A Study of Cloud Computing in Education Sector

Megha Arora
PG Department of Computer Science & IT
Lyallpur Khalsa College, Jalandhar, Punjab, India

Abstract- Cloud computing is also known as "on-demand Computing", is use for sharing data, resources and Information. It has now become a highly demanded service. Cloud Computing is one of the important and popular internet computing and It appear as a new computing paradigm that provide reliable and customized computing environments to end-users. From the past few years, there has been a rapid progress in Cloud Computing and today's IT professionals in educational institutions are responding quickly to increasing demands from students and faculty, Currently IaaS (Infrastructure as a Service), PaaS (Platform as a Service) and SaaS (Software as a Service) are used as business model for Cloud Computing. This paper also introduces the cloud computing infrastructure provided by Microsoft, Google and Amazon Web Service. This paper also discover some cloud benefits in the education sector and highlight security challenges that institutions face when utilizing cloud technologies and also discover some preventive solutions that overcome the challenges to cloud computing.

Keywords- Cloud Computing, Cloud Services, IaaS, PaaS, SaaS, Challenges, Risk

I. INTRODUCTION

Cloud computing is a computing model that plays an important role in improving the quality of education and offer services through a shared computing infrastructure, flexibility, scalability, processing power, storage and networking. It is considered as one of the major innovations that entered worldwide classrooms in recent years. With its capability to cut IT costs and at the same time create a modern collaborative environment.

Generally, cloud computing can be defined as a set of hardware and network resources that combine the power of multiple servers to deliver different kinds of services through web. The U.S. National Institute of Standards and Technology gives the following definition of cloud computing:"Cloud computing is a model for enabling ubiquitous, 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"

Beside this, it provides facility to store critical information of users and access it on-demand from anywhere through internet. Some smart examples of using cloud are Drop box which is an internet storage that provides 2 GB of free storage to the users. Users can use services and applications of cloud computing to store and access their local data in the remote data center by using their personal computers and mobile

devices. In this paper, the author discover some cloud benefits in the education sector and also discuss services provided to educational institutions. Beside this there are some drawbacks of main cloud services as well as security issues that institutions face while utilizing cloud technologies. Since 2012, the level of cloud computing technology adoption is by all accounts achieving an attractive state [9]. The innovative advancement of CC administrations is blooming its rates of adoption. Various applications based on cloud computing are now adopted in different facts of human effort, education not only proving to be an exception but Cloud computing is changing in such a manner that organizations can work together and assist their related elements. For advanced education, it offers the capacity to be beneficial not only to administrators and educators, but also students, who have their own technology-based gadgets and desires to be taken into account
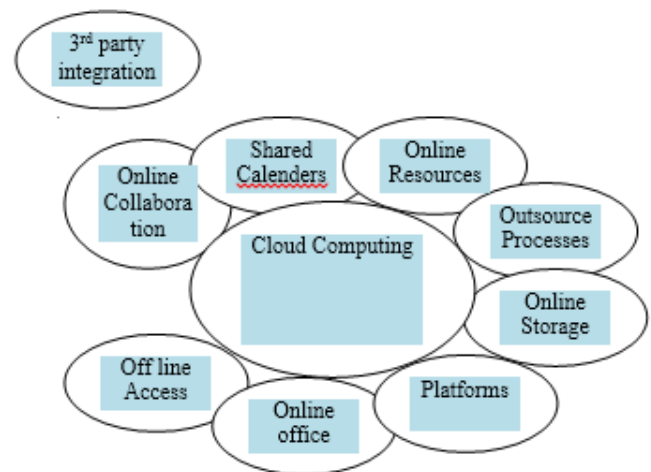

Fig.1: Cloud Computing [13]

II. CLOUD COMPUTING IN E-LEARNING

Web based training (WBT) provides advancement of computer technologies to make the tasks easy with the help of software applications and virtual learning surroundings. The computer that facilitates E Learning transfers the knowledge from Source of internet to end user machines.

ELearning is taking place in many institutions for distance learning students. On the Other hand, many institutions do not have the Proper resources infrastructure to implement state of the art e-learning. The Cloud Oriented applications have taken place over to the blackboards, moodle and adopted in many organizations.

The advantages of e-learning to students include taking an online course, taking examinations, sending feedback, projects and homework. on the other hand, trainers can manage learning content, handle projects, provide feedback and have discussion forum with students friendly environment and improved learning results.

