

# Usability of Cloud Computing in Information Systems: A Review

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**Abstract**—Nowadays, Cloud Computing is widely used to deliver services over the Internet for both technical and economic reasons and believing that cloud computing will reshape the entire ICT industries. Cloud Computing has a lot of resources as open source which gives different platform and services for better computing utilization. They are managed by Cloud Management tools and offer all the benefits of a public utility system, in terms of economy of scale, flexibility and convenience but has its own limitations. The primary objective of this paper is to provide a reference source and classification scheme for usability of cloud computing in the information system for researchers interested in cloud computing and highlights the under-researched areas as well as future directions. The paper presents an in-depth review of Cloud Computing where main service and deployment models, benefits and limitations of cloud computing as well as terminologies adopted in cloud computing were discussed.

**Keywords**—Cloud Computing, Green Cloud, Usability, Information system, Datacenters.

## I. INTRODUCTION

Advances in the field of massive computing power in the age of information and globalization, cloud computing has become a significant research topic of the scientific and industrial communities since 2007 [1]. The ever growing demand in computer applications coupled with the desired to generate business insights and competitive advantage, enterprises find it cheaper and less complicated to operate their private data centres in order to keep up with rapidly growing data processing requests. This has led to an explosive growth of application models such as software as a service, community network, web store, and so on. Cloud computing (CC) is a new paradigm that has grown from a promising idea to one of the fastest and exciting area of research and development paradigm that is applied to all sectors where high performance and fast access to resources and services are required. It promises to provide on-demand computing power with quick implementation, low maintenance, fewer IT staff and consequently lower cost. Such appealing promises have made cloud computing a dominant in IT is depicted in Fig 1.

Cloud computing is being used as a platform for various types of applications with different Quality of Service (QoS)

aspects, such as performance, availability and reliability [2]. Cloud computing apply virtualization technology to assist organizations in breaking the physical bonds between the information technology infrastructure and the user. The shared pool which is external to the organization, will not have the insight, knowledge or the control of the resources and its location. Among the challenges that are common in the world of cloud computing is security, for the fact that the data is trusted to third-parties.

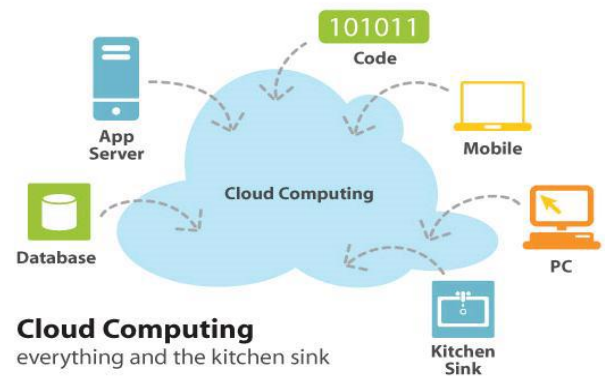


Fig. 1 Definition of Cloud Computing [1]

Other issues are: Interoperability, Hidden costs, unexpected behavior and threshold policy. Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the data centers that provide such services. The services themselves have long been referred to as Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). When a Cloud is made available in a pay-as-you-go manner to the general public, it is called a Public Cloud because services are being sold as Utility Computing. The term Private Cloud refers to internal datacenters of a business or other organization that not made available to the general public. Community Cloud on the other hand is shared by the community with the same goal while the combination of two Private and Public or Community Cloud is referred to as Hybrid Cloud. The information system is a system with a specific reference to information and the complementary networks of hardware and

software that people and organizations use to collect, filter, process, create and distribute data. The rapid development of cloud computing markets has attracted much attention from information systems (IS) academics [3, 5].

The present paper aims to assess the state of cloud computing research, portray the current landscape of where it is today, and most importantly, given the current relevance of the topic. Some suggestions as to where more effort should be focused in the future in order to produce more consumable research were also highlighted. The remainder of this article is organized as follows: First a brief overview of cloud computing is given. The paper discusses the need for cloud computing, advantages, limitations and presented classification models (service, deployment). The green computing as a new area of future cloud computing research was also discussed this paper. The Future direction and challenges was also highlighted with conclusions.

