

Cloud Computing As an Emerging Paradigm

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Abstract

The emergence of cloud computing provides many opportunities for academia, the information technology (IT) industry and the global economy as an information technology revolution. Compared to other distributed computing paradigms such as Grid computing and High Performance Computing (HPC), cloud computing provides broader inter operability over the world-wide web networks. As IT industry leaders such as Google, IBM and Amazon are striving to promote this innovative computing paradigm, it is reasonable to expect that cloud computing will bring profound changes to every aspect of the IT industry and to various sectors of the economy.

Keywords:

Cloud Computing, Technology, Internet, Information Technology, Optimization, Software as a Service.

1. INTRODUCTION

Cloud computing is Web-based processing, in which distributed assets, programs, and information are supplied to computers and other devices (such as smart phones) on demand through the Internet. Cloud computing is a natural development of the prevailing adoption of virtualization, Service-oriented structures and utility computing. Details are abstracted from buyers, who no longer have required for know-how in, or command over, the expertise infrastructure in the cloud that carries them. The period cloud is utilized as a metaphor for the Internet, founded on the cloud drawing utilized to comprise the phone network in the past, and subsequent to depict the Internet in computer mesh design drawings as an abstraction of the inherent infrastructure it represents. Typical cloud computing providers consign widespread enterprise submissions online that are accessed from another Web service or programs like a Web browser, while the programs and facts and numbers are retained on servers.

2. AIMS AND OBJECTIVES

- (1)To determine how IT management strategies is adjusted to remain competitive.
- (2)To determine how computing utilities impacts the

ability of incumbent companies to compete.

- (3)To determine how cloud computing can create a competitive advantage in certain circumstances.
- (4)To determine the advent of Cloud computing.
- (5)To determine how Cloud Computing plays a vital role in the transformation of Information Technology and business.

3. MATERIALS AND METHODS

The research starts with the orientation on the area of cloud computing, what is cloud computing about and which security issues are in dire need of investigation. By consulting websites of current cloud service offerings, reading news articles, participating in seminars and discussing cloud computing and security issues with professionals within Capgemini, the research questions of this research are formulated.

To answer the research questions, knowledge must be obtained that supplements the information found during the orientation on the topic. As finding information on the web on groundbreaking technologies is a very time-consuming process, this research employs a structured method to obtain high quality information, called a Literature Review.

4. LITERATURE REVIEW

To explore the available knowledge on the area of cloud computing and confidentiality, a literature review is conducted using a systematic approach. The objectives of a literature review are:

- (1) To understand the current state of knowledge in a research area
- (2) What is known/generally accepted?
- (3) What questions remain unanswered?
- (4) Where do conflicting results exist?
- (5) To show how the current research project is linked to previous research (cumulative tradition)
- (6) To summarize and synthesize previous research
- (7) To critically analyze previous research: strengths and weaknesses
- (8) To learn from others and stimulate ideas

The first step in a literature review is selecting the top 25

journals to search information in. This ranking is researched and published by several groups, of which the Association of Information Systems is the most recent one. The second step is selecting one or more search engines that index these top 25 journals, after which the journals can be examined by searching on a predetermined set of keywords.

Analyzing the results of this top down search will filter out a fair share of results due to irrelevance. Supplementing the shrunken set of results can be achieved by conducting a bottom up search, using both backward and forward citation analysis. The former relates to finding papers referenced by papers found earlier, while the latter is an acronym for finding papers that cite papers we have found earlier, using search engines.

The papers found in the search are analyzed to distill useful concepts with respect to our research. Papers containing topics such as privacy, IT regulation and security in distributed environments, are scrutinized for dimensions to be used in our mapping from confidential data classes to cloud.

5. RESULT

The results of this research also indicate that for cloud computing vendors to fully satisfy customers' needs for alternate computing environments; they must address the factors identified in this research. The decision on whether or not to adopt cloud computing technology appears to depend on whether the technology is cost effective, satisfies organizational needs, can be relied upon, and employs effective security measures. This market focus could require a more complex interaction between a vendor and a potential customer than simply furnishing a catalog or price sheet. Addressing market needs can include supplying data to current and potential users on areas such as organizational costs of cloud computing, cloud computing reliability, cloud computing security, and how cloud computing can meet organizational needs (Bharadwaj, 2004).

