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Cloud Computer Architecture based on Enterprise-Class Cloud Model and its Key Technologies Research

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ABSTRACT

This paper presents a cloud computer architecture based on enterprises cloud. The architecture is suitable for the requirements of SMEs. Its application framework of is elaborated by description of enterprises-class cloud notation, analysis of the difficulties and critical technologies, construction of flow chart, and system functional analysis.

Keywords: cloud computer architecture; enterprises-class cloud; Pattern Recognition; public clouds; business clouds; High performance computing; SMEs(small and medium enterprises)

INTRODUCTION

Along with the development of parallel computation, distributional computation and grid computation[1], computer science has been evolving from workflow based on sequential computations to cloud architecture in recent years. Since early 2006, Amazon Web Services (AWS) has provided companies of all sizes with an infrastructure web services platform in the cloud[2]. Microsoft, Yahoo! and IBM expose their cloud plans. Apple's foray into the consumer Cloud follows similar efforts by Google with GMail, Google Docs, Picasa Web Albums, Google Books and Google Music, the last of which went into private beta only recently. [3] In China, there are many research institutes want to build their own cloud services platform or experimental centers.

Despite its promise, most cloud computing innovations have been driven by a few industry leaders, such as Google, Amazon, Microsoft, Yahoo!, Apple and IBM. It is featured by on-demand, Broadband access, virtual pool of resources, fast flexible architecture and measurable service. However, in the attractive model behind cloud computing, its security, performance, availability, integration and custom capabilities have become the concern of people [9-11].In our opinion, the limited participations stem from the "paradox" existed in the "public cloud" applications. Cloud's direction is bound to follow the development of enterprise-class cloud model.

"Public cloud" applications "paradox" can go along the following logical reasoning. According to the logic of the cloud model, its technical architecture includes the physical resource layer, resource pool layer, middleware layer and Service Oriented Architecture construction layer [12]. Physical resources are composed of computers, storage, network infrastructure, databases and software. Physical resources refer to the servers in LAN(local area network) under thin client model condition, while they refer to all online computers, mobile devices and related software and hardware in the cloud computing model. This means a lot of physical resources must be online simultaneously. However, it is also implied that the cloud computing mode can make provisions for users at any location, who accesses to services by means of a variety of terminals. From the "economic man" point of view, it means that people will choose to have a scheme which is similar with thin client model. In extreme cases, everyone online will only buy a monitor and possesses others' free resources. Imagine if the user choose the aforementioned case, the shortage of physical resources will appear on the network.

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This will be a deadly threat to the cloud model. Therefore, the cloud computing model development needs to rely on some new ideas to avoid the extreme case.

This paper presents enterprises cloud architecture. It aims to add some new content and operational scheme for the canonical cloud model.

STATE OF THE ART

Definition of Public Cloud and Private Cloud

A number of related concepts are derived from cloud such as "public cloud", "private cloud", "business cloud" etc., since the notation of cloud is proposed.

National Institute of Standards and Technology (NIST) has proposed a set of definition of cloud. The definition proposed four different cloud configurations:

Public Cloud: This type of cloud service is usually all over the Internet, able to serve almost unlimited number of customers have the same basic architecture. Amazon, Rackspace, Salesforce.com, Microsoft and Google introduced a number of popular public cloud offerings competing products, as well as provides a variety of IT services and business applications.

Private cloud: This type of cloud especially tailored for individual institutions, for example, some financial institutions or government agencies. In general, such institutions will adopt virtualized operating systems and network technologies, thereby reducing the number of servers and network devices - or at least be able to make more explicit management of these devices.

Community cloud: This type of cloud designed as a series of unconnected, strictly defined institutions established. Mention of such a cloud, we will think of the Commonwealth of the supply chain, or a number of government agencies such good use instance.

Hybrid cloud: This cloud performance for a variety of the above combination of cloud configuration, the number of cloud in some way to integrate support for some of the business plan. Sometimes users may need access to multiple cloud with a separate certificate, sometimes the data may need to flow between multiple cloud or a private cloud applications may require the temporary use of public cloud resources (in this case called "cloud explosion ").

