A Survey on Cloud Computing

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Abstract - Today, computing has become steadily more important and more used in day to day life. Cloud computing has appeared as a conventional computing model for processing very large or small volume of data. Cloud computing is an inescapable and vital trend in the future computing development of technology. In this paper, authors have discussed the basics of cloud computing, how it is implemented, terms related to cloud computing, essential characteristics of cloud computing and different types of cloud computing. This paper will also provide an idea of design and challenges of cloud computing along with applications of cloud and also help in identifying vital research directions in this field.

Keywords - Cloud computing, distributed computing, cloud computing issues, Cloud architecture.

1. INTRODUCTION

With the invention of internet, concept of computing has totally changed. Earlier only one processor was used for computing. Later on, concept of parallel computing has enhanced the power of computing. Parallel computing and distributed computing are two ways of utilizing parallelism in computing to achieve higher computational performance. Various processing elements are used to solve multiple problems. Cluster computing, utility computing, grid computing, and cloud computing are some of the various types of distributed computing [1].

In world of Today, computing has become more important and we are getting used to it. The number of amount of data exchanged over the internet or which is stored in a computer is increasing continuously. Thus, the processing of this increasing heap of data requires more computer equipments to fulfil the various needs of organizations [2]. Cloud computing is necessary trend in the future of computing development of technology. It's vital importance lies in its ability to provide all the users with high performance and unfailing calculation. Cloud computing is the growth of distributed computing, grid computing, and several other techniques. In the cloud computing data moves from users end to data centres. By the means of virtualization expertise, one physical host can be virtualized into numerous virtual hosts and these hosts are used as a basic computing unit. [3]. In this paper, author have tried to elaborate the cloud computing architecture along with its merits, demerits, issues and applications in current state of affairs based on the current advances from academic circles. This paper is organized as follows: Section 2 discusses the overview of the cloud environment. Section 3 discusses the kinds of cloud. Section 4 gives details of cloud computing architecture. Challenges in cloud computing has been discussed in section 5. Section 6 gives overview of cloud computing application. Conclusion is given in section 7.

2. CLOUD OVERVIEW

Definition

A *cloud* refers an environment which is designed for the purpose of remotely provisioning scalable and measured IT resources. Cloud is originated as an allegory for the Internet which is, in essence, a network of networks providing remote access to a set of decentralized resources. Prior to cloud computing is becoming its own dignified IT industry segment, Cloud Computing defined as the practice of using a network of remote servers hosted on the Internet to manage, store and process data, rather than a local server or a personal computer. The basic goal of cloud computing is to manage and schedule uniformly computing resources which are connected by a network, and constitute a computational resources group which provides user service according to their wish. The network which provides the resources is known as "cloud". From the end of the user, the resources in "cloud" have no limits, and they can be used at any moment of time [4].

Cloud is also defined as a kind of parallel and distributed system consisting of a collection of interrelated and virtualized computer devices which are dynamically provisioned and presented as one or multiple joined computing resources based on service level agreements (SLA) finalized via intervention between the service providers and customers [5].

Cloud computing is a network based computing technique, which has shared resources, software and information, are provided to user's devices on-demand, like the electricity grid [7].

National Institute of Standards and Technology (NIST) defined the Cloud Computing model by describing its important qualities,

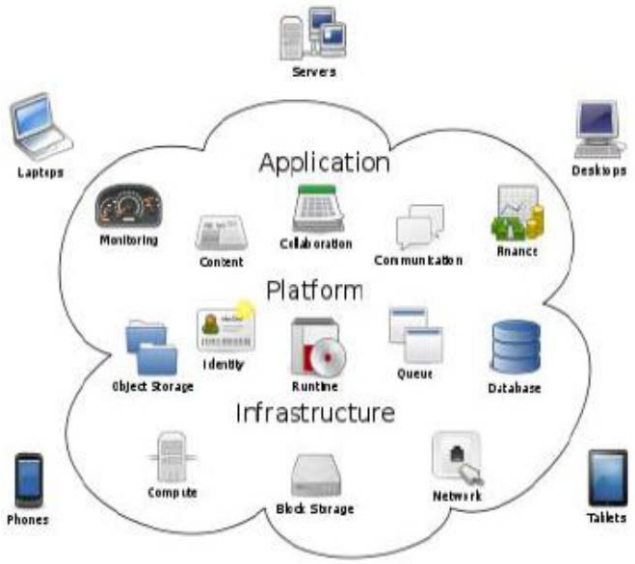

Figure 1: cloud computing [6]

three cloud services models and four cloud deployment models as shown in figure 2 showing its layered architecture.

