Elementary Idea And Issues Of Cloud Computing

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***ABSTRACT*:** *Cloud computing is the latest effort in delivering computing resources as a service. Cloud computing is attractive to business owners as it eliminates the requirement for users to plan ahead for provisioning, and allows enterprises to start from the mall and increase resources only when there is a rise in service demand. It is the growing acceptance of innovative technologies that has seen cloud computing become the biggest buzzword in IT. The development of cloud computing technology is currently at its infancy, with many issues still to be addressed. In this paper, we present a survey of cloud computing, highlighting its key concepts, architectural principles, and state-of-the-art implementation as well as research challenges. The aim of this paper is to provide a better understanding of the design challenges of cloud computing and identify important research directions in this increasingly important area.*

***KEYWORDS*:**
Cloud Computing, SaaS, Paas, IaaS, virtualization, utility computing, Grid computing, Autonomic computing.

I. INTRODUCTION

Cloud computing is the next generation in computation. Maybe Clouds can save the world, possibly people can have everything they need on the cloud. Cloud computing is the next natural step in the evolution of on-demand information technology services and products. The Cloud is a metaphor for the Internet, based on how it is depicted in computer network diagrams, and is an abstraction for the complex infrastructure it conceals. It is a style of computing in which IT-related capabilities are provided "as a service", allowing users to access technology-enabled services from the Internet (i.e., the Cloud) without knowledge of, expertise with, or control over the technology infrastructure that supports them. Economically, the main appeal of cloud computing is that customers only use what they need, and only pay for what they actually use. Resources are available to be accessed from the cloud at any time, and from any location via the internet. There is no need to worry about how things are being maintained behind the scenes; you simply pay for the IT service you require as you would do to any other utility.

II. WHAT IS CLOUD COMPUTING??

As a metaphor for the Internet, "the cloud" is a familiar cliché, but when combined with "computing," the meaning gets bigger and fuzzier. We can understand it more clearly by an example- Let's say you're an executive at a large corporation. Your particular responsibilities include making sure that all of your employees have the right hardware and software they need to do their jobs. Buying computers for everyone isn't enough -- you also have to purchase software or software licenses to give employees the tools they require. Whenever you have a new hire, you have to buy more software or make sure your current software license allows another user. It's so stressful that you find it difficult to go to sleep on your huge pile of money every night. Soon, there may be an alternative for executives like you. Instead of installing a suite of software for each computer, you'd only have to load one application. That application would allow workers to log into a Web-based service which hosts all the programs the user would need for his or her job. Remote machines owned by another company would run everything from e-mail to word processing to complex data analysis programs. It's called **cloud**

computing, and it could change the entire computer industry.

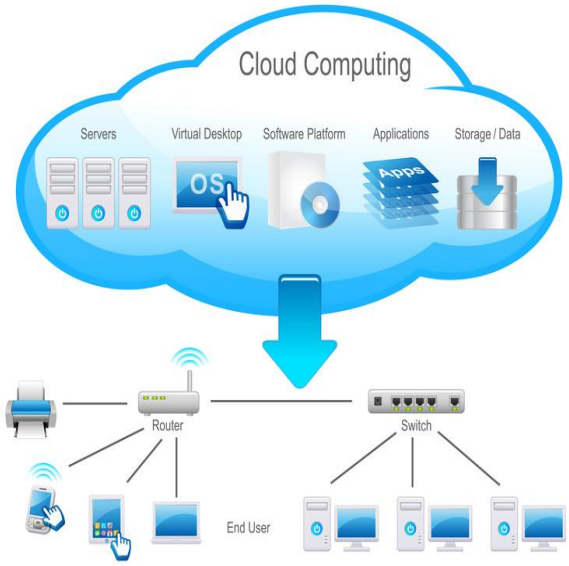

Figure. Cloud Computing Network

III. RELATED TECHNOLOGIES

Cloud computing is often compared to the following technologies, each of which shares certain aspects with cloud computing:

A. Grid Computing:-

Grid computing (or the use of a computational grid) is applying the resources of many computers in a network to a single problem at the same time - usually to a scientific or technical problem that requires a great number of computer processing cycles or access to large amounts of data. A well-known example of grid computing in the public domain is the ongoing SETI (Search for Extraterrestrial Intelligence) @Home project in which thousands of people are sharing the unused processor cycles of their PCs in the vast search for signs of "rational" signals from outer space. Grid computing requires the use of software that can divide and farm out pieces of a program to as many as several thousand computers.