The explanation of the distinction between public and private cloud is usually made in the following way: public cloud is managed by an organization to maintain, and provide external cloud services that can be owned by the public. The private cloud is the management of an organization operating platform. The type of view believes that since the promotion of the cloud computing, there have been a large number of private clouds, public clouds can be hardly found. At present, Microsoft is building her own cloud platform. Microsoft is a giant, it is building the cloud is bound to become a big private cloud. Construction of public cloud need government funds to find a team of technical engineers, management engineers and other construction management. Such public clouds need tens of thousands of computers. Public cloud needs to be applied to the computer as the main body of the cloud. Of course, if there are the selfless large companies, they can build such a public cloud through their own computer clusters,

Public and Private Cloud Redefine and Contrast

Although there are little public clouds, the current users regard Saas mode delivery services without deployment as public cloud. In this paper, the definition of public and private cloud is followed this thinking. The cloud model that needs to deploy is defined as a private cloud; the cloud model does not require the deployment is defined as a public cloud. From this definition, it shows that IBM's Salesforce and Google Documents have this feature. Therefore, we contrast Saas with Iaas and Paas which need to deploy, and can not be directly cloud model for enterprise applications from the cost of operating convenience, security, data integrity, reliability, etc., in order to identify the cloud mode that can be truly adapt to enterprise development.

Table 1 provides a brief comparison of the cloud model. Such a contrast aims to find the shortcomings of the cloud model. In fact, the major companies develop both public and private cloud. However, companies increasingly want to transfer the existing all kinds of applications and infrastructure

services to the cloud platform. This difficulty lies in the idea of the cloud model, the different types of services and facilities components docking program is a set of self-slapping. In addition, this article refers to public and private cloud security and reliability issues. Google's Gmail and Amazon website ever have a short stop. These big companies cloud platform hidden cloud model must be innovative in order to avoid the problem of failure can not be short-term recovery.

In short, to get rid of the cloud mode selection tangled the best way to rethink cloud model from the perspective of enterprise Oriented.

Table1. *Comparison between Public and private cloud*

Aspects	Public cloud（Salesforce、Google Documents）	Private cloud（Amazon EC2、Hadoop、Google App Engine、Microsoft Azure）
cost	Low (Rental charges but no deployment costs)	High (Rental charges and deployment costs)
Operation and maintenance convenience	Relatively simple operation and maintenance by the service provider	Operation is more complex, the need to maintain
Security	medium	High
Data integrity	good	Storage capabilities of the Amazon EC2 Hadoop are very good, and others are good
Reliability	medium	medium
Covering the scope of business	small	fair
Resource Management	general	Have advantages
Safety control measures	general	More comprehensive (for example: network isolation, firewall, database privacy, secure connection)
Binding risk	big	small

ENTERPRISES CLOUD ARCHITECTURE

Although there are many cloud pattern classification, these classification is often standing on the service provider point of view. The concepts which are classified from the perspective of enterprises customers are rarely proposed.

The emergence of cloud model brings changes in business management in terms of enterprises. Enterprises customers often do a cost benefit analysis. It is not worth for SM enterprises which needs little data process capacity to expose its private data. The basic aim for the enterprises to change management model and reengineer business process is to enhance the enterprises' efficiency. The most common marketing information system, for example, the basic module consists of four parts, i.e. internal reporting system, marketing research systems, statistical analysis systems, and intelligence systems. Among them, the statistical analysis system requires large amounts of data storage and high data processing capability. If the company deems it necessary, statistical analysis can be cross-processing in the cloud computing center. This operation needs to be re-architecture in the cloud model firstly.

