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REVIEW ARTICLE

Review Paper on E-learning Using Cloud Computing

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Abstract:
Internet broadband connectivity and rich education content has created a global phenomenon in which information and communication technology (ICT) is being used to transform education. Therefore, there is a need to redesign the educational system to meet the needs better. The advent of computers with sophisticated software has made it possible to solve many complex problems very fast and at a lower cost. This paper introduces the characteristics of the current E-Learning and then analyses the concept of cloud computing and describes the architecture of cloud computing platform by combining the features of E-Learning. Cloud computing provides a low cost solution to academic institutions for their browser-based applications can also be accessed through mobile devices in addition to being available to a variety of laptop and desk top computers, provided internet access is available. In this paper we present a solution that is based on cloud computing and can be used for building a virtual environment both for teaching and learning

Keywords: *Cloud Computing, E-learning, Architecture, SaaS, PaaS, IaaS*

I. INTRODUCTION

At present, most of the conventional education forms are becoming not being suitable for requirements of social progress and educational development and not being able to catch up with the changes of learning demand in time, thus computer networks have brought opportunities for it. One of the most promising paradigms for education is e-learning. E-learning is commonly referred to the intentional use of networked information and communications technology (ICT) in teaching and learning. Some other terms are also used to describe this mode of teaching and learning including online learning, virtual learning, distributed learning, network and web-based learning.

Cloud Computing is a new paradigm that provides an appropriate pool of computing resources with its dynamic scalability and usage of virtualized resources as a service through the Internet. The resources can be network servers, applications, platforms, infrastructure segments and services. In integration of e-learning and network, emphasis is placed on

building of software and hardware platform of e-learning system, functional structure, network security management and training, information technology integration to teaching, campus network environment, online education, semantic web technologies-based multi-agent system. Cloud computing applications provide flexibility for educational universities, schools and institutions. The cloud platform in institutions' campuses provides effective infrastructure and deployment model for their dynamic demands. The benefits of cloud computing can support education institutions to resolve some of the common challenges such as cost reduction, quick and effective communication, security, privacy, flexibility and accessibility.

II. CLOUD COMPUTING

Cloud Computing is a technology that uses the internet and central remote servers to maintain data and applications. Cloud computing allows consumers and businesses to use applications without installation and access their personal files at any computer with internet access. This technology allows for much more efficient computing by centralizing data storage, processing and bandwidth.

Cloud computing is the use of computing resources (hardware and software) that are delivered as a service over a network (typically the Internet). The name comes from the use of a cloud-shaped symbol as an abstraction for the complex infrastructure it contains in system diagrams. Cloud computing entrusts remote services with a user's data, software and computation.

According to the official NIST (National Institute of Standards and Technology) definition, "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." The NIST definition lists five essential characteristics of cloud computing: on-demand self-service, broad network access, resource pooling, rapid elasticity or expansion, and measured service. It also lists three "service models" (software, platform and infrastructure), and four "deployment models" (private, community, public and hybrid) that together categorize ways to deliver cloud services. The definition is intended to serve as

a means for broad comparisons of cloud services and deployment strategies, and to provide a baseline for discussion from what is cloud computing to how to best use cloud computing.Cloud computing employs a service driven business model. Cloud offers services that can be grouped into the following categories:

A. Cloud Services

1) Infrastructure as a service (IaaS): Hardware resources (such as storage) and computing power (CPU and memory) are offered as services to customers. This enables businesses to rent these resources rather than spending money to buy dedicated servers and networking equipment.. As examples in this category, Amazon1 offers S3 for storage, EC2 for computing power, and SQS for network communication for small businesses and individual consumers.

*2) Software as a service (SaaS)**:*** In this model, software applications are offered as services on the Internet rather than as software packages to be purchased by individual customers. One of the pioneering providers in this category is Salesforce.com offering its CRM application as a service. Other examples include Google web-based office applications (word processors, spreadsheets, etc.),

3) Platform as a service (PaaS): This refers to providing facilities to support the entire application development

lifecycle including design, implementation, debugging, testing, deployment, operation and support of rich Web applications and services on the Internet. Most often Internet browsers are used as the development environment. Examples of platforms in this category are Microsoft Azure Services platform6, Google App Engine7, Salesforce.com Internet Application Development platform8 and Bungee Connect platform9. PaaS enables SaaS users to develop add-ons, and also develop standalone Web based applications, reuse other services and develop collaboratively in a team.

B. Models of Cloud

1) *Private Cloud:* The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises.

2) *Public Cloud:* Public cloud applications, storage, and other resources are made available to the general public by a service provider. These services are free or offered on a pay-per-use model. Generally, public cloud service providers like Amazon

AWS, Microsoft and Google own and operate the infrastructure and offer access only via Internet (direct connectivity is not offered).