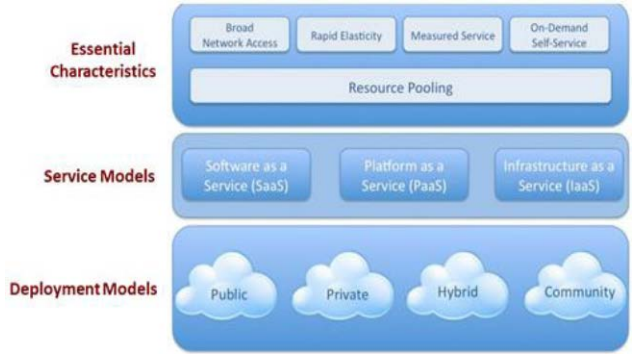

Figure 2: Model of cloud computing [6]

Essential Characteristics

Key features of cloud computing system are given below:

Elasticity and Scalability: Elasticity is capability to enlarge or contract a computing resource in real time, based on the user's computing requirements. Cloud platform can be extended or contract dynamically according to the situation of the application and the total number of the users. *Virtualization:* The most vital characteristic is virtualization in cloud computing. With it, one physical resource could be pretended as multiple virtual resources. Cloud computing provides resources to its users by the help of virtualization ,by this feature provider can run multi application and operating systems on a single physical device by partitioning the current available resources which reduces hardware cost and work load.

Large scale infrastructure: There are more than one thousands of servers in Google's cloud other cloud services platform. So, Cloud computing gives users special computing capabilities.

Ubiquitous: Services of cloud can be accessed through any part of the world any time without human interaction. The only thing required is internet connection to access the service.

Utility based pricing: When customer uses cloud communications that utilizes more resources, they have to pay for using these resources. When the peak load is over, the cloud service provider shrinks its resources, or scales down, to the required resources. At this moment of time, the customer is only paying the reduced infrastructure cost unless paying for extended resources cost

3. CLOUD DEPLOYMENT MODEL

The four cloud computing models are as follows:

Public Cloud: A public cloud is one in which a third-party provider makes resources, such as applications and other computing resources, to the general public via the Internet. It is offered on a pay-per-usage model. The cloud service provider is responsible for setting up the hardware, software, applications, and networking resources. Public clouds do not imply that the user's data is public. In many cases, access control mechanisms are required before the user can make use of cloud resources. The advantage of public clouds is that they allow client to build on-demand virtual systems on almost any scale with minimal in-house hardware [8].

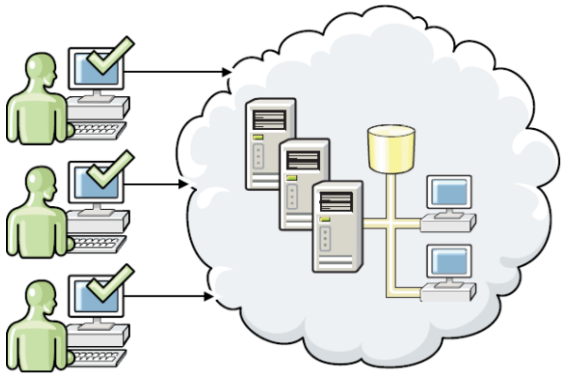

Figure 3: Public cloud [6]

Private Cloud: This type of the cloud is available exclusively for a single organization. Private Cloud intentionally limits access to its resources to service consumers that belong to the same organization that owns the cloud. The infrastructure is managed and operated for one organization only. The main aim is to uphold a consistent level of control over security, privacy, and

governance. With a private cloud, computing resources are pooled and managed internally. This provides for greater efficiencies. Resources can be applied dynamically according to demand. A private cloud allows the enterprise to continue to follow workflow and security procedures. This ensures that the correct level of "code" is executing. These types of clouds are not burdened by network bandwidth and availability issues or potential security exposures that may be associated with public clouds. Private clouds can offer the provider and user greater control, security, and resilience. IBM Smart Business Development and Test Cloud is an example of a private cloud.

