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CRITIQUE ON CLOUD COMPUTING

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Abstract - Cloud computing is a recently emerging paradigm of distributed computing One of the giant steps towards this world was taken in mid 1990s when grid computing was first coined to allow users to obtain computing power on demand. The origin of cloud computing can be seen as an evolution of grid computing technologies. Many cloud applications are gaining popularity day by day for their availability, reliability, elasticity and utility model. These applications made distributed computing easy as the critical aspects are handled by the cloud provider itself. Technologies such as cluster, grid, and now, cloud computing, have all aimed at providing access to large amounts of computing facility in a fully virtualized manner, by providing resources and offering a virtual system view and delivering computing as a utility. Utility computing describes about a business model for on-demand delivery of computing power; consumers pay based on usage ("pay-per-use"), Cloud computing has been coined as an umbrella term to describe a on-demand computing services offered by commercial providers, such as IBM,Amazon, Google, and Microsoft etc. It denotes a model on which a computing infrastructure is appeared as a "cloud," from which enterprises and individuals users access applications from remotely on demand. The main principle behind in this model is offering Infrastructure, Platform and Software "as a service."

I. INTRODUCTION

The cloud is essentially a bunch of commodity computers networked together in same or different geographical locations, operating to serve a number of customers with different need and workload on demand basis with the help of virtualization. Cloud services are provided to the cloud customer as utility services like electricity, telephone using pay-as-you-go business model. These utility services are described as Software or Platform or Infrastructure as a service etc. Cloud customers use these services provided by the cloud providers and build their applications in the Internet and thus deliver them to their users. So the cloud users no need to installing, maintaining hardware and software needed. And they also can utilize these services as they have to pay as much they use. So the cloud users can reduce their expenses ,maintenance cost and effort in the field of IT using cloud services instead of establishing IT infrastructure themselves.

Cloud is generally provided by large distributed data centers. These data centers are generally organized as grid and the cloud is built on top of these services. Cloud users are provided with virtual images of the physical machines in the data centers. This visualization is one of the key concept of cloud computing as it essentially builds the abstraction over the physical system

II. ROOTS OF CLOUD COMPUTING

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The main roots of clouds computing can be analyzed by finding the advancement of several technologies, hardware virtualization, Internet technologies (Web services, service-oriented architectures, Web 2.0), distributed computing techniques(clusters, grids), and systems management services (autonomic computing,. Figure 2.1 shows the convergence of technology fields that mainly advanced and contributed to the of cloud computing.

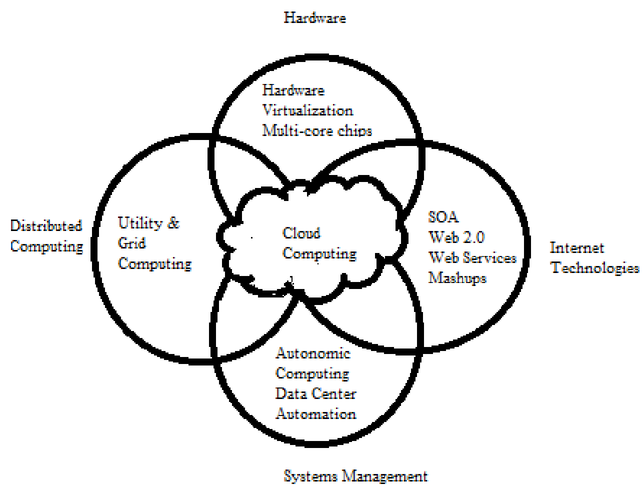

Figure 2.1The advent of cloud computing (Roots of Cloud computing)

From Mainframes to Clouds

The mainframe paradigm is overcomes with the advent of fast and inexpensive microprocessors and IT data centers moved to collections of large number of high configured servers. Apart from its clear advantages, this new model inevitably led to isolation of workload into specific servers, mainly due to incompatibilities between software stacks and operating systems [6]. We are currently experiencing a technique in the IT world, from in-house generated computing capability into utility-supplied computing resources delivered over the Internet as Web services.

