Cloud Computing: Now and Road Ahead

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Abstract: *Cloud computing, the practice of hosting and saving data and programs on the Internet, has been booming ever since its introduction. But with advancing technology, it has been widely adopted by large corporations and users alike. The revenue from cloud services is already in billions and with its ever-growing popularity, it is expected to create more income and jobs in future. The applications cloud computing is being used for are large and diverse. Banking services, healthcare, education etc. have readily shifted towards this new technology. There are various deployment and service models which are in place to oversee the functioning of this service. It definitely has extensive uses. It has its advantages which help it overcome past problems. But it has limitations which can be overcome using resources smartly and implementing new ideas. This paper discusses evolution of cloud computing, its components and relevance for users today.*
Keywords: *Cloud computing, Security, Service Model*

I. Introduction

In decades gone-by, Internet had been a large contributor towards development of new technologies. But in recent times, cloud computing has easily become one of the most promising field of interest for users and companies. In layman's term, cloud computing is the practice of hosting and storing different services over Internet. Cloud Computing is defined as a service which can provide various services to clients with the help of Internet. Through cloud services, it is possible to manage resources in real-time and meet users demand easily quickly which makes it very reliable. It supports multi-tenancy, meaning they can be shared between a pool of different users within an organization. In many cases, different organizations who are working together can pool their sources for mutual benefits.

With growing potential of cloud services, small and large enterprises alike have shifted to cloud. Professionals and daily users are regularly using cloud based services like e-mails, chatting apps etc.

The biggest benefit of cloud service is that a user can define the amount of resource he/she needs at any instance. From an individual to large corporations, this flexibility to either upscale or downscale the resources is very useful. This has huge advantage where business growth is of prime importance with limited resources.
Cloud computing can be divided into two broad categories on which they can differentiated. These are:
1. Deployment Models
2. Service Models

II. Deployment models

There various deployment models in cloud computing. They are divided into four types depending on the services they provide to their customers:

1. ***Private Cloud*** –It is created solely for a single organization where it is managed by in-house professionals or third party contractors. It gives access to only authorized persons which make it most secure of all model. But as it is being set-up for private parties, it is quite expensive to setup and maintain. It is highly customizable allowing the administrator great control over how users use the resources available. Most popular private clouds are Hewlett Packard Enterprise (HPE) and VMware. [3]

2. ***Public Cloud***–As name suggests, public cloud is open for public use. They are mostly free of cost for general use. But as anyone can use it over public Internet, it is less secure than private cloud. Third-party vendors can sell/lease cloud services to business for rent based on bandwidth used, CPU power and storage. Companies like Microsoft Azure, Amazon Web Services offer their services on lease to businesses. [3]

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3. *Community Cloud* – It is type of cloud which is in collaboration between different organizations to pool in their resources concerning a specific matter. It may be managed by the organizations themselves or outsourced to a contractor. [3]

4. *Hybrid Cloud* – It can be classified as the integration of private and public cloud services. It can act as either of them depending on the need of user. It is proven to be highly scalable and cost-effective of all cloud models. [3]
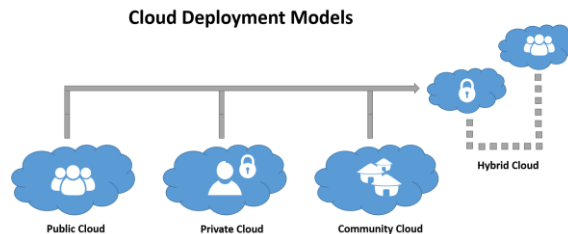

Fig. 1 – Deployment Models

III.   Service Models

There are 3 service models for cloud services that are currently in use:

1. *Infrastructure as a service (IaaS)* – In this mode, the vendor and clients work on pay-as-you-go model. Clients are given access to storage, networking, servers etc. on the demand. Resources can be scaled up or down according to client's need. It reduces the cost for hardware. [3]

2. *Platform as a service (PaaS)* – In this next mode, access is provided by service provider to users to develop their own applications using pre-built suite of tools. The tools required for applications like security, operating systems, server software and backups. are provided by service provider. [3]

3. *Software as a Service (SaaS)* – In this mode, a service provider delivers their own software and applications over Internet. Users can access these applications via web-browsers. This means they can be accessed from a range of devices. Resources can be up-scaled whenever needed. [3]
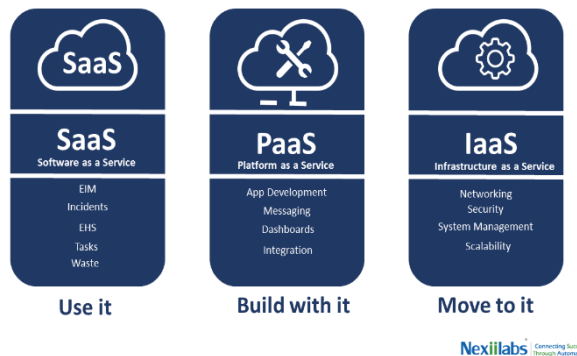

Fig. 2 – Service Models

IV.   Advantages of cloud computing

Cloud computing provides several compelling features that make it attractive to business owners, as shown below.