## II. CLOUD OVERVIEW

### A. Definition.

Cloud have several definitions in both academia and industry. Most of the researchers agreed on the one proposed by U. S National Institute of Standard and Technology (NIST). Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models [5] as depicted in Fig. 2.

Authors of [6] defined cloud computing as a distributed computing model that reaps the benefits of economy, quality of service, virtualization, scalability, resource sharing and enormous storage. In their definition the authors, R. Sharma and R. K. Trivedi [7], define Cloud computing as a set of resources that are being allocated on demand that bring new innovations and changes in pricing opportunities in the way business operates.

### B. Information System.

An information system (IS) is any organized system for the collection, organization, storage and communication of information. An information system is the information and communication technology (ICT) that an organization uses, and also the way in which people interact with this technology in support of business processes. An information system is a work system whose activities are devoted to capturing, transmitting, storing, retrieving, manipulating and displaying information [8].

### C. Cloud Architecture.

Clouds are usually referred to as a large pool of computing and storage resources which can be accessed via standard

protocols with an abstract interface. The fabric layer contains the raw hardware level resources, such as compute, memory and network resources. On the unified resource layer, resources have been virtualized so that they can be exposed to upper layer and end users as integrated resources. The platform layer adds to a collection of specialized tools, services and middleware on top of the unified resources to provide a development and deployment platform. The application layer includes the applications that would prevail in the clouds.

## III. THE NEED FOR CLOUD COMPUTING

There are many fundamental reasons for organizations to move from traditional IT infrastructure to Cloud Computing. One of the most cited benefits is the economics of the Cloud [9]. The benefits of Cloud Computing in this paper have been categorized under Technical, Users, Infrastructural, Companies and Environmental aspects and they are as follows:

### A. Technical Aspects

Cloud computing in information system has a lots of advantages in every aspect of our day-to-day activities which includes:

- *Power Management:* From the aspect of power management, it is easier to manage virtual server as compared to physical server.
- *Scalability:* It is the one of the main positive aspects of cloud computing. If there is peak load or high traffic for a site, cloud can handle easily without need of any additional hardware infrastructure or equipment and without disturbing user's normal work.
- *Data Storage:* There are various data centers spread throughout the world and it makes easy for the businesses to choose the data Centre as per their convenience to get fast and easy access of services with unlimited data storage.
- *Trouble shooting and Backup (Disaster) recovery:* Hardware failure can also be easily traced out and rectified with ease. Similarly, the assessment of data can be done anytime and is highly beneficial for the IT industry in reducing workloads and whenever data needs to be recovered.
- *Efficiency and Reliability:* To find efficiency many organizations are moving towards cloud and backup is another significant advantage to the cloud and it maintains backup for all remote sites and branch offices. It will remove many challenges like bandwidth allocation, security and disaster recovery. Applications in cloud are so vital and these are available and reliable for all services. Any business leader worried about the security and reliability of their data in the cloud should remember that they have trusted, saved and stored their personal financial assets in an external, virtual banking cloud for years.

- **Cost Reduction:** The consumer does not need to take the stress of updating the software and hardware as they can get the latest and updated resources and services relatively in less time. The consumers do not need to worry about the configuration of the system, storage capacity and capability while using the local system because all these are handled and maintained by the cloud provider from where they are bought.

It is the main advantage or main reason why organizations are going to apply cloud solutions as it saves the cost involved in building infrastructure and setting up a data Centre i.e. both (CAPEX and OPEX). Even a small-scale business can adopt or go into the cloud. This allows a company to concentrate more on improvements of their core competencies. It certainly helps to be more advantageous in longer run.

- **Environmental Advantage:** The Green Cloud computing share the resources that is very good in the context of environment or going green as it reduce many power-hungry carbon footprints data centers and reduces the need of more electric power for maintaining datacenters. The work of continuous running servers within the organization is reduced if we start using cloud computing.