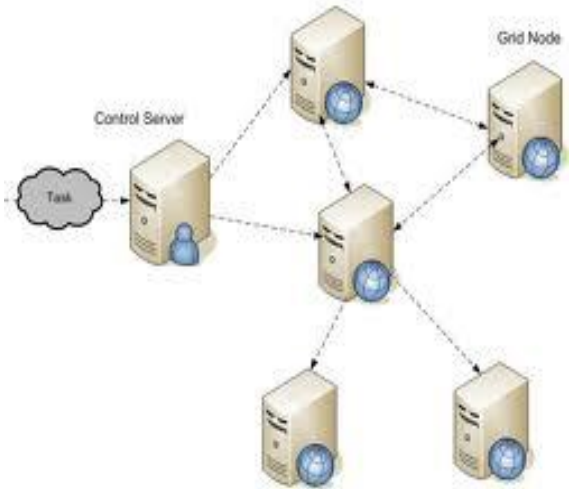

Figure. Grid Computing

B. Utility Computing:-

Utility computing is a service provisioning model in which a service provider makes computing resources and infrastructure management available to the customer as needed, and charges them for specific usage rather than a flat rate. Like other types of on-demand computing (such as grid computing), the utility model seeks to maximize the efficient use of resources and/or minimize associated costs.

C. Virtualization:-

In computing, virtualization means to create a virtual version of a device or resource, such as a server, storage device, network or even an operating system where the framework divides the resource into one or more execution environments. Even something as simple as partitioning a hard drive is considered virtualization because you take one drive and partition it to create two separate hard drives. Devices, applications and human users are able to interact with the virtual resource as if it were a real single logical resource.

D. Autonomic Computing:-

Autonomic computing is a self-managing computing model named after, and patterned on, the human body's autonomic nervous system. An autonomic computing system would control the functioning of computer applications and systems without input from the user, in the same way that

the autonomic nervous system regulates body systems without conscious input from the individual. The goal of autonomic computing is to create systems that run themselves, capable of high-level functioning while keeping the system's complexity invisible to the user.

IV. ESSENTIAL CHARACTERSTICS OF CLOUD COMPUTING

At the most fundamental level, cloud computing provides flexible real---time access to a shared pool of computing resources (e.g., networks, servers, storage, applications, and services). Indeed, one of the main attractions of cloud computing is its capability to provide on---demand IT resources and services offering rapid provision and de-provisioning as well as "pay by the drink" pricing.

In its definition of cloud computing, The National Institute of Standards and Technology (NIST) describes cloud computing as having the following essential characteristics:

A. On demand self service:-

On-demand self service refers to the service provided by cloud computing vendors that enables the provision of cloud resources on demand whenever they are required. In on-demand self service, the user accesses cloud services through an online control panel.

B. Broad network access:-

Broad network access refers to resources hosted in a private cloud network (operated within a company's firewall) that are available for access from a wide range of devices, such as tablets, PCs, Macs and Smartphone. These resources are also accessible from a wide range of locations that offer online access.

C. Resource Pooling:-

The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.

D. Rapid Elasticity:-

Elasticity is defined as the ability to scale resources both up and down as needed. To the consumer, the cloud appears to be infinite, and the consumer can purchase as much or as little computing power as they need.

E. Measured Service:-

In a measured service, aspects of the cloud service are controlled and monitored by the cloud provider. This is crucial for billing, access control, resource optimization, capacity planning and other tasks.

