

Cloud Computing: Changing Cogitation about Computing

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Abstract—Cloud Computing is a new technology that helps us to use the Cloud for compliance our computation needs. Cloud refers to a scalable network of computers that work together like Internet. An important element in Cloud Computing is that we shift processing, managing, storing and implementing our data from, locality into the Cloud; So it helps us to improve the efficiency. Because of it is new technology, it has both advantages and disadvantages that are scrutinized in this article. Then some vanguards of this technology are studied. Afterwards we find out that Cloud Computing will have important roles in our tomorrow life!

Keywords—Cloud Computing, Grid Computing, Internet as a Platform, On-demand Computing, Software as a Service.

I. INTRODUCTION

SUN Microsystems's slogan was "The network is the computer" and that's as good as any to describe how Cloud Computing works. In this article it is understood that how Cloud Computing helps us to use the network as computer.

A. From Past to Now

Many years ago when the electricity revolution occurred, it was so expensive and everyone who wanted to use this resources, used freestanding generators to produce electricity power. After that people and businesses shutdown their generators and bought electricity from utilities.

Nowadays we experience new revolution, Cloud Computing. Such as electricity, Cloud Computing invites us to change the way that we think about computing: *user-centric* instead of *desktop-centric*. It means that the potential of the Cloud is used to transfer the computing and processing from locality into the Cloud, so the capacity of the Cloud is used in the way that we didn't face before.

B. How Cloud is made?

The key to Cloud Computing is the "Cloud", a massive network of servers or even individual PCs interconnected in a grid [1] (as in Fig. 1).

In fact the most prolific Cloud which can be used is the Internet. So in this article Cloud is a metaphor for the Internet.

The important element in Cloud is that human management isn't needed for allocating processes to resources.

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As you see in the Fig. 1, since hardware is in the Cloud, it's invisible. This Cloud is simple; However it needs to be managed for working intelligently to approach the task processing.

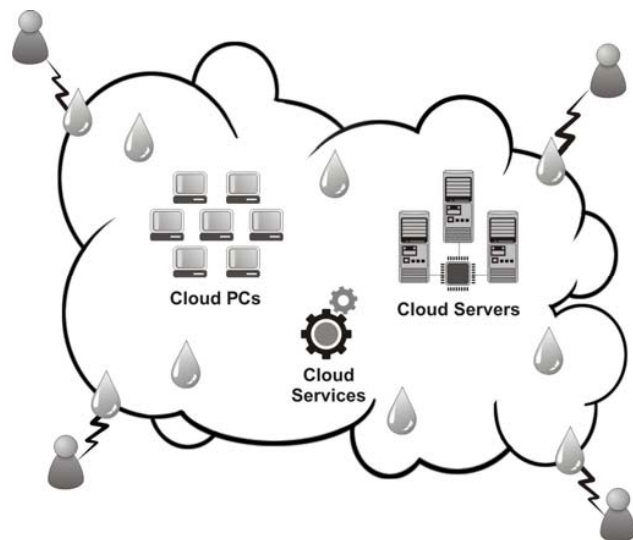


Fig. 1 How users connect to the Cloud

C. Definition of Cloud Computing

Cloud Computing is a paradigm that focuses on sharing data and computations over a scalable network of nodes. Examples of such nodes include end user computers, data centers, and Cloud Services. We term such a network of nodes as a Cloud [12]. (as in Fig. 1).

Cloud Computing is the next generation in computing [2]. It is a type of computing that is comparable to grid Computing, relies on sharing computing resources rather than having local servers or personal devices to handle applications. The goal of Cloud Computing is to apply traditional super computing power (normally used by military and research facilities) to perform tens of trillions of computations per second [3]. The memorable point about this advantage is that this performance can be produced by a grid of computing resources that work together or even by the force of the low-cost PCs, like Personal PCs. In fact you get super-computing power at PC prices. It's similar to the rain power that is made by water drops and the Cloud has significant role in this event!

The main idea is to use the existing infrastructure in order to bring all feasible services to the Cloud and make it possible to access those services regardless of time and location [2].