#### IV. ELEMENTS OF CLOUD COMPUTING

The elements of Cloud Computing are as follows:

##### A. On-Demand Self-Service:

A consumer with an instantaneous need at a particular time slot can avail computing resources (such as CPU time, network storage, software use, and so forth) in an automatic (i.e. convenient, self-serve) fashion without resorting to human interactions with providers of these resources [8].

##### B. Broad Network Access:

These computing resources are delivered over the network (Internet) and used by various client applications with heterogeneous platforms (such as mobile phones, laptops, and PDAs) situated at a consumer's site [4, 8].

##### C. Resource Pooling:

A cloud service providers computing resources are 'pooled' together in an effort to serve multiple consumers using either the multi-tenancy or the virtualization model, "with different physical and virtual resources dynamically assigned and reassigned according to consumer demand" [9]. The motivation for setting up such a pool-based computing paradigm lies in two important factors: economics of scale and specialization. The result of a pool-based model is that physical computing resources become 'invisible' to consumers, who in general do not have control or knowledge over the location, formation, and originalities of these

resources (e.g. database, CPU, etc.) . For example, consumers are not able to tell where their data is going to be stored in the Cloud.

##### D. Rapid Elasticity:

For consumers, computing resources become immediate rather than persistent: there are no up-front commitment and contract as they can use them to scale up whenever they want, and release them once they finish scaling down. Moreover, resources provisioning appears to be infinite to them, the consumption can rapidly rise in order to meet peak requirement at any time.

##### E. Measured Service:

Although computing resources are pooled and shared by multiple consumers (multi-tenancy), the cloud infrastructure is able to use appropriate mechanisms to measure the usage of these resources for each individual consumer through its metering capabilities. An anatomy of cloud computing showing the various units of essential characteristics and inter-relationship with service levels and deployment models is diagrammatically represented in Fig. 2 below.

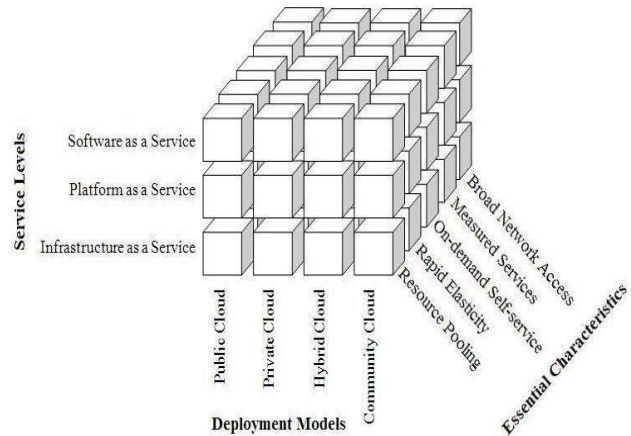


Fig. 2 Anatomy of Cloud Computing [4]

#### V. CLOUD COMPUTING SERVICE MODELS

Cloud Computing Service Models are categorized as follows:

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

Cloud consumers release their applications on a hosting environment, which can be accessed through networks from various clients (e.g. web browser, PDA, etc.) by application users. Cloud consumers do not have control over the Cloud infrastructure that often employs multi-tenancy system architecture, namely, different cloud consumers' applications are organized in a single logical environment on the SaaS cloud to achieve economies of scale and optimization in terms of speed, security, availability, disaster recovery, and

maintenance. Examples of SaaS include SalesForce.com, Google Mail, Google Docs, and so forth [10, 11].

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

This is a development platform supporting the full “Software Lifecycle”, which allows cloud consumers to develop cloud services and applications (e.g. SaaS) directly on the PaaS cloud. Hence the difference between SaaS and PaaS is that SaaS only hosts completed cloud applications whereas PaaS offers a development platform that hosts both completed and in-progress cloud applications. This requires PaaS, in addition to supporting application hosting environment, to possess development infrastructure including programming environment, tools, configuration management, and so forth. An example of PaaS is Google AppEngine [3, 5, and 10].

