International Journal of Cloud Computing and Services Science (IJ-CLOSER)
Vol.2, No.2, April 2013, pp. 134~140
ISSN: 2089-3337

Cloud Computing : Research Issues and Implications

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Article Info

Article history:

Received Dec 15th, 2012
Accepted Dec 30th, 2012

Keyword:

Cloud computing
Service model
Deployment model
Issues
Implications

ABSTRACT

Cloud computing is a rapidly developing and excellent promising technology. It has aroused the concern of the computer society of whole world. Cloud computing is Internet-based computing, whereby shared information, resources, and software, are provided to terminals and portable devices on-demand, like the energy grid. Cloud computing is the product of the combination of grid computing, distributed computing, parallel computing, and ubiquitous computing. It aims to build and forecast sophisticated service environment with powerful computing capabilities through an array of relatively low-cost computing entity, and using the advanced deployment models like SaaS (Software as a Service), PaaS (Platform as a Service), IaaS (Infrastructure as a Service),HaaS (Hardware as a Service) to distribute the powerful computing capacity to end-users. This paper will explore the background and service models and also presents the existing research issues and implications in cloud computing such as security, reliability, privacy, and so on.

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1. INTRODUCTION

Cloud computing is not a new concept; it is originated from the earlier large-scale distributed computing technology. However, it will be a subversion technology and cloud computing will be the rapid revolution in the Computer Science and Information Technology field. Which represent the development trend in the IT industry from hardware to software, software to services, and distributed service to centralized service. Cloud computing is also a new mode of business computing is virtualization. It will be widely used in the near future. The core concept of cloud computing is reducing the processing burden on the users. Eventually users use a wide variety of devices, including PCs, Laptops, Smart Phones, and PDAs to access different kinds of utility programs, storage, and application development platforms over the Internet. All these services offered by cloud computing providers. An advantage of the cloud computing technology includes cost savings, high availability, and easy scalability. However, still there exist many problems in cloud computing today, the current researchers or practitioners pointing that data security and privacy risks have become the primary concern for people to transfer or migrate to cloud computing [1].The figure.1 shows six phases of computing paradigms[2] from terminals/mainframes, to PCs, Networking Computing, Internet Computing to Grid and Cloud Computing.

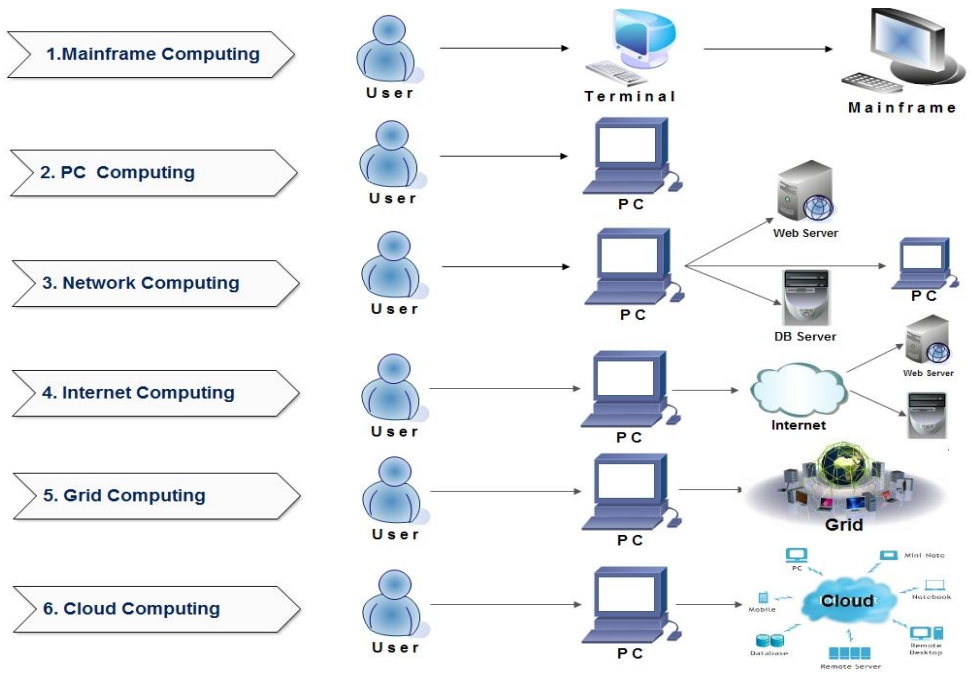


Figure.1 Six Computing Paradigms – from Mainframe Computing to Internet Computing, to Grid Computing and Cloud Computing (Adapted from Voas and Zhang (2009))

