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Designing Issues for E-Learning Services on Cloud Environment

Sonia Duggal and Anupriya Jain
Research Scholar, Jagan Nath University, Jaipur, (Rajasthan), INDIA

ABSTRACT: E-Learning is the topic related to the virtualized distance learning by means of electronic communication mechanisms, specifically the Internet. The need for education is increasing constantly. The development and improvement of the e-learning solutions is necessary. Also, the e-learning systems need to keep the pace with the technology, so the new direction is to use cloud computing. Cloud computing is highly scalable and creates virtualized resources that can be made available to users. Cloud computing will have a significant impact on the educational environment in the future.
In this paper, we give an overview of the current state of Cloud Computing. We provide details of the most common infrastructures for e-learning, and finally we present some challenges of e-learning approaches for Cloud Computing.

Keywords-Cloud Computing, E-learning, ICT, SaaS, PaaS, IaaS.

I. INTRODUCTION

The Electronic Learning, better known as E-Learning , is defined as an Internetenabled learning. Components of e-Learning can include content of multiple formats, management of the learning experience, and an online community of learners, content developers and experts. The study summarized the main advantages, which include flexibility, convenience, easy accessibility, consistency and its repeatability.

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. Cloud computing deliver services autonomously based on demand and provides sufficient network access, data resource environment and effectual flexibility. This technology is used for more efficient and cost effective computing by centralizing storage, memory, computing capacity of PC's and servers. With the tremendous advantages of cloud computing, we expect this technology to revolutionize the field of e-learning education. Cloud computing applications provide flexibility for all 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. "Cloud computing" is the next accepted action in the evolution of on-demand information technology services and products. Cloud computing allows to move the processing effort from the local devices to the data center facilities. The software is seen as a service and the applications and data are stored on multiple servers that can be accessed from the Internet. However, in traditional web-based e-learning mode, system construction and maintenance are located in interior of educational institutions or enterprises, which results in a lot of problems existed. cloud computing has many advantages such as expected performance, reduced upfront investment (i.e., software, hardware, and professional staff to maintain servers and upgrade software), high availability, reduced launching time, infinite scalability, tremendous fault-tolerance capability, and accessibility, enhanced collaboration, and mobility, allow users to use any device, such as a mobile phone, personal computer (PC) etc. Cloud computing is becoming an attractive technology due to its dynamic scalability and effective usage of the resources; it can be utilized under circumstances where the availability of resources is limited. This paper presents the impact of using cloud computing upon e-learning solutions development.

II. WHAT IS CLOUD COMPUTING?

Cloud computing is a colloquial expression used to describe a variety of different types of computing concepts that involve a large number of computers that are connected through a real-time communication network (typically the Internet). Cloud computing is a jargon term without a commonly accepted non-ambiguous scientific or technical definition. In science, cloud computing is a synonym for distributed computing over a network and means the ability to run a program on many connected computers

at the same time. The phrase is also, more commonly, used to refer to network based services which appear to be provided by real server hardware, but which in fact are served up by virtual hardware, simulated by software running on one or more real machines. Such virtual servers do not physically exist and can therefore be moved around and scaled up (or down) on the fly, without affecting the end user - arguably, rather like a cloud.

The popularity of the term can be attributed to its use in marketing to sell hosted services in the sense of application service provisioning that run client server software on a remote location.

Cloud computing providers offer their services according to several fundamental models:[2][54] infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS) where IaaS is the most basic and each higher model abstracts from the details of the lower models. Other key components in anything as a service (XaaS) are described in a comprehensive taxonomy model published in 2009, such as Strategy-as-a-Service, Collaboration-as-a-Service, Business Process-as-a-Service, Database-as-a-Service, etc. In 2012, network as a service (NaaS) and communication as a service (CaaS) were officially included by ITU (International Telecommunication Union) as part of the basic cloud computing models, recognized service categories of a telecommunication-centric cloud ecosystem.