The Basic Enterprise-Class Cloud Model Program

Enterprise-class cloud model is mainly composed of two parts, the enterprise-level data processing centers and public cloud. Public cloud is provided by the service provider. Enterprise-class cloud is a program which is provided by the service provider, and a data processing center which is developed by the service provider joint small software developers. Company's confidential data is in a traditional mode of C-S. A server or server cluster in the enterprise-level data processing centers builds their own LAN. Company access the external network through a distributed architecture. The external user access the company's LAN through setting permissions, certification, and licensing. Non-confidential business data can be transmitted through the virtual delivery in the public cloud HPC (high performance computing) center. Specific mechanism is mainly as follows, when the computing tasks are proposed, company's confidential data is processed by a comprehensive set of data conversion technology. For example: defining a rule set, conversion to another form of the corresponding "sparse."

In short, enterprise-class cloud model an enterprise business model, which have a sharing scheme provided by the external computing power, and the enterprise data storage, processing, conversion programs self-organized within the company.

Difficulties and Key Technologies in Enterprise-Class Cloud Model

Confidentiality and Non-Confidential Data Clustering Analysis

With the development of artificial intelligence, pattern recognition has become a widely used technique. Company's data can be classified into confidential and non-confidential data through a variety of clustering algorithms in the pattern recognition analysis technique. The data also should be identified with a clear distinction.

Confidentiality and Non-Confidential Data Involving in the Data Computing

Most of the business processes in a company require confidentiality and non-confidential data to participate. For example: the acquirements of the sales profit need the access to confidential data such as cost data and non-sensitive data such as sales data. Once "public cloud" involves in the computing, it is easy to expose confidential data to persons outside the enterprise. Therefore, it is necessary to design a set of data conversion technology to ensure information security in the operation of the business confidential data involving in the "public computing".

Discrimination of Data Involving in "Public Cloud" or "Enterprise Cloud"

Before the data is involved in the "public cloud" HPC data center computing, it is necessary to determine whether the use of HPC center's computing power or its operational level. Once a task is convicted of operating without the use of HPC center's computing power, the data processing center in the enterprise will run. Otherwise, the operational level must be clearly identified.

HPC Center Data Return Data Management and Cleaning

Cloud model generally provides a class of managed data services such as software systems to ensure that the operation is performed after the data will be very easy to find. When the enterprise access "public cloud" of the interface layer, a similar "security check" process is required. After the program is running, redundancy data and singularity data will be removed.

The Automatic Identification and Manual Check in Data Transmission

The manual review should be minimized in order to enable business processes run fast. The artificial intelligence technology in the automatic identification technology is mainly employed. But necessary process, such as: data is the use of "public cloud" HPC center, should be identified by a combination of automatic recognition and manual check in order to prevent leakage of confidential data.

Flowchart of Enterprise-Class Cloud Model

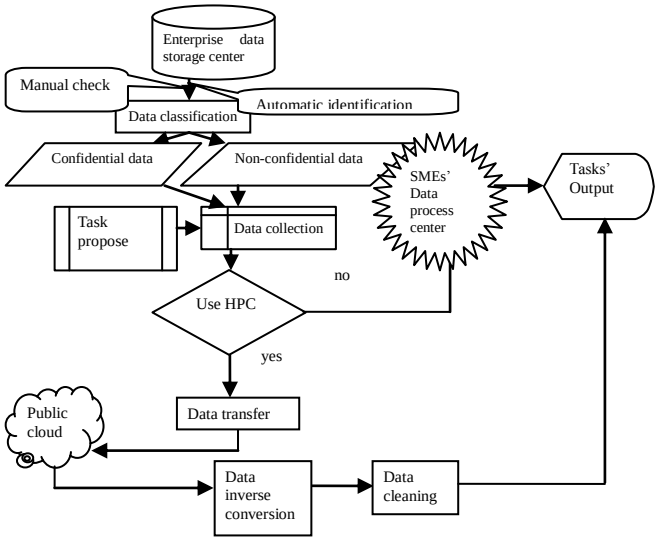

Fig1. *Flowchart of enterprise-class cloud model*

FUNCTIONAL ANALYSIS OF ENTERPRISE-CLASS CLOUD MODEL

On the surface, enterprise-class cloud-cloud model and business model concepts are not very different. However, in terms of its functional expansion, the security of enterprise data has been ensured. Moreover, the enterprise cloud model for breaking the pattern of the "paradox" has far-reaching meaning in a deeper theoretical sense; its value in this level has been a real highlight. Specifically, its four aspects can be compared with the "Business Cloud".