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

Cloud consumers directly use IT infrastructures (processing, storage, networks, and other fundamental computing resources) provided in the IaaS cloud. Virtualization is extensively used in IaaS cloud in order to integrate/decompose physical resources in an ad-hoc manner to meet growing or shrinking resource demand from cloud consumers. The basic strategy of virtualization is to set up independent virtual machines (VM) that are isolated from both the underlying hardware and other VMs. Notice that this strategy is different from the multi-tenancy model, which aims to transform the application software architecture so that multiple instances (from multiple cloud consumers) can run on a single application (i.e. the same logic machine). An example of IaaS is Amazon’s EC2 [6]. Other cloud computing service models include the following: Context as a Service (CaaS), Desktop as a Service (DaaS) and Resource as a Service (RaaS).

VI. CLOUD DEPLOYMENT MODELS

More recently, four cloud deployment models have been defined in the cloud community:

*A. Private Cloud:*

The cloud infrastructure is operated solely within a single organization, and managed by the organization or a third party regardless whether it is located premise or off premise. The motivation to setup a private cloud within an organization has several aspects such as maximization, optimization and utilization of existing in-house resources. Secondly, security concerns including data privacy and trust also make Private Cloud an option for many firms. Thirdly, data transfer cost from local IT infrastructure to a Public Cloud is still rather considerable. Fourthly, organizations always require full control over mission-critical activities that reside behind their firewalls and lastly, academics often build private cloud for research and teaching purposes [5, 6, 10].

*B. Community Cloud: protocols*

Several organizations jointly construct and share the same cloud infrastructure as well as policies, requirements, values and concerns. The cloud community forms into a degree of economic scalability and democratic equilibrium. The cloud infrastructure could be hosted by a third-party vendor or within one of the organizations in the community [2, 6].

*C. Public Cloud*

This is the dominant form of current Cloud computing deployment model. The public cloud is used by the general public cloud consumers and the cloud service provider has the full ownership of the public cloud with its own policy, value, and profit, costing, and charging model. Many popular cloud services are public clouds including Amazon EC2, S3, Google AppEngine, and Force.com.

*D. Hybrid Cloud*

The cloud infrastructure is a combination of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds). Organizations use the hybrid cloud model in order to optimize their resources to increase their core competencies by margining out peripheral business functions onto the cloud while controlling core activities on-premise through private cloud. A representation of the characteristics of cloud computing defined by NIST is depicted in Fig. 3 as a cloud computing framework.

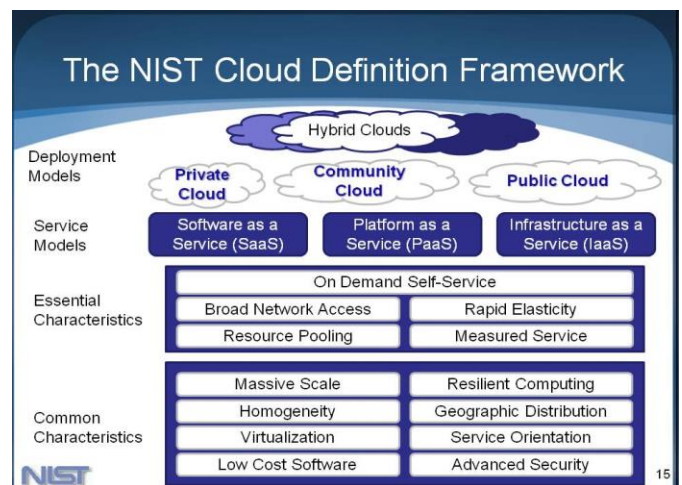


Fig. 3. Cloud Computing Usability Framework [5].