SOA, Web Services, Web 2.0, and Mashups

The evolution of Web services (WS) open standards has significantly contributed to advances in the domain of software integration [7]. Web services can glue together applications running on different messaging product platforms, enabling information from one application to be made available to others, and enabling internal applications to be made available over the Internet. Web services standards created on top of existing ubiquitous technologies such as HTTP and XML, thus providing a mechanism for delivering services, making them ideal for implementing a service-oriented architecture (SOA). The main use of a SOA is to address requirements of loosely coupled, standards-based, and protocol-independent distributed computing.

Grid Computing

Grid computing enables collection of distributed resources and transparently access to them. Most production grids such as TeraGrid [8] and EGEE [9] seek to share compute and storage resources distributed across different administrative domains, with their main focus is being speeding up a broad range of scientific applications, such as climate modeling, drug design, and protein analysis techniques. A key aspect of the grid vision realization has been building standard Web services-based protocols which allow distributed resources to be “discovered, accessed, allocated, monitored, accounted, and billed etc., and in general managed as a single virtual system.” The Open Grid Services Architecture (OGSA) addresses this need for best standardization by defining a set of core capabilities and behaviors that address key concerns in grid systems.

Utility Computing

In utility computing paradigm, users assign a “utility” value to their jobs, where utility is a fixed or time-varying valuation that collects various QoS constraints (deadline, importance, satisfaction). The valuation is the amount they are wanted to pay a service provider to satisfy their demands. Service Providers can choose to prioritize high yield (i.e., profit per unit of resource allocated) user jobs, leading to a situation where shared systems are viewed as a marketplace for applications, where users compete for resources based on the value of their jobs.

Hardware Virtualization

Cloud computing services are usually a collection of large-scale data centers composed of thousands of computers. These data centers are built to serve many users and host many applications. For this purpose, hardware virtualization can be considered as a solution to overcome most operational issues of data center building and maintenance. The concept of virtualizing is , a collection of computer system’s resources, including processors, memory, and I/O devices, has been well established for many years, aiming at sharing and utilization of computer systems [10]. Hardware virtualization allows running many OSs and softwares on a single platform to complete applications. As represented in Figure 2.2, there is a software layer, the virtual machine monitor (VMM), also called as a hypervisor, is an interface to access the physical hardware presenting to each guest operating system in a virtual machine (VM), which is a set of virtual platform interfaces [11].

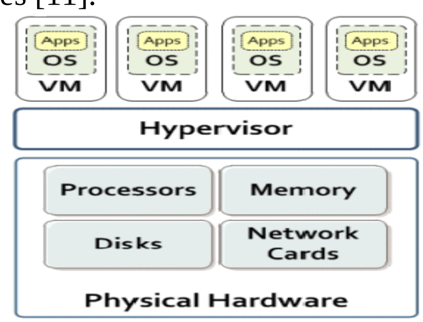

Figure 2.2 A hardware virtualized server hosting three virtual machines

Autonomic Computing

In the increasing complexity of computing systems has motivated research on autonomic computing, which seeks to improve systems by decreasing human work in their operation. In other words, systems should manage themselves, with high-level guidance from humans [12]. Autonomic, or self-managing, systems rely on monitoring probes and gauges (sensors), on an adaptation engine for computing optimizations based on monitoring data, and on effectors to carry out changes on the system. IBM’s Autonomic Computing era has contributed to define the four properties of autonomic systems: self-configuration, self-optimization, self-service, self-healing, and self-protection. IBM has also suggested a model for autonomic control loops of autonomic managers, called Monitor Analyze Plan Execute—Knowledge (MAPE-K) [12, 13]..

