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Cloud Computing- A Review

Avantika Singh[1], Sukhwinder Singh[2]

Student, Electronics and Communication Engineering Department, PEC University of Technology, Chandigarh, India[1]

Mentor, Assistant Professor, Electronics and Communication Engineering Department, PEC University of Technology, Chandigarh, India[2]

Abstract: In computer networking, cloud computing refers to the connection of several computers connected over the internet for service utility, which acts as a pool of virtualised computer source. It is a means of running a same program at the same time over a number of connected computers. The basic foundation is service oriented architecture and virtualisation of hardware and software. A cloud is able to host different workloads and it allows workloads to be deployed/scaled-out on-demand by rapidly providing virtual or physical machine, redundancy, self-recovering, highly-scalable programming models and allowing workloads to recover from hardware/software failures and rebalance allocations. The technology faces several significant challenges and the current research focuses on the technical issues that arise when building and providing clouds and the implications on enterprises and users.

Keywords: Cloud computing, cloud technologies, review, project, clouds, and technology.

I. INTRODUCTION

Many of today's services rely on efficient access to computing services. Cloud computing has recently reached popularity and developed into a major trend in IT. Industries have been researching the Cloud research agenda for a long time; academia has only recently joined, which can be seen through the sudden rise in workshops and conferences which focus on Cloud Computing. In response to the resulting demand for flexible computing resources, cloud computing has taken the IT industry by storm over the past few years. The term "Cloud Computing" became famous in 2007, when IBM and Google announced research in this field, and later on, IBM announced "Blue Cloud" effort[1]. A key element of cloud computing is the creation of a user-defined experience. Cloud computing users avoid capital expenditure on hardware, software, and services and they pay the provider only for what they use.

Fig.1: Searches for 'cloud computing' on Google.com

II. DEFINITIONS

There has been much discussion over what cloud computing actually is. The US National Institute of Standards and Technology (NIST) has developed a definition[2] that summarises cloud computing as a model for convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction enabling This definition is one of the clearest definitions of cloud computing thus, is widely referenced in US government documents and projects. The essential characteristics of cloud computing are:

1) *On-demand self-service*: Computing resources e.g. processing power, storage, virtual machines can be used at anytime without the need of human interaction with cloud service providers.
2) *Broad network access*: The resources can be accessed over a large network using devices such as laptops or mobiles phones.
3) *Resource pooling*: The service providers pool their resources and then they are shared by multiple users. This is referred to as *multi-tenancy* where for example a physical server may host several virtual machines belonging to different users.
4) *Rapid elasticity*: User can quickly acquire more resources by scaling out. They can scale back in by releasing those resources once they are no longer required.

The above characteristics apply to all clouds but each cloud provides users with services at a different level of abstraction, which is referred to as a service model in the NIST definition. The most common service models are:

1) *Software as a Service (SaaS)*: It is where, the users make use of a web-browser to access software that others have developed and offer as a service over the web.
2) *Platform as a Service (PaaS)*: It provides the users with a high level of abstraction which allows them to focus on developing their applications. Users do not have control or access to the underlying infrastructure which is being used to host their applications at the PaaS level.
3) *Infrastructure as a Service (IaaS)*: This is where users acquire computing resources such as processing power, memory and storage from the provider and use the resources to use and run their applications.

Clouds can be classified as:

1) *Private cloud*: It is a cloud which is used exclusively by only one organisation. Concur Technologies [3]

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are example organisations that have private clouds.

2) *Public cloud*: Cloud which are to be used (on payment of fee) by the general public. Public clouds require significant amount of investment and are usually owned by large corporations such as Microsoft, Google or Amazon.
3) *Community cloud*: A cloud that is shared by several organisations and is generally setup for their specific requirements. The Open Cirrus cloud test bed could be regarded as a community cloud that aims to support research in cloud computing [4].
4) *Hybrid cloud*: A cloud that is setup using a mixture of the above three research models. Each cloud in a hybrid cloud could be independently managed but applications and data would be allowed to move across the hybrid cloud.

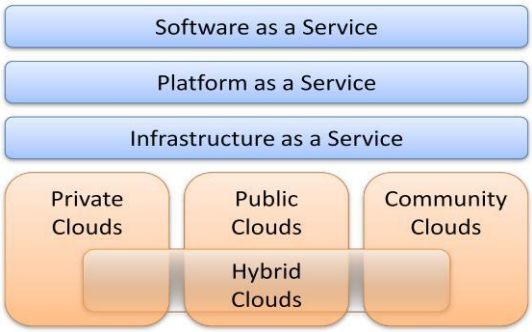

Fig 2: Cloud computing deployment and service models

The two-page NIST definition of cloud computing could be summarised using Joe Weinman's retro-fitted *CLOUD* acronym that describes a cloud as a **C**ommon, **L**ocation-independent, **O**nline **U**tility provisioned on-**D**emand .

III. CONCEPTS

A powerful underlying and enabling concept is computing through service-oriented architectures (SOA) – which conceptualises the delivery of an integrated and orchestrated suite of functions to an end-user through composition of both loosely and tightly coupled functions, or services – often network based.

A. *Service-oriented Architecture*

Service-oriented Architecture is not a new concept, although it has gained popularity in a short time. End-users request an IT service at the desired functional, quality and capacity level, and receive it either at the same time or at a specified later time.

B. Components

The key to a SOA framework that supports workflows is componentization of its services, an ability to support a range of couplings. Component-based approach is characterized by *reusability* (elements can be re-used in other workflows), *substitutability* (alternative implementations), *extensibility and scalability* (ability to readily extend system component pool, increase capabilities of individual components, have an extensible and architecture that can automatically discover new resources, etc.), *customizability* (ability to customize generic features to the needs of a particular scientific domain and problem), and *composability* (easy construction of more complex functional solutions using basic components, reasoning about such compositions, etc.). There are other characteristics that also are very important. Those include *reliability* and *availability* of the components and services, the cost of the services, *security*, total cost of ownership.

C. *Virtualization*

Virtualization is another very useful concept. It allows abstraction and isolation of lower level functionalities and underlying hardware. This concept has been around in some form since 1960s (e.g., in IBM mainframe systems). Since then, the concept has developed considerably and it has been applied to all aspects of computing – memory, storage, processors, software, networks, as well as services that IT offers.

IV. CLOUD COMPUTING AND DECISION MAKING

In this section, we get a brief summary of the benefits and challenges of cloud computing, with a focus on decision making. Cloud computing brings two unique features for enterprises: elasticity and flexibility. High level of elasticity in the cloud allows enterprises to scale their IT resources up and down within very short amounts of time. Flexibility presents a large set of options for an enterprise to configure its IT resources, such as operating systems, software, memory, CPU, etc. Another challenge is that much part of IT resource management and access is typically shared by regular work force in the enterprise, which makes management related considerations in the enterprise more complex. Also, transition to the cloud employs new privacy protection paradigms and methods that will allow third party users to process data without the need of accessing it (Gentry 2010). In spite of these challenges and concerns, consumer demand for cloud services is growing by the day.

V. NEW USE CASES IN CLOUD COMPUTING

We see the new technologies and use cases that have become possible through the use of cloud computing. Chun and Maniatis [5] describe one such use-case, where cloud computing enables a technology which otherwise would not be possible i.e. to overcome hardware limitations and enable more powerful applications on smart phones.

Another use-case that becomes feasible and affordable through the use of cloud computing is large-scale non-functional requirements testing, as described by Ganon and Zilbershtein [6]. They tested Network Management Systems for systems where much of the functionality is in the endpoints, such as in voice over IP software. Further, implications of using the cloud for this setup are evaluated, such as security, safety of intellectual property or software export restrictions, and solutions to tasks such as creating setups that emulate problems including noisy or delayed network connections are presented.

A. *Pros*

1) *Reduced Cost*: Cloud technology is paid incrementally (you pay only for what you need), saving organizations money in the short run. Money saved can be used for other important resources.
2) *Increased Storage*: Organizations can store more data than on private computer systems.
3) *Highly Automated*: IT personnel need not to keep software updated as maintenance is the job of the service provider on the cloud.
4) *More Mobility*: Employees can access information wherever they are, rather than having to remain at their desks.
5) *Allows 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.

B. Cons

1) *Security*: Is there a security standard?
2) *Reliance on 3rd Party*: Control over own data is lost in the hands of an "difficult-to-trust" provider.
3) *Cost of transition:* Is it feasible for a person to move from the existing architecture of his data centre to the architecture of the cloud?
4) *Uncertainty of benefits*: There is not any surety of long term benefits.

VI. THE FUTURE

According to Gartner's Hype cycle, Cloud computing has reached a maturity that leads it into a productive phase. This means that most of the main issues with Cloud computing have been addressed to a degree that Clouds have become interesting for full commercial exploitation. Cloud computing is therefore still as much a research topic, as it is a market offering.

In 2012 the European Commission has issued an analysis of the relevance of the open research issues for commercial stabilisation in which various experts from industry and academia identify in particular the following major concerns:

1) Open interoperation across (proprietary) cloud solutions at IaaS, PaaS and SaaS levels.
2) Managing multitenancy at large scale and in heterogeneous environments.
3) Dynamic and seamless elasticity from in-house clouds to public clouds for unusual (scale, complexity) and infrequent requirements.
4) Data management in a cloud environment, taking the technical and legal constraints into consideration.

VII. CONCLUSION

Various definitions of cloud computing were discussed and the NIST working definition by Mell and Grance was found to be the most useful as it described cloud computing using a number of characteristics, service models and deployment models. "Cloud" computing builds on decades of research in virtualization, distributed computing, utility computing, and, more recently, networking, web and software services. It implies a service-oriented architecture, reduced information technology overhead for the end-user, great flexibility, reduced total cost of ownership, and many other things. This paper discusses the concept of "cloud" computing, the issues it tries to address, related research topics, and a "cloud" implementation based on VCL technology.

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