A Novel Approach For Cloud-Based E-Learning System

B. Backialakshmi, Dr. V. Sumalatha

Abstract— As with rapid growth of the Information and Communication Technologies play a vital role in the field of education and e-learning has become a very popular trend of the education technology. This paper analyzes and measures the cloud computing architecture usage, more and more industries move their focus from investing into processing power to renting processing power from a specialized vendor. Education field is no different. E-learning systems usually require many hardware and software resources. There are numerous educational institutions that cannot afford such investments, and cloud computing is the best solution for them. The main aim of the study is to identify ways to improve the learning process through the use of cloud computing technologies, while reducing the complexity associated with these technologies the main focus is about the requesting, creation, deployment, monitoring and management of virtual laboratories using Cloud Computing. Finally, this paper presents some solutions of cloud computing in e-learning and describes the most common architecture adopted. Issues in implementing cloud based e-learning systems and some potential ways to overcome them are also discussed.


1 INTRODUCTION

THE Education or Learning is a very essential component of life and No human beings are able to survive properly without education [1]. Today, there are lots of paradigms for getting knowledge or learn through Internet. One of the most promising paradigms for education is e-learning. E-Learning refers to the use of networked information and communications technologies and offers a wide range of new opportunities for the development of education and brought profound impact to teaching and learning methods. Today, e-learning has become one of the most popular teaching and learning methods by stretching the spatial and temporal barriers [2]. E-learning is widely enclosure of all kinds of educational technology in learning and teaching. E-learning is enclosure of, and is widely synonymous with technology-enhanced learning, computer-based training, multimedia learning, computer-assisted instruction, computer-based instruction or internet based training, web-based training, online education, computer-aided instruction, virtual education, m-learning, virtual learning environments and digital educational collaboration. These other alternative names dwell on a specific component, aspect or delivery Method [2]. Educational institutions can take advantage of cloud applications to provide students and teachers with free or low-cost alternatives to expensive, proprietary productivity tools [3]. Browser-based applications are also accessible with a variety of computer and even mobile platforms, making these tools available anywhere the Internet can be accessed [2] [3]. This paper presents a cloud computing based solution for building a virtual and personal learning environment which combines a wide range of technology, and tools to create an interactive tool for science education.

This paper focused on study investigates various security issues involved in cloud based e-learning technology with an aim to suggest solutions in the form of security measures and security management standards. These will help to overcome the security threats in cloud based e-learning technology [5] [6]. To achieve our thesis aim, we used theoretical and empirical studies. Empirical study is made through the information gathered through various cloud based e-learning solution vendors websites [12][13]. These analysis and research studies are leads to find various security issues in cloud based e-learning technology.

2 E-LEARNING ENVIRONMENTS

E-Learning environment is nothing but the environment which offers through E-Learning applications to the students to get the access the materials and tools relating their studies [8].

2.1 Virtual Learning Environment

Virtual learning environment (VLE) is simply another term used to represent the E-Learning systems, where the students are able to get face to face class room environment through computer applications with the help of web sources. VLE is enhanced application from blended learning approach [2] [9]. The main objective of VLE is to provide the e-learning facility to large number of student communities to provide the virtual class room environment. There are many terms which are very similar to Virtual learning environment. They are learning management system (LMS), Content management system (CMS), Learning content management system (LCMS), Managed learning environment (MLE), Learning support system (LSS), Online learning Centre (OLC), Open courseware (OCW), Learning platform (LP). Virtual learning environment basically works with the help of internet and provides the learning materials and tools to e-learning users for uploading files, chatting, and web conferencing. It also gives information regarding student group management systems, questionnaires, peer assessment, wikis, blogs, 3D virtual learning classrooms, online feeds like RSS. Many universities and institutions are using VLE to improve the intractable learning environment and break the interaction barrier on learning environment [10].
Cloud computing technologies have changed the way applications are developed and accessed. They are aimed at running applications as services over the Internet on a scalable infrastructure. Many applications such as word processing, spreadsheets, presentations, databases and more can all be accessed from a web browser, while the software and files are housed in the cloud[14] [15]. Although cloud computing is becoming very popular, it is difficult to get a clear definition of it. The key of cloud computing lies in its component-based nature, i.e. reusability, substitutability (e.g. alternative implementations, specialized interfaces and runtime component replacements), extensibility, customizability and scalability [6] [7] The major players in the field of Cloud Computing are Google, Microsoft, Amazon, Yahoo, IBM and Intel. Cloud Computing applications are mainly intended to help companies and individuals to stretch resources and work smarter by moving everything to the cloud [2] [3]. The cloud computing as a new kind of advanced technology accelerates the innovation for the computer industry. Cloud computing is a computing model based on networks, especially based on the Internet, whose task is to ensure that users can simply use the computing resources on demand and pay money according to their usage by a metering pattern similar to water and electricity consumption. Therefore, it brings a new business model, where the services it provides are becoming computing resources [10].