III.   How Cloud Computing is changing education sector

A.   *Used as massive open online Courses*

Cloud Computing has become more efficient for business and schools to protect data and communication purposes. As more individuals use cloud computing to share services such as drop box and google drive. It has become widely recognized as a means of improving productivity and community in education. When the file is on the cloud, the user need not to remember in which computer the file is created and can access it from any computer.

B.   *Communicate and share data*

Students can use cloud (Google Docs) to collaborate on their projects at any time as long as connected to internet. By using Google Docs, students can chat, leave comment or edit the projects**.** Instead of saving file on the hard disk or on the computer, students can save it on google cloud.

C.   *No expensive hardware required*

Students need not to buy any expensive hardware or computers as using cloud based applications, Smartphones can access different applications. Also they need not to purchase external storage devices as there are many more Companies like google that offer cloud based storage [7]

D.   *No expensive software required*

One of the model of Cloud based computing as SaaS (Software – as – a- Service) which provide many Software Programs either free or on low cost Subscription basis. For example, Students can purchase a Cloud based subscription for five computers or five mobile devices for only $10 per month instead of purchasing a Single Microsoft office licence for $140.Also they can use google docs for free.

E.   *No more outdated learning materials*

Students use Outdated material from most of the expensive textbooks. Cloud based materials are easy to update in real time therefore students can get updated topics related to their subject and most learning rsources.

IV.   Services Offered by Cloud Computing

A.   Software as a service (SaaS)

Software-as-a-service (SaaS) is a method for delivering software applications over the Internet, on demand and on a subscription basis. Consumer is provided Software usage and on the basis of demand, the consumer can choose his software to use. Cloud providers host and manage the software application and handle its maintenance, like software upgrades and security patching. Users can connect to the application over the Internet SalesForce.com, Google Mail, Google Docs are examples for SaaS Furthermore, Users can access anytime and from anywhere to applications provided and managed by the service provider. Currently, SaaS is considered as the most interested for stockholders in education. Google Drive, Twitter, Drop box, YouTube, and One Drive are general examples of cloud-based services. Both Microsoft and Google provide some services that are suited for education such as Live@edu and Google Apps**.** In this Figure, User need not to manage any service, he will directly get all the services and is provided by service providers, In this Service ,Customer's data is totally safe and secure.
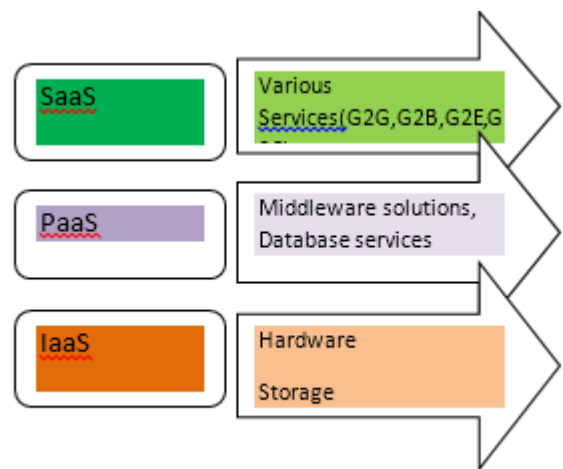

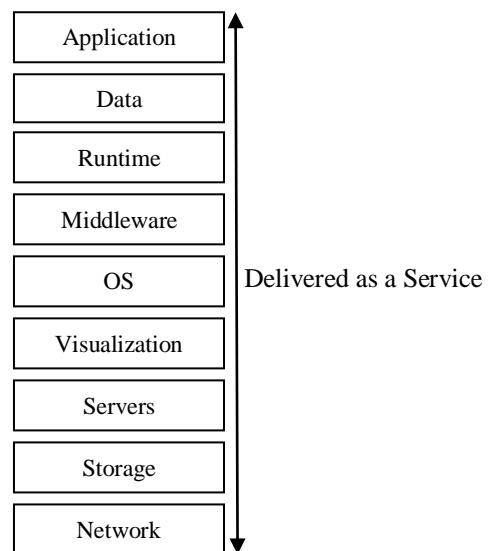FIG. 2: SERVICES OF CLOUD COMPUTING

Fig.3 Software as a Service

B.   *Platform as a Service(Paas)*

In PaaS, the service provider provide development tools to developers to build or customize their applications or services in the cloud irrespective of the platform. PaaS requires programming environment, tools, configuration management etc., to support the application hosting environment. Google App Engine is the example for Platform as a Service, where a developer can install and customize their applications using Python language. In the given fig, User will get IaaS along with that middleware, OS for example Linux based OS and then user have to manage its application and can deliver it.