6. DISCUSSION AND ANALYSIS

In order to understand cloud computing, one must understand its proper definition and the history surrounding the term to discern the hype from the reality. Cloud computing has generated so much discussion in the information technology field that The Wall Street Journal printed an article in March dealing with its fuzzy definitions and debate. Worthen and Fowler quotes Oracle CEO Larry Ellison whom spoke on cloud computing at a financial analyst conference in September.

While the term cloud computing may be new for discussion

and debate, Alex Bochanek, a curator at the Computer History Museum in Mountain View, Calif., said that engineers have been using cloud images for decades to show where their network joins another more unfamiliar network. As technology advanced, analysts began to use clouds to refer to the Internet.

Still, what does cloud computing mean? Berkeley researchers Armbrust Fox, Griffith, et. al. write about cloud computing in their 2009 technical report Above the clouds: A Berkeley view of cloud computing. Cloud computing, the researchers say, refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services (Aymerich, 2008).

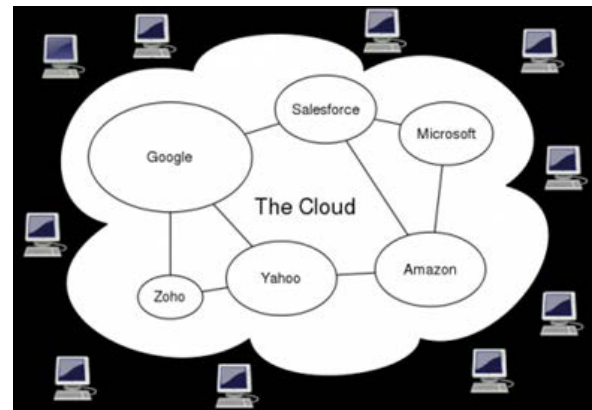


Fig 1: A Graphic Illustration of Cloud Computing

The researchers say that cloud computing has the potential to transform a large part of the information technology industry and list the Top 10 obstacles for a company to move to cloud computing along with their related opportunities to advance to the cloud. This project will analyze their list especially in how it relates to the security principles of confidentiality, integrity and availability (Biddick, 2008).

7. HISTORY OF CLOUD COMPUTING

The concept of cloud computing was invented in 2002 by Amazon, a leading e-business, which had invested in a fleet of huge machines, sized to handle the heavy load of orders made on their site at the time of Christmas, but Instead, the unused balance of the year. Under-sizing their fleet would have caused downtime of their website at peaks, thereby jeopardizing their business during the holidays (a big part of their turnover) (Grossman 2009). Their idea has been to open these unused resources to businesses to hire them on demand. Since then, Amazon has invested heavily in this area and continues to expand its fleet and services.

Recently, other players in the IT world such as Google and

Microsoft, in turn, offer similar services. These cloud services based on the data center hardware (digital stations) huge (only these large companies can afford), and in software on virtualization techniques offer enterprise customers of IT resources. It varies the size over time (no need to purchase and maintain on-site large servers) a few minutes to start up a new server in the Cloud. Instead of several months in situ it can absorb large load peaks (the suppliers offer CPU and high-performance network) the availability of which is guaranteed by contract (eg, less than 5 minutes of downtime per year, if not refund) (Armsbrust, 2009).

8. WORKING

The operation of cloud technology is simple as there is only need of the installation of small application of the software that the client wants to use in PC. Whenever the client wants to get connected through this technology, they run the application and the server provided them the platform server for the use-age (Androutsellis, Spinellis, 2004). This is also called a client-server program, which is responsible for sending information to the server to sprint the job.

Operations of cloud technology are quite similar to network terminal machine. The advantage and disadvantage to this technology is the low space utilization and mobility but only central computer can be used for efficient performance. Further, the central computer will be responsible for addressing and providing a solution to the issues arising through cloud technology.

9. CLOUD TYPES

The three applications which are mostly used in cloud technology are mentioned below.

1. Public clouds for global use.
2. Private clouds, which are oriented enterprise solutions.
3. Hybrid clouds, which are a mixture of clouds above.

