Cloud Computing: Problems and Solutions

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ABSTRACT
In this era of internet, big organizations as well as individuals are finding the means that can reduce their cost of communication, storage and computing. Cloud computing is an emerging technology that can provide better services to them. Cloud computing is the phenomenon that describes "the idea of relying on Web-based applications and storing data in the ‘cloud’ of the Internet. So instead of storing software applications and data locally on a personal computer, the software applications and data are stored on remote servers and are accessed through a connection to the Internet." The services offered by Cloud Computing over the Internet are rapidly changing the way we use computers. Companies that have built large “server farms” to offer these services include Microsoft, Amazon, Google, and Yahoo. By 2012, 80 percent of Fortune 1000 companies will pay for some cloud computing service, and 30 percent of them will pay for cloud computing infrastructure.

In this paper we define the Cloud computing and discuss its advantages and disadvantages. We also briefly describe the problems in this new technology and possible solutions of them.

KEYWORDS
Internet, Virtualization, Trust computing, Cloud Computing

1. INTRODUCTION
We have seen the tremendous growth in the Web over the last decade. With this growth we are also observing a change in the concept of computing. A variety of computing devices and software, such as gaming systems, mobile phones, virtual worlds, cloud computing and trusted computing are some new computing paradigms. However these future computing do not seem to be without problems. There are already challenges such as managing millions of search queries a day or managing thousands of concurrent e-commerce transactions.

In response, technology companies such as Google, Amazon, Microsoft, eBay, or Yahoo have built increasingly large data centers, which consolidate a great number of servers with associated infrastructure for storage, networking, and cooling, to handle this ever-increasing demand. The iPod Touch incorporates WiFi connectivity that allows a user to download music and videos from the iTunes store without the use of a personal computer. Younger generations are substituting text messaging on mobile phones for emailing on computers. More and more functionality that used to rely on personal computers is being shifted to mobile devices. Further, millions of people worldwide are now spending enormous amounts of time in virtual worlds. These virtual worlds demonstrate that large numbers of people will invest time and energy in something that only works when connected to remote servers.

(image from "Cleaning the air: Cloud Computing by Farhad Javidi")
Cloud computing is the phenomenon that describes “the idea of relying on Web-based applications and storing data in the ‘cloud’ of the Internet. So instead of storing software applications and data locally on a personal computer, the software applications and data are stored on remote servers and are accessed through a connection to the Internet. Cloud computing is a newly recentralized computing architecture which returns us to architecture with a great deal of similarity to the mainframe and terminal model of computing. Non-personal computer, Internet-accessing devices combined with the transfer of software operating systems and applications into the cloud could bring about the disappearance of the personal computer as we understand it today. The services offered by Cloud Computing over the Internet are rapidly changing the way we use computers. Facebook, Twitter, Gmail, ibibo etc. are all cloud applications. The city Los Angles uses Google’s...
Apps service for e-mail and other routine applications. The airline, retail, financial industries and educational institutions are examples of those that could benefit from Cloud Computing. BSA members such as Apple, CA, CISCO, IBM, Microsoft, SAP, Sybase and Symantec are leaders in Cloud computing. Companies that have built large “server farms” to offer these services include Microsoft, Amazon, Google, and Yahoo. By 2012, 80 percent of of Fortune 1000 companies will pay for some cloud computing service, and 30 percent of them will pay for cloud computing infrastructure.

Trusted Computing is another phenomenon in which systems can be trusted by outsiders against the people who use them. Trusted Computing originated as a computer architecture intended to help protect data in commercial computers from software and physical attack. The term now encompasses commercial methods of computer security, storage security and network security. Although there is doubt that trusted computing could be fully efficacious within an environment of uncontrolled personal computers, trusted computing would have an impact. All in all, it would probably lead users to lose control over their machines, but it would also make copying more easily controlled by verifying that users are trustworthy. Together, the trend towards Cloud Computing and the Trusted Computing could evolve into a very different computing in the future than the present computing of personal computer model. In this article we will cover only the first computing phenomenon, namely, Cloud Computing

**Past Computing:** Prior the microprocessors and the personal computers

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2. WHAT IS CLOUD COMPUTING?

(Image from: Cleaning the air: Cloud Computing by Farhad Javidi)

There are so many interpretations of cloud that it is confusing to the consumer. There is true cloud, part cloud, private cloud, hybrid cloud and many other such references. The word “cloud” refers to something over an internet or public network. Cloud computing is a computing paradigm shift where computing is moved away from personal computers or an individual application server to a “cloud” of computers. Users of the cloud only need to be concerned with the computing service being asked for, as the underlying details of how it is achieved are hidden. This method of distributed computing is done through pooling all computer resources together and being managed by software rather than a human. The services being requested of a cloud are not limited to using web applications, but can also be IT management tasks such as requesting of systems, a software stack or a specific web appliance.

According to David Chappell [11], Cloud computing is “a style of computing where massively scalable IT related capabilities are provided ‘as a service’ across the internet to multiple external customers.” In other words, it is an IT infrastructure in which dynamically shared computing resources are virtualized and accessed as a service.

Users are already using the services that run on a cloud computing component such as, e-mail services, photo and video services and online applications etc. Even at the corporate level, cloud computing services are already available from Google, Amazon, Yahoo, and Salesforce. Google and IBM, in conjunction with six major research universities in the United States, have already been using cloud computing for providing research, education and faculty.

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**Greeks transform mathematics** - a deductive science.
Aristotle - logic.
Leibniz - a universal logical language
Real numbers & the foundations of the calculus
Russell & Whitehead - *Principia Mathematica*
Alan Turing - the limits of computation & intelligent computers.
Many cloud solutions, both public and private, leverage virtualization to deliver their functionality. Amazon’s EC2 is all about virtualized infrastructure. Microsoft’s Windows Azure uses virtual instances of a customized version of Windows Server. Virtualization assists organizations who adopt Cloud Computing. Organizations should be able to virtualize all or just part of their data centre.