2. CLOUD COMPUTING

2.1. Evolution

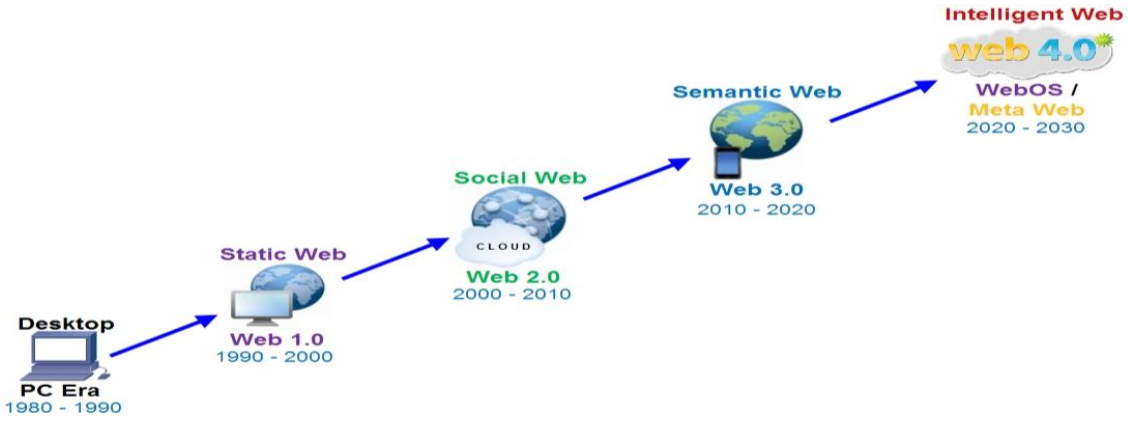


Figure.2 Cloud Computing Evolution in IT [3].

2.2.Defination

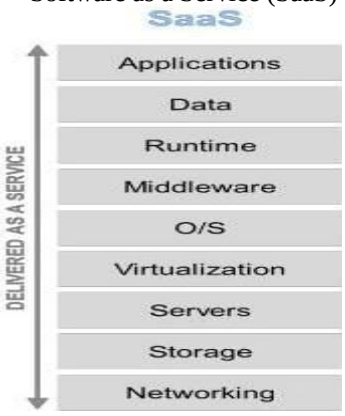
"Cloud" is a virtualized pool of computing reusable resources. It can:

- Control or customizing a variety of different workloads.
- Batch update of back-end and front-end operations with GUI applications.
- Rapidly deployment and increase workload by physical or virtual machines.
- Support for redundancy, self-healing and highly scalable API.
- Real-time monitoring resource usage [4].

Cloud computing is categorically into three major segments: "Applications", "Platforms," and "Infrastructure". Each segment serves a different purpose and offers different products for businesses and individuals around the world. The server administrator monitoring traffic and client demands to ensure everything runs accurately. It follows a set of rules called protocols and using software is called middleware.

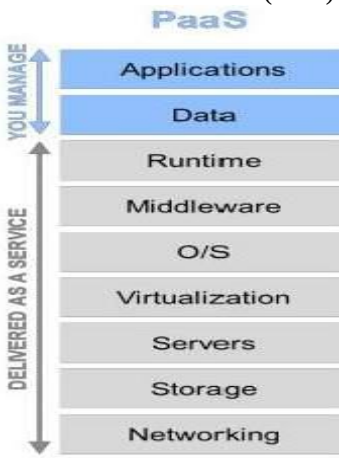
2.3. Service Model

- Software as a Service (SaaS) :



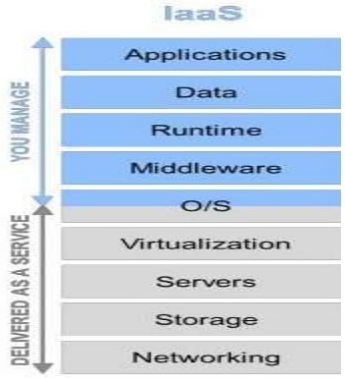
In this model software deployment over the internet is deployed to run behind a firewall in LAN or personal computer or laptop. This is a "pay-as-you go" model. The capability provided to the end-users is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through a thin client interface such as a web browser (e.g., web enabled e-mail). The end-users does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user specific application configuration settings. Present SaaS is offered by companies such as Google, Salesforce, Microsoft, Zoho, etc.

- Platform as a Service (PaaS) :



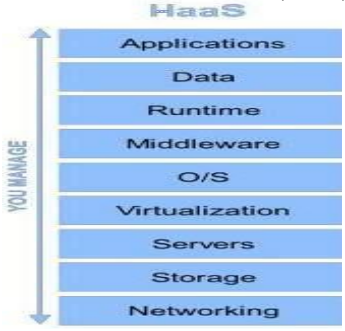
It is the delivery of computing platform and solution stack as a service. Trust of use the middleman's equipment to develop their own program and deliver it to users through Internet and servers. The capability provided to the end users to deploy the cloud infrastructure, user created or acquired applications using programming languages and tools supported by the provider. The end user does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage. PaaS providers offer a predefined combination of OS and application servers, such as WAMP platform [5] (Windows, Apache, MySql and PHP), LAMP platform (Linux, Apache, MySql and PHP), and XAMP (X-cross platform) limited to J2EE, and Ruby etc. Google App Engine, Salesforce.com, etc are some of the popular PaaS examples.