### 3.1 Type of Cloud

Cloud computing have four different clouds which vary on their modes of deployment of computing:

#### Private cloud
Provided for exclusive use by a single organization. It may be owned, managed, and operated by the organization;

#### Community cloud
Provided for exclusive use by a specific community of consumers from organizations that have shared concerns;

#### Public cloud
The cloud infrastructure is provisioned for open use by the general public;

#### Hybrid cloud
The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities

### 3.2 Cloud Computing Layer

Cloud computing architecture mainly consists of three layers called IAAS, PAAS, and SAAS. These three layers are helpful to serve the variety of services to their customers from cloud vendors [2] [4].

#### Software as a Service (SaaS):

In this kind of model, hosted applications in the cloud are provided to be accessed and used by consumers via a network. These applications are considered as broad network access, which means they can be accessed by any clients' platforms [7] [8].

#### Infrastructure as a Service (IaaS):

In this kind of cloud models, computing infrastructure (e.g., processing, storage, networks, etc.) are provided to consumers, in which they can deploy software including applications or operating systems

#### Data Storage as a Service (DaaS):

<table>
<thead>
<tr>
<th>Category</th>
<th>Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>Email</td>
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<tr>
<td></td>
<td>Discussion board</td>
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<tr>
<td></td>
<td>Live chat</td>
</tr>
<tr>
<td>Content delivery</td>
<td>Lecture support notes</td>
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<tr>
<td></td>
<td>Images</td>
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<td></td>
<td>Audio</td>
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<td></td>
<td>Video</td>
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<tr>
<td></td>
<td>PowerPoint presentations</td>
</tr>
<tr>
<td>Assessment</td>
<td>Assessment tools</td>
</tr>
<tr>
<td></td>
<td>Online grades</td>
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<tr>
<td>Miscellaneous</td>
<td>Interactive whiteboards</td>
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<td></td>
<td>File exchange</td>
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<td></td>
<td>Calendar and task list</td>
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</table>

**Table 1. Some of the most useful VLE tools as follow**

**Table 2. The list below is of the software use for personal learning environment**

<table>
<thead>
<tr>
<th>Category</th>
<th>Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word processor</td>
<td>Nisus Writer Express</td>
</tr>
<tr>
<td>E-mail</td>
<td>Mac Mail</td>
</tr>
<tr>
<td>Diary</td>
<td>iCal linked</td>
</tr>
<tr>
<td>Audio</td>
<td>Garage Band</td>
</tr>
<tr>
<td>Video</td>
<td>iMovie</td>
</tr>
<tr>
<td>Weblog</td>
<td>Jumbla</td>
</tr>
<tr>
<td>Content Management System</td>
<td>Jumbla</td>
</tr>
<tr>
<td>Personal Weblog</td>
<td>Knotes</td>
</tr>
<tr>
<td>Photo sharing service</td>
<td>Flickr</td>
</tr>
<tr>
<td>Web Browser</td>
<td>Firefox</td>
</tr>
<tr>
<td>Podcast publishing</td>
<td>Jumbla plug in</td>
</tr>
<tr>
<td>Instant messaging and VOIP</td>
<td>Skype</td>
</tr>
<tr>
<td>Search engines</td>
<td>Google</td>
</tr>
<tr>
<td>FTP</td>
<td>FileChute</td>
</tr>
</tbody>
</table>

2.2 Personal Learning Environment

Personal learning environment (PLE) is a single user E-Learning system which helps the E-Learners to manage and modify their own learning. PLE is mainly used to integrate the WEB 2.0 technologies like Wikis, blogs, online feeds, online social communities with the independent E-Learner[11][12].

1. To allow the user to manage his or her profile.
2. To present to the user any new information gathered by the Context Reasoner.
3. To allow the user to access independent service providers.
4. To enable other users to access gathered information from the user profile as a public portal.