V. EVOLUTION OF CLOUD COMPUTING

Enterprise organizations will likely experiment with cloud computing, carefully choosing projects that benefit from cloud's features and cost benefits as they develop more formal cloud computing strategies. This evolution has already begun as enterprise businesses take a "crawl, walk, run" approach that builds toward an eventual cloud implementation. Figure below depicts an IT progression that begins with basic use of server virtualization, evolves into responsive and dynamic internal IT, and finally advances to cloud computing.

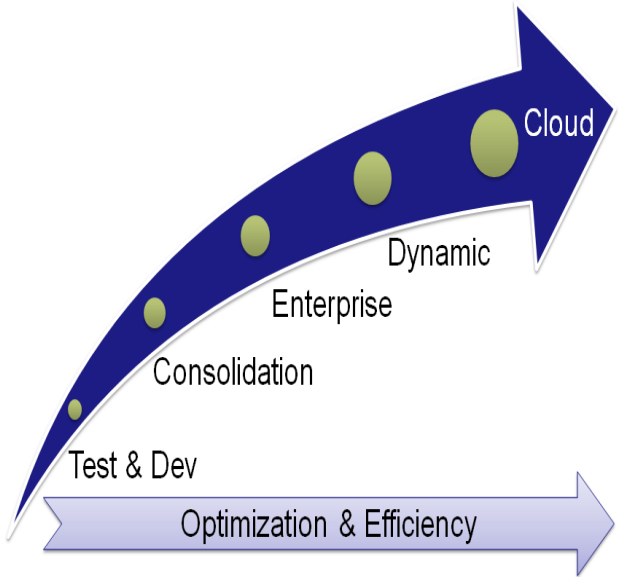

Figure. Cloud Computing Migration Phases

The phases of the model include:

A. Test and development:-

This phase introduces cloud for proof-of--concept use. During this initial phase, IT becomes comfortable with server virtualization and gains experience with system performance, application response times, and technology stability.

B. Consolidation:-

This phase is highlighted by the migration of physical servers to virtual machines—typically referred to as P2V. At this point, IT rapidly moves workloads that have been identified as viable candidates and gives them the green light for production usage on the virtualized infrastructure.

C. Enterprise:-

This phase is a significant milestone where the business chooses a virtualization platform for mission critical applications, standardizes data protection, implements disaster recovery, automates routine tasks, and meets SLAs. The goal in this phase is a near 100% virtualized data center.

D. Dynamic.:-

In this phase, the IT infrastructure is tightly integrated with IT and business processes. As administrators apply security, performance, and availability policies, the virtualization platform responds automatically without manual interaction. This is the really the beginning of a true private cloud.

E. Cloud:-

The cloud or final phase provides a real--time consumption model that meets the descriptions and definitions detailed previously. At this phase, business owners only pay for what they consume and can quickly provision and decommission resources as needed. Control shifts into the hands of the application owner, allowing for management of an extremely fluid environment that instantaneously responds to change across distributed resources regardless of whether they are owned or leased from/hosted by a third party. This entire process is completely transparent to the application and its administrators.

VI. CLOUD DEPLOYMENT STRATEGIES

This section explains the basic cloud deployment strategies. A cloud can be deployed using any of the below mentioned strategies.

A. Public Cloud:-

A **public cloud** is one based on the standard cloud computing model, in which a service provider makes resources, such as applications and storage, available to the general public over the Internet. Public cloud services may be free or offered on a pay-per-usage model. Applications, storage, and other resources are made available to the general public by a service provider. There are limited service providers like Microsoft, Google, etc., who own all infrastructure at their Data Center and the access will be through Internet mode only.

