing construction work, and have achieved initial success. While China has just started its cloud computing operations, the question on how to carry out the development, will be further explained and analyzed in this paper.

3.2. Foreign and local telecom operators cloud computing strategy and development status quo

Comparison of cloud computing business between international and local telecom operators

International telecom operators	Local telecom operators
Focus on IaaS solutions and communications collaboration SaaS solutions; an addition to the existing business, and gradually expand into a strategic business, but has not yet formed a large-scale business and customer base	Mainly focus in the promotion of cloud computing technology applications within the country, such as the business counters and call center desktop cloud; external planning to the cloud based on the direction of the development of IDC is currently a small pilot, yet to have large-scale commercial

Focus on IaaS solutions and communications collaboration SaaS solutions; an addition to the existing business, and gradually expand into a strategic business, but has not yet formed a large-scale business and customer base
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Foreign telecom operators cloud computing strategy and the status quo

	Cloud computing strategy	Development status
AT&T	• Supports cloud computing as a Managed Hosting service • Collaborate with ISV to deliver enterprise applications using cloud computing models • Work with consumer application providers to provide cloud-based applications for their mobile devices • Communicate and collaborate as SaaS • plans to establish PaaS services based on IBM WebSphere • positioning itself as an enterprise cloud computing service provider	• 2008 - launched the first cloud computing service Synaptic Hosting • May 2009 - launched Synaptic Storage as a Service • November 2009 – launched Synaptic Compute as a Service. Payment according to usage, no fixed and minimum usage payment • 2011 – invested $ 1 billion to provide cloud-based solutions for enterprise users based on global networks

Verizon	• sees cloud computing as part of IT's evolution to Everything as a Service • sees cloud computing as natural evolution of its Managed Hosting business • Emphasize that cloud computing is the service's 'delivery engine' • Targeting itself as a major global provider of managed security services	• 2008 - launched the first cloud computing service Synaptic Hosting • May 2009 - launched Synaptic Storage as a Service • November 2009 – launched Synaptic Compute as a Service. Payment according to usage, no fixed and minimum usage payment • 2011 – invested $ 1 billion to provide cloud-based solutions for enterprise users based on global networks
BT	• sees cloud computing as a key driver of enterprise product strategy • Cloud computing is divided into three areas: IaaS, SaaS, CaaS (Communication as a Service) • View CaaS as a cloud service built around real-time communications (such as voice, video, web conferencing, instant messaging, etc.) • Think of the network as a key factor in delivering enterprise-class cloud computing services • Provide enterprise-class cloud computing services for end-to-end performance and availability	• 2009 agreement with Microsoft to launch Microsoft's online business for business customers, providing cloud computing and collaborative communications services to customers • Provision of managed IP PBX and Unified Communications services in Europe and the United States using the Cisco HUCS multi-tenant platform
Orange	• Positions itself as an IT operator as an extension of the network operator • Packaging network services and cloud computing services as end-to-end hosted services, providing a single computing resource provisioning portal, a single help desk, and a single end-to-end SLA • Divide the cloud into four components: IaaS, SaaS, Collaboration as a Service, Security as a Service • Plan to integrate voice, video	• Launch of SaaS solution in 2008 IT Plan, for the SME market, is based on a monthly fee of 3 per user per month, and the solution provides Office productivity applications, mail applications and business applications (SAP, Sage, etc.) • In 2009, IaaS solutions were launched for flexible computing, upgraded in 2010, plus self-service portal and customer management capabilities, which are paid for usage