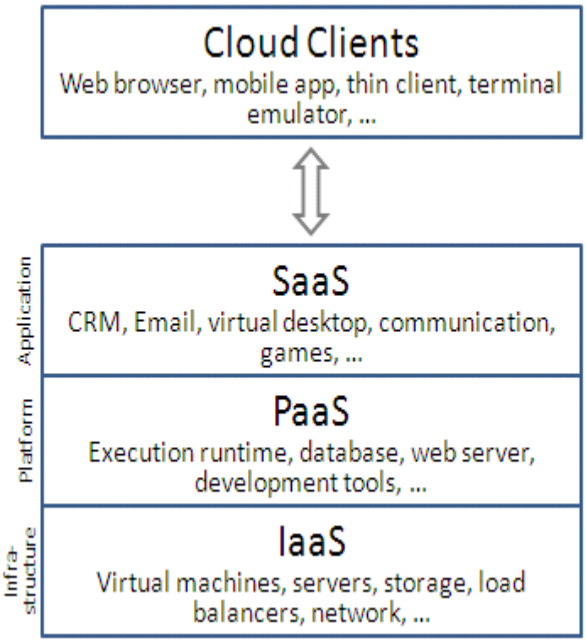

Fig. 1. Infrastructure of cloud computing.

Infrastructure as a service (IaaS)

In the most basic cloud-service model, providers of IaaS offer computers - physical or (more often) virtual machines - and other resources. (A hypervisor, such as Xen or KVM, runs the virtual machines as guests. Pools of hypervisors within the cloud operational support-system can support large numbers of virtual machines and the ability to scale services up and down according to customers' varying requirements.) IaaS clouds often offer additional resources such as a virtual-machine disk image library, raw (block) and file-based storage, firewalls, load balancers, IP addresses, virtual local area networks (VLANs), and software bundles. IaaS-cloud providers supply these resources on-demand from their large pools installed in data centers. For wide-area connectivity, customers can use either the Internet or carrier clouds (dedicated virtual private networks).

To deploy their applications, cloud users install operating-system images and their application software on the cloud infrastructure. In this model, the cloud user patches and maintains the operating systems and the application software. Cloud providers typically bill IaaS services on a utility computing basis: cost reflects the amount of resources allocated and consumed.

Examples of IaaS providers include: Amazon EC2, Google Compute Engine, HP Cloud, Joyent, Linode, Navi Site, Rackspace, Windows Azure Cloud Services, and Ready Space Cloud Services.

Cloud communications and cloud telephony, rather than replacing local computing infrastructure, replace local telecommunications infrastructure with Voice over IP and other off-site Internet services.

Platform as a service (PaaS)

In the PaaS model, cloud providers deliver a computing platform, typically including operating system, programming language execution environment, database, and web server. Application developers can develop and run their software solutions on a cloud platform without the cost and complexity of buying and managing the underlying hardware and software layers. With some PaaS offers, the underlying computer and storage resources scale automatically to match application demand so that the cloud user does not have to allocate resources manually.

Examples of PaaS include: AWS Elastic Beanstalk, Cloud
Foundry, Heroku, Force.com, EngineYard, Mendix, Op enShift, Google App Engine, AppScale, Windows Azure Cloud Services, OrangeScape and Jelastic.

Software as a service (SaaS)

In the business model using software as a service (SaaS), users are provided access to application software and databases. Cloud providers manage the infrastructure and platforms that run the applications. SaaS is sometimes referred to as "on-demand software" and is usually priced on a pay-per-use basis. SaaS providers generally price applications using a subscription fee.

In the SaaS model, cloud providers install and operate application software in the cloud and cloud users access the software from cloud clients. Cloud users do not manage the cloud infrastructure and platform where the

application runs. This eliminates the need to install and run the application on the cloud user's own computers, which simplifies maintenance and support. Cloud applications are different from other applications in their scalability—which can be achieved by cloning tasks onto multiple virtual machines at run-time to meet changing work demand. Load balancers distribute the work over the set of virtual machines. This process is transparent to the cloud user, who sees only a single access point. To accommodate a large number of cloud users, cloud applications can be *multitenant,* that is, any machine serves more than one cloud user organization. It is common to refer to special types of cloud based application software with a similar naming convention: desktop as a service, business process as a service, test environment as a service, communication as a service.

The pricing model for SaaS applications is typically a monthly or yearly flat fee per user, so price is scalable and adjustable if users are added or removed at any point.

Examples of SaaS include: Google Apps, Microsoft Office 365, Petrosoft, Onlive, GT Nexus, Marketo, Casengo, TradeCard, Rally Software, Salesforce and CallidusCloud.