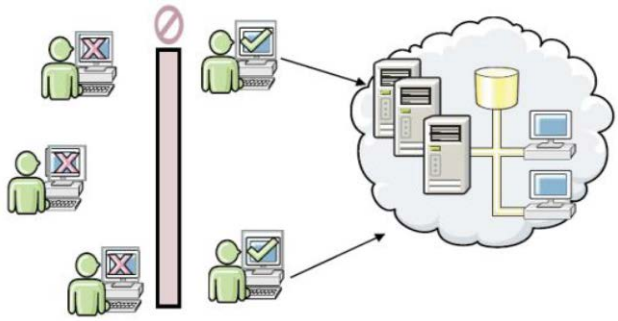

Figure 4: Private cloud [6]

Hybrid Cloud: Hybrid clouds are combinations of public and private clouds that work together. In this model, IT typically outsources noncritical information and processing to the public cloud, while keeping business critical services and data in their control. The hybrid cloud environment works to seamlessly integrate external applications on other private and public clouds, with your in-house processes.

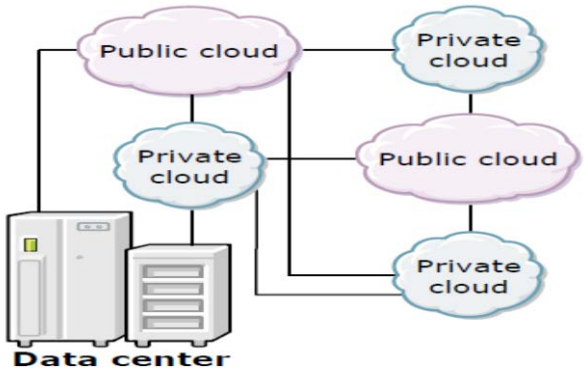

Figure 5: Hybrid cloud [6]

Community Cloud: A community cloud can be a private cloud purchased by a single user to support a community of users, or a hybrid cloud with the costs spread over a few users of the cloud. A community cloud is often set up as a sandbox environment where community users can test their applications, or access cloud resources.

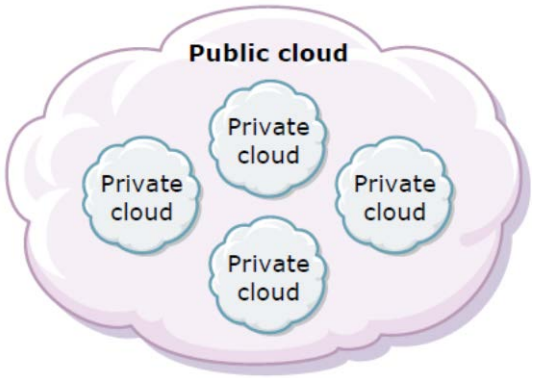

Figure 6: Community cloud [6]

4. CLOUD SERVICE MODEL ARCHITECTURES

There are three kinds of Cloud Services Models and these three basic classifications are referred to as "SPI model" can be stated as software, platform or infrastructure respectively.

Cloud Software as Service: In the software as a service model, the same software is provided to n number of customer by the mean of Internet. The software is no longer available on the consumer's workstation. In SaaS model, the software provider is responsible only for the, updating, maintenance and creation of the software, which includes the responsibility for licensing the software. Customers generally rent the software on usage basis. An example may perhaps be web-based email running on a cloud infrastructure. Examples of SaS are Google Apps such as, Spreadsheets, Salesforce.com and Google Mail etc [6].

Cloud Platform as Service: In this model, the computing platform is available as a service. Customers are capable of testing, and deploying their applications on cloud. The user of the service is responsible for the updating, creating, maintain the application. Customers of PaaS are unable to control the underlying infrastructure as the can do in SaaS, but they can control the deployed applications. Typical example of PaaS are Google App Engine which allows applications to be run on Google's communications, Engine Yard, Force.com, Windows Azure [8].

Cloud Infrastructure as Service: In this service model, the end user can provision essential computer resources like processors, storage and networking resources. An IP(infrastructure provider) makes an complete computing infrastructure available "as a service", more willingly than purchasing the servers, data storage, and networking paraphernalia, customers gives on rent the resources provisioned over the network. Infrastructure services are built on top of a standardized and scalable infrastructure. Examples of IAAS are The Amazon Web Services with its Elastic Compute Cloud (EC2) is an example of IaaS.

