International Journal of Advanced Science and Research
ISSN: 2455-4227, Impact Factor: RJIF 5.12
www.allsciencejournal.com
Volume 1; Issue 6; June 2016; Page No. 01-06

Cloud computing: An asset or a drawback (A survey)

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Abstract
Cloud computing has been revolutionizing the IT organizations with a lead to manage their information resources over a wide range of network. Although, it is very flexible, proficient and cost-effective but there are some security exploits on the other side of the coin. Cloud computing is penetrating in small scale enterprises very promptly, but still large scale enterprises feel insecure after knowing about the constraints occurring in the cloud in regard to security. In this paper, we will discuss the various cloud service providers, assets of clouds, architecture, acceptance of clouds from last 5 years and the limitations that are disrupting it to enter the organizations.

Keywords: Cloud computing, cloud providers, benefits, risks, BSA

1. Introduction

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [5]. Earlier as all the computing was being done at the workstation of own company or home. There was trust in the mainframe systems followed in the past. The organizations were fully dependent on themselves to maintain their information system. Now, the time has changed and the management of data and computation are carried out inside the 'clouds'. In contrast, cloud computing service is a dependent service. In this, you don't have a control of the information rather the service provider manage everything [14]. All the computations are managed by the third party. This party provides the three categories of cloud; one is 'public' which is provided to the general public on a paid basis. Second is 'private', which is run for a particular organization and proper infrastructure is made depending upon the requirements of the organizations. Third, is the hybrid which involves the combination of private as well as public?

1.1 Mainframe and clouds

The mainframe and clouds both have assets as well as impediments. Depending upon the criticality of data and the requirements of the organization; the companies decide switching on cloud or not. Let us discuss some of the benefits and limitations of mainframe and clouds.

Many organizations still give more value to mainframe computers as they feel that mainframes are more secure [14]. This may be the reason in developing countries. The internet connection is not that reliable in such countries, so the organizations try to be in a safer mode and keep all the data with them for faster access. On the other hand, big research enterprises like NASA have already switched towards clouds as they feel more reliable with clouds.

Table 1: Difference between mainframe and cloud

S. No	Mainframe	Cloud
1	It costs more	Costs less than mainframe
2	It involves unsafe upgrades related to storage	It involves safe upgrades as the companies put their best to retain their customers.
3	More secure as you only have access to your records	Less secure as all the information is on cloud.
4	More Maintenance cost	Less maintenance cost
5	Less portable	More portable
6	Can have access without the use of internet	Use is restricted to internet access

There are different images of cloud computing as the concept of cloud computing is not new; rather a new model which has been developed from many existing technologies. In fact, many technologies used by cloud computing like virtualization and utility-based pricing, are not new. As an alternative, cloud computing is emerging as a polished concept to meet the demands of today's information technology [8].

2. Cloud Computing Architecture

This section describes various operational models of cloud computing.

2.1 A layered model

Generally, the architecture of cloud computing is divided into four layers. They are hardware, infrastructure, platforms and application as depicted in Figure 1:

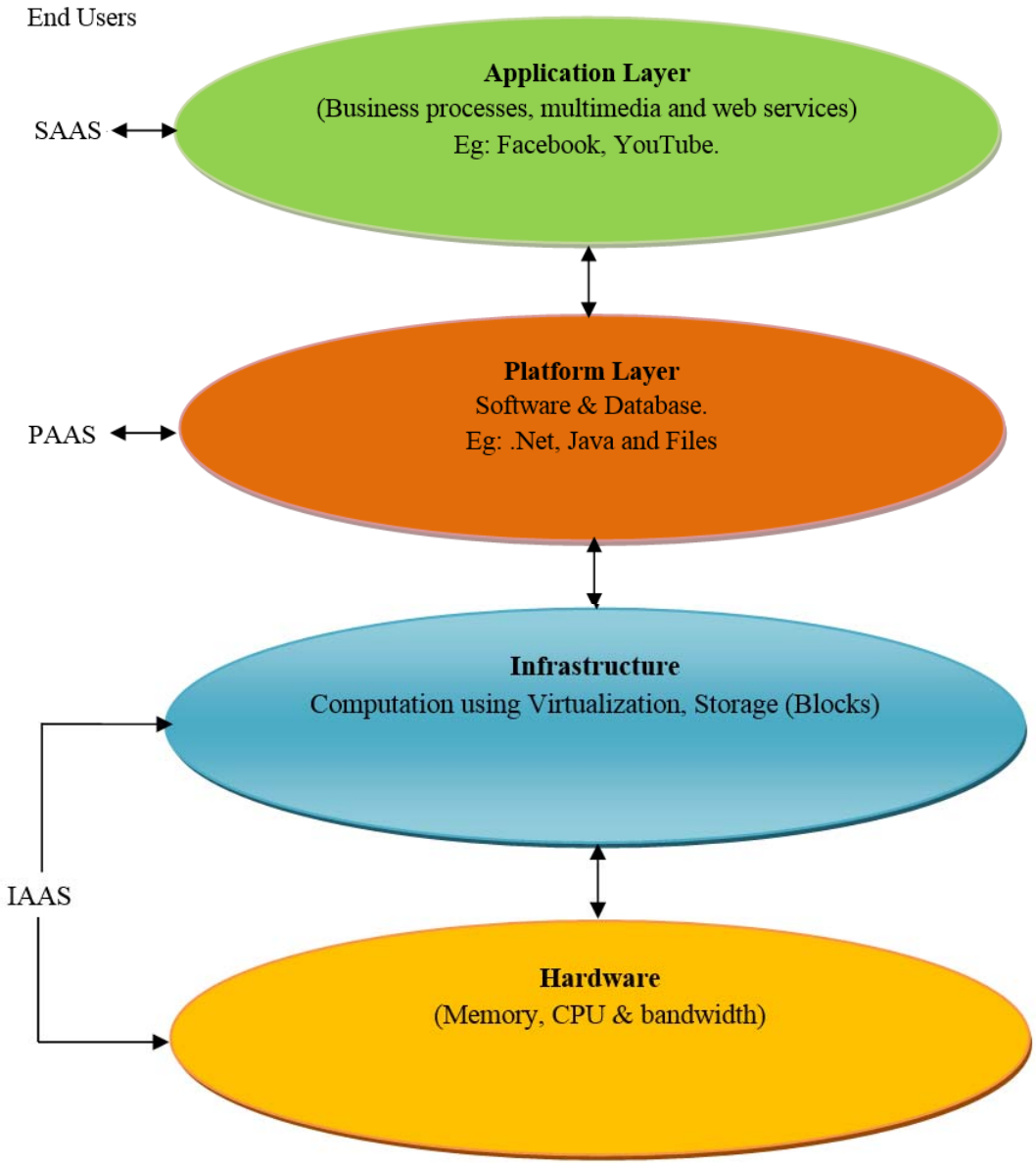

Fig 1: Cloud Computing Architecture

- **Hardware Layer:** The various resources handled in a cloud are managed at this level. Generally, the hardware part of the layer is implemented in the data centers. The various resources are power consumption, routers, CPU, servers and switches [12]. In this layer, thousands of servers are managed which are interlinked using switches and routers. The main issues that are required to be managed are the configuration issues related to hardware, fault-tolerance, issues related to power supply and load management [7]. For example: Datacenters.
- **Infrastructure Layer:** This layer is also referred as virtual layer. As, all the resources are combined and divided using virtualization technology. The various virtual technologies used to create such a partitioning of resources are KVM [9], Xen [10] and VMware [11]. This layer is considered crucial because the dynamic allocation of resources, which is one of the important task of cloud computing is carried by virtualization. Example: Amazon EC2, Flexiscale.
- **Platform Layer:** This layer consists of application frameworks and operating systems. This layer is responsible for reducing the burden on virtualization as the deployment activity is minimized to greater extent in the VM containers. For example Amazon s3 operates at platform layer to provide support of storage. To exemplify: Google AppEngine, Microsoft Azure.
- **Application Layer:** At the top, this layer consists of cloud applications. In contrast to traditional applications, the cloud applications can influence the automatic feature to have better reliability, performance and low cost. For example: Google Apps, YouTube, Face book [12, 22].

2.2 A business model

The business model of cloud is categorized mainly in terms of three layers; infrastructure, PAAS and the application layer at the top. In other words, the various services like hardware and platform level are provided on-demand basis. Moreover, all the three layers can also be implemented as a service and provided to the layer above it. Conversely, clouds present services that are categorized in three forms: software as a

service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS).

2.2.1 IaaS

It deals with providing on-demand infrastructural resources using virtualization. The cloud owner who offers IaaS is called an IaaS provider. The various IAAS providers are Amazon EC2 [13], Flexiscale [18] and GoGrid [15].

2.2.2 PaaS

It deals with providing the resources needed at platform layer like support of operating system. We consider development platforms and business platforms differently; in the former the application is developed first and code is written in the cloud; Google App Engine [20], Microsoft Windows Azure [53]. Whereas in the later, the development, deployment and management of applications is done in the cloud; salesforce.com [41].

2.2.3 SaaS

It refers to providing on-demand applications over the Internet. Examples of SaaS providers include Salesforce.com [41], Rackspace [17] and SAP Business ByDesign [44]. The salesforce.com is an American company using CRM (customer relationship management) framework [25]. This company is getting high popularity in the field of cloud computing.