Proponents claim SaaS allows a business the potential to reduce IT operational costs by outsourcing hardware and software maintenance and support to the cloud provider. This enables the business to reallocate IT operations costs away from hardware/software spending and personnel expenses, towards meeting other goals. In addition, with applications hosted centrally, updates can be released without the need for users to install new software. One drawback of SaaS is that the users' data are stored on the cloud provider's server. As a result, there could be unauthorized access to the data.

Network as a service (NaaS)

A category of cloud services where the capability provided to the cloud service user is to use network/transport connectivity services and/or inter-cloud network connectivity services. NaaS involves the optimization of resource allocations by considering network and computing resources as a unified whole.

Traditional NaaS services include flexible and extended VPN, and bandwidth on demand. NaaS concept materialization also includes the provision of a virtual network service by the owners of the network infrastructure to a third party (VNP – VNO).

III. WHAT IS E-LEARNING?

E-learning refers to the use of electronic media and information and communication technologies (ICT) in education. E-learning is broadly inclusive of all forms of educational technology in learning and teaching. E-learning is inclusive of, and is broadly synonymous with multimedia learning,

Technology-enhanced learning (TEL),
Computer-based instruction (CBI),
Computer-based training (CBT),
Computer-assisted instruction or computer-aided instruction (CAI),
Internet-based training (IBT),
Web-based training (WBT),
Online education, virtual education,
Virtual learning environments (VLE) (which are also called learning platforms),
M-learning,
Digital educational collaboration.

These alternative names emphasize a particular aspect, component or delivery method.

E-learning includes numerous types of media that deliver text, audio, images, animation, and streaming video, and includes technology applications and processes such as audio or video tape, satellite TV, CD-ROM, and computer-based learning, as well as local intranet/extranet and web-based learning. Information and communication systems, whether free-standing or based on either local networks or the Internet in networked learning, underlay many e-learning processes.

E-learning can occur in or out of the classroom. It can be self-paced, asynchronous learning or may be instructor-led, synchronous learning. **E-learning** is suited to distance learning and flexible learning, but it can also be used in conjunction with face-to-face teaching, in which case the term blended learning is commonly used.

It is commonly thought that new technologies make a big difference in education. Many proponents of e-learning believe that everyone must be equipped with basic knowledge of technology, as well as use it as a vehicle for reaching educational goals.

There are various e-learning solutions from open source to commercial. There are at least two entities involved in an e-learning system: the students and the trainers. Some benefits of e-learning are discussed below: Time: One of the key benefits of online study is that one can learn or take a course through e-learning at any time as it is convenient for them. Pod casts and downloadable lectures mean that students are no longer constricted by a conventional timetable of lectures. Location: Neither are students restricted by their physical location. With an Internet connection, they can attend live online tutorials, participate in dedicated discussion forums or download course material and notes regardless of where they are. Communication: Another key advantage of online study is that it encourages and enables students to collaborate and communicate with their fellow students as well as their tutors.

Improved training and material costs: With e-learning, each time the course is accessed our return on investment improves because users are dividing the fixed production costs by number of uses. We also have

savings through decreased travel, reduced material, and hopefully improved (and more efficient) performance.

Increased productivity: Because e-learning is not bound by geography or time, you can control training's impact on production by training people during down times. In addition, with the current economy, you're asking people to do more with less. So e-learning is a great way to give them the tools and skills needed to enhance their performance.

IV. CLOUD COMPUTING BASED E-LEARNING

With the increase in number of students, rapid growth of education content and changing IT infrastructure, the educational institutes are confronted with a dramatic increase in costs and a decrease in budgets which leads to the need of finding some alternative for their e-learning solutions. Also, the current e-learning systems are not scalable and do not lead to the efficient utilization of the resources. As a response to this increase in pressure and to increase the efficiency and availability of their current e-learning system, the educational institutes may adopt a service oriented approach. The potential efficiency of using cloud computing in higher education has been recognized by many universities such as University of California, Washington State University's School of Electrical Engineering and Computer Science, higher education institutes from UK, Africa, US and others.

In cloud based e-learning systems, the institutions are responsible for content creation, management and delivery while the cloud service provider is responsible for

system construction, development, management and maintenance. The institutes are charged according to the usage that directly depends on the number of students.