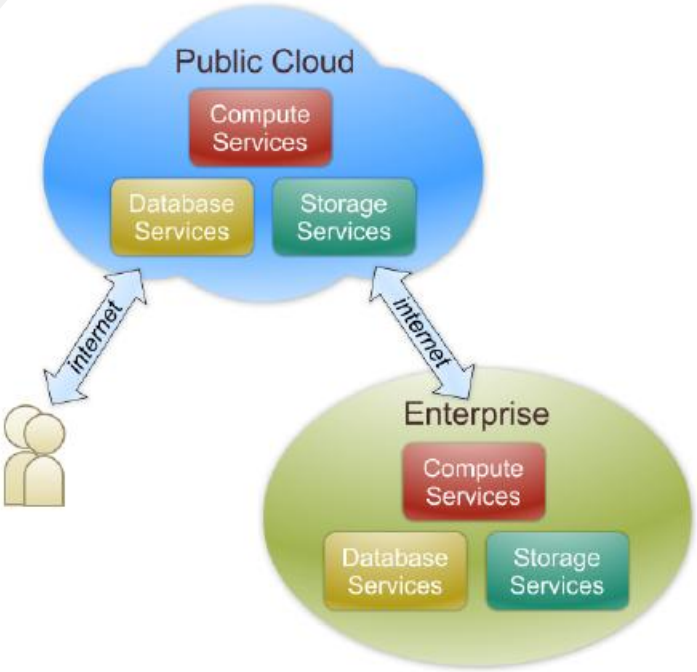

Figure. Public Cloud

B. Private Cloud:-

The phrase used to describe a cloud computing platform that is implemented within the corporate firewall, under the control of the IT department. A private cloud is designed to offer the same features and benefits of public cloud systems, but removes a number of objections to the cloud computing model including control over enterprise and customer data, worries about security, and issues connected to regulatory compliance.

C. Community Cloud:-

A community cloud is a cloud service model that provides a cloud computing solution to a limited number of individuals or organizations that is governed, managed and secured commonly by all the participating organizations or a third party managed service provider.

D. Hybrid Cloud:-

A hybrid cloud is an amalgamation of at least one private cloud and at least one public cloud. Although the elements of the hybrid cloud are bound together, they remain unique entities, which allow hybrid clouds to offer the benefits of multiple deployment models at once. A hybrid clouds offers a cloud-computing environment in which an organization provides and manages some resources in-house and has other resources provided externally. For example, an organization might elect to use a public cloud service for its archived data but keep the maintenance of its operational customer data in-house.

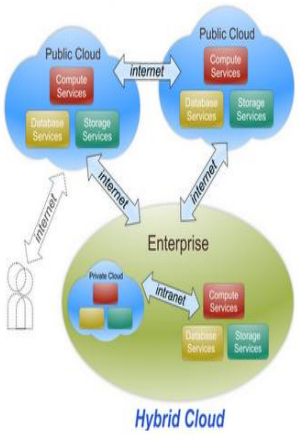

Figure. Hybrid Cloud

VII. CLOUD SERVICE MODEL

In order to create the illusion of infinite resources and elasticity, virtualization technology is needed. Depending on how abstracted resources are, different service models are differentiated.

A. Software-as-a-Service (SaaS):-

Software as a service (or SaaS) is a way of delivering applications over the Internet—as a service. Instead of installing and maintaining software, you simply access it via the Internet, freeing yourself from complex software and hardware management.

SaaS applications are sometimes called Web-based software, on-demand software, or hosted software. Whatever the name, SaaS applications run on a SaaS provider's servers. The provider manages access to the application, including security, availability, and performance.

B. Platform-as- a-Service (PaaS):-

Platform as a Service (PaaS) is a way to rent hardware, operating systems, storage and network capacity over the Internet. The service delivery model allows the customer to rent virtualized servers and associated services for running existing applications or developing and testing new ones.

C. Infrastructure-as-a-Service (IaaS):-

Short for Infrastructure as a Service, IaaS is defined as computer infrastructure, such as virtualization, being delivered as a service. IaaS is popular in the data centre where software and servers are purchased as a fully outsourced service and usually billed on usage and how much of the resource is used - compared to the traditional method of buying software and servers outright. May also be called enterprise-level hosting platform.