Comparison about Theoretical Basis

Cloud computing is based on the theory of distributional computation, parallel computation and computation. Enterprise-class cloud computing is based on pattern recognition, data conversion technology, distributional computation, parallel computation and computation. It focuses on the application of artificial intelligence technology. It has more theoretical value than the prevailing engineering and business solutions in "Business Cloud" which is based on stitching together existing technology and tools. The model is of great significance for the expansion of the content of cloud model.

Comparison about Technical Architecture

The current cloud computing system architecture includes a distributed file system layer, layer of distributed computing, data analysis middleware layer, application layer platform. This system architecture has increased the enterprise middleware-based distributed systems and pattern recognition, data conversion application interface program. Middleware-based distributed systems embedded in the enterprise's information system not only effectively avoid non-necessary business logic reside on the virtual machine, but also to prevent the problems such as the commercial code exposure etc.. The application of the application program interface will enhance the control of confidential data within the force.

Comparison about Value

The question of cloud computing is currently focused on the implementation in a small or medium enterprise, that is, whether it can provide true services for the majority of the enterprises. So far, cloud computing has been applied to the biological analysis of DNA information, education and research platform, real-time financial systems and other fields[8] in foreign countries. China is still at an early exploratory stage. According to incomplete statistics, there are three companies which developed cloud computing model by means of Paas (Platform as a Service) model in Liaoning Province in China. In sum, most cloud computing innovations have been almost exclusively driven by a few industry leaders. They use their long-standing clients' confidence to win more customers. Baidu announced opening its cloud computing platform on Baidu World Conference in 2011. It will gradually provide a full range of cloud services including storage resources, development environment, and application API interface platform etc. to the users all around world. This means that, following the Amazon, Google, Baidu will also open its cloud computing capacity and platform and become "public clouds".

It shows that, up to present, Baidu open platform has 3,500 resources partners. It has also received more than 30,000 applications submitted by a number of open platform developers and operators, and reviewed more than 20,000 on-line application APP. Despite its promise, this proposal would help more software and hardware companies to participate in the cloud computing model. It is conducive to cloud computing implementation, and it helps from a business perspective to rethink the needs of the SMEs (small and medium enterprises) and technical solutions. Therefore, it has more practical value.

Comparison about Cost-Benefit

The current cloud model vendors provide customers with the program include building private clouds and public clouds or two programs integration. The cost of building a private cloud may be more expensive. Private clouds usually do not have economies of scale that public cloud providers have. Legacy hardware requires manual configuration to migrate to the private cloud servers. Automatic configuration and management of collaborative arrangements for these old machines may not apply. After building a private cloud, it can be transferred to a mixed mode if public cloud services are needed. This will involve how to protect the safety of the system, and how to verify the work load in public and private clouds. This conflict on the costs and benefits hardly enables the customers to make quickly purchase decisions.

The proposal in this paper is based on the use of existing hardware-based intelligent software systems. It can achieve economies of scale and less investment. As the number of software companies to participate in the model, it can inhibit the technical monopoly; meet the customized requirements of SMEs.

CONCLUSIONS

The father of grid computing, Ian Foster believes, cloud computing is a large-scale distributional computing model. It is driven by large-scale economy. Enterprise applications in the cloud model must have the premise of large-scale distributional computing needs in this sense. The purpose of this paper is to put forward a cloud platform solution for SMEs. The concept of enterprise-class cloud model is described. Its key technologies of the difficulties are analyzed. A flow chart is built. System analysis and functional analysis is conducted. The pattern application framework is given.

This upside of the work is that cloud computing is applied directly to the business, especially SMEs applications. The downside is that the study of this issue has not been entered into the actual operation and application level. Currently, the early research already has a more solid foundation, and then a more in-depth study will be conducted.

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