D. Gainers

The main idea in Cloud Computing is that it covers all the range of users, from home users that use Cloud Computing to approve their works better and IT staffs and enterprise managers that use Cloud Computing for optimizing, planning and implementing their enterprises. So we can face it that Cloud Computing has the big roles in our life in the future.

II. CLOUD COMPUTING ARCHITECTURE

As you can see in Fig. 2, at first, user select a Cloud service under the Interface, then the System Management choose the appropriate service, next this service is started and at last launches appropriate data and web application.

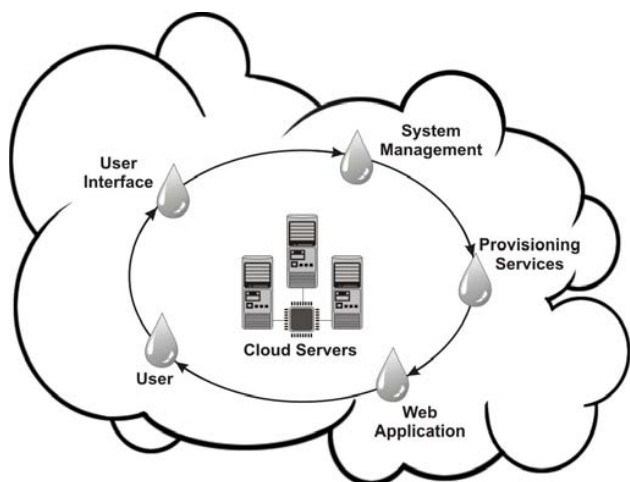


Fig. 2 The architecture behind Cloud Computing

It was just a simple sample of Cloud Computing architecture to show a way how it works; Many researches are doing now to make Cloud Computing more intelligent by means of *Autonomic Computing*¹ to make this architecture more efficient.

III. ADVANTAGES OF CLOUD COMPUTING

A. Improve Performance

A vast Cloud which is made by thousands of computers that network together, provide the salient ability that we didn't have before. In Cloud Computing the processing power is provided from many CPUs that interact to process the data.

B. Decrease Costs

Since users only pay for the service that they get, expenditure such as the cost for the new hardware with high performance, saved.

In the other hand, Cloud Computing reduces both software and hardware maintenance cost because it is needed to

improve the sufficiency of the Cloud that we use, not our organization.

Cloud Computing users can avoid capital expenditure (*CapEx*) on hardware, software and services. Consumption is billed on a utility (e.g. resources consumed, like electricity) or subscription (e.g. time based, like a newspaper) basis with little or no upfront cost. Other benefits of this time sharing style approach are shared infrastructure, low management overhead and immediate access to a broad range of applications. Users can generally terminate the contract at any time (thereby avoiding return on investment risk and uncertainty) and the services are often covered by service level agreements with financial penalties [8], [9]. As you see in Fig. 3, diagram shows economics of Cloud Computing versus traditional IT, including capital expenditure (*CapEx*) and operational expenditure (*OpEx*), that is an on-going cost for running a product.

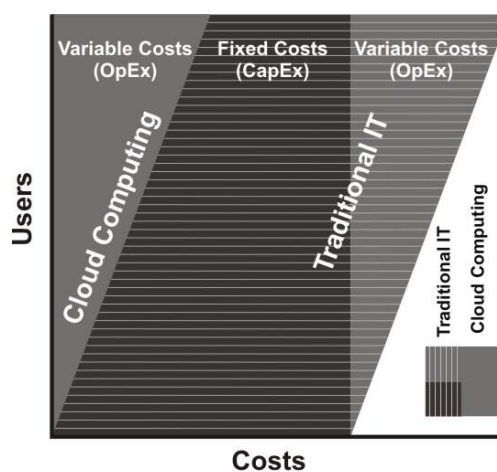


Fig. 3 Comparing economics of Cloud Computing and Traditional IT.

C. Increase Storage Capacity

In Cloud Computing we have extreme resources for storing data because our storage consists of many bases in the Cloud.