VII. ADVANTAGES OF CLOUD COMPUTING

Specifically, cloud computing offers the following advantages to the user:

- It dramatically lowers the cost of entry for smaller firms trying to benefit from compute-intensive business analytics that were hitherto available only to the largest corporations. These computational exercises typically involve large amounts of computing power for relatively short amounts of time, and cloud computing makes such dynamic provisioning of resources possible. Cloud computing also represents a huge opportunity to many third-world countries that have been so far left behind in the IT revolution, some cloud computing providers are using the advantages of a cloud platform to enable IT services in countries that would have traditionally lacked the resources for widespread deployment of IT services [1, 4].
- It can provide an almost immediate access to hardware resources, with no upfront capital investments for users, leading to a faster time to market in many businesses. Treating IT as an operational expense in industry-speak, employs an Opex as opposed to a Capex model) also helps in dramatically reducing the upfront costs in corporate computing. The cloud becomes an adaptive infrastructure that can be shared by different end users, each of whom might use it in very different ways. The users are completely separated from each other, and the flexibility of the infrastructure allows for computing loads to be balanced on the fly as more users join the system. The beauty of the arrangement is that as the number of users goes up, the demand load on the system gets more balanced in a stochastic sense, even as its economies of scale expand [4].
- Cloud computing can lower IT barriers to innovation, as can be witnessed from the many promising startups, from the ubiquitous online applications such as Facebook and Youtube to the more focused applications like TripIt (for managing one's travel) or Mint (for managing one's personal finances) [4, 11].
- Cloud computing makes it easier for enterprises to scale their services which are increasingly reliant on accurate information according to client demand. Since the computing resources are managed through software, they can be deployed very fast as new requirements arise. In fact, the goal of cloud computing is to scale resources up or down dynamically through software APIs depending on client load with minimal service provider interaction. [5,6]
- Cloud computing also makes possible new classes of applications and delivers services that were not possible before. Examples include (a) mobile interactive applications that are location-, environment- and context-aware [9] and that respond in real time to information provided by human users, nonhuman sensors (e.g. humidity and stress sensors within a shipping container) or even from

independent information services (e.g. worldwide weather data); (b) parallel batch processing, that allows users to take advantage of huge amounts of processing power to analyze terabytes of data for relatively small periods of time, while programming abstractions like Google's MapReduce or its open source counterpart Hadoop makes the complex process of parallel execution of an application over hundreds of servers transparent to programmers; (c) business analytics that can use the vast amount of computer resources to understand customers, buying habits, supply chains and so on from voluminous amounts of data; and (d) extensions of compute-intensive desktop applications that can offload the data crunching to the cloud leaving only the rendering of the processed data at the front-end, with the availability of network bandwidth reducing the latency involved [12].

### VIII. LIMITATIONS OF CLOUD COMPUTING

Listed below are the limitations of Cloud Computing:

#### A. *Data Segregation:*

As data of many users are stored in same data center and same server or same hard disks it will raise the question from the users about the problem of mismatch i.e. how cloud securely isolate users and differentiate the memory and storage of each users as this failure could lead to leakage of information from one customer to another.

#### B. *Deletion of Data:*

Many consumers' data will be stored in same data center, server and hard disk. After completion of their task with cloud if the consumer want to cancel the contract and withdraw the SLA from the provider and want to delete his data i.e. completely remove from the cloud but it is very hard to do since deletion of data can only be done by erasing entirely, repeatedly re-writing the disk sectors with random data, and possibly formatting the servers hard disk which is not possible to do so there always remain the threat of recovering the erased data or if it is not perfectly overwritten or overlapped with random data then there will remain the chance of leaking information out.

##### i) *The Offline Cloud:*

As cloud computing is fully dependent upon internet connection. If the customer has a problem with internet connection then he/she is unable to access the application or data from internet.

##### ii) *Privacy:*

Privacy is one of the major issues in cloud as it needs high degree of trust among the users and it is fundamental human right not to be granted privilege by authority. Users are

always concerned about their data so to overcome this issue provider should assure the users in following points:

- Employees are aware of their responsibilities related to the confidentiality, integrity, availability of data and information systems.
- The confidential and/or personal client data including system access credentials are protected (e.g. encrypted) from unauthorized interception.