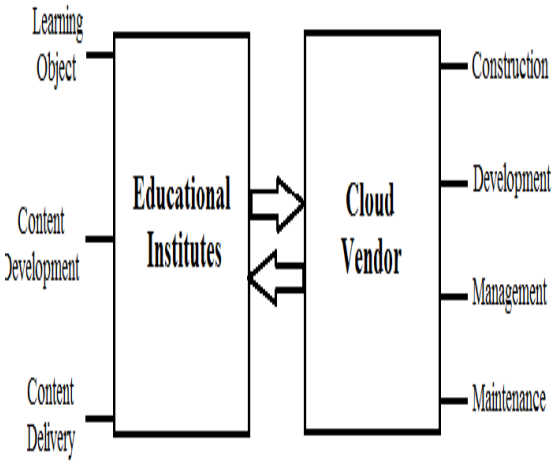

Fig. 2. Separation of roles in Cloud based E-learning.

In , Kaewkiriya and Utakrit have proposed a model for elearning using cloud computing which is shown in fig.3.

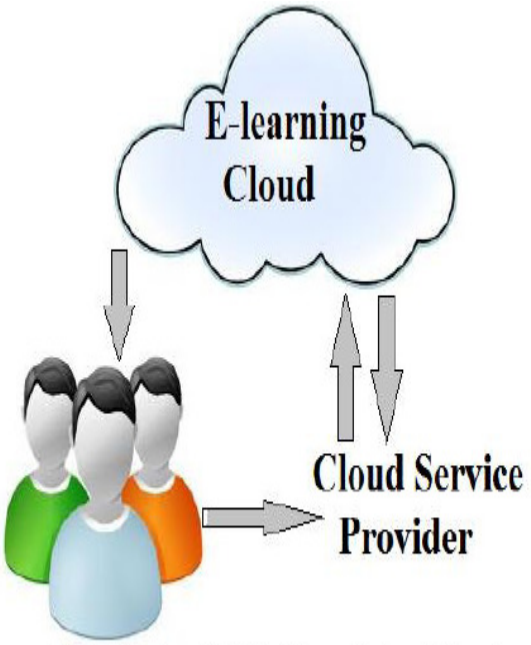

Fig. 3. Abstract model of Cloud Computing based E-learning.

In this model, the request from the user is sent to the cloud service provider which in turn connects to the e-learning cloud in order to give response to the user.s query.

The architecture of a system that uses cloud computing as an e-learning solution is shown in Fig. 4

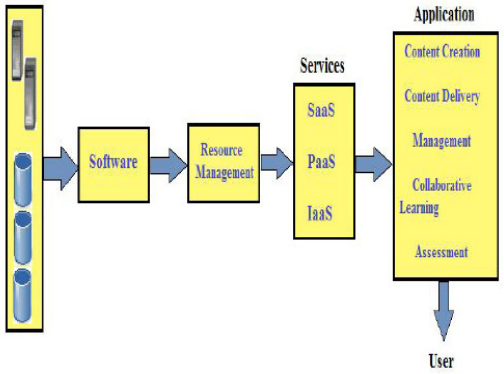

Fig. 4. Cloud Computing Architecture.

This architecture has five layers:

- ***Infrastructure Layer*** is composed of dynamic and scalable resources such as physical memory, CPU and memory etc.
- ***Software Resource Layer*** mainly consists of operating system and middleware to provide interface to the software developers for easy development of applications

that will be made available to the end users.

Resource Management layer is used to achieve loose coupling of hardware and software resources so as to provide on demand service.

Service Layer has three levels namely IaaS, PaaS and SaaS that help the cloud users to use various cloud services.

Application Layer includes specific applications to integrate teaching resources with cloud computing model.

V. BENEFITS OF USING CLOUD COMPUTING IN E-LEARNING

One of the most interesting applications of cloud computing is educational cloud. The educational cloud computing can focus the power of thousands of computers on one problem, allowing researchers search and find models and make discoveries faster than ever. The universities can also open their technology infrastructures to private, public sectors for research advancements. The efficiencies of cloud computing can help universities keep pace with ever-growing resource requirements and energy costs. Students expect their personal mobile devices to connect to campus services for education. Faculty members are asking for efficient access and flexibility when integrating technology into their classes. Researchers want instant access to high performance computing services, without them responsibility of managing a large server and storage farm. The role of cloud computing at university education should not be underestimated as it can provide important gains in offering direct access to a wide range of different academic resources, research applications and educational tools. Usually, E-learning systems are developed as distributed applications, but not limited to. The architecture of an e-learning system, developed as a distributed application, includes a client application, an application server and a database server, beside the hardware to support it (client computer, communication infrastructure and servers).