III. LAYERS AND TYPES OF CLOUDS

Cloud computing services are divided into three basic classes, according to the abstraction level of the capability provided and the service model , namely: (1) Infrastructure as a Service, (2) Platform as a Service, and (3) Software as a Service [3]. Figure 3.1 depicts the layered organization of the cloud stack from physical infrastructure to applications. These abstractions can also be viewed as a layered architecture where services of a higher layer can be composed from services of the underlying layer [14]. Cloud development environments are built on top of infrastructure services to offer development of application and deployment capabilities; in this level, various programming models, libraries, and APIs enable the creation of a range of business applications, Web, and scientific applications. Once deployed in the cloud, these applications can be consumed by end users.

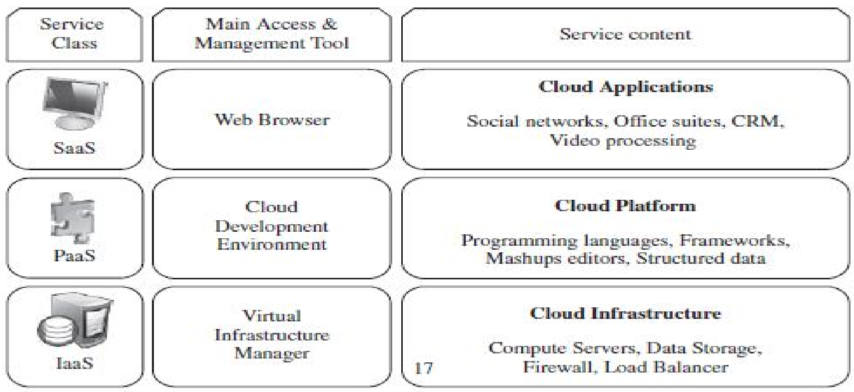

Figure 3.1 The Cloud Computing Stack.

Infrastructure as a Service

Offering virtualized resources such as computation, storage, and communication on demand is known as Infrastructure as a Service (IaaS) [4]. A cloud infrastructure enables on-demand provisioning of servers running several choices of different operating systems and customized software. Infrastructure services are considered to be the bottom layer of cloud computing systems [15].

Platform as a Service

The on the top of infrastructure as a services clouds that provide raw computing and storage services, another approach is to offer a higher abstraction to make a cloud easily computable, known as Platform as a Service (PaaS). A cloud platform offers a place on which developers can create and deploy applications and do not necessarily need to know how many processors/servers or how much memory/space that applications will be using. In addition, multiple programming models and special services (e.g., data access, authentication, and payments) are offered as building blocks to new applications [16].

Software as a Service

All the applications reside on the top of the cloud stack. Services provided by this layer can be accessed by end users through Web sites. Therefore, consumers are increasingly shifting from locally installed computer programs to on-line software services that offer the same type of functionally. Traditional desktop applications such as word processing can now be accessed as a service in the Web portal. This model of delivering applications, known as Software as a Service (SaaS), The burden of software maintenance and management for customers and simplifies development and testing for providers [14, 17].

IV. DEPLOYMENT MODELS

The cloud computing has emerged mainly from the appearance of public computing utilities, other deployment models, with changes in physical location and distribution, have been adopted. In this sense, regardless of its service class, a cloud can be public, private, community, hybrid [3]

Public Clouds

A public cloud is a available to general public, so it is publicly accessible cloud environment owned by a third-party cloud provider. The IT resources on these clouds are usually supply via the previously described cloud delivery models and are offered to cloud costumers at a cost or commercialized via other avenues (such as advertisement).The cloud vendor is responsible for the creation and maintenance of the public cloud and its IT resources. Figure 4.1 shows a partial view of the public cloud, highlighting some of the primary vendors in the marketplace

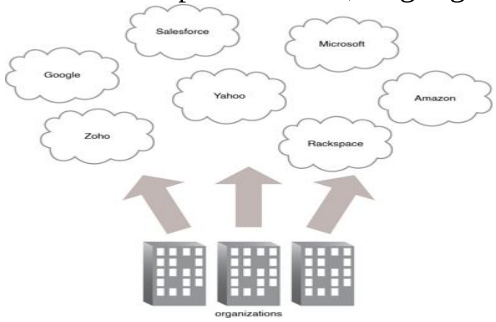

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Figure 4.1 Organizations act as cloud consumers when accessing cloud services and IT resources made available by different cloud providers.