T-Systems	and end-to-end availability as the core competencies of cloud computing, building yourself as a trusted cloud computing service provider • Standardize the various components of the cloud computing data center (server, storage, network equipment and software), automate the operation and management of the cloud computing data center, optimize the cost structure of the cloud computing data center, and gradually enrich the functions of the cloud computing platform • Collaborate with industry leaders to create industry cloud solutions and actively participate in industry cloud standards • Reduce IT costs and dynamic IT resource management through cloud computing • Build energy-efficient green data centers through cloud computing technology • Build a vendor-independent cloud computing solution	• Started operations in 2004 IaaS cloud computing platform AppCom, providing virtual servers, storage, shared firewalls and virtual local area networks, etc. • Hosting databases, middleware, SAP, and other standard applications for enterprise clients on their own AppCom cloud computing platform • Launch managed workbench service, based on cloud computing data center for mission-based workers, knowledge workers and mobile workers to provide managed workstations • Introduces unified communications services based on cloud computing, including services such as voice and video conferencing, instant messaging • Cloud computing consulting services, including cloud-ready assessment, migration of traditional IT models to cloud computing models and system integration, optimization of cloud computing models • More than a dozen cloud computing data centers in Europe, North America, South

Local telecom operators cloud computing strategy and the status quo

	Cloud computing strategy	Development status
China Mobile	• Build a cloud computing platform based on virtualization, centralized management, automatic scheduling and distributed computing, provide a reasonable allocation of internal resources, and provide cloud-based IT services • Large-scale data processing and parallel computing based on cloud computing • Building a cloud-based management platform to support internal and external business needs	• Launched the 'Big Cloud' program in 2009, launched the 'Big Cloud' 1.0 system in 2010 • Large scale promote desktop cloud • A 3-year expansion plan for the data center was officially launched in 2010 • In 2011, collaborated with Xinhua to launch Pangu search based on the 'big cloud' platform • At the end of 2011 China Mobile National Cloud Computing Center was built in Harbin

China Unicom	• Utilizes the basic and secure and reliable operational capabilities of the public communication network to develop information services, information production, information service, 'cloud computing' services based on the development of broadband communications and cloud computing technology.	• Conducted VDC pilot test in offices in Beijing, Shanghai, Guangzhou, Hubei and other branches • Introduces the DIOS Distributed Intelligent Open System, which covers Virtual Data Center VDC, BI System Cloud Architecture, OSS Cloud Computing, Cloud Terminal Renovation Call Center, Future Network and Cloud Computing Research • Investing $ 500 million in Qingdao in 2011 to build a cloud computing data center • At the end of 2011, the 'Voyage' strategy was launched
China Telecom	• driven by business needs, combined with the advantages of telecommunications resources, according to market and technology maturity to actively promote the cloud computing services • To meet the needs of a large number of small and medium enterprises of flexible IT resources, internal IT system to improve efficiency and reduce costs	• 2010 launched the 'Nebula' program, in Guangzhou, Shanghai, Chengdu and Nanchang four cities carried out cloud computing field experiments, involving IDC construction , Business platform, the ability to open the platform and IT applications • Cloud Computing Research Institute was established in Guangdong in 2010 • Jiangsu Telecom pilot IDC data center service cloud

3.3. Analysis on the Advantages and Disadvantages of Telecom Operators Developing Cloud Computing

Analysis of advantages of telecom operators to develop cloud computing

a) With resources such as Internet access, IDC (Internet Data Center), mobile communication networks and WiFi hotspots, these resources are the most basic resource for cloud computing development, on which telecom operators can create more attractive ICTs (Information Communication Technology) service portfolio.

b) Take full advantage of its global backbone network for cloud computing to provide safe and reliable network access services, which ensure end-to-end SLA (Service-Level Agreement).

C) Has the experience of providing large-scale communication services to tens of millions of users. The billing mode is also paid by usage. These experiences can be directly reused to cloud computing services to ensure the reliability and performance of cloud computing services.

d) The traditional IDC (Internet Data Center) business has been developed for decades, has accumulated a large enterprise customer base and has won their trust. These customers prefer the telecom operators to provide cloud computing services.