VIII. A LAYERED MODEL OF CLOUD COMPUTING:-

Generally speaking, the architecture of a cloud computing environment can be divided into 4 layers: the hardware, the infrastructure layer, the platform layer and the application layer.

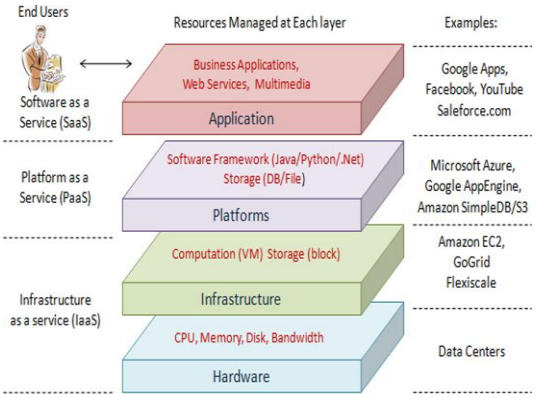

Figure. Cloud computing architecture

A.The hardware layer:-

This layer is responsible for managing the physical resources of the cloud, including physical servers, routers, switches, power and cooling systems. In practice, the hardware layer is typically implemented in data centres. A data centre usually contains thousands of servers that are organized in racks and interconnected through switches, routers or other fabrics. Typical issues at hardware layer include hardware configuration, fault tolerance, traffic management, power and cooling resource management.

B. The infrastructure layer:

Also known as the virtualization layer, the infrastructure layer creates a pool of storage and computing resources by partitioning the physical resources using virtualization technologies such as Xen, KVM and VMware. The infrastructure layer is an essential component of cloud computing, since many key features, such as dynamic resource assignment, are only made available through virtualization technologies.

C. The platform layer:

Built on top of the infrastructure layer, the platform layer consists of operating systems and application frameworks. The purpose of the platform layer is to minimize the burden of deploying applications directly into VM containers. For example, Google App Engine operates at the platform layer to provide API support for implementing storage, database and business logic of typical web applications.

D. The application layer:

At the highest level of the hierarchy, the application layer consists of the actual cloud applications. Different from traditional applications, cloud applications can leverage the automatic-scaling feature to achieve better performance, availability and lower operating cost.

IX. CHALLENGES & ISSUES:-

In this section we explain the challenges & issues cloud computing has to face. As a lot of economics is tied to this field it will be better that these issues are resolved as early as possible.

A. Security

The most compelling challenge for someone attempting to switch from their existing computing module to the cloud is to ascertain how secure cloud computing is. Aficionados of conventional computing often allege that the extensive use of virtualization, which is a fundamental tenant of cloud computing, only adds viable security risks. Virtualization software might be compromised which could jeopardize the entire infrastructure which includes cloud computing, storage and networking.

In defence of cloud computing, and to negate these claims, it is pertinent to mention that cloud computing is comprised of a comprehensive set of defensive implementations. These implementations or security controls are derived keeping in view hurdles which might occur, as well as to shield the cloud architecture against an external or internal threat. The security control suite consists of deterrent controls, corrective controls, preventive controls and detective controls. The stringent implementation of these meticulously crafted security measures with respect to asset, vulnerability and threat assessment matrices makes cloud computing a totally secure gambit.

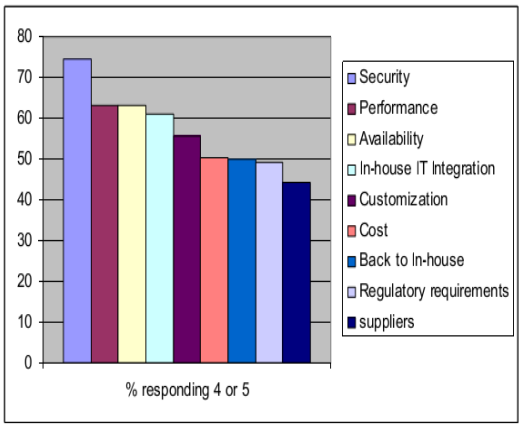

Figure. Graph depicting the concerns of clients on
Cloud computing issues.