3. Features of cloud computing

Cloud computing has many characteristics that makes it a very important and different from traditional technologies. Some of them are as follows:

- **Sharing of Resources:** The infrastructure in the cloud computing is built in such a way that the resources can be dynamically shared between different consumers. With the increase in the sharing process, the costs are minimized; performance gets boost up and reduction in power consumption [26].
- **Multi-occupancy:** All the services owned by the providers are all together held in data centers. If any problem encounters, then the issues are handled by all the providers. In other words, the layered architecture helps in dividing the performance and management issues among different stakeholders. The difficulty arises in handling the interactions among stakeholders [14].
- **Service-Oriented:** As the cloud providers offers different agreement at all three levels i.e. PaaS, IaaS, SaaS to the consumers. So, there arises a need to manage the critical service level agreement (SLA) with all the consumers by the providers [31]. So, there are many factors to decide the between various cloud providers [6, 16, 19].
- **Resource provisioning:** In the cloud environment, the resources are dynamically provisioned depending upon the current demand. This automatically lowers down the operating cost [26].
- **Pay per use based:** The pricing model in cloud computing vary from the kind of service provided. To exemplify, SaaS provider can charge customers based on the clients they serve; salesfroce.com. The salesforce.com works on customer relationship management [8].

4. Cloud Computing Offerings

Currently, many providers are raising their infrastructure and platform levels to reach the demands of cloud computing in terms of capacity, computation and database. Let us look at the various providers in terms of service type they offer and pricing model.

Table 2: Service Offerings by various providers

Company	Service Type	Pricing Model
Amazon EC2, S3, SimpleDB, SQS, FPS, DevPay	Computing, Storage, Database, Payment, Billing	Pay-per-use
FlexiScale	Infrastructure	Pay-per-use
Appian Anywhere	Business Process Management	Pay-per-use
Gmail Drive	Storage, Email	Free or Pay-per-use
MuxCloud	Data Processing (Video): uses Amazon's EC2	Pay-per-use
Network.com	Infrastructure	Pay-per-use
OpSource	Billing	Subscription
MS SkyDrive	Storage	Free(conditions apply)
Salesforce.com	Platform	Pay-per-use
XDrive	Storage	Subscription

4.1 Comparison of Commercial Products

There are many commercial products for cloud computing. Depending upon the business requirements, users are allowed to choose any one or combination of many. They differ in the kind of service and infrastructure and storage provided. Let us examine some of the commercial products:

Table 3: Details of commercial cloud products

Cloud Provider	Microsoft Windows Azure [20]	Amazon EC2 [21]	Google App Engine [23]
Capacity	Azure storage and SQL	Amazon simple storage (S3), Amazon simple DB- Block structure	Stored in the form of BigTable and Megastore
Service Type	Platform	Infrastructure	Platform
Computing	Operating system- Based on Xen Virtual Machine	CLR- common language Runtime	Web applications working frame is predefined
End Applications	Windows applications	General-Purpose Application	Traditional Applications

5. Cloud Acceptance & Security

In spite of all the advantages offered by cloud computing, there are still areas of concern. Though cloud computing is an emerging field but valuable input in few restricted areas can make this technology penetrate in almost all spheres of life. Moreover, large enterprises still want more transparency in account of their critical data. More availability and visibility of their records in terms of locations and transferring between different locations can influence them to opt for this technology to large extent [14].

Many small scale enterprises as well as large scale have migrated to clouds. Still, many of them keep track of their records at their local workstations. Undoubtedly, sometimes it is really easy to get records from local Pc's as compared to the cloud providers in which we need access to the internet.

According to the first ever yearly generated report by BSA in 2013, it has been found that the cloud acceptance is increasing but unevenly [27]. Moreover, it has been found that most of the large companies backtracked due to policy issues. According to a survey, it was communicated in 2013 that the acceptance of cloud computing will generate 16 billion jobs by 2015.

This shows the acceptance of cloud in various countries in 2013. The major factor to lack behind was considered to have policy improvements. It was found in Brazil, where the cybercrime rate was more and thus the acceptance of cloud was lacking behind [28]. Thus, the improvements in the policies made the Brazil jump from the last position to adopt cloud to two slots up. On the other hand, Japan approved the policies on cybercrime and setting a positive example for other countries. Of course, the cloud providers need a support from all the countries in terms of policies and agreement to emerge as a leading technology in the future. Let us examine the rankings of the countries even after considering concerning factors about cloud.