#### C. Data Lock-In:

Customers once stored their data in one data center and gone through SLA of one provider, then they cannot easily extract their data and programs from other providers. This concern about the difficulty of extracting data from the cloud prevents some organizations from adopting cloud computing. Data lock-in or customer lock-in is beneficial to cloud computing providers but users will suffer if price increases, reliability problems, or even when the providers are going out of business.

#### D. Data Confidentiality and Auditability:

This aspect concerns customers worries that data kept in a public cloud is exposed to more attacks and could be intercepted by a third party to compromise data integrity in the absence of adequate security. Similarly, Auditability could be added as an additional layer providing facilities arguably more secure than those built into the applications themselves.

#### E. Network:

For the proper utilization of cloud computing application/services, there is the need for high speed internet connection. Lack of speed and high bandwidth are the causes for not accessing the cloud services, so still there are a lot of questions regarding the cloud computing. Similarly, network failures can result in loss to the organisations by causing extensive time delays. It is possible in developed countries where there is high internet connectivity, while in other countries the problem is prevalent and is a big issue.

#### F. Software Licensing:

Many cloud providers relied heavily on open source software as the licensing model for commercial software is not a good match to Utility Computing because. In this users are made to first pay for the software and later for annual maintenance.

#### G. Security

If you are adopting cloud then the data which you store in data center is not under your direct control and it will be stored somewhere, where you cannot get physical access to it. Moreover, users do not trust the security of cloud computing taking it as a potential that personal information will be

exposed to some extent. Cloud computing providers support encryption and rudimentary identity management but still people do not want to place secrets in to the cloud. The security traits pose by cloud computing is represented in Fig. 4 below.

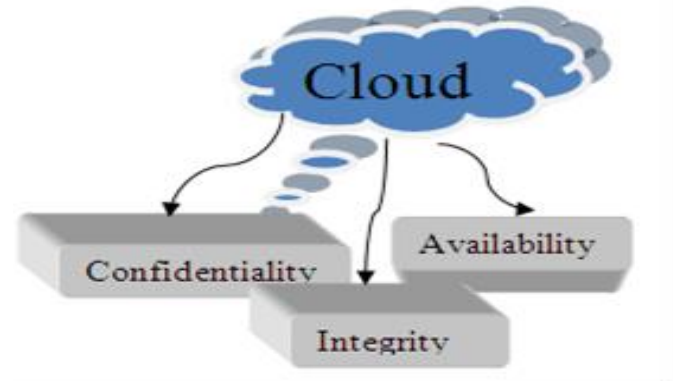


Fig. 4 Basic Security Traits of Cloud Computing [7]

#### H. Control

Control means that when you leverage a cloud computing provider, you are giving up control of all your data and file to them, so now you are at control of provider who could cause you a bunch of trouble like shutting down the account if you accidentally violate some policy or in case your provider go out of business if the services are no longer profitable. You need to address these considerations into the case for cloud computing.

### IX. GREEN CLOUD COMPUTING

Global warming has been a big concern of late. With the continuously increasing popularity and usage of cloud computing and the increasing awareness of the people across the globe towards the use of eco-friendly resources has forced the researchers to devise concepts towards an eco-friendly energy efficient flavor of cloud computing called green cloud computing, green cloud computing facilitates the reduction of power consumption and CO<sub>2</sub> emission along with the reutilization of energy in an efficient way [14, 17]. Cloud uses thousands of data-centers in order to process the user queries and to run these data-centers bulk amount of power is used for cooling and other processes.

There are various techniques and algorithms used to minimize this expenditure such as in [15]. Among various avenues, one area of research focuses on reduction in energy consumption by computer servers [16], whereas the other lays stress on dynamic cluster server configuration [15] to reduce the total power consumption by balancing load and effectively utilizing only a subset of the resources at hand. Similarly Dynamic CPU clock frequency scaling again incorporates some form of load balancing to save power during different load conditions. In addition to these, some more techniques are used to measure the power consumption in data-centers.

The first one was developed by the Green Grid called Power Usage Effectiveness (PUE) metric to measure the effectiveness of data centers. PUE tells about the amount of extra power required for cooling IT equipment [14].