**Figure 1. Cloud Service and Deployment Models**
This model can be considered as a sub model of IaaS, as it refers to providing storage as a service, however it is introduced in as a separate cloud model

Platform as a service (PaaS):
This model offers to consumers a development platform that allows them to develop applications using programming languages, libraries and other tools supported by the cloud provider. The tasks are managed by a Cloud management system Architecture as shown in Fig. 2. The CMA have a several layers for extensibility and maintainability. However, the Monitoring and Management and Security components are incorporated through all layers to ensure high reliability and secured services [14] [15]. The explanations of each layer are:

Figure 2. Cloud management system Architecture

The tasks are managed by a Cloud management system Architecture as shown in Fig. 2. The CMA have a several layers for extensibility and maintainability. However, the Monitoring and Management and Security components are incorporated through all layers to ensure high reliability and secured services [14] [15]. The explanations of each layer are:

User interface layer: This layer delivers various access points to users and/or administrators of the CMA in accessing our cloud system

Business layer: This layer aims to regulate resource supply and demand through the use of economy (price) and Service-Level Agreements (SLA). In addition, this layer enables users to reserve VMs in advance and manage their personal VMs

System layer: This layer is responsible for daily operation of the CMS, such as submitting jobs, managing user accounts and monitoring Quality of Service (QoS)

Resource interface layer: This layer deals with the physical hardware. It provides interfaces and plugins to various virtualization, database and distributed systems as well as other technologies, such as Xen, Amazon EC2, Amazon S3, and Nagios

Monitoring and management component: To ensure the reliability of each layer in the cloud, a monitoring and management component is needed. Thus, this component allows the system administrator to monitor and to initiate activities of each layer. In case of failures, conflicts [15] with SLA objectives, under- or over-utilized resources.

Security component: To ensure the privacy, recovery, integrity and security of user data and transactions, a security feature on all layers is required. Besides the technical solutions, issues in areas such as regulatory compliance and data auditing are important. Therefore, this component also addresses these issues. In this paper, we only focus on describing some components from the System and Security layers to address different needs of students and staff [9][10].

4 Security Threats and Challenges in Cloud Based E-Learning

There are so many cloud services provider like GOOGLE, MICROSOFT, AMAZON are become cloud vendors [1] [2]. All these cloud services are already familiar for their trustworthy applications and services to IT world, but still peoples are have doubts about cloud safety from those companies. So those companies are following many security standards and measures to ensure the security in their cloud products and services. In the same time, E-Learning solution vendors also have security standards and measures to overcome problems on e-learning applications and its security in e-learning materials and e-learners. Since cloud computing alone is not our track, we discuss the both cloud computing and e-learning technology's security issues and measures separately to find out the key security issues and measure for cloud based e-learning[10].

4.1 Cloud computing security threats
Since the cloud computing offers numerous services provides to the various applications and technologies, some of key security concerns in cloud computing are mainly deals with server security and the information security stores in cloud sources from various technology and applications[8]. Those key challenges and threats in cloud computing are as follows

4.2 Basic Security Concerns
Physical security is lost with the cloud model control, because companies don’t have the knowledge or control of running resources when they share the computing resources with third party companies. In most cases, a company violates the law when they use cloud services [2] [4]. And also there is a chance of data seizure by foreign nations. Most of cloud vendor’s services are not compatible with other cloud vendors. So it may be becomes a problem when the company tries to move their sources from one cloud vendor to another. When e-learning solution providers use the cloud source, a question arises on who should control the authentication procedures. Usually customers only have those encryption/decryption keys. Cloud providers need to ensure the data integrity by authorized transactions such as transfer, storage, and retrieval of data. For this problem, cloud providers need to follow same standards to ensure this problem on integrity issues. Customers need to process against cloud vendors if customer’s privacy rights are violated. Cloud providers should provide clear answers on how the customer’s personal information is used or leaked to third parties. Cloud vendors should provide the updates regularly to their customers to ensure up to date security.

5 Secure Group Learning And Content Sharing In Cloud

The digital learning is more popular among the several organizations and implemented in a secure manner. The security plays a role in assigning the tasks or allowing the authorized member only to access that content. Suppose a member wish to utilize the digital content; the member has to join that community and needs the permission to access that content[6][7]. The admin creates the profile for the newly joined member and sets the permission for accessing the content. Not all the content are accessible to every individual member. Therefore, to implement this secure system, access
control mechanisms are implemented along with the group key management. The Figure 3 shows the key management is a way to secure the e-learning content and to make sure that only authorized members access the content. A simple way is to distribute the key to the group member’s alone.