10. THE ENTERPRISE IMPACT OF CLOUD COMPUTING

10.1 Pricing Transparency

Whether industries or companies jump into cloud computing later on or right away, the pricing transparency

from the providers of cloud completely alters organization's doings for benchmarking Information Technology costs. Companies regularly spend big amounts to understand Information Technology effectiveness & expenses. Peak line relations based on Research and Development dollars to income are simple to discover in SEC things, but further thorough metrics were fraction skill, fraction discipline that is science, wearing a veil in a dark mist of business intellect (Armsbrust, Griffith, 2009). Cloud computing has changed everything. At the present everybody could be able to understand precisely how much it costs to rent an x86 server, a terabyte of storage space, or a content release service by just a little number of clicks in the direction of Amazon Web Services or a swarm of other suppliers. Clearness can be granular, too.

10.2 Departmental Decisions

It used to be that organizing a new request destined days or weeks of investigation, approvals, planning, budgeting, and setup. At the present it ways that persons that are outside the enterprise Information Technology area can choose a service contributions of their option, choose a plan, and disburse for it themselves. The fences to initiate are near to the ground, the profits of level are sky-scraping, and the verdict gets boiled down to the straightforwardness of a liberated experiment or fancy purchase. Arranged, this is not the likely progression of events for major venture systems, but for those swirling around outside of the enterprise, in the outer price (Apache, 2010).

10.3 Data breaches

With the onset of a mobile workforce that expects data access anytime and anywhere, cloud computing is a low-cost solution to this need. Employees will no longer need to rely on portable devices for data storage that are easily lost or stolen. Data theft is a special concern in the economic recession as the number of security breaches has increased in the downturn. Many executives say a top concern is the security threat posed by laid-off workers, according to Robert McMillan in his computerworld.com article "With economic slump, concerns rise over data theft." Portable storage devices make data theft all too easy. McMillan cites the case of a financial analyst faces charges of downloading about 20,000 records onto his personal thumb drive. He quotes McAfee CEO Dave DeWalt: For \$100, you can buy a 100 GB drive. 100GB can be the entire customer base for an entire large company." McAfee adds that USB drives are one of the most underestimated sources of data leaks (Androutsellis, Spinellis, 2004).

Since cloud computing offers companies the ability to store data in a central, offsite location, does it provide greater security confidence in the ability to control access to that data? Will company executives feel compelled to turn to a

cloud service provider in the wake of increased risk of data loss and the rising cost of a data breach? Stolen laptops and removable media are the most common forms of data breaches that are currently reported as can be seen by the data provided from the Open Security Foundation. The Open Security Foundation is a volunteer organization that maintains an online database of data breaches involving personal identifiable information such as names, addresses, and dates of birth, Social Security numbers, and medical and financial data that occur mostly in the United States. The volunteers examine news accounts and web sites to gather data and also regularly send Freedom of Information requests to various states to request breach notification documents that the states receive as a result of legislative requirements. The information is posted in a database that is available for education and research and to increase awareness of information security and identity theft threats for consumers, government officials and executives.

Based on data provided by the Open Security Foundation, data loss by stolen laptops or computers did not become an issue until 2003 at the first recorded data breach from a stolen laptop with one incident reported involving 43,000 records. The number of data breach incidents involving lost or stolen laptops soared in 2005 with 22 incidents reported involving 520,996 records. In 2006, 137 incidents of lost/stolen laptops were reported involving 2,810,128 records.

In 2007, the group tracked 120 incidents of lost/stolen laptops that affected 3,760,157 records. In 2008, that number grew to 145 incidents of lost, stolen or missing laptops that involved 3,843,735 records. The data reveals lost, stolen or missing laptops are the most common type of data breach in recent years with hacks and web incidents coming in second and third respectively. However, another risk to information security is the increased use of removable media such as flash or USB drives, CDs and DVDs and portable hard drives (Aymerich, 2008).

11. CHARACTERISTICS OF CLOUD COMPUTING

Mell and Grance list the essential characteristics of cloud computing as:

On-demand self-service to allow computing capabilities for consumers such as server time and network storage that do not require the need for human intervention.

Ubiquitous network access to allow for computing capabilities at any time over the network for any kind of client platforms such as cell phones, laptops and personal digital assistants.

Location independent resource pooling where a provider pools its computing resources, such as storage, processing, memory, network bandwidth, and virtual machines, from various physical locations that enables it to offer them based

on consumer demand (Bharadwaj, 2004).