Cloud scenario power consumption is very high with high carbon emission whereas at the same time in green cloud this is very less as compared to traditional cloud. Green clouds avoid power wastage and this is the reason for adoption of this technology by IT companies like Google, Microsoft, Yahoo!, etc. According to a survey done in the year 2007 IT industries contribute to percent of the total carbon emission every year [13, 14]. European Union (EU) is also of the view that severe reductions of the order of 15 percent-30 percent is required to maintain the global temperature and stop it from increasing drastically before 2020 [14].

## X. GREEN CLOUD COMPUTING ARCHITECTURE

The goal of this architecture is to make Cloud green from both user and providers perspective. In the Green Cloud architecture, users submit their Cloud service requests through a new middleware Green Broker that manages the selection of the greenest Cloud provider to serve the users request. A user service request can be of three types i.e., software, platform or infrastructure. The Cloud providers can register their services in the form of green offers to a public directory which is accessed by Green Broker and energy efficiency information are allocated services to private cloud. The green offers consist of green services, pricing and time when it should be accessed for least carbon emission. Green Broker gets the current status of energy parameters for using various Cloud services from Carbon Emission Directory. The Carbon Emission Directory maintains all the data related to energy efficiency of Cloud service. This data may include PUE and cooling efficiency of Cloud datacenter which is providing the service, the network cost and carbon emission rate of electricity, Green Broker calculates the carbon emission of all the Cloud providers who are offering the requested Cloud service. Then, it selects the set of services that will result in least carbon emission and buy these services on behalf users [15]. And finally give the result to the users. This new proposed architecture is the idea this paper is focusing on as the future green cloud architecture that will smartly include client oriented in the Cloud Middleware. This idea is shown in Fig. 5.

The Green Cloud framework is designed such that it keeps track of overall energy usage of serving a user request. It relies on two main components, Carbon Emission Directory and Green Cloud offers, which keep track of energy efficiency of each Cloud provider and also give incentive to Cloud providers to make their service Green. From user side, the Green Broker plays a crucial role in monitoring and selecting the Cloud services based on the user QoS requirements and ensuring minimum carbon emission for serving a user [11, 17]. In general, a user can use Cloud to access any of these

three types of services (SaaS, PaaS, and IaaS), and therefore the process of serving them should also be energy efficient [14-16]. In other words, from the Cloud provider side, each Cloud layer needs to be Green conscious [18, 19].

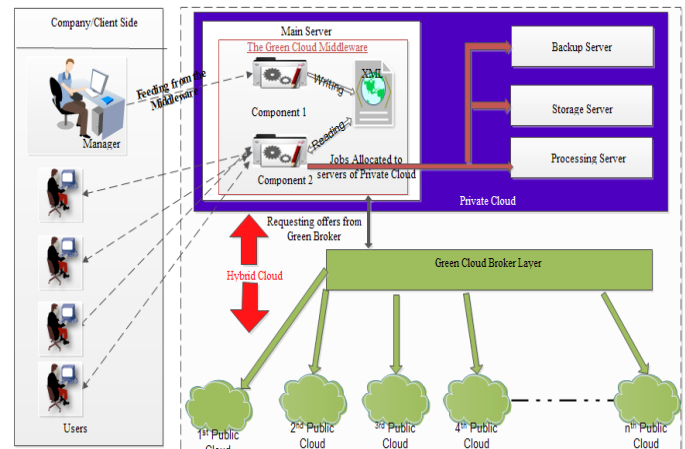


Fig. 5 Harmonized Green Cloud Computing Architecture

### A. Features of Cloud enabling Green Computing:

There are several technologies and concepts employed by Cloud providers to achieve better utilization and efficiency than traditional computing. Therefore, comparatively lower carbon emission is expected in Cloud computing due to highly energy efficient infrastructure and reduction in the IT infrastructure itself by multi-tenancy. The key driver technology for energy efficient Clouds is Virtualization, which allows significant improvement in energy efficiency of Cloud providers by leveraging the economies of scale associated with large number of organizations sharing the same infrastructure. By consolidation of underutilized servers in the form of multiple virtual machines sharing same physical server at higher utilization, companies can gain high savings in the form of space, management, and energy. There are four key factors that have enabled the Cloud computing to lower energy usage and carbon emissions from ICT.