Fig 3. Platform as a Service

C.   *Infrastructure as a Service(IaaS)*

Infrastructure as a Service is a self-service model in which cloud vendor allows developers to access, monitor and manage computing resources (processors, storage, networks, etc.) The advantage of using IaaS is that it Provide an on-demand data center without requiring user to purchase or install new expensive equipment. Organizations can make use of the unlimited storage Space of the cloud infrastructure. They can expand and shrink this storage space according to the requirement without worrying about dedicated servers on site For Example Amazon's Elastic Compute Cloud. In this Figure, Customer will be provided infrastructure including Network, storage, servers and visualization and has to manage with data ,applications and has to install his own OS.

Delivered as a Service

Fig.5 Infrastructure as a Service

In **Education Sector**, each of these three models plays an important role in education transformation.Cloud vendors make advanced computing tools by storing complex IT infrastructure on remote servers, available to institutions, companies or organizations at low Cost, due to Which there is rapid adoption of these services. Also, new provisioning models have triggered amplitude of various business intelligence software programs that are cost-efficient, collaborative platforms and web applications, the approval of which is often seen as a major transformation in different sectors, including education.

V.   CLOUD COMPUTING PROVIDERS

A. Microsoft Live@edu for education

In educations institutions, It provides a set of hosted collaboration services including collaboration services, communication tools, mobile, desktop, and web-based applications [10]. It also provide feature of data storage capabilities .It includes Office Live Workspace (For collaborative document editing), Windows Live SkyDrive (Skydrive provides 25 GB of internet based file storage), Windows Live Spaces (A Web space where one can share information and ideas using documents, blogs, discussion groups and more), Microsoft Shared View Beta, Microsoft Outlook Live, Windows Live Messenger and Windows Live Alerts. Microsoft Live@edu is mainly for the institutions for enabling facilities for their academic activities.Students can have a free mailbox with their educational institution's domain name, and can keep it for later usage. Now a days these email accounts provide 10 GB of storage and include calendaring, spam filtering, and other features.
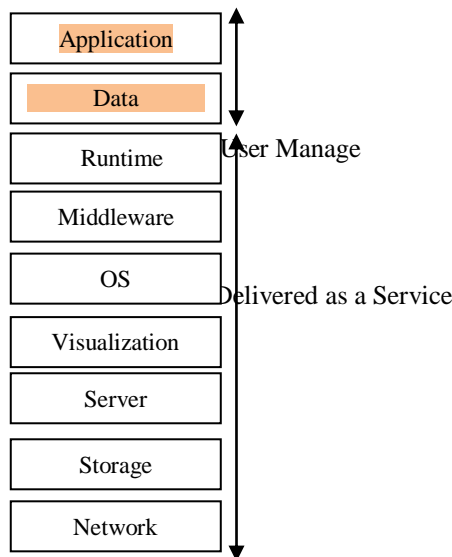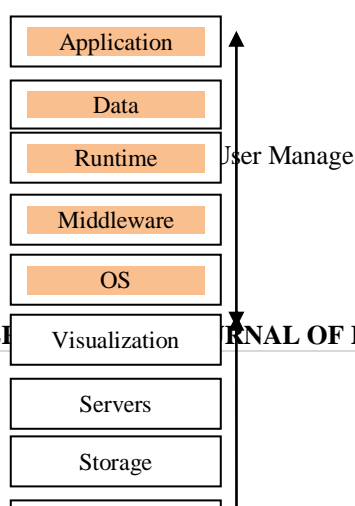
B. Google Apps for Education

It is a collection of web-based programs and file storage that run in a web browser, in which users need not to buy or install software. Users just need to simply log in to the service to access their files and the tools to implement them. The communication tools of Google Apps are Gmail, Google Talk, and Google Calendar and the productivity tools are Google Docs: text files, spreadsheets, and presentations, iGoogle and Google Sites to develop web pages .The tools are free of cost , or users can pay for a Premium Edition that adds more storage space and other features. It is a widely used platform for outsourcing free web-based email, calendar and documents for collaborative study**.**

C. Amazon Web Services

Amazon Web Services is an Amazon's cloud web hosting platform that offers flexible, reliable, scalable, easy-to-use, and cost-effective solutions.