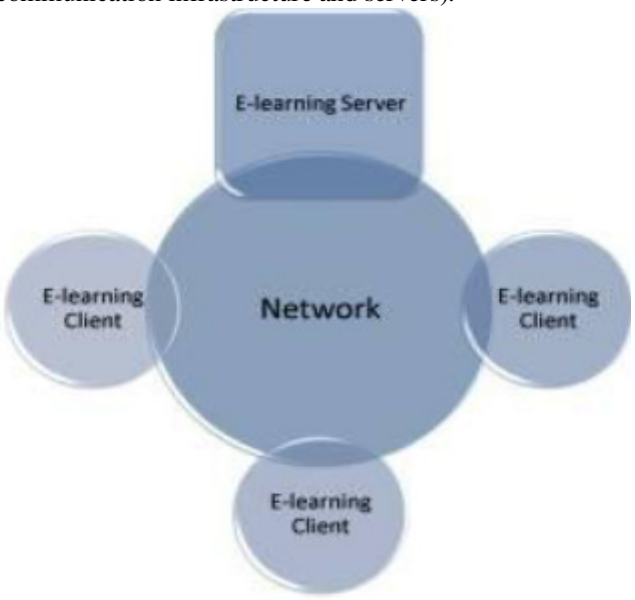

Fig. 5. E-Learning System.

E-learning systems can use benefit from cloud computing using:

A. Infrastructure: use an e-learning solution on the provider's infrastructure

B. Platform: use and develop an e-learning solution based on the provider's development interface

C. Services: use the e-learning solution given by the provider.

Key Benefits of Cloud Based E-Learning

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

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.

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.

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.

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.

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. ***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.

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 provides some major security benefits for individuals and companies that are using/developing e-learning solutions.

VI. CURRENT CHALLENGES OF E-LEARNING SYSTEMS

Among the learning technologies, web-based learning offers several benefits over conventional classroom-based learning. Its biggest advantages are the reduced costs since a physical environment is no longer required and therefore it can be used at any time and place for the convenience of the student. Additionally, the learning material is easy to keep updated and the teacher may also incorporate multimedia content to provide a friendly framework and to ease the understanding of the concepts. Finally, it can be viewed as a learner-centered approach which can address the differences among teachers, so that all of them may check the confidence of their material to evaluate and re-utilize common areas of knowledge.

However, there are some disadvantages that must be addressed prior to the full integration of e-Learning into the academic framework. Currently, e-Learning systems

are still weak on scalability at the infrastructure level. Several resources can be deployed and assigned just for specific tasks so that when receiving high workloads, the system need to add and configure new resources of the same type, making the cost and resource management very expensive.

This key issue is also related to the efficient utilization of these resources. For example, in a typical university scenario, PC labs and servers are under-utilized during the night and semester breaks. In addition, these resources are on high demands mainly towards the end of a semester, following a dynamic rule of use. The physical machines are hold even when they are idle, wasting its full potential.

Finally, we must understand that there is a cost related to the computer (and building) maintenance, but that the educational center must pay for the site licensing, installation and technical support for the individual software packages.

VII. CONCLUSION

Cloud computing as an exciting development is a significant alternative today's educational perspective. Students and administrative personnel have the opportunity to quickly and economically access various application platforms and resources through the web pages on-demand. This automatically reduces the cost of organizational expenses and offers more powerful functional capabilities. There will be an online survey to collect the required data for the use of cloud computing in the universities and other governmental or private institutions in the region. This will help us review the current status and probable considerations to adopt the cloud technology. Beginning with the outsourcing of email service seems attractive. The gradually removal of software license costs, hardware costs and maintenance costs respectively provides great flexibility to the university/corporate management. In this paper we discuss a cloud computing based e-learning. Describe its definition and some benefits. Cloud based education will help the students, staff, Trainers, Institutions and also the learners to a very high extent and mainly students from rural parts of the world will get an opportunity to get the knowledge shared by the professor on other part of the world. Even governments can take initiatives to implement this system in schools and colleges in future and we believe that this will happen soon.

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