3) *Community Cloud:* Community cloud shares infrastructure between several organizations from a specific community with common concerns (security, compliance, jurisdiction, etc.), whether managed internally or by a third-party and hosted internally or externally. The costs are spread over fewer users than a public cloud (but more than a private cloud), so only some of the cost savings potential of cloud computing are realized**.**

4) Hybrid cloud: Hybrid cloud is a composition of two or more clouds (private, community or public) that remain unique entities but are bound together, offering the benefits of multiple deployment model

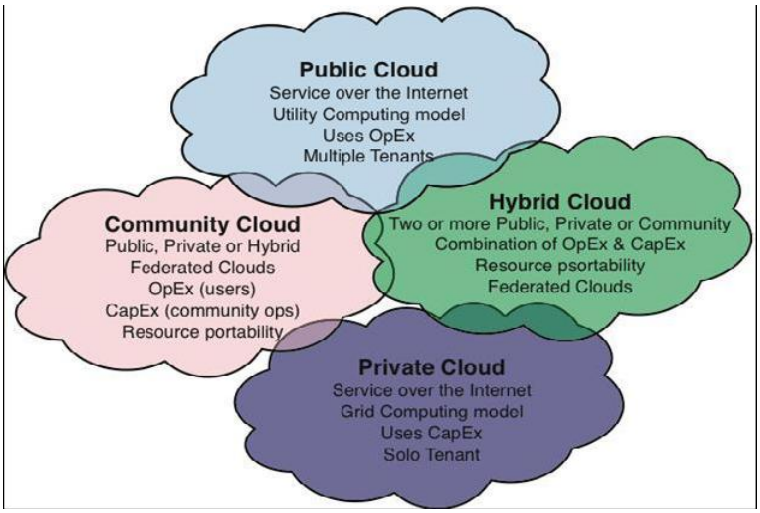

Fig 1 Cloud Model

III. E-LEARNING

A. From Traditional E-learning Network to Cloud E-Learning

E-learning is an Internet-based learning process, using Internet technology to design, implement, select, manage, support and extend learning, which will not replace traditional education methods, but will greatly improve the efficiency of education. As e-learning has a lot of advantages like flexibility, diversity, measurement, opening and so on, it will become a primary way for learning in the new century as in Fig 2.

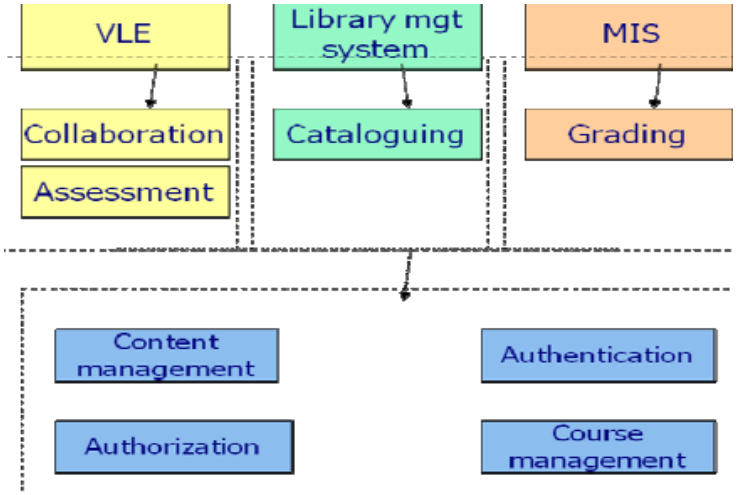

Fig 2 Architecture of simplified Learning System

Mendez illustrates that in traditional web-based learning mode, system construction and maintenance are located inside the educational institutions or enterprises, which led to a lot of problems, such as significant investment needed but without capital gains for them, which leads to a lack of development potential. In contrast, cloud-based e-learning model introduces scale efficiency mechanism, i.e. construction of e-learning system is entrusted to cloud computing suppliers, which can make providers and users to achieve a win-win situation. The cloud-based environment supports the creation of new generation of e-learning systems, able to run on a wide range of hardware devices, while storing data inside the cloud.

Ouf has presented an innovative e-learning ecosystem based on cloud computing and Web 2.0 technologies. The article analyses the most important cloud-based services provided by public cloud computing environments such as Google App Engine, Amazon Elastic Compute Cloud (EC2) or Windows Azure, and highlights the advantages of deploying E-Learning 2.0 applications for such an infrastructure. The authors also identified the benefits of cloud-based E-Learning 2.0 applications (scalability, feasibility, or availability) and underlined the enhancements regarding the cost and risk management.