B. Performance

Any enterprises adopting cloud computing services certainly expect the kind of improved performance that an elastic computing environment should provide.

But cloud services are not perfect. Through limitations such as still-evolving technologies and the confines of bandwidth, questions about performance are sure to arise in even the most efficient, well-designed cloud environment.

Inherent cloud tenants that like increased availability, on-demand resource provisioning and scalability are all designed to deliver peak performance and enhance the overall usability of applications and data hosted in the cloud. The most common mistake that people make is equating application performance issues with cloud computing environment. When a cloud computing subscriber selects a cloud computing flavor not well aligned with their business module, the performance is, at best, degraded. However, that does not mean that from time to time some performance issues that are totally centric to cloud computing environment do not arise.

C. Cost:-

Pay-As-You-Go is the unique payment method introduced by cloud computing. This method entails that the subscriber is only charged for the resources consumed (e.g. bandwidth consumed, storage used, or enhanced processor time requested). Utilizing cloud computing also renders maintaining on-premises optimized hardware, having a team on site to maintain it and worrying about managing costly software licenses. Needless to say that all of these aspects are considerable cost savers!

D. Privacy regulations:-

The proposal to use of cloud computing in India has raised many regulatory and security concerns. Without meeting these regulatory and security concerns, software as a service (SaaS) and cloud computing should not be used in India. In fact, cloud computing in India must be techno legal in nature and till it meets the techno legal requirements, it should not be used in India.

Besides regulatory framework for cloud computing in India we must also ensure high availability levels, appropriate data erasing mechanisms, data privacy at the service provider's level, export restrictions upon data, data handling monitoring mechanisms, jurisdictional issues, cloud computing security issues, licensing issues for cloud computing, etc.

Till now we have no cloud computing policy of India. There is no cyber security in India and even cyber security policy of India is missing. There is no privacy law in India. There is no data protection law in India. And there is no data security law in and cyber security law in India. In short, there is no legal framework for cloud computing in India at all.

E. Availability:-

The fact of the matter is that making applications highly available is hard. It requires highly specialized tools and trained staff. On top of it, it's expensive. Many companies are required to run multiple data centers due to high availability requirements. In some organizations, some data centers are simply on standby, waiting to be used in a case of a failover. Other organizations are able to achieve a certain level of success with active/active data centers, in which all available data centers serve incoming user requests. While achieving high availability for services is relatively simple, establishing a highly available database farm is far more complex. In fact it is so complex that many companies establish yearly tests to validate failover procedures.

To a certain degree certain IaaS provides can assist with complex disaster recovery planning and setting up data centers that can achieve successful failover. However the burden is still on the corporation to manage and maintain such an environment, including regular hardware and software upgrades. Cloud computing on the other hand removes most of the disaster recovery requirements by hiding many of the underlying complexities.

F. Bandwidth requirement:-

When you move an application onto a platform in the cloud, you will be paying utility-style prices, which are "pay as you go." Thus, you need to estimate those costs up front. In addition, you'll need to estimate whether the additional load on your connectivity will require a bigger pipe. Here's how to do it.

Putting an application into the cloud can happen in at least two ways. You can do it as Software as a Service (SaaS) or you can put it on a Platform as a Service (PaaS). If it's SaaS, such as hosted Exchange, you'll usually be charged for the service, not for the underlying processor, storage and bandwidth. But if you put an application on a platform, you will be charged for those underlying items. This article addresses how to estimate bandwidth when you're putting an application onto a platform. It also shows you how to estimate the load on your connectivity.

Bandwidth is usually measured in one of two ways, and both of them are needed when moving to the cloud. Measuring total usage in kilobits (or Megabits) per second will tell you what size Internet access connection you need. Measuring bandwidth in total number of Megabytes sent and received by the server per month will predict your charges from the cloud provider.