Another thing about storing data in the Cloud is that, because of our data in the Cloud can automatically duplicated, they will be more safety.

D. Highly Automated

We not have to suspend our system for maintaining software. It means that updating software take automatically in the Cloud and doesn't affect the environment workflow.

E. More Mobility

For doing our work, we not have to have our personal computer for working with our documents; Because we can access them in the Cloud so the Cloud is accessible anywhere, anytime!

¹ Autonomic Computing is an initiative started by IBM in 2001. Its ultimate aim is to develop computer systems capable of self-management, to overcome the rapidly growing complexity of computing systems management, and to reduce the barrier that complexity poses to further growth.

F. Allow IT to Shift Focus

No longer having to worry about constant server updates and other computing issues, government organizations will be free to concentrate on innovation in the Cloud [2].

G. Collaboration

Sharing documents leads directly to collaborating on documents. To many users, this is one of the most important advantages of Cloud Computing, the ability for multiple users to easily collaborate on documents and projects [1].

In an enterprise, It helps IT staffs to work simultaneously on a project and be connected to each other in the Cloud by Cloud services, so this is improve efficiently.

IV. DISADVANTAGES OF CLOUD COMPUTING

A. Security

The most challenge ahead Cloud Computing is security. Is there any guarantee that our data cannot be accessed by unauthorized user? How users can trust providers to control their data? How we can encrypt our data safety? Next, in this article it is shown a survey about the effect of security on willing of IT executive to move to Cloud Computing.

B. Reliance on 3rd Party

As we talked about, due to losing control, we must assign the control to third party in the Cloud, so there is one question, is there any reliance on the third party?

C. Cost of Transition

As IPv6², for Cloud Computing we must undertake the cost of transition, so after that we can save money in the Cloud.

Furthermore we must transfer our users to Cloud Computing. In 1990s, users didn't have motive to be familiar with Internet. Now we must be grafter in the relation between users and Cloud Computing.

D. Require Constant Internet Connection

Cloud Computing is, quite simply, impossible if you can't connect to the Internet. Because you use the Internet to connect to both your applications and documents [1].

V. VANGUARDS

Cloud Computing is in the adolescence, so there are many research in this field. Let's face the most pioneers of Cloud Computing.

A. Enterprise

1) Google

As you might suspect, Google offers a robust Cloud development environment.

It includes the following features:

- Dynamic web serving
- Full support for all common web technologies

- Persistent storage with queries, sorting, and transactions
- Automatic scaling and load balancing
- APIs for authenticating users and contact with Google Products.

The other services that Google present, is *Google Docs*. *Google Docs* is the link to the concept software as a service (SaaS) i.e. a type of Cloud Computing. A web based application that provides online resource to the users for creating, editing and storing their documents online [11]. In other word Google docs is a new implementation of Microsoft based on Cloudy features.

2) Amazon

Amazon is one of the primary providers of Cloud development services.

The service in question is called the Elastic Compute Cloud, also known as EC2. A commercial web service that allows developers and companies to rent capacity on Amazon's proprietary Cloud of servers, which happens to be one of the biggest server farms in the world.

EC2 is just part of Amazon's Web Services (AWS) set of offerings, which provides developers with direct access to Amazon's software and machines [1], [13].

3) IBM

IBM is offering a Cloud Computing solution. The company is targeting small- and medium-sized businesses with a suite of Cloud-based On-demand services via its Blue Cloud initiative.

To manage its Cloud hardware, IBM provides open source workload-scheduling software called Hadoop, is an open source framework for running large data processing applications on a cluster. It allows the creation and execution of applications using Google's MapReduce programming paradigm, which divides the application into small fragments of work that can be executed on any node in the cluster [16].

4) Salesforce

Salesforce.com is probably best known for its sales management SaaS, but it's also a leader in Cloud Computing development. Supplementing Force.com is AppExchange, a directory of web-based applications.

Developers can use AppExchange applications uploaded by others, share their own applications in the directory, or publish private applications accessible only by authorized companies or clients. Many applications in the AppExchange library are free, and others can be purchased or licensed from the original developer accounts.