3.4.2 Analysis of disadvantages of telecom operators to develop cloud computing

a) Cloud computing technology and professionals are less compared to internet companies such as Google and Amazon, and IT companies such as IBM and Microsoft. New research and development is lacking.

b) Rather than being a core business, cloud computing acts as sub-business to traditional telecommunication business, leading to poor resources.

c) Operating style is biased towards robustness and conservatism, less competitive in the rapid development of cloud computing field.

d) The complexity of having a complex IT infrastructure including different vendors, different types of servers, storage and networking equipment, has increased the difficulty of building a cloud computing platform on this infrastructure.

4. Ideas on local telecom operators to develop cloud computing

4.1. To broaden the scope of business, strengthen capacity

For traditional telecommunications companies, its business scope is limited to telephone communications related business, and with the development of the Internet and the rapid progress of smart phones, people are no longer confined to home with a network cable to connect to the Internet. More people prefer to use the smart phone or 3G-enabled Tablet PC to surf the Internet. Due to the change to portability and trends of wireless and high-speed usage, the traditional business has long been unable to meet the needs of the users. Broaden of business scope is necessary. Through cloud computing, businesses can be expanding to mobile internet, entertainment, shopping, payment, office and so on.

Specifically:

1) Increased infrastructure coverage and upgrading of equipment to accommodate more high-speed users.

2) To develop own integrated information service system. Without it, business and operational capacity will greatly reduce.

3) Develop user resources. Users are the most important element in cloud computing. Through a long period of development, telecom operators have accumulated and cultivated a large user group. Their needs and user experiences cannot be ignored. When combined with cloud computing, this user group will be even larger. It is an important matter to develop and establish the telecom operator within this large user base.

4) To strengthen the ability to integrate the Internet. For Internet and IT companies, the ability of Chinese operators to integrate the Internet is too weak. Technology and talent must be introduced. The application of cloud computing can only be achievable with the ability to integrate the internet.

4.2. Establish a platform to nurture ecosystems

In biology, ecosystem is a great concept, and it is same in the case of internet and telecommunications. A scattered operation is unable to form a good climate for the cloud to develop. More and more enterprises especially Internet companies have begun to notice the concept of the migration of ecosystems. Platform construction is a long-term planning and investment, and once the platform is built, it will have its own vitality in which the development of this platform will have more innovation and development. Telecom operators can cooperate with Internet business to complement each other. It is very important to create an ecosystem for today's multi-network integration in which it will provide enterprises and the overall industry considerable development and vitality.

5. Conclusions

Today, cloud computing development has just begun. Although there are risks for telecom operators to develop cloud computing, but by seizing the right opportunity and maximizing its use, great benefit will come. Combining the above analysis and trend on China's telecom operators developing cloud computing: Firstly, it is recommended to accumulate experience and the introduction of talent and technology; Secondly, it is recommended to develop the more mature Iaas and SaaS technology to quickly involve in cloud computing field and gain experience. As for the yet to mature Paas technology, stong development capability is needed and is associated to greater risks. Once again, it is recommended to invest in infrastructure construction and expand the physical area of service. Absorb application developers to provide a platform for the integration of information service. Finally, establish information cloud computing and telecommunications internet, and the ecosystem of the mobile integrated multi-network.

References

1. Zhang Min, Chen Yun-hai. Research and development of cloud computing for telecommunication operators. Business and Operations, 2010-12

2. Iang Wei. Telecom operators cloud computing development strategy analysis. Telecommunications Technology, Industry and Information Technology Ministry of Telecommunications Institute 2011
3. Shanghai Research Institute, China Telecom Co., Ltd., Shanghai 200122, China; China Telecom Co., Ltd., Sichuan Telecom Co., Ltd., Company Chengdu 610021
4. LIU Guo-hong. Research on cloud computing application of telecom operators in China. Mobile Communications. China Mobile Communications Group Shaanxi Co., Ltd. 2009-5
5. Yu Yulan, Wei Min, Xiao Yi. The cloud computing platform and application of telecommunication operators with core capability as the core. Telecommunication Science 2010.