- Infrastructure as a Service (IaaS):



The platform virtualization or infrastructure as a service. The capability provided to the end users is to provision processing, storage, networks, and other fundamental computing resources where the end user is able to deploy and run arbitrary software. This can include operating system and applications. The user does not manage or control the underlying cloud infrastructure but it has control over operating systems, storage, deployed applications, and possibly limited control of select networking components. Rather than purchasing servers, software, data center space or network equipments, clients etc., this resource is fully outsourced and controlled by outsourcing organizations. Some of the common examples are Amazon, GoGrid, 3tera, etc.

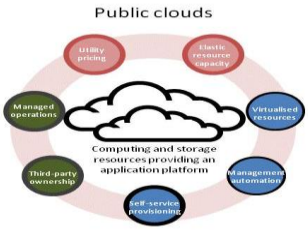
- Hardware as a Service (HaaS):



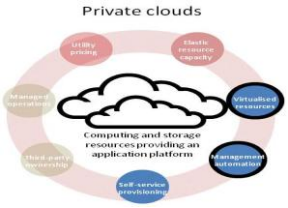
According to Nicholas Carr [6], "the idea of buying IT hardware or even an entire data center as a pay-as-you-go subscription service that scales up or down to meet your needs. But as a result of rapid advances in hardware virtualization, IT automation, and usage metering and pricing, I think the concept of hardware-as-a-service, let's call it HaaS, and may at last be ready for prime time." This model is advantageous to the enterprise users, since they do not need to invest in building and managing data centers. In the future days HaaS has to be available on pre and post paid payment basis.

2.4. Deployment Model

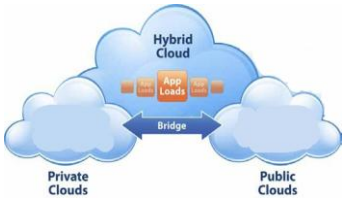
- Public Cloud (or External Cloud) **:** In this model, computing resources are dynamically provisioned over the Internet via Web applications or Web services from trusted third party provider. Public clouds are run by third parties, and applications from different customers are likely to be mixed together on the cloud's servers, storage systems, and networks. Although the public cloud has compelling advantages, there existing the hidden risk of security, regulatory policy compliance and quality of service (QoS) requirements.



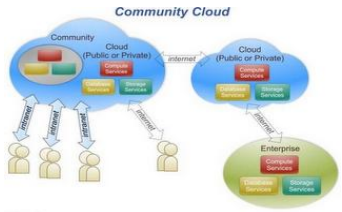
- Private Cloud (or Internal Cloud) **:** In the private cloud deployment, computing resources are used and controlled by a private enterprise. It is generally deployed in the enterprises data center and managed by internal personnel or service provider. The main advantage of this model is that the security, compliance, and QoS are under the control of the enterprises [7].



- Hybrid Cloud (or Mixed Cloud) **:** The Hybrid Cloud environment intersects and combines multiple public and private cloud models. It enables the enterprise applications to running state-steady workload in the private cloud, and requesting the public cloud for intensive computing resources when peak workload occurs. Hybrid clouds introduce the complexity of determining how to distribute applications across both a public and private cloud.



- Community Cloud(or Group Cloud)**:** In this Community deployment model several organizations jointly construct and share cloud infrastructure as well as policies, requirements, values, and concerns. The cloud community forms into a degree of economic scalability and democratic equilibrium. The cloud infrastructure could be hosted by a third-party vendor or within one of the organization in the community. This is emerging cloud used by many social networking website like facebook, orkut, etc.



3. CLOUD COMPUTING FEATURES

Cloud computing brings an array of new features and advantages compared to any other computing paradigms. There are briefly described in this section.

- *Scalability and On-Demand Services* - Cloud computing provides resources and services for users on demand. The resources are scalable over several data centers.
- *Quality of Service (QoS)* - Cloud computing can guarantee QoS for users in terms of hardware or CPU performance, bandwidth, and memory capacity.
- *User-Centric Interface* - Cloud interfaces are location independent and they can be accessed by well established interfaces such as Web services and Web browsers.
- *Autonomous System* - Cloud computing systems are autonomous systems managed transparently to users. However, software and data inside clouds can be automatically reconfigured and consolidated to a simple platform depending on user's needs.
- *Pricing* - Cloud computing does not require up front investment. No capital expenditure is required. Users may pay and use or pay for services and capacity as they need them.