Private Clouds

A private cloud is only for a single organization. Private clouds enable an organization to use cloud computing technology as a centralizing access to IT resources by different parts, locations, or departments of the organization. When a private cloud is located as a controlled environment, the problems described in the Risks and Challenges section are do not tend to apply.The usage of a private cloud can change how organizational and trust boundaries are defined and applied. The actual management of a private cloud environment may be carried out by internal or outsourced staff. With a private cloud, the same organization is technically acts as both the cloud consumer and cloud provider (Figure 4.2). In order to separate these roles:

- a separate organizational department typically assumes the responsibility for provisioning the cloud (assumes the cloud provider role)
- departments requiring access to the private cloud assume the cloud consumer role

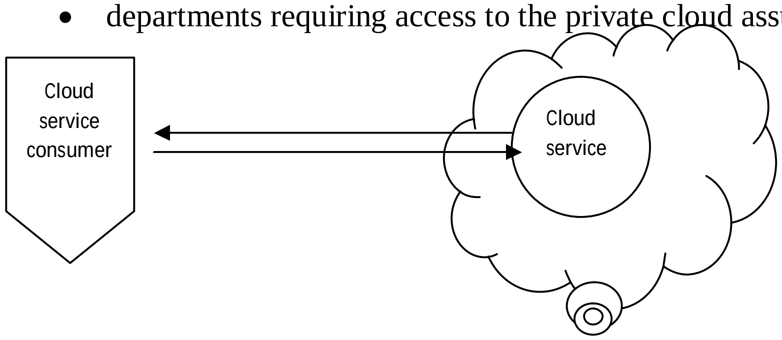


Figure 4.2 - A cloud service consumer in the organization's on-premise environment accesses a cloud service hosted on the same organization's private cloud via a virtual private network.

Community Clouds

A community cloud is same as a public cloud except that its access is limited to a specific community of cloud consumers. The community cloud jointly owned by the community members or by a third-party cloud provider that provisions a public cloud with limited access permissions. The member cloud consumers of the community typically share the responsibility for creating and evolving the community cloud (Figure 4.3). Membership in the community does not necessarily guarantee access or control of all the other cloud's IT resources. Parties outside the community are generally not granted access unless allowed by the community.