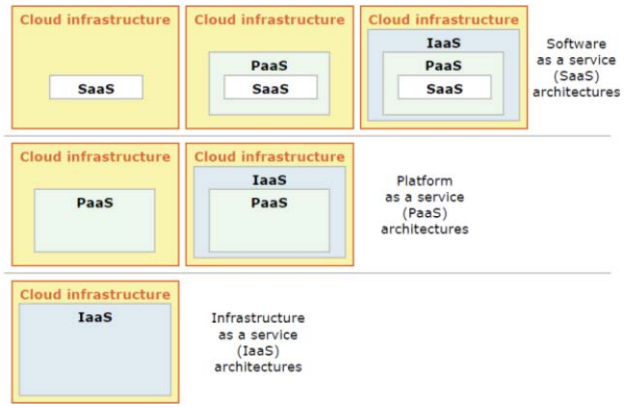

Figure 7: Cloud architecture [6]

5. RESEARCH CHALLENGES

Although cloud computing has been widely adopted. But still its analysis is in its early stages, and some scientific challenges remain unsolved by the scientific community. Some main challenges are:

Security: Due to dynamic scalability, service abstraction, location transparency, openness of cloud and shared virtualized resources by multi-tenant features of cloud computing models it is difficult to maintain data confidentiality, data integrity. So there is need of security model which will increase the consumer's trust in cloud computing service provider. Data security in cloud computing is a contractual and technical issue [10].

Load Balancing: In cloud environment, servers are continuously monitored and when one becomes non responsive then a load balancing mechanism is called to avoid system failure. There is a need of efficient load balancing strategy which will ensure the virtualization, availability, even load distributions in data center and elasticity. This will improve the customer satisfaction level and help service provider to achieve scalability [11].

Stored data management: There is an exponential increase in data stored across the network due to data outsourcing. So the stored data management has become a main challenge for successful implementation of cloud computing. How can we distribute the data to the cloud for optimum storage of data while maintaining fast access [12].

Automated service provisioning: Elasticity is the most important feature of cloud environment. Due to this feature resources can be allocated or released according to demand. How then can we use or release the resources of the cloud, by keeping the same performance as traditional systems and using optimal resources.

Energy Management: Efficient utilization of energy is another big challenge in cloud environment. It has been estimated that the cost of powering and cooling accounts for 53% of the total operational expenditure of data centers**.** So cloud service providers are under huge pressure to decrease energy use. The objective is not only to cut down energy cost in data centers, but also to fulfill government regulations and environmental standards [12].

6. PROS, CONS & APPLICATIONS

Advantages

Pay as per usage: From client's perspective, utility-based payment model allows client to only use the amount of service they actually need, and only pay for the amount of service they have actually used. Also these services are available in uninterrupted manner.

Zero upfront investment: From service provider's perspective, there is no requirement for up-front investment in hardware and software. It just leases resource from the cloud as per requirement and pay for the usage. So working expenditure is the only expenditure and maintenance headache is very less.

Less Operational Cost: Flexibility and scalability of a cloud environment is also an added advantage for cloud and service provider. It enables easy and fast scaling of required computing resources on demand. This results in large saving as resources can be freed to minimize operating costs when service requirement is low.

Disadvantages

When a client wants to use cloud it requires an upfront investment in the combination of the client's infrastructure and applications with a Cloud.

Due to unavailability of standards for the IaaS, PaaS, and SaaS interfaces, it becomes very difficult to choose cloud provider.

Client has to depend on the promise of the service provider in context of availability, security, reliability, performance and Quality of the Service (QoS) of the resources.

Client is not aware of the actual server on which his data is stored or processing.
To use cloud's services, user has to transfer his own data on cloud. So due to transfer data back and forth there is a higher security and privacy risks related to data.

Applications

There are many different areas where cloud computing have applications. Some major areas in which cloud computing have applications are:

Document processing: It can be used to convert very large collections of documents from one format to another (e.g., from *Word* to *PDF*), or encrypts the documents.

Video trans-coding: It can be used to convert one video format to another.

Image processing: The image-processing application support image conversion (e.g., enlarging an image or creating thumbnails). It can also be used to compress or encrypt images.

Data mining: It can support searching very large collections of records to locate items of interests.

Report Generation: It has applications in daily basis, weekly basis, monthly basis, and annual basis activity reports generations for organizations in retail, manufacturing, and other economic sectors [13].

7. CONCLUSION

Cloud computing is a latest technology extensively studied in present years. It is a model through which IT services are delivered and charged on the basis of usage.

But still present technologies are not developed enough to utilize its full capacity. There are many untouched issues in this domain, including security management, stored data management, load balancing, automatic service provisioning and energy management have just started to receive attention from academician and industry. So, we believe that still there is a wide scope of research in this field.

Our proposed taxonomy will help researcher to understand cloud computing architecture along with its strength, weakness

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