In 2006, these Services started to offer IT services to the market in the form of web services, which is nowadays known as cloud computing. With this cloud, User need not to plan for servers and other IT infrastructure which take lots of time in advance. Instead, these services can instantly spin up hundreds or thousands of servers in minutes and deliver results faster. User need to pay only for what he uses with no up-front expenses and no long-term commitments, which makes AWS cost efficient.

The basic structure of AWS EC2(Elastic Compute Cloud) is Shown below. In this figure, EC2 allow users to use virtual machines of different configurations according to the requirement. It also allows various configuration options, mapping of individual server, various pricing options.
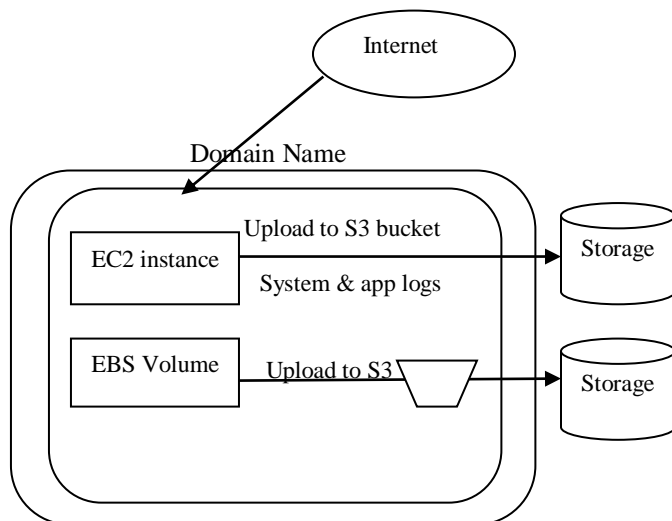

Fig.6: Amazon Web Services

VI.   SECURITY CHALLENGES AND RISKS

 Education sector is using cloud services that are not completely different from those services that are managed within their own Organization. However, they are facing some new challenges. There is some crucial security and privacy-related challenges and risks in cloud computing and to understand that in higher educational institutions, there is need to investigate various view of challenges such as threats, risks, and attack models. There are four aspects under which cloud challenges fall- Network, Access control, Cloud infrastructure, and Data Security [1].

A.   Network Security

In this category, User connect to the cloud infrastructure through transmission medium but there is Provisioning secure medium that prevents leakage of sensitive information during transmission. Furthermore, users migrate their data to cloud servers and the most security challenges are associated with the network used. Also service provider has to provide a protection ways to keep data in safe from a traditional network-based attack such as DoS, Man-in-the-Middle attack, IP spoofing, packet sniffing, port scanning, et because users store their data at remote cloud servers. figure 7 .below Shows possible attacks threaten in cloud computing services.

Threats	Description
DoS	Denial-of-service (DoS) attacks mostly flood servers or networks with traffic in order to inundate the victim resources and make it difficult for legitimate users to use them.
IP Spoofing	It is way to gain unauthorized access to the server.
Packet Sniffing	It is a tool that interrupt data flowing in a network. If computers are connected to a local with the network that is not filtered, then the traffic can be broadcast to all computers contained in the same segment
Port Scanning	In this , Attacker sends queries to search for vulnerable ports on the server and attempts to identify kind of used service.
Phishing	Phishing is an attack used to steal user data, including login credentials and credit card numbers

Fig.7: Attacks on Cloud Computing [1]

Due to this ,hacking and intrusion are increased With the concern to the risks of network security in a cloud environment, This requires the use of strong network security techniques such as Secure Socket Layer (SSL) and Transport Layer Security (TLS) protocols. Furthermore, adequate rules in firewall router, auditable access rights, and some security policies must be implemented to secure system and avoid service hijacking. One can also maintain strong setting in cloud data security policies,apply encryption to sensitive data and also Backing up encryption with DLP and activity monitoring.

B.   Access Control

It includes important security issues such as authentication, identification, and authorization.

Unauthorized can easily access the insecure interface of the web application that is expose an educational institution. Furthermore, through the multi-tenancy cloud. Weak

authentication mechanism might increase the possibility of an unauthorized access to data or services which are globally accessible and shared with other users.

Due to this, there is requirement of using strong authentication mechanism mandatory for any cloud system to ensure the privacy of user information and data stored on a cloud provider's server.