4. CLOUD COMPUTING ISSUES AND IMPLICATIONS

The new paradigm of cloud computing provides sophisticated benefits and advantages over the previous computing paradigms and many organizations are customizing, migrating and adopting it. In the last few years, cloud computing has grown from being a promising logic; business is virtualization concept to one of the fastest growing segments of the IT industry. Now, recession-hit companies are increasingly realizing that simply by tapping into the cloud and gain fast access to best-of-breed business applications or drastically boost their infrastructure resources, all at negligible cost. However, there are still a number of issues, challenges and implications are identified, which are currently addressed by researchers, academicians and BI (business intelligence) practitioners.

1. Security
   Clouds provide companies are still concerned about security when using cloud computing. Users are also worried about the vulnerability to attacks, when information and critical IT resources are outside the firewall. Where is the data more secure, on local hard drive or on high security servers in the cloud? However, in the cloud, the data will be distributed over the network through individual computers regardless of where the repository of data is ultimately stored. Industrious hackers can invade virtually at any server, and there are the statistics show that one-third of breaches result from stolen or lost laptops and other devices and from employees' accidentally exposing data on the Internet, with nearly 16 percent due to insider stealing [8].

2. Reliability
   Clouds computing still always offer round the clock reliability. There were few cases where cloud computing services suffered few hours' outages. In the present and future days to expect more cloud computing providers, richer services, established standards and best practices. Servers in the cloud have the same problems as your own resident servers. The cloud servers also experience downtimes and slowdowns, what the difference is that users have a higher dependent on cloud service provider (CSP) in the taxonomy of cloud computing. Once you choose a particular provider, you may be locked-in, thus bring a potential business secure risk.

3. Privacy
   Different from the traditional computing model, cloud computing utilizes the virtual computing technology, users personal data may be scattered in various virtual data center rather than stay in the same hard drive physical location, even across the national borders, at this time, data privacy protection will face the controversy of different legal systems. On the other hand, users may leak hidden information when they accessing cloud computing services. Attackers can analyze the critical task depend on the computing task submitted by the users [9].

4. Open Standard
   Open standards are critical to the growth of cloud computing. Most cloud provider's interpretation with APIs which are typically well-documented but also unique to their implementation and thus not interoperable. Some vendors have adopted others' APIs [10] and there are a number of open standards under development, including the OGF's Open Cloud Computing Interface. The Open Cloud Consortium (OCC) [11] is working to develop consensus on early cloud computing standards and practices.

5. Performance
   The major issue in performance can be for some intensive transaction-oriented and other data intensive applications, in which cloud computing may lack adequate performance. Also, users who are at a long distance from cloud providers may experience high latency and delay.

6. Bandwidth Cost
   Cloud computing offered companies, can save money on hardware and software; however they could incur higher network bandwidth charges. Bandwidth cost may be low for smaller Internet-based applications, which are not data intensive, but could significantly, grow for data-intensive applications.

7. Long-term Feasibility
   Users may be sure that the cloud data or information put into the cloud storage will never become invalid even particular cloud computing service provider go broke or get acquired and swallowed up by a larger company. "The cloud potential providers how to would get the data back, and it would be in any format that it is import into a replacement application"-Gartner [12].

8. Legal Issues
   In the same way that the electricity one uses may have been generated in another country where costs are lower, the computer processing power or storage one buys via a Cloud service may be based in another country, or indeed may be divided between multiple countries. But as well as the cost and efficiency advantages brought in this arrangement, this also raises vexing legal issues in the case of Cloud Computing arising out of exporting customers data abroad; also, the Cloud Services Provider has to contend with the Legal Systems under different Jurisdictions with not so much of visibility as to where the Data resides and how it is routed to the End User while passing through different Legal Jurisdictions. Again, vexing Legal Issues relating to ownership of data and liability for its loss or misuse have to be dealt with by the Cloud Service Providers. The legal issues differ from those arising from conventional outsourcing or hosting [15].

5. CONCLUSION

In this paper, to analyze and discussed an emerging technology: Cloud Computing. The evolving is one of the core platform for Computer Science (academics) and Information Technology (industry) in the professional world. It describes cloud background, evolution, definition, service models, deployment models and some existing issues. There is no doubt that the cloud computing is the emerging development trend in the future. Cloud computing brings us the approximately infinite computing capability, good scalability, on-demand service and so on, also challenges at security, reliability, and privacy, legal issues and so on. Because of this, it has been attracted by everyone including the attackers. The paper is expected to be a right path or URL for those who works or does research in cloud computing. We acknowledge the cloud computing era, to solving and prevent the existing issues and implications for maximum necessity is required.

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