G. Quality of Service:-

Quality of Service (QoS) plays a critical role in the affective reservation of resources within service oriented distributed systems and has been widely investigated in the now well established paradigm of Grid Computing. The emergence of a new paradigm, Cloud Computing, continues the natural evolution of Distributed Systems to cater for changes in application domains and system requirements. Virtualization of resources, a key technology underlying Cloud Computing, sets forth new challenges to be investigated within QoS and presents opportunities to apply the knowledge and lessons learnt from Grid Computing. QoS has been an issue in many of the Distributed Computing paradigms, such as Grid Computing and High Performance Computing. The aim of this paper is to address QoS especially in the context of the nascent paradigm Cloud Computing and propose relevant research questions. The objectives of this paper are to discuss the confusion surrounding the term "Cloud", the current consensus of what Cloud Computing is and the legacy bequest by Grid Computing to this emergent paradigm. Emphasis is placed on the state of QoS provisioning in Grids and the technology to enable it in Cloud Computing. Finally open research questions within QoS relevant to Cloud Computing are proposed and the direction of various future researches is envisioned.

H. Data Limits:-

Cloud storage is a model of networked online storage where data is stored in virtualized pools of storage which are generally hosted by third parties. Hosting companies operate large data centers, and people who require their data to be hosted buy or lease storage capacity from them. The data center operators, in the background, virtualized the resources according to the requirements of the customer and expose them as storage pools, which the customers can themselves use to store files or data objects. Physically, the resource may span across multiple servers. The safety of the files depends upon the hosting websites.

I. Major Suppliers:-

There are many companies expecting to number among those 10 or 20 major suppliers are Amazon and IBM. Amazon is developing a cloud model that relies on third-party suppliers operating within its cloud environment. IBM has just joined the OpenStack Foundation, an open source initiative that will create a foundation to develop open source cloud software. The company intends to offer a complete range of software services in the cloud.

Smaller suppliers are offering pure cloud storage. Companies such as Rackspace, MediaFire, and ElephantDrive let you back up or store your files on their systems and access them from anywhere. Some offer basic additional functions, such as sharing, but the emphasis is on pure storage.

X. FUTURE SCOPE:-

The cloud has the potential to become the preferred mechanism for software delivery, bringing more choices to organizations when selecting an application provider, and resulting in fewer reasons to maintain their own applications on-premise. Compare that to 2012 - today, if you use on-premise business application suites like SAP or Oracle, you're effectively tied to those applications.

Looking ahead to 2013, we are going to see more and more organizations seeking alternatives to on-premise deployments. As such, cloud adoption will increase dramatically; and when moving to the cloud, businesses will need to think carefully about how they will ensure that cloud providers can meet promised service-level agreements (SLAs).

XI. CONCLUSION:-

We've looked at the basics of cloud. There are interests and concerns in the cloud. From a technology point of view, there are interesting technical problems to solve. From a service or consumer point of view, there are essential usability, stability, and reliability problems to solve.

However, despite the significant benefits offered by cloud computing, the current technologies are not matured enough to realize its full potential. Many key challenges in this domain, including automatic resource provisioning, power management and security management, are only starting to receive attention from the research community. Therefore, we believe there is still tremendous opportunity for researchers to make groundbreaking contributions in this field, and bring significant impact to their development in the industry.

One of the other aspects of the cloud which is left is the social aspect of it. The Cloud is going to happen but which services should be offered on the cloud and for whom. What happens if smaller IT companies start to offer their services on the cloud and no one uses them?! I believe that everything eventually can move to the Cloud. The question is if users are ready for that and if it's the right move and this need must be addressed.

ACKNOWLEDGEMENT

To complete this work, we have got valuable suggestions and guidance from Mr. Ashish Sharma (HOD, Dept. of computer science, MAIIT, Kota).I also thankful to all the researcher and authors of the manuscript from where I got valuable information for completing the work.

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