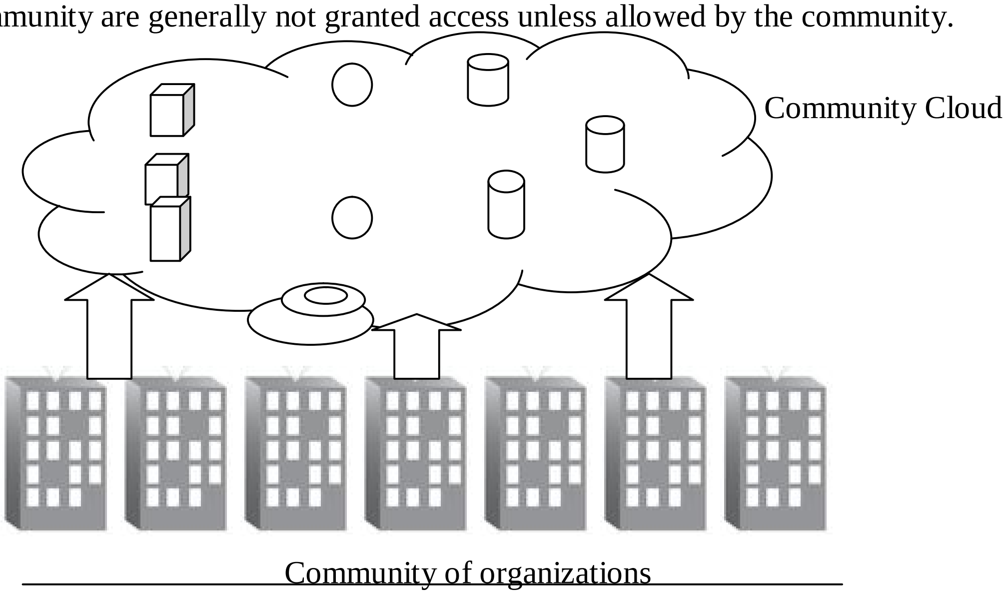
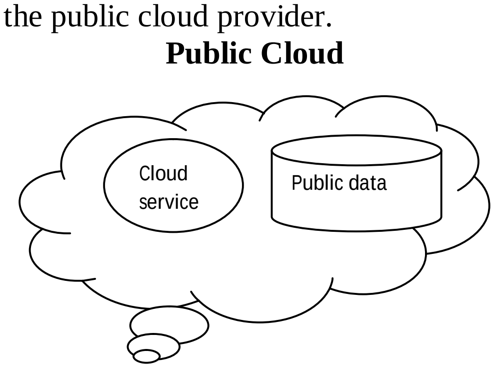


Figure 4.3 - An example of a "community" of organizations accessing IT resources from a community cloud.

Hybrid Clouds

A hybrid cloud environment is comprised of two or more different cloud deployment models. For example, a cloud users to deploy cloud services processing impotent data to a private cloud and other, less sensitive cloud services to a public cloud environment. The result of this combination is a hybrid deployment model (Figure 4.4).Hybrid deployment model can be complex and challenging to create and maintain due to the potential disparity in cloud models and the fact that management responsibilities are mainly split between the private cloud provider organization and the public cloud provider.



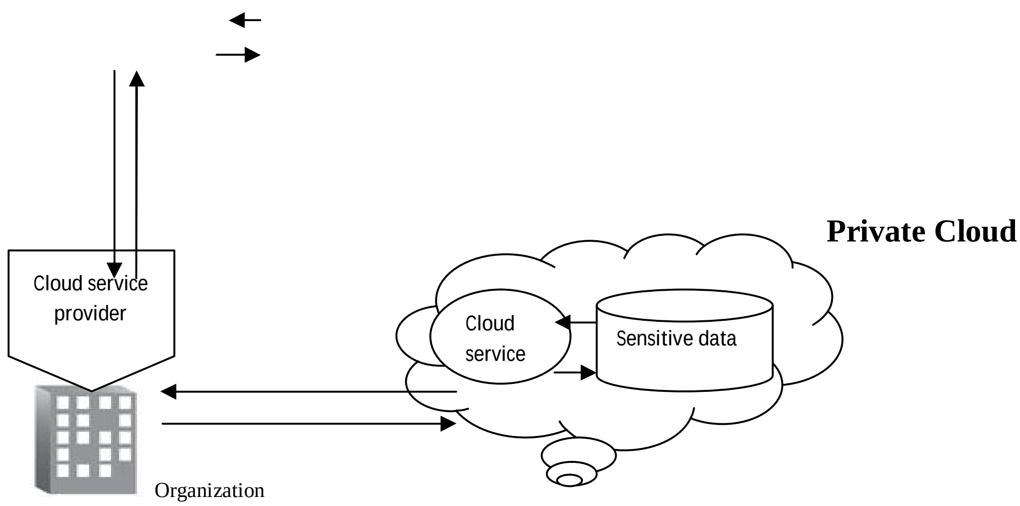


Figure 4.4 - An organization using a hybrid cloud architecture that utilizes both a private and public cloud.