Chandral focused on current e-learning architecture model and on issues in current e-learning applications. The article presents the Hybrid Instructional Model as the blend of the traditional classroom and online education and its customization for e-learning applications running on the cloud computing infrastructure. The authors underline the e-learning issues, especially the openness, scalability, and development/customization costs. The existing e-learning systems are not dynamically scalable and hard to extend –integration with other e-learning systems is very expensive. The article proposed the hybrid cloud delivery model that can help in fixing the mentioned problems.

In this article a new paradigm is highlighted in educational area by introducing the cloud computing in order to increase the scalability, flexibility and availability of e-learning systems. The authors have evaluated the traditional e-learning networking model, with its advances and issues, and the possibility to move the e-learning system out of schools or enterprises, inside a cloud computing infrastructure. The separation of entity roles and cost effectiveness can be considered important advantages. The institutions will be responsible for the education process, content management and delivery, and the vendor takes care of system construction, maintenance, development and management. The e-learning system can be scaled, both horizontally and vertically, and the educational organization is charged according to the number of used servers that depends on the number of students as in Fig 3 .

B. Cloud based E-Learning architecture

The e-learning cannot completely replace teachers; it is only an updating for technology, concepts and tools, giving new content, concepts and methods for education, so the roles of teachers cannot be replaced. The teachers will still play leading roles and participate in developing and making use of E-learning cloud.

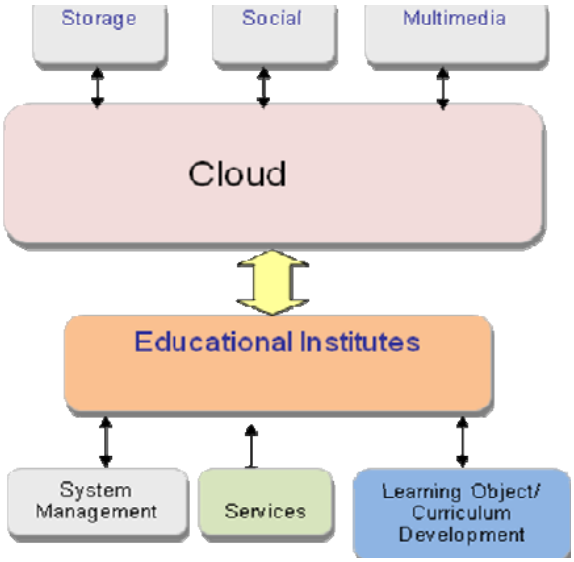

Fig 3 Modified E-learning System Architecture.

The blended learning strategy should improve the educational act. Moreover, the interactive content and virtual collaboration guarantee a high retention factor.

On the other hand, E-learning cloud is a migration of cloud computing technology in the field of e-learning, which is a future e-learning infrastructure, including all the necessary hardware and software computing resources engaging in E-learning.

After these computing resources are virtualized, they can be afforded in the form of services for educational institutions, students and businesses to rent computing resources. E-learning cloud architecture is shown in Fig 4.

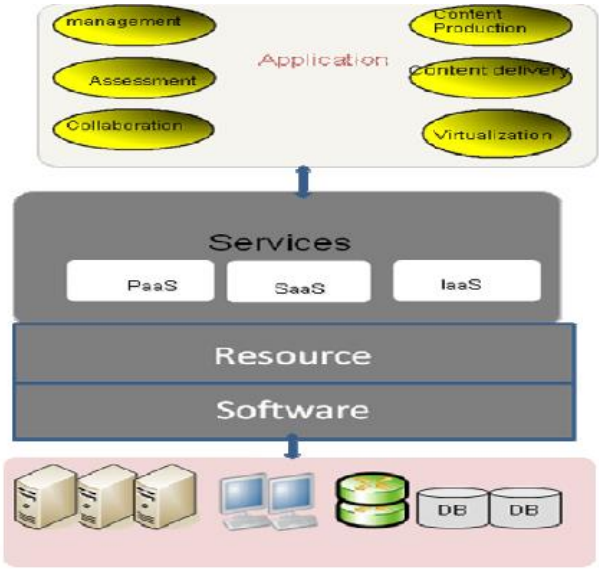

Fig 4 E-learning Cloud Architecture.

The proposed e- learning cloud architecture can be divided into the following layers: Infrastructure layer as a dynamic and scalable physical host pool, software resource layer that offers a unified interface for e-learning developers, resource management layer that achieves loose coupling of software and hardware resources, service layer, containing three levels of services (software as a service, platform as a service and infrastructure as a service), application layer that provides with content production, content delivery, virtual laboratory, collaborative learning, assessment and management features.