(Image via Wikipedia)

**Virtualization?**

Virtualization lets you run multiple virtual machines on a single physical machine, sharing the resources of that single computer across multiple environments. Different virtual machines can run different operating systems and multiple applications on the same physical computer.

(Image from DISA, Tom Greenfield)

The concept of Cloud Computing generally incorporates combinations of Infrastructure as a service (IaaS), Platform as a service (PaaS) and Software as a service (SaaS).

1. **IaaS** refers to providing a computer infrastructure as a service. Amazon’s Elastic Compute Cloud (EC2), IBM Blue house or VMWare are some examples.
2. **PaaS** refers to providing a computer platform or software stack as a service. It provides application services. Amazon simple storage solution, IBM virtual images, Google’s App Engine or Salesforce are some examples of PaaS.
3. **In SaaS**, Software or an application is hosted as a service and provided to customers across the Internet. It alleviates the customer’s burden of software maintenance, and reduces the expense of software purchases by on demand pricing. Gmail, Google Calendar, Microsoft’s ‘Software + service’, IBM Lotus live, Google’s Chrome browser and Salesforce.com are some examples of SaaS.

The concept is not entirely new and is evolving even today. In the recent past, several past, several variations have been introduced through ‘Grid’, ‘Utility’ and ‘Autonomic’ Computing.

**Not to be confused with**

1. **Grid Computing** – a form of distributed computing, Cluster of loosely coupled, networked computers acting in concert to perform very large tasks
2. **Utility Computing** – packaging of computing resources such as computing power, storage, also a metered services
3. **Autonomic computing** – self managed
2.1 TYPES OF CLOUD COMPUTING

- **Private cloud**: The cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off premise.
- **Community cloud**: The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns. It may be managed by the organizations or a third party and may exist on premise or off premise.
- **Public cloud**: It is a style of computing in which scalable and elastic IT-enabled capabilities are delivered as a service to external customers or a large industry group using Internet technologies. It is owned by an organization selling cloud services.
- **Hybrid cloud**: The cloud infrastructure is a composition of two or more clouds (private, community, or public).

**IT Trends enabling (and driven by) Cloud Computing**

- Increased Parallelism
  - New Moore’s Law - 2X processors per chip generation
  - Parallel software industries emerging to address challenges
  - Redundant networks and storage increasing performance
- Increased Virtualization
  - Processing, Storage, Bandwidth, Delivery
  - Commodity Components
  - X86 servers, consumer hard drives, ethernet
  - Open Source SW – Freedom to customize and adapt
  - Increased Outsourcing of Core Elements
  - “By 2012, 80 percent of Fortune 1000 companies will pay for some cloud computing service, and 30 percent of them will pay for cloud computing infrastructure.” Gartner

2.2 ADVANTAGES OF CLOUD COMPUTING

1. Shared resources, information, hardware, software and other resources can be delivered more rapidly and searched.
2. Reducing the number of hardware components and replacing them with remote cloud computing systems will reduce energy costs for running hardware and cooling as well as will reduce carbon footprint.
3. We can potentially use several years worth of energy in literary a few hours
4. Large corporations use the cloud for their data centers combining their local LANs with the cloud to increase capacity, in other words, a hybrid cloud.
5. Lower costs for data storage, searching and retrieval.
6. No more spending on computer upgrades
7. Better performance by PCs in the cloud network
8. Synchronization with experts worldwide on different issues and projects
9. Work from any PC and on the move, with the availability of internet access

2.3 MAJOR PROBLEMS WITH CLOUD COMPUTING

1. Not only could stored data be stolen by hackers or lost to breakdowns, but a cloud provider might mishandle data – or forced to give it up in response to a subpoena.
2. Anyone with whom you shared document access could also see documents you shared with anyone else.
3. Data centers are essential to nearly every industry and have become as vital to the functions of society as power stations are. Since data centers consume vast amounts of energy (for powering and cooling the servers), locations with cheap energy are highly attractive.
4. If geographic and political borders fracture the cloud into smaller groupings, the real advantage of the cloud dissipates into the ether.

3. POSSIBLE SOLUTIONS

1. San Diego, MIT researchers and a group from microsoft have suggested a way to prevent users of one virtual machine on a server from gleaning information by monitoring the use of shared cache memory by another virtual machine on the same server.
2. IBM researchers have proposed a security mechanism that would, in essence, frisk new virtual machines as they entered the cloud.
3. The field of cryptography is the tool that can also ensure the security of cloud computing. Cloud users can already encrypt data to protect it from being leaked, stolen, or perhaps above all released by a cloud provider facing a subpoena. This approach can be problematic, though. Encrypted documents stored in a cloud can’t easily be searched or retrieved, and it’s hard to perform calculations on encrypted data. Emerging encrypted technologies, however, could protect data in clouds even as users search it, retrieve it, and perform calculations on it.

Microsoft research recently introduced a theoretical architecture that would stitch together several cryptographic technologies to make the encrypted cloud more searchable.

4. CONCLUSION AND FUTURE SCOPE

The Cloud Computing is definitely at the beginning and knocking doors to gain attention. It is an attractive operating environment for enterprises and individuals who are expected to worry less about hosting solutions. There are already billions of users accessing millions of services through thousands of service providers over the millions of servers and processing exabytes of data that is delivered through terabytes of network traffic. Market researchers, financial analysis, and business leaders all want to assess its potential markets and business impact. There many other things which have to be sorted out for making cloud computing attracting for the small and large enterprises and individuals. The information technology’s next
grand challenge will be to secure the cloud and prove we can trust it.

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