V. CLOUD STAKEHOLDERS

To know why cloud computing is used , we need to first concentrate on who use it and then what advantages they get using cloud. Mainly there are three types of stakeholders cloud providers, cloud users and the end users [Figure 1]. Cloud vendors provide cloud services to the cloud users. These cloud services are of the form of utility computing i.e. the cloud users uses these services pay-per-use model. The cloud users develop their product using these services and deliver the product to the end users

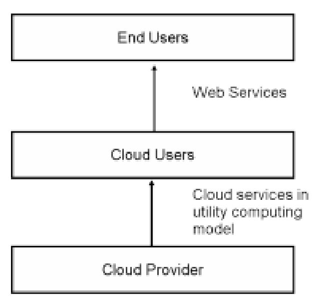


Figure 5.l: Interconnection between cloud stakeholders

VI. DESIRED FEATURES OF A CLOUD

There are some features of a cloud are essential to enable services that truly represent the cloud computing model and satisfy expectations of cloud consumers, and cloud offerings must be (i) self-service, (ii) per-usage metered and billed, (iii) elastic, and (iv) customizable.

Self-Service

Consumers or users of cloud computing services expect on-demand, nearly instant access to resources. To support this expectation, clouds must allow self-service access so that users can request, customize, pay, and use services without intervention of human operators [3].

Per-Usage Metering and Billing

Cloud computing paradigm eliminates up-front commitment by users, allowing them to request and use only the necessary amount. Services must be priced on a short term basis or timely basis (e.g., by the hour), allowing users to release resources as soon as they are not needed [2]. For these reasons, clouds must implement features to allow efficient measure of service such as pricing, accounting, and billing [1]. Metering should be done accordingly for different types of service like, storage, processing, and bandwidth etc,and usage promptly reported, thus providing greater transparency [3].

Elasticity

Cloud computing gives the belief of infinite computing resources available on demand [2]. Therefore users expect clouds to quickly provide resources in any quantity at any time. In particular, it is expected that the additional resources can be (a) provisioned, generally automatically, when an application load increases and (b) released when load decreases (scale up and down) [3].

Customization

In a multiple client organizations, cloud a great disparity between user needs is often the case. Thus, resources rented from the cloud should be highly customizable. In the case of infrastructure services, customization means allowing users to deploy specialized virtual appliances and has to be given privileged (root) access to the virtual servers. Other services (PaaS and SaaS) offer less flexibility and are not fit for general-purpose computing [2], but still are expected to provide a certain level of customization.

VII. BENEFITS

Cloud computing offers users to set up what is essentially a virtual office to give the flexibility of connecting to the business anywhere, any time. With the growing number of web-enabled devices used in today's business environment (e.g. smart phones, tablets), access to data is even easier. There are many benefits to moving user business to the cloud:

Reduced IT costs

Moving to cloud computing may reduce the cost of managing and maintaining user's IT systems. Rather than purchasing expensive systems and equipment for their business, stakeholders can reduce spending costs by using the resources of cloud computing service provider and also can be able to reduce operating costs because:

- the cost of system upgrades, new hardware and software may be included in contract
- Users no longer need to pay wages for expert staff

Scalability

Stakeholder's business can scale up or scale down their operation and storage needs quickly to suit their situation, allowing flexibility as their needs change. Rather than purchasing and installing expensive upgrades, the cloud service provider can handle all the responsibilities for the customers.

Business continuity

Protecting data and systems is an important part of business continuity planning. Whether there a natural disaster, power failure or other crisis, having data stored in the cloud ensures it is backed up and protected in a secure and safe location. Being able to access data again quickly allows users to conduct business as usual, so that it minimizes any downtime and loss of productivity.

Collaboration efficiency

Collaboration in a cloud environment gives the ability to communicate and share more easily outside of the traditional methods. If the users are working on a project across different locations, they could use cloud computing to give employees, contractors and third parties access to the same files and also could choose a cloud computing model that makes it easy for users to share their records with advisers (e.g. a quick and secure way to share accounting records with their accountant or financial adviser).

Flexibility of work practices

Cloud computing allows employees to be more flexible in their work practices. The users can have the ability to access data from home, on holiday, or via the commute to and from work (providing they should have an internet connection). If user needs to access their data while they are in off-site, they can connect to their virtual office, quickly and easily.

Access to automatic updates

Access to automatic updates for stakeholder's IT requirements included in their service fee. Depending on cloud computing service provider, system will regularly be updated with the latest technology. This could include up-to-date versions of software, as well as upgrades to servers and computer processing power.

VIII. CHALLENGES AND RISKS

Despite the initial success and popularity of the cloud computing paradigm and the extensive availability of providers and tools, a significant number of challenges and risks are inherent to this new model of computing. Providers, developers, and end users must consider these challenges and risks to take good advantage of cloud computing. Issues to be faced include user privacy, data security, data lock-in, and availability of service, disaster recovery, performance, scalability, energy-efficiency, and programmability.

Security, Privacy, and Trust

Security and privacy affect the entire cloud computing stack, since there is a massive use of third-party services and infrastructures that are used to host important data or to perform critical operations. In this scenario, the trust toward providers is fundamental to ensure the desired level of privacy for applications hosted in the cloud Legal and regulatory issues also need attention. When data are moved into the Cloud, providers may choose to locate them anywhere on the planet. The physical location of data centers determines the set of laws that can be applied to the management of data. For example, specific cryptography techniques could not be used because they are not allowed in some countries. Similarly, country laws can impose that sensitive data, such as patient health records, are to be stored within national borders.

Data Lock-In and Standardization

A major concern of cloud computing users is about having their data locked-in by a certain provider. Users may want to move data and applications out from a provider that does not meet their requirements. However, in their current form, cloud computing infrastructures and platforms do not employ standard methods of storing user data and applications. Consequently, they do not interoperate and user data are not portable.

Availability, Fault-Tolerance, and Disaster Recovery

It is expected that users will have certain expectations about the service level to be provided once their applications are moved to the cloud. These expectations include availability of the service, its overall performance, and what measures are to be taken when something goes wrong in the system or its components. In summary, users seek for a warranty before they can comfortably move their business to the cloud.

SLAs, which include QoS requirements, must be ideally set up between customers and cloud computing providers to act as warranty. An SLA specifies the details of the service to be provided, including availability and performance guarantees. Additionally, metrics must be agreed upon by all parties, and penalties for violating the expectations must also be approved.

Resource Management and Energy-Efficiency

One important challenge faced by providers of cloud computing services is the efficient management of virtualized resource pools. Physical resources such as CPU cores, disk space, and network bandwidth must be sliced and shared among virtual machines running potentially heterogeneous workloads. The multi-dimensional nature of virtual machines complicates the activity of finding a good mapping of VMs onto available physical hosts while maximizing user utility. Dimensions to be considered include: number of CPUs, amount of memory, size of virtual disks, and network bandwidth. Dynamic VM mapping policies may leverage the ability to suspend, migrate, and resume VMs as an easy way of preempting low-priority allocations in favor of higher-priority ones.

IX. CONCLUSION

Cloud computing is a newly developing paradigm of distributed computing. Virtualization in combination with utility computing model can make a difference in the IT industry and as well as in social perspective. Organizations like Google, Yahoo, and Amazon are already providing cloud services. The products like Google App-Engine, Amazon EC2, and Windows Azure are capturing the market with their ease of use, availability aspects and utility computing model. Users don't have to be worried about the hinges of distributed programming as they are taken care of by the cloud providers. Business organizations are also showing increasing interest to indulge them into using cloud services.

There are many open researches in this domain like security aspect in the cloud, virtual machine migration, dealing with large data for analysis purposes etc. In developing counties like India cloud computing can be applied in the e-governance and rural development with great success.

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