1) *Infrastructure layer*: is composed of information infrastructure and teaching resources. Information infrastructure contains Internet/Intranet, system software, information management system and some common software and hardware; teaching resources is accumulated mainly in traditional teaching model and distributed in different departments and domain. This layer is located in the lowest level of cloud service middleware, the basic computing power like physical memory, CPU, memory is provided by the layer. Through the use of virtualization technology, physical server, storage and network form virtualization group for being called by upper software platform. The physical host pool is dynamic and scalable, new physical host can be added in order to enhance physical computing power for cloud middleware services

2) *Software resource layer:* mainly is composed by operating system and middleware. Through middleware technology, a variety of software resources are integrated to provide a unified interface for software developers, so they can easily develop a lot of applications based on software resources and embed them in the cloud, making them available for cloud computing users.

3) *Resource management layer*: is the key to achieve loose coupling of software resources and hardware resources. Through integration of virtualization and cloud computing scheduling strategy, on-demand free flow and distribution of software over various hardware resources can be achieved.

4) *Service layer:* has three levels of services namely,SaaS (Software as a service), Paas (Platform as a service), IaaS (Infrastructure as a service). In SaaS, cloud computing service is provided to customers. As is different from traditional software, users use software via the Internet, not to need a one-time purchase for software and hardware, and not to need to maintain and upgrade, simply paying a monthly fee.

5) *Application layer:* is the specific application of integration the teaching resources in the cloud computing model, including interactive courses and sharing the teaching resources. The interactive programs are mainly for the teachers, according to the learners and teaching needs, taken full advantage of the underlying information resources after finishing made, and the course content as well as the progress may at any time adjust according to the feedback, and can be more effectiveness than

traditional teaching. Sharing of teaching resources include teaching material resources, teaching information resources (such as digital libraries, information centers), as well as the full sharing of human resources. This layer mainly consists of content production, educational objectives, content delivery technology, assessment and management component.

C. *Key Benefits of Cloud Based E-Learning*

There are numerous advantages when the e-learning is implemented with the cloud computing technology, they are:

1) *Low cost:* E-Learning users need not have high end configured computers to run the e-learning applications. They can run the applications from cloud through their PC, mobile phones, tablet PC having minimum configuration with internet connectivity. Since the data is created and accessed in the cloud, the user need not spend more money for large memory for data storage in local machines. Organizations also need to pay per use, so it's cheaper and need to pay only for the space they need.

2) *Improved performance:* Since the cloud based e-learning applications have most of the applications and processes in cloud, client machines do not create problems on performance when they are working.

3) *Instant software updates:* Since the cloud based application for e-learning runs with the cloud power, the software's are automatically updated in cloud source. So, always e-learners get updates instantly.

4) *Improved document format compatibility:* Since some file formats and fonts do not open properly in some PCs/mobile phones, the cloud powered e-learning applications do not have to worry about those kinds of problems. As the cloud based e-learning applications open the file from cloud.

5) *Benefits for students:* Students get more advantages through cloud based e-learning. They can take online courses, attend the online exams, get feedback about the courses from instructors, and send their projects and assignments through online to their teachers.

6) *Benefits for teachers:* Teachers also get numerous benefits over cloud based e-learning. Teachers are able to prepare online tests for students, deal and create better content resources for students through content management, assess the tests, homework, projects taken by students, send the feedback and communicate with students through online forums.

7) *Data security:* A very big concern is related to the data security because both the software and the data are located on remote servers that can crash or disappear without any additional warnings. Even if it seems not very reasonable, the cloud computing provide some major security benefits for individuals and companies that are using/developing e-earning solutions.

IV. CONCLUSION

Cloud computing has recently emerged as a compelling paradigm for managing and delivering services over the internet. The rise of cloud computing is rapidly changing landscape of Information technology and ultimately turning to the long-held promise of utility computing into a reality. Cloud computing can help communities and nations, can transform education. An entire world of knowledge can now be made available to teachers and students through cloud based services From any device. By helping countries worldwide, lowering the cost and simplifying the delivery of educational services, cloud computing enables students across the globe to acquire the 21st-century skills and training they need to compete and succeed in the global information society.

Present economic situation will force different educational institutions and organizations to consider adopting a cloud solution. Universities have begun to adhere to this initiative and there are proofs that indicate significant decreasing of expenses due to the implementation of cloud solutions. The aim of our work was to identify an architecture which will be using Cloud Computing within higher education. Mainly, we have considered the benefits of cloud architecture. Future research will include a study regarding the attitude and strategy for migration to the proposed architecture based on clouds.

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