B. Academia

1) Eucalyptus

Eucalyptus is an open source software framework developed by University of California - Santa Barbara, for Cloud Computing that implements what is commonly referred to as Infrastructure as a Service (IaaS); Systems that give users the ability to run and control entire virtual machine instances deployed across a variety physical resources [4], [5].

² Internet Protocol version 6 (IPv6) is the next-generation Internet Protocol version designated as the successor to IPv4.

2) *Nimbus*

The University of Chicago Science Cloud, codenamed *Nimbus*, provides compute capability in the form of Xen virtual machines (VMs) that are deployed on physical nodes of the University of Chicago TeraPort cluster (currently 16 nodes) using the Nimbus software. The Nimbus Cloud is available to all members of scientific community wanting to run in the Cloud. [6], [7].

VI. NOW TO FUTURE

We are currently in the early days of the Cloud Computing revolution. All you need to know for now is that, there is a big future in Cloud Computing and everybody is jumping on the bandwagon [1].

For understanding the position of Cloud Computing in nowadays, and user sights on it, referencing to a research is the best thought:

This research is done by Kelton Research in January 2009 that its summary is mentioned below:

- Nine in 10 of C-level executives and IT decision-makers in the United States, and six of 10 globally, are familiar with Cloud Computing.
- Business executives and IT decision-makers overwhelmingly agree that Cloud Computing is the real deal (71 percent worldwide and 87 percent in the United States)
- Furthermore, nearly two in three IT execs worldwide and four of five in the United States believe that Cloud Computing reduces up-front costs.
- At this time about 61 percent of companies don't use Cloud Computing. And the vast majority (84 percent) of those that currently depend on internal IT systems have no plans to switch to Cloud Computing technologies in the next 12 months.
- Even though nearly half of respondents consider themselves early adopters of new technologies, the majority of companies are afraid to change to Cloud Computing technologies.
- By a 5-to-1 ratio, companies trust internal IT systems over Cloud-based technologies due to fear about security threats and loss of control of data and systems [10].

This results shows that most issues about future of Cloud Computing is referred to its security. In the other hand best reason for acceptance this technology is its role in reducing cost.

We talk about the today's Cloud Computing , so as we can find from this survey; most challenge in Cloud Computing nowadays is security. One technology analyst and consulting firm, Gartner, lists seven security issues which one should discuss with a Cloud Computing vendor:

- *Privileged User Access*: Sensitive data processed outside the enterprise brings with it an inherent level of risk, because outsourced services bypass the "physical, logical and personnel controls" IT shops exert over in-house programs. Get as much

information as you can about the people who manage your data. "Ask providers to supply specific information on the hiring and oversight of privileged administrators, and the controls over their access," Gartner says.

- *Regulatory Compliance*: Customers are ultimately responsible for the security and integrity of their own data, even when it is held by a service provider. Traditional service providers are subjected to external audits and security certifications. Cloud Computing providers who refuse to undergo this scrutiny are "signaling that customers can only use them for the most trivial functions," according to Gartner.
- *Data Location*: When you use the Cloud, you probably won't know exactly where your data is hosted. In fact, you might not even know what country it will be stored in. Ask providers if they will commit to storing and processing data in specific jurisdictions, and whether they will make a contractual commitment to obey local privacy requirements on behalf of their customers, Gartner advises.
- *Data Segregation*: Data in the Cloud is typically in a shared environment alongside data from other customers. Encryption is effective but isn't a cure-all. "Find out what is done to segregate data at rest," Gartner advises. The Cloud provider should provide evidence that encryption schemes were designed and tested by experienced specialists. "Encryption accidents can make data totally unusable, and even normal encryption can complicate availability," Gartner says.
- *Recovery*: Even if you don't know where your data is, a Cloud provider should tell you what will happen to your data and service in case of a disaster." Any offering that does not replicate the data and application infrastructure across multiple sites is vulnerable to a total failure," Gartner says. Ask your provider if it has "the ability to do a complete restoration, and how long it will take."
- *Investigative Support*: Investigating inappropriate or illegal activity may be impossible in Cloud Computing, Gartner warns. "Cloud services are especially difficult to investigate, because logging and data for multiple customers may be co-located and may also be spread across an ever-changing set of hosts and data centers. If you cannot get a contractual commitment to support specific forms of investigation, along with evidence that the vendor has already successfully supported such activities, then your only safe assumption is that investigation and discovery requests will be impossible."
- *Long-Term Viability*: Ideally, your Cloud Computing provider will never go broke or get acquired and swallowed up by a larger company. But you must be sure your data will remain available even after such