Rapid elasticity to allow computing capabilities to be rapidly expanded or decreased based on consumer demand.

Measured Service to allow resource usage to be monitored, measured and controlled based on consumer demand.

Like Mell and Grance, the Cloud Security Alliance authors describe cloud computing using principal characteristics, delivery models and deployment models. While their terminology may differ, the ideas remain the same. The Cloud Security Alliance authors also list five principal characteristics of cloud computing. They are:

- Abstraction of infrastructure allows for service delivery to be independent of the physical location of the infrastructure.
- Pooled resources and the use of virtualization render geographic location of hardware less significant than with traditional service delivery.
- Resource democratization allows for pooled resources to be made available to any user who is authorized to use them.
- Services oriented architecture puts the focus on the delivery of pooled resources rather than the management of the infrastructure.
- Elasticity/dynamism is achieved through pooled resources, virtualization, automation and reliable, high-speed network connectivity. Cloud providers can offer a self-service model with an as-needed capacity.
- Utility model of consumption and allocation is achieved through the above listed characteristics that allow for greater cost efficiencies and more manageable and predictive costs.

Based on both sets of characteristics, one can obtain a working definition of cloud computing as a service that is available on demand regardless of the geographic location of the provider's physical resources and that service can be monitored to expand or decrease based on customer demand. With the ability to monitor the use of computing capabilities, the customer pays only for the computing resources that are used (Ahuja, 2000).

12. DISADVANTAGE OF CLOUD COMPUTING

The following disadvantages of Cloud Computing are those most frequently cited:

12.1 PRIVACY and data security

This would be a major concern to anyone who is considering putting their data into a third-party storage space. After all,

users will not know exactly where their data are going to be stored and who would have the privilege to access it inside the cloud infrastructure (Ahuja, Curba, 2001). Some Cloud Computing providers may allocate their data centers in different countries. The data stored in these countries may face different regulations and are thus protected or unprotected according to the local governments.

12.2 Performance stabilities

Although, in most cases, performance in a cloud is quite stable, there are times when the cloud infrastructure is under heavy loads. This may be observed at certain times in a business day typically during the business hours. The performance for an application in a cloud environment will depend on network traffic and the resources other virtual machines running on the same physical machine as the application's virtual machine are taking. It can be difficult to repeat the performance demonstrated from one run to another (Armsbrust, 2009).

12.3 Inflexibility to switch

Due to the fact that different cloud providers may offer different levels of services (e.g. Google App Engine provides PaaS, Amazon EC2 provides IaaS, Salesforce provides SaaS) and APIs, it may be difficult for a user to switch from one cloud provider to another (Androutsellis, Spinellis, 2004). This is also known as the "lock-in" problem in other literatures. In general, IaaS provides easier possibilities of switching than PaaS while SaaS is the most difficult one to switch to or from.

12.4 Network speed

There are two network speeds that need to be mentioned here: one is intra-cloud network speed and the other is inter-cloud speed. Intra-cloud network speed is the network transfer speed inside the cloud infrastructure. It is usually limited by switches in the cloud infrastructure network. Depending on the cloud infrastructure network setup, this intra-cloud network speed may vary. For some data or message passing intensive applications, the latency might not be acceptable. Inter-cloud speed refers to the network speed between the cloud provider and the user or among different cloud providers (Ahuja, Curba, 2001).

12.5 Data lock-in

Taking Geographic Information System (GIS) applications as an example, a typical GIS application usually involves a great deal of data. The data format and how data are stored may produce a large performance difference to the GIS application. Furthermore, data import and export in a GIS

application may be very important in some cases (Alexandre, 2009).

13. CONCLUSION

Utility cloud computing has the potential to revolutionize the way companies purchase and use IT. With this new technology come new risks and threats that need to be thoroughly understood and analyzed. The opportunity exists to understand these risks and threats now and build in the security to circumvent the risks and threats early in development and adoption phase.

An additional positive turn on this homogenization of software is that it might make datasets reserved in the cloud equally well matched & interoperable. If we all use the similar software, the data we store will be available in code and principle to any person using the same software. If, however, software design constrains the kinds of dataset that it can store, interoperability begins to twist into homogeneity, and towards the loss of options and innovations.

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