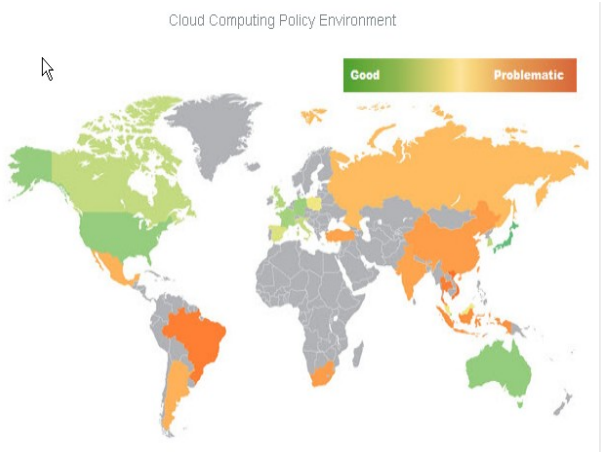

Fig 2: Map showing the acceptance of clouds around the world in 2013.

The ranking of various countries in 2013 & 2016 based on the cloud penetration is as follows [28-29]:

Table 4: Ranking of countries

Rank	2013	2016
1	Japan	Japan
2	Australia	US
3	US	Germany
4	Germany	Canada
5	Singapore	France
6	France	Australia
7	UK	Singapore
8	Korea	Italy
9	Canada	UK
10	Italy	Poland

*India ranked 17 on the score of acceptance in 2013 and dropped down by one position i.e. ranked 18th in 2016.

5.1 Parameters of concern in 2013 [28]

1. Data Privacy

Many countries and the users agreed to use the cloud if and only if their data is maintained privately and is not disclosed by the providers. Due to the lack of transparency, many customers feel insecure as they are not aware of their information details within the cloud. Different privacy policies should be encouraged depending upon the type of cloud service [3]. This will surely raise confidence among the customers and the acceptance will increase. For example, the registration policies among cross border is a burdensome and is followed by some countries like Europe [28].

2. Security

All the consumers need surety, that their information is managed from the related risks as all the crucial data and applications are shared on the cloud. It was then assured that whether the security laws are followed in every jurisdiction or not. It was found that the security requirements were generally imposed in the jurisdiction, but the proper audits related to this were missing [1].

3. Cybercrime

The clouds are collection of hefty amounts of data which are stored in data centers. So, there arises are intense need to manage the data from the unauthorized users and Cyber-attacks. The countries need to update their cyber-crime laws. It was found that few countries were still following old cyber principles. However, countries like Australia, France and German ranked above in terms of managing and updating cyber-crime laws.

4. Infrastructure

For any country to adapt this innovative technology requires

certain advancements in terms of bandwidth, broadband arrangement and international connectivity. If these parameters are up to date, then the country will automatically think to adapt the technology. Else, the cloud services will not be penetrated in every house. It was found that the broadband connectivity was higher in developed countries and though the acceptance of clouds. For example, Japan, Korea, Singapore and US had highest scoring in these factors. It was found from the survey that there are many countries that lack in the infrastructure and have yet not planned anything to take the benefit of cloud technology.

5.2 Parameters of concern in 2016 [29]

1. Data Privacy

Most countries deployed certain security measures to adapt cloud computing. But, many of the countries still feel unsafe before placing their critical records over clouds. Among many countries, Canada ranked first after adapting comprehensive privacy regime. Some countries like Russia fell after implementing certain requirements of data localization in privacy [3]. It is difficult for the cloud providers to deal with different privacy policies and constraints of different countries.

2. Data security & Cyber Crime

Though the acceptance towards cloud increased to a large extent but the incidents of high cyber-attacks made many countries backtrack from the cloud. For these reasons, some of the countries made changes in their cyber laws which in turn restrict the penetration of cloud in those countries.

3. *Infrastructure*: Although many developing countries tried their best to advance in the broadband connectivity. They dropped only being lacked in the implementation of security or privacy policies. For example: countries like Thailand and Vietnam made high benefits in some policy areas but were lacked behind in terms of security policies [29].

6. Conclusion

From the findings, it has been found that despite the major advancements in infrastructure, privacy policies and updating of cyber crime laws, the cloud penetration still remained inconsistent in developing countries. Undoubtedly, the dynamic sharing of resources creates efficiency and flexibility in work. Cloud will remain a promising technology in the future where people will be able to communicate and share resources through web.

7. Future Scope

The major issues like privacy, security and infrastructure need to be taken into account to allow small scale as well as large scale organization take advantage of cloud computing. The following issues can be taken into account:

1. Cloud providers should bring transparency to their consumers in order to have their confidence.
2. Common API should be made to allow the migration between the clouds effectively [2].
3. Research need to be done in automating the resource provision effectively. With the automation, dynamic orchestration of resources will be achieved. For example, IaaS platform will add new servers or storage spaces for users automatically according to the CPU utilization of the server, so as to fulfill the terms of service level made with users beforehand.
4. The dependency on the internet connection sometimes outweighs the benefit of localized file system.
5. Application format need to be more flexible according to the requirements of the consumers. For example, a person cannot upload a document in the Google docs using any other application.
6. No information is available about the cloud data, when a customer migrates from one provider to another. Consumers are concerned about the availability of their records with the previous providers [4].

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