1. *No up-front investment*: It's probably most important aspect of cloud computing. Users get the flexibility of 'pay-as-you-go'. Service provider rents their resources to users. There are various tiers to choose from. Anyone can use the service depending on their needs. [1]

2. *Lowering operating cost:* The allocation and de-allocation of resources at any end-user is very rapid. So this overcomes the providers' investment in monitoring the total distribution of resources over a range of users. [1]

3. **Highly scalable:** As stated, cloud services gained popularity because of their ability to recognize users' requirements and allocate resources. Service providers can easily tackle a surge in demand from a particular user by allocating them un-used or idle resources from others. [1]

4. *Reducing business risks and maintenance expenses:* Many companies are saving huge amounts of money by shifting to cloud services and they are now less prone to failures. This is largely because now they manage only economical aspect and technological aspect is looked after by cloud experts who are trained to carry out these actions. [1]

5. *Easy access***:** As all cloud services are Internet based, it's very easy to access any service via a large number of devices like laptops, mobile phones, PCs etc. [1]

V. Different uses of cloud computing

Chatbots: All the information that the devices daily use like smart phones save the user data over cloud. Programmers develop intelligent cloud-based AI which can recognize usage pattern, voice, preferences etc. Various assistants like Siri, Bixby use this technology to work. [2]

Social Networking: Facebook, Twitter etc. work in real-time and gather a lot of data from users. To keep their services running 24x7, they employ powerful cloud servers which host and store user data with ease even when there is high internet traffic. [2]

Backup & Recovery: Choosing a cloud service for storing data is very common and cost-effective method. This way users can have a backup of their important files and an on-demand storage facility. Recoveries can be made at any time in case of system failure. Dropbox, Google Drive have become popular cloud storage services. [2]

Communication: Email services like Gmail & Yahoo and messaging apps like WhatsApp also rely on cloud services. All the messages and media sent are stored on a cloud server which makes it possible to access it from anywhere via internet. [2]

Productivity: Various productivity software like MS-Office and Google Docs have shifted to cloud. This makes it easy to edit and save files anywhere on an Internet enabled devices. Work is synced in real-time. This increases productivity and prevents data loss. [2]

VI. Adoption of cloud computing by industry:

Aside from tech-savvy companies, cloud computing has sought firm grounds in various 'traditional' industries which are integrating cloud to their day-to-day functionality. [4,5]

Banking:

Banking institution has been around for hundreds of years. It has changed with landscape over the years. Same goes for cloud computing, more specifically in last five years. Tech companies have been introducing financial service apps on behalf of banks to promote digital banking. All the information and transactions are carried out with help of cloud servers which are very fast and can handle multiple requests at any point of time. This technology has helped banks to embrace new customers with ease.

Healthcare:

Leading healthcare providers and hospitals have shifted to cloud to achieve interoperability and sharing of patient-data. Cloud services have become widely adopted across healthcare industry because of their easiness, safe data storage and improved data analysis. It is sure to expand folds in coming times.

Insurance:

Insurance companies have shifted their focus on cloud services to improve customer experience and meet their expectations. It has vastly improved working efficiency, created mobility and increased flexibility for growth and integration. This has made old legacy systems absurd and greatly increased customer experience.[10]

Energy and Utilities:

Although the spread of cloud services has not been as impressive as other mentioned industries, they are gradually shifting their focus towards cloud due increasing criticism from users owing to not-so-good system

performance, blackouts etc. Cloud would greatly enhance performance, reliability and regulatory compliance.[6,8]

VII. Disadvantages of cloud computing

Despite the obvious advantages of cloud computing like reduced costs on hardware and reliable connections, cloud computing has also posed some challenges to its adopters.[7] Many of these obstacles are a reason many people shy away switching to cloud. Some of the obstacles are:

Downtime:

Probably one of the biggest fault of cloud services is downtime. It refers to the service outages for a period of time. As cloud computing are internet based, it is a common problem. It doesn't matter how big or capable hardware is behind the service, fear of downtime always looms over and it can make companies bleed in cash. For example, an outage on Amazon Web Services in 2017 cost the businesses an estimated $150 million. Possible solution includes designing a service which is based around the globe to provide multiple support systems in case of service failure or any other complication. [1]

Security & Privacy:

In this age of everything digital, privacy of oneself and security of one's data is very crucial. Cloud computing is no different. When someone share our personal and business data with a third party, user expect outmost security and privacy for our data.[9,11] But every now and then we hear about hackers stealing data of millions of users from a cloud service. This brings a bad name for industry and discourages potential users from switching to platform. Service providers must keep up with latest security developments in industry and update their systems likewise. Users should also be careful with their data and only given credentials to trust-worthy people. Multi-factor authentication also helps by creating an extra layer of security. [1]

Vendor Lock-In:

It is another perceived disadvantage of cloud computing which is faced by users who try to switch/migrate between vendor platforms. [13] Some compromises made during the process could lead to exposure of user data which leaves it vulnerable to attack from data stealers. Sometimes users are forced to incur additional costs and face configuration complexities. Best solution to avoid vendor lock-in is to understand before-hand all the terms and benefits of the services when you are buying them. Always choose a package which best suites your needs and do not fall for 'more is good' trap. [1]

Costs:

Cloud computing is maybe a better and cheap option for instant data sharing and retrieval, but not everybody shares the opinion.[14,15] Big enterprises do not shy away from investing into cloud because they have sizeable client base to pay-off such service. Same cannot be said for small-businesses and individuals who can't afford to pay huge sums of money at once. The best way to tackle increasing costs is to look for providers which have flexible prices and choosing the one which best suites your needs. Scaling resources in either direction is important. Tracking the usage of resources is also valuable as it determines functioning costs. [1]

VIII. Conclusion

The penetration of cloud computing in daily life and businesses has been commendable. From social networking to running large corporates, cloud services have proven to be reliable, fast and cost-friendly option. But there are still some concerns as discussed which plaque this platform. If developers are to overcome or at least minimize the negative effects of cloud services, it is surely poised to become a massively adopted technology in various fields like mobile systems, database management etc. in future.[12]

Fig. 3- Future of Computing Industry

Acknowledgement

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