![Figure 3. Secure data sharing in trusted cloud with access control mechanism](image)

**Figure 3. Secure data sharing in trusted cloud with access control mechanism**

The Figure 4. Shows depicts the group-based e-learning system in a secure manner. The group manager or the data owner uploads the data in the cloud [2] [14]. The group manager is also responsible for maintaining the groups and to provide access permission to the members. Every individual member who wishes to access the e-learning content needs to join the group first and request the group manager for the content access. The group manager verifies the member authenticity and gives permission to the new member according to the privilege provided to the member.

![Figure 4. Process of secure data sharing in cloud](image)

**Figure 4. Process of secure data sharing in cloud**

The group manager creates the members profile with the permission settings [9]. The access control mechanism is implemented along with the group key management for secure content sharing for e-learning systems. Considering the scenario depicted in Figure 5, the member 1 and member 2 are part of group 1; similarly, other members are part of other different groups. The e-learning contents uploaded in cloud are accessible to group members. For group 1, only few e-learning contents are accessible, and similarly, for other remaining group members also. This variation of access is created by the group manager [10].

5.1 *Key Generation*

In this proposed secure group-based e-learning scheme, a random value (R) is chosen by the member, a secret value (S) is assigned to every individual member when member joins the group-based e-learning system, and g is the random generator [2] [3]. The group manager can able to generate the group key using the value R and S of the users, which is given in Equation (1)

$$KG_1 = g(r_1 \oplus s_1)(r_2 \oplus s_2) + K_1$$  \hspace{1cm} (1)

$$KG_2 = g(r_3 \oplus s_3)(r_4 \oplus s_4) + K_2$$  \hspace{1cm} (2)

$$KG_3 = g(r_5 \oplus s_5)(r_6 \oplus s_6) + K_3$$  \hspace{1cm} (3)

The group manager secret value Ki is selected randomly such that Ki < g(r_i \oplus s_i), where i = 1, 2, … n.

5.2 *Member join*

Whenever a new member wishes to join and access the e-learning content, first, member requests the group manager for including in the particular group and to provide access to the e-learning content available to the group members [4]. The group manager will compute using the formula (1) and generate the new key to the member who joined newly to Group 1 and also update the ACL list.

$$KG_1 = g(r_1 \oplus s_1)(r_2 \oplus s_2)(r_7 \oplus s_7) + K_1.$$  \hspace{1cm} (4)

The new member with id = 7 joins the group 1 and the new key is generated and distributed to all the members of group 1. Now, the new member 7 of Group 1 computes the key using the following equation.

$$M_7 = KG_1 \mod g(r_7 \oplus s_7)$$  \hspace{1cm} (5)
5.3 Member leave
When a member leaves the group, the group manager removes the member from the group and also the access capabilities assigned to that member. Moreover, new key is generated and distributed to the remaining group members. The group manager generates a new group key as follows.

\[ KG1 = g((r1 \oplus s1) \oplus (r2 \oplus s2)) + K'1 \]  

Considering the leave operation in Group 1 and assume member 7 leaves the group. In this case, the key is newly generated with and distributed to remaining group members. Although access control provided access rights in accessing the content, the DO is responsible for content upload and sharing [5]. The DO will upload the content in cloud encrypted using the secret key. The group members will download the encrypted content and request the DO for the secret key to access. The DO verifies the member and then shares the secret key to the group member. Only authorized member is allowed to receive the secret key for decryption. If the member is not the part of the group, then the DO will reject the request and content cannot be decrypted. By using the key management and access control mechanism together, both forward and backward secrecy can be achieved in the e-learning systems [6].

6 Conclusion
This paper has found many useful security measures which are being used to handle various security threats over cloud-based e-learning technology. The third party cloud server is partially trusted and there is a need to provide security. As more number of users are involved in e-learning, the access control restricts the unauthorized users in accessing the cloud content. To add more security to the e-learning in cloud, the key management supports the organization by providing the access key only to the authorized group members for accessing the content from cloud. The system was implemented and tested by two groups of users, one for teachers second for students and they were asked to run the system, then evaluate its simplicity, the material and the user interface. In addition, key management techniques can be implemented along with the access control mechanism for achieving security in e-learning systems. They reported that the system overcomes most of the problems in teaching group-based e-learning scheme. In this proposed system, we designed the cloud-based e-learning architecture, which includes SaaS, PaaS, IaaS, and also Operational and Maintenance Services. Devices such as mobile, laptop, etc., are used to access the cloud e-learning system, which are said to be access layers. The 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. In future work we conceptual cloud computing security requirements model with four components – data security; risk assessment; legal & compliance requirements; and business & technical requirements.

References