This is the responsibility of service provider to protect cloud service and user data against unauthorized access. In current practices, some good security solutions are recommended to avoid invasion such as VPNs technology, Privileged Access Management, Next Generation Firewalls, etc.

C. Data Security

This type of risks constitute to the biggest challenge for adopting cloud computing in higher education institution. Some institutions still prefer to store their critical data into own archive instead of moving into remote cloud.

Several security issues have been identified and classified according to data states in the cloud: Data-at-Rest which refers to the data stored in the cloud servers, and need to be protected and to validate that an unauthorized user has not modify the data stored in the cloud. Especially, when data stored far away with no physical control over it such as in public cloud. In the state of Data-in-Transit, the possibility of data loss or leakage occurring is increased when travelling from one location to another. The major risk might face data security is the use of inappropriate encryption protocol and weak key in the cloud environment.

VII. OVERCOMING BARRIERS TO CLOUD ADOPTION

The major Obstacles of cloud computing are Security, reliability and confidentiality .Therefore, the requirement is the recommendation of an approach that is provide preventive solution. Thus, several measures help to overcome the challenges to cloud computing.

A. Encryption

It is a process in which information is transformed or changed in such a manner that it cannot be read by anyone without authorization. Therefore, anyone who does not possess the password or code for decrypting the encrypted data is unable to get the data being transmitted when this technique is employed. In this way, the data is securing by ensuring its integrity as well as authenticity by preventing the confidential educational data to be disclosed improperly[2].

B. Digital Signature

Digital signatures can also be used for overcoming privacy and security issues. A digital signature is an electronic signature that is used for authenticating the users who access the cloud services. In this technique, users need to provide their proper access/login credentials in order to access the applications or information they require. As a result, the integrity, accountability and authenticity of data stored on the cloud are ensured and Safe[3].

C. Direct contact with the Cloud Vendor

The chances that the data may be compromised increase with the growing number of moderate stages or levels between the vendor and the user. Therefore, a direct contact should be established by the university with the cloud service provider with no interference from an intermediary. This may ensure one-way movement of data from the cloud service provider to the higher learning institution.

D. Gradual Migration

It is recommended to migrate towards the cloud in a progressive manner and moving low-risk applications first. In this way, the university analyze if the vendor chosen or the cloud project is worthy or not; if it is found to be worthy, then only rest of the applications should be moved in a stepwise manner. The Congruity between the systems of the cloud service provider and the university should be ensured to overcome the barriers of privacy and security concerns. This can be done by gradual migration since both the parties would have find out their compatibility before the migration of sensitive data to the cloud[4].

VIII. RESULTS & DISCUSSION

The author[1] reviewed and discussed about the results obtained through the questionnaire conducted in various universities that adopted cloud computing. Around 64% of universities covered by the survey are cloud beneficiary, whereas only 36% of them are cloud service provider. The Author also noticed while reviewing the questionnaire that many of the respondents were not familiar with security risks that threaten their cloud or security mechanisms used to avoid. Also Educational institutions are less inclined to change. Especially, when this change means more mobile or computer-oriented labor and less paperwork. It is one of the reasons cloud adoption is still at developing stage in the vertical. According to TechJournal's research on cloud computing in schools, cloud adoption is at approximately 28% in schools, whereas 29% of schools are planning cloud initiatives and 32% are in the discovery stage. While, the research also noticed that 76% of higher education cloud users reduced costs by moving applications to the cloud with an average savings of 21%.

IX. CONCLUSION

The Conclusion of this paper is that cloud computing is not only creating an environment where all students can have access to high-quality education and resources but also reducing costs. Now it is a great time to explore how cloud-based applications can benefit in education Sector. Furthermore, Cloud computing provides an opportunity for educational institutions to take advantages of the huge benefits of cloud services and resources in the educational process.

On the Contrary, the cloud users should remain concern about security issues that represent the major obstacle and may prevent the adoption of cloud computing on a large scale. In this paper, there is an overview of cloud computing and its benefits in higher educational institution. The drawbacks of this models were also investigated in addition to challenges and risks that threaten the cloud computing. This study shows

that most of the educational institutions are not familiar with possible security risks or methods used to protect data or cloud application. Furthermore, it also indicates that the most serious attacks might threaten cloud networks like Denial of Service (DoS) and phishing attacks. In the future research, the security risks and challenges of virtualization technology will be covered in details to provide a secure infrastructure for IaaS service in the Educational cloud.

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