an event. "Ask potential providers how you would get your data back and if it would be in a format that you could import into a replacement application," Gartner says [14].

In the future data in the Cloud will have more effective in our life, like water drops. Conquest of the problems of security is more important in the future of Cloud Computing. Furthermore the ownership in Cloud Computing is more important next days; and ordaining rules for happy life in the Cloud!

In the other hand the market will be more important. Merrill Lynch has estimated a \$160- billion addressable market opportunity, including \$95- billion in business and productivity applications, and another \$65-billion in online advertising for Cloud Computing [15]. We are going to the Cloud for experience new Computing generation. And whatever we go, we will find out more that life is a Cloud!

REFERENCES

- [1] Michael Miller, *Cloud Computing web-based application that change the way you work and collaborate online*, QUE, 2008
- [2] Nariman Mirzaei, *Cloud Computing*, Indiana University, Fall 2008
- [3] (2008, 10), *Technology Terms to Know For 2009*, [Online]. Available: http://www.webopedia.com/DidYouKnow/Internet/2008/terms_to_know_2009.asp
- [4] *Eucalyptus*, [Online]. Available: <http://eucalyptus.cs.ucsb.edu/>
- [5] Daniel Nurmi, Rich Wolski, Chris Grzegorzczak, Graziano Obertelli, Sunil Soman, Lamia Youseff, Dmitrii Zagorodnov, *The Eucalyptus Open-source Cloud-Computing System*, Computer Science Department, University of California - Santa Barbara, Santa Barbara, California 93106.
- [6] *Nimbus*, [Online]. Available: <http://workspace.globus.org/>
- [7] *Introduction to Nimbus @ UC*, [Online]. Available: <http://workspace.globus.org/clouds/nimbus.html>
- [8] Clint Boulton, *Forrester's Advice to CFOs: Embrace Cloud Computing to Cut Costs*, eweek.com, Oct 31, 2008
- [9] Frank Dzubeck, *Five Cloud Computing questions*, Network World, May 08, 2008
- [10] "2009 Global Survey of Cloud Computing" Kelton Research. Jun 2009
- [11] C.M. Nadeem Faisal, *Usability Evaluation of Cloud Based Application*, Department of Interaction and System design school of engineering Blekinge Institute of Technology, Sweden, Jan 2009
- [12] Lijun Mei, W.K. Chan, T.H. Tse, "A Tale of Clouds: Paradigm Comparisons and Some Thoughts on Research Issues", in *Proceedings of the 2008 IEEE Asia-Pacific Services Computing Conference (APSCC 2008)*, IEEE Computer Society Press, Los Alamitos, CA
- [13] *Amazon web service*, [Online]. Available: <http://aws.amazon.com/>
- [14] Brodtkin, Jon. (2008, 07), : *Seven Cloud-Computing security risks*, [Online]. Available: <http://www.infoworld.com/d/security-central/gartner-seven-cloud-computing-security-risks-853>
- [15] R. Buyya, C. S. Yeo, and S. Venugopa, "Marketoriented Cloud Computing: Vision, hype, and reality for delivering it services as computing utilities", in *Proceedings of the 10th IEEE International Conference on High Performance Computing and Communications (HPCC-08, IEEE CS Press, Los Alamitos, CA, USA) 2008*
- [16] Greg Boss, Padma Malladi, Dennis Quan, Linda Legregni, Harold Hall, *Cloud Computing, High Performance On Demand Solutions (HiPODS)* 08 Oct 2007.