### B. Low Energy Consumption in Cloud Enabling Green Computing:

In traditional setting, datacenters and private infrastructure used to be maintained to fulfill worst case demand. Thus, IT companies end up deploying far more infrastructure than needed. There are various reasons for such overprovisioning: (a) it is very difficult to predict the demand at a time; this is particularly true for Web applications and (b) to guarantee availability of services and to maintain certain level of service quality to end users. The virtual machines in a Cloud infrastructure can be live migrated to another host in case user application requires more resources. Cloud providers monitor and predict the demand and thus allocate resources according to demand. Those applications that require less number of

resources can be consolidated on the same server. Thus, datacenters always maintain the active servers according to current demand, which results in low energy consumption than the conservative approach of over-provisioning [19].

#### C. Multi-Tenancy:

Cloud computing infrastructure reduces overall energy usage and associated carbon emissions. The SaaS providers serve multiple companies on same infrastructure and software. This approach is obviously more energy efficient than multiple copies of software installed on different infrastructure. Furthermore, businesses have highly variable demand patterns in general and hence multi-tenancy on the same server allows the flattening of the overall peak demand which can minimize the need for extra infrastructure. The smaller fluctuation in demand results in better prediction and results in greater energy savings.

#### D. Server Utilization:

In general, on-premise infrastructure run with very low utilization, sometimes it goes down up to 5 to 10 percent of average utilization. Using virtualization technologies, multiple applications can be hosted and executed on the same server in isolation, thus leading to utilization levels of up to 70 percent [20]. Consequently, dramatically reduces the number of active servers with high utilization of servers and resulting in more power consumption, but processes more workload with similar power usage.

#### E. Datacenter Efficiency:

By using the most energy efficient technologies, Cloud providers can significantly improve the PUE of their datacenters. Today's state-of-the-art datacenter designs for large Cloud service providers can achieve PUE levels as low as 1.1 to 1.2, which is about 40 percent more power efficiency than the traditional datacenters [20]. The server is designed in the form of modular containers, water or air-based cooling [17-19] systems and/or advanced power management through power supply optimization are all approaches that have significantly improved PUE in datacenters. In addition, Cloud computing allows services to be moved between multiple datacenter with better PUE values using high speed network, virtualized services, measurement monitoring and accounting of datacenters.

## XI. CONCLUSION AND FUTURE DIRECTION

Cloud computing is an emerging computing paradigm that offers end users the benefit of virtually unlimited computing resources, the convenience of professional system operation and maintenance and the economy of on-demand billing. One advantage cloud computing does not offer is absolute security of subscriber data with respect to data integrity, confidentiality and availability. Security threats that arise in cloud computing include malicious activities made possible by the provision of

shared computing resources, as well as inadvertent loss of confidentiality or integrity resulting from negligence or mismanagement. Advantages of cloud computing and different ways by which communities are using it have been identified to make other users more conversant and more knowledgeable about using it. Information System is the heart beat of every organization that makes good organizations to grow bigger using information system.

The goal is to provide information by ensuring that key areas of evaluation and consumer needs are not overlooked. It is believed that the review forms the bases for a good framework for developing usability metrics for organizations adopting the cloud. While this article reviews the usability of cloud computing, another area that cloud computing is receiving rapt attention is the green cloud environment. However, the paper addresses the problem of efficient way to fetch results from the cloud to achieve all the features covered in the paper. Additionally, evaluating the performances of this technology in terms of energy efficiency, security, robustness and so forth, is challenging and therefore focus should be directed towards achieving the purpose of measuring and analysing the performance of different cloud computing environments. Thus, the goal is to develop a methodology for evaluating elements of usability metrics.

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