Cloud Computing: A Review

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Abstract
Cloud computing is the next step on the path to more efficient use of computing resources which is a mixture of the new ideas, technology and delivery models. This means that access to infrastructure such as servers, software, and data center space or network equipment; a computing platform and solution stack are all delivered cheaply and efficiently over the Internet. All of this is available instantly on demand and is billed according to usage or subscription, just like for any other utility. In this paper, we have discussed the concept of cloud computing along with types, benefits, limitations and applications.

Keywords
IaaS, Paas, SaaS, Cloud Computing, IT

I. Introduction

Cloud Computing, the long held dream of computing as a utility, has the potential to transform a large part of the IT industry .Cloud Computing refers to both the applications delivered as services over the Internet and the servers and system software in the data centers that provide those services. Cloud adopts an on-demand infrastructure to provide its computing resource as an elastic service. A collection of servers stands at the ready, available to whichever agency or department needs them at any given moment. Depending on the number of people using a service at the same time, the cloud automatically pulls in the right number of servers, adding or releasing servers dynamically as demand fluctuates. Reducing costs, accelerating processes and simplifying management are all vital to the success of an effective IT infrastructure. Companies are increasingly turning to more flexible IT environments to help them realize these goals. Cloud computing enable the tasks to be assigned to a combination of software and services over a network. This network of servers is the cloud. Cloud Computing can help businesses transform their existing server infrastructures into dynamic environments, expanding and reducing server capacity depending on their requirements. Today clients are capable of running their software applications in remote computing clouds where data storage and processing resources could be acquired and released, almost instantaneously. Cloud computing is a very specific type of computing that has very specific benefits. But it has specific negatives as well. And it does not serve the needs of real businesses to hear only the hype about cloud computing – both positive and negative. One thing that is hoped to be accomplished with this paper is not only a clear picture of what the cloud does extremely well and a brief overview of them, but also a short survey on their criteria and challenges ahead of them [4, 5, 13].

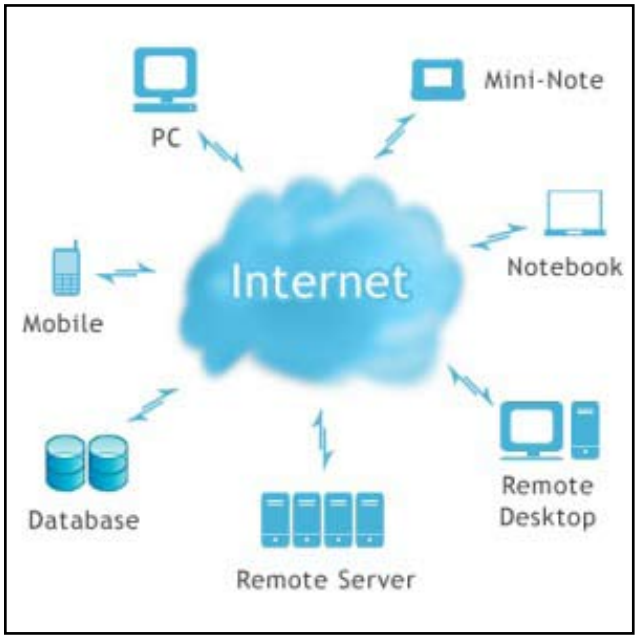

Fig. 1: Cloud Computing

II. Definition

Cloud Computing has no single definition. However, we give below a few definitions:

A. It is an Internet based computing whereby shared resources, software and information are used by computers and other devices on demand [9].
B. It is a specialized distributed computing paradigm that could deliver scalable and virtualized resources to users outside the cloud in the form of services over the Internet [8].
C. A technical definition is "a computing capability that provides an abstraction between the computing resource and its underlying technical architecture, enabling convenient, on demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction". This means that Clouds have five essential features: On demand self-service, Broad Network access, Resource Pooling, Rapid Elasticity and Measured Service [6].

III. Types of Clouds

As with all buzzwords there is much confusion as to what exactly are the different types of clouds. Clouds are typically identifiable as:

A. Public Cloud

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 where a service provider offers, maintains and bills for this service. They often offer inexpensive and even free services over the Internet. For instance, IBM has made available new, free Amazon Machine Images (AMIs) on Amazon Web Services for development and test purposes, enabling software developers to quickly build pre-

production applications based on IBM software within the Amazon Elastic Compute Cloud (EC2) environment [10].

B. Private Cloud

Private clouds are built for the exclusive use of one client, providing the utmost control over data, security, and quality of service .A private cloud allows the enterprise to gain better control over the entire process of information processing resulting in reduction of costs, greater flexibility, reduction in wastage due to monitored consumption, standardized, better quality of service, agility in response, greater security due to better encryption. For instance, BMI, the second-largest airline at London Heathrow, has aggressive targets to move approximately 90 percent of its infrastructure onto a private cloud [10].

C. Hybrid Cloud

Hybrid clouds combine both public and private cloud models. They deliver a computing environment that maximizes the benefits of the cloud, addresses core concerns such as security, data protection and service levels, whilst minimizing cost through the utilization of existing assets. Hybrid clouds introduce the complexity of determining how to distribute applications across both a public and private cloud. Google has started offering applets (downloadable appliances), that let users deploy the company's cloud-based offerings internally [10].

IV. Variation of Cloud

Clouds can be classified as:

A. Infrastructure as a Service (IaaS)

This layer provides basic infrastructure such as CPUs, memory and storage, and is henceforth denoted as Infrastructure as a Service. Servers, storage systems, switches, routers, and other systems are pooled and made available to handle workloads that range from application components to high-performance computing applications. It offers full control of server infrastructure, not limited specifically to applications, instances .It has a limitation that Service providers may demand higher prices for services offered. Amazon's EC2, through which users can request Linux Virtual Machine instances, is an example of IaaS [3].

B. Platform as a service (PaaS)

Platform as a service encapsulates a layer of software and provides it as a service that can be used to build higher-level services. This cloud takes away the concept of servers, while providing an application centric environment. While creating this kind of cloud computing platform, a vendor "builds a cloud platform first and then develops applications that run on it". Significant dependency on cloud infrastructure providers is a limitation of PaaS. Commercial examples of PaaS include the Google Apps Engine, which serves applications on Google's infrastructure [3].

C. Software as a Service (SaaS)

Software as a service features a complete application offered as a service on demand. A single instance of the software runs on the cloud and services multiple end users or client organizations. Here companies host applications on the Internet and users sign up and use them, without concerning themselves about its maintenance and whereabouts .It is mostly free, very easy to use, feature rich, easy to access and promises good consumer adoption. In SaaS, user can only use the application and would not know the technology leveraged to develop the application; thereby user has little control over application development. The most widely known example of SaaS is salesforce.com, though many other examples have come to market, including the Google Apps offering of basic business services including email and word processing [7].

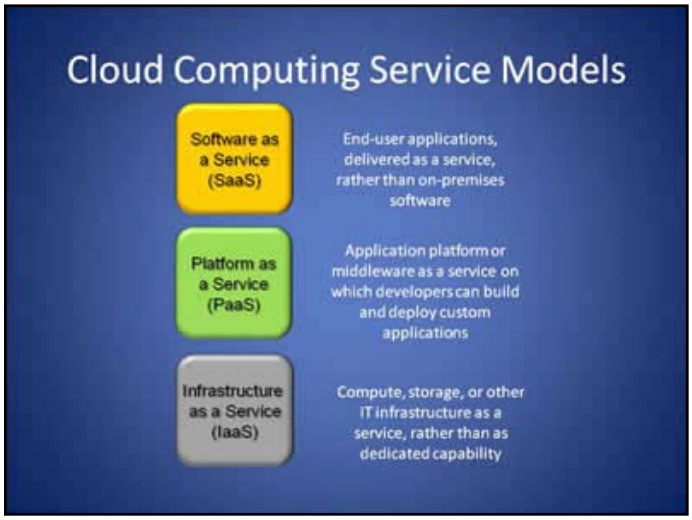

Fig. 2: Cloud Computing Service Models

V. Benefits of Cloud Computing

In order to benefit the most from cloud computing, developers must be able to re-factor their applications so that they can best use the architectural and deployment paradigms that cloud computing supports.

A. Scalability and Speed

Enterprises can cut down the time involved in buying and setting up the hardware, software and other resources necessary to support a new application. They can quickly respond to scale up or scale down their usage of services on the cloud as per market demands, during peak hours of activity, while running sales campaigns, etc. The performance of the cloud is also normally good, since many service providers have data centers in multiple locations so as to keep the processing near those accessing it over the Internet [1].

B. Easy Implementation

Without the need to purchase hardware, software licenses or implementation services, a company can get its cloud-computing arrangement off the ground in record time — and for a fraction of the cost of an on-premise solution [1].

C. Ease of Use

Entry to a cloud is easy and shared infrastructure and costs ensure low overheads and immediate availability of all requisite applications. Consumption of resources is as a service with payments made on the basis of actual consumption only. The services are delivered and billable just like in any other utility for, say, electricity or water supply. Details of billing are made available by the service provider; this helps control costs. The enterprise does not need specially trained manpower or any equipment other than an Internet-connected device to use cloud computing services.

D. Freedom of Location

Service providers can set up infrastructure in areas with lower overheads and pass on the benefit to the end-user. They can set

up multiple redundant sites, to facilitate business continuity and disaster recovery. This helps the enterprise cut costs further as these contingencies do not have to be taken care of separately.

E. Quality of Service

Network outages can send an IT department scrambling for answers. But in the case of cloud computing, it's up to a company's selected vendor to offer 24/7 customer support and an immediate response to emergency situations. That's not to suggest that outages don't occur. In February 2008, Amazon.com's S3 cloud-computing service experienced a brief outage that affected a number of companies. Fortunately, service was restored within three hours.

F. Minimize Infrastructure Risk

IT organizations can use the cloud to reduce the risk inherent in purchasing physical servers.

If the application's success is short-lived, will the IT organization invest in a large amount of infrastructure that is idle most of the time? When pushing an application out to the cloud, scalability and the risk of purchasing too much or too little infrastructure becomes the cloud provider's issue. In a growing number of cases, the cloud provider has such a massive amount of infrastructure that it can absorb the growth and workload spikes of individual customers, reducing the financial risk they face.

G. Lower Cost of Entry

There are a number of attributes of cloud computing that help to reduce the cost to enter new markets:

1. Because infrastructure is rented, not purchased, the cost is controlled, and the capital investment can be zero. In addition to the lower costs of purchasing compute cycles and storage "by the sip," the massive scale of cloud providers helps to minimize cost, helping to further reduce the cost of entry.
2. Applications are developed more by assembly than programming. This rapid application development is the norm, helping to reduce the time to market, potentially giving organizations deploying applications in a cloud environment ahead start against the competition [6].

H. Increased Pace of Innovation

Cloud computing can help to increase the pace of innovation. The low cost of entry to new markets helps to level the playing field, allowing start-up companies to deploy new products quickly and at low cost. This allows small companies to compete more effectively with traditional organizations whose deployment process in enterprise data centers can be significantly longer. Increased competition helps to increase the pace of innovation — and with many innovations being realized through the use of open source software, the entire industry serves to benefit from the increased pace of innovation that cloud computing promotes [6].

I. High Availability and Reliability

Availability of servers is high and more reliable as the chances of infrastructure failure are minimal [3].

J. Flexibility

Users can end the contract as and when required and thus gain a high level of operational flexibility. The services are usually covered by service level agreements with financial penalties imposed on the service provider if the contracted quality is not provided [3].

K. Reduction in Costs

The cloud obviates the need for each user to invest in stand-alone servers or software that traditionally demand heavy capital investment, but are under-utilized most of the time. Then too, in time, as technological innovations take place, these resources become obsolete and must be replaced with the latest in the field if the enterprise has to operate efficiently – this calls for yet more capital investment. The cloud eliminates the need for such 'replacement' capital expenditure. As many end-users share a cloud, this distributes cost and enables economies of scale in terms of centralization of resources including real estate, bandwidth, and power. Over a period of time, the costs of using cloud computing are bound to come down as more and more users sign up. The enterprise also saves on overheads such as management costs, data storage costs, costs of software updates, quality control etc., and at the same time gains access to necessary services at economical rates [10].

VI. Limitation of Cloud Computing

A. I/O and Scalability Limitations

Virtualized and cloud environments use software emulation to abstract IT resources away from the physical hardware, which comes at a cost. Overhead is incurred because virtual resources have to be mapped to physical resources, including the physical server's buses, I/O adapters and disks. Applications that are I/O-intensive often experience latency issues in a virtualized environment for that reason [2].

B. Fail Over and Fault Isolation

As mentioned earlier, virtualization software enables fail over: the ability to transfer processing from one virtual machine to another virtual machine on a different server in the event of a hardware or application failure (and during scheduled maintenance). Storage capacity may be virtualized as well. Depending on the capabilities of the virtualization or cloud solution you choose, failover may be neither automatic nor instantaneous. Virtualization and cloud software solutions on the market today cannot isolate and then determine the root cause of a hardware or software failure. Even virtualization and cloud solutions that enable high availability or fault tolerance in software are not designed to deal with transient (temporary) hardware errors that can lead to downtime and data corruption when these errors are left unaddressed [2].

C. Data Integrity

The need for data integrity is a trait of application environments that depend on high performance, have a high density of virtual machines or are mission-critical in nature. As just observed, error-handling and problem resolution have a meaningful impact on data integrity. And virtualization or cloud software alone does not provide the complete protection required [2].

VII. Applications

A. Scalable Website

Many websites experience fluctuations in demand – some can predict that demand, some cannot. Either way, the cloud's virtually infinite resources paired with RightScale's autoscaling make a perfect solution [9].

B. Grid Computing

Media transcoding, fraud detection, statistical research – all require batches of multiple "jobs" to process. More the servers, faster the result. The cloud can be used to spread a workload over many more servers than one would be able to access in one's own data center [9].

C. Test & Development

Given the trend toward iterative, agile development, the ability to test and roll out fast can be a competitive differentiator. With the cloud, developers can deploy and test complete production-scale systems on demand in the cloud – saving time and expense over traditional testing scenarios and enabling faster handoff from development to operations [10].

D. Eliminate Lock-in with Cloud Portability

It gives the freedom and flexibility to choose among a variety of development languages, software stacks, data stores and cloud providers. The user can choose the right cloud infrastructure for his unique requirements, whether that involves security and regulatory compliance, geographical location, special features or pricing. The user can manage and migrate deployments across clouds – public or private – so that he may never get locked in to a single provider [10].

VIII. Conclusion

Cloud computing today is the beginning of "network based computing" over Internet in force. It is the technology of the decade and is the enabling element of two totally new computing models, the Client-Cloud Computing and the Terminal-Cloud computing. These new models would create whole generations of applications and business. However, there are no standard, open protocols and discover mechanisms for different kind of clouds. We need a new research method. Also, today clouds are mainly targeting at professionals. How ordinary users, currently the service consumers, can benefit from Cloud